Installation Guide

English

# FS63

## Composite Temperature Sensor

Hottinger Baldwin Messtechnik GmbH
Im Tiefen See 45
D-64239 Darmstadt
Tel. +49 6151 803-0
Fax +49 6151 803-9100
info@hbm.com
www.hbm.com

HBM FiberSensing, S.A.
Optical Business
Rua Vasconcelos Costa, 277
4470-640 Maia
Portugal
Tel. +351 229 613 010
Fax +351 229 613 020
fibersensing@hbm.com
www.hbm.com/fs

Mat.: 7-2002.4260
DVS: A4260-1.1 HBM: public
05.2015

Sensor Design Version: v1.0

# 1 Technical Details

## 1.1 General Information

This installation guide applies to the following products:

| Part Number | Description |
|---|---|
| K-FS63-17-11-202 | FS63 - Composite Temperature Sensor • Indoor • FC/APC |
| K-FS63-17-13-202 | FS63 - Composite Temperature Sensor • Indoor • SC/APC |
| K-FS63-17-10-202 | FS63 - Composite Temperature Sensor • Indoor • NC |
| K-FS63-17-11-302 | FS63 - Composite Temperature Sensor • Outdoor • FC/APC |
| K-FS63-17-13-302 | FS63 - Composite Temperature Sensor • Outdoor • SC/APC |
| K-FS63-17-10-302 | FS63 - Composite Temperature Sensor • Outdoor • NC |

### 1.1.1 Overview

The FS63 - Composite Temperature Sensors are Fiber Bragg Grating (FBG) based sensors, designed to be bonded to surfaces and materials.

### 1.1.2 Characteristics

**: Robustness**

Long-term reliability ensured by innovative sensor design and careful selection of materials.

**: Completely passive**

Inherent immunity to all electromagnetic effects (EMI, RFI, sparks, etc.) and safe operation in hazardous environments.

**: High multiplexing capability**

Connection of a large number of sensors to a single optical fiber, reducing network and installation complexity.

**: Remote sensing**

Large distance between sensors and interrogator (several kilometers).

**: Compatible with most interrogators**

Provided with calibration sheet, allowing easy and accurate configuration.

**: Self-referenced**

Based on the measurement of an absolute parameter - the Bragg wavelength - independent of power fluctuations.

### 1.1.3 Applications

HBM FiberSensing temperature sensors can be used in several strain measuring applications. They are particularly suited for structural health monitoring in large structures (SHM).

: Civil Engineering
: Transportation
: Energy
: Aeronautics
: R&D

### 1.1.4 Quality

All HBM FiberSensing's processes are strictly controlled from development to production. Each product is subjected to high standard performance and endurance tests, individually calibrated and checked before shipping.

HBM FiberSensing, S.A. concentrates all optical sensing activity of HBM and is an ISO 9001:2008 certified company.

### 1.1.5 Accessories

The implementation of complex sensing networks in large structures is made simpler with HBM FiberSensing accessories. These include cables especially designed to resist harsh environments as in civil engineering, not only during construction, but also during the lifetime of the structure (humidity, corrosion, etc.).

## 1.2 General Specifications

| Sensor | |
|---|---|
| Sensitivity[1)] | 10 pm/ºC |
| Measurement range | -20 to 80 ºC |
| Resolution[2)] | 0.1 ºC |
| Maximum calib. error | 0.5 ºC |
| **Optical** | |
| Central wavelength | 1500 to 1600 nm |
| Spectral width (FWHM) | < 0.2 nm |
| Reflectivity | > 65% |
| Side lobe suppression | > 10 dB |
| **Inputs / Outputs** | |
| Cable type | Ø 3 mm indoor (kevlar)<br>Ø 3 mm outdoor (armor) |
| Cable length | 2 m each side (±5 cm) |
| Connectors | FC/APC<br>SC/APC<br>NC (No Connectors) |
| **Environmental** | |
| Operation temperature | -20 to 80 ºC |
| **Mechanical** | |
| Materials | GFRP and polyurethane |
| Dimensions | 130 x 20 x 6 mm |
| Weight | 21 g |

1) Typical values
2) For 1 pm resolution in wavelength measurement

# 2 Sensor Installation

## 2.1 List of Materials

**Included Material**

Composite Temperature Sensor

**List of Needed Equipment**

Deburring Machine (optional)

**List of Needed Material**

| | |
|---|---|
| Glue | Sika® Fast 5211 (or similar) |
| Paper | Sand Paper (optional) |
| Cleaning | Alcohol and tissues |
| Tape | Drafting tape |

The Sika® Fast 5211 is bi-component glue and the mixture takes place in the tip of the syringe (*Fig. 2.1*).


