

ENGLISH

User Manual



FS22SI

Industrial BraggMETER SI

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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 FS22 - Industrial BraggMETER SI with real time embedded Smart Peak Detection (SPD) is a continuous swept laser scanning interrogator specifically designed to interrogate Fiber Bragg Grating (FBG) based sensors in industrial environments.

BraggMETER interrogators include 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 combined with the Smart Peak Detection (SPD) allow high resolution to be attained even for long fiber leads and lossy connections.

Multiple sensors can be connected in series in each optical fiber, in combination with one, four or eight optical channels with parallel acquisition. The FS22 - Industrial BraggMETER SI is particularly suitable for large scale sensing networks acquiring a large number of sensors simultaneously and providing 1 S/s acquisition rates with sub picometer resolution.

The BraggMETER is available either in Standard and Rack-mountable formats. This Manual applies to the following equipment:

- K-FS22 (1S/s option)
- 1-FS22SI-ST/4CH
- 1-FS22SI-ST/8CH

1.2 System Components

The FS22 - Industrial BraggMETER SI set includes:

Standard format	Rack-mountable format
<ul style="list-style-type: none">- Interrogator- AC-DC power supply unit 24V- Power cords (EU, US, UK, Aust/NZ)- Ethernet cable (L ~2 m)- Mounting blocks with M6 screws- Connector protection caps- Mounting holes protection caps- Quick start guide- Digital support material- Calibration certificate	<ul style="list-style-type: none">- Interrogator- Power cords (EU, US, UK, Aust/NZ)- Ethernet cable (L ~2 m)- Connector protection caps- Quick start guide- Digital support material- Calibration certificate

1.3 Software

FS22SI Interrogators are delivered with BraggMONITOR SI software that enables easy device configuration, data viewing, saving and management, and can operate as a simple interface for command communication.

These interrogators can be integrated into any system through SCPI like commands (ASCII strings). LabView Drivers are also available for third party integration. Relevant software packages are available for download on our website (<https://www.hbkworld.com/en/services-support/support/support-hbm/downloads/downloads-software/software-firmware-downloads-for-optical-interrogators>).

The static industrial BraggMETER is compatible with the powerful professional catman Easy/AP software. Catman is available for purchase and download on our website (<https://www.hbkworld.com/en/services-support/support/support-hbm/downloads/downloads-software/support-downloads-catman>)

1.4 Synchronization

FS22 follows the NTP synchronization via Ethernet method, using an external NTP server.

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.

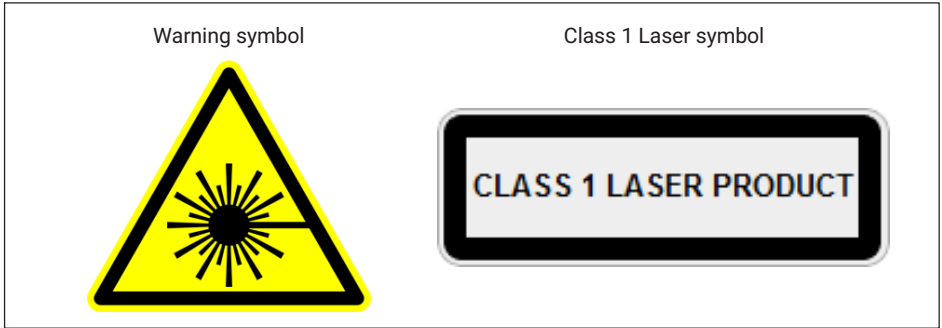
HBK FiberSensing is a manufacturer registered in the ANREEE - "Associação Nacional para o Registo de Equipamentos Eléctricos e Electrónicos" under number PT001434. HBK FiberSensing celebrated a "Utente" type contract with Amb3E - "Associação Portuguesa de Gestão de Resíduos de Equipamentos Eléctricos 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 HBK FiberSensing to Amb3E.

2.2 Laser Safety

The FS22 - Industrial BraggMETER SI 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 1 M, Class 2, Class 2 M, Class 3R and Class 4.

2.2.1 Symbols



2.2.2 Class 1 Laser

The FS22 - Industrial BraggMETER SI 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.

Laser Safety	
Laser Type	Fiber Laser
Laser Class (IEC 60825-1)	1
Typical Output Power per channel	≈ 0.3 mW (-5 dBm)
Max Output Power per channel	≈ 0.5 mW (-3 dBm)
Wavelength	1500-1600 nm

2.2.3 General Precautions Considerations

Everyone who uses a laser 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.

When an optical connector is not in use (no optical cable plugged to the interrogator), a proper connector cap must be used. The optical connectors are subjected to maintenance and/or inspection. *Please refer to section 4.4.1 "Dirty Connector" for maintenance procedure.*

Do not attempt to open or repair a malfunctioning interrogator. It must be returned to HBK FiberSensing for repair and calibration.

2.3 Certification

2.3.1 CE marking



This product carries the CE marking and complies with the applicable international requirements for product safety and electromagnetic compatibility, according to the following Directives:

- Low Voltage Directive (LVD) 2014/35/EU - Electrical Safety
- Electromagnetic Compatibility (EMC) Directive 2014/30/EU

It is in compliance with the EN61326/EN55011 Emission Radiated Test Class A, under the Electromagnetic Compatibility Standard.

The corresponding Declaration of Conformity is available upon request.

2.3.2 UKCA Marking



This product carries the UKCA marking and complies with the applicable international requirements for product safety and electromagnetic compatibility, according to the following Directives: Low Voltage Directive (LVD) 2014/35/EU – Electrical Safety Electromagnetic Compatibility (EMC) Directive 2014/30/EU.

The corresponding Declaration of Conformity is available upon request.

2.3.3 Marking of pollutant emission limit values (for deliveries to China)



Statutory marking of compliance with emission limits in electronic equipment supplied to China.







2.3.4 Degree of protection

In compliance with the IEC/EN 60529 Degrees of protection provided by enclosures is:

- For the Standard format: IP40 certification (protection against the ingress of solids larger than 1 mm in diameter).
- For the Rack-mountable format: IP20 certification (protection against the ingress of solids larger than 12.5 mm in diameter).

2.4 The marking used in this document

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

Symbol	Significance
	This marking warns of a <i>potentially</i> dangerous situation in which failure to comply with safety requirements <i>can</i> result in slight or moderate physical injury.
	This marking draws your attention to a situation in which failure to comply with safety requirements <i>can</i> lead to damage to property.
	This marking draws your attention to <i>important</i> information about the product or about handling the product.
	This marking indicates application tips or other information that is useful to you.
	This marking draws your attention to information about the product or about handling the product.
<i>Emphasis</i> 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

3 OPERATION

3.1 Connectors

3.1.1 Standard

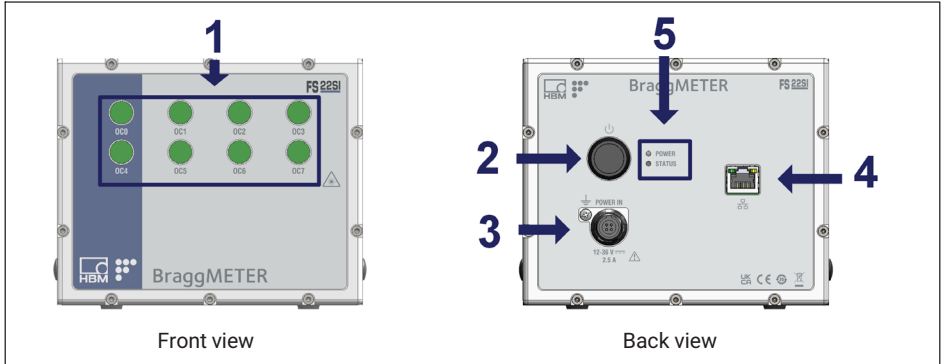


Fig. 3.1 Front and back views of FS22SI Standard

The connectors and buttons on Fig. 3.1 are:

- 1 Optical Output Connectors
- 2 ON/OFF Button
- 3 Power Connector
- 4 Ethernet Connector
- 5 POWER and STATUS LEDs

3.1.2 Rack-Mountable

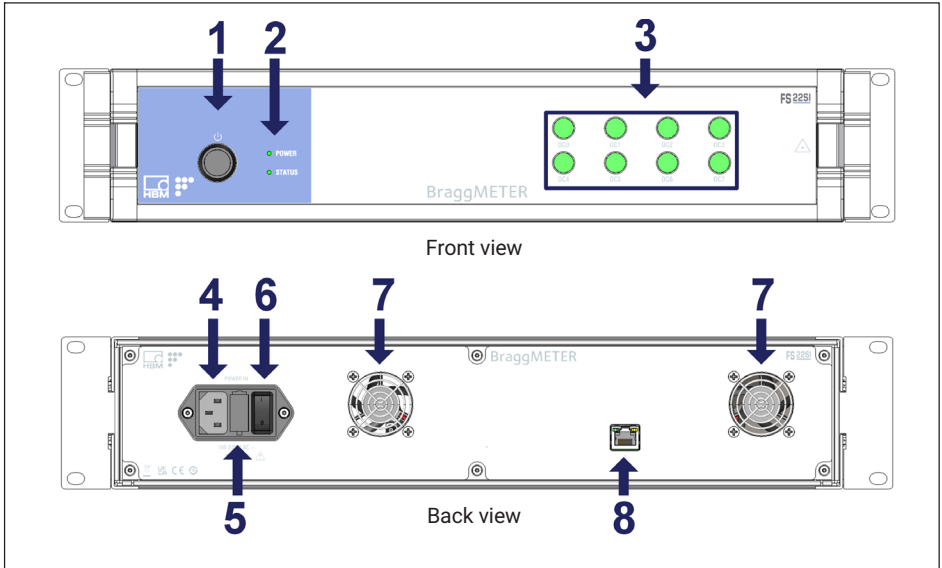


Fig. 3.2 Front and back views of FS22SI Rack-Mountable

The connectors and buttons on Fig. 3.2 are:

- 1 ON/OFF Button
- 2 POWER and STATUS LEDs
- 3 Optical Output Connectors
- 4 Power Connector
- 5 Electric fuse
- 6 Safety Power Button
- 7 Fans
- 8 Ethernet Connector

3.2 Setting Up

3.2.1 Power Supply

To start the FS22 - Industrial BraggMETER SI interrogator connect the power cable to the interrogator Power Connector (number **3** on Fig. 3.1 or number **4** on Fig. 3.2). To acknowledge proper power supply, the POWER LED will turn green during 2 seconds after connecting the power supply.

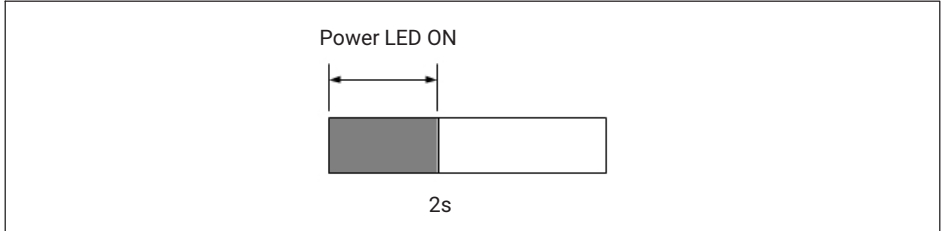


Fig. 3.3

i Information

For the Standard version of the interrogator the power supply must have a minimum of 30 W, with an output voltage between 12-36 v and must withstand a peak of 4 A for at least 4 ms. For the Rack-Mountable version of the interrogator the power must be 100-240 V AC, 50-60 Hz, 1A.

Notice

Powering above the specified limits will damage the equipment. For the Rack-mountable version there is a fuse protection that can be replaced. please see section 4.4.5 Fuse failure.

i Information

The interrogator must be powered using a power supply source not shared with other equipment's. A replacement AC-DC power supply unit 24 V (1-NTX001) for the Standard version or Power Cable (1-KAB274) available with different plug formats can be ordered from HBK.

3.2.2 Optical Connectors

The FS22 - Industrial BraggMETER SI can be purchased either with FC/APC, or SC/APC optical connectors. number **1** on Fig. 3.1 exemplifies FC/APC connectors.

Attention should be paid to the cleaning of the optical connectors. A dirty connector can compromise the measurement and will degrade the interrogator performance. It is advisable to frequently clean the connectors using appropriate tools.

FS22 - Industrial BraggMETER SI can have one, four or eight optical channels in parallel.

3.2.3 Ethernet Connection

Connect the Ethernet RJ45 connector directly to a PC using a Ethernet cross-over cable, or to a network connector using a direct Ethernet cable (in this case, the FS22 - Industrial BraggMETER SI must be in the same subnet as your Local Network).



Important

The interrogator default network configuration is "10.0.0.10:255.0.0.0:0.0.0.0".

3.2.4 Positioning

When installing the FS22 interrogator, please exercise caution regarding its placement.

The FS22 interrogator can be positioned in any orientation without impacting its functionality, providing that the remaining environmental conditions as specified on the data sheet are observed. However, it is essential to handle the fiber optic cables connected to the optical channels with care to avoid strain or damage. Pay careful attention to rack doors or cabinet lids that may force, twist or pinch the cables (optical or electrical) compromising measured signals.

If you have questions or require assistance, please reach out to HBK FiberSensing for support.

3.3 Maintenance

3.3.1 Wear parts

HBK Optical Interrogators have wear parts (such as ventilation fans, optical connector adapters and batteries) that require minimum running conditions to ensure a correct operation of the equipment.

Wear parts are covered by a limited warranty as they are components that depend on the usage and on the environmental conditions the equipment operates in, such as humidity, temperature and dust.

A periodic maintenance should be planned and managed by the customer considering the actual operation conditions. Warranty will only be applied to wear parts if the cause of the defect can be clearly traced back to the material or manufacturing fault.

3.3.2 Ventilation

The FS22SI is an electronic equipment with active ventilation, meaning that it uses fans for thermal control of the device. Fine dust particles over time can reduce the life time of optical and electronic components leading to a general degradation of the equipment, so it is important to prevent dust from entering the device. For that reason the interrogators should be kept on a controlled environment, far or protected from major dust areas.

3.3.3 Optical connectors

Optical connectors of the interrogator are subject to degradation and can actually break upon misuse (see section 4.4.2. *Broken Connector*). If this happens, the interrogator must be sent back to HBK FiberSensing for repair.

3.3.4 Calibration

BraggMETER interrogators have a built-in NIST traceable gas cell that ensures calibrated measurements at all time. For this reason, a compulsory periodic calibration is not required. Nevertheless, for regulatory reasons or internal rules, a periodic certified calibration procedure is sometimes required. For those cases, the calibration service is available and can be requested to HBK FiberSensing.

3.4 Switching On

Pressing the ON/OFF button will start the interrogator. The STATUS LED will start blinking at 2 Hz. After approximately 30 seconds it will start blinking at 1 Hz. This means that the interrogator is already on and responsive, but the optoelectronic module is still warming up. After approximately 90 seconds it should stay on permanently. This means that the interrogator is able to measure.

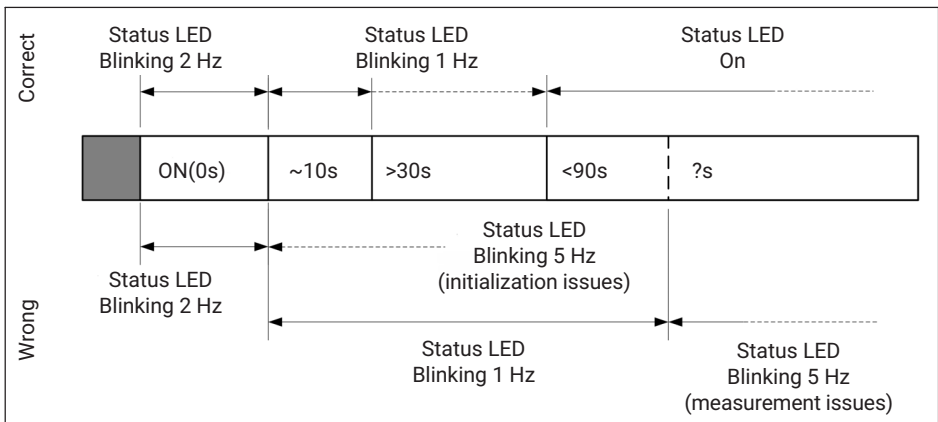


Fig. 3.4 Power ON/OFF button and status LED behavior



Information

If the interrogator does not start correctly, the STATUS LED will blink faster. If this happens please contact HBK FiberSensing technical support.

3.5 Switching OFF

To avoid accidental shut-down of the interrogator, it is necessary to press the "ON/OFF" button between 2 and 6 seconds (Fig. 3.5).

If for some reason the 6 seconds are exceeded the user can release the button before 10 seconds are reached and the interrogator will remain ON (Fig. 3.6).

Notice

If the ON/OFF button is pressed more than 10 seconds irreversible changes on the interrogator configuration are performed.

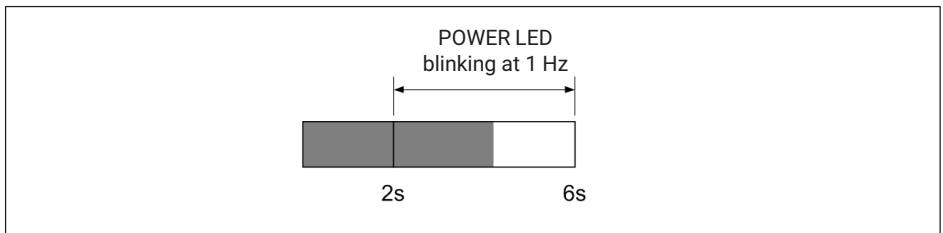


Fig. 3.5 Power LED while pressing Switching Off between 2 s and 6 s

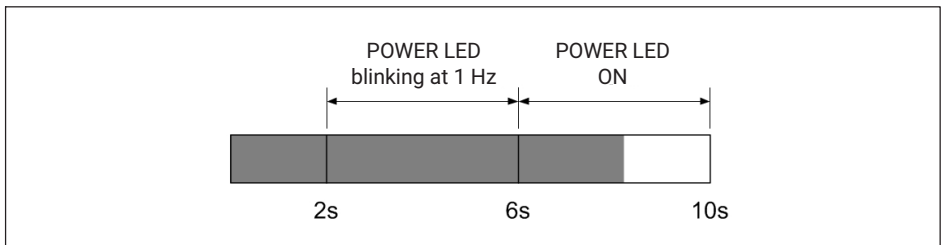


Fig. 3.6 Power LED while pressing Switching Off between 6 s and 10 s

3.6 Operating the Interrogator

3.6.1 Network Properties

To operate the FS22 - Industrial BraggMETER SI from a personal computer, the PC network properties should be set so that both elements are configured in the same subnet.

To configure your personal computer so that it is on the same subnet as the default for the interrogator, proceed as follows:

- ▶ On the control panel choose **Network Connections**.
- ▶ Select the LAN connection. The window displayed in Fig. 3.7 will appear. Click on **Properties**.

