Installation Guide

English

FS63

Weldable Temperature Sensor

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Sensor Desing Version: v1.0

1 Technical Details

1.1 General Information

This installation guide applies to the following products:

Part Number	Description
K-FS63-20-11-202	FS63 – Weldable Temperature Sensor • Indoor • FC/APC
K-FS63-20-13-202	FS63 – Weldable Temperature Sensor • Indoor • SC/APC
K-FS63-20-10-202	FS63 – Weldable Temperature Sensor • Indoor • NC
K-FS63-20-11-302	FS63 – Weldable Temperature Sensor • Outdoor • FC/APC
K-FS63-20-13-302	FS63 – Weldable Temperature Sensor • Outdoor • SC/APC
K-FS63-20-10-302	FS63 – Weldable Temperature Sensor • Outdoor • NC

1.1.1 Overview

The FS63 - Weldable Temperature Sensors are Fiber Bragg Grating (FBG) based sensors, designed to be spot welded to structures and components.

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 temperature measuring applications. They are particularly suited for temperature mapping in large structures (SHM).

: Industry
: Civil Engineering
: Energy
: 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.).

For the installation of weldable temperature sensors in severe environments, an optional metallic protection cover is available.

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) Ø 3 mm outdoor (armor)
Cable length	2 m each side (±5 cm)
Connectors	FC/APC SC/APC NC (No Connectors)
Environmental	
Operation temperature	-20 to 80 ºC
Mechanical	
Materials	Stainless steel
Dimensions	45 x 15 x 0.6 mm
Weight	5 g

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

2 Sensor Installation

2.1 List of Materials

Included Material

Weldable Temperature Sensor

List of Needed Equipment

Spot welding Machine

List of Needed Material

Tape Drafting Tape

2.2 Spot Welding Machine

HBM FiberSensing uses a machine from Portable Welders Ltd. Our console is the B3 (http://www.-portablewelders.com/technical-data-poke-consoles.html) and the Poke Welding Gun is the PG2 (http://www.-portablewelders.com/poke-welding-guns-details.html).

The following instructions are based on our welding machine and should be considered as an indication, since ideal settings may differ from situation to situation (machine, material, thickness, welding ground clamp position, etc.).

The spot welding machine is composed by a console, one ground gramp (*Fig. 2.1*) and one welding gun (*Fig. 2.2*).

Fig. 2.1

Fig. 2.2

Typical settings are shown in *Fig. 2.3* below. This is a starting point that should be adjusted to optimize the shot and the welding.

Fig. 2.3

Refer to section 2.4 on page 12 for welding process instructions.

2.3 Preparing the Surface

Deburr the surface until reaching a weldable material while ensuring that there are no irregularities on the surface. Clean the surface with a tissue to remove any dust.

Fig. 2.4

2.4 Welding the Sensor

Take the sensor out of its box taking care not to touch the back side of the metal part.

Align the sensor on the surface and fix it with a small piece of drafting tape across the edge of the assembly and at the buffer.

Fig. 2.5

Give the first set of shots with the welding machine (points 1 to 1') as shown in *Fig. 2.6*.

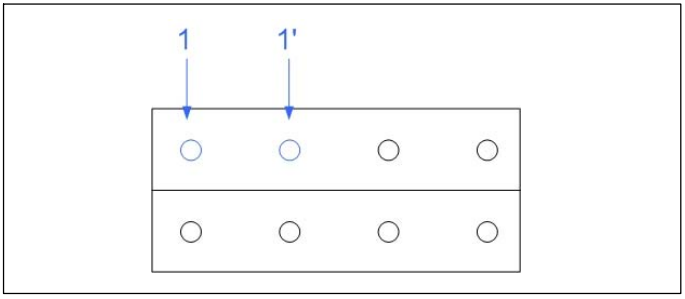

Fig. 2.6

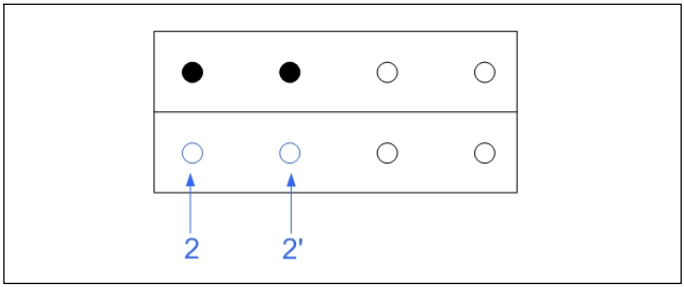

Fig. 2.7

Proceed with the second sets of shots as shown in *Fig. 2.7*.

