



Operating instructions

GB

**VVB301
VVB302
VVB305
VVB306**

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1 Safety instructions

- The unit described is a subcomponent for integration into a system.
 - The system architect is responsible for the safety of the system.
 - The system creator undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.

2 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

2.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

2.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:



WARNING

Warning of serious personal injury

- ▷ If the warning is not observed, fatal and serious injuries are possible.



CAUTION

Warning of minor to moderate personal injury

- ▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

- ▷ If the warning is not observed, damage to property is possible.

3 Intended use

- Condition monitoring on machines and systems by detecting condition indicators (vibrations and surface temperature)
- Parameter setting and process value transfer to an IO-Link master and thus indirectly to a machine controller (e.g. PLC) via the IO-Link interface or to an IT infrastructure via MQTT / REST API
- Asynchronous reading of raw data (time signal) or a characteristic value history (BLOB - Binary Large Object)

3.1 Article versions

Four articles are available, which essentially differ in terms of the IO-Link process data flow and the unit in the IO-Link process data flow.

Article number	Properties
VVB301 Basic condition monitoring	The process data flow consists of 5 process values with configurable measurement axes. The IO-Link process data flow has 16 bytes. Transmission units: m/s, m/s ² and °C.
VVB302 DataScience condition monitoring	The process data flow consists of 13 process values with fixed axis parameters. The IO-Link process data flow has 32 bytes. Transmission units: m/s, m/s ² and °C.
VVB305 Basic condition monitoring	The process data flow consists of 5 process values with configurable measurement axes. The IO-Link process data flow has 16 bytes. Transmission units: mm/s, mg und °C.
VVB306 DataScience condition monitoring	The process data flow consists of 13 process values with fixed axis parameters. The IO-Link process data flow has 32 bytes. Transmission units: mm/s, mg und °C.

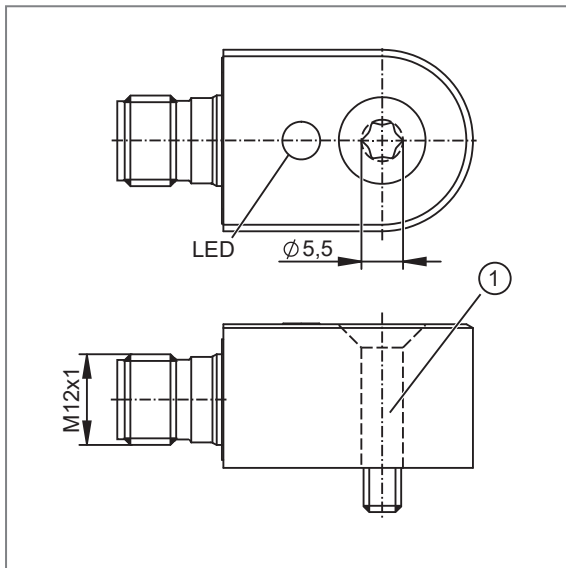
3.2 Indicators

Trend indicators	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
v-RMS	(Component) fatigue Set the setpoint SP1/2 Set the reset point rP1/2	0.2...300.0 mm/s 0...299.8 mm/s	0.2...300.0 mm/s 0...299.8 mm/s
a-Peak	Impact Set the setpoint SP1/2 Set the reset point rP1/2	204...16000 mg 0...15796 mg	204...16000 mg 0...15796 mg
a-RMS	Friction Set the setpoint SP1/2 Set the reset point rP1/2	204...16000 mg 0...15796 mg	204...16000 mg 0...15796 mg
Crest	Crest factor Set the setpoint SP1/2 Set the reset point rP1	2...50 1...49	Not available

Trend indicators	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
Temperature	Temperature Set the setpoint SP1/2 Set the reset point rP1/2	-28...80 °C -30...78 °C	-28...80 °C -30...78 °C

Trend indicators	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
Unbalance detector	Unbalance analysis – acyclic value Limit value for event can be set	0...300.0 mm/s Factory setting: 3 mm/s	0...300.0 mm/s Factory setting: 3 mm/s
Bearing analysis	Bearing analysis (BearingScout) – acyclic value Limit value for event can be set	Not available	0...16000 mg Factory setting: 300 mg

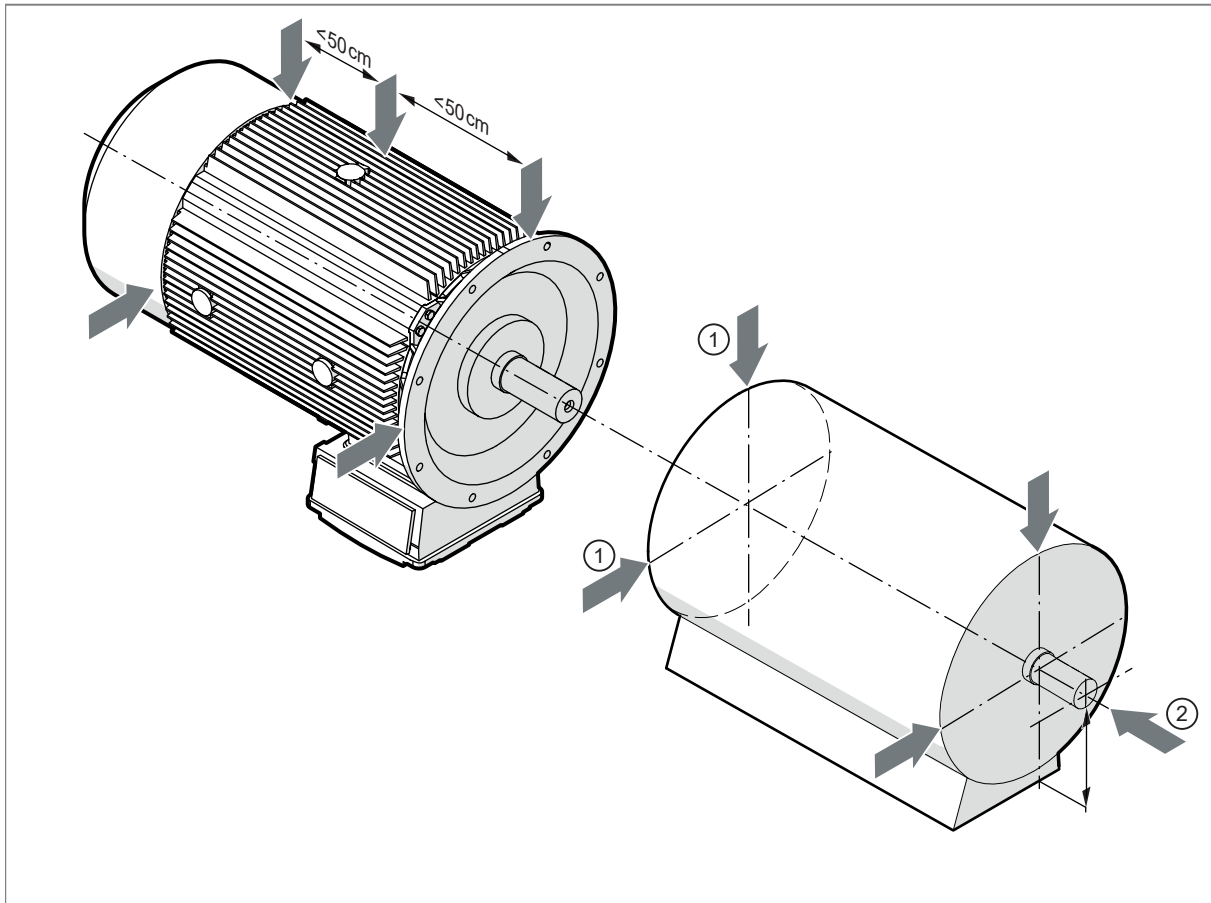
4 Installation



1: M5 threaded screw

Torx adapter with tightening torque 4.6 Nm

- Drill and tap a hole at the mounting location: M5 hole / depth min. 10 mm for the mounting screw



The measurement axis should be in the direction of the main vibration. The main vibration is usually in radial direction to the shaft (1).

