FiberSensing by HBK
HOTTINGER BRÜEL & KJÆR

ENGLISH

Mounting Instructions

FS64TLS

Tilt Sensor

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1 GENERAL INFORMATION

The following instructions refer to the installation procedure of FS64TLS Tilt Sensors.

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

Material Numbers
K-FS64TLS
1-FS64TLS-10/2510
1-FS64TLS-10/2530
1-FS64TLS-10/2550
1-FS64TLS-10/2570

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,...

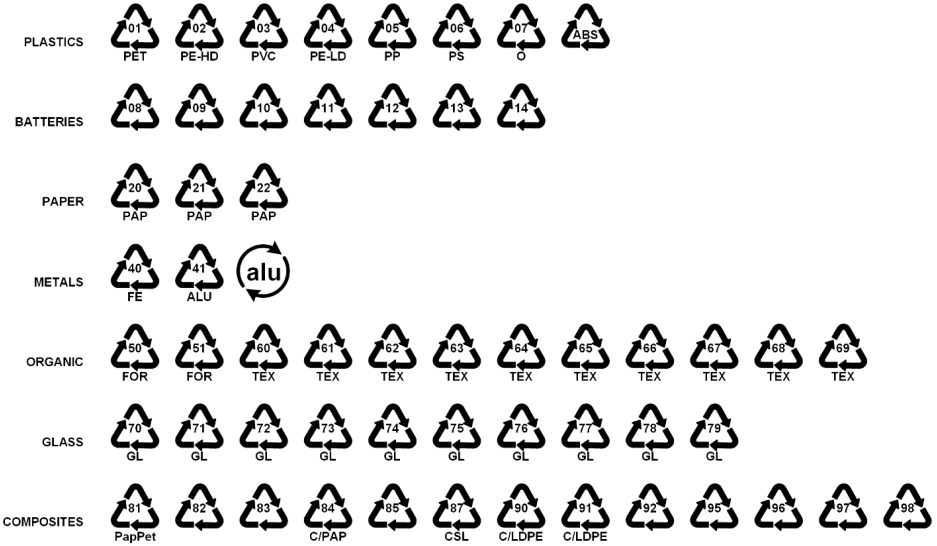

Fig. 1.2 Recycling symbols

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.

1.2 Marking used in this document

Important instructions for your safety are specifically identified. It is essential to follow these instructions to prevent accidents and property damage.

Symbol	Significance
⚠ **CAUTION**	This marking warns of a *potentially* dangerous situation in which failure to comply with safety requirements *can* result in slight or moderate physical injury.
Notice	This marking draws your attention to a situation in which failure to comply with safety requirements *can* lead to damage to property.
Important	This marking draws your attention to *important* information about the product or about handling the product.
Tip	This marking indicates application tips or other information that is useful to you.
Information	This marking draws your attention to information about the product or about handling the product.
Emphasis *See …*	Italics are used to emphasize and highlight text and identify references to sections, diagrams, or external documents and files.
▶	This marking indicates an action in a procedure

2 SENSOR INSTALLATION

2.1 List of materials

Included Material
Tilt Sensor
Sealant stickers (two sets)

Needed equipment
Drilling Machine (optional)

Needed material
Anchors (M6 Bolt) Suggested: HAS-R M6 5/-/- from Hilti or similar
Slotted screwdrivers (L30 D2.8 E0.7 mm and D7 E1.1 mm)
Spanner wrench (10mm)
Specifically designed Mounting brackets (optional)
Bubble level

The needed tools to install the FS64TLSTilt 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 spot where it is going to be installed.

2.2 Introductory notes

When mounting FS64TLS sensors, please pay attention to the following:

- Please handle with care.
- These are precision sensors and so their achievable accuracy highly depends on correct mounting.
- Tilt sensors measurement principle is based on a pendulum mass that is locked for ensuring the sensor's integrity during transportation and installation. Ensure that the sensor is locked whenever being handled outside the installation position.
- Do not overload the sensors.
- Avoid lateral forces or torque.
- The sensors are very heavy when compared to the cables. 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 Tilt Sensors are precision measuring elements and need to be handled carefully. Dropping or knocking the transducers may cause permanent damage. Make sure that the transducer cannot be overloaded, including while it is being mounted.

