Selection and Installation of Vibration Sensors
SIPLUS CMS2000, SIPLUS CMS1200 SM1281

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1 Introduction

To get measurement data for SIPLUS CMS1200 SM1281 as well as for SIPLUS CMS2000, vibration feeders, in the following called sensors, are necessary. To get clearly analyzable signals, the choice of the right sensors and the measuring point is crucial.

This FAQ describes how to choose applicable sensors and how to install them correctly.

2 Choosing the sensors

CMS2000, as well as CMS1200 SM1281 only use piezoelectric sensors according to the IEPE-standard. IEPE-sensors provide a continuous vibration acceleration time signal and have a huge dynamic range. Therefore better evaluation of damages / progress of damage especially at the envelope analysis is possible.

2.1 Prerequisites

- CMS2000 or CMS1200
- An appropriate sensor
e.g. SIPLUS CMS2000 VIB-Sensor (6AT8002-4AB00)
- An appropriate sensor cable
e.g. SIPLUS CMS2000 CABLE-MIL-300 with 3m length (6AT8002-4AC03)
or SIPLUS CMS2000 CABLE-MIL-1000 with 10m length (6AT8002-4AC10)
- CMS2000 as well as SM1281 support a maximal cable length of 30 meters. If no pre-assembled cables are used, please consider the following cable and connector:
- Recommended cable: Polyurethane-cable, two-core, braided shield with shield wire
- Recommended connector: Screw connection MIL-C-5015-Style, two-pole, casting with epoxy
2.2 Proceeding

2.2.1 Selection of appropriate sensors

There are two important characteristic values for the sensor selection:

Sensitivity

The sensitivity is stated in mV/g. In most use cases a sensitivity of approx. 100 mV/g is sufficient.

The sensitivity of a sensor is either lasered onto the case or documented at an attached datasheet.

Partly is also the sensor offset documented at an attached data sheet. With knowledge of the sensor offset, the maximum measurable vibration acceleration of a vibration channel can be determined.

The CMS1200 and CMS2000 have a voltage measurement range at the IEPE inputs from 6.2 V to 15.0 V. If the operating point of a connected IEPE sensor is around 12 V, for example, wanted signals up to ±3 V can be measured before a measuring range limit is reached. When a sensor with a typical sensor sensitivity of 100 mV/g is used, the module can measure vibration accelerations up to ±30 g.

Power supply

IEPE-sensors are supplied with constant current. CMS2000 and CMS1200 supply their connected sensors with a constant current of 4 mA.

Technical data of the Accelerometer

<table>
<thead>
<tr>
<th>General and scope of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring principle: Piezo-quartz sensor with integrated evaluation electronic</td>
</tr>
<tr>
<td>Frequency range (+3dB): 0.5 up to 15000Hz</td>
</tr>
<tr>
<td>Sensitivity: 100mV/g (±10%)</td>
</tr>
<tr>
<td>Resolution: 0.002g</td>
</tr>
<tr>
<td>Max. measurement range: 50g</td>
</tr>
<tr>
<td>Resonance frequency: 23kHz</td>
</tr>
<tr>
<td>Output signal: BIAS voltage 10 up to 14V DC</td>
</tr>
<tr>
<td>Power supply: IEPE 2 up to 10mA</td>
</tr>
<tr>
<td>Connection technology: MIL-23015</td>
</tr>
</tbody>
</table>

Environmental conditions

- Ambient temperature (operation): -50°C... +120°C
- Degree of protection: IP65

Design

- Material of body: stainless steel
- Type of fixing: incl. mounting bolts UNF1/4-28 on M8
2.2.2 Mechanical Installation

Fixing recommendation for stationary mounting

<table>
<thead>
<tr>
<th>Mounting type and limits</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded bolts with a flat and smooth contact surface</td>
<td><img src="image1.png" alt="Threaded bolts" /></td>
</tr>
<tr>
<td>Upper frequency limit 10 – 20 kHz</td>
<td></td>
</tr>
<tr>
<td>Adapter for uneven and/or coated surfaces</td>
<td><img src="image2.png" alt="Adapter" /></td>
</tr>
<tr>
<td>Upper frequency limit 10 – 20 kHz</td>
<td></td>
</tr>
<tr>
<td>Fixing by gluing</td>
<td><img src="image3.png" alt="Gluing" /></td>
</tr>
<tr>
<td>Upper frequency limit 10 – 18 kHz</td>
<td></td>
</tr>
</tbody>
</table>

NOTE

For more information see e.g. VDI 3839 Page 1 and VDI 3832.

