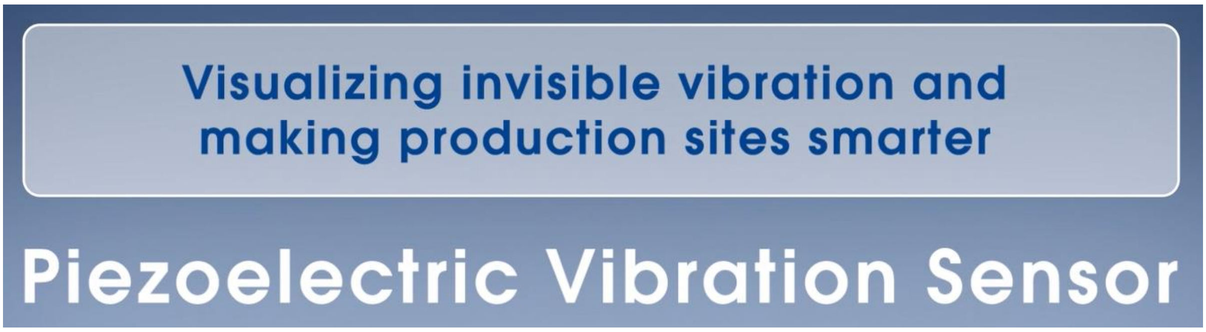


Vibration Analyses Setup for KEMET Vibration Sensors

User Guide

Rev. 1.1

DEC 2021

1 VIBRATION SENSOR SETTING PROCEDURE

1.1 Identification of Sensor Installation Location

KEMET vibration sensors should be placed within the system to maximum exposure to potential vibration. Attention to the direction of vibration should also be taken care of by the placement of the sensors. The three main modes of vibration that we encounter are rotational, longitudinal and horizontal. Please ensure that your choice and placement of the vibration sensor is suitable for the modes and frequencies that you expect may occur.

1.2 Selection of Mounting Method

Depending on the device you have selected, you have several options on how to affix the sensor to your system. These range from mechanic bolt options to strong adhesive tapes. If adhesives are to be selected, please ensure that your selection will not fail under normal operating conditions. For example, epoxy resin can crack or fatigue and silicon adhesive can dampen the motion of vibration. Often it is better to select a thin but very sticky adhesive tape.

1.3 Noise Confirmation and Countermeasures

As with any accurate analogue sensor, care must be taken with regard to Signal to Noise ratios, so please pay particular attention to suitable signal conditioning with regard to power supplies and the output signal of the sensor.

1.4 Threshold Setting

Once you have positioned your sensor within the system to maximize the exposure to potential vibration, KEMET recommends that you employ analog or software differential signaling techniques in order that "normal" levels of vibration can be differentiated from "abnormal" or unexpected vibrations.

1.5 Final Verification

To conclude the setup, obtain confirmation of reproducibility and variation, and complete appropriate verification of threshold.

2 IDENTIFICATION OF SENSOR INSTALLATION LOCATION

2.1 Sensor Mounting Direction

The direction in which the vibration increases changes, depends on the type of abnormality. ISO recommends mounting the vibration sensor in the **axial, vertical, and horizontal directions** of the measurement target.

If you want to install the vibration sensor in one place only, select either **axial, vertical** or **horizontal**. Alternatively, install it in the direction in which the vibration of the measurement target increases.

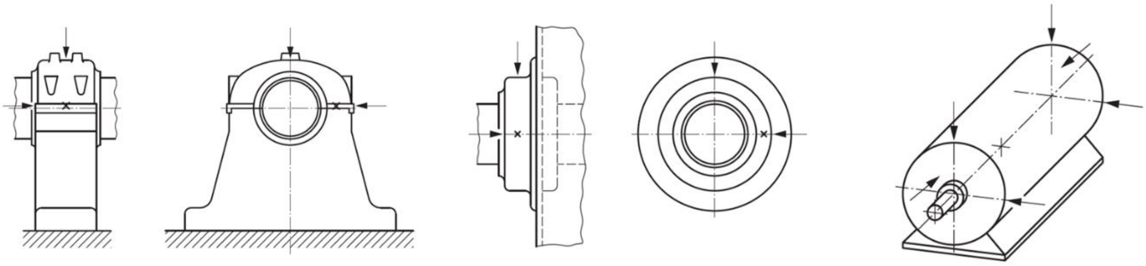


Figure 1 – Types of Structures and Equipment

2.2 Sensor Mounting Location

The frequency performance of the sensor is highly dependent on the method of installation. The sensor must be secured tightly on a flat, hard surface. It should be positioned closest to the measurement point.

