GO SYSTEMELEKTRONIK

WE MAKE LIQUIDS TRANSPARENT.

Manual
ISA Spectrometer

Operation at Work

Version of this manual: 7.12 en

www.go-sys.de

Changes
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Manufacturer's declaration
When installing the system, it is necessary to ensure correct electrical connection, protection against moisture and foreign bodies and excessive condensation, and system heating which can arise from both correct and incorrect use. It is the responsibility of the installer to ensure that the correct installation conditions are provided.

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Creation date: 10.5.2023
Version of this manual: 7.12 en
Article number of this manual: DOC 486 XXXX-E-7.12-BDA-1
File name: DOC 486 XXXX-E-7.12-BDA-1 Manual ISA.pdf

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Table of Contents

1 Introduction

This manual describes the **operation at work** of the ISA* Spectrometer System of GO Systemelektronik.

The operation performs at the display of the BlueBox and with the BlueBox PC Software, here especially with the program AMS and the program Spectrum Visual.

- Described firmware version BlueBox R1/RS and BlueBox Panel: 5.01.30
- Described firmware version spectrometer electronic: ≥ 5.00
- Described software version AMS and Spectrum Visual: 4.5

This manual describes **only the spectral analyser specific operation**.
The general operation of the BlueBox and the BlueBox PC Software is described in the manuals:

- *Manual BlueBox R1 and Panel*
- *Manual BlueBox PC Software*

A comprehensive documentation of the BlueBox system can be found on www.go-sys.de/downloads.

This manual **does not describe the commissioning, maintenance and service**. This is described in the *Manual ISA and Process Spectrometer Commissioning – Maintenance –Service*.

The symbol indicates useful additional information.

The symbol indicates a note to avoid an operating error.

The symbol indicates an instruction, the non-fulfilment of which may affect the measuring operation.

Note on Text References
References to passages in this document or to passages in other documents are marked in italics.

- *5.1 Overview* e.g. refers to the section 5.2 in this document. The short form is *5.2*.
- *Manual BlueBox PC Software* there *5 AMS – Advanced Managing Software* e.g. refers to the chapter 5 in the Manual BlueBox PC Software.

The products of GO Systemelektronik are constantly being developed, therefore deviations between this manual and the delivered product can result. Please understand that no legal claims can be derived from the contents of this manual.

1.1 Meaning of the Safety Instructions

	Danger: Used if non-observance threatens serious injury or death.
	Warning: Used if non-observance threatens slight injuries or serious property damage.
	Caution: Used if non-observance threatens minor property damage.
	Symbol of safety instruction relating to the use of electricity.
EX	Symbol of safety instruction relating to the ATEX directive.

* Intelligent Spectral Analyser

2 Scope of Delivery

The ISA Spectrometer is available in two versions:

- **ISA BlueBox RS** BlueBox RS with integrated spectrometer sensor unit*
- **ISA BlueBox R1 and Panel** BlueBoxR1 or Panel with one or more external spectrometer sensor modules

1. **BlueBox**
   If the spectrometer will not be integrated into an existing BlueBox system, the BlueBox is part of the delivery scope. In the BlueBox measured data are saved and forwarded, the values for the desired parameters are calculated and calibration parameters are stored. Via the PC interface all ISA data and settings can be remotely controlled and read out for further processing. The BlueBox is delivered with all the required accessories. Information about the properties, installation and use of the BlueBox can be found in its manual.
   ℹ A comprehensive documentation of the BlueBox system can be found on www.go-sys.de/downloads.

2. **Sensor head**
   The sensor head is available in two versions:
   - **Sensor head ISA**
     Article-No. 461 6002
     The measurement path is stepless adjustable from 0.5 to 20 mm with a screw thread. The sensor head has an integrated compressed air cleaning.
   - **Sensor head ISA-SDU**
     Article-No. 461 6010
     The measurement path is stepless adjustable from 0.5 to 20 mm with a screw thread. The sensor head is mounted in a flow-through housing with integrated cleaning wiper and has no compressed air cleaning.
     see *6 Technical Data* there *Specifics Sensor Head ISA-SDU*

   The sensor head of the ISA is made of high-quality steel (optional titanium). Only the optics and the compressed air cleaning (exception ISA-SDU) are integrated in the sensor head. The sensor head can thereby be deployed in high temperature ranges (up to +110 °C).

3. **Sensor head cable** (does not affect ISA-SDU)
   The sensor head is connected with the spectrometer sensor unit via the special covered sensor head cable. The spectrometer sensor unit contains all the electronics. In the sensor head cable there are two fibre optic cables and a compressed air line. The sensor head cable must not be bent or kinked in a tighter radius than 40 mm. At installation the sensor head shall not be hung up at the measuring head cable; therefore use the appropriate lugs.

4. **External spectrometer sensor module with compressed air connector or wiper module**
   The entire ISA control- and analysis-electronics are fitted in the CAN-bus sensor module.

5. **Software** (optional)
   USB stick with the system software

6. **USB Dongle** (optional)
   Protection against unauthorized access

7. **CAN-bus cable** (only Spectrometer Sensor Module)

8. **Spectrometer data sheet of Zeiss**

9. **Configuration data sheets and test protocols**

* Additional sensor units can be connected with external sensor modules via the CAN-bus interface.

3 Commissioning

The commissioning of the ISA spectrometer is described in detail in the
***Manual ISA and Process Spectrometer Commissioning - Maintenance - Service*.**

4 Notes on Operation

4.1 Safety Instructions and Warnings

Never deliver the BlueMon to other persons without this manual. The manufacturer is not liable for improper or unintended usage.

The instrument is constructed according to the low voltage code and to the safety regulations for electronic measuring devices.

Correct function and safety can only be ensured when both general and system-specific safety measures are followed.

Before connecting the power supply, make sure that the power supply voltage is suitable.

The proper functioning and operational safety of the devices can only be maintained under the ambient conditions specified in chapter *4 Technical Data* in this manual.

If the instrument is moved from a cold to a warm environment, condensation might form which could influence its function. In this case, wait for the instrument to reach equilibrium with the new surroundings before use.

Maintenance and repairs may only be carried out by GO-authorised technicians.

If it can be assumed that the devices can no longer be operated safely, they must be taken out of service and secured against further use by labelling.

The user's safety might be affected if the instrument shows signs of damage, does not function properly, has undergone long storage under unsuitable conditions or was subject to extreme transport conditions.

If in doubt, contact the manufacturer GO Systemelektronik GmbH and send the instrument for repair or maintenance if necessary.

Caution: The sensor head must not be exposed to negative pressure or pressure shocks.

Caution:
The sensor head cable must not be bent or even kinked in a tighter radius than 40 mm.

Caution: The sensor head must not be hung on the sensor head cable, use the lugs for installation of the sensor head.

4.2 ATEX Notes

These ATEX notes only apply to the ISA R1 version with the sensor head ISA at a Spectrometer Sensor Module.

Guideline 2014/34/EU, known as the ATEX directive of the European Union, requires in Annex II to the fulfilment of basic safety requirements for devices that are provided within the EU for use in potentially explosive atmospheres.

Ex	The sensor head of the spectrometer has the following ATEX-characterisation*: Ex II 3/- G Ex op is IIA T4 Gc/-

EX	**Danger:** The spectrometer sensor module must absolutely be located outside the explosion-endangered area.

⚠	**Warning:** The supply voltage must not be applied to the housing of the spectrometer sensor module; the housing of the spectrometer sensor module must always be earthed.

⚠	**Danger:** The electrical resistance between the lower lug of the sensor head and the earthing screw of the spectrometer sensor module must be less than 50 Ω.

Parameter:

Electrical data:	maximal input voltage of the sensor module:	28 VDC
Range of ambient temperature:	Sensor head:	0 °C to +110 °C
	Sensor module:	0 °C to +40 °C

Special conditions for safe use:

The ambient temperature of the sensor is 0 °C to +110 °C.
The sensor module must be installed outside of explosion-endangered areas.
The ambient temperature of the sensor module is 0 °C to +40 °C.

The basic safety and health requirements are fulfilled by compliance with:

DIN EN 60079-0:2014-06	General requirements
DIN EN 60079-28:2016-04	Optical Radiation 'op is'

Identification of the sensor head:
Laser engraving

Identification of the spectrometer sensor module: abrasion resistant label on the outside right

Spectrometer Sensor Module

* If a separate ATEX certificate is attached, this certificate is valid. On request **II 2/- G Ex op is IIB T4 Gb/-** is available.

5 Description of the ISA Spectrometer

5.1 Overview

The ISA Spectrometer is available in two versions:

- **ISA BlueBox RS** BlueBox RS with integrated spectrometer sensor unit[1]
- **ISA BlueBox R1 and Panel** BlueBoxR1 or Panel with one or more external spectrometer sensor modules

The ISA measures the absorbance[2] in the wavelength range from 200 to 708 nm (UV/VIS). The result of a single measurement is each a raw spectrum and an absorbance spectrum calculated there from over the entire wavelength range.

A spectrometer is a very multi-purpose measuring instrument because it can be implemented in very diverse applications through a relevant calibration. In contrast to electrochemical sensors, multi-parameter measurements are also possible. Moreover, the ISA offers an adjustable measurement path length whereby the number of potential applications is increased even more.

A great advantage of the ISA is the special coating of the glass panes in the optical measurement path and the possibility to clean the measurement path automatically with compressed air (exception ISA-SDU, here cleaning is done with a wiper), thus very long service lives and service intervals can be achieved.

Only the optics and the compressed air cleaning system are integrated in the in situ submersible measuring head made of stainless steel (material number 1.4404) or titanium. The entire control- and analysis-electronics are mounted in a BlueBox RS with integrated spectrometer sensor unit or in an external Spectrometer Sensor Module. The ISA is thereby usable in a high temperature range (up to 110 °C). ISA is thus suitable for use in medicine or in the food industry, since the measuring head can be sterilized at high temperatures.

All necessary settings are stored in the spectrometer electronic, so the external spectrometer sensor modules can be connected to another BlueBox without changing the BlueBox settings.[3]

The ISA can be used in potentially explosive areas, for details see *4.2 ATEX Notes*.

The properties of the ISA in summary:

- Connection of the only optical sensor head with the analysis unit via the sensor head cable (integrates two fibre optic cables and a compressed air line).
- Measurement path length freely adjustable from 0.5 – 20 mm
- Cleaning of the measuring section with compressed air
- Suitable for a wide temperature range (0 °C to +110 °C)
- Recording of absorbance spectra and raw spectra in the range 200 – 708 nm
- Saving of raw data and calibrated data
- Calibration and service software
- Calculation of the statistical reliability of measured values (SQI)
- Adjustment of calibration by remote maintenance
- Multi-parameter calculation
- Simple installation
- High cost-efficiency

[1] Additional sensor units can be connected with external sensor modules via the CAN-bus interface.

[2] In absorption, radiation is absorbed by a substance. Further attenuating effects due to scattering or reflection are summarized in the optics together with the absorption under the term **absorbance**, also called **extinction**.

[3] Applies only to spectrometers of the second and third generation, see *6.2 Notes on Current and Old Spectrometers*

Applications:

- Sewage treatment plants (inflow, outflow, process control)
- Industrial waste water (process water, waste water treatment)
- Waste water collection systems (load monitoring, corrosion protection)
- Water treatment, reuse and irrigation
- Environmental monitoring (monitoring of surface water)
- Aquacultures and fish farms
- Monitoring of landfill leachate
- Drinking water (source monitoring, process control, early warning of contamination)
- Groundwater management
- and other

Parameter examples:

- **Nitrate:** for NO_3/NO_3-N measurements
  Measurement range 0.1 - 100 mg/l NOx_eq in water bodies (other measurement ranges are possible)
- **Carbon compounds TOC/COD:** Calibration by comparison analysis. Resolution and accuracy depend on the stability of the water-matrix and its ability to be analysed.

5.2 Notes on Compressed Air Cleaning

does not affect ISA-SDU

In most applications, it is useful to use the compressed air cleaning of the spectrometer. The compressed air line must be connected to the provided plug-in connection of the BlueBox RS or the external spectrometer sensor module. **Use only oil-free compressors.**

The air consumption of the compressed air cleaning depends on the connection pressure (4 - 6 bar) and the back pressure in the medium and is at 6 bar at a maximum of 1 litre per second.

Example: At an interval of 60 seconds and a cleaning time of 5 seconds, the maximum consumption is 300 litres per hour.

5.3 Notes on the Cleaning Wipers

The ISA sensor head can be equipped with a cleaning wiper. Precondition is, that the spectrometer board is equipped with a wiper module. see *Appendix B – The Spectrometer Board*

The ISA-SDU sensor head is supplied from the factory with a cleaning wiper. This wiper is controlled by a PLC* program in the BlueBox.

5.4 Notes on the SQI (Spectral Quality Index)

The SQI is a degree of the statistical reliability of measurement values of an application-specific parameter (see *9.3 The Sensor Setup Window of an Application-Specific Parameter*). Precondition is the creation of a corresponding calibration file in the xml format.

see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service*
see *Appendix E – SQI (Spectral Quality Index)*

* Programmable Logic Controller

6 Technical Data

The ISA Spectral Analyser with its in situ submersible sensor head is either integrated into a BlueBox (BlueBox RS) or into an external sensor module that is connected to a BlueBox system with CAN-bus.
ATEX notes see *4.2*

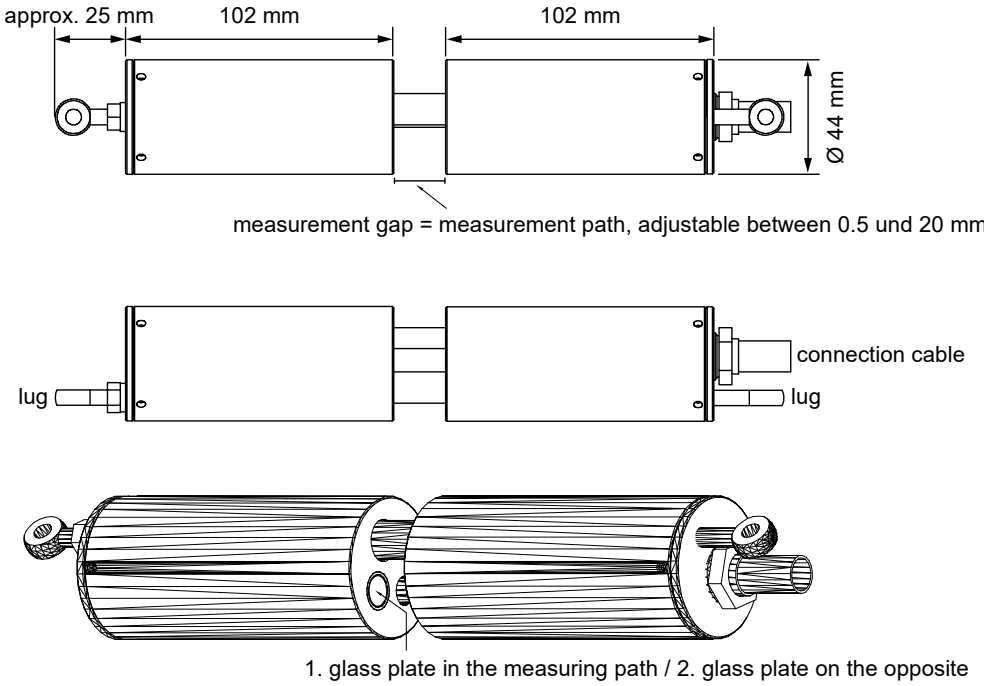
Spectrometer unit	
Wavelength range	200 nm to 708 nm, resolution 2 nm
Measurand	UV/VIS spectra in the range 200 to 708 nm
Measurement principle	Spectral analysis
Measurement interval	Adjustable, min. 30 s
Light source	Xenon flash lamp

BlueBox RS	**Article-No. 486 00RS**
The technical data of the BlueBox RS are quite similar to those of a BlueBox R1. see *Manual BlueBox R1 and Panel* see also *Appendix C – Housing Connections at the BlueBox RS*	

Spectrometer sensor module (external) see also *Appendix D – The External Spectrometer Sensor Module*	**Article-No. 486 6000**
Power supply	24 VDC (18 – 28 VDC) via CAN-bus cable
Pulse input	Frequency (rising edge) or static ⓘ The pulse input is galvanically isolated from the system.
Compressed air connector	Quick connector for 4 mm PU-tube, 4 – 6 bar
Temperature range	0 °C to +40 °C
Weight	approx. 2.6 kg
Housing material	Die-cast aluminium, powder coated
Dimensions	303 x 200 x 93 mm (L x W x H)
IP protection code	IP65

Sensor head ISA	**Article-No. 461 6002 / 410 6012**
Material	High grade steel (material number 1.4404) – Titanium optional
Cable length	| 2.5 m | 6 m | 10 m | other cable lengths on request
Temperature range	0 °C to +110 °C
Measurement gap	0.5 – 20 mm stepless adjustable Measurement gap = Measurement path
Weight (High grade steel)	1.5 kg
Ambient pressure	max. 6 bar ⚠*
IP protection code	IP68

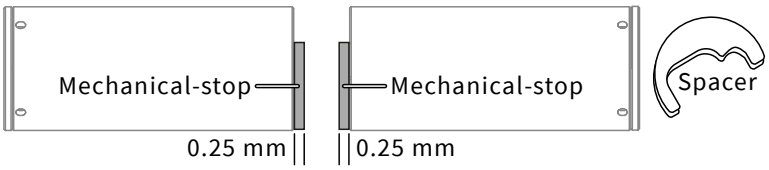
* ⚠ **Caution:** The sensor head is not suitable for environments with negative pressure or pressure shocks!



