Brüel & Kjær Vibro
A member of the NSK Group

Product Specifications and Ordering Information

VIBRO Condition Monitoring 3 (VCM-3 / VCM-3 Ex)

Overview

The VCM-3 is a powerful 24-channel edge device, ideal for the monitoring of auxiliary machines. The combination of comprehensive, highly flexible vibration measurements together with process data allows monitoring of your assets and operation at the edge.

This has the benefit of providing:

- Early bearing fault detection
- Application specific solutions to monitor operations and process
- Eliminating walkaround programs that may find problems too late
- Removing personnel from dangerous areas

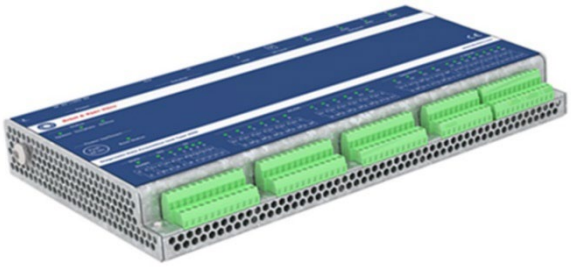
VCM-3 provides 12 dynamic channels that can each return measurements for:

- Bandpass (with option for integration)
- Narrowband (with option for integration or double integration) amplitude and phase
- Acceleration enveloping (ECU)
- Narrowband acceleration enveloping (with option for integration)
- Asynchronous, synchronous, and enveloping waveforms
- Bias voltage/gap measurement
- Bearing Condition Unit (BCU)

In addition, the following channels are also provided:

- Four tachometer channels to provide speed and phase reference
- Eight process variable channels (4–20 mA inputs)

The VCM-3 provides an easy-to-implement vibration condition monitoring solution to detect potential failure modes of your production assets that could, if not checked, result in a catastrophic failure, downtime, and production loss. The fault detection measurements offer an "Early Warning System" that brings go/no-go decisions directly into the control room as part of regular plant operations. In addition to actionable information, the VCM-3 instantly also feeds filtered and refined vibration health data to the historian, DCS, and/or SCADA systems for subsequent analysis.



Out of the box, VCM-3 detects potential rolling element bearing machine problems using a few simple machine fault indicators. One does not need to find the root cause of the vibration problem to make decisions about asset operation. This simple approach prevents DCS or SCADA systems from being flooded with information that can mask other issues. The fast 24/7 reaction of the VCM-3 provides the right information, when and where it is needed, without the shortcomings of data gaps or low-quality data of alternate periodic monitoring strategies.

When machine and process conditions dictate a more comprehensive solution and as condition monitoring capabilities grow, we offer services to extend the built-in functionality to optimize a monitoring solution to meet your needs. VCM-3 can also be used for monitoring fluid film bearing machines, variable speed machines, and process variables with custom templates offered through our services department. Come talk with us about unlocking the full potential of VCM-3 to optimize your uptime.

VCM-3 offers seamless integration into the PI System® and SETPOINT® Condition Monitoring System to enable vibration analysts to remotely monitor and analyze machine condition. With all plant data, including waveforms, located in one repository you can unlock is full potential for advanced analytics and automation.

When you need even more flexibility, the VCM-3 offers a web API (Application Programming Interface), allowing all data processed at the edge to be brought into a customer's predictive maintenance, advanced analytics, or remote monitoring application. With this web API, data can easily be centralized in the cloud. This offers ultimate flexibility when you already have software in place but need additional data to drive a successful plant optimization initiative.

Features and Benefits

Fault detection – Descriptors for trending
VCM-3 uses descriptors to enable fault detection. A descriptor is a measurement produced from the raw vibration (sensor) signal into one or more scalar values. A descriptor value is very well suited for long term trending to indicate failure modes of machines. VCM-3 measures a range of descriptors, such as real-time standardized bandpass filters for true energy measurements, narrowband filters to detect characteristic fault frequencies, and envelope bandpass for bearing fault detection.

High number of input channels/High value
Suitable for advanced condition monitoring of several machines in one device. All input channels are sampled simultaneously (synchronous sampling).

Field mountable edge device
Environmentally robust -40 °C to +60 °C (-40 °F to +140 °F) operation with built-in protocols for MODBUS TCP and OPC UA. VCM-3 can be installed as field monitors mounted at remote locations next to machines [1] or in an instrument cabinet. It can also operate in a hazardous environment [2].

