Mounting Instructions

English

FS65ACC

Accelerometer

HBM

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1 General Information

The following instructions refer to the installation procedure of FS65ACC Optical Accelerometer

These sensors are delivered individually. Nevertheless, these sensors have two fibers for easy assembly in series for example to be mounted in bi- or triaxial configurations.

Material Numbers
K-FS65ACC
1-FS65ACC-10/1530
1-FS65ACC-10/1540
1-FS65ACC-10/1550
1-FS65ACC-10/1560
1-FS65ACC-10/1570

1.1 newLight technology

The FS65ACC is based on the **newLight®** technology developed by HBM FiberSensing to combine particular advantages of the FBG overcoming technical compromises that existed so far. newLight® sensors employ **high strength fiber coatings** and **different FBG fabrication techniques** to ensure increased strain measurement ranges, enhanced fatigue resistance and higher measurement accuracy. **The low bend loss**, **telecom compatible fiber** opens the possibilities for innovative sensor designs as well as the straightforward usage of multiplexed sensors on the same fiber even if kilometers apart. The technology is completely **passive**, **self-referenced** and **compatible with most interrogators**.

2 Sensor Installation

2.1 List of materials

Included material
FS65ACC Accelerometer

Needed equipment
Drilling Machine (optional)

Needed material
Anchors (M5 Bolt)
Specifically designed mounting brackets (optional)

The needed tools to install the FS65ACC Optical Accelerometer depend on the structure the sensor is to be installed on. In many cases, mounting parts may need to be designed in order to adapt the sensor to the spot where it is going to be installed.

2.2 Preparation of the mounting area

The installation solution should be carefully designed in order to meet the sensor measuring direction and the structure characteristics.

2.3 Positioning the sensor

The sensor can be placed headed up, headed down or towards the side (Fig. 2.1), in accordance to the desired measuring direction.

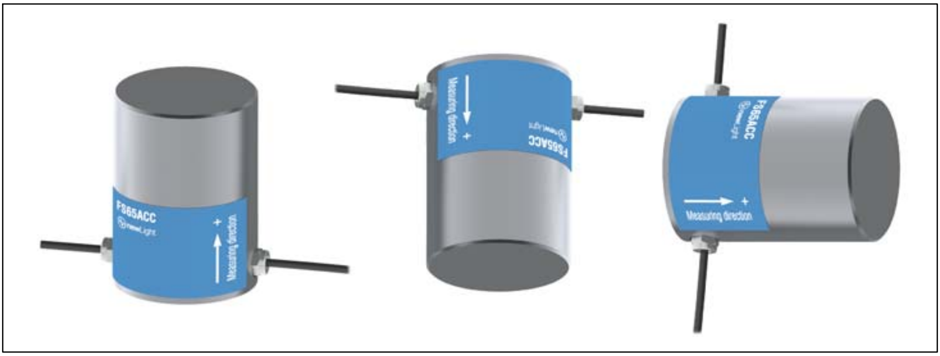

Fig. 2.1 Versatile mounting positions

Information

This will only alter the sensor's DC output. Dynamically, it will still have the same behavior.

2.4 Fixing the sensor

The sensor has an M5 hole at its base. The sensor can be fixed directly on an anchor with a compatible bolt. For some situations a mechanical mounting base should be used for easier onsite installation and sensor orientation.

2.5 Routing and protecting the cables

Sensor cable should be routed without being left hanging. The cable should be fixed by means of plastic clamps, for example (*Fig. 2.2*).

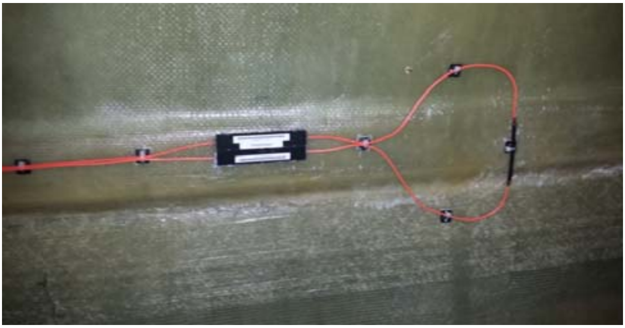

Fig. 2.2 Cable fixed with plastic clamps

Plastic corrugated tubes can also help routing the longer lead cables that will connect to the interrogator (*Fig. 2.3*).

