



Product specifications and ordering information

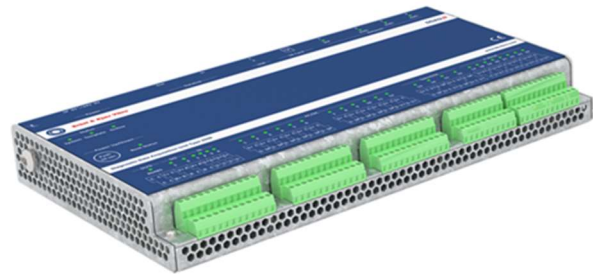
VIBRO Condition Monitoring 3 (VCM-3)

At a Glance Overview

The VCM-3 is the cost effective 12 channel data acquisition hub targeted at monitoring of auxiliary machines, balance-of-plant (BOP) machines and less critical assets as part of enterprise Industry 4.0 digitization efforts. Multiple VCM-3 monitors can be connected to your network with wired technology providing the next generation of asset condition monitoring without batteries or spotty occasional monitoring provided by route based or multiplexed systems.

The monitor devices are robust, simple to install, and provide industry standard CCS (Constant Current Supply) acceleration sensor inputs and power. Along with advanced signal processing the VCM-3 provides extensive alarm capability. For trouble shooting and commissioning purposes for each channel and main descriptor a spectra (FFT) type data plot can be accessed via the built-in VCM-3 Homepage (Web server).

The VCM-3 will end your frustration monitoring your balance-of-plant (BOP) and smaller less critical machines. These machines are often difficult to identify and diagnose potential problems especially with the periodic low bandwidth data provided by most existing systems. These machines need high fidelity continuous data streams for effective monitoring. Whether your monitoring strategy uses alternative on-premise or internal VCM-3 descriptor alarming - for instance to comply to ISO 10816 respectively 20816 standard - be ready for a step change down in the cost of maintaining and understanding your less critical machines.



Spanning the gap between periodic monitoring with data collectors and wireless sensors and the need for continuously connected assets managed 24/7 for reliability and plant optimization. The VCM-3 provides continuous monitoring of BOP and spared equipment in a wide range of industries. Often these mechanical assets are naturally located with multiple machines in close proximity. The VCM-3 is ideal for continuously monitoring up to four (or even six) machines - typically being equipped with two bearings- utilizing the twelve dynamic vibration signal inputs.

This data is concentrated into a single network stream using Modbus TCP Server or OPC UA Server acting as a functional edge device powering the enterprise digital transformation.

NOTE, the VCM-3 has an integrated OPC UA Server functionality in the hardware. All measurement, alarm and status data can be transferred directly from the VCM-3 hardware to an OPC UA Client application. Thanks to the built-in network switch functionality, no additional external Ethernet switch hardware is required when integrating multiple VCM-3 devices. The available optical SFP network connector supports a stable long distance network connection.

The VCM-3 processes advanced descriptors which are extracted key features from parallel AD processing for direct monitoring of roller element bearings (REB). Use of modern electronic design elements allows the VCM-3 to provide continuous monitoring of the 12 channels of sensor input at a very competitive cost point that will help you accelerating your enterprise's digital transformation.



Key Features and System Benefits

- **Fault detection – Descriptors for trending**
VCM-3 is using descriptors for fault detection. A descriptor is created by post processing 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, 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).
 - 12 Dynamic vibration input channels, sampled at 204,8K samples per second via 24 Bit analog to digital converter (ADC)
- **Field mountable edge device**
Environmentally robust -40 to +60 °C (-40F to +140F) 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 the machines* or in an instrument cabinet.

*in a suitable field housing
- **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, data diodes, and multi-tiered networks to meet industry's most stringent data security requirements
- **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.
- **VCM-3 Homepage (embedded Web server)**
Acceleration/Velocity spectrum and Envelope spectrum plot (all FFT, Hanning Window) can be accessed for each of the 12 dynamic vibration input channels via the built-in Homepage (Web server). This can perfectly be used for commissioning or remote diagnostic access use cases.
- **Field proven**
Based off the third generation of the world's most popular wind turbine monitoring system with over tens of thousands installed units.
- **Rolling Element Bearing (REB) descriptors**
 - Acceleration band pass with flexible filter corners (simultaneously measured detectors rms, peak, crest factor)
 - Velocity (integrated from acceleration) with flexible filter corners (rms, ISO 10816 / ISO 20816 support)
 - Enveloped Bearing Condition ECU with flexible filter corners
- **Designed for the future (without change of VCM-3 device hardware)**
The computational power, the existing sensor input and analysis capabilities, and the flexibility in the design make VCM-3 a technology leader for many years to come. Supports any state-of-the-art condition monitoring method and provides a platform for customizations and development of future new monitoring methods.