Specifics Sensor Head ISA-SDU **Article-No. 461 6010**

- The sensor head of the SDU version has no compressed air cleaning; the sensor head cable has no compressed air line and is therefore more flexible

- The cable of the SDU sensor head has a length of 1 m, others on request.
- The SDU sensor head is mounted in a flow through fitting with integrated cleaning wiper.
- The SDU sensor head is designed for operation with a cleaning wiper. The wiper is controlled by a PLC* program in the BlueBox.
  For more information, please contact GO Systemelektronik.
- The measuring path is continuously adjustable from 0.5 to 20 mm with a screw thread.
- The SDU sensor head has a mechanical-stop on each side of the measuring path.



The minimum measuring path length is therefore 0.5 mm.
The wiper thickness must match the gap of the measuring path.
The standard range of the gap width is 0.5 to 5 mm.
Available spacers in thickness | 0.5 mm | 1 mm | 5 mm | 10 mm | 20 mm |

* Programmable Logic Controller

6.1 Sensor Head ISA: Notes on the Glass Panes in the Measurement Path

Older ISA sensor heads have glass plates made of quartz glass. New ISA sensor heads have glass plates made of sapphire glass: Sapphire glass is more resistant than quartz glass.

Year of manufacture ≤ 2018 ⇨ Quartz glass Year of manufacture ≥ 2019 ⇨ Sapphire glass

Year of Revision ≥ 2019 ⇨ Sapphire glass

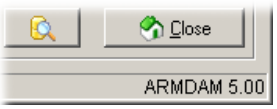
In case of doubt please contact GO Systemelektronik.

Caution: Quartz glass plates are not suitable for contact with strong organic solvents (e.g. acetone), strong acids and strong bases.

6.2 Notes on Current and Old Spectrometers

There are three generations of ISA spectrometers.

- **First generation**
  The CAN-ID starts with isa in small letters, e.g. isa00001. Hardware: BlueBox TS and external spectrometer sensor module with the Article-No. 486 6002 or 486 6004.
- **Second generation**
  The CAN-ID starts with ISA in capital letters, e.g. ISA00001. Hardware: BlueBox TS and external spectrometer sensor module with the Article-No. 486 6002 or 486 6004.
- **Third and current generation**
  The CAN-ID starts with ISA in capital letters, e.g. ISA00001, and the Firmware version of the spectrometer electronic is ≥ 5.00.
  The Firmware version of the spectrometer unit is displayed as ARMDAM at the lower right end of the Sensor Setup Window of the spectrometer, see *9.2 The Sensor Setup Window of the Spectrometer.*



  Hardware: BlueBox RS and external spectrometer sensor module with the Article-No. 486 6000.

Second generation and third generation spectrometers are largely compatible. For detailed information on hardware and software compatibility, please contact GO Systemelektronik.

7 Measurement Cycle

1. **Cleaning** (only if automatic cleaning is activated)
   Compressed air cleaning of the sensor head optics (Duration: configuration parameter **Cleaning time**)
   The frequency of the cleaning is determined by the configuration parameter **Cleaning interval**.
   1 ⇨ cleaning before each measurement, 2 ⇨ cleaning before each second measurement etc.

2. **Wait** (only if automatic cleaning is activated)
   The waiting time after cleaning serves to ensure that any remaining air bubbles or whirled-up dirt do not interfere with the following measurement. (Duration: configuration parameter **Waiting time**)

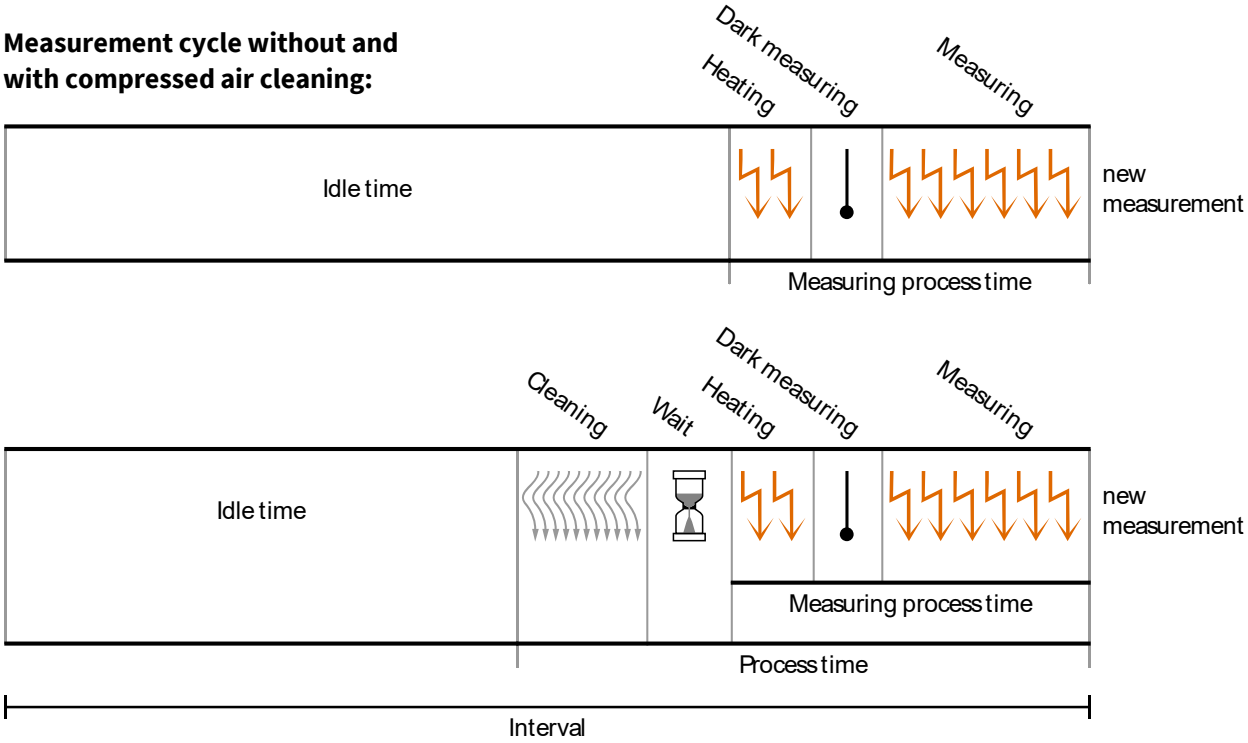
3. **Heating**
   The Xenon lamp is heated up through a few light flashes.
   (Number of flashes: configuration parameter **Heating**)

4. **Dark measuring**
   The dark measuring is a measurement without light flash and is used to compensate individual system properties.

5. **Measuring**
   The period in which an actual measurement occurs. It consists of an individual measurement (Number of light flashes per single measurement: configuration parameter **Intensity**) repeated a number of times (Number of repetitions: configuration parameter **Average**). The final measurement result is the arithmetic mean of the individual measurements.

6. **Interval**
   Interval is the period between the end of a measurement and the end of the next measurement.[1]

Measurement cycle without and with compressed air cleaning:



It is not possible to change configuration parameters during the measuring process time.[2]

[1] The measurement interval is calculated in advance from the set interval time and the configuration parameters. This results in a low time drift of the recording times of the measured values.

[2] Except in extreme cases there is enough time for the input of settings after the end of the measuring process time to the begining of the next measurement cycle. The measurement process period is calculated from the Heating period, Dark measuring period and Measuring period. The Heating period is generally negligible. The dark measurement is negligible too, because it takes place only once.
Heating + Dark measuring + (Intensity x Average) 100 light flashes have a duration of approx. 1.6 s.

8 Display Operation

BlueBox firmware version: 5.01.30

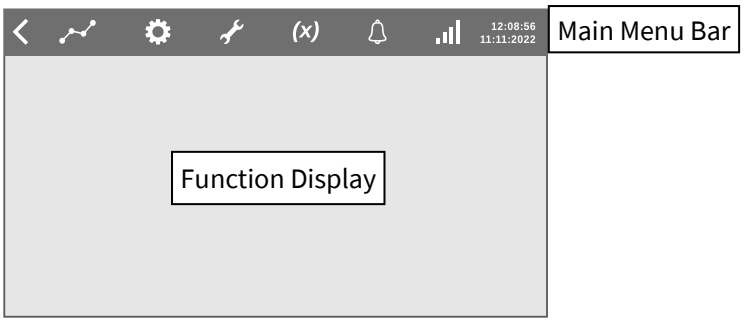
The touch screen is divided in two sections, the Main Menu Bar and the Function Display.

Operating the touch display

tapping

swiping horizontal

swiping vertical



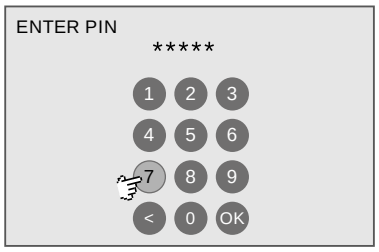
Main Menu Bar

- Switches back to the previous display.
- Switches to the Parameter Display.
- Switches to the System Display.
- Switches to the Service Display.
- (x) Switches to the User Variables Display.
- Switches to the Notifications Display.
- Bar chart for the intensity of an optional LTE and GPS connection
- 12:06:28 11:11:2022 Time and date display

Standard BlueBox Password (PIN) input display

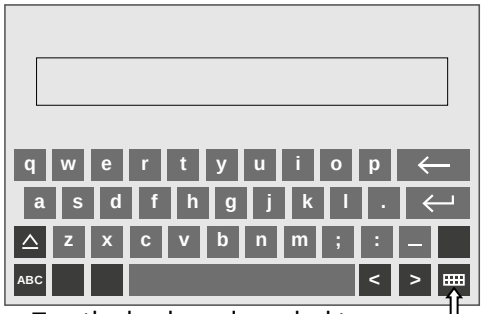
- Tap in the PIN.
- Tap (<) to delete the last entered digit.
- Tap (OK) to enter the PIN.

You will find the PIN in the enclosed Configuration Data Sheet.



Standard alphanumeric input display

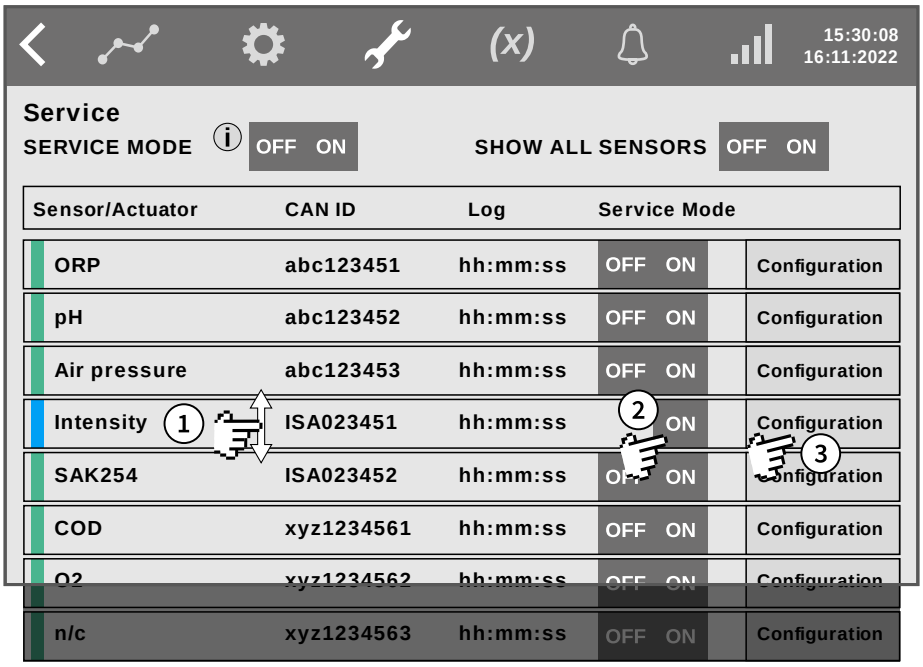
- Tap **ABC** to open the digit view.
  Tap **&123** to open the letter view.
- △ is off △ yellow dot is on
  Letter view - Tap △ to switch between small and capital letters as well as **;** **:** **-** and **,** **_**
- Digit view – Tap △ to change the special character assignment
- Deletes the last entered character. ←
- Saves the entry. ↵
- One character back/forward **<** **>**



- Tap the keyboard-symbol to return to the previous display without saving an entry.

8.1 The Service Display

Open the Service Display.



The Service Display lists the connected sensors in order of the CAN ID.

In the Service Display you can handle the service mode. The service mode deactivates automatic cleaning, data output and alarm notifications. Measurement data recorded during Service Mode is marked.

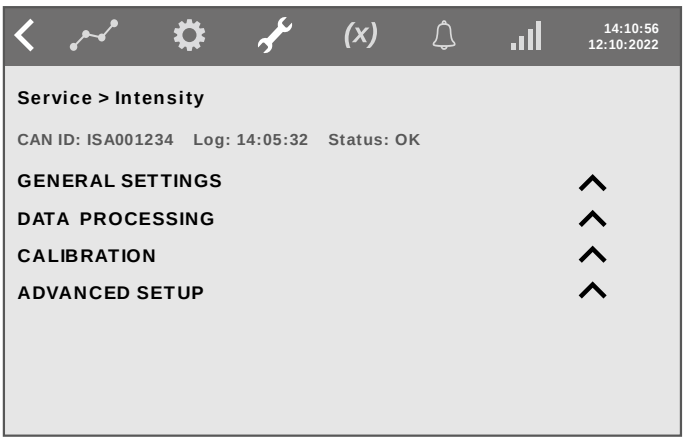
Ensure that the necessary precautions have made and relevant personnel had been informed.

1. If necessary, swipe vertical to the Intensity line.
2. Activate the Service Mode. After the next measurement Intensity is highlighted in blue in the marker bar to the left of it.
3. Tap on Configuration to open the Spectrometer Configuration Selection Display.

8.2 The Spectrometer Configuration Selection Display

Configuration 8.1 The Service Display > Intensity

Switches back to the Service Display.



Switches to the respective Display.

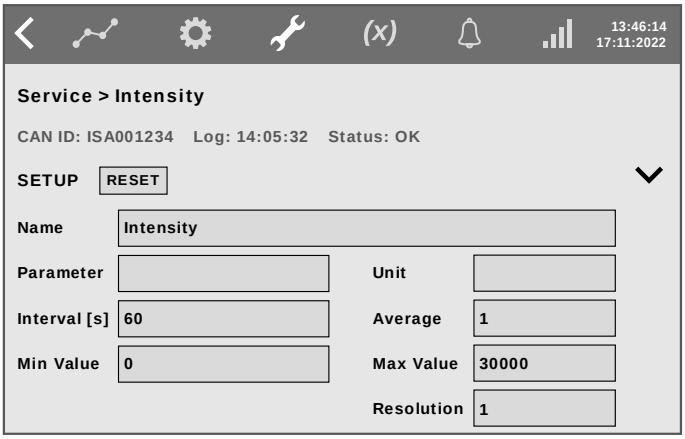
CAN ID: CAN ID of the sensor | **Log:** Time of the last measurement | **Status:** Sensor status

DATA PROCESSING is rarely needed with spectrometers. When required see *Manual BlueBox R1 and Panel* there from *6.2.2 Data Processing* to *6.2.2.3 Data Processing Smoothing*

8.2.1 General Settings

GENERAL SETTINGS ⌃ 8.2 The Spectrometer Configuration Selection Display

Switches back to the Selection Display.



Switches back to the Selection Display.

Tap on a rectangle.

The entries shown here are the factory default settings.

Wait until the end of a measurement before making an input.

RESET	Resets the general settings of the spectrometer to the factory settings.
Name	Switches to the input of a spectrometer name. max. 20 characters
Parameter	Switches to the input of the name of the measured parameter. max. 20 characters
Unit	Switches to the input of the unit of the measurement value.
Interval [s]	Switches to the input of the measurement interval. see *7 Measurement Cycle* Measurement interval = time period between the end of a measurement and the end of the next measurement[1], lowest value is 30. The higher the interval is set, the fewer spectra are stored, which shortens the download times and saves storage space. One absorbance spectrum needs 1540 Byte (1548 with GPS data). GO Systemelektronik recommends a minimum interval of 60, otherwise the lifetime of the xenon flash lamp will be shortened.
Average	The number of single measurements from which the arithmetic mean is derived. The arithmetic mean values of the respective spectral values of the single measurements result the measured spectrum.
Min Value **Max Value**	Switches to the input of a Measuring range lower limit/Measuring range upper limit of the MVR[1]. At underrun and overrun the Sensor Status is set to 50 or 51 (see *Manual BlueBox R1 and Panel* there *Appendix B – Status Messages*). So it is marked by a < or > in List Views and in orange. The entered Min Value or Max Value is the measurement value.
Resolution	Switches to the input of the measurement resolution of the MVR[2]. Input 1 corresponds to decimal place = 0 in the Sensor setup of AMS[3]. Input 0.1 corresponds to decimal place = 1 in the Sensor setup of AMS[2], etc.

