

VIM3*PP*-IO-*
Vibration Sensors
With Raw Acceleration Data

Manual



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1 Introduction

1.1 Content of this Document

This document contains information that you need in order to use your product throughout the applicable stages of the product life cycle. These can include the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



Note

This document does not substitute the instruction manual.



Note

For full information on the product, refer to the instruction manual and further documentation on the Internet at www.pepperl-fuchs.com.



Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com/device-information.

The documentation consists of the following parts:

- Present document
- Instruction manual
- Datasheet

Additionally, the following parts may belong to the documentation, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Functional safety manual
- Additional documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismantling of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols



Note

This symbol brings important information to your attention.



Tip

This symbol brings an useful tip to your attention.



Example

This symbol provides an example of the issue described.



Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

1.4 Intended Use

The vibration sensor is used exclusively for measuring mechanical vibrations on machines and mechanical systems. Use is only permitted within the specifications stated in the datasheet.

The vibration sensor provides the data obtained as process data via the IO-Link interface in accordance with the "IO Link Consortium" standard. The vibration sensor is to be integrated into an IO-Link network and should be used only in this way.

Typical applications are monitoring fans, ventilators, electric motors, pumps, centrifuges, separators, generators, turbines, and similar oscillating mechanical systems. Read through this manual carefully. Familiarize yourself with the device before installing, mounting, or operating.

Some product versions are suitable for use in hazardous areas. The relevant national or international directives and the instruction manual for the product must be followed.

Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and the plant is guaranteed only if the device is operated in accordance with its intended use.

1.5 General Safety Instructions

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Installation and commissioning of all devices may be performed only by trained and qualified personnel.

It is dangerous for the user to make changes and/or repairs. Additionally, doing so voids the warranty and excludes the manufacturer from any liability. In the event of any serious errors, stop using the device. Secure the device against unintended operation. To have the device repaired, return it to your local Pepperl+Fuchs representative or your sales center.



Note

Disposal

Electronic waste is dangerous. When disposing of the equipment, observe the current statutory requirements in the relevant country of use and local regulations.

2 Product Description

2.1 Use and Application

The vibration sensors in the VIM3*-IO-* product family determine the vibration magnitude using the root mean square (RMS) method. This form of quadratic average determination or pre-filtering allows precise statements to be made about trends relating to the status of the application. The vibration magnitude is both the vibration velocity and vibration acceleration. The vibration sensor also provides both an output of the peak values of the vibration acceleration ($t = 1 \text{ sec}$) and a temperature output. Depending on the product versions, a bearing condition parameter is output that is determined and scaled in accordance with DIN ISO 13373.

BLOB transfer allows large amounts of data to be transferred, enabling high-frequency vibration acceleration measurements. This measured data can be used as the basis for frequency analysis using a fast Fourier transform (FFT).

What is IO-Link?

IO-Link enables seamless communication and digital data transfer from the control panel level down to the sensor level. The intelligence of sensors can be used to their full potential with IO-Link, paving the way for Industry 4.0 in automation technology. The internationally standardized interface delivers impressive efficiency and sustainable cost reduction, from plant design and installation through to operation and maintenance.

Standardized device description files (IODDs) and parameterization via software tools ensure convenient configuration and integration of IO-Link sensors. Intelligent and transparent parameter management increases application flexibility and keeps downtimes to a minimum. Parameters can be customized quickly and easily, even for complex production and batch changes. Transparency right down to the sensor gives users access to a comprehensive range of parameterization options and device diagnostics functions, allowing them to perform predictive maintenance.

The technology offers particular benefits for service activities (troubleshooting, maintenance, and device exchange), for commissioning (cloning, identification, configuration, and localization), and during operation (job changeover, continuous parameter monitoring, and online diagnostics).

Device Description File (IODD)

The device parameters are different for each device. A standardized description of these parameters can be found in the IODD (IO Device Description). IODDs can be integrated into a control environment to allow IO-Link devices to be used for IO-Link operation. Both programming and exchanging process data can be performed with a PLC, for example. The IODD can also be imported into a range of engineering tools from various system providers for programming and diagnostics, provided these tools support IODD.

Offline Parameterization

For offline parameterization, IO-Link devices are already configured before mounting. To do this, use the Pepperl+Fuchs IO-Link USB master.

We recommend using the "PACTware" software as an FDT frame application and user interface.

The software components required in each case are collated in the latest version of the "IO-Link Offline Parameterization Tool" software package. The software package can be found online at www.pepperl-fuchs.com along with the corresponding documentation for installation and operation.

If you use the "IO-Link Offline Parameterization Tool" software package, have active internet access, and have connected your device via the Pepperl+Fuchs IO-Link USB master, you can integrate the IODD directly into the IO-Link Offline Parameterization Tool via the "IODD DTM Configurator."

The device description file (IODD) required for integration in an IO-Link system and for parameterization and diagnostics is available online at www.pepperl-fuchs.com, on the relevant product page for the vibration sensor.

Online Parameterization

When commissioning machines and plants, master and IO-Link devices must be integrated into the relevant control environment. Depending on the components used, different software is required.

The devices can then be configured and parameterized using an IO-Link configuration tool. During operation, you can check the parameter settings of the IO-Link devices and read out and monitor status and diagnostic data. IO-Link data is integrated into an application program using function blocks.

2.2 Vibration Monitoring

2.2.1 Vibration Velocity Operating Range

The operating range of the vibration velocity is not constant over the entire measuring range. It always depends on the current frequency at which the vibration sensor is vibrating.

Essentially, the higher the current frequency, the lower the detectable vibration velocity. This can lead to a significantly high frequency, which can then lead to the current operating range of the sensor in this state being smaller than the specified measuring range.

The maximum detectable operating range can be derived from the maximum detectable acceleration. This is 14 g (137.3 m/s²) for the entire frequency range.

The maximum measurable vibration velocity results from the following physical correlation:

$$v_{max} = \int a_{max}$$

The following applies to sinusoidal vibrations:

$$v_{max} = \frac{a_{max}}{2\pi f}$$

The following figure depicting the vibration monitoring shows the operating range, which is limited by the maximum measurable vibration velocity in mm/s depending on the frequency. The area above the curve shows the operating range that cannot be measured when recording the vibration velocity, because the frequency is too high. The sensor outputs the vibration velocity value that can only just be detected.

Example for a version with a measuring range of 128 mm/s:

- Assumption: Application vibrates at 80 mm/s at 400 Hz
- Sensor output: 64 mm/s

This is the vibration velocity value that can only just be detected at this frequency.

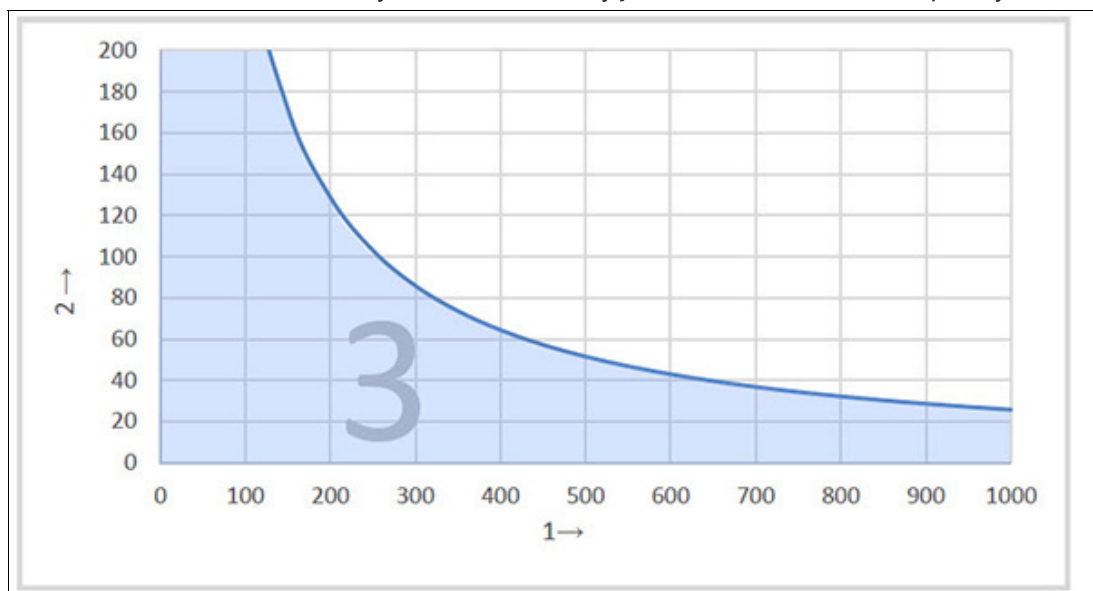


Figure 2.1

- 1 Frequency in Hz
- 2 Vibration velocity in mm/s
- 3 Operating range of vibration monitoring

