**User Manual**

English

# SOFO VII / MuST

## Reading Unit

Engineered by HBM FiberSensing

SMARTEC

# SOFO VII / MuST Universal Reading Unit
# Equipment User Manual

User manual version: 2.0
07.2015

Reading Unit version: 1.1
BraggMONITOR Software version: 1.3

Subject to modifications.
All product descriptions are for general information only.
They are not to be understood as a guarantee of quality or durability.

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# 1 Technical details

## 1.1 General Information

The SOFO VII / MuST is a continuous swept laser scanning measurement unit for interrogating SOFO and fiber Bragg grating (FBG) sensors. It includes a NIST traceable wavelength reference that provides continuous calibration to ensure system accuracy over long term operation. The high dynamic range and high output power allows high resolution to be attained even for long fiber leads and lossy connections.
Five SOFO sensors can be measured with each optical channel with the use of a SOFO MUX 1x5. Multiple FBG sensors can be connected in series in each optical fiber. This, in combination with the four or eight optical channels with parallel acquisition, make the SOFO VII / MuST particularly suited for large scale sensing networks, acquiring a large number of sensors of different technologies simultaneously.

**Important**

*The SOFO sensors cannot be connected directly to the SOFO VII. The only way to measure a SOFO sensor is to plug it to a channel of the SOFO MUX 1x5 or using a hybrid patch cord with a E2000/APC connector on one side (to the reading unit) and a E2000/PC (to the SOFO sensor). Never connect a SOFO sensor directly to a channel of the reading unit, this can damage the core of fibers of both connectors.*

This Manual applies to the following equipment:

| **PN S10.2021-4CH** |
|---|
| SOFO VII/MuST Universal Reading Unit • 4 OC • Standard Temperature Operation Range |
| **PN S10.2021-8CH** |
| SOFO VII/MuST Universal Reading Unit • 8 OC • Standard Temperature Operation Range |
| **PN S10.2021-MUX** |
| SOFO MUX 1x5 |

## 1.2 System Components

The SOFO VII / MuST set includes:

- Measurement Unit
- Power cord
- Adapter protection caps
- SOFO Reference sensor
- SOFO MUX 1x5 (optional)

## 1.3 SOFO VII/MuST Reading Unit Technical Data

### 1.3.1 Performance

| | SOFO Sensors Measurement | MuST /FBG Sensor Measurement |
|---|---|---|
| **Measurement Resolution** | 2 µm RMS | 1 pm |
| **Linearity/Accuracy** | < 2‰ | 2 pm |
| **Measurement Range** | Max. 50 mm | 100 nm (1500 to 1600 nm) |
| **Calibration** | None, not required | NIST traceable wavelength reference |
| **Measurement time** | < 2 s (inc SDB writing) per channel | < 2 s (inc SDB writing) per channel |
| **Available channel count** | 4 or 8 channels total, software configurable between SOFO and MuST | |

### 1.3.2 Technical Characteristics

| | |
|---|---|
| **AC power supply** | 230 V 50 Hz / 110 V 60 Hz Auto detect |
| **External connections** | Ethernet connection, 8 optical ports, power supply, display and screen (optional) |
| **Data logger capacity** | Typical 5 year of data with measurements every 1h |
| **Dimensions** | 500 mm x 500 mm x 210 mm |
| **Weight** | ~25 Kg |
| **Operating temperature** | 10 ºC to +40 ºC<br>-40 ºC to + 40 ºC with heating option* |
| **Humidity** | 90% non-condensed |
| **Protection Index** | IP 66† |

* optional

† if the base of the SOFO VII is properly drilled and hermetic gland nuts are used.

## 1.4 SOFO MUX 1x5 Technical Data

### 1.4.1 Performance

| | |
|---|---|
| **Channel Multiplexing** | 1x5 |
| **Operating Range** | |
| Channel 1 | 1501 to 1519 nm |
| Channel 2 | 1521 to 1539 nm |
| Channel 3 | 1541 to 1559 nm |
| Channel 4 | 1561 to 1579 nm |
| Channel 5 | 1581 to 1599 nm |
| **Insertion loss** | <1.5 dB |

### 1.4.2 Technical Characteristics

| | |
|---|---|
| **Connectors to Measurement Unit** | E2000/APC |
| **Connectors to SOFO Sensors** | E2000/PC |
| **Dimensions** | 163mm x 103 mm x 53 mm |
| **Weight** | 0.43 Kg |
| **Material** | Aluminum |
| **Operating temperature** | -25 to 70 ºC |
| **Humidity** | < 90% at 40 ºC |

# 2 Regulatory and Certification Considerations

## 2.1 Environment Considerations

### 2.1.1 Disposal of your Old Appliance

When the attached symbol combination - crossed-out wheeled bin and solid bar symbol – is attached to a product it means the product is covered by the European Directive 2002/96/EC and is applicable in the European Union and other countries with separate collection systems.
All electrical and electronic products should be disposed of separately from the municipal waste stream or household via designated collection facilities appointed by the government or the local authorities. The correct disposal of your old appliance will help prevent potential negative consequences for the environment and human health. For more detailed information about disposal of your old appliance, please contact your city office, waste disposal service or distributor that purchased the product.
HBM FiberSensing is a manufacturer registered in the ANREEE - "Associação Nacional para o Registo de Equipamentos Eléctricos e Electrónicos" under number PT001434. FiberSensing celebrated a "Utente" type contract with Amb3E - "Associação Portuguesa de Gestão de Resíduos de Equipamentos Eléctricos e Electrónicos", which ensures the transfer of Electrical and Electronic appliance waste management, i.e. placing Electronic and Electrical appliances in the Portuguese market, from the manufacturer (HBM FiberSensing) to Amb3E.

## 2.2 Laser Safety

The SOFO VII / MuST product contains a laser in its core. A laser is a light source that can be dangerous to people exposed to it. Even low power lasers can be hazardous to a person's eyesight. The coherence and low divergence of laser light means that it can be focused by the eye into an extremely small spot on the retina, resulting in localized burning and permanent damage.

The lasers are classified by wavelength and maximum output power into the several safety classes: Class 1, Class 1M, Class 2, Class 2M, Class 3R and Class 4.

### 2.2.1 Symbols

*Warning symbol*

*Class 1 Laser symbol*

*Fig. 2.1*

### 2.2.2 Class 1 Laser

The Measurement Unit is a class 1 laser product:

«Any laser or laser system containing a laser that cannot emit laser radiation at levels that are known to cause eye or skin injury during normal operation. »

It is safe under all conditions of normal use. No safety requirements are needed to use Class 1 laser devices. This product contains a laser within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser.

### 2.2.3 General Precautions

Everyone who uses a laser's equipment should be aware of the risks. The laser radiation is not visible to the human eye but it can seriously damage user's eyesight.
The laser is enabled when the interrogator is turned on.
Users should never put their eyes at the level of the horizontal plane of the optical adapters of the interrogator or uncovered optical connectors.
Adequate eye protection should always be required if there is a significant risk for eye injury.
Do not attempt to open or repair a malfunction interrogator. It must be returned to Smartec for repair and calibration.

# 3 Operation

## 3.1 Connectors

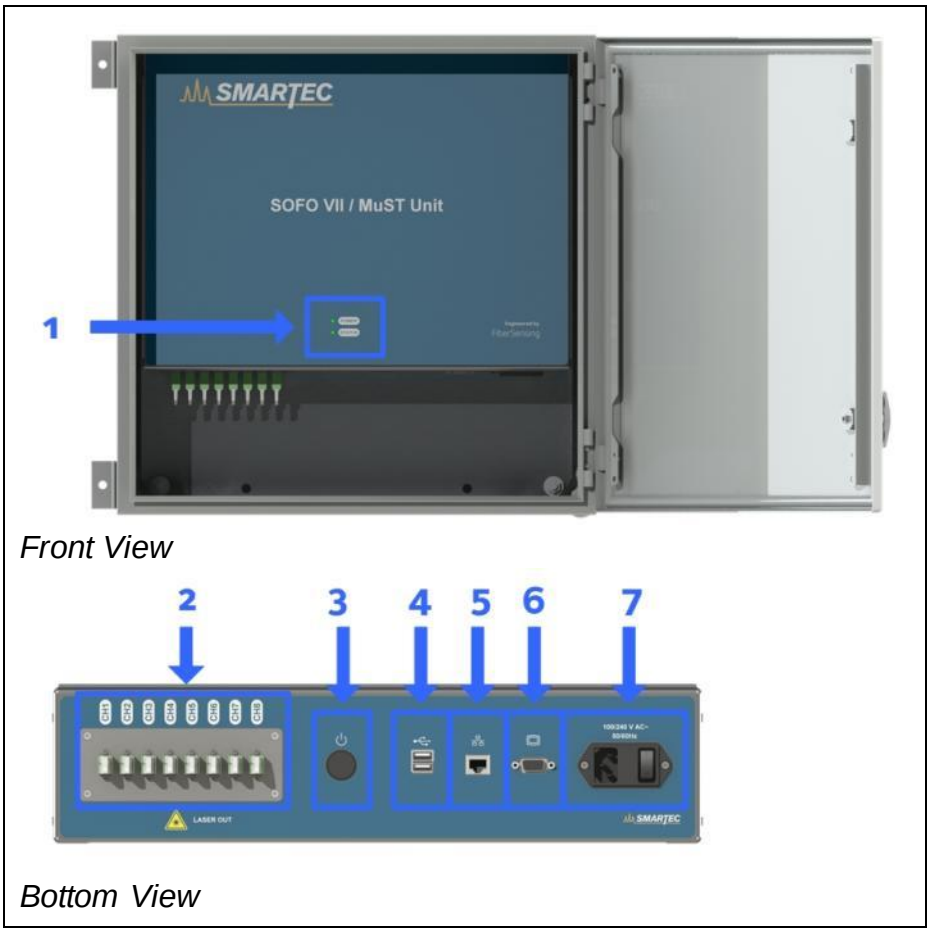



*Fig. 3.1*

The connectors and buttons on Fig. 3.1 are:

1. Power and Status LEDs
2. Optical Output Connectors
3. ON/Off Button
4. USB Connectors
5. LAN Connector
6. VGA Connector
7. Power Connector

### 3.1.1 Type of connectors

The SOFO VII Reading unit has 4 or 8 E2000/APC Optical Output Connectors to which can be plugged only E2000/APC connector. The E2000/APC connectors and Mating are identified by the green color, in the Fig. 3.2 are shown an E2000/APC connector and an E2000/APC Mating adapter:

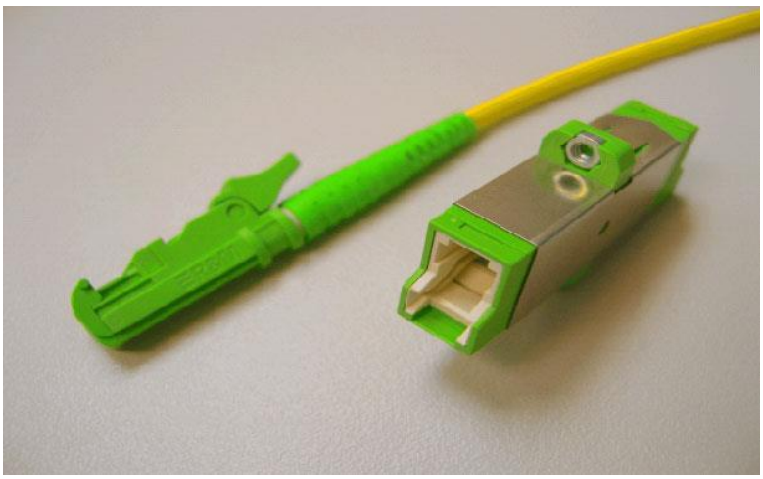


*Fig. 3.2*

The SOFO VII Reading unit can measure FBG sensors (identified by a green E2000/APC connector) and SOFO sensors (identified by a blue E2000/PC connector) plugged to the SOFO MUX 1x5, in the Fig. 3.3 are shown a E2000/APC connector (FBG) and E2000/PC Connector (SOFO):

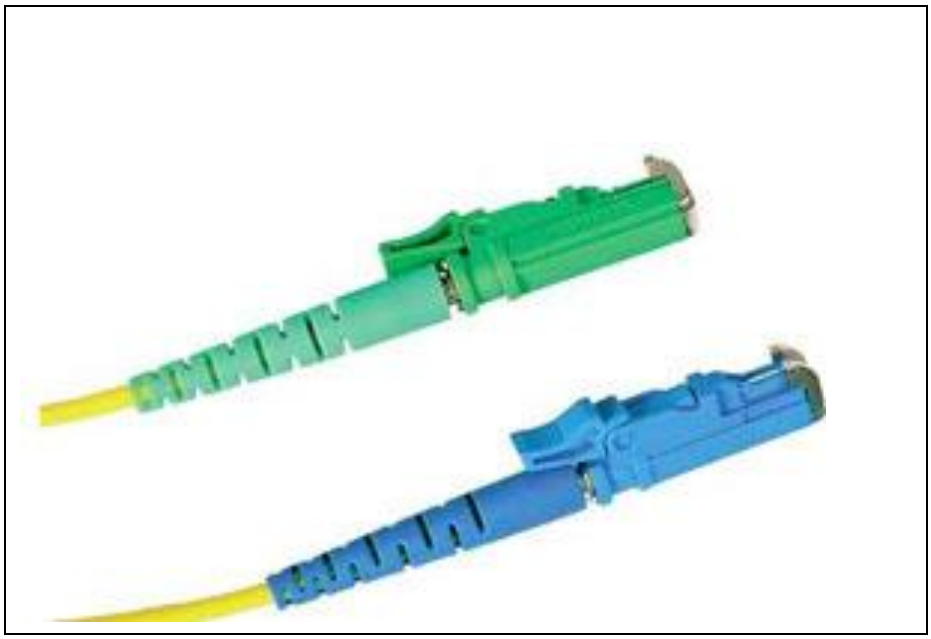


*Fig. 3.3*

## 3.2 Setting Up

### 3.2.1 Power supply

To power supply the SOFO VII / MuST connect the supplied power cable to 100 - 240 V power line to the measurement unit Power Connector (7 on Fig. 3.1). Then switch the power switch to its “I” position. The measurement unit powering off can be performed by disconnecting the power supply or by switching the power switch to its “O” position.
The measurement unit has internally: one acquisition module and a PC. Whenever the power supply is interrupted (either by a power shortage or a mechanical switch off of the power switch or the power plug) the internal PC will start up and the acquisition module will resume to its configuration at the time of power shortage when device is powered on again.

**Information**

*Check the status and power led (1 on Fig. 3.1) to ensure that the unit is ready to measure.*

*Fig. 3.4*

### 3.2.2 Optical connectors

The SOFO VII / MuST can be purchased either with 4 or 8 E2000/APC optical connectors. Number 2 on Fig. 3.1 exemplifies an 8 connector removable base.

Attention should be paid to the cleaning of the optical connectors. A dirty connector can compromise the measurement and will degrade the measurement unit performance. It is advisable to frequently clean the connectors using appropriate tools (see Cleaning Procedure on page 19).

### 3.2.3 Bottom plate

The bottom plate of the measurement unit is prepared for receiving gland nuts ensuring the closet's water tightness. Two PG21 and 24 PG11 can be used. It is supplied with covers on the holes and without glands.

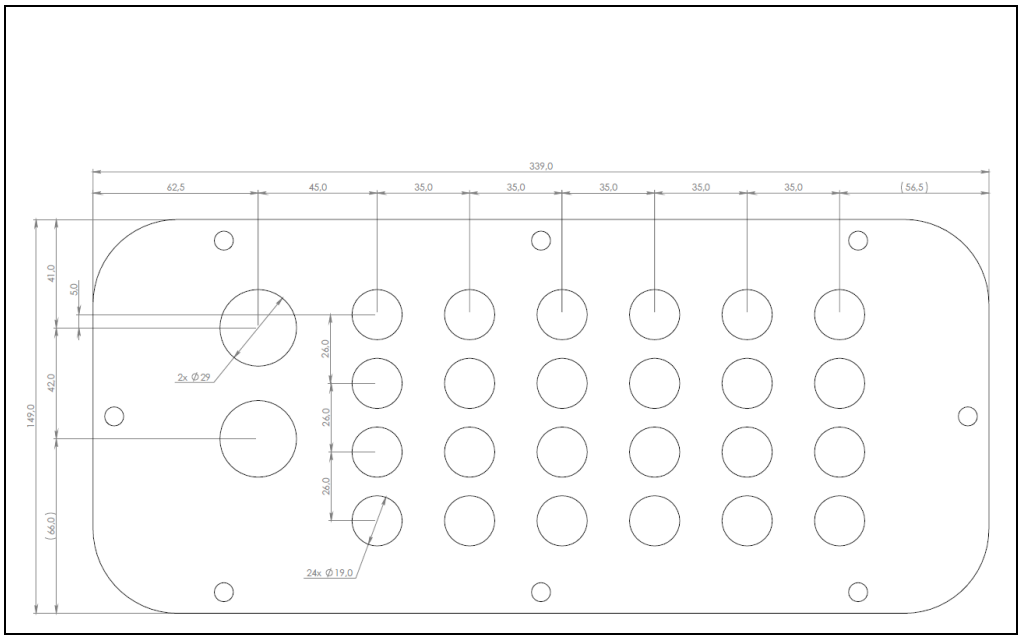



*Fig. 3.5*

## 3.3 Switching On

### 3.3.1 Internal PC

The internal PC will start every time the power is turned from off to on.

### 3.3.2 Acquisition Module

Pressing the “ON/OFF” button (3 on Fig. 3.1 will start the acquisition module of the unit.

## 3.4 Switching OFF

### 3.4.1 Internal PC

The internal PC can be shut down either by software – using the Start Menu in Windows – or when power is turned off.

### 3.4.2 Acquisition Module

To avoid accidental shutting-down of the acquisition module of the measurement unit, it is necessary to press the “ON/OFF” button (2 on Fig. 3.1) during 4 seconds to power-off the module.

**Information**

*The "ON/OFF" button (2 on Fig. 3.1) will not shut down the PC.*

## 3.5 Power and Status LEDs

Power and status LEDs are related to the acquisition module of the measurement unit.

### 3.5.1 Power LED

Whenever the acquisition module of the measurement unit is running, the power LED will be on. If the acquisition module of the measurement unit is off, the power LED will be off.

| LED | Acquisition module |
|---|---|
| Green steady | Running |
| OFF | Not running |

### 3.5.2 Status LED

The Status LED (1 on Fig. 3.1) will start blinking at 2Hz. After approximately 30 seconds it will start blinking at 1Hz. This means that the acquisition module of the measurement unit is already on and responsive, but the optoelectronic module is still warming up. After approximately one and a half minutes (90 s) it should stay on permanently. This means that the measurement unit is able to measure.

**Important**

*If the acquisition module of the unit does not start correctly, the status led will blink faster. If this happens please contact Smartec technical support.*

| LED | Acquisition module |
|---|---|
| Green blinking 2Hz | Powering up |
| Green blinking 1Hz | Warming up |
| Green steady | Running |
| Green blinking 0.5Hz | Running in error mode |
| OFF | Not running |

## 3.6 Interface

To operate the measurement unit a Monitor and a mouse and keyboard should be connected to the VGA connector (6 on Fig. 3.1) and to the USB ports (4 on Fig. 3.1).

The measurement unit operates on a Windows 7 Professional environment.

Please refer to the software manual for further details.

## 3.7 Control

The SOFO VII / MuST measurement unit can be fully controlled using two software:

- BRAGGMONITOR: to control the status of the reading unit, to see the optical traces of each physical channel, to take some measurements of the FBG sensors connected. Please refer to the BraggMONITOR software manual for further details.
- SDB: it is a software for long term static monitoring. I can measure both SOFO sensors and FBG sensors connected to the reading unit. Please refer to the SDB software manual for further details.

## 3.8 Sofo mux 1x5

The SOFO MUX 1X5 is a device that allows to measure up to 5 SOFO sensors on a single channel of the reading unit. It is an external 1x5 splitter, a picture of the device is the following:

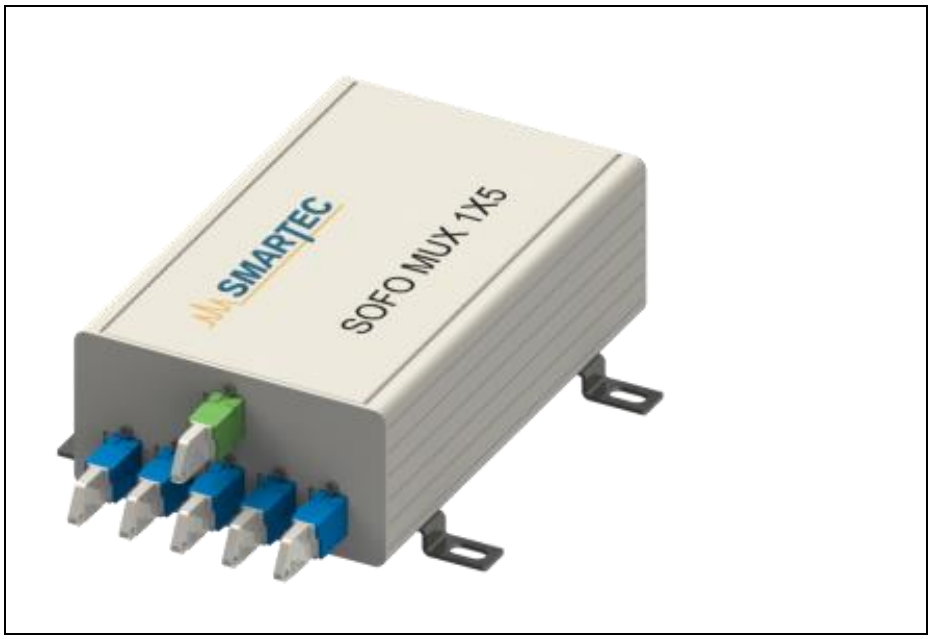



*Fig. 3.6*

The connection schema of the SOFO MUX 1X5 to the SOFO VII is the following:

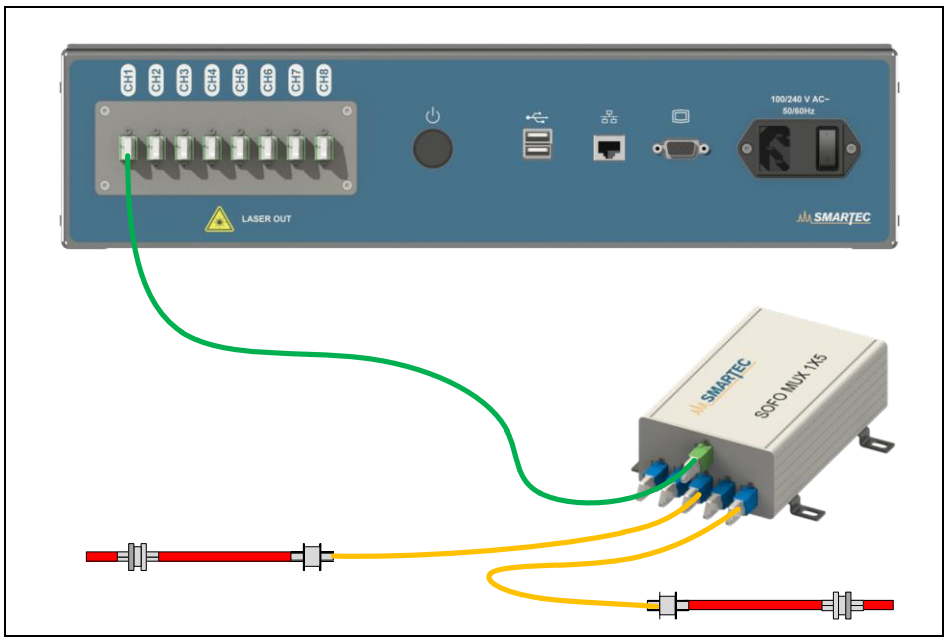



*Fig. 3.7*

**Important**

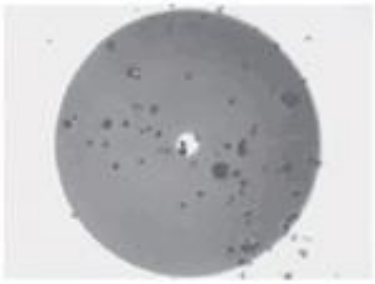
*The SOFO MUX 1X5 has six connectors: five E2000/PC for the SOFO sensors and one E2000/APC to which must be connected the patch cord attached to a channel of the SOFO VII. All the SOFO sensors connected to the MUX must mount an E2000/PC connector and the patch cord used to connect the MUX to the SOFO VII must have on both sides E2000/APC connectors. If this is not respected there is the possibility to irretrievably damage the core of the fiber and as consequence it will be impossible to measure the SOFO sensors.*

The characteristics of SOFO MUX are shown section SOFO MUX 1x5 Technical Data on page 7.

## 3.9 Cleaning Procedure

Proper performance of a fiber optic connection is strongly dependent on the cleanliness of the mated ferrules. After repeated matings, however, or when degraded performance is observed, it may become necessary to clean the individual ferrules and mating sleeve. In this section are outlined the proper cleaning and inspection procedures to help ensure optimal connector performance.
When a Measurement Unit is repeatedly being plugged in and out with optical connectors, it is very important that the connectors are cleaned prior to any connection. If not, dust and moister can be deposited in the measurement unit adaptor and this will compromise measurements. On Fig. 3.8 a picture of a magnified connector is presented. The dark gray circle corresponds to the fiber cladding and the small light gray circle is the core of the fiber. One picture for a clean connector and one picture for a dusty connector are presented.

*Clean connector*



*Dirty connector*

*Fig. 3.8*

The most common effect of dirt on the connections is that there is a large amount of broad band light that is being reflected at the connection, at both directions, meaning that the dynamic range for measuring becomes smaller.

On the market there are several tool aimed to clean the connectors, some of them are:

- Dust and shutter caps
- Isopropyl alcohol
- Cotton swabs
- Soft tissues
- Pipe cleaner
- Compressed air

**Information**

*Before reporting the general procedure for cleaning connectors it is important to highlight some reminders that shall always be kept into account:*

- *Always turn off any laser sources before you inspect fiber connectors*
- *Always inspect the connectors or adapters before you clean.*
- *Always inspect and clean the connectors before you make a connection.*
- *Always use the connector housing to plug or unplug a fiber.*
- *Always keep a protective cap on unplugged fiber connectors.*
- *Always store unused protective caps in a sealable container in order to prevent the possibility of the transfer of dust to the fiber. Locate the containers near the connectors for easy access.*

**WARNING**

**Some warnings as well:**

- **Never use alcohol or wet cleaning without a way to ensure that it does not leave residue on the end face. It can cause damage to the equipment.**
- **Never look into a fiber while the system lasers are on.**
- **Never use unfiltered handheld magnifiers or focusing optics to inspect fiber connectors.**
- **Never connect a fiber to a fiberscope while the system lasers are on.**
- **Never touch the end face of the fiber connectors.**
- **Never twist or pull forcefully on the fiber cable.**
- **Never touch the clean area of a tissue, swab, or cleaning fabric.**
- **Never touch any portion of a tissue or swab where alcohol was applied.**
- **Never touch the dispensing tip of an alcohol bottle.**
- **Never use alcohol around an open flame or spark; alcohol is very flammable.**

The here below section describes the connector cleaning process.

- Inspect the fiber connector, component, or bulkhead with a fiberscope with a proper E2000 adapter.
- If the connector is dirty, clean it with a dry cleaning technique.
- Inspect the connector.
- If the connector is still dirty, repeat the dry cleaning technique.
- Inspect the connector.

- If the connector is still dirty, clean it with a wet cleaning technique followed immediately with a dry clean in order to ensure no residue is left on the end-face.

**Important**

*Wet cleaning is not recommended for bulkheads and receptacles. Damage to equipment can occur.*

- Inspect the connector again.
- If the contaminate still cannot be removed, repeat the cleaning procedure until the endface is clean.

Here below dry and wet cleaning technique are described:

### 3.9.1 Dry cleaning technique

**Necessary tool**

Lint-free wipes, preferably clean room quality.

*Fig. 3.9*

**Starting Pre-Caution**

Read the reminders and warnings before you begin this process.

- ► Make sure that the lasers are turned off before you begin the inspection.
- ► Remove the protective cap using the E2000 service adapter.
- ► Fold the wipe into a square about 4 to 8 layers thick, see Figure 8.
- ► Inspect the connector with a fiberscope.

If the connector is dirty, clean it with a lint-free wipe.

**WARNING**

**Be careful not to contaminate the cleaning area of the wipe with your hands or on a surface during folding.**

- ► Lightly wipe the ferrule tip in the central portion of the wipe with a figure 8 motion.

**WARNING**

**Do not scrub the fiber against the wipe. If you do it, it can cause scratches and more contamination.**

- ► Repeat the figure 8 wiping action on another clean section of the wipe.
- ► Properly dispose of the wipe.
- ► Inspect the connector again with the fiberscope.
- ► Repeat this process as necessary.

### 3.9.2 Wet cleaning technique

**Necessary tool**

Lint-free wipes, preferably clean room quality, and 99% isopropyl alcohol.

- ► Make sure that the lasers are turned off before you begin the inspection.
- ► Remove the protective cap using the E2000 service adapter.
- ► Inspect the connector with a fiberscope.
- ► Fold the wipe into a square, about 4 to 8 layers thick.

- ► Moisten one section of the wipe with one drop of 99% alcohol. Be sure that a portion of the wipe remains dry.
- ► Lightly wipe the ferrule tip in the alcohol moistened portion of the wipe with a figure 8 motion. Immediately repeat the figure 8 wiping action on the dry section of wipe to remove any residual alcohol.

**WARNING**

**Do not scrub the fiber against the wipe, doing so can cause scratches.**

- ► Properly dispose of the wipe.

**Important**

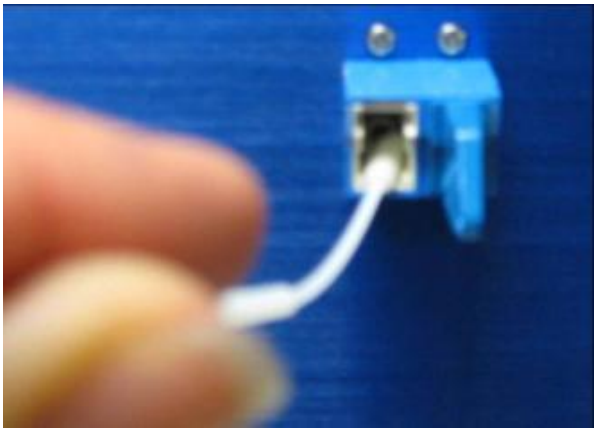
*Never reuse a wipe.*

- ► Inspect the connector again with a fiberscope.
- ► Repeat the process as necessary.

To clean an optical measurement unit adapter, use an appropriate cotton swab (there are several fiber clean swabs in the market frequently used for telecom) embedded in isopropyl alcohol.

- ► Ensure the reading unit is disconnected and switched off
- ► put some isopropyl alcohol on cleaning stick
- ► Push the metallic protection inside the connector with the help of the cleaning stick. You with then see a white plastic ring
- ► insert the stick inside the ring and gently clean the inner part of the connector rotating the swab always on the same direction.

*How to clean an FC connector of a reading unit*



*How to clean an E2000 connector of a reading unit*

*Fig. 3.10*

## 3.10 Fuse Replacement

Electrical shorts may cause fuse failure and when that happens it is necessary to replace the fuse located on the Power Connector (Fig. 3.11). To replace the fuses release the top and bottom springs of the fuse's support and then remove the piece (Fig. 3.11).