- Suitable adhesive for fixing a sensor: e.g. HBM Hottinger Baldwin Messtechnik GmbH, Darmstadt; Kleber X60 (two-component adhesive)
- The installation of this accelerometer will be screwed by a threaded pin on the front side of the sensor. Included in the scope of sensor delivery is a threaded pin with UNF1/4-28 to M8-thread.
- Before sensor installation the M8-thread and the contact surface of a measuring point should be prepared.

<table>
<thead>
<tr>
<th>Mechanical preparation</th>
<th>Dimensions and technical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane seating:</td>
<td>Diameter 21mm x 1,3 ≈ 28mm</td>
</tr>
<tr>
<td>Blind hole:</td>
<td>Bore diameter 6,8mm, Drill depth 10mm, Thread M8</td>
</tr>
<tr>
<td>Tightening torque:</td>
<td>2,7- 6,8 Nm</td>
</tr>
</tbody>
</table>
Fixing recommendation for mobile measuring

<table>
<thead>
<tr>
<th>Mounting type and limits</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixing with permanent magnets</td>
<td></td>
</tr>
<tr>
<td>Upper frequency limit acc. To holding force (approx. 5 – 15 kHz)</td>
<td></td>
</tr>
<tr>
<td>Handheld test probe</td>
<td></td>
</tr>
<tr>
<td>Upper frequency limit approximately 2 kHz</td>
<td></td>
</tr>
</tbody>
</table>

2.2.3 Electrical installation

Red wire:
- Positive pole PIN A at the Sensor
- VIBX+ at the module

Black wire:
- Negative pole PIN B at the Sensor
- VIBX- at the module

The accelerometer could be connected on the corresponding terminal block, e.g. VIB1+ and VIB1-:

<table>
<thead>
<tr>
<th>SIPLUS CMS2000 Basic Unit / VIB-MUX</th>
<th>VIB-Sensor S01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal block Basic Unit</td>
<td>Core color</td>
</tr>
<tr>
<td>A</td>
<td>red</td>
</tr>
<tr>
<td>B</td>
<td>black</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIB+</td>
<td>signal</td>
</tr>
<tr>
<td>VIB-</td>
<td>ground</td>
</tr>
</tbody>
</table>

Connection to SIPLUS CMS2000 Basic Unit / VIB-MUX

Connection to SIPLUS CMS1200 / CMS1200
2 Choosing the sensors

Shield connection

Detailed information about the shield connection of the CMS1200 can be found at the Entry ID: 109481446

Detailed information about the shield connection of the CMS2000 can be found at the Entry ID: 56902410
Choosing a suitable measuring point

3.1 Introduction

To get meaningful measurement data from the sensors, they have to be mounted and connected correctly. The placement of the sensor at the measuring object is crucial for the type and quality of damage detection.

Acceleration sensors have usually one reference direction. The desired measuring direction has to comply with the reference axis of the acceleration sensor.

Cross-sensitivity < 1% of rated sensitivity

Reference direction
3.2 Prerequisites

The measuring distance between the machine bearing and the measuring point must be as short and as direct as possible, because vibration signals weaken as the signal path lengthens. In the field, the sensor should be mounted very close to the bearing.

The larger the axial distance of the acceleration sensor from the bearing, the larger the damping.

Every material transition (e.g. joint) attenuates and/or reflects the signal to be measured, so the signal path should therefore only comprise the material transition between the bearing and bearing housing.

Acceleration sensors cannot always be mounted in accordance with theory alone. The final position of the sensor must be determined by local conditions.

Freely vibrating or elastically deformable housing or cladding components (such as fan covers) are not suitable for measurement!

When an online CM system is used, in practice there are not three sensors mounted (axial, vertical, horizontal), but only one. This sensor must be placed inside the **load zone**.

The **load zone** is the area, where the weight force of the rotor affects the bearing for design reasons. In this direction the input of oscillation-stimulation to the bearing is the highest.

Therefore it is recommended to mount the sensor with its reference direction in opposite to the load direction.

Using a belt or gear drive the load direction is explicitly defined.

Using a coupling, the load zone depends on the alignment. In this case it is recommended to mount a sensor with a 45 degree angle in the lower area of the machine. On this occasion, the vibrations can be monitored in horizontal and vertical direction and the weight force of the rotor will be considered.

Examples for applicable measuring points are described in e.g. ISO 10816-3.
3.3 Proceeding

The following examples serve as an orientation.

Example coupling

Example gear wheel
3 Choosing a suitable measuring point

Example belt drive
Choosing a suitable measuring point

Example Alignment

Reference direction

Reference direction

Reference direction

Reference direction
Example Imbalances

Exception Imbalance:
Imbalance runs in accordance with the rotation.
A sensor mounted in any load zone is able to detect an imbalance.
There is no special load direction for an imbalance.