Reading Example

Frequency (Hz)	Maximum Measurable Vibration Velocity (mm/s)
250	103
400	64
1000	25

Table 2.1

2.2.2 Frequency Response

The typical frequency response of vibration monitoring for two frequency ranges is depicted below.

Typical Frequency Response for Vibration Measured Variables with Cyclic Process Data

All vibration measured variables available as cyclic process data have cut-off frequencies with -3 dB damping. This is based on a third-order Butterworth filter.

As an example, the following figure shows filtering with cut-off frequencies of 10 Hz and 1000 Hz.

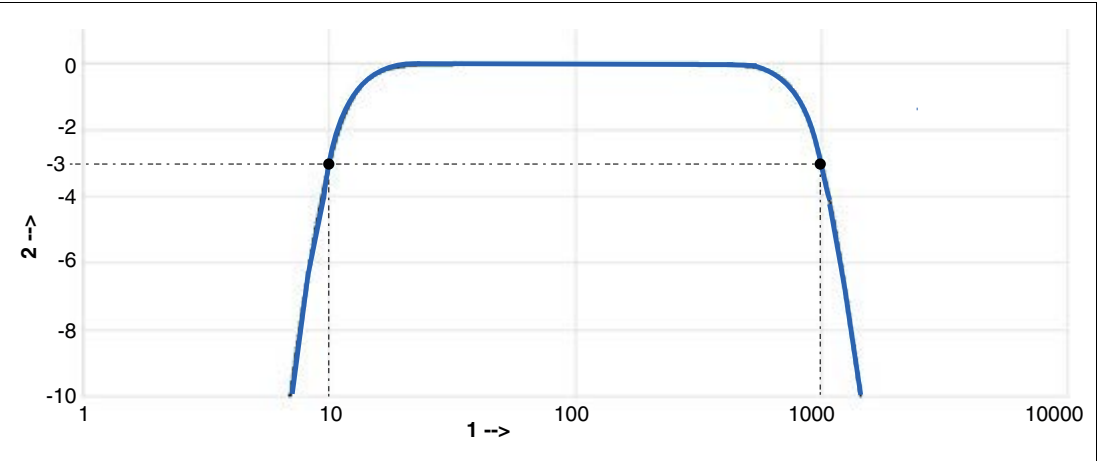


Figure 2.2

- 1 Frequency in Hz
- 2 Gain in dB

Typical Frequency Response for Raw Acceleration Data with Acyclic BLOB Transfer

The raw acceleration data provided via the acyclic BLOB transfer have cut-off frequencies with -3 dB damping in the upper frequency range at 12 kHz. This damping behavior at 12 kHz is based on a third-order Butterworth filter.

No filter is stored in the lower frequency range. This corresponds to a lower cut-off frequency of 0 Hz. The advantage of this is that low-frequency acceleration data can be recorded without damping behavior. However, it must be noted that the acceleration data, which is read out with the acyclic BLOB transfer, contains an offset value due to gravitational forces that is dependent on the mounting position.

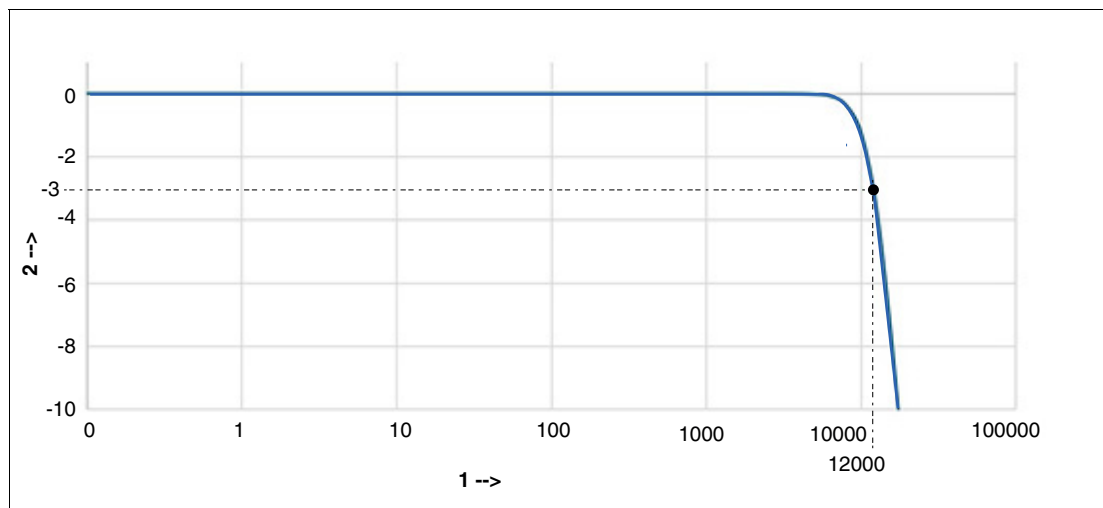


Figure 2.3

- 1 Frequency in Hz
- 2 Gain in dB

2.3 Accessories



Note
Various accessories are available for the VIM3* vibration sensors. These are available online at www.pepperl-fuchs.com, on the product page for the relevant VIM3* vibration sensor.

Available Accessories

Accessories	Use
Cordset for plug versions	Electrical connection for plug versions.
EMC adapter	For insulating the sensor from the mounting point to protect against sources of EMC interference.
Mounting adapter	Adapter with different thread sizes for specific mounting requirements at the mounting point.
Magnetic adapter	Magnetic adapter for mounting VIM3*/VIM6* vibration sensors via magnetic holding force in applications where there is no direct screw-in possibility, internal thread M8 x 1.25 x 10, holding force 35 kg.
Rubber protective sleeve	Flexible plastic cover for additional protection of the sensor against chemical and mechanical influences.

3 Installation

3.1 Instructions for Mechanical and Electrical Installation



Note

Further installation-relevant information on technical data, mechanical data, and available connection lines for the relevant vibration sensor types can be found in the corresponding datasheet.

Always observe the following instructions to ensure safe operation of the vibration sensor:



Warning!

Work must be performed by trained and qualified personnel only!

Commissioning and operation of this electrical device must be performed by trained and qualified personnel only. This means individuals who are qualified to commission (in accordance with safety engineering), connect to ground, and label devices, systems, and circuits.



Warning!

Perform work only when the device is de-energized!

De-energize your device before performing work on the electrical connections. Short circuits, voltage peaks, and similar events can lead to faults and undefined statuses. This presents a significant risk of personal injury and property damage.



Warning!

Protect cables against interference and damage!

Protect the connection cable and any extension cables from electrical interference and mechanical damage. Always observe the local regulations and instructions.



Warning!

Check electrical connections before switching on the plant!