*Realeasing the top and bottom springs*

*Fuses on the piece*

*Fig. 3.11*

Fuse characteristics:

- Rated voltage: 250 Volt AC
- Interrupting rate: 2 Ampere
- Number of fuses: 2

# 4 BraggMONITOR Software

The BraggMONITOR graphical interface is divided into two different areas (Fig. 4.1):

1. General Bar
2. Graphical Area

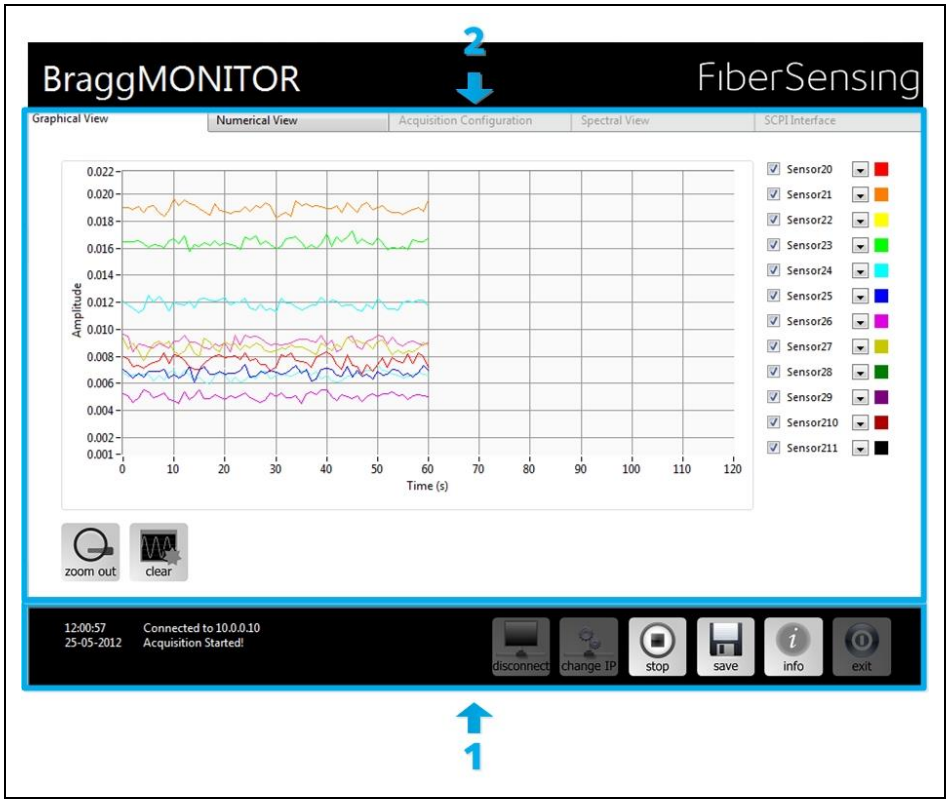



*Fig. 4.1*

## 4.1 General Bar

The General Bar, that is always active, is where the main acquisition actions can be performed.
On the left, the current date and time are shown (number 1 on Fig. 4.3).
To establish connection between the measurement unit and the software press the connect button (number 2 on Fig. 4.3). The measurement unit IP Address to which the software connects is set as 10.0.0.10 by default. This address can be changed on the “config.ini”

file found on the software folder (C:\Program Files\FiberSensing\BraggMONITOR\Config.ini).
To perform this change, open the file with notepad and change the written IP to the IP Address you wish the software to connect to (Fig. 4.2).

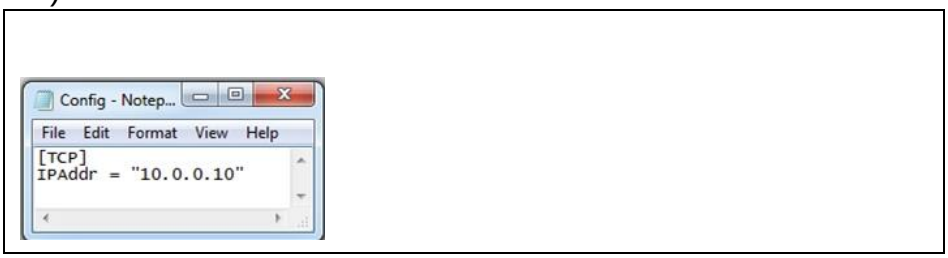



*Fig. 4.2*

If BraggMONITOR software finds the device on the default IP, the connect button (number 2 on Fig. 4.3) changes to disconnect.

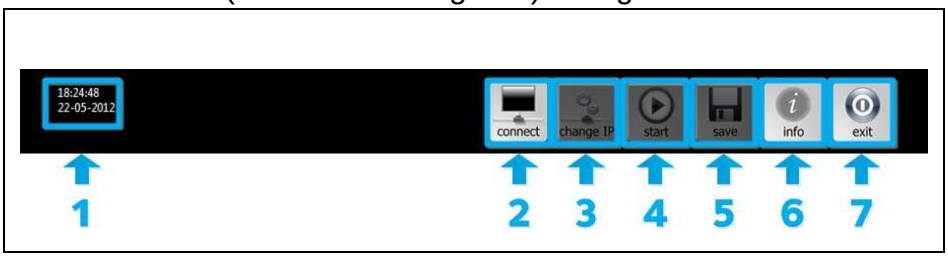



*Fig. 4.3*

*Fig. 4.4*

General information on the software version can be called by pressing the info button (number 6 on Fig. 4.3).

### 4.1.1 Acquisition

**Start Acquisition**

Press the start button to start acquisition. This will start the acquisition and representation of the measured values for all optical channels.

**Important**

*Before start acquisition make sure that the network configuration on «Acquisition Configuration» tab is up to date. For more details refer to page 40.*

Measured values are represented in WaveLength (nm) or engineering values, according to the defined formula on the acquisition configuration tab (see section “Add and Edit ” on page 40). It is possible to obtain absolute values of temperature, strain, acceleration, etc. However, a sensor configuration must be defined (see “Acquisition Configuration” section on page 40).

### Saving Data

To save data, press the save button (number 5 on Fig. 4.4). To stop recording and save the data, uncheck the stop button. A pop up window will appear for file path definition. Select the folder path where data is stored and define the file name (see Fig. 4.5). Data sets will be recorded in .txt format.

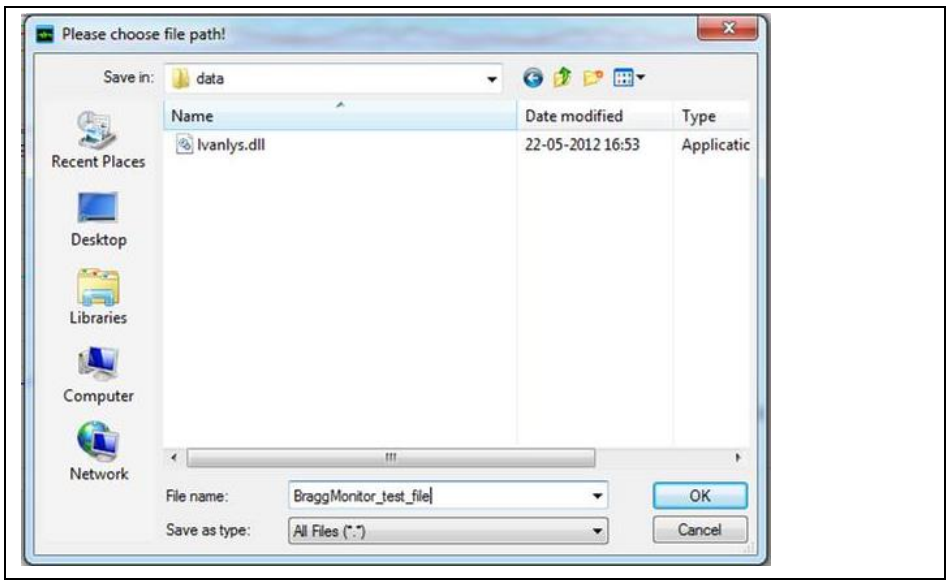



*Fig. 4.5*

Saved data file collects the data between the instant the save button is pressed and the instant it is pressed back.

It is organized in columns (see Fig. 4.6). The first row is a header indicating the columns meaning:

3. 1st column – measurement unit data stamp with format «DD-MM-YYYY»
4. 2nd column – measurement unit time stamp with format «HH:MM:SS »
5. Following columns – Wavelengths (in nm) or engineering values (units in accordance with Formula from acquisition configuration tab) ordered by optical channel.

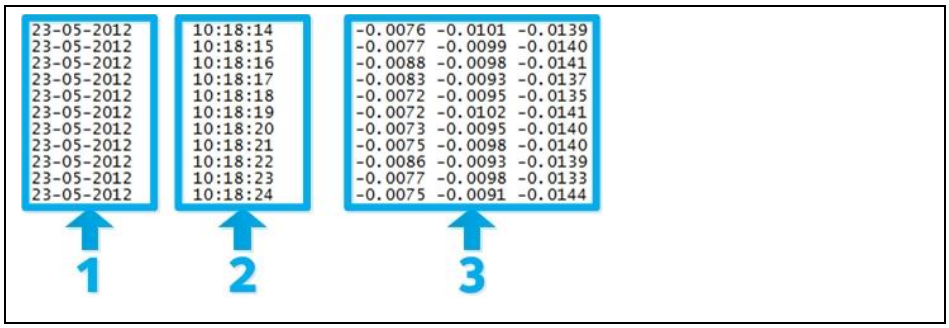



*Fig. 4.6*

### Opening Data in Microsoft Excel

To import the data file to a Microsoft Office Excel Workbook proceed as follows:

Once Microsoft Excel is opened, press button “From Text” from menu Data>Get External Data (see Fig. 4.7) and select the file data file.

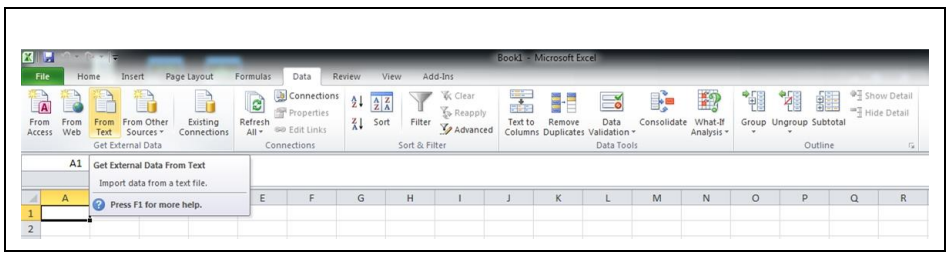



*Fig. 4.7*

Then it is necessary to complete text import wizard. All options must be set as shown on Fig. 4.8 to Fig. 4.12.

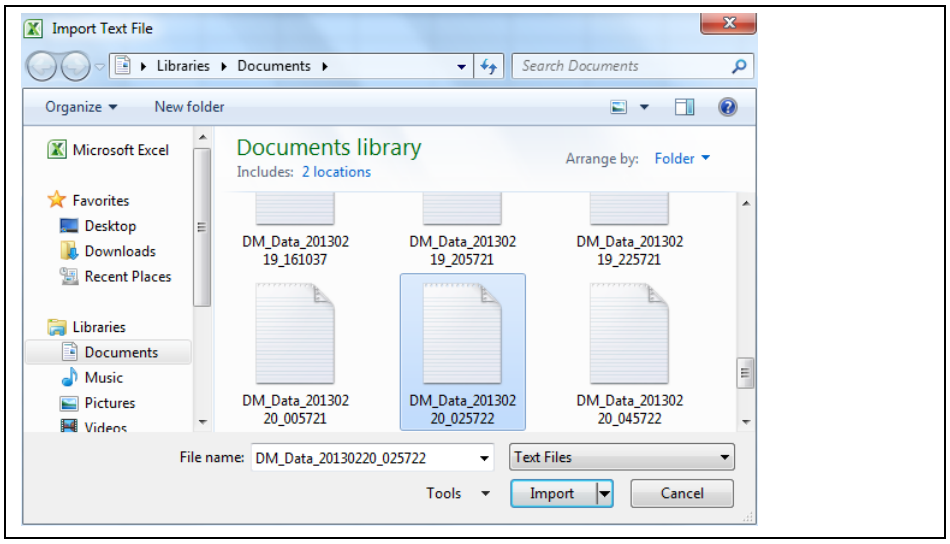

Import Text File
Libraries ▸ Documents ▸
Search Documents
Organize
New folder
Microsoft Excel
Favorites
Desktop
Downloads
Recent Places
Libraries
Documents
Music
Pictures
Videos
Documents library
Includes: 2 locations
Arrange by: Folder
DM_Data_20130219_161037
DM_Data_20130219_205721
DM_Data_20130219_225721
DM_Data_20130220_005721
DM_Data_20130220_025722
DM_Data_20130220_045722
File name: DM_Data_20130220_025722
Text Files
Tools
Import
Cancel

