VIM6* Vibration Sensors

Manual

CE

Your automation, our passion.

PEPPERL+FUCHS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

Worldwide

Pepperl+Fuchs Group

Lilienthalstr. 200

68307 Mannheim

Germany

Phone: +49 621 776 - 0

E-mail: info@de.pepperl-fuchs.com

North American Headquarters

Pepperl+Fuchs Inc.

1600 Enterprise Parkway

Twinsburg, Ohio 44087

USA

Phone: +1 330 425-3555

E-mail: sales@us.pepperl-fuchs.com

Asia Headquarters

Pepperl+Fuchs Pte. Ltd.

P+F Building

18 Ayer Rajah Crescent

Singapore 139942

Phone: +65 6779-9091

E-mail: sales@sg.pepperl-fuchs.com

https://www.pepperl-fuchs.com

2023-08

1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

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

Note

For full information on the product, refer to the 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.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

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

1.2 Target Group, Personnel

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

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting 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.

2023-08

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.

Action

1. 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.

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 dismounting 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

Vibration sensors from the VIM6* product family determine the vibration magnitude using the root mean square (RMS) formation. This form of quadratic average determination or pre-filtering allows precise statements to be made about trends relating to the status of the application. Depending on the product versions, the vibration magnitude is determined either as the vibration acceleration (in g rms), as the vibration velocity (in mm/s), or as the vibration velocity and temperature (in °C).

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.

Vibration sensors from the VIM6* product family always have two temperature readings: the measuring head temperature T_M and the ambient temperature T_A.

- The measuring head temperature T_M describes the maximum permissible temperature range directly at the location where the sensor is mounted. The machine surface to be monitored must therefore not exceed or fall below the specified measuring head temperature T_M for the sensor.
- The ambient temperature T_A describes the maximum permissible temperature range for the ambient atmosphere in which the sensor is used.

The two temperatures are related as described below. The measuring head temperature T_M is always permitted to be a higher temperature than the corresponding ambient temperature T_a in the upper range. This means that the machine to be monitored is permitted to heat up to the upper limit of T_M and therefore contribute to the heating of the ambient atmosphere. However, the resulting ambient temperature must not exceed the upper limit of T_A.

Example

Temperature specifications:

- $-35\ °C \leq T_M \leq 125\ °C$
- $-35\ °C \leq T_A \leq 60\ °C$

The machine to be monitored must not exceed 125 °C at the location where the sensor is mounted, while the ambient atmosphere in which the sensor is used must not exceed 60 °C.

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 16.5 g (161.8 m/s^2) 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.