Robust cybersecurity
The ports in our VCM-3 hardware have been hardened with encryption and designed to push data out to upper networks without exposing critical infrastructure to external vulnerabilities.
It is specifically designed to work with firewalls, and multi-tiered networks to meet industry's most stringent data security requirements.

NOTES:

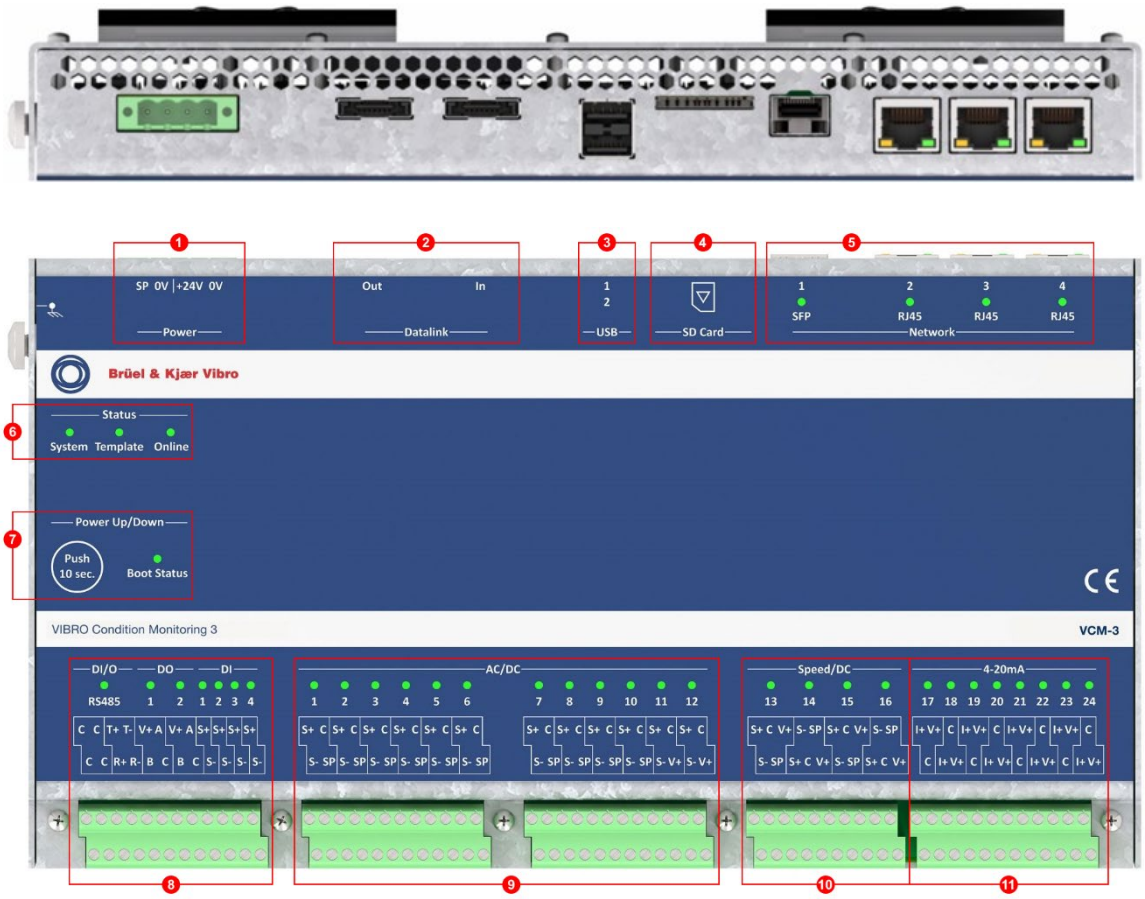
1. In a suitable field housing
2. When ordered with approvals (VCM-3 Ex) and installed according to the hazardous area installation instructions

OPC UA Server embedded in the device
Remove the need for additional software and PC/server hardware infrastructure for the OPC UA Server application, as OPC UA is embedded directly into the VCM-3 hardware device.