In case of fixed bearings with high axial force absorption or axial bearings, the preferred measuring direction can be axial to the shaft (2).

The sensor offers the option of monitoring all three measurement axes. This allows flexible positioning of the sensor to detect axial and radial forces at a mounting position.

- Mount only in a thick housing wall and vertically to the machine surface close to the bearing or at the end shield.

- Ensure a safe vibration transmission and allow no elastic intermediate layers.
- Position the sensor at a distance of < 50 cm from the bearing.
- Tighten the device with a tightening torque of 4.6 Nm.

The measurement axes of the sensor are marked on the sensor housing.

Adapters of any kind have an impact on the vibration measurement.

The mass, shape and stiffness of the adapter have an influence on the frequency response of the entire system. Both resonances and damping effects may occur in different frequency ranges.

- Use tested mounting accessories from ifm: documentation.ifm.com



A tightening torque that is too low will lead to insufficient coupling between the sensor and the machine.

A tightening torque that is too high may damage the sensor and the screw.



To measure the process value temperature, a safe mechanical connection of the sensor must be ensured.

- Ensure proper and direct installation.

4.1 Preparing the contact surface

- Prepare a clean and smooth contact surface that is free from any coating to fix the sensor.

The prepared contact surface must be a little larger than the sensor or the mounting adapter.

4.2 Types of mounting

The following table indicates the transferable measuring range of 3 different types of mounting.

Type of mounting	Frequency range
Screw connection	up to approx. 15 kHz
Direct gluing	up to approx. 8 kHz
Magnet	up to approx. 3 kHz

4.3 Screw connection

For the permanent installation of sensors a screw connection is the ideal and recommended method.

- Screw sensor.
- Increase the rigidity of the connection by means of a screw retaining compound.



The supplied screw is pre-coated with a screw retaining compound. This screw retaining compound will become ineffective if the screw is unscrewed again.

- Optionally, apply technical Vaseline / lubricating grease to the contact points.

4.4 Gluing

Gluing is suitable for temporary measurements or if the surface is not suitable for a screw connection.

- Use an adhesive adapter so that the sensor can be replaced.
- Fix the sensor to the adhesive adapter.
- Fix the adapter/sensor unit to the machine according to the instructions of the glue used.
- Apply the adhesive layer as thinly as possible.



In general, methyl-cyanoacrylate adhesives (e.g. Loctite 454) or epoxy adhesives (e.g. Loctite EA 3450) are used.



When choosing a suitable adhesive always take the materials and the environmental conditions (e.g. temperature range) into account.

4.5 Magnet

Using magnets is only recommended for temporary measurements and is only suitable for magnetic surfaces.

- ▶ Fix the sensor to the magnet.
- ▶ Carefully fix the magnet/sensor unit to the machine.



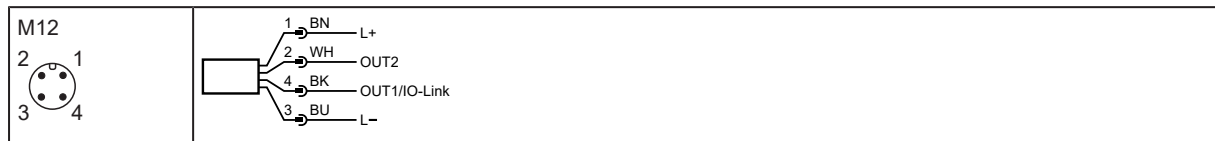
Careless fixing can result in very high g-forces which may damage the sensor.

5 Electrical connection



The unit must be connected by a qualified electrician.

► Observe the national and international regulations for the installation of electrical equipment.



6 Function

6.1 Application area

The device

- detects vibrations and the surface temperature of industrial machines (e.g. electric motors, centrifugal pumps, fans, vertical bearings etc.) on non-rotating components.
- provides condition indicators that enable the machine condition to be assessed in real time.
- can be operated in SIO mode (standard input-output) or in IO-Link mode.
- The device provides many options for machine diagnostics.
 - Monitoring a machine unbalance
 - Detecting the actual machine uptime based on the vibration level
 - Detecting the switch-on operations of the machine
 - Accessing raw acceleration data for in-depth diagnostics
 - Bearing diagnostics using the demodulation method (BearingScout)
- Device statuses can be visualised via a status LED on the device and signalled via IO-Link events.

6.2 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is regulated in the IEC 61131-9 standard.



General information about IO-Link can be found at io-link.ifm.



The Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device can be found at documentation.ifm.com.

IO-Link offers the following advantages:

- Noise immune transmission of all data and process values
- Parameter setting during operation or default setting outside the application
- Parameters to identify the connected devices in the plant
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD – Input Output Device Description) for easy configuration
- Standardised electrical connection
- Remote maintenance

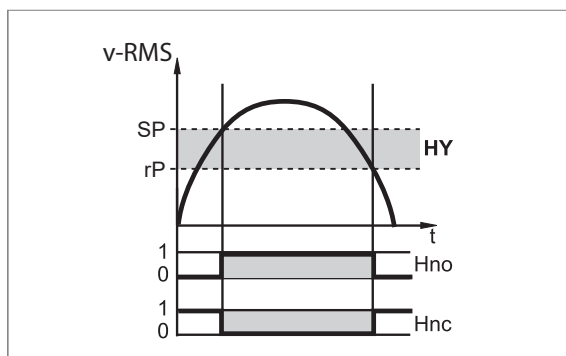
6.3 Switching function

The switching output OUX changes its switching status if it is above or below the set switching limits. Hysteresis or window function can be selected.

VV devices offer the option of setting switching limits in all three measurement axes:

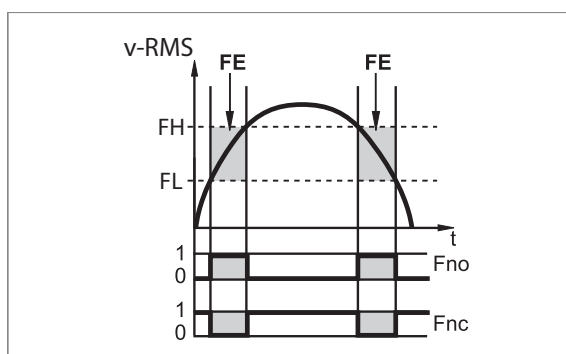
Basic condition monitoring VVB301 / VVB305	DataScience condition monitoring VVB302 / VVB306
- v-RMS (configurable: x, y or z axis, magnitude) - a-Peak (configurable: x, y or z axis, magnitude) - a-RMS (configurable: x, y or z axis, magnitude) - Crest (configurable: x, y or z axis, magnitude) - Temperature - Unbalance event - Virtual switching output (v-ou1)	- v-RMS (x axis) - v-RMS (y axis) - v-RMS (z axis) - v-RMS (magnitude) - a-Peak (x axis) - a-Peak (y axis) - a-Peak (z axis) - a-peak (magnitude) - a-RMS (x axis) - a-RMS (y axis) - a-RMS (z axis) - a-RMS (magnitude) - Temperature - Unbalance event - Bearing event (BearingScout) - Virtual switching output (v-ou1)

Hysteresis function



t: Time
 SP: Setpoint
 rP: Reset point
 HY: Hysteresis
 Hno: Hysteresis NO (normally open)
 Hnc: Hysteresis NC (normally closed)

Window function



t: Time
 FH: Upper limit value
 FL: Lower limit value
 FE: Window
 Fno: Window NO (normally open)
 Fnc: Window NC (normally closed)



For both switching outputs, a switch-on and switch-off delay can be set.