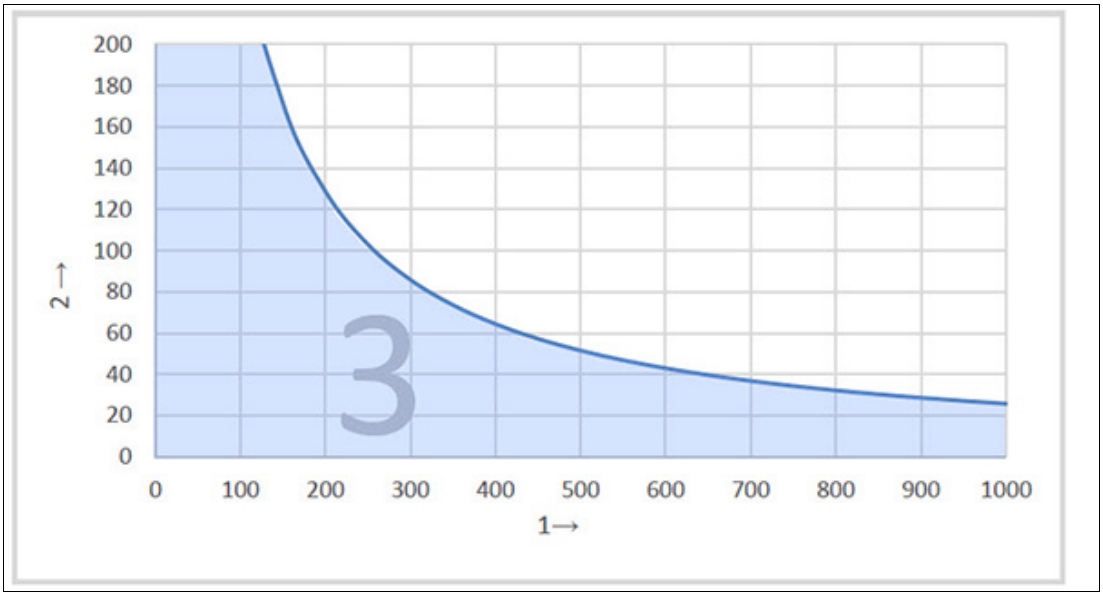

Figure 2.1

1 Frequency in Hz

2 Vibration velocity in mm/s

3 Operating range of vibration monitoring

2023-08

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.

Frequency Response: 10 Hz to 1000 Hz

The cut-off frequencies are 10 Hz and 1000 Hz with -3 dB damping.

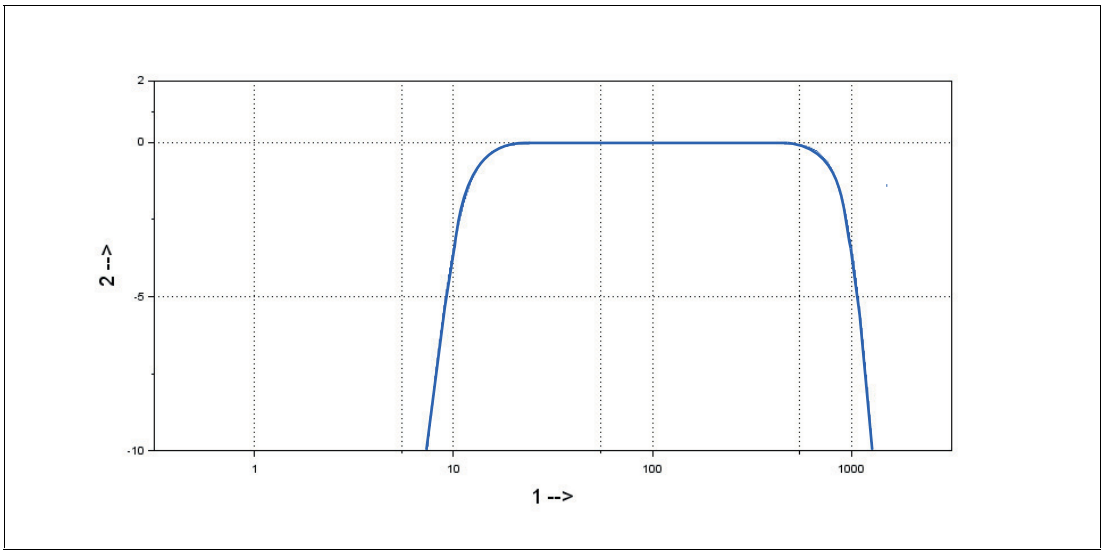

Figure 2.2

1 Frequency in Hz

2 Gain in dB

Frequency Response: 1 Hz to 1000 Hz

The frequency response was recorded using two reference sensors.

The cut-off frequencies are 1 Hz and 1000 Hz with -3 dB damping.