Check all electrical connections before switching on the plant. Incorrect connections present a significant risk of personal injury and property damage. Incorrect connections can lead to malfunctions.



Caution!

Do not perform any electrical modifications!

It is not permitted to perform electrical modifications on the vibration sensor. If you open or modify the device yourself, you are endangering yourself and others, voiding any warranty, and absolving the manufacturer of any liability.



Caution!

Ensure that the data cable and power supply cable are physically separated!

To prevent interference, route the cordset for the vibration sensor so that it is a suitable distance away from power supply cables. Shielded cables must be used to ensure reliable data transfer. A perfect ground connection must be ensured. Always observe the local regulations and instructions.

3.2 Mounting

Prerequisites

Mounting the vibration sensor on the mounting surface:

- The mounting surface must be clean and flat, i.e., free of paint, rust, etc.
- The measuring head surface of the vibration sensor must lie flat on the mounting surface.
- The vibration sensor is fitted with an M8 screw-in thread as standard. Insert the screw-in thread into a threaded hole in the mounting surface. If the thread in the hole is different, thread adapters are available as an accessory.

Mounting the Vibration Sensor

For safe and error-free operation, observe the following requirements during mounting:

- Mount the vibration sensor on the mounting surface correctly to obtain accurate data.
- Avoid mounting the vibration sensor on auxiliary structures. If it is absolutely necessary to use auxiliary structures, make sure these are designed to be as rigid as possible.



1. Screw the vibration sensor into the threaded hole in the mounting surface using a hexagon wrench (SW 24) at a tightening torque of 8 Nm.
2. For plug versions: Connect the connection cable and note that the tightening torque of the connector's M12 union nut must not exceed 0.4 Nm.

3.3 Electrical Connection



Note

Suitable cordsets can be found at www.pepperl-fuchs.com. Navigate to the product page for the relevant vibration sensor under "Accessories."



1. Use a suitable connection cable to connect the rotary encoder to the higher-level control panel, an IO-Link master, or the IO-Link-Master02-USB.

Electrical Connection	Pinout

Table 3.1

4 Cybersecurity and Decommissioning Information

Cybersecurity Information

From a security perspective, the following precautions must be taken for the product by the responsible plant operator:

- Physically secure the device against unauthorized access
- Ensure that the IO-Link device communicates with the remote station via a point-to-point connection.

The product features a proprietary Pepperl+Fuchs service interface that uses the existing connection lines. This interface is used exclusively for initially storing and updating the firmware during production. Once switched on, the interface is deactivated after 20 seconds.

Decommissioning

The device stores adjustable parameter data, temperature information, and the operating time. Parameter data can be deleted by restoring the factory settings.

The operating time counter and temperature information cannot be deleted. To delete this data, the device must be physically destroyed.

5 Commissioning with IO-Link on a Control Panel (Online Parameterization)



Note

The device description file (IODD) required for integration in an IO-Link system and for parameterization and diagnosis is available online. Visit www.pepperl-fuchs.com and navigate to the relevant product page for the VIM3*-IO-* vibration sensor.



To activate the vibration sensor via IO-Link using a control system, proceed as follows:

1. Check the connection between the vibration sensor and the IO-Link master.
2. Set the status to "IO-Link" on the corresponding port on the IO-Link master to which the vibration sensor is connected.
 - ↳ Once communication has been successfully established, parameterize the vibration sensor with the higher-level application either by using an IO-Link configuration tool or retrieving diagnostic information. The device sends the determined data as process data.

6 Commissioning with IO-Link via FTD Framework Program (Offline Parameterization)

IO-Link Offline Parameterization Tool

An IODD (IO-Link Device Description) file is available to download for parameterizing the vibration sensor via IO-Link and diagnosis. See the product page for the relevant VIM3*-IO-* vibration sensor online at www.pepperl-fuchs.com or use the IODDfinder at <https://ioddfinder.io-link.com/>.

With offline parameterization, IO-Link devices are already configured before installation. To do this, use the Pepperl+Fuchs IO-Link USB master.

The software components required in each case are summarized in the latest version of the "IO-Link Offline Parameterization Tool" software package. The software package and the documentation on its installation and use can be found online at www.pepperl-fuchs.com.

If the "IO-Link Offline Parameterization Tool" software package is used, there is active internet access, and the device is connected via the Pepperl+Fuchs IO-Link USB master, the IODD can be directly integrated into the IO-Link Offline Parameterization Tool via the "IODD DTM Configurator."

Note

Suitable cordsets can be found at www.pepperl-fuchs.com. Navigate to the product page for the relevant vibration sensor under "Accessories."



To activate the vibration sensor via IO-Link using the corresponding IODD, proceed as follows:

1. Make sure that the "IO-Link Offline Parameterization Tool" software package is installed on the computer.
2. Connect the vibration sensor to an IO-Link master with a suitable M12 cordset.
3. Connect the IO-Link master to a USB connection on your PC via a USB cable.
4. Start PACTware.

↳ PACTware automatically communicates with the vibration sensor if PACTware from the "IO-Link Offline Parameterization Tool" is used and the IODD was found automatically online.

7 Process Data Structure

Six different measured variables are transferred as process data by the VIM3*PP*-IO-* vibration sensor. These are each transmitted as a Measurement Data Channel (MDC) 1 ... 6. These are vibration velocity RMS, vibration acceleration RMS, vibration acceleration peak, temperature, crest factor, and the bearing condition parameter.

The figure below illustrates the process data structure:

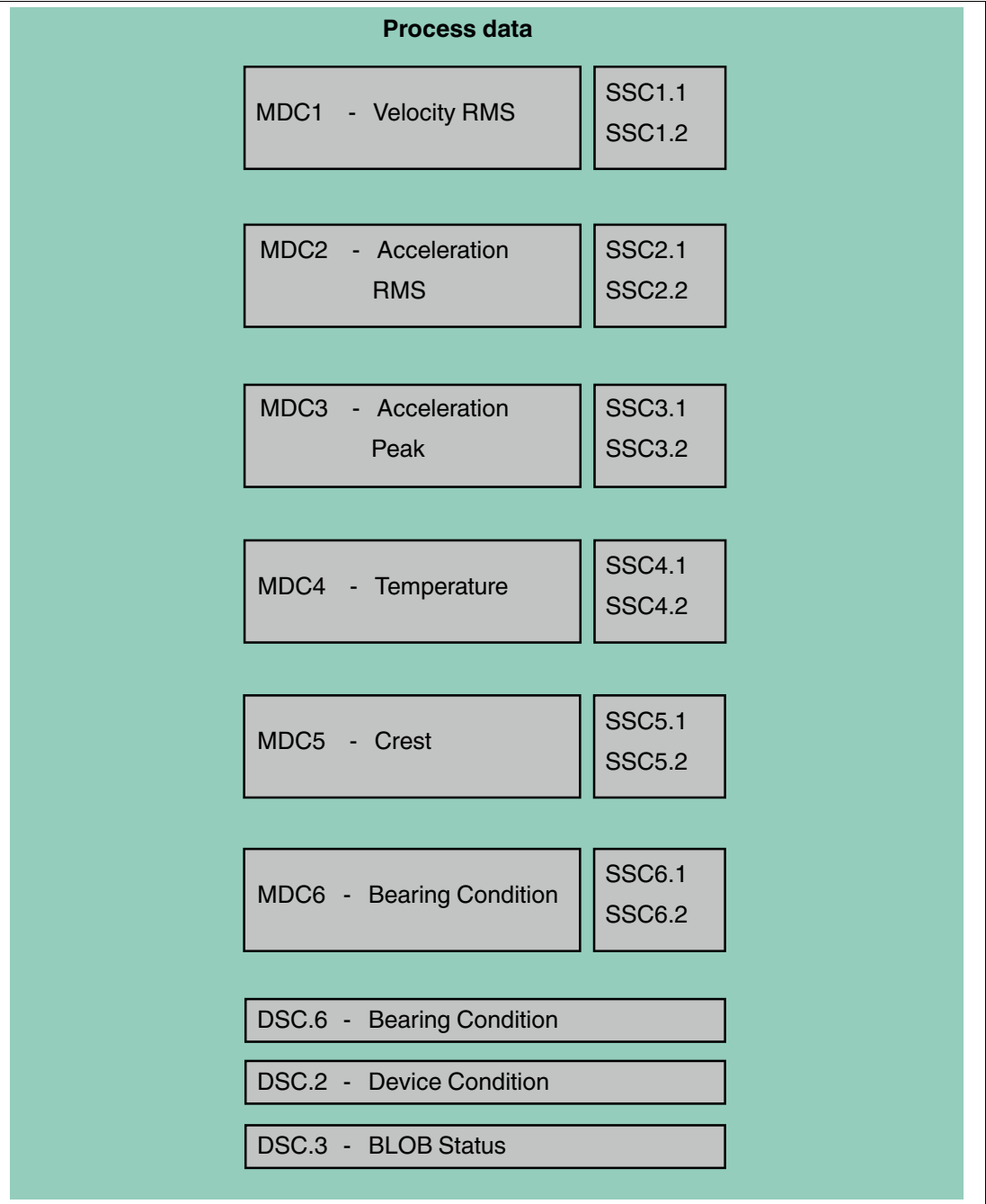


Figure 7.1

Two independent adjustable switching signals (SSC) are transmitted for each measured variable. The diagnostic signal (DSC) 6 shows the current rating of the measured variable MDC6 in accordance with the DIN ISO 13373-3 standard.

The diagnostic signal (DSC) 2 describes the current status of the sensor. Among other things, this can be used to show necessary plant maintenance. For this purpose, a plant maintenance cycle can be defined on the device using adjustable thresholds and measured values. The "Device Status" then shows whether a plant maintenance cycle is necessary.

The diagnostic signal (DSC) 3 indicates whether the sensor is ready to transfer raw acceleration data via BLOB transfer.

7.1 Parameterizing a Switching Signal (SSCx)

Two independent switching signals (SSC) can be parameterized for each measured variable. The principle for parameterization is the same for each measured variable (SSC).

The figure below illustrates the relationships:

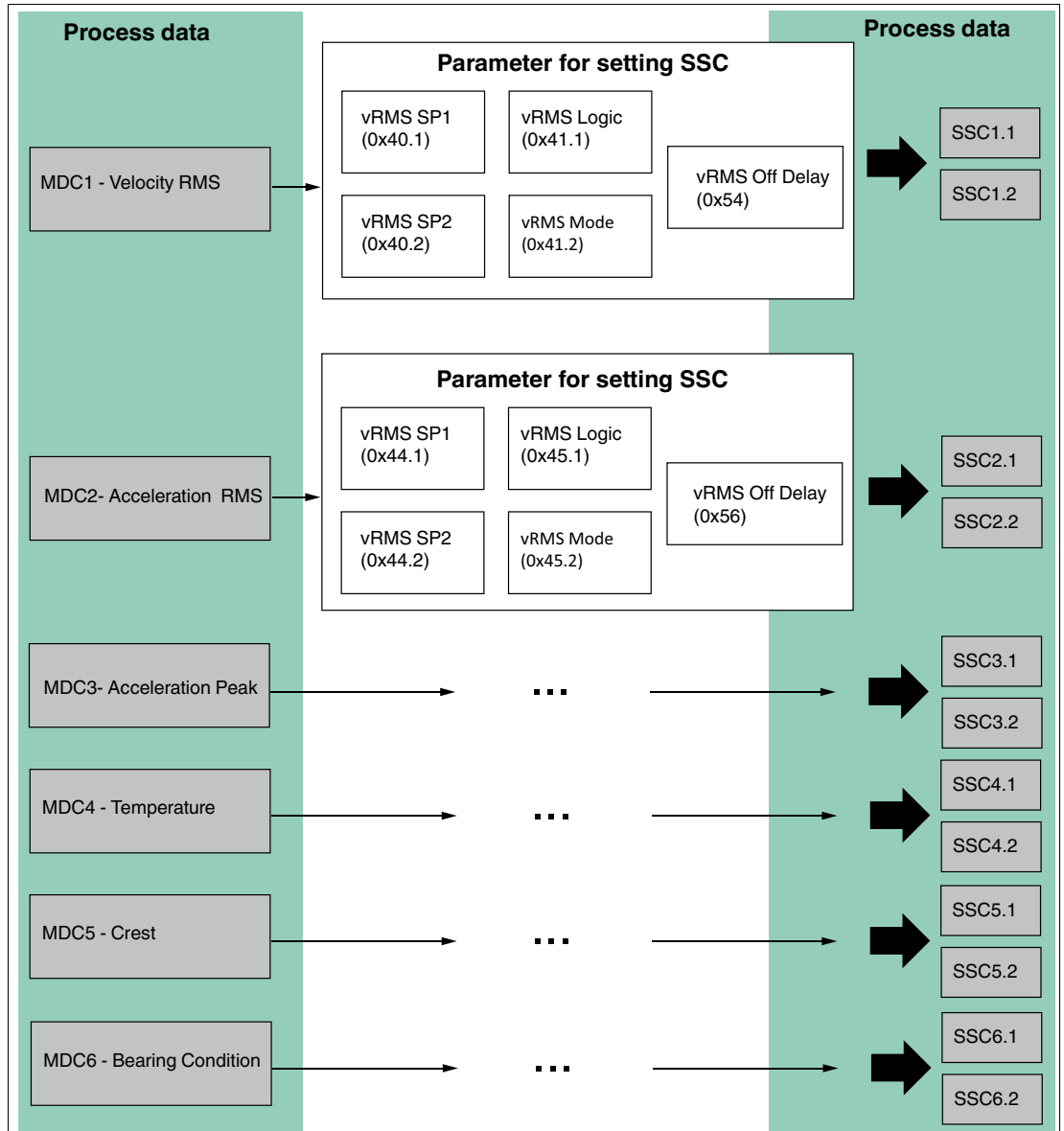


Figure 7.2

For example, the SSC1.1 switching signal can be used to monitor the vibration velocity "Velocity RMS." Two independent measured value limits (SP1 and SP2) can be set for monitoring a measurement range. This mode can also be used to switch between monitoring a measurement range and monitoring an individual point. You can use "Off Delay" to set a delay time for how long the measured value limit can be minimally exceeded before the switching signal responds. This is done to prevent the SSCx switching signal from switching back and forth.

This concept is implemented for each SSCx. The appropriate parameters are available and can be set independently of each other.

7.2 Parameterizing a Plant Maintenance Cycle

A plant maintenance cycle can be parameterized by defining the monitored threshold values that correspond to the measured variables of the cyclic process data. The threshold values are independent of the SSCx switch points from the process data. For example, a plant maintenance cycle can be defined by exceeding the vRMS vibration velocity thresholds.

