Brüel & Kjær Vibro

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Instructions

VC-8000 Machine Protection System

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Instructions - **VC-8000 Machine Protection System**
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Best Practice VC-8000 Installation
16 position rack, bulkhead mounted to subpanel

1 VC-8000 Machinery Protection System

The VIBROCONTROL 8000, or VC-8000 is a versatile API 670, ISO 10816 and ISO 7919 compliant machinery protection system consisting of the following components:

- VC-8000 rack, 3 sizes with different mounting options.
- Rack Connection Module (RCM)
- System Access Module (SAM)
- Universal Monitoring Module (UMM)
- Temperature Monitoring Module (TMM)
- Touch Screen Display Panel (optional)

There are many advantages with the VC-8000, starting with the architecture of the system which is designed to simplify your installation and sustaining costs as much as possible.

For example:

No I/O Modules, Compact Design

The rack was designed to save space. The 8 slots (8P) version of the rack (our most popular) is only 9.1’ (H) x 11.0’ (W) x 11.5’ (D) [230 mm (H) x 279 mm (L) x 217 mm (D)]. Yet it can easily handle most machines with up to 24 channels available.

Integrated Relay, Phase, Modbus and Display

The VC-8000 does not require separate cards for Phase Trigger, Relay Channels, Modbus or local Display. This saves up to four slots per rack and allows a smaller size rack to be used for many machines.

Only 4 Spare Cards for Your Entire Site (that’s it!)

A single UMM handles every channel type and external interfaces. For example, Phase, Differential Expansion, Radial Vibration, Relay Logic, and Analog Outputs.
Only four spares are needed for your entire site (RCM, SAM, UMM, TMM).

Simple Configuration Interface

The VC-8000 Rack Setup software uses a grid based interface, making it easy to see the relationships between channels and configure your system.

1.1 Rack Chassis

The VC-8000 rack provides flexibility in mounting and arranging monitors modules. The rack is available in three sizes:

- 16 slots, full size rack (19”)
- 8 slots, half-sized rack (most popular)
- 4 slots, compact rack

All rack sizes support panel, bulkhead, and weatherproof box mounting. The 19” full size rack also supports mounting in a 19” EIA enclosure.

There is an optional locking door to prevent tampering with wiring and network lines. The rack can also be ordered with a touchscreen display.

The rack supports 1 to 15 Monitoring Modules depending on rack size and number of System Access Modules. UMMs and TMMs will operate correctly when installed into any slot other than the first slot which is reserved for the RCM.

Figure 2: The VC-8000

1.2 Four Basic Cards for the VC-8000

There are only four basic cards for the VC-8000 Machinery Protection System.

- **RCM:** Rack Connection Module
- **SAM:** System Access Module
- **UMM:** Universal Monitoring Module
- **TMM:** Temperature Monitoring Module

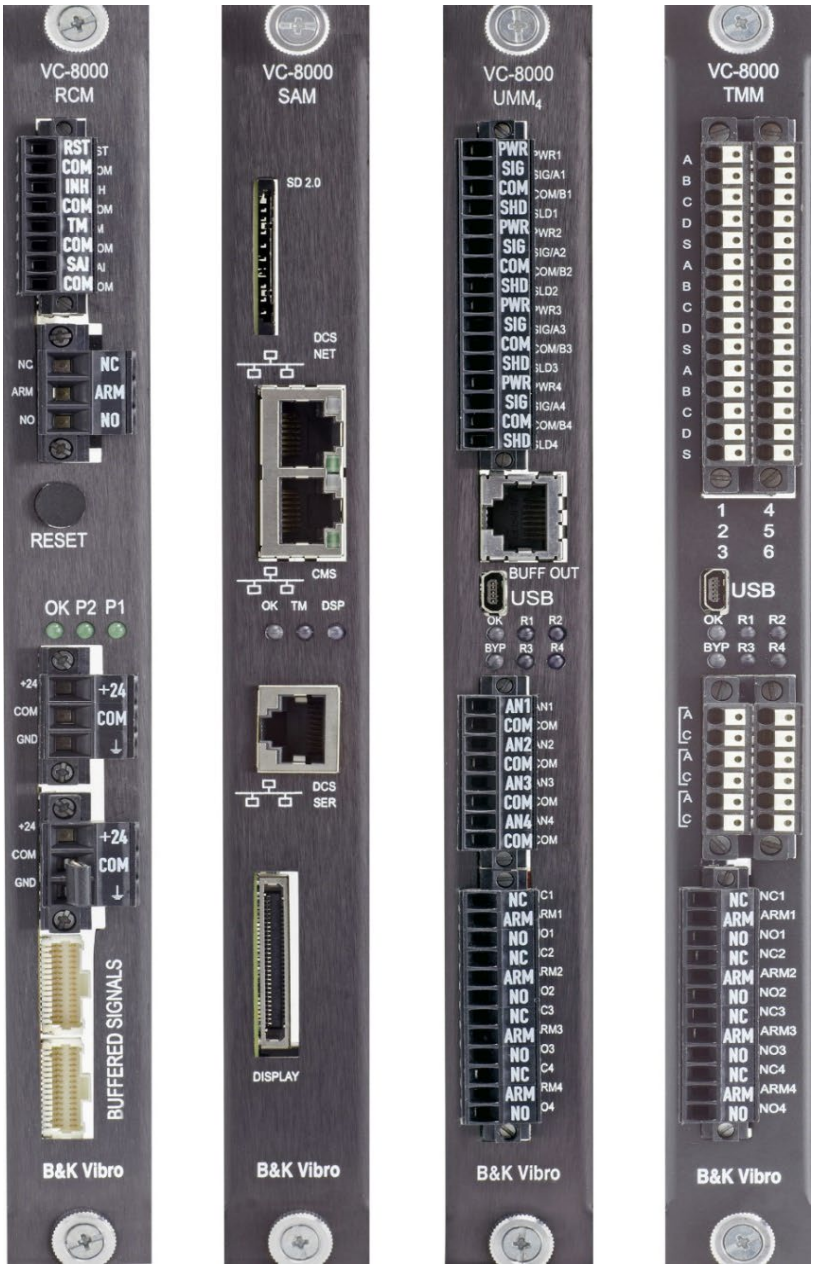


Figure 3: Four basic cards for the VC-8000

1.2.1 Rack Connection Module (RCM)

The Rack Connection Module (RCM) installs in slot 1 and provides rack power connections and other rack level interfaces.

- Primary power input
- Secondary power input
- Discrete contact control inputs
- Rack Fault Relay
- Reset button
- LED indictors
- Buffered transducer outputs

1.2.1.1 Redundant Power Supplies

The VC-8000 rack requires +24 Vdc external power to operate. Redundant power inputs are provided.

Plant +24 Vdc power can also be used.

Important

+24Vdc COM is not isolated from the Signal COM (in the UMM).
When using plant power (+24 Vdc), a 24V to 24V isolator is necessary.

Refer to the datasheets for information on external power supply hardware, input voltage tolerance, and current requirements.

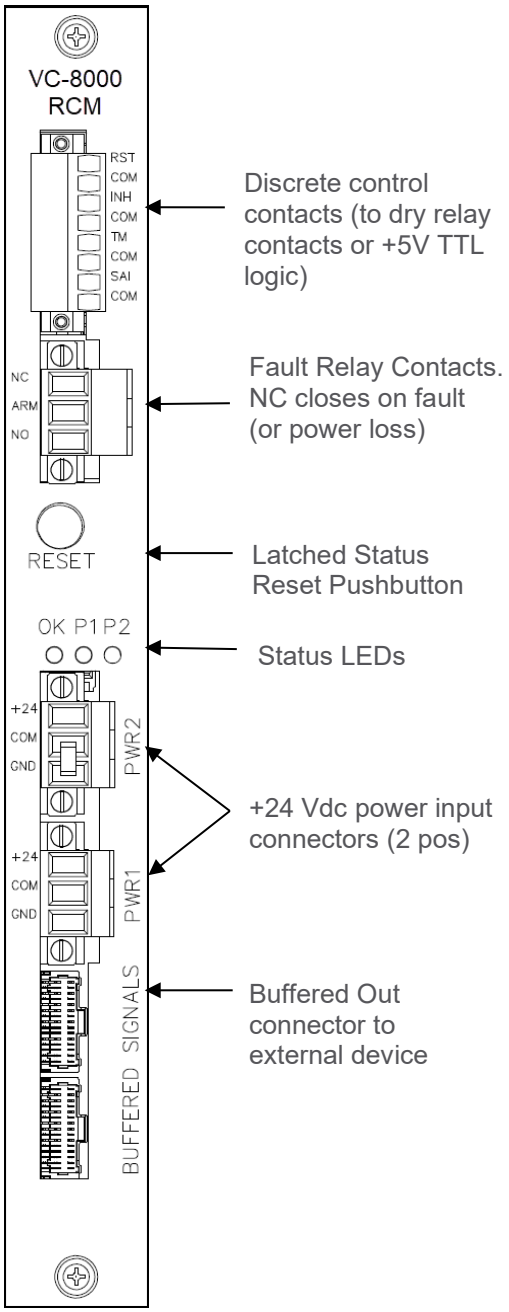


Figure 4: RCM

1.2.2 System Access Module (eSAM or bSAM)

The System Access Module (SAM) installs in slot 2 of the rack, it provides data to external systems and simplifies configuration of the rack. There are two versions of the SAM; The basic SAM (bSAM) and the enhanced SAM (eSAM).

bSAM

- Configuration of all modules
- Rack system and alarm event lists
- Modbus data

eSAM (preferred)

- All bSAM functionality
- Remote configuration and display
- CMS-SD
- CMS-HD
- CMS-XC
- CMS-PI
- Local touch panel display

eSAM features are a la carte and must be selected (licensed) when ordering.

The serial Modbus links for the SAM include RS-232, RS-422, and RS-485. The Serial Modbus port uses an RJ-45 connector for convenience, but it is not an Ethernet port.

Redundant Ethernet Modbus is accomplished using a primary SAM in slot 2 and a secondary SAM in slot 3.

A SAM is not mandatory. Both slot 2 and slot 3 support monitoring modules if a SAM is not installed. All UMM/TMM monitoring and alarming functions are independent of the SAM. However, without a SAM in the rack, all modules must be configured independently.

The bSAM and the eSAM use the same faceplate and look the same. Use VC-8000 maintenance software to verify which SAM (and licenses) that you have installed (see 24.10 - Hardware Information).

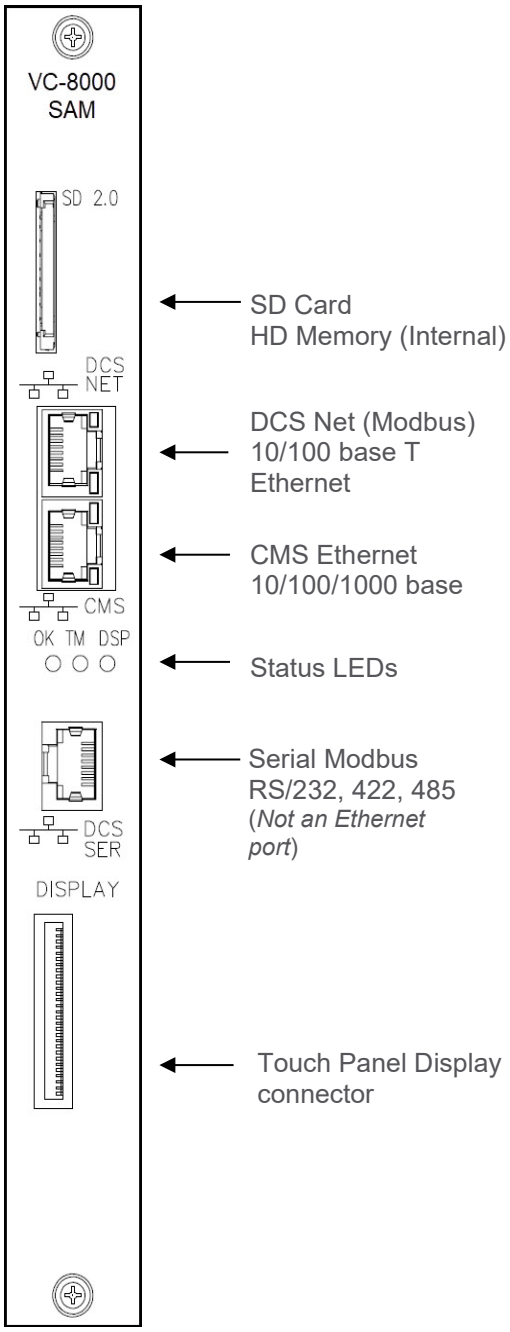


Figure 6: SAM

1.2.3 Redundant SAM

A redundant SAM can be installed in slot 3. Normally this is to provide redundant modbus:

The following is supported:

- Modbus Ethernet (With custom or standard modbus maps)
- Modbus Serial (Using the standard modbus map only)

The following is not supported:

- CMS data collection is not supported on the redundant SAM (slot 3)
- Clock synchronization is not supported on the redundant SAM (slot 3)
- Remote MPS Configuration (via CMS Ethernet port) is not supported on the redundant SAM (slot 3)
- Custom MODBUS maps are not allowed if serial MODBUS RTU is being used on either SAM

1.2.4 Universal Monitoring Module (UMM)

The UMM is configurable for nearly 50 different channel types for monitoring rotating and reciprocating machinery; this includes vibration, position, speed and many others. The UMM supports proximity sensors, seismic, loop powered 4-20 mA transmitter, phase trigger, etc.

The four UMM channels are independently configured, and you can assign single channel types to any of the 4 channels.

The UMM also includes 4 relay outputs. Each relay output is programmable to trip independently and may include logic elements from other cards in the rack.

Four analog outputs (4 to 20 mA) can be configured to be driven from any measurement in the UMM.

Each UMM module is autonomous and performs the following functions internally:

- Power to sensors and signal conditioning.
- Extract measurements, and compare to configured alarm set-points
- Perform alarm voting logic and drive relays
- Drive Analog outputs
- Collect waveforms
- Provide data to the SAM for display, Modbus, and CMS data acquisition.

The architecture of the VC-8000 system restricts the location of some UMM channels. For example:

- Composite measurements such as Case Differential Expansion require two channels and must be paired (1&2, or 3&4)
- To view orbits in CMS, XY Radial Vibration channels must be paired (channels 1&2 or 3&4)
- The Phase Trigger channel is restricted to channel 4 of a UMM card installed in slots 4-9 only – for a maximum of five phase trigger channels in an 8P rack or six phase trigger channels in a 16P rack

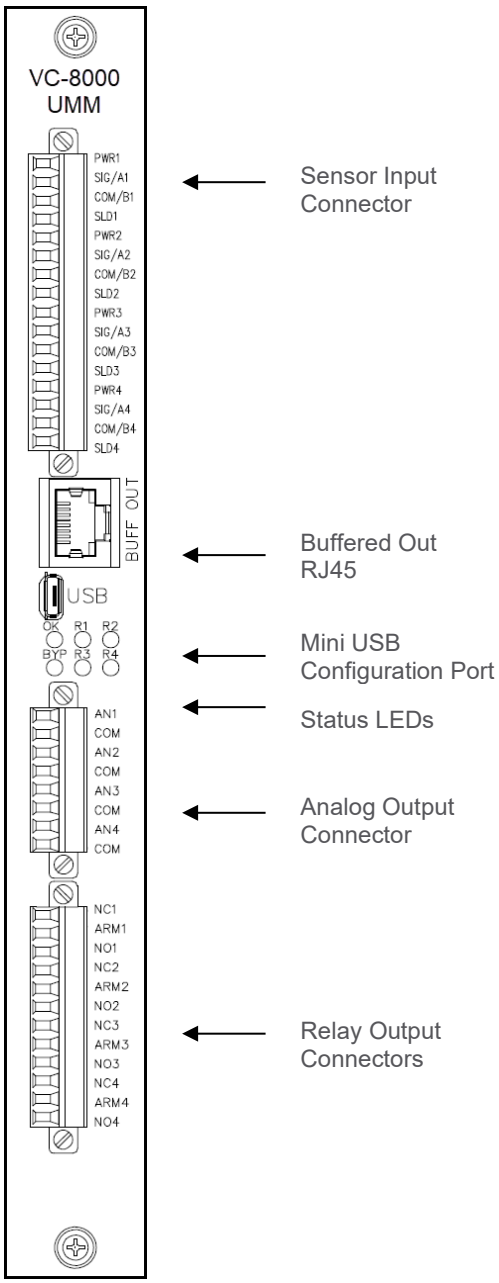


Figure 7: UMM

1.2.5 Temperature Monitoring Module (TMM)

The TMM module supports 6-channels of thermocouple, RTD, and/or Process Variable inputs. The TMM conditions the transducer signals, including filtering and noise rejection.

Each channel input is independently configurable allowing you to mix thermocouples, RTDs, and Process Variable channels. The following sensor types are permitted.

- Type J Thermocouple
- Type K Thermocouple
- Type T Thermocouple
- Type E Thermocouple
- 100-ohm platinum RTD (0.00392)
- 100-ohm platinum RTD (0.00385)
- 120-ohm nickel RTD
- 100-ohm copper RTD
- 10-ohm copper RTD

The TMM also includes 4 relay outputs. Each relay output is programmable to trip independently and may include logic elements from other cards in the rack (including UMM).

Six analog outputs (4 to 20 mA) can be configured to be driven from any measurement in the TMM.

A TMM card may be used as a Process Variable input by running the 4-20 mA signal through an external 68-ohm resistor. The TMM does not provide transmitter power.

The TMM is autonomous and performs all functions internally.

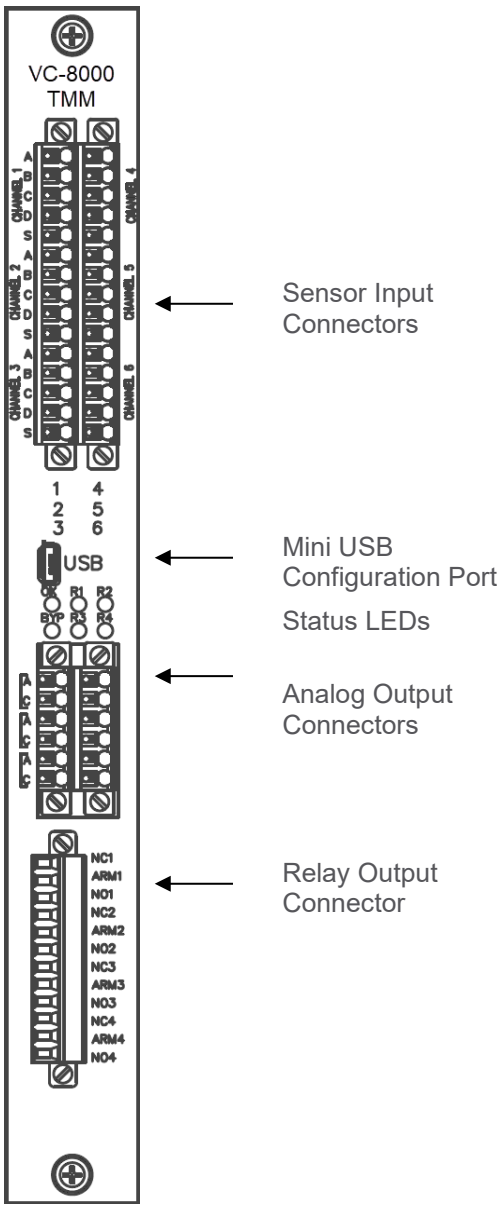


Figure 8: TMM

Caution!

A six channel TMM can be used for Process Variable (4-20 mA) Channels. However, wiring mistakes (over voltage) will damage the TMM.

For a more robust solution, consider using a UMM for process variable inputs.

1.3 Touch Screen Display Panel

The VC-8000 rack has an (optional) color touchscreen display module mounted on the rack or remotely up to 10 ft. (3 m) away (like a cabinet door). The display module shows:

- All current data values
- All current data statuses
- Alarm set-points
- System Event List
- Alarm Event List
- Other hardware information

Figure 9: Remote Display

The display is mainly “view only”. Actions that cannot be performed include:

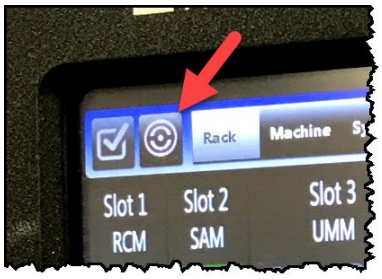
- You cannot modify configuration settings
- You cannot bypass channels (alarms), or relays.

Actions that can be performed include:

- Reset latched alarms and acknowledgement
- Selecting signals for the 3 buffered output BNC connectors

1.3.1 Buffered Output BNC Connectors

There are three BNC connectors on the panel.
Select the BNC icon on the screen to choose the channels for the BNC connectors. Any of the channels in the rack can be selected (see section 12.5.1).



1.4 Rack Setup and Maintenance Software

Two software programs are used to configure and commission the VC-8000: VC-8000 Setup software and VC-8000 Maintenance software.

The VC-8000 Setup software provides:

- Configuration for all modules

The VC-8000 Maintenance software provides:

- Data display (verification) for all modules
- Other rack maintenance functions

2 Safety Information

This manual is a part of the product. Read the manual carefully before using the product and keep it accessible for future use.

2.1 Intended use

The VC-8000 is a rack-based continuous machinery monitoring platform designed to fully comply with American Petroleum Institute Standard 670 for machinery protection systems. The system measures and alarms on a wide variety of vibration, position, speed, temperature, and process variable inputs.

Please see the data sheet (product specifications) for approved sensor types, as well as power specification - provided to each sensor type.

2.2 Sources of Danger

When installing or maintaining the VC-8000 live parts are a potential source of danger that can lead to serious, irreversible personal damage or death.

2.2.1 Supply Voltage

The VC-8000 is powered by +24Vdc. However, voltages powering external power supplies can be much higher; 110/220 Vac, or 90-250 Vdc (for example).

Figure 10:
External power supply

2.2.2 Relay/Trip Voltage

The VC-8000 contains relay (trips) which are connected to third party systems. These trip circuits may contain high voltages which remain present even when the power to the VC-8000 has been turned off.

Always use safe practices and test relay connections with a multi-meter to verify if external voltages are present.

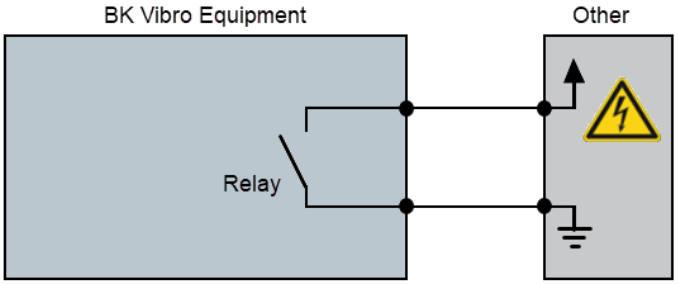


Figure 11: High voltage present on relays

Danger!
High voltages and/or currents can lead to injury or even death! See the VC-8000 data sheets for permissible voltages on contacts.

2.2.3 Handling

Wear suitable protective equipment on your hands during assembly, commissioning, maintenance and decommissioning of the VC-8000.

Important

The modules must be screwed tight after being pushed in, otherwise injuries may be caused by modules slipping out.

In rare cases, sharp edges or pointed corners on the mechanical housing parts of the VC-8000 can lead to cut injuries.

2.3 User Qualification

Transport, storage, installation, assembly, connection, commissioning, maintenance and service must be undertaken by qualified technicians (for ATEX systems according to EN 60079-14). The following must be observed:

- The instructions in this manual
- Instructions for product and safety
- Any product specific provisions and requirements
- All national and regional regulations for safety and accident prevention

Installation and commissioning require work on electrical equipment. This work may be performed by electricians or workers instructed and supervised by an electrician in accordance with appropriate regulations/directives.

2.4 Regular Maintenance Schedules

Brüel & Kjær Vibro recommends rack verification every 3 years. There are no calibration resistors etc. inside the VC-8000 rack. Regular maintenance includes executing procedures to validate the configuration and expected functions (i.e. alarms and trips) (see section 23).

Decrease the maintenance interval to 1 year when operating near the upper temperature or upper humidity specifications, or if the rack is installed in a corrosive environment.

2.4.1 Firmware Updates

VC-8000 firmware is updated on a regular basis. However, firmware upgrades are not necessary unless you specifically require new functionality. B&K Vibro recommends upgrading to the latest firmware during major shutdowns and maintenance cycles (see section 24.7).

2.5 Pictograms

The following pictograms are used throughout the instruction manual.

Pictogram	Meaning
	Notes or other highlighted material
	Tips and good ideas
	Use caution (avoid common mistakes)
	Dangerous electrical voltage

2.6 Related Documents

2.6.1 Instruction Manuals

The following manuals contain instructions for specific machines and/or applications. These manuals can be found at the B&K Vibro website.

Document Number	Title
S1079330	VC-8000 Operation & Maintenance Manual (this document).
S000024	VC-8000 for Hydro and Low Speed Machines
S1342998	VC-8000 for Reciprocating Machines
S00002001	VC-8000 for Rolling Element Bearings
S1160865	VC-8000 Hazardous Area Installation
S1354794	VC-8000 Functional Safety Assessment
S1176125	SETPOINT Condition Monitoring Software

2.6.2 Specifications

The following specifications and ordering information can be found at the B&K Vibro website.

Document Number	Title
S1077785	VC-8000 System Overview
S1078950	Rack Connection Module (RCM) and External Power Supplies
S1077786	System Access Module (SAM)
S1077787	Universal Monitoring Module (UMM)
S1077788	Temperature Monitoring Module (TMM)
S1490124	Setup & Maintenance Software
S1157533	SETPOINT Condition Monitoring Software
S1095333	Signal Simulator Interface

2.6.3 Drawings

The following drawings and installation aids can be found at the B&K Vibro website.

Document Number	Title
1089867	Outline, Panel Cutouts, Dimensions, and Wiring
1109209	Panel Cutout Dimensions for Remote Display Panel
100473	Secondary Buffered Output Cable (Don't use) (See 9.4.2)

2.6.4 Other Papers

The following papers can be found at the B&K Vibro website.

Document Number	Title
S1466106	Using Buffered Outputs and Patch Panels
S1224323	Understanding Waveforms and I-Factor
S1365855	VC- 8000 and API 670 5th Edition
S000018	Understanding Boost Mode Data Collection
N/A	Integration of SETPOINT into Aveva PI Eco System
S1331100	Cybersecurity Considerations for Vibration Monitoring Systems

3 Engineering – Choosing a Mounting Method

The VC-8000 rack's flexible design allows the monitoring modules to be installed facing forward (wiring in the front of the cabinet) or facing backward (wiring in the rear of the cabinet). This can be helpful, but also confusing if the correct option is not ordered. Please consider the following when planning your installation.

3.1 Helpful Tips for Rack Installation

Modules inserted (wired) at the rear (for replacement *systems*)

If the existing system is wired at the rear (i.e. BN 7200, 3300). That is (most likely) where you will want the monitoring modules of the VC-8000 rack. This will minimize cable rework and allow the full utilization of existing wiring trays etc.

Space for signal cables (Door, or Door with Display)

A bulkhead mount rack, with a door on the front, has less only 3.0" (76 mm) for wiring. Consider removing the door if it is not needed.
A panel mount rack (front wired system), with a door on the front, has less only 3.0" (76 mm) for wiring. Consider wiring from the rear if possible.
A rack (front wired) with a touchscreen display has only 2.0" (50 mm) of space for wiring. The back of the display will most likely push on the cables when the door is closed. Consider removing the door and locating the display remotely or wiring from the rear if possible.

8P Rack or 16P Rack

The 16 slot VC-8000 rack is the same height and width as the Bently Nevada 7200 and 3300 series 8P racks. A 16P rack will mount in the existing cut-outs without modification. In this situation a 16P rack may be the best choice for ease of installation.
The 8 slot VC-8000 rack is very popular. It has capacity for 24 channels, is small and light and very easy for bulkhead mount installations.

Display or No Display

The optional touchscreen display is highly recommended. it provides immediate viewing of channel values and status, as well as easy verification of signals using the BNC connectors.

3.2 Bulkhead Mounting

Bulkhead mounting takes full advantage of the VC-8000 rack design. The rack is compact and light. All modules are easily accessible.

The bulkhead mount rack, has flush mount brackets installed on the backside of the rack as shown. The mounting-hole pattern for bulkhead mounting is the same as for panel mounting. For mounting hole drawings please go to the downloads section on the B&K Vibro website.

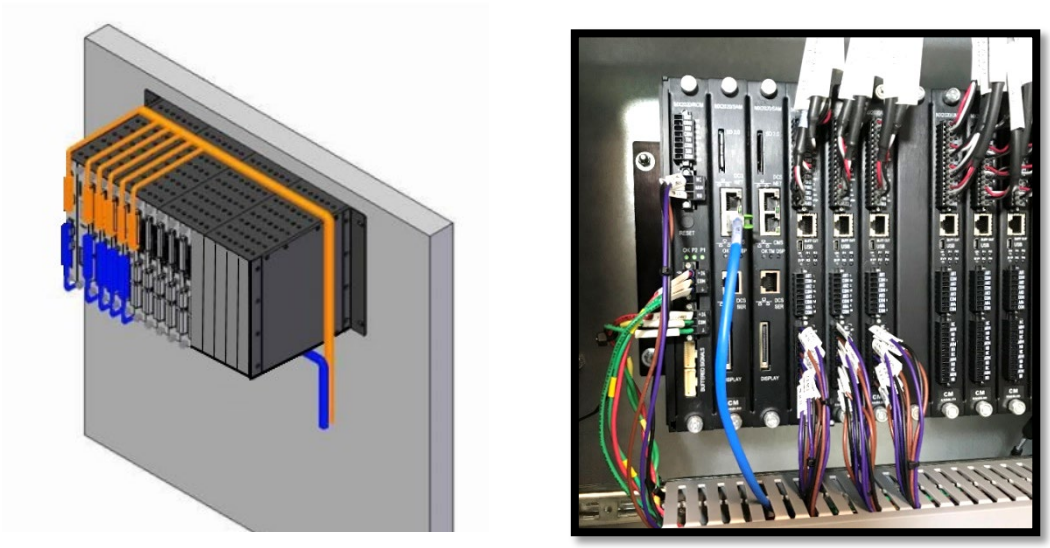


Figure 12: Bulkhead Mounted, no faceplate, no display

Be sure to use a wiring harness to keep signal cables from blocking the airflow through the rack. Airflow is needed for cooling.

A bulkhead mounted rack with a door mounted on the front of the rack, is not recommended. This allows more room for signal cables etc. A door on a 16P rack is very long; when it is opened it creates a hazard for persons working in the cabinet.

A bulkhead mounted rack with a door mounted display is not recommended. Use a remote display panel instead. This allows more room for the signal cables etc.

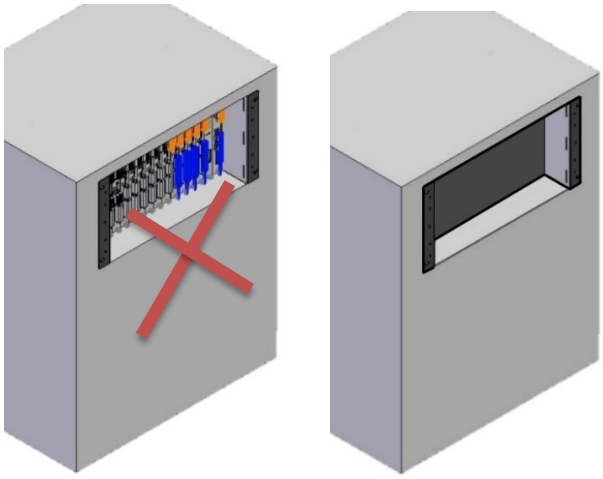
3.3 Panel Mounting

The panel mounted option is required when mounting the system in an existing cut-out. Bulkhead mounting is preferred if there are not cut-outs.

Normally, mounting brackets will be placed so that wiring is from the rear of the cabinet.

If you choose to install the rack so that wiring is from the front of the cabinet, be aware that the wiring space between the UMMs and the front door is only 3.0” (76 mm) and only 2.0” (50 mm) if there is a display in the door.

The VC-8000 rack does not come with panel clamps.



Wiring from the front of the cabinet (Not recommended)

Wiring in the back of the cabinet.

Figure 13: Panel Mounting

3.3.1 VC-4000, VC-6000, or BN 3300 Replacement (Wire from Rear)

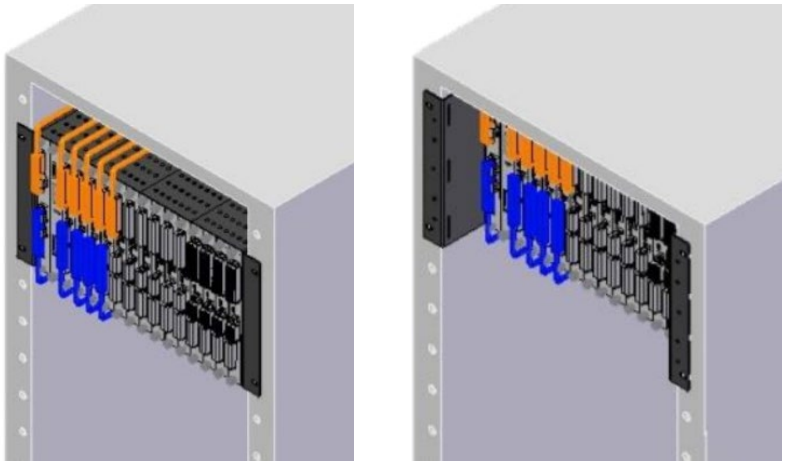
The picture below shows a VC-8000 rack which replaced a 3300 rack (panel cutout). This orientation of the rack (wiring from the front) is not recommended. This orientation makes it very difficult to wire, to replace cards, and to troubleshoot wiring.

The preference in this situation would be to order the rack mounting options so that “modules insert from the rear”. A longer display cable (blue cable) would have been provided and the customer would have easier access to the wiring. The touch panel (door) would still open for maintenance access to the display. But all wiring and module access would now be at the back of the rack.

Figure 14: Wiring from the front is not recommended in this situation.

3.4 19” EIA Rack Mounting (rare)

This method is possible, but rare because most 19” EIA cabinets mount the equipment to the very front of the cabinet (see below); this does not leave any room for wiring or wiring harnesses. Recessed brackets can be ordered which push the rack several inches into the cabinet, but it is much better to bulkhead mount the rack onto a subpanel in the cabinet rather than mounting to the rails.



Flush Brackets Recessed Brackets

Figure 15: Rack mounting

3.5 Weather Proof Enclosure Mounting

The small, compact VC-8000 rack easily mounts in weatherproof or explosion proof boxes. Please see data sheet S1078951 for more information on weather proof housings (like IP54, splash protected).

Figure 16: VC-8000 8P Rack & Enclosure
14” (H) x 24” (L) x 18” (D) Enclosure
355 (H) x 609 (L) x 457 (D) mm

Be sure to consider heat dissipation and ensure that temperatures will stay within specified limits. If possible, keep the enclosure out of direct sunlight. Refer to the datasheets for power dissipation information. Provide ventilation air if required.

3.6 Mounting Hole Drawings

For mounting hole drawings please visit the downloads page on the B&K Vibro website.

3.7 Other Considerations

3.7.1 Mounting the Display Remotely

You can mount the touch screen display (like on a door) up to 10 feet (3.0 m) from the rack. Secure the display cable every 6” (15 cm).

A rack mounted display can be modified in the field to be remote mounted. A longer display cable will be needed.

See the datasheet for part numbers and ordering information for the remote display.

See Drawing 1109209 on the B&K Vibro website for cut-out dimensions for the remote display.

3.7.2 Clearance and Cooling

VC-8000 racks require 4” (100 mm) of clearance between the rack and any other component. This clearance provides proper airflow for cooling.

When modules are wired from the front of the rack, it is common to find racks with wires laying on top of the rack and blocking the airflow through the rack. Please use wiring harnesses etc. to keep the airflow open around the rack.

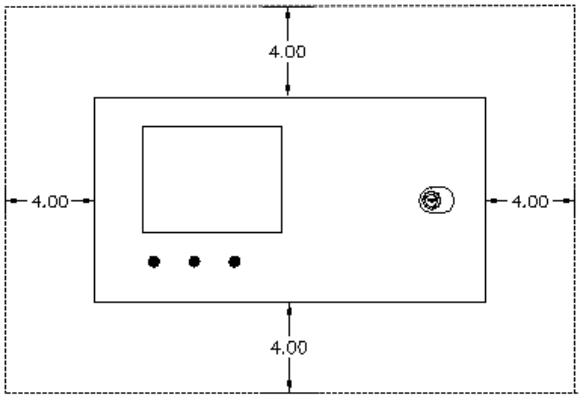


Figure 17: Clearance (inch)

3.7.3 3300 or 7200 Replacement

The 16 slot VC-8000 rack is the same size as the Bently Nevada 7200 and 3300 series 8 Position rack. VC-8000 Racks will mount in the existing panel cut-outs without modification.

When replacing a larger BN 3300 or 2700 rack (10P, 12P, and 14P), a blank cover is required to fill the unused space.

In Figure 18 the VC-8000 16P rack is installed in the same location where the 3300 rack was removed. The blank panel on the bottom is where a second 3300 rack was installed. All channels from both racks now fit in the single VC-8000 rack.

Many 3300 & 7200 racks use 18 AWG cable. VC-8000 wiring connectors can use 18 AWG cable as long as there are no ferrules on the wires.

Figure 18: VC-8000 replaces a 3300 rack (same cut out).

3.7.4 Mounting Orientation

Mount the VC-8000 rack with the modules vertical in all cases. Other orientations are not advised.

3.7.5 Moving Mounting Brackets in the Field

Newer rack chassis (since 2017) have mounting pads for brackets on both the front side and backside of the chassis;

Mounting brackets (for these racks) can easily be removed and inverted in the field from one side to the other.

If your field modification also moves the display panel, you will need to order a longer display cable (see datasheet).

Use a removable thread locker (Loctite Blue 242) when replacing the bracket screws.

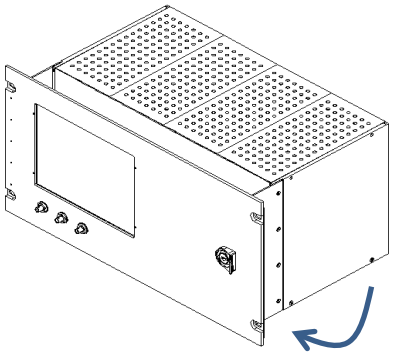


Figure 19: Moving brackets (for forward or reverse mounting)

4 Engineering – Channel Layout

There are certain rules that you should be aware of when planning the channel layout in the VC-8000 rack. These are explained below.

4.1 Phase Trigger Channels

The VC-8000 rack allows for six Phase Trigger channels maximum (16P rack). Phase Trigger channels can only be selected in channel 4 of a UMM installed in slots 4-9.

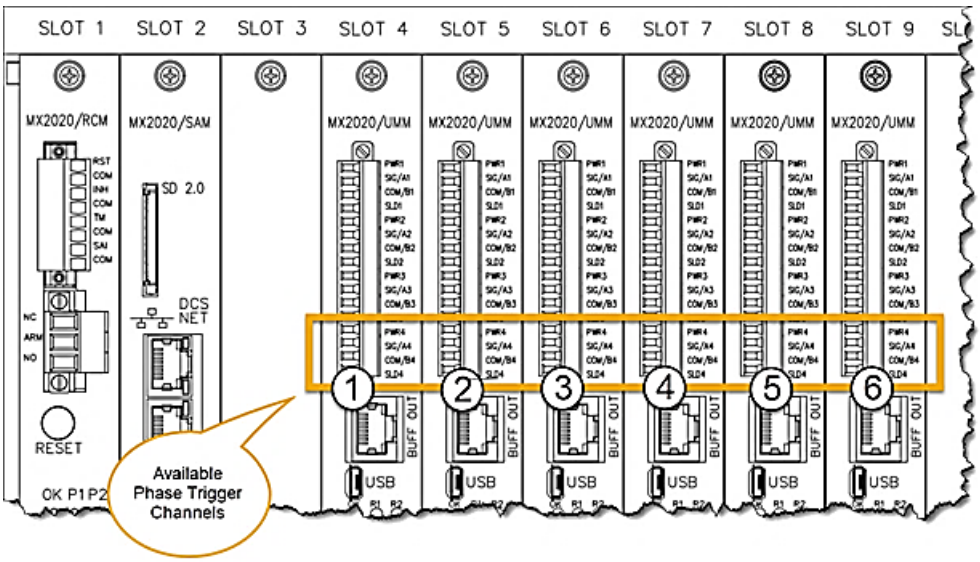


Figure 20: Phase Trigger channels selection.

4.2 Orbit (XY) Pairs

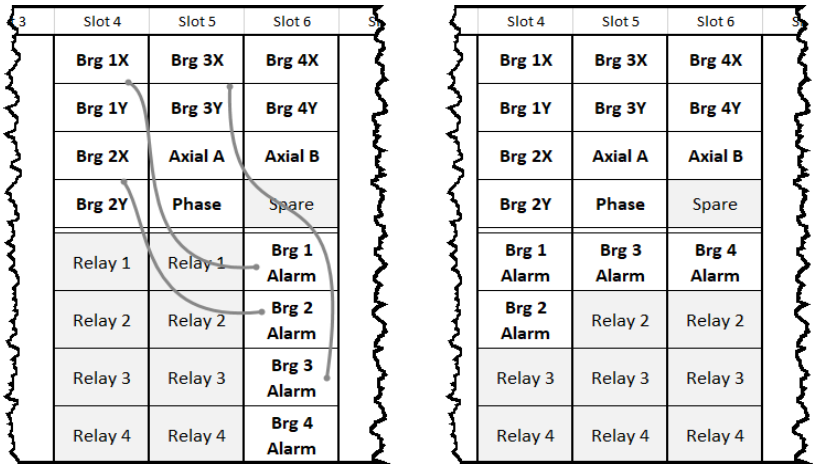
If your rack will be providing CMS data (like orbit, or shaft centerline), all XY pairs need to be in channels 1 & 2 (or channels 3 & 4) of the same UMM.

4.3 Relay Logic (Group Lines)

Although rare, complicated relay logic may exceed the allowable limit for “cross monitor voting”. Cross monitor voting occurs when the logic for the relay channel (i.e. in slot 6) includes signals (i.e. from Slots 4 and 5), as shown in the example below.

The original VC-8000 architecture provides 16 “group lines” for cross monitor voting. Newer hardware provides up to 25 group lines with newer TMM’s being limited to 19. If you exceed this limit, you will get an error message when you attempt to send the configuration to the rack. During off-line configuration, the MPS Setup software does not know what hardware you have – and it will only provide warnings when you exceed the original 16 group line limit.

If you have concerns, one way to minimize cross monitor voting logic (for example) is to place ‘Brg 1’ relay channel in the same monitor as the ‘Brg 1’ signal channels as shown below.

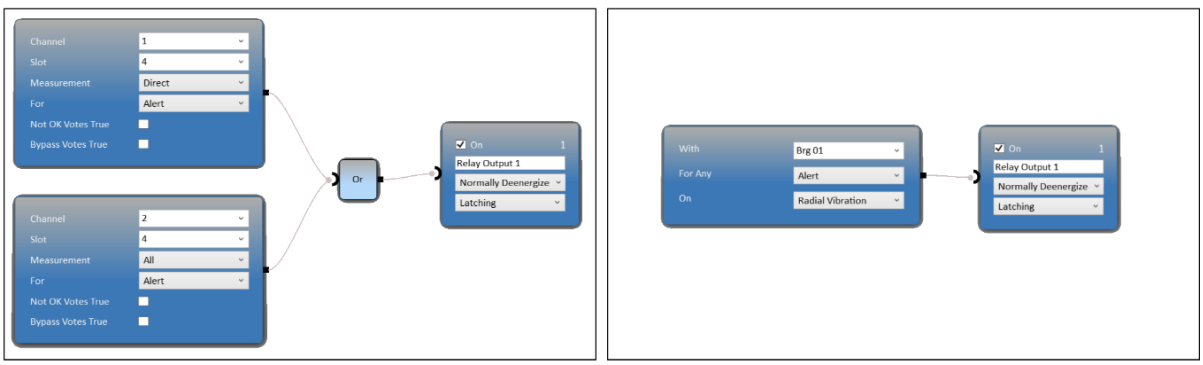


Scenario 1
Three group lines are used

Scenario 2
No group lines are used

Figure 21

Using Asset Groups helps as well. In scenario 1 (**Figure 22**), two group lines are used to bring each channel (independently) from slot 4 to the relay in slot 6. In scenario 2 only one group line will be used to bring the status of the group “Brg 01” to the relay in slot 6. Note: The connector lines used to build relay logic do not represent group lines.



Scenario 1
Two group lines are used

Scenario 2
One group line is used

Figure 22

5 Engineering – CMS Gateway

The VC-8000 is perfectly designed to replace existing machinery protection racks (for example BN 3300 or 3500). However, in some cases this is not practical and the VC-8000 will be installed as a gateway for CMS data only.

This solution can be very effective, and the VC-8000 rack remains usable for machinery protection, in the future, if required.

The most common concern when implementing a CMS Gateway solution is where to locate the VC-8000 and how to connect to the existing protection system. Most existing protection systems have connectors on the back of the rack for permanent connection to buffered output signals.

Please consider the following when implementing a CMS gateway solution.

Signal Noise (Environment)

Most signal noise issues are caused by poor cabling decisions. For example, the cable is not properly shielded, or is not shielded at all, or the signal cable is in the same cable tray with power cables.

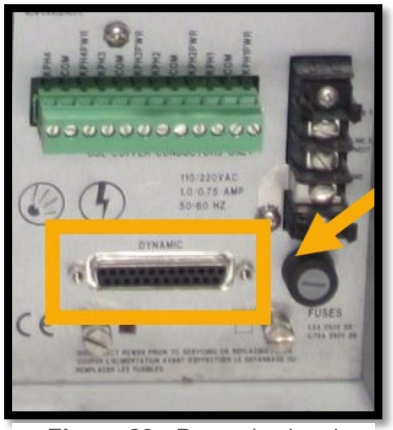


Figure 23: Dynamic signal connector

Multi-signal cables

In a CMS Gateway solution, it is typical to run multiple signals (channels) in a single cable. For example, the connector shown in **Figure 23** has 24 buffered output signals for a single cable connection. B&K Vibro recommends limiting the length of multi-signal cable lengths to 30 ft. (10 m).

Standard signal cable (with one signal per cable)

For standard shielded cables with one signal per cable, the allowed length is 1000 ft. (300 m) (or more) depending on your cable specifications and signal frequencies.
For the connector +in **Figure 23**, a longer cable run can be achieved by using a breakout device (**Figure 24**). The long cable run can be made with individual signals per cable.

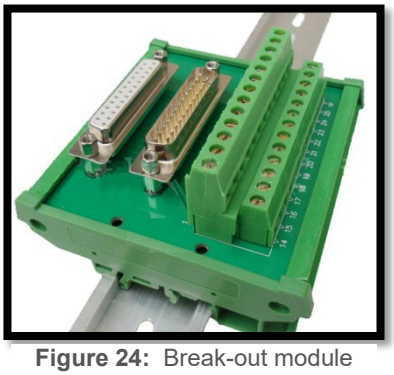


Figure 24: Break-out module

Configuration Tips for CMS Gateway Applications

When VC-8000 input signals come from buffered outputs (from another monitoring system), set the VC-8000 channel (transducer power) to high impedance (High-Z Input).

Note

When there is no connection to an active UMM channel configured with ‘High-Z Input’ transducer power, the UMM Gap voltage will show 18.0 Vdc

6 Engineering – Managing and Minimizing Alarms

The VC-8000 rack has several features to help you manage alarms. Those familiar with plant control rooms know that many of the alarms are initially questioned (i.e. Is it real?). Faulty wire connections, faulty sensors, and faulty equipment often make false alarms more common than real alarms. The following features (and recommendations) may help to improve the reliability of the alarms coming from the VC-8000 system.

6.1 Set Effective Time Delays

All alarms have time delays. Typical delays for critical machines are 3 seconds for Alert alarms, and 1 second for Danger alarms. For balance of plant machines (and for troublesome sensors), a time delay of 5 seconds for Alarm, and 3 seconds for Danger may make sense. This can help minimize alarms caused by spikes or noisy signal lines etc.

6.2 Use Non-Latching Alarms, & Latching Relays

Most alarm management is performed at the DCS (or ESD/IPS). Operators will view, acknowledge and reset alarms at the DCS, and go to the lower level device (VC-8000) if more information is needed.

Using non-latching alarms in the VC-8000 will make the VC-8000 event list more useful. You will get an event when the alarm annunciates, and a second event when the alarm goes away. This allows you to establish the exact timing of the alarm when it occurs.

The VC-8000 trip relay should be latched. The relay is the action that was programmed to take place based on the alarm. This can be latched and reset, by the operators, after the appropriate procedures have been followed.

6.3 Increase Confidence with Regular Maintenance

Regular maintenance will increase plant personnel's confidence in the VC-8000 system (see section 2.4).

6.4 Install a Remote Reset

A remote reset command allows your operators to reset all latched alarms (and/or relays). You can easily design a remote reset for the rack using the discrete contact on the RCM module or by sending a Modbus 'rack reset' command.

6.5 Use Rack Inhibit for Light Maintenance Activities

Rack Inhibit prevents all signal channels from going into alarm. This is useful when you are doing light troubleshooting on a sensor.

Rack Inhibit (when compared to Bypass) does not “turn off” the channel. You will still be able to see the measurement locally (for troubleshooting). The operators will be able to see the values at the DCS (Modbus). The only thing disabled are the signal alarms.

A Maintenance Override Switch is preferred over the use of Rack Inhibit (see sections 6.9.2 and 6.9.3). Rack Inhibit will not prevent false trips that can occur when (for example) a UMM card is reconfigured, or the rack loses power.

6.6 Use Channel Bypass Appropriately

Signal (or relay) Channel Bypass is typically used when a signal (or relay) channel is not working correctly and is causing nuisance alarms. This is a semi-permanent solution that is put in place until the sensor can be replaced.

Channel Bypass will leave the sensor powered, but all other channel functions are turned off. This means no values will be seen on the local display or on the DCS.

If you use channel bypass, verify how it will affect your relay logic. For example, if channel Brg 1X is placed in bypass, how will it affect a relay configured to trip when both Brg 1X & Brg 1Y are in alarm. The VC-8000 Maintenance software is used to enable Channel Bypass (see section 9.3.4).

Do not use Channel Bypass for maintenance activities. When troubleshooting sensor issues, touching wires etc., a Maintenance Override Switch should be used (see section 6.9.3).

6.7 Reading the Event List

When you need to spend time in the VC-8000 event list, connect with your laptop and use the VC-8000 Maintenance software.

Clicking on the column headers will sort the columns. You can also perform a multi-column sort. Sort the first column by clicking the header; hold the SHIFT key and click the second header to add a second (or third) column to the sort.

From the software, you can move events to Excel for further evaluation (or documentation). Select the upper left corner of the event list and then copy and paste the list into Excel.

6.8 Trip Multiply

Trip Multiply was designed for large machines that pass through critical speeds (resonance) on start-up. It allows “protection” to remain in place but the alarms are temporarily raised to a higher value (i.e. 9 mils instead of 3 mils). In practice, the startup of large critical machines is so closely monitored by plant personnel that Trip Multiply is rarely used.

6.9 Avoid False Trips

Helping you avoid false trips is a high priority with B&K Vibro. Education is a large part of helping our customers avoid false trips. The following suggestions are common for any protection system.

6.9.1 If the Machine is Running – Don’t Touch the Rack.

Everyone has a story; “I just opened the cabinet, and the machine tripped”, or “All I did was touch a wire etc.”

If you must do maintenance on the VC-8000 rack while the machine is running, you must isolate the VC-8000 trips externally (See section 6.9.3).

VC-8000 Channel Bypass, and VC-8000 Rack Inhibit functions are not designed for maintenance activities (see section 6.9.2).

6.9.2 Can I Bypass “the Rack” to Avoid a False Trip? No.

No. You cannot bypass “the rack”. The bypass function is often misunderstood. Most of the time the phrase “bypass the rack” means “isolate the rack from external trip systems”. The rack bypass function is a “self-governing” feature; whereas “isolation” is external to the rack.

An analogy will help. You can ask a child to stop yelling (alarming). If the child obeys, he is self-governing. Or you can isolate the child by placing him in another room. The child can yell (alarm) as loud as he wants – but it does not matter because you can’t hear him.

Channel Bypass and Rack Inhibit are self-governing features in the rack. The rack needs power and must be running normally for self-governing to occur.

The rack cannot “self-govern” during maintenance activities such as re-configuration, card removal, power cycles etc. The rack needs to be isolated with circuitry (or systems) external to the rack. If the rack is isolated externally, it can alarm (yell) as much as it wants while the maintenance takes place (see Maintenance Override Switch in Section 6.9.3).

6.9.3 Install a Maintenance Override Switch (MOS)

A Maintenance Override (or Bypass) Switch is recommended for all VC-8000 installations and must be implemented according to plant safety policy.

The MOS operates independent and external to the VC-8000 rack. **Figure 25** shows the MOS forcing +24 Vdc (Normal) to the trip circuit. The MOS contains two circuits that operate together, the second switch notifies plant operations that the MOS is active.

If the VC-8000 trip relays are tied to a DCS you may not require an MOS; as you can add logic in the DCS to override the trip signal from the VC-8000.