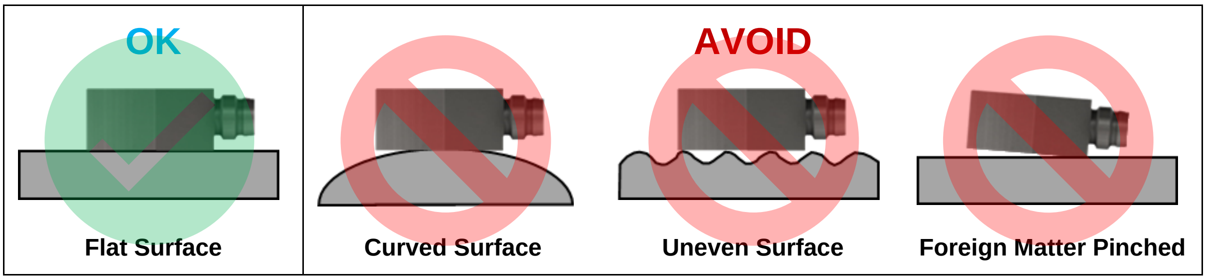
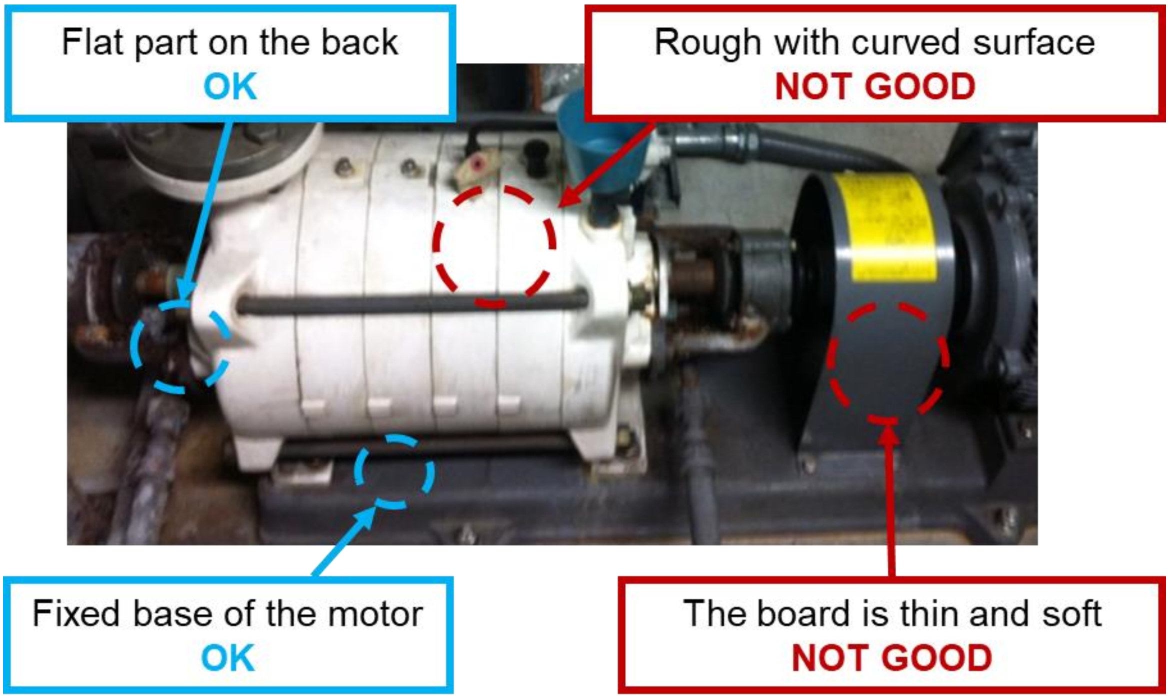


Figure 2 – Using the Right Surface



Object to be Measured: Motor

Figure 3 – Choosing the Right Location (Example)

3 SELECTION OF MOUNTING METHOD

3.1 Sensor Fixing Method

The frequency performance of the sensor largely depends on the installation location and fixing method. The fixing method should be selected according to the measurement frequency.