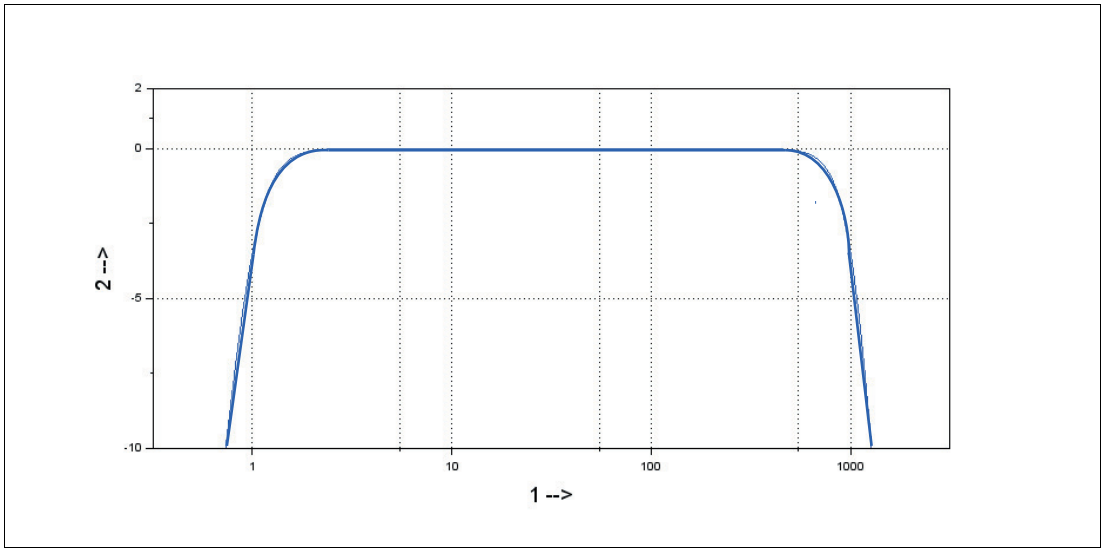

Figure 2.3

1 Frequency in Hz

2 Gain in dB

2.3 Accessories

Note

Various accessories are available for the VIM6* vibration sensors. These accessories are available online at **www.pepperl-fuchs.com**, on the product page for the relevant VIM6* 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.
Rubber protective sleeve	Flexible plastic cover for additional protection of the sensor against chemical and mechanical influences.
Flexible metal conduit	Flexible metal conduit for additional protection of the internal cable against chemical and mechanical influences.

2023-08

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 system 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!

Performing work in a hazardous area!

De-energize your device or remove the housing cover before performing work on the electrical connections.

Seal all unused cable glands with protective covers. Prevent the inside of the device from becoming contaminated when the connector is disconnected.

Disconnected connectors must always be de-energized.

Lock the connection with interlock protection. Pay attention to the warning marking.

Do not remove the warning marking "Warning – Do not disconnect when energized!"

For VIM6***-*****-*P*-******* vibration sensors with type of protection Ex i and a connector plug, only use V15-W-N4-*M-PUR-N4S5 connection cables from Pepperl+Fuchs.

Ensure that the device and its measuring head are only operated in their permissible temperature ranges. This information can be found in the relevant datasheet.

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!

The housing must be grounded!

The housing of the vibration sensor must be grounded when mounting, either via the machine body or via a separate protective conductor (PE)!

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.

2023-08

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 thread as standard. Insert the screw 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.
- Earth and ground loops are among the most common problems when using measuring setups with sensitive sensor technology. These loops are caused by unwanted differences in potential in the circuit between the sensor and the control interface. As a countermeasure, we recommend our standard grounding concept or, depending on the application, our alternative grounding concept
- Make sure that the ground connection is electrically safe.

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

Connection Diagram

Earth and ground loops are among the most common problems when using measuring setups with sensitive sensor technology. These loops are caused by unwanted differences in potential in the circuit between the sensor and the control interface.

Four different grounding concepts are described below. The appropriate concept should be selected for the application. Note that different cable types and other accessories may be required depending on the grounding concept.

Note

Various accessories are available for the VIM6* vibration sensors. These are available online at **www.pepperl-fuchs.com**, on the product page for the relevant VIM6* vibration sensor.

Grounding Concept 1 (Recommended)

Only applicable for:

- Versions with an integrated cable outlet
- Plug versions with a P+F connection cable accessory

Situation/Requirements of the Application	Effects of the Grounding Concept
No EMC interference is expected from the machine side, e.g., from the frequency inverter	• The machine should be connected to the sensor housing, or there is no effect on the quality of the measurements provided by the sensor. • EMC interference that still directly affects the sensor head can discharge via the machine earth.
Prevention of earth loops necessary, e.g., when using long cables approx. 500 m in length.	No conductive connection between the sensor housing and the cable shield required: This means that there is no connection between the machine earth (point 1 in Fig.) and the earth at the control interface (-> point 6 in Fig.).
Coupled interference must be deflected	• Deflected via machine earth (-> point 1 in Fig.) or • Deflected via earth at the control interface (-> point 6 in Fig.)

Table 3.1

2023-08

The following diagram applies to each version with an integrated cable outlet or to each plug version that is used in combination with a suitable P+F connection cable accessory. This grounding concept is also recommended if no sources for EMC pollution, such as frequency inverters, are used on the machine side. In the standard grounding concept, the sensor cable shield is not connected to the sensor housing (represented by the red dashed circuit in the Fig.). The sensor housing has the same potential as the machine earth.