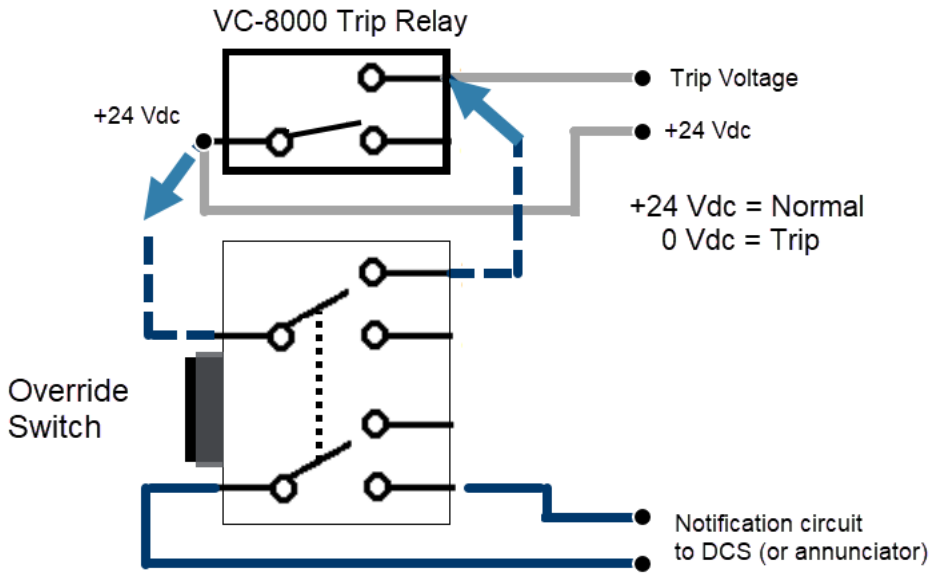


Figure 25: Maintenance Override Switch (MOS)

6.9.4 Every Card is a Relay Card

By design, every monitoring card in the VC-8000 system is also a relay card. If you 'Send' a configuration to a UMM module, you are configuring a relay card; If the relay channels are Normally Energized, the relays will change state.

Any monitoring system connected to a running machine (in production) should be externally isolated using a Maintenance Override Switch (MOS) before any maintenance takes place (see section 6.9.3). In many places and industry this is even mandatory. When the rack is externally isolated it will not matter if the card reboots, or if the relays change state.

7 Wiring – Power and Grounding

7.1 RCM Power Strategy

Redundancy

The (single) RCM accepts two external and independent supplies.
The RCM routes the +24 Vdc (from each supply) to the backplane. Each module (UMM, TMM, and SAM) selects the highest in-specification voltage line. As soon as one voltage is removed or drops below the other, all modules seamlessly switch to the alternate source, assuring uninterrupted operation

Distributed regulation

Some protection systems centrally regulate incoming power and then distribute every voltage needed, the VC-800 does not. The RCM ensures that primary and secondary supplies are within acceptable limits and then passes the voltage to the backplane. Each monitor (individually) uses that voltage to generate the power (i.e. transducer power) that is needed.
This design philosophy reduces the potential for single-point failures. In the VC-8000 system, regulator problems affect only a single monitoring module, not the entire rack

Minimize heat inside the rack

Because the +24 Vdc power supplies are located outside the rack, heat inside the rack is minimized and the life of the system is prolonged.

7.2 Connecting Power

7.2.1 RCM Power Connections

The RCM provides the following power and grounding connections:

- +24 Vdc System Power Connection 1
- +24 Vdc System Power Connection 2
- System Chassis Ground (GND)
- Single Point System Common to Chassis Ground jumper (COM to GND)

7.2.2 Input Power Fuse Protection

The RCM includes power input fuse protection and reverse wiring protection. The fuse is not replaceable. All other power supply voltages and conditioning circuits are distributed on the SAM and monitoring modules.

7.2.3 Power Status (LEDs)

The RCM has two LEDs that indicate power status. Refer to section 24.3.1 for information on troubleshooting if the LEDs are not as shown.

Table 1: RCM LED States

LED	Normal Condition	Description
P1	On (Green)	Power 1 is between +18 and +36 Vdc.
P2	On (Green)	Power 2 is between +18 and +36 Vdc.

You can monitor the status of the power supplies through Modbus.

7.2.4 Selecting an External Power Supply

The amount of power required varies greatly depending on the number (and loading) of the monitoring modules. The power supply wattages (from the MPS datasheet) shown here, will handle fully filled and fully loaded racks for the size given.

- 480W supply for a 16P rack
- 180W supply for an 8P rack
- 90W supply for a 4P rack

See the RCM data sheet (S1078950) for more information on the external power supplies provided by B&K Vibro.

Electrical Shock Hazard

The external power supplies are powered from hazardous high voltages. Only qualified personnel should make connections to the power supply. See safety instructions included with the power supply module.

7.2.5 Using Plant-Wide +24Vdc Power

Occasionally a site will have a main +24 Vdc line that is used by all +24 Vdc devices. In this case a 24 Vdc isolator would be required for the VC-8000 rack.

The isolator is needed because the VC-8000 rack power common is the same as the UMM common; and connecting the plant-wide +24 Vdc to the RCM may cause a ground fault. If this is your scenario – the site/plant may simply prefer for you to use a standard power supply (i.e. 120-230 Vac to +24 Vdc) – rather than using an isolator.

Important

The rack power connector (COM terminal) is not isolated from UMM signal COM. When using plant-wide (+24 Vdc) power, a 24V to 24V isolator will be necessary (BKV #100549)

7.2.6 Designating a "Primary" Power Supply

The VC-8000 draws power from the power supply with the highest (in specification) voltage. To prefer a primary supply over a secondary (redundant) supply, adjust the voltage of the primary supply to be 1 V higher than the secondary.

7.2.7 Power Redundancy (Do I need a PCM?)

Power supply redundancy is external to the rack. The (single) RCM distributes the power from the two redundant power supplies.

The PCM card was designed (rare cases) as a temporary backup power source when an RCM needs to be replaced without losing power to the rack. A blank slot would be required to install the PCM. The PCM is not designed as a permanent redundant power card.

7.2.8 Power Wiring Cable Lengths

The following table shows the maximum wire length for fully loaded racks when powered with a +24 Vdc power supply.

Table 2: Maximum Power Wire Length at +24 Vdc Input Power

Wire Size	16P Rack	8P Rack	4P Rack
12 AWG	23 m (75 ft.)	61 m (200 ft.)	104 m (340 ft.)
14 AWG	18 m (50 ft.)	46 m (150 ft.)	76 m (250 ft.)
16 AWG	9 m (30 ft.)	24 m (80 ft.)	41 m (135 ft.)
18 AWG	6 m (20 ft.)	16 m (50 ft.)	26 m (85 ft.)

7.3 Connecting Grounds

7.3.1 System Chassis Ground

Connect the chassis ground wire to the chassis terminal at the RCM. Follow electrical codes when selecting wire size, maximum wire length, and maximum earth ground resistance. When used in Zone 2 hazardous area applications, use a 4 mm^2 wire with crimp style lug to connect the chassis ground wire to earth ground.

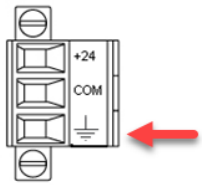


Figure 26:
Chassis Ground

Important

The VC-8000 must be properly grounded to operate correctly. Be sure to adhere to proper grounding practices, providing a single point ground and avoiding ground loops.

7.3.2 Single Point Ground (System Common to Chassis Connection)

To connect Chassis (GND) to System (Instrument) Common (COM) insert the jumper between COM and GND as shown. You can install the jumper at either the Power 1 or Power 2 plugs. Both work the same.

To isolate the internal instrument ground (COM) from earth ground (GND) removing the jumper. An example of this situation would be when using Zener safety barriers, or when the internal system ground is connected to another instrument ground.

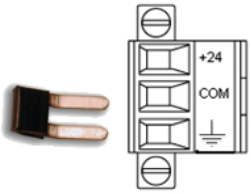


Figure 27:
Chassis to COM Jumper

8 Wiring – Sensors

8.1 UMM Sensor Wiring

This section describes wiring for the following sensor to the UMM:

- -24 V, 3-wire Proximity Transducers
- -24 V, 3-wire Acceleration Transducers
- +24 V, 2-wire IEPE Accelerometers
- +24 V, 2-wire IEPE Velocity Sensors
- Moving coil velocity sensors
- -24 V, 3-wire Proximity type speed sensors
- 2-wire loop powered process variable transmitters
- Externally powered process variable transmitters

8.1.1 3-Wire Proximity Transducers

Connect standard, -24 V powered Proximity transducers as shown below:

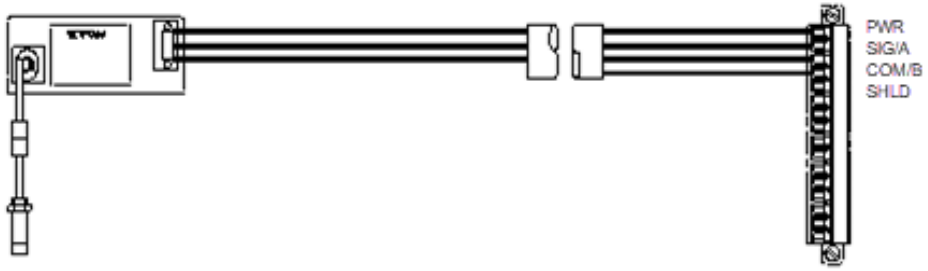


Figure 28: -24 V Proximity Sensor Wiring

8.1.2 Wiring 3-Wire Accelerometers

Connect 3-wire, voltage mode accelerometers as shown below:

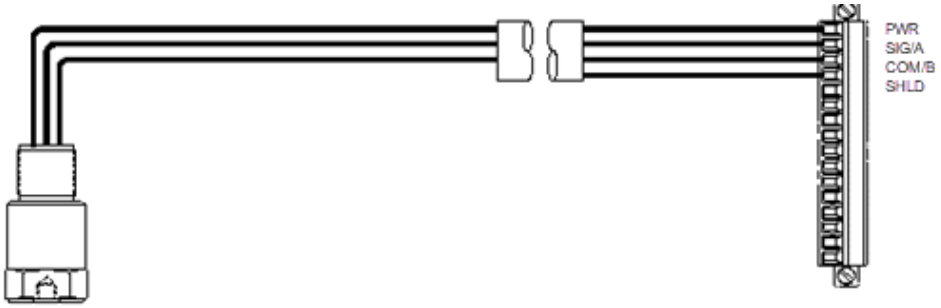


Figure 29: -24 V, 3-wire Accelerometer wiring

8.1.3 Wiring IEPE Transducers

The UMM provides +24 Vdc at 3 mA constant current to power typical IEPE 2-wire sensors. Connect the transducer “A” wire to the UMM Sig/A wire and the transducer “B” wire to the UMM COM/B terminal as shown in below.

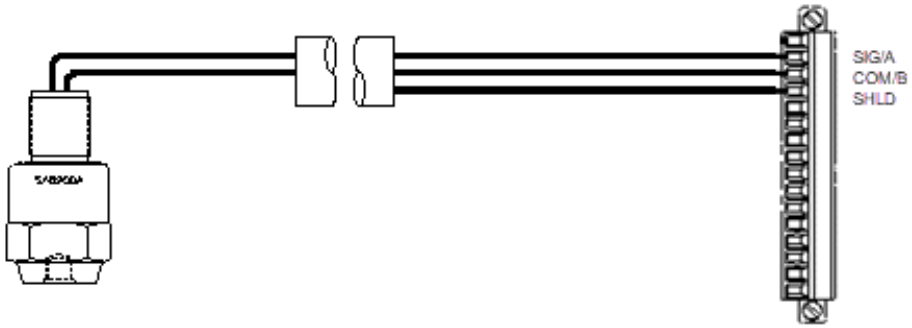


Figure 30: IEPE Transducer Wiring

Important

Sensors designed for negative voltage operation, such as the Bently Nevada Velomitor, typically have the A (COM) and B (-24V)

The BN Velomitor can be connected to the VC-8000, connecting A (SIG) and B (COM), as shown in **Figure 30:** IEPE Transducer Wiring

8.1.4 Wiring Moving Coil Velocity Sensors

Connect moving coil transducers between the UMM SIG/A and COM/B terminals as shown in **Figure 31**. When the sensor is properly connected, the bias is 0 Volts. If the transducer is disconnected, the input will change to -6 V and the UMM will set the channel as faulted.

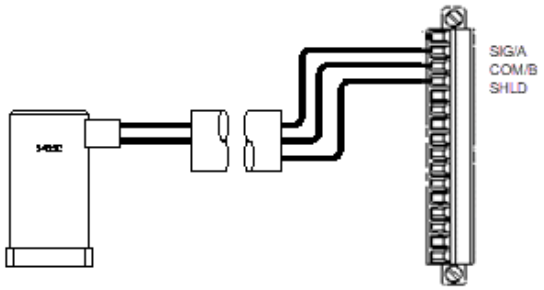


Figure 31: Moving Coil Velocity Sensor Wiring

8.1.5 Wiring Proximity - Speed Sensors

Wire speed sensors as shown. Although Tachometers can be installed on any UMM channel, Phase Trigger channels are limited to Channel 4 (slots 4-9) only. Power supplied is -24 Vdc.

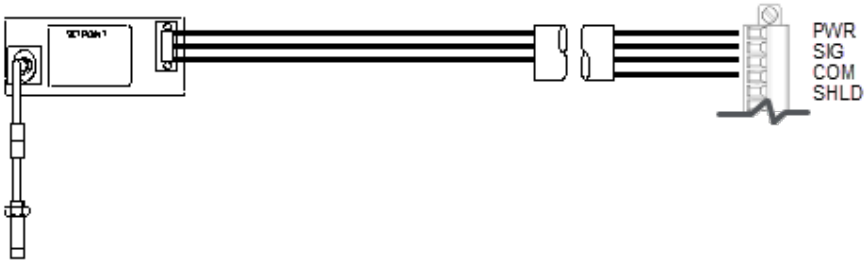


Figure 32: Proximity Probe Wiring

8.1.6 Wiring Magnetic Pickup - Speed Sensors

The UMM can also accept Magnetic Speed Pickups. The UMM can trigger from either wiring polarity.

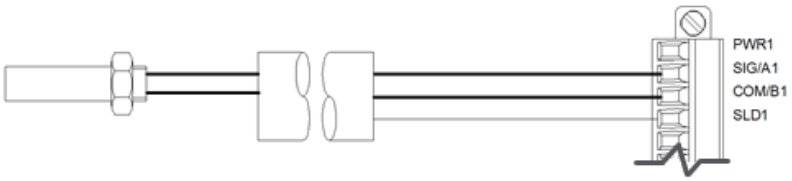


Figure 33: Phase Trigger Magnetic Sensor Wiring

8.1.7 Wiring Proximity Switch - Speed Sensors

The UMM can also accept an +18V Proximity Switch. The UMM provides a load between the sensor signal line and common. Since the UMM provides negative power, the switch must be an NPN type which requires the output load between the signal line and the higher supply voltage.

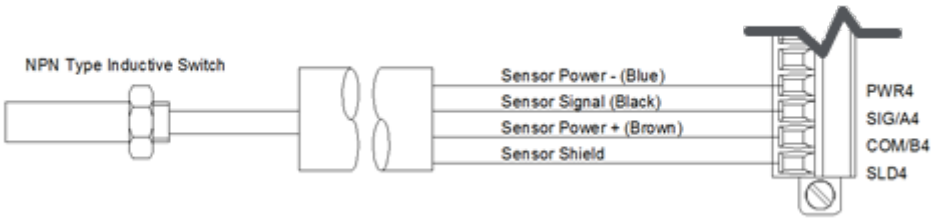


Figure 34: NPN Inductive Proximity Switch Wiring

Important

If using an externally powered proximity switch or optical pickup, the output voltage must be kept less than +18V to prevent the sensor from driving current back into the UMM.

8.1.8 Wiring Two-wire (4-20 mA) Loop-Powered Transmitters

Connect 4 to 20 mA 2-wire, loop-powered transmitters, as shown below. The UMM provides power (-24 Vdc) sufficient to power the transmitter. Inside the UMM the 4 to 20 mA current signal passes through a 249-ohm sense resistor to create a -1.0 V to -5.0 V analog signal.

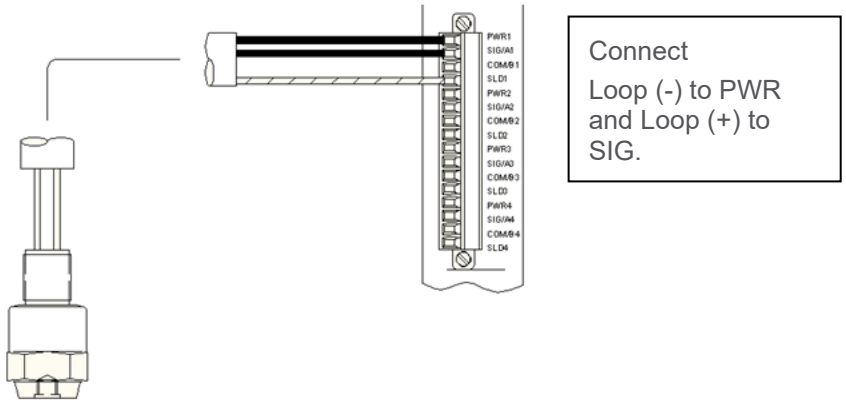


Figure 35: UMM 2-wire transmitter wiring

8.1.9 Wiring Externally Powered (4-20 mA) Transmitters

You can use externally powered transmitters. This includes 4 to 20 mA, 0 to 5 Volts, 1 to 5 Volts, and 0 to -10 Volts. Connect as shown in **Figure 36** with the transmitter loop(+) connected to SIG and loop(-) connected to COM.

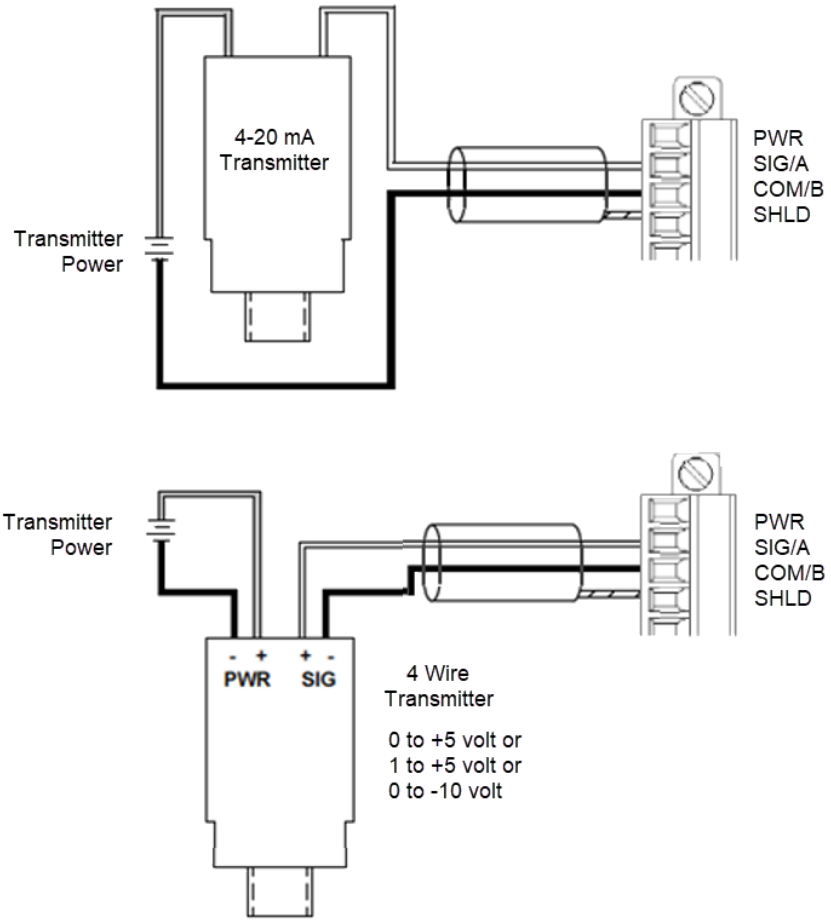


Figure 36: Externally powered transmitter wiring

Application Alert!

An externally powered transmitter that outputs 24 mA (or more) on an over-range condition will cause erroneous readings because the UMM will reduce its output voltage to limit the current.

8.2 TMM Sensor Wiring

The TMM can accept any combination of 2, 3, and 4-wire RTDs or thermocouples.

8.2.1 Wiring RTDs

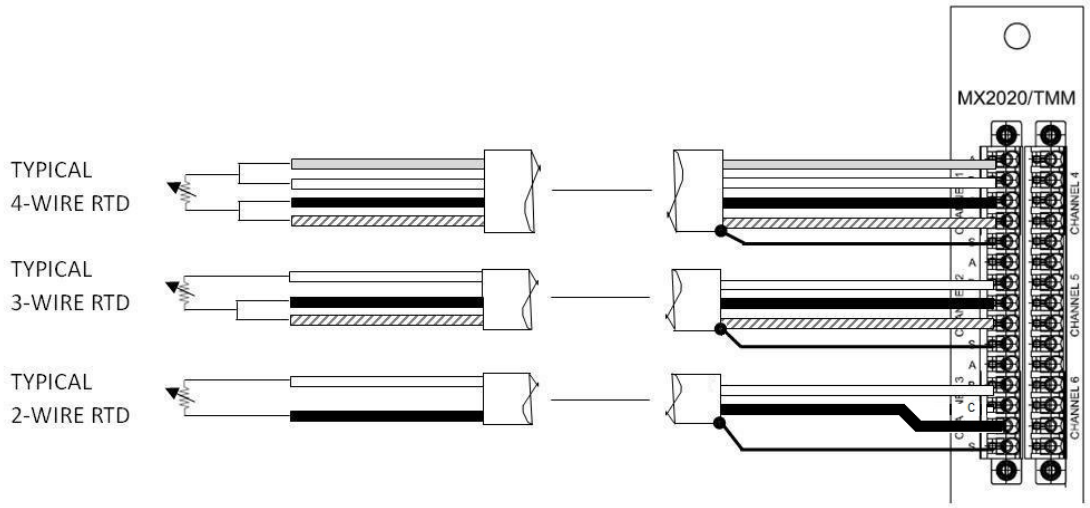


Figure 37: RTD Wiring

Table 3: RTD wiring table (IEC 751/ASTM Color Codes)

RTD	A	B	C	D	Shield
2-wire	NC	White	NC	Red	Shield
3-wire	NC	White	Red	Red	Shield
4-wire	White	White	Red	Red	Shield

Note
Some RTD manufacturers (e.g. Minco) have color codes other than IEC 751/ASTM. Be sure to verify wiring with the information provided with the RTD.

The TMM compensates for the RTD wiring resistance. However, differences in resistance between the legs of 3-wire RTDs, or temperature drift of the 2-wire RTD extension wires will introduce errors. Brüel & Kjær Vibro recommends a maximum of 25 ohms of field wiring resistance.

Note
You can share common RTD return wires across channels 1, 2, & 4 and across channels 3, 5, & 6. Using common return wires between these two groups will cause reading errors. To avoid confusion - do not share return wires.

The TMM scans two channels at a time in groups of channels 1,2,4 and 3,5,6. If your RTDs share a common return line, the common line should not be shared across these two groups. Otherwise the TMM will drive two sensing currents through the common return line and cause reading errors. To avoid confusion – do not share return wires.

8.2.2 Wiring Thermocouples

Wire thermocouples as shown. The VC-8000 isolates thermocouple common lines; this allows connection to grounded tip thermocouples. All thermocouple inputs share the same common plane, so grounded tip thermocouples should be at the same ground potential.

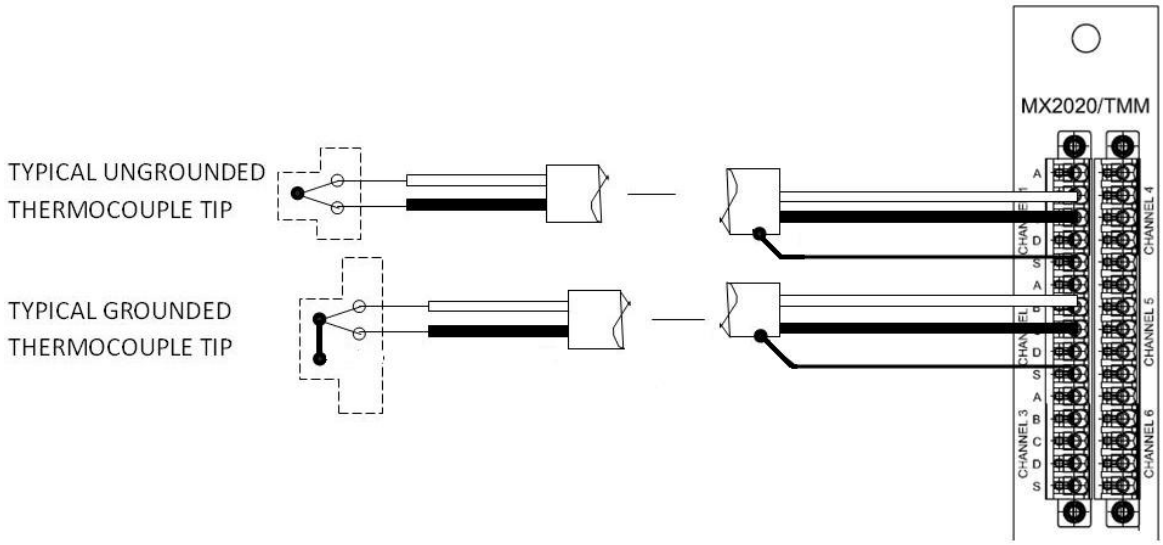


Figure 38: Thermocouple wiring

Table 4: Thermocouple color coding

	ANSI/ASTM E-230 Color Coding		IEC 584-3 Color Coding	
Type	**B Terminal (+)**	**C Terminal (-)**	**B Terminal (+)**	**C Terminal (-)**
J	White	Red	Black	White
K	Yellow	Red	Green	White
T	Blue	Red	Brown	White
E	Violet	Red	Violet	White

8.2.3 TMM and Externally Powered (4-20 mA) Transmitters (Use Caution)

The TMM can be used with 4 to 20 mA transmitters (externally powered) using a 68-ohm resistor. The resistor converts the current into a voltage range suitable for TMM measurements.

Use Caution. Incorrectly wired transmitters may cause over-voltage and subsequent circuit failures in the TMM. Whenever possible, it is recommended to use a UMM module for 4-20 mA (Process Variable channels).

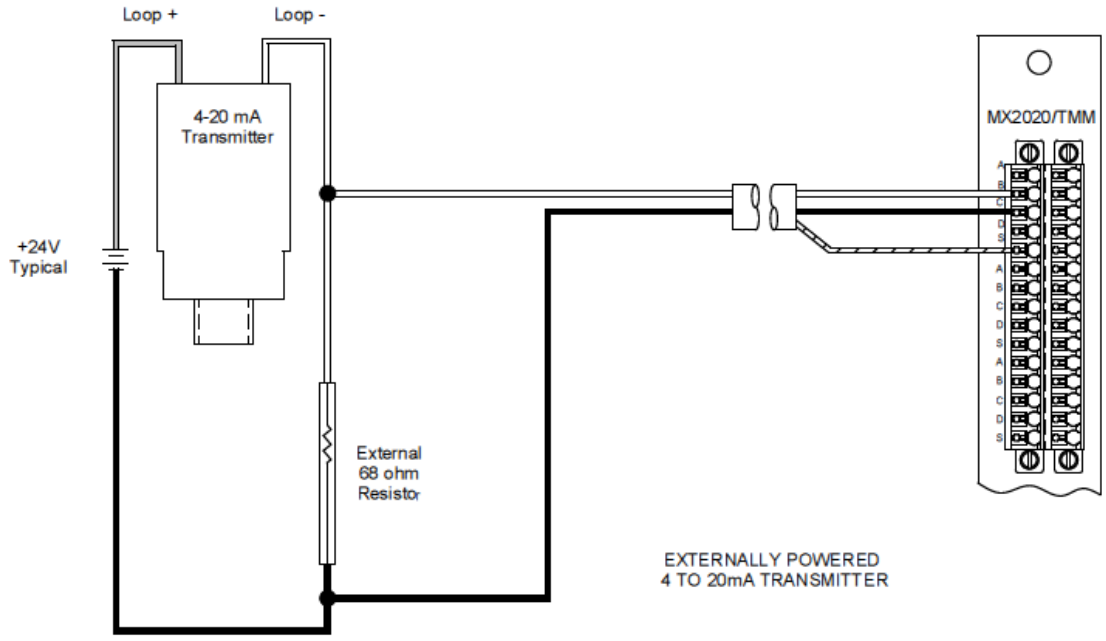


Figure 39: TMM process variable transmitter wiring

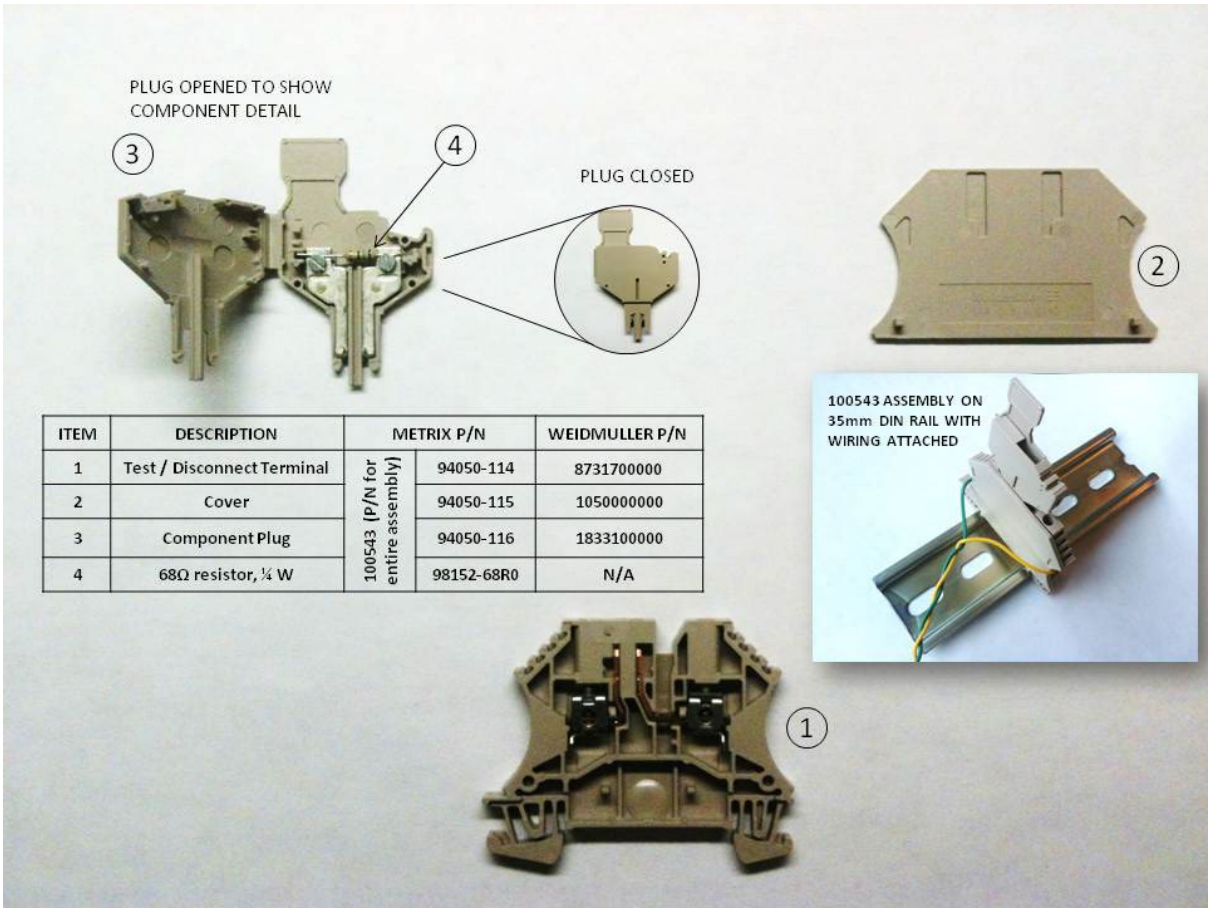
Brüel & Kjær Vibro sells a 35 mm DIN rail mount component terminal for conveniently mounting the 68-ohm resistor as shown in **Figure 40**.

Application Alert

Do not connect TMM PV channels as listeners in loops connected to other devices. This will cause errors in the readings.

Caution

Wiring mistakes can cause an over voltage of the TMM input circuitry and will damage the TMM. For a more robust solution, please use a UMM for Process Variable inputs (4-20 mA).



ITEM	DESCRIPTION	METRIX P/N		WEIDMULLER P/N
1	Test / Disconnect Terminal	100543 (P/N for entire assembly)	94050-114	8731700000
2	Cover		94050-115	1050000000
3	Component Plug		94050-116	1833100000
4	68Ω resistor, ¼ W		98152-68R0	N/A

Figure 40: TMM process variable terminal block

8.2.4 Connecting Voltage Mode (< 1.5V) Transmitters

Voltage mode transmitters, with an output voltage range of less than 1.5 volts, can connect directly to the TMM. Wire the positive output to the TMM channel B terminal and the negative output to the TMM channel C terminal.

Overvoltage can damage the TMM. Generally, it is best to use a UMM for transmitter inputs.

9 Wiring – Interfacing to External Systems (DCS)

There are many features in the VC-8000 hardware designed specifically to interface to the DCS or other external systems. Some are for sharing information, others allow a measure of control. This section provides some guidelines on how best to use these interfaces.

9.1 Modbus Connections and Wiring

The Modbus communications link allows the VC-8000 to respond to data requests from a DCS (for example) for operator viewing screens. This communication link is very common and highly recommended.

Two Modbus ports are available on the SAM module. The Modbus TCP (Ethernet) port, as well as a Serial (RS-232/RS-422/485) port.

Modbus provides measurements and statuses to a control system. Modbus does not provide waveform data (i.e. orbits, spectra).

If you were to see a full list of the Modbus data available from the rack it would be a little overwhelming. Typically, only a small fraction of the available data is shared with other systems. The table below shows examples of data that is commonly read from the rack.

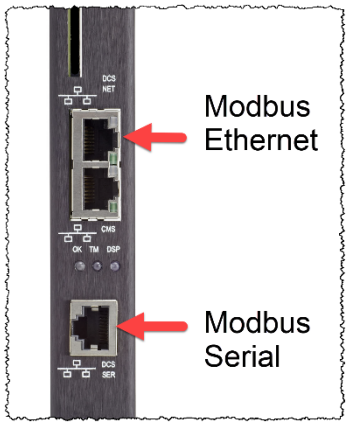


Figure 41:
SAM Modbus Connectors

Table 5: Typical Modbus registers read by DCS

Modbus Data	Register Type	Example Register
Channel value	32-bit (or 16-bit)	30001
Channel Fault	Status bit	10001
Channel in Alert	Status bit	10002
Channel in Danger	Status bit	10003
Rack Power Supply 1	Status bit	10004
Rack Power Supply 2	Status bit	10005
CMS Data Collection Ok	Status bit	12955

9.1.1 Modbus/TCP Ethernet Port (Also NTP)

The DCS NET port on the SAM is for Modbus/TCP communications. This port is an Ethernet port (10/100baseT, using a standard CAT5 or CAT6 cable with an RJ45 connector).

Normally there is only one Modbus client (i.e. DCS) reading data from the rack; but (when needed) Modbus TCP does support multiple clients.

Note: The DCS NET port is a dual function port. Normally it is only used for Modbus TCP; but it can be used for Network Time Protocol (NTP) as well. Be aware, the port only has a single IP address. When the port is used for both functions, the two external systems (Modbus TCP, and NTP) must be on the same network. See more about NTP in section 9.7.2.

The maximum length for twisted pair wiring without an interposing switch is 100 m (328 ft.).

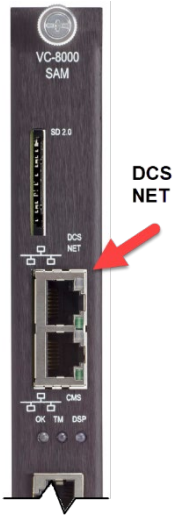


Figure 42:
Modbus TCP port

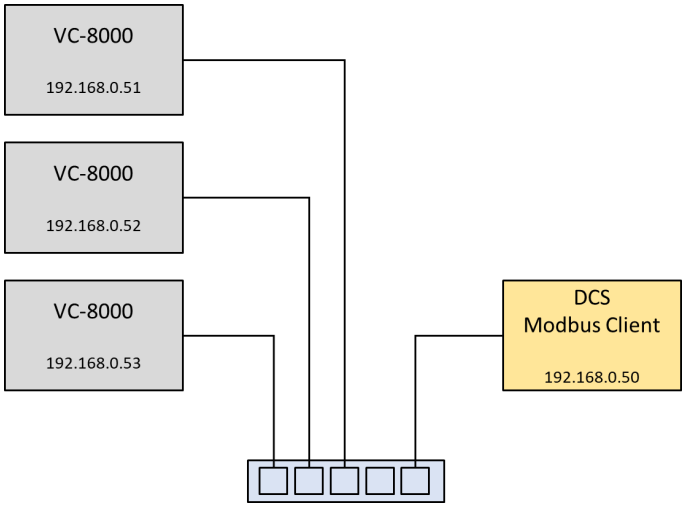


Figure 43: Typical Modbus TCP architecture

9.1.2 Modbus Serial Port (RS-232, RS-422/485)

The SAM provides a single RJ45 connector for Modbus serial communication. The RJ-45 port is used for convenience; this connector is not a network port.

The serial port can used to connect to RS-232, RS-422 (4-wire), RS-485 (4-wire), and RS-485 (2-wire) Modbus clients. See **Table 6** below for the RJ-45 port pinout.

An RJ-45 breakout board is used to connect the Modbus client cable(s) to the serial port (RJ-45) on the rack.

Figure 44:
Serial Modbus port

Table 6: SAM Modbus (RJ-45) Serial Connector

RJ-45 PIN	RS-485/422	RS-232
4	RD-	Rx
5	RD+	-
6	COM	COM
7	TD-	Tx
8	TD+	-

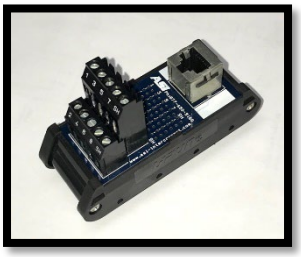


Figure 45:
RJ-45 Breakout board

Table 7: Protocol maximum cable lengths

Protocol	Maximum Cable Length
RS-232	30 m (100 ft.)
RS-422	1200 m (4,000 ft.)
RS-485	1200 m (4,000 ft.)

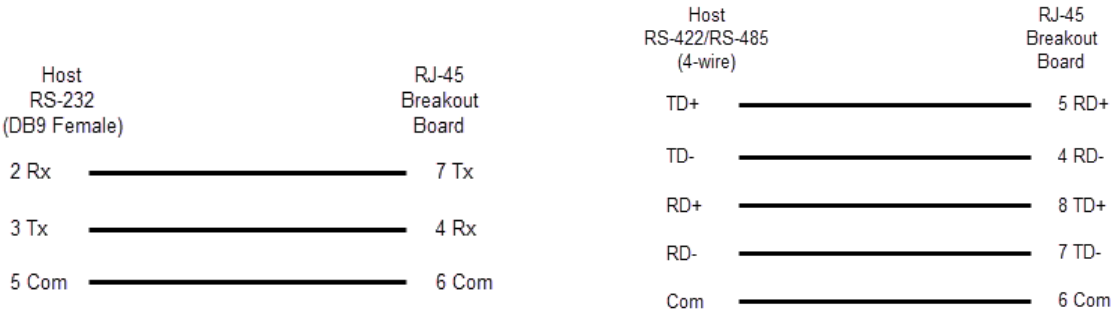


Figure 46:
RS-232 and RS-422/485 (4-Wire) wiring examples

9.1.2.1 RS-422 (4-Wire) Daisy Chain

The VC-8000 rack does not support RS-422 daisy chain. If the DCS (Modbus Client) is an RS-422 port, we recommend two viable options.

- Use a Modbus Serial (RS-422) to Modbus TCP converter and configure the VC-8000 racks for Modbus TCP
- An RS-422 (4-Wire) client (the DCS) can connect to field devices configured for RS-485 (4-Wire)

9.1.2.2 Termination for RS-485 Communication

Normally termination is not needed on RS-485 cables. If the cable length is short and the baud rate low, reflections are attenuated by the time the signal is read, so termination is not required. However, if your cable length exceeds the length shown in **Table 8**, you will need to terminate your network.

Terminate at the farthest ends of the network (both ends). Keep connections, from the main trunk to each rack, as short as possible. To terminate, place external 120-ohm termination resistors between RX- and RX+ and between TX- and TX+.

Table 8: RS-485 Cable Lengths

Baud Rate (bps)	Maximum Cable Length Without Termination Resistors
1200, 2400, 4800	Termination not required.
9600	850 m (2,800 ft.)
19200	425 m (1,400 ft.)
38400	213 m (700 ft.)
57600	143 m (470 ft.)
115200	71 m (234 ft.)

9.1.2.3 Maximum Racks on an RS-485 Network

RS-485 multi-drop networks are limited to 64 devices and 4000 ft. (120 m) of cable total.

9.1.2.4 Fail Safe Biasing Resistors

The VC-8000 Modbus serial port does not require biasing resistors. The fail-safe function is built in.

9.1.2.5 RS-485 (2-Wire) Half Duplex Communication

Externally connect the receive and transmit pairs together (RD+ to TD+, and RD- to TD-) for half duplex RS-485 communication. The SAM settings (RS-485 2-wire, and RS-485 4-wire) are the same; no communication electronics are changed between these two settings.

9.1.3 Redundant Modbus Communication

Redundant *Ethernet* Modbus is accomplished using a primary SAM (in slot 2) and a secondary SAM (in slot 3). Each SAM works independently and must be configured independently. For example, if you are using a custom Modbus map, the map must be configured in both modules.

Redundant *Serial* Modbus is only supported using the Standard Modbus Map in both SAM modules.

9.2 Fault (Not OK) Relay

The Fault (Not OK) Relay activates whenever machine protection is compromised due to a detected VC-8000 or instrumentation failure such as a sensor going bad (Not OK).

When the DCS is connected to the Fault (Not OK) Relay, plant operators can be notified that there is a problem with the machinery protection system.

Figure 47:
OK LED (on RCM)

The relay and its associated LED is located on the RCM module. When the system is operating correctly the relay is energized and the OK LED is green. When there is a fault the relay de-energizes and the OK LED is off. The relay will always de-energize on complete power loss. The status of the relay can also be viewed via Modbus.

The following events will cause the Fault (Not OK) relay to activate:

- Sensor failure (Channel with a Not OK status)
- Any module reboots (UMM, TMM, or SAM)
- Any module is re-configured (UMM, TMM, or SAM)

Other (less common) events that will drive the Fault (NOT OK) Relay:

- The SAM is removed from the rack (or stops communicating with the UMMs/TMMs)
- Internal Faults in a UMM/TMM
- If UMM/TMM relays are not in the expected state
- Invalid configuration in a UMM/TMM

The following events will NOT trip the OK Relay (fault tolerant):

- A single power supply fault will not trip the OK relay
- Loss of communication to the PI Server (or other CMS Data Server) will not trip the OK relay

Caution

Sensor faults (and sensor wiring issues) will trip the Fault (Not OK) Relay. Therefore, this relay is not recommended for machine shutdown (trips); it is for notification only.

9.2.1 Wiring to the Fault (Not OK) Relay

The Fault relay is 'Normally Energized'. The relay is labelled NC for Normally Closed, ARM for Armature, and NO for Normally Opened. These labels indicate the position of the armature when there is no power applied to the rack (i.e. ARM will be connected to NC.).

The Fault (Not OK) relay is a single-pole, double-throw (form C) relay. Use 12 to 24 AWG wire (0.2 mm^2 to 4 mm^2).

Specifications for the fault relay current and voltage ratings are found in the RCM datasheet (S1078950).

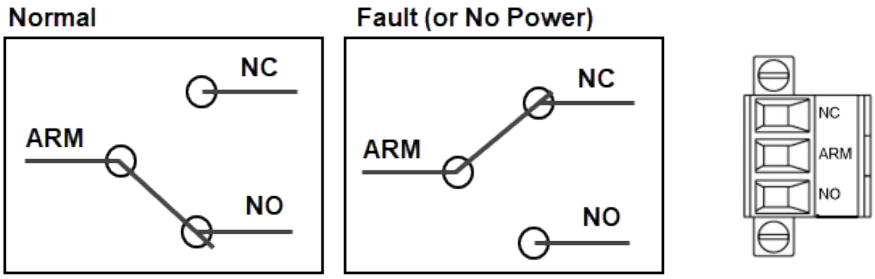


Figure 48: Fault Relay Diagram

Electrical Shock Hazard!

High voltages (powered by external systems) may be present on relay wiring. Verify external voltages with a multi-meter before servicing relay connections

Danger!

High voltages and/or currents can lead to injury or even death! See the VC-8000 data sheet for permissible voltages on contacts.

9.3 Rack Control Signals (Reset, Inhibit, Trip Multiply, SAI, Bypass)

There are six input commands (controls) available on the VC-8000. These functions are described in the table below.

Table 9: VC-8000 control inputs

Command	Description
Reset (RST)	Resets all latched alarms. This control is highly recommended when using latched alarms in the MPS.
Inhibit (INH)	Inhibits (disables) all alarming on all signal channels. Inhibited channels still show data, but the channels will not alarm. INH does not disable relays, it disables alarms that drive the relays. Using this control is highly recommended. It allows the operators to temporarily disable alarming; for example, when a technician is troubleshooting a sensor.
Trip Multiply (TM)	Alarm set-points will be increased by the configured TM factor (i.e. 2x, or 3x). This feature is intended for large machines that pass through critical speeds (resonance) on start-up.
Special Alarm Inhibit (SAI)	Special Alarm Inhibit is typically only used for Aero Derivative channels. When enabled, it inhibits all alarming (Alert and Danger) on all measurements of the Aero-Derivative channel. For other channel types (i.e. Radial Vibration) Special Alarm Inhibit will inhibit alarming (Alert only) on all secondary measurements (i.e. 1X Amplitude, 2X Amplitude, Bandpass).
Signal Channel Bypass	Bypasses the signal channel. No data will be shown. No Modbus data will be available. No 4-20 mA current will be available. This function is typically used to temporarily disable a channel if there is a sensor malfunction causing nuisance alarms. If you use channel bypass, verify the effect on your relay logic. For example, if channel Brg 1X is placed in bypass, how will it affect a relay configured to trip when both Brg 1X & Brg 1Y are in alarm. This command is only available via the Rack Maintenance software or a UMM Discrete input channel.
Relay Channel Bypass	Bypasses the relay channel. This command is only available using the Rack Maintenance software.

Four of the control signals (RST, INH, TM, SAI) can be activated using the discrete input (DI) connector on the RCM. These same four controls can be activated using Modbus. These controls act on the rack (all channels).

Two of the controls (Signal Bypass, Relay Bypass) can be activated with the VC-8000 Maintenance software. These controls act on the channel.

Although rarely used, three of the controls (Signal Bypass, INH, TM) can be activated using a UMM Discrete Input channel and act on a machine group (rather than the whole rack). The machine group is defined by the Asset Level 1 setting (see section 12.2.3).

Table 10 shows these six commands and how they can be set, and if the command applies to the whole rack, a (machine) group within the rack, or a single channel.

Table 10: Control input - acting on rack, (machine) group, or channel

Command	RST	INH	TM	SAI	Signal Bypass	Relay Bypass
RCM DI Connector	Rack	Rack	Rack	Rack	--	--
UMM Discrete Input channel	--	Group	Group	--	Group	--
Modbus Command	Rack	Rack	Rack	Rack	--	--
Maintenance Software	Rack	--	--	--	Channel	Channel
Touch Screen Display	Rack	--	--	--	--	--

9.3.1 RCM Discrete Input Connector

There are four discrete control input signals on the RCM: Rack Reset (RST), Rack Inhibit (INH), Rack Trip Multiply (TM), and Rack Special Alarm Inhibit (SAI).

These four controls operate at the rack level. For example, if the Inhibit contact is closed, all signal channels in the rack will be inhibited.

These are dry contact, discrete inputs; they are active low and are asserted (turned on) when the input signal is pulled to common. The discrete inputs are 5 V logic compatible and can be pulled low by logic gates.

Connect to the discrete inputs using AWG 14 to AWG 28 wire. When using ferrules, the maximum wire size is 1 mm² (17 AWG).

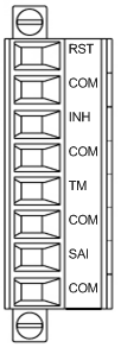


Figure 49: RCM Discrete Inputs

Caution

Connecting high voltage wetted relays to the discrete contacts can damage the module. Connect only dry contact relays or low voltage logic.

Caution

Rack Inhibit (INH) prevents internal signals (in the rack) from driving an alarm. Rack Inhibit does not prevent a relay trip that occurs when the rack loses power, a card is removed from the rack, or when a card is re-configured.

9.3.2 UMM Discrete Input Channel

Although rarely used, you can configure UMM Discrete Input channels to perform Trip Multiply, Inhibit, and Bypass functions for machine groups defined in the rack. Use the Asset Level 1 field to define the machine groups.

When the rack is protecting multiple machine trains, this feature allows independent control functions for each train (see section 26.3).

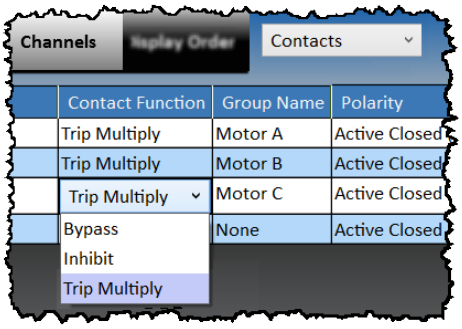


Figure 50:
UMM Discrete Input channel

9.3.3 Modbus Discrete Input Commands

Modbus commands can be used to set the Reset, Inhibit, Trip Multiply, or SAI commands at the rack level only; for example, you cannot use Modbus commands to place a "Machine Group" into Trip Multiply.

To use a Modbus command, Allow Status Register Writes must be enabled in the SAM Modbus settings.

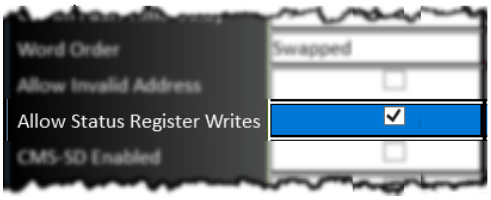


Figure 51:
Allow Modbus write commands

9.3.4 VC-8000 Rack Maintenance Software Commands

The VC-8000 Rack Maintenance Software can be used to reset the rack, bypass a signal channel, or bypass a relay channel.
To bypass a signal (or relay) channel, connect to the rack (local USB, or Remote), select the channel (or relay), and then select Enable Bypass. The channel will remain bypassed until the user selects Disable Bypass.

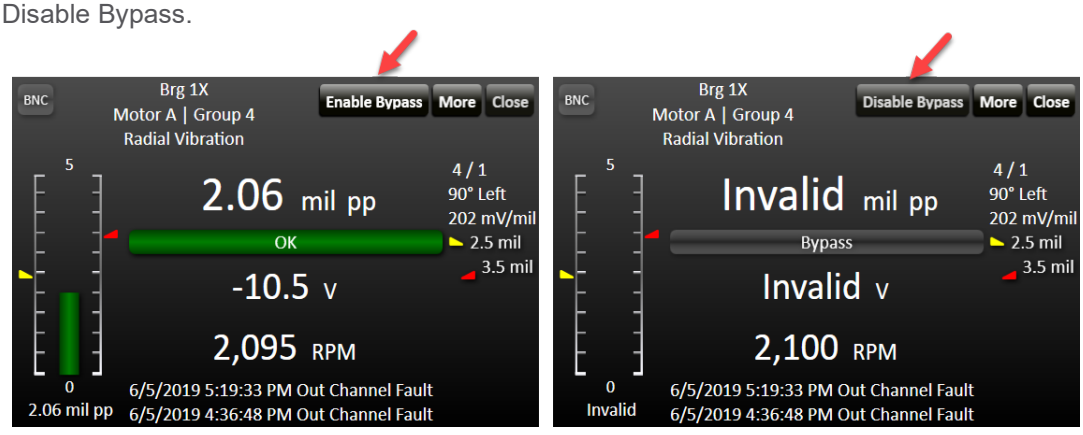


Figure 52: Bypass a channel

Note

Enable Bypass is not possible from the touch screen display. You must connect to the rack with a PC and run the VC-8000 Rack Maintenance software.

9.4 Buffered Output Connectors

9.4.1 UMM Buffered Output Connector (RJ-45)

Each UMM has an RJ-45 connector that provides access to buffered output signals in the UMM. These can serve for temporary or permanent connections.

Breakout cable 100431-AA is used to connect the UMM to the back of a patch panel. Users can then connect multi-meters (or other devices) to the front of the patch panel. Standard CAT5/CAT6 cables with couplers can be used to extend cable lengths up to 30 ft. (10 m).

