FiberSensing by HBK
HOTTINGER BRÜEL & KJÆR

ENGLISH

Mounting Instructions

FS61DSP

Displacement Sensor

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TABLE OF CONTENTS

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 Environment Considerations

1.1.1 Packaging Disposal

The packaging of this equipment is designed to protect it from damage during transportation and storage. It is also made of materials that can be recycled or reused, in accordance with the European Union's waste management regulations to minimize its environmental impact.

If you plan to move your equipment to different locations it is advisable that you keep the original package for reuse. This will not only grant proper protection for transportation, but also ensure the reduction of waste creation.

Packing boxes include a label with information on the materials used on that specific package.

Fig. 1.1 Packing label example

Please follow the instructions below to dispose of the packaging properly and responsibly and contribute to the preservation of our planet. Thank you!

To dispose of packaging, you should:

- Remove any labels, adhesives, nails, staplers or caps that are not part of the same material.
- Rinse the packaging with water to remove any residues or dirt.
- Flatten or fold the packaging to reduce its volume and save space (except for glass that should not be crushed).
- Separate the packaging by material and place it in the appropriate recycling bin or bag.

Most of our packing are made of paper and plastic and aimed to be reused or recycled, but they are not appropriate for food containing. Please consult the chapter “Packing Symbols” for more detailed information about the packing materials used by HBK FiberSensing, marked in the packing label of each product delivered to customers.

Packaging Symbols

Packing materials are marked with the correspondent symbol for guidance.

Not appropriate for food

Recyclable

The recycling symbols for the different materials include numbers and letters that identify the material type. For example, PET (polyethylene terephthalate) is marked also with the number 1, and PE-HD (high-density polyethylene) is marked with the number 2. For paper (PAP) 20 corresponds to corrugated cardboard and 22 to paper as seen in newspapers, books,...

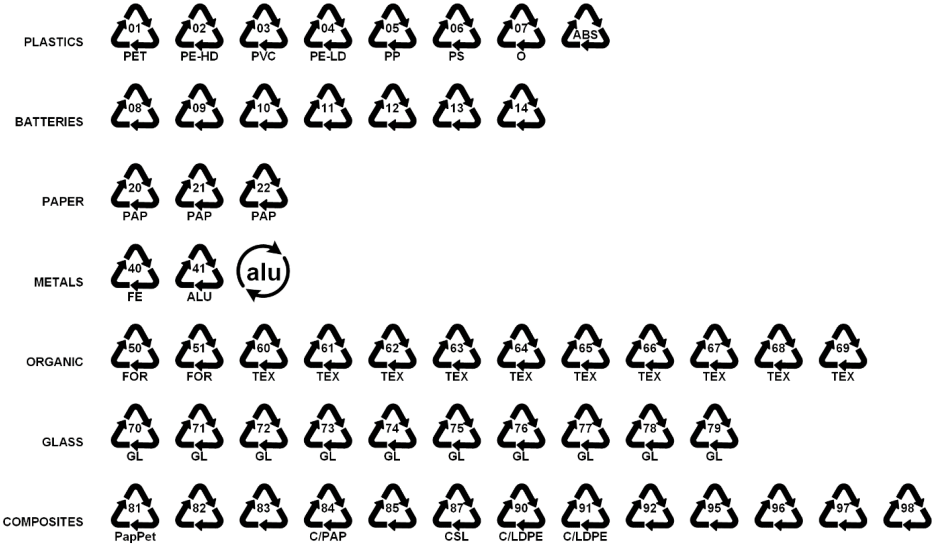

Fig. 1.2 Recycling symbols

Plastics

Plastic packaging materials are commonly bags, films, trays, blisters or containers.

Batteries

Batteries are not part of the packaging, but they may be included in the equipment or its accessories. Please refer to section 2.1.1 Disposal of your old appliance for more information.

Paper

Paper packaging materials are commonly boxes, cartons, envelopes, or labels.

Metals

Metal packaging materials are commonly cans, foils, caps, or wires.

Organic

Organic packaging materials could be wood, cork, or cotton and are made of natural or biodegradable materials that can be composted or reused.

Glass

Glass packaging materials are bottles, jars, or vials.

Composites

Composite packaging materials are made of layers of different materials, such as paper, plastic, and aluminum. They are marked with a recycling symbol and a letter that indicates the composition of the packaging. For example, PAP is for paper and plastic, and ALU is for aluminum.

2 SENSOR INSTALLATION

2.1 Introductory notes

When mounting FS61DSP sensors, please pay attention to the following:

- Handle with care.
  These are precision sensors and so their achievable accuracy highly depends on correct mounting.
- Do not overload the sensors.
- Avoid lateral forces or torque.
- Handle the cables with care before fixing to avoid damage. Do not hold the sensor by the cables.
- Nuts from the cable exiting from the sensors are part of the sensors' body and must not be unfastened.

Notice

The FS61DSP sensors are precision measuring elements and need to be handled carefully. Dropping or knocking the sensors may cause permanent damage. Make sure that the sensors cannot be overloaded, including while they are being mounted.

2.2 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.

2.3 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.