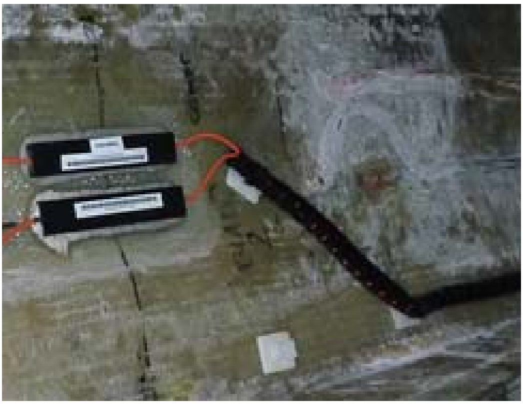

Fig. 2.3 Cable protected with corrugated tubes

Excess cable should be coiled and stored in a suitable IP case, so it can be used in case of network refurbishment (*Fig. 2.4*).

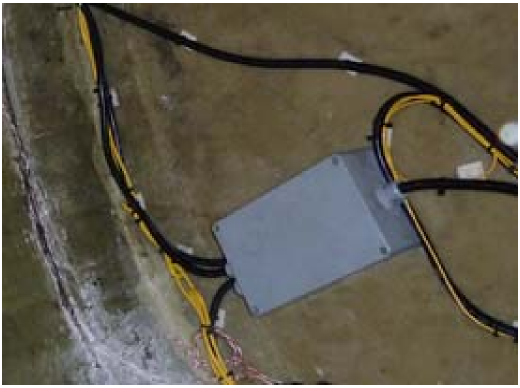

Fig. 2.4 Protection boxes for extra cable and connections

2.6 Protecting the sensor

The FS65ACC Accelerometer is IP68 rated, meaning that ultimately no protection is needed. Nevertheless, it can be protected with a box or other for higher mechanical protection level.

3 Sensor Configuration

3.1 Sensors documentation

Calibrated HBM FiberSensing Sensors are delivered with a Calibration Sheet.

Within the sensor's packing this installation instructions document is delivered in a printed version. Installation instructions can also be downloaded from HBM website (www.hbm.com).

3.2 Measurement computation

The FS65ACC Accelerometer is a single axis measurement sensor that shows a linear calibration formula.

3.2.1 Acceleration

The calculations that should be performed for converting a wavelength measurement into acceleration are the shown in *Fig. 3.1*.

$$A = S \times (\lambda - \lambda_0)$$

Fig. 3.1 Acceleration computation formula

Where

- A is the measured acceleration in g
- λ is the measured Bragg wavelength of the accelerometer sensor in nm
- λ_0 is the Bragg wavelength of the accelerometer sensor at reference instant in nm
- S is the calibration factor as delivered by the calibrtion sheet in g/nm

3.2.2 Measurement flatness

The calibration of the FS65ACC Accelerometer Sensors is performed at a reference frequency. Nevertheless, calibration dependency on the measurement frequency is kept under strict limits as referred on the sensors calibration sheet.

A typical deviation on the wavelength for a fixed acceleration amplitude is depicted below:

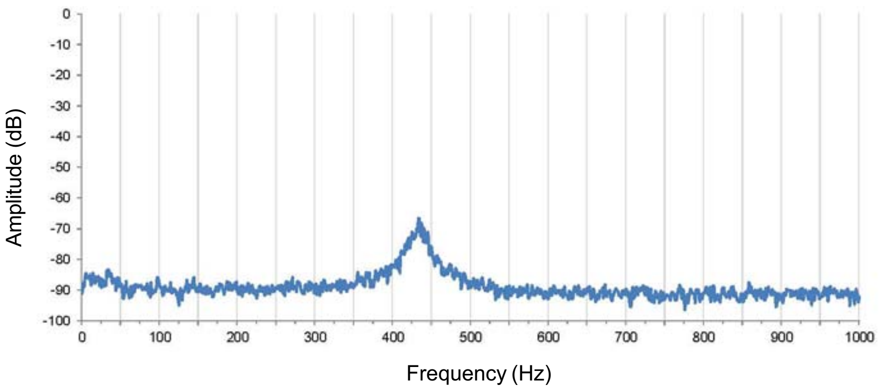

Fig. 3.2 Typical frequesncy dependency curve of the FS65ACC

3.3 Signal resolution

The bare fiber Bragg grating measurement resolution is dictated directly by the resolution in the wavelength measurement of the used interrogator system. If we add, on top of the FBG, some kind of transducer the resolution becomes also dependent on the mechanics of the sensor.

3.3.1 Time based measurement

For determining the signal resolution of a fiber Bragg grating based sensor on the time domain there is the need to consider the sensitivity of the transducer combined with the resolution of the interrogator that is used for the measurement

$$Sensor\ Resolution = \frac{Interrogator\ Resolution}{Sensor\ Sensitivity}$$

Fig. 3.3 Time domain resolution determination

When combining a typical FS65ACC sensor sensitivity (59 pm/g) with the typically used FS22DI interrogator (with a resolution of 1pm) we can estimate a sensor resolution of 17mg.