Figure 53: Buffered output connectors

Table 11: UMM Buffered-Out RJ45 Pin-out

RJ45 Pin	Signal Name	Conductor Color (TIA/EIA-568-B.1-2001 T568B)
1	Channel 1 Signal	White/Orange
2	Common	Orange
3	Channel 2 Signal	White/Green
4	Common	Blue
5	Channel 3 Signal	White/Blue
6	Common	Green
7	Channel 4 Signal	White/Brown
8	Common	Brown

9.4.2 RCM (Secondary) Buffered Output Connector

The RCM buffered output connector provide secondary access to buffered analog signals from all UMM modules.

This connector is rarely used and is limited to just 10 ft. (3 m) maximum.
It is preferred to use the RJ-45 connector on the UMM.

Contact B&K Vibro technical support for the connector pinout (if needed).

Note

Generally, it is more convenient to use the buffered output RJ-45 connector on each UMM to route the buffered signals to a permanent patch panel.

9.5 Analog (4-20 mA) Output

Each UMM/TMM has analog outputs corresponding to a designated measurement selected in the configuration software. 4 mA corresponds to the configured bottom-scale, 20 mA corresponds to the configured full-scale. The 4 to 20 mA is self-powered (sourcing) and requires no external power source.

For example, the following table shows a radial vibration channel with a range of 0-5 mils (0-127 µm).

Table 12: Analog output (4-20 mA) examples

Radial Vibration Channel	Analog Output
Fault	2.0 mA (if 2mA clamp is enabled)
0 mils (0 µm)	4.0 mA
1 mil (25 µm)	7.2 mA
2 mils (51 µm)	10.4 mA
3 mils (76 µm)	13.6 mA
4 mils (102 µm)	16.8 mA
5 mils (127 µm)	20 mA

Historically the DCS would use this signal to drive annunciation relays and/or trips and to show the values on operator viewing screens.

Today the use of analog signals (4-20 mA) is less common. Most customers now use the VC-8000 system itself to drive relays and/or trips, and the operator screens get their data from a Modbus communications link.

Wiring analog signals adds cost to the project; costs for wiring the signals and the hardware cost for the input cards at the DCS. Again, Modbus is a more efficient way to send data to the DCS for visualization.

9.5.1 4-20 mA Fault Conditions

In the event of a sensor fault, the 4 to 20 mA output will drop to bottom scale (4 mA). This value is configurable in the MPS Setup software. A 2 mA clamp option is also available for faulted channels. An output between 20 mA and 24 mA indicates an over-range condition.

9.5.2 4-20 mA Output Wiring

The maximum cable length is a function of the supply voltage and the total loop resistance as shown in **Figure 54**.

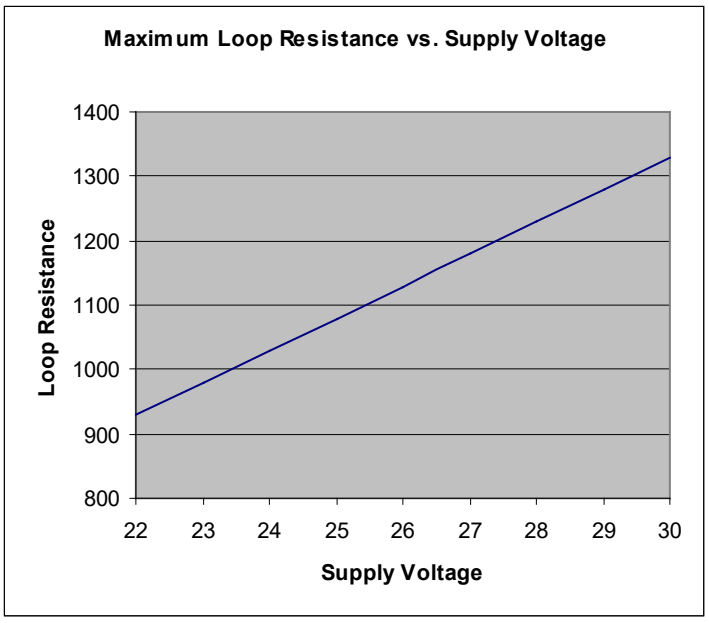


Figure 54: Analog Output Maximum Loop Resistance

The total loop resistance includes the sensing load and the total wire resistance. For wire runs longer than 1,500 m (5,000 ft.) 24 AWG is the minimum recommended wire size.

Use 20 AWG wire for runs up to 3,000 m (10,000 ft.). Above 3,000 m (10,000 ft.) the cable capacitance may limit frequency response. Consult with Brüel & Kjær Vibro if you need analog output wiring runs longer than 3,000 m (10,000 ft.)

Shielded wire is recommended to reduce electrical noise. Terminate shielding at the receiving device.

9.6 Relay Output

Relay outputs from the VC-8000 can be used to drive annunciators (lights, horns), to drive a machine trip circuit, or to connect to a DCS etc. The DCS might use the input for a status indicator on an operator screen (HMI) or to drive a secondary relay.

There are four relays in each UMM/TMM. Each relay is programmable and independent. For example, a “Common High Vibration” relay can be programmed, with input signal (logic) coming from every signal channel on the machine.

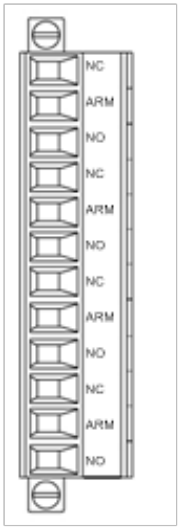


Figure 55: Relay Connector

9.6.1 Relay Wiring

Relay wiring ARM-NC (or ARM-NO) will depend on your site. The labelling of the relay connector is: NO (normally open), ARM (armature), and NC (normally closed); the labeling refers to the position of the relay contact when the rack is not powered.

The relay can be configured to be normally energized (fail safe) or normally de-energized operation (see section 17).

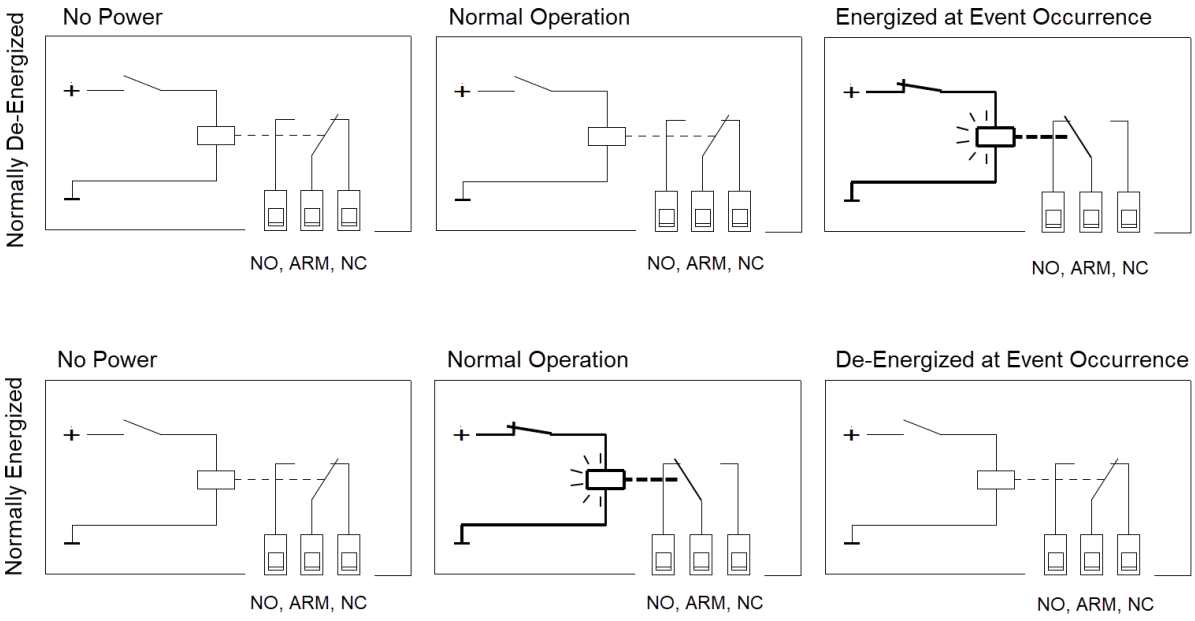


Figure 56: Relay Operation

The VC-8000 does not place any voltage on the connectors (ARM, NC, NO); the voltages come from other systems connected as part of the trip circuit. If you power down the VC-8000 rack, these external voltages will still be present on the wires!

Electrical Shock Hazard

High voltages (from trip circuits) may be present on relay wiring. Remove power from trip circuits before servicing VC-8000 relay connections. See UMM product data sheet for max voltage allowed on relays.

UMM and TMM relay connectors support wire gauges from 16 to 28 AWG. When using ferrules, the maximum wire size is 1 mm2 (17 AWG).

Application Alert

The De-Energize to Trip (Normally Energized) relay setting will cause a relay trip on loss of power, configuration change, or firmware download.

Relays signals to 3rd party systems must be externally bypassed when making system changes to the VC-8000.

9.7 Rack Time Synchronization

The VC-8000 has an internal clock. The clock time is kept internally in UTC time. The rack uses the time setting to keep the event list and to send data to CMS.

When data is sent to CMS, it is sent in UTC time. All conversion to local time settings are performed in PI/CMS. The times displayed in the rack event list are converted from UTC using the configured Time Zone setting in the rack.

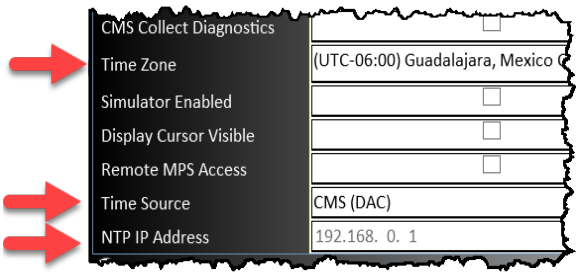


Figure 57: Rack Time Synchronization

9.7.1 Choosing a Time Zone

Because the rack uses UTC time internally, you must select a Time Zone. This will allow the rack time to display the time correctly. The time zone only affects the times shown in the VC-8000 Maintenance software and on the touch screen display. The Time Zone setting does not affect data being sent to CMS PI or CMS XC.

9.7.2 Time Synchronization via CMS (DAC)

If CMS is being used, the rack will synchronize its internal time to the computer (PI or XC).
If you are using a CMS PI System, the time will be synchronized with the PI Data Archive server. If you are using CMS XC the time will be synchronized to the computer running the SETPOINT PI/XC Adapter software.

9.7.3 Time Synchronization via NTP (via SAM DCS port)

The VC-8000 rack can synchronize its time with a master clock using an NTP server.
This connection uses the DCS NET (Modbus TCP) port. To use an NTP server, change the Time Source setting to “NTP (via DCS Port)”. Then enter the IP Address for the NTP server. The rack will now send NTP requests to the specified IP address.

Although the DCS NET port is dual function (Modbus and NTP); the port only has one IP address. If both Modbus TCP, and NTP are being used, both “functions” are using the same IP address. For example, in **Figure 58** the Modbus address of Rack 1 is 192.168.0.51, so the NTP address of Rack 1 must also be 192.168.0.51.

Normally, NTP should not be used if you are connected to a CMS system.

9.7.4 Set Rack Time with Rack Maintenance Software

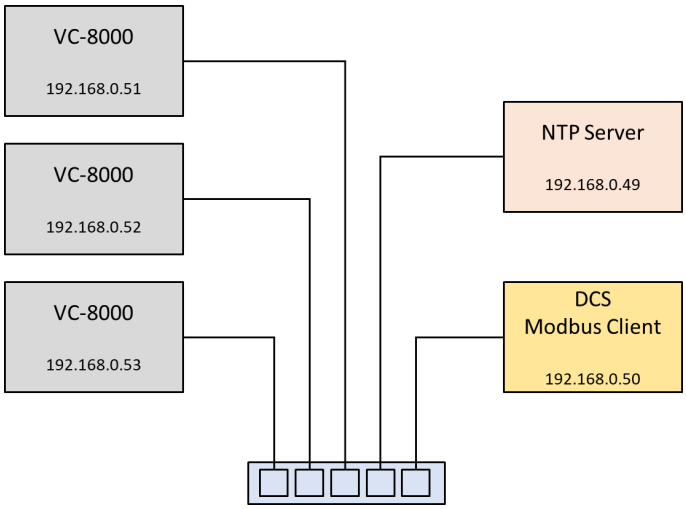


Figure 58: Modbus TCP Architecture with NTP Server

If there is no external system for time synchronization, you can set the rack time using your laptop and the Rack Maintenance software. This is a single (one-time) push from your laptop to the rack.

Note: To use this feature, the Time Source (in SAM configuration) must be set to CMS (DAQ).

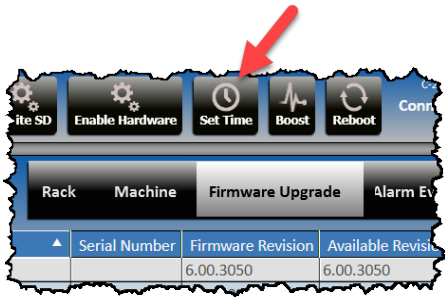


Figure 59:
Set Rack Time

9.7.5 Time Synchronization via Modbus

The rack time can also be sent using a Modbus command. The Modbus timestamp value is an epoch timestamp and is the number of “tics” that have elapsed since January 1, 1970 at midnight.
In the VC-8000 one “tic” = 100 nanoseconds.

To learn more about epoch time, you can browse various converters and tutorials on the Internet (i.e. http://www.epochconverter.com).

Example: Set the VC-8000 time to Jan 1, 2020 9:00 AM PST.

Table 13: SAM settings (Modbus Time Synch)

SAM Setting	Selection
Time Source	Modbus
Allow Status Register Writes	Enabled
Time Zone	UTC -08:00 (Pacific Time)
Word order	Swapped

- Calculate the epoch time for the time zone of the rack. In this example I am using the internet to find a web page to convert to epoch time.
  - Jan 1, 2020 9:00 AM PST = 1,577,898,000 seconds
- Multiply by 10x7 to convert to tics (In VC-8000 one tic = 100 nanoseconds)
  - 15,778,980,000,000,000 tics
- Convert to Hex
  - 0038 0EE6 11D1 6800
- Use function code 16 to write registers. The word order in this example is Swapped. So, the most-significant word (MSW) of the time value is in register 1009, and LSW is in 1012.

Table 14: Epoch time conversion example

Register	Hex Value (swapped)	Hex Value (non-swapped)
4x (1009)	0038	6800
4x (1010)	0EE6	11D1
4x (1011)	11D1	0EE6
4x (1012)	6800	0038

- You can verify the time in the VC-8000 by viewing the event list. Press the reset button to create an event and verify the time.

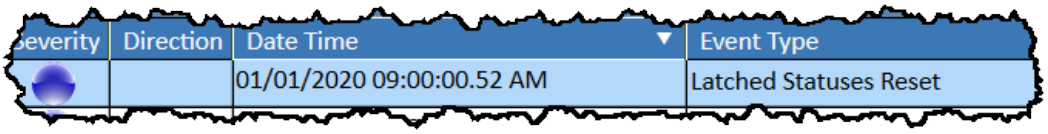


Figure 60: VC-8000 date, time shown in the Event List

10 Software – Introduction (Start Here)

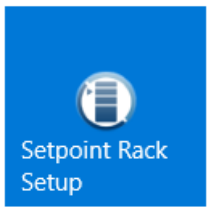
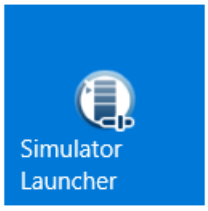
10.1 Software Installation

Download the latest software from the Brüel & Kjær Vibro website. You must have Administrator privileges on your computer to install the software. To install the software:

- Double Click on MPS_Setup.exe
- Follow the instructions to complete installation

Three applications will be installed.

Table 15: MPS Software

Icon	Software	Description
	Rack Setup	Contains spreadsheet type views used to configure the full rack, modules, channels, measurements, limits and relay, etc.
	Rack Maintenance	Contains several displays (bar graphs, event lists etc.) to view data and perform maintenance tasks – such as firmware upgrades.
	Simulator Launcher	Used with Rack Maintenance software to simulate a rack (virtual) and verify the display layout or other functionality like CMS. This shortcut may be removed if the user isn't involved in maintenance or testing.

10.2 Rack Setup - Software Navigation

The Rack Setup software is a spreadsheet type application. The configuration parameters are viewed in rows and columns. Copying and pasting between cells, sorting columns, and filtering are available. There are five main areas used for navigation and setting properties.

Figure 61: Software Navigation Features

Table 16

Control	Description
(1) Tab Selection	Select major categories
(2) View Selection	Select sub-categories
(3) Filter	Filters on all columns marked with an asterisk
(4) Properties Window	Show all properties for the selected row
(5) Grid	Edit properties in the main configuration grid

In a typical configuration of a VC-8000 rack the user will start with the Modules tab, then proceed to the Channels tab etc. At each tab, the user will progress through each View, before moving on to the next tab.

Note: Always start by setting Module Type, and Channel Type settings first. If you change the Module, or Channel type, the channel properties will return to default values.

10.3 Helpful Tips

10.3.1 Default Units

Before you start adding modules - set the default units (imperial or metric) from the File menu. New modules and channels will default to these units.

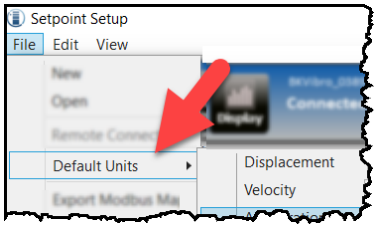


Figure 62: Set default units

10.3.2 Language Preferance

It is possible to change the display language to one of the supported languages without installing a different version of the VC-8000 software. This is done from the File Menu Language Preference option. If the configured language is changed, the VC-8000 software will need to be restarted in order for the new language to be displayed.

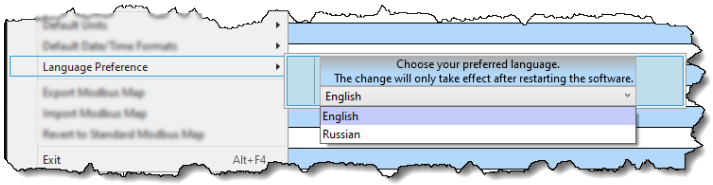


Figure 63: Language Preference

10.3.3 Time/Date Format

The Time/Date format can be configured for the VC-8000 software running on a local computer and for the local display on the VC-8000 rack.

To configure the format on a computer running the VC-8000 software, go to the File Menu and select Default Date/Time Formats. The Date and Time formats can be configured independently from the available options, see **Figure 64**.

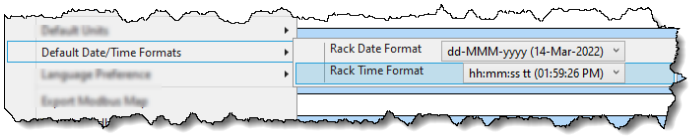


Figure 64: VC-8000 Date/Time Format

To configure the Date/Time format used on the VC-8000 Rack local display, the available options are on the SAM specific module configuration view, see **Figure 64**.

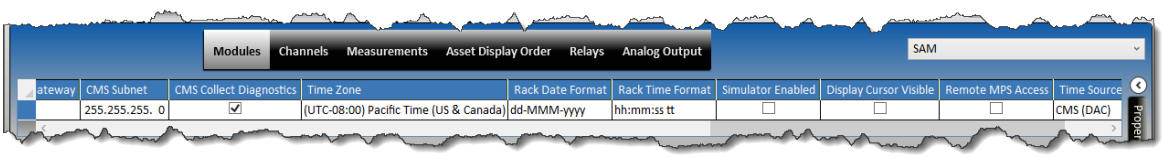


Figure 65: Front Panel Date/Time Format

10.3.4 Copy and Paste

The software supports copy and paste functions. You can copy a single cell and paste to multiple cells. You can also copy a block of cells and paste to a block of cells. You can also copy and paste from Microsoft Excel.

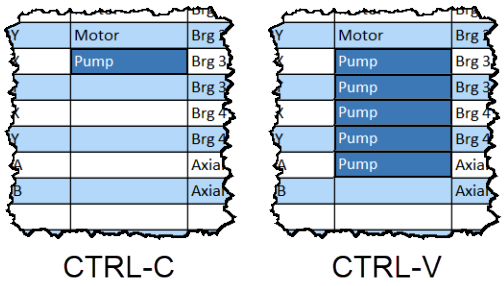


Figure 66: Pasting Across Multiple Cells

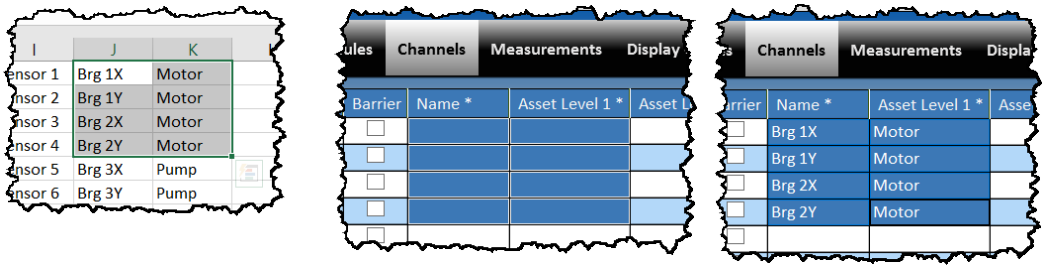


Figure 67: Copy and paste from Excel

> **Note**
> All cells can be copied, but some cells do not support ‘paste’ functionality.

10.3.4.1 Copy With Headers

The software supports copy with headers.
You can copy one or multiple cells, along with their accompanying headers so that data can be properly labeled when pasted into Microsoft Excel.

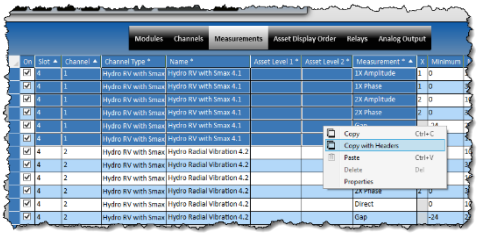


Figure 68: Copying With Headers

	A	B	C	D	E	F	G	H
1	Slot	Channel	Channel Type *	Name *	Asset Level 1 *	Asset Level 2 *	Measurement *	
2	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			1X Amplitude	
3	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			1X Phase	
4	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			2X Amplitude	
5	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			2X Phase	
6	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			Gap	
7	4	1	Hydro RV with Smax	Hydro RV with Smax 4.1			Smax	
8								

Figure 69: Paste With Headers to Excel

10.3.5 Sort and Multiple Column Sort

You can sort a single column. Click the mouse on the column header to sort by that column. Click on the column label again to change the order of the sort.

You can sort multiple columns. Sort the first column by clicking the mouse on the column header. Then press the SHIFT key and click the second column header. Then press the SHIFT key and click the third column header.

In the screen capture (**Figure 70**), the grid was sorted first by machine (pump), second, by units, and then third, by measurement type.

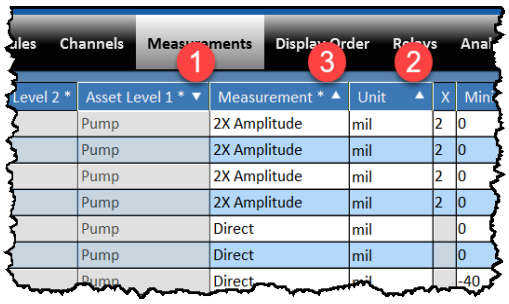


Figure 70:
Use SHIFT + mouse click to multi-sort

10.3.6 Disable Unused (Spare) Channels

Disable channels from the Channels Tab. Deselect the box in the 'On' column. It also helps to change the tag name of disabled channels to "Spare".

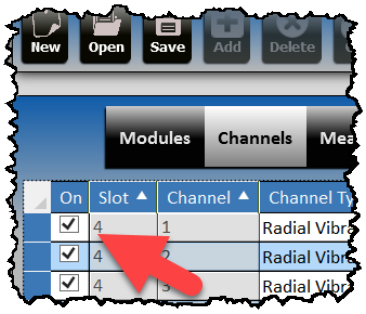


Figure 71:
Disable Unused Channels

10.3.7 Configuration Errors

When configuration errors occur, the channel with the error will be marked with a red 'X'. The setting that caused the error may be on another tab (or view).

Hover the mouse over the red X to see a description of the error. Or, clicking on the red X to display the error at the bottom of the window.

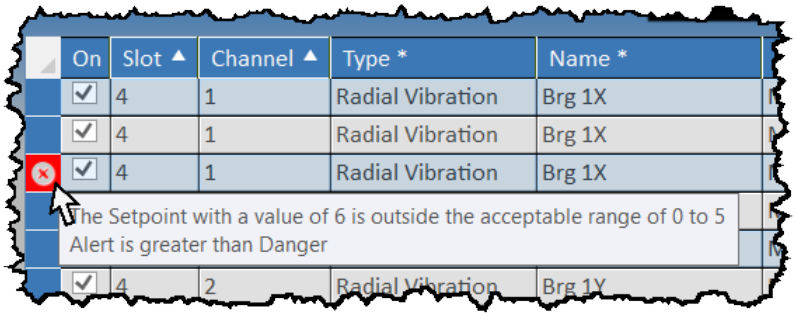


Figure 72: Configuration Error Indication

10.3.8 Grid Filter

Use the filter to show only the rows you are interested in seeing. The filter is not case sensitive and applies to all column headers (marked with an asterisk) simultaneously. When the filter is active the filter control has a bold border. Click on the “x” to clear the filter.

Table 17: Filtering the grid, examples

Filter Examples	Filter will show
(1) Phase Trigger” or “Phase”	Only the Phase Trigger channel
(2) “Axial”	Two Axial channels
(3) “Motor”	Five “Motor” rows
(4) “Brg 4”	Two “Brg 4” rows

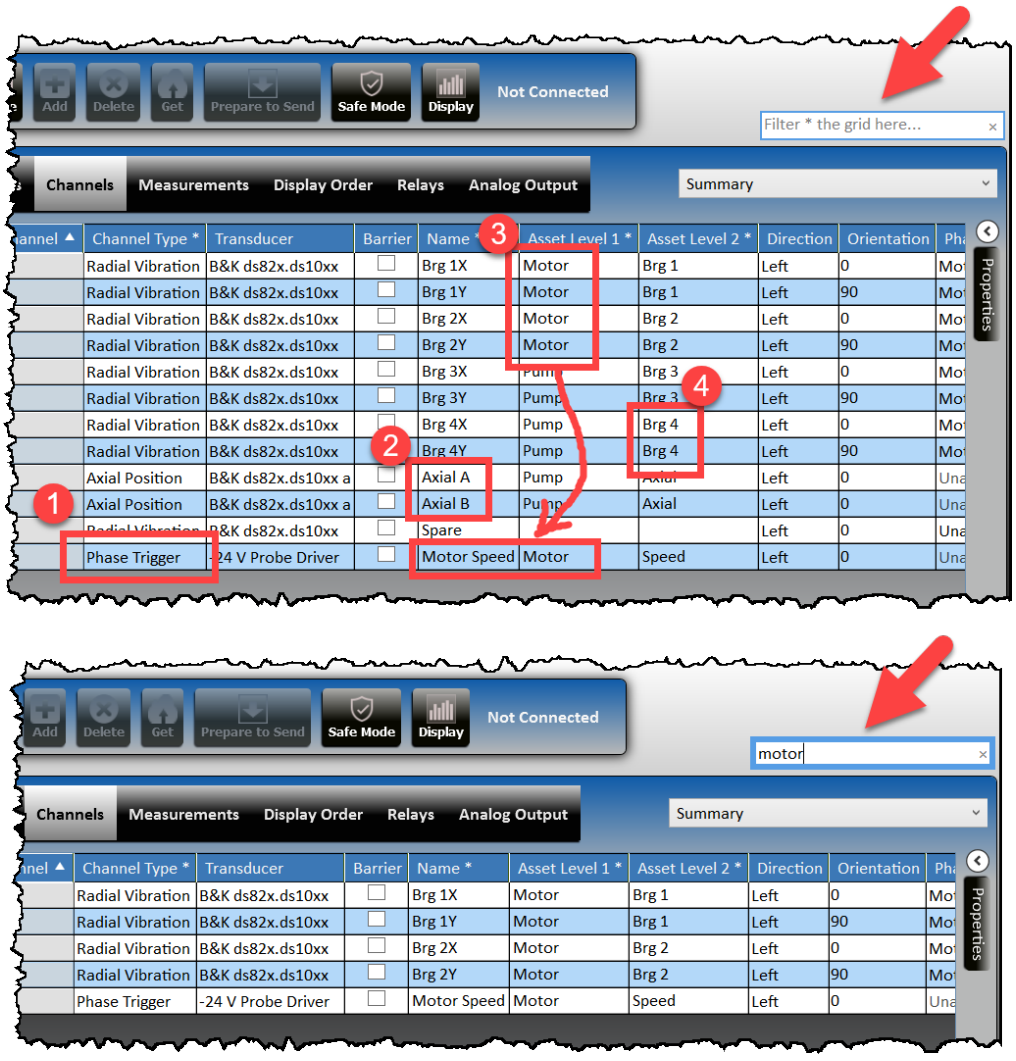


Figure 73: Grid Filter

10.3.9 Hard to Find (Hidden) Properties

A few channels and measurements have configuration properties that are not shown in the spreadsheet view. These properties can only be found in the properties panel. An example is the Ramp Angle for a Differential Expansion channel.

If you are not familiar with the channel type you are configuring, you will need to check the properties pane to ensure that all settings have been configured.

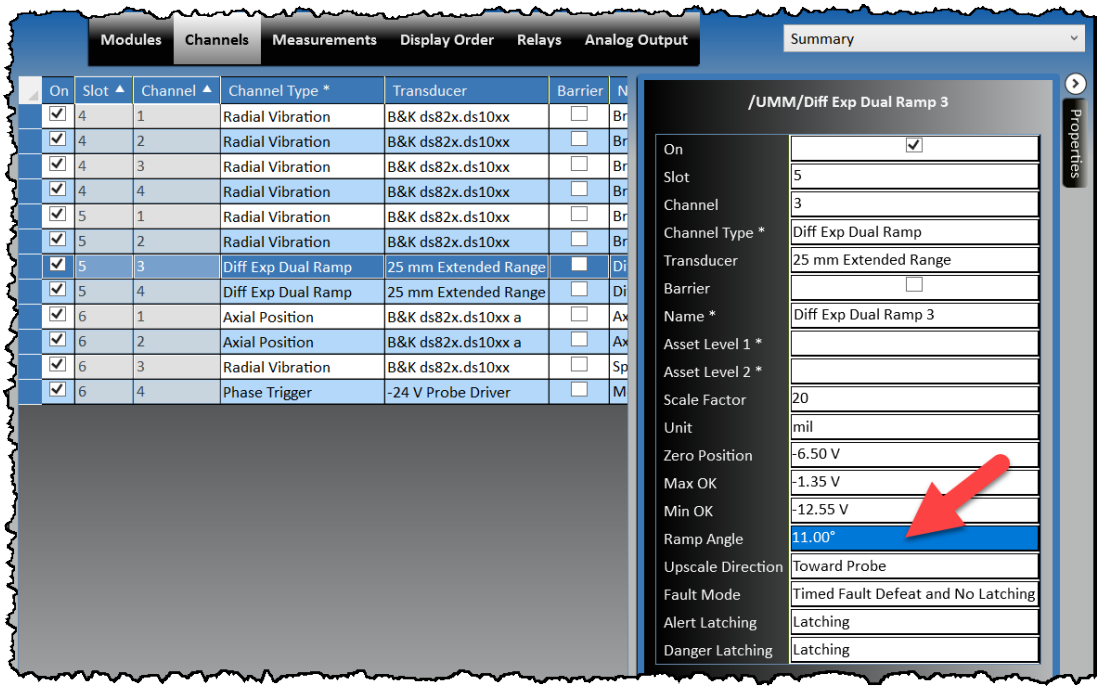


Figure 74: Opening the Properties List

10.4 Basic Rack Configuration

Follow these basic steps when starting a new configuration:

1. Start MPS Setup Software
2. Set your default units (File, Default Units)
3. Select File, New
4. Select the Modules Tab
5. (Off-Line Configuration) Select the module type (for each slot) in the Type column. Make sure to select the correct slot. If you configure the module in the wrong slot you will have to start over.

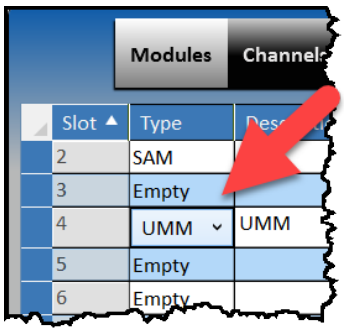


Figure 75:
Select Module Type

(On-Line Configuration) If you are connected to the rack, select GET and the module types will populate for you.

6. Select Slot 2 (SAM), open the Properties Pane, and enter the rack name. Typically, this will be the Machine Train name.
7. Select the Channels Tab
8. Select the Channel Type for each channel (by default all channels are Radial Vibration). Remember Phase Trigger channels can only be assigned to Channel 4 (Slot 4-9).
9. Enter Channel Tag, Asset 1 (Group), and Asset 2 (Sub-Group). Asset 1 is typically the machine (i.e. Motor or Pump). Asset 2 is typically the bearing (i.e. Brg 1 or Brg 2).
10. Save the configuration file (and or SEND to the rack).

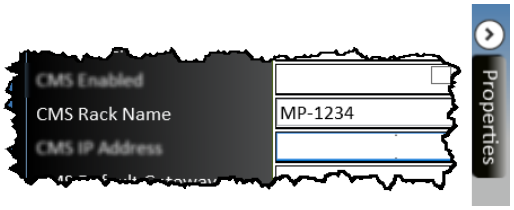


Figure 76:
Enter Rack Name (identifier)

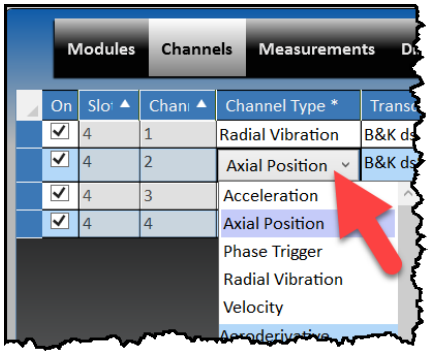


Figure 77:
Select Channel Type

These steps give you a basic layout to your configuration, and you are now ready to enter the other configuration parameters.

Note: Changes to the selected Module, or Channel Type will erase your inputs and return the channel properties to their default values.

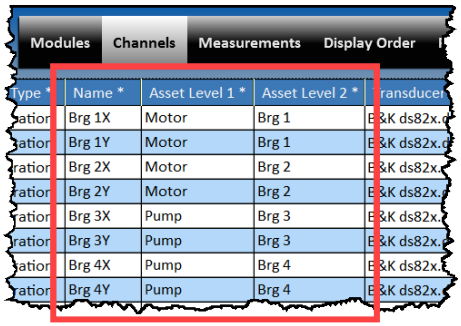


Figure 78:
Enter Channel and Asset Names

11 Software – Connecting to the Rack

You can connect to the rack locally over a USB connection, or remotely over an ethernet connection. For security reasons, the remote connection requires a software license and local (USB) setup before it will work. Local connection requires a USB cable and (of course) access to the rack.

11.1 Local Connection (Mini-B USB port)

The MPS software connects to the rack over a USB connection. Every VC-8000 monitoring module has a USB port. First generation racks required each module to be configured independently. Now, with a SAM module, any port can be used to configure all modules.
The USB port is a Mini-B. A USB A-Male to Mini-B cable is supplied with each rack. USB auto detects the connection.

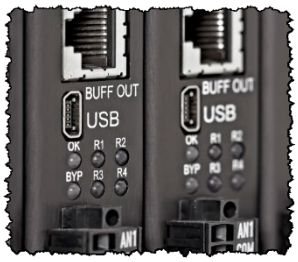


Figure 79:
Mini-B USB Port

To connect to the rack:

- Start the MPS software
- Connect the USB cable to your computer and to the VC-8000
- Wait about 10 seconds
- The software status will change from ‘Not Connected’ to ‘Connected’

To disconnect, simply disconnect the USB cable from the rack or the computer.

Figure 80: ‘Not Connected’ changes to ‘Connected’

11.1.1 Troubleshooting the USB Connection

Although rare, USB can be troublesome at times. If (after 30 seconds) the connection does not occur, you might try these steps:

- Try a different USB port on the rack (wait 30 seconds)
- Try a different USB port on your computer (wait 30 seconds)

If you are still having connection problems, try a different laptop or computer. Otherwise please contact B&K Vibro Technical support.

11.2 Remote Connection (Ethernet)

Remote (Ethernet) connection to the rack uses the CMS ethernet port, and the CMS IP address. The remote connection feature must be licensed, configured, and enabled (see section 11.6).

To connect remotely:

- Start MPS Setup software
- Select File, Remote Connect
- Select a recent connection or enter the rack (CMS port) IP Address
- Select the account: Administrator (to configure) or User (View Only)
- Enter the password
- Select OK

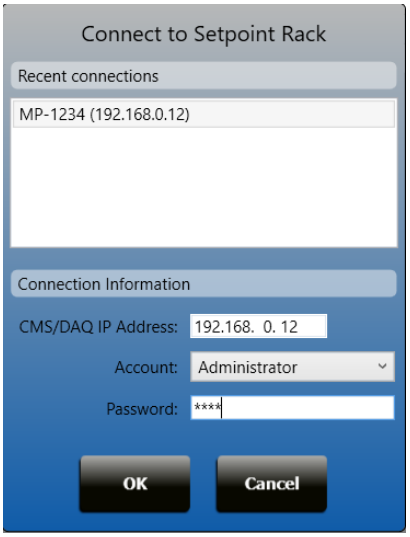


Figure 81:
Remote Connect Dialogue

After the connection is established, you can then open MPS Maintenance software and you will be automatically connected.

To disconnect a remote session, use the MPS Setup Software:

- Select File, Remote Disconnect

11.2.1 Troubleshooting Remote Connection

Local access will be required to troubleshoot remote connection problems.

- Follow the steps in section 11.6 to verify remote connection settings.
- Simplify the network. Use an ethernet cable to connect your laptop directly to the CMS port to verify that the VC-8000 remote connection is working.
- If the error message states that the rack “actively refused” the connection, then 1) the remote connection feature is disabled (see SAM properties) or 2) the password was incorrect or 3) The ethernet cable is connected to the wrong port (i.e. the Modbus port rather than the CMS port).

11.2.2 I Forgot My Password

See 24.9 - Password Reset

11.2.3 Simultaneous Connections (Local and Remote etc.)

The software does not prevent different users from making simultaneous remote connections to the MPS rack. For example, a scenario with
one user connected local (via USB) and a
second user connected remotely (via ethernet) is possible.
Likewise, two (or more) users connected remotely (via ethernet) is also possible.

11.3 Get the Configuration from the Rack

Use the MPS Setup software to Get and view the current rack configuration.

- Open MPS Setup Software
- Wait for the software to connect
- Select ‘Get’
- The current configuration will be uploaded

Figure 82:
Get and Prepare to Send

11.4 Send the Configuration to the Rack

Sending the configuration is a two-step process.

Step 1:
Select Prepare to Send. This instructs the software to build and validate the configuration file.
If your configuration has errors, the software shows the errors and prevents the user from continuing to Step 2.

Step 2:
Select ‘Commit’ to send the configuration to the rack

Caution

Sending a configuration may trip relay channels. Externally isolate the rack from other systems before performing any rack maintenance.

11.5 User Account Connection Privileges

There are two accounts that are used to control access to the VC-8000. The User (View Only) account and the Administrator account.

The User (View Only) account is only for remote access. It will allow remote users to see information, but they cannot change any settings.

The Administrator account is used for remote and local (USB) access. Remote connections require a password, and the password is requested at the time the connection is made. Local (USB) connections behave differently – depending on the Administrator password setting.

Local (USB) connections are always Administrator connections. If there is no password set on the Administrator account, Administrator login is not required, and the connection is automatically granted full access.

Even if there is an Administrator password, local (USB) connections will allow anyone to connect (without a password) and see data (View Only). Administrative login will be requested the first time the user attempts an administrative action – such as downloading a configuration file. If the user cannot provide the password, the action will not be permitted. After the user enters the Administrative password, the connection is granted full administrative privileges until the session is disconnected. See **Table 18** for a full list of account privileges.

Table 18: Remote access account privileges

	Authority	User (Remote)	Admin (Remote)	Local USB
Maintenance Software	Connect	X	X	X
	Save a VC-8000 Maintenance file	X	X	X
	View display screens, event lists, etc.	X	X	X
	Acknowledge alarms	X	X	X
	Bypass signal channels or relays	--	X	X (PW)
	Update Firmware	--	X	X (PW)
	Upgrade Licenses	--	X	X
	Password reset file (forgot password)	--	--	X
	Set rack time	--	X	X
	Request a set of Boost mode waveforms	X	X	X
	Reboot SAM (CMS) port	--	X	X (PW)
Setup Software	Connect	X	X	X
	Set and enable initial passwords	--	--	X (PW)
	Change User (View Only) Password	--	X	X (PW)
	Change Administrator Password	--	X	X (PW)
	Get (upload) configuration	X	X	X
	Save configuration file	X	X	X
	Send configuration	---	X	X (PW)

PW: Requesting this action will Initiate the administrative logon screen. This is only applicable for local (USB) connections when the Administrator password is set.

11.6 Configure Remote Connection

Remote access to the rack is provided through the CMS Ethernet port. Remote access can be given to the User (View Only) account, the Administrator account, or both. If the account has a password set, and remote access is enabled, remote access will be granted. A local (USB) connection is required to enable remote access and set the initial passwords.

To enable remote access:

- Verify that the rack includes an 'MPS Remote' license
- Set the account password.
- Enable MPS Remote Access in the SAM configuration settings
- Configure the CMS IP Address in the SAM configuration settings.

Again, this initial setup must be done locally using a USB connection. After the password is set locally, it can be changed remotely using the Administrator account. If the password is disabled (set to blank), remote access for that account will also be disabled.

Note: Functional Safety (SIL) systems prohibit remote configuration. All remote connections (including Administrative) have "View Only" privileges.

11.6.1 Verify Your Remote MPS License

Remote connection requires a software license.

To see if you have the appropriate license:

- Connect to the rack with MPS Maintenance software.
- Select the Hardware Info tab and view the 'supported features' column for Slot 2 (SAM)
- If 'MPS Remote' is green you have an active license.

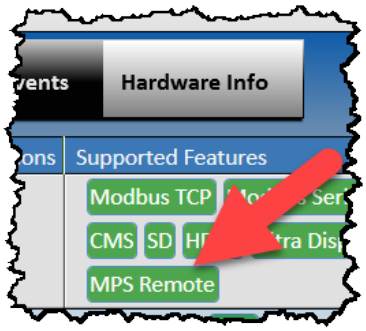


Figure 83:
MPS Remote License is Active

11.6.2 Configure Remote Access in the SAM

Remote MPS Access uses the CMS port on the SAM. An IP address must be configured and Remote MPS Access must be specifically enabled.

- Connect to the rack with MPS Setup software.
- Select the Modules tab
- Select row 2 (SAM) in the grid
- Open the Properties pane
- Enable Remote MPS Access, and set the CMS IP Address
- Send the configuration changes

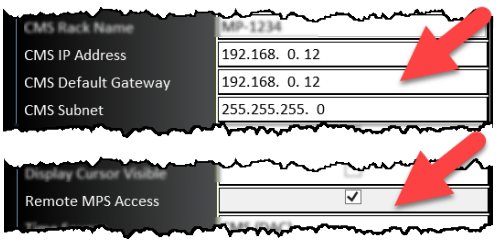


Figure 84: Enable Remote MPS Access

If Remote Connection is not licensed you will get a configuration error "MPS Remote access is enabled, but is not supported by this module".

11.6.3 Set User Account Passwords

A remote connection is not permitted until a password is set on the user account. Passwords are set using the MPS Setup software.

To set the password:

- Connect to the rack
- Select File, Set Passwords
- (dialogue opens)
- Check Set Password
- Enter the password
- Click OK.

To change a password:

- Connect to the rack
- Select File, Set Passwords
- Enter the current password.
- (dialogue opens)
- Enter the new password
- Click OK.

Figure 85:
Set Rack Passwords

11.6.3.1 Setting Legacy Passwords (SAM Firmware 5.2 and older)

To set the password:

- Open Properties pane for SAM configuration.
- Select to show the Legacy Passwords.
- Enter the password in the Password and Confirm Password cells.

If you do not see any passwords under the Legacy Passwords, then you have SAM firmware 6.0 or newer.

Figure 86:
Show Legacy Passwords

Migration Notes

If you change passwords using software version 6.0 or higher, other PCs (with older revision MPS software) will not be able to configure that rack.

If the SAM firmware is upgraded from an older revision to Revision 6.0 or higher, the software will migrate the old rack password to the Administrator password and the old CMS password to the User (View Only) password.

11.6.4 Disable Remote MPS Access

There are two ways to disable remote connections:

Method 1: Disable all remote connections (both accounts)

- Disable Remote MPS Access in the SAM settings

Method 2: To disable remote connections on any account

- Delete the password to the account (set the password to blank)

Note

If the SAM setting “Remote MPS Access” is cleared (disabled) while using a remote connection – remote access will be disabled. A local USB connection will be required to re-enable this field.

11.7 Is it Safe to Connect a Laptop (or PC) to VC-8000?

Connecting a laptop (running on battery power) is safe.
Caution: If you are using a PC (or a laptop that is plugged into an outlet), the USB port will tie the rack signal COM to the PC power ground.

Getting the configuration is safe. You can perform a ‘Get’ at any time, even if your system is on-line; No parameters are changed, and monitoring is not interrupted.

Sending a configuration is NOT SAFE. You should only ‘Send’ a configuration if the machine is down, or if all trip systems have been externally bypassed.

Caution

USB connections short VC-8000 Signal COM to computer power ground. Use a battery powered laptop whenever possible.

12 Software – Visualizing VC-8000 Data

VC-8000 data is typically visualized as follows:

- VC-8000 local display on touch screen panel (optional)
- VC-8000 Maintenance software (laptop computer)
- Multimeter connected at the rack.
- DCS screens (via Modbus, or Analog 4-20 mA)
- SETPOINT CMS software

This section focuses on viewing VC-8000 data using the Local Display panel, the maintenance software, or using a multi-meter connected directly to the rack.

12.1 Viewing the Maintenance Display

The VC-8000 Touch Screen display and the VC-8000 Maintenance software display are essentially the same - with a few exceptions; for example, the touchscreen cannot be used to bypass channels, view licensing, or perform firmware upgrades.

The display has the following tabs

- Rack
- Machine
- System Events
- Alarm Events

The colors used on the displays indicate the following:

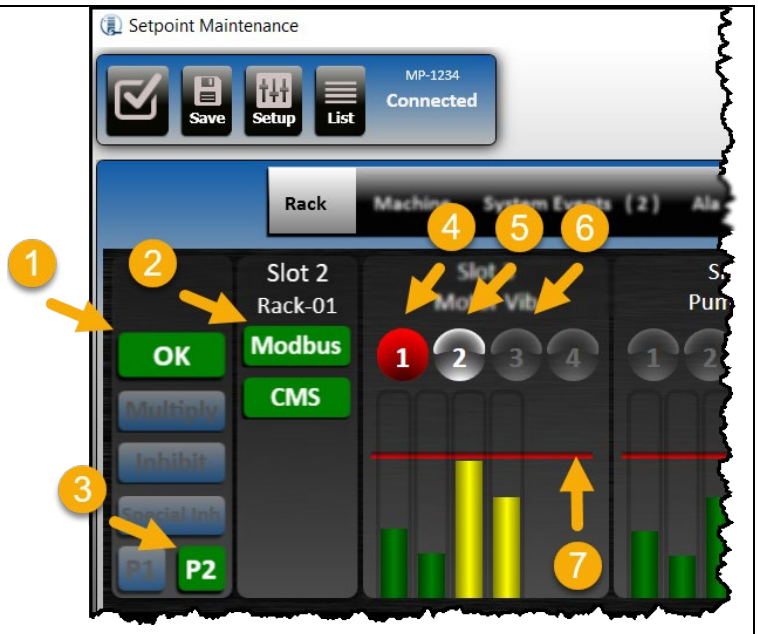
Color	Activity	Description
Green	Solid	Channel is OK
	Flashing	Unacknowledged fault or alarm event
Red	Solid	Channel in Danger
	Flashing	Unacknowledged Danger event
Yellow	Solid	Channel in Alert
	Flashing	Unacknowledged Alert event
Gray	Solid	Channel is in Fault
	Flashing	Unacknowledged Fault event

12.1.1 Rack View

Connect MPS Maintenance software to see the Rack view.

Rack view shows the status of specific functions of the RCM and SAM (on the left panel). It also shows bar graph values and icons for each relay channel status. The display is organized according to the layout of the rack (slot/channel).

1. RCM functions (status) (here the rack is OK, and there are no active commands)
2. Modbus and CMS status (here both Modbus and CMS are running)
3. Power Supply status (here there is P2 only)
4. Relay channel icon (here the relay is active)
5. Relay channel icon (here the relay is not active)
6. Relay channel icon (here the relay is disabled (unused))
7. Percent-to-Danger Line
8. Rack List View icon



RCM and SAM functions and their respective indicators on the Rack View display are described in the table below.

Table 19: RCM and SAM functions (indicators)

Indicator	Color	Description
OK	Green	OK relay normal (all channels are in OK)
	Gray	OK relay tripped (channel(s) in a fault condition)
Multiply	Green	Trip Multiply Active
	Gray	Trip Multiply Off
Inhibit	Green	Inhibit Active
	Gray	Inhibit Off
Special Inh	Green	Special Alarm Inhibit Active
	Gray	Special Alarm Inhibit Off
P1, P2	Green	Power On (and in valid range)
	Gray	Power Off
Modbus	Green	Modbus enabled with active communication occurring
	Yellow	No incoming requests for data (no communication)
	Gray	Modbus not enabled (Off)
SD or SD Busy	Green	SD card installed and functioning
	Green (SD Busy)	SAM writing to the SD card
	Yellow	SD is enabled, but the SAM cannot write to the card
	(Not shown)	SD not enabled (off)
HD or HD Full	Green	HD is On
	Green (HD Full)	HD is full. New data is overwriting the oldest data
	Yellow	HD write failure
	(Not shown)	HD not enabled (off)
CMS	Green	CMS OK
	Yellow	CMS Not Ok (Adapter not communicating)
	(Not shown)	CMS is not enabled (off)

12.1.2 Percent-to-Danger (Red) Line

The Percent-to-danger line represents the danger alarm. However, it does not represent a real number, such as 4 mils (100 µm); Instead it represents how close a channel is to entering danger (percentage).

For example:

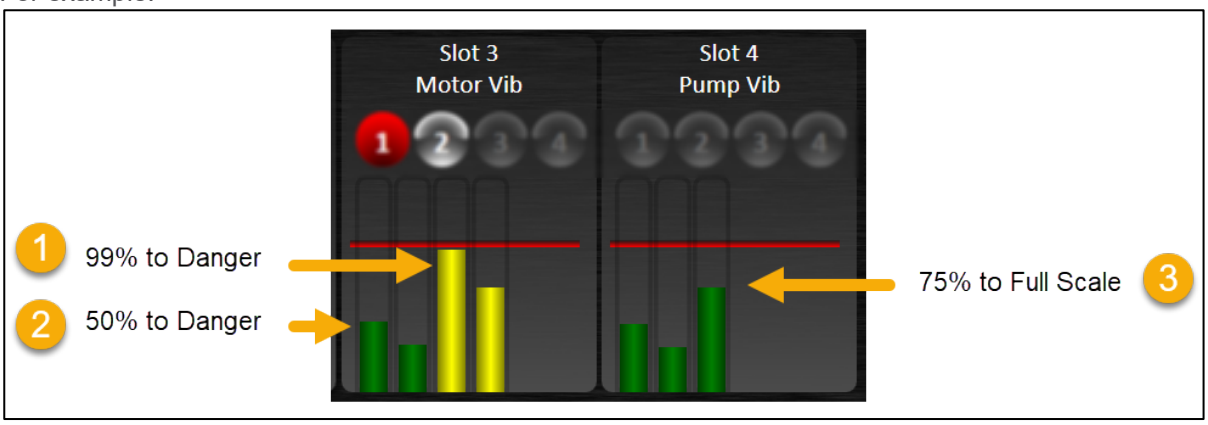


Figure 87: Percent-to-Danger

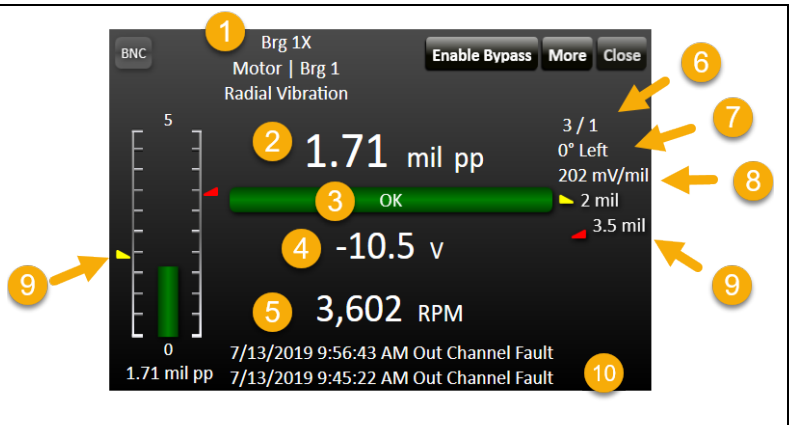
See #1, and #2 in **Figure 87** (above). #1 appears to be nearly at the red line (99% of the way there). #1 appears to be halfway to the red line (50% of the way there). So, with a quick scan I can easily see which channels are closest to Danger.