*Fig. 2.1*

**Important**

*Do not use the first part of the glue coming out of the syringe (Fig. 2.1).*

## 2.2 Preparing the Surface

If there are protection layers applied on the material, such as paint or rust, deburr (*Fig. 2.2*) or sand (*Fig. 2.3*) the surface to remove them ensuring that the surface does not become irregular.

*Fig. 2.2*

*Fig. 2.3*

Clean the surface with a tissue and alcohol, always wiping in the same direction until the tissue comes out clean (*Fig. 2.4*).

*Fig. 2.4*

## 2.3 Placing the Sensor

Carefully take the sensor out of the box. The sensor has a bondable side that is the one with the composite material. *Fig. 2.5* shows the polyurethane protection facing up, which is the right position of the sensor. In *Fig. 2.6* the composite material side is facing up. This is the side that must be facing the surface where the sensor is going to be installed.

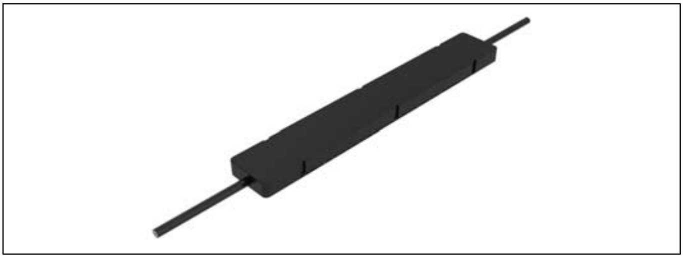

*Fig. 2.5*

*Fig. 2.6*

Spread the glue homogeneously on the sensor's surface to be bonded (*Fig. 2.7*). Please ensure that glue is spread on the correct side (refer to *Fig. 2.6*).

*Fig. 2.7*

Press the sensor evenly during 1 min, while waiting for the glue to cure (*Fig. 2.8*).

Chemical reaction of glue's components is very fast, so changing position of the sensor while pressing can lead to poor adhesion of sensors to the structure's surface.

*Fig. 2.8*

Complete curing time will take around 4 hours, but once the first bonding is done, sensors can be released just after the first minute.

## 2.4 Protecting the Sensor

The composite temperature sensor is a ruggedized sensor designed with protection for mechanical and environmental actions, meaning that it does not need much more protection.

However, although the sensor is protected, the adhesive may be exposed to moisture and environmental effects, meaning that it is prone to a faster degradation.

## 2.5 Sensor Cable Routing and Cable Protection

Sensor cable should be routed without being left hanging. The cable should be fixed by, for example, means of plastic clamps (*Fig. 2.9*).

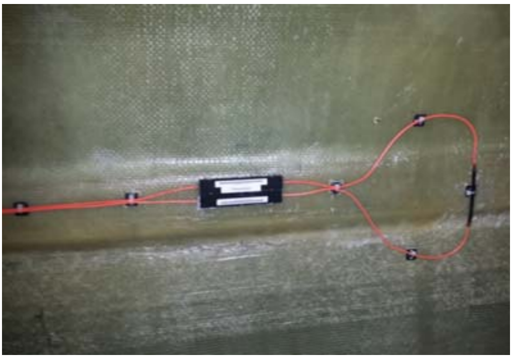

*Fig. 2.9*

Plastic corrugated tubes can also help routing the longer lead cables that will connect to the interrogator (*Fig. 2.10*).

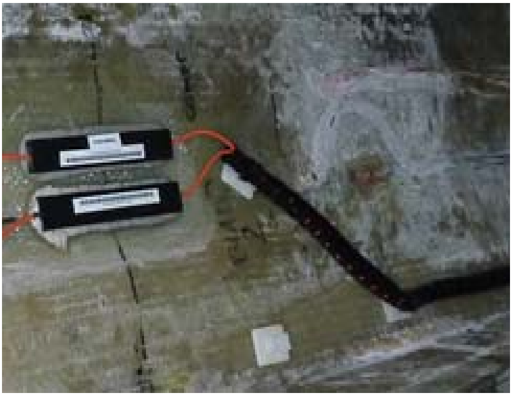

*Fig. 2.10*

Excess cable should be coiled and stored in a suitable IP case, so it can be used in case of network refurbishment (*Fig. 2.11*).