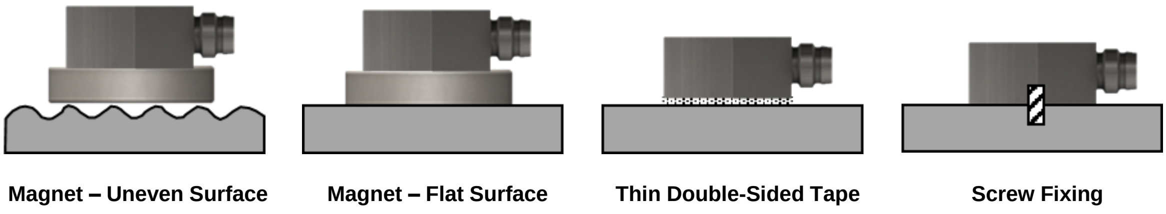


Figure 4 – Fixing Methods

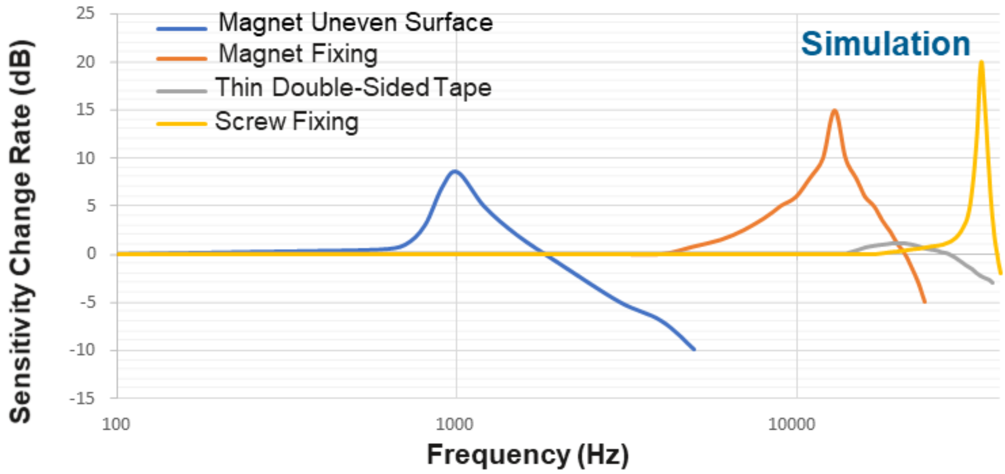


Figure 5 – Fixing Method and Frequency Characteristics

If you need to measure high frequencies, it is recommended to fix the sensor with screws.

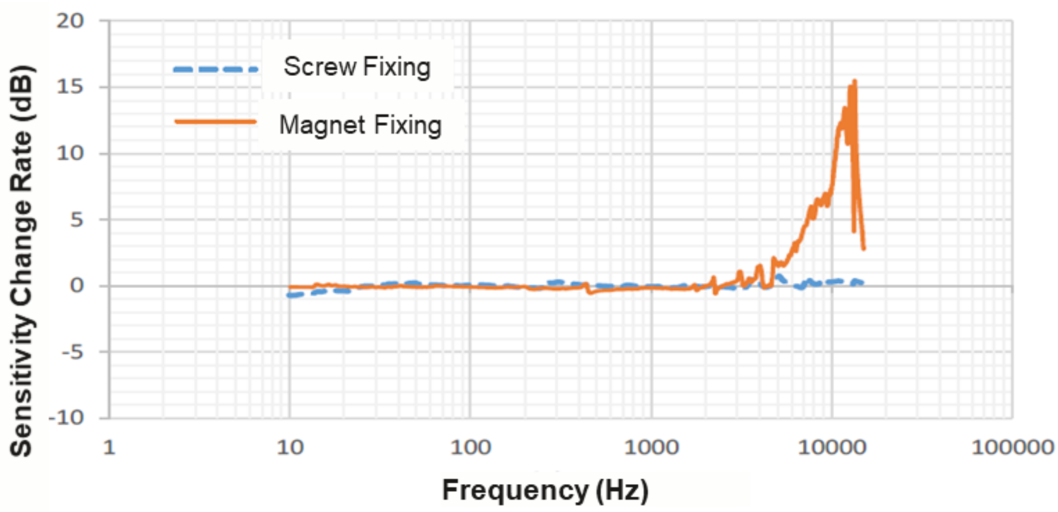


Figure 6 – Measured Value (VS-JV10A)

3.2 Cable Fixing Method

Please use the following with caution in order to obtain correct measurement and stable data.

- Secure the cables at appropriate intervals to minimize cable vibration.
- Select the cable layout and fixing so that tension is not applied.
- Do not bend the cable more than necessary (keep the minimum bending radius).