8.2.2 Notes on Calibration

When calibrating a spectrometer, many circumstances must be taken into account.
A detailed description of calibration can be found in the *Manual ISA and Process Spectrometer Commissioning – Maintenance – Service* there *4 Commissioning*.

[1] The measurement interval is calculated in advance from the set interval time and the configuration parameters. This results in a low time drift of the recording times of the measured values.

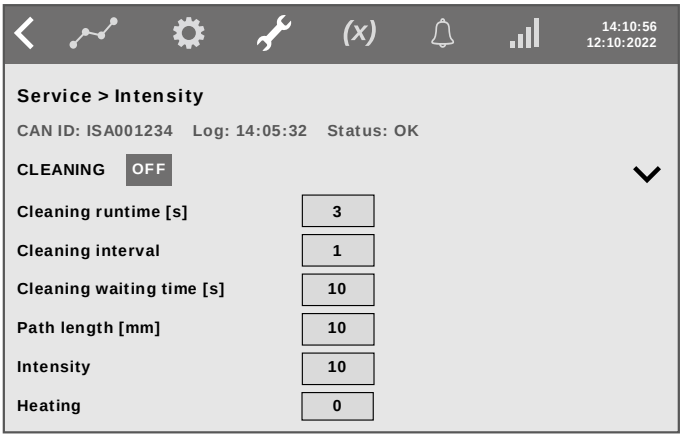
[2] MVR = Maximum digital Value of a Raw spectrum

[3] The program AMS is part of the BlueBox PC Software.

8.2.3 Advanced Setup

ADVANCED SETUP ⌃ 8.1.1 The Spectrometer Configuration Selection Display

Switches back to the Selection Display.



Switches back to the Selection Display.

Tap on a rectangle.

The entries shown here are the factory default settings.

Wait until the end of a measurement before making an input.

CLEANING OFF ON — Deactivates/activates automatic cleaning with compressed air or wiper. The button is also a status indicator.

Cleaning runtime [s] Duration of compressed air flushing/wiper action in seconds.

Cleaning interval Switches to the input of the Interval of the compressed air flushing/wiper action:
1 ⇨ before every measurement,
2 ⇨ before every second measurement
and so on.

Cleaning waiting time [s] To ensure, that air bubbles or swirled-up dirt do not interfere with the following measurement, a waiting time in seconds can be set here. This is the time that elapses between the end of the compressed air flushing/wiper activity and the following measurement.

Path length [mm] Switches to the input menu of the measurement path length of the sensor head in mm. Only visible if the path length is used in an AMS formula (query command **ISA.PathLength**)
The initial input is performed in the AMS configuration window,
see *9.2.1 The Configuration Window of the Spectrometer*.

Intensity Number of flashes per single measurement

Heating Number of light flashes to heat up the xenon lamp before each measurement

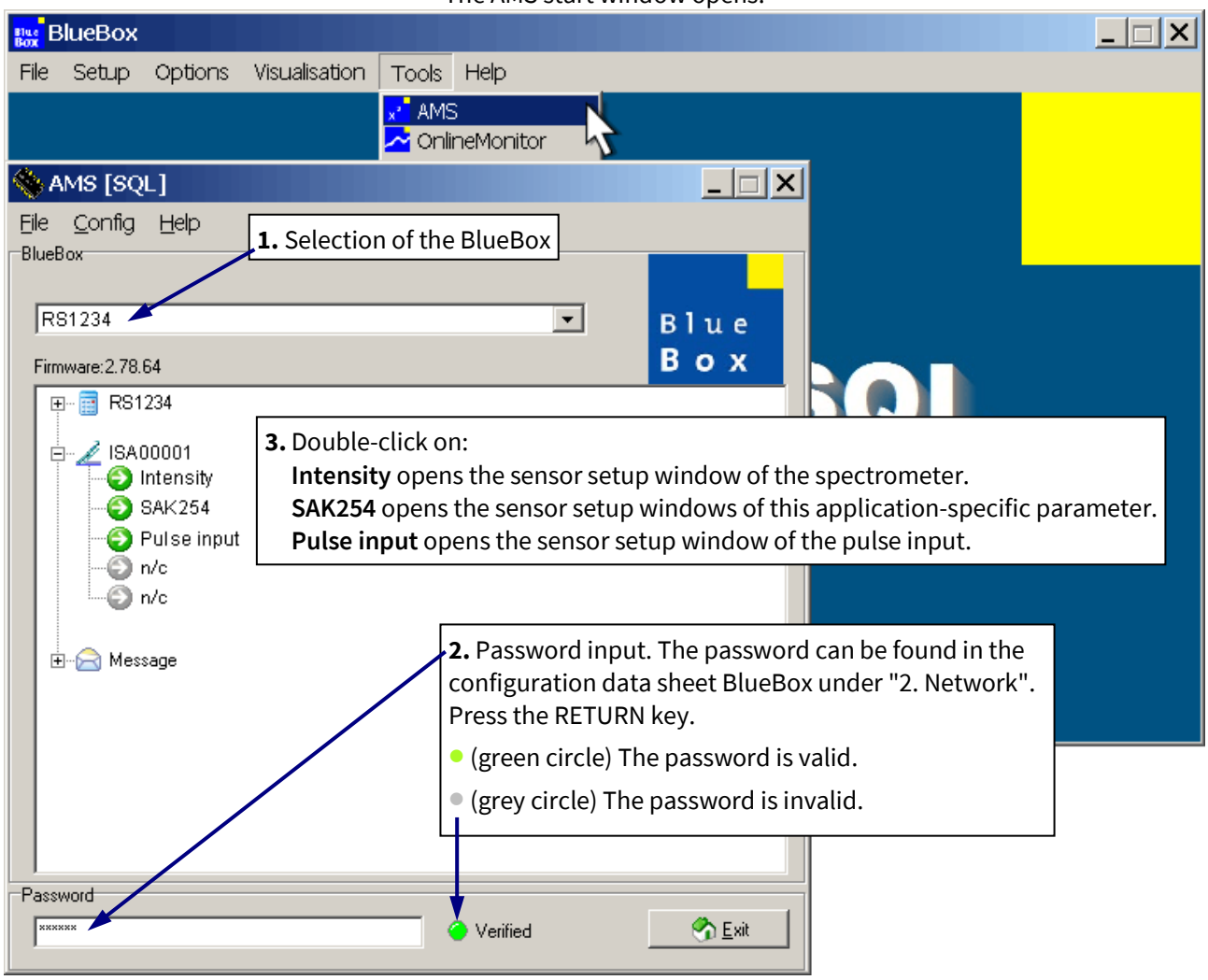
9 Operation with AMS

Software version BlueBox SQL: from 4.5.0.0
Software version AMS: from 4.5.0.0

9.1 The AMS Start Window

Start the program AMS *, e.g. via the program BlueBox SQL like here.

The AMS start window opens:



Example: Configuration with only one connected spectrometer and the application-specific parameter SAK254 (set up by default).

If several spectrometers are connected, they are displayed accordingly.

The greyed-out icons with the designation n/c are placeholders for application-specific parameters.

Icons

 Icon of the virtual sensors

 Icon of a spectrometer

 Icon of the messages (SMS and e-mail)

Sensor modules connected via CAN bus can have their own icons.

There are three generations of spectrometers, for the compatibility of old spectrometers see *6.2 Notes on Current and Old Spectrometers*

* For a detailed description of the AMS software, see *Manual BlueBox PC Software* there *5 AMS - Advanced Managing Software*.

There are 6 different sensor icons with the following meanings:

	green	The sensor works.
	grey	The sensor name of the spectrometer has been set with AMS to "n/c", therefore the sensor is not active.
	red	Sensor error
	blue with magnifying glass	Waiting for the first measurement value
	Warning sign	The measurement value is outside the measurement range limits[1] or the limit value of the SQI value of an application-specific parameter[2] is exceeded.
	Scale	The maximum calibration interval [3] of the clearwater calibration is exceeded.

[1] see *9.2 The Sensor Setup Window of the Spectrometers* there *Min. Value* and *Max. Value*

[2] see *9.3.1 The Configuration Window of an Application-Specific Parameter* there *Max h*

[3] see *9.2.1 The Configuration Window of the Spectrometer* there *Max. calibration interval [days]*

9.2 The Sensor Setup Window of the Spectrometer

Intensity Double-click in the AMS start window

The sensor setup window of the spectrometer opens. The default values for the spectrometer are set at the factory. Usually, the user can only change the interval and the average.

Sensor-ID of the spectrometer = CAN-ID + sensor number (uniquely defined for each sensor, factory preset)

Opens the configuration window of the spectrometer.
see *9.2.1 The Configuration Window of the Spectrometer*

Opens the spectra window.
see *9.2.2 The Spectra Window*

Opens the spectra window.
see *9.2.2 The Spectra Window*

Name	Name of the sensor, is queried by other BlueBox programs.	max. 20 characters
Comment[3]	Any comment text for AMS and BlueBox SQL Software	max. 20 characters
Parameter	Name of the measured parameter	max. 20 characters

[1] **MVR** = Maximum digital Value of a Raw spectrum
[2] If the calibration interval of the clear water calibration is exceeded, the scale symbol additionally appears here.
[3] In older software versions, here it was also possible to determine how a measurement value is saved in the database. Now the setting is made via the button <All values>.

Unit Unit of the output value
More than 5 characters can't be displayed at the BlueBox display.

Digits before Factory default setting, 5 pre-decimal places are displayed.

Digits after Factory preset, 0 decimal places are displayed. Because integer counts are measured here, there are no decimal places.

Interval Measurement interval = time period between the end of a measurement and the end of the next measurement[1], lowest value is 30.
The higher the interval is set, the fewer spectra are stored, which shortens the download times and saves storage space. One absorbance spectrum needs 1540 Byte (1548 with GPS data). GO Systemelektronik recommends a minimum interval of 60, otherwise the lifetime of the xenon flash lamp will be shortened.

Min. Value[2] Lowest expected measuring value, default setting 0

Max. Value[1] Highest expected measuring value, default setting 30000

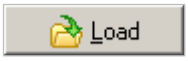
Average The number of single measurements from which the arithmetic mean is derived. The arithmetic mean values of the respective spectral values of the single measurements result the measured spectrum.

Wait until the end of a measurement before making an input.

Opens a menu where you can define how the measurement values and states of actuators are stored in the database. The determination has no effect on spectra itself and affects only the MVR[3] of the spectra.

Transfers the formula from the input field to the BlueBox.
The button is inoperable here.

Opens a window to save the formula on the PC.
The button is inoperable here.



Opens a window for to load a saved formula from the PC.
The button is inoperable here.

Opens a window for to print these sensor-settings.

Opens a list of the current variables with their current values.

Closes the sensor setup window.

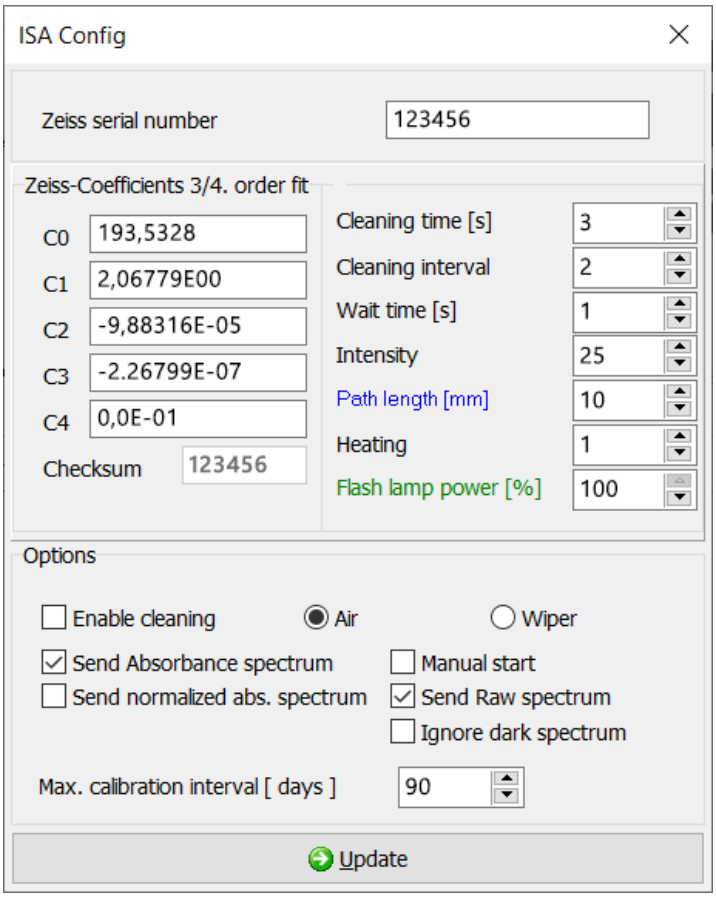
[1] The measurement interval is calculated in advance from the set interval time and the configuration parameters. This results in a low time drift of the recording times of the measured values.

[2] If there is an overrun or underrun of the range, the measurement value is displayed and stored for real sensors. In the case of virtual sensors, the overrun or underrun is marked by a "<" or ">", then the entered minimum or the entered maximum measurement value is stored. In addition, the sensor icon is displayed as a warning sign in the AMS start window.

[3] **MVR** = Maximum digital Value of a Raw spectrum

9.2.1 The Configuration Window of the Spectrometer

Sensor setup window

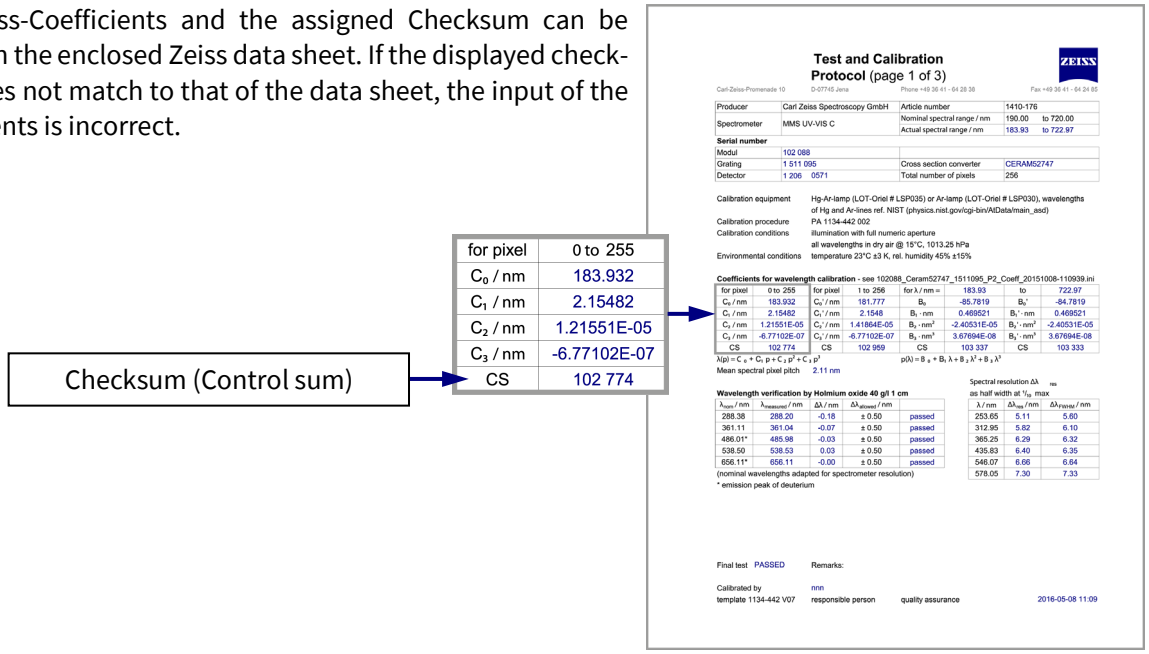


Zeiss serial number Serial number of the Zeiss spectrometer

Zeiss-Coefficients C0, C1, C2, C3, C4 Zeiss-Coefficients
In the case that the Zeiss-Coefficients need to be changed, the Checksum field serves to verify the inputted values.