*Fig. 4.8*

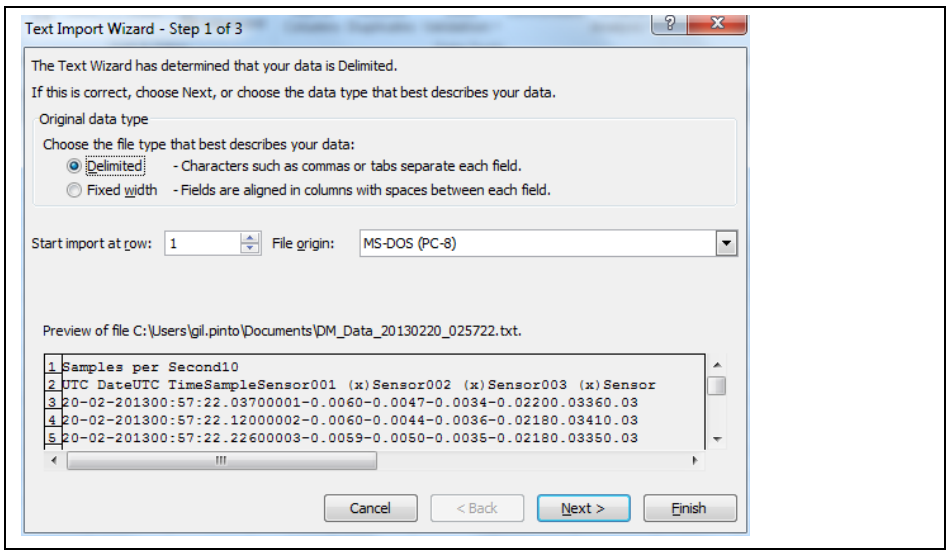

Text Import Wizard - Step 1 of 3
The Text Wizard has determined that your data is Delimited.
If this is correct, choose Next, or choose the data type that best describes your data.
Original data type
Choose the file type that best describes your data:
Delimited - Characters such as commas or tabs separate each field.
Fixed width - Fields are aligned in columns with spaces between each field.
Start import at row: 1
File origin: MS-DOS (PC-8)
Preview of file C:\Users\gil.pinto\Documents\DM_Data_20130220_025722.txt.
1 Samples per Second10
2 UTC DateUTC TimeSampleSensor001 (x)Sensor002 (x)Sensor003 (x)Sensor
3 20-02-201300:57:22.03700001-0.0060-0.0047-0.0034-0.02200.03360.03
4 20-02-201300:57:22.12000002-0.0060-0.0044-0.0036-0.02180.03410.03
5 20-02-201300:57:22.22600003-0.0059-0.0050-0.0035-0.02180.03350.03
Cancel
< Back
Next >
Finish

*Fig. 4.9*

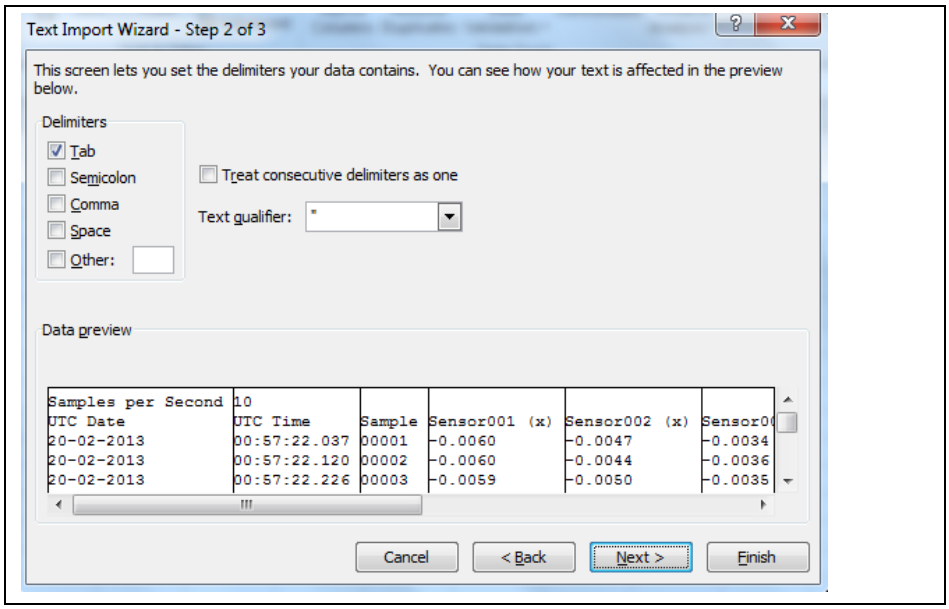



*Fig. 4.10*

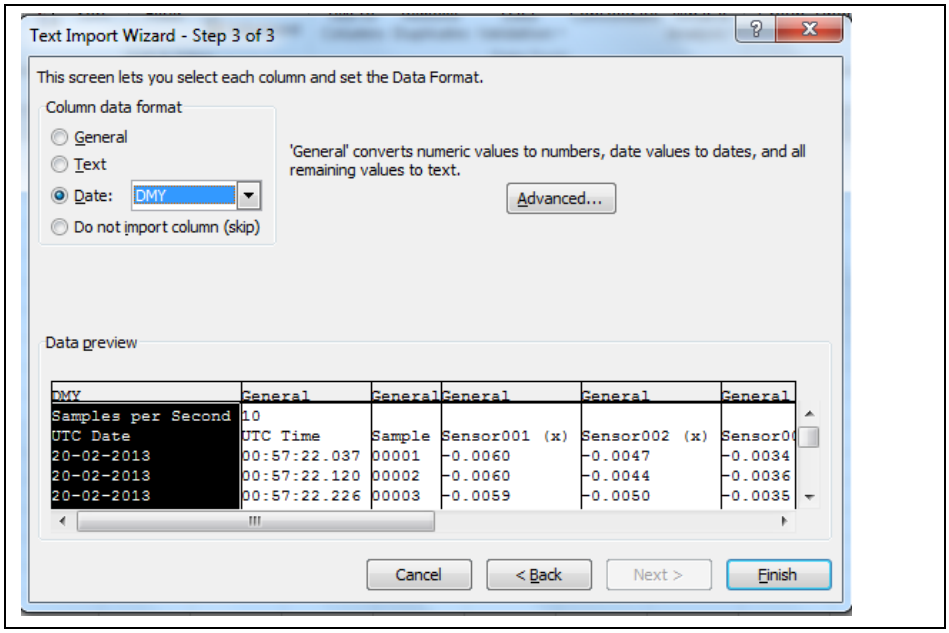



*Fig. 4.11*

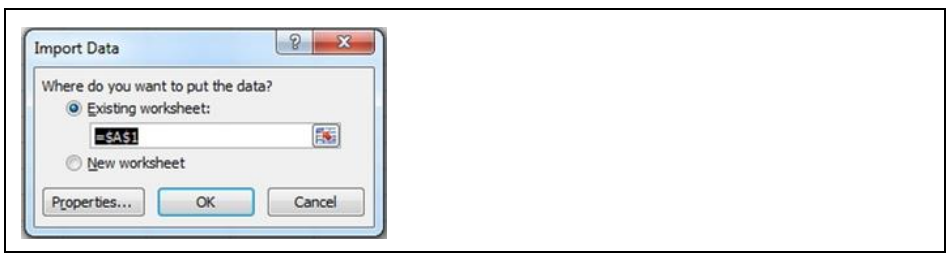



*Fig. 4.12*

### Change IP Address

To change the IP Address of the measurement unit, you must be connected and access the Acquisition Configuration tab. To check if the status is connected the buttons should be as depicted in Fig. 4.4. Press the change IP Address button (number 3 on Fig. 4.3) to pop-up the change IP Address interface (see Fig. 4.13).

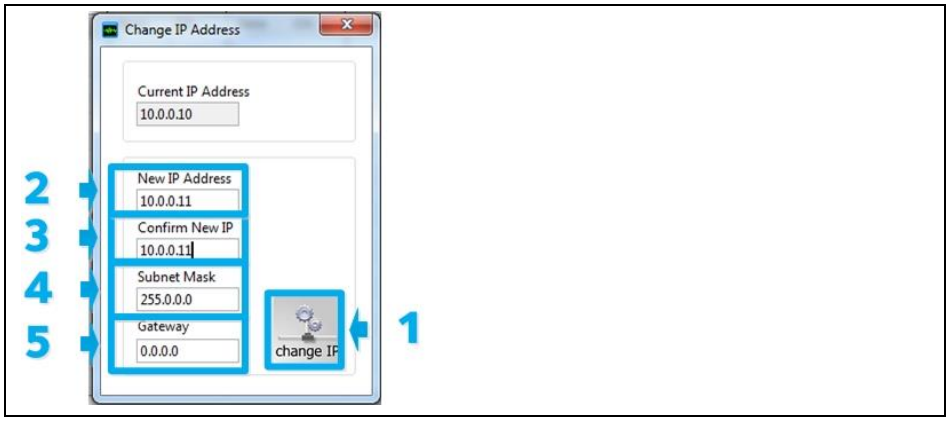



*Fig. 4.13*

Define the new IP Address (number 2 on Fig. 4.13) and confirm it (number 3 on Fig. 4.13). The Subnet Mask (number 4 on Fig. 4.13) will be automatically defined according to the IP Address. The Gateway is 0.0.0.0 by default and is user changeable. Then press the Change IP button (number 1 on Fig. 4.13). After a few seconds a validation message will appear (see Fig. 4.14).
When the IP is changed, a connection message appears as shown in Fig. 4.14.
At this point, the connection between the computer and the equipment will be lost and the unit will reboot with the new IP Address. This operation might take a few minutes.
The next time the Connect button (number 2 Fig. 4.3) is pressed, BraggMONITOR will connect to the new IP.

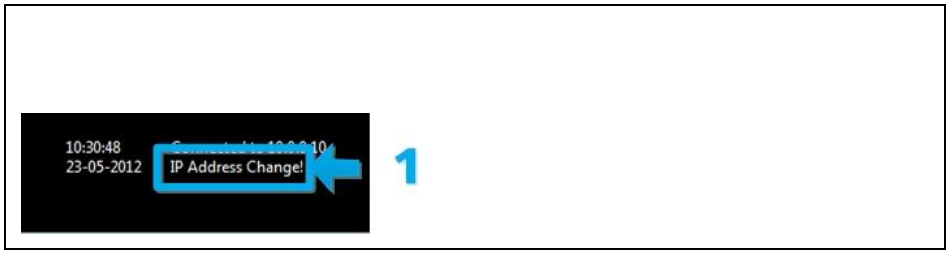



*Fig. 4.14*

### Stop Acquisition

To stop acquisition press the start button again. It will turn from active to the state showed in Fig. 4.4.