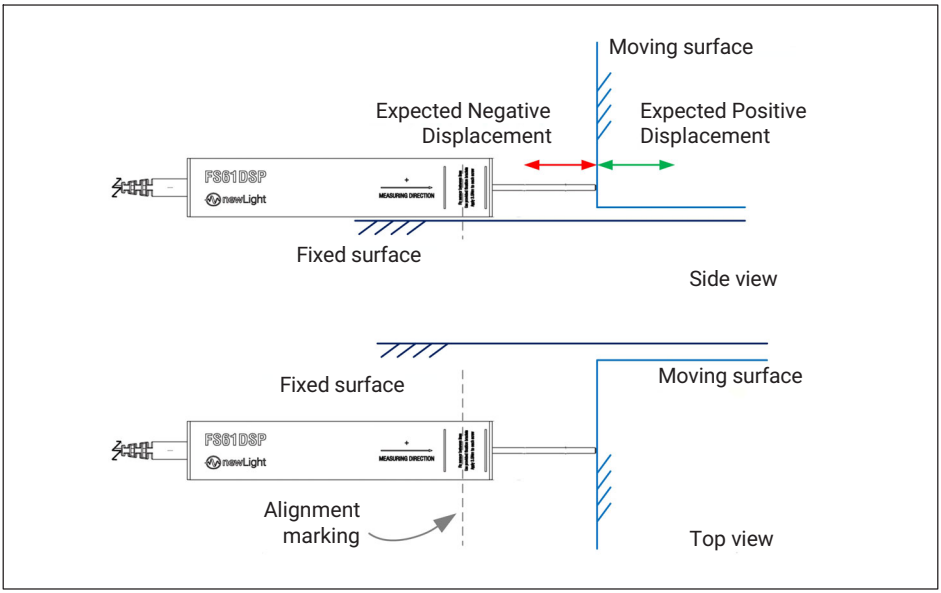

Fig. 2.2 Position marking

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

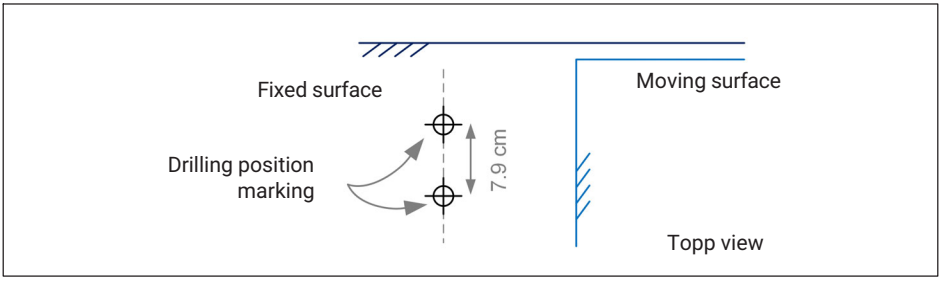

Fig. 2.3 Drilling marking

- 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

2.4 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.

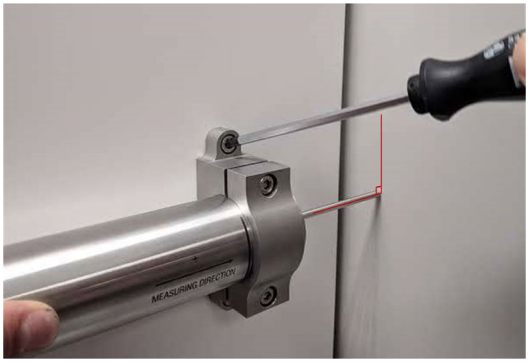

Fig. 2.6 Tightening the sensor brackets

- 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*.

2.5 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.

2.6 Sensor protection

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

2.7 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*).

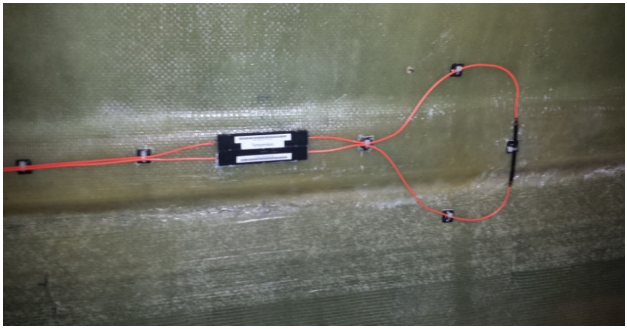

Fig. 2.7 Cable fixed with plastic clamps

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

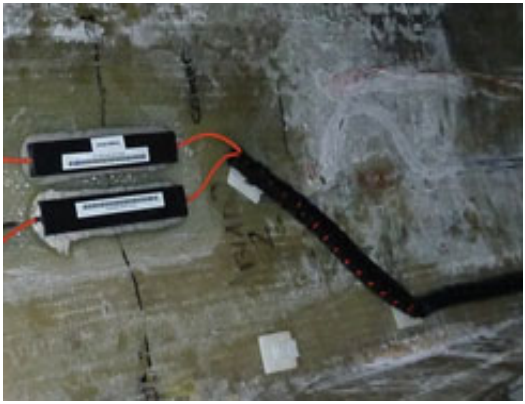

Fig. 2.8 Cable protected with corrugated tubes

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*).

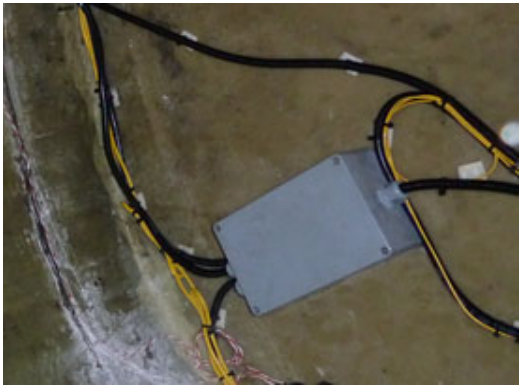

Fig. 2.9 Protection boxes for extra cable and connections

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.hbkworld.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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