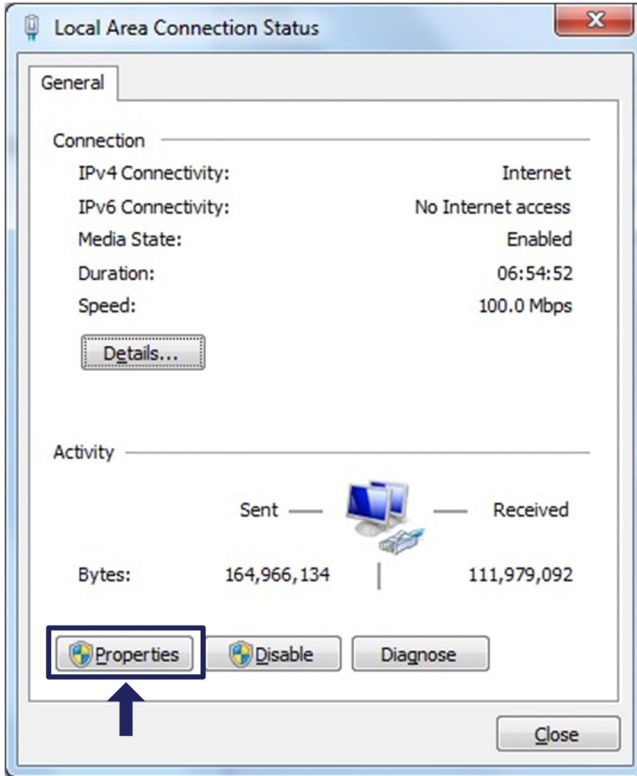


Fig. 3.7 Local Area Connection Status

- ▶ Select the Internet Protocol (TCP/IP) and click on the button **Properties** (Fig. 3.8).

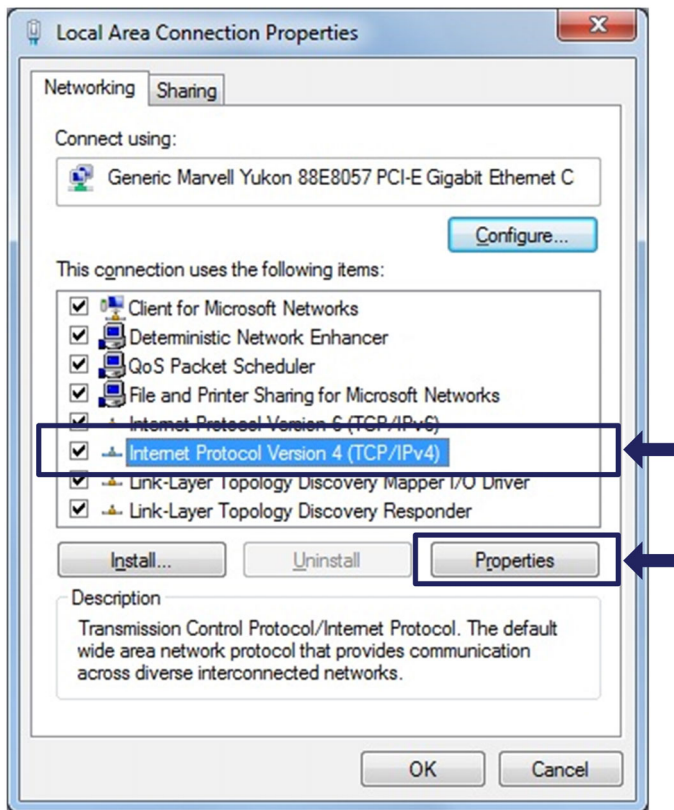


Fig. 3.8 Local Area connection properties

- ▶ Set the IP address and the subnet mask as in Fig. 3.9.

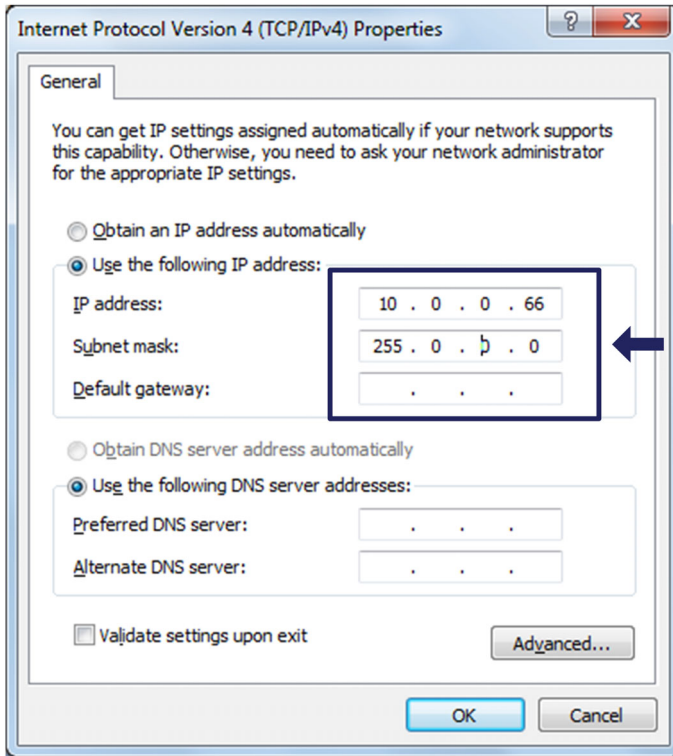


Fig. 3.9 Internet Protocol Version 4 Properties

- ▶ Press OK.

3.6.2 Resetting the IP Address of the Interrogator

If for any chance there is the need to physically change the IP address of the interrogator, there is a reset procedure that consists on pressing the ON/OFF button for more than 10 seconds.

When the button is being pressed for 10 seconds the POWER LED blinks 3 times and goes OFF. At this moment the ON/OFF button can be released and the reset of IP address will happen.

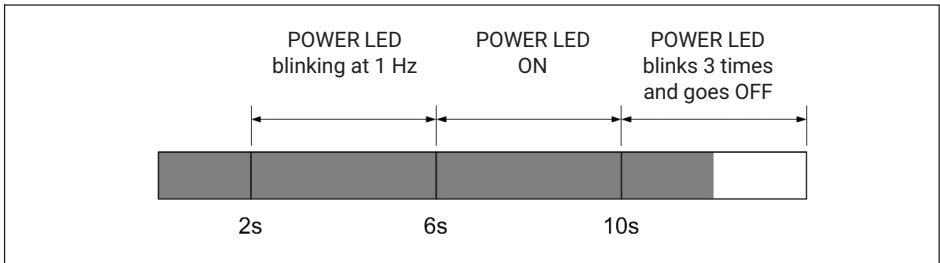


Fig. 3.10 Power LED while pressing Switching Off for more than 10 s

This procedure resets the interrogator changing its IP address to the default and its measuring settings to the last stored.

i Information

The interrogator default network properties are "10.0.0.10:255.0.0.0:0.0.0.0".

3.6.3 Synchronization

In order to achieve synchronous measurements between different devices the NTP (*Network Time Protocol*) synchronization via Ethernet must be used.

Each optical Interrogator can synchronize its internal clock with an NTP server. It is possible to achieve accuracies of 1ms or higher, depending on whether or not a dedicated NTP server is being used.

Further information about NTP can be found at <http://www.ntp.org>.

Measuring Systems Typology

A measurement system can be as simple as a single interrogator or a bit more complex with combined interrogators with the same or different sampling rates, and interrogators combined with other equipment.

Single interrogator For the usage of a single interrogator no special synchronization is needed.

BraggMONITOR SI software can only operate one interrogator at a time. If an NTP server is running on the same PC as the BraggMONITOR SI, the interrogator internal clock – hence BraggMONITOR SI – will sync.

Multiple interrogators

If more than one interrogator is used, synchronization becomes important and if an NTP server is running the equipment will start syncing as soon as a first communication from the server is received.

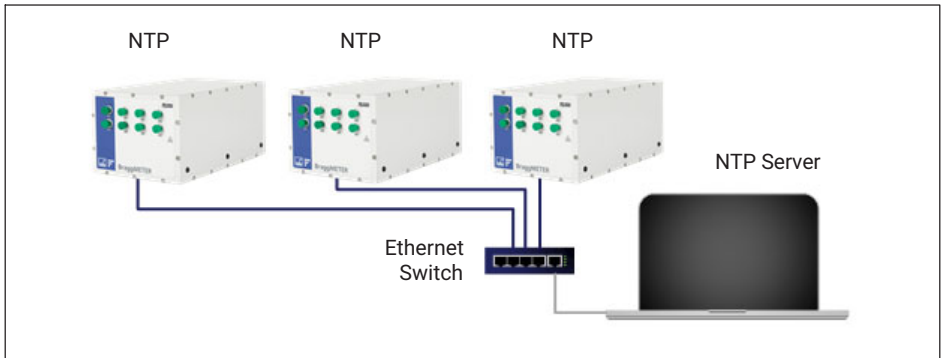


Fig. 3.11 Synchronizing multiple interrogators

Hybrid

A hybrid measurement system is a system composed by different equipment types and technologies that can be operated with different sampling rates. Taking the example of HBK families a hybrid system could be a combination of Interrogators with QuantumX.

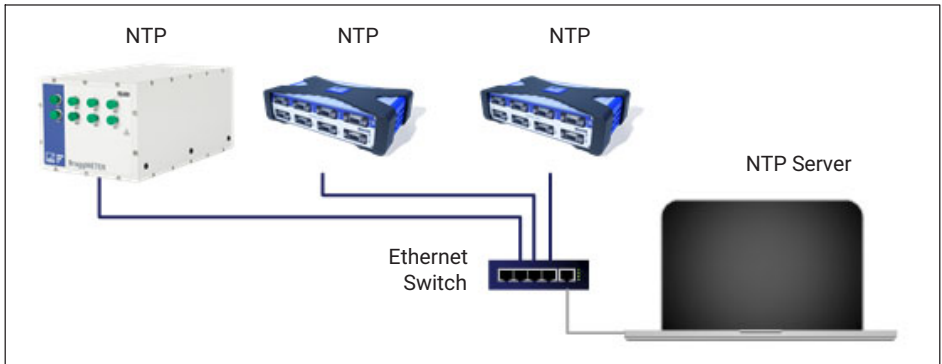


Fig. 3.12 Synchronizing interrogators with conventional technology

Synchronization is again of extreme importance in such systems. When an NTP server is running the Interrogator will start synching as soon as a first communication from the server is received.

For details on the other equipment please refer to their respective user manuals.

Synchronization process

Each interrogator synchronizes its internal clock with the NTP server. Upon starting, all devices and the NTP server need some settling time to achieve the best synchronism possible.

The following features for NTP synchronization are available:

Number of devices to be synchronized	Unlimited
Synchronization accuracy	10 μ s to 10 ms
Synchronization settling time	Up to 30 min during first start, up to 2 min during restart
Synchronization master	External SyncMaster, e.g. PC

For a good synchronization, the dedicated NTP server should run continuously. The accuracy is described by the two values:

- *Offset*: average deviation from time server
- *Jitter*: typical variation range of the offset value

The clock synchronization is classified using the following offset intervals:

- <500 μ s: excellent
- <1 ms: very good
- <2 ms: good
- <5 ms: acceptable
- <10ms: poor
- >10ms: not acceptable

A successful NTP Sync is achieved if the offset between the internal clock of the device and the NTP server is below 5ms.

The quality of the NTP synchronization can be queried using the SCPI commands (please refer to section “Synchronization” on page 53 for further details).

3.6.4 Operation

The FS22 - Industrial BraggMETER SI interrogator can be fully controlled using standard SCPI syntax commands (for a complete command list, *please refer to section 5.1 “Communication Protocol Syntax” on page 38*).

Using the Provided Drivers

These drivers can be used within the LabVIEW™ environment. To develop custom applications using this language, copy the drivers' library supplied on the CD. A set of ready to use examples to run on LabVIEW™ is also provided.



Important

Before using the provided LabVIEW™ examples on a PC, make sure the Regional and Language options (in standards and formats) are defined as dot for decimal symbol, comma for digit grouping symbol and dash for date separation.

Operational States

The FS22 - Industrial BraggMETER SI interrogator has six operational states:

- | | |
|---------------------------------|--|
| 0 Error | The error state corresponds to a malfunction of the optoelectronic module of the interrogator. The system can only recover from this state by resetting. |
| 1 Ready | In the ready state, the FS22 - Industrial BraggMETER SI is ready to start acquisition. |
| 2 Free acquisition | The free acquisition state enables the FS22 - Industrial BraggMETER SI interrogator to perform single measurements on a specified optical channel. The interrogator can be configured in terms of threshold and the corresponding configuration can be stored for further measurements. |
| 3 Continuous acquisition | The continuous acquisition state allows continuous wavelength acquisition over all optical channels and also performs continuous OSA trace acquisition at 1 S/s. |
| 4 Scheduled acquisition | The scheduled acquisition state allows periodic data acquisition with a pre-defined period and number of samples while saving data to the internal interrogator memory. Whenever the acquisition period minus the number of samples (at 1 S/s rate) is higher than 10 minutes, the interrogator will enter into sleep mode during inactive time intervals, to reduce power consumption. The minimum period is 5 s and the number of samples (at 1 S/s) cannot overcome the defined period. |
| 5 Warming-up | The FS22 - Industrial BraggMETER SI interrogator starts on the warming-up state that enables the settling of the operation parameters and recall of the acquisition configuration. |



Information

The interrogator will only answer when the STATUS LED is already blinking at 1 Hz (see section 3.4 "Switching On" on page 16).

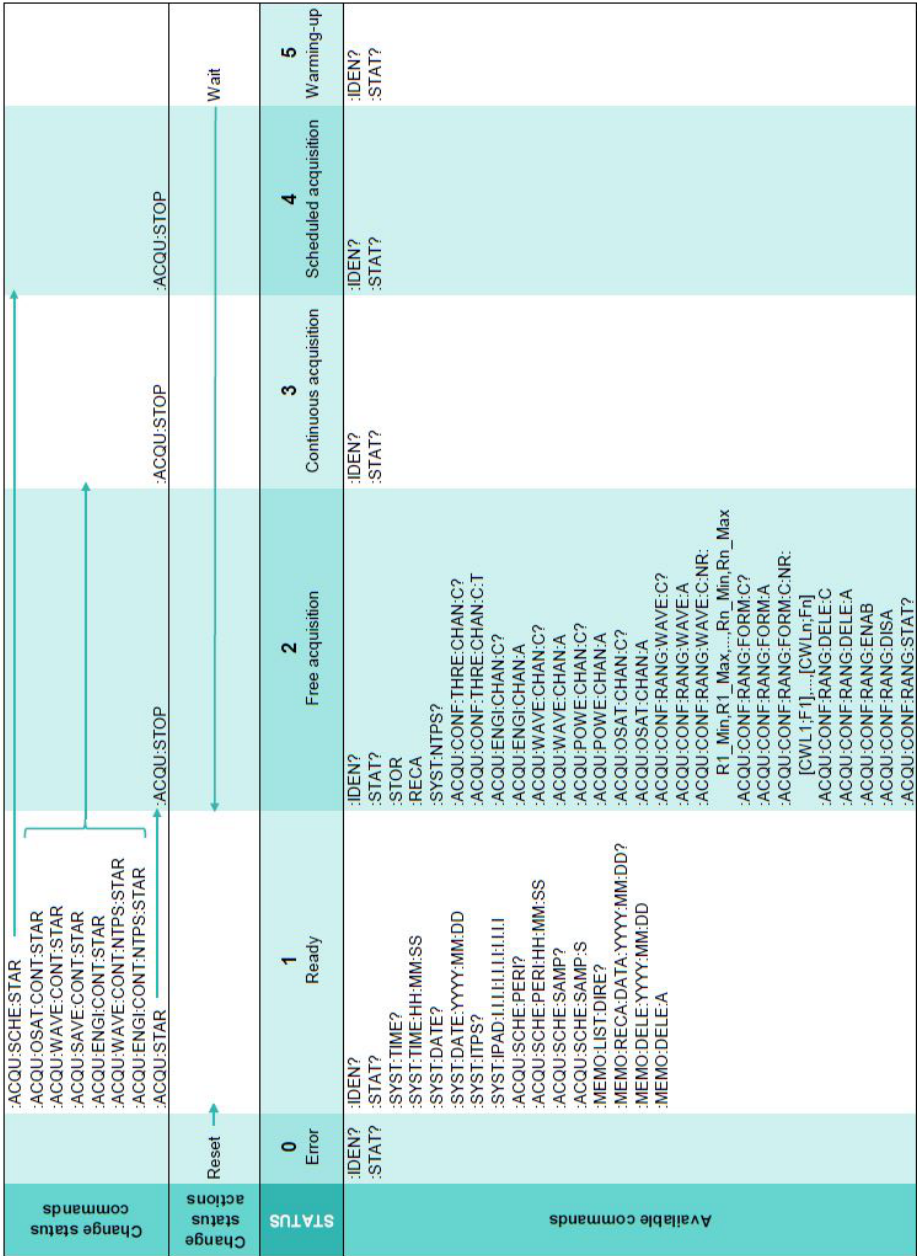


Fig. 3.13 Operational States and commands

Power Shortage

If a power shortage happens when the - FS22 Industrial BraggMETER SI interrogator is running in the ready, free acquisition or continuous acquisition states, the operational state is maintained once the power supply is reestablished with the stored acquisition settings.

If the power shortage occurs in the scheduled acquisition mode, the operational state is maintained once the power supply is reestablished except in the case the interrogator is in sleep mode for power saving.

Notice

If the interrogator is in sleep mode when a power shortage occurs, scheduling will not resume upon power up.

Default Network Properties

The default network properties are "10.0.0.10:255.0. 0.0:0.0.0.0". Whenever there is the need, the interrogator can be reset to this default address (see section 3.6.2 "Resetting the IP Address of the Interrogator" on page 20). The default address cannot be changed.

4 MEASURING

4.1 Typical Configuration

Typically, a fiber Bragg grating Sensing Network is divided into branches of several sensors connected in series. On Fig. 4.1 there is a scheme of a usual fiber Bragg grating sensing branch.

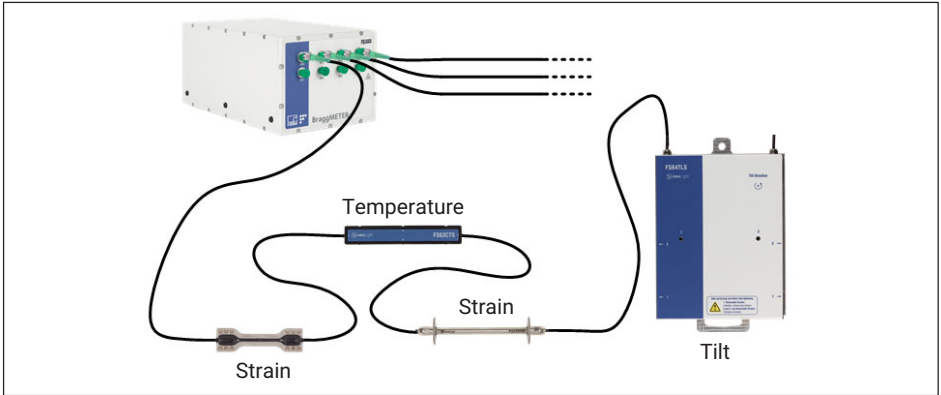


Fig. 4.1 Typical network configuration

A branch can accommodate sensors with wavelengths between 1500 nm to 1600 nm. The number of sensors in an optical connector can vary if there is previous knowledge about the spectral range the sensors will cover. The major concern is the overlap of adjacent sensors. The available optical connectors have simultaneous acquisition, meaning that the sensing network can have a large number of fiber Bragg grating sensors interrogated at the same time.