3.3.2 Frequency based measurement

On the particular case of the FS65ACC Accelerometer one can also take advantage of a dynamic measurement and increase the measurement resolution by performing a frequency based measurement.

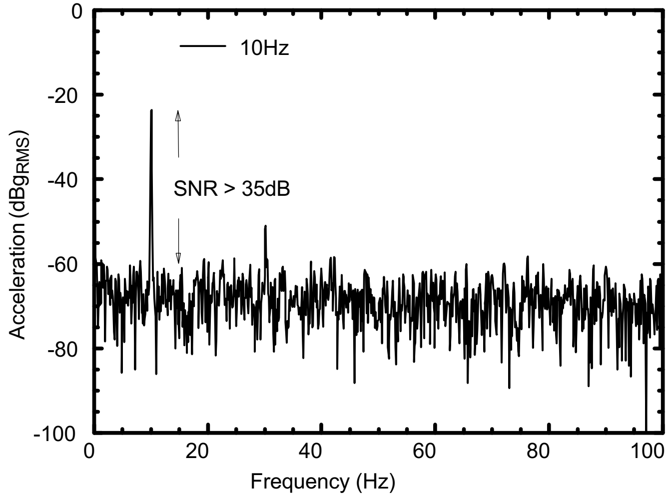

Fig. 3.4 Zoom of the FTT analysis for a signal at 10 Hz

The relation between the time domain peak acceleration value (A) and the FFT peak RMS value (A_{RMS}) is given by

$$A = \sqrt{2}\,10\left(\frac{A_{RMS}}{20}\right)$$

Fig. 3.5 Frequency domain acceleration determination

The FFT trace peak value is -23.3 dBg_{RMS} at 10 Hz that corresponds to a peak acceleration of 0.097 g. Taking into account that the noise level is at -60 dBg_{RMS} the system resolution can be calculated as 1mg (45 µg/√Hz considering the system bandwidth of 500 Hz).

3.4 Temperature compensation

The accelerometer output is sensitive to temperature changes.
Temperature changes are commonly slow when compared to the desired measurements. In dynamic applications involving short acquisition periods, the temperature influence on the measurement is not relevant.

On the other hand, for long term measurements the effect of temperature on the accelerometer output cannot be neglected.

The temperature effect can be easily compensated by using one of the following methods:

3.4.1 Signal filtering

When the desired signal has a faster behavior than the temperature change, a high pass filter, such as a Butterworth high pass filter, can be used on the signal eliminating the slow effect of temperature.

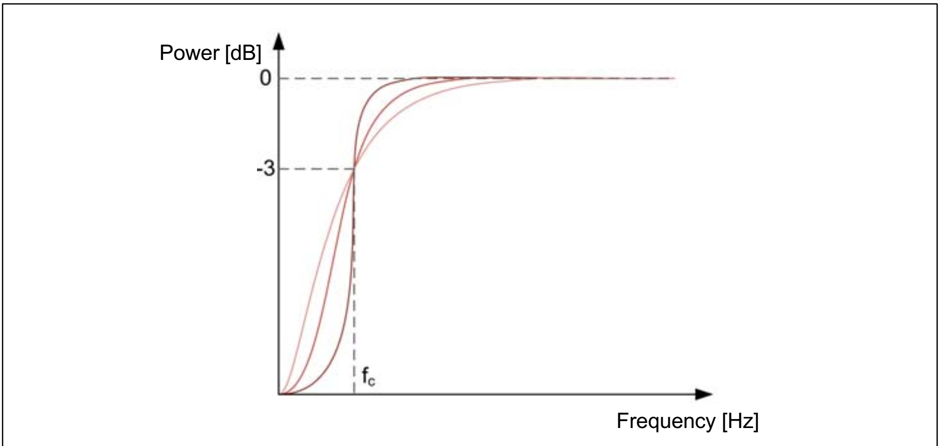

Fig. 3.6 Butterworth high pass filter

Measuring temperature

By means of using a temperature sensor (optical or electrical) the temperature variation can be determined and used for signal compensation as in *Fig. 3.7*.

$$A = S \times (\lambda - \lambda_0) - TCS \times (T - T_0)$$

Fig. 3.7 Acceleration measurement with temperature compensation

Where

- A is the measured acceleration in g
- λ is the measured Bragg wavelength of the accelerometer in nm
- λ_0 is the Bragg wavelength of the accelerometer sensor at the reference instant in nm
- S is the calibration factor as delivered by the calibration sheet in g/nm
- TCS is the temperature cross sensitivity of the accelerometer sensor in g/ºC
- T-T_0·is the temperature variation since the reference instant to the measurement instant in ºC

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