

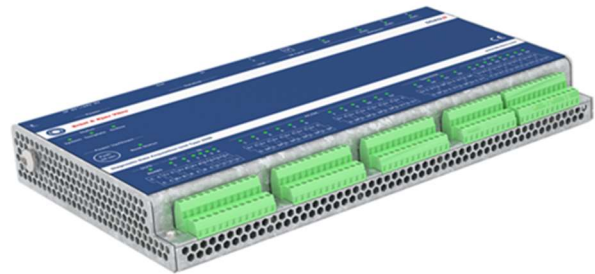


Product specifications and ordering information VIBRO Condition Monitoring 3 (VCM-3)

At a glance overview

The VCM-3 is the cost effective 24 channel data acquisition hub targeted at full featured 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 (RJ-45) 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 sensor inputs and power. Along with very advanced signal processing the VCM-3 provides internal buffering (covering network outages), extensive alarm capability, and sensor raw signal (time waveform) data. For trouble shooting and commissioning purposes a Spectrum (FFT) and time waveform (oscilloscope plot) can be accessed via the built-in 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 (essential medium to less critical) 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/IP or OPC UA Server acting as a functional edge device powering the enterprise digital transformation. It is remarkable that VCM-3 has already integrated the OPC UA Server functionality in the hardware. It is therefore not necessary to install additional computer hardware/industrial PCs in the network. 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 switch hardware is required when integrating up to three VCM-3 devices.

The VCM-3 processes advanced descriptors which are extracted key features from very high speed (20K samples per second) parallel ADs for direct monitoring of roller element bearing (REB) frequencies, gear mesh frequencies, velocity, proximity and enveloped acceleration. 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 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 large 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 from one to four or even six machines in one device. All input channels are sampled simultaneously (synchronous sampling).
 - 12 Dynamic (AC/DC) vibration input channels, sampled at 204,8K samples per second
- **Field mountable edge device**
Environmentally robust -40 to +60 °C (-40F to +140F) operation with built in protocols for MODBUS TCP/IP 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 infrastructure as OPC UA (acting as a Server) is supported directly from the hardware device.
- **VCM-3 Homepage (embedded Web server)**
Spectrum (FFT, Hanning) and time waveform (oscilloscope) plots can be accessed via internet browser for each dynamic vibration input channel 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.
- **Rolling Element Bearing (REB) descriptors**
 - Acceleration band pass with flexible filter corners (rms, peak, crest)
 - Velocity (integrated from acceleration) with flexible filter corners (rms, ISO 10816 / 20816 support)
 - Envelope Bearing Condition ECU
- **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 Web server
(device cockpit/homepage, in-built)
- 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 is in ideal a **“Descriptor”** of a characteristic failure mode and indicates the status of the machine component with respect to that potential failure mode. An increase in the level of a descriptor is a symptom of a developing fault on the machine component. A descriptor respectively series may be the value of NX for indicating misalignment or unbalance, or 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 huge 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 a very early indication of a progressing fault of machine component, 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 Monitoring Template combines each sensor with measurement functions (descriptors), detector functions and post processing functions in order to provide a list of descriptors expressing the characteristics of the measured input signal. 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 Templates

To simplify the system set up work a set of currently two generic Standard Monitoring Templates is supplied together with the VCM-3 System. Each of these templates has been developed to cover most 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 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 Templates

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.	Template No.: 1.1, 1.2	Descriptors (Measurements)
1	Accel. (CCS)	BP (band pass): accel. m/s ² or g; rms/peak/crest factor; (1Hz – 10 kHz)*
2	Accel. (CCS)	
3	Accel. (CCS)	
4	Accel. (CCS)	
5	Accel. (CCS)	ECU (Envelope Condition Unit): accel. ECU (1 kHz – 10 kHz)*
6	Accel. (CCS)	
7	Accel. (CCS)	
8	Accel. (CCS)	
9	Accel. (CCS)	BPi (band pass, integrated): velocity mm/s or in/s; rms; (10Hz - 1000Hz)*, ISO 10816
10	Accel. (CCS)	
11	Accel. (CCS)	
12	Accel. (CCS)	

NOTE:

- Each of the 12 channels supports the same descriptors (measurements) however the descriptor parameter set up (e.g. frequency range, alarm limits, etc.) can be set up on an individual base. All channels can be enabled/disabled.
- For the descriptors BP, BPi and ECU 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
- The default scaling of all accelerometer input channels is 100 mV/g
- On each of the twelve vibration input channels a descriptor (measurement) called PT is available. This descriptor represents the sensor bias (average) voltage (vavg). There is not alarming on this.
- The default power settings for the accelerometer input channels is "power on"
- CCS stand for Constant Current Supply. CCS supply can be switched on/off on a channel individual base.

VCM-3 Homepage (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, time waveform (oscilloscope) and frequency spectra. Figure 1 to 3 examples will illustrate this. The homepage access is controlled by user login with username and password.