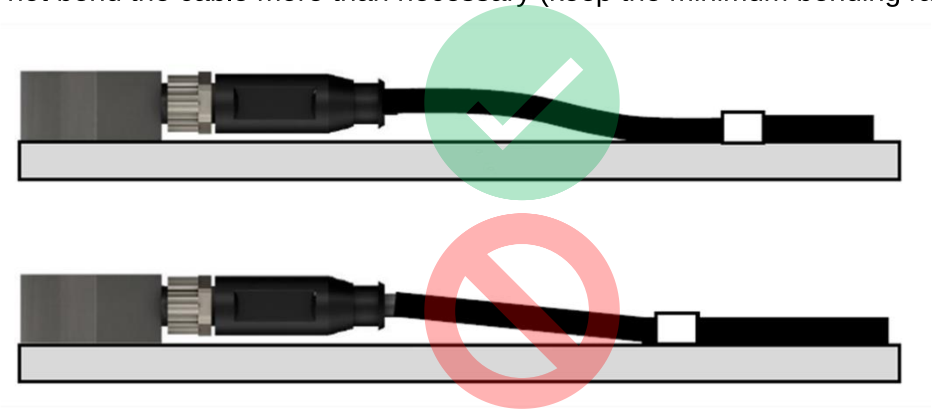
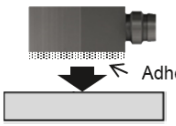
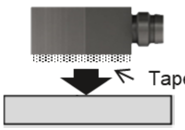
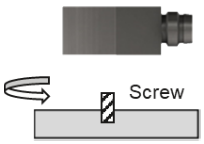
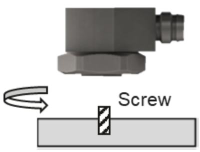
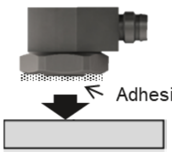
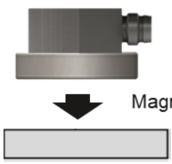


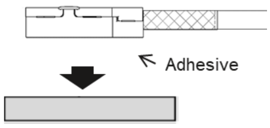
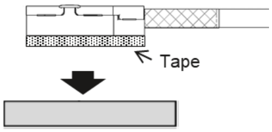
Figure 7 – How to Fix the Cable Correctly

3.3 Fixing the Sensor VS-JV10A

Fixing Method	Fixing Description	Pros and Cons
Adhesive fixing	 Apply thin layer to the entire bottom surface	Suitable for high frequency measurement Difficult to attach or detach the sensor
Double-sided tape	 Hard and thin material is recommended	High frequency measurement is also possible (depends on the material of the tape) Be careful of changes over time
Screw	 Recommended torque 1.5N・m Add adhesive to prevent screws from loosening	Suitable for high frequency measurement Need to embed screws
Mounting stud  VA-01	 	Easy to attach or detach the sensor Mounting stud stabilizes the fixed surface and reduces the effects of strain Need to embed screws (fixing screws)
Magnet base  VM-03		Easy to attach or detach the sensor Not recommended for high frequency measurements

Make sure the installation surface is flat and smooth, it must also be free of burrs and foreign matter. Please remove oil and dirt on the adhesive surface. After applying a thin coat of adhesive, press gently to bond.

3.4 Fixing the Sensor VS-BV203

Fixing Method	Fixing Description		Pros and Cons
Adhesive fixing		Apply thin layer to the entire bottom surface	Suitable for high frequency measurement Difficult to attach or detach the sensor
Double-sided tape		Hard and thin material is recommended	High frequency measurement is also possible (depends on the material of the tape) Be careful of changes over time

4 NOISE COUNTERMEASURES

4.1 Is There Any Power Supply Noise ?

Using an Oscilloscope or spectrum analyzer it should be possible to see the frequency spectrum of the signal output. It will become apparent if you have 50/60 Hz mains noise present. Careful grounding or EMI shielding methods can be deployed to minimize these effects.