Both switching outputs (OU1 or OU2) can optionally be set to inactive.



A switching delay can be set for unbalance and bearing events.
A hysteresis and window function is not possible, as only one limit value can be set via IO-Link (no setpoint and reset point).

6.4 Automatic parameter setting according to DIN ISO 20816-3

Predefined parameter profiles can be used to set the setpoints, reset points and filtering depending on the respective machine type according to DIN ISO 20816-3.

The setpoints, reset points and filtering are set via the respective system command:

	Large machines 0.3...50 MW	Medium-sized machines 15...300 kW
Fast machines > 600 rpm	System command 233	System command 231
Slow machines 120...600 rpm	System command 234	System command 232



The factory settings correspond to a universal profile that can be changed depending on the respective application using the corresponding system command. The exact parameter changes are described in chapter "Machine configuration according to DIN ISO 20816-3".



DIN ISO 20816-3 is a globally valid standard for the measurement and evaluation of mechanical vibrations on industrial machines and the successor to DIN ISO 10816-3.

6.5 Virtual switching output (v-ou1)

The device offers a linking of the individual process values to a virtual switching output. The virtual switching information is part of the process data flow and can be optionally assigned to the switching outputs (OU1 or OU2) via the SEL1/2 parameter.

For the Basic condition monitoring device versions, the internal linking is unchangeable and includes all 5 process values.

For the DataScience condition monitoring device versions, the internal linking of the 13 process values can be freely configured via a parameter.



The virtual switching output is set to active as soon as the switching limit of an individual process value is exceeded.

If the virtual switching output (v-ou1) is assigned to a switching output (OU1 or OU2), the device can switch actively.

6.6 Process data description

6.6.1 v-RMS – fatigue

v-RMS (effective value of the vibration velocity) measures the total energy of a rotating machine. The most common types of overload (unbalance, misalignment, loosening), which result in an increase in the energy content in the machine, are reflected in the v-RMS value.

An increased load can damage the machine in the long term due to fatigue or, in extreme cases, destroy it within a short time.



With the Basic condition monitoring version, free parameter setting of the measurement axes is possible; with the DataScience condition monitoring version, all three measurement axes and the magnitude are output separately.



The magnitude corresponds to the sum signal of several axes (e.g. x, y and z). Magnitude = $\sqrt{(x^2 + y^2 + z^2)}$



v-RMS is measured according to the DIN ISO 20816-3 standard (measurement and evaluation of machine vibration).

6.6.2 a-RMS – friction

a-RMS (effective value of the acceleration) detects mechanical friction of machine components. This friction typically occurs due to wear (defective bearings, worn toothed wheels, etc.) or lubrication problems (impurities in grease, water in oil, etc.).



With the Basic condition monitoring version, free parameter setting of the measurement axes is possible; with the DataScience condition monitoring version, all three measurement axes and the magnitude are output separately.

6.6.3 a-Peak – impact

a-Peak monitors the maximum acceleration value.

This can be an indicator of “impacts”. Impacts can occur once or periodically (e.g. in the event of damage to rolling element bearings).



With the Basic condition monitoring version, free parameter setting of the measurement axes is possible; with the DataScience condition monitoring version, all three measurement axes and the magnitude are output separately.

6.6.4 Crest factor

The crest factor is a described characteristic value of the signal analysis. It is defined as the ratio of the maximum value to the effective value (peak/RMS).

In condition monitoring, the characteristic value is used for the evaluation of the bearing condition. The high-frequency acceleration signals with a short pulse duration of a bearing damage generate higher peak values in relation to the effective value. This ratio can be read in the crest factor and can serve as an early warning system for incipient bearing damage.



Free parameter setting of the measurement axes is only available for devices of the Basic condition monitoring type.



The crest factor decreases with advanced bearing damage and should always be used in combination with another characteristic value.

6.6.5 Surface temperature

An increased surface temperature occurs with rotating parts due to friction. This characteristic value can also be an indication of electrical problems in the drive unit. A temperature rise is the measure of energy loss and increased wear.

6.7 Event counter, event history and operating hours counter

For VV devices

- an event history can be used to call up a list of the last 20 events that occurred. These are stored in an internal ring buffer and can be exported as a CSV file via the IO-Link BLOB function (index 49 / -5001).
- an event counter can be used to count different events. The event counter is incremented by 1 if the corresponding event occurs.
- an operating hours counter is used to count the devices's operating hours since delivery. The internal memory is persistent and cannot be reset.



- Reset the event history and the event counter via system commands.

6.8 Maximum value memory

VV devices have a maximum value memory for each process value, which can be read via IO-Link. The maximum value memory can be reset if required.



- If the measurement axis of a process value is changed during operation, the maximum value memory is automatically reset.



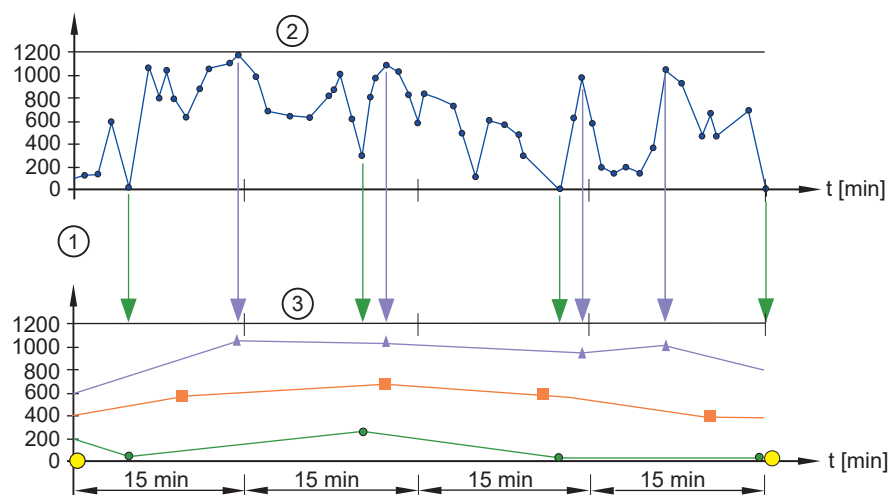
- The process value temperature also has a minimum value memory.

6.9 Characteristic value history

VVB3 devices offer a statistical characteristic value history of the last 9 days (= 800 entries), readable via the IO-Link BLOB function (index 49 / -5004).

The history saves all characteristic values in an interval of 15 minutes as maximum, minimum and mean values.

The time stamp corresponds to an internal counter that can be calculated back from the moment of readout based on the measuring interval.