Note that some channels do not have a danger alarm set. In this case the red line represents 'full scale'. #3 shows a bar graph for a phase trigger channel. There is no danger alarm set. The bar graph is about 75% of the configured full scale.

The Alert alarm is not shown in this view.

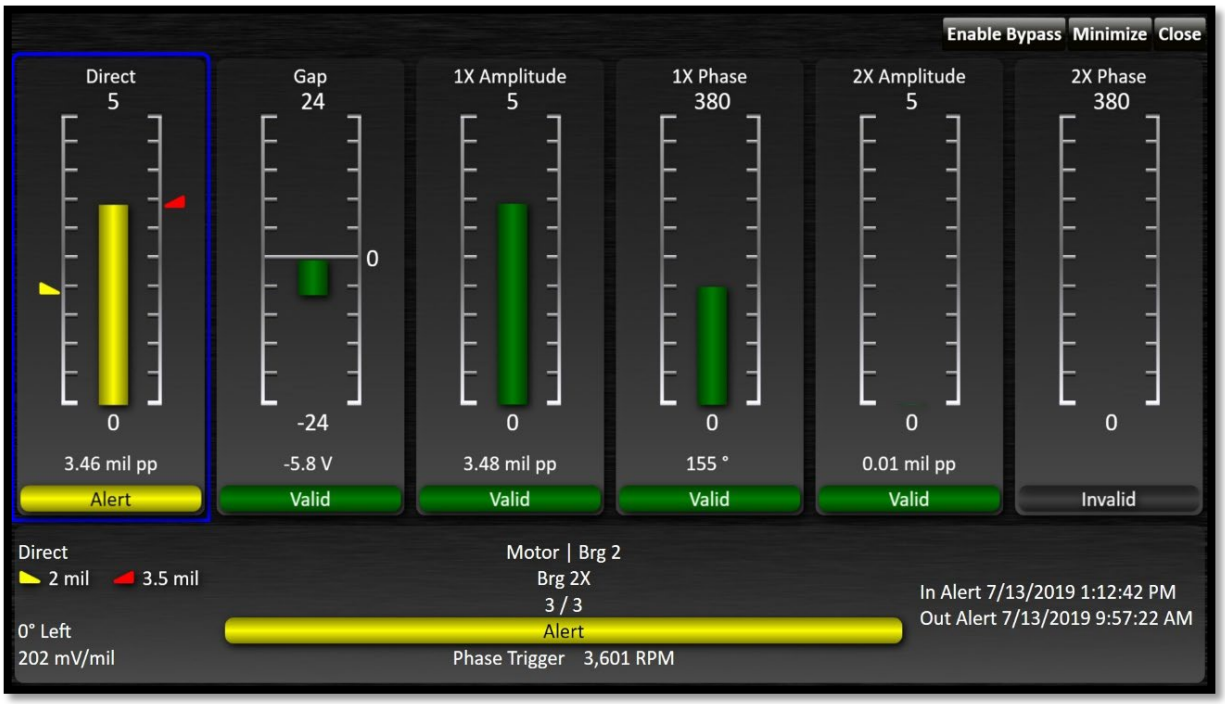
12.1.3 Signal Channel View

Select any channel to see the signal channel view.

1. Channel name, Asset groups, and channel type 2. Channel primary value 3. Channel status 4. Gap (or bias) value 5. Speed (if associated) 6. Slot, channel designation 7. Orientation 8. Scale factor 9. Alarm values 10. Last two events	

12.1.4 Full Signal Channel View

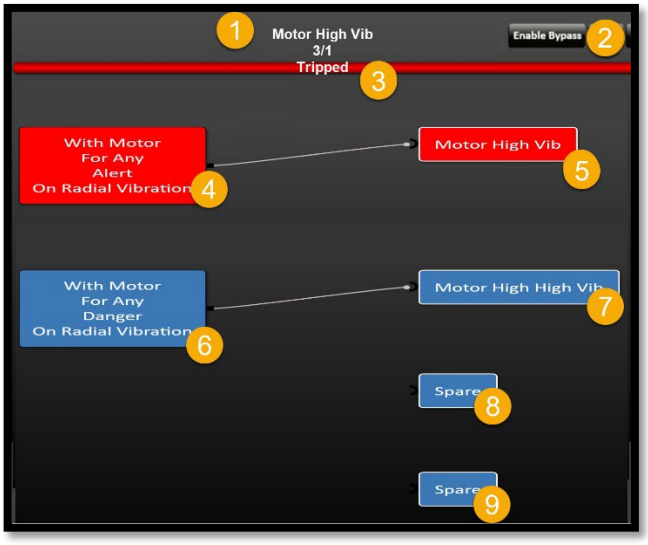
Select More (channel detail view) to see the Full Channel view.



12.1.5 Relay Channel View

Select any relay channel to see the relay channel view. Notice that all four relay channels are shown on the screen, but only one channel is the "*selected*" channel.

1. *Selected* relay channel
2. Bypass the *selected* relay channel
3. *Selected* relay channel status
4. Logic block – Motor High Vib
5. Relay – Motor High Vib
6. Logic block – Motor High High Vib
7. Relay – Motor High High Vib
8. Relay – Spare (Ch 3)
9. Relay – Spare (Ch 4)



The logic and/or relay channel will turn red when active.

Enable Bypass is only available using the Maintenance software connected to the rack from a laptop. Enable Bypass is not available from the local touchscreen panel.

12.1.6 Machine View

The Machine view shows the data organized by Asset Level 1 and Asset Level 2 groups.

In the example shown below (**Figure 88**) “101 Steam Turbine” is an Asset Level 1 group. “Turb Speed” and “B1 Turb OB” etc. are Asset Level 2 groups. Channels within Asset groups are in the order specified by the Display Channel Order setting. See section 12.2 for more information on setting up the Machine view.

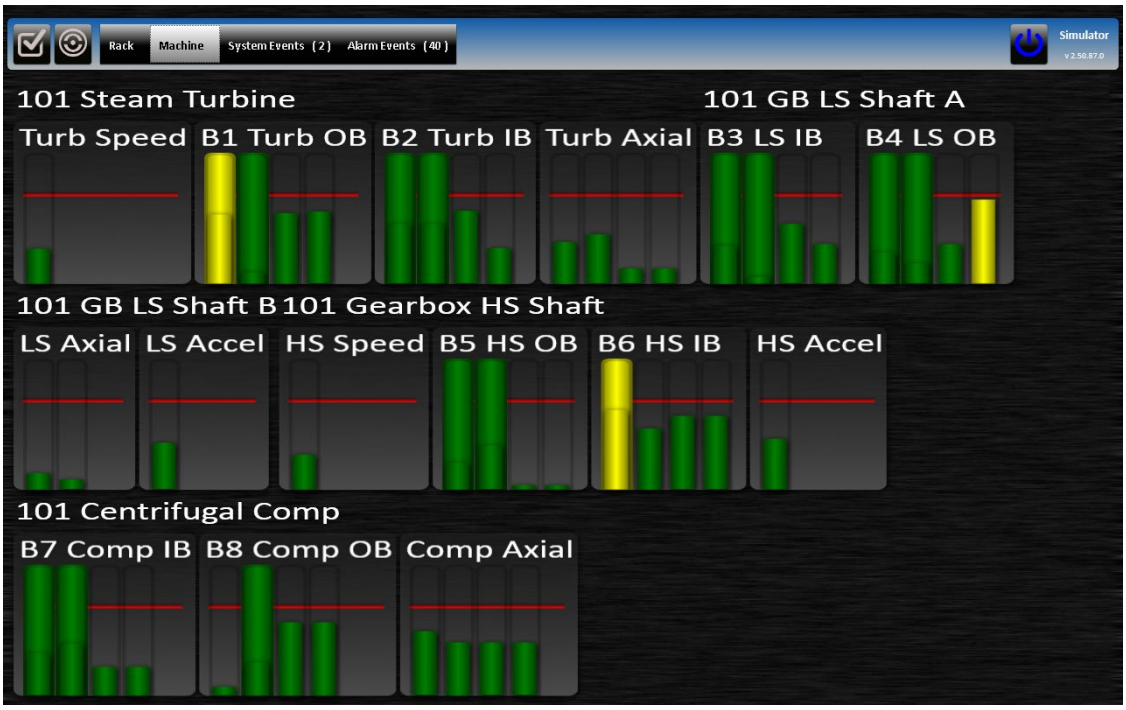


Figure 88: Machine view

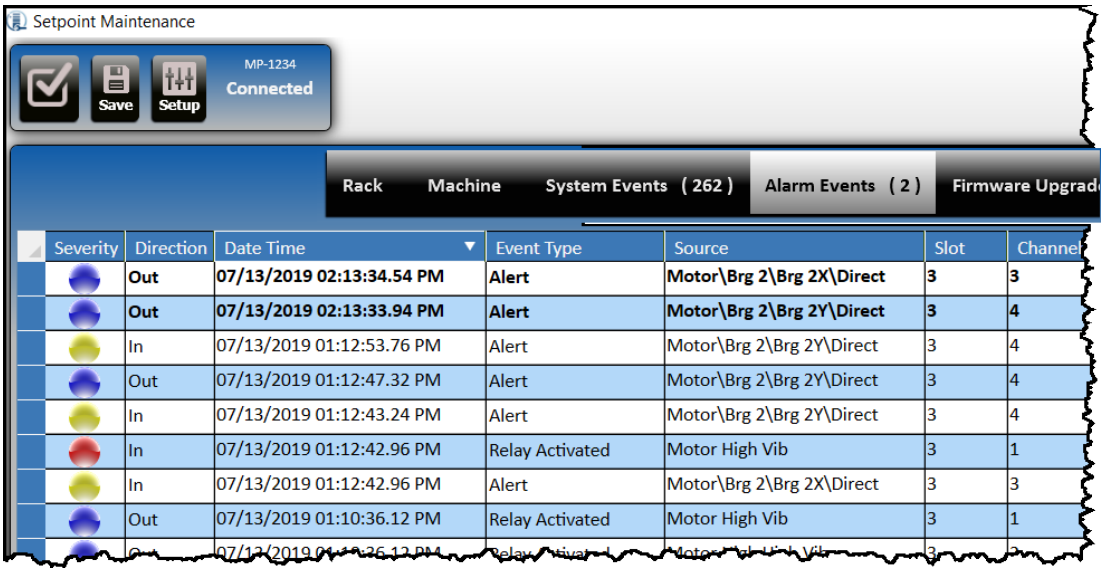
12.1.7 Large Speed Readout

Double click on the speed channel (Full channel view) to fill the display with the machine speed readout. This is typically used on the touch screen display panel located near the machine.

12.1.8 Event Lists

View the event lists (Alarm or System) by selecting the appropriate tab. The event lists can be sorted by clicking on the column header.

A laptop running Maintenance software should be used to view the event lists. The event list can be multi-sorted by holding the SHIFT key while clicking the second column header etc. Also, the event list can be copied to a spreadsheet by clicking in the top left corner (select all) and then copy and paste.



Severity	Direction	Date Time	Event Type	Source	Slot	Channel
	Out	**07/13/2019 02:13:34.54 PM**	**Alert**	**Motor\Brg 2\Brg 2X\Direct**	**3**	**3**
	Out	**07/13/2019 02:13:33.94 PM**	**Alert**	**Motor\Brg 2\Brg 2Y\Direct**	**3**	**4**
	In	07/13/2019 01:12:53.76 PM	Alert	Motor\Brg 2\Brg 2Y\Direct	3	4
	Out	07/13/2019 01:12:47.32 PM	Alert	Motor\Brg 2\Brg 2Y\Direct	3	4
	In	07/13/2019 01:12:43.24 PM	Alert	Motor\Brg 2\Brg 2Y\Direct	3	4
	In	07/13/2019 01:12:42.96 PM	Relay Activated	Motor High Vib	3	1
	In	07/13/2019 01:12:42.96 PM	Alert	Motor\Brg 2\Brg 2X\Direct	3	3
	Out	07/13/2019 01:10:36.12 PM	Relay Activated	Motor High Vib	3	1

12.1.9 Firmware and Hardware Info

Firmware and Hardware information tabs are not available on the touchscreen display.
They can only be viewed when connected to the rack with VC-8000 Maintenance software.

See Firmware and Hardware Info in section 24 Troubleshooting (Maintenance).

12.2 Configuring the VC-8000 Displays

There are several text fields and grouping options used to customize the VC-8000 Maintenance software, and Touch Screen Display. They are:

Table 20: Configuring the Maintenance displays

Parameter	Location
Module Description	Modules tab, All view
Channel Name	Channels tab, Summary view
Asset Level 1	Channels tab, Summary view
Asset Level 2	Channels tab, Summary view
Channel Display Order	Channels tab, Summary view
Asset Level 1 Order	Asset Display Order tab, All view
Asset Level 2 Order	Asset Display Order tab, All view

12.2.1 Module Description

The module descriptions will be shown in the Maintenance display on the Rack tab of the Maintenance display. The SAM description should be 8 characters or less. The UMM/TMM description can be 18 characters.

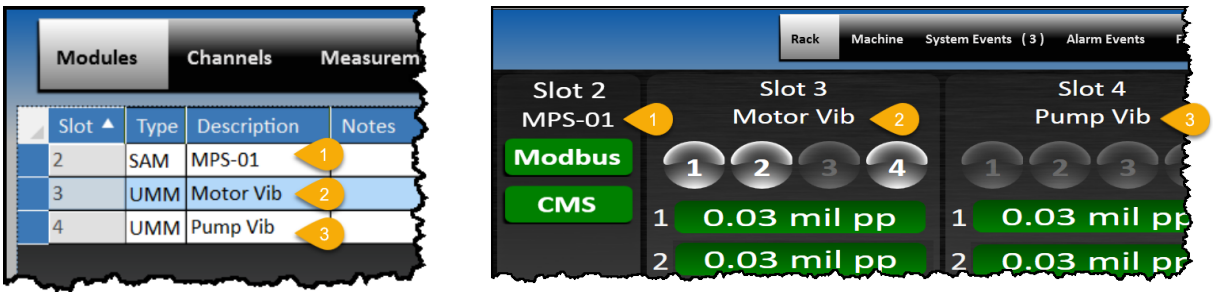


Figure 89: SAM, UMM, TMM description field

12.2.2 Channel Names

Channel names are used on all the display screens to identify the channels. A descriptive channel name usually works best. A few examples are shown below.

Table 21: Channel (tag) name examples

Name (Examples)	Comment
VXE-932 VYE-932 VXE-931 VYE-931	Not enough information. If this is a small installation with a minimal number of points – this could be acceptable.
VXE-932 (T-NDE) VYE-932 (T-NDE) VXE-931 (T-DE) VYE-931 (T-DE)	Good. The abbreviations used are typical for the United States. T = Turbine, NDE = Non-Drive End, DE = Driven End.
Turb NDE X (VXE-932) Turb NDE Y (VYE-932) Turb DE X (VXE-931) Turb DE Y (VYE-931)	Good. For CMS systems this may work better as it allows a more natural grouping when the channels are sorted alphabetically.
Motor Lower Bearing Vib X Motor Lower Bearing Vib Y Pump NDE Vib X Pump NDE Vib Y	Good. These names are long, but there is no possibility of confusion here.
Gearbox H/S Horz NE-784-22A C-1A Vib 1_VE-757-74A H/S Phase Trig NEN-3 Comp OB Horz NE-16A	Hard to read. These names are long, but there is no possibility of confusion here. Use parenthesis to improve readability. For example: Gearbox H/S Horz (NE-784-22A)

12.2.3 Asset level 1 & Asset Level 2 Groups

Asset 1 and Asset 2 are used to help organize, identify, and group channels.

Asset names have multiple uses in the VC-8000 system.

- Asset names are used to organize the Machine view display (see 12.2.3.1).
- Asset names are used in the VC-8000 event list to indicate the source of the alarm.
- Asset names are used in the relay logic blocks (Figure 91). This is very convenient, but you must recognize that if the groups change – so does your relay logic.
- Asset names are not used in CMS software. The CMS software uses the “CMS Navigation Path”.

For large machines,

- Asset 1 is typically the machine group (i.e. Turbine, or Compressor)
- Asset 2 is typically the bearing group (i.e. Brg 1, Brg 2, etc.)

For smaller machines,

- Asset 1 is typically the machine train name (MP-1211, MP-1222)
- Asset 2 is the machine name (Motor, Pump)

Use the strategy that works best for you.

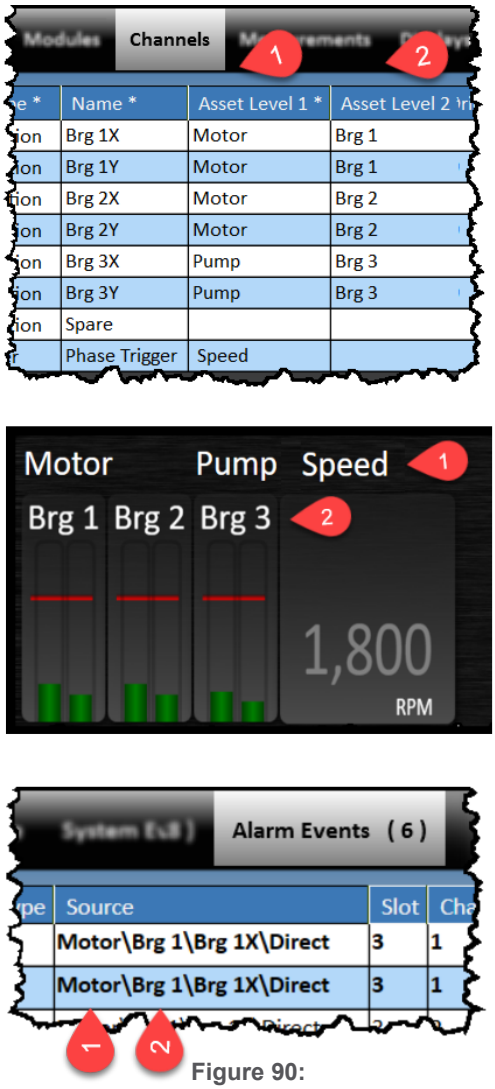


Figure 90:
Asset Level 1 & 2 group names

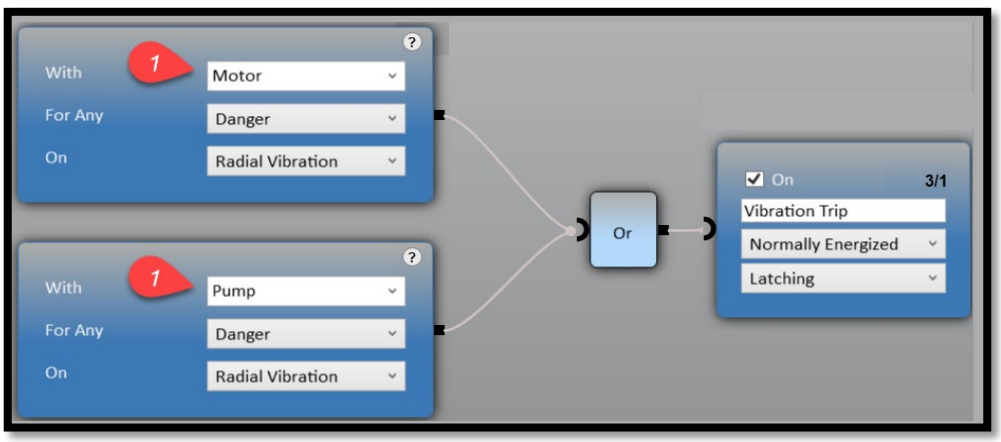


Figure 91: Asset Level 1 used in relay logic

12.2.3.1 Asset Group Example (Large Machine)

Table 22 shows a typical arrangement for a rack with only one machine. Asset Level 1 is the machine case. Asset Level 2 is the sensor location or measurement name.

Table 22: Example of Asset 1 and Asset 2 groups (large machine)

Name	Asset Level 1	Asset Level 2	Channel Display Order
Brg 1Y Vib	Turbine	Brg 1	1
Brg 1X Vib	Turbine	Brg 1	2
Brg 2Y Vib	Turbine	Brg 2	1
Brg 2X Vib	Turbine	Brg 2	2
Brg 3Y Vib	Generator	Brg 3	1
Brg 3X Vib	Generator	Brg 3	2
Brg 4Y Vib	Generator	Brg 4	1
Brg 4X Vib	Generator	Brg 4	2
Eccentricity	Turbine	Eccentricity	1
Axial Position A	Turbine	Axial	1
Axial Position B	Turbine	Axial	2
Zero Speed 1	Turbine	Zero Speed	1
Zero Speed 2	Turbine	Zero Speed	2
Phase Trigger	Speed		1

12.2.3.2 Asset Group Example (Small Machines)

Table 23 shows is a typical arrangement for a rack with multiple machines. Asset Level 1 is the machine train name. Asset Level 2 is the machine case name.

Table 23: Example of Asset 1 and Asset 2 groups (small machines)

Name	Asset Level 1	Asset Level 2	Display Channel Order
V-311 Motor NDE	MP-1231	Motor	1
V-312 Motor DE	MP-1231	Motor	2
V-313 Pump DE	MP-1231	Pump	1
V-314 Pump NDE	MP-1231	Pump	2
V-321 Motor NDE	MP-1232	Motor	1
V-322 Motor DE	MP-1232	Motor	2
V-323 Pump DE	MP-1232	Pump	1
V-324 Pump NDE	MP-1232	Pump	2

12.2.4 Channel and Asset Group Order

Asset Level 1 Order, Asset Level 2 Order, and Channel Display Order are used to manage the Machine View display. It is best to complete your configuration before setting the order of your channels, and Assets.

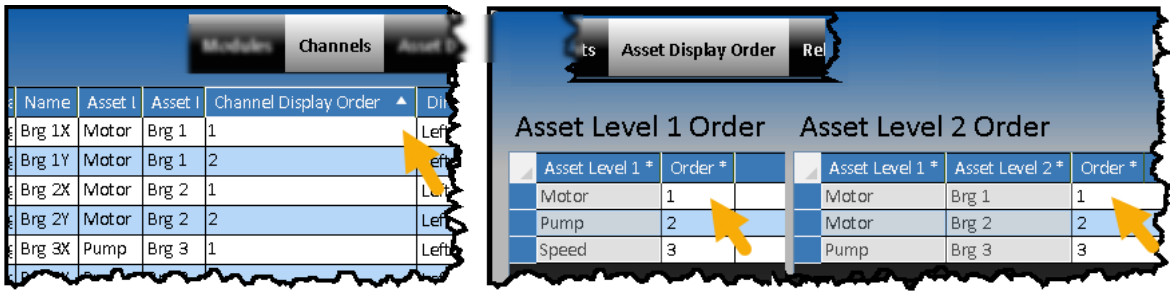


Figure 92: Channel and Asset Display Order

Table 24 shows how the Assets and channels are ordered. Asset 1 is first, then Asset 2, and finally the Display Channel order is third.

Table 24: Display order of assets and channels

Asset Level 1 Order	Asset Level 2 Order	Channel Display Order
1	1	1
		2
	2	1
		2
	3	1
		2

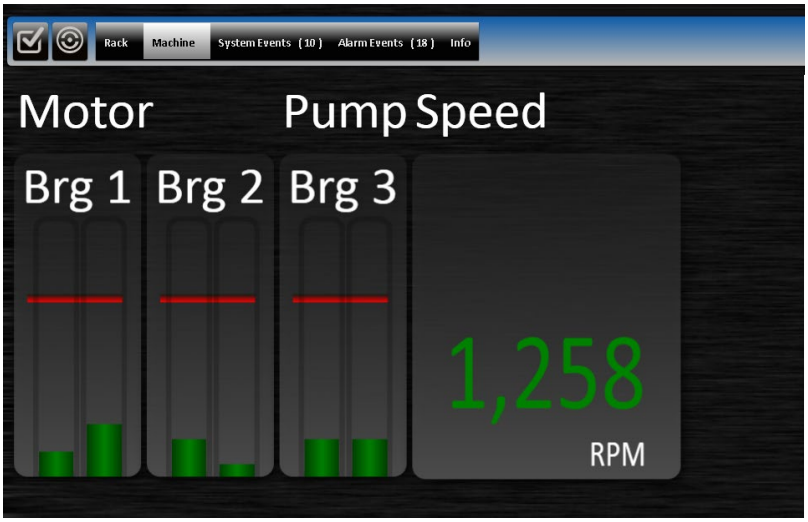
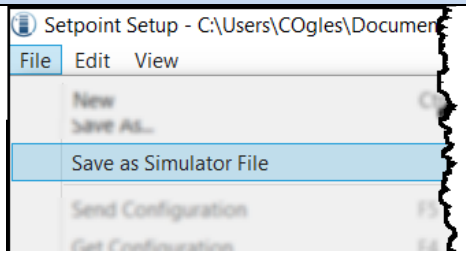
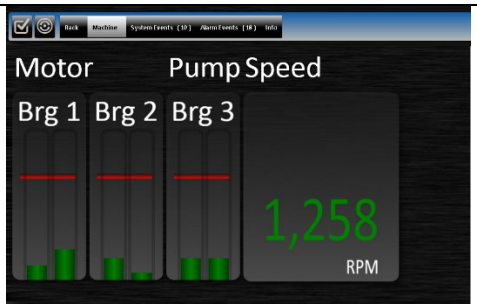
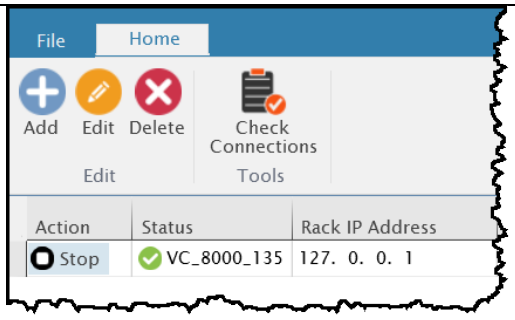


Figure 93: Ordering example

12.3 Simulating the Display

You can easily simulate the front panel display (on your laptop) to verify your display configuration.

Step	Screen Capture
Complete your configuration.	
Close all other MPS programs. Open the Simulator Launcher.	
Wait a few seconds… then select Open and select your simulator file. Note: The simulator runs in Full Screen mode. Use Alt-Tab to navigate to other programs.	
The simulation will begin to run. Note: The simulator will show random values for all signals.	
Connect CMS (if desired) You can also use the simulator file to view simulated data in CMS. This allows you to verify your CMS Navigation Path. The simulator and the PI Adapter must be running on the same computer. The simulator IP address is 127.0.0.1.	

12.4 Troubleshooting the Display Panel

12.4.1 Display Cursor Visible

In the SAM configuration there is a setting called Display Cursor Visible. When checked, this option places a very small dot (one pixel) on the touch screen showing the current cursor position. The cursor is most often used when troubleshooting touch screen issues.

12.4.2 Replacing the Display Cable

Unplug the display cable at the SAM. The display connectors have retention locks. Gently squeeze the two latches, gently wiggle back and forth, and pull the connector straight out.

When inserting the display cable at the display board, be sure the cable connector gold contacts are facing up as shown in **Figure 96**.

When inserting the display cable at the SAM, make sure the connector gold contacts face to the left (towards the RCM) as shown in **Figure 95**.

Figure 94: Display Connector Retention Locks

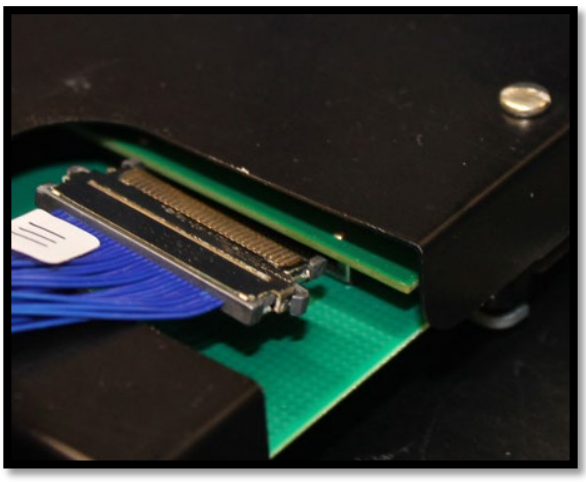


Figure 96:
Display Cable at the Display

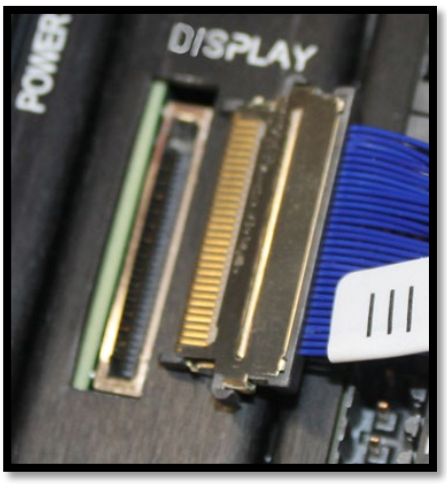


Figure 95:
Display Cable at the SAM

Potential Damage

Older SAM modules (1.5D) must be powered down before inserting or removing the blue display cable. Newer hardware (1.5J) are ok for hot insert, or hot removal of the display cable.

12.4.3 Touch Screen Calibration

Touch screen calibration is required when the cursor (selection) on the screen does not match the location where the user touched the screen.

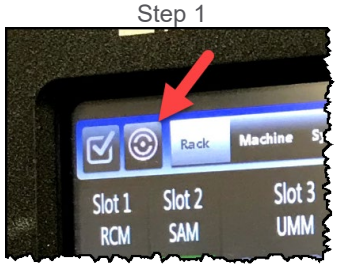
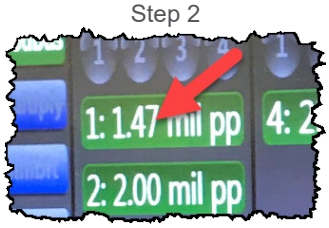
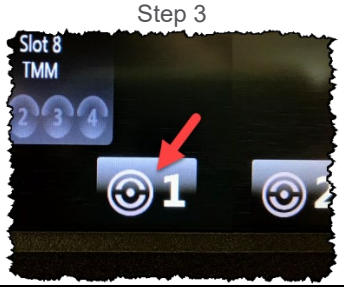
Please contact B&K Vibro technical support. A calibration file will be sent with instructions.

12.5 Connecting a Digital Multimeter

12.5.1 Touch Screen Display Buffered Output Connectors (BNC)

Each touch screen display has 3 BNC connectors that provide selectable access to any of the channels in the rack.

Table 25: Connecting to the BNC connectors on the touch screen display

Step 1	Step 2	Step 3
		
Step 4	**Step 5**	
		

12.5.2 UMM Buffered Output Connector (RJ-45)

Each UMM has an RJ-45 connector that provides access to the four buffered output signals using cable 100431-AA and a BNC adapter (Pomona 1269).

Figure 97: Connecting to the UMM buffered output connector

13 Configuring – CMS Data Collection

13.1 Data Types

The SETPOINT CMS system collects a full suite of data types to increase your ability to diagnose machinery problems (see **Table 26**).

Table 26: CMS Data Types

Data Type	Examples
Static	Radial Vibration (Direct) Gap, Axial (Direct), Seismic (Direct)
Vector Data	1X Amplitude, 1X Phase
Waveforms	Synchronous, Asynchronous (also Peak Stretch)
Status	Alarm, Faults, Quality etc. for each measurement and waveform

13.2 Managing Data Collection

CMS data collection and data storage configuration settings are found in several locations in the VC-8000 Setup software configuration. These settings are shown in the table below.

Table 27: CMS data collection settings

CMS Setting	Location
VC-8000 CMS licensing	Maintenance software Hardware Info Tab
Enable CMS data collection, Rack Name, IP Address etc.	Setup software Modules Tab SAM Settings
CMS Navigation Path, Waveform collection triggers, Startup/Shutdown window definition, etc.	Setup software Channels Tab CMS Framework View
Asynchronous and Synchronous waveform settings	Setup software Measurements Tab Waveform View

13.2.1 SETPOINT CMS Licensing & Firmware Revisions

VC-8000 SAM, UMM & TMM modules must be licensed for CMS data collection. To view the licenses, connect to the rack using VC-8000 Maintenance software (see section 24.10).
To purchase a CMS license please contact your local B&K Vibro representative.

UMM/TMM modules require firmware revision 3.0 or higher as shown in the table below.

Table 28: UMM/TMM CMS compatible firmware

Module	Firmware Revision Required
UMM	3.0 or higher
TMM	3.0 or higher

The SAM (CMS) firmware must be version 3.0 or higher as shown in the table below.

Table 29: SAM Firmware revision for CMS functions

CMS Function	CMS (SAM) Firmware Revision Required
CMS PI	3.0 or higher
CMS SD	4.02 or higher
CMS HD	5.0 or higher
CMS XC	3.0 or higher

13.2.2 CMS (SAM) Connection Settings

This CMS Ethernet port provides the network connection for the CMS PI/XC Adapter software. The port is configured in the SAM settings.

The following settings must be configured for CMS data collection:

- CMS Enabled
- CMS Rack Name
- CMS IP Address
- CMS Subnet mask

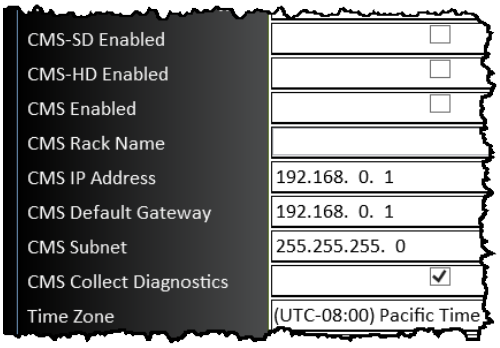


Figure 98:
CMS Connection Settings

13.2.2.1 CMS Rack Name

A unique rack name is required. If you are using OSI Soft PI for CMS data collection, this name will be used as a prefix to the PI tags.

13.2.3 CMS Navigation Path (Groups)

The CMS Navigation path is used to build the navigation structure in the CMS software.
A CMS Navigation path is required only for CMS enabled systems.

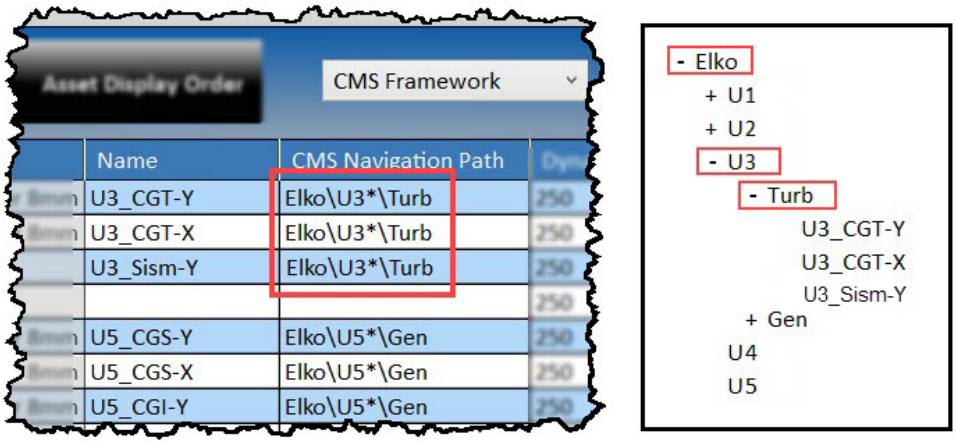


Figure 99: CMS Navigation Path

The path is used to create groups of points. For example, U3_CGT-Y, and U3_CGT-X should have the exact same navigation path (Elko\U3*\Turb).

Notice in **Figure 99** that U3 and U5 have an asterisk next to them. The asterisk (*) is not visible in the CMS software. An asterisk is mandatory and is used to designate the component (in the path) that represents the machine train.

If you are using an OSI Soft PI System, the CMS Navigation Path is imported into the PI Asset Framework (AF) database. After the initial instance is created, the user can modify the AF database (using OSI Soft PI tools) if needed.

13.2.4 Synchronous Waveforms

Synchronous Waveform data collection is configured in terms of the number of samples collected per shaft revolution, evenly spaced in phase. Higher sample rates give better Orbit and Timebase plot resolution, but more coarse resolution for spectrums displayed in orders.
More samples (or revolutions) take longer to collect and provide greater spectrum resolution. The collection time of synchronous waveforms is dependent on the speed of the machine.

Table 30: Synchronous Sampling Configuration Examples

Rate	Maximum Speed	Number of Samples	Revolutions	Spectrum Range	Spectrum Resolution
128X	12,500 rpm	1024	8	50X	0.125X
		2048	16	50X	0.0625X
64X	25,000 rpm	1024	16	25X	0.0625X
		2048	32	25X	0.03125X
32X	50,000 rpm	1024	32	20X	0.03125X
		2048	64	10X	0.015625X
16X	100,000 rpm	1024	64	5X	0.015625X
		2048	128	5X	0.0078125X

13.2.5 Asynchronous Waveforms

You can change the asynchronous sample rate and number of samples collected to optimize your spectrum display. As the number of lines increases, the amount of time it takes to collect the spectrum increases; If the machine speed is changing, this can cause smearing of the spectrum.

Table 31: Asynchronous Sampling Configuration Examples

Samples per Second	Span	Samples (Lines)	Resolution	Time to Collect
256	100 Hz	1024 (400)	0.25 Hz, 15 cpm	4 s
		2048 (800)	0.125 Hz, 7.5 cpm	8 s
512	200 Hz	1024 (400)	0.5 Hz, 30 cpm	2 s
		2048 (800)	0.25 Hz, 15 cpm	4 s
1280	500 Hz	1024 (400)	1.25 Hz, 75 cpm	0.8 s
		2048 (800)	0.625 Hz, 37.5 cpm	1.6 s
2560	1,000 Hz	1024 (400)	2.5 Hz, 150 cpm	400 ms
		2048 (800)	1.25 Hz, 75 cpm	800 ms
5120	2,000 Hz	1024 (400)	5 Hz, 300 cpm	200 ms
		2048 (800)	2.5 Hz, 150 cpm	400 ms
12800	5,000 Hz	1024 (400)	12.5 Hz, 750 cpm	80 ms
		2048 (800)	6.25 Hz, 375 cpm	160 ms
25600	10,000 Hz	1024 (400)	25 Hz, 1500 cpm	40 ms
		2048 (800)	12.5 Hz, 750 cpm	80 ms
51200	20,000 Hz	1024 (400)	50 Hz, 3000 cpm	20 ms
		2048 (800)	25 Hz, 1500 cpm	80 ms

13.3 Waveform Data Collection Triggers

Each UMM channel is in an infinite loop of continuously sampling waveforms. The “triggers” described in this section are used by the UMM channel to determine when the sample is to be saved. If the sample is to be saved, the UMM channel stores the waveform until it is polled (queried) for the waveform.

In a 16P rack, the waveform polling interval is every 5 seconds. In an 8P (or 4P) rack, the interval is every 2.5 seconds. If a UMM channel samples a new waveform (during the 5 second interval), only the most significant waveform is saved.

Note that “Boost mode” is a special case as explained in the sections below.

13.3.1 Delta Time (Dynamic Collection Rate (Time))

The dynamic collection rate (also called delta-time) specifies the periodic rate for collecting waveforms. When the dynamic collection rate time elapses, a waveform is saved. The default is 20 minutes.

13.3.2 Delta RPM (Dynamic Collection Rate (RPM))

Changes in machine speed during machine transients (start-up or shut-down) are used to trigger waveform dynamic collection. Each channel has its own Delta RPM setting (default is 60 RPM).

In the VC-8000 the Delta RPM trigger is always enabled. In other words, even when the machine is in steady state (not transient), the Delta RPM trigger is still looking for speed changes.

For machines that run with few speed variations the best practice is to set the Delta RPM at 2-3% of the normal machine speed. For machines that operate with lots of speed variation you may need to set a much higher Delta RPM, well above the normal variation in running speed. For example:

Normal Speed	Delta RPM	Comment
3,000 +/- 2 RPM	90 RPM	3% of normal speed
10,000 +/- 350 RPM	450 RPM	100 RPM more than speed variation
40,000 +/- 2,000 RPM	2,200 RPM	200 RPM more than speed variation

Remember that Delta RPM is only one of the waveform triggers during a transient speed event. The I-Factor will also trigger waveforms.

Application Alert

If Delta RPM is set too low, waveforms will be triggered constantly – during normal (steady state) operation – degrading the performance of the system.

13.3.3 I-Factor % (Dynamic Collection Rate (% Change))

The VC-8000 monitor will save a waveform whenever there is a significant change in vibration. The patented I-Factor % allows you to tell the VC-8000 what you consider to be a “significant” or “interesting” change in vibration amplitude.

The default I-Factor is 6%. The percentage is calculated with reference to the Danger Alarm setting of the Direct measurement. If there is no Danger Alarm, then the percentage is calculated with reference to the Full-Scale Range setting. Some examples are shown below.

Table 32: I-Factor Examples

Channel	Danger Alarm	Full-Scale Range	I-Factor % and Actual Value	
Radial Vibration	4 mils (102 µm)	10 mils (254 µm)	5 %	0.2 mils (5 µm)
Radial Vibration	N/A	10 mils (254 µm)	5 %	0.5 mils (13 µm)
Axial Position	20 mils (0.5 mm)	-40 to +40 mils (-1 to +1 mm)	5 %	1 mil (0.025 mm)
Axial Position	N/A	-40 to +40 mils (-1 to +1 mm)	5 %	4 mils (0.10 mm)
Seismic	0.5 in/s (12.7 mm/s)	1 in/s (25 mm/s)	10 %	0.05 in/s (1.27 mm/s)
Seismic	N/A	1 in/s (25 mm/s)	10 %	0.1 in/s (2.5 mm/s)

Row 1 in **Table 32** shows a Radial vibration channel with a Danger Alarm of 4 mils (102 µm). The I-Factor is set at 5%. A waveform will be saved when the Direct value changes (up or down) by more than 0.2 mils (5 µm).

Row 2 shows a channel without a Danger Alarm. In this case the actual value of the I-Factor will be calculated using the Full-Scale Range setting. The I-Factor is set at 5%. A waveform will be saved when the Direct value changes (up or down) by more than 0.5 mils (13 µm).

13.3.4 Adaptive I-Factor

Adaptive I-Factor is a tracking mechanism that will adjust the I-Factor % in real time if too many (or too few) waveforms are being collected. Normally the Adaptive I-Factor is enabled.

Note

SAM (CMS) firmware 6.0.3050, and UMM firmware 4.02.9046 are required for Adaptive I-Factor.

The Adaptive I-Factor requires a target value for comparison. The Dynamic Collection Rate (Minutes) setting is used as this target value. The Adaptive I-Factor compares the number of waveforms collected with the target and adjust the I-Factor setting accordingly.

13.3.5 Boost Mode

In Boost Mode the rack suspends Delta RPM and I-Factor waveform collection and begins saving all waveforms continuously. It is ideally suited for electric motor start-ups which are measured in seconds rather than minutes.

Boost mode channels require five settings (Boost Mode enabled, Phase Trigger association, Delta RPM, High Trigger (RPM), Low Trigger (RPM))

When enabled, a channel enters Boost mode when the speed is between the Low and High Trigger range (see 13.4.1), and the speed is changing (Delta RPM).

A channel exits Boost mode when the speed is outside the Low and High Trigger range or when the speed has not changed (Delta RPM) for 10 seconds (or if a phase trigger error occurs).

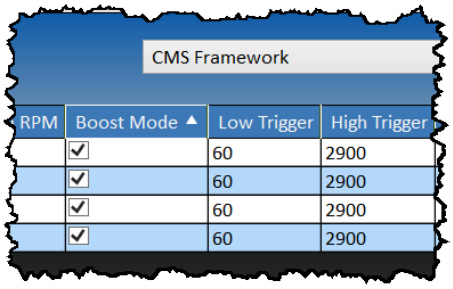


Figure 100:
Boost Mode Configuration

Additionally, the channel will exit Boost mode if the UMM memory fills up. When the channel exits Boost mode it reverts to standard sampling. This provides time for the UMM to send the waveforms to the CMS system. When at least 25% of the memory is available the channel will return to Boost Mode (given that the Boost Mode criteria is still being met).

Application Alert

Use Boost mode with discretion.

Collecting too many waveforms will impact data base storage and CMS system performance. Normal waveform collection is sufficient for most machines.

To avoid collection of too many waveforms, Boost Mode parameters must be set with clear knowledge of the machine speeds. Set the Low Trigger at least 100 RPM greater than the expected slow roll value. Set the High Trigger to at least 100 RPM below running speed.
If the machine speed fluctuates make sure the High Trigger is 100 RPM below the lowest speed of the machine.

Boost Mode should not be enabled on a machine that starts/stops many times a day; too many waveforms would be collected (repeatedly). In these cases, Boost Mode would only be enabled temporarily when the high-resolution waveform data is needed.

For large VC-8000 systems, moving the full amount of Boost Mode memory into CMS PI/XC can take up to 20 minutes.

13.3.5.1 Low Trigger (RPM), High Trigger (RPM) – Boost Mode Data Collection

The Low to High Trigger setting defines the machine transient window. This window is used to control Boost Mode, Exception Deviation, and PI Compression Deviation.

For more information see 13.4.1.

13.3.6 Paired Channels (XY)

Paired channels will always collect waveforms together. There are two ways that channel pairs are created, automatically and explicitly.

13.3.6.1 Automatic Pairing

For example: If Brg 1X and Brg 1Y are paired, and Brg 1X has a waveform collection triggered (I-Factor), Brg1Y will also have a waveform collection triggered and the waveforms will have the same time stamps.

Channels are paired automatically under the following conditions:

- The two channels are in the same UMM and are in channels 1 & 2 (or 3 & 4)
- They have the same Phase Trigger association
- They are the same channel type
- The channels are Radial Vibration, Hydro Radial Vibration, Shaft Absolute Radial Vibration, Rod Position, or Cylinder Pressure
- To view Orbit and Shaft Centerline plots the channels must have the same CMS Navigation Path (for example “Unit 1*\Brg 1”)

13.3.6.2 Explicit Pairing

Channels can be explicitly paired from the channel view. This allows the user to pair channel types that are not automatically paired as described above. Explicit pairs are only allowed for channels 1/2 and channels 3/4. This pairing is done be selecting the Pair A/B check box on either channel 1 or channel 3. If the channel types are not the same, this box will be disabled.

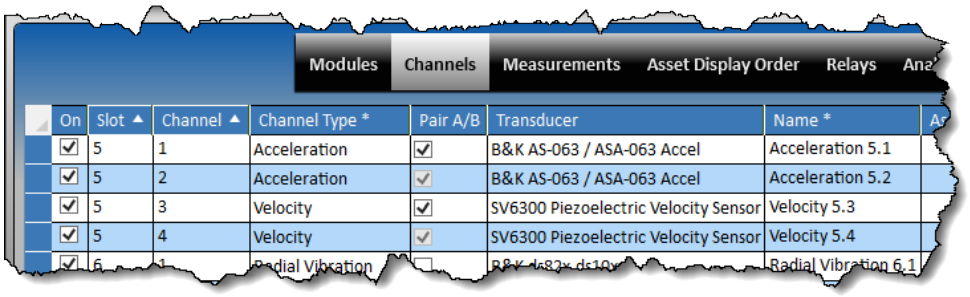


Figure 101: Explicit Pairing

13.3.6.3 Removing Automatic Pairing

You can remove pairing, if needed. For example, with two Radial Vibration channels – but monitoring different bearings. Deselecting the Pair A/B check box to turn off pairing (this will also disable validations forcing 90 degree probe orientation).

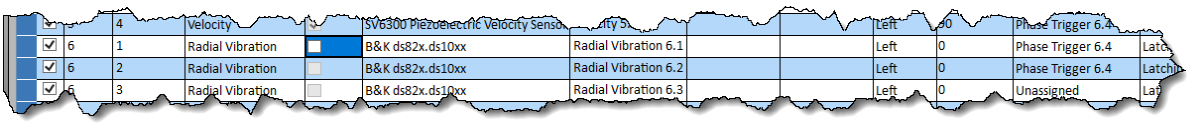


Figure 102: Remove Automatic Probe Pairing

13.3.7 Group Channels (Machine Train)

Creating Channel Groups forces all channels in the group to save a waveform when any (single) channel in the group saves a waveform. Grouping is typically used to trigger waveform data collection on all sensors on the machine at approximately the same time.

Generally, grouping should only be enabled on Radial Vibration channels. Do not use channel grouping on Acceleration, or Velocity channels. These channels types can be very noisy and at times, can drive a lot of waveforms to be collected. A noisy velocity sensor could cause all sensors to be continuously collecting waveform data – bogging down the system.

When grouping is enabled, the actual groups are defined by the phase trigger association. A rack with multiple phase triggers will have multiple groups. Channels with different phase triggers cannot be “grouped” together.

Use with discretion; channel grouping can cause a lot of waveforms to be collected. Remember, that during startups there are already multiple waveform triggers working together (Delta RPM, I-Factor, and Channel Pairs); usually, this provides plenty of data for transient data analysis.

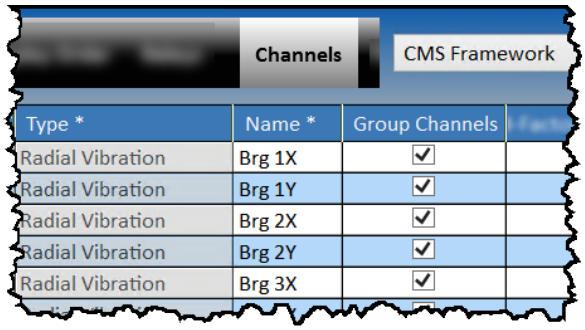


Figure 103:
Group channels option

Application Alert

Do not use channel grouping on Acceleration, or Velocity, or “noisy” channels.

These channels types are “noisy” and can trigger all channels in the group to continuously collect waveforms, drastically slowing CMS system performance.

13.4 Static Data Collection Triggers

Static data is updated in the UMM channel every 80 ms (no configuration needed).

Unlike waveform data, which is “collected” using criteria in the UMM, static data “collection” criteria are determined in the SETPOINT PI/XC Adapter. In other words, all 80 ms data is sent to the Adapter, and the Adapter determines what will be saved and what will be thrown away.

13.4.1 Low Trigger (RPM), High Trigger (RPM) – Static Data Collection

The Low to High Trigger setting defines the machine transient window. This window is used to control Exception Deviation, PI Compression, and Boost Mode.

Table 33: Machine transient window

Feature	Description
Reduced Exception Deviation (divide by 4)	Defines when higher density static data is saved (by the Adapter) during start-ups and shutdowns. This feature is always enabled.
PI Compression Off/On (PI systems only)	Defines when PI compression will be disabled, and more data will be stored. This feature is always enabled.
Boost mode (rarely used)	See 13.3.5

Note

Most of the time the machine transient window is only used to control higher resolution static data collection. If Boost Mode is being used, the same window is used for both features.

When the machine speed is within the defined window the SETPOINT PI/XC Adapter will collect higher resolution static data by modifying two data collection settings:

- Reduces the Exception Deviation (divide by 4)
- Turns data compression off (PI Systems only)

There is no enable/disable for this feature. It is always on.

13.4.1.1 Exception Deviation (PI, XC, SD, and HD)

Many of the 80 ms data samples coming from the UMM will be redundant (i.e. 25.0 µm, 25.1 µm, 25.0 µm, 25.1 µm etc.). Redundant data is filtered using the Exception Deviation setting.

Exception Deviation defines when a new sample should be stored. For example:

- There was a significant change in the data (i.e. 25.0 µm to 35.0 µm).
- There have been no significant changes in the data, but a long time has passed since that last data point was stored (10 seconds).

Filtering the data using Exception Deviation improves system performance; less data is stored, and data retrieval is much faster. The SETPOINT PI Adapter manages the Exception Deviation values.

Examples of Exception Deviation are shown below.

Table 34: Exception Deviation examples

Channel Type	Sensor	Exception Deviation
Radial Vibration (mils (µm) pp))	200 mV/mil (7.87 mV/ µm)	0.06 mils (1.52 µm)
Acceleration (g)	100 mV/g	0.012 g

For CMS-XC, SD, and HD the Exception Deviation setting is not shown and cannot be edited. For CMS-PI the setting is an attribute of the PI tag and can be edited using PI tools.

When the machine is in a transient condition, the SETPOINT PI Adapter will reduce the Exception Deviation setting (divide by 4). This allows higher resolution data to be stored and improves diagrams (Bode, Polar, etc.) used for startup and shutdown analysis (see 13.4.1).

13.4.1.2 Compression Deviation (PI Only)

The OSI Soft PI Data Archive uses a “swinging door” algorithm to compress time-series data. The algorithm stores only what is needed to provide an accurate data history. The sensitivity of the algorithm is controlled by the Compression Deviation setting. Compression Deviation should be set at twice the Exception Deviation value.

When the machine is in a transient condition, the SETPOINT PI Adapter can temporarily bypass PI Compression. This allows higher resolution data to be stored and improves diagrams (Bode, Polar, etc.) used for startup and shutdown analysis (see 13.4.1).

Note

To learn more about Exception Deviation and Compression Deviation see the many tutorials available on the OSI Soft YouTube channel.

