Mounting Instructions

English

FS61DSP

Displacement Sensor

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1 General Information

The following instructions refer to the installation procedure of FS61DSP Displacement Sensors.

These sensors are delivered individually. Nevertheless, they are designed with two fibers for easy assembly in series with other sensors.

Material Numbers
K-FS61DSP
1-FS61DSP-O80/2510
1-FS61DSP-O80/2530
1-FS61DSP-O80/2550
1-FS61DSP-O80/2570

1.1 newLight Technology

The FS61DSP 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
Optical Displacement Sensor
Fixation Brackets
2 M5x20 Screws

Needed Equipment
Drilling machine (optional)

Needed Material
Anchors (M5 Bolt L>25mm) Suggested: Bossard 1233300 bolt with Bossard 1118293 anchor
Hexagon socket key (size 4)
Specifically designed Mounting brackets (optional)
Ruler or measuring tape

The needed tools to install the FS61DSP Displacement Sensor depend on the structure it is to be installed on. In some cases, mounting parts may need to be designed in order to adapt the sensor to the two moving parts of the structure where it is going to be installed.

2.2 Preparing the fixation surface

The surface where the mounting bracket of the sensor is to be installed should be regular.

Fig. 2.1 Removing irregularities from the surface

► Make sure that there are no major irregularities that could interfere with the sensor's mounting bracket stability (*Fig. 2.1*).

Information

If there are any bumps and/or irregularities when tightening up the sensor's mounting bracket, it might get unstable and influence the sensor's behavior.

► Afterwards define the position of the mounting brackets considering the expected movements and the sensor's measurement range (*Fig. 2.2*).Use an auxiliary ruler or measuring tape to support on the position definition.

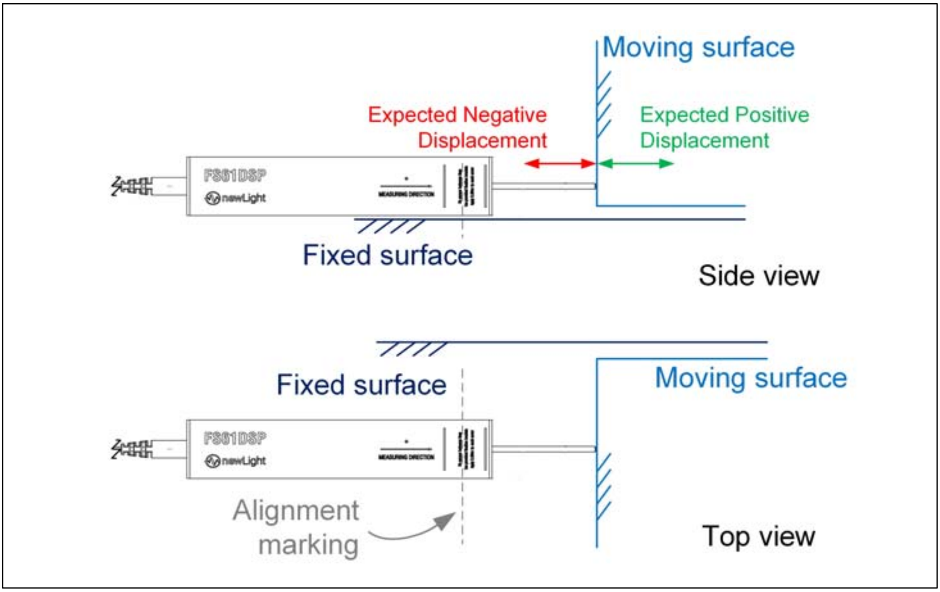

Fig. 2.2 Position marking

► Mark a line perpendicularly to the direction of the measurement, at the defined position.