- 1: Characteristic values (e.g. v-RMS)
2: Process data measurement
3: Historical data

- ▲ Maximum value
● Minimum value
■ Mean value
● Moment of readout



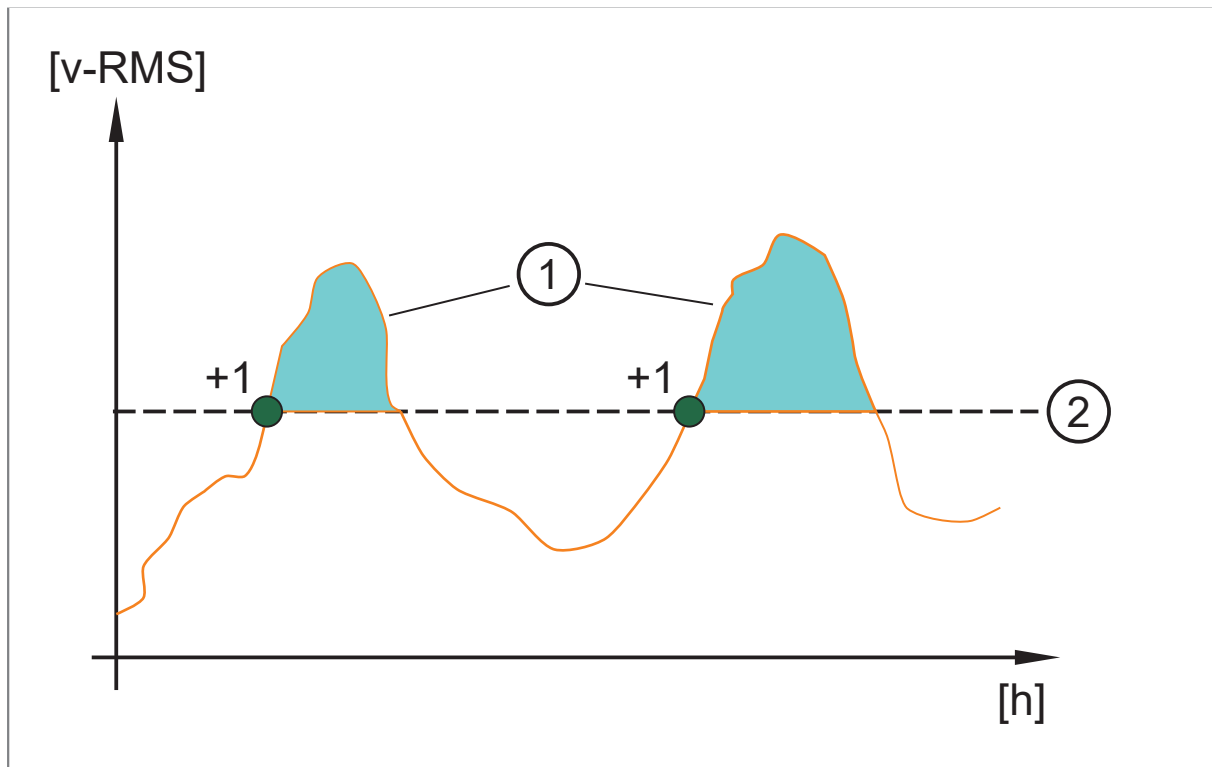
- The characteristic values are saved in the RAM; if the sensor is not supplied with current, the history values will be lost.

6.10 Machine operating time and switch-on operations

VV devices record the machine's operating time (index 8003) and switch-on operations (index 8003) via the process value v-RMS.

The threshold value for the operating time (mrcT) must be set.

If the set threshold value is exceeded, the operating time counter (mrc) is incremented by 1 and the operating time (mot) is increased by the exceeded time (in seconds).



1: Operating time

● Operating time counter

2: Threshold value for the operating time (mrcT)



The sensor uses the z axis to detect the machine operating hours.

6.11 Unbalance detection

VV devices can measure the vibration energy due to increased unbalance in a frequency-selective manner via an acyclic parameter (index 8010).

The required speed information of the machine to be monitored can be configured as PDout via the machine controller or as an IO-Link parameter.

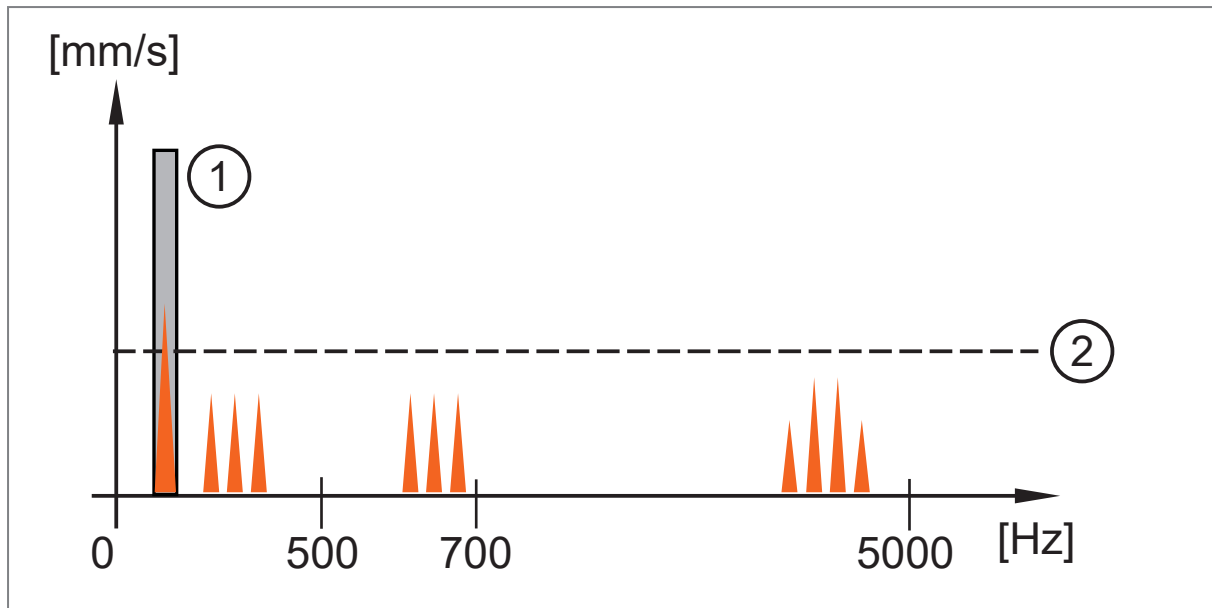
The relevant measurement axis for the unbalance measurement (x, y or z) can be initially configured via an additional IO-Link parameter.

An event bit can be set to active in the process data flow via a configurable threshold value. This virtual switching information can be assigned to a switching output (OU1 or OU2).



1: Device status

2: Unbalance



1: Unbalance measurement



The unbalance characteristic value is updated in the device every 2.4 ms. For very dynamic applications, a switching delay and the transmission time of IO-Link for acyclical values should be taken into account.



The measurement axis for the unbalance measurement should be in the direction of the main vibration, in most cases this is radial to the shaft axis.