To ensure a complete strain isolation form the sensor, only one half of the sensor should be welded.

2.5 Protecting the Sensor

For the weldable temperature sensor it is advisable to further protect the sensor. The following instructions are only suggestions of procedure.

2.5.1 Moisture Protection

To protect the sensor from direct moisture contact, HBM FiberSensing uses a synthetic air tight rubber (Polyisobutylene rubber).

Cut a piece of rubber tape with approximately 70x23 mm.

Fig. 2.8

Remove the protection sheet from the tape and carefully place it over the sensor. Press the tape towards the sensor and the surface.

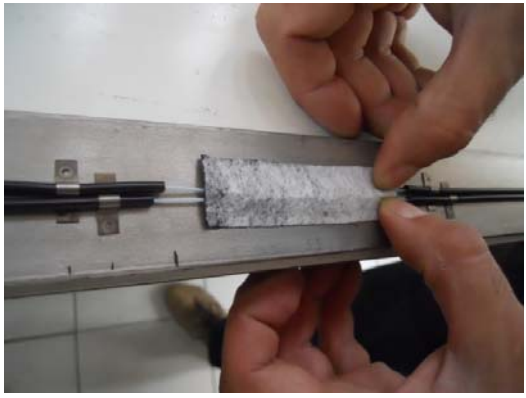

Fig. 2.9

2.5.2 Mechanical Protection

HBM FiberSensing has a sensor cover that can be used with weldable temperature sensor. Weld the cover to the surface.

Fig. 2.10

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.

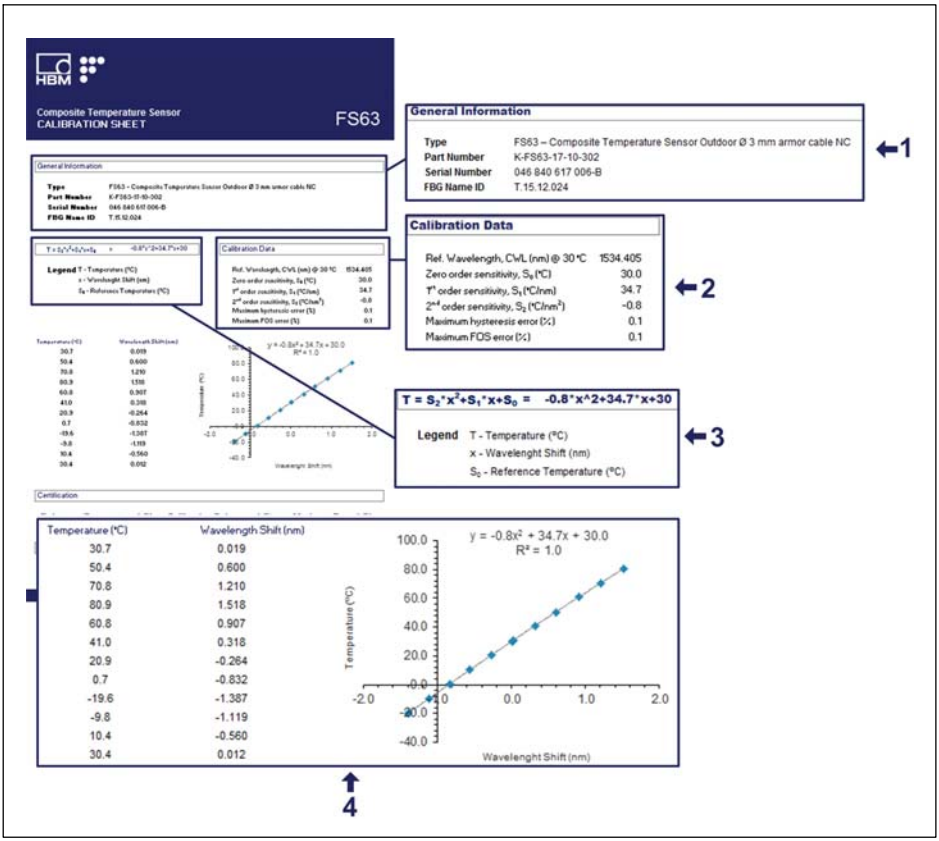

Fig. 3.1

3.1.1 General Information

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

3.1.2 Calibration Data

Under the calibration data table (number **2** in *Fig. 3.1*) there is the most important information on the strain sensor: its central wavelength at room temperature and its sensitivity – values that should be used for temperature computation.

3.1.3 Temperature Computation

Number **3** in *Fig. 3.1* exemplifies the calculations that should be performed for wavelength measurement to temperature conversion. The temperature variation of a weldable 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 zero moment in nm
- WL is the measured wavelength in nm.

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

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