The employed technology allows multi-functionality meaning that on the same branch it is possible to measure Strain, Temperature, Displacement, Pressure, Acceleration, etc...

The sensing network can be placed several kilometers from the interrogator without significant losses on transmission over the optical fiber, operating under EM/RF interferences.

Each fiber Bragg grating sensor has a characteristic central wavelength (λ_0) that depends only on the measurand. This means that with this technology there is no need for recalibrations every time the system is shut down. The FS22 - Industrial BraggMETER SI is a ruggedized interrogator designed for standalone operation.

4.2 Definitions

The following definitions are applicable to this equipment only.

4.2.1 Wavelength

The Wavelength value corresponds to the wavelength at the peak of the fiber Bragg grating reflection spectrum, commonly referred as Bragg wavelength (Fig. 4.2).

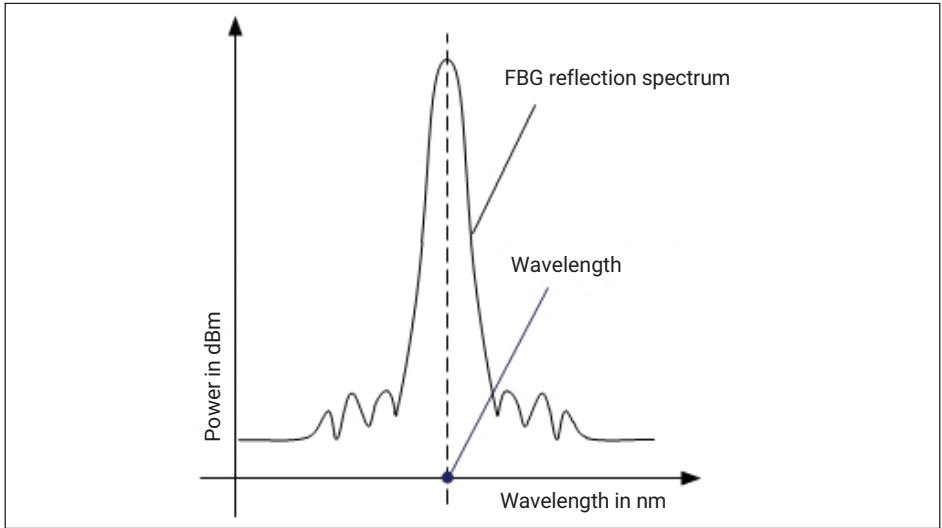


Fig. 4.2 Wavelength

4.2.2 Power

The Power value corresponds to the optical power reflected by the fiber Bragg grating at the peak wavelength (Fig. 4.3).

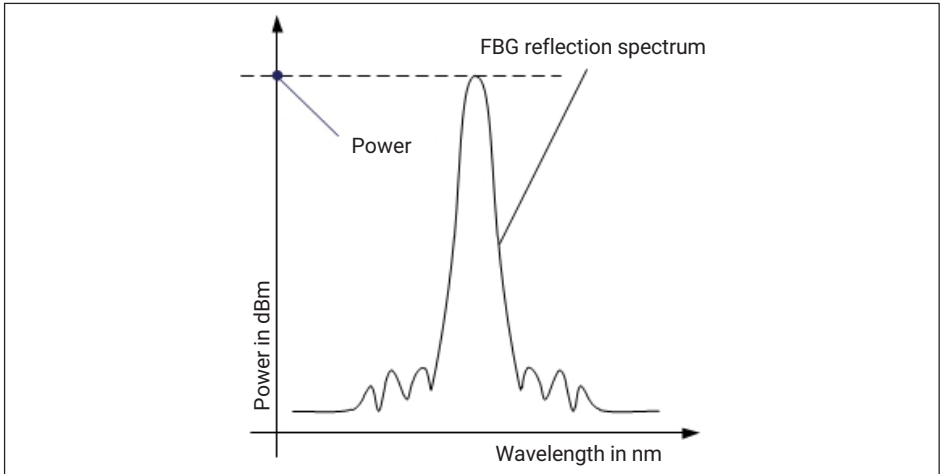


Fig. 4.3 Power

4.3 Measurement Methods

BraggMETER interrogators incorporate two distinct measurement methods. The Conventional in which a global threshold is considered for the detection and measurement of the fiber Bragg grating sensors and the Smart peak Detection (SPD), in which individual configurable sensor ranges are used combined with a defined threshold for the optical channel, referenced to the peak inside each range.

4.3.1 Conventional

In the conventional measuring approach, the threshold level is defined in dB for each optical channel individually and it is defined from the maximum peak power of the channel (refer to Fig. 4.4). The threshold value corresponds to the considered power level for the FBG peak computation, so that side lobes and ground noise are disregarded. Although it is considered an expedited way of performing measurements, the use of this method should be limited to laboratory applications with reduced power losses between sensors.



Important

When measuring with the conventional method the configuration of all sensors can be affected by local insertion losses. If power losses are expected (field applications) the SPD method is recommended.

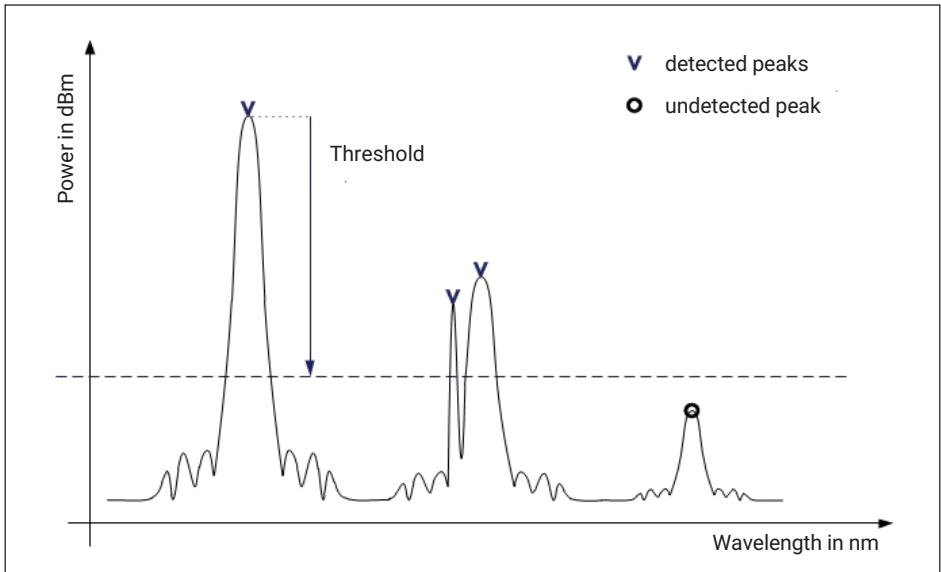


Fig. 4.4 Conventional detection method

4.3.2 Smart Peak Detection (SPD)

SPD allows the effective use of the high dynamic range offered by the interrogator through the introduction of individual and adaptive thresholds, referenced to the peak on each sensor's configurable range (refer to Fig. 4.5).

As in the conventional measuring method, the threshold value corresponds to the considered power level for the FBG peak computation and it is defined in dB for each optical channel individually. The difference on the SPD is that the threshold value is referenced to the highest peak of each range, operating individually in every range.

Within each sensor range, even though it happens, either permanently or occasionally, that multiple peaks overcome the threshold, only one FBG sensor will be computed, thus eliminating problems indexed to the measurements. Additionally, any influence these spurious peaks could exert on the measurements is canceled.

Summarily, the increased robustness provided is especially suited to overcome the limitations found in the conventional methods where low and high reflectivity FBGs coexist and signal losses are often a problem. SPD therefore improves the stability and accuracy of the measurements, contributing to the system's efficiency.



Information

When SPD is active, the total number of sensors that can be measured by the interrogator should not exceed 400.

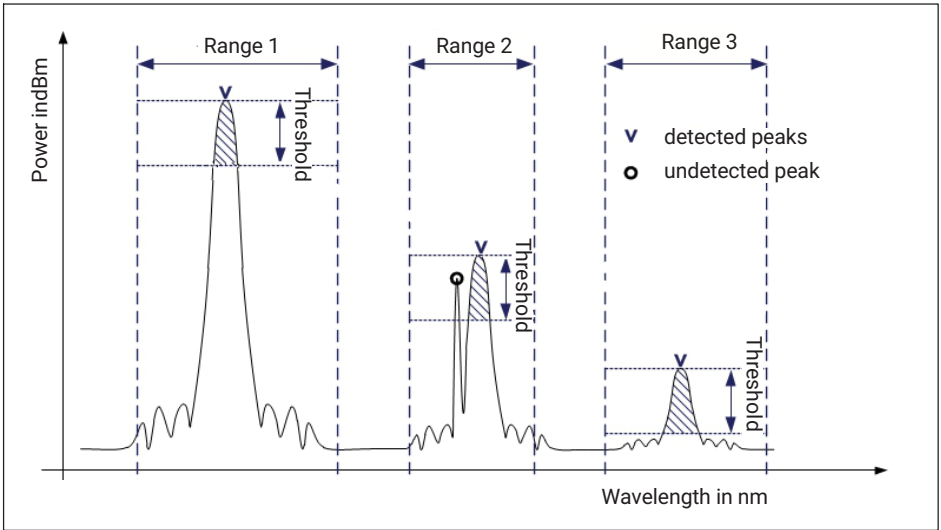


Fig. 4.5 Smart Peak Detection (SPD) detection method

4.4 Common Measuring Difficulties

There may be the possibility of having measuring malfunctions due to several problems in the sensing network or optical connections. A list of some of the usual problems is described below with the explanation for its occurrence and correction.

4.4.1 Dirty Connector

When an interrogator 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 moisture can be deposited in the interrogator adaptor and this will compromise measurements. On Fig. 4.6 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.

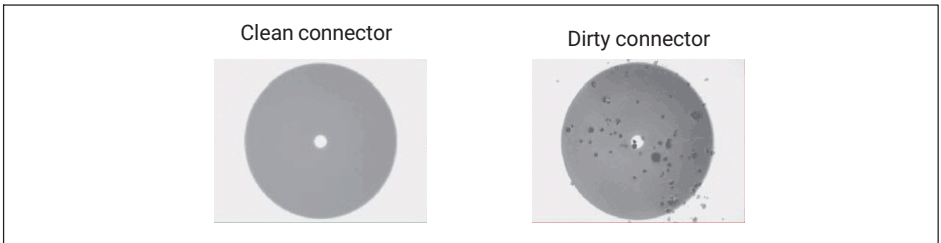


Fig. 4.6 Magnified Clean vs Dirty connector

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

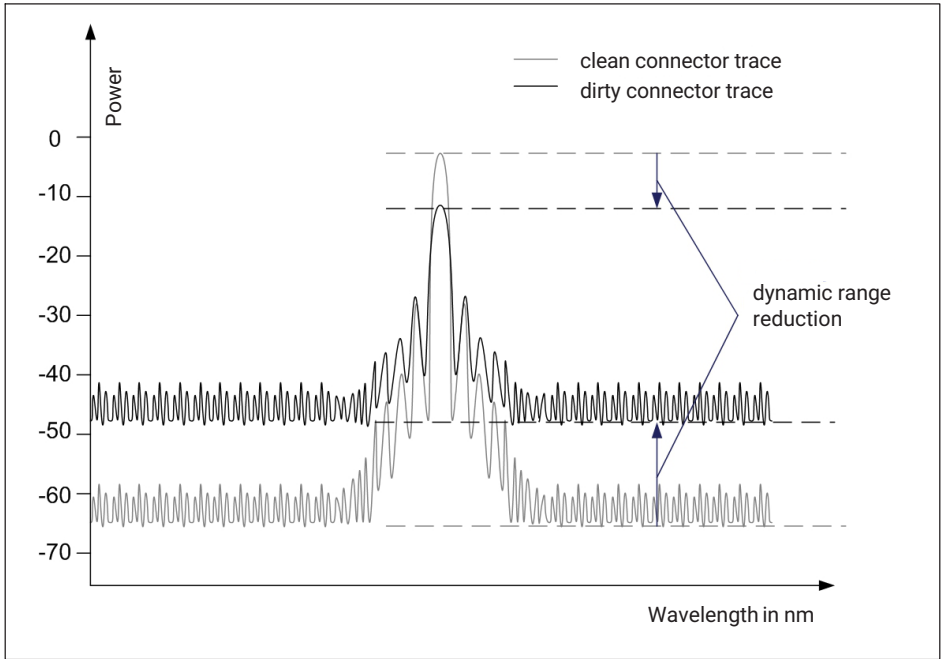


Fig. 4.7 Dirt impact on sensor signal

To clean an optical interrogator adapter, use an appropriate cleaner (1-FSCLEANER from HBK or similar). Insert it in the optical adapter, number **1** in Fig. 4.8, and press it against the inside of the connector to clean.

Alternatively, use an appropriate cotton swab (there are several cleaning swabs in the market frequently used for telecom) embedded in isopropyl alcohol. Insert it in the optical adapter, number **2** in Fig. 4.8, and rotate the swab always on the same direction.



Fig. 4.8 Cleaning connectors

4.4.2 Broken Connector

It may also occur that the interrogator adapter sleeve breaks. In this case, when an optical connector is inserted it does not get proper alignment and measurements are compromised. A broken sleeve will look as shown in Fig. 4.9.

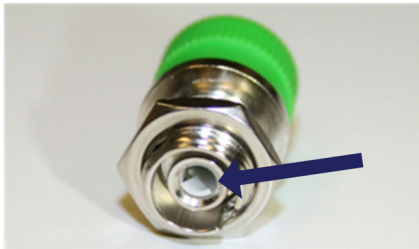


Fig. 4.9 Broken connectors

To solve this problem you should contact HBK FiberSensing.

4.4.3 Reflective Fiber Ending

It may occur that the interrogator does not find any sensor on an array even if connections were performed correctly. One of the reasons may be the excess of reflected light saturating the detectors.

When a fiber is perfectly cut (Fig. 4.10 on the left) a large amount of light is reflected right back into the core of the fiber in such an angle that it gets guided back heading to the interrogator detectors. When this occurs, an index matching gel or an angled termination must be used. If these are unavailable, the tip of the fiber can be smashed with a metallic tool. This will destroy the perfect geometry (Fig. 4.10 on the right) and the light that is reflected at the surface will take random directions ending up outside the core.

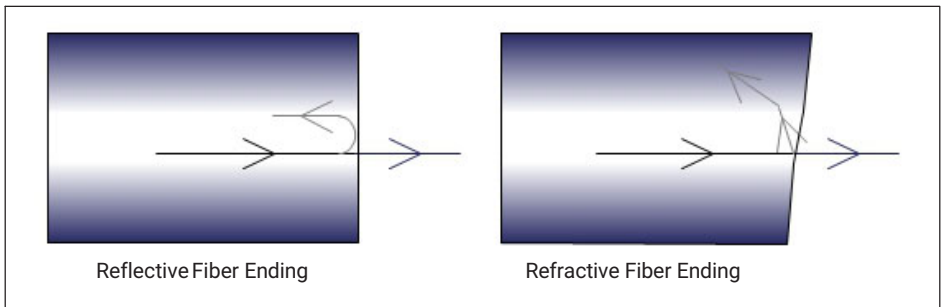


Fig. 4.10 Refraction and reflection at fiber end

4.4.4 Cut Fiber

When the fiber, for any reason, is broken between two sensors in a series, the sensors that are after the fault may disappear from the optical spectrum and may not be detected.

There may also be the case that the fiber is cut, but not completely spread apart (e.g. the fiber is damaged in an area covered with glue). This will cause a Fabry-Pérot effect – the light will suffer multiple reflections inside the cavity creating sinusoidal background reflection. Fig. 4.11 shows a schematic representation of the reflected spectrum for these three presented cases.

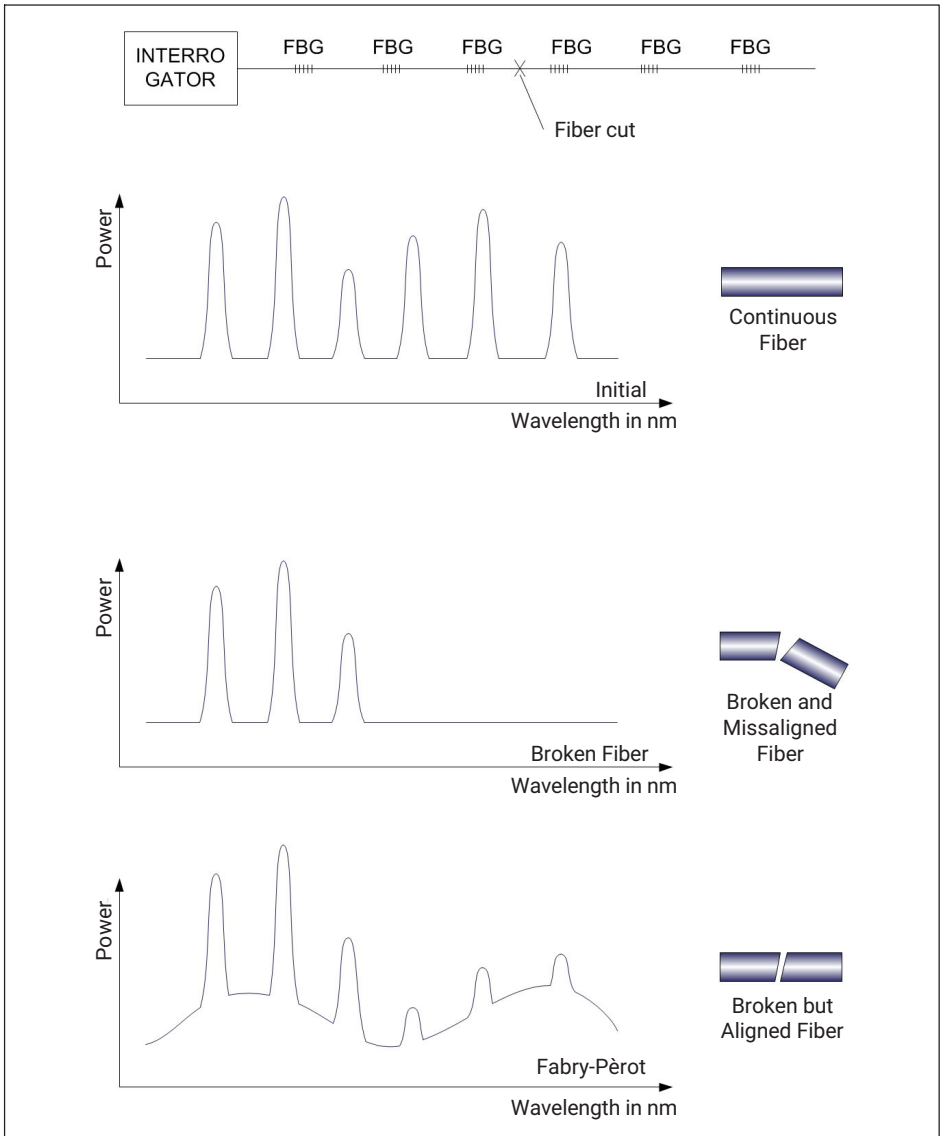


Fig. 4.11 Cut fiber effect

4.4.5 Fuse Failure

Electrical shorts on the power supply may cause problems to the interrogators. The Industrial BraggMETER SI on its Rack-Mountable format is directly connected to the

100-240 V power line meaning that it has no external protection. Replaceable fuses are available on the interrogator's back-side next to the power connector (*number 5 in Fig. 3.2*). To replace the fuses, release the top and bottom springs of the fuses' support (*Fig. 4.12*) and then remove the piece (*Fig. 4.13*).