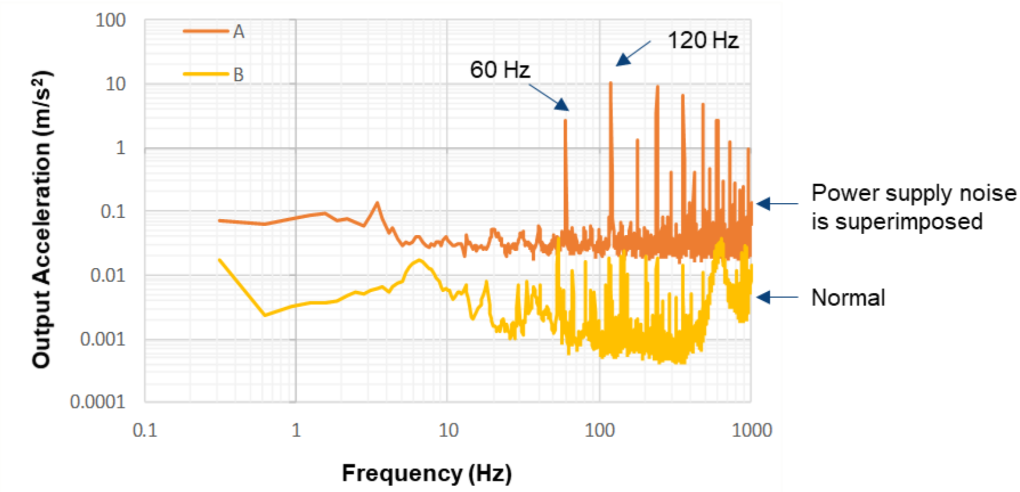


Figure 7 – FFT Example of Vibration Sensor

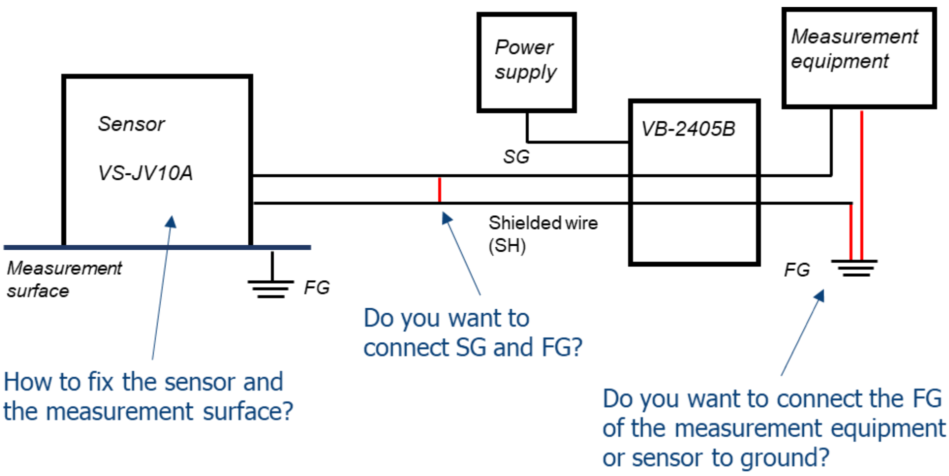


Figure 8 – Connection Checkpoint

4.2 Noise Countermeasures for VS-BV203

Power Supply Noise

Connect the power supply to a stable power supply separated from the equipment, such as batteries or other non-switching "linear" power supplies.

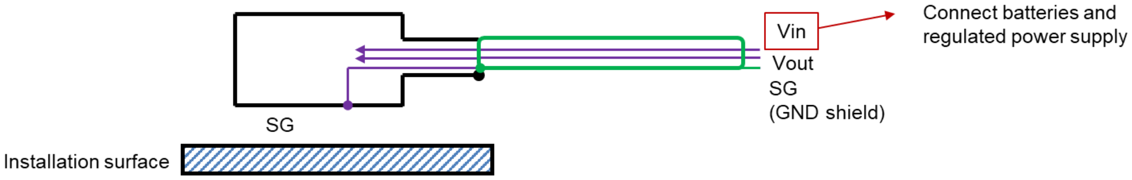


Figure 9 – In Case of Noise from the Power Supply

If there is a noticeable difference in the output signal, then the power supply can be considered the potential cause of electrical noise. If this is the case, we recommend deploying EMI countermeasures on the supply lines.

Installation Surface Noise

Attach or detach the housing to or from the measurement surface.

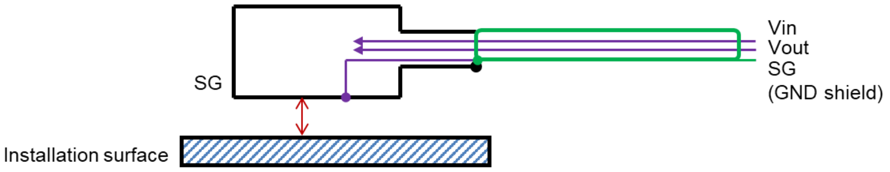


Figure 10 – In Case of Noise from the Installation Surface

If effective, the noise can be considered as coming from the installation surface. KEMET recommends, in that case, to use the sensor VS-JV10A, chassis insulation type.

Cable Noise

Cover the entire cable with screening and attach to a ground point at the measurement side of the cable. An alternative is to deploy ferrite countermeasures on the cable to reduce electrical noise. Care must be taken to ensure that any ferrite placed on the cable should not dampen or reduce the magnitude of the electrical vibration signal.