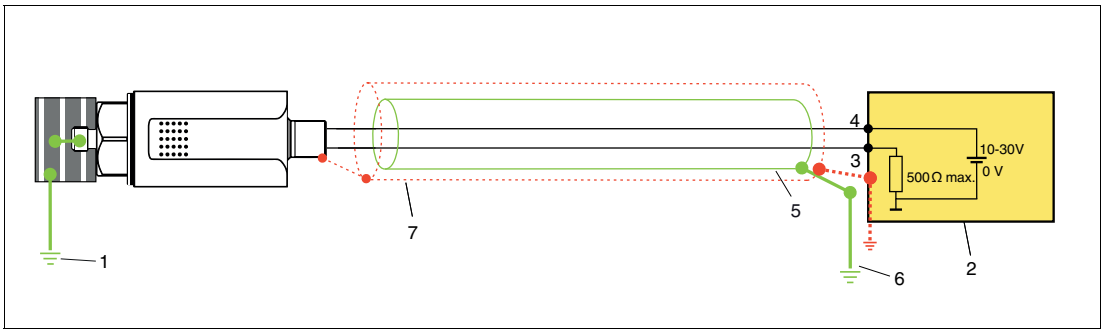

Figure 3.1

1 Machine earth

2 Control interface (measuring instrument, PLC, etc.)

3 4 mA ... 20 mA power signal

4 10 V DC ... 30 V DC

5 Cable shield

6 Ground potential for the control interface

7 Optional flexible metal conduit (only available for version with an integrated cable)

In principle, there is a risk that very long cable lengths with a long distance between the machine earth (1) and the earth (6) of the control interface could lead to an earth loop. This would lead to continuous equipotential bonding between the machine and the control interface. To prevent these earth loops, the housing potential and the cable shield are not connected in this grounding concept. Nevertheless, coupled interference can discharge either via the machine earth (1) or via the earth (6) of the control interface.

This separated design is available in all versions with an integrated cable. The sensor housing potential and the cable shield can also be separated for plug versions that are used with a suitable P+F connection cable accessory.

Grounding Concept 2 (Special Case)

Only applicable for:

- Plug versions with connection cable accessories from third-party suppliers.
- Assumption: The sensor housing and the cable shield are connected.

Situation/Requirements of the Application	Effects of the Grounding Concept
Severe EMC interference is expected from the machine side, e.g., from the frequency inverter	The machine and the sensor housing should not be connected. Insulation via an EMC adapter protects the sensor's measurement data acquisition from interference.
Risk/prevention of earth loops necessary, e.g., when using a long cable approx. 500 m in length.	The sensor housing and the mounting point on the machine are not connected: This means that there is no continuous connection between the machine earth (-> point 1 in Fig.) and the earth at the control interface (-> point 6 in Fig.).
Coupled interference must be deflected	Deflected via earth at the control interface (-> point 6 in Fig.)

Table 3.2

The following diagram only applies to plug versions that are used with a commonly available cordset to connect the sensor housing potential and the cable shield. The EMC adapter (red) must also be used as an accessory. This grounding concept is recommended when sources of EMC pollution, such as frequency inverters, are present on the machine side.

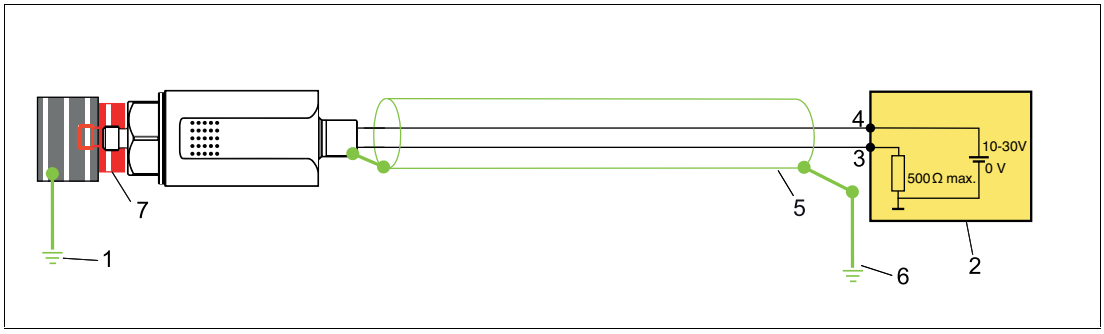

Figure 3.2

1 Machine earth
2 Control interface (measuring instrument, PLC, etc.)
3 4 mA ... 20 mA power signal
4 10 V DC ... 30 V DC
5 Cable shield
6 Ground potential for the control interface
7 EMC adapter