VCM-3 System Components

A VCM-3 system consists of the following basic components:

- VCM-3 device hardware
- VCM-3 Homepage (built-in Web server)
- VCM-3 Editor (Software application to set up the configurable parameters of a Standard Monitoring Template and download to the VCM-3 Web server)

NOTE!

To start up a VCM-3, a personal computer (PC) with Microsoft Windows operating system is required. For more information please consult the dedicated section **Ordering Information** and **VCM-3 Editor – PC and Software Requirements** at the end of this document.

Fault detection, Trending and Identification

The VCM-3 has been designed to continuously acquire different characteristic values from the sensor raw input signal of the connected sensor. Each of these characteristic values are captured as a “**Descriptor**”. In future version releases, descriptors can be customized to accurately monitor for specific component failure modes. An increase in the level of a descriptor is a symptom of a developing fault on the machine. A descriptor respectively series may be the ECU value, which indicates a bearing fault. A descriptor value may also be used to express the severity of the vibration level of the component compared to international standards such as ISO 10816. The powerful inbuilt signal processing capabilities enables the VCM-3 to extract a number of descriptors measured simultaneously on the independent measurement channels.

Experience shows that long term trending on the each of the descriptors derived from the input signal provides a very sensitive measure of the operational state of the machine and gives an early indication of a progressing fault, thus maximizing lead time to plan a service shutdown or to provide enough evidence to postpone a repair to the next scheduled shutdown.

Monitoring Templates

The configuration of the VCM-3 hardware units is organized in “**Monitoring Templates**”.

The VCM-3 can be loaded with different monitoring templates implementing a specific monitoring strategy adapted to the type of machine and monitoring requirements without the need for changing the hardware.

Standard Monitoring Template

To simplify the system set up work a set of two Standard (Master) Monitoring Templates- is supplied together with the VCM-3 System. Each of these templates has been developed to cover applications for the following types of machinery:

Standard Monitoring Templates*			
No.	Template name	Machine/Asset Application	Input channels
1.1	VCM-3-TPL-AUX-SI	Auxiliary Machinery, REB, Constant Speed (SI = Metric units)	12 accel.
1.2	VCM-3-TPL-AUX-IMP	Auxiliary Machinery, REB, Constant Speed (Imperial units)	12 accel.

*Further Standard Monitoring Templates supporting other machine/asset applications to come in future. Please contact your local Sales representative.



Technical Specification – Standard Monitoring Template

The VCM-3 input channels enable acceleration sensors (CCS, Constant Current Supply) to be used as signal inputs. The table below shows how each channel of the VCM-3 is configured for each of the available Standard Monitoring Templates. All descriptors on all measurement channels are measured in parallel (simultaneously) and are continuously updated.

Sensor and Descriptor configuration on input channels (Chl.)		
Chl.	Sensor Input	Descriptors (each measurement once/Chl.)
1	Accel. (CCS)	Acceleration “BP” (<u>B</u> and <u>P</u> ass): m/s ² or g; rms/peak/crest factor; adjustable filters (*1Hz - 10kHz)
2	Accel. (CCS)	
3	Accel. (CCS)	
4	Accel. (CCS)	
5	Accel. (CCS)	
6	Accel. (CCS)	Acceleration enveloping “ECU” (<u>E</u> nveloped <u>C</u> ondition <u>U</u> nit): adjustable filters (*1kHz - 10kHz)
7	Accel. (CCS)	
8	Accel. (CCS)	
9	Accel. (CCS)	
10	Accel. (CCS)	Velocity “BPI” (acceleration <u>B</u> and <u>P</u> ass integrated to velocity): mm/s or in/s; rms; adjustable filters to ISO Standards 10816/20816 (*10Hz - 1000Hz)
11	Accel. (CCS)	
12	Accel. (CCS)	

NOTE:

- All sensor input channels can be enabled/disabled.
- For the descriptors “BP” (acceleration), “ECU” (acceleration enveloping) and “BPI” (velocity integrated from acceleration) on each of the twelve vibration input channels an individual Alert and Danger alarm limit (including delay time) can be set.
- *The given (frequency range) is the default setting and can be fully adjusted by the user.
- The default scaling of all accelerometer input channels is 100 mV/g and can be fully adjusted by the user
- On each of the twelve vibration input channels the CCS sensor average bias voltage (vavg) is measured. The associated measurement (descriptor) in the template is called “PT”. There is not alarming on this.
- CCS stand for Constant Current Supply. CCS supply can be switched on/off on a channel individual base. The default (power) supply settings for the accelerometer input channels is “power on”
“CCS” is also known as ICP® or IEPE.