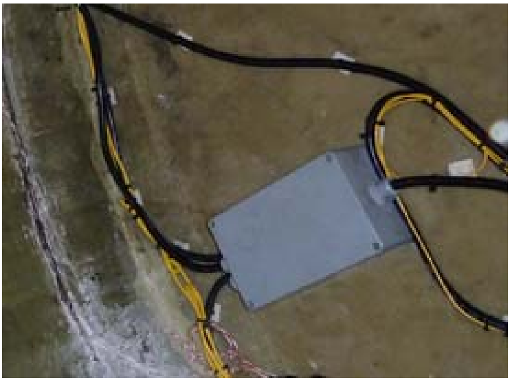

*Fig. 2.11*

# 3 Sensor Configuration

## 3.1 Sensor Calibration Sheet

Every HBM FiberSensing sensor is provided with a calibration sheet. The layout of this document is the same for all temperature sensors.

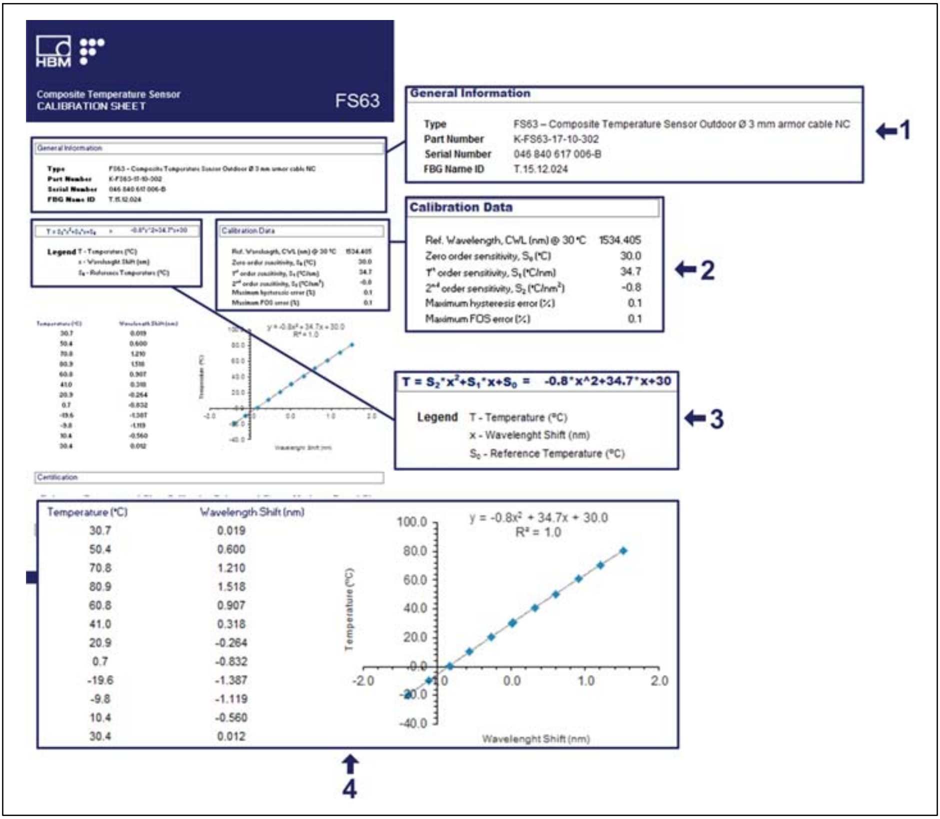


*Fig. 3.1*

### 3.1.1 General Information

Table **1** on *Fig. 3.1* shows the general information on the particular sensor, such as type, part number, serial number and the production tracking number, the FBG ID.

### 3.1.2 Calibration Data

The most important information related to the temperature sensor - central wavelength at room temperature and sensitivity - is shown in the calibration data table (number **2** on *Fig. 3.1*). These values should be used for temperature computation.

### 3.1.3 Temperature Computation

Table **3** on *Fig. 3.1* exemplifies the calculations that should be performed for wavelength measurement to temperature conversion. The temperature variation of a temperature sensor is given by a second order polynomial equation obtained by the sensor calibration.

$$temperature = S_2x^2 + S_1x + S_0$$

*Fig. 3.2*

Where

- $S_0$ is the zero order sensitivity (reference temperature) in ºC
- $S_1$ is the first order sensitivity in ºC/nm
- $S_2$ is the second order sensitivity in $ºC/nm^2$
- And

- x is the wavelength shift in nm computed as:

$$x = WL - CWL$$

*Fig. 3.3*

Where

- CWL is the central wavelength of the sensor at the reference temperature in nm
- WL is the measured wavelength in nm.

Table **4** on *Fig. 3.1* represents collected data during the calibration procedure on the temperature sensors.

www.hbm.com

A4260-1.1 7-2002.4260 HBM: public

**HBM Test and Measurement**
Tel. +49 6151 803-0
Fax +49 6151 803-9100
info@hbm.com

measure and predict with confidence