### Exit Application

To exit BraggMONITOR application, press the exit button (number 7 on Fig. 4.3).

## 4.2 Graphical Area

The graphical area is divided into six tabs:

- Graphical View
- Numerical View
- Acquisition Configuration
- Spectral View
- SCPI Interface

### 4.2.1 Graphical View

On the Graphical View, graphical representation of the measured values can be found over time (number 1 on Fig. 4.15).
It is possible to enable and disable the graphical representation of one or more sensors by checking and unchecking the check boxes (number 2 on Fig. 4.15). The displayed sensors can be changed by clicking on the scroll down menus along the right-hand side of the interface (number 2 on Fig. 4.15).

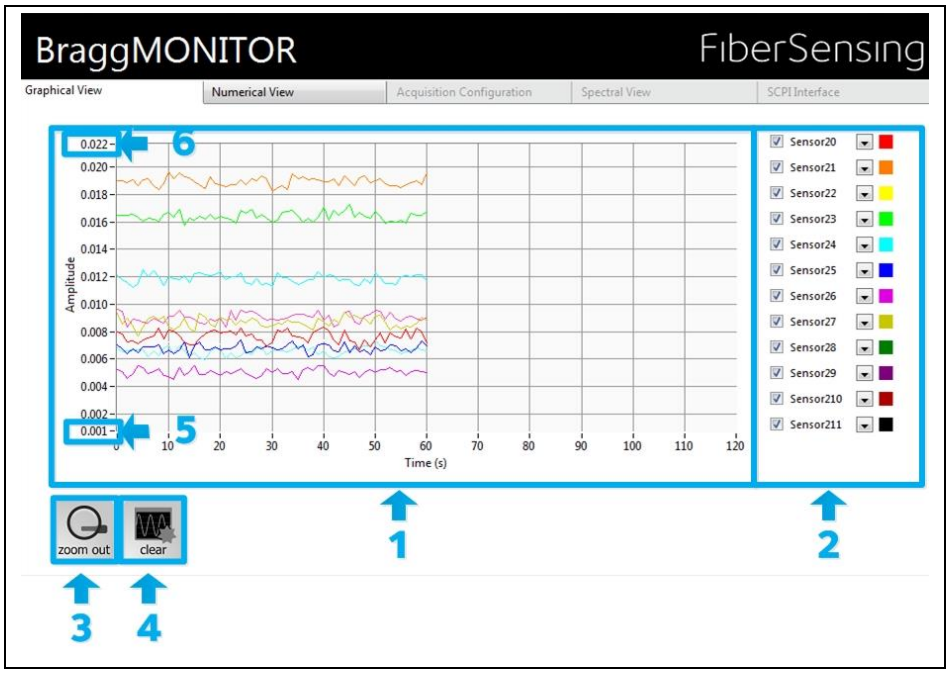



*Fig. 4.15*

### Zoom In and Out

The graphical display automatically adjusts its vertical scale to fit all the measured values. Nevertheless, it is possible to manage the graphical representation using zoom in and zoom out functions.
The zoom in functionality is always on. To zoom in along the vertical axis drive the mouse arrow to the graphical area and press the left mouse button while moving the mouse up or down. This way a zoom in section will be defined. Once the desired Zoom In section is defined, release the left mouse button. The display will show the zoomed in section only.
In order to zoom back to full scale, press the Zoom Out button (number 3 on Fig. 4.15).
It is also possible to modify vertical axis scale by clicking and inserting the axis numbers, identified with numbers 5 and 6 on Fig. 4.15.

### Clear Graph

All displayed data can be deleted by pressing clear button (number 4 on Fig. 4.15).

### 4.2.2 Numeric View

The Numeric View shows the acquired measurements for each sensor, organized by optical channel as shown in Fig. 4.16. For each channel there are two columns, one with the name of sensors and another with Wavelengths (in nm) or engineering values (units defined by the sensor Formula from acquisition configuration tab).

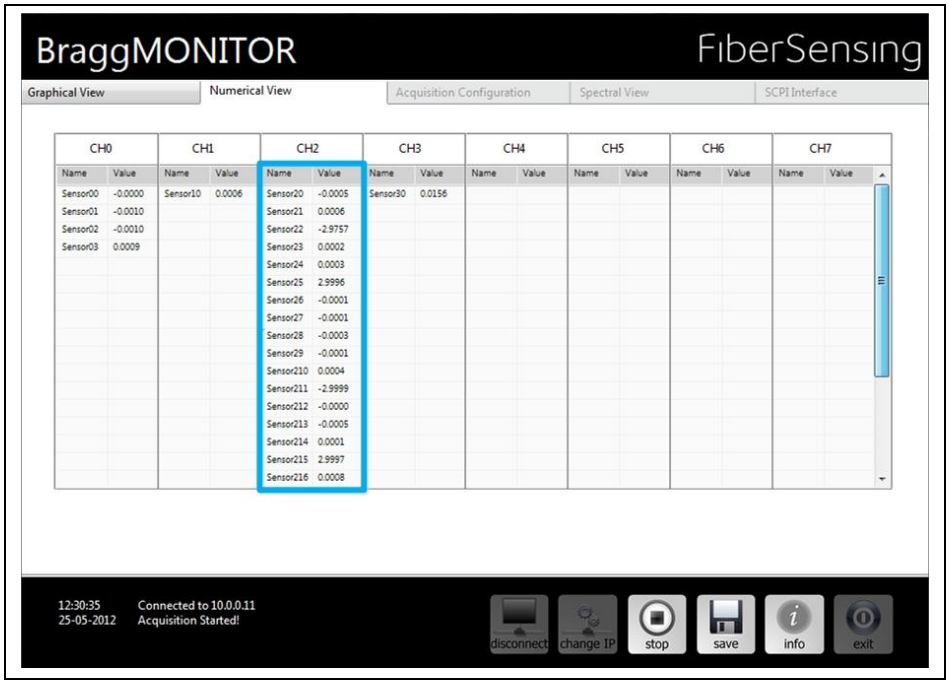



*Fig. 4.16*

### 4.2.3 Spectral View

The spectral view tab is only accessible when data acquisition is stopped.
This tab represents the spectral response of the sensors connected to the measurement unit. The full spectrum contains 20000 data points corresponding to the reflected optical power in dBm from 1500nm to 1600nm with a 5pm sampling resolution (number 1 on Fig. 4.17).

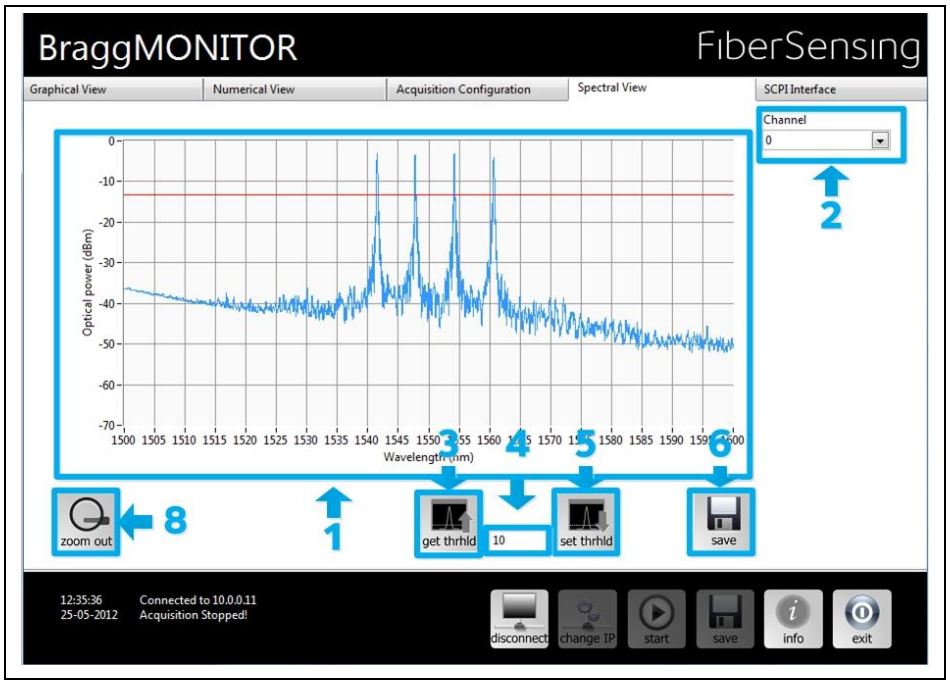



*Fig. 4.17*

The spectral view can only represent one channel at a time. Channel selection can be performed on number 2 on Fig. 4.17.

### Measurement Configuration

Measurement settings can influence sensor readings. Threshold values should be defined according to the FBG sensing network status, so that no FBG side lobes are detected as peaks. Threshold values are configured independently for each optical channel.

### Threshold

Threshold defines the line between usable signals and noise. It is an integer value between 0dB and 60dB that sets the detection line below the maximum power of the most reflective FBG sensor. Operations for getting and defining threshold values can be performed by using the threshold buttons (number 3 and 5 on Fig. 4.17). The current threshold value can be found using the Get Threshold button (number 3 on Fig. 4.17). The threshold value is updated every time the spectral monitor tab is selected or a new channel is defined. To define a new threshold value, write it on the threshold box (number 4 on Fig. 4.17) and press the set threshold button (number 5 on Fig. 4.17). Threshold is stored to the measurement unit so that when software or measurement unit restarts, last saved configuration values are valid.

If the maximum power is -5.6dBm and the threshold is set to 10dB, then the detection threshold is -15.6dBm, meaning that all FBG sensors above this level will be detected (see Fig. 4.17). The threshold value is updated every time the spectral monitor tab is selected or a new channel is defined.
This value is also represented graphically as a horizontal line on the graph.

### Zooming

The OSA graph can be zoomed in or out. The Zoom In tool is available every time the cursor is on the graph area. Zooming In is only possible over the horizontal axis. By pressing the left mouse while moving the mouse to the left or right, a Zoom In section will appear (Fig. 4.18). Once the desired zoom in section is defined, release the left mouse button and the display will show the Zoomed In section only.

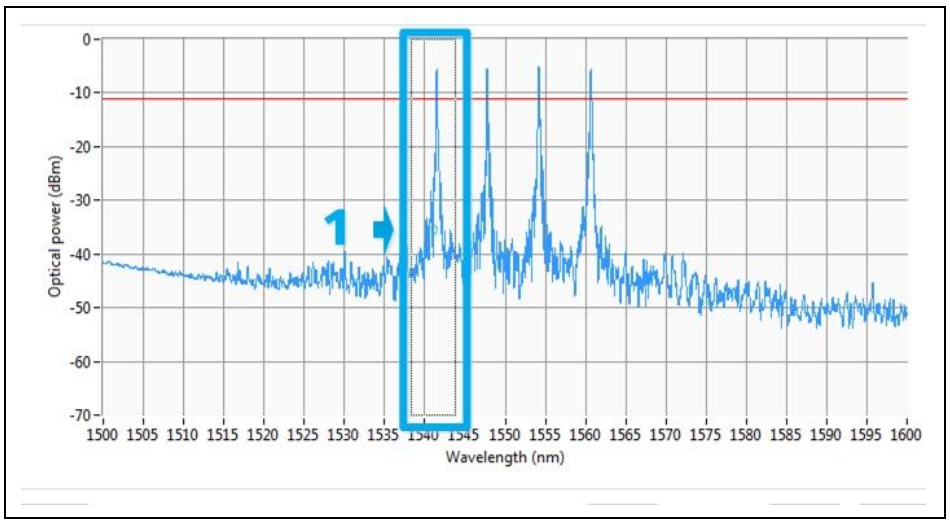



*Fig. 4.18*

In order to zoom back to full scale press the Zoom Out button (number 8 on Fig. 4.17).