Checksum Control sum of the Zeiss-Coefficients

The Zeiss-Coefficients and the assigned Checksum can be found on the enclosed Zeiss data sheet. If the displayed checksum does not match to that of the data sheet, the input of the coefficients is incorrect.



for pixel	0 to 255
C_0 / nm	183.932
C_1 / nm	2.15482
C_2 / nm	1.21551E-05
C_3 / nm	-6.77102E-07
CS	102 774

Checksum (Control sum)

Test and Calibration Protocol (page 1 of 3)

ZEISS

Carl-Zeiss-Promenade 10 D-07745 Jena Phone +49 36 41 - 64 28 38 Fax +49 36 41 - 64 24 85

Producer	Carl Zeiss Spectroscopy GmbH	Article number	1410-176
Spectrometer	MMS UV-VIS C	Nominal spectral range / nm	190.00 to 720.00
		Actual spectral range / nm	183.93 to 722.97
Serial number			
Modul	102 088		
Grating	1 511 095	Cross section converter	CERAM52747
Detector	1 206 0571	Total number of pixels	256

Calibration equipment: Hg-Ar-lamp (LOT-Oriel # LSP035) or Ar-lamp (LOT-Oriel # LSP030), wavelengths of Hg and Ar-lines ref. NIST (physics.nist.gov/cgi-bin/AtData/main_asd)
Calibration procedure: PA 1134-442 002
Calibration conditions: illumination with full numeric aperture; all wavelengths in dry air @ 15°C, 1013.25 hPa
Environmental conditions: temperature 23°C ±3 K, rel. humidity 45% ±15%

Coefficients for wavelength calibration - see 102088_Ceram52747_1511095_P2_Coeff_20151008-110939.ini

for pixel	0 to 255	for pixel	1 to 256	for λ / nm =	183.93	to	722.97
C_0 / nm	183.932	C_0' / nm	181.777	B_0	-85.7819	B_0'	-84.7819
C_1 / nm	2.15482	C_1' / nm	2.1548	B_1 · nm	0.469521	B_1' · nm	0.469521
C_2 / nm	1.21551E-05	C_2' / nm	1.41864E-05	B_2 · nm²	-2.40531E-05	B_2' · nm²	-2.40531E-05
C_3 / nm	-6.77102E-07	C_3' / nm	-6.77102E-07	B_3 · nm³	3.67694E-08	B_3' · nm³	3.67694E-08
CS	102 774	CS	102 959	CS	103 337	CS	103 333

$\lambda(p) = C_0 + C_1 p + C_2 p^2 + C_3 p^3$ $p(\lambda) = B_0 + B_1 \lambda + B_2 \lambda^2 + B_3 \lambda^3$

Mean spectral pixel pitch 2.11 nm

Wavelength verification by Holmium oxide 40 g/l 1 cm

λ_{nom} / nm	$\lambda_{measured}$ / nm	$\Delta\lambda$ / nm	$\Delta\lambda_{allowed}$ / nm	
288.38	288.20	-0.18	± 0.50	passed
361.11	361.04	-0.07	± 0.50	passed
486.01*	485.98	-0.03	± 0.50	passed
538.50	538.53	0.03	± 0.50	passed
656.11*	656.11	-0.00	± 0.50	passed

(nominal wavelengths adapted for spectrometer resolution)
* emission peak of deuterium

Spectral resolution $\Delta\lambda_{res}$ as half width at $^1/_{10}$ max

λ / nm	$\Delta\lambda_{res}$ / nm	$\Delta\lambda_{TRIOS}$ / nm
253.65	5.11	5.60
312.95	5.82	6.10
365.25	6.29	6.32
435.83	6.40	6.35
546.07	6.66	6.64
578.05	7.30	7.33

Final test PASSED Remarks:

Calibrated by nnn
template 1134-442 V07 responsible person quality assurance 2016-05-08 11:09

Cleaning time Duration of compressed air flushing/wiper action in seconds.

Cleaning interval Interval of the compressed air flushing/wiper action:
1 ⇨ before every measurement,
2 ⇨ before every second measurement
and so on.

Wait time To ensure, that air bubbles or swirled-up dirt do not interfere with the following measurement, the waiting time in seconds can be set here. This is the time that elapses between the end of the compressed air flushing/wiper activity and the following measurement.

Note regarding the compressed air cleaning: In many applications, it will be advisable to use the compressed air cleaning of the spectrometer. In this case it is necessary to connect a compressed air line to the assigned plug-in connection at the BlueBox RS or the Spectrometer Sensor Module.

Intensity Number of light flashes per single measurement
Can also be set in the spectra window (see 9.2.2 *The Spectra Window* there *Functions of the button bar*).

Path length [mm] Input of the measurement path length of the sensor head in mm. The path length is measured e.g. with a calliper; take care not to damage the optics.
If the path length is used in an AMS formula (query command **ISA.Pathlength**), you must enter the path length mandatory here. Otherwise, the software uses a default value (10 mm).

Heating Number of light flashes to heat up the xenon lamp

Flash lamp power [%] Light power of the xenon flash lamp
Entry 100 ≙ Maximum power Entry 0 ≙ Minimum power

! Wait until the end of a measurement before making an input.

Options

☑ **Enable cleaning** Deactivates/activates automatic cleaning with compressed air or mechanical wiper. Choice between the air cleaning (◉ Air) and the wiper (◉ Wiper)

☑ **Send Absorbance spectrum** Absorbance spectra are stored on the BlueBox.

☑ **Send normalized abs. spectrum** Absorbance spectra are stored on the BlueBox normalized on 1/m. These normalized spectra have intensity values related to a standardized measurement path of one meter length.

☑ **Manual start** The spectrometer can be time-controlled with the AMS software.
AMS formula entry **ISA.MEASURE()**

☑ **Send Raw spectrum** Raw spectra are stored on the BlueBox.

☑ **Ignore dark spectrum** The dark spectrum of the dark measuring is not used,
see *7 Measurement Cycle*.

Max. calibration interval [days] Input of a clearwater calibration interval in days, after this interval, the sensor icon changes to a scale image in the AMS start window. The resetting is carried out after a clearwater calibration.

Update Transmits the settings to the spectrometer unit.

9.2.2 The Spectra Window

The spectrometer measures raw spectra, from the raw spectra the system calculates the absorbance spectra. In an absorbance spectrum, the **absorbance/attenuation of the single wavelengths** is displayed with a logarithmic scaling. The maximum value is 4.5.

$$Value_i \text{ of the absorbance spectrum} = -log_{10}\left(\frac{Value_i \text{ of the raw spectrum}}{Value_i \text{ of the clearwater spectum}}\right)$$

i = 0 to 254[1]

For each spectral measurement, 255 raw values are recorded over the range of 200 – 708 nm. For each of these 255 raw values, an absorbance value is calculated for an even wavelength[2] of 200 – 708 nm.

Main functions of the spectra window

- Display of the currently recorded absorbance and raw spectra and the current clearwater spectrum
- Saving and displaying of fingerprints
- Performance of clearwater calibrations and intensity calibrations in clearwater

Call up with 

or 

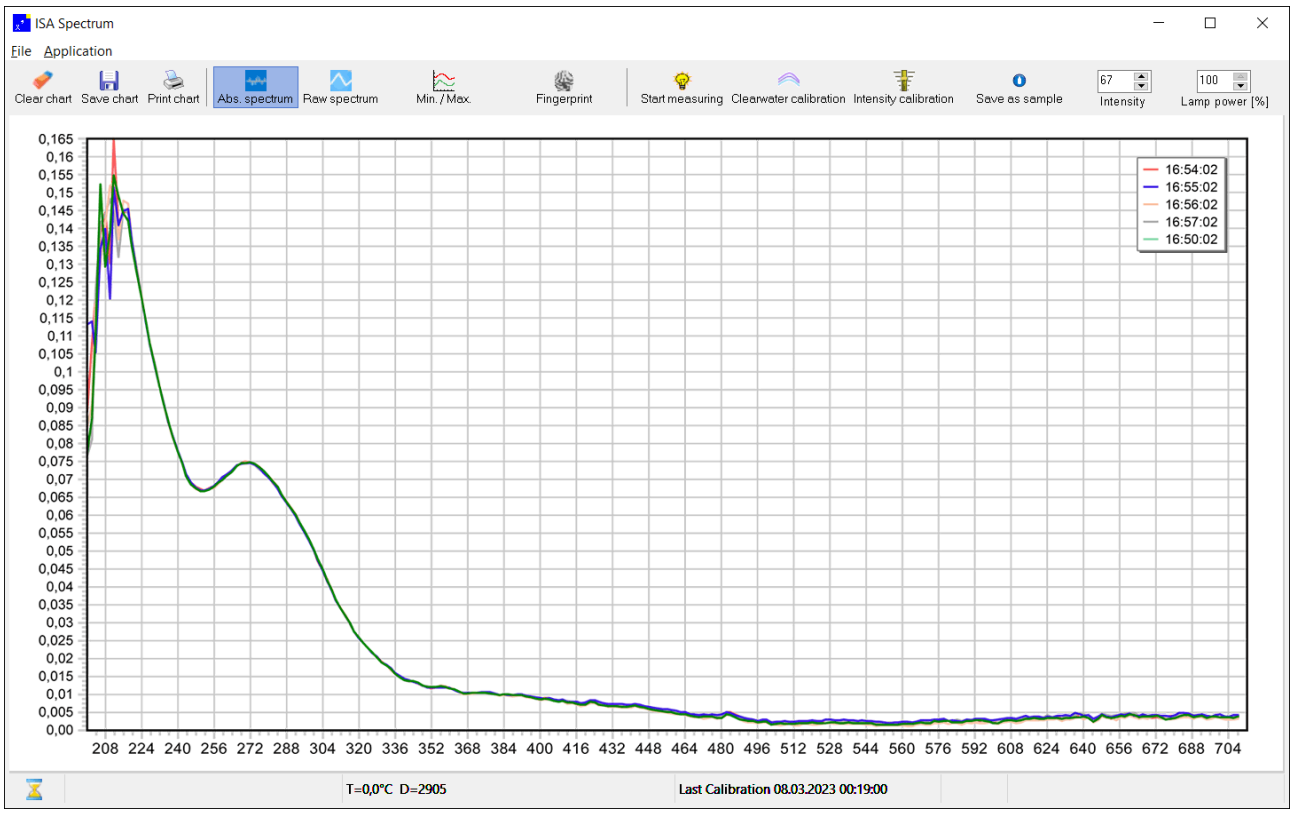
in the Sensor setup window of the spectrometer

The spectra window with the display of the absorbance spectra appears. see next page

[1] This corresponds to 255 values.

[2] When querying the absorbance values with AMS formula (see *Manual BlueBox PC Software* there *Appendix H – List of the AMS Formula Elements* there *20. ISA*), the absorbance value of the preceding even wavelength is output when entering odd wave lengths from 201 to 709.

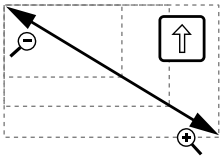
9.2.2.1 The Absorbance Spectra View



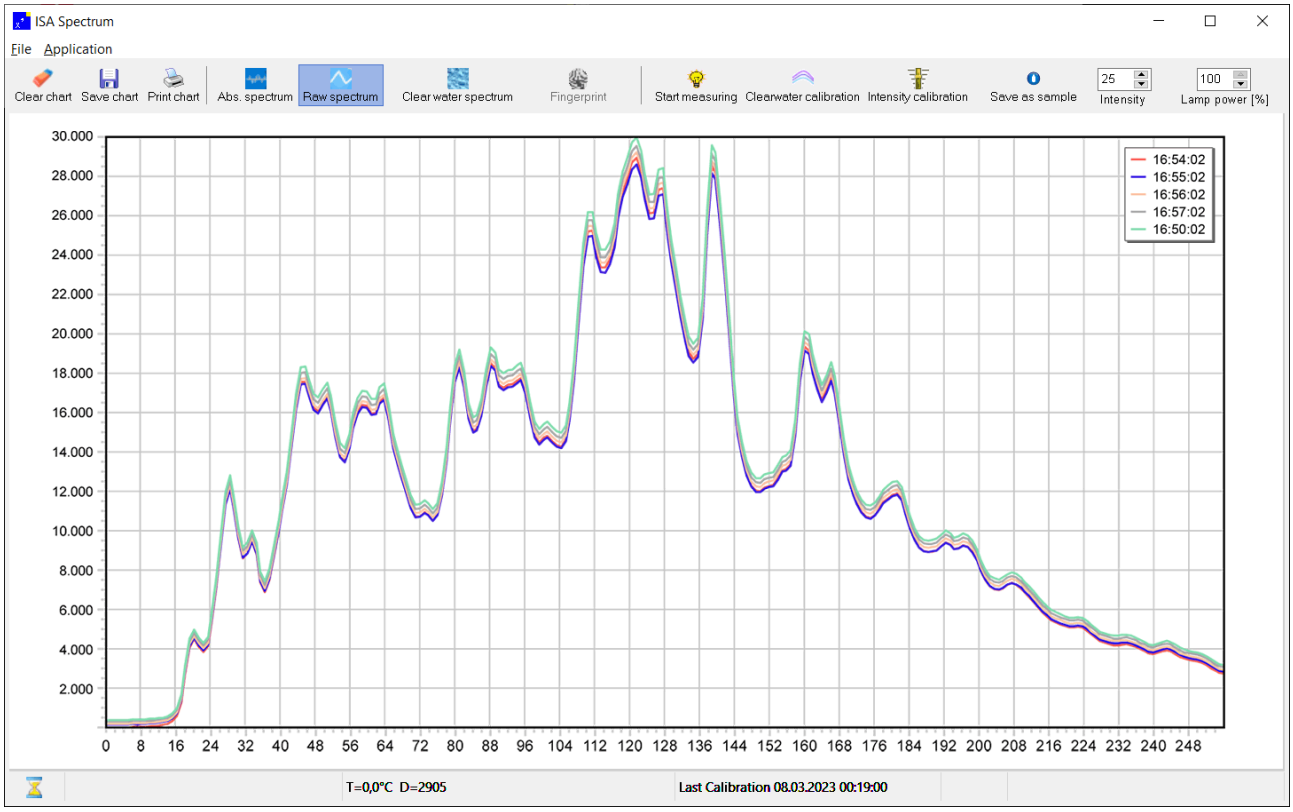
After each measurement an absorbance spectrum is displayed as a line diagram. The most recent 20 absorbance spectra are displayed in different colours. Colour and recording time of the spectra are listed in the upper right.
The values of the x-axis are the light wavelengths of 200 nm to 708 nm, the values of the y-axis the absorbance factor.

The spectra shown here are typical clear water absorbance spectra, the corresponding raw spectra are shown on the next page.

You can zoom the spectra view in and out by drawing a rectangle to the right or to the left with the mouse while pushing the left mouse button.
Zooms are reset with the next spectrum capture.



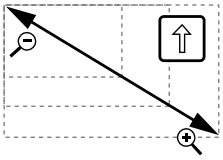
9.2.2.2 The Raw Spectra View



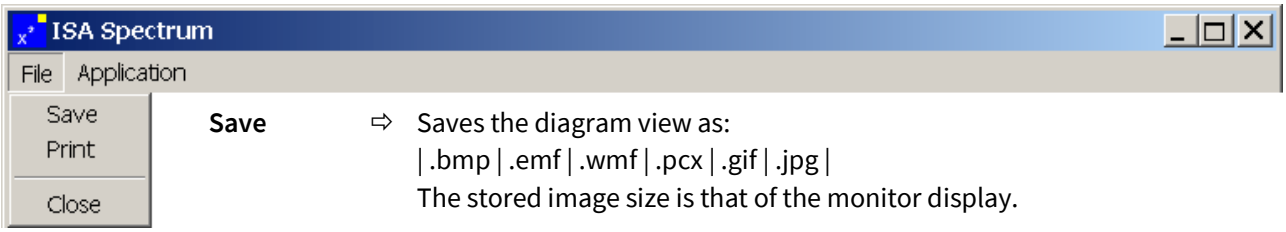
After each measurement a raw spectrum is displayed as a line diagram. The most recent 20 raw spectra are displayed in different colours. Colour and recording time of the spectra are listed in the upper right.
The values of the x-axis are the steps of the spectral resolution of the spectrometer (0 – 254), the values of the y-axis the counts of the AD converter (0 – 30000).

The spectra shown here are typical clear water raw spectra, the corresponding absorbance spectra are shown on the previous page.

You can zoom the spectra view in and out by drawing a rectangle to the right or to the left with the mouse while pushing the left mouse button.
Zooms are reset with the next spectrum capture.



9.2.2.3 Menu Bar Functions (File)



Save ⇨ Saves the diagram view as:
| .bmp | .emf | .wmf | .pcx | .gif | .jpg |
The stored image size is that of the monitor display.

Print ⇨ Prints the diagram view.

Close ⇨ Closes the window.