In principle, there is a risk that very long cable lengths with a long distance between the machine earth (1) and the earth (6) of the control interface could lead to an earth loop. This would lead to continuous equipotential bonding between the machine and the control interface. To prevent these earth loops, the housing potential and the cable shield are not connected in this grounding concept.

This separation is implemented using an insulating EMC adapter (red). The sensor is therefore protected from couplings from the machine side. Nevertheless, further coupled interference can discharge away or discharge via the earth of the control interface (6).

2023-08

Grounding Concept 3 (Special Case)

Only applicable for:

- Plug versions with connection cable accessories from third-party suppliers.
- Assumption: The sensor housing and the cable shield are connected.

Situation/Requirements of the Application	Effects of the Grounding Concept
No EMC interference is expected from the machine side, e.g., from the frequency inverter	• The machine should be connected to the sensor housing, or there is no effect on the quality of the measurements provided by the sensor. • EMC interference that still directly affects the sensor head can discharge via the machine earth.
Risk/prevention of earth loops necessary, e.g., when using a long cable approx. 500 m in length.	The earth on the control interface (-> point 6 in Fig.) is not integrated. On the control interface, there is insulation between the cable shield and the earth.
Coupled interference must be deflected	Machine earth (-> point 1 in Fig.)

Table 3.3

The following diagram only applies to plug versions that are used with a commonly available cordset to connect the sensor housing potential and the cable shield.

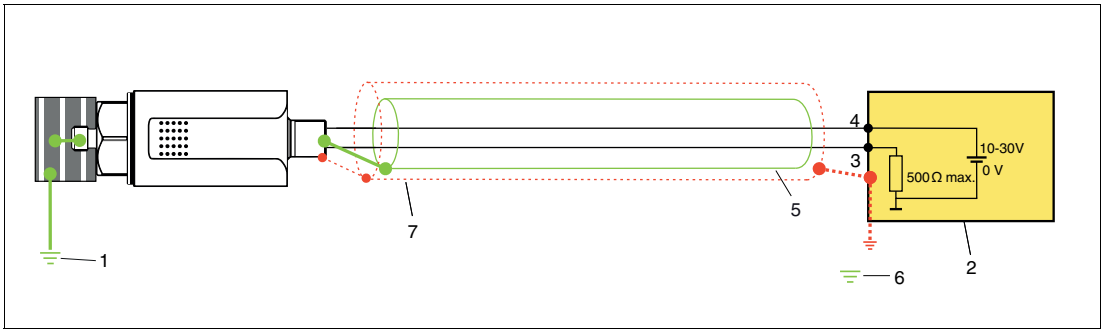

Figure 3.3

1 Machine earth

2 Control interface (measuring instrument, PLC, etc.)

3 4 mA ... 20 mA power signal

4 10 V DC ... 30 V DC

5 Cable shield

6 Ground potential for the control interface

7 Optional flexible metal conduit (only available for version with an integrated cable)

In principle, there is a risk that very long cable lengths with a long distance between the machine earth (1) and the earth (6) of the control interface could lead to an earth loop. This would lead to continuous equipotential bonding between the machine and the control interface.

To prevent these earth loops, this grounding concept is designed so that the grounding on the side of the control interface is not connected. Therefore, there is no continuous connection between the machine earth (1) and the earth (6) of the control interface. Coupled interference can only be discharged via the machine earth (1).

Grounding Concept 4 (For Use in Hazardous Areas with Type of Protection Ex i)

Only applicable for:

- VIM6***-*****-*P*-******* vibration sensors
- Plug versions with V15-W-N4-*M-PUR-N4S5 connection cable accessories from Pepperl+Fuchs.
- Assumption: The sensor housing and the cable shield are connected.

Warning!

Connection cable for VIM6***-*****-*P*-******* vibration sensors with connector plug.