Open Application Programming Interface (API)
The VCM-3 API allows a flexible transfer of data from the device to a remote server over a secure connection. Data is pushed to a remote server. This requires only an outgoing network firewall port to be opened, which maintains compliance with operational network security policies. Network outages can seamlessly be recovered from through internal buffered historical data. This enables a bring-your-own software solution ideal for combining best-in-class edge computing with customer-specific analytics packages.

Field proven
Based off the third generation of the world's most popular wind turbine monitoring system with over 30 000 installed units.

Seamless integration with SETPOINT® and the PI System®
Balance of plant condition monitoring has never been easier and more valuable with seamless integration to the PI System® and SETPOINT®. Now all plant users can benefit from rich vibration and process data.



1	**Power:** 24 V Power Supply separate sensor power	
2	**Datalink:** Currently not active	
3	**USB:** 2x USB Type A mass storage	
4	**SD Card:** SD card for mass storage	
5	**Network:** 1x Optical connector, 3x RJ45 connectors (Built-in Ethernet switch)	
6	**Status:** Watchdog Indicators	
7	**Power Up/Down:** Power Up/Down and Boot Status	
8	**DI/O:** RS485 Interface **DO:** 2x Digital Outputs **DI:** 4x Digital Inputs	Incl. LED indicators for sensor status and alarm status
9	**AC/DC:** 12x AC/DC Inputs for CCS accelerometers (ICP), Displacement Probes, Direct Input Voltage	
10	**Speed/DC:** 4x Speed Inputs	
11	**4-20mA:** 8x 4–20 mA Input for Process data	

Specifications

12x AC/DC Analog Input Channels	
A/D converter – one per channel	24-bit
Sampling Frequency	204.8 kHz synchronous on all channels
Analysis Frequency Range	0.1 Hz – 80 kHz (6–4 800 000 CPM) Lower to upper (filter) corner frequency span minimum 1 : 3 but may not exceed 1 : 5 000
Input Type	Differential, bipolar (-25.5 V to +25.5 V)
Dynamic Range	> 100 dB at 1 kHz, > 94 dB at 0.1 kHz
Channel Interference	> -100 dB
AC Amplitude Accuracy	±0.5 dB
DC Amplitude Accuracy	1 % relative of full scale with ±40 mV Offset.
Total Harmonic Distortion	< 0.01%/250Hz/4Vpp
Input Impedance	> 100 kΩ
Common Mode Rejection	> 50 dB at 50 Hz
Phase Match Between Channels	< 0.3° at 80 kHz

4x Speed/Phase Reference/ DC Analog Input Channels [1, 2]	
As Speed/REF Channel (pulse input)	Industrial switches: NPN and PNP (Namur compatible) Analog: Displacement sensors
Input Range (pulse frequency)	1–14 400 RPM (0.0167–240 Hz)
Minimum pulse width	High ≥ 0.25 ms, Low ≥ 0.25 ms
Speed Accuracy (For PPR = 1)	1–300 RPM: ±0.1 % 301–3 600 RPM: ±1 % 3 601–14 400 RPM: ±3 % (For PPR > 1, accuracy depends on pulse frequency.)
Pulse Divider	For use with tacho signals with multiple pulses per revolution (PPR)
Sampling Frequency	8 kHz
Accuracy	< ±5 mV Absolute
Dynamic Range	> 100 dB

8x 4–20 mA Analog Input Channels [1]	
Sensor Types	Normal and NAMUR sensor types are accepted
Bandwidth	0–20 Hz
Sampling Frequency	4 kHz
Accuracy	Absolute accuracy: < 0.5 % Non-linearity (typical): < 0.03 % non-linearity (worst case): < 0.2 %
Offset Current Drift	< 6.5 µV/°C
Current Source	Internal or External

Real Time Descriptor Types (Scalar measurements) [1]	
Time Domain Analysis	Low pass, High pass, Band pass (tracking and fixed), ECU-Envelope Condition Unit (tracking and fixed), BCU-Bearing Condition Unit, DC, Speed, Process Inputs
Frequency Domain Analysis (DFT)	Narrowband – CPB (constant percentage bandwidth) - fixed or tracking Narrowband Envelope Condition Unit – CPB Envelope filter - fixed or tracking
Detectors	RMS, Peak, Peak-Peak, Crest factor, Phase
Physical Parameters	Acceleration, Velocity, Displacement (with proximity probes)
Speed (for tracking analysis)	Either direct from sensor, or derived speed using pulse divider and/or gearbox exchange ratio.
Process	Any 4–20 mA transducer signal. DC via AC/DC or Speed/DC (high accuracy measurements)

NOTES:

1. Ships with solution for constant speed rolling element bearings (see document C108041 for details). All other solutions delivered through Custom Template (Service) see page 8.
2. Speed measurement at higher pulse frequencies is possible via vibration (AC/DC) channels and requires dedicated configuration support from BKV.