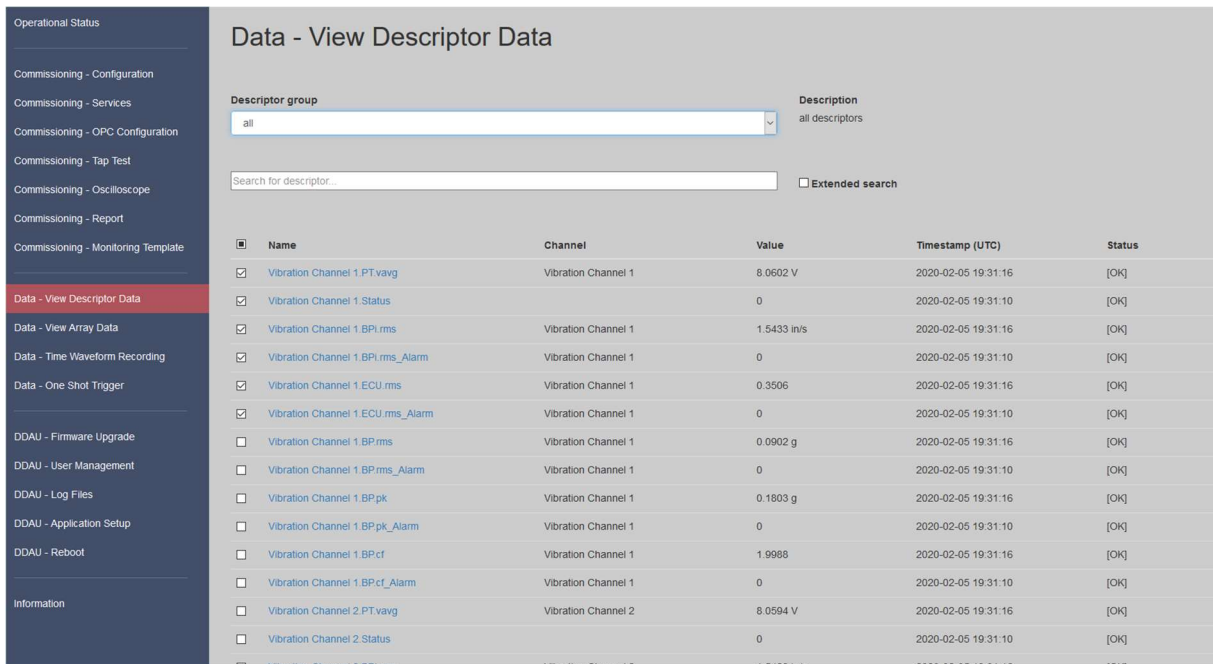


Figure 1 VCM-3 Homepage: Data – View Descriptor Data (All data from all enabled channels will be continuously updated)