9.2.2.4 Button Bar Functions

 Clear chart	Deletes the spectra view.
 Save chart	Saves the spectra view as a pixel image in jpg format, the size of the saved image is that of the monitor display.
 Print chart	Prints the spectra view.
 Abs. spectrum	Displays the absorbance spectra.
 Raw spectrum	Displays the raw spectra.
 Min. / Max.	Opens the Min-Max spectral values view. see *9.2.2.6 Fingerprint*
 Fingerprint	Displays the deviation in percent of the last recorded absorbance spectrum from the enveloped area of the fingerprint with the identification number 0. see *9.2.2.6 Fingerprint* there *Save fingerprint* and *Applying a fingerprint to an extinction spectrum*
 Clearwater spectrum	Only visible at raw spectra view. Displays the current clearwater spectrum (raw spectrum of the last clearwater calibration). This clearwater spectrum is used as a reference, the spectra are calculated from the deviation from this reference. The date and time of the current clearwater calibration are displayed above the line diagram.
 Start measuring	Starts a measurement, the measurement interval then starts again.
 Clearwater calibration	Performs a clearwater calibration. see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.2.6.2 Clear Water Calibration with the program AMS*
 Intensity calibration	Performs an intensity calibration. The intensity calibration in DI-water is part of the intensity adaptation, which in turn is part of the base calibration. see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.2.5 Intensity Calibration (Light Intensity) with the program AMS*

Save as sample	Opens an input window for a sample number[1], entered commas are stored as a point. This sample number is assigned to the last spectrum captured. **Definition:** A spectrum with an assigned sample number is a reference spectrum. Already assigned sample numbers can be assigned to another spectrum with AMS, but cannot be deleted. Sample numbers are only deleted in the database with the Spectrum Visual program (see *11 Spectrum Visual* there *11.2 Enter and Delete Sample Numbers*).
8 Intensity	Display and setting of the number of light flashes per single measurement as in *9.2.1 The Configuration Window of the Spectrometer*
100 Lamp power [%]	Light power of the xenon flash lamp Entry 100 ≙ Maximum power Entry 0 ≙ Minimum power

9.2.2.5 Base Bar Functions

1		Cleaning is running.
		Measurement or intensity calibration in clearwater is running.
		Transmission of spectra data to the spectrometer unit is running.
		Clearwater calibration is running.
2		Field for status messages
3		**T= *nn,n* °C** Temperature of the spectrometer electronic **D=*nnn*** MVR[2] of the dark measuring, see *7 Measurement Cycle*

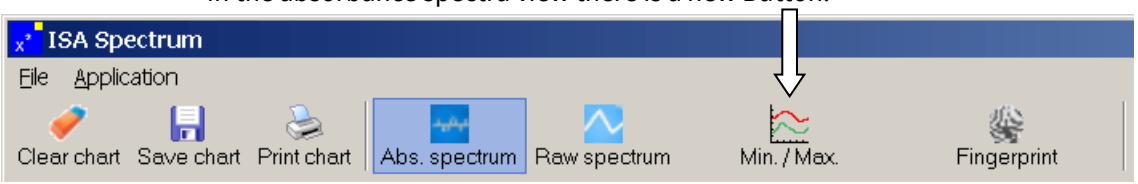
[1] Also called probe number or probe name. Character set: ASCII standard
This sample number is required in the application-specific calibration in connection with a multi-parameter calibration, and is stored together with the spectra data at an export in the JCAMP-DX format.
see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.3 Application-Specific Calibration*

[2] **MVR** = Maximum digital Value of a Raw spectrum

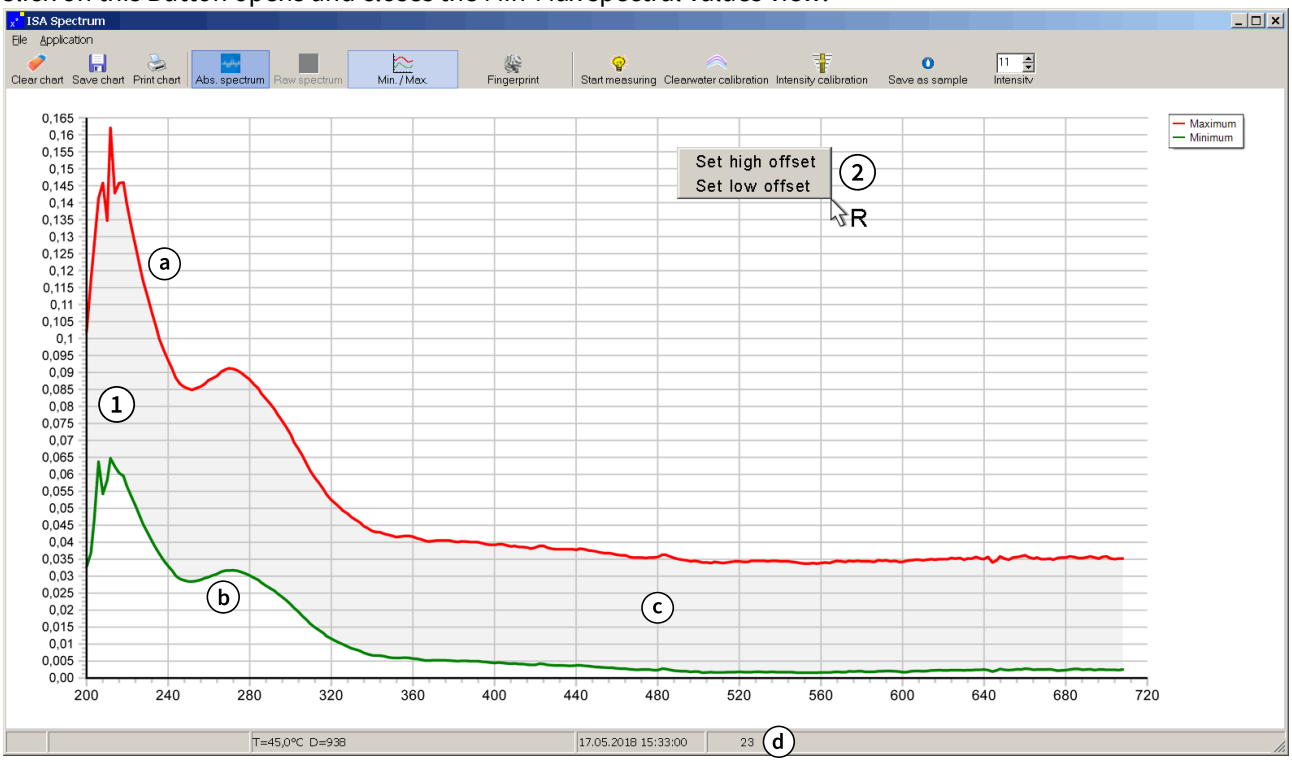
9.2.2.6 Fingerprint

The fingerprint is the enveloped area between the curves of the maximum values and the minimum values of the extinction spectra recorded after opening the spectra window.

In the absorbance spectra view there is a new Button:



Click on this Button opens and closes the Min-Max spectral values view.



① The minimum and maximum values of the single wavelengths of the absorbance spectra recorded after opening the spectra window are displayed.

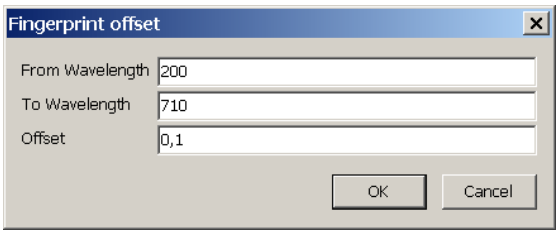
ⓐ Red line: maximum values curve

ⓑ Green line: minimum values curve

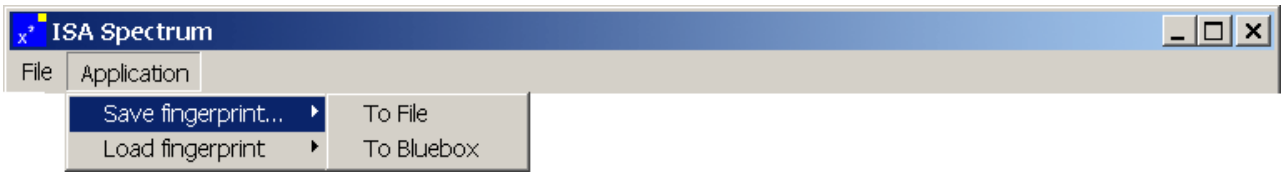
ⓒ Enveloped area (marked grey here)

ⓓ Number of absorbance spectra recorded after opening the spectra window

② You can offset the maximum values curve and the minimum values curve at specific wavelength ranges. Right mouseclick in the spectra view field opens an offset selection menu.
In [Set high offset] and set [Set low offset] you can determine a wavelength range and an offset value.
If you are in zoom mode, the wavelength range will shift accordingly.



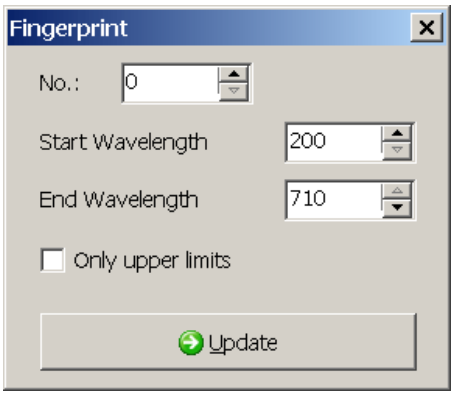
Save fingerprint



Click on <Save fingerprint> <To file> opens a window in which the storage path can be selected. The fingerprint is saved as an fp file.

Click on <Save fingerprint> <To BlueBox> opens a menu:

Click on <Update> saves the fingerprint on the BlueBox.



No.: Saves the current fingerprint with an identification number (0, 1, 2, 3).
With this identification number you can call up a fingerprint with AMS Formula.

Formula entry: **ISA.FP**(*identification number*)
– greatest deviation in percent from the fingerprint

ISA.FP(*identification number*,*wavelength*)
– deviation in percent from the fingerprint at a wavelength

The previous formula entry **ISAFP**(*n*) is no longer valid.

Start Wavelength
End Wavelength Limits the enveloped area of the fingerprint to a wavelength range.

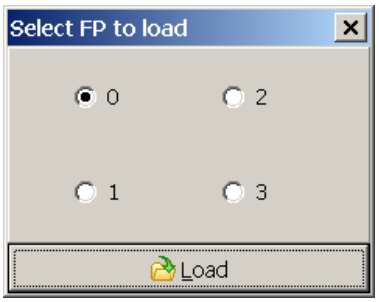
Only upper limits ☑ The minimum values curve is not considered. The enveloped area of the fingerprint lies between the maximum values curve and the x-axis (y=0). see above

Load fingerprint

Click on <Load fingerprint> <From File> opens a window in which you can select the storage path of a fingerprint saved as an fp file. The fingerprint appears in the Min-Max spectral values view.

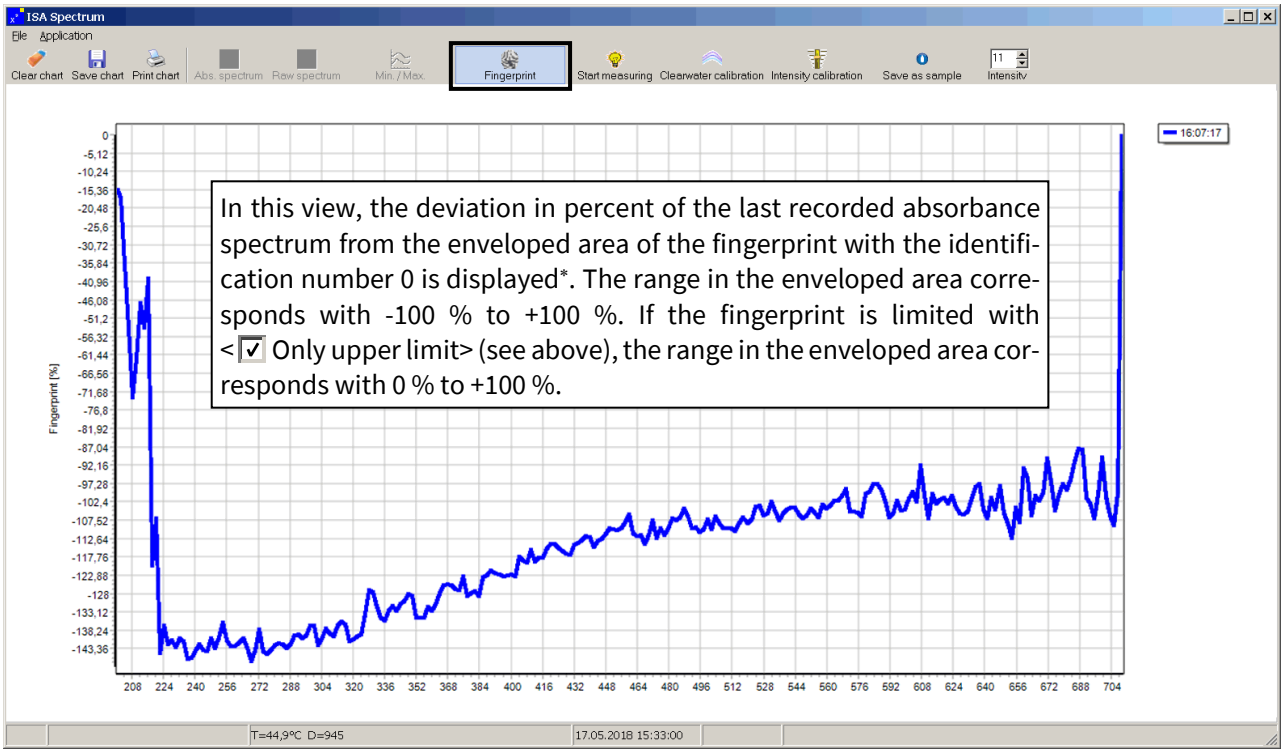
Click on <Load fingerprint> <From BlueBox> opens a menu:
Use the radio buttons to determine the identification number (see above) of the fingerprint.

Click on <Load> loads the fingerprint in the Min-Max spectral values view



Applying a fingerprint to an extinction spectrum

Click on the fingerprint button applies the fingerprint with the identification number 0 (see above) to the last recorded absorbance spectrum.



* i.e. the "position" of the absorbance spectrum in the fingerprint

9.3 The Sensor Setup Window of an Application-Specific Parameter

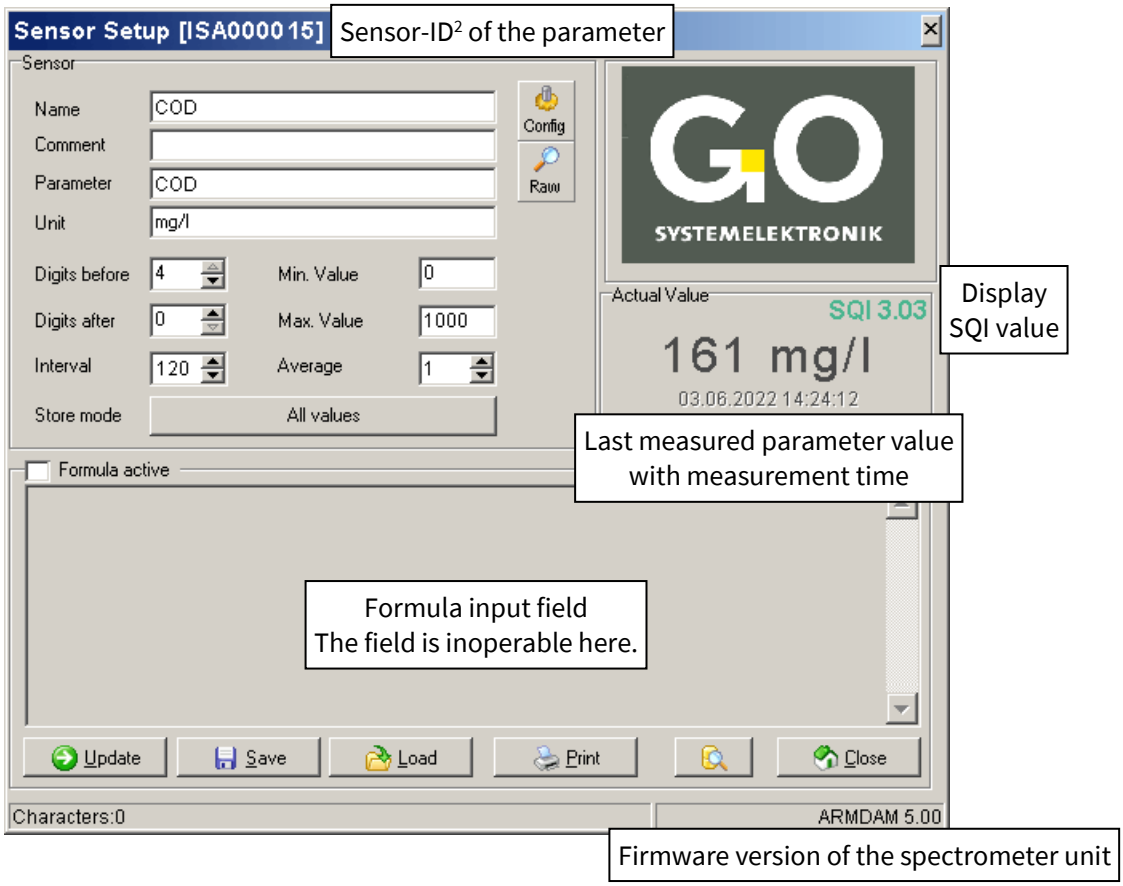
The application-specific parameters generated from spectral data are, such as virtual sensors (see *13 Virtual Sensors*), calculated parameters. The main difference to virtual sensors is the type of calibration that allows a continuous calculation of the **SQI**[1] (Spectral Quality Index).

AMS handles the application-specific parameters such as sensors.
By default, each spectrometer is configured with SAC254 as an application-specific parameter. In addition, there are three free parameters which can be customized configured. For more information on customer specific application parameters, please contact GO Systemelektronik.