Networking	
Network Connections	3x (RJ45), 1x optical SFP connector [1]
Low level protocol	Ethernet TCP/IP, IPv4
Switch functionality	4 network ports with built-in switch functionality

System Integration	
OPC UA Server	For data export to controllers, SCADA systems or other system components (internal update rate 5 seconds)
Modbus TCP Server	For data export to SCADA systems or other system components (internal update rate 1 second)

Cyber Security	
Secure protocols	Communication takes place through secure and encrypted protocols, such as Web-sockets, HTTPS, SCP.
Port configuration	All services using a TCP/IP port (e.g. https, default port 443) can be configured to use another port
NERC Compliance	The VCM-3 can be part of solutions complying with NERC CIP Standards. (North American Electric Reliability Corporation – Critical Infrastructure Protection).
Strong passwords	The use of strong passwords is enforced. Compliance with NIST SP800-118 – Guide to enterprise Password Management. Can be changed by user.

NOTE:

1. The SFP module must support 100BASE-FX over multi-mode fiber (MMF). Cables must be OM3 (50/125 µm) or higher with LC connectors.
   The following modules are verified to work:
   Avago HFBR-57E0ALZ and MicroOptics 100Mb LAN SFP transceivers.

Environmental *(1/2)*	
Ambient Temperature	In operation. -30 °C to +60 °C (-22 °F to +140 °F) in accordance with EN/IEC 60068-2-2. Applies to device and to device mounted in cabinet. -40 °C (-40 °F) with reduced accuracy, -70 °C (-94 °F) with de-rated Mean Time Between Failures (MTBF).
Ambient Temperature	Storage. -40 °C to +85 °C (-40 °F to +185 °F) in accordance with EN/IEC 60068-2-2
Temperature Change	Operational during a temperature change rate of 1 °C per minute in accordance with EN/IEC 60068-2-14
Static Damp Heat, Cyclic Damp Heat	In operation. According to EN/IEC 60068-2-78 EN/IEC 60068-2-30 EN/IEC 60068-2-38
Random & Sine Vibration	According to EN/IEC 60068-2-6.
Rough Handling	Storage. According to EN/IEC 60068-2-31.
High Altitudes	According to EN/IEC 60068-2-13. Air pressure equivalent to 3 500 m altitude.
Inclination	According to IEC 60092-504.
IP Rating	The device IP rating is IP20 according to EN/IEC 60529.
HALT Test	Has been subject to HALT test. Excessive vibration and temperatures and combinations hereof
CE-compliant with	EMC acc. 2014/30/EU EN IEC 61326-1 ROHS acc. 2011/65/EU EN IEC 63000:2018 ATEX acc. 2014/34/EU EN IEC 60079-0 EN IEC 60079-7

Environmental *(2/2)*	
Hazardous Area Approval (Only available for VCM-3 Ex)	24 V dc / max. 1.6 A / max. 30 W T4 Tamb -30 °C to +60 °C **UL Hazardloc Area Approval** Class I, Division 2, Groups A–D Class I, Zone 2, Group IIC **IECEx Approval IECEx UL 20.0034X** Ex ec IIC T4 Gc **ATEX Approval UL 20 ATEX 2467 X** II 3G Ex ec IIC T4 Gc **CCC Ex Approval** Applies only to the VCM-3 Ex variant identified for CCC! Reference to standards: GB/T 3836.1-2021 GB/T 3836.3-2021 Marking: Ex ec IIC T4 Gc Certificate: 2022322314004880

Mechanical	
Dimensions	280 x 153.5 x 35 mm (11.02 x 6.02 x 1.38 in)
Weight	1.5 kg (3.31 lbs)
Mounting	DIN Rail Mounting or Wall mount