Fuse characteristics:

- Rated voltage: 250 Volt AC
- Interrupting rate: 1 Ampere
- Number of fuses: 2



Fig. 4.12 Removing the fuse



Fig. 4.13 Fuse holder

The Standard format of the interrogator is powered at 11-36 VDC, which means that the electrical protection should be granted by the power source or the adapter. If, by any chance, the power supply is overcome, the interrogator might be damaged and need repair at HBK FiberSensing.

5 REMOTE COMMUNICATIONS

5.1 Communication Protocol Syntax

The interrogator is controlled using standard SCPI syntax commands.

5.1.1 Command Syntax

Each command is an ASCII string with arguments separated by ":" and terminated with the "Line Feed" and "Carriage Return" characters ("End of Line").

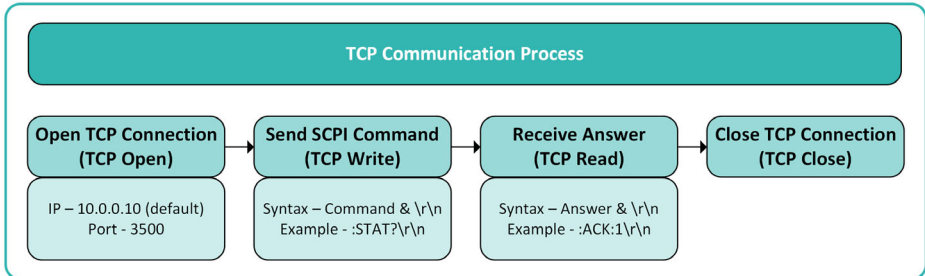


Fig. 5.1 TCP Communication Process

Commands for the Industrial BraggMETER SI are sent by port 3500. All commands, except for *Continuous Acquisition* (see page 47), are received via the same port. Continuous Acquisition answers are retrieved via port 3365.

The commands for the FS22 - Industrial BraggMETER SI have the following correspondence:

C	Optical Channel	String. Integer FS22 single: 0 FS22 quad: from 0 to 3. FS22 octo: from 0 to 7. Character A for all channels.
T	Threshold	Floating point. From 0 to 60 (dB)
R	Sampling rate	Floating point. Valid Sampling Rates: 1 (S/s)
NR	Number of Ranges	Integer.

RN	Range Number	Integer. From 1 to NR
Min, Max	Range limits	Interval Min: Floating point. From 1500.00 to 1600.00. Max: Floating point. From 1500.00 to 1600.00. Ordered from the range with lowest wavelengths to the range with higher wavelengths.
FML	Formula	Polynomial Considering "x" as the wavelength shift (in nm).
I	IP, subnet mask and gateway	Integer
S	Number of samples	Integer
YYYY:MM:DD	Date	Integer. YYYY – year. MM – month. DD – day.
HH:MM:SS	Time	Integer. HH – hours. MM – minutes. SS – seconds.
Q	NTP Quality	Integer. 0 for "Not acceptable", 1 for "Acceptable"

There are several possible answers with error messages:

:NACK:INVALID COMMAND

The command does not exist. Check if the spelling is correct.

:NACK:COMMAND NOT ACCEPTED AT CURRENT STATUS

It is not possible to execute the command sent at the current status. Ask the current status of the interrogator (:STAT?) and confer with scheme from *Fig. 3.13* to see how to change it.

:NACK: '?' MUST BE THE LAST CHARACTER

The sent command should have a '?' at the end of the command string.

:NACK:ARGUMENT OUT OF RANGE

The defined value for the parameter that is being configured with the command is outside the possible interval.

5.1.2 Common Commands

:IDENTification?

Queries the FS22 - Industrial BraggMETER SI interrogator type and firmware revision. The return string is a list separated by “:” consisting of Manufacturer, Unit Name, Revision, Number of Channels, Serial Number and Date.

Example:

Command :IDEN?

Answer :ACK:HBK FiberSensing:FS22SI v4.0:046 840 201 050:20231025

:STORe

Stores the current threshold values of all channels to the configuration file. Once the interrogator is restarted, the last stored values will be configured.

Example:

Command :STOR

Answer :ACK

:RECAll

Recalls previously saved instrument settings from the file. The command restores the state of the FS22 to a setup previously stored in the configuration file.

Example:

Command :RECA

Answer :ACK

5.1.3 System Commands

:SYSTem:DATE?

Queries the date of the real-time clock of the FS22. The answer is a string with date in the following format «YYYY:MM:DD»

Example:

Command :SYST:DATE?

Answer :ACK:2011:08:19

:SYSTem:DATE:YYYY:MM:DD

Sets the date of the real-time clock of the FS22. The date is defined as «YYYY:MM:DD».

Example:

Command :SYST:DATE:2011:08:19
Answer :ACK

:SYSTem:TIME?

Queries the date of the real-time clock of the FS22. The answer is a string with time in the following format «HH:MM:SS»

Example:

Command :SYST:TIME?
Answer :ACK:12:27:34

:SYSTem:TIME:HH:MM:SS

Sets the date of the real-time clock of the FS22. The time is defined as «HH:MM:SS».

Example:

Command :SYST:TIME:12:28:00
Answer :ACK

Synchronization

NTP query

:SYSTem:NTPSync?

Queries for the NTP synchronization status. Retrieves information on three parameters separated by “.”

Q: NTP Quality:

0 = not acceptable if offset >= 10ms;

1 = acceptable if offset <10ms.

Offset: time difference in milliseconds between the server clock and host clock.

Jitter: time difference in milliseconds between 2 samples.

Example:

Command :SYST:NTPS?
Answer :ACK:1:0.489:0.345

:SYSTem:IPADdress:I.I.I.I:I.I.I.I:I.I.I.I:I.I.I.I

Sets the IP address, the subnet mask and the gateway of the FS22. The default IP address, subnet mask and gateway are "10.0.0.10:255.0.0.0:0.0.0.0". After this command is successfully executed, the FS22 will restart automatically. The gateway content is not optional.

Example:

Command	:SYST:IPAD:192.168.2.100:255.255.255.0:0.0.0.0
Answer	No reply

5.1.4 Status Commands

:STATus?

Queries the operation condition status of the FS22. Returns the current status of the instrument: 0 error; 1 ready; 2 free acquisition; 3 continuous acquisition; 4 scheduled acquisition; 5 warming up.

Example:

Command	:STAT?
Answer	:ACK:1

5.1.5 Acquisition Commands

Free Acquisition

:ACQUisition:START

Starts the acquisition of the fiber Bragg grating sensors in all channels of the FS22.

Example:

Command	:ACQU:STAR
Answer	:ACK

:ACQUisition:STOP

Stops the acquisition (free, continuous and scheduled) of the fiber Bragg grating sensors in all channels of the FS22.

Example:

Command	:ACQU:STOP
Answer	:ACK

:ACQUisition:CONFIguration:THREshold:CHANnel:C:T

Sets the threshold value for the peak detection algorithm in the C channel of the FS22. The threshold is a value from 0 to 60 dB.

Note: The threshold value returns to the last stored threshold when the interrogator restarts. To change the current threshold to permanent run the :STORe command.

Example:

Command :ACQU:CONF:THRE:CHAN:2:20
Answer :ACK

:ACQUisition:CONFIguration:THREshold:CHANnel:C?

Queries the threshold value for the peak detection algorithm in the C channel of the FS22. The threshold is a value from 0 to 60 dB.

Note: The answer corresponds to the last used threshold value that may not be the stored value that will be active once the interrogator restarts.

Example:

Command :ACQU:CONF:THRE:CHAN:2?
Answer :ACK:20.0

:ACQUisition:CONFIguration:RATE?

Queries the actual sampling rate of the FS22.

Example:

Command :ACQU:CONF:RATE?
Answer :ACK:1

:ACQUisition:CONFIguration:RATE:R

Sets the FS22 sampling rate to R. The sampling rate for the static interrogator is currently limited to 1 (S/s).

Example:

Command :ACQU:CONF:RATE:1
Answer :ACK

:ACQUsition:CONFIguration:RANGe:WAVElength:C?

Queries the actual limits of defined ranges on channel C. The number of channels can be set A to retrieve all ranges in all channels simultaneously.

Example:

Command	:ACQU:CONF:RANG:WAVE:3?
Answer	:ACK:1534.13, 1536.13,1544.13, 1546.13

:ACQUsition:CONFIguration:RANGe:WAVElength:C:NR:MIN,MAX.,MIN,MAX

Defines NR number of ranges and their MIN and MAX limits on channel C.

Note: The ranges should be sent with the wavelengths sorted in ascending order.

Note: The minimum width accepted for the ranges defined via SCPI command is 1 nm.

Example:

Command	:ACQU:CONF:RANG:WAVE:3:2:1534.13, 1536.13,1544.13, 1546.13
Answer	:ACK

:ACQUsition:CONFIguration:RANGe:FORMula:C:NR:[CWL;FML],...,[CWL;FML]

Defines the formula(s) and central wavelength(s) for the range(s) on channel C. NR defines the number of ranges in channel C, CWL represents the central wavelength of the sensor in the specific range and FML represents the corresponding formula.

Note: This command shall be used after the ranges have been defined with the :ACQUsition:CONFIguration:RANGe:WAVElength:C:NR:MIN,MAX,...,MIN,MAX command.

Note: The central wavelengths and formulas shall be sorted by wavelength in ascending order.

Note: The variable "x" is used in the formulas to represent the wavelength variation of the sensor relatively to the central wavelength.

Example:

Command	:ACQU:CONF:RANG:FORM:1:2:[1512.1;-96.2*x^2+104.8*x+30],[15 20.5;x*0.78]
Answer	:ACK

:ACQUisition:CONFIguration:RANGe:FORMula:C:RN:FML

Defines the formula for the range number RN on the channel C. Range Number RN is an integer from 1 to the total number of ranges NR.

Example:

Command :ACQU:CONF:RANG:FORM:3:2:-13.2*x^2+104.8*x+30
Answer :ACK

:ACQUisition:CONFIguration:RANGe:DELEte:C

Allows the user to delete the configuration of a single channel (using an integer value to define the channel C) or of all the channels at once (using "A" to define all the channels).

Note: It is available only in state 2.

Example:

Command :ACQU:CONF:RANG:DELE:A
Answer :ACK

:ACQUisition:CONFIguration:RANGe:ENABle

Enables the use of Ranges. Measurement method changes from Conventional to Smart Peak Detection method (SPD).

Example:

Command :ACQU:CONF:RANG:ENAB
Answer :ACK

:ACQUisition:CONFIguration:RANGe:DISAble

Disables the use of Ranges. Measurement method changes from Smart Peak Detection method (SPD) to the Conventional.

Example:

Command :ACQU:CONF:RANG:DISA
Answer :ACK

:ACQUisition:CONFIguration:RANGe:STATus?

Queries the actual status of the ranges. There are two possible answers:

0 Disabled - Interrogator operating with Conventional Method

1 Enabled – Interrogator operating with Smart Peak Detection (SPD) Method

Example:

Command :ACQU:CONF:RANG:STAT?

Answer :ACK:1

:ACQUisition:ENGLneering:CHANnel:C?

When interrogator is operating with the Smart Peak Detection (SPD) Method acquires the engineering values, according to the range formula (FML), in the C channel of the FS22.

When the interrogator is operating with the Conventional Method acquires the peak wavelength of the fiber Bragg grating sensors in the C channel of the FS22.

Returned value is always in accordance to the defined threshold for the channel.

The number of channels can be set to A to retrieve the data relative to all sensors in all channels simultaneously.

Example:

Command :ACQU:ENGI:CHAN:1?

Answer :ACK:30.4512,25.8503,0.2582,3.2154

:ACQUisition:OSATrace:CHANnel:C?

Acquires the optical spectrum trace of the fiber Bragg grating sensors in the C channel of the FS22. Returns the optical spectrum trace over the complete wavelength range. The number of channels can be set A to retrieve the optical spectrum trace of all channels simultaneously. The optical spectrum trace of each channel consists of 20001 points indicating the power of the wavelengths in the [1500; 1600] nm range; equally spaced by 5 pm.

Example:

Command :ACQU:OSAT:CHAN:1?

Answer :ACK:-41.064,-40.965,-40.719,-40.420,-40.116,-39.848,-39.651,-39.574,-39.624,-39.755,-39.919,-40.074,-40.176,-40.203,-40.182,
(...)

:ACQUsition:POWEr:CHANnel:C?

Acquires the power of the fiber Bragg grating sensors in the C channel of the FS22. Returns the power value of the fiber Bragg grating sensors accordingly to the threshold settings and measurement method. The number of channels can be set to A to retrieve the data relative to all sensors in all channels simultaneously.

Example:

Command :ACQU:POWE:CHAN:1?

Answer :ACK:-41.064,-40.965

:ACQUsition:WAVElength:CHANnel:C?

Returns the peak wavelength of the fiber Bragg grating sensors in channel C of the FS22 according to the threshold settings. The number of channels can be "A" to simultaneously retrieve the data relative to all sensors in all channels.

Example:

Command :ACQU:WAVE:CHAN:1?

Answer :ACK:1523.6573, 1554.0709, 1566.7846

Continuous Acquisition

:ACQUsition:OSATrace:CONTInuous:STARt

Simultaneous continuous acquisition of optical spectrum traces of all channels. This command is sent via port 3500 and corresponding data is received through port 3365 in binary format. The answer is a big endian binary stream representing a double precision (8 bytes) array with 20001 points times the number of optical channels of the interrogator. The first 4 bytes of the binary stream indicate the number of channels and the last 4 bytes indicate the number of data bytes to be read. To be in agreement with the communication protocol syntax of the interrogator, Carriage Return/Line Feed (CR/LF) are also included in the stream and, therefore, "2" must be added to the value returned by the last 4 bytes of the stream.

The returned data represents the power values of the OSA traces for all optical channels with points from 1500 nm to 1600 nm sampled every 5 pm.

Example:

Command :ACQU:OSAT:CONT:STAR

Answer Port 3500 » :ACK
Port 3365 »

$$\left[\begin{array}{ccc} -68,92 & -20,46 & \dots \end{array} \right]_{\#OCx20001}$$

:ACQUisition:WAVElength:CONTInuous:STARt

Continuous acquisition of the peak wavelengths of the fiber Bragg grating sensors in all channels of the FS22. This command is sent via port 3500 and corresponding data is received through port 3365. The answer is a string starting with the timestamp with the format «YYYY.MM.DD:hh:mm:ss» followed with the wavelengths in growing order of wavelength separated by ",", from all channels separated by ":".

Note: if there are channels with no sensors, the answer will have no wavelength between ":".

Example:

Command	:ACQU:WAVE:CONT:STAR
Answer	Port 3500 » :ACK Port 3365 » 2011.10.07:16:04:52: 1523.6573, 1554.0709, 1566.7846:: 1567.6987, 1584.9825: 1534.9824

:ACQUisition:ENGIneering:CONTInuous:STARt

When the Smart Peak Detection (SPD) is enabled, this command returns the engineering values according to the range formula (FML) in all defined ranges of all channels.

When the Smart Peak Detection (SPD) is disabled, this command returns the peak wavelength of the fiber Bragg grating sensors in all channels.

This command is sent via port 3500 and corresponding data is received through port 3365. The answer is a string starting with the timestamp with the format «YYYY.MM.DD:hh:mm:ss» followed with the values in growing order of wavelength separated by ",", from all channels separated by ":".

Note: on the conventional measurement method if there are channels with no sensors, the answer will have no wavelength between ":". On the SPD method if there are no sensors detected within a defined range the interrogator returns -998.

Example:

Command	:ACQU:ENGI:CONT:STAR
Answer	Port 3500 » :ACK Port 3365 » 2016.07.29:14.18.42: 12.1254,23.4511::14.2301:25.6322

:ACQUIsition:WAVElength:CONTInuous:NTPSync:START

Continuous acquisition of wavelengths of all the channels of the interrogator. This command is sent via port 3500 and corresponding data is received through port 3365. The received data is in binary format and contains information on Timestamp, Wavelength values of all sensors from all optical channels with the following structure:

- 1) Fixed Header (30 bytes) [always sent independently of the payload content (even without sensors)]:
 - a) 2 bytes (sync "#0")
 - b) 4 bytes (remaining header length 24 bytes + payload length)
 - c) 8 bytes (timestamp):
 - i) LWORD1: seconds since 1.1.1970
 - ii) LWORD2: fraction of current second mapped to an integer range of 32 bit (i.e. 0.5 s would correspond to $\frac{1}{2} * 2^{32}$)
 - d) 2 bytes #sensors CH0 + 2 bytes #sensors CH1 + 2 bytes #sensors CH2 + 2 bytes #sensors CH3 + 2 bytes #sensors CH4 + 2 bytes #sensors CH5 + 2 bytes #sensors CH6 + 2 bytes #sensors CH7
 - 2) Payload:
 - a) Payload on interrogator with 1 optical channel:
4 bytes CH0/wvl0 + 4 bytes CH0/wvl1 + (...)
 - b) Payload on interrogator with 4 optical channels:
4 bytes CH0/wvl0 + 4 bytes CH0/wvl1 + (...) + CH3/wvl0 + CH3/wvl1 + (...)
 - c) Payload on interrogator with 8 optical channels:
4 bytes CH0/wvl0 + 4 bytes CH0/wvl1 + (...) + CH7/wvl0 + CH7/wvl1 + (...)
- with wavelengths in ascending order [wvl0 < wvl1 < (...)].