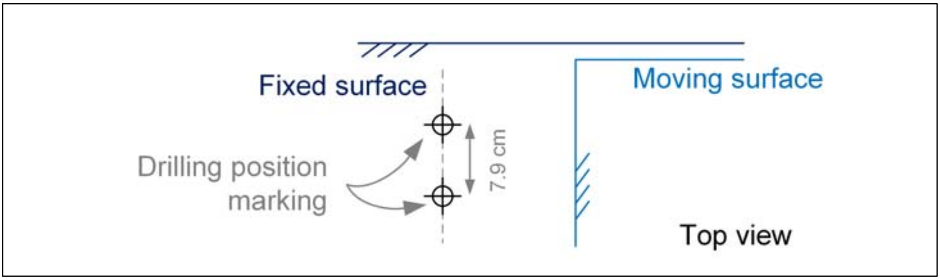

Fig. 2.3 Drilling marking

► Define the drilling points, along the line, at 7.9 cm apart (use the mounting bracket to mark the drilling position).

► Drill holes according to the chosen M5 metallic anchors.

Fig. 2.4 Drilling the fixation holes

2.3 Fixing the sensor

Carefully remove the Optical Displacement Sensor from the packaging and place it on a stable and clean surface.

► Mount the brackets between the black lines, printed over the sensor, as in *Fig. 2.5*, with the specified torque of 3.5 Nm.

Fig. 2.5 Fixing the sensor brackets

► Once the brackets are mounted align their screw holes with the drilled holes.

► Lightly fix the screws and check with a set square ruler that the sensor is perpendicular to the measurement surface.

Fig. 2.6 Tightening the sensor brackets

► After checking, tightly anchor the sensor in place, with the specified torque of the selected anchors.

The sensor will remain fixed in position. And the sensor is now ready to measure. Displacement value can be calculated by using the equation from the calibration sheet. Please refer to section *4.2 Measurement computation*.

2.4 Moving surface

The FS61DSP operates as normally opened which means that it will push its shaft against the moving structure.

The tip is round and of ceramic material to ensure an aligned loading and reduce transverse forces.

Depending on the surface material and ending, it might be important to smooth the surface either by the application of a finishing coating (e.g. resin) or the application of a polished plate (glass, metal, ceramic tile…) to the contact point.

Information

There might be the need to specifically design brackets to adjust the expected structure movement to the sensor's measuring direction. These brackets are not delivered with the sensor.

2.5 Sensor protection

The FS61DSP Displacement Sensor is designed for outside use with IP66.

2.6 Routing and cable protection

The Displacement Sensor has armored cables. Nevertheless, it is advised to prepare the sensor cables path with an appropriate, flexible and resistant tube for added protection.

Sensor cable should be routed without being left hanging. The cable should be fixed by means of plastic clamps, for example (*Fig. 2.7*).

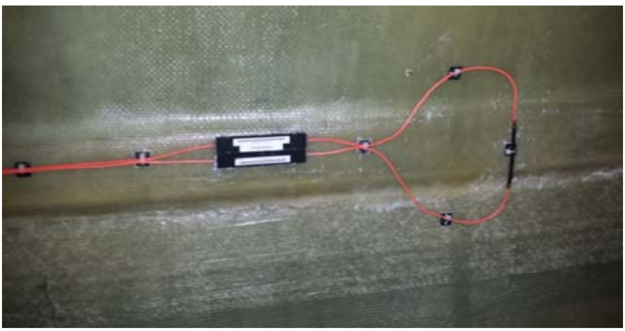

Fig. 2.7 Cable fixed with plastic clamps

Plastic corrugated tubes can also help routing the longer lead cables that will connect to the interrogator (*Fig. 2.8*).

Fig. 2.8 Cable protected with corrugated tubes

Excess cable should be coiled and stored in a suitable IP case, so it can be using in case of network refurbishment (*Fig. 2.9*).

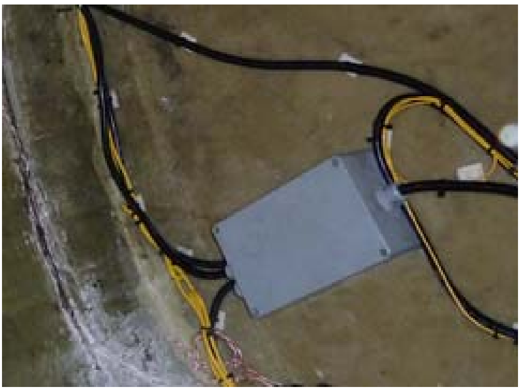

Fig. 2.9 Protection boxes for extra cable and connections

3 Sensor Maintenance

The FS61DSP sensor is designed to withstand harsh environments and has an IP66 ingress protection rating. Nevertheless, it is advisable to perform lubrication on the shaft from time to time. It is very difficult to state the correct maintenance period as it will widely depend on the present conditions where the sensor is installed.