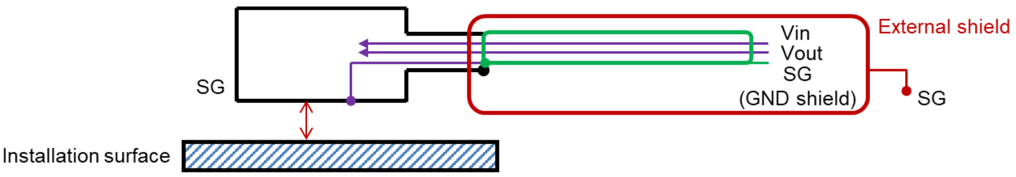
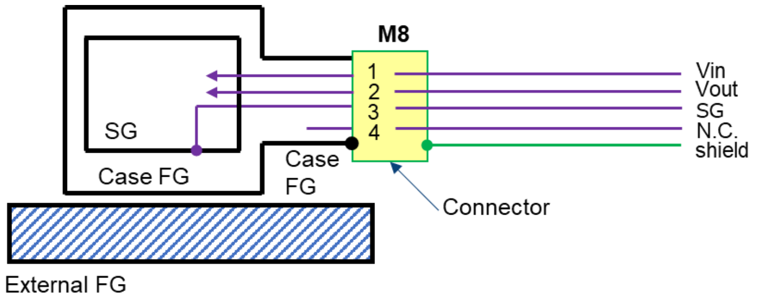


Figure 11 – In Case of Noise from the Cable

If it works, the origin of the noise can be considered as coming from the cable. KEMET recommends, in that case, to use the sensor VS-JV10A, as its cable has a strong shield and is effective as a noise countermeasure.

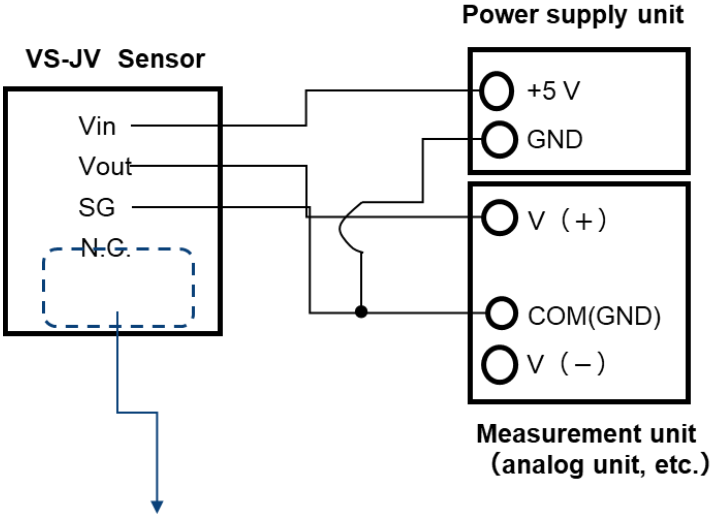
4.3 Noise Countermeasures for VS-JV10A

Refer to Figure 12 for the connection between the sensor, power supply unit and measurement unit.



- SG and case FG are separated (insulated).
- SG is closed with a shield.
- Shield and case FG are connected.

Even if it is installed on the external FG as it is, it will be insulated from the SG.



- If you do not need to separate FG and SG, connect to SG.
- When separating FG and SG, open or connect to FG.

Please select the connection destination according to the noise situation.

Figure 12 – Connection Example

Thus, we can consider 4 patterns to solve noise issues through ground connection when using the sensor VS-JV10A.