Power Supply	
Voltage/Power Consumption	18–26 V DC/10 W + power consumption of each sensor.
Fuses	Power supply inputs are fused to protect against over-voltage and fire

Operational	
Fully remote operation	Upload of firmware updates and monitoring templates via network
VCM-3 Homepage	For remote or local service. Commissioning, view of trend and array data, view Log files
Calibration	Factory calibrated. (for re-calibration please contact B&K Vibro)
Service	No specific onsite service required. VCM-3 has no moving parts, or other parts which requires regular service
Design lifetime	20 years

VCM-3 Editor Computer Hardware Requirements	
Processor	Intel 64-bit or compatible
Main Memory	1 GB
Required disk space	300 MB

VCM-3 Editor Supported Operating Systems	
Microsoft Operating System	Windows 10 (64-bit) Windows 11 (64-bit) Windows Server 2019 (64-bit)

Additional Software
For editing the VCM-3 Monitoring Template parameter a spreadsheet editor is required. Excel 2010 or newer.

Ordering Information

VCM-3, Spares and Services

Use the following order codes when ordering a VCM-3 device or associated accessories. All VCM-3 devices ship with VCM-3 Editor software, standard templates, and product documentation.

VCM-3 MONITOR	
Order Code	**Description**
VCM-3-DIN	"VIBRO Condition Monitoring 3" base monitor hardware type VCM-3. **Including two DIN- rail mounting clips (screwed on).**

VCM-3 Ex MONITOR	
Order Code	**Description**
VCM-3 Ex	"VIBRO Condition Monitoring 3" hazardous area monitor hardware type VCM-3 Ex. **Including two DIN- rail mounting clips (screwed on).**

EA2039 DIN clip for VCM-3	
Order Code	**Description**
EA2039	2x DIN clip (set) including screws, for mounting a VCM-3 to a DIN-rail (One set required for one VCM-3).

EP2136 Adapter plate for VCM-3	
Order Code	**Description**
EP2136	1x stainless aluminium mounting plate including screws for wall mounting a VCM-3.

Weatherproof Housing

Painted steel housing (IP66) with a viewing window is available with a VCM-3, 24 V power supply and circuit breaker included.

CM360/CG-VCM-3 [1]	
Order Code	**Description**
CM360/CG-VCM-3	Weatherproof housing for VCM-3. Includes VCM-3, 24 V power supply, circuit breaker, and housing.

NOTE:

1. This housing is not rated for hazardous area. Please contact our service department for appropriate housing solutions when deploying in hazardous areas.

Refer to document *"CM360-CG/VCM-3 Product Specifications and Ordering Information (C107897)"* for details about the housing bundle.

Custom Template (Service)

Custom templates offer solutions for specific machines and customer application needs. When additional measurements are needed to monitor specific machinery failure modes or process-related issues, B&K Vibro application engineers can provide these solutions (Asset Health Monitoring Strategy) as a service offering. The resulting asset health monitoring strategy provides additional information and notification of developing machine and process failures in simple-to-use trends and alarms of core structural machine failure modes and machine-specific components. This simplifies the process of identifying defects and analyzing the root cause so that decisive go/no-go actions can be taken to maintain operations and optimize maintenance.

Order one custom template per type of machine train. [1]

CORE Monitoring Template [2]	
Order Code	**Description**
VCM-3-TEMP-CORE	Service to create a customized configuration (monitoring template) for VCM-3 that provides an early indication of developing faults linked to the core structure of the asset. Templates are applicable to constant speed, variable speed, rolling element bearing and fluid film bearing machines. Typical errors and problems that can be recognized are, e.g., bearings, imbalances, misalignment, looseness, and excessive stress on the machine structure due to vibrations.

COMPONENT Monitoring Template [2]	
Order Code	**Description**
VCM-3-TEMP-COMP	Service to create a customized configuration (monitoring template) for VCM-3 that provides not only an early indication of developing faults linked to the core structure of the asset (see VCM-3-TEMP-CORE) but will also indicate the health of machine components. For example, the inner race bearing frequency vibration amplitude can be measured to track this specific component failure. Additional measurements (descriptors) to cover rolling element bearings, gears, blades, and other mechanical components simplify monitoring by providing more precise information on each failure mode of the machine.