Example customized parameter COD:

COD Double-click in the AMS start window opens the sensor setup window.

The CAN-ID of a newer spectrometer starts with **ISA** in capital letters, e.g. **ISA00001**.



Opens the configuration window of the parameter.
see *9. 3.1 The Configuration Window of an Application-Specific Parameter*

Opens a window with the display of the last recorded single value of an averaged measurement value.[3]

[1] SQI (Spectral Quality Index)
see *9.3.1 The Configuration Window of an Application-Specific Parameter* and *Appendix E – SQI (Spectral Quality Index)*

[2] CAN-ID + sensor number (uniquely defined for each sensor, factory preset)

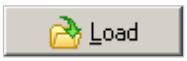
[3] Is useful in some cases for testing purposes.

Name	Name of the virtual sensor, is queried by other BlueBox programs.	max. 20 characters
Comment	Any comment text for AMS and BlueBox SQL software*	max. 20 characters
Parameter	Name of the measured parameter	max. 20 characters
Unit	Unit of the output value More than 5 characters can't be displayed at the BlueBox display.	
Digits before	Number of displayed pre-decimal places	
Digits after	Number of displayed decimal places	
Interval	Time period in seconds between the calculations The minimum interval is the spectrometer interval. The interval of an application-specific parameter can only be an integer multiple of the spectrometer interval, in this example 120, i.e. in case of a spectrometer interval of 60 the calculation of the sensor value takes place at every second spectrum capture. Other values are taken as the next largest integer multiple of the spectrometer interval.	
Min. Value	Lower value limit	
Max. Value	Upper value limit	
Average	The number of single measurements from which the arithmetic mean is derived.	

Opens a menu where you can define how the parameter values are stored in the database. see *Manual BlueBox PC Software* there *5.4.1 Sensor Setup* there *Display and save mode*

Transfers the formula from the input field to the BlueBox.
The button is inoperable here.

Opens a window to save the formula on the PC.
The button is inoperable here.



Opens a window to load a saved formula from the PC.
The button is inoperable here.

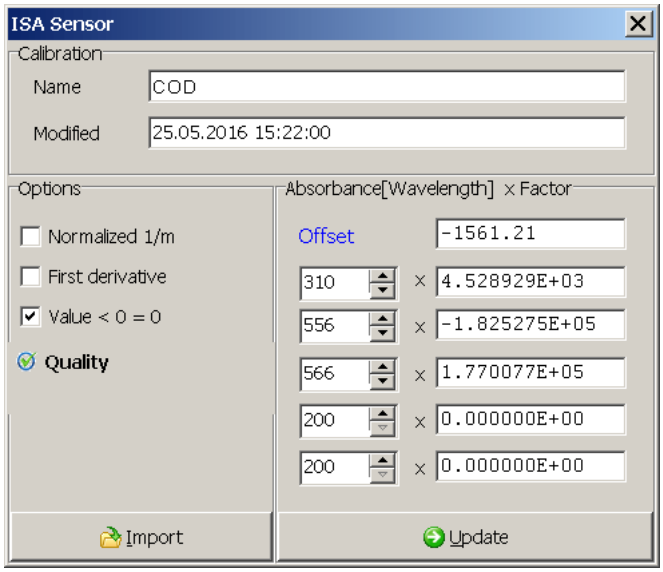
Opens a window for to print these sensor-settings.

Opens a list of the current variables with their current values.

* In older software versions, here it was also possible to determine how a measurement value is stored in the database. The setting is now made via the <All values> button.

9.3.1 The Configuration Window of an Application-Specific Parameter

Sensor setup window of the parameter



Calibration

Name	Name of the calibration
Modified	Date and time of the last transmitted changes from this window

Options

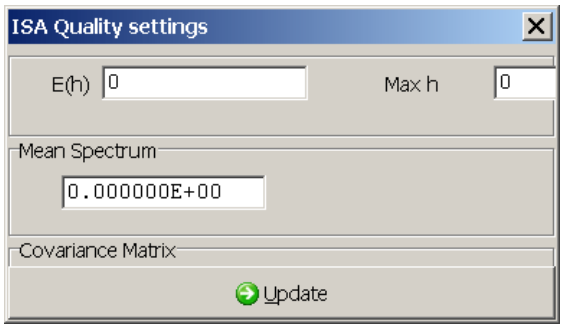
☑ **Normalized auf 1/m**
The calibration is calculated with normalized spectra. These normalized spectra have intensity values related to a standardized measurement path of one meter length.

☑ **First derivate** — The calibration is calculated with the values of 1. derivation* of the absorbance spectra.

☑ **Value < 0 = 0** — A measurement value <0 is set to 0.

At the BlueScan Plus spectrometer from GO Systemelektronik, which is not described here, a pressure sensor and a temperature sensor can also be selected here.

Opens the window of the quality settings, only visible if the SQI is calculated.



In this window the calculation values of the SQI are displayed.
Only the value for **Max h** is of interest for the operation, h is the **value of the SQI**. If the **Max h** is exceeded, the measurement value is displayed in square brackets in the sensor setup window and in the display of the BlueBox.
In addition, the sensor icon is displayed as a warning sign ⚠ in the AMS start window.

SQI (Spectral Quality Index)
The SQI is a degree of the statistical reliability of measurement values and is calculated continuously for each parameter. Precondition is the creation of a corresponding calibration file in the xml format.
see *Appendix E – SQI (Spectral Quality Index)*

Absorbance[Wavelength] x Factor — Calibration values

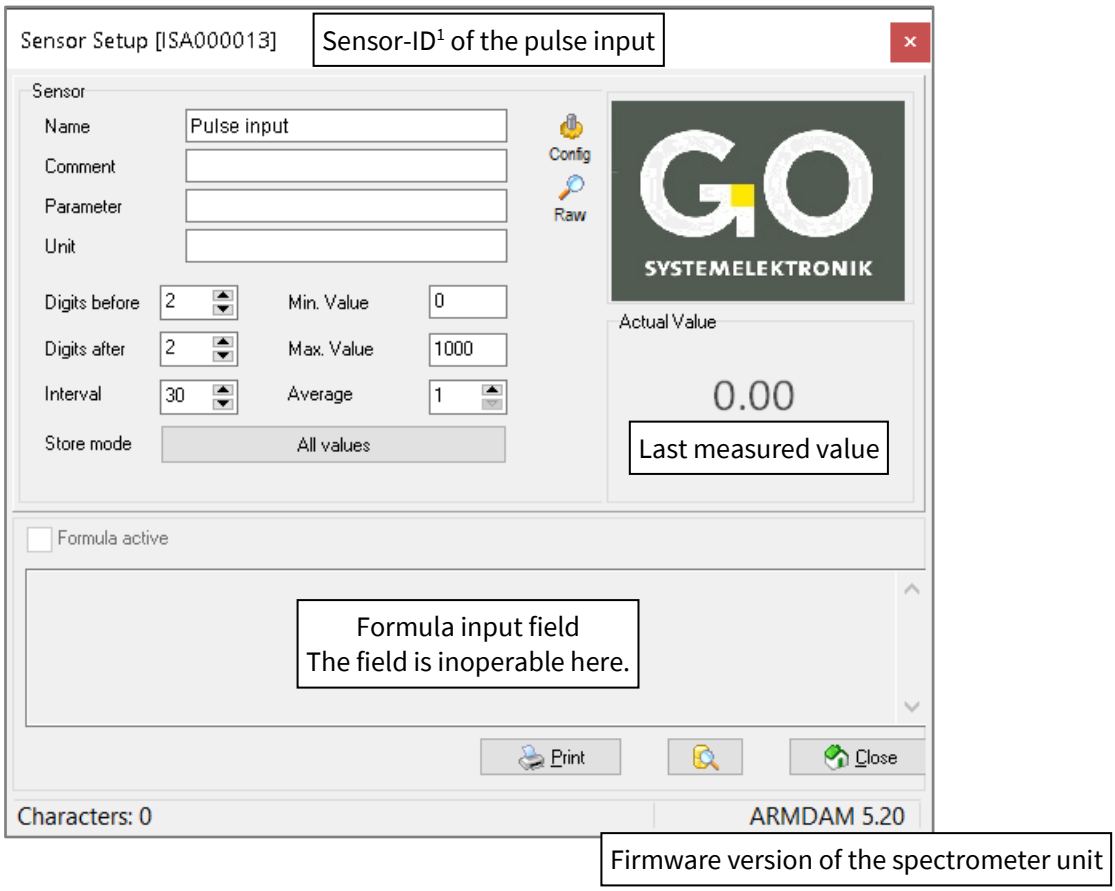
Imports ISA Plus calibration data in the txt-format and in the xml-format.

Transmits the settings to the spectrometer unit.

* means the differences of the adjacent absorbance values

9.4 The Sensor Setup Window of the Pulse Input

Pulse input Double-click in the AMS start window opens the sensor setup window.

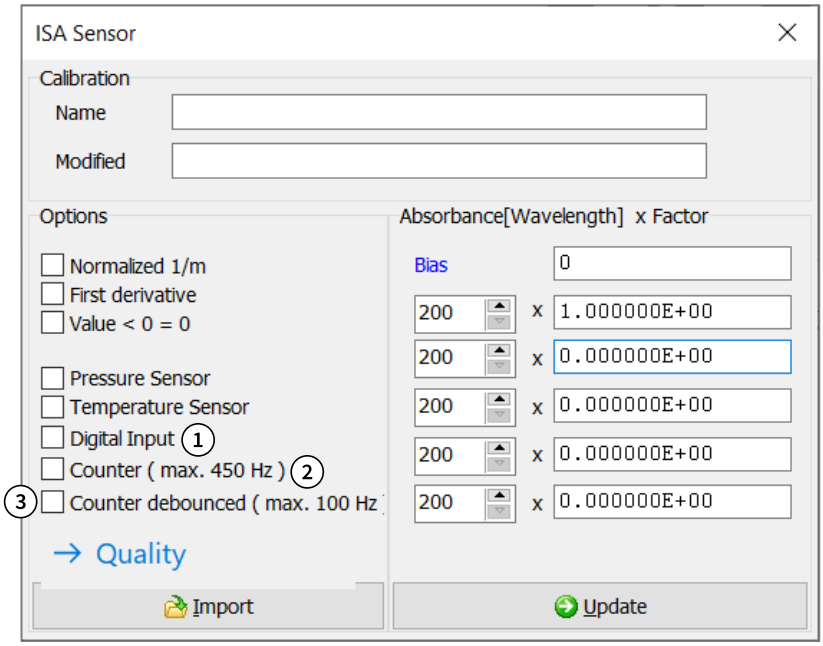


Opens the configuration window of the pulse input.
see *9. 4.1 The Configuration Window of the Pulse Input*

Opens a window with the display of the last recorded single value of an averaged measurement value. [2]

[1] CAN-ID + sensor number (uniquely defined for each sensor, factory preset)
[2] Is useful in some cases for testing purposes.

9.4.1 The Configuration Window of the Pulse Input

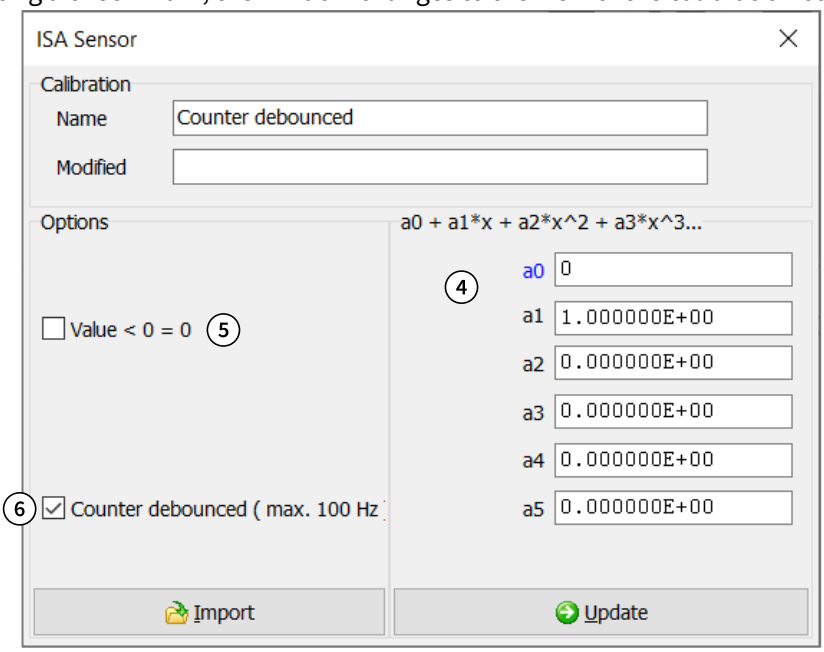


① Selection ☑ Static input

② Selection ☑ Frequency (edge trigger) – Triggering on the rising edge, max. 450 Hz

③ Selection ☑ Frequency (debounced) – Triggering on the rising edge with debounce, max. 100 Hz

After setting a check mark, the window changes to the view of the calibration coefficients.



④ Input fields of the calibration coefficients

⑤ Selection of whether values less than zero are set to zero or not.

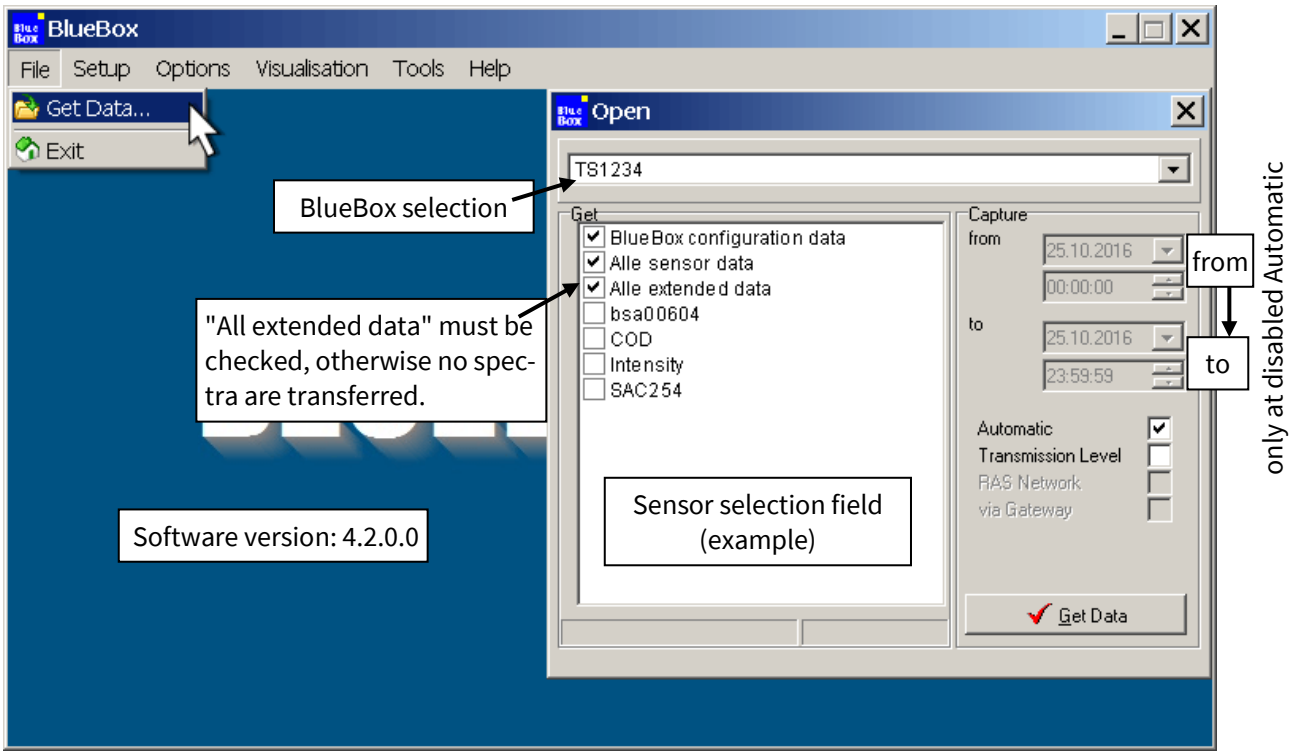
⑥ If the check mark is removed, the configuration view reappears

Imports calibration data.

Transfers the settings to the spectrometer unit.

10 Transmitting the Data to the PC with the program BlueBox SQL

To transfer the data from the BlueBox to the PC, call-up <File> <Get Data> in the BlueBox SQL Software.
see also *11 Spectrum Visual*



When checking these items in the sensor selection field the following data will be transmitted to the PC:

☑ BlueBox configuration	configuration data of the BlueBox
☑ All sensor data	the measurement data of all connected sensors (in case of Intensity for each the MVR* of the raw spectrum)
☑ All extended data	the raw spectra and the absorbance spectra
☑ bsa00604 ☑ COD ☑ Intensity ☑ SAC254	the measurement data of the selected sensors (in case of the ISA for each the MVR* of the raw spectrum)
Automatic ☑	If this check box is activated, all those values are transmitted automatically, which had been recorded since the point in time of the last data transmission. This point in time is determined by the most current data set of the data base.
Transmission Level ☑	Only for measurement data. If this check box is activated, only those values are transmitted, which differs from the previous value for a certain degree. The value of this difference is determined in: BlueBox SQL <Options><Sensor Details…> "Data transmission level" (see *Manual BlueBox PC Software*).
RAS Network via Gateway	Only active, if the connection is established via modem or gateway.
Get Data	Transmits the data to the PC.