13.4.1.3 High Trigger, Low Trigger (0,0) – Special Case

When Low Trigger and High Trigger are both set to zero the SETPOINT PI/XC Adapter uses an algorithm to detect when the machine is in transient mode. The algorithm is continuously executed (every second or faster) and performs as follows:

- Calculate max speed, min speed, and delta speed (over the last 30 seconds)
- Evaluate using current speed, and look-up table

For systems using the PI/XC Adapter 7.x or later the algorithm is shown in **Table 35**. For systems using CMS 6.x or earlier the algorithm is shown in **Table 36**.

Table 35: Algorithm (CMS 7.x and later)

Current Speed	If Delta Speed is…	Machine Condition =
Below 7,500 RPM	Above 5 RPM	Transient
7,500 to 60,000 RPM	Above (max speed * 0.002) RPM (Typically, 15 to 120 RPM)	Transient
Above 60,000 RPM	Above (max speed * 0.004) RPM (Typically, above 240 RPM)	Transient

Table 36: Algorithm (CMS 6.x and earlier)

Current Speed	If Delta Speed is…	Machine Condition =
Below 1,000 RPM	Above 2 RPM	Transient
1,000 to 60,000 RPM	Above (max speed * 0.002) RPM (Typically, 2 to 120 RPM)	Transient
Above 60,000 RPM	Above (max speed * 0.004) RPM (Typically, above 240 RPM)	Transient

13.5 CMS-SD, and CMS-HD

13.5.1 Excellent “Flight Recorder” Solution

The most common usage of CMS-SD (HD) is for post-event analysis (flight recorder data).

CMS-SD/HD is a powerful flight recorder solution. Data is recorded inside the rack; network issues, server issues etc. will not prevent data from being collected. When a machine event occurs, the data can be extracted, saved, and shared for post-event analysis.

Using CMS-SD/HD for real time condition monitoring is not recommended. A CMS-XC or CMS-PI solution will provide much faster and easier access to the data.

CMS-SD (HD) can be used concurrently with CMS-PI, or CMS-XC. In this case the CMS-SD (HD) works only as a backup in case of data loss at the server.

Application Alert

Using CMS-SD/HD for real time condition monitoring is not recommended.
A CMS-PI (or XC) solution will provide much faster and easier access to the data.

13.5.2 CMS-SD (SD Card)

The SD card provides local CMS data storage for the rack. This data is for post-event analysis and can be viewed using the CMS software. The SD card is independent of the CMS (DAC) Ethernet port; they can both be used at the same time.

This feature must be enabled in the SAM configuration. Appropriate CMS licensing is required.

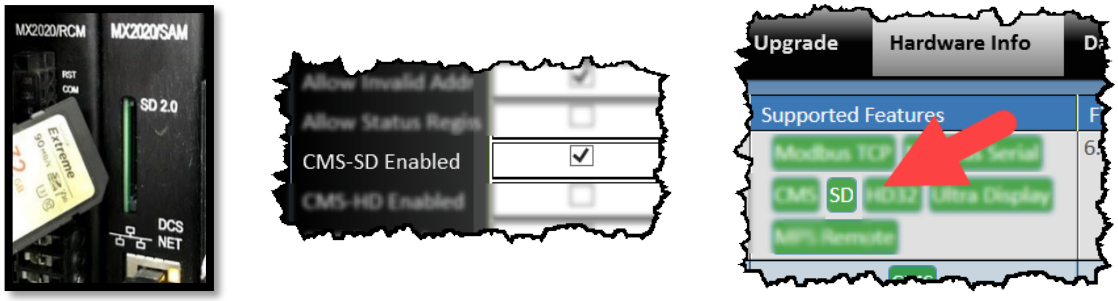


Figure 104: SD Card

The SD card must be removed and copied to a computer to view the data. The SD card can be manually removed (replaced) at any time. When the disk is full the oldest data will be over-written. The following table shows SD cards that can be used.

Table 37: SD Card Requirements:

Type	Size	Speed
SDSC (Standard Capacity)	Up to 2 GB	Class 10, at least 95 MB/s
SDHC (High Capacity)	Up to 32 GB	Class 10, at least 95 MB/s
SDXC (Extended Capacity)	Not supported	

13.5.3 CMS-HD (Internal Solid Sate Drive)

CMS-HD uses an internal solid-state drive (SSD) to store CMS data. Users connect directly to the VC-8000 ethernet port to view CMS-HD data.

Important

The CMS ethernet port should not be placed on a public data network (i.e., remote users). For remote connectivity, use CMS-XC or CMS-PI.

CMS HD does not require configuration. HD enabled hardware will automatically store static and dynamic data from all CMS enabled modules.

When the HD storage is full it will begin to overwrite the oldest data. The CMS software provides basic information on the HD storage capacity.

The CMS HD feature requires the rack to have a connection password (see 11.6.3).

14 Configuring – Modules Tab

Use the Modules tab to add, or remove monitors.

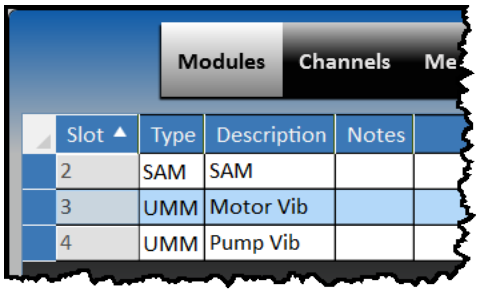


Figure 105: Modules Tab

14.1 All View

The Modules tab only has two views; All and SAM. Normally you will use the 'All' view.

Figure 106: Modules Tab - Views

14.1.1 Slot, Type, Description, Notes

Slot: The position of the monitor in the rack. Slot 1 is the RCM and is not shown in the grid. Slot 2 is normally the SAM.

Type: The installed Module Type (UMM or TMM)

Description: Provides a general description for the card. This field is shown in the Maintenance software screen (see **Figure 107**), and on the touch panel (if used).

Notes: Are used to help track changes, or store comments for others who may access the configuration later. The notes are also visible from the Maintenance software (hardware info screen).

If the rack is an eight-slot rack, slots 9 through 16 must be configured as empty.

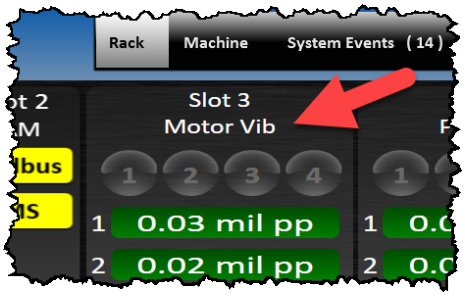


Figure 107:
Module description is shown here

14.2 SAM View

The SAM view shows all SAM properties. However, it is easier to edit the SAM properties by selecting the SAM (in the grid) and opening the properties panel.

SAM properties include connection parameters for Modbus, CMS, Remote Access, and NTP Time synchronization. Please see the following sections:

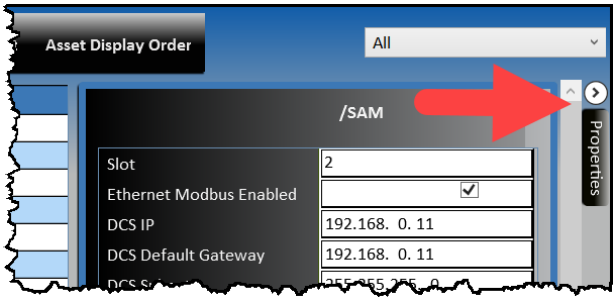


Figure 108: SAM, Properties panel

- Section 21 Configuring – Modbus
- Section 13 Configuring – CMS Data Collection
- Section 11.2 Remote Connection (Ethernet)
- Section 9.7 Rack Time Synchronization

15 Configuring – Channels Tab

Use the channels tab to set the channel and transducer properties. Begin with the Summary view. Then progress to the other Channel Views; such as Customize Transducer view, or the Phase Trigger view.

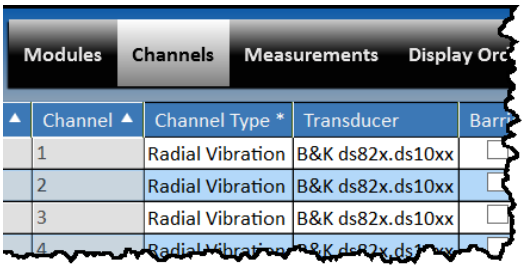


Figure 109: Channels Tab

15.1 Summary View

The Summary view shows common channel settings as described in the following sections.

15.1.1 Channel On/Off, Slot, Channel

On: Enables (or disables) the channel.
Slot: Slot number - where the module is installed.
Channel: Channel number – where the sensor is connected.

15.1.2 Channel Type, Transducer Type

Channel Type (Radial Vibration, Axial, etc.)

Transducer Type allows you to select a sensor. The transducer you choose will set the (OK) limits, the scale factor, and other settings to their default values.

Tip

Configure Channel Type and Transducer Type before configuring other settings.

Many settings are dependent on Channel and Transducer Type, and they will “reset” to defaults when changes are made.

15.1.3 Transducer Direction, Orientation

Transducer Direction and Orientation define the sensor position (i.e. 45 Left, 45 Right). Left and Right are typically seen looking down the machine (driver to driven); for example, standing at the head of the motor (or turbine).

Radial vibration XY sensors must be 90 +/- 10 degrees.

15.1.4 Associated Phase Trigger

Associated Phase Trigger defines the Phase Trigger to associate with the channel. A Phase Trigger association is required for synchronous data (i.e. waveforms, 1X tracking filters).

Always associate a phase trigger with the channel when possible. You can only choose one speed to associate with each channel; If your sensor (i.e. accelerometer) is on a gearbox you will need to choose which phase trigger association will provide you the most value.

15.1.5 Channel Pair A/B

This checkbox is used to pair channels 1 & 2 (or 3 & 4). When a channel pair is enabled additional features may be available. For example, Orbit plots in CMS software for Acceleration channels, or the Max X/Y measurement (see 25.1.1).

In many instances this box will be checked automatically, and cannot be disabled. For example, Radial Vibration channels with the same phase trigger association will be paired automatically.

15.1.6 Channel (Tag) Name

The Channel Name is used to identify the channel. The name will be shown in the event lists, the display screens, and in the CMS software. A good naming methodology is essential to a well-organized MPS system. The channel name is limited to 30 characters.

15.1.7 Asset Level 1 & Asset Level 2

Asset Level 1 and Asset Level 2 are used in conjunction with the tag name, to identify the machine train, machine case, and location of the sensor.

Asset Level 1 and Asset Level 2 are also used as major (level 1) and minor (level 2) groupings. These groups are used to assist in configuring the following:

- Relay Logic (See 0)
- Rack Touch Screen Display (see 12.2.3)
- Rack Maintenance Software (see 12.2.3)

15.1.8 Alert & Danger Latching

Alert & Danger Latching allows the user to set alarms to Latching or Non-Latching.

Tip

Consider Non-Latching alarms (with Latching Relays) for improved event list management. Non-Latching alarms update the event list when the channel leaves alarm. In contrast, a latched alarm updates the event list when the user resets the alarm.

15.1.9 Display Order

This setting controls the position of the channels on the Maintenance software screens. Channels are grouped by Asset Level 2, and then ordered by the Display Order setting (see section 11.7).

If the Display order column is not used (all values are set to zero), the channels will be ordered by slot and then by channel.

Figure 110: Display Order column

15.2 Customize Transducer View

Use the Customize Transducer view to change transducer settings.

Figure 111: Customize Transducer view

15.2.1 Barrier

When the box is checked, the transducer scale factor is reduced by 4%. This compensates for the small voltage drop across the barrier. For some channel types (i.e. Axial) the OK Limits may also be slightly adjusted.

15.2.2 Scale Factor (mV) & Unit

This setting allows the user to set Transducer scale factor (mV) and units. When you select a transducer, this value is set automatically depending on the transducer selected. The scale factor can be changed if needed.

15.2.3 Max OK & Min OK (Fault Limits)

The setting specifies the fault values for the selected transducer. When the transducer signal is outside the OK limits the channel is faulted (Not OK) and channel data is marked invalid.

When you select a transducer, these values are set to recommended values.

15.2.4 Transducer Power

Specifies the power to be provided to the sensor. When you select a transducer, this value is set to the recommended setting.

If you are using the VC-8000 rack as a PI/CMS Gateway (see section 5), set the transducer power to ‘High-Z Input’. High-Z input is used when connecting to low-impedance sources (i.e. buffered output signals from another monitoring system).

15.2.5 Transducer Fault Mode

Controls how sensor faults are handled. When you select a Channel Type, this value is set to the “best practice” value automatically.

Fault Mode	Description
1. Latching Faults	Latches the fault condition until the user resets the rack. This setting is rarely used.
Non-latching Faults	Channel state returns to valid immediately, when the sensor returns to normal conditions.
Timed Fault Defeat and No Latching	Channel state returns to valid 20 seconds after the sensor returns to normal conditions. This is the recommended setting for Radial Vibration channels.

15.2.6 Transducer Linearization

In rare circumstances it may be necessary to extend a probe measurement outside of the (normal) linear range. The Axial, Differential Expansion single probe and Differential Expansion Complimentary Input channel types can do this using a custom linearization.

To enter the linearization data, go to the Channels tab, Customize Transducer view. Enable Custome Linearization, and define the number of entries (segments) for the linearization table. This table can be accessed by opening the properties view while selecting the desired transducer.

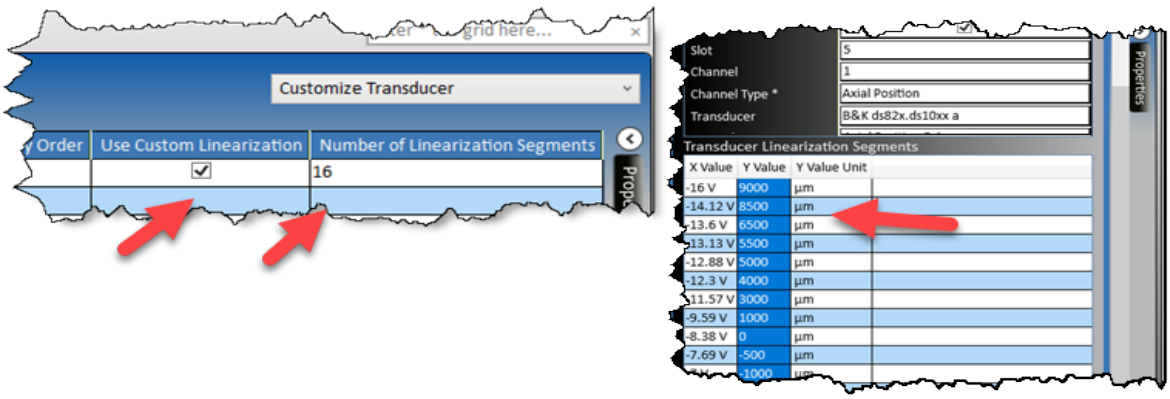


Figure 112: Transducer Linearization Segments Table

> **Note**
>
> A maximum of 19 user defined segments can be specified.
>
> The transducer's zero position voltage must have an entry in the Transducer Linearization Segments table.
>
> All voltage (X-value) entries in the table must be within the configured OK limits of the transducer.
>
> Using this feature may reduce the channel types that can be configured on the UMM.

15.3 Other Views

Other Views on the Channels Tab include:

- CMS Framework (see section 13)
- Phase Trigger (and Speed) (see section 20.3)
- Position (see section 20.2)
- Process Variable (see section 20.4)
- Recip (see section 2.6.1, VC-8000 for Recip Machines)
- Temperature (see section 20.6)
- Contacts (see section 26.4)
- Hydro (see section 2.6.1, VC-8000 for Hydro and Low Speed Machines)
- States (see section 2.6.1, VC-8000 for Hydro and Low Speed Machines)

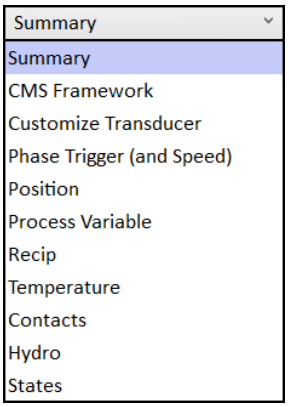
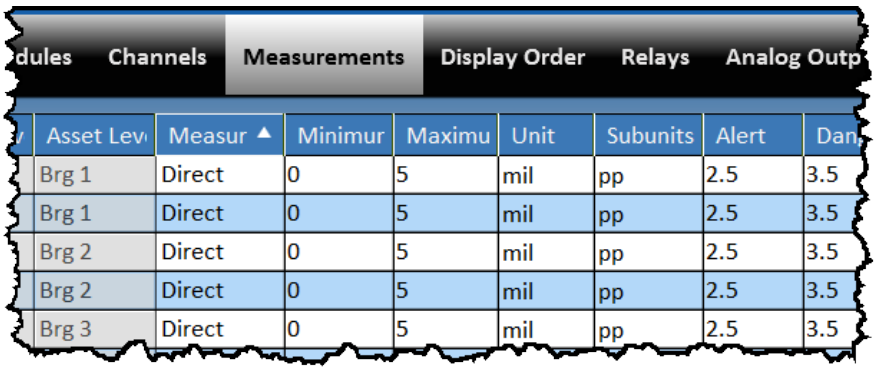


Figure 113: Channel Tab, View Options

16 Configuring – Measurements Tab

Modify alarms and full-scale range settings from the Measurements tab. Use the Primary view selection to simplify the layout (this will hide all 1X, 2X, and Gap measurements).



Asset Lev	Measur ▲	Minimur	Maximu	Unit	Subunits	Alert	Dan
Brg 1	Direct	0	5	mil	pp	2.5	3.5
Brg 1	Direct	0	5	mil	pp	2.5	3.5
Brg 2	Direct	0	5	mil	pp	2.5	3.5
Brg 2	Direct	0	5	mil	pp	2.5	3.5
Brg 3	Direct	0	5	mil	pp	2.5	3.5

Figure 114: Measurements Tab

16.1 Primary and All – Views

Both the Primary view and the All view show the same columns headers. The Primary removes all 1X, 2X, Gap, etc. measurements and only shows the primary measurement for the channel; for example, the Direct measurement on a Radial Vibration channel. The definition of each column header is explained below.

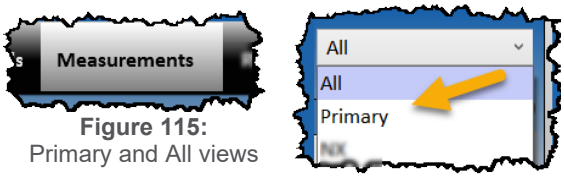


Figure 115:
Primary and All views

16.1.1 Measurement Name

The Measurement column shows each measurement for the channel. Most channel types have multiple measurements. For example, Direct, Gap, 1X, 2X, on a Radial Vibration channel.

The name of the measurement is editable and can be modified (although it is rare to do so).

16.1.2 Maximum & Minimum Scale, Units & Sub Units

The measurement's maximum and minimum scale values and unit. For example:
0-10 mils pp, or 0-25 µm pp.

These values are used on the local display panel VC-8000, and in Setpoint CMS. They are also used when sending scaled Modbus data. For example, the Modbus value (0-65535) would be scaled to the range configured on the Radial Vibration channel (0-10 mils pp).

16.1.3 Alert Alarm Type, Alert Alarms

The Alert Type options are shown below.

Table 38: Alert Alarm Types

Alert Type	Available Set Points	Operation
Disabled	None	The Alert set point is disabled.
Over	Alert	Alarms when the input is greater than the Alert set point.
Under	Under Alert	Alarms when the input is less than the Under Alert set point.
Out of Band	Alert, Under Alert	Alarms when the input is greater than the Alert set point OR less than the Under Alert set point.
In Band	Alert, Under Alert	Alarms when the input is less than the Alert set point AND greater than the Under Alert set point.

16.1.4 Danger Alarm Types, Danger Alarms

The Danger Type options are shown below.

Table 39: Danger Alarm Types

Danger Type	Available Set Points	Operation
Disabled	None	The danger set-points are disabled.
Over	Danger	Alarms when the input is greater than the Danger set point.
Under	Under Danger	Alarms when the input is less than the Under Danger set point.
Out of Band	Danger, Under Danger	Alarms when the input is greater than the Danger set point OR less than the Under Danger set point.
In Band	Danger, Under Danger	Alarms when the input is less than the Danger set point AND greater than the Under Danger set point.

16.1.5 Alert and Danger Alarms - Time Delay

The amount of time the measurement must remain above (or below) the set point before an alarm is annunciated.

The Default settings are 3 seconds for Alert Time Delay, and 1 second for Danger Time Delay. These are good default settings for critical machines. For less critical machines you may consider extending time delays to minimize false alarms.

16.1.6 Custom Hysteresis

The Process Variable channel allows the user to configure a custom hysteresis value. This was designed for a specific situation and is rarely used.

To configure the hysteresis, use the properties panel with the Direct measurement selected (**Figure 116**). Check the “Use Custom Hysteresis” box and enter the new value. The value is entered as a percentage of full scale. For example, with a full scale of 0 to 10 psi, a value of 2.0 provides a Hysteresis setting of 0.2 psi.

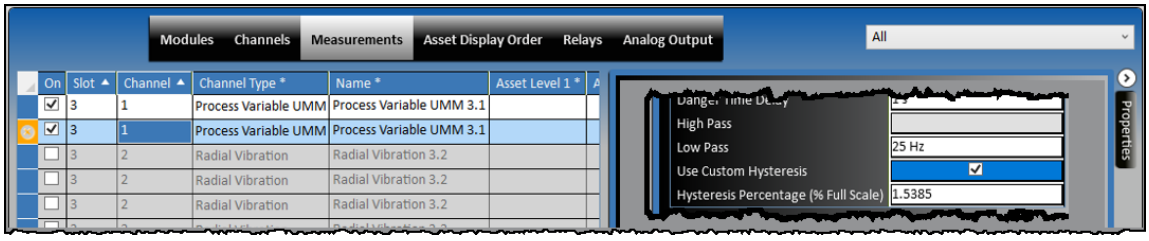


Figure 116: Use Custom Hysteresis on Process Variable Direct Measurement

Software validations will check the new hysteresis setting; for example, a setting where a measurement goes into alarm but can never leave alarm. However, not all permutations are covered by this validation, so a validation Warning message will always be shown when custom hysteresis is used; reminding the user to test carefully when using this setting.

16.1.7 High Pass, Low Pass Corner Frequency

Measurements that show a high pass, and low pass filter, apply a pre-filter first, and then determine the measurements indicated. This pre-filter is applied to these static measurements only – and not the waveforms.

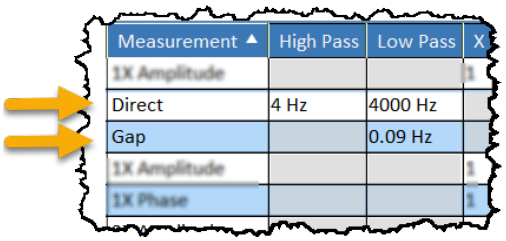


Figure 117: High/Low Pass filters

Filter setting restrictions:

- The low-pass filter corner should be no more than 1000 x high-pass filter corner.
- If the low-pass and high-pass filters are too close, there can be significant attenuation. The configuration software does not enforce filter separation.
  As a guideline, maintain the filter separation shown in the table below.

Table 40: High-Pass and Low-Pass Filter Corner Separation

Measurement	Recommended Filter Separation
Radial Vibration Shaft Absolute Radial Vibration	Low-Pass Corner > 10 x High-Pass Corner
Velocity Acceleration Low Frequency Acceleration Low Frequency Velocity Shaft Absolute Velocity	Low-Pass Corner > 2.5 x High-Pass Corner
Hydro Displacement Hydro Velocity Dynamic Pressure	Low-Pass Corner > 1.1 x High-Pass Corner
Aero Velocity (Tracking or Bandpass) Aero Acceleration Acceleration Enveloped	Low-Pass Corner > 1.3 x High-Pass Corner

Note
High Pass, Low Pass does not apply to waveform data collection.

16.1.8 Trip Multiply

Trip Multiply (when enabled) increases the alarm set-points by the value specified. For example, a Trip Multiply value of 2 will change the Alert alarm from 3 mils to 6 mils when Trip Multiply is enabled. If Trip Multiply was 2.5, the Alert alarm would change from 3 mils to 7.5 mils.

The default value for Trip Multiply is 1. With a value of 1 the alarm will not change when trip multiply is enabled (i.e. 3 mils x 1 = 3 mils) using Trip Multiply on measurements with integrated units, the user must ensure that the Trip Multiply alarm is within the range of the selected sensor - at the frequency where the highest vibration is expected.

16.1.9 X (Tracking Filter)

The X column sets the tracking filter for the measurement (when applicable). Tracking filters can be set from 0.01 to 15.99. A radial vibration measurement has two standard tracking filter measurements (1X, and 2X). A tracking filter includes both an amplitude and a phase measurement.

To change (for example) the existing 2X tracking filter to 0.5X, simply edit the X field (from 2 to 0.5). Don't forget to also change the measurement name from 2X Amplitude to 0.5X Amplitude.

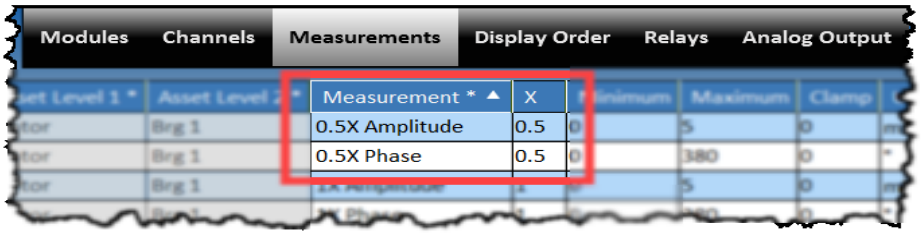


Figure 118: Modify nX tracking filter

16.1.10 Below Minimum Amplitude (BMA)

When the nX amplitude is less than 5mV peak to peak, the signal is too small to provide a stable phase measurement. When this occurs the phase measurement is marked as BMA (Below Minimum Amplitude) and is set to zero.

Although not recommended, the minimum amplitude threshold can be modified. To change the threshold, select the phase measurement and then view the properties pane. Enter the new minimum value in engineering units or in mV. Each individual phase measurement must be modified.

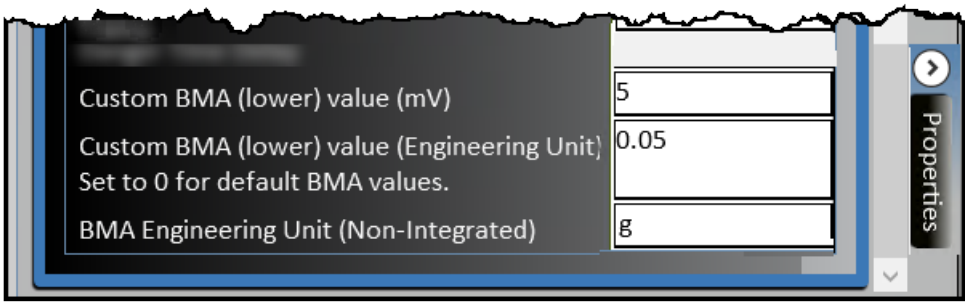


Figure 119: Setting nX Phase BMA

Note

Adjusting the BMA threshold can cause erratic and noisy phase measurements which can cause excessive data collection of phase data.

16.1.11 Measurement Time Averaging

Most Direct and Bandpass measurements have a calculated averaging time determined by the high pass corner frequency (see section 16.1.7).

Although not recommended, the averaging time can be modified for some measurements. To change the value, select the measurement and view the properties pane. If adjustment is allowed, you will see a setting called “Use Custom Averaging”. Select the checkbox and enter the desired averaging time. Each measurement must be configured individually.

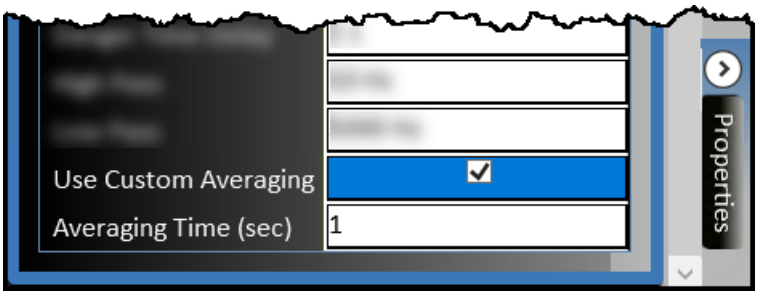


Figure 120: Set Custom Averaging Time

Smaller averaging times, have a quicker response time but are susceptible to noise. Larger values create a smoother vibration signal (less noise) but are much slower in responding to real vibration changes in the system.

To revert to the calculated (recommended) averaging time uncheck the box and send the configuration to the rack.

16.1.12 Clamp & 2 mA Clamp

The Modbus output values will clamp (freeze) to this scaling value when the channel is bypassed or faulted. The default value is 0 (i.e. 0 mils pp).

The Analog value will also clamp to this value when the channel is bypassed or faulted. If the clamp value is 0 (i.e. 0 mils pp) the output will clamp to 4 mA. If 2mA Clamp is enabled the analog output will clamp to 2 mA.

Example 1:
Radial Vibration channel, Scale = 0-10 mils pp, Clamp = 0 (0 is at bottom scale). If the channel goes Not OK, Modbus will send 0 mils pp. The analog output will be 4 mA.

Example 2:
Axial channel, Scale = -40 to 0 to +40 mils, Clamp = 0 (0 is at midscale). If the channel is bypassed the Modbus value will send 0 mils. In Modbus scaled data (i.e. 0-65535) midscale is 32767 (0 mils). For the analog signal midscale is 12 mA.

The default clamp value is 0. It is rarely changed.

16.1.13 Adding Measurements or Waveforms to a Channel

Many channel types allow you to add measurements. For example, you may want to measure both integrated and non-integrated data from an acceleration sensor or add an additional tracking filter to a Radial Vibration channel.

To add a measurement:

1. Select the Measurement tab (All view)
2. Select Add
3. Navigate to the monitor channel and select from the available measurements.

If no measurements are shown, then adding measurements is not supported for that channel type, or all available measurements have already been added.

After adding, the new measurement may appear at the bottom of the measurement list (and be hard to find). Change the View from All to Primary and then back again. This will sort the list and place all measurements in their correct locations. If a waveform is added, it will appear in the Waveform view.

16.1.14 Deleting Measurements or Waveforms from a Channel

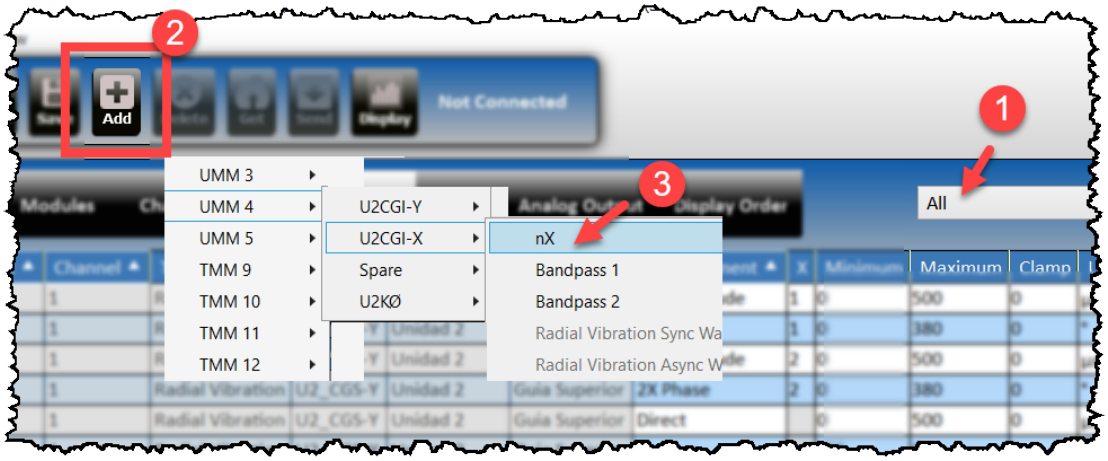


Figure 121: Add a measurement or waveform

To delete a measurement, select the row and then click the Delete button. You cannot delete the primary measurement or gap/bias measurements.

To delete a waveform, select the row and then click the Delete button. Waveforms cannot be enabled/disabled by the user; they can only be added or deleted. Synchronous waveforms are automatically disabled (by the software) if there is no associated phase trigger.

16.2 Vector (nX) View

This nX view displays all vector measurements and displays the Revs Per Vector parameter.

The Revs Per Vector parameter allows you to tune vector calculations for fast response (20 Revs Per Vector) or high differentiation (100 Revs Per Vector). The default value is 20 shaft revolutions per vector calculation; this provides a 0.05X resolution and good response time.

Modifying the Rev Per Vector parameter is rare. One possible application is when diagnosing a motor (running at steady state) and differentiating 1X vibration components from the synchronous speed (which is very close to the running speed).

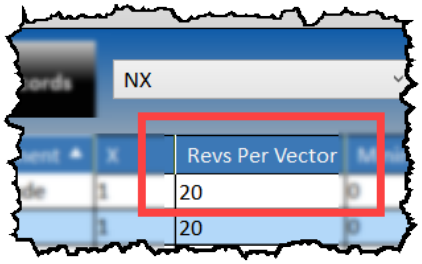


Figure 122:
Revs Per Vector
(rarely changed)

> **Note**
> Sampling the signal for 100 shaft revolutions delays the vector output causing significant shifts for machines that change speeds rapidly.

16.3 Waveform View

The Waveform view shows all waveforms that will be collected for each channel. Waveforms can only be viewed using the SETPOINT CMS software.

To add or delete waveforms see section 16.1.13.

For more information on configuring the CMS data collection parameters see section 13.

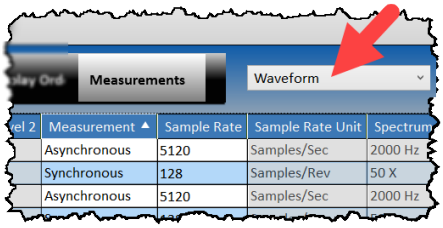


Figure 123:
Waveform View

16.4 Recip Segments View

To configure Recip Alarm Segments select the Recip Segments view.

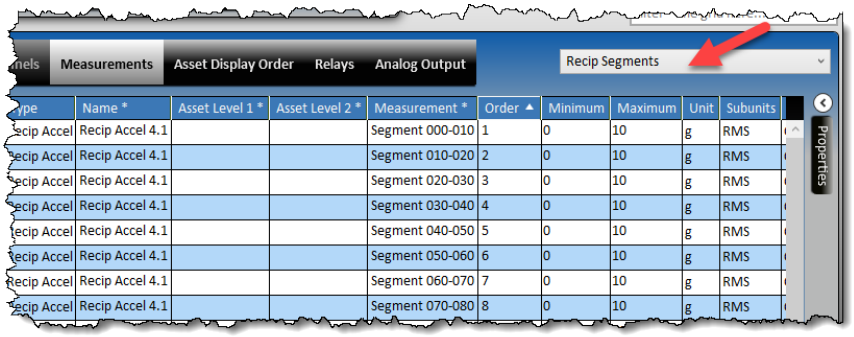


Figure 124: Recip Segments View

17 Configuring – Relays Tab

17.1 Basic Navigation and Layout

The Relay Logic tab allows you to diagram your logic. The basic elements are shown below.

Figure 125: Relays tab

Table 41: Relay Logic Editor

Control	Description
(1) Add button	Add logic blocks as needed
(2) View	Select Relay Editor or Summary view.
(3) Monitor	Select Monitor. All four relay channels on the selected monitor will be shown on the screen.
(4) “For Any” Logic Block	This logic block is a logical OR of all channels specified in the group.
(5) Connector	Connects Logic to the relay channel
(6) Relay channel	Specifies the relay channel (1-4), the relay channel name, and the Energized, and Latching settings

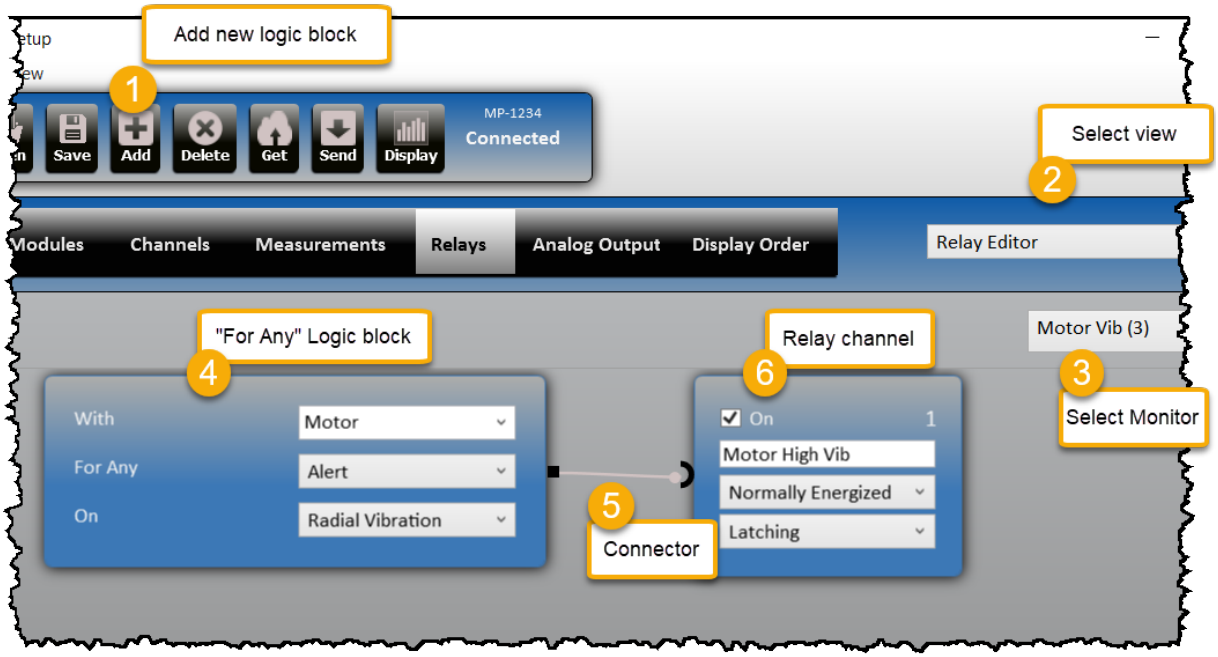


Figure 126: Relay Logic Editor

17.2 Enable Relay Channel (and Relay Settings)

Follow these steps to configure the relay operation (see **Figure 127**):

1. To enable a relay, check the box labeled On. To disable the relay, uncheck the box.
2. Notice the channel number (1 through 4).

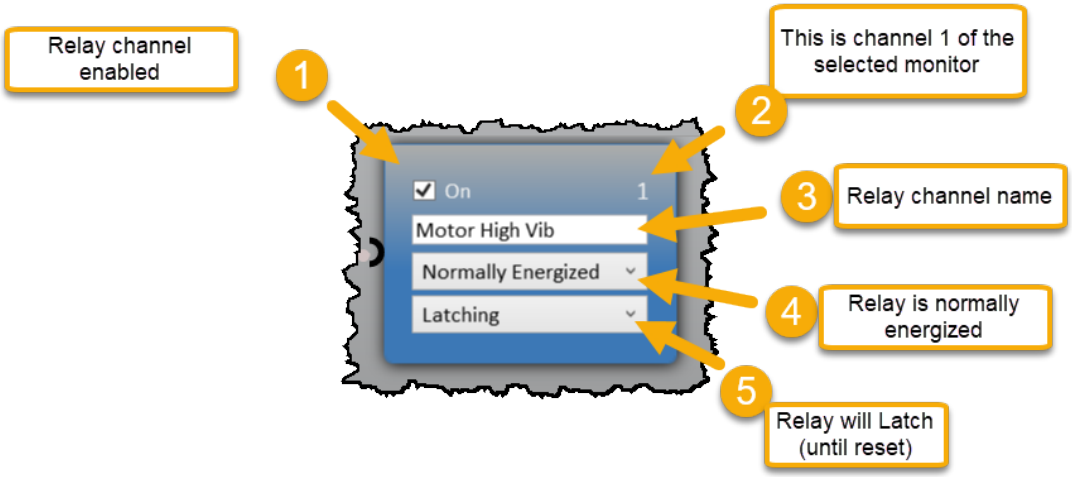


Figure 127: Relay channel settings

3. Name the relay channel to identify the relay on the Maintenance display.
4. Set the normal position of the relay armature. For example, relays that are “Normally Energized” will de-energize to trip the relay, and when the rack loses power. Relays that are “Normally De-Energized” will energize to trip but will not energize (trip) when the rack loses power (see section 9.6.1).
5. Set the latching state. Latched relays will hold their state until a RESET event occurs

Note
Configure modules and channels prior to configuring relay voting logic.

Avoid False Trips!
Relays will transition to the de-energized state on loss of power, during monitor re-configuration, or during a firmware upgrade.
If your machine is running, relays must be externally isolated from trip circuits before servicing the rack.

17.3 Using Pre-Programmed Logic Blocks

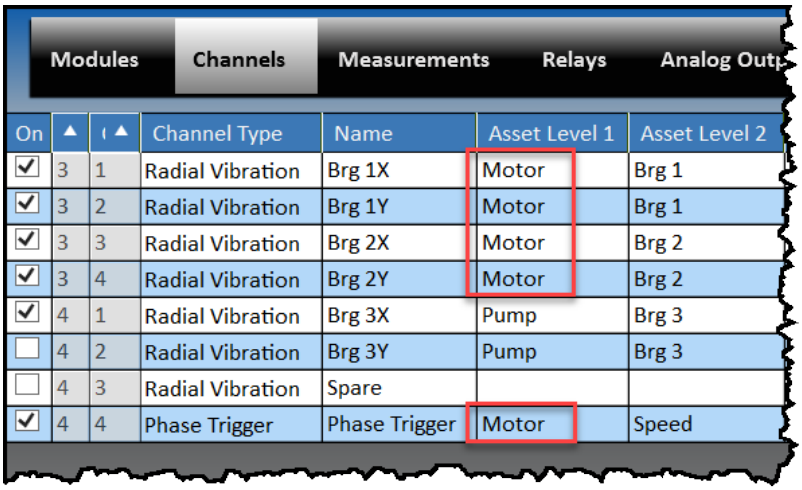
Pre-programmed logic blocks make relay configuration robust and simple.
The 'For Any (1 or 2 or 3…)' logic block is shown in the table below.

Table 42: Logic block example

Control	Selection	Description
	1) With	Selected group (Asset Level 1 or 2)
	2) For Any	Select Alert or Danger alarm
	3) On	Select to restrict the group to a specific channel type (i.e. Radial Vibration)

17.3.1 Define Machine Groups and Channel Types

Pre-programmed logic blocks use your Asset Level 1 and Asset Level 2 groups (Channels tab, Summary view). These groups are used to help organize the data on the rack display, and they are also used to define relay logic groups. The groups shown in **Figure 128** include: Motor, Pump, Brg 1, Brg 2, Brg 3, and Speed.



On	▲	▲	Channel Type	Name	Asset Level 1	Asset Level 2
☑	3	1	Radial Vibration	Brg 1X	Motor	Brg 1
☑	3	2	Radial Vibration	Brg 1Y	Motor	Brg 1
☑	3	3	Radial Vibration	Brg 2X	Motor	Brg 2
☑	3	4	Radial Vibration	Brg 2Y	Motor	Brg 2
☑	4	1	Radial Vibration	Brg 3X	Pump	Brg 3
☐	4	2	Radial Vibration	Brg 3Y	Pump	Brg 3
☐	4	3	Radial Vibration	Spare		
☑	4	4	Phase Trigger	Phase Trigger	Motor	Speed

Figure 128: First, define your asset groups (Motor group highlighted)

Channel types are also used in pre-programmed logic blocks. Typically, they are used to exclude unwanted channels from the group. For example, the Phase Trigger (**Figure 128**) is part of the Motor group, but it will be excluded when "On Radial Vibration" is selected.

Be careful of spelling errors when defining your groups. For example "Motor" vs. "Motor " (with an extra space) will create two distinct groups. Further, if "Motor" is used in both Asset 1 and Asset 2, the groups are combined into a single group.

17.3.2 For Any (1 or 2 or 3…) Logic Block

The 'For Any (1 or 2 or 3…)' logic block performs the logical OR function. All channels in the selected asset group ("With: The Rack", or "With: Motor A") are included in this logic. This block is often used for annunciation of any Alert alarm on the machine.

Table 43: Truth table For Any Channel (1 or 2 or 3…) logic block

	Channel Status		
	(Any) Alert/Danger	Fault	Bypass
Logic block output	True	False*	False

This block performs as follows:

Logical OR function between *all channels* in the selected asset group. For example:
(1X or 1Y or 2X or 2Y or 3X etc.). When any channel evaluates to true the output of the block is true.

* Behavior for a channel Fault is configurable.

A Bypassed channel will vote False.

17.3.2.1 Fault (Not OK) is Configurable

When Not OK is selected (rather than Alarm, Alert, or Danger) this block will trip the relay when any channel in the group is Not OK. The Alert, Danger, or Bypass conditions for any channel in the group will be ignored.

17.3.2.2 Radial Vibration Channel Example

The following logic (**Figure 129**) will activate the relay when any radial vibration channel in the Motor group goes into Alert.

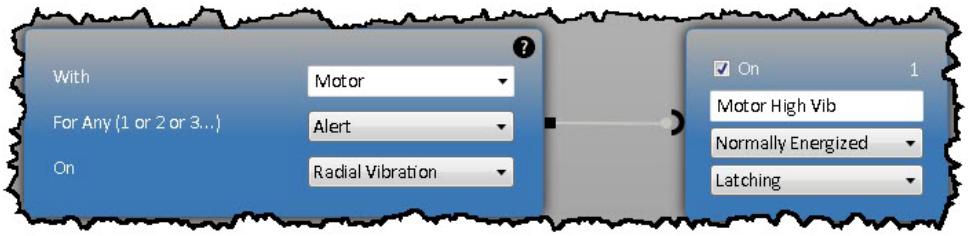


Figure 129: 'For Any (1 or 2 or 3…)' logic block example

A channel that is faulted (or bypassed) cannot vote "True" and cannot trip the relay. See **Table 44** for a few examples.

Table 44: Radial Vibration channel, 'For Any (1 or 2 or 3…)' logic block, scenarios

	1	2	3	4	5
Brg 1X	Alert	Alert	Alert	Fault	Bypass
Brg 1Y	Ok	Fault	Bypass	Fault	Bypass
Brg 2X	Ok	Fault	Bypass	Fault	Bypass
Brg 2Y	Ok	Fault	Bypass	Fault	Bypass
Output	True	True	True	False	False

17.3.3 For All (1 and 2 and 3…) Logic Block

The "For All" block performs the logical AND function. All channels in the selected asset group (“With: The Rack”, or “With: Motor A”) are included in this logic. If any channel votes “False” the block will evaluate to “False”.

Table 45: Truth table For All (1 and 2 and 3…) logic block

	Channel Status		
	(All) Alert/Danger	(Any) Fault	(Any) Bypass
Logic block output	True	False*	False

This block performs as follows:

Logical AND function between all channels in the selected asset group. For example:
(1X and 1Y and 2X and 2Y and 3X etc.) All channels must evaluate to ‘True’ for the output of the block to be ’True’.

* Behavior for a channel Fault is configurable.

A Bypassed channel will vote ‘False’.

17.3.3.1 Thrust Channel Example

A common use of the ‘For All’ logic block is a Thrust channel pair voting two-out-of-two (2oo2). **Table 46** shows several possible scenarios of the logic block in **Figure 130**.

Notice that Thrust channels do not have a Fault state. A critical thrust event on a machine may damage the thrust probes; to protect the machine, thrust probes will “Fault to Danger”.

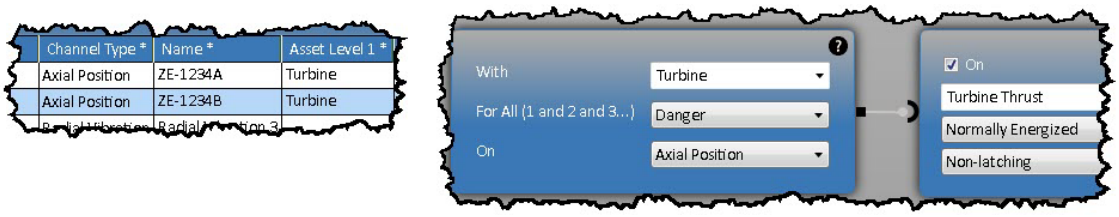


Figure 130: Thrust channel, ‘For All (1 and 2 and 3)’ logic block

Table 46: Thrust channel, ‘For All’ logic block, scenarios

	1	2	3	4	5
Thrust 1A	Danger	Danger	Fault (Danger)	Ok	Bypass
Thrust 1B	Danger	Fault (Danger)	Fault (Danger)	Fault (Danger)	Bypass
Output	True	True	True	False	False

17.3.3.2 For All (1 and 2 and 3…) with Not OK

When Not OK is selected (rather than Alarm, Alert, or Danger) this block will trip the relay when all channels are Not OK. Alert and/or Danger conditions will be ignored. If all channels are bypassed, the relay will not trip.

17.3.4 For Any XY Pair (2oo2 Enforced)

In this block, channels X and Y must be UMM channels 1,2 (or 3,4) and have the same channel type. This is called a channel pair. All paired channels in the selected asset group (“With: The Rack”, or “With: Motor A”) are included in this logic.

Table 47: "For Any XY Pair (2oo2 Enforced)" truth table

Channel A \ Channel B	Danger	Fault	Bypass
Danger	True	False	False
Fault	False	False	False
Bypass	False	False	False

This block performs as follows:

1. Logical AND function between the two channels in the pair. Both channels must vote TRUE for the block to vote TRUE. This is called “2 out of 2 Enforced” voting. For example: (1X and 1Y) where both 1X and 1Y must vote True.
2. Logical OR function between other pairs in the selected asset group. For example: (1X and 1Y) or (2X and 2Y) or (3X and 3Y) or…
3. A Bypassed channel votes ‘False’. For example, If Channel 1X is in Bypass the relay logic ((1X and 1Y) or (2X and 2Y)) will become ((False and 1Y) or (2X and 2Y)).
4. A Faulted channel votes ‘False’. For example, If Channel 1X is in fault (Not OK) the relay logic ((1X and 1Y) or (2X and 2Y)) will become ((False and 1Y) or (2X and 2Y)).

Figure 131: For Any XY Pair (2oo2 Enforced)

This block minimizes false trips because both channels must vote. However, this strategy may increase missed trips because a failed probe votes False. This block is not commonly used. A few scenarios are shown in **Table 48**.

Table 48: ‘For Any XY Pair (2oo2 Enforced)’ scenarios

	1	2	3	4	5
Brg 1X	Danger	Danger	Danger	Danger	Bypass
Brg 1Y	Danger	Bypass	Fault	Ok	Bypass
Brg 2X	Ok	Ok	Ok	Danger	Danger
Brg 2Y	Ok	Ok	Ok	Ok	Ok
Relay Active	True	False	False	False	False

17.3.4.1 For Any XY Pair (2oo2 Enforced) with Not OK

When Not OK is selected (rather than Alarm, Alert, or Danger) this block will trip the relay only when both channels in the XY Pair are Not OK. Alert and/or Danger conditions will be ignored. If one or both channels are bypassed the relay will not trip.

17.3.5 For Any XY Pair (2oo2)

The 'For Any XY Pair (2oo2)' block performs the logical AND functions across the two channels in an XY pair and then the logical OR function across all pairs in the group.

Channels X and Y must be UMM channels 1,2 (or 3,4) and have the same channel type. This is called a channel pair. All paired channels in the selected asset group
("With: The Rack", or "With: Motor A") are included in this logic.

Table 49: "For any XY Pair (2oo2)" truth table

Channel A \ Channel B	Danger	Fault	Bypass
Danger	True	True	True
Fault	True	False	False
Bypass	True	False	False

This block performs as follows:

1. Logical AND function between the two channels in the XY pair. This is called "2 out of 2". For example: (1X and 1Y).
2. Logical OR function between other pairs in the selected asset group. For example: (1X and 1Y) or (2X and 2Y) or (3X and 3Y) or…
3. Bypassed channels are removed from the logic. For example, If Channel 1X is bypassed the relay logic ((1X and 1Y) or (2X and 2Y)) will become ((1Y) or (2X and 2Y)).
4. Faulted channels are removed from the logic. For example, If Channel 1X is faulted the relay logic ((1X and 1Y) or (2X and 2Y)) will become ((1Y) or (2X and 2Y)). If both Channels 1X and 1Y are faulted the relay logic becomes (2X and 2Y).

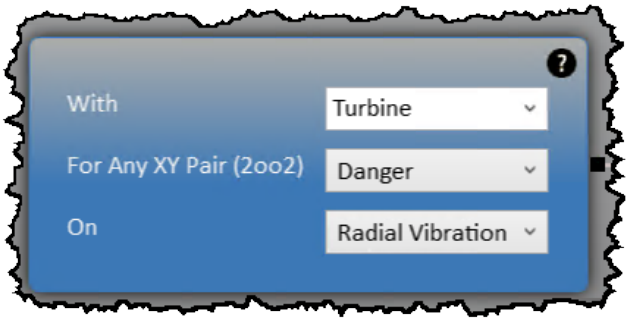


Figure 132: For Any XY Pair (2oo2)

Table 50: 'For Any XY Pair (2oo2)' scenarios

	1	2	3	4	5
Brg 1X	Danger	Danger	Danger	Danger	Bypass
Brg 1Y	Danger	Bypass	Fault	Ok	Bypass
Brg 2X	Ok	Ok	Ok	Danger	Danger
Brg 2Y	Ok	Ok	Ok	Ok	Ok
Relay Active	True	True	True	False	False

17.3.5.1 For Any XY Pair 2oo2 with Not OK

When Not OK is selected (rather than Alarm, Alert, or Danger) this block will trip the relay when both channels in the XY Pair are Not OK. Alert and/or Danger conditions will be ignored. A bypassed channel is removed from the logic and 2oo2 voting will fall to 1oo1. If both channels are bypassed the relay will not trip.