2.3 Preparation the surface

The surface where the sensor is to be installed should be vertical and regular.

Information

If the sensor wall is not vertical, it will not have the expected behavior. There is the possibility to design mounting plates to ensure the right position of the sensor.

Fig. 2.1 Removing irregularities of the surface

- Make sure of the verticality of the surface and that there are no major irregularities that could interfere with the sensor's back side (*Fig. 2.1*).

Important

If there are any bumps and/or irregularities when tightening up the sensor, its back can get deformed which will influence the sensor's behavior.

- Afterwards mark two points 20 cm apart and vertically aligned (*Fig. 2.2*).

Information

The tilt sensor has a slot to ensure that small corrections towards the vertical can be performed when the sensor is being fixed.

Fig. 2.2 Fixation points

Fig. 2.3 Anchor tightening

- Drill the holes according to the chosen M6 anchors *see section 2.1, page 8* with a minimum depth of 42 mm.
- Verify the screws position with a measuring tape and then anchor them definitely (*Fig. 2.3*), tightening them with a torque of 5 Nm.
- Remove the nut before proceeding.

2.4 Placing the sensor

- Carefully take the tilt sensor out of the transportation box and place it on the support (*Fig. 2.4*).

Important

The tilt sensor is a sensitive sensor. Please take extra care when handling the sensor.

Fig. 2.4 Placing the sensor on the supports

Fig. 2.5 Applying the washers and hexagon nuts

- Place the washer and hexagon nut on both anchors (*Fig. 2.5*).
- With the help of a bubble level rotate the sensor along the slot and place the sensor as close to the vertical as possible (*Fig. 2.6*). Screw the nuts loosely to allow final adjustments.

Fig. 2.6 Vertical alignment using a bubble level

2.5 Unlocking the sensor

Important

The FS64TLS is based on a pendulum mass that must be secured during sensor transportation. For correct operation of the sensor these fixations must be properly removed. The next installation steps must be followed strictly.

Throughout the next steps, it is advisable to control both FBG wavelength changes.

- Connect the sensor to an interrogator and control the Center Wavelengths of the two FBGs.

Tip

The easiest way to perform this control is to configure the sensor so that the tilt value is measured. Nevertheless, if the available equipment does not have software to perform this automatically, it can be done manually by looking directly at the absolute wavelength values. The difference between the two FBG is the stated on the calibration sheet for an unlocked sensor that is in the vertical position.

Fig. 2.7 Unlocking sequence

2.5.1 Mass Locking Screws

Fig. 2.8 Mass locking screws (number “1”)

The locking screws marked with “1” are physically fixing the pendulum mass for transportation.

- Start by unlocking the right (white) side slowly, using the bigger slotted screwdriver (D7 E1.1 mm), while controlling the wavelength values. Then change to the left (blue) side and repeat.

These screws should be fully removed from the sensor and stored so that they can be attached again if the sensor is to be transported.

2.5.2 Front Locking Screws

Fig. 2.9 Front locking screws (number “2”)

Marked with number “2” are the front locking screws. These screws are not removable.

- Starting again on the right (white) side, use the smaller slotted screwdriver (L30 D2.8 E0.7 mm) and turn 3 to 4 times to unfasten the screw half way. Repeat on the left (blue) side.

Tip

If wavelength values start to separate visibly switch sides more often.

- Return to the right (white) side hole and finish unlocking.

Notice

Do not force the screw. Once you feel it has hit the end stop rotating it.

- Repeat on the left (blue) side.

2.5.3 Side Locking Screws

Fig. 2.10 Side locking screws (number “3”)

Last to unfasten should be the side locking screws marked with number “3”. The process for these lockers is the same as for the previous.

- Starting on the right (white) side, use the smaller slotted screwdriver (L30 D2.8 E0.7 mm) and turn 3 to 4 times to unfasten the screw half way. Repeat on the left (blue) side.

Information

On this direction the wavelength change should be smaller. Nevertheless, if wavelength values start to separate visibly switch sides more often.

- Return to the right (white) side hole and finish unlocking.