A special V15-W-N4-5M-PUR-N4S5 connection cable from Pepperl+Fuchs must be used with VIM6***-*****-*P*-******* vibration sensors with type of protection Ex i and a connector plug in order to meet the requirements of the standard for type of protection Ex i.

When using this connection cable, the cable shield is connected to the potential of the sensor housing, which is typically located on the machine earth. On the sensor side of the connection cable, the cable shield is connected to the knurled nut on the cable connector and pin 5 of the cable—i.e., it is live. This means that when the cable is connected, the cable shield is connected to the sensor housing potential. The shield must not be grounded at the other end of the connecting cable.

Situation/Requirements of the Application	Effects of the Grounding Concept
No EMC interference is expected from the machine side, e.g., from the frequency inverter	• The machine should be connected to the sensor housing, or there is no effect on the quality of the measurements provided by the sensor. • EMC interference that still directly affects the sensor head can discharge via the machine earth.
Coupled interference must be deflected	Deflected via earth at the sensor mounting point (-> point 1 in Fig.)

Table 3.4

The following diagram applies only to VIM6***-*****-*P*-******* vibration sensors. In this connection concept, a KFD2-STC4-Ex1 SMART transmitter power supply is used as an intrinsic safety barrier.

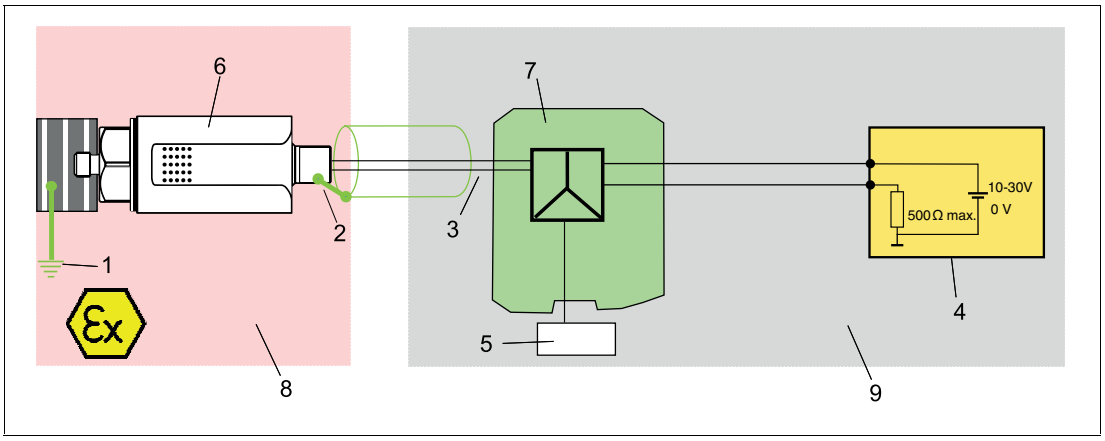

Figure 3.4

1 Machine earth

2 The cable shield for the Ex i cable is located above pin 5 of the M12 connector on the housing potential

3 Do not ground the cable shield

4 Control interface (measuring instrument, PLC, etc.)

5 Power supply

6 Sensor

7 KFD2-STC4-Ex1 SMART transmitter power supply

8 Hazardous areas in Zones 1 and 21 / Zones 2 and 22

9 Non-hazardous area

1. Connect the vibration sensor to a higher-level electronics / control environment using one of the four grounding concepts discussed above.

4 Troubleshooting

4.1 What to Do in Case 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, you can 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
No measured value	No supply voltage	Check the voltage supply and/or supply lines.
	Interruption in the connection cable	Replace the connection cable.
	Faulty fuse	Replace the fuse in the voltage supply area of the sensor.
	Reversed polarity in the connection	Check the voltage supply and ensure the polarity is correct.
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 you want to estimate/monitor the corresponding vibration behavior.
EMC problems	Earth loops / ground loops	Check the explanations provided in the chapter "Electrical Connection" for the relevant sensor grounding concept ().

Table 4.1

5 Repair and Servicing

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

Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

Pepperl+Fuchs Quality
Download our latest policy here:

www.pepperl-fuchs.com/quality

PEPPERL+FUCHS

www.pepperl-fuchs.com

/ DOCT-7900B