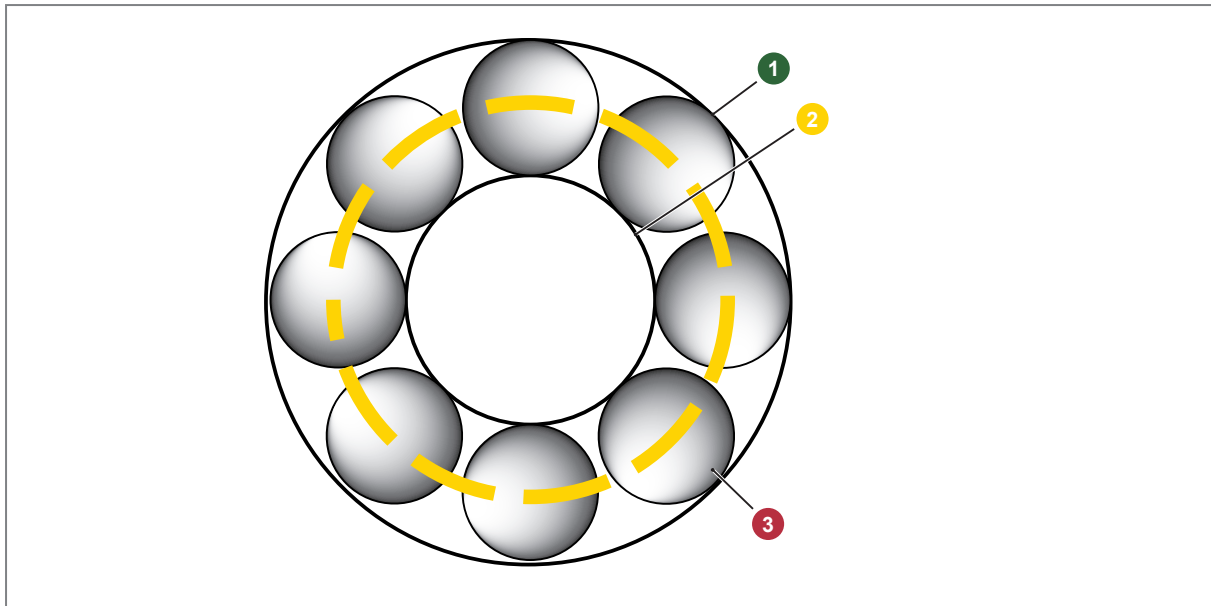
6.12 Bearing analysis (BearingScout)

VV devices of the DataScience type have an integrated bearing analysis using the demodulation method. This bearing characteristic value is calculated acyclically and can also trigger an event in the process data flow.

- Step 1:
Configure the required speed information (index 8009) of the machine to be monitored as PDout via the controller or as an IO-Link parameter.
- Step 2:
Initially configure the relevant measurement axis (x,y or z) via another IO-Link parameter.

Optional parameter setting of the frequency factors of the rolling element bearing

Optionally, the frequency factors (BPFO – outer ring, BPFI – inner ring, BSF – rolling element) of the installed bearing can be configured via an IO-Link parameter and thus improve the precision of the measurement result. If the frequency factors are not configured in the device (corresponds to the set value 0), a generic bearing value is formed via demodulation.



- 1: Damage frequency (outer ring) =
 $\text{BPFI (index 8021 / subindex 2)} * \text{speed (index 8009)}$
- 2: Damage frequency (inner ring) =
 $\text{BPFO (index 8021/subindex 1)} * \text{speed (index 8009)}$
- 3: Damage frequency (rolling element) =
 $\text{BSF (index 8021 / subindex 3)} * \text{speed (index 8009)}$

When the configured threshold value is exceeded, an event bit is set to active in the process data flow. This virtual switching information can be assigned to a switching output (OU1 or OU2).



- 1: Device status
- 2: Unbalance / rolling element bearing



The unbalance characteristic value and bearing characteristic value (BearingScout) fall on the same event bit in the process data flow.



The measurement axis for the bearing calculation should be in the direction of the main vibration.

In most cases this is radial to the shaft axis, directly at the bearing.

► Take into account the speed information at the bearing.

6.13 Marking

- Application Specific Tag
 Freely definable text, assign to the device.
- Function Tag
 Freely definable text describing the device function in the plant.
- Location Tag
 Freely definable text describing the installation location in the plant.
- Installation date
 Entry of an installation date. After a device replacement, the date is not restored.
- Date of last machine maintenance
 Enter the date of the last machine maintenance.

7 Operating and display elements

7.1 Device LEDs

The device has an LED that indicates deviations from normal operation via a colour change.

LED behaviour (status LED)	Description	Action
	Lights green	Device is connected to the voltage supply and ready for operation
	Flashes green (double flash)	Sensor identification / Locator active
	Flashes red (double flash)	IO-Link error event (see troubleshooting)
	Lights red	MEMS self-test failed. Device damaged.



When using the Flash-On command, the LED flashes for 10 minutes and then switches off automatically.

► Alternatively, switch off the identification mode prematurely using another command.



The device should be in rest position when the self-test is active.

8 Parameter setting

Parameters can be set before installation or during operation.



Changing parameters during operation

- ▷ Influences the function of the plant.
- ▶ Ensure that there will be no malfunctions in your plant.

During parameter setting the device remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.

Requirements for parameter setting via the IO-Link interface:

- A suitable parameter setting software, e.g. ifm moneo|configure
- The Input Output Device Description (IODD) for the device, see documentation.ifm.com
- An IO-Link master
- ▶ Connect the IO-Link master to a parameter setting software.
- ▶ Set the port of the master to the IO-Link operating mode.
- ▶ Connect the device to a free port of the IO-Link master.
- ▷ The device changes to the IO-Link mode.
- ▶ Change the parameter settings in the software.
- ▶ Write the parameter settings to the device.



Notes on parameter setting → Manual of the parameter setting software

8.1 Parameter description

The following IO-Link parameters merely provide an overview. A complete list can be found in the IODD of the respective device.

8.1.1 Identification

Parameter	Description	Setting range
Identification		
Application Specific Tag	Free text fields, maximum 32 characters per field	
Function Tag		
Location Tag		
Installation date	Installation date of the device in the plant. This parameter is not restored after a device replacement. ▶ Enter a new installation date after replacing the device.	Setting range: yyyy-mm-dd
Date of last machine maintenance	The date of the last machine maintenance can be stored in the device.	Setting range: yyyy-mm-dd

8.1.2 Output configuration

Parameter	Description	Setting range Basic condition monitoring VVB301 / VVB305	Setting range DataScience condition monitoring VVB302 / VVB306
Output configuration			
ou1 ou2	Switching characteristics hysteresis / window function	Hno / Hnc / Fno / Fnc / OFF	
SEL1 SEL2	Process value that is evaluated at the switching output	v-RMS (axis configurable) a-Peak a-RMS Crest (axis configurable) Temperature Virtual switching output (v-ou1) Unbalance event	v-RMS (x axis) v-RMS (y axis) v-RMS (z axis) v-RMS (magnitude) a-Peak (x axis) a-Peak (y axis) a-Peak (z axis) a-peak (magnitude) a-RMS (x axis) a-RMS (y axis) a-RMS (z axis) a-RMS (magnitude) Temperature Virtual switching output (v-ou1) Unbalance / rolling element bearing event
P-n	Output function	PnP/nPn	
FOU1 FOU2	Response of OU1/OU2 in case of a fault	OU / ON / OFF	
Digital output 1/2	Switch-on delay dS1/2 Switch-off delay dr1/2	0...50 s 0...50 s	
Unbalance event	Current status of the acyclic unbalance calculation	Unbalance event can be assigned to a switching output via SEL1/2	Not available
Unbalance / bearing event	Current status of the acyclic unbalance / bearing event	Not available	Unbalance / rolling element bearing event can be assigned to a switching output via SEL1/2
Virtual switching output (v-ou1)	Current status of the virtual switching output (v-ou1)	Linking of all 5 process values	Configurable linking of the process values for the virtual switching output

8.1.3 Process values

Process values (trend indicators)	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
v-RMS	(Component) fatigue Set the setpoint SP1/2 Set the reset point rP1/2	0.2...300.0 mm/s 0...299.8 mm/s	0.2...300.0 mm/s 0...299.8 mm/s
a-Peak	Impact Set the setpoint SP1/2 Set the reset point rP1/2	204...16000 mg 0...15796 mg	204...16000 mg 0...15796 mg