The figure below illustrates the relationships:

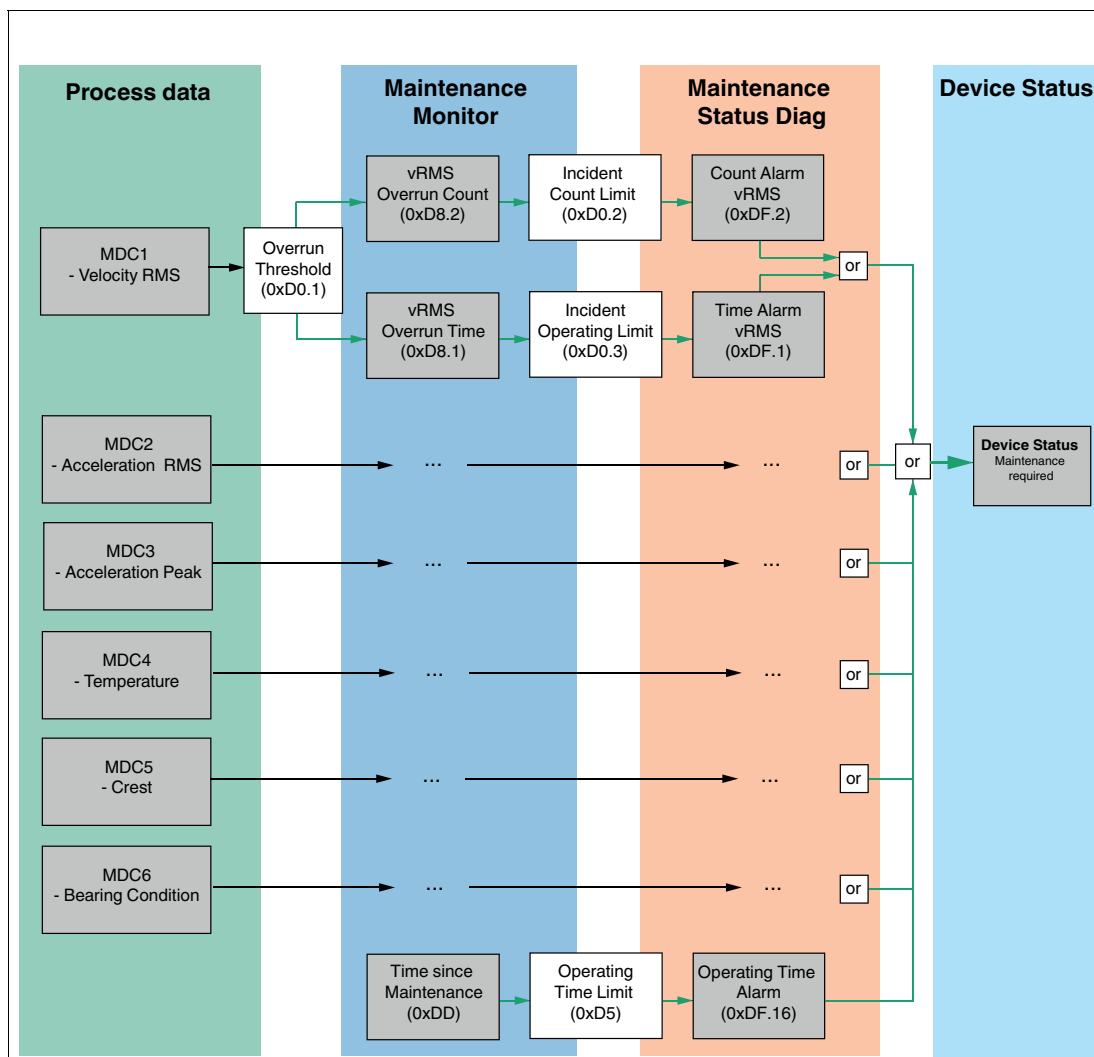


Figure 7.3

When parameterizing a plant maintenance cycle, e.g., using the vRMS vibration velocity, a threshold value is defined in the "Overrun Threshold" parameter. If the set threshold value is exceeded, both a counter and a timer are incremented. The counter totals how often the process data measured value has exceeded the "Overrun Threshold." The timer totals how long the process data measured value was above the "Overrun Threshold."

Threshold values for limiting the value of the counter and timer can also be defined. As soon as one of these limits is exceeded, this triggers the binary information "Count Alarm vRMS" or "Time Alarm vRMS." Once an alarm parameter is triggered, the device status is changed to "Maintenance required," which in turn is also shown in the process data in the device status. This concept for triggering the device status to "Maintenance required" can be applied to each available measured variable. An "Overrun Counter" and "Overrun Timer" are therefore available for each measured variable. The sum of these parameters is described as "Maintenance Monitor."

A binary "Count Alarm" and a binary "Time Alarm" are therefore available for each measured variable. The sum of these parameters is described as "Maintenance Status Diag." In addition, triggering based purely on time is possible with "Time since Maintenance." Once maintenance has been successfully carried out on the plant, the "Maintenance Reset" command can be executed on the device. This command only resets all "Maintenance Monitor" and "Maintenance Status Diag" parameters back to zero and a new plant maintenance cycle can begin.

8 BLOB Transfer for Raw Acceleration Data

BLOB stands for Binary Large Object. It corresponds to an IO-Link technology profile and describes the transfer of large amounts of data via IO-Link. The VIM3*PP* sensor uses this technology profile to transfer the raw acceleration data. The sensor therefore has two channels for transferring measured data from measured variables that use the same IO-Link connection.

- On the one hand, this is the process data of the measured variables that is transferred cyclically.
- On the other hand, the raw acceleration data can be requested acyclically via the BLOB transfer.

The following table provides an overview of this.

Data Group	Type of Data	Transfer Mode
Process data	MDC1, SSC1.1; SCC1.2 MDC2, SSC2.1; SCC2.2 MDC3, SSC3.1; SCC3.2 MDC4, SSC4.1; SCC4.2 MDC5, SSC5.1; SCC5.2 MDC6, SSC6.1; SCC6.2; DSC.6 DSC.2, DSC.3	Cyclic data transfer
BLOB transfer	Raw acceleration data a-Raw	Acyclic data transfer based on the following sequences: - Data storage in the sensor memory - Data transfer - Retriggerring of new data storage in the sensor memory

Table 8.1

8.1 Advantage of BLOB Transfer for Raw Acceleration Data

The VIM3*PP* sensor can scan a vibration signal at up to 64 kHz. The resulting data volume would overwhelm the cyclic process data transfer method, since more data is generated in the sensor per unit of time than can be transferred. However, this detailed vibration raw acceleration data is of great interest for frequency analyses. In the case of acyclic BLOB transfer, the sensor is set to different statuses to record the large amount of data and then transfer it.

These statuses are:

- Idle, no BLOB transfer active
- Raw data recording
- Recording finished, wait for transfer
- Transfer active
- Deleting memory

However, regardless of the current status of the sensor, the process data is transferred cyclically without interruption or loss of quality.

8.2 Trigger for Recording the Raw Acceleration Data a-Raw

Generally, the sensor is in the "Idle, no BLOB transfer active" status without recording or transferring the BLOB raw acceleration data a-Raw. A trigger for setting the sensor to the "Raw data recording" status can be executed in three ways:

- "Trigger with BLOB_ID -4096" parameter
- SSC trigger on switching edge with BLOB_ID -4097
- PDO trigger via IO-Link master with BLOB_ID -4098

The sensor shows which trigger has been used in parameter 102 (0x66) "BLOB Active ID."

8.3 Parameter Trigger with BLOB_ID -4096

Initially, the sensor is in the "Idle, no BLOB transfer active" status. The sensor also shows this in the "DSC.3 BLOB status" in the process data. If the write command "0xF1 0xF0 0x00" is now sent to parameter 50 (0x32), this sets the sensor to the BLOB status "Raw data recording." Simultaneously, parameter 102 (0x66) "BLOB Active ID" shows the value "-4096."

If the BLOB status is not in "Idle," this causes, the already saved raw acceleration data a-Raw to be immediately deleted in the sensor's memory and the BLOB status "Idle, no BLOB transfer active" to be adopted.

8.4 SSC Trigger on Switching Edge with BLOB_ID -4097

Initially, the sensor is in the "Idle, no BLOB transfer active" status. The sensor also shows this in the DSC.3 BLOB status in the process data. If a switching signal (SSC) is now selected in parameter 101 (0x65) "BLOB Config – SSC Trigger," then a trigger is executed on a falling or rising edge of the selected SSC. This sets the sensor to the BLOB status "Raw data recording."