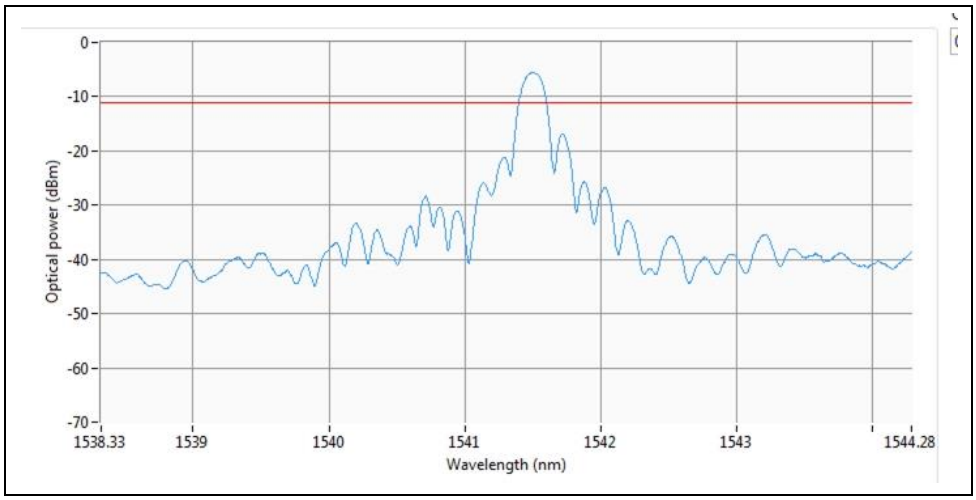



*Fig. 4.19*

### Saving Spectral Data

To save spectral data, press the save button (number 7 on Fig. 4.17), then select the file path to define the folder where data is stored and define the file name. Data sets will be recorded in .txt format for a single sweep. The save button will be pressed back automatically.

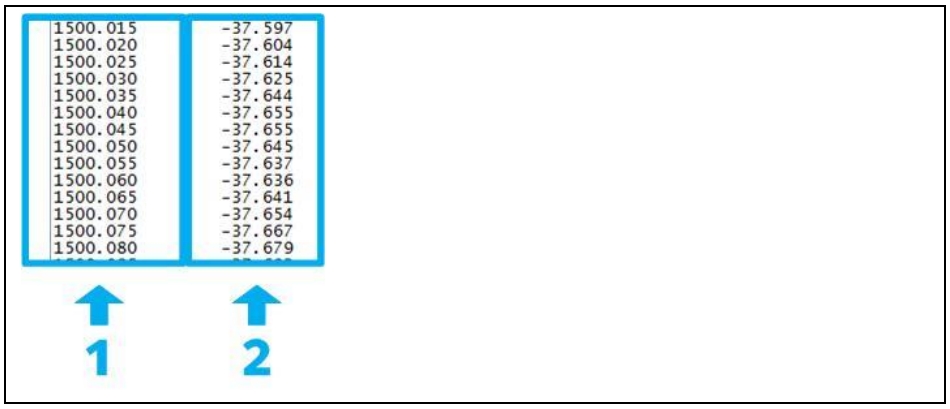



*Fig. 4.20*

Saved data file is organized in columns (see Fig. 4.20), meaning:

1. 1st column – wavelength values in nanometers.
2. 2sd column – optical power values in dBm.

### 4.2.4 Acquisition Configuration

Acquisition configuration allows one to perform sensors configuration for the acquisition of engineering values. To accomplish this step correctly, sensors' calibration sheets might be needed.

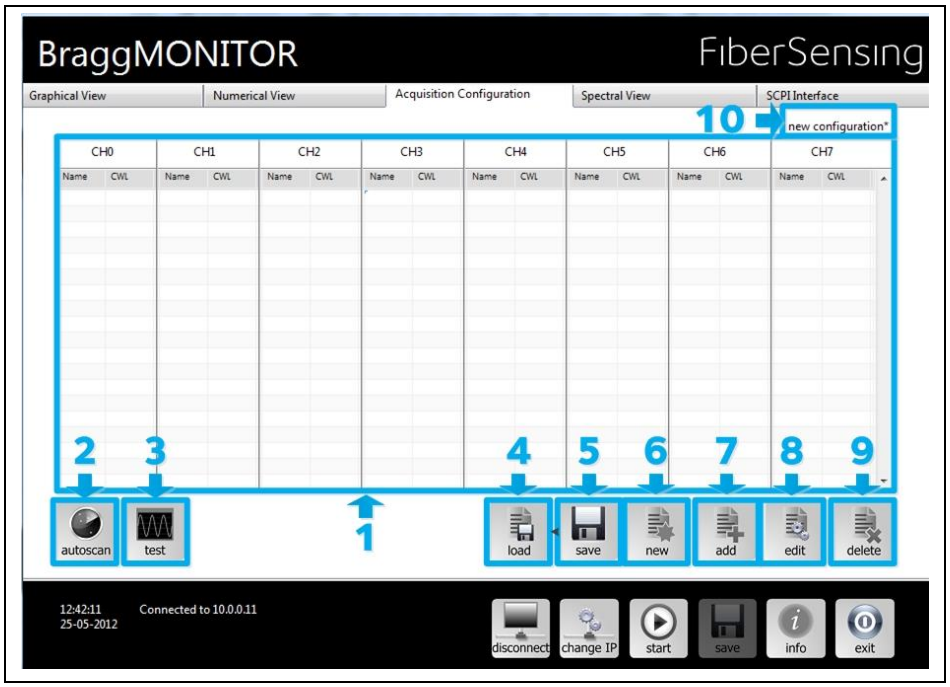



*Fig. 4.21*

#### Clear configuration

If an old configuration is set, it is possible to clear it and start a new configuration by pressing button New (number 8 on Fig. 4.21). Be aware this operation will discard all previous unsaved configurations of all channels.

#### Add and Edit Configuration

In order to Add new sensors to an existing configuration, first it is necessary to select the cell where the operation takes place (Fig. 4.22). To Edit a sensor, the cell with the corresponding sensor should be selected.
Once one of the cells is selected, press Add or Edit button to configure sensors individually. A dialog box will pop up (Fig. 4.22). Additional info about this dialogue box might be found at the table below.

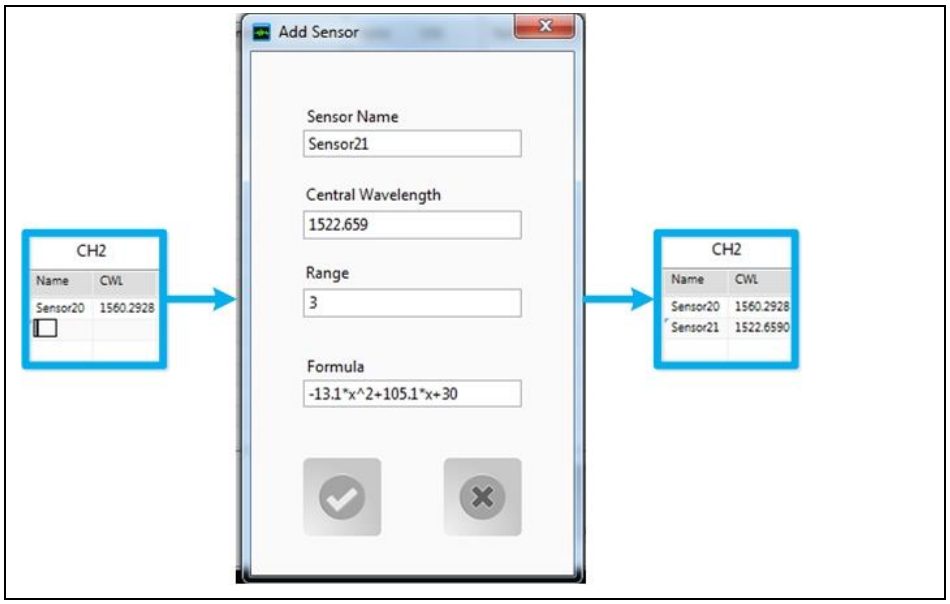



*Fig. 4.22*

| | |
|---|---|
| **Sensor Name** | Sensor's identification field. It is not possible to have two sensors with the same name. |
| **Central Wavelength (CWL)** | Reference wavelength from which WaveLengthShift is calculated. |
| **Range** | Safety bands defined to avoid crosstalk between sensors. Each sensor has its own operation range. For instance, if we have a CWL of 1522.659nm and a range spanning 3nm, only WaveLength values between 1525.659 and 1519.659 are accepted. WaveLength values out of the defined bands are returned as -998. Inside each band only the highest peak is considered. |
| **Formula** | Function defining the correlation between the WaveLengthShift (x) and the engineering values. Here it is possible to set a formula manually, although it is also possible to copy and paste from other locations. If the desired output is WaveLengthShift, insert x on formula textbox. |

| **Do** | **Do not** |
|---|---|
| -11.3 | -11,3 |
| -11.3*x | -11.3x |
| -11.3*x^2+105.4*x+30 | =-11.3*x^2+105.4*x+30 |

To Delete one sensor from the configuration, select the sensor cell, press the Delete button and confirm the operation as shown in Fig. 4.23

*Fig. 4.23*

**AutoScan**

**WARNING**

**AutoScan will erase unsaved acquisition configurations.**

When AutoScan is performed for the first time, the measurement unit executes a measuring sweep and the BraggMONITOR defines a new configuration with all the found sensors. This configuration sets the current measured WaveLength as Central WaveLength with a default Range of 3 nm.
Attention must be paid to assure that threshold is correctly defined so that no sensor is left out and that no noise is configured as a sensor.

**WARNING**

**Confirm that gain and threshold values are correctly defined so that no sensor is left out and that no noise is configured as a sensor (see section «Measurement Configuration» on page 37).**

Sensor Names are set by default as SensorXZZ, where X is the optical channel and ZZ is the number of the sensor on that optical channel ordered by wavelength.
*Example:*
Sensor315 corresponds to the 15$^{th}$ sensor of optical channel 3.

**Test configuration**

Test Configuration (number 3 on Fig. 4.21) allows the user to check the current values from each sensor according to its configuration (number 1 on Fig. 4.24)..