1. The signal ground (SG) and frame ground (FG) are separated.

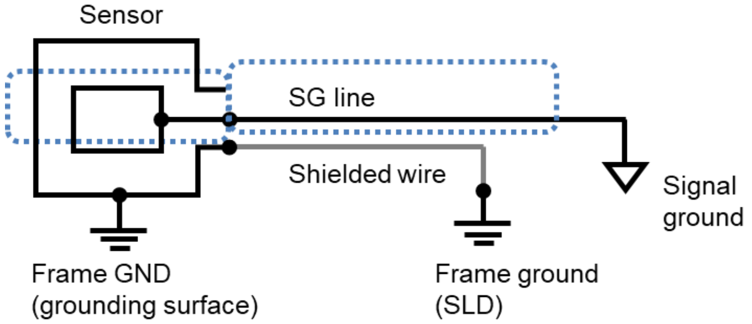


Figure 13 – Pattern 1 Standard System

2. When the noise of the frame ground (FG) is small enough.

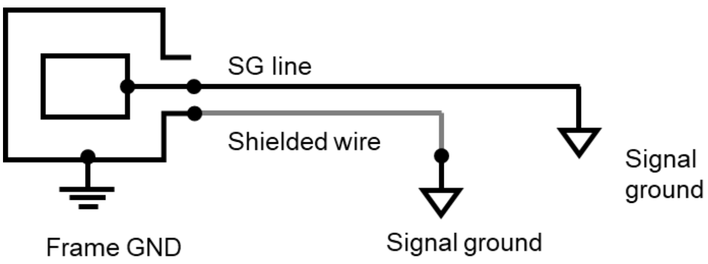


Figure 14 – Pattern 2

3. When the noise of the frame ground (FG) is large.

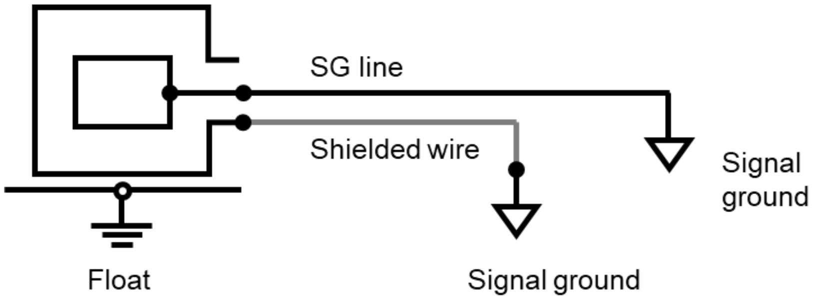


Figure 15 – Pattern 3

4. Measures against ground loops.

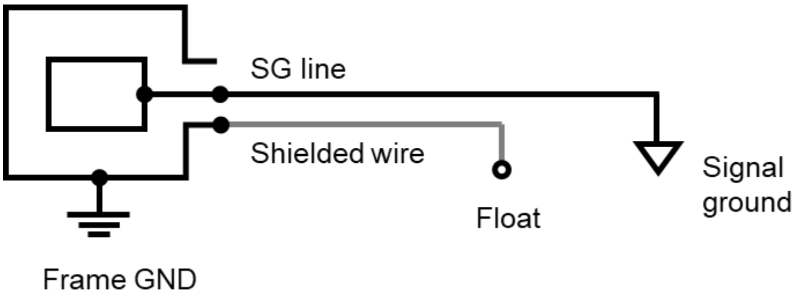


Figure 16 – Pattern 4

5 THRESHOLD SETTING

5.1 Sensor Diagnosis Method

Recommended Set-up and Analysis Methods

Measure a known working system "deemed to be of full working condition" and obtain several "reference" frequency spectrum levels where vibration magnitude and frequency levels can be assessed. These levels should be considered "normal" operation or background vibrations. Your analysis system should now consider deviations from this reference data an indication of unwanted vibrations or of a potential mechanical failure.

As a guide, set a threshold value that is at least 4 times the standard value. It compares the measured values and judges whether it is good or bad.

Judgement	Threshold Setting
Good	Less than twice the standard value
Caution	2 to 4 times the standard value
Risk	4 times or more of the standard value

The above threshold settings are for reference only.

6 FINAL VERIFICATION

6.1 Examples of Damage to Rotating Machines

Figure 17 shows a simplified representation of a rotating machine, and Figure 18 details examples of damages to such machinery and how the detection sensor can pick up vibrations related to these examples.

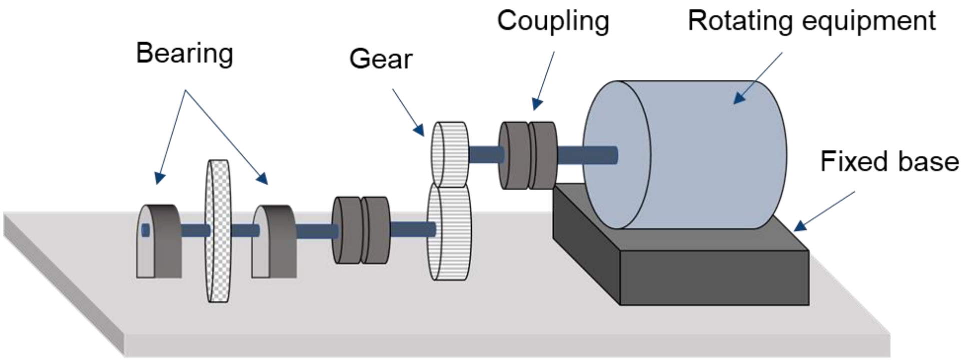


Figure 17 – Rotating Machine Example

Frequency Band (Hz)	Damaged Part	Damage Details	Detection Sensor
3k – 10k	Bearing	Abrasion, burnout	**Vibration**, acoustic, sound, heat
1k – 5k	Gear	Missing tooth, gears do not mesh	**Vibration**, acoustic
50 – 200	Coupling	Misalignment	**Vibration**, heat
30 – 100	Rotating equipment	Unbalance	**Vibration**
10 – 50	Fixed base	Rattle, loose fixing bolt	**Vibration**