VCM-3 Homepage (built-in web server)

The configuration of VCM-3 is done via the VCM-3 Homepage. Apart from specific configuration the Homepage offers on-line/on-site check of descriptors and frequency spectra. Figure 1 and 2 examples will illustrate this. The Homepage access is controlled by user login with username and password.

Data - View Descriptor Data

Descriptor group: Description: all descriptors

Extended search

<input checked="" type="checkbox"/>	Name	Channel	Value	Timestamp (UTC)	Status
<input checked="" type="checkbox"/>	Vibration Channel 1 PT.vavg	Vibration Channel 1	8.0602 V	2020-02-05 19:31:16	[OK]
<input checked="" type="checkbox"/>	Vibration Channel 1 Status		0	2020-02-05 19:31:10	[OK]
<input checked="" type="checkbox"/>	Vibration Channel 1 BPl.rms	Vibration Channel 1	1.5433 in/s	2020-02-05 19:31:16	[OK]
<input checked="" type="checkbox"/>	Vibration Channel 1 BPl.rms_Alarm	Vibration Channel 1	0	2020-02-05 19:31:10	[OK]
<input checked="" type="checkbox"/>	Vibration Channel 1 ECU.rms	Vibration Channel 1	0.3506	2020-02-05 19:31:16	[OK]
<input checked="" type="checkbox"/>	Vibration Channel 1 ECU.rms_Alarm	Vibration Channel 1	0	2020-02-05 19:31:10	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.rms	Vibration Channel 1	0.0902 g	2020-02-05 19:31:16	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.rms_Alarm	Vibration Channel 1	0	2020-02-05 19:31:10	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.pk	Vibration Channel 1	0.1803 g	2020-02-05 19:31:16	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.pk_Alarm	Vibration Channel 1	0	2020-02-05 19:31:10	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.cf	Vibration Channel 1	1.9988	2020-02-05 19:31:16	[OK]
<input type="checkbox"/>	Vibration Channel 1 BP.cf_Alarm	Vibration Channel 1	0	2020-02-05 19:31:10	[OK]
<input type="checkbox"/>	Vibration Channel 2 PT.vavg	Vibration Channel 2	8.0594 V	2020-02-05 19:31:16	[OK]
<input type="checkbox"/>	Vibration Channel 2 Status		0	2020-02-05 19:31:10	[OK]

Figure 1 VCM-3 Homepage: Data – View Descriptor Data (All data from all enabled channels will be continuously updated)

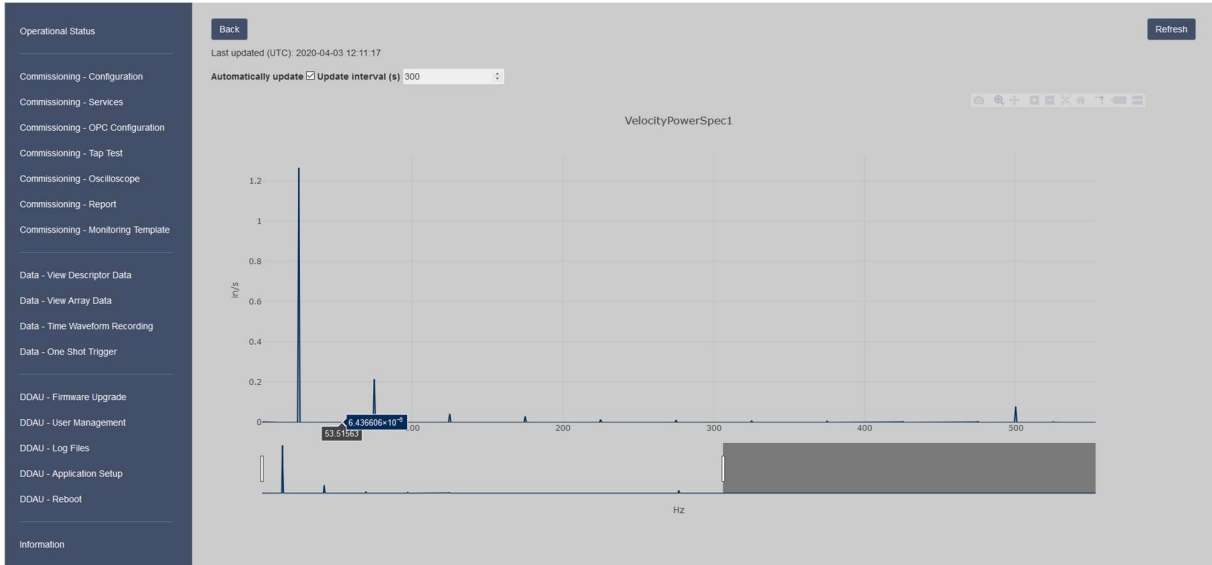


Figure 2 VCM-3 Homepage: Data – View Array Data
(Example: FFT spectra derived from vibration velocity descriptor “BPI”)