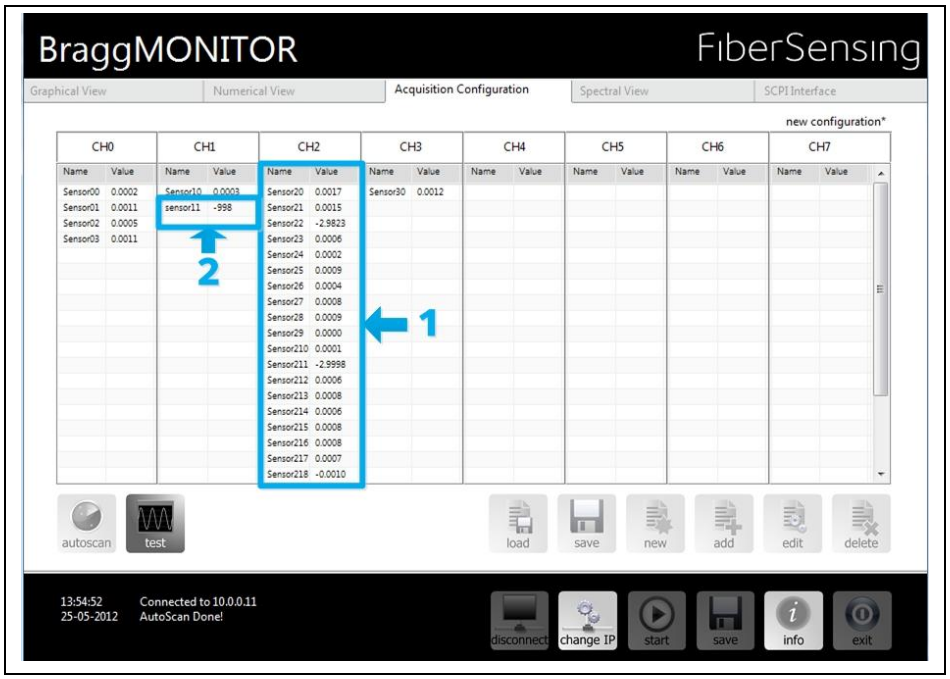



*Fig. 4.24*

**Information**

*Error code will be displayed as -998 when no sensor is found within the defined range (number 2 on Fig. 4.24).*

### Save and Load configuration

Acquisition configuration can be saved in .txt extension file by pressing the Save button (number 5 on Fig. 4.21) and choosing a save path as shown on Fig. 4.25.

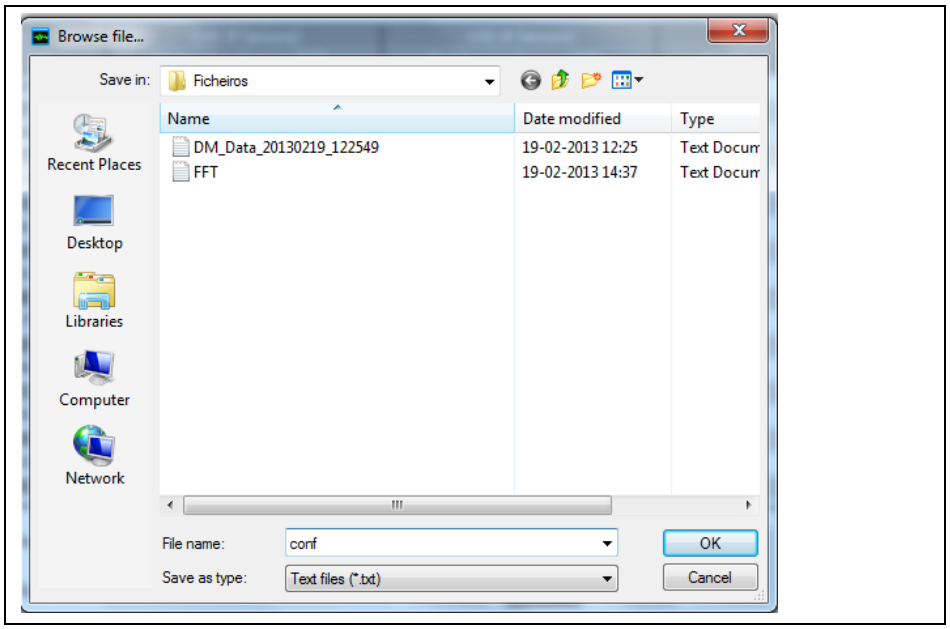



*Fig. 4.25*

For each channel there are 4 columns: Name, Central WaveLength(nm), Range(nm) and Formula (number 1,2,3 and 4 on Fig. 4.26). This file might be edited in Notepad or Excel (see "Opening Data in Microsoft Excel" section on page 30) and saved as .txt extension file after editing.

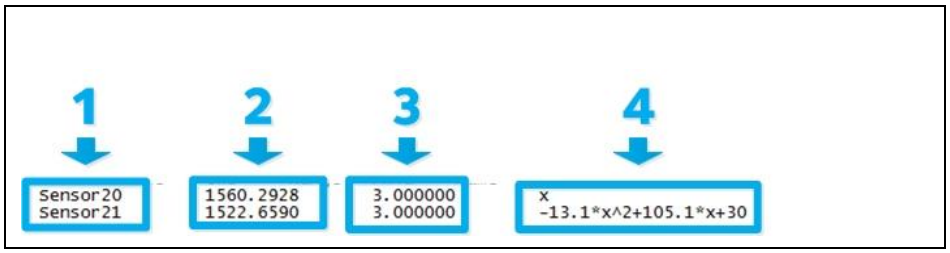



*Fig. 4.26*

Configuration file can always be loaded by the user by pressing the Load button (number 4 on Fig. 4.21) and pick the configuration saved file (see Fig. 4.27).

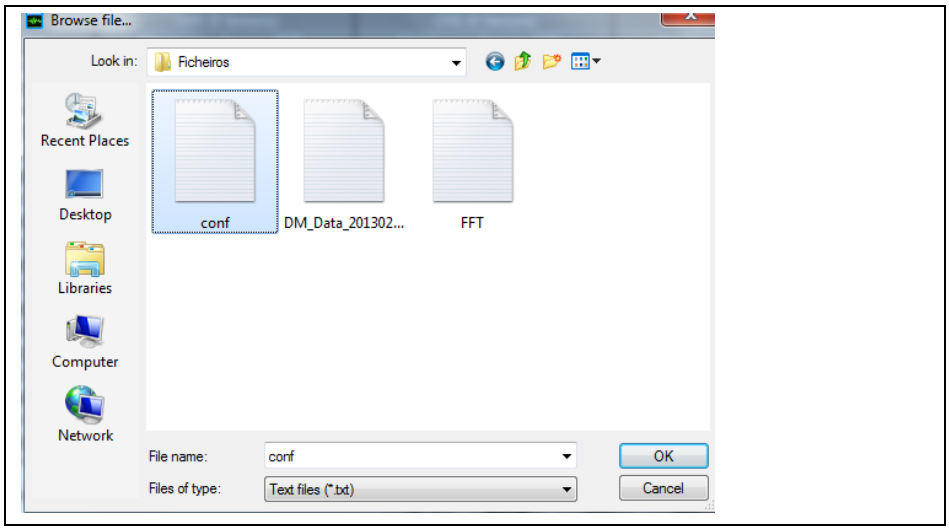



*Fig. 4.27*

Configuration file name is always visible at the right top corner (see number 10 on Fig. 4.21). While working on unsaved files, an asterisk (*) is added to the file name.

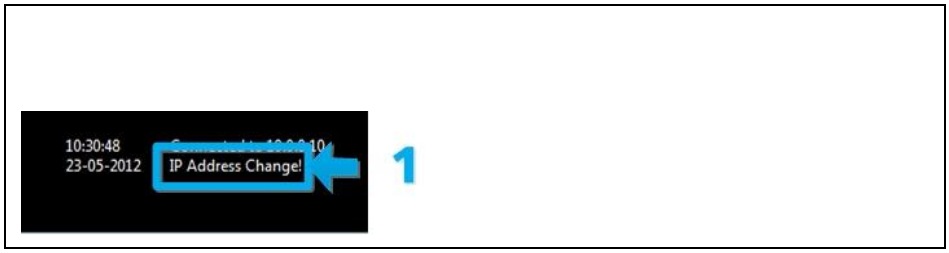



*Fig. 4.28*

### 4.2.5 SCPI Interface

This tab allows the user to send Standard Commands for Programmable Instruments (SCPI) to the equipment. Please refer to FS2x00 unit "User's Manual" for a list of the commands available to communicate with the measurement unit.
Commands are inserted on the command line (number 2 on Fig. 4.29) and sent by pressing Enter or Send cmd button (number 3 on Fig. 4.29). The unit's answers appear on the command board (number 1 on Fig. 4.29). Each time new answers are displayed, older ones are pushed down.

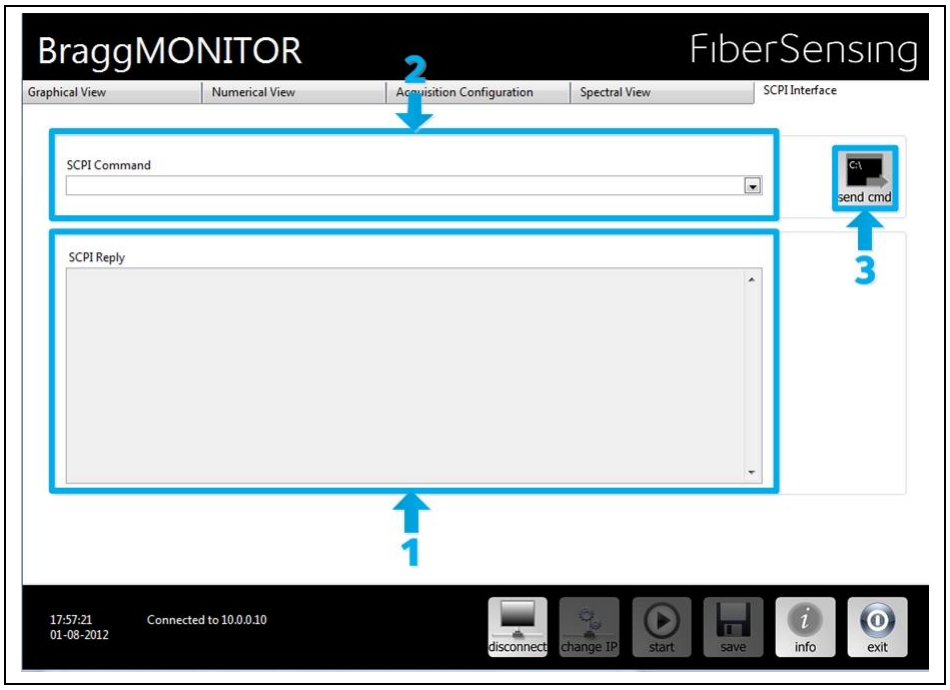



*Fig. 4.29*

Each time a new command is sent, a shortcut at the scroll down box is created, as shown at Fig. 4.30.

*Fig. 4.30*

**WARNING**

**When the user leaves SCPI Interface tab, unit status is changed and Schedule acquisitions are disabled.**

www.hbm.com/fs

SOFO VII / MuST Manual v2.0

Any questions or comments regarding this guide please report to:
**support@smartec.ch**

SMARTEC