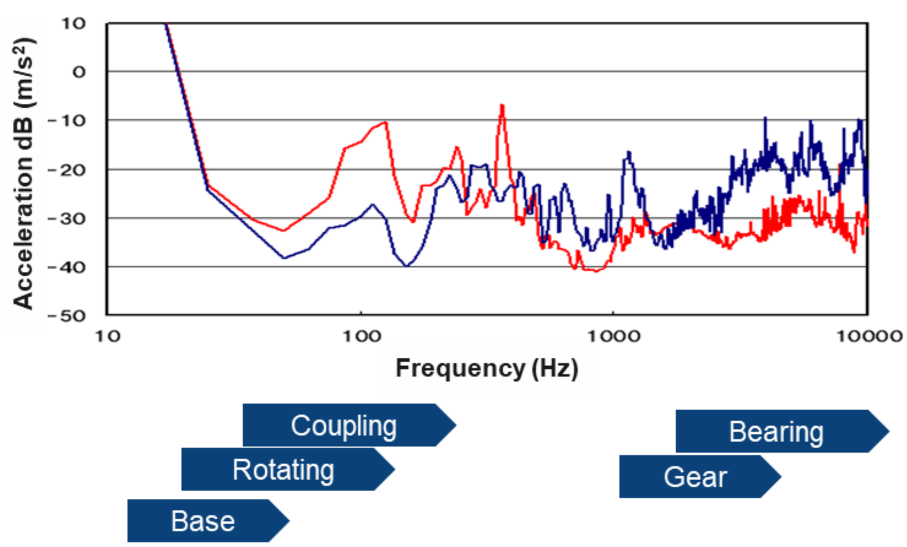


Figure 18 – Fast Fourier Transform (FFT) Output

6.2 Sensor Comparison Calibration Method

The vibration sensor is measured according to the comparative calibration method.

In the comparative calibration method, the standard sensor and the measurement sensor are overlapped and vibrated. This method allows measurement of the output sensitivity by comparing the difference between the two sensors' outputs.

As shown in Figure 19, if the standard sensor has sufficient rigidity, exactly the same vibration will be applied to both sensors.

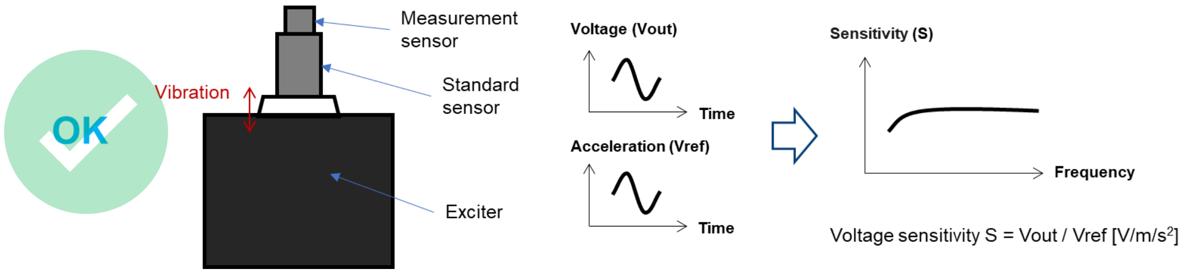


Figure 19 – Comparative Calibration Method with Screw Fixing

If unsuitable fixing methods are used, analysis will reveal a difference in signal magnitude and/or frequency (see Figure 20). Differences will occur in the measured values and errors will occur in the frequency characteristics and sensitivity.

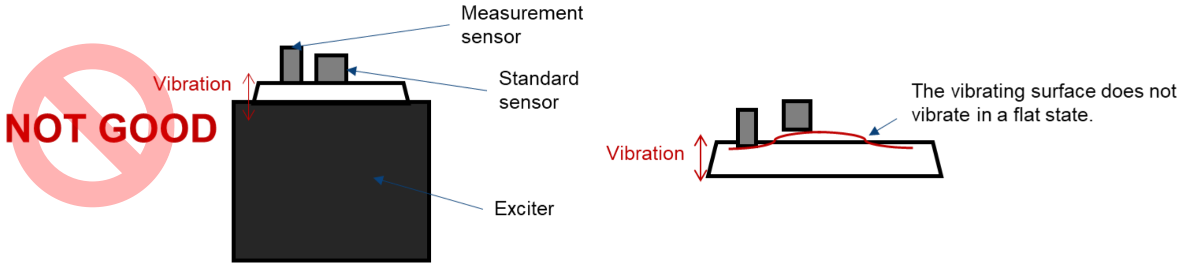


Figure 20 – Comparative Calibration Method with Screw Fixing