Process values (trend indicators)	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
a-RMS	Friction Set the setpoint SP1/2 Set the reset point rP1/2	204...16000 mg 0...15796 mg	204...16000 mg 0...15796 mg
Crest	Crest factor Set the setpoint SP1/2 Set the reset point rP1	2...50 1...49	Not available
Temperature	Temperature Set the setpoint SP1/2 Set the reset point rP1/2	-28...80 °C -30...78 °C	-28...80 °C -30...78 °C

Process values (analysis events)	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
Unbalance detector (index 8010)	Unbalance analysis – acyclic value Limit value for event can be set	0...300.0 mm/s Factory settings: 3 mm/s	0...300.0 mm/s Factory settings: 3 mm/s
Bearing analysis (index 8023)	Bearing analysis (BearingScout) – acyclic value Limit value for event can be set	Not available	0...16000 mg Factory settings: 300 mg



The Basic condition monitoring devices allow free parameter setting of the measurement axes (speed & acceleration).



Articles VVB301 and VVB302 offer the units “m/s”, “m/s²” and “°C” as transmission unit.
Articles VVB305 and VVB306 offer the units “mm/s”, “mg” and “°C” as transmission unit.

8.1.4 Analysis functions

Analysis function	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
Unbalance detector (index 8010)	Unbalance analysis – acyclic value Limit value for event can be set	0...300.0 mm/s Factory setting: 3 mm/s	0...300.0 mm/s Factory setting: 3 mm/s
Bearing analysis (index 8023)	Bearing analysis (BearingScout) – acyclic value Limit value for event can be set	Not available	0...16000 mg Factory setting: 300 mg
Measurement axis (index 8007)	Measurement axis for analysis Selection of the measurement axis for internal analysis calculation	x axis, y axis, z axis	x axis, y axis, z axis

Analysis function	Description	Setting range Basic condition monitoring	Setting range DataScience condition monitoring
Speed input (index 8008)	Selection of the speed input Parameter or control signal (PDout)	Index (parameter) Control signal (PDout)	Index (parameter) Control signal (PDout)
Speed value (index 8009)	Machine speed value Value of the machine speed in [rpm]	0...16000 rpm	0...16000 rpm
Bearing frequencies (index 8021)	Frequency factors of the in- stalled rolling element bearing Frequency factors BPFI, BP- FO, BSF of the installed ball bearing	Not available	Optional parameter

8.1.5 Signal filtering

Filtering for internal signal processing and calculation of the process values.

Signal	Description	Setting range Basic condition monitoring VVB301 / VVB305	Setting range DataScience condition monitoring VVB302 / VVB305
Filter DC	High-pass Filter for the DC component (static acceleration) - for the calculation of all characteristic values	2 / 10 Hz	
Filter A	Bypass / high-pass / low-pass filter for characteristic acceler- ation values	1 / 3 / 4 kHz	Not available
Filter V	Low-pass Filter for the characteristic vi- bration velocity value	1 kHz	
Filter A-Peak	Bypass / high-pass / low-pass filter for characteristic acceler- ation values	Not available	1 / 3 / 4 kHz
Filter A-RMS	Bypass / high-pass / low-pass filter for characteristic acceler- ation values	Not available	1 / 3 / 4 kHz

Application example 1:

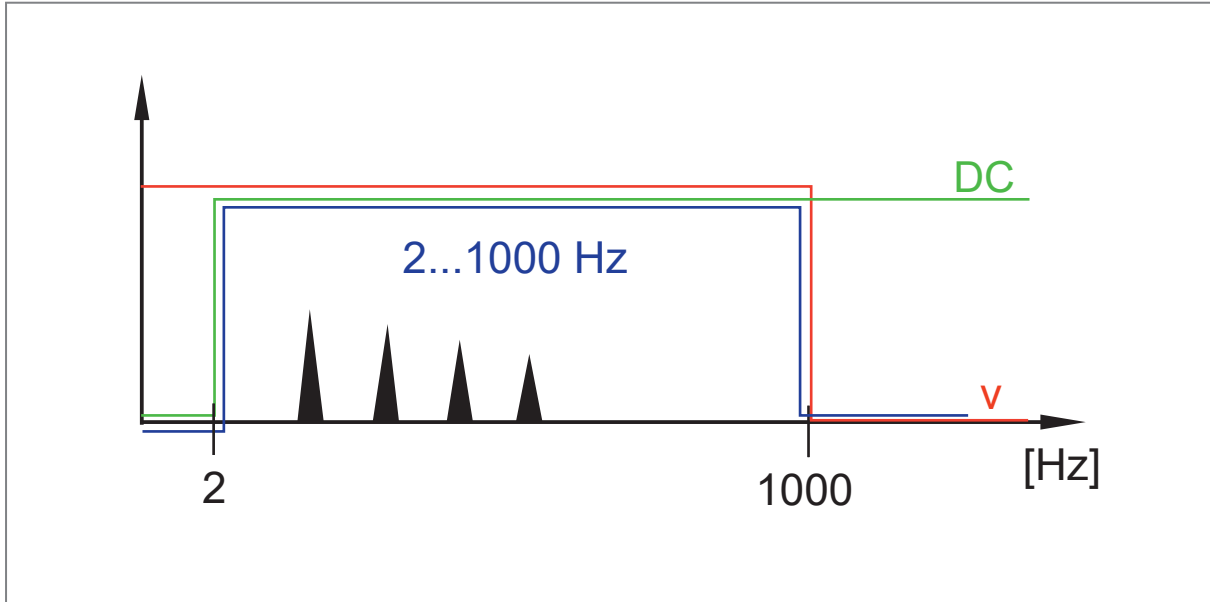
Filter speed (v) - evaluation of the signal components between 2...1000 Hz

Settings:

DC filter: 2 Hz, high-pass (fixed), v filter: 1 kHz, low-pass (fixed)

Typical errors in this area:

Unbalance, misalignment, loosening, belt issues



Application example 2:

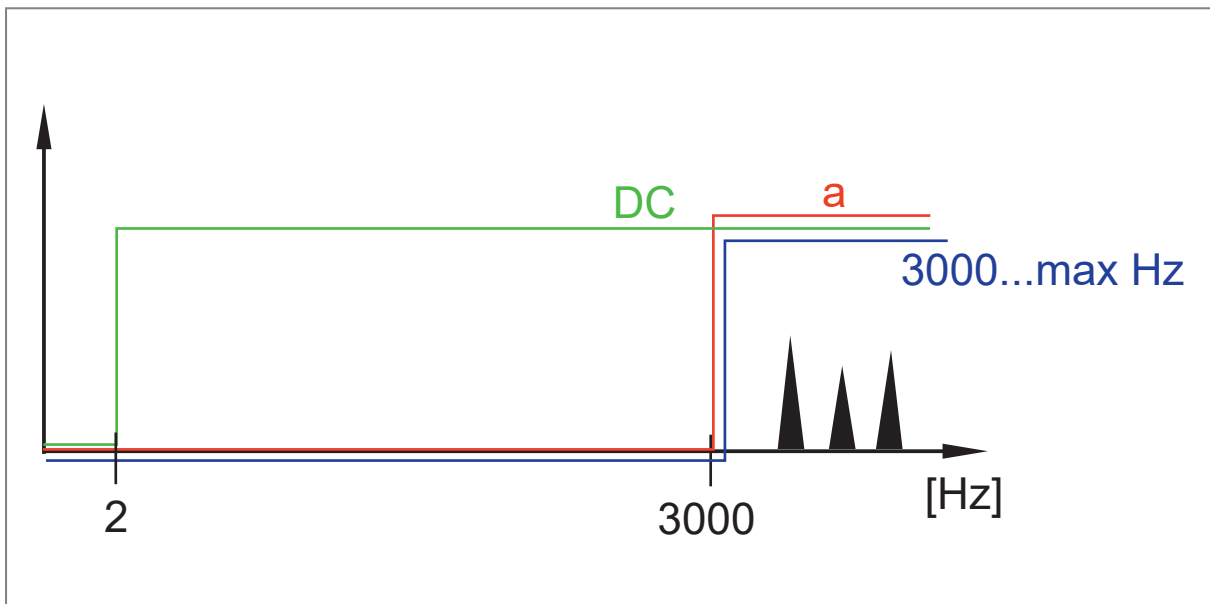
Filter acceleration (a) - evaluation of the signal components > 3000 Hz