Example:

Command :ACQU:WAVE:CONT:NTPS:STAR

Answer Port 3500 » :ACK

Port 3365 »

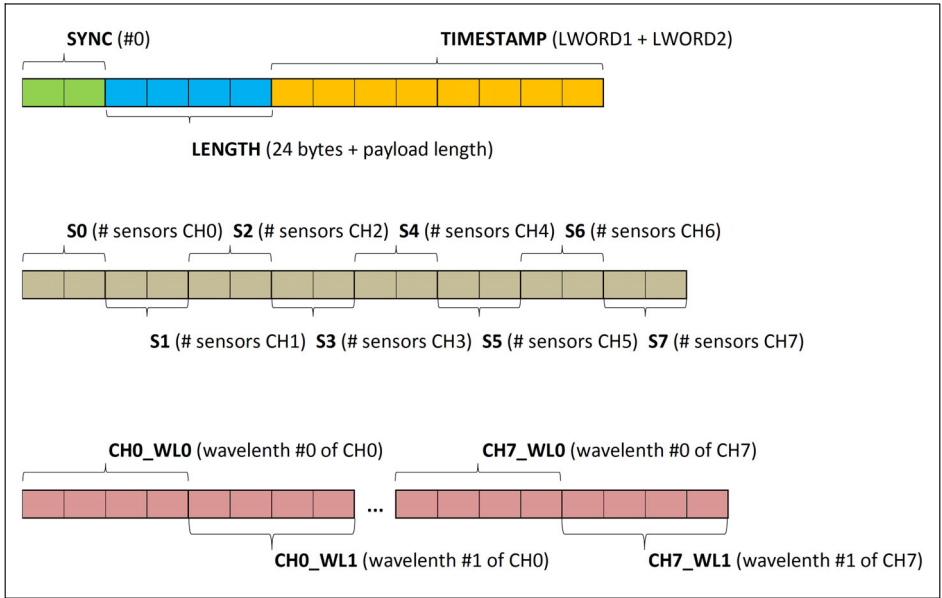


Fig. 5.2 NTP answer scheme (wavelength values)

:ACQIstion:ENgINEERING:CONTInuous:NTPSync:STArT

Continuous acquisition of engineering data of all the channels of the interrogator. This command is sent via port 3500 and corresponding data is received through port 3365. The received data is in binary format and contains information on Timestamp, Engineering values of all sensors from all optical channels with the following structure:

- 3) Fixed Header (30 bytes) [always sent independently of the payload content (even without sensors)]:
 - a) 2 bytes (sync "#0")
 - b) 4 bytes (remaining header length 24 bytes + payload length)
 - c) 8 bytes (timestamp):
 - i) LWORD1: seconds since 1.1.1970
 - ii) LWORD2: fraction of current second mapped to an integer range of 32 bit (i.e. 0.5 s would correspond to $\frac{1}{2} * 2^{32}$)
 - d) 2 bytes #sensors CH0 + 2 bytes #sensors CH1 + 2 bytes #sensors CH2 + 2 bytes #sensors CH3 + 2 bytes #sensors CH4 + 2 bytes #sensors CH5 + 2 bytes #sensors CH6 + 2 bytes #sensors CH7
 - 4) Payload:
 - a) Payload on interrogator with 1 optical channel:
4 bytes CH0/s0 + 4 bytes CH0/s1 + (...)
 - b) Payload on interrogator with 4 optical channels:
4 bytes CH0/s0 + 4 bytes CH0/s1 + (...) + CH3/s0 + CH3/s1 + (...)
 - c) Payload on interrogator with 8 optical channels:
4 bytes CH0/s0 + 4 bytes CH0/s1 + (...) + CH7/s0 + CH7/s1 + (...)
- with sensors in reference wavelength ascending order [$s_{0_{wvl}} < s_{1_{wvl}} < (...)$].

Example:

Command :ACQU:WAVE:CONT:NTPS:STAR
Answer Port 3500 » :ACK
 Port 3365 »

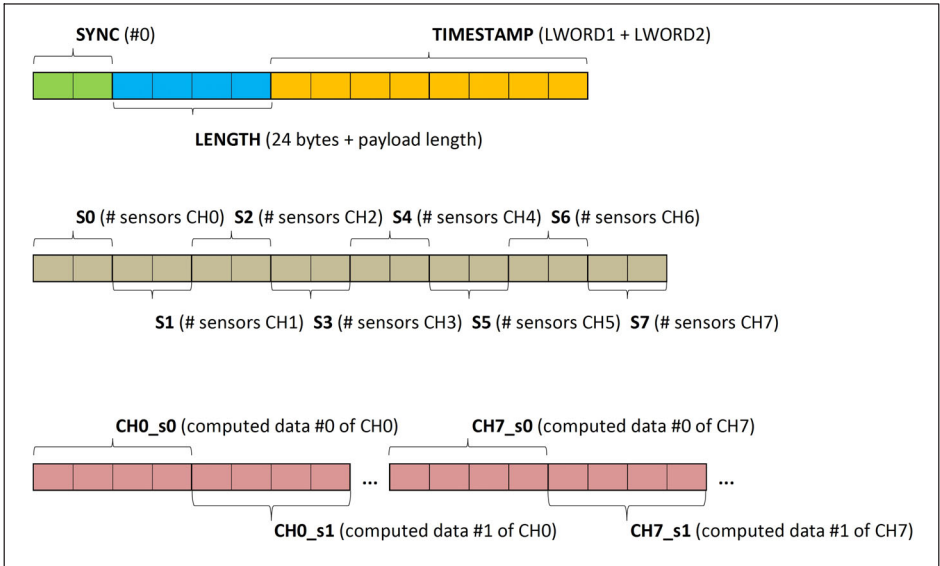


Fig. 5.3 NTP answer scheme (engineering values)

:ACQUisition:SAVE:CONTinuous:STARt

Starts continuous absolute wavelength peak saving on the instrument internal memory. Saved data is stored on a separate directory for each day. The directory name is the date in the format «YYYYMMDD»

Note: Saving with different operating methods may be saved on the same data set, if these two types of data recording have been selected on the same day.

Note: Scheduled acquisition may be saved on the same data set as continuous acquisition if these two types of data recording have been selected on the same day (see section "Scheduled Acquisition" on page 53).

Example:

Command :ACQU:SAVE:CONT:STAR
Answer Port 3500 » :ACK

Scheduled Acquisition

:ACQUisition:SCHEdule:START

Starts scheduled acquisition with the defined period and number of samples. Data is stored on the instrument internal memory on a separate directory for each day. The directory name is the date in the format «YYYYMMDD».

Note: Scheduled acquisition may be saved on the same data set as continuous acquisition if these two types of data recording have been selected on the same day (see section “Continuous Acquisition” on page 47).

The interrogator does not resume scheduled acquisition if power fails during sleep.

Example:

Command :ACQU:SCHE:STAR

Answer :ACK

:ACQUisition:SCHEdule:PERIod?

Queries the set period for scheduled acquisitions on the FS22. The answer is a string with time in the following format «HH:MM:SS»

Example:

Command :ACQU:SCHE:PERI?

Answer :ACK: 01:00:00

:ACQUisition:SCHEdule:PERIod:HH:MM:SS

Sets the period for scheduled acquisitions on the FS22. The period is defined as a time interval with the format «HH:MM:SS». The minimum period is 5 seconds and maximum period is 23 hours, 59 minutes and 59 seconds.

Note: the defined period must never be smaller than the needed for the defined number of samples.

Example:

Command :ACQU:SCHE:PERI:01:00:00

Answer :ACK

:ACQUisition:SCHEdule:SAMPles?

Queries the set number of samples to collect on each scheduled acquisition on the FS22. The answer is an integer.

Example:

Command :ACQU:SCHE:SAMP?

Answer :ACK:300

:ACQUisition:SCHEdule:SAMPles:S

Sets the number of samples to collect on each scheduled acquisition on the FS22. It is an integer that will correspond to the number of seconds. The minimum definable number of samples is 1 and the maximum is 86399.

Note: the defined number of samples must never be higher than the number of seconds available with the defined schedule period.

Example:

Command :ACQU:SCHE:SAMP:300

Answer :ACK

5.1.6 Memory Commands

:MEMORy:LIST:DIREctory?

Queries for directory list of previously saved data. Returns a list of directories separated with ";".

Example:

Command :MEMO:LIST:DIRE?

Answer :ACK:20150903;20151005;20151006;1051007

:MEMOry:RECA:DATA:YYYYMMDD?

Queries for data previously stored in the internal memory of the FS22 on the specified directory. Directories name have the following format «YYYYMMDD». Returns the data containing the timestamp and the absolute wavelength values of the fiber Bragg grating sensors in each channel. Timestamp is calculated using the number of seconds elapsed since 12:00 A.M. Friday, January 1st, 1904. The interrogator will not be responsive to other commands, while data file is being transferred. The command does not delete downloaded data. This command is sent via port 3500 and corresponding data is received through port 3365. Files larger than 100 MB must be downloaded using BraggMONITOR.

Example:

Command	:MEMO:RECA:DATA:20111007?
Answer	Port 3500 » :ACK Port 3365 » :2011.10.07:00:00:00: 1523.6573, 1554.0713, 1566.7851:: 1567.6991, 1584.9830: 1534.9824 :2011.10.07:00:00:01: 1523.6579, 1554.0709, 1566.7846:: 1567.6987, 1584.9825: 1534.9824 :2011.10.07:00:00:02: 1523.6571, 1554.204, 1566.7849:: 1567.6985, 1584.9828: 1534.9844

:MEMOry:DELEte:YYYYMMDD

Deletes the YYYYMMDD data file previously stored in the internal memory of the FS22. The file name can be set to A to delete all stored files in the internal memory.

Example:

Command	:MEMO:DELE:20140718
Answer	:ACK

6 BRAGGMONITOR SI SOFTWARE DETAILS

6.1 Software Version

This document refers to BraggMONITOR SI Software version v2.6.

This application is compatible with all FS22 Series 1S/s acquisition rate interrogators.

6.2 Install and Uninstall Software

6.2.1 System Requirements

To operate the current version of BraggMONITOR, your PC must have the following requirements:

- Intel Pentium or equivalent processor upwards from 1 GHz
- Windows® XP (32 Bit and 64 Bit versions), Windows Vista® (32 Bit and 64 Bit versions), Windows® 7 (32 Bit and 64 Bit versions, Home, Professional or Ultimate editions) or Windows® 8/8.1 (32 Bit and 64 Bit versions) or Windows® 10 (32 Bit and 64 Bit versions)
- Main memory (RAM):
 - at least 512 Mbyte for Windows® XP
 - at least 1,024 Mbyte for Windows Vista®
 - at least 2,048 Mbyte for Windows®7 or higher
- Graphics card (and screen) with a resolution of 1,024 x 768 pixel or higher
- Approx. 1 Gbyte of free storage capacity for the program installation; at least a further 1 Gbyte is needed for the temporary storage of data; however you can also use a different drive for this.
- Ethernet interface (100/1000 MBit)

The above requirements are sufficient if you use low sample rates and some sensors. You must use a more powerful PC if you wish to use a large number of sensors with high sample rates.

Processor	
Pentium III / Celeron	
866 MHz	
Operating system	
Windows XP (with SP3) or higher	
Memory	
RAM	1 GB
available disk space	1.5 GB
Screen	
video adapter	Super VGA
resolution	1024x768

6.2.2 Software Installation

To install HBK FiberSensing BraggMONITOR SI Software on a PC, please follow the described steps:

- ▶ Insert the provided disk with software in the PC;
- ▶ Run **Setup.exe** inside BraggMONITOR folder;

i Information

When the operating system is Windows Vista or higher, open setup.exe as an Administrator with a right-click (see Fig. 6.1).

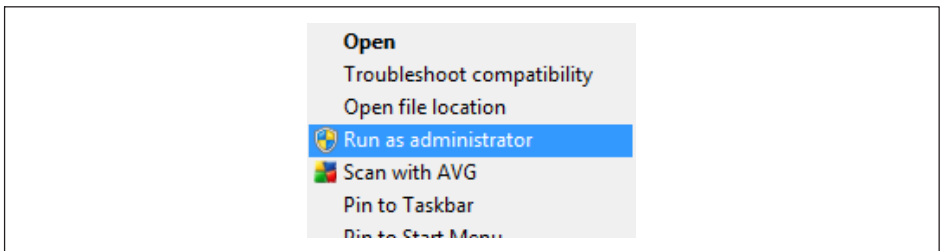


Fig. 6.1 Run as administrator (once)

- ▶ Follow the described steps and press **finish**.

The installation is now completed. You will need to restart the computer before using the application.



Information

Using windows display settings with the size of text not set to 100% might compromise the correct visualization of BraggMONITOR SI software.

6.2.3 Software Uninstall

To uninstall the application, use the Add/Remove programs tool in Windows

- ▶ Enter control panel
- ▶ Select programs and features
- ▶ Select BraggMONITOR SI Software
- ▶ Click **uninstall/change** option and follow the steps.

6.3 Running the Software

6.3.1 Network Properties

To operate the interrogator, the PC network properties should be set so that both elements are configured in the same subnet.

To configure your personal computer so that it is on the same subnet as the default for the interrogator, *proceed as described on section 3.6.1 "Network Properties"*.

6.3.2 Run as Administrator

The BraggMONITOR SI Software should run with full administrator privileges. To have these privileges when the operating system is Windows Vista or higher, the user shall right-click the BraggMONITOR SI Software icon and then select the "Run as administrator" option (see Fig. 6.1).

To configure the application to always open with Administrator privileges, right-click on the software icon and select "Properties > Compatibility". Check the box "Run this program as administrator" (see Fig. 6.2).

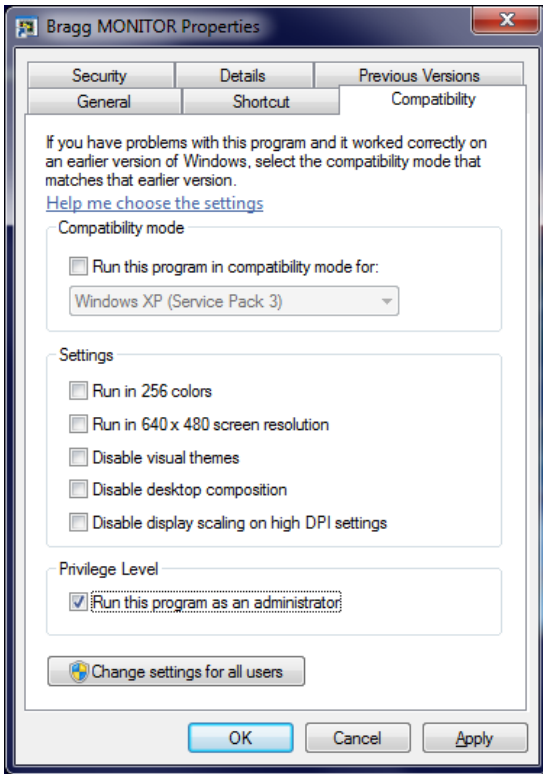


Fig. 6.2 Set Run as administrator automatically

7 BRAGGMONITOR SI USER INTERFACE

The BraggMONITOR SI Software graphical interface is divided into two different areas (Fig. 7.1):

- 1 General Bar
- 2 Graphical Area

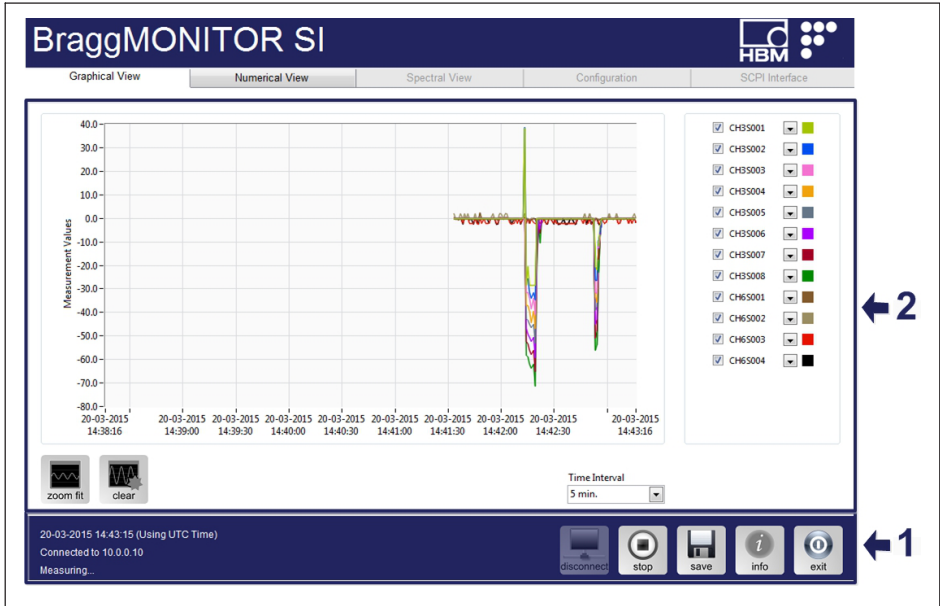


Fig. 7.1 BraggMONITOR SI User interface

7.1 General Bar

The General Bar (number 1 in Fig. 7.1) is where the main acquisition actions can be performed. This bar is always on, although its buttons may be disabled due to the interrogator status.

On the left, general information is presented (see Fig. 7.2):

- On the first line interrogator configured date and time is presented.
- The second line is destined for the connection status to the interrogator.
- The last and third line is destined to inform the user on the current status of the interrogator and error messages. For attention, error messages are shown in orange (see Fig. 7.3).

```
20-03-2015 14:43:15 (Using UTC Time)
Connected to 10.0.0.10
Measuring...
```

Fig. 7.2 Current status information

```
20-04-2017 09:36:52 (Using UTC Time)
Connected to 10.0.0.10
Check sensor CH0S011 (Range min. value overlaps with previous range interval)
```

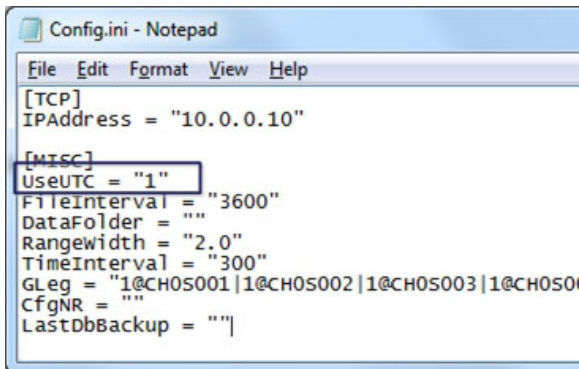
Fig. 7.3 Error message

7.1.1 Date and Time

The BraggMONITOR SI Software uses by default the UTC defined time on the PC that it is operating with. The BraggMONITOR updates the interrogator date and time settings when it connects to the device. Data, either by using the BraggMONITOR or the internal memory of the interrogator, will be saved with this time stamp.

It is possible to change the BraggMONITOR SI Software time reference from UTC to the defined Local Time on your device. To do so, you should change the "config.ini" file that is on the Application folder.

- ▶ Close the BraggMONITOR application;
- ▶ Open and edit the **Config.ini** file;
- ▶ Change the parameter «UseUTC = "1"» to «UseUTC = "0"» and save the file (Fig. 7.4);
- ▶ Run the BraggMONITOR application as an administrator.



```
Config.ini - Notepad
File Edit Format View Help
[TCP]
IPAddress = "10.0.0.10"

[MISC]
UseUTC = "1"
FileInterval = "3600"
DataFolder = ""
Rangewidth = "2.0"
TimeInterval = "300"
GLeg = "1@CH0S001|1@CH0S002|1@CH0S003|1@CH0S004"
CfgNR = ""
LastDbBackup = ""
```

Fig. 7.4 Config.ini file

The Time definitions on the PC can be checked and/or configured on the Control Panel under the Date and Time (Fig. 7.5).