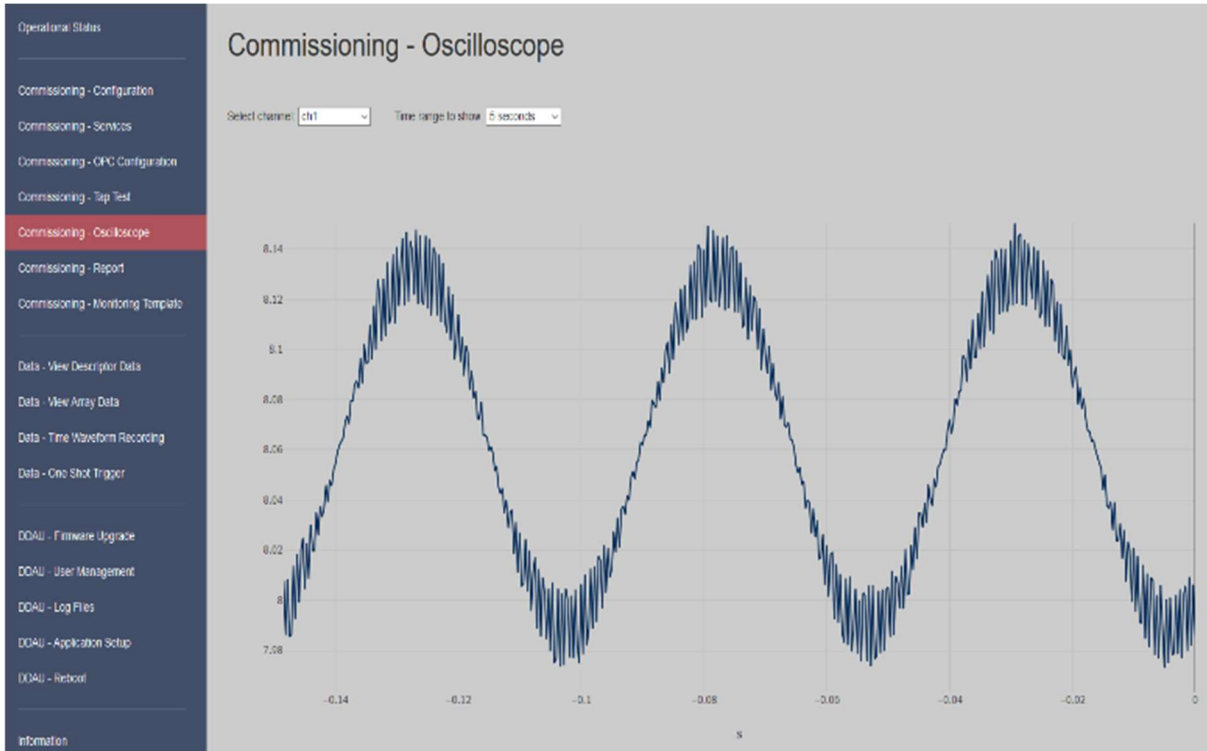


Figure 2 VCM-3 Homepage: Commissioning Oscilloscope (Time waveform plot/display from all enabled channels)

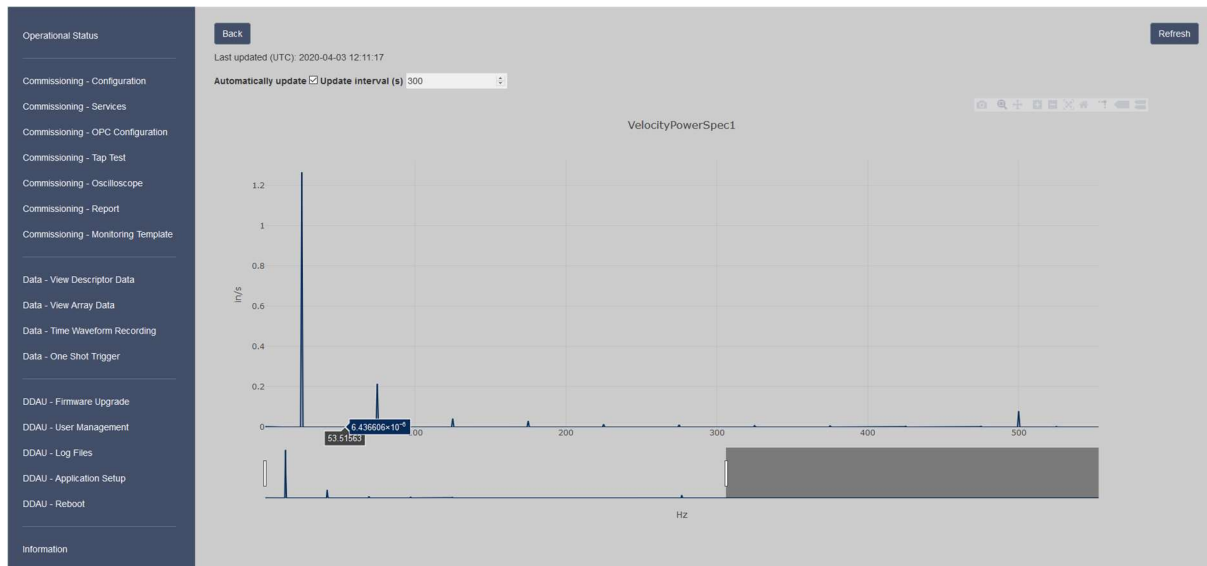


Figure 3 VCM-3 Homepage: Data – View Array Data
(Example: FFT spectra from BPI descriptor means the frequency content of an ISO vibration overall)

Technical Specification (device)

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

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

12, AC/DC Analog Input Channels	
Sampling Frequency	204.8kHz synchronous on all channels
Analysis Frequency Range	DC-80kHz
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"> - Band pass - ISO Band pass (integrated) - ECU Envelope Condition Unit - Bias Voltage
Detectors	RMS, Peak, Crest factor

	Physical Parameters	Acceleration, Velocity
Frequency Domain Analysis (DFT)	Narrowband Envelope Condition Unit – ECU envelope filter	
	Detectors	RMS
	Physical Parameters	Acceleration
Waveforms		
Time Domain.	Time Waveform – absolute	
	No. of samples: 65536 stored in history buffer	
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	
Modbus TCP/IP Server	For data export to SCADA systems or other system components	
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 Web server)	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 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.
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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).
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EA2039 DIN clip for DDAU3/VCM-3	
Order Code	Description

EA2039	2x DIN clip including screws, for mounting a DDAU3/VCM-3 to a DIN-rail (2x DIN clips required for one VCM-3).
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EP2136 Adapter plate for DDAU3/VCM-3	
Order Code	Description

EP2136	1x stainless steel mounting plate including screws for wall mounting a DDAU3/VCM-3.
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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