* **MVR** = Maximum digital Value of a Raw spectrum

11 Spectrum Visual

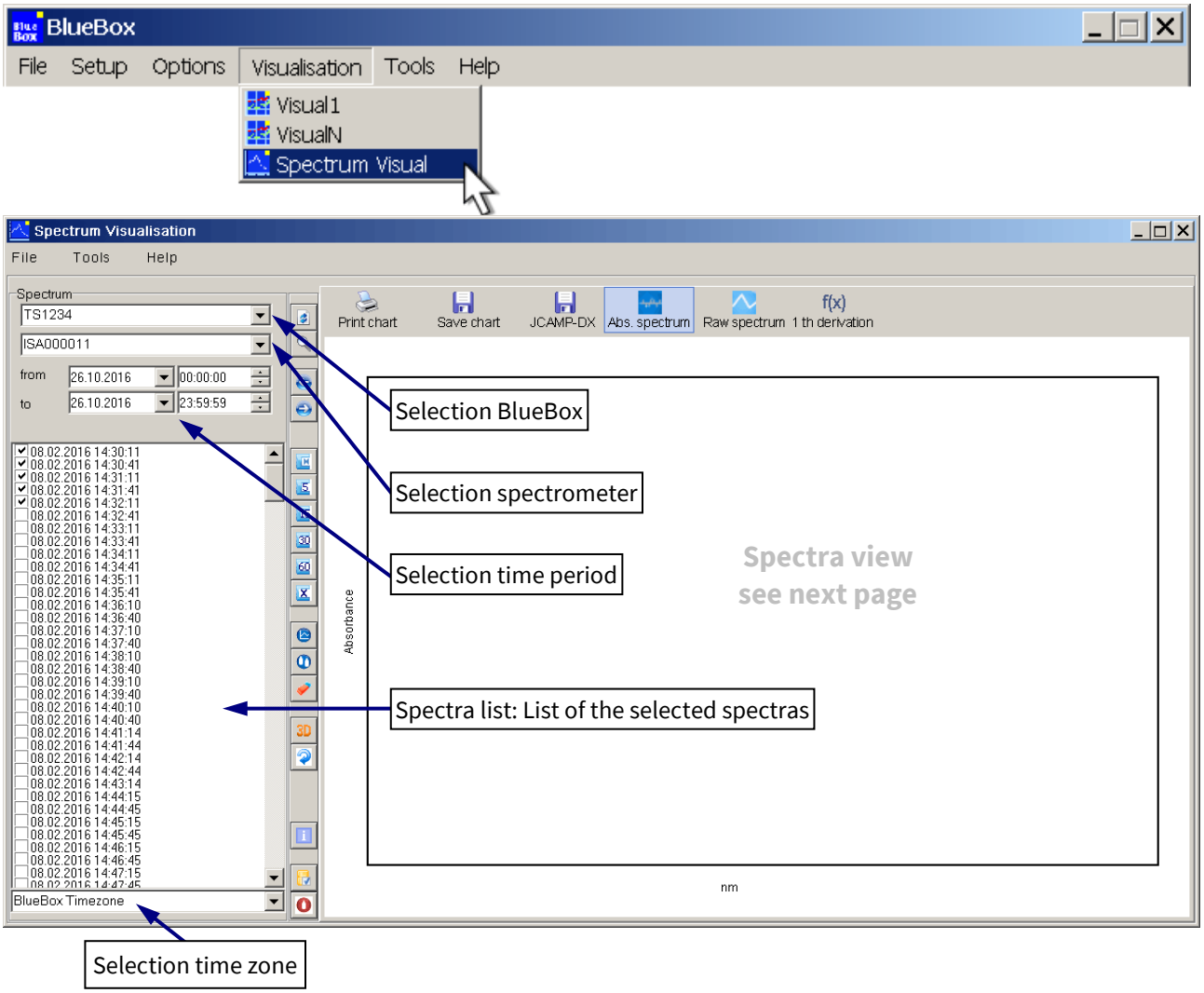
Software version Spectrum Visual: 4.5

The program Spectrum Visual

- displays graphically the spectra stored in the database on your PC,
- assigns sample numbers to spectra,
- stores spectral graphics in common graphic formats,
- exports spectral data into common formats,
- generates a fingerprint from selected spectra,
- imports spectral data,
- and applies application calibrations to spectra in the database.

11.1 Call up and Display the Spectra

The call up is made with the program **BlueBox SQL**.



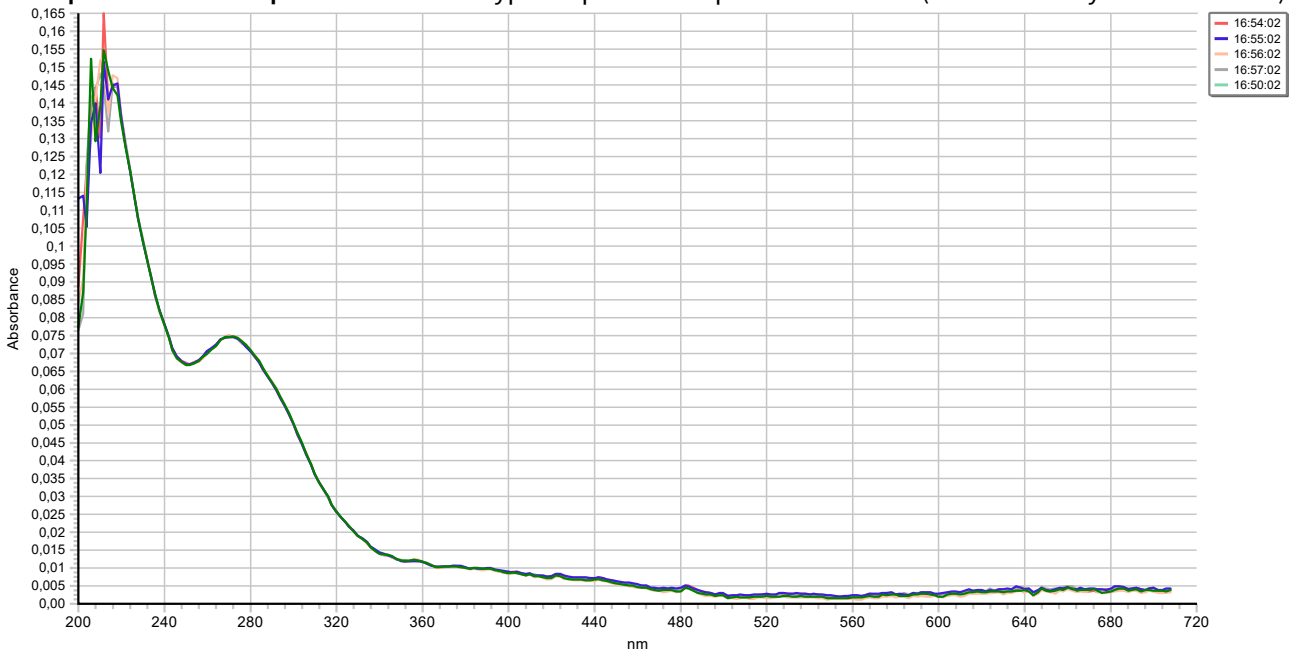
Select a BlueBox, a spectrometer, a time period and a time zone. The selected spectra are listed in the spectra list.

There are two ways of marking spectra in the spectra list:

1. With the **checkbox**: The spectrum is checked and **marked**. A multiple marking is possible, checked spectra are displayed as a line diagram.
2. **Click on time information** to the right of the checkbox: The time of a selected spectrum is highlighted in blue and therewith **marked blue**.

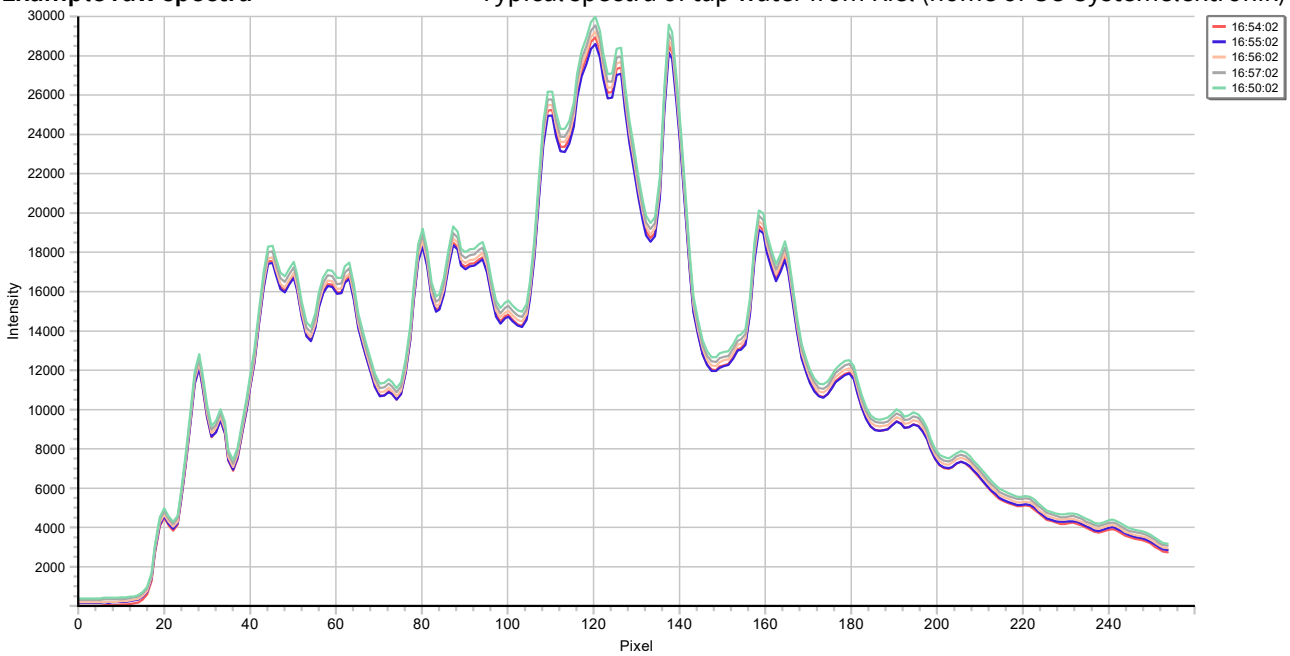
Marked spectra are displayed as a line graph (max. 500):

Example absorbance spectra Typical spectra of tap water from Kiel (home of GO Systemelektronik)



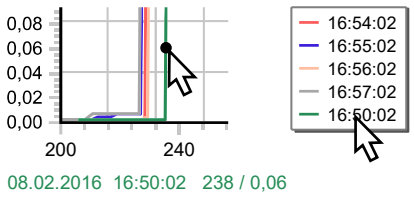
The marked absorbance spectra are displayed as a line diagram in different colours.
The values of the x-axis are the light wavelengths of 200 nm to 708 nm, the values of the y-axis the absorbance factor.

Example raw spectra Typical spectra of tap water from Kiel (home of GO Systemelektronik)

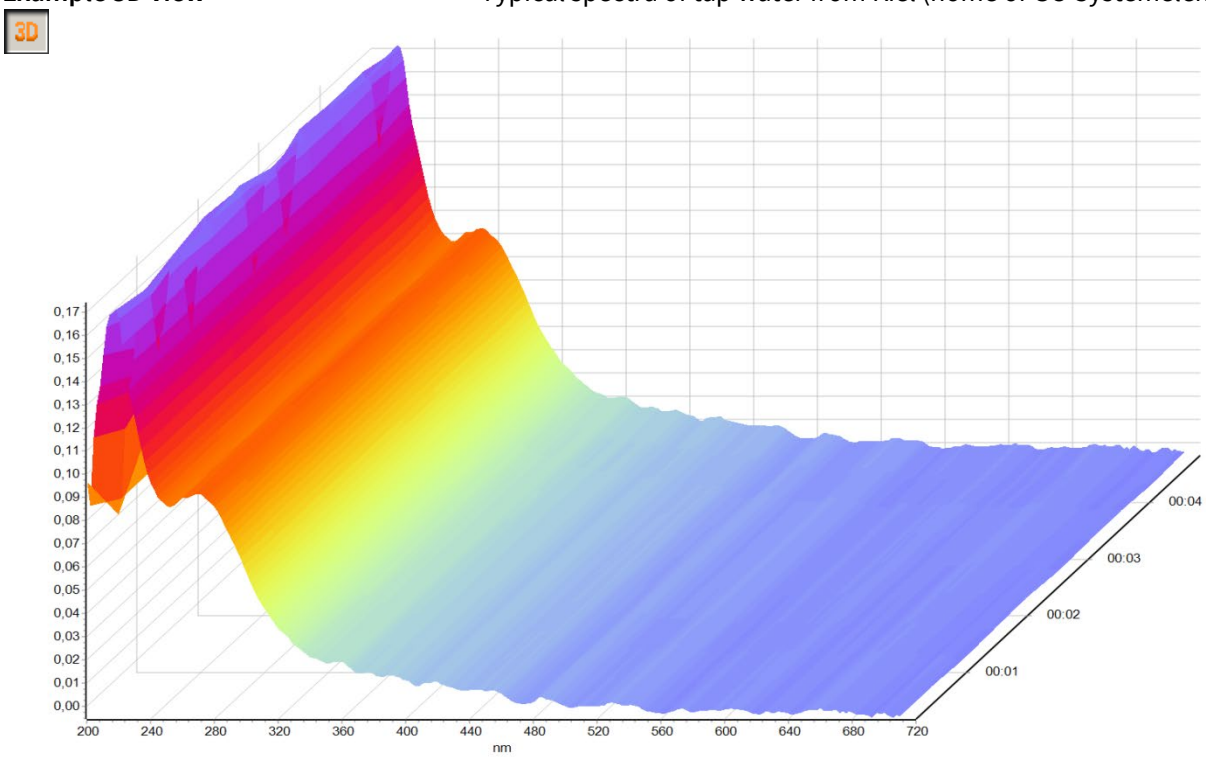


The marked raw spectra are displayed as a line diagram in different colours.
The values of the x-axis are the steps of the spectral resolution of the spectrometer (0 – 254), the values of the y-axis the counts of the AD converter (0 – 30000).

In the upper right the recording times of the spectra are listed with their line colour. Click on an entry activates the respective spectrum. You can then use the cursor to move to the single line points.
On the bottom left the date and time of the spectrum recording and the xy-values of the line point are displayed.

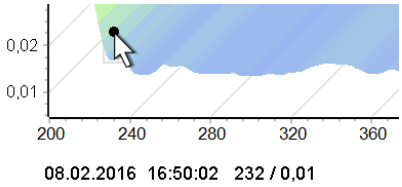


Example 3D view Typical spectra of tap water from Kiel (home of GO Systemelektronik)

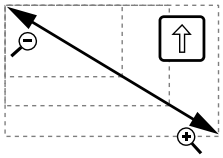


The values of the y-axis are displayed in different colours. The values of the z-axis are the recording times of the spectra.

You can then use the cursor to move to the single points of the spectra surface. On the bottom left the date and time of the spectrum recording and the xy-values of the point are displayed.



You can enlarge or reduce the size of any spectra view by dragging a rectangle to the right or left while holding down the shift keys and holding down the left mouse button. Click on for the normal view*.



* see vertical button bar

Menu bar functions

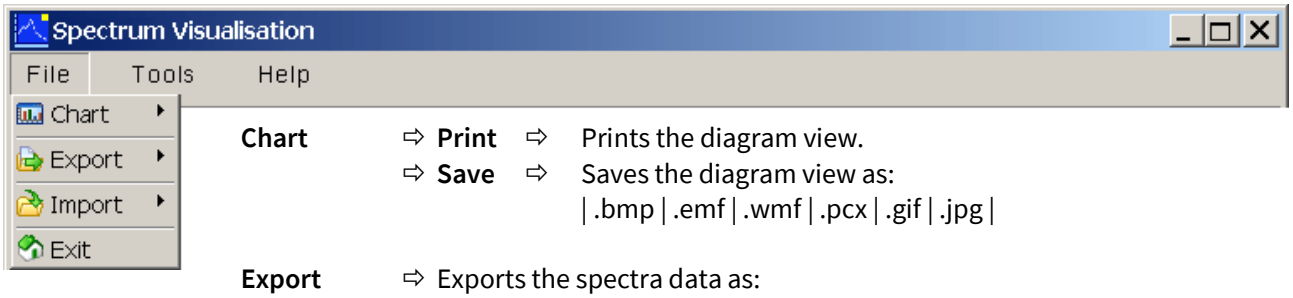


Chart ⇨ **Print** ⇨ Prints the diagram view.
⇨ **Save** ⇨ Saves the diagram view as:
| .bmp | .emf | .wmf | .pcx | .gif | .jpg |

Export ⇨ Exports the spectra data as:
| JCAMP-DX | Text Format | B+L Format | BlueBox data base |
see *11.3 Export Spectra Data*

Import ⇨ Imports:
| spectra data | calibration data |
see *11.4 Import Spectrometer Data*

Exit ⇨ Closes Spectrum Visual.