Notice

Do not force the screw. Once you feel it has hit the end leave it.

- Repeat on the left (blue) side.

Notice

Before removing the sensor to use it in a different location the mass must be locked again. Only by doing so it is granted that no damage is done to the sensor. Please follow the instructions of chapter 2.8 on page 18.

2.6 Aligning the sensor

Now it is time to set the final alignment of the sensor.

- For the sensor to be installed vertically, ensure that the difference between the two measured wavelengths equals the wavelength difference of the two reference wavelengths as stated on the calibration sheet.

Information

If you have information on the tilt value, you should set it as close as possible to zero.

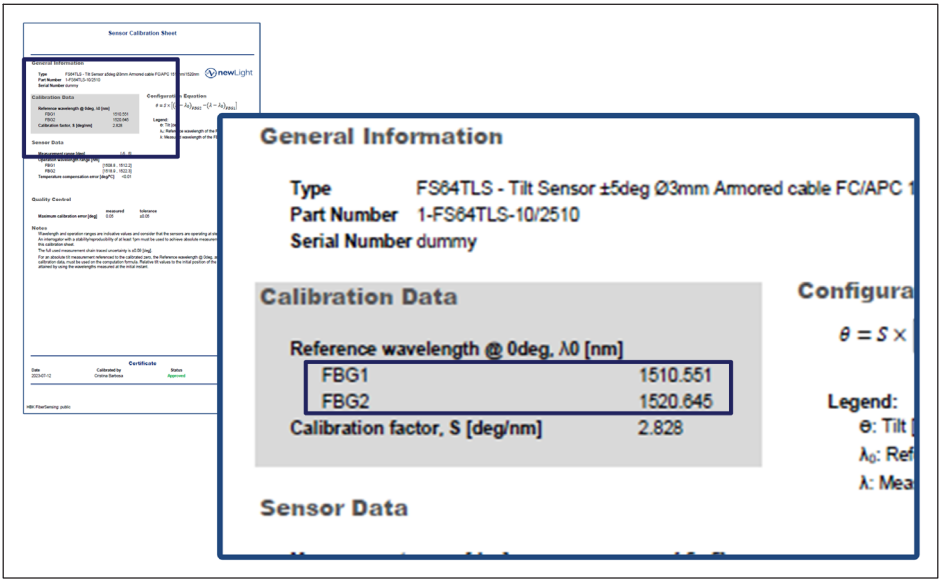

Fig. 2.11 Calibration sheet example - FBG wavelengths

Fig. 2.12 Fastening hexagon nuts

- After ensuring that the sensor is in its vertical position, fasten the hexagon nuts (*Fig. 2.12*) with a torque of 5 Nm.

Important

Care must be taken to avoid rotating the sensor while fastening the nuts.

2.7 Protecting the sensor

Once the sensor is tightly set in place, cover the holes from the locking screws with the provided sealant stickers (Fig. 2.13).

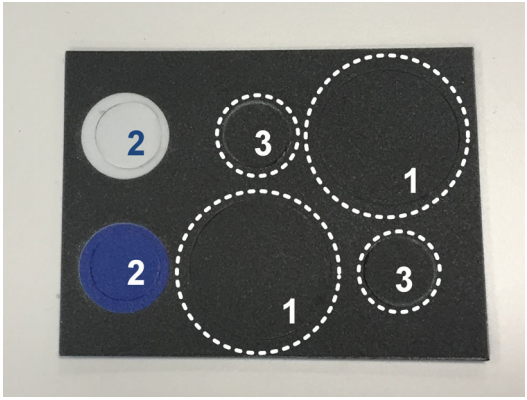

Fig. 2.13 Sealant stickers

With the sensor two complete sets for tilt protection are provided. Each is composed by four smaller stickers and two bigger stickers. Use the bigger stickers for covering holes “1” and the smaller ones for “2” and “3”, by matching the color.

If the sensor is to be placed outdoors, it should be installed inside a box with a proper IP. This box will protect the sensor from moisture, sun and the influence of the shades on the measurement.

Notice

Despite being a thermally compensated sensor, the measurement can be affected if the sensor is, for example, subjected to sunlight and shade at the same time.