17.3.6 Recip Adjacent Segments Logic Block

The 'Recip Adjacent Segments' block alarms when the configured number of **adjacent** segments are in alarm for the configured number of **sequential** revolutions.

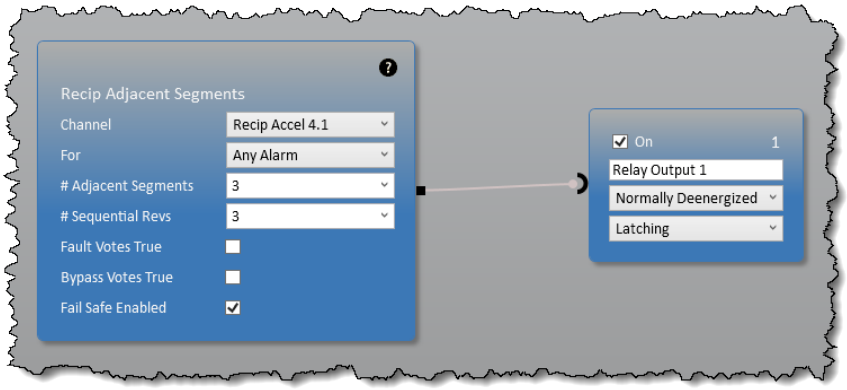


Figure 133: Recip Adjacent Segments

Table 51: Example with 3 Adjacent Segments, and 3 Sequential Revolutions

	Example 1	Example 2	Example 3	Example 4	Example 5
Revolution 1	35,36,1	1,2,3	1,2,3,4,5	1,2,3	1,2,3,4
Revolution 2	35,36,1	1,2,3,4	2,3,4,5	1,2,3	2,3,4
Revolution 3	35,36,1	1,2,3,5	2,3,4	2,3,4	1,2,3
Block Votes	TRUE	TRUE	TRUE	FALSE	FALSE

17.3.6.1 Recip Adjacent Segments with Fail Safe Enabled

A valid phase trigger is required to determine recip segments. When Fail Safe is enabled, a faulted Phase Trigger will cause the logic to ignore segment alarms and evaluate the channel status based on the alarm settings of the Direct measurement. This allows the machine to still have protection when the phase trigger is faulted.

17.4 Using Channel Input Blocks

17.4.1 Channel Input with 'Or'

Channel Input blocks (**Figure 134**) allow you to select the channel, measurement, and alarm status to apply to Boolean logic. To connect the blocks, select the black square and drag the mouse over to the input socket on the next block.

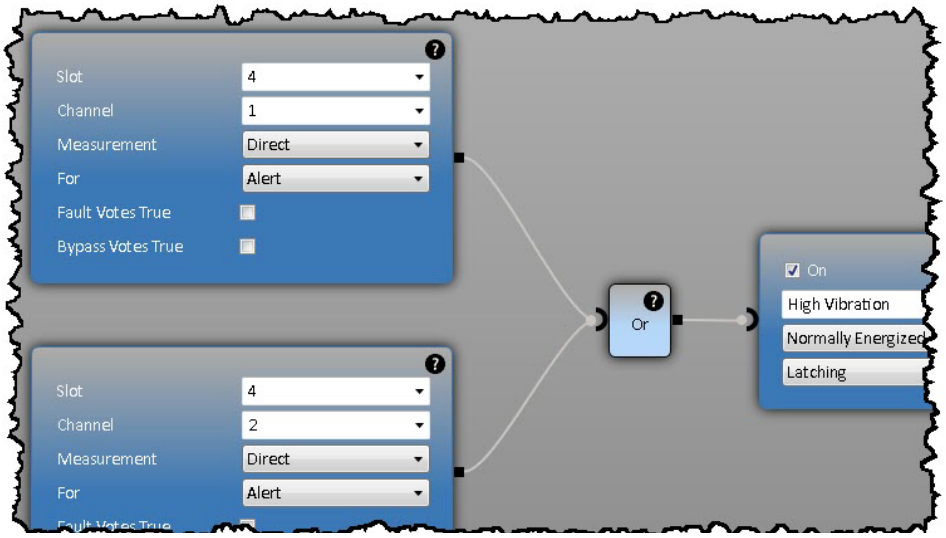


Figure 134: Channel Input block (or logic)

Table 52 shows an example that requires one channel to be in Alert before the relay will trip.

Table 52: 'Channel Input' block, 'Or' logic

		1	2	3	4	5
Or	Channel 1	Alert	Fault	Bypass	Fault	Bypass
	Channel 2	Ok	Ok	Ok	Fault	Bypass
	Relay Active	True	False	False	False	False

Checking the 'Fault Votes True' checkbox causes the block to evaluate to True when the channel is faulted (See **Table 53**). This scenario increases the potential for false trips; Use this selection with caution.

Table 53: 'Channel Input' block, 'Or' logic, Fault Votes True

		1	2	3	4	5
Or	Channel 1	Alert	Fault	Bypass	Fault	Bypass
	Channel 2	Ok	Ok	Ok	Fault	Bypass
	Relay Active	True	True	False	True	False

The 'Bypass Votes True' option causes the block to evaluate to True when the signal channel is bypassed. This option is not recommended. See section 6.6 Use Channel Bypass Appropriately.

17.4.2 Channel Input with ‘And’

Below are examples of the Channel Input block combined with ‘And’ logic (**Figure 135**).

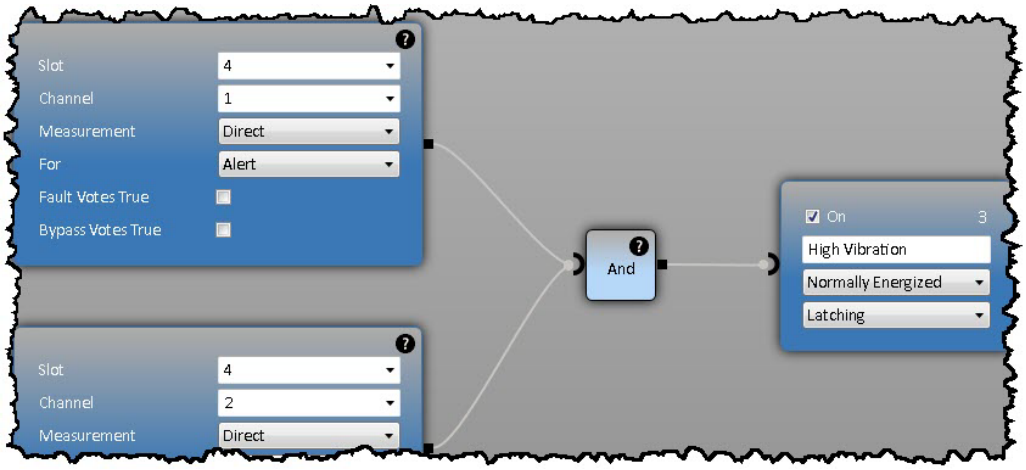


Figure 135: Channel Input block (And logic)

Table 54 shows an example that requires two channels to be in Alert before the relay will trip. This scenario minimizes false trips but may increase missed trips.

Table 54: ‘Channel Input’ block, ‘And’ Logic

		1	2	3	4	5	6
And	Channel 1	Alert	Alert	Alert	Alert	Bypass	Fault
	Channel 2	Alert	Ok	Fault	Bypass	Bypass	Fault
	Relay Active	True	False	False	False	False	False

Table 55 shows the same scenario but with ‘Faults Vote True’ selected. This scenario increases the potential for false trips (two faults will trip the relay).

Table 55: ‘Channel Input’ block, ‘And’, Fault Votes True

		1	2	3	4	5	6
And	Channel 1	Alert	Alert	Alert	Alert	Bypass	Fault
	Channel 2	Alert	Ok	Fault	Bypass	Bypass	Fault
	Relay Active	True	False	True	False	False	True

The ‘Bypass Votes True’ option causes the block to evaluate to True when the signal channel is bypassed. This option is not recommended. See section 6.6 Use Channel Bypass Appropriately.

Note

For firmware older than 4.X revision, leave the Measurement field at the default value of “ALL”.

17.4.3 Channel Input with 'Not'

The Not logic block inverts the input from True to False (or vice-versa). This block can only have a single input.

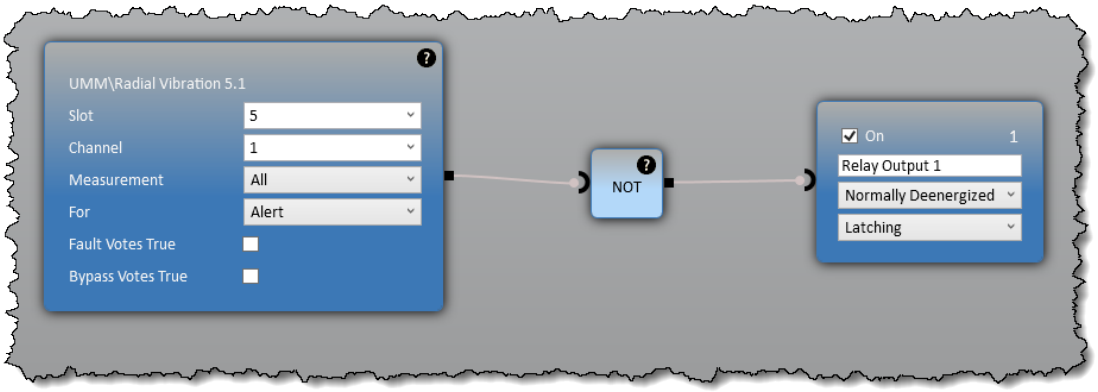


Figure 136: Channel Input Block (Not logic)

Table 56: 'Channel Input' block, 'Not' Logic (See **Figure 136**)

Slot 5 Channel 1 Status	Alert	Bypass	Fault
Relay Active	False	True	True

Note
The "Not" logic block is only available in 7.10.X firmware and later.

17.5 Using Shared Input/Output Blocks

Shared Input and Shared Output blocks allow complex relay logic to be split across multiple monitors and provides precise control of the group lines consumed (see section 4.3).

Note
The Shared Input/Output blocks are only available in 7.10.X firmware and later.

17.5.1 Shared Output

Use a Shared Output block to make your relay logic available to other monitors (see **Figure 137**). A named group line is required (see section 17.5.3)

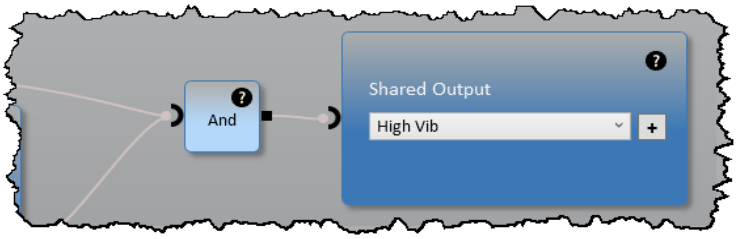


Figure 137: Shared Output Block

Two or more Shared Outputs can use the same named group line. In this case, the behavior will act as an OR gate. If any Shared Output results in a logic True, the corresponding Shared Input will be True.

17.5.2 Shared Input

Use a Shared Input block to bring relay logic from a different monitor (i.e. UMM 5) into a new monitor (i.e. UMM 6); A named group is required (see section 17.5.3).

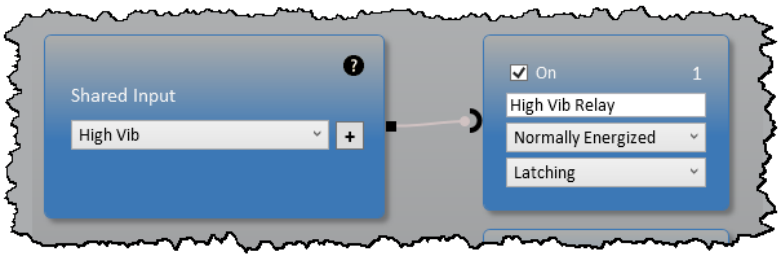


Figure 138: Shared Input Block

Multiple monitors (i.e. UMM 6, UMM 7) can use the same Shared Input (i.e. from UMM 5). This allows redundant relays to be driven by the same logic.

17.5.3 Naming Group Lines

Shared Input and Shared Output blocks require a named group line. To create a named group line:

- Add a Shared Input (or Output) block.
- Select the + button.
- Enter a name for the group line.
- Select the check box to commit the name.

All named group lines are available in the drop-down list. If a group line name needs to be edited, create a new name with the corrected spelling. Unused names will be automatically removed.

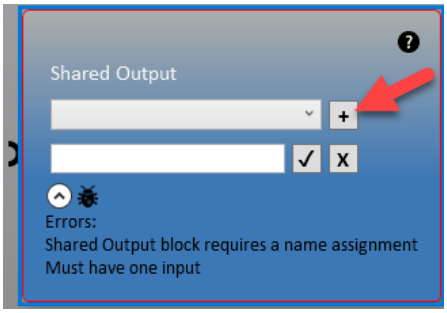


Figure 139: Add a named Group Line

17.6 True And Logic, vs. Normal And Logic

Tere are two types of AND voting. There is forced voting (sometimes called “True And”) and there is normal voting (called “Normal And”). The method you use will depend on how you want to treat faulted sensors.

When ‘Normal And’ voting is used, a bad channel is removed from the equation. For example “Brg 1X AND Brg 1Y” becomes “Brg 1X”, when Brg 1Y is bad. Or in other words 2oo2 logic will revert to 1oo1 logic when a channel faults. Further, if all sensors are bad, the logic will never be TRUE.

Forced voting (True And) requires all inputs to vote. If a channel is faulted it votes FALSE, and the logic is essentially locked. For example, three sensors could be voting TRUE (high vibration!) but since the fourth sensor is bad, it cannot see the high vibration and it continues to vote FALSE.

Users who prefer “Normal And” have a slightly higher tolerance for false trips (i.e. I will trip on just one sensor, if the other sensor is bad). Users who prefer “True And” have a slightly higher tolerance for missed trips (i.e. I will only trip if every sensor is working!)

Most AND logic in the VC-8000 uses True And (forced voting) (see **Table 57**).

Table 57: AND Logic blocks

Logic Blocks with AND voting	True And (Forced)	Normal And
For All (1 and 2 and 3…)	X	
For Any XY Pair (2002)		X
For Any XY Pair (2oo2 Enforced)	X	
And block	X	

However, many of the relay logic blocks allow the user to enable the feature “Fault Votes True”. This can cause confusion, and needs to be used carefully.

17.6.1 Fault Votes True (AND Logic)

Some logic blocks have an option for “Fault Votes True”. This can be useful with AND logic, because the bad channel does not “freeze” the logic (see 17.6).

One drawback of this option occurs when all of the input channels are bad, the logic evaluates to TRUE, and a machine trip occurs.

Using a “For All” block evaluating Not Ok (fault) status, combined with a “Not” block (see **Figure 140**) prevents the false trip from occurring. The effect on the relay logic is shown in .

Using “Fault Votes True” and adding the “For All” and “Not” blocks essentially changes the “True And” logic (where a faulted channel vote FALSE) into a “Normal And” expression (where a faulted channel is removed from the logic).

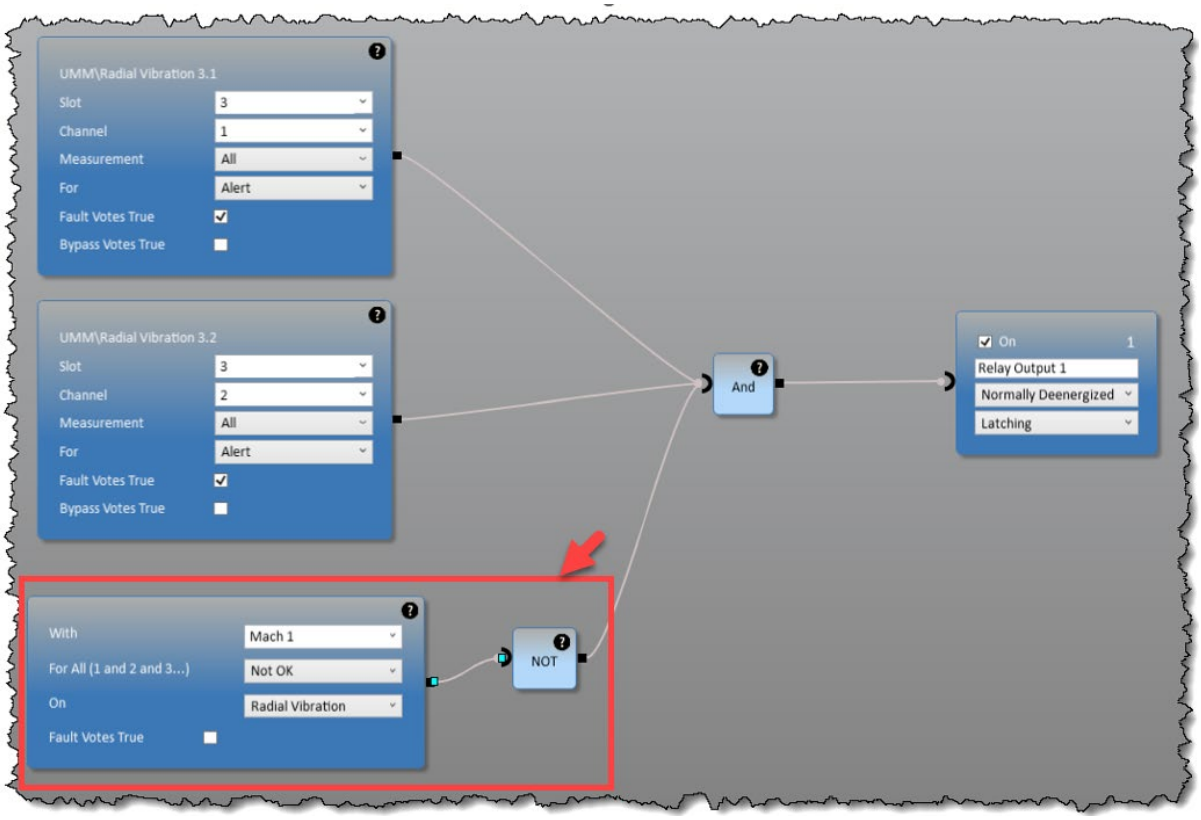


Figure 140: Using a “For All”, with a “Not” block (all sensors faulted example)

Notice that the “For All” block is evaluating the Asset Group identified as “Mach 1”, In this example the group “Mach 1” contains the same two channels (Slot 3 Channel 1 and Slot 3 Channel 2).

Table 58: Using a “For All” with a “Not” block (see **Figure 140**)

Without “For All”, and “Not" blocks

Channel A \ Channel B	Danger	Fault
Danger	True	True
Fault	True	True

Using “For All”, and “Not” blocks

Channel A \ Channel B	Danger	Fault
Danger	True	True
Fault	True	False

17.7 Additional Configuration Information

17.7.1 Deleting a Block

To delete a block, select the block and select delete on your keyboard.

To delete a connector, select the connector at the input to the block and select delete on your keyboard.

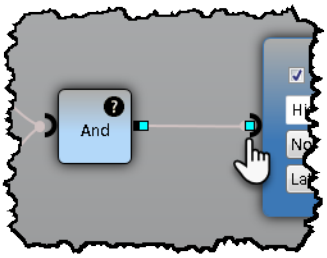


Figure 141: Delete connector

17.7.2 Configuring DPDT Pairs

Sometimes it is necessary to trip two relays instead of one. To trip two relays, simply connect a second relay to the logic output as shown in **Figure 142**. This simulates a Double-Pole, Double-Throw (DPDT) relay output by driving two Single-Pole, Double-Throw relays from the same logic output.

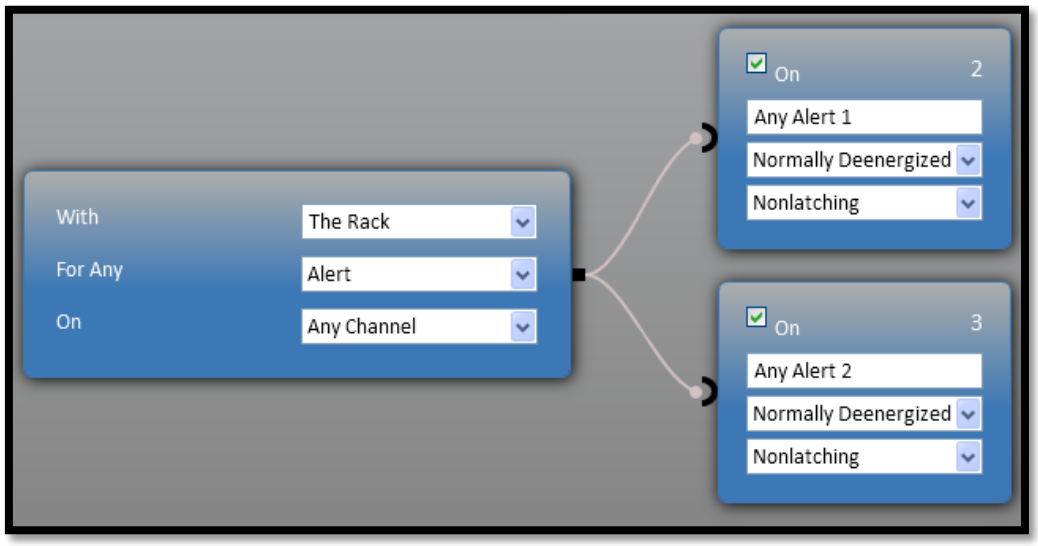


Figure 142: DPDT configuration

17.7.3 Group Line Limitation

The VC-8000 system originally had 16 “group lines” that provide voting across multiple monitors. Updated hardware and firmware can provide up to 25 “group lines”. Please see section 4.3 for more information.

17.7.4 Viewing the Summary

To see a summary chart of the relay configuration, select Summary from the view drop list as shown in **Figure 143**.

Figure 143: Relay Summary view

18 Configuring – Analog Outputs Tab

Use the settings on the Analog Output tab to specify which measurements (from that module) will be sent to the 4-20 mA connector on the UMM (or TMM).

Any measurement (Gap, or 1X) can be assigned as the output to the analog output channel. The Direct measurement is set as the output by default.

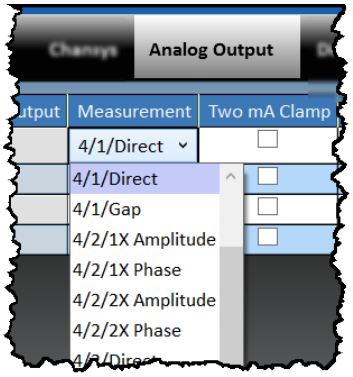


Figure 144:
Analog Output tab

19 Configuring – Asset Display Order Tab

The order of channels and groups is set in two locations.
The order of groups is set from the Asset Display Order tab (see figure below). The order of channels (within groups) is set from the Channels tab (Summary view). See more on setting Asset (group) names in section 12.2.3.1.

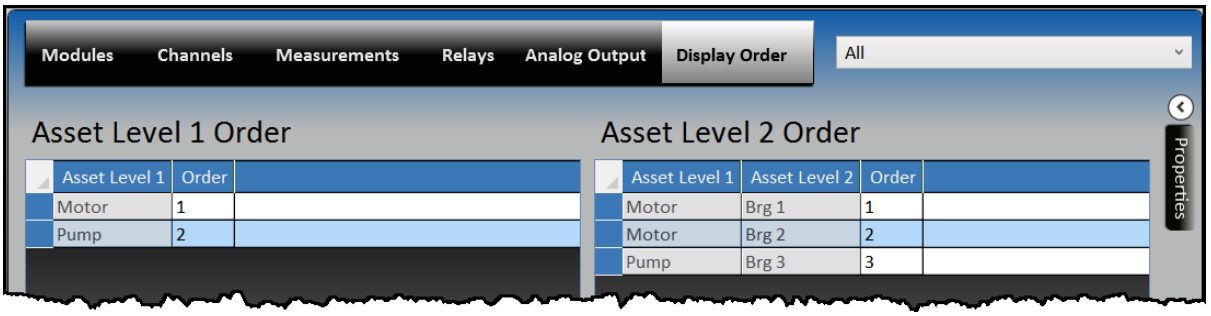


Figure 145: Asset Display Order tab

20 Configuring – Examples

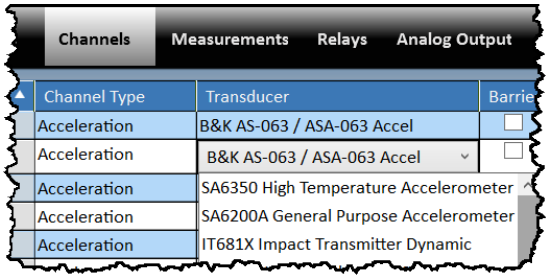
This section contains examples of commonly used channel types, and how they can be configured.

20.1 Acceleration

Use the Channels tab and the Summary view to configure channels. Select the Channel Type and then select the Transducer.

Change to the Customize Transducer view to verify the correct Scale Factor, Units, and Transducer Power setting.

The OK limits will be set according to the transducer you selected. They can be modified if needed.



20.2 Axial Position (Thrust)

Use the Channels tab and the Summary view to configure channels. Select the Channel Type and then select the Transducer.

Change to the Customize Transducer view to verify the correct Scale Factor, Units, and Transducer Power setting.

The OK limits will be set according to the transducer you selected. They can be modified if needed.

The Position view provides configuration of parameters specific to Axial Position (or Thrust), Eccentricity, Rod Drop, and Differential Expansion measurements.

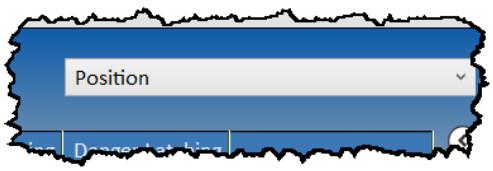


Figure 146: Position view (i.e. Thrust Channels)

20.2.1 Zero Position

For Axial Position measurements the zero position is typically the center of the thrust float zone. The Axial Position alarm levels are set in reference to the zero position.

For Differential Expansion measurements, this is the distance between the rotating and stationary parts when at a known temperature. Long and Short Rotor measurement alarms are set in reference to a change from the zero position.

20.2.2 Upscale (Normal) Direction

The setting “Upscale Direction” specifies the normal (or expected) thrust direction (5).
In **Figure 147** the setting would be Upscale Direction = “Away from probe”.

Axial shaft movement is predictable. Machine pressures and/or processes continuously push the shaft the normal (or expected) direction (5).

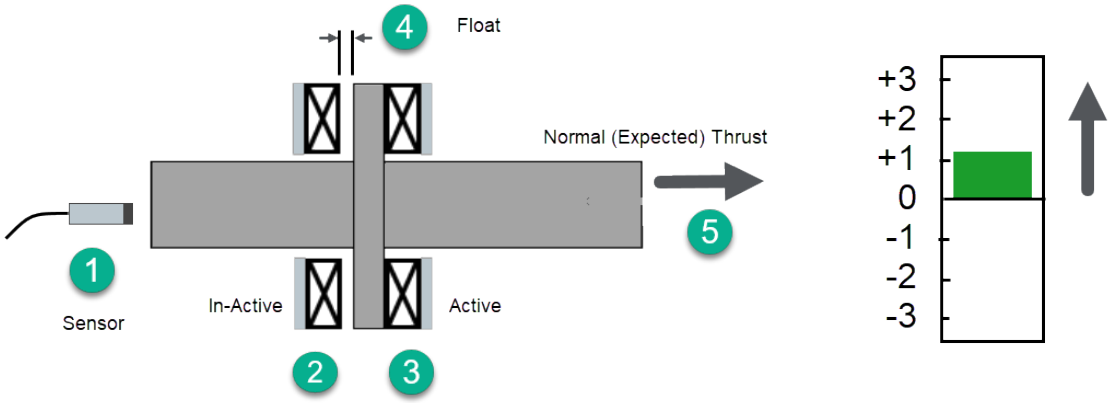


Figure 147: Axial Position

The protection system detects movement at the location (1) where the sensor is installed. But since the sensor could be installed on either side of the machine – we need to specify if the normal movement is “towards” or “away from” the sensor.

20.2.3 Fault Mode

A Thrust channel will not disable alarming (or measurements) in a fault condition. This is a safety condition to guarantee an alarm during a thrust event that destroys the sensor or if the thrust value has exceed the linear range and OK limits of the sensor. The Fault Mode for Thrust channels should always be set to Non-latching Fault.

20.3 Phase Trigger

The following settings apply specifically to Phase Trigger Channels. These are set on the Channels tab, with the Phase Trigger (and Speed) view selected.

20.3.1 Direction of Rotation

Set the direction of rotation (Clockwise or Counter Clockwise). Direction of rotation does not affect signal processing; this parameter is used in the CMS software. Direction of rotation is typically determined when viewing the shaft from the driver looking towards the load.

20.3.2 Event Ratio

Event Ratio is the number of trigger pulses per shaft revolution. For a true phase trigger (with an absolute phase reference), the event ratio must be 1.

For a probe observing gear teeth, the event ratio is the number of teeth. The Event Ratio can be set to non-integer values (i.e. multiple gears between the transducer and the shaft).

When a multi-toothed gear is used for a phase trigger, there is no absolute phase reference. The VC-8000 may know that there are 52 teeth (for example) but it cannot isolate to a single tooth; it is just a string of pulses. When the machine starts and the events (pulses) start to come into the rack, the VC-8000 will select one as a reference. On the next startup, one pulse (out of 52) will be selected as the reference pulse for that run. Phase comparisons between runs will not be meaningful.

For example, if the machine speed is 3,600 rpm and the event ratio is 40, the expected signal frequency (at running speed) will be 2,400 Hz.

Note

The maximum signal frequency that can be detected is 20,000 Hz or 100,000 RPM, whichever is lower based on the configured EPR.

20.3.3 Auto Threshold and Hysteresis

Auto threshold measures the peak-to-peak phase trigger signal and sets the threshold at the midpoint. The auto threshold value is updated each revolution. Auto Threshold is the most typical setting and normally works just fine.

Hysteresis is a dead-band region (centered on the threshold) that provides noise immunity. Half of the hysteresis is applied above the threshold and half below. The default hysteresis value of 2.0 Vdc is great for most applications.

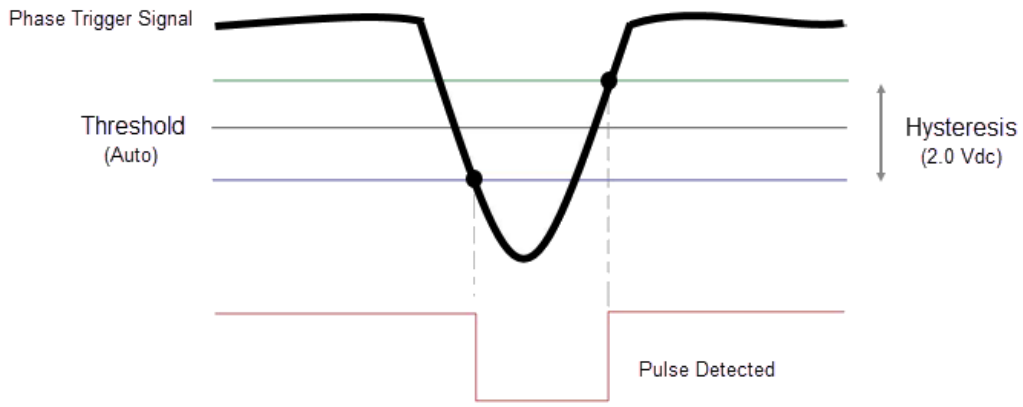


Figure 148: Detecting a phase trigger pulse

20.3.4 Threshold (manual)

If the phase trigger is not triggering correctly, you may have to set the threshold manually. You will need an oscillosope (or CMS data) to observe the behavior and range of the signal, and then you can correclty set a manual threshold.

The configured threshold specifies the center of the triggering region as shown in **Figure 148**. Typically, this is set at the midpoint of the signal pulse.

When Auto Threshold is enabled, the manual threshold value is ignored.

20.3.5 Trigger Type

Setting the triggering to “Notch” causes the Phase Trigger event to occur on a falling sensor signal. Setting the triggering to “Projection” causes the Phase Trigger event to occur on a rising sensor signal.

20.3.6 Phase Trigger Installation

Use caution when installing the Phase Trigger sensor. The probe’s surface target (on the shaft) must be known. Is the probe currently viewing a notch, a projection, or a portion of the notch and a portion of the shaft (50/50)? The Gap voltage will vary greatly depending on the probe’s surface target during the installation process.

20.4 Process Variable Channels

Use this view to configure process variable measurements.

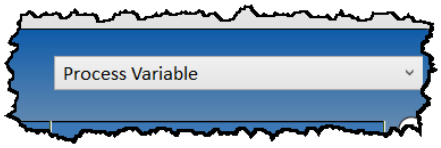


Figure 149:
Process Variable Channels

For process variable channels the top scale, bottom scale, and units are set in two locations.

- First, set the scaling in the Process Variable view (Channels tab). This is the input scaling. For example, 4 to 20 mA = 0 to 150 deg C.
- Second, set the display scaling and units on the Measurements tab. Make sure the units match in both locations.

An error will be shown if there is a problem with the scaling or the units (see **Figure 150**).

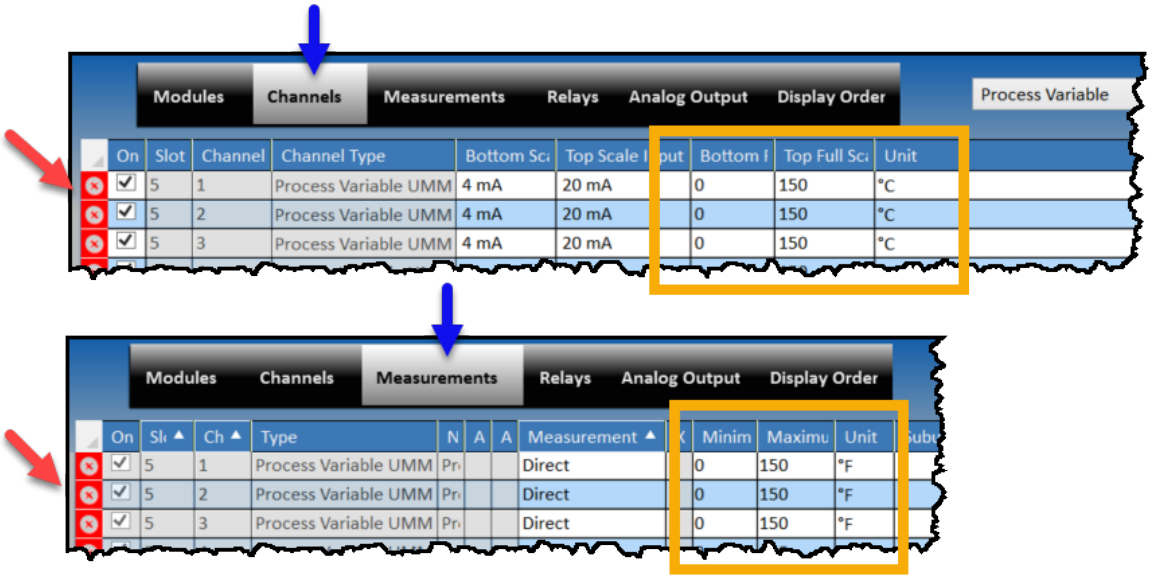


Figure 150: Process Variable Channels with mismatched units error

20.5 Radial Vibration

Use the Channels tab and the Summary view to configure channels. Select the Channel Type and then select the Transducer.

Change to the Customize Transducer view to verify the correct Scale Factor, Units, and Transducer Power setting.

The OK limits will be set according to the transducer you selected. They can be modified if needed.

20.6 Temperature Channels

Use this view to configure temperature channels.

Figure 151: Temperature Channels

20.6.1 Transducer Power

Select whether the connected sensor is a Thermocouple, RTD (2, 3, or 4 wire) or Process Variable transmitter. The TMM will switch the inputs according to the transducer power to provide the correct sensor excitation.

Transducer Power	Description
2. 2-Wire RTD 3. 3-Wire RTD 4. 4-Wire RTD	Provides power for the selected RTD.
Thermocouple (Isolated)	For isolated thermocouple sensors. This setting includes a bias voltage used for fault detection.
Grounded Tip Thermocouple	For grounded tip thermocouples. This option turns off the bias voltage (fault detection) as it can interfere with temperature readings from grounded tip sensors. Set Fault Mode to Latching to prevent repeating faults from saturating the event list.
Process Variable	This setting allows the TMM to read 4-20 mA through a 68-ohm resistor. *Wiring mistakes will damage the TMM*. Please use a UMM Process Variable channel instead. It is a more robust solution.

Important

Brüel & Kjær Vibro recommends *isolated* tip thermocouples.

Isolated tip thermocouples have fault detection (bias voltage); Grounded tip thermocouples do not. Set the Fault Mode to “Latching” when using grounded tip thermocouples.

20.7 Velocity

Use the Channels tab and the Summary view to configure channels. Select the Channel Type and then select the Transducer.

Change to the Customize Transducer view to verify the correct Scale Factor, Units, and Transducer Power setting.

The OK limits will be set according to the transducer you selected. They can be modified if needed.

21 Configuring – Modbus

The SAM module has two ports for Modbus communication. The most commonly used port is the Modbus TCP (Ethernet). The SAM also provides a serial Modbus RTU port.

The Modbus Serial port uses the RJ-45 jack for convenience only. This port is NOT an Ethernet port.

A standard Modbus map is provided and will meet most applications. A custom register map can be created if needed (see following paragraphs).

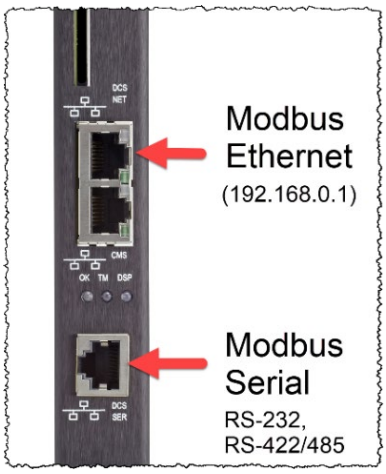


Figure 152: Modbus Connections

21.1 Modbus Ethernet Connection

To use the Modbus Ethernet port, you must:

- Enable Modbus Ethernet
- Set the IP address of the SAM

Access these settings from the Modules tab. Select the SAM, and then open the Properties pane.

The VC-8000 uses a static IP address.
DHCP is not supported.

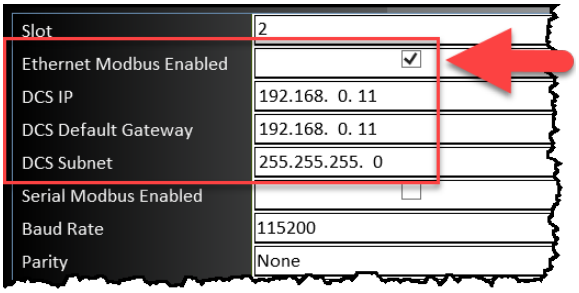


Figure 153: Modbus Ethernet

21.2 Serial Modbus Connection

To use the Modbus Serial port, you must:

- Enable Serial Modbus
- Set communication parameters
- Select the format (RS-232/485 etc.)

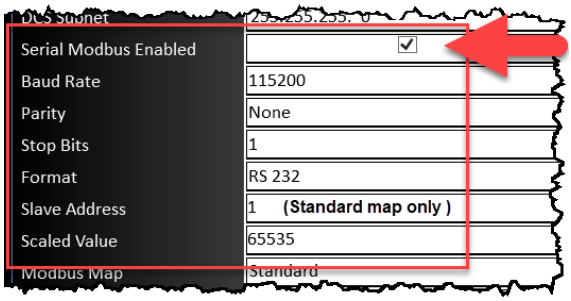


Figure 154: Modbus Serial

21.3 Modbus Settings

21.3.1 Slave Address

The Slave Address (shown in SAM settings) is only used for the standard (default) Modbus map. This setting is ignored when a custom Modbus map is used. In a custom Modbus map, the slave address is set in the excel file (imported map) (see section 21.5).

If you are doing a rack replacement (i.e. one VC-8000 replacing two BN 3300 racks) you can use multiple Modbus slave addresses in the custom Modbus map. This will allow the customer to install the new VC-8000 without reprogramming the DCS Modbus program.

21.3.2 Scaled Value

Scaled Value sets the full-scale data range for Modbus data.

Table 59: Modbus Scaled Values

Scaled Value	Bits	Application
4095	12	Compatibility with BN 3300 (i.e. 0-4095 is 0-10 mils)
65535	16	16-bit DCS systems (i.e. 0-65535 is 0-10 mils)

21.3.3 Modbus Map (Standard or Custom)

This value indicates whether the SAM is using the standard (or default) Modbus map, or a custom Modbus map.

Important

Custom Modbus maps use the Modbus address in the excel file; The Modbus address shown in SAM properties is ignored.

Custom Modbus maps are not allowed if a redundant SAM is configured and either SAM is using a Serial Modbus connection.

21.3.4 Communications Fault - Time Delay

If the SAM does not receive a valid Modbus command within the configured time, the SAM will indicate a Modbus error and log a failure event in the System Event list.
Communications Fault Time Delay applies to both Ethernet and Serial Modbus connections.

21.3.5 Word Order

Controls the word order of the Modbus data (a word is 16 bits).

Not-Swapped: The lower (least significant) word is placed in the lower register
Swapped: The higher (most significant) word is placed in the lower register

21.3.6 Allow Invalid Address

Use with caution. When Allow Invalid Address is checked, requests for a register with an undefined address will not generate a Modbus error; Undefined registers will return a value of zero. When not enabled, the SAM follows the Modbus standard and returns an error response when a command addresses an undefined register.

This setting can be useful in a rack replacement scenario – where the end user does not want to modify the DCS Modbus program. The DCS can request registers that are not in the VC-8000, and the rack will simply return a value of zero for those registers.

21.3.7 Allow Status Register Writes

Enables Modbus write commands. When disabled, the SAM will return an exception when a write register command is attempted.

21.4 The Standard (or Default) Modbus Map

When a user creates a rack configuration a standard (or default) Modbus map is created. The map is based on the active channels (once configuration is ended), as well as their slot and channel position in the rack.

If a new module is added, or a new channel is activated, the standard (or default) map is updated automatically. When the new configuration is Sent, the new configuration will include the updated standard Modbus map.

The register assignments in the standard map may not be convenient; for example, if the registers are spread out and it is difficult to use block read commands. In this case, a custom map may be preferred.

21.4.1 View (Export) the Modbus Map

To export the Modbus map (.csv), select File, Export Modbus Map. You can then view the map in Excel.

The columns headers in the exported map are as follows:

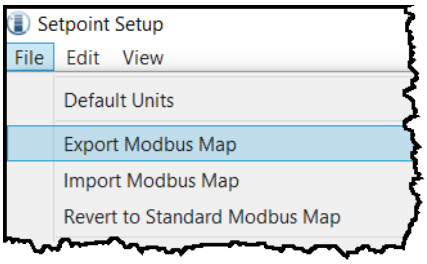


Figure 155:
Export Modbus Map

Table 60: Modbus spreadsheet column headers

Column	Description
Slave Id	The identification of the Modbus passive device.
Address	The data starting register address.
Bit	The bit number within a word (or 1 for non-packed statuses).
Group	Rack, Channel, or Measurement
Value	The returned value.
Slot	The rack slot number providing the data.
Channel	The rack channel number providing the data.
Measurement Name	The measurement name (i.e. Direct, Gap, 1X).
Channel Name	The user assigned channel name / tag (i.e. Brg 1X)
Asset 1	The user assigned Asset 1 name.
Asset 2	The user assigned Asset 2 name.
Data Format	The register data format. See Table 62.
Unit	Engineering units (measurements only)
Subunits	Subunits (measurements only)
Minimum	The bottom scale value (measurements only)
Maximum	The top, full scale value (measurements only)

21.5 Create a Custom Modbus Map

Creating a custom Modbus map is not complex. Custom maps allow the user to place the data into sequential registers and use block read commands in the DCS program. A custom map also allows the user to exactly replicate the map of an existing system you are going to replace with a VC-8000. Follow these steps to create a custom Modbus Map.

1. **Finish your MPS configuration and Export the Standard Map**
   Your MPS configuration will need to be completed before you export the map. Start with the standard map. Open (or upload) your MPS configuration and select File, Export Modbus Map.

2. **Modify the Standard Map in Excel**
   Open the file in Microsoft Excel. Delete unwanted rows (only rows). Do not change the order of columns or the column headers. Do not delete columns.
   Change the register and bit addresses as needed. Remember that the VC-8000 register addresses use 6 digits; so, register 30001 will be written as 300001.
   Save the file as a CSV (Comma delimited) file.

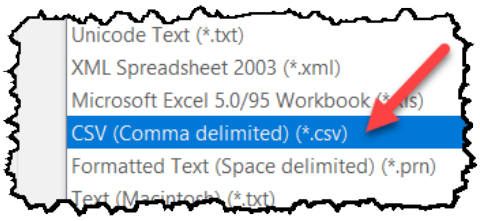


Figure 156:
Save file as .CSV

Common Mistake

VC-8000 register addresses are written using 6 digits. Register 30001 will be written as 300001. Or in other words function (3) register (00001).

3. **Import the .CSV file into the configuration file**
   First, open (or upload) your MPS configuration file. Then import the new Modbus map (File, Import) into the configuration file. The custom map is now integrated into your computer (software) – but is not yet in VC-8000.
   If there are no errors, the software will display “Modbus Map imported successfully”. If there are errors, the dialog will show the spreadsheet rows that contain the errors.

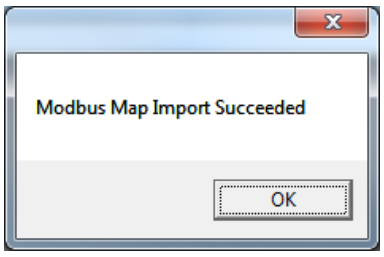


Figure 157:
Import succeeded

4. **SEND the new configuration file to the rack**
   You must SEND the configuration to update the rack with the new Modbus map.

Common Mistake

The Modbus map is part of the rack configuration file. You must SEND the configuration file to the rack after you import the map.

Caution

Custom Modbus maps are not allowed is there are redundant SAMs configured in the rack using MODBUS RTU.

21.5.1 Reverting Back to the Standard Map

If you decide not to use the custom Modbus Map (or you just want to start over) you can revert to the original standard map:

- Open (or GET) the current rack configuration file.
- Select File, then select Revert to Standard Modbus Map.
- SEND the configuration file (with the revised map) to the rack.

21.6 Modbus Functions

The following Modbus functions are supported in the VC-8000.

Table 61: Modbus Functions

Code	Name
01	Read Coils (Read Coil Status)
02	Read Discrete Inputs (Read Input Status)
03	Read Multiple Registers (Read Holding Registers)
04	Read Input Registers
07	Read Exception Status
15	Force Multiple Coils
16	Write Multiple Registers (Preset Multiple Registers)
22	Mask Write Register
23	Read/Write Registers

21.6.1 Read Relay Channel Status Registers

You can read the relay channel status. There is no ‘Valid’ or ‘Fault’ status bit for relay channels. If there is a hardware problem with a relay channel, the rack Not OK relay will trip.

Register Type	Data Format	Typical
Channel Relay	1 = Active 0 = Inactive	X

Currently the VC-8000 Modbus function does not include a status bit for the Bypass status of the relay channel.

21.6.2 Read Channel (or Measurement) Status Registers

You can read alarm status at the Channel level, or the Measurement level.

Channel status reports the overall status of the channel. Measurement status reports the individual status of each measurement. For example, a Radial Vibration channel has six individual measurements (Direct, Gap, 1X Amplitude, etc.). Normally, you will only read the (overall) Channel status.

Most customer sites only read a few of the registers that are available. **Table 62** shows that users typically will read Fault, Alert, and Danger status at the Channel level; The other registers do not get used as much.

Table 62: Channel and Measurement status

Register Description	Data Format		Typical
Channel (Data) Valid	1 = Valid	0 = Invalid	
Channel Fault	1 = Fault	0 = No Fault	X
Channel Alert	1 = Alert	0 = No Alert	X
Channel Danger	1 = Danger	0 = No Danger	X
Channel Trip Multiply	1 = TM Active	0 = TM Inactive	
Channel Bypass	1 = Bypassed	0 = Not Bypassed	
Measurement Valid	1 = Valid	0 = Invalid	
Measurement Alert	1 = Alert	0 = No Alert	
Measurement Danger	1 = Danger	0 = No Danger	

Measurement status registers are rarely used. But here is an example to explain the difference between Channel status and Measurement status.

Example: Brg 1X Radial Vibration channel has alarms configured for the Direct, 1X Amplitude, and 2X Amplitude measurements. **Table 63** shows a scenario where the Direct Measurement is in Alert, and the 1X Amplitude Measurement is in Danger. The Channel status will follow the highest measurement status.

Table 63: Channel and Measurement status example

	Measurement Registers		Channel Registers	
Measurement	**Alert Status**	**Danger Status**	**Alert Status**	**Danger Status**
Direct	1	0	1	1
1X Amplitude	1	1		
2X Amplitude	0	0		

21.6.3 Read Rack Status Registers

Rack status registers are shown below. Most customer sites only read a few of the registers that are available. The registers that are typically used are shown in the table below.

Register Description	Data Format (1 = Active, 0 = Not Active)	Typical
Rack Reset	Write a 1 to reset the rack	X
Rack Inhibit	Rack Inhibit status This register is writeable. Write a 1 to enable Rack Inhibit. Write a 0 to disable Rack Inhibit	X
Rack Trip Multiply	Trip Multiply status This register is writeable. Write a 1 to enable Trip Multiply. Write a 0 to disable Trip Multiply.	
Rack OK	1 = Not OK 0 = OK	X
Rack Power 2	1 = Active 0 = In Fault	X
Rack Power 1	1 = Active 0 = In Fault	X
Rack Special Alarm Inhibit	Special Alarm Inhibit status This register is writeable. Write a 1 to enable. Write a 0 to disable.	
SD Card Present	SD card is present in the rack	
SD Card Locked 	SD card is locked (the tab on the SD card)	
SD Card Failed	1 = Card Failed 0 = Card OK	
SD Card Busy	1 = Card Busy (data being written) 0 = Not Busy	
SD Card Full	1 = Card Full 0 = Not Full	
Front Panel Communication Failure	Don't use	

21.6.4 Read System Status Registers

The System registers are for customers using the SETPOINT PI/XC Adapter and the CMS software. The register that is commonly used is “Adapter Overall”.

There are two groups of System status registers. The first group indicates a “Data Link Fault”. The second group indicates “Full”

21.6.4.1 Data Link Fault

The registers can be used to notify operations of a fault in the CMS system. Typically, only the ‘Adapter Overall’ status would be used by the customer.

Register Description	Data Format	Typical
Adapter Overall	SETPOINT PI/XC Adapter not communicating (general)	X
Rack to Adapter	PI/XC Adapter not communicating to rack	
AF to Adapter	PI/XC Adapter not communicating to AF Server	
Backup (XC)	XC Data is not being saved	
SD Card	SD card is not storing data	
HD	HD Memory is not storing data	
Modbus	Modbus data is not being read	

21.6.4.2 Full

The registers can be used to notify operations of a fault in the CMS system.

Register Description	Data Format	Typical
Adapter Overall	Don’t use	
Rack to Adapter	Don’t use	
AF to Adapter	Don’t use	
Backup	XC hard drive is full	
SD Card	SD Card is full	
HD	HD (SAM) is full	
Modbus	Don’t use	

21.6.5 Bit Packing (Status) into 16 bit Registers

If needed, the status bits can be packed into 16-bit registers. These registers would then be accessed via the Holding registers (4x) or the Input registers (3x).

The standard map only uses coil or discrete input address range and Bit is always set to “1”.

	A	B	C	D	E	F	G	H	I	J
1	Slave I	Address	Bit	Group	Value	Slot	Chan	Measurement Na	Channel N	Data Format
2	1	100001	1	Channel	Channel Valid	3	1	Direct	Brg 1X	1 = Valid : 0 = Invalid
3	1	100002	1	Channel	Channel Valid	3	2	Direct	Brg 1Y	1 = Valid : 0 = Invalid
4	1	100085	1	Channel	Channel Fault	3	1	Direct	Brg 1X	Fault
5	1	100086	1	Channel	Channel Fault	3	2	Direct	Brg 1Y	Fault
6	1	100169	1	Channel	Channel Alert	3	1	Direct	Brg 1X	Alert
7	1	100170	1	Channel	Channel Alert	3	2	Direct	Brg 1Y	Alert
8	1	100253	1	Channel	Channel Danger	3	1	Direct	Brg 1X	Danger
9	1	100254	1	Channel	Channel Danger	3	2	Direct	Brg 1Y	Danger
10	1	100337	1	Channel	Channel Trip Multiply	3	1	Direct	Brg 1X	Trip Multiply
11	1	100338	1	Channel	Channel Trip Multiply	3	2	Direct	Brg 1Y	Trip Multiply
12	1	100421	1	Channel	Channel Bypass	3	1	Direct	Brg 1X	1 = Bypassed : 0 = Not By

Figure 158: Address and bit settings for individual status registers

To create a register with packed status bits.