CHANGE Monitoring Template	
Order Code	**Description**
VCM-3-TEMP-CH	Service to change an existing configuration (monitoring template) for VCM-3. Minor and straight forward changes to an existing (CORE or COMPONENT) monitoring template (monitoring configuration).

NOTES:

1. VCM-3 Editor can adjust all relevant settings for a custom template.
2. Template may be delivered with asynchronous and enveloping waveforms or with asynchronous and synchronous waveforms, but not all three together.

Wiring Diagrams

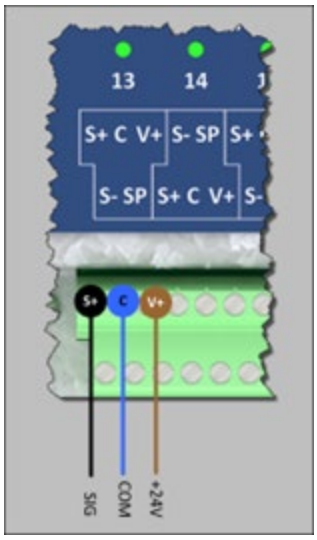


Figure 1:
Constant Current Sensors

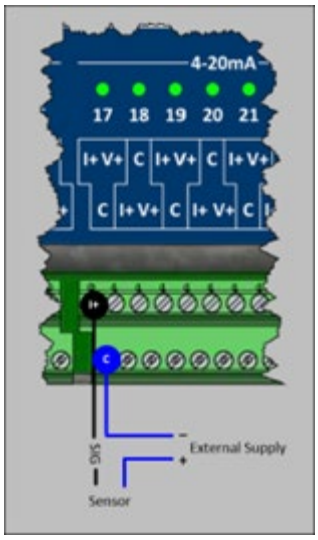


Figure 2:
4–20 mA inputs

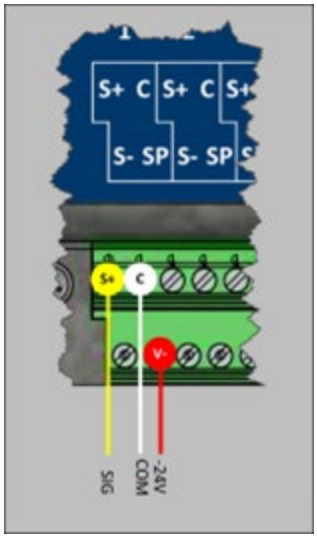


Figure 3:
Displacement Sensors

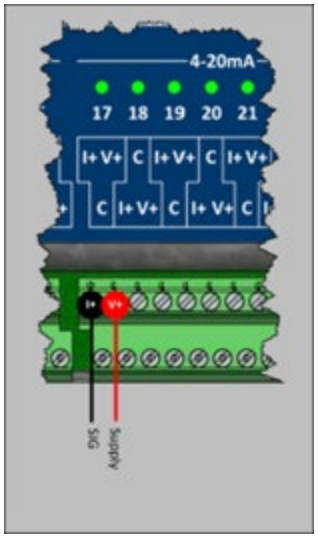


Figure 4:
4–20 mA inputs with external supply

Refer to document *"VCM-3 Instructions (C108418)"* for details about sensor installation and wiring.

Additional documentation

Document type	Document title	Document no.
Product Specifications and Ordering Information	VIBRO Condition Monitoring 3 (VCM-3 / VCM-3 Ex)	C107757
	VIBRO Condition Monitoring 3 (VCM-3) – Reliability	C108080
	CM360-CG/VCM-3 Condition Monitoring System	C107897
	VCM-3 Monitoring Template – S01 Standard	C108041
	SETPOINT CMS Overview	S000029
Quickstart Guide	VCM-3	C108026
Instructions	VIBRO Condition Monitoring 3 (VCM-3 / VCM-3 Ex) – Safety	C107761
	VIBRO Condition Monitoring 3 (VCM-3 / VCM-3 Ex)	C108418
	CM360-CG/VCM-3	C107899
	VCM-3 Editor	C107762
	VCM-3 Firmware Update Tool	C108141
Troubleshooting Guide	VCM-3 Condition Monitoring Unit	C108291
Release Notes	VIBRO Condition Monitoring 3 Firmware	C107825

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