Settings:

DC filter: 2 Hz, high-pass (fixed), a filter: 3 kHz, high-pass

Typical errors in this area:

Bearing damage, mesh frequency, lubrication problems, cavitation, friction



Application example 3:

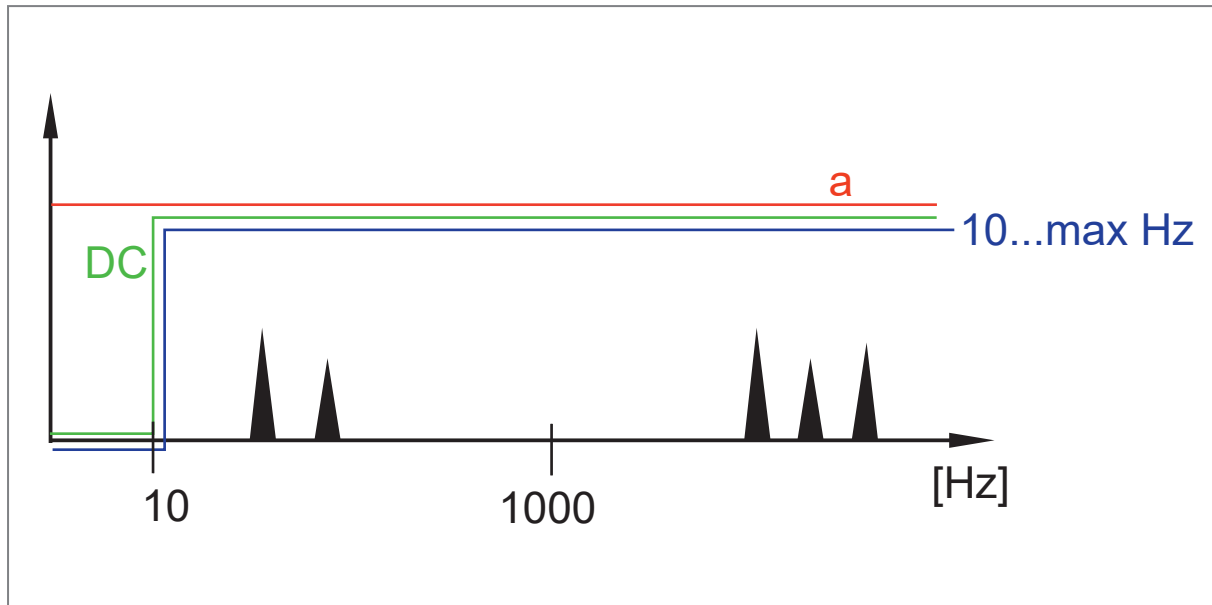
Filter acceleration (a) - evaluation of the signal components 10...6000 Hz

Settings:

DC filter: 10 Hz, high-pass (fixed), a filter: bypass

Typical errors in this area:

Impacts, bearing damage, mesh frequency, lubrication problems, cavitation, friction



8.2 Reading of raw data (BLOB)

The device can record, save and then transmit the raw acceleration via the IO-Link BLOB mechanism. This raw data can be used to analyse vibrations in greater depth in order to diagnose damage.

An IO-Link parameter can be used to configure the axis and the recording length (4 s and 12 s per axis, as well as 4 s synchronously for all 3 axes).

The sensor always stores one second of the raw data in a ring buffer. If it is triggered, it can fall back to one second before triggering.

BLOB ID (index 49 / -5002)

The raw data is recorded according to the recording parameters and transmitted.

BLOB ID (index 49 / -5003)

The raw data is only read. Triggering takes place separately via internal triggering by an event at switching output OU1, system command or PDOut signal from the machine controller.

Raw data parameter	Description	Setting range
Memory selection (index 8016)	Selection of the data source for the raw data memory	x axis (4s) y axis (4s) z axis (4s) x axis (12s) y axis (12s) z axis (12s) xyz axis (4s)
Activation of the trigger for raw data recording (index 8017)	System command / internal event (OU1) / PDOut	Activation (Yes/No)
BLOB ID (index 49 / -5002)	Record raw data and read immediately	Record raw data and read immediately
BLOB ID (index 49 / -5003)	Read existing raw data	Read existing raw data

The raw data block has a configurable recording length (4 s or 12 s) and a sampling rate of 13.3 kHz (exact value is contained in the raw data header). Each individual sample has a bit width of 16 bits and is transmitted in signed integer format.

Each raw data block has a data file header that contains additional information about the time of raw data recording. The header is structured as follows

Parameter	Description
IO-Link device ID	Device ID of the respective device (VVB301/VVB302/VVB305/VVB306)
BLOB ID	BLOB ID (-5002 / -5003)
Raw data length	Raw data length in bytes
Raw data scaling	The scaling factor to normalise the signed integer format to 1g gravitational acceleration (manual calculation required).
Raw data sample frequency	Sample frequency of the raw data recording in Hertz [Hz]
Raw data trigger source	Source of the raw data trigger (e.g. system command, PDOOut, internal event)
Raw data source	Measurement axis of the raw data
Process values	All process values at the time of recording in x,y and z, as well as the magnitude (e.g. v-RMS (z), v-RMS (x), surface temperature...)
Internal device temperature	Internal device temperature
Unbalance value	Value of the unbalance calculation at the time of recording (if configured)
BearingScout (bearing characteristic value)	Value of the bearing calculation at the time of recording (if configured)
Speed	Configured speed value at the time of recording (if configured)
Delta time	Delta time between reading and recording the raw data
Machine operating hours (mot)	Value of the machine operating hours counter at the time of recording (if configured)

The download area of the device contains a detailed description of how to read and convert the raw data and a sample code for integration into external software - see documentation.ifm.com.



VV devices provide a memory area for raw data recording regardless of the recording method. This memory is always filled with the last event and the existing memory is overwritten.



The raw data is transmitted in binary format and saved as a *.bin file. In the parameter setting software VES004 (> version 2.35.00) the raw data can be imported and analysed.



The IIoT platform moneo can be used for time-based and event-based raw data recordings.

9 Factory setting

The detailed factory settings of the parameters are available at documentation.ifm.com (PDF – IO-Link interface description).