- Copy the status registers (rows) in the Modbus map to the 3x or 4x register section
- Enter the new register address (i.e. 30501)
- Enter the new Bit field 1 thru 16

	A	B	C	D	E	F	G	H	I	J	K
1	Slave	Address	Bit	Group	Value	Slot	Chan	Measuren	Channel Na	Data Format	Unit
2	1	320501	1	Channel	Channel Valid	3	1	Direct	Brg 1X	1 = Valid : 0 = Invalid	
3	1	320501	2	Channel	Channel Fault	3	1	Direct	Brg 1X	Fault	
4	1	320501	3	Channel	Channel Alert	3	1	Direct	Brg 1X	Alert	
5	1	320501	4	Channel	Channel Danger	3	1	Direct	Brg 1X	Danger	
6	1	320501	5	Channel	Channel Trip Multipl	3	1	Direct	Brg 1X	Trip Multiply	
7	1	320501	6	Channel	Channel Bypass	3	1	Direct	Brg 1X	1 = Bypassed : 0 = Not Bypassed	
8	1	320502	1	Channel	Channel Valid	3	2	Direct	Brg 1Y	1 = Valid : 0 = Invalid	
9	1	320502	2	Channel	Channel Fault	3	2	Direct	Brg 1Y	Fault	
10	1	320502	3	Channel	Channel Alert	3	2	Direct	Brg 1Y	Alert	
11	1	320502	4	Channel	Channel Danger	3	2	Direct	Brg 1Y	Danger	
12	1	320502	5	Channel	Channel Trip Multipl	3	2	Direct	Brg 1Y	Trip Multiply	
13	1	320502	6	Channel	Channel Bypass	3	2	Direct	Brg 1Y	1 = Bypassed : 0 = Not Bypassed	

Figure 159: Address and bit settings for packed status registers

21.6.6 Read Current Values

The channel value can be read from either Input Registers (3x) or Holding Registers (4x). The value can be read as a 32-bit floating point value, or as a scaled value (0 to 65535). B&K Vibro recommends using the floating-point value if it is supported by your DCS system.

Table 64

Format	Description
32-bit floating point	Value is read in actual engineering units (i.e. 2.5 mils)
16-bit unsigned integer	Value is read as a scaled value (percentage) (i.e. 0 to 10 mils = 0 to 65535, or 0 to 4095). For example: Current value = 2.5 mils, Measurement range is 0 to 10 mils (2.5 mils = 25%), Modbus range = 0-4095. Modbus Value (25%) = 1023.

Data provided as 32 Bit Floating point values use two 16-bit registers. The word order can be swapped (see section 21.3.5).

21.6.7 Read Alarm Setpoint Values

The alarm setpoints can be read from either Input Registers (3x) or Holding Registers (4x). The value can be read as a 32-bit floating point value, or as a scaled value (0-65535). B&K Vibro recommends using the floating-point value if it is supported by your DCS system.

The alarm setpoint values are ‘read only’ and do not change when Trip Multiply is enabled.

Table 65: Alarm setpoint registers

Format	Description
32-bit floating point	Alarm setpoint is read in actual engineering units (i.e. 2.5 mils)
16-bit unsigned integer	Alarm setpoint is read as a scaled value (percentage). For example: Alarm setpoint = 2.5 mils, Measurement range is 0 to 10 mils (2.5 mils = 25%), Modbus range = 0-4095. Modbus Value (25%) = 1023.

Data provided as 32-Bit Floating point values use two 16-bit registers. The word order can be swapped (see section 21.3.5).

21.6.8 Read Rack Time

The rack time can be read as an epoch timestamp; and is the number of “ticks” that have elapsed since January 1, 1970 at midnight, where 1 tick equals 100 nanoseconds (10^{-7} seconds).

Table 66: Rack time register

Format	Description
64-bit unsigned integer	Rack (system) time read as an epoch timestamp

There are various converters on the Internet to convert a Unix hexadecimal timestamp to a human readable date (i.e. epochconverter.com).

21.7 Modbus Wiring

See section 9.1 - Modbus Connections and Wiring

21.8 Common Mistakes

There are a couple of settings on the Modbus configuration that are important to understand.

Serial Modbus Slave Address

If you are using a custom Modbus map – the slave address (Serial Modbus) is taken from the Modbus map column from the imported spreadsheet.

If you are using a standard Modbus map – the slave address (Serial Modbus) is taken from the SAM properties screen.

Modbus Register Writes

To reset (or Inhibit, or enable trip multiply) the rack using a Modbus write function, you must enable "Allow Status Register Writes". If it is not enabled the rack will return an error message when you try to write to the register.

Allow Invalid Address

Be careful with the "Allow Invalid Address" setting; normally this should be turned off. However, it can be handy when the DCS register mapping is not known (i.e. rack replacement scenario).

Normally, if the DCS requests a register that does not exists an error is returned. However, if "Allow Invalid Address" is checked the VC-8000 will not give an error; it will simply return a data value of zero for that register.

Register Address is Six Digits (300,001)

Most systems use 5 digits to represent the Modbus register address (i.e. 30,001).
The VC-8000 uses 6 digits (i.e. 300,001).

Some examples:

Table 67: Register address field

Register Address	How VC-8000 interprets the address field	
1	0x (Read Coils),	Address 00,001
101	0x (Read Coils),	Address 00,101
10,021	0x (Read Coils),	Address 10,021
30,001	0x (Read Coils),	Address 30,001
100,042	1x (Read Discrete Inputs),	Address 00,042
300,001	3x (Input Register),	Address 00,001
407,834	4x (Holding Register),	Address 07,834

SAM (Main) Firmware

Older firmware versions (3.x) do not support write functions.

21.8.1 Modbus Error Messages

The table shows common errors encountered when commissioning a VC-8000 Modbus communications link.

Table 68: Modbus communication - error messages

Exception Response	Possible solution
Illegal data address	Rack does not allow writing to the register. Enable **Allow Status Register Writes** in the SAM configuration. See section 21.3.7
Timeout Error	The rack does not respond. This is usually a problem with the communications link. Simplify the communications link if possible to verify the functionality of the VC-8000. For example, use a laptop to communicate directly to the VC-8000.

When you import the CSV file into the MPS software, you may encounter the following error messages.

Table 69: Import Modbus Map - error messages

Example Message	Possible Solution
Row 133. The Modbus address 30,001 cannot have a value width of 1.	30,001 is a read coils register 0x30,001. 'Data Format' value (Column L) cannot be "32 bit floating point", or "16 bit unsigned integer". Change the address to 300,001
Row 156. Conflicting address between…	You have overlapping or duplicate addresses.

22 Locked Functional Safety System

A Functional Safety VC-8000 rack requires a rack lock feature to prevent unauthorized access to the VC-8000. There are two specific features to prevent unauthorized access.

First, a password is required. If the rack is not secured with a password, a “no password” event is recorded in the system even list, and the Fault Relay is activated to notify plant personnel.

Second, a Lock File is required when a SAM module is replaced. The Lock File prevents a user from replacing the SAM module to override the rack password. When a SAM is replaced, the Functional Safety rack is “unlocked” and configuration changes will not be allowed until the rack is “locked” with a new Lock File.

Further, if a password is not set and a module is replaced, the Functional Safety rack is un-locked and cannot be configured until it is locked again.

Once a rack is un-locked the following occurs:

- The Fault Relay will go active
- An event is recorded in the system event list (one of two events will occur, a no password event or a module mismatch event.)
- An error message will be shown if a user connects with the MPS software and attempts to send the configuration

Once a Functional Safety Rack becomes “un-locked”, specific steps must be taken to lock it again. These steps are explained in the sections below.

22.1 Initial Configuration – Locking the SAM module

Functional Safety racks will ship from the factory with no password configured. The user will be required to set the password and create a Lock File when the system is commissioned.

To configure the password and create the Lock File follow these steps using the VC-8000 Rack Setup software.

- Select the File menu and choose Set Passwords
- Select “Set Password” for the Administrator account
- Enter the password. The password cannot be blank
- Select OK
- A message box is displayed (see Figure 160), select Continue
- Save the Lock File and store in a secure location as it may be required when modifying your rack in the future. When you Send a configuration down to the rack, a dialog will appear indicating the rack will be locked during this process and the lock file will be requested
- If you need to change the password, you will also have to create a new Lock File. To change the password (and create a new Lock File) go to the File menu, choose Set Passwords, and enter the old password. Then follow the steps as described here

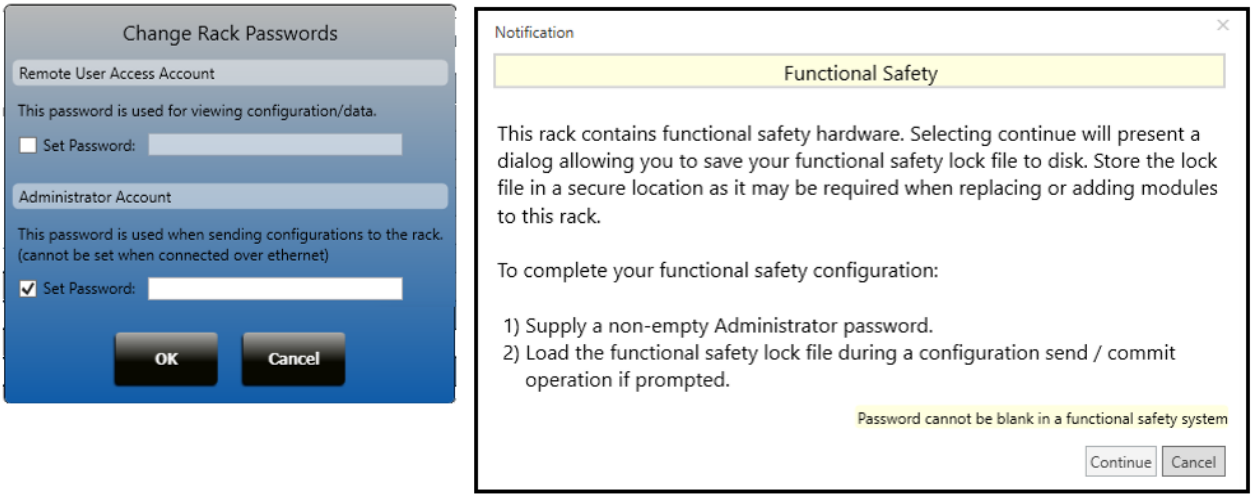


Figure 160: Functional Safety - Set Password

Note: After sending a configuration to a Functional Safety rack, the configuration should then be retrieved and saved. This saved configuration file should then be used at future instances to modify the configuration on the rack. Failure to do so will result in the configuration having to be downloaded to the entire rack instead of only the modules that have changed.

22.2 Adding a new UMM/TMM module to a Functional Safety System

A new or replacement UMM-FS or TMM-FS can be installed in a Functional Safety Rack using the rack password; the Lock File is not required.

When the UMM-FS/TMM-FS module is replaced the module will be mismatched from the rest of the system. When this happens, the Fault Relay is activated, and a Lock Mismatch event will be posted to the System Event List (**Figure 161**).

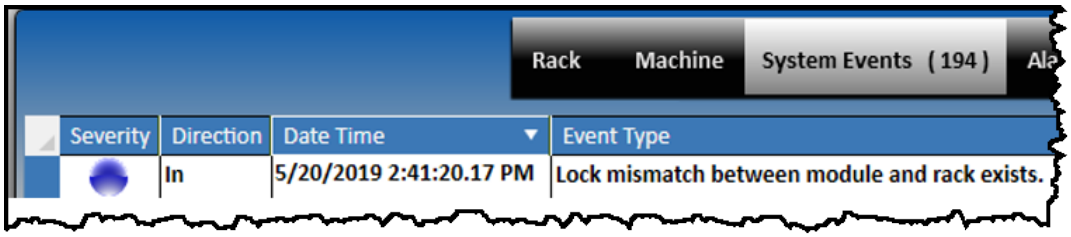


Figure 161: System Event list: Lock mismatch exists

A mismatch error will also be shown in the VC-8000 Setup Software (**Figure 162**).

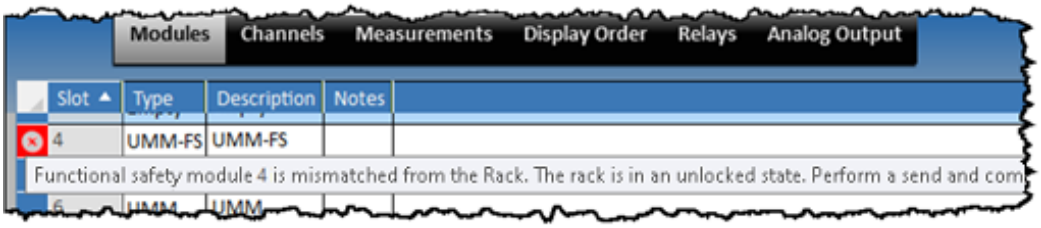


Figure 162: MPS Setup software, module mismatch

To clear the faults the user must configure the new module using the rack password. After a successful configuration, the UMM-FS/TMM-FS module mismatch error will be removed, and the Rack Fault relay will be deactivated.

A new Lock File can be created but is not required.

22.3 Adding a new SAM module for slot 3 to a Functional Safety System

A new or replacement SAM can be installed for slot 3 in a Functional Safety Rack using the rack password; the Lock File is not required.

When the SAM module for slot 3 is replaced the module will be mismatched from the rest of the system. When this happens, the Fault Relay is activated, and a Lock Mismatch event will be posted to the System Event List (**Figure 163**).

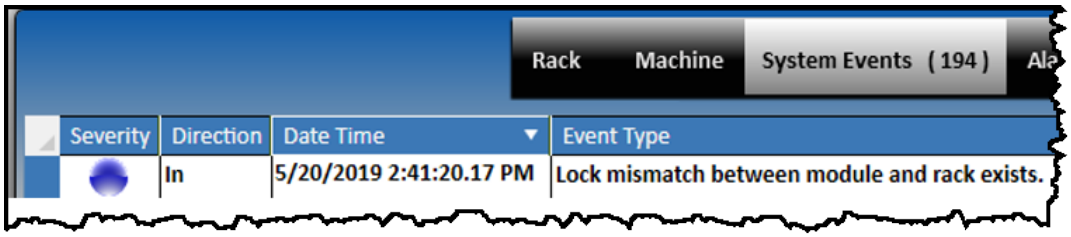


Figure 163: System Event list: Lock mismatch exists

A mismatch error will also be shown in the VC-8000 Setup Software (**Figure 164**).

Figure 164: MPS Setup software, module mismatch

To clear the faults the user must configure the new module using the rack password. After a successful configuration, the SAM module for slot 3 mismatch error will be removed, and the Rack Fault relay will be deactivated.

A new Lock File can be created but is not required.

22.4 Replacing a SAM module for slot 2 in a Functional Safety System

When a SAM module in slot 2 is replaced in a Functional Safety system the Lock File is required to configure the rack.

When a SAM module is replaced the rack will become “un-locked”; a module mismatch event will be recorded in the VC-8000 System Event list, and the Fault Relay will be activated.

To re-lock the rack (with the new SAM module) follow these steps:

- Connect to the rack with the VC-8000 Setup software
- Retrieve the existing rack configuration
- You will see a module mismatch error
- Configure the new SAM module, select Prepare to Send
- A pop-up screen will appear requesting the Lock File
- Select Load Lock File
- Browse to the Lock File and select Open. This needs to be the same lock file produced during the Set Password step during the initial setup of this rack

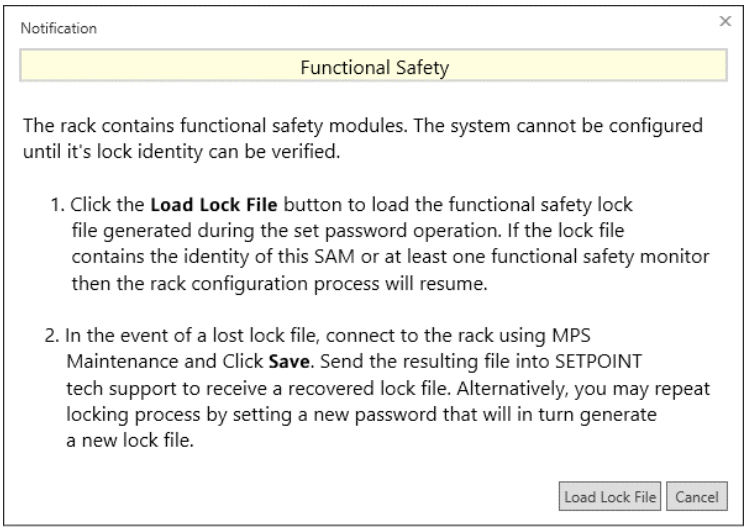


Figure 165: Provide Lock File

If the Lock File has been lost, create a Rack Maintenance file (see section 24.1) and email the file (along with your contact information) to techsupport@bkvibro.com to request a new Lock File. Alternatively, you may create a new password and the resulting lock file may be used.

23 Verification

23.1 Verification Procedure (General)

Follow the steps in this section to verify the operation of the VC-8000.

1. Set the input signal inside the normal operating region (not in alarm).
2. Reset the rack (press the reset button) to clear any latched alarm conditions.
3. Raise (for over alarms) or lower (for under alarms) the input amplitude until the measurement crosses the Alert set-point.
4. Wait the configured alarm time delay.
5. Verify the channel entered the Alert condition. There will be an event in the Alarm Event List and the alarm will be annunciated on the display.
6. Press the reset button. Since the input is still outside the normal operating region, the bar graph will still indicate Alert.
7. Continue increasing (for over alarms) or lowering (for under alarms) the signal amplitude until the measurement crosses the Danger set-point.
8. Wait the configured alarm time delay.
9. Verify the channel entered the Danger condition. There will be an event in the Alarm Event List and the alarm will be annunciated on the display.
10. Press the reset button. Since the input is still outside the normal operating region, the bar graph will still indicate Danger.
11. Return the signal amplitude to the normal operating range.
12. If the alarms are configured as “non-latching” the alarms should clear, and an exit event will appear in the Alarm Event List. If the alarms are configured as “latching”, press the reset button to clear latched alarms. After reset the exit event will appear in the Alarm Event List with the time stamp of the ‘reset’ action.

Note

Alarm set-points generally have hysteresis (dead-band) of approximately 1.5% of full-scale by default.
The alarm will continue to be annunciated until the measurement is back inside the normal operating region by at least the hysteresis value.

23.2 Channel Verification (Common Channel Types)

The following sections include verification procedures for the most common channel types in the VC-8000. For other channel types (Steam Turbine, Hydro, Recip, etc.) See the application guide for that machine type.

23.2.1 Verifying Axial (Thrust) Channels

Use a DC power supply to validate these channels. The bias and Gap measurements will follow the power supply input voltage.

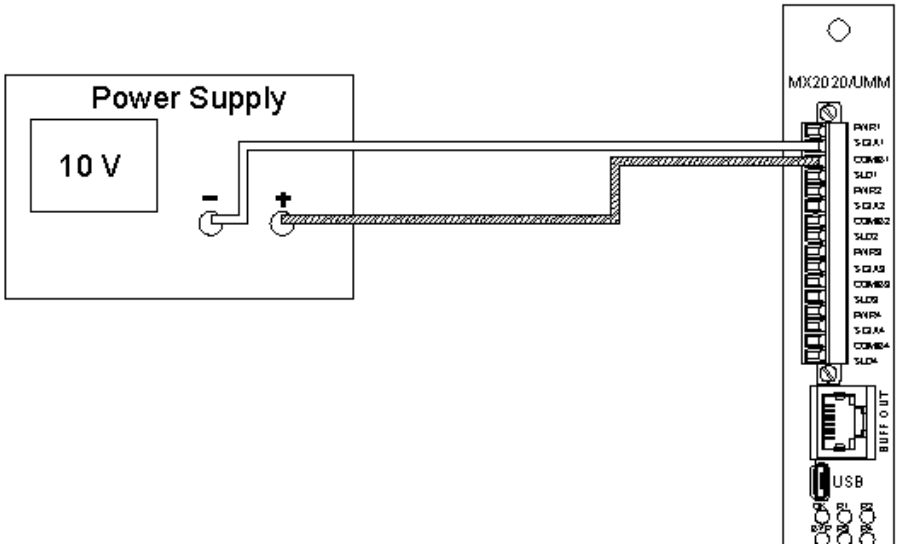


Figure 166: Axial and Position verification

Position measurements are calculated from the Zero Position.
The UMM Position measurement will be:

$$Position = 1000 * \frac{Voltage - ZeroPosition}{ScaleFactor}$$

Where the Voltage is the input power supply voltage, the Zero Position is the configured zero position (Volts) and the Scale Factor is the transducer scale factor (mV/Unit). The Upscale Direction setting determine the sign (+ or -) of the data. For a standard proximity probe, the equation above is for Upscale Direction = “Towards Probe”.

For example, if the input signal is -9 Vdc, the Zero Position is set at -10 Vdc, the transducer Scale Factor is 200 mV/mil, and the Upscale Direction is “Towards Probe”, the position reading is:

$$1000 * \frac{-9\,Vdc - (-10\,Vdc)}{200\,\frac{mV}{mil}} = 5\,mils$$

If the Upscale Direction setting is “Away From Probe” the Position will be - 5.0 mils.

23.2.2 Verifying Radial Vibration, Acceleration, and Velocity

Set up the test equipment as shown, wiring the power supply polarity for positive or negative bias transducers. The figure shows the wiring for negative bias sensors, reverse the "-" and "+" leads when verifying IEPE sensors. Set the power supply to the transducer Center Gap or Bias voltage.

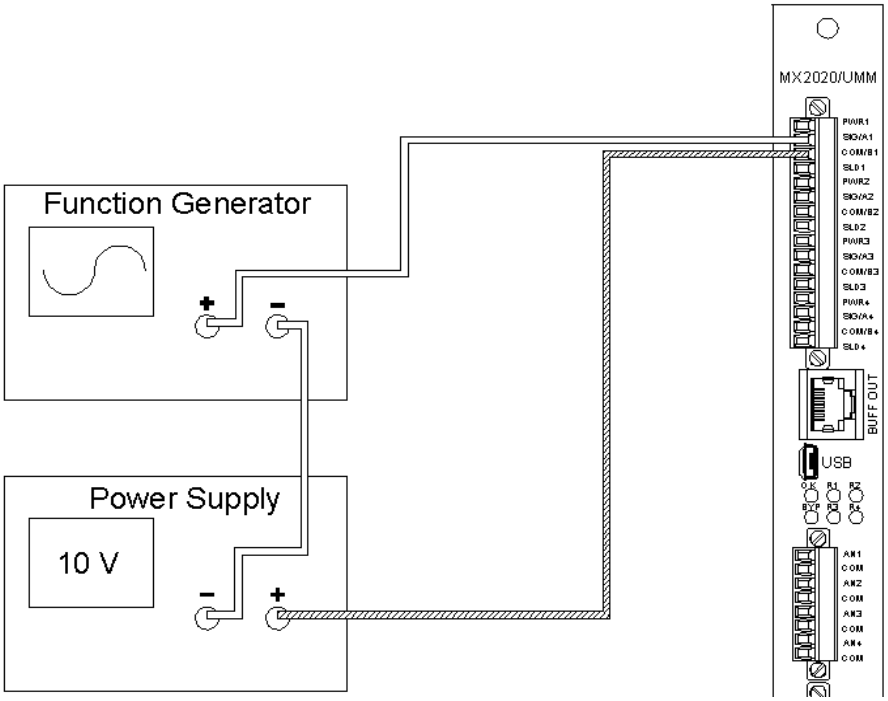


Figure 167: Dynamic Measurement Test Setup

Note

When testing IEPE powered sensors the UMM will drive a small constant current out the SIG terminal which can cause an error in the function generator output. If this error is a problem, convert the transducer power to "Hi-Z" for the verification.

Set the function generator for the desired amplitude with a frequency well inside your band-pass filtered region so the filter does not significantly attenuate the signal.
Table 70 shows some examples.

Table 70: Dynamic Measurement Test Frequencies Examples

Measurement	High Pass	Low Pass	Test
Radial Vibration Direct	4 Hz	4,000 Hz	100 Hz
Velocity Direct	10 Hz	1,000 Hz	100 Hz
Acceleration Direct	1,000 Hz	10,000 Hz	3,000 Hz
Hydro Displacement Direct	0.3 Hz	200 Hz	25 Hz
Hydro Velocity Direct	0.3 Hz	200 Hz	25 Hz
Dynamic Pressure	0.5 Hz	500 Hz	50 Hz
PP Eccentricity	None	15.6 Hz	1.5 Hz
Recip Rod Runout	None	600 Hz	10 Hz
Aero Velocity Bandpass	3 Hz	3,000 Hz	60 Hz
Aero Accel Bandpass (acceleration units)	10 Hz	10,000 Hz	200 Hz
Aero Accel Bandpass (integrated velocity units)	25 Hz	350 Hz	100 Hz

Set the function generator amplitude according to the desired measurement level.
Set the amplitude according to the equation:

$$Voltage = DesiredOutput * \frac{ScaleFactor}{1000}$$

For example, if you want the measurement to be 3 mils peak to peak with a 200 mV/mil transducer setting, set your function generator amplitude to:

$$3\ mils\ pp * \frac{200\frac{mV}{mil}}{1000} = 0.6\ Vpp\ or\ 0.212\ Vrms$$

When working with integrated units, use a conversion tool to calculate the non-integrated sensor signal at the required frequency. There are many internet websites that provide conversion tools.

For example, if you want to test a velocity amplitude of 0.5 in/sec pk at 3,600 rpm, the tool provides a sensor input of 0.345 g rms. When using a 100 mV/g accelerometer, the input would be 34.5 mV rms.

23.2.3 Verifying Process Variable

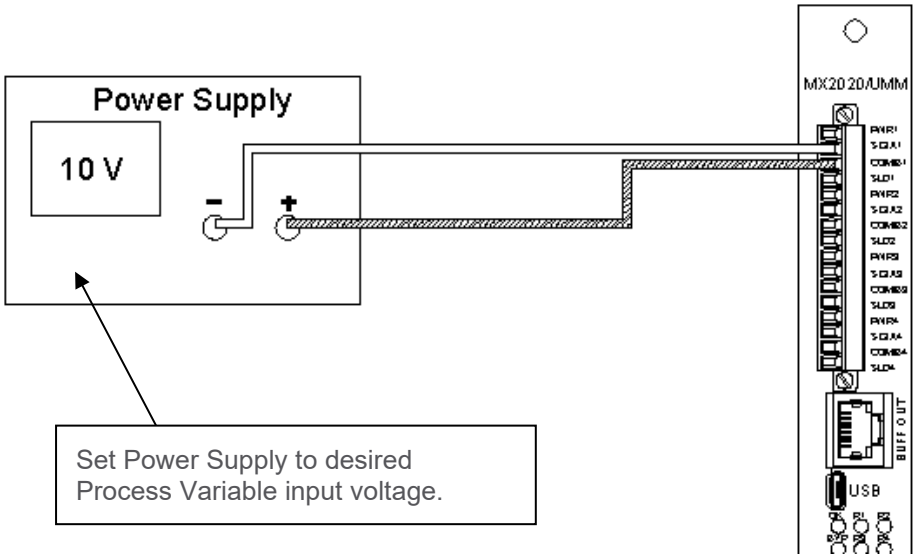


Figure 168: Process Variable Test Set Up

The UMM converts the input currents to voltages through a 249-ohm resistor. For the default transmitter ranges (e.g. Top Scale = 20 mA, Bottom Scale = 4 mA), vary the power supply input over the Process Variable input range according to **Table 71**.
The measured value will be:

$$Value = (\frac{(InputVoltage - BottomScaleInput\ Voltage)}{FullScaleVoltageChange}(FullScale - BottomScale)) + BottomScale$$

Where Input Voltage is the input power supply voltage, Full Scale is the maximum transmitter output in Engineering Units, Bottom Scale is the minimum transmitter output in Engineering Units and the Full Scale Voltage Changes is as shown in **Table 71**.

For example, an Input Voltage of -3 Vdc is input into a UMM channel configured for a 4 to 20 mA transmitter that outputs 4 mA at 0 PSI and 20 mA at 100 PSI.

$$Value = \frac{-3\ Vdc - (-1Vdc)}{-4}(100\ PSI - 0\ PSI) + 0\ PSI = \ 50\ PSI$$

Table 71: UMM Process Variable Input Voltage Ranges

Transmitter Type	Bottom Scale Input Voltage	Top Scale Input Voltage	Full Scale Voltage Change
UMM Power 4 to 20 mA	-1 V	-5 V	-4 V
Externally Powered 4 to 20 mA	+1 V	+ 5 V	4 V
0 to 5 V	0 V	+ 5 V	5 V
+1 V to 5 V	+1 V	+ 5 V	4 V
0 to -10 V	0 V	- 10 V	10 V

If you change Bottom Scale Input or Top Scale Input values, you will need to recalculate the FullScale VoltageChange and the BottomScaleInputVoltage.

For example, if you set 0% open to correspond to 5 mA and 100% open to correspond to 17 mA, the FullScaleVoltageChange is (17 mA – 5 mA) * 249 = 2.988V.

The BottomScaleInputVoltage would be 5 mA *249 = 1.245 V.

Where the 249 factor is the impedance the UMM uses to convert from current to voltage.

23.2.4 Verifying nX Amplitude and Phase

Follow the instructions in this section to verify:

- Radial Vibration 1X, 2X, nX Amplitude and Phase
- Velocity 1X, 2X, nX Amplitude and Phase
- Acceleration 1X, 2X, nX Amplitude and Phase

Use the measurement equipment set up shown in **Figure 169**.

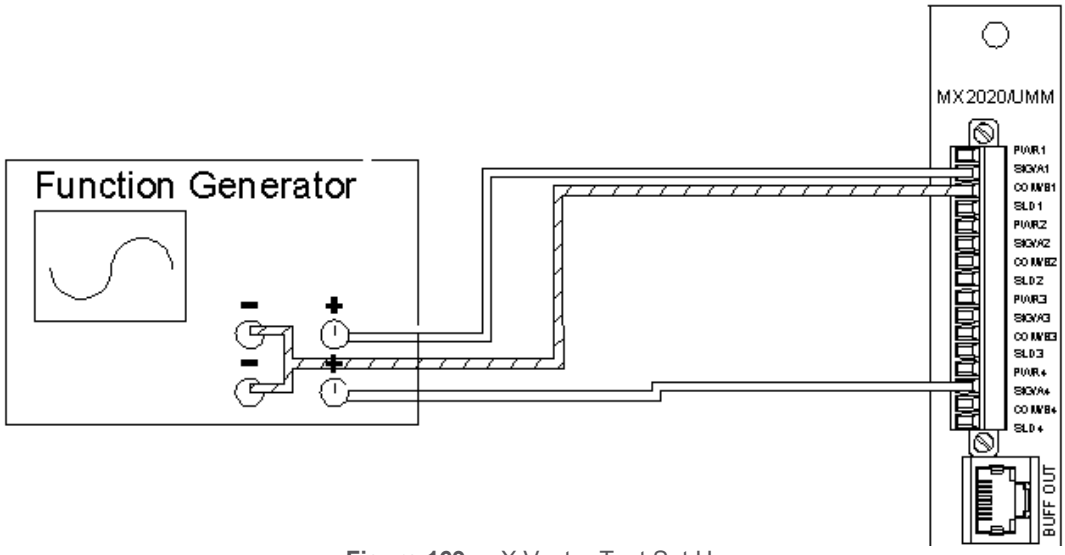


Figure 169: nX Vector Test Set Up

You will need a function generator capable of two outputs that are synchronized, with the ability to vary the frequency between the two waveforms. You can use the Sync output for the Phase Trigger input if the Phase Trigger channel is configured for “+18V Proximity Switch”.

Set the DC bias on the function generator within the OK limits for the transducer. Connect one function generator channel to the Phase Trigger input and the other to the channel under test. If the function generator cannot support the offset required for the signal to be in the OK range, you can offset the function generator using a power supply.

Set the Phase Trigger frequency to the machine running speed/60 Hz. Set the channel input frequency “n” times the Phase Trigger frequency.

Example:

If the machine speed is 3600 rpm, set the Phase Trigger frequency to 60 Hz. Set the input frequencies as shown in **Table 72**.

Table 72: nX Vector Test Frequencies

Measurement	Function generator frequency
Phase Trigger (example 3600 rpm)	60 Hz
1X	60 Hz
2X	120 Hz
3X	180 Hz
0.5X	30 Hz

Note

Phase measures the lag between the phase trigger edge and the next highest vibration peak. Function generators define the phase (0 degrees) where the sine wave crosses the zero axis. Expect a 90 (or 270) degree difference between the function generator phase and the vector phase. The difference will depend on the Phase Trigger “Notch” or “Projection” edge trigger setting.

23.2.5 Verifying Temperature Channels

Use a commercial temperature calibrator (such as manufactured by Omega Engineering Inc.) to verify the TMM. Connect the inputs as described in Section 8.2 and follow the calibrator instructions to set the input value.

Note

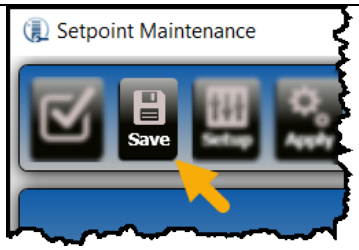
The RTD inputs cannot be verified using digital simulators due to the TMM periodic scan rate. Use a resistance box to verify RTD channels.

24 Troubleshooting (Maintenance)

The following sections describe typical procedures for performing VC-8000 system maintenance and troubleshooting.

24.1 Save a Rack Maintenance File

A rack maintenance file provides troubleshooting information to B&K Vibro tech support.

Action	Screen Capture
Connect to the rack with MPS Rack Maintenance software.	
Wait (60 seconds) while System and Alarm events are read from the rack. If you just rebooted the SAM wait 5 minutes before saving.	
Select Save.	

Note

When connected to a rack, VC-8000 Setup software version 5.0 or higher will automatically save rack maintenance information from the rack along with the configuration.

24.2 USB (or Remote) Connection Problems

See 11.1.1 - Troubleshooting the USB Connection.
See 11.2.1 - Troubleshooting Remote Connection.

24.3 LED Indicators

LED indicators are found on each of the modules. The LED status is a good first step when troubleshooting. See the following sections for an explanation of the LEDs available on each monitor.

24.3.1 RCM LED Indicators

The RCM has three LEDs labeled OK, P1, and P2. The table below provides a description of each LED condition and recommended actions.

Table 73: RCM LED Indicators

LED	Condition	Description	Action
P1	On (Green)	Power 1 is connected and is between 18 and 36 Vdc.	No action required.
	Off	Power 1 is not connected or is outside the specified range.	Verify the external supplies are powered. Verify that wiring is not reversed. Verify that the supply voltage is within the specified range.
P2	On (Green)	Power 2 is connected and is between 18 and 36 Vdc.	No action required.
	Off	Power 2 is not connected or is outside the specified range.	Verify the external supplies are powered. Verify that wiring is not reversed. Verify that the supply voltage is within the specified range.
Ok	On (Green)	The rack is functioning normally, and the OK relay is inactive.	No action required.
	Off	• Transducer fault (Not Ok) • Module inserted (rebooting) • Module hardware failure • SAM removed from rack	Check the event list. Find (and repair) the faulted sensor. If it is a module error, then replace the module.

24.3.2 SAM LED Indicators

The table below describes the SAM LEDs and their functions:

Table 74: SAM LED Indicators

LED	Condition	Description	Action
OK	Green	SAM is operating normally	
	Green (blinking)	SD card is full. Oldest data will be overwritten by newest data.	
	Off	SAM is faulty	Verify the SAM is fully seated in the slot. If powered, and seated ok, SAM is faulty, replace.
	Orange (Steady)	CMS is enabled but not functioning correctly	Check SETPOINT PI/XC Adapter (software). Verify network connections.
		Modbus is enabled but not functioning correctly (no queries received)	Verify the device is connected. Disable the SAM Modbus communications if it is not being used.
		SD is enabled but not functioning correctly.	Install (or replace) SD card.
	Orange (Brief blink)	Writing to SD card.	
	Red	SD Card Failure	Re-insert or replace SD card.
	Red	SAM COM-Express Failure (Touch Screen Display stops working)	Replace SAM
TM	On (Green)	Trip Multiply mode enabled Note: Trip multiply can be enabled via Modbus, or Discrete Contacts.	
	Off	Trip Multiply mode disabled	
Display OK	On (Green)	Display module connected	
	Off	Display module not connected or not installed.	Verify the cable is properly installed (see 12.4.2)

24.3.3 UMM and TMM LED Indicators

The table below describes the UMM/TMM LEDs and their functions:

Table 75: UMM and TMM LED States

LED	State	Description	Action
OK	On (Green)	No faults detected.	No action required.
	Off	Module is faulty (or unpowered).	Verify the rack has power. Verify the module is fully seated in the slot (see 24.1). If powered, and seated, module is faulty, replace.
	On (Amber)	A channel is faulted. Most likely this is a sensor fault. Note: The Bypass light (red) will also come on if there are configured setpoints on the faulted channel.	Check the event list. Repair the faulted sensor (or wiring).
	On (Red)	The module is faulted.	Replace the module.
	Blinking (Red)	Module configuration fault	Re-download the configuration. Update module firmware. If the problem persists, contact B&K Vibro Service.
Bypass (BYP)	On (Red)	A channel is faulted, bypassed, or Rack Inhibit is enabled. Note: rack Inhibit can be enabled via Modbus, or Discrete Contacts.	View the system event list to determine which event occurred. Typically, this will be a sensor (or wiring) fault.
	Off	No channels are in bypass.	No action required.
R1, R2, R3, R4	On (Red)	Relay is active	View the alarm event list to determine the cause of the alarm.
	Off	Relay is not active.	No action required.

24.4 Touchscreen Display

See the following sections:
12.1 - Viewing the Maintenance Display
12.4 - Troubleshooting the Display Panel

24.5 Event Lists

The following entries can appear in the VC-8000 System Event List.
The event list can be viewed from the Touch Panel display or by connecting to the rack with a laptop running the VC-8000 Maintenance software.

Table 76: System Event Events

Event Name	Description	Recommended Actions
Inhibit Rack	Rack Inhibit is enabled.	None
Trip Multiply	Trip Multiply is enabled.	None
Latched Statuses Reset	The reset contact (or button) was activated.	None
Special Alarm Inhibit	Special Alarm Inhibit is enabled.	None
Bypass Channel	The channel is in bypass.	None
Critical Hardware Failure	The module has failed a critical self-test.	Replace the module.
Module Rebooted	The module processor has reset.	None
Configuration Slot does not match Actual Slot	The slot number (software) does not match the physical location of the module. Operation is suspended.	Download the correct configuration to the monitor.
Power 1 Lost	Power Supply 1 fault	Check Power Supply 1
Power 2 Lost	Power Supply 2 fault	Check Power Supply 2
Channel Fault (Not OK)	Transducer signal is faulted	Check the sensor field wiring
Module Inserted into System	A module has been inserted into the system.	None
Module Removed from System	A configured module has been removed from the system.	None
DCS Link Failure	The VC-8000 is not receiving Modbus queries.	Verify Modbus connections.

24.6 Replacing Modules

You may remove VC-8000 Modules while the system is powered (Hot Swap). Remember that every VC-8000 UMM/TMM card has relay channels.

Before removing cards:

- Make sure the rack (all trips) are externally bypassed
- Notify operators that VC-8000 channel statuses will become invalid and the Fault relay will activate

Before installing cards:

- Verify the card is not upside down. The card will fit into the slot upside down, but will not seat into the backplane. If you push hard to force the card to seat, the connector on the card may break
- When hot inserting modules into a rack make sure all VC-8000 relays are externally bypassed (see section 6.9). Modules inserted into a live rack will begin protection functions as soon as the module boots up and the signal processing filters settle
- Functional Safety modules share a Lock File with the SAM module. Replacement Functional Safety UMM and/or TMM modules must be configured (or re-configured) after they are installed in the VC-8000 rack

To prevent unwanted configuration sends and reboots to modules already installed in a rack, use the saved configuration file previously used to configure the rack. The VC-8000 software will only send the configuration to modules that are configured differently from those stored in the saved configuration file.

Important

VC-8000 Modules can be damaged by electrostatic shock when removed from the rack. Take appropriate precautions such as grounding straps.

Important

Configuring a new UMM/TMM may force a re-configuration of other monitors in the rack (due to shared relay logic parameters). Make sure all VC-8000 relays are externally bypassed (see section 6.9) until the rack is correctly configured.

24.7 Firmware Upgrades

B&K Vibro recommends upgrading to the latest firmware during major shutdowns and maintenance cycles.

VC-8000 modules can be easily upgraded to the latest firmware. Firmware upgrades are not necessary unless you specifically require new functionality. Note that the VC-8000 UMM has over 45+ different channel types and the firmware is constantly being updated.

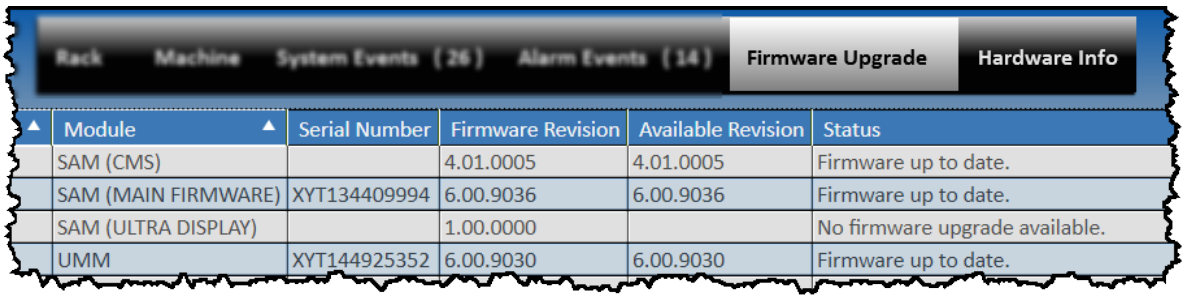
Firmware files are embedded in the VC-8000 Maintenance software. Download the latest software before performing firmware updates.

Important

Relays will transition to the de-energized state during a firmware upgrade.

24.7.1 View Current Firmware Revisions

Download the latest revision of the VC-8000 Maintenance software (MPS) from the B&K Vibro website to correctly show the Available Revision ((last release) of the firmware. If you are using an older version of the MPS software, you will not see what is currently available.



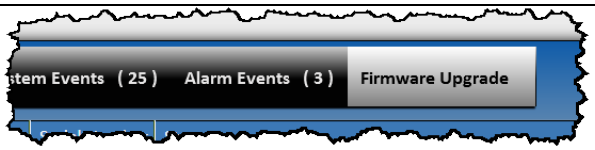
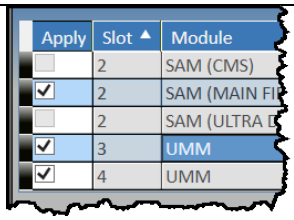
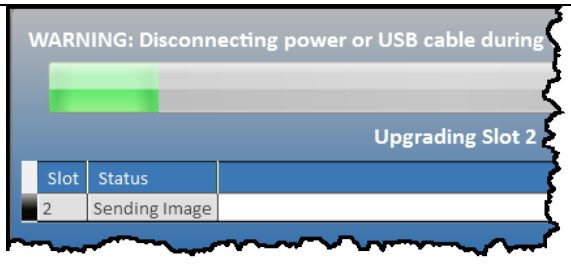
Module	Serial Number	Firmware Revision	Available Revision	Status
SAM (CMS)		4.01.0005	4.01.0005	Firmware up to date.
SAM (MAIN FIRMWARE)	XYT134409994	6.00.9036	6.00.9036	Firmware up to date.
SAM (ULTRA DISPLAY)		1.00.0000		No firmware upgrade available.
UMM	XYT144925352	6.00.9030	6.00.9030	Firmware up to date.

Figure 170: Firmware Upgrade Screen

24.7.2 Update Firmware

Be aware – This procedure may trip relays. Do not perform this procedure unless all relays are externally bypassed, or the machine is down.

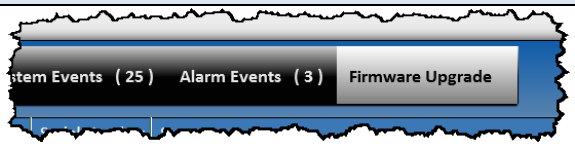
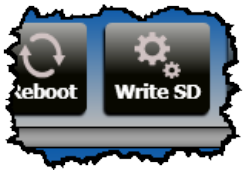
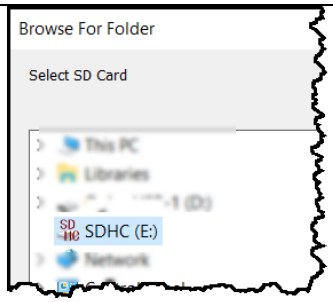
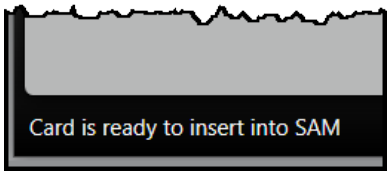
Follow these steps to update the firmware on all modules:

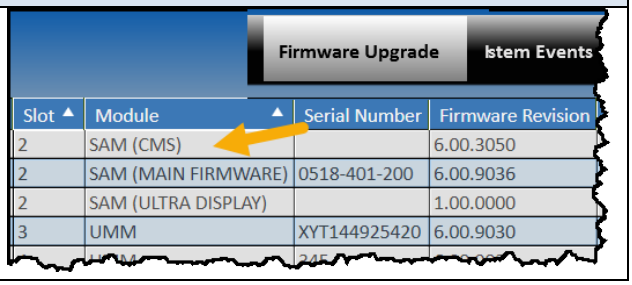
Action	Screen Capture
Important! - Externally bypass the rack (trips) and notify operations that data will be temporarily lost, relays may change state, and the OK relay may change state - Install the latest version of VC-8000 MPS Software to get the latest updates	
Connect to the rack.	
Select the Firmware Upgrade Tab.	
Review the information and select modules to update.	
Select Apply to update the firmware.	
The firmware update window will appear. Note: Firmware updates can take up to 20 minutes for large racks.	

24.7.3 Upgrading the SAM (CMS) Firmware

Currently the SAM (CMS) firmware is not updated during the normal firmware update process. It must be updated by inserting a firmware-update SD card into the SAM.

Prepare the SD card by following these steps.

Action	Screen Capture
Insert the SD card into your laptop. Erase all files from the SD card. Open VC-8000 Maintenance software and select the Firmware Upgrade tab.	
Select Write SD.	
The Select SD card window will appear. Select the SD card.	
A message is displayed in the message bar (lower left).	
Verify the SD card contains only one file (it will have the extension of .bin)	
Insert the SD card into the SAM. If your rack has a display, A pop up screen will appear, a 10 second count down will begin, and then the display will reboot. Wait 60 seconds and then remove the SD card.	

Action	Screen Capture
Use VC-8000 Maintenance software to verify that the upgrade was successful.	

The SAM (CMS) firmware only affects the display and the CMS interface and has no impact on machine protection or Modbus communication.

24.7.3.1 Rebooting the SAM (CMS)

You may need to reboot the SAM (CMS) after upgrading the firmware. You can reboot the SAM (CMS) by cycling the power on the rack, or use the SAM (CMS) reboot button on Firmware Upgrade tab.

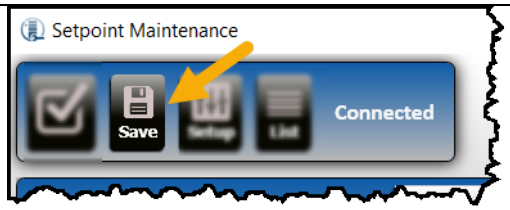
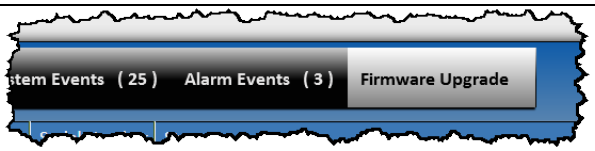
Important

A SAM reboot will trip the VC-8000 OK relay (on the RCM).

24.8 License Upgrades

Be aware – This procedure may trip relays. Do not perform this procedure unless all relays are externally bypassed, or the machine is down.

You should also **Notify Operations** that data will be temporarily lost, relays may change state, and the OK relay may change state.

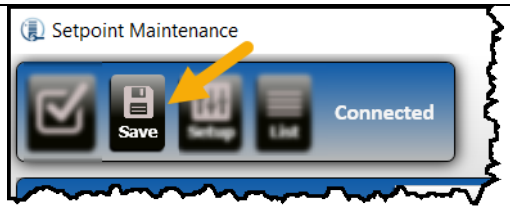
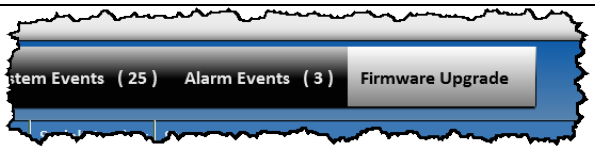
Action	Screen Capture
Install the latest version of VC-8000 MPS Software on your laptop. Open VC-8000 Rack Maintenance software	
Connect to the rack. A local connection does not require a password for license updates.	
Save a Rack Maintenance file.	
Email the file to B&K Vibro Technical Support requesting a license update. Please reference the purchase order. The support request will take up to 24 hours.	
A license update file will be emailed to you. The file extension is ".setk"	
Select the Firmware Upgrade Tab.	
Select Enable Hardware	
Select the license update file. The file extension is ".setk".	

Action	Screen Capture
Look for a message in the lower left corner of the software, indicating that “Hardware support activation is complete”	

24.9 Password Reset

Be aware – This procedure may trip relays. Do not perform this procedure unless all relays are externally bypassed, or the machine is down.

You should also **Notify Operations** that data will be temporarily lost, relays may change state, and the OK relay may change state.

Action	Screen Capture
Install the latest version of VC-8000 MPS Software on your laptop. Open VC-8000 Rack Maintenance software	
Connect to the rack. A local (USB) connection does not require a password to perform a password reset.	
Save a Rack Maintenance file.	
Email the file to B&K Vibro Technical Support requesting a password reset. The support request can take up to a day – depending on time zone.	
A password reset file will be emailed to you. The file extension is ".setk"	
Select the Firmware Upgrade Tab.	
Select Enable Hardware	
Select the password reset file.	

Action	Screen Capture
Look for a message in the lower left corner of the software, indicating that “Hardware support activation is complete”	

24.10 Hardware Information

Hardware and licensing can be viewed using the VC-8000 Maintenance software.

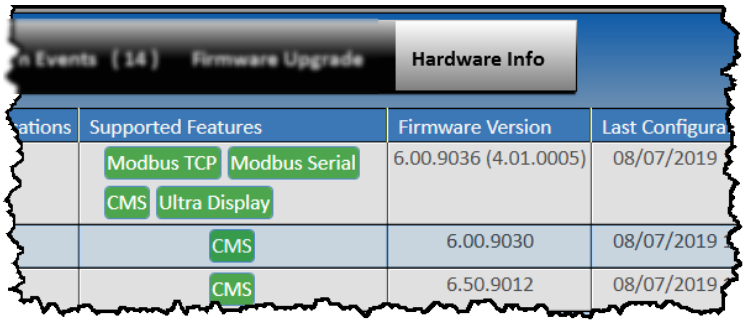


Figure 171: VC-8000 Hardware and Licensing Information

The following table describes information available.

Table 77: Hardware Information

Label	Description	
Slot	The rack slot number the module is installed in.	
Module	The module type	
Sales Order	The sales order the module was purchased under.	
Order Options	Option dash numbers	
Serial Number	The module serial number.	
Hardware Version	The hardware version and revision numbers.	
Modifications	Part number for modifications applied. (optional)	
Supported Features Lists special features or plug-ins purchased with the module.	SAM available supported features:	
	Modbus TCP	Supports Modbus over Ethernet
	Serial Modbus	Supports Modbus over Serial Networks
	CMS	Supports data output to SETPOINT CMS
	SD	Supports storing dynamic data to the SD card
	HD32	Includes a 32 GB solid state drive
	HD256	Includes a 256 GB solid state drive
	Standard Display	Supports the standard display
	Ultra Display	Supports the ultra-bright backlight display
	MPS Remote	Supports remote configuration access via the CMS Ethernet port
	TMM and UMM supported features:	
	CMS	Supports data output to SETPOINT CMS
Firmware Version	The firmware revision	
Last Configuration	The date the current configuration was downloaded	

24.11 Bypass a Signal (or Relay) Channel

If a transducer is faulty and causing nuisance alarms, you can easily bypass the signal channel (or the relay channel) as a temporary solution until the sensor is replaced.

When you bypass a signal channel, the Modbus signal will be set to the signal clamp value; typically, this value is zero (see section 16.1.12). The analog output (4-20 mA) signal will also be set to the clamp value or to the 2mA clamp (if enabled).

Important

Do not use the Signal/Relay Bypass function when reconfiguring a rack.