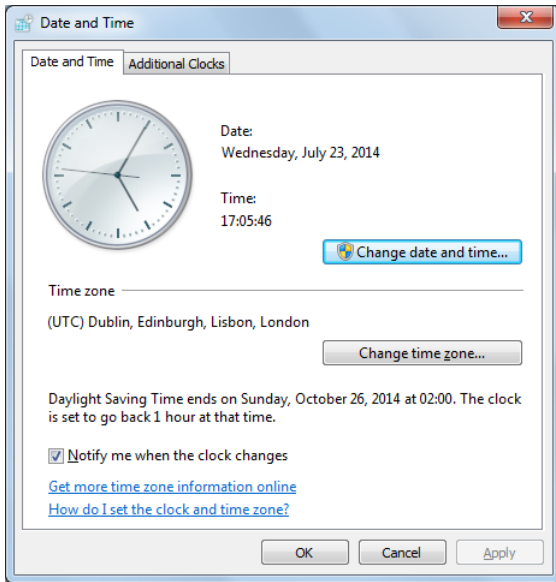


Fig. 7.5 Date and time window

To adjust the time zone, chose the "Change time zone..." button (Fig. 7.5).

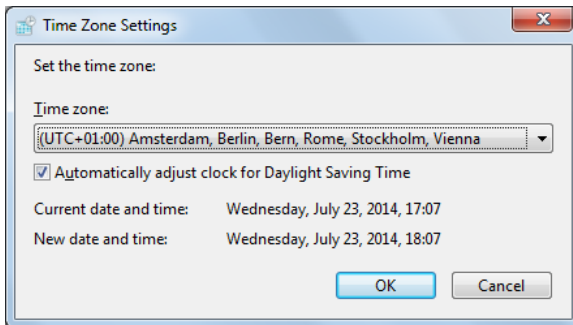


Fig. 7.6 Date and time settings - time zone

To adjust the Local Time, chose the "Change date and time..." button (Fig. 7.5).

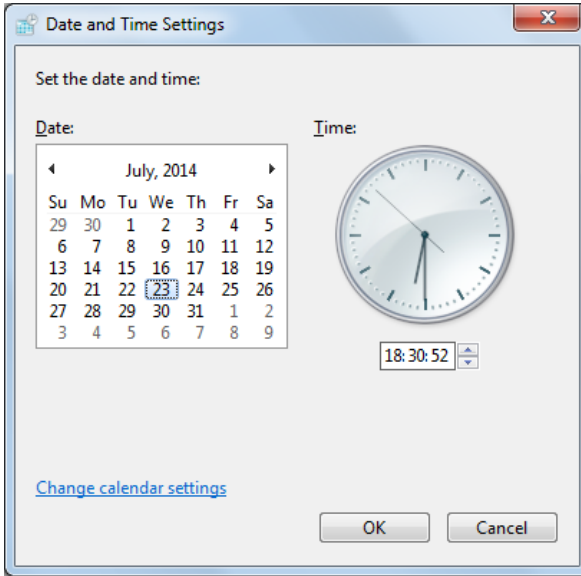


Fig. 7.7 Date and time settings - date and time

7.1.2 Connecting to the Interrogator

The first action to perform before starting an acquisition is to establish a connection between the interrogator and BraggMONITOR. For that, press the “Connect” button (number 1 in Fig. 7.8).

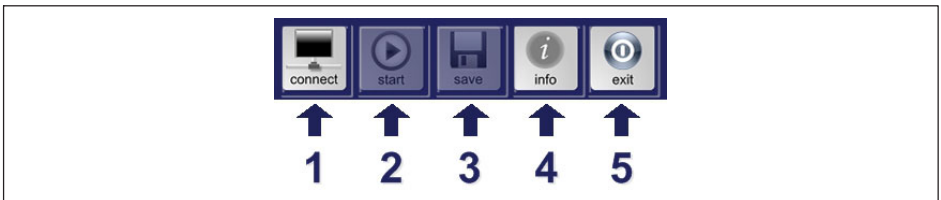


Fig. 7.8 Buttons on General Bar

A popup window will appear to indicate/select the IP Address of the interrogator to which the connection will be established (see Fig. 7.9). This popup window also allows one to search for FS22 interrogators in the network. To perform this search the “search” button shown with number 1 in Fig. 7.9 should be pressed.

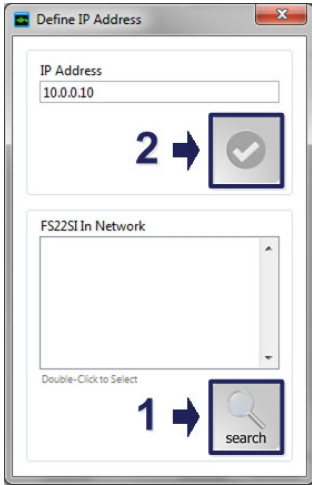


Fig. 7.9 Connecting via IP address

After successfully connecting to the IP indicated, the “connect” button (number 1 in Fig. 7.8) changes to “disconnect” (Fig. 7.10).



Fig. 7.10 Connect/Disconnect button status

7.1.3 Acquisition

Start Acquisition

Whenever the software is connected to an interrogator and the software is on the Graphical View and Numerical View Tabs, the “start” button (number 2 in Fig. 7.8) becomes active, as shown in Fig. 7.11.



Fig. 7.11 Active Start Button

Press “start” button to start acquisition. This will start the acquisition and representation of the configured sensors.

i **Information**

It is necessary to configure sensors in order to start an acquisition.

Once the “start” button is pressed, it will change its appearance to “stop” button (Fig. 7.12).

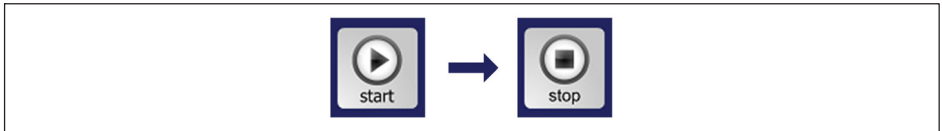


Fig. 7.12 Start and Stop button status

Measured values are represented in wavelength shift (in nm) relative to the central wavelength or engineering values, according to the formula defined on the Configuration tab (see section “Add, Edit and Delete Sensor(s)” on page 79). It is possible to obtain absolute values of temperature, strain, acceleration, etc. However, a sensor configuration must be defined.

Saving Data

To save data, press the “save” button (number 3 in Fig. 7.8). The data will be saved in the path specified in the field “Data Folder” on the Configuration tab (see section “Data File” on page 81).

The button will change its appearance stating the software status (see Fig. 7.13). It will also change its appearance whenever the mouse is on top of the button stating the action to perform.

To stop recording, uncheck the “saving” button.

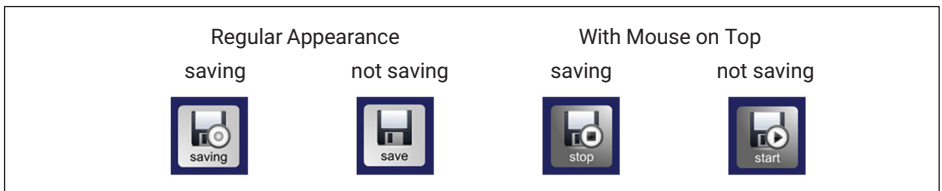


Fig. 7.13 Data saving button status

Saved Data Files

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

Data sets will be recorded in .txt files automatically named, as follows:

BraggMONITOR SI Data [YYYY.MM.DD.HH.MM.SS ; YYYY.MM.DD.HH.MM.SS].txt.

The YYYY.MM.DD.HH.MM.SS parts of the filename represent the start and finish, respectively, of the period during which the data has been saved.

Data is organized in columns (see Fig. 7.15). The first row is a header indicating how many samples were acquired per second. The second row is a header containing the labels of each column:

Samples per Second		1				
UTC Date	UTC Time	Sample	CH1.S01 (1522.122 ; x)	CH1.S02 (1528.579 ; x)	CH1.S03 (1534.815 ; x)	CH1.S04 (1541.2108 ; x)
24-07-2014	09:56:47	00001	1522.1218	1528.5776	1534.8151	1541.2113
24-07-2014	09:56:48	00002	1522.1222	1528.5773	1534.8152	1541.2108
24-07-2014	09:56:49	00003	1522.1220	1528.5777	1534.8146	1541.2106
24-07-2014	09:56:50	00004	1522.1218	1528.5773	1534.8148	1541.2110
24-07-2014	09:56:51	00005	1522.1219	1528.5773	1534.8153	1541.2109
24-07-2014	09:56:52	00006	1522.1221	1528.5774	1534.8148	1541.2109
24-07-2014	09:56:53	00007	1522.1220	1528.5773	1534.8147	1541.2108
24-07-2014	09:56:54	00008	1522.1219	1528.5769	1534.8149	1541.2111
24-07-2014	09:56:55	00009	1522.1214	1528.5770	1534.8148	1541.2108
24-07-2014	09:56:56	00010	1522.1219	1528.5774	1534.8147	1541.2107
24-07-2014	09:56:57	00011	1522.1215	1528.5770	1534.8143	1541.2106
24-07-2014	09:56:58	00012	1522.1218	1528.5770	1534.8146	1541.2112
24-07-2014	09:56:59	00013	1522.1219	1528.5769	1534.8148	1541.2108
24-07-2014	09:57:00	00014	1522.1220	1528.5775	1534.8144	1541.2105
24-07-2014	09:57:01	00015	1522.1215	1528.5771	1534.8146	1541.2107

Fig. 7.14 Data file header

- 1st column – UTC or Local Date (according to what is configured) with format «DD-MM-YYYY»
- 2nd column – UTC or Local Time with format «HH:MM:SS »
- 3rd column – Sample number
- 4 Following columns – Sensor name (Central wavelength (nm); formula) - ordered by optical channel and then by wavelength. The values along these columns represent either wavelengths (in nm) or engineering values (units in accordance with Formula from Configuration tab) of the corresponding sensors.

Samples per Second		1				
UTC Date	UTC Time	Sample	CH1.S01 (1522.122 ; x)	CH1.S02 (1528.579 ; x)	CH1.S03 (1534.815 ; x)	CH1.S04 (1541.2108 ; x)
24-07-2014	09:56:47	00001	1522.1218	1528.5776	1534.8151	1541.2113
24-07-2014	09:56:48	00002	1522.1222	1528.5773	1534.8152	1541.2108
24-07-2014	09:56:49	00003	1522.1220	1528.5777	1534.8146	1541.2106
24-07-2014	09:56:50	00004	1522.1218	1528.5773	1534.8148	1541.2110
24-07-2014	09:56:51	00005	1522.1219	1528.5773	1534.8153	1541.2109
24-07-2014	09:56:52	00006	1522.1221	1528.5774	1534.8148	1541.2109
24-07-2014	09:56:53	00007	1522.1220	1528.5773	1534.8147	1541.2108
24-07-2014	09:56:54	00008	1522.1219	1528.5769	1534.8149	1541.2111
24-07-2014	09:56:55	00009	1522.1214	1528.5770	1534.8148	1541.2108
24-07-2014	09:56:56	00010	1522.1219	1528.5774	1534.8147	1541.2107
24-07-2014	09:56:57	00011	1522.1215	1528.5770	1534.8143	1541.2106
24-07-2014	09:56:58	00012	1522.1218	1528.5770	1534.8146	1541.2112
24-07-2014	09:56:59	00013	1522.1219	1528.5769	1534.8148	1541.2108
24-07-2014	09:57:00	00014	1522.1220	1528.5775	1534.8144	1541.2105
24-07-2014	09:57:01	00015	1522.1215	1528.5771	1534.8146	1541.2107

↑
1

↑
2

↑
3

↑
4

Fig. 7.15 Data in data file

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 **From Text** → **Data** → **Get External Data** (see Fig. 7.16) and select the data file.

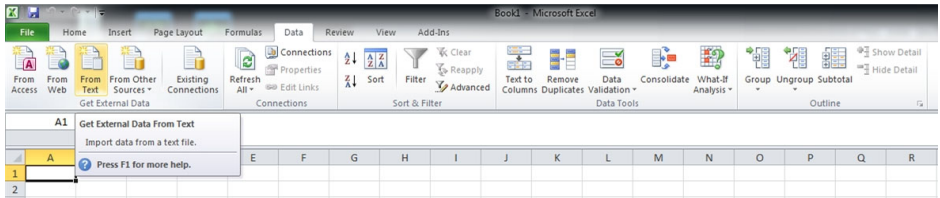


Fig. 7.16 Import data in Excel

Then, it is necessary to complete text import wizard. All options must be set as shown in Fig. 7.17, Fig. 7.18, Fig. 7.19, Fig. 7.20 and Fig. 7.21.

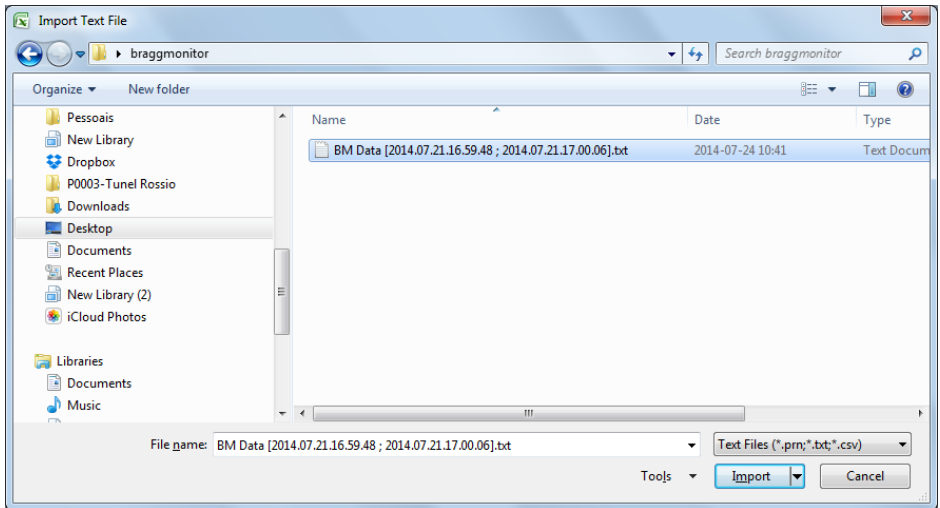


Fig. 7.17 Select data file

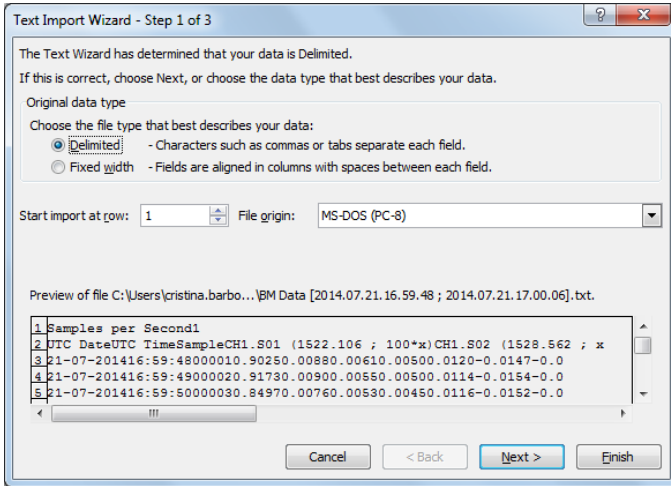


Fig. 7.18 Text Import Wizard 1/3

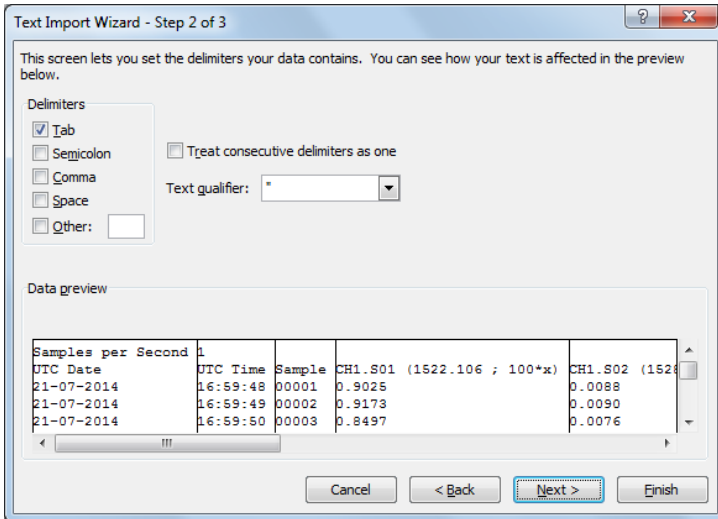


Fig. 7.19 Text Import Wizard 2/3

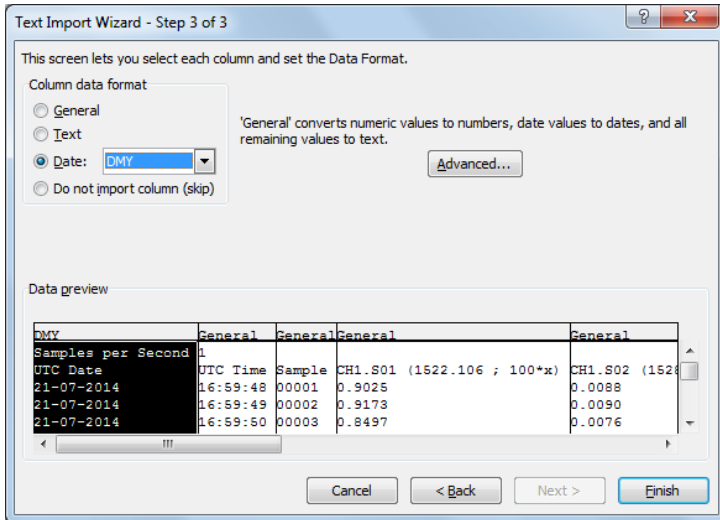


Fig. 7.20 Text Import Wizard 3/3

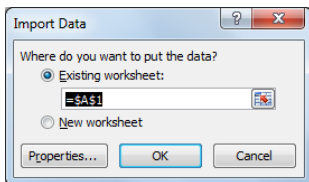


Fig. 7.21 Select data import location

Stop Acquisition

To stop the acquisition, press the “stop” button (Fig. 7.12), on position number 2 in Fig. 7.8. It will return to the state showed in Fig. 7.11.

7.1.4 Software and Interrogator Information

General information about the software and the interrogator can be displayed by pressing the “info” button (number 4 in Fig. 7.8).

7.1.5 Exit Application

To exit BraggMONITOR SI Software application, press the Exit button (number 5 in Fig. 7.8).

7.2 Graphical Area

The graphical area is divided into five tabs:

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

7.2.1 Graphical View

On the Graphical View, graphical representation of the measured values can be found over time (number 1 in Fig. 7.22).

It is possible to enable and disable the graphical representation of one or more sensors by checking and unchecking the check boxes (number 2 in Fig. 7.22). The displayed sensors can be changed by clicking on the scroll down menus along the right-hand side of the interface (number 2 in Fig. 7.22).