HBM FiberSensing recommends a periodic inspection of the installed system and, if needed, the lubrication of the moving shaft.

Needed Material
Grease paste lubricant Suggested: Fuchs GLEITMO 805k
Brush for lubricant application
Compressed air duster can or similar Suggested: Ewent Air Duster

Tip

Record the displacement values on all sensors before maintenance to correct eventual changes on the displacement measurements caused by the maintenance actions. By the end of the maintenance procedure you will be able to correct any deviation on the displacement value caused by the procedure on the computation formulas.

► Clean the sensor from dust.

► Apply the lubricant paste with a brush or a lint-free cloth on the shaft's entering hole on the sensor body.

► Perform cyclic displacement movements to the shaft to ensure the proper spreading of the lubricant.

4 Sensor Configuration

4.1 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).

4.2 Measurement computation

The FS61DSP Displacement Sensor is a single axis measurement sensor that uses two fiber Bragg gratings in a push-pull configuration for effective thermal compensation of the measurement.

4.2.1 Displacement

The calculations that should be performed for converting two wavelength measurements from FBG 1 and FBG2 into displacement are the shown in *Fig. 4.1*.

$$D = S_2 \cdot [(\lambda - \lambda_0)_{FBG2} - (\lambda - \lambda_0)_{FBG1}]^2 + S_1 \cdot [(\lambda - \lambda_0)_{FBG2} - (\lambda - \lambda_0)_{FBG1}] + S_0$$

Fig. 4.1 Calculation formula for converting wavelength measurements into displacement

Where

- D is the measured displacement in mm
- λ is the measured Bragg wavelength of the FBG1 and FBG2 sensors in nm
- λ_0 is the Bragg wavelength of the of the FBG1 and FBG2 sensors at the mid span (position 0 mm) in nm

- S_0 is the zero order calibration factor as delivered by the calibration sheet in mm
- S_1 is the first order calibration factor as delivered by the calibration sheet in mm/nm
- S_2 is the second order calibration factor as delivered by the calibration sheet in mm/nm^2

4.2.2 Correction after maintenance

The small displacement change caused by performing maintenance tasks on the sensor might need to be corrected. If this is the case, before performing any maintenance actions (see section Sensor Maintenance) it is advisable that every sensor value is recorded so that corrections can be applied on the computation formulas after the tasks.

There are several ways to perform the same correction.

One easy way is to record the displacement values obtained without any correction and later apply this offset:

► Perform a measurement after the maintenance procedure and record its value.

► Compare the measurement after the maintenance (D_{after}) with the displacement before (D_{before})

$$\Delta D = D_{before} - D_{after}$$

Fig. 4.2 Displacement offset after maintenance.

► Apply the calculated offset on the computation formula:

$$D = S_2 \cdot [(\lambda - \lambda_0)_{FBG2} - (\lambda - \lambda_0)_{FBG1}]^2 + S_1 \cdot [(\lambda - \lambda_0)_{FBG2} - (\lambda - \lambda_0)_{FBG1}] + S_0 + \Delta D$$

Fig. 4.3 Calculation formula for converting wavelength measurements into displacement with maintenance error correction.

Where

- D is the measured displacement in mm
- λ is the measured Bragg wavelength of the FBG1 and FBG2 sensors in nm
- λ_0 is the Bragg wavelength of the of the FBG1 and FBG2 sensors at the mid span (position 0 mm) in nm
- S_0 is the zero order calibration factor as delivered by the calibration sheet in mm
- S_1 is the first order calibration factor as delivered by the calibration sheet in mm/nm
- S_2 is the second order calibration factor as delivered by the calibration sheet in mm/nm^2
- ΔD is the maintenance offset correction.

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