Figure 3 VCM-3 Homepage: Data – View Array Data
(Example: Envelope spectra (SED) derived from acceleration enveloping descriptor “ECU”)

Technical Specification (device)

For additional information and instructions, refer to the following companion documents:

Document/Description	Document No.
VCM-3 Installation Instruction	C107758.002
Product specifications and Ordering information	C107757.002
VCM-3 Safety (short) Instruction	C107761.001
VCM-3 On-Site Commissioning Manual	C107759.002
VCM-3Homepage Manual	C107760.002
VCM-3 Editor Software Manual	C107762.002

12, AC/DC Analog Input Channels	
ADC	24 Bit
Sampling Frequency	204.8kHz synchronous on all channels
Analysis Frequency Range	0.1Hz - 80kHz (ECU: 1kHz to 80kHz) Lower to upper (filter) corner frequency span minimum 1 : 3 but may not exceed 1 : 5000
Input Type	Differential, bipolar (-25.5V to +25.5V)
Dynamic Range	> 100dB at 1kHz, > 94dB at 0.1kHz
Channel Interference	>-100dB
AC Amplitude Accuracy	±0.5dB
DC Amplitude Accuracy	1% relative of full scale with ±40mV Offset.
Total Harmonic Distortion	< 0.01%/250Hz/4Vpp
Input Impedance	>100kΩ
Common Mode Rejection	>50dB at 50Hz
Phase Match Between Channels	<0.3° at 80kHz
Sensor Power Supply	10mA/+24 Volt/ -24 Volt (external)
Scalar Measurements (Descriptors)	
Time Domain Analysis	<ul style="list-style-type: none"> - Acceleration band pass - Velocity band pass (accel. integrated, ISO) - ECU Envelope Condition Unit - Sensor Bias Voltage

	Detectors	RMS (Accel. Vel.), Peak (Accel), Crest factor (Accel.)
	Physical Parameters	Acceleration, Velocity
Networking		
Network Connections	3x (RJ45), 1x optical SFP connector	
Low level protocol	Ethernet TCP/IP, IPv4, (prepared for IPv6)	
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 seconds)	
Modbus RTU	(in preparation)	
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.	



Environmental	
Ambient Temperature	In operation. -30°C to +60°C (-22F to +140F) in accordance to EN/IEC 60068-2-2. Applies to device and to device mounted in cabinet. -40°C (-40F) with reduced accuracy, -70°C (-94F) with de-rated Mean Time Between Failures (MTBF).
Ambient Temperature	Storage. -40°C to +85°C (-40F to +185F) in accordance to EN/IEC 60068-2-2
Temperature Change	Operational during a temperature change rate of 1°C per minute in accordance to 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 and 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 3500m 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
UL Certification	cULus certified (in preparation)
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/10W + 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 (embedded)	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 (Software) - PC and Software requirements

The VCM-3 Editor application allows adjustment of the configuration parameters for Standard Monitoring Templates provided with the software.

Hardware Requirements	
Processor:	Intel 64 Bit or compatible
Main Memory	1GB
Required disk space	300 MB
Supported Operating Systems	
Microsoft Operating System	Windows 10 (64 Bit) Windows Server 2016 (64 Bit)
Additional Software	
For editing the VCM-3 Monitoring Template parameter a spreadsheet editor is required. Excel 2010 or a newer version is recommended, but other spreadsheet editors capable of handling .xlsx files can be used as well	

Ordering Information

Use the following order codes when ordering a VCM-3 device or associated accessories.

VCM-3 MONITOR (SPARE)

Order Code	Description
VCM-3	“VIBRO Condition Monitoring 3” base monitor hardware type VCM-3. 1 to 12-channel monitoring system without mounting accessories.

VCM-3 MONITOR (DIN Rail)

Order Code	Description
VCM-3-DIN	“VIBRO Condition Monitoring 3” base monitor hardware type VCM-3. 1 to 12-channel monitoring system 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 steel mounting plate including screws for wall mounting a VCM-3.

Contact

Brüel & Kjær Vibro GmbH
Leydheckerstrasse 10
64293 Darmstadt
Deutschland

Phone: +49 (0) 6151 428 0
Fax: +49 (0) 6151 428 10 00
E-Mail: support@bkvibro.com
www.bkvibro.com

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Brüel & Kjær Vibro A/S
2850 Nærum – Denmark

Phone: +45 77 41 25 00
Fax: +45 45 80 29 37

BK Vibro America Inc
2243 Park Place, Suite A
Minden, Nevada 89423
USA

Phone: +1 (775) 552 3110