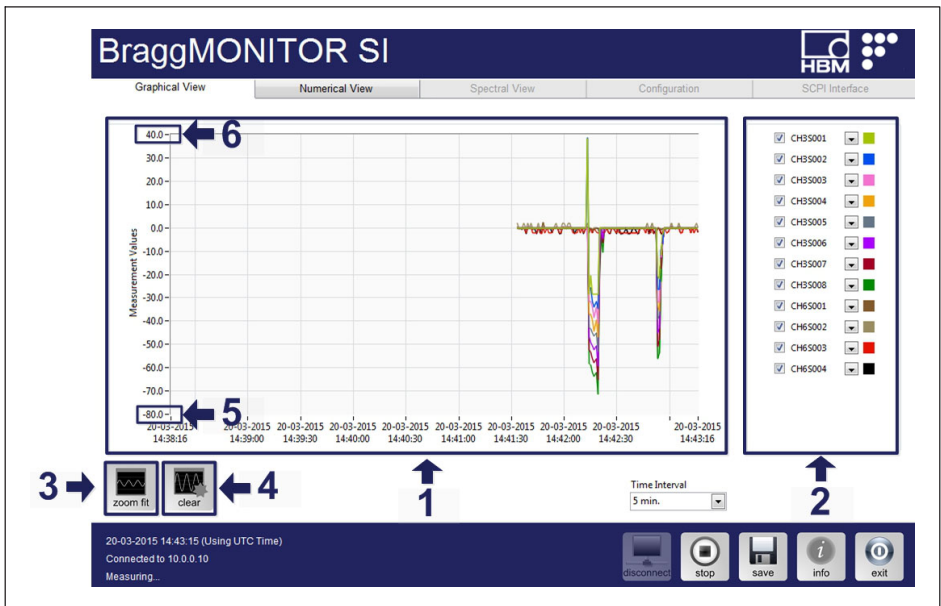


Fig. 7.22 Graphical View

Zooming

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 fit button (number **3** in *Fig. 7.22*).

It is also possible to modify vertical axis scale by clicking and inserting the axis numbers, identified with number **5** and **6** in *Fig. 7.22*.

The represented time interval (on the horizontal axis) can be selected from the Time Interval drop-down menu (number **7** in *Fig. 7.22*). The horizontal scale cannot be manually changed.

Clear Representation

Data represented on graphical display can be erased by pressing the clear button (number **4** in *Fig. 7.22*).

7.2.2 Numerical View

The Numerical View tab shows the acquired measurements for each sensor, organized by optical channel as shown in *Fig. 7.23*. For each channel there are two columns, one with the name of the sensors and another with wavelength shift (in nm) relative to the central wavelength or engineering values (units defined by the sensor Formula in Configuration tab) (number **1** in *Fig. 7.23*). Next to the channel identifier, the number of sensors detected in that channel is stated (number **2** in *Fig. 7.23*).

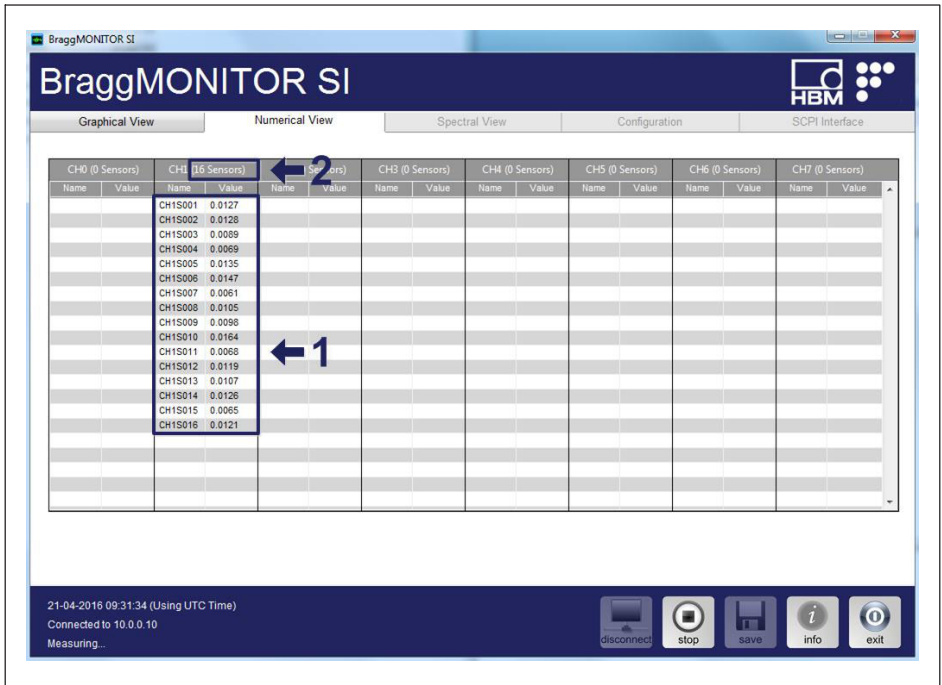


Fig. 7.23 Numerical View

7.2.3 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 interrogator. The full spectrum contains 20001 data points corresponding to the reflected optical power in dBm from 1500 nm to 1600 nm with a 5 pm sampling resolution (number 1 in Fig. 7.24).

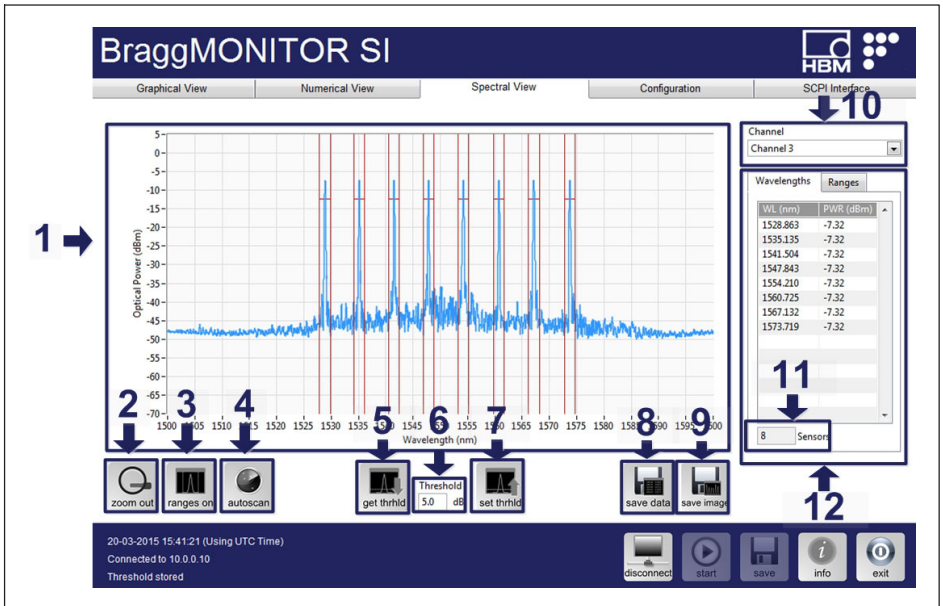


Fig. 7.24 Spectral View - Smart Peak Detection (SPD)

The spectral monitor can only represent one channel at a time. Channel selection can be done at the Channel scroll down box (number 10 in Fig. 7.24).

The BraggMONITOR can now be used to activate and configure two methods for FBG sensor detection. A conventional method (ranges OFF) that uses a global threshold and the Smart Peak Detection (ranges ON) that uses the threshold individually inside each sensor range.

Ranges

Using the "ranges on/off" button (number 3 in Fig. 7.24) the user may select which FBG sensor detection method will be used.

When ranges are ON (see Fig. 7.24), the spectral graph will display the range associated with each sensor that is listed in the Configuration tab and the respective threshold used for the FBG peak computation. Even when multiple peaks occur inside one range, only one FBG sensor will be detected.

When the ranges are OFF (see Fig. 7.25), the spectral graph will contain the optical spectrum of the selected channel and an horizontal line representing the threshold level considered for the detection of the FBG sensors.

On the right side of the spectral view tab, below the optical channel selector, one can find info regarding the detected sensors (number 12 in Fig. 7.24).

Conventional Measurement Method

When the conventional method for FBG sensor detection is selected only the "Wavelengths" table is displayed (see Fig. 7.25). In that table it is possible to observe the wavelengths of the detected sensor peaks (WL (nm)) and the corresponding powers (PWR (dBm)). Below the "Wavelengths" table a numeric indicator shows the number of detected sensors on the selected channel (number **11** in Fig. 7.24).

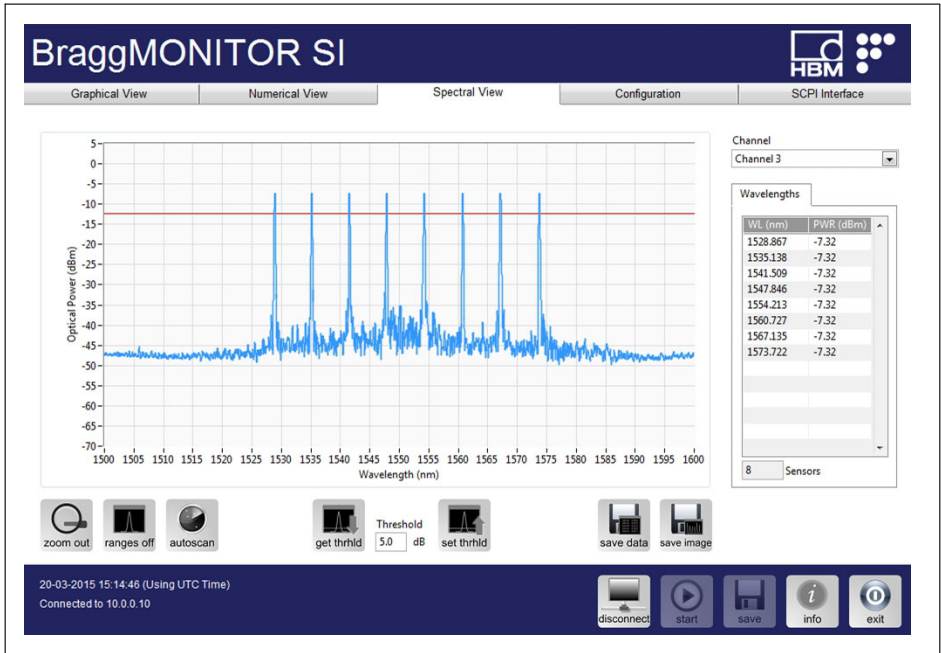


Fig. 7.25 Spectral View - Conventional detection method

SPD Measurement Method

When the Smart Peak Detection method is selected, besides the "Wavelengths" table, the "Ranges" table is also presented (number **1** in Fig. 7.26), in which the lower (Min. (nm)) and upper (Max. (nm)) limits of each sensor range are displayed. These limits can be manually edited here by the user by clicking on each box to be edited.

The "Plot Ranges" checkbox (number **2** in Fig. 7.26) can be used to activate or deactivate the display of the ranges limits on the spectral graph.

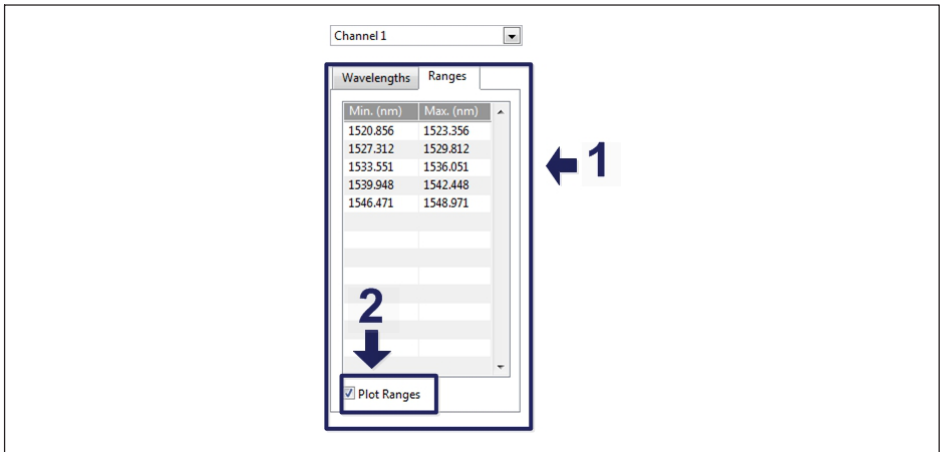


Fig. 7.26 Plot ranges

Threshold

The threshold value is defined for each channel, independently of the FBG sensor detection method, through the "set thrhld" button (number 7 in Fig. 7.24). The "get thrhld" button (number 5 in Fig. 7.24) can be used to return the threshold value that is stored for the selected optical channel on the interrogator.

The threshold value can be defined from 0 to 60 dB and corresponds to the considered power level for the FBG peak computation, so that side lobes and ground noise are disregarded.

The threshold value is updated every time the "spectral view" tab is selected.



Important

Measurement settings can influence sensor readings.

Conventional Measurement Method

When the ranges are OFF, the threshold is defined for each channel and is the same for all the sensors in that channel, see Fig. 4.4 on page 30.

SPD Measurement Method

When the ranges are ON, the Smart Peak Detection is active, allowing the effective use of the high dynamic range offered by the interrogator through the introduction of a threshold referenced to the peak on each sensor's configurable range (refer to Fig. 4.5 on page 31). As in the conventional measuring method, the threshold value corresponds to the considered power level for the FBG peak computation and it is defined in dB for each optical channel individually.

Autoscan

The autoscan functionality is used to detect the FBG sensors and to store the resulting configuration when its result is successful.

Upon an autoscan, Sensor Names are set by default as CHX.SABC, where X is the optical channel and ABC is the number of the sensor on that optical channel sorted by wavelength in ascending order.



Important

After an autoscan is successfully performed, the resulting configuration overwrites any previously existent one.

Conventional Measurement Method

In the case the ranges are OFF, the autoscan procedure will detect the sensors that are above the specified threshold. This threshold is referenced to the highest peak on the spectral trace.

SPD Measurement Method

For the case in which the ranges are ON, besides the threshold level, the autoscan procedure also takes into consideration the width of the ranges to detect the FBG sensors. When performing the autoscan with this method a pop up will appear for selecting the desired range width (see Fig. 7.27). The FBG sensor peaks are automatically detected accordingly to the autoscan threshold value. The minimum autoscan threshold value is 1dB, being the maximum limited to 30dB. The minimum admissible range width is 0.5 nm while the maximum is 100 nm.

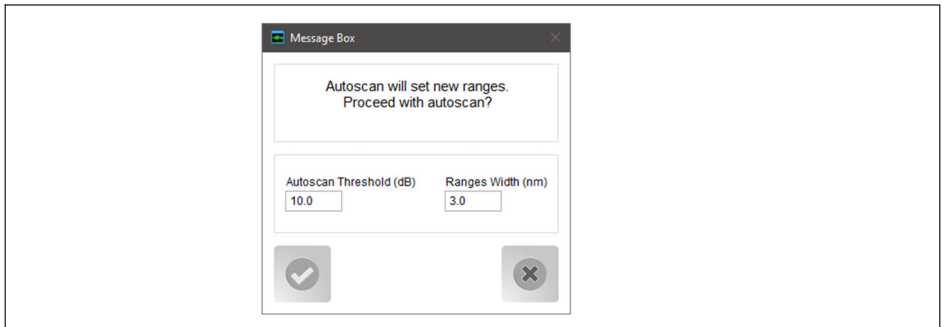


Fig. 7.27 Autoscan

Ranges maximum and minimum wavelengths will be set as the detected central wavelength of the FBG (displayed on the "Wavelengths" table as in number 12 in Fig. 7.24) plus/minus half the range width. Maximum and minimum range limits can then be changed on the "Ranges" table (number 1 in Fig. 7.26).



Important

If the autoscan detects errors like overlapping ranges, it will show the error message and will not be considered valid. The latest successfully defined configuration will be active.

Zooming

The spectral 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. 7.28). Once the desired zoom in section is defined, release the left mouse button and the display will show the Zoomed In section only (Fig. 7.29).

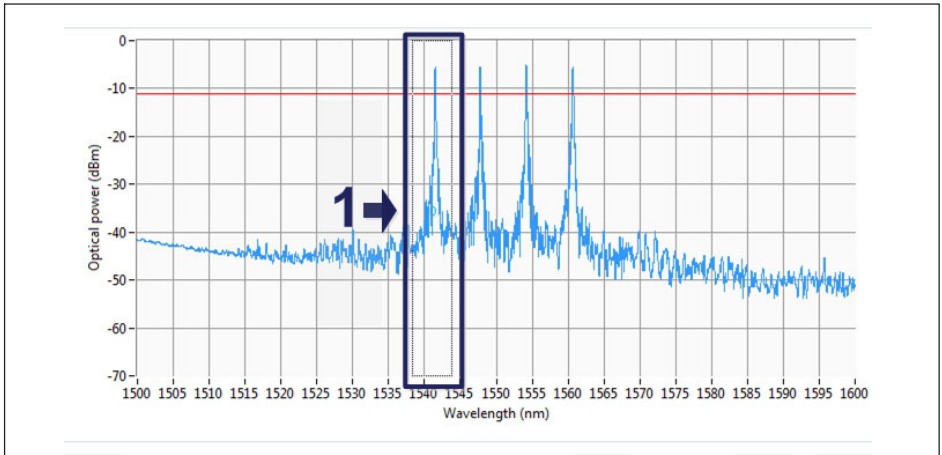


Fig. 7.28 Zoom section

In order to zoom back to full scale press the Zoom Out button (number 8 in Fig. 7.24).

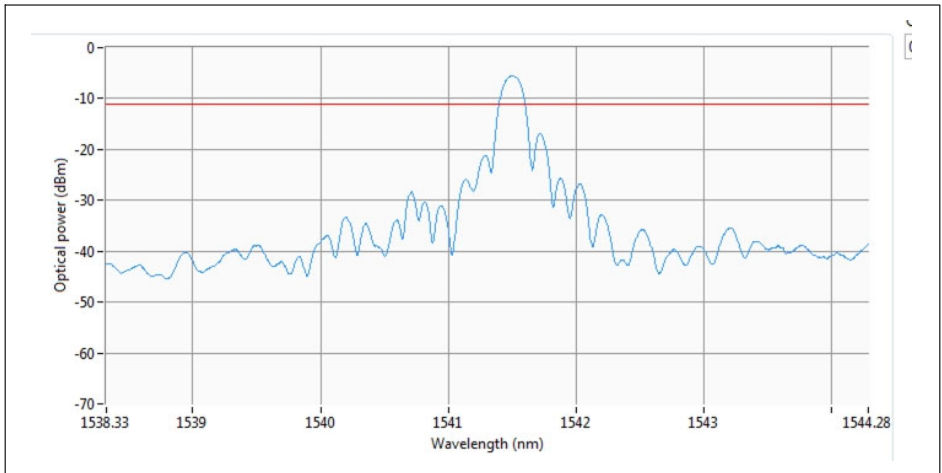


Fig. 7.29 Zoomed spectrum

Saving Spectral Data

To save spectral data, press the “save data” button (number 8 in Fig. 7.24), 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 (see Fig. 7.30). The save button will automatically return to its default state.