9.1 General configuration

Output configuration	ou1	ou2	P-n
	Hnc	Hnc	PnP
Digital output 1	dS1	dr1	
	1 s	0 s	
Digital output 2	dS2	dr2	
	0 s	0 s	
Fault configuration	FOU1	FOU2	
	OFF	OFF	

9.2 Units

Display settings (configurable)	Article number	uni - v-RMS	uni - a-Peak, a-RMS	uni - T	Crest
	VVB301, VVB302	m/s	m/s ²	°C	-
	VVB305, VVB306	mm/s	mg	°C, °F	-

Process data unit (not configurable)	Characteristics	VVB301	VVB305	VVB302	VVB306
	Velocity	m/s	mm/s	m/s	mm/s
	Acceleration	m/s ²	mg	m/s ²	mg
	Temperature	°C	°C	°C	°C

9.3 Switch points and filtering

Output configuration	VVB301	VVB305	VVB302	VVB306
SEL1	v-ou1	v-ou1	v-ou1	v-ou1
SEL2	a-Peak	a-Peak	a-Peak-mag	a-Peak-mag
v-RMS				
SP1 - v-RMS	0.0045 m/s	4.5 mm/s	0.0045 m/s	4.5 mm/s
rP1 - v-RMS	0.0043 m/s	4.3 mm/s	0.0043 m/s	4.3 mm/s
SP2 - v-RMS	0.0071 m/s	7.1 mm/s	0.0071 m/s	7.1 mm/s
rP2 - v-RMS	0.0069 m/s	6.9 mm/s	0.0069 m/s	6.9 mm/s
a-Peak				
SP1 - a-Peak	19.6 m/s ²	1998.6 mg	19.6 m/s ²	1998.6 mg
rP1 - a-Peak	17.6 m/s ²	1794.7 mg	17.6 m/s ²	1794.7 mg
SP2 - a-Peak	29.4 m/s ²	2997.9 mg	29.4 m/s ²	2997.9 mg
rP2 - a-Peak	27.4 m/s ²	2794.0 mg	27.4 m/s ²	2794.0 mg
a-RMS				

Output configuration	VVB301	VVB305	VVB302	VVB306
SP1 - a-RMS	9.8 m/s ²	999.3 mg	9.8 m/s ²	999.3 mg
rP1 - a-RMS	7.8 m/s ²	795.4 mg	7.8 m/s ²	795.4 mg
SP2 - a-RMS	19.6 m/s ²	1998.6 mg	19.6 m/s ²	1998.6 mg
rP2 - a-RMS	17.6 m/s ²	1794.7 mg	17.6 m/s ²	1794.7 mg
Crest				
SP1 - CREST	5	-	5	-
rP1 - CREST	4	-	4	-
SP2 - CREST	7	-	7	-
rP2 - CREST	6	-	6	-
Temperature [°C]				
SP1 - TEMP	60 °C	60 °C	60 °C	60 °C
rP1 - TEMP	58 °C	58 °C	58 °C	58 °C
SP2 - TEMP	80 °C	80 °C	80 °C	80 °C
rP2 - TEMP	78 °C	78 °C	78 °C	78 °C
Filter DC				
FILT-DC. FCUTOFF	10	10	10	10
FILT-DC. Type	High-pass	High-pass	High-pass	High-pass
Filter v				
FILT-V. FCUTOFF	1000	1000	1000	1000
FILT-V. Type	Low-pass	Low-pass	Low-pass	Low-pass
Filter a	Filter a	Filter a	Filter a	Filter a
FILT-A. FCUTOFF	4000	-	4000	-
FILT-A. Type	Bypass	-	Bypass	-
Filter a-Peak				
FILT-A-PEAK. FCUT-OFF	-	4000	-	4000
FILT-A-PEAK. Type	-	Bypass	-	Bypass
Filter a-RMS				
FILT-A-RMS. FCUT-OFF	-	4000		4000
FILT-A-RMS. Type	-	Bypass		Bypass

9.4 Machine configuration according to DIN ISO 20816-3

Depending on the respective machine type according to DIN ISO 20816-3, the original parameter setting can be changed using the corresponding system command.

System command [index 2]	231	232	233	234
Machine description according to DIN ISO 20816-3	Medium-sized machines 15...300 kW Fast machine > 600 rpm	Medium-sized machines 15...300 kW Slow machine 120...600 rpm	Large machines 0.3...50 MW Fast machine > 600 rpm	Large machines 0.3...50 MW Slow machine 120...600 rpm
v-RMS				
SP1 - v-RMS	0.0028 m/s	0.0028 m/s	0.0045 m/s	0.0045 m/s
rP1 - v-RMS	0.0026 m/s	0.0026 m/s	0.0043 m/s	0.0043 m/s
SP2 - v-RMS	0.0045 m/s	0.0045 m/s	0.0071 m/s	0.0071 m/s
rP2 - v-RMS	0.0043 m/s	0.0043 m/s	0.0069 m/s	0.0069 m/s

System command [index 2]	231	232	233	234
a-Peak				
SP1 - a-Peak	9.8 m/s ²	9.8 m/s ²	19.6 m/s ²	19.6 m/s ²
rP1 - a-Peak	7.8 m/s ²	7.8 m/s ²	17.6 m/s ²	17.6 m/s ²
SP2 - a-Peak	19.6 m/s ²	19.6 m/s ²	29.4 m/s ²	29.4 m/s ²
rP2 - a-Peak	17.6 m/s ²	17.6 m/s ²	27.4 m/s ²	27.4 m/s ²
a-RMS				
SP1 - a-RMS	2.4 m/s ²	2.4 m/s ²	3.4 m/s ²	3.4 m/s ²
rP1 - a-RMS	0.4 m/s ²	0.4 m/s ²	1.4 m/s ²	1.4 m/s ²
SP2 - a-RMS	4.4 m/s ²	4.4 m/s ²	5.4 m/s ²	5.4 m/s ²
rP2 - a-RMS	2.4 m/s ²	2.4 m/s ²	3.4 m/s ²	3.4 m/s ²
Filter DC				
FILT-DC. FCUTOFF	10	2	10	2
FILT-DC. Type	High-pass	High-pass	High-pass	High-pass

10 Troubleshooting

Possible cause	Solution
Short-circuit at switching output OU1/OU2	Check the wiring
Supply voltage outside the specification (see data sheet)	Adjust supply voltage
Upper limit of the measuring range exceeded	Check basic vibration in the application and compare with upper limit of the measuring range
MEMS self-test error	MEMS cell of the sensor damaged, replace sensor
Parameter setting fault	Check parameter setting by means of IO-Link parameter setting software

If the device behaves unexpectedly or incorrectly:

- Disconnect the device from the voltage supply (restart)
- Restore factory settings (via IO-Link)

If the problems persist:

- Contact the ifm support at www.ifm.com.

11 Resetting the device

The device can be reset in two ways:

Application (application reset)

Reset of the parameter settings. All application-specific parameters are reset.



If IO-Link data storage is activated, this triggers a parameter update in the master. The parameters configured in the master will be written to the device again. An application reset may therefore be ineffective.

Factory settings (back-to-box)

Reset to factory settings. All application-specific parameters, writeable device parameters, diagnostic parameters and events are reset. The factory settings can be viewed in the Factory setting chapter or in the IO-Link interface description.



After the back-to-box reset, the sensor suspends communication and measurement operation until the voltage is interrupted. The IO-Link data storage is not triggered.

12 Maintenance, repair and disposal

The unit is maintenance-free.

Only the manufacturer is allowed to repair the unit.

- ▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

Cleaning the unit:

- ▶ Disconnect the unit from the voltage supply.
- ▶ Clean the unit from dirt using a soft, chemically untreated and dry micro-fibre cloth.