Auto Calibration without function

Export Fingerprint ⇨ Creates a fingerprint from the selected spectra and opens a window where the storage path can be selected. The fingerprint is saved there as an fp file. see also *9.2.2.6 Fingerprint*

Opens an info window with the version number of Spectrum Visual.

Functions of the horizontal button bar


Print chart

Prints the diagram view.


Save chart

Saves the diagram view as |.bmp | .emf | .wmf | .pcx | .gif | .jpg |


JCAMP-DX

Exports the spectra data as a JCAMP-DX data format.
see *11.3 Export Spectra Data*

Abs. spectrum	Display of the absorbance spectra
Raw spectrum	Display of the raw spectra
f(x) 1th derivation	Displays the graphs of the first derivation.[1] Has no influence on the exported spectra data.
1/X Norm	Absorbance spectra[2] are displayed normalized to 1/m. These normalized spectra have intensity values related to a standardized measurement path of one meter length.

Functions of the vertical button bar

Reload: Updates the spectra view.
If, in the meantime, new spectra have been stored in the database, click on Reload loads the new spectra into the spectra list. Already marked spectra remain marked.

Back to the normal view
If the spectra view is zoomed, click on this button switches back to the normal view.

Moves the selected time period by one day ahead.

Moves the selected time period by one day back.

Marks all spectra (max. 500).

Marks spectra (max. 500) at intervals of 5, 15, 30 and 60 minutes,
Click again demarks all spectra.

Marks max. 500 spectra distributed evenly over the selected time period.

Retrieves all ever captured spectra of the clearwater calibration.

Retrieves all ever defined reference spectra.

Demarks all marked spectra.

[1] means the differences of the adjacent absorbance or raw values
[2] Does not work with spectra generated with older spectrometers.
see *6.2 Notes on Current and Older Spectrometers*

Displays the spectra in a 3D diagram.
Below the next button a slider is displayed, with this slider you can adjust the display range of the z-axis of the 3D-diagram.
Click again to return to the 2D display.

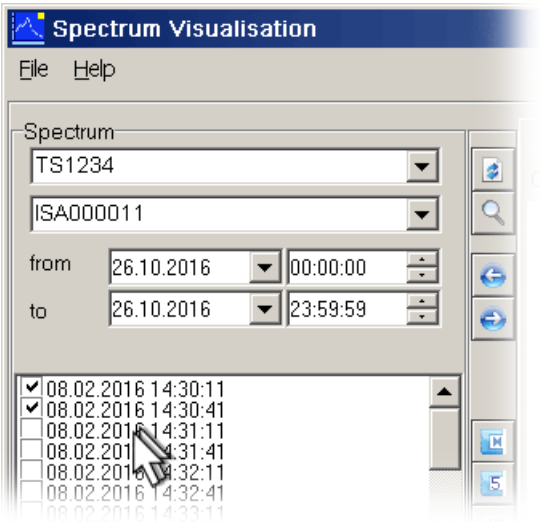
The diagram display can be rotated around the x- and y-axis using the cursor and the pressed left mouse button.
Click again to return to the initial position.

Opens an info window with properties of the spectrum recording of a blue marked spectrum.

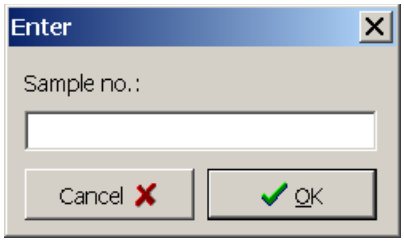
Marks all reference spectra (spectra with sample number) additionally to the already marked spectra.
Click again to return to demark all reference spectra.

Opens a window for entering a sample number for a blue-marked spectrum.
You can also double-click in the spectra list.
see *11.2 Enter and Delete Sample Numbers*

11.2 Enter and Delete Sample Numbers



Click on in the vertical button bar opens a window for entering a sample number* for a blue marked spectrum. You can also double-click in the spectra list.
Here you can assign a **sample number*** to a marked spectrum, entered commas are saved as point. A spectrum with sample number is a **reference spectrum** and is red marked in the spectra list.

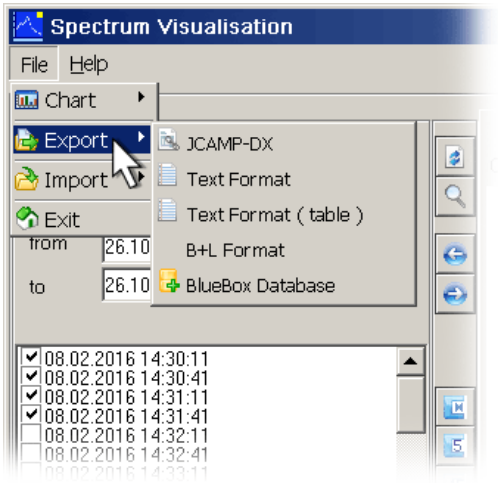


You delete a sample number by clicking on <OK> without input.

* Also called probe name or sample number. Character set: Standard ASCII
The sample number is required for an application specific calibration in connection with a multi-parameter calibration, and is stored in the JCAMP-DX format together with the spectral data.
see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.3 Application-Specific Calibration*

11.3 Export Spectra Data

You can export the selected spectra data of all spectra as one or various files.
Click on <File><Export> opens a selection menu.

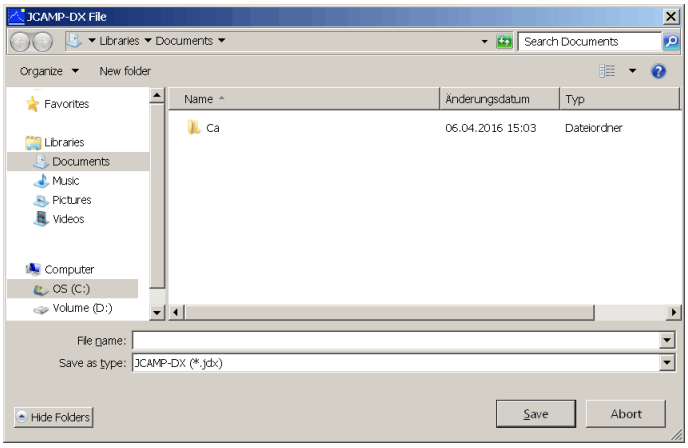


If no spectrum is marked, all spectra of the spectra list are exported.

JCAMP-DX (with the extension jdx) is a standardized file format for exchanging spectra and related chemical and physical information between systems from different manufactures. The JCAMP-DX files are needed for calculating the calibration coefficients in the application-specific calibration (see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.3 Application-Specific Calibration*).

In the next window you specify name and memory location of the file. The file will then be saved with the file extension jdx.

The spectral data of the selected spectra are then summarized in a jdx file.



Text Format
The spectral data of each selected spectrum will be stored in a single txt file.

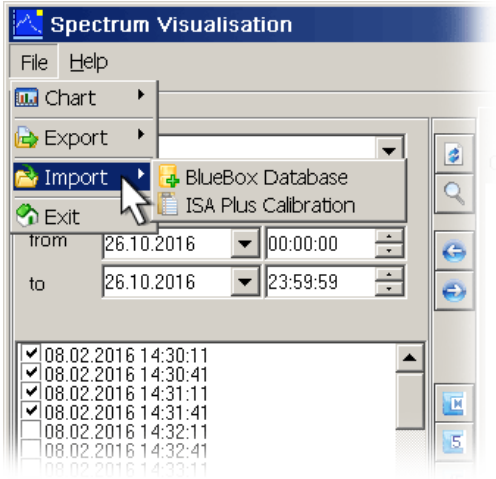
Text Format (table)
The spectra data of all marked spectra are saved in a csv file.

B+L Format
The spectral data of each selected spectrum will be stored in a single asc file.
The modification date* of the file is the recording time point of the spectrum.

BlueBox Database
The spectral data of all selected spectra are stored in one file with the extension isa.
With this isa file the spectra data could be imported from other computers (*see 11.4.1 BlueBox Database*).

* not the creation date

11.4 Import Spectrometer Data

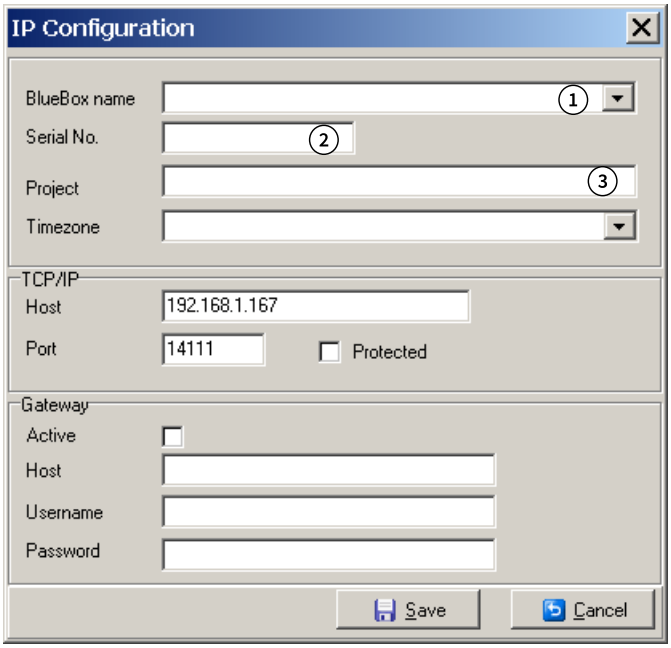


11.4.1 BlueBox Database

Spectrum Visual can generate BlueBox export files with the isa file extension, see *11.3 Export Spectra Data*. With these files you can export spectra data from a database (source database) to a database of the same name (target database) on another computer (target computer).

Prerequisite: If this database of the same name does not exist on the target computer, it must be set up.*

Setting up a database with the program BlueBox SQL:



see *Manual BlueBox PC Software* there *3.2.2 Setup of a New BlueBox*

① Freely selectable name, does not have to match the BlueBox name on the source computer – Under this name (Selection BlueBox, see *11.1*) you can call up the spectra from the imported database.

② Serial number of the BlueBox of the source database

③ Name of the source database, standard name is *bluebox*

Click on Save creates the database on your computer.

Note on the time stamp: The record times of the spectra are stored in the database in Universal Time Coordinated (UTC), just like all other acquisition times. Changing the time zone, e.g. in Spectrum Visual, only changes the time stamp of the display, and not the time stamp in the database.

* The created database appears in the BlueBox PC Software as an actually existing BlueBox, to which direct access (e.g. retrieving data from the BlueBox or changing settings) is not possible.

11.4.2 ISA Plus Calibration – Apply Calibration Data to Existing Spectra

Here you can apply **ISA Plus calibration files** in the xml format and in the txt format to your spectra in the database.

This import is not to be confused with the import of the calibration files to a BlueBox.
see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.3 Application-Specific Calibration*

The calibration files are generated with an **application calibration**[1] and are used to calculate parameters of a specific application.
The parameter values are displayed as a line graph.

Import a calibration file:
Two additional buttons[2] appear in the horizontal button bar.


Calculated value

Displays the calculated parameter values as a line graph.
You can then use the cursor to move to the single points of the line graph. On the bottom left date and time and calculated parameter value of the point are displayed.
Beneath the name of the calibration file with date.


Quality [SQI]

Displays the SQI (Spectral Quality Index) of the calculated parameter values and the spectra.
A third button appears.

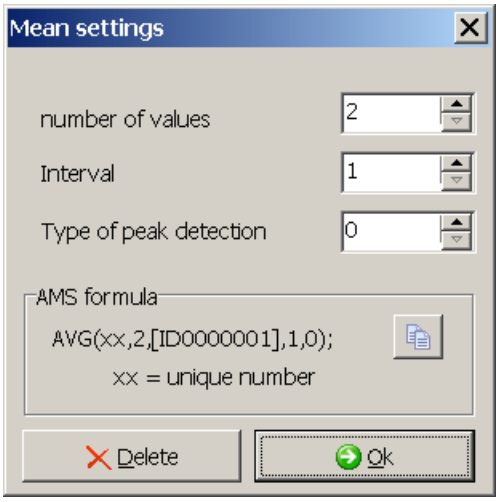

Ignore neg. values

Sets negative values to zero.

In the vertical button bar another button appears ⇨ 
Click on this button the window of the mean settings.
Here you can determine how a moving average of the calculated parameter values is generated and how outliers are treated.

Cancels the effect of the mean settings.
You can also click on ☒

Calculates the mean values and displays them graphically.



Number of values Number of parameter values from which the moving average is calculated, minimum is 2.

Interval Parameter values are calculated only from those spectra whose time difference, starting with the first marked spectrum, is greater than or equal to the interval.[3]

[1] see *Manual ISA and Process Spectrometer Commissioning - Maintenance - Service* there *4.3 Application-Specific Calibration*
[2] and button **f(x)** disappears
[3] Values less than/equal to the interval of the spectrometer are of no effect.
see *8.2.1 General Settings* and *9.2 The Sensor Setup Window of the Spectrometer*

Type of peak detection

0	No outlier detection

The measurement values determined with *number of values* (see above) are sorted by size.

1	The lower and upper 10 percent by number are removed and the arithmetic mean is calculated
2	The lower and upper 20 percent by number are removed and the arithmetic mean is calculated.
3	The lower and upper 30 percent by number are removed and the arithmetic mean is calculated.
4	The lower and upper 40 percent by number are removed and the arithmetic mean is calculated.
5	The calculated mean is the median of all n values.

AMS formula

This field displays the corresponding AMS formula entry.

AVG(xx,b,[Sensor-ID],d,e);

xx = Consecutive identification number of the moving average (0 to 9999)

b = Number of measurement values to be averaged.

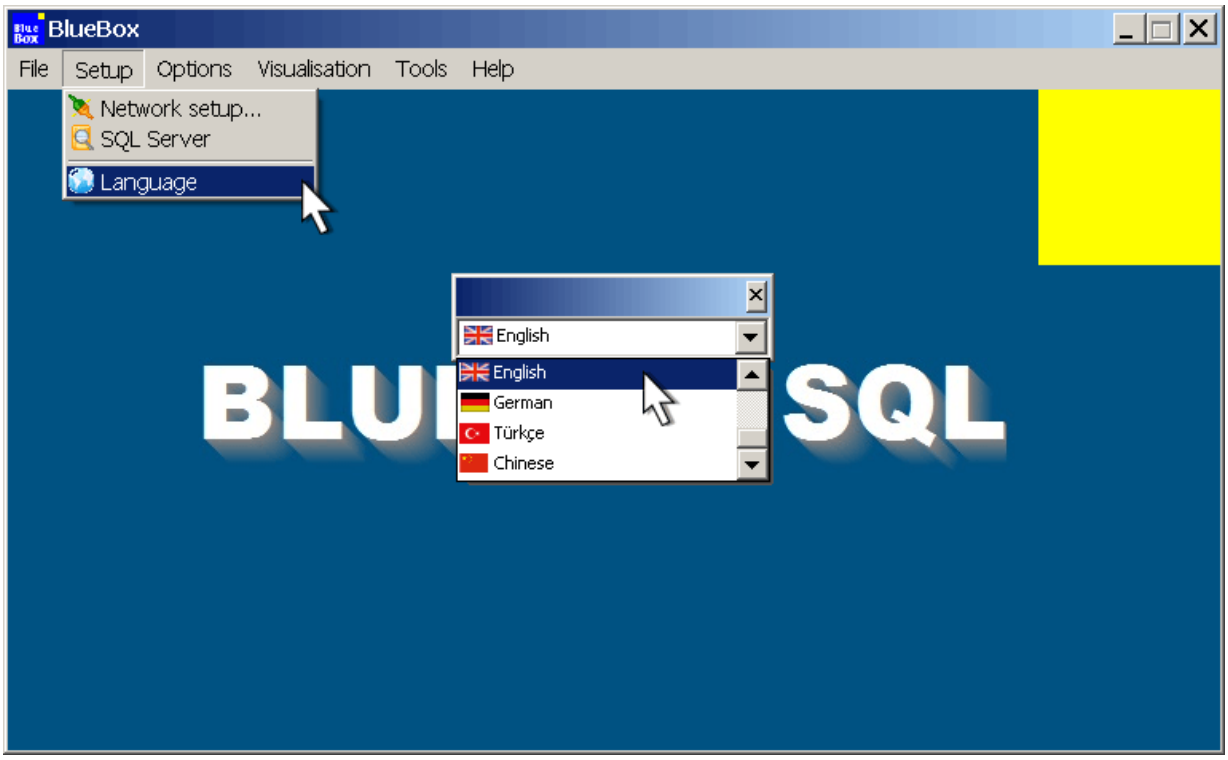
[Sensor-ID] = measurement value of the sensor

d = Interval

e = Type of outlier detection

Click on copies the formula entry into the clipboard.

12 Language Options