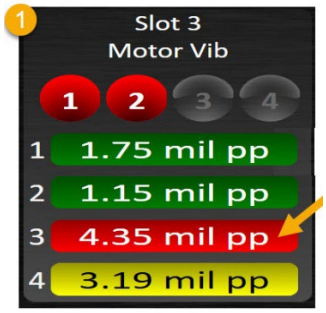
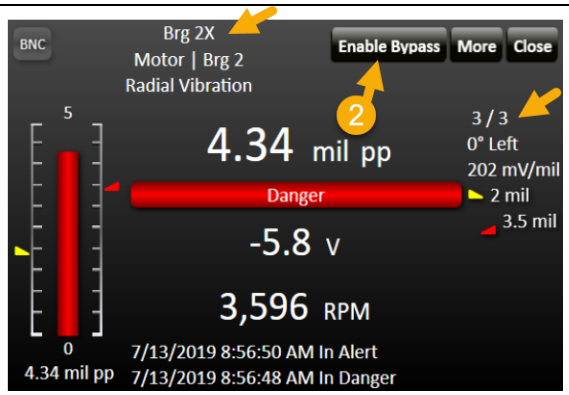
Servicing a rack includes: power cycle, cards removed, configuration changes, firmware upgrades etc. The rack should be externally bypassed when being serviced (See section 6.9 Avoid False Trips).

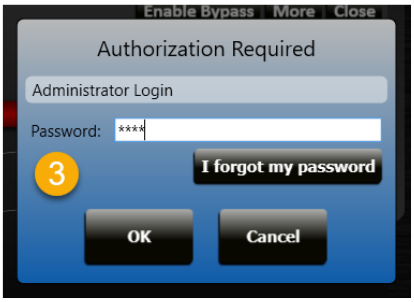
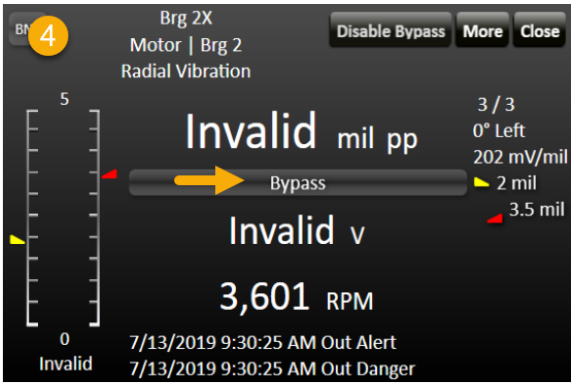
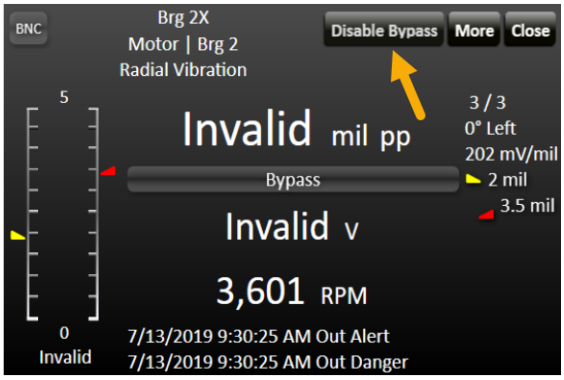
Only use Signal/Relay Bypass to temporarily disable nuisance alarms.

24.11.1 Bypass Signal Channel

Signal Bypass disables the signal channel, regardless of any alarm conditions in the rack. Use the VC-8000 Maintenance software to bypass signal channels; the Maintenance display on the touch screen panel cannot bypass signal channels.

Follow these steps to bypass a signal channel.

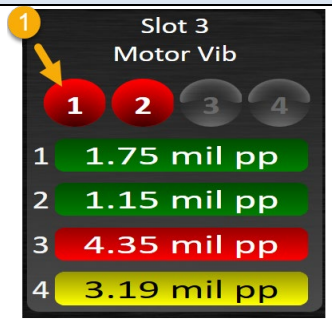
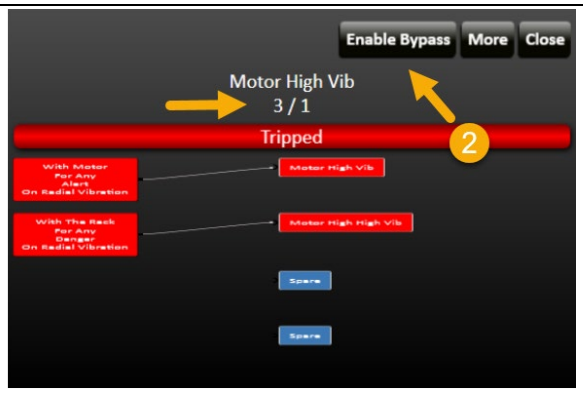
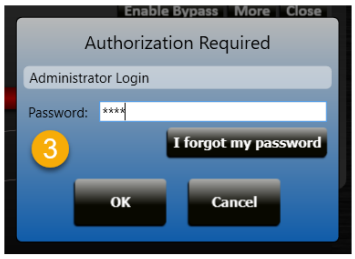
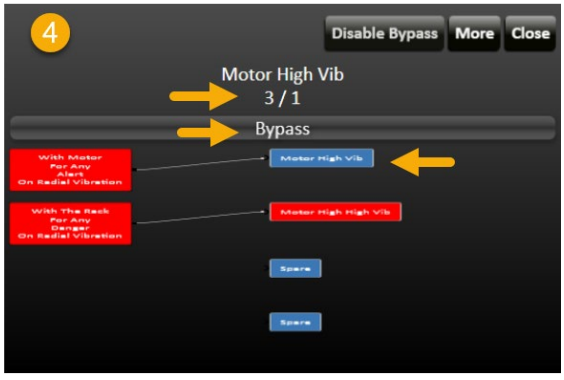
Action	Screen Capture
Select the signal channel.	
Confirm that you are viewing the correct signal channel (Slot 3 Channel 3 (Brg 2X)) Select Enable Bypass	

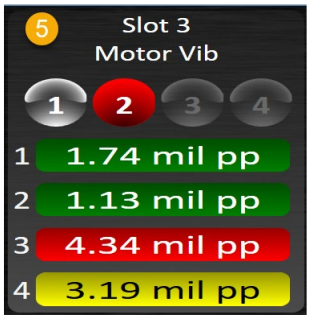
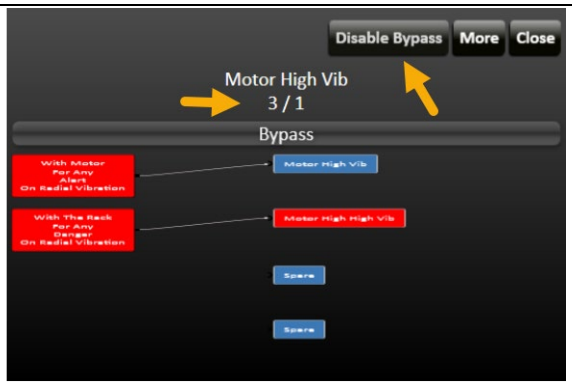
Action	Screen Capture
Enter password (if required).	
Confirm that the channel is bypassed. Select Close to return to the main screen.	
Slot 3 Channel 3 is now in bypass. Note: Relay channel 2 is no longer in alarm because the channel driving the alarm has been bypassed. Note: Modbus and Analog outputs for slot 3 Channel 3 will go to their clamp values.	
To re-enable the channel, select Disable Bypass.	

24.11.2 Bypass Relay Channel

Relay Bypass forces the relay into the non-alarm state, regardless of any alarm conditions in the rack. Use the VC-8000 Maintenance software to bypass relays; the Maintenance display on the touch screen panel cannot bypass relays.

To bypass a relay, follow these steps

Action	Screen Capture
Select the relay channel.	
Although all four relay channels are shown, Slot 3 Channel 1 (Motor High Vib) is the *selected* channel. Select Enable Bypass	
Enter password (if required).	
Confirm. Slot 3, channel 1 (Motor High Vib) is bypassed. Notice that channel 2 is still active. Select close to return to the main screen.	

Action	Screen Capture
Again, Notice that relay Slot 3 Channel 2 is still active. Also notice that the signal channels are still in alarm. Follow these same steps to bypass relay channel 2 (if needed).	
To re-enable the relay channel, select Disable Bypass.	

Caution

Bypass cannot be used to prevent relays from changing state during re-configuration, power cycle, cards removed, firmware upgrades etc.

See section 6.9 Avoid False Trips

24.12 Troubleshooting Phase Trigger Channels

A Phase Trigger can have several different operation states which will result in different readings and status errors as shown in the following figures and summarized in **Table 78**.

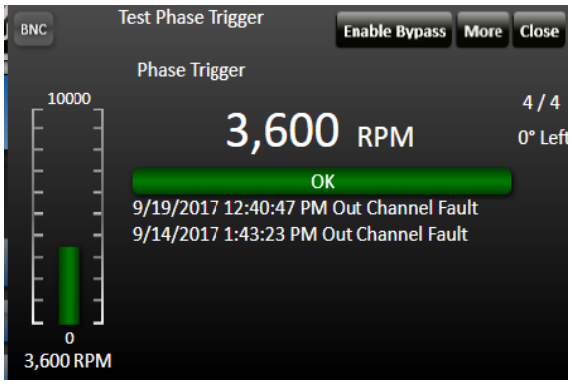


Figure 172:
Phase Trigger is OK

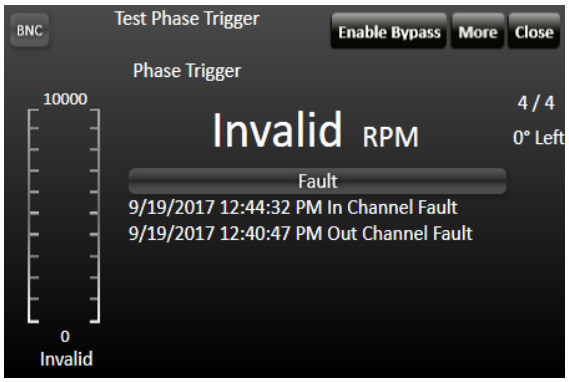


Figure 173:
Phase Trigger Transducer Fault

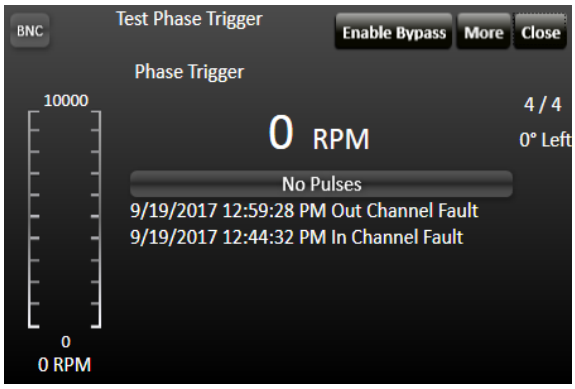


Figure 174:
No Phase Trigger Pulses

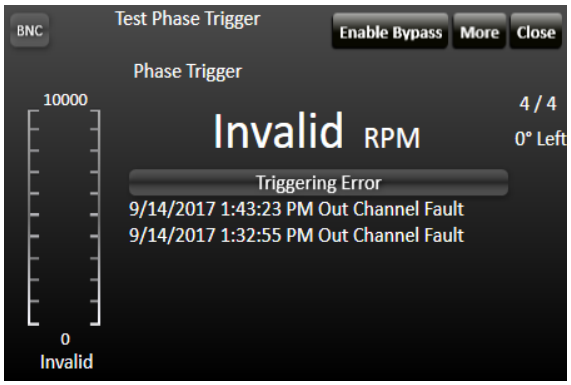


Figure 175:
Phase Trigger Triggering Error

Warning!

A reading of 0 rpm with the “No Pulses” fault is an unknown machine condition. The machine may still be running but a transducer fault has occurred.

Table 78: Phase Trigger Statuses and Errors

Status	Speed	Description	Action
OK	Current Speed	The Phase Trigger signal is triggering correctly.	No action required.
Fault	Invalid	The input Phase Trigger signal is outside the configured range check.	This may be due to a faulty transducer or incorrect configuration. Verify the transducer Gap value is inside the configured OK limits. Repair transducer or adjust OK limits as required.
No Pulses	0	The system has not received a valid Phase Trigger pulse within the timeout.	Either the machine has stopped, or the triggering configuration is incorrect. If the machine is running, view the Phase Trigger signal in SETPOINT CMS or on an oscilloscope and review the triggering configuration.
Triggering Error	Invalid	The system is receiving sporadic Phase Trigger pulses and cannot determine the speed.	View the Phase Trigger signal in SETPOINT CMS or on an oscilloscope and review the triggering configuration.

25 Complete List of Channel Types

The following sections show channel types (applications) and associated measurements supported by the VC-8000.

- Default measurements are included automatically when the channel is added. Measurements included by default can be deleted. See section 16.1.14
- Some measurements can be added (if needed). See section 16.1.13
- Required PT measurements require a Phase Trigger to function
- The measurement marked as (primary), is the main measurement for the channel. The CMS software uses this designation to apply filtering (i.e. show only the main (or primary) measurement for the channel)

25.1 Standard Channels

25.1.1 Acceleration

Typical uses:
Casing acceleration.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Bias	DC sensor bias voltage (for diagnostics)	Default
1X Amplitude and Phase	A synchronous amplitude and phase measurement at running speed. Maximum speed: 60,000 rpm	Default Requires PT
2X Amplitude and Phase	A synchronous amplitude and phase measurement at twice running speed. Maximum speed: 60,000 rpm	Default Requires PT
nX Amplitude and Phase	A synchronous amplitude and phase measurement at “n” times running speed. Maximum speed: 28,000 rpm	Add (if needed) Requires PT
Bandpass	Bandpass filtered dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off. Maximum speed: 28,000 rpm	Add (if needed)
Max X/Y	The value of the largest Direct measurement between the two channels. Requires two paired channels (A & B). Max X/Y will only appear on channel A.	Add (if needed)

25.1.2 Axial Position

Typical uses:
Thrust position with optional Phase Trigger association.

Measurement	Description	Configuration
Direct (primary)	Measures the position change in the axial direction. Commonly used for thrust position measurements.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
Axial Vibration	Bandpass filtered Peak-Peak displacement -6dB/octave (1 pole) roll-on, roll-off	Add (if needed)
nX Amplitude and Phase	An additional synchronous amplitude and phase measurement at the configured multiple of running speed.	Add (if needed) Requires PT

Important

The channel type Axial Position with Sync has been removed. The standard Axial Position channel can now support the synchronous waveform. Upon retrieval of a configuration that has Axial Position with Sync, a migration will occur converting it to a standard Axial Position channel type. If the configuration is then sent to the rack, all UMMs that had an Axial Position with Sync will receive the new updated configuration.

25.1.3 Phase Trigger

Typical uses:
Tachometer, Keyphasor®.

Measurement	Description	Default or Add
Speed (primary)	Rotational speed.	Default
Gap	The average Gap voltage for diagnostics.	Default
Rotor Acceleration	Change in rotational speed	Add (if needed)
Peak Speed	Maximum speed reached since the peak speed was reset.	Add (if needed)

25.1.4 Radial Vibration

Typical uses:
Radial Vibration on fluid film bearings using proximity probes.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 6 dB/octave (1 pole) roll-on, -6 dB/octave (1 pole) roll-off.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
1X Amplitude and Phase	A synchronous amplitude and phase measurement at running speed.	Default Requires PT
2X Amplitude and Phase	A synchronous amplitude and phase measurement at twice running speed.	Default Requires PT
nX Amplitude and Phase	An additional synchronous amplitude and phase measurement at the configured multiple of running speed. Commonly used for 0.5X or 3X measurements.	Default Requires PT
Bandpass 1	An additional Peak-Peak bandpass filtered measurement. Add this band-pass filter to filter a different region, change units or subunits, or provide additional alarms.	Add (if needed)
Bandpass 2	An additional Peak-Peak bandpass filtered measurement. Add this band-pass filter to filter a different region, change units or subunits, or provide additional alarms.	Add (if needed)
Max X/Y	The value of the largest Direct measurement between the two channels. Requires two paired channels (A & B). Max X/Y will only appear on channel A.	Add (if needed)

25.1.5 Velocity

Typical uses:
Velocity measurements as measured from piezo-electric, or moving coil velocity transducers.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Bias	The sensor bias voltage for diagnostics.	Default
1X Amplitude and Phase	The velocity component occurring at the rotor speed.	Default Requires PT
2X Amplitude and Phase	The velocity component occurring at twice the rotor speed.	Default Requires PT
nX Amplitude and Phase	The velocity component occurring at “n” times the rotor speed.	Add (if needed) Requires PT
Bandpass	A band-pass filtered and amplitude detected measurement. May be used in conjunction with Direct to measure a different frequency region, integration, or units.	Add (if needed)
Max X/Y	The value of the largest Direct measurement between the two channels. Requires two paired channels (A & B). Max X/Y will only appear on channel A.	Add (if needed)

25.2 Aero Derivative

25.2.1 Aero-Derivative Accel

Typical uses:
Aero-Derivative Gas Turbines with high temperature accelerometers.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. -48 dB/octave (8 pole) roll-on and roll-off.	Default
1X Tracking Filter	Signal is band-pass filtered with -48dB (8 pole) roll-on/roll-off and then filtered around the 1X speed frequency. Integrated to velocity (configurable).	Default Requires PT
Bias	DC sensor bias for diagnostics.	Default
Bandpass 1	Typically used for wideband velocity measurements. Bandpass filtered measurement. -48 dB/octave roll-on, roll-off. Integrated to velocity (configurable)	Default

25.2.2 Aero-Derivative Velocity Tracking

Typical uses:
Aero-Derivative Gas Turbines with Aero Interface Modules using Tracking Filters.

Measurement	Description	Default or Add
1X Tracking Filter (primary)	Filtered around the 1X speed frequency.	Default Requires PT
Bias	DC sensor bias for diagnostics.	Default
Bandpass	Bandpass filtered dynamic amplitude measurement. -48 dB/octave (8 pole) roll-on, roll-off. May be used for a wideband velocity measurement.	Default

25.2.3 Aero-Derivative Velocity Bandpass

Typical uses:
Aero-Derivative Gas Turbines with Aero Interface Modules using Band Pass Filters.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. -48 dB/octave (8 pole) roll-on, roll-off.	Default
Bias	DC sensor bias for diagnostics.	Default
Bandpass	Bandpass filtered dynamic amplitude measurement. Commonly used for a narrow band velocity measurement. -48 dB/octave (8 pole) roll-on, roll-off.	Default

25.3 Diagnostic Channels

Diagnostic channels are standard channel types but with default settings typical for a Machinery Diagnostic Services (MDS) engineer using a VP-8000 (for high speed data collection) and connected to the buffered output of an existing protection system.

25.3.1 Diagnostic Proximity (Radial Vibration)

Same measurements as the standard Radial Vibration Channel.

25.3.2 Diagnostic Velocity

Same measurements as the standard Velocity channel.

25.3.3 Diagnostic Acceleration

Same measurements as the standard Acceleration channel.

25.3.4 General Dynamic

Typical uses:
Basic (undefined) channel type for large voltage range +/- 24 Vdc or
special circumstances (like for special sensor and unit i.e. a current clamp and Amps).

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Bias	DC sensor bias voltage for diagnostics.	Default

25.4 Hydro and Low Speed Machines

25.4.1 Air Gap

The Hydro Air Gap channel uses capacitive displacement sensors to assist in detecting generator faults such as dislocation of poles, loose rotor rims, deformed rim or center-line offset.

Measurement	Description	Default or Add
Minimum Air Gap (primary)	The measured minimum Air Gap updated each revolution.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Rotor Profile (Sync) Waveform	The Rotor Profile waveform saves the lowest filtered value (minimum air gap) for each pole. All other samples are removed.	Default
Asynchronous Waveform	The Asynchronous waveform is the raw, unprocessed signal from the sensor.	Default

25.4.1.1 Rack Layout

The Hydro Air Gap channels can be installed in any UMM channel in the rack (they are not XY pairs).

25.4.2 Magnetic Flux

The Hydro Magnetic Flux channel uses Hall effect sensors to assist in detecting generator faults such as shorted pole coils and diagnostic of generator magnetic fields.

Measurement	Description	Default or Add
Minimum (primary)	The measured minimum Magnetic Flux updated each revolution.	Default
Maximum	The measured Maximum Magnetic Flux updated each revolution.	Default
Average	The measured average Magnetic Flux updated each revolution.	Default
Profile (Sync) Waveform	The Profile waveform saves the lowest filtered value (minimum magnetic flux) for each pole. All other samples are removed.	Default
Asynchronous Waveform	The Asynchronous waveform is the raw, unprocessed signal from the sensor.	Default

25.4.2.1 Rack Layout

The Hydro Magnetic Flux channels can be installed in any UMM channel in the rack. There is generally one sensor per machine.

25.4.3 Hydro Radial Vibration

The Hydro Radial Vibration channel is optimized for low speed (< 720 RPM) and provides a selection of tracking filters and bandpass filters.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude bandpass filtered measurement. High Pass = 0.3 Hz minimum (14 pole) Low Pass = 200 Hz maximum (12 pole)	Default
Gap	Gap voltage for diagnostics.	Default
1X Amplitude and Phase	Amplitude and phase measurements. This measurement defaults to 1X, but can be changed if desired (i.e. 0.5 X).	Default Requires PT
2X Amplitude and Phase	Amplitude and phase measurements. This measurement defaults to 2X, but can be changed if desired (i.e. 0.5 X).	Default Requires PT
Bandpass 1 Bandpass 2	Peak-Peak bandpass filtered measurements that can be added (if desired). See MPS Manual S1079330. Search for “Adding Measurements”. High Pass = 0.3 Hz min (14 pole) Low Pass = 200 Hz max (12 pole)	Add (if needed)

25.4.3.1 Rack Layout

Hydro Radial Vibration channels (XY pairs) must be in the same UMM using Ch 1 & 2 (or Ch 3 & 4).

Hydro Radial Vibration channels (XY pairs) must have the same CMS Navigation path. This “groups” the two channels together and allows the software to show Orbit plots etc.

25.4.4 Hydro Velocity

The Hydro Velocity channel is specifically designed for Hydro machines. It provides a good selection of tracking filters (1X, 2X) and bandpass filters to be used depending on the installed location of the sensor.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
1X Amplitude and phase	A synchronous amplitude measurement at running speed.	Default Requires PT
2X Amplitude and phase	A synchronous amplitude measurement at twice running speed.	Default Requires PT
Bandpass 1	Peak-Peak bandpass filtered measurement that can be added (if desired).	Add (if needed)
Low F Bandpass 2	Peak-Peak bandpass filtered measurement that can be added (if desired).	Add (if needed)

The Hydro Velocity channel also has a very steep High Pass filter (14 pole). This allows the channel to return a strong signal at the lowest frequencies and still eliminate noise from the channel.

Measurement	High Pass Min	Low Pass Max
Direct	0.7 Hz (14 pole)	200 Hz (12 pole)
Direct (Integrated)	0.7 Hz (14 pole)	200 Hz (12 pole)
Band-pass 1	0.7 Hz (14 pole)	200 Hz (12 pole)
Band-pass 1 (Integrated)	0.7 Hz (14 pole)	200 Hz (12 pole)
Band-pass 2 (Low F)	0.2 Hz (14 pole)	25 Hz (12 pole)
Band-pass 2 (Low F) (integrated)	0.2 Hz (14 pole)	25 Hz (12 pole)

25.4.4.1 Rack Layout

To view casing orbit plots in SETPOINT CMS software, the Hydro Velocity channels must be in Ch 1 & 2, or Ch 3 & 4 and the two channels must be paired. Otherwise, the Hydro Velocity channel can be in any location.

25.4.5 Low Frequency Acceleration

The Low F Acceleration channel is a modification of the Standard Acceleration channel with some improvements for lower frequency signal components.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
1X Amplitude and Phase	A synchronous amplitude measurement at running speed.	Default Requires PT
Bandpass	Addable bandpass measurement. Can be integrated to provide integrated and non-integrated measurements	Add (if needed)

The band-pass frequency of the Low F Accel channel is very wide (see table below). The integration of a signal (with low frequency and a wide band-pass) requires extra processor power; some measurements were removed to allow for this option.

Measurements	High Pass Min (LP[1])	(HP[1]) Low Pass Max
Direct	0.2 Hz (- 1,000 Hz) (4 pole)	(1 Hz -) 5,000 Hz (4 pole)
Direct (Integrated) pk	0.7 Hz (- 3,500 Hz) (4 pole)	(1 Hz -) 5,000 Hz (4 pole)
Direct (Integrated) rms	0.2 Hz (- 1,000 Hz) (4 pole)	(1 Hz -) 5,000 Hz (4 pole)
Bandpass 1	2.0 Hz (- 10,000 Hz) (4 pole)	(2.0 Hz -) 10,000 Hz (4 pole)
Band-pass 1 (Integrated) pk	10 Hz (- 10,000 Hz) (4 pole)	(10 Hz -) 10,000 Hz (4 pole)
Band-pass 1 (Integrated) rms	2.0 Hz (- 10,000 Hz) (4 pole)	(2.0 Hz -) 10,000 Hz (4 pole)

1) The High Pass (HP) and Low Pass (LP) filters must be within 5000x. For example, if I select a High Pass filter of 0.2 Hz, my Low Pass filter must be less than 1,000 Hz.

25.4.5.1 Rack Layout

If the customer is viewing casing orbit plots in SETPOINT CMS software, the channels must be in Ch 1 & 2, or Ch 3 & 4 and the two channels must be paired.

If the customer is not using casing orbits in CMS software the channels can be in any location in the rack and they are not required to be in XY pairs.

25.4.6 Low Frequency Velocity

The Low F Velocity channel is a modification of the Standard Velocity channel with some improvements for lower frequency measurements.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
1X Amplitude and Phase	A synchronous amplitude measurement at running speed.	Default Requires PT

The band-pass frequency of the channel is very wide (see table below). The integration of a signal (with low frequency and a wide band-pass) requires extra processor power; some measurements were removed to allow for this option.

Measurement	High Pass Min (LP[1])	Low Pass Max (HP[1])
Direct	0.2 Hz (1,000 Hz) (4 pole)	5,000 Hz (1 Hz) (4 pole)
Direct (Integrated)	0.7 Hz (3,500 Hz) (4 pole)	5,000 Hz (1 Hz) (4 pole)

1) The High Pass (HP) and Low Pass (LP) filters must be within 5000x. For example, if I select a High Pass filter of 0.2 Hz, my Low Pass filter must be less than 1000 Hz.

25.4.6.1 Rack Layout

If the customer is viewing casing orbit plots in SETPOINT CMS software, the Low F Velocity channels must be in Ch 1 & 2, or Ch 3 & 4 and the two channels must be paired.

If the sensor is not providing casing orbit plots in CMS software, the channel can be in any location in the rack and is not required to be part of an XY pair.

25.5 Pressure and Sound

25.5.1 Acoustic

Typical uses:
Sound level measurements.

Measurement	Description	Default or Add
Direct (primary)	A-weighted wideband sound level from 20 Hz to 20 kHz.	Default
Bias	DC sensor bias for diagnostics.	Default
Bandpass filters 1 to 8	Typically used for sound level octave filtering.	Default

25.5.2 Dynamic Pressure

Typical uses:
Cavitation, Humming.

Measurement	Description	Default or Add
Direct (primary)	Bandpass filtered dynamic amplitude. 84 dB/octave (14 pole) roll-on, roll-off	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Pressure Bandpass 1	Bandpass filtered dynamic amplitude. 84 dB/octave (14 pole) roll-on, roll-off	Add (if needed)
Pressure Bandpass 2	Bandpass filtered dynamic amplitude. 84 dB/octave (14 pole) roll-on, roll-off	Add (if needed)
Pressure Bandpass 3	Bandpass filtered dynamic amplitude. 84 dB/octave (14 pole) roll-on, roll-off	Add (if needed)

25.6 Process Variable

25.6.1 Discrete Input

Typical uses:
Switched input.

Measurement	Description	Default or Add
Digital State (primary)	100% if logic input is > 2Vdc or contact is open. 0% if logic input is < 1Vdc or contact is closed.	Default

25.6.2 Process Variable

Typical uses:
Analog 4 to 20 mA, 0 to +5 V, +1 to +5 V, or 0 to -10 V transmitters.

Measurement	Description	Default or Add
Direct (primary)	The transmitter output value converted to the configured full scale and units.	Default
Bias	Voltage of the input signal. (If the input is 4-20 mA the voltage is the calculated voltage using the internal 250-ohm resistor)	Default

25.7 (Other) Miscellaneous

25.7.1 Accel Slow RMS

Typical uses:
Vibration monitoring with a slower rms detector. The slow rms calculation (over 30 seconds) will stabilize the rms measurement, for example when the rms measurement is jumping around a lot.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. RMS value is calculated over a 30-s interval. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Bias	DC sensor bias voltage for diagnostics.	Default

25.7.2 Air Machine Radial Vibration

Typical uses:
Centrifugal air machines.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 6 dB/octave (1 pole) roll-on, -6 dB/octave (1 pole) roll-off	Default
Gap	DC sensor Gap voltage for diagnostics	Default
1X Amplitude	A synchronous amplitude measurement at running speed	Default Requires PT
2X Amplitude	A synchronous amplitude measurement at 2 times running speed	Default Requires PT
3X Amplitude	A synchronous amplitude measurement at 3 times running speed	Default Requires PT
4X Amplitude	A synchronous amplitude measurement at 4 times running speed	Default Requires PT
Bandpass	A bandpass filter commonly used for bearing related vibration	Default
Bandpass	A bandpass filter commonly set at the machine resonance	Default
Bandpass	A bandpass filter commonly set at twice the machine resonance	Default

25.7.3 Radial Vibration with Smax

Typical uses:
Applications where the Smax measurement is used (ISO 7919-5, VDI 2059).

25.7.3.1 Channel 1

Smax is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Smax (primary)	Maximum Orbit displacement calculated using an XY probe pair.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
1X amplitude and Phase	A synchronous amplitude and phase measurement at running speed.	Default Requires PT
2X Amplitude and Phase	A synchronous amplitude and phase measurement at twice running speed.	Default Requires PT

25.7.3.2 Channel 2

Smax is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 6 dB/octave (1 pole) roll-on, -6 dB/octave (1 pole) roll-off.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
1X Amplitude and Phase	A synchronous amplitude and phase measurement at running speed.	Default Requires PT
2X Amplitude and Phase	A synchronous amplitude and phase measurement at twice running speed.	Default Requires PT

25.8 Reciprocating Machines

25.8.1 Recip Crankcase Velocity

Typical uses:
Reciprocating Compressors.

Measurement	Description	Default or Add
Direct	Similar to the standard Velocity channel except that Fault events are valid for alarming. This allows the channel to alarm in the event that a liquid slug causes an excessive amplitude spike.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
1X Amplitude and Phase	A synchronous amplitude and phase measurement at running speed.	Default Requires PT
2X Amplitude and Phase	A synchronous amplitude and phase measurement at twice running speed.	Default Requires PT

25.8.2 Recip Cylinder Pressure

Typical uses:
Measurement of rod loads, pressure/volume curves for reciprocating compressors.

Measurement	Description	Default or Add
Discharge Pressure (primary)	Pressure measured at the discharge.	Default
Compression Ratio	Ratio of suction and discharge pressures.	Default
Maximum Pressure	Highest pressure measured over a cycle.	Default
Minimum Pressure	Lowest pressure measured over a cycle.	Default
Peak Rod Compression	Maximum compressive rod load measured over a cycle.	Default
Peak Rod Tension	Maximum tensile rod load measured over a cycle.	Default
Rod Reversal Degrees	Number of degrees of the cycle when the rod load was reversed.	Default
Suction Pressure	Pressure measured at the inlet.	Default

25.8.3 Recip Impact

Typical uses:
Detection of mechanical looseness on reciprocating machines.

Measurement	Description	Default or Add
Impact Count (primary)	Count of mechanical impact events that exceeded the configured threshold occurring within the set time window.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Maximum	The maximum peak acceleration value measured. Used to set the Impact Count threshold.	Default
Bandpass	Bandpass measurement. 6 dB/octave (1 pole) roll-on, -6 dB/octave (1 pole) roll-off.	Add (if needed)

25.8.4 Recip Rod Drop

Typical uses:
Rider band wear measurements on non-lubricated or lightly lubricated horizontal reciprocating compressors.

Measurement	Description	Default or Add
Average Piston Position (primary)	The piston position calculated from the measured probe Gap at the average probe position over a stroke.	Default
Average Gap	The probe Gap at the average probe position over a stroke.	Default
Rod Runout	A dynamic peak to peak measurement.	Default
Triggered Piston Position	The piston position as calculated from the probe to rod instantaneous Gap measured at the configured trigger angle.	Default Requires PT
Triggered Gap	The probe to rod instantaneous Gap measured at the configured trigger angle.	Default Requires PT

25.8.5 Recip Rod Position

Typical uses:
Single or dual transducer rod position measurements.

Measurement	Description	Default or Add
Direct PP (primary)	The overall peak to peak change in rod displacement.	Default
Gap	The proximity probe gap voltage representing the average distance between the probe face and the rod.	Default
1X Amplitude and Phase	The amplitude and phase components synchronous to the crank rotational speed.	Default Requires PT
Crank Angle	The crank rotation angle when the rod position maximum magnitude occurred.	Default Requires PT
Rod Pos Magnitude	Measures the maximum displacement of the rod center from the cylinder centerline.	Default Requires PT
Rod Pos Phase	The phase angle from the cylinder centerline to the point of the maximum rod position magnitude	Default Requires PT
Segment 000-045	Recip Segment representing 0° to 45° This is added by adding “8 Segments RV” in the add menu	Add (if needed)
Segment 045-090…270-315, and 315-360	All “other” Recip Segments representing 45° increments from 45°-90° to 315°-360° (7 individual measurements in total). These are added by adding “8 Segments RV” in the add menu **NOTE:** Deletion of these segment measurements occurs automatically when the Segment 000-045 measurement is deleted.	Add (if needed)

25.8.6 Recip Accel

Typical uses:
Reciprocating cylinder and crosshead impact monitoring.

Measurement	Description	Default or Add
Direct (Primary)	Overall dynamic amplitude measurement.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Segment 000-010	Recip Segment representing 0° to 10° This is added by adding “36 Segments Accel” in the add menu	Add (if needed)
Segment 010-020…340-350, and 350-360	All “other” Recip Segments representing 10° increments from 10°-20° to 350°-360° (35 individual measurements in total). These are added by adding “36 Segments Accel” in the add menu **NOTE:** Deletion of these segment measurements occurs automatically when the Segment 000-010 measurement is deleted.	Add (if needed)

25.9 Rolling Element Bearing Monitoring

There are five channel types targeted specifically for machines with Rolling Element Bearings (REB). They are:

Channel Type	Description
Enveloped Acceleration	Don't use.
REBAM	Special use with Proximitor. Don't use in other cases.
REB Acceleration	Good to use when there is not a phase trigger (no PT).
REB Acceleration (slow)	Good to use for low speed machines (no PT)
Tracking REB Acceleration	Best to use (with a PT)

25.9.1 Enveloped Acceleration (Don't use)

Don't use.

25.9.2 REBAM channel

Typical uses:
Rolling Element Bearings using a specifically designed proximity probe. This channel type is rarely used.

Measurement	Description	Default or Add
Direct (primary)	Overall dynamic amplitude measurement. 6 dB/octave (1 pole) roll-on, -6 dB/octave (1 pole) roll-off	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
Rotor Region	Bandpass filtered measurement typically used for rotor related information. 6 dB/octave (1 pole) filter roll-on, -36 dB/octave (6 pole) roll-off	Default
Prime Spike	Bandpass filtered measurement typically used for bearing related information. 36 dB/octave (6 pole) filter roll-on, -6 dB/octave (1 pole) roll-off	Default
Waveforms	Standard, asynchronous and synchronous	Default

25.9.3 REB Acceleration

Good to use when there is no phase trigger available.

Measurement	Description	Default or Add
Overall (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Prime Spike	Bandpass filtered measurement typically used for bearing related information. 24 dB/octave (4 pole) filter roll-on, -12 dB/octave (2 pole) roll-off	Default
HF Demodulated	Filtered and peak-stretch demodulated measurement typically used for early warning of lubrication and bearing faults.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Waveforms	Asynchronous and Peak-Stretch (enveloping)	Default

25.9.4 REB Acceleration (Slow)

Typical uses:
Rolling Element Bearings using an accelerometer on low speed or noisy machines. RMS and peak detector response times are slower than standard REB Acceleration channel type.

Measurement	Description	Default or Add
Overall (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Prime Spike	Bandpass filtered measurement typically used for bearing related information. 24 dB/octave (4 pole) filter roll-on, -12 dB/octave (2 pole) roll-off	Default
HF Demodulated	Filtered and peak-stretch demodulated measurement typically used for early warning of lubrication and bearing faults.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
Waveforms	Asynchronous and Peak-Stretch (enveloping)	Default

25.9.5 Tracking REB Acceleration (Recommended)

Typical uses:
Rolling Element Bearings using an accelerometer on a variable speed machine (up to 4500 rpm).
This channel type can only be selected in channels 1 through 3.

Measurement	Description	Default or Add
Overall (primary)	Overall dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off.	Default
Bias	DC sensor bias voltage for diagnostics.	Default
1X amplitude and phase	A synchronous amplitude and phase measurement at running speed.	Default PT required
Cage	Envelope demodulated and tracking filtered amplitude.	Default PT required
IRBP	Envelope demodulated and tracking filtered amplitude.	Default PT required
ORBP	Envelope demodulated and tracking filtered amplitude.	Default PT required
Ball Spin	Envelope demodulated and tracking filtered amplitude.	Default PT required
2X Ball Spin	Envelope demodulated and tracking filtered amplitude.	Default PT required
Waveforms	Asynchronous and Peak-Stretch (enveloping)	Default

25.10 Rotation and Speed

Application Alert

VC-8000 speed channels are not suitable for over-speed protection.

25.10.1 Reverse Rotation

Typical uses:
Determine shaft rotation direction using two Phase Trigger inputs.

25.10.1.1 Channel 1

Reverse Rotation is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Rev Speed (primary)	Reverse Speed. The current measured speed in the reverse direction.	Default
Gap A	DC sensor Gap voltage for diagnostics.	Default
Num Rev Rotations	Number of Reverse Rotations. A cumulative count of the number of rotations in the reverse direction. Reset using the peak hold reset button.	Default
Rev Peak Speed	Reverse Peak Speed. Holds the maximum speed read in the reverse direction. Reset using the peak hold reset button.	Default
Forward Speed	Forward speed reading for the first sensor.	Default

25.10.1.2 Channel 2

Reverse Rotation is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Speed B	Speed reading for the second sensor.	Default
Gap B	DC sensor Gap voltage for diagnostics.	Default

25.10.2 Tachometer (Rotation and Speed)

Typical uses:
Machine speed only (not a phase reference).

Measurement	Description	Default or Add
Speed (primary)	The machine rotational speed.	Default
Gap	For proximity probes, the Gap is the average distance between the probe face and shaft as measured in volts. For passive magnetic transducers the Gap voltage is near zero.	Default

25.10.3 Zero Speed

Typical uses:
Turbine turning gear engagement.

25.10.3.1 Channel 1

Zero Speed is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Zero Speed (primary)	Speed indicator to ensure safe engagement of the turning gear. This measurement is only active below 100 rpm and requires two channels. Both channels must be valid and agree for the measurement to be valid.	Default
Gap A	For proximity probes, the Gap is the average distance between the probe face and shaft as measured in volts. For passive magnetic transducers the Gap voltage is near zero.	Default
Speed	The machine rotational speed.	Default
Peak Speed	The maximum speed measured since the last held value reset.	Add (if needed)

25.10.3.2 Channel 2

Zero Speed is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Speed B (primary)	The machine rotational speed.	Default
Gap B	For proximity probes, the Gap is the average distance between the probe face and shaft as measured in volts. For passive magnetic transducers the Gap voltage is near zero.	Default
Peak Speed	The maximum speed measured since the last held value reset.	Add (if needed)

25.11 Steam Turbine Monitoring

25.11.1 Case Expansion

Typical uses:
Steam Turbine case expansion measurements using an LVDT transmitter.

Measurement	Description	Default or Add
Direct	Single channel case expansion measurement from the LVDT displacement.	Default

25.11.2 Case Expansion Dual Channel

Typical uses:
Steam Turbine case expansion measurements using two LVDT transmitters.

25.11.2.1 Channel 1

This is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Differential Case Expansion (primary)	Calculates the difference between two case expansion transducers.	Default
Direct 1	Single channel measurement from LVDT 1.	Default

25.11.2.2 Channel 2

This is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Direct 2 (primary)	Single channel measurement from LVDT 2.	Default

25.11.3 Diff Exp Single Probe

Typical uses:
Steam Turbine single probe differential expansion.

Measurement	Description	Default or Add
Direct (primary)	Differential Expansion position.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default

25.11.4 Diff Exp Comp Input

Typical uses:
Steam Turbine complementary input differential expansion.

25.11.4.1 Channel 1

This is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Composite (primary)	Differential expansion measurement combining the measurements from sensors 1 and 2 to double the available range.	Default
Direct A	Position measurement from sensor 1.	Default
Gap A	DC sensor 1 Gap voltage for diagnostics.	Default

25.11.4.2 Channel 2

This is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Direct B (primary)	Position measurement from sensor 2.	Default
Gap B	DC sensor 2 Gap voltage for diagnostics.	Default

25.11.5 Diff Exp Dual Ramp

Typical uses:
Steam Turbine dual ramp differential expansion.

25.11.5.1 Channel 1

This is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Composite (primary)	The differential expansion measurement using two probes to eliminate common errors.	Default
Direct 1	The position measurement for sensor 1.	Default
Gap 1	DC sensor 1 Gap voltage for diagnostics.	Default

25.11.5.2 Channel 2

This is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Direct B (primary)	The position measurement for sensor 2.	Default
Gap B	DC sensor 2 Gap voltage for diagnostics.	Default

25.11.6 Diff Exp Single Ramp

Typical uses:
Steam turbine single ramp differential expansion.

25.11.6.1 Channel 1

This is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Composite (primary)	The differential expansion measurement using two probes to eliminate common errors.	Default
Direct A	The position measurement for sensor 1.	Default
Gap A	DC sensor 1 Gap voltage for diagnostics.	Default

25.11.6.2 Channel 2

This is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Direct B (primary)	The position measurement for sensor 2.	Default
Gap B	DC sensor 2 Gap voltage for diagnostics.	Default

25.11.7 Eccentricity

Typical uses:
Steam turbine eccentricity.

Measurement	Description	Default or Add
PP Eccentricity (primary)	Peak to peak eccentricity measurement.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
Min	The minimum position measured during a single shaft rotation.	Default
Max	The maximum position measured during a single shaft rotation.	Default
Ecc Position	The shaft position. Below the crossover speed Ecc Position is the instantaneous measured position. Above the crossover speed Ecc Position is the average position.	Default

25.11.8 Shaft Absolute RV & Velocity

Typical uses:
Shaft vibration measurements where the absolute casing vibration is large. Also used as replacement for shaft-riders.

25.11.8.1 Channel 1 (RV)

This is a two-channel measurement. The following measurements are for Channel 1.

Measurement	Description	Default or Add
Shaft Abs Direct (primary)	Summation of the relative direct with the integrated case velocity to obtain the absolute vibration displacement.	Default
Direct	Shaft relative overall dynamic amplitude measurement. 6 dB/octave roll-on, -6 dB/octave roll-off.	Default
Gap	DC sensor Gap voltage for diagnostics.	Default
1X amplitude and phase	Shaft relative synchronous amplitude and phase measurement at running speed.	Default
2X amplitude and phase	Shaft relative synchronous amplitude and phase measurement at 2x running speed.	Default

25.11.8.2 Channel 2 (Velocity)

This is a two-channel measurement. The following measurements are for Channel 2.

Measurement	Description	Default or Add
Velocity Direct (primary)	Casing velocity dynamic amplitude measurement. 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off	Default
Intg Direct	Casing velocity integrated to displacement dynamic amplitude measurement. Used in the Shaft Absolute calculation 24 dB/octave (4 pole) roll-on, -24 dB/octave (4 pole) roll-off	Default
Bias	DC sensor bias voltage for diagnostics	Default
1X amplitude and phase	Casing velocity integrated to displacement (shaft relative) at 1X speed.	Default
2X amplitude and phase	Casing velocity integrated to displacement (shaft relative) at 2X speed.	Default

25.11.9 Valve Position

Typical uses:
Steam turbine valve position measurement using an AC LVDT and transmitter.

Measurement	Description	Default or Add
Valve Position (primary)	Measures the valve % open or % closed	Default
Bias	Voltage of the input signal. (If the input is 4-20 mA the voltage is the calculated voltage using the internal 250-ohm resistor).	Default

25.12 Temperature

Typical uses:
Thermocouple or RTD temperature measurements.

Measurement	Description	Default or Add
Direct (primary)	Temperature	Default
Difference	Difference between two temperature sensors (or between a temperature sensor and an average temperature)	Add (if needed)
Average	An average temperature taken across multiple channels	Add (if needed)

26 Other MPS Features (less used)

26.1 Simulated Phase Triggers

Use a simulated Phase Trigger (PT) under the following conditions only.

- No physical speed sensor is installed
- Your machine runs at a constant speed
- 1X, 2X, nX amplitudes (at running speed) are needed
- Synchronous waveform (at running speed) is needed

Figure 176:
Add simulated phase trigger

Create simulated PT from the Channels tab, Phase Trigger view: Click “Add” and select simulated phase trigger:

Simulated Phase Triggers will be shown in the list of available Phase Triggers (Channels Tab, Summary View) where they can be associated with a vibration channel.

Simulated Phase Triggers:

- Do not consume a channel
- Always show the simulated speed (even when machine is stopped)
- Do not have alarm or fault statuses
- Do not show as a bar graph on the VC-8000 front panel
- Cannot be used as a phase reference (associated channels will have invalid phase)
- Show on the display detail views
- Show in CMS
- Are not synchronized between UMMs

Important
A simulated phase trigger channel will always show the configured speed value (i.e. 3600 RPM) - even when the machine is not running.

26.2 My Rack Does Not Use a SAM Module

VC-8000 monitor modules can operate without a SAM installed in the rack. Operation without a SAM provides a cost-effective solution when the monitors do not need to function as a system, such as when monitoring many small machines.

The following have restricted functions when there is no SAM in the rack.

Function	Behavior without SAM
Configuration Software	Rack (system) communications are not supported. To configure any module, you must connect to the USB port on that module. Each module must be configured independently. When you 'Get' a configuration, you will only see one module (the module the USB cable is connected to). When you 'Send' a configuration you will only change one module and you will have a configuration file for each module. Relay logic is restricted to the channels in that module. You cannot include channels from other modules in your relay logic.
Event List	Each monitor module records only the events generated by that module, and its event list is cleared when the module is rebooted. Events are recorded in sequence but there is no time-stamp. The monitors record the results of system level actions, such as channels leaving alarm on a reset, rather than the reset event itself.
Maintenance Software	The Maintenance Software can only connect to, and display information from, one module at a time. It will not be possible to see RCM conditions and statuses (power OK, rack inhibit, rack trip multiply, etc.)

26.3 Resetting Held Values

Peak Speed, Peak Reverse Speed, Number of Reverse Rotations values are held until reset. VC-8000 Maintenance software is required to reset the values back to zero; navigate to the Detail More View and click the Reset Held Values button.

26.4 Contacts View (Discrete Input Channels)

UMM Discrete Input channels can perform Trip Multiply, Inhibit, and Bypass functions for groups of channels within the rack. The discrete contacts on the RCM only perform these functions for the entire rack.

Figure 177:
Channels tab, Contacts view

To configure Discrete Contact channels:

- Set the channel type as: Discrete Input
- Select the transducer (input signal) type. Typically, this will be set to: Dry Contact
- Configure Asset Level 1 (Machine Train) group names
- Set parameters in the Contacts View

26.4.1 Contact Function

The available contact (control) functions are:

- **Bypass:** places all channels in the group into Channel Bypass
- **Inhibit:** places all channels in the group into Alarm Inhibit
- **Trip Multiply:** places all channel in the group into Trip Multiply

26.4.2 Group Name (Asset Level 1)

The Group Name (Asset Level 1) defines the group of channels that will be controlled by the Discrete Input. Typically, each group is a different machine train.

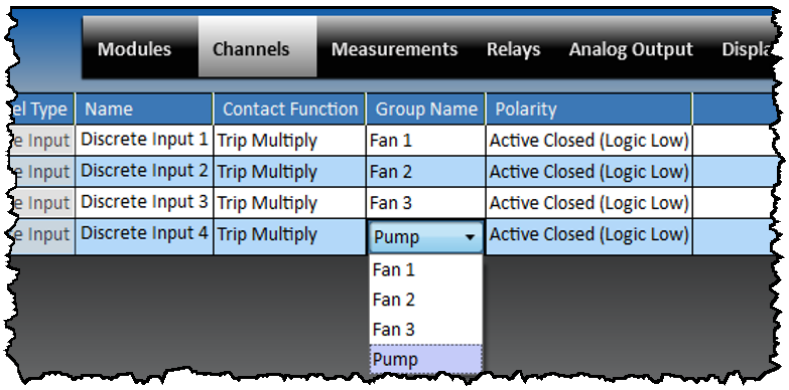


Figure 178: Discrete Input channel configuration (Contacts view)

26.4.3 Polarity

Contact polarity is defined here.

- **Logic Low:** active when the input contact is closed, inactive when opened
- **Logic High:** active when the input contact is open, inactive when closed

26.5 Simulator Enable (SAM)

For demonstration purpose only (sales persons etc.).

This option enables the demonstration mode for the front panel display. This mode affects the display only.

26.6 Power Connection Module (PCM)

The Power Connection Module is an optional module that provides power connections to the backplane from any rack slot. In the unlikely event of a partial RCM failure, you can use the PCM to maintain rack power while hot swapping the RCM.

The PCM is not designed to provide permanent power redundancy. It is for temporary power in very rare situations. Power redundancy to the VC-8000 rack is provided by the two external power supplies.

You can connect power to both the RCM and the PCM as shown in **Figure 179**. The total power provided into either Power 1 or Power 2 must be fused or current limited at 10 A to prevent exceeding system ratings on an electrical failure.

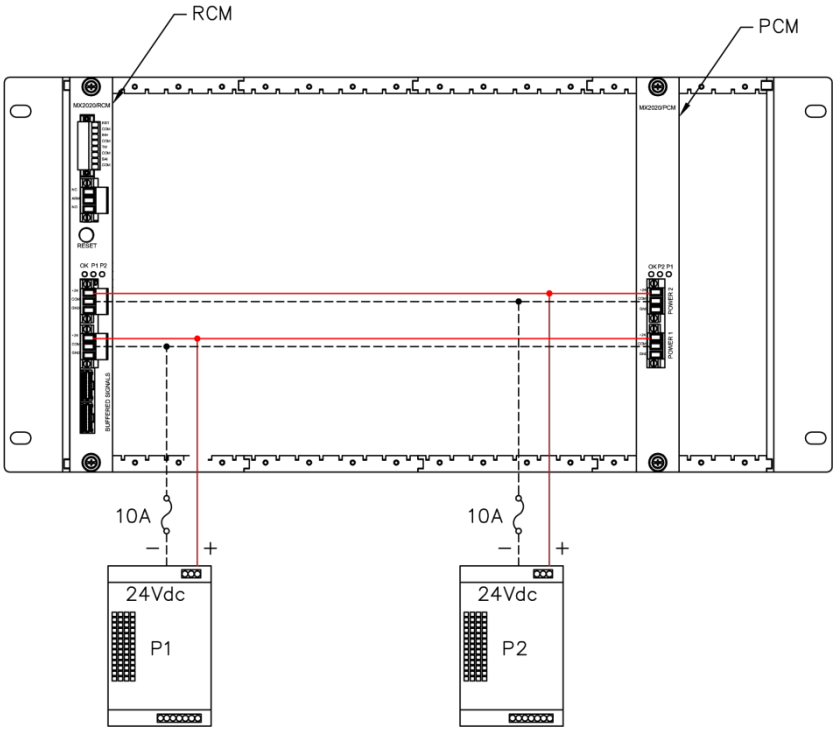


Figure 179: Connecting the Same Power Supply to RCM and PCM

Note

The PCM is not designed as a redundant power supply for the rack. It is designed as temporary power in very rare situations.

27 Appendices

27.1 Environmental Information

After use, dispose of the systems, cables and sensors in an environmentally friendly manner, in accordance with the applicable national provisions.

WEEE Reg. No. DE 69572330

Note

The VC-8000 SAM module includes a small lithium battery. Please follow proper disposal practices.

27.2 File Extensions

Table 79 lists the file extensions used by the VC-8000 system.

Table 79: Software File Extensions

File Extension	Description
.set	VC-8000 MPS Configuration + diagnostic in a single file type but can be opened by either Maintenance or Setup software. If you open a file containing only configuration information, the maintenance software will indicate that no diagnostic information is available, such as when creating a configuration on your laptop before connecting to a physical rack – or a legacy configuration file where diagnostic information was not saved.
.setk	VC-8000 Key (License upgrade, Functional Safety Lock File or password reset)
.cms	Condition Monitoring Software A single file containing CMS-formatted data. Can span no more than 7 days. Note: Currently a .cms file displays time according to the time zone of the computer viewing the file.
.cmssd	CMS Storage Directory Used with CMS-SD, CMS-HD, and CMS-XC to point to directory containing unformatted CMS data. Individual unformatted files use a variety of extensions and cannot be opened and read by CMS Display directly. They are meant to be opened as groups of files via the .cmssd extension. Unlike 7-day limit on .cms files, .cmssd has no limit on number of days spanned.
.met	Old configuration file. This format is no longer used. Please update your MPS software to the latest version.

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Subject to technical changes