Simultaneously, parameter 102 (0x66) "BLOB Active ID" shows the value "-4097."

If the BLOB status is not in "Idle," this type of trigger is ignored.

8.5 PDO Trigger via IO-Link Master with BLOB_ID -4098

Initially, the sensor is in the "Idle, no BLOB transfer active" status. The sensor also shows this in the DSC.3 BLOB status in the process data. If the "PDO Output Data" is now written with the value "0x01" in the IO-Link master, this sets the sensor to the BLOB status "Raw data recording." Simultaneously, parameter 102 (0x66) "BLOB Active ID" shows the value "-4098." If the BLOB status is not in "Idle," this type of trigger is ignored.

8.6 Raw Acceleration Data Memory Size

The sensor has an internal volatile memory for recording the raw acceleration data. The parameter 98 (0x62) defines the number of measuring points (samples) in thousands that determine the memory size for raw data recording. Each measuring point (sample) has a size of 32 bits, whereby 18 bits are measured data and the remaining 14 bits are statically zero. LSB = 0.00005 g.

8.7 Recording Time

The parameter 99 (0x63) shows the estimated raw data recording time resulting from the configured sampling rate (samples) and the configured memory size. A high sampling rate and a small memory size results in a short recording time and follows the formula:

Recording time = memory size / sampling rate

Example:

320,000 samples / 64,000 (1/s) = 5 s

8.8 Sampling Rate of the Raw Acceleration Data

Parameter 97 (0x61) defines the internal sampling rate at which the vibration signal is scanned, and the associated low pass applied to the vibration signal. A high sampling rate results in a short recording time.

8.9 BLOB Transfer of the Raw Acceleration Data

Note

Detailed information on the topic of "BLOB transfer" can be found at www.io-link.com

As soon as the sensor is in the BLOB status "Recording finished, wait for transfer," the BLOB transfer can be started. If the write command "0xF1 0xEF 0xFE" is now sent to parameter 50 (0x32), this sets the BLOB status to "Transfer active." The entire raw acceleration data memory is now divided internally into smaller subpackets.

If the read command is then sent to parameter 50 (0x32), the sensor initially responds with the header information. If another read command is issued to parameter 50 (0x32), the sensor responds with the first subpacket. This must be repeated until all subpackets have been transferred and therefore the entire memory has been read out. In the last subpacket, the sensor responds with a checksum.

The duration of the transfer depends on the set memory size and the speed at which a read command is sent to parameter 50 (0x32).

The duration follows the following formulas:

Memory size * 4 bytes = number of bytes to be transferred

(Each measuring point (sample) consists of 4 bytes)

Example:

320,000 * 4 = 1,280,000 bytes

For each ISDU read, 200 bytes are transferred

(Memory size * 4) / 200 = number of required ISDU reads

Example:

320,000 * 4 / 200 = 6400 ISDU reads

Depending on the time per ISDU read, there is a large tolerance as to how long the total transfer time is.

The parameter 100 (0x64) estimates this total transfer time based on 375 ms per ISDU read.

Example:

6400 ISDU reads * 375 ms = 2,400,000 ms = 2400 s = 40 minutes

Depending on the higher-level system, the transfer time may vary significantly in practice and is really intended to familiarize the user with the sensor and its adjustment options with regard to BLOB transfer.

Finally, the write command "0xF2" must be sent to parameter 50 (0x32), whereby the transfer is ended and the BLOB status changes to "Deleting memory." Once the memory has been deleted, the BLOB status changes to "Idle, no BLOB transfer active."

Alternatively, an "Abort" can also be sent during transfer. To do this, the write command "0xF0" must be sent to parameter 50 (0x32), which also causes the memory to be deleted and the BLOB status "Idle, no BLOB transfer active" to be adopted.

Only then can a new trigger be executed for recording the raw acceleration data.

The following table shows an overview of the most relevant commands with regard to BLOB transfer.

Task	Parameter	Command	Description
Start Recording	50 (0x32)	write: 0xF1 0xF0 0x00	BLOB_ID = -4096
Start Recording	101 (0x65)	select SSC	BLOB_ID = -4097
Start Recording	Master PDO	write 0x01	BLOB_ID = -4098
Start Transmission	50 (0x32)	write: 0xF1 0xEF 0xFF	Use just for -4097
Start Transmission	50 (0x32)	write: 0xF1 0xEF 0xFE	Use just for -4098
Do Transmission	50 (0x32)	read	The sensor responds to each ISDU read with a BLOB sub-packet. Do this as often as necessary. After the first ISDU read, the BLOB status changes to "Transfer active"
Finish Transmission	50 (0x32)	write 0xF2	Triggers deleting
Abort Transmission	50 (0x32)	write 0xF2	Triggers deleting

Table 8.2

8.10 Converting BLOB Data into Acceleration Data [g]

8.10.1 Converting BLOB Data into g Values

Example of the structure of the received BLOB data after a successful ISDU read.

Name	Data	Description
Response to one ISDU read	0x21 0x00 0x01 0xFC 0xE3 0x00 0x01 ...	
First byte is counter on each ISDU read	0x21	
Other 200 bytes are the data points with 4 bytes per point	0x00 0x01 0xFC 0xE3 0x00 0x01 ...	
First point (4 bytes per point)	0x00 0x01 0xFC 0xE3	Data Type: Big Endian Most Significant Byte (MSB) is sent first
Second point (4 bytes per point)		Data Type: Big Endian Most Significant Byte (MSB) is sent first
Third point (4 bytes per point)		Data Type: Big Endian Most Significant Byte (MSB) is sent first

Table 8.3

Each measuring point of the BLOB data is transferred as the "Big Endian" data type. They correspond to raw acceleration data to which no filter has been applied. As a result, the values are influenced by the mounting-position-dependent gravitational force.

The same example as in the table above is used to convert the BLOB data into g values. First, the data is converted from hexadecimal to decimal format.

Name	Data in Hex	Data in Dec
First byte is counter on each ISDU read	0x21	33
First point (BLOB Value) (4 bytes per point)	0x00 0x01 0xFC 0xE3 Data Type: Big Endian Most Significant Byte (MSB) is sent first	130275

Table 8.4

A conversion factor must then be used to convert the data into g values. See the following table.

Formula	Example	Description
BLOB Transfer	130275	Data Type: Big Endian in decimal
Con [LSB/g]	$128 / ((2^{18}) - 1) = 2047.9921$	Conversion factor
BLOB Value/Con = Acc_unfiltered	$130275 / 2047.9921 = 63.6111 \text{ g}$	Value still affected by Offset and Gravity

Table 8.5

The unfiltered acceleration value generally has an offset of 60 g due to the data format. This must also be corrected based on the influence of the mounting-position-dependent gravitational force. Further details can be found in the following section.

8.10.2 Influence of Frequency Range



Note

All statements in this section refer only to the measurement of raw acceleration data provided via BLOB transfer. All other measured variables of the cyclic process data MDC1, MDC2, MDC3, MDC4, MDC5, and MDC6 are not influenced by the mounting position of the sensor.

The raw acceleration data provided via the BLOB transfer can be detected in the frequency range from 0 Hz to 12 kHz.

The figure below illustrates this frequency range.