Important

Note that some protection boxes may require their installation on the wall previous to the sensors.

2.8 Locking the sensor for transportation

Before removing a sensor from its location it must be locked back to ensure a safe transportation. The procedure should be the reverse of the explained in *chapter 2.5 on page 12,*.

2.8.1 Sealant stickers

- Remove the sealant stickers from the sensor to reveal the locking screws.

2.8.2 Side Locking Screws

- Start by fastening the left (blue) side locking screw, marked with number 3 on the label, half way (3 to 4 screwdriver turns). Repeat on the right (white) side. Alternate sides until screws are fully fastened.

2.8.3 Front Locking Screws

- Repeat the process on the front screws marked with number 2.

2.8.4 Mass Locking Screws

- Collect the previously stored mass screws and attach them to the sensor, on the holes marked as 1 on the labels, alternating sides and starting on the left (blue) side.

2.9 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. 2.14*).

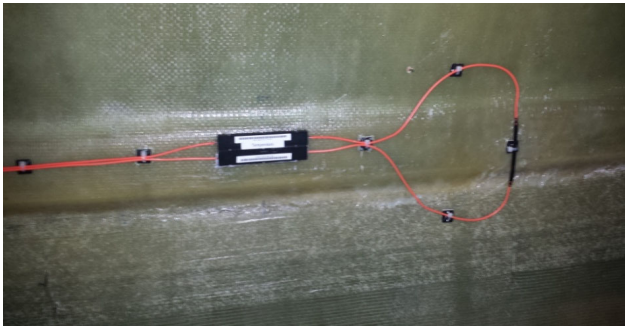

Fig. 2.14 Cable fixed with plastic clamps

Plastic corrugated tubes can also help routing the longer lead cables that will connect to the interrogator (*Fig. 2.15*).

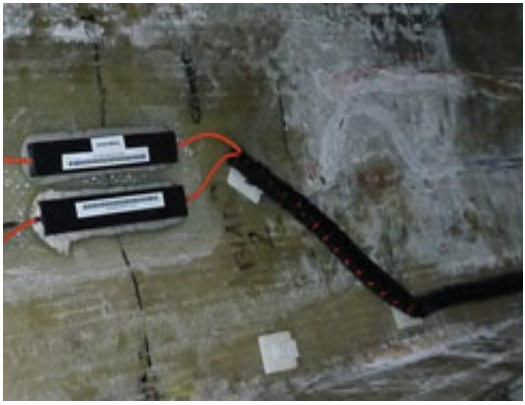

Fig. 2.15 Cable protected with corrugated tubes

Excess cable should be coiled and stored in a suitable IP case, so it can be used in case of network refurbishment (*Fig. 2.16*).

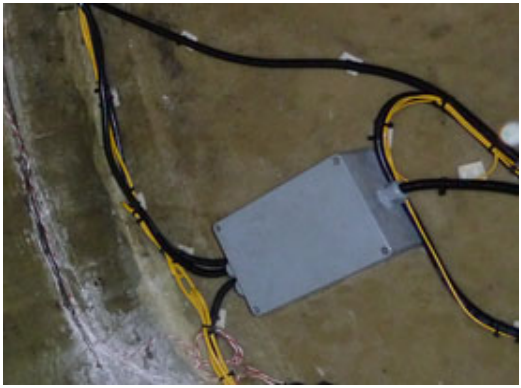

Fig. 2.16 Protection boxes for extra cable and connections

3 SENSOR CONFIGURATION

3.1 Sensors documentation

Calibrated HBK 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 HBK website (www.hbkworld.com).

3.2 Measurement computation

The FS64TLS Tilt 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.

3.2.1 Tilt towards the vertical

The calculations that should be performed for converting two wavelength measurements from FBG 1 and FBG2 into tilt are the shown in *Fig. 3.1*.

$$\theta = S \times \left[(\lambda - \lambda_0)_{FBG2} - (\lambda - \lambda_0)_{FBG1} \right]$$

Fig. 3.1

Where

- θ is the measured Tilt in deg
- 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 vertical (0 deg) in nm
- S is the calibration factor as delivered by the calibration sheet in g/nm

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