Saved data file is organized in columns (see Fig. 7.30), meaning:

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

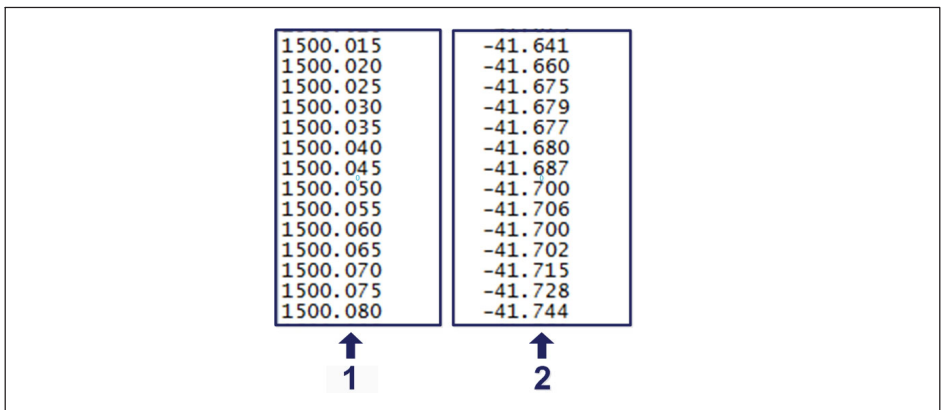


Fig. 7.30 Saved spectrum file

The “save image” button allows one to save a .bmp file containing an instant capture of the displayed spectral graph (number 9 in Fig. 7.24).

7.2.4 Configuration

Acquisition configuration allows one to perform sensors configuration. To accomplish this step correctly, sensors’ calibration sheets might be needed.

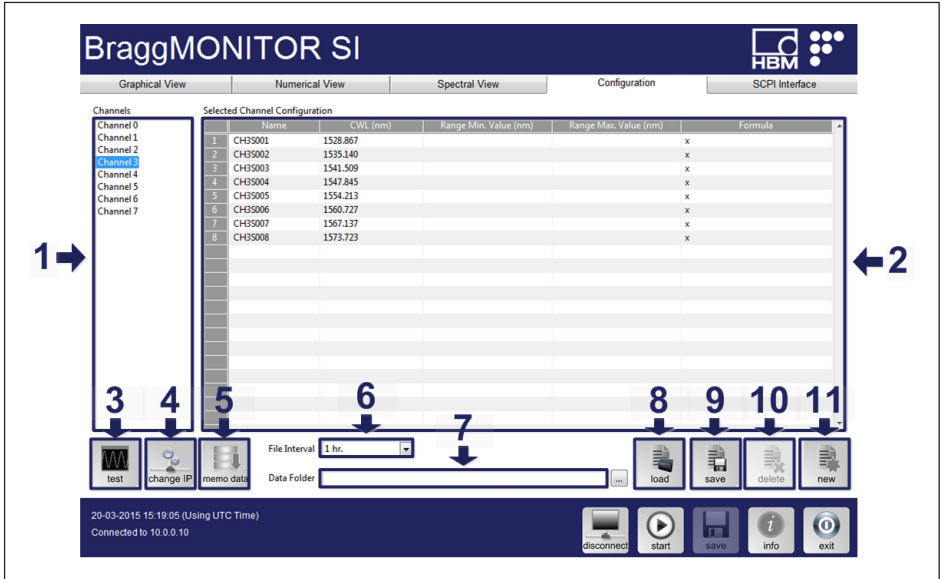


Fig. 7.31 Configuration View

Clear configuration

If an old configuration is set, it is possible to clear it and start a new configuration pressing button “new” (number 11 in Fig. 7.31). Be aware this operation will discard all previous configurations of all channels.

Add, Edit and Delete Sensor(s)

In order to Add a sensor to a configuration, the user is required to fill the fields (Name, Central wavelength (nm), Range Min. Value (nm), Range Max. Value (nm) and Formula) in the table (number 2 in Fig. 7.31). In the end, the new sensor is automatically sorted in the list by ascendant order using its central wavelength (nm). If any error is detected (for example, the Range Min. Value (nm) is higher than the central wavelength (nm)) an auxiliary message is displayed in the “General Bar”.

To Edit a sensor, the user can manually edit the fields corresponding to that particular sensor. The user can also delete a single sensor or all the sensors in an optical channel,

either selecting a sensor or the channel, respectively, and then pressing the "delete" button.

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 wavelength shift ($\Delta\lambda=x$) is calculated.	
Range Min. Value (nm) Range Max. Value (nm)	<p>Safety ranges defined to avoid crosstalk between sensors. Each sensor has its own operation range.</p> <p>It is not possible to configure sensors with overlapping ranges. Sensor measured wavelength values out of the defined bands are returned as -998. Inside each band only one peak is considered.</p> <p>Note: Ranges are only used/accessible when the SPD method is active (ranges ON).</p>	
Formula	Function defining the correlation between the wavelength shift ($\Delta\lambda=x$) 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 wavelength shift, insert x on formula text box.	
	The wavelength shift ($\Delta\lambda=x$) is calculated as the difference between the measured value at each sweep and the central wavelength (λ_0) defined for that peak.	
	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	

Tab. 7.1

Test configuration

Test Configuration (number **3** in Fig. 7.31) allows the user to check the current values from each sensor according to its configuration. Measured values will be displayed on the central wavelength field, in accordance to the defined formula for the sensor.

Information

Error code -998 will be displayed when no sensor is found within a range.

Data File Definition: Path and Length

As referred on section "Saved Data Files" on page 65, data sets are named automatically.

The path for file saving and the maximum duration of each file can be defined under the Configuration Tab.

By opening the "Data Folder" box (number 7 in Fig. 7.31) the default files path can be searched and defined.

The "File Interval" (number 6 in Fig. 7.31) will define the maximum length of each saved file. Consecutive files will be created every time the defined time is achieved. The duration of the files can be set to: 1 min, 5 min, 10 min, 15 min, 30 min, 1 Hour, 2 Hours, 3 Hours or 6 Hours.

Save and Load configuration

The configuration is stored in the interrogator and updated while starting the BraggMONITOR SI.

Any defined configuration can be saved in .txt extension file by pressing the "Save" button (number 9 in Fig. 7.31) and choosing a save path.

```
[RANGES;OFF]
[CH:1]
[THRESHOLD; 5.0]
CH1.S01 ; 1522.116
CH1.S02 ; 1528.571
CH1.S03 ; 1534.810
CH1.S05 ; 1547.735
[CH:2]
[THRESHOLD; 5.0]
CH2.S01 ; 1550.124
CH2.S02 ; 1562.879
[CH:3]
[THRESHOLD; 5.0]
[CH:4]
[THRESHOLD; 5.0]
[CH:5]
[THRESHOLD; 5.0]
[CH:6]
[THRESHOLD; 5.0]
[CH:7]
[THRESHOLD; 5.0]
```

Fig. 7.32 Configuration file (ranges on)

```
[RANGES;ON]
[CH:1]
[THRESHOLD; 5.0]
CH1.S01 ; 1522.106 ; 1520.856 ; 1523.356 ; x
CH1.S02 ; 1528.562 ; 1527.312 ; 1529.812 ; x
CH1.S03 ; 1534.801 ; 1533.551 ; 1536.051 ; x
CH1.S05 ; 1547.721 ; 1546.471 ; 1548.971 ; x
[CH:2]
[THRESHOLD; 5.0]
CH2.S01 ; 1550.142 ; 1549.892 ; 1552.392 ; x
CH2.S02 ; 1562.898 ; 1559.848 ; 1564.448 ; x
[CH:3]
[THRESHOLD; 5.0]
[CH:4]
[THRESHOLD; 10.0]
[CH:5]
[THRESHOLD; 5.0]
[CH:6]
[THRESHOLD; 15.0]
[CH:7]
[THRESHOLD; 5.0]
```

Fig. 7.33 Configuration file (ranges off)

The header of the file indicates whether it contains information of a configuration with ranges OFF ([RANGES;OFF] - Fig. 7.32) or with ranges ON ([RANGES;ON] - Fig. 7.33).

Conventional Measurement Method

For the case of a configuration without ranges, only the Name (number 1 in Fig. 7.33) and Central wavelength (nm) (number 2 in Fig. 7.33) are stored. This file might be edited in Notepad or Excel (see "Opening Data in Microsoft Excel" section on page 67) and saved as .txt extension file after editing.

SPD Measurement Method

In the case of a configuration with ranges ON, for each channel there are 5 columns: Name (number 1 in Fig. 7.33), Central wavelength(nm) (number 2 in Fig. 7.33), Range Min. Value (nm) (number 3 in Fig. 7.33), Range Max. Value (nm) (number 4 in Fig. 7.33), and Formula (number 5 in Fig. 7.33).

Configuration file can always be loaded by the user by pressing the Load button (number 8 in Fig. 7.31) and selecting the file containing the desired configuration (see Fig. 7.34).

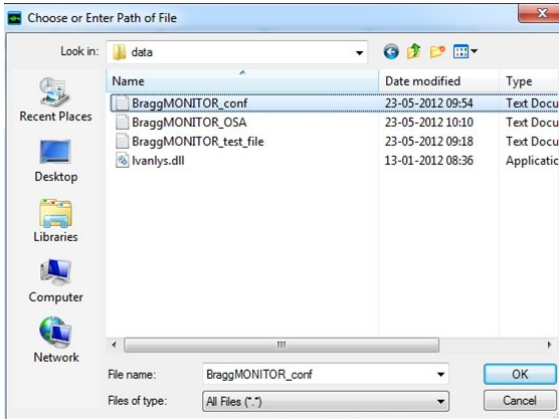


Fig. 7.34 Loading a configuration

Change IP Address

To change the IP address of the interrogator, you must be connected and access the Configuration tab. To check if the status is connected please refer to the connection status message displayed on the left of the General Bar. Press the change IP button to pop-up the change IP Address interface (see Fig. 7.35).

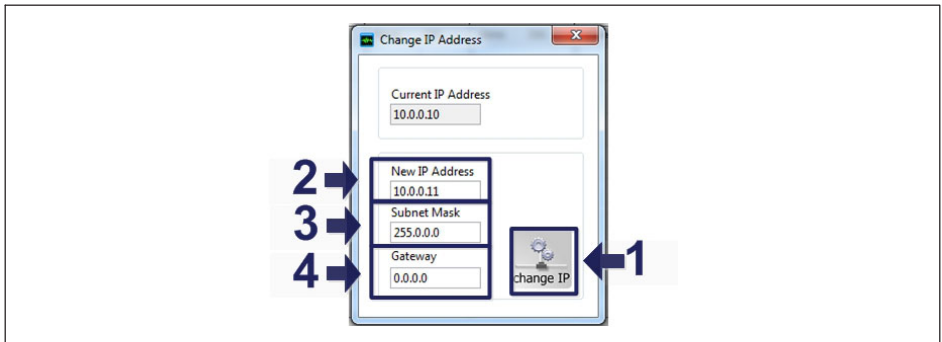


Fig. 7.35 Change IP address

Define the new IP Address (number **2** in Fig. 7.35). The Subnet Mask (number **3** in Fig. 7.35) will be automatically defined according to the IP Address. The Gateway is 0.0.0.0 by default and is user changeable (number **4** in Fig. 7.35). Then, press the Change IP button (number **1** in Fig. 7.35). The following procedure and status messages will be shown:

1. Interrogator is restarting. This can take more than a minute. Please wait.
2. Ping to interrogator is successful. Please wait.
3. Interrogator is ready.

After this process is complete, the connection will be established with the new IP.

Internal Memory Management

The data files created during scheduled acquisitions are saved into the internal memory of the interrogator (see “Scheduled Acquisition” section on page 53 for details).

To view the file list and download the data stored in the internal memory press the “memo data” button on the number **5** in Fig. 7.31. This button launches a pop up (see Fig. 7.36). Once a file is selected, on number **1** in Fig. 7.36, it is possible to download it by pressing the “download button” (number **2** in Fig. 7.36) or delete it using “delete” button (number **3** in Fig. 7.36). The files will be downloaded to the chosen directory on number **4** in Fig. 7.36.

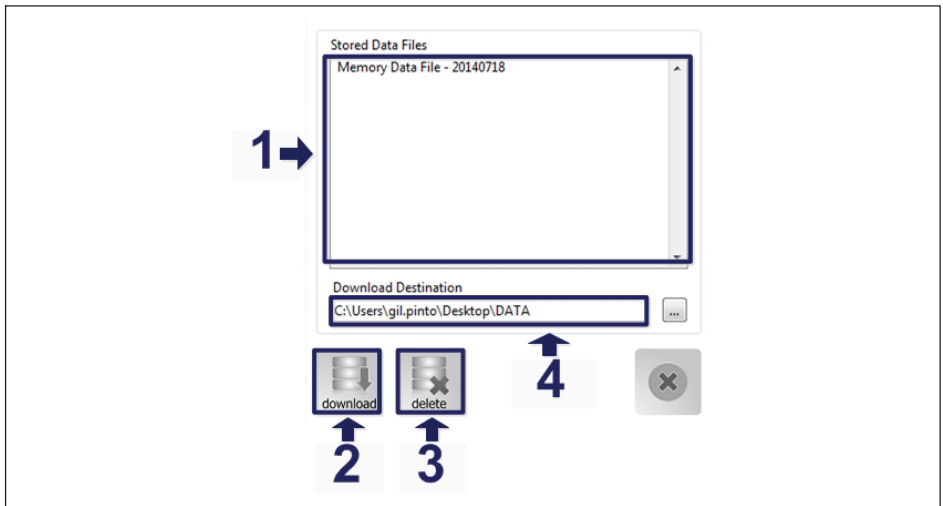


Fig. 7.36 Manage internal data memory

7.2.5 SCPI Interface

This tab allows the user to send Standard Commands for Programmable Instruments (SCPI) to the equipment. *Please refer to the available command list in section 5 "Remote Communications" on page 38.*

Commands are inserted on the command field (number **2** in Fig. 7.37) and sent by pressing Enter on the keyboard or the "send cmd" button (number **3** in Fig. 7.37). The interrogator's answers appear on the Reply field (number **1** in Fig. 7.37). Each time new answers are displayed, older ones are pushed down.

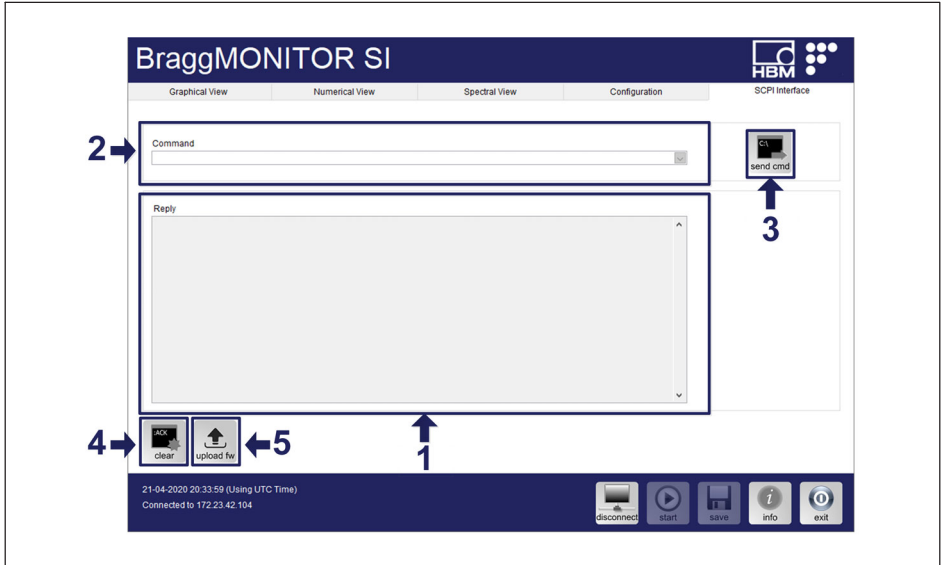


Fig. 7.37 SCPI Interface

Each time a new command is successfully executed, a shortcut at the scroll down box is created, as shown in Fig. 7.38.



Fig. 7.38 Recently used commands



Important

When the user leaves SCPI Interface tab, interrogator status is changed and Scheduled and Continuous acquisitions are disabled. In order to keep the current interrogator status, the user shall not select other tab than the SCPI Interface one and the BraggMONITOR application shall be closed using the "exit" button.

The list of replies can be cleared by pressing the "clear" button (number 4 in Fig. 7.37).

Firmware Update

It is possible to upgrade/downgrade the firmware version of the FS22SI by pressing the upload firmware button (number 5 in Fig. 7.37).

- ▶ Download the new version of the firmware from the product page from HBM website (www.hbm.com).
- ▶ Select the file on the pop up of the Select Image File interface (see Fig. 7.39).

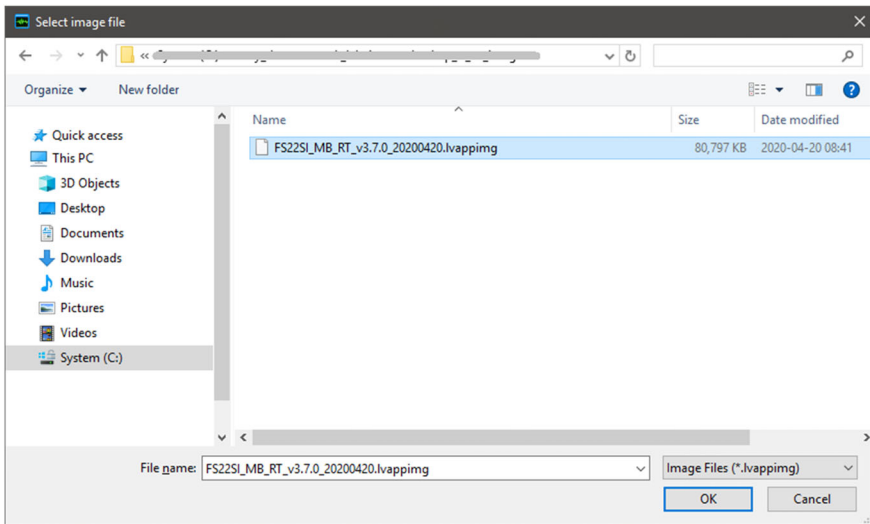


Fig. 7.39 Firmware update

The firmware upload process is performed automatically, being the FS22SI rebooted after completion and a successful update pop up message is depicted once the communication with the FS22SI is reestablished (Fig. 7.40).

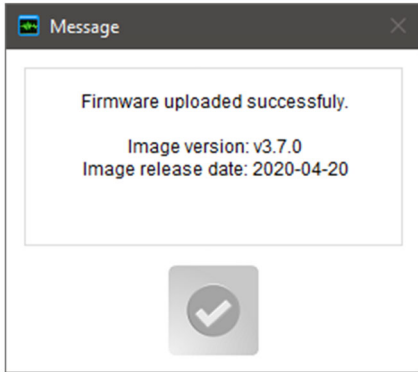


Fig. 7.40 Update info window