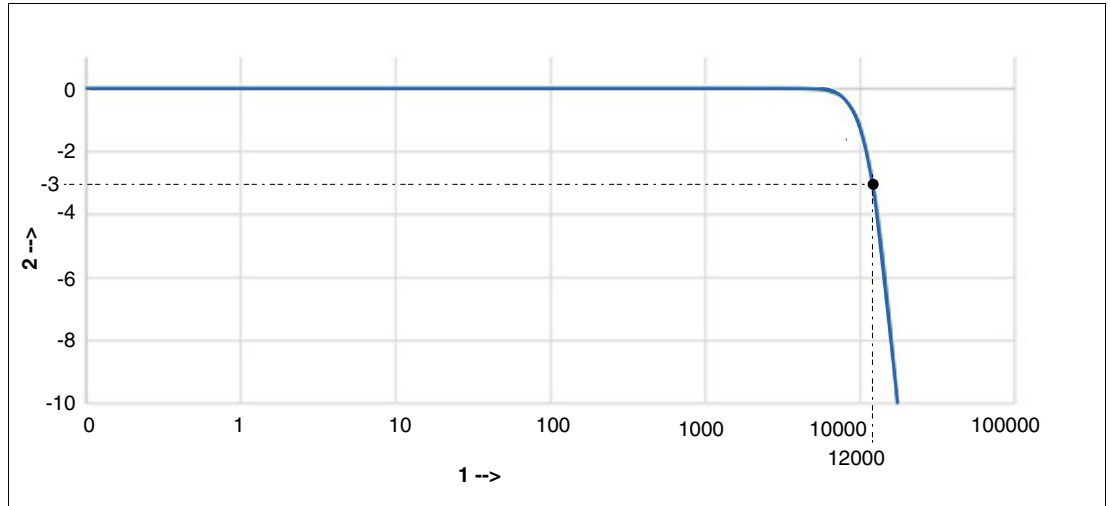


Figure 8.1

- 1 Frequency in Hz
- 2 Gain in dB

When filtering acceleration signals above 12 kHz, a third-order Butterworth filter was stored. Acceleration signals of 0 Hz are not filtered out but are part of the recording provided via the memory and BLOB transfer. The advantage of this is that even very low-frequency acceleration signals can be measured.

This also means that static or linear accelerations are recorded. Consequently, the gravitational force, and therefore the mounting position with regard to the measuring axis orientation, has an influence on the measured acceleration data.

If you would like to eliminate this to obtain acceleration data that is independent of the mounting position, then you must subtract the offset from each measured acceleration value.

The offset = the arithmetic mean of the entire series of measurements:

$$\text{Offset} = 1/n \times \sum x_i \quad (i = 1 \dots n)$$

Three examples are shown below.

Mounting Position Parallel to Gravitational Force

The following figure shows an example of the mounting position and the measuring axis of the sensor.

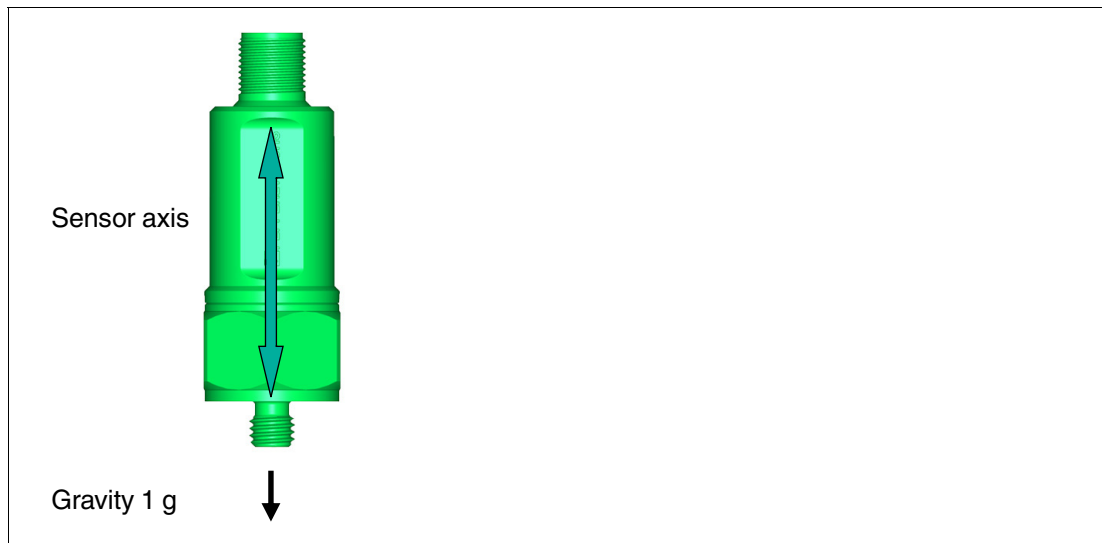


Figure 8.2

This mounting position means that the static acceleration of the gravitational force is contained in the measured raw acceleration data. This influence can also be understood as a static offset. This means that a cyclic vibration behavior oscillates back and forth around the offset = 1 g.

The figure below illustrates this.

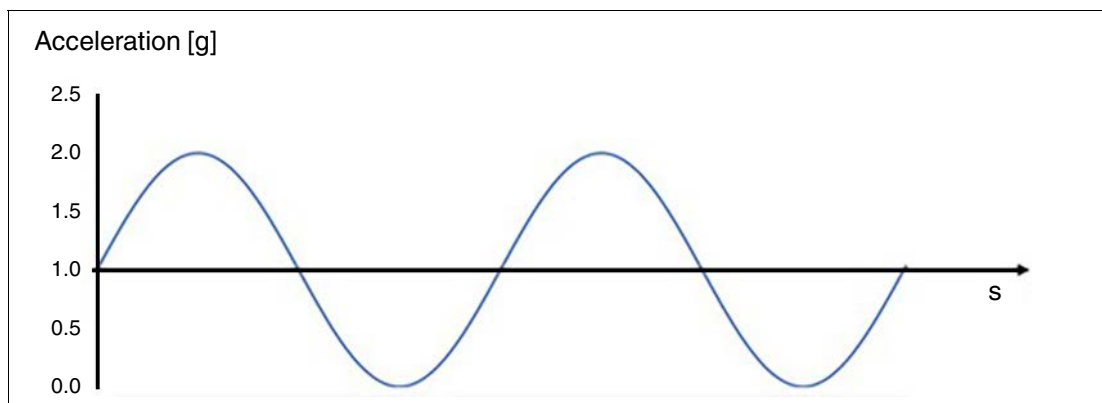


Figure 8.3

To obtain acceleration data that is independent of the mounting position, you must subtract the offset (= arithmetic mean of the entire measurement series) from each measured acceleration value.

Mounting Position Horizontal to Gravitational Force

The following figure shows an example of the mounting position and the measuring axis of the sensor.

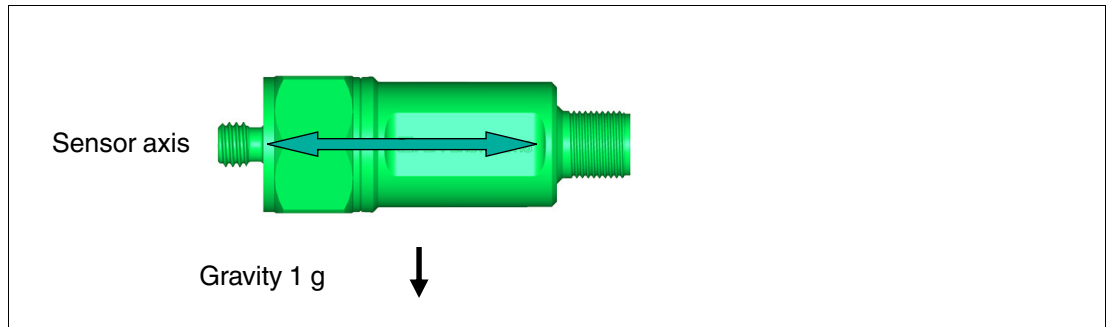


Figure 8.4

This mounting position means that the static acceleration of the gravitational force is not contained in the measured raw acceleration data.

This means that a cyclic vibration behavior oscillates back and forth around the offset = 0 g and does not affect the actual data.

The figure below illustrates this.

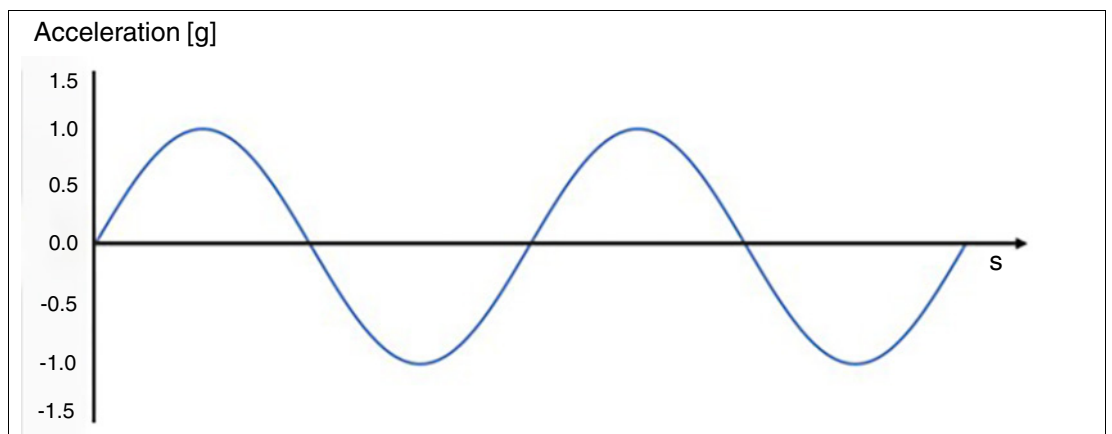


Figure 8.5

Mounting Position Aligned at an Angle to the Gravitational Force

The following figure shows an example of the mounting position or the measuring axis of the sensor.

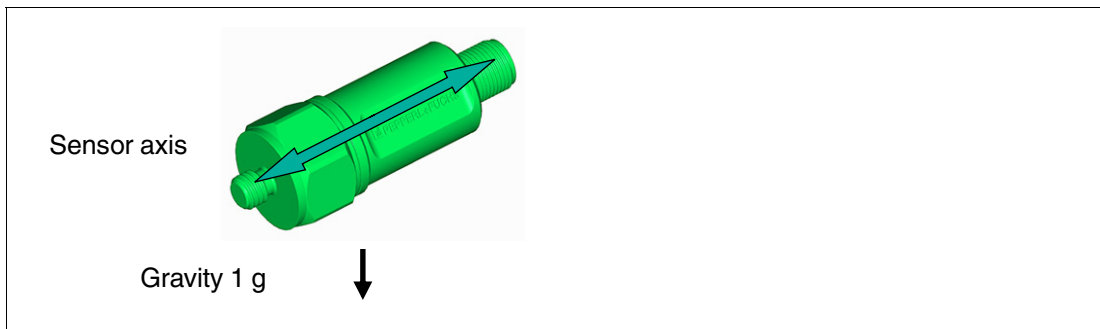


Figure 8.6

This mounting position means that the static acceleration of the gravitational force is contained in the measured raw acceleration data. To obtain acceleration data that is independent of the mounting position, you must subtract the offset (= arithmetic mean of the entire measurement series) from each measured acceleration value.

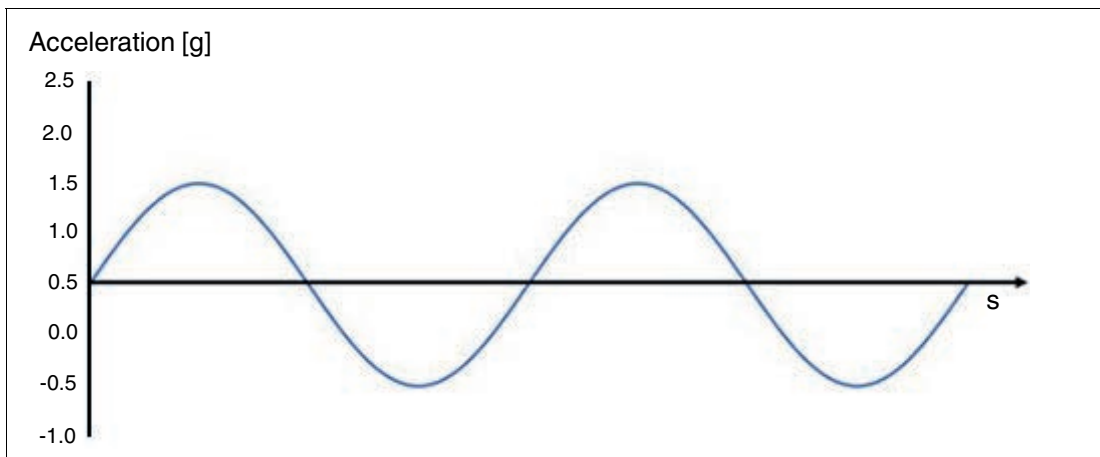


Figure 8.7

8.10.3 Example Calculation for Eliminating the Offset Caused by Gravitational Force

The following example calculation shows in principle how the arithmetic mean should be understood over the entire series of measurements and how it should be subtracted individually from each transferred raw acceleration data value.

		Acceleration Value [g]						
		Acc_unfiltered						
		transferred by BLOB			Subtract offset		Acceleration value adjusted by offset and mounting position	
Start Measurement	0	63,6111	63,6111	-	60,5649	=	3,0462	
	1	63,0100	63,0100	-	60,5649	=	2,4451	
	2	62,0200	62,0200	-	60,5649	=	1,4551	
	3	63,0300	63,0300	-	60,5649	=	2,4651	
	4	60,0400	60,0400	-	60,5649	=	-0,5249	
	5	59,0500	59,0500	-	60,5649	=	-1,5149	
	6	59,0600	59,0600	-	60,5649	=	-1,5049	
	7	58,0699	58,0699	-	60,5649	=	-2,4950	
	8	59,0799	59,0799	-	60,5649	=	-1,4850	
	9	60,0899	60,0899	-	60,5649	=	-0,4750	
	10	61,0998	61,0998	-	60,5649	=	0,5349	
	11	61,1098	61,1098	-	60,5649	=	0,5449	
	12	62,1197	62,1197	-	60,5649	=	1,5548	
	...	...	...	...	...	...	...	
End Measurement	20000	58,6197	58,6197	-	60,5649	=	-1,9452	

Arithmetic means

60,5649

This process adjusts the transferred raw acceleration data values a-Raw by the influence of the mounting position and the initial offset. We recommend always using this process.

9 Troubleshooting

9.1 What to Do in the Event of a Fault

In case of a fault, use the following checklist to determine whether a fault with the vibration monitoring can be remedied.

If none of the information provided in the checklist solves the problem, contact Pepperl+Fuchs via your sales office with any queries. Have details of the model number and firmware version of the sensor ready if possible.

Checklist

Error	Cause	Remedy
Incorrect measured value	Vibration sensor not mounted correctly	Check that the sensor is mounted correctly. Ensure that the sensor thread is tightened with a tightening torque of 8 Nm.
	Vibration sensor mounted in the wrong position	The vibration behavior can vary depending on the measuring point/mounting point. Therefore, mount the sensor as precisely as possible at the point where the corresponding vibration behavior should be estimated/monitored.
No IO-Link connection to vibration sensor	The C/Q communication port on the sensor is not connected to the IO-Link master. The data connection between the PC (PACTware), IO-Link master, and the sensor is not working.	Make sure the C/Q communication port is connected to the IO-Link master. Restart PACTware if necessary.
	No voltage supply	Check whether there is a reason for the absence of the voltage supply, e.g., a faulty fuse. Switch on the voltage supply.

Table 9.1

10 Repair and Servicing

The device must not be repaired, changed, or manipulated. In case of failure, always replace the device with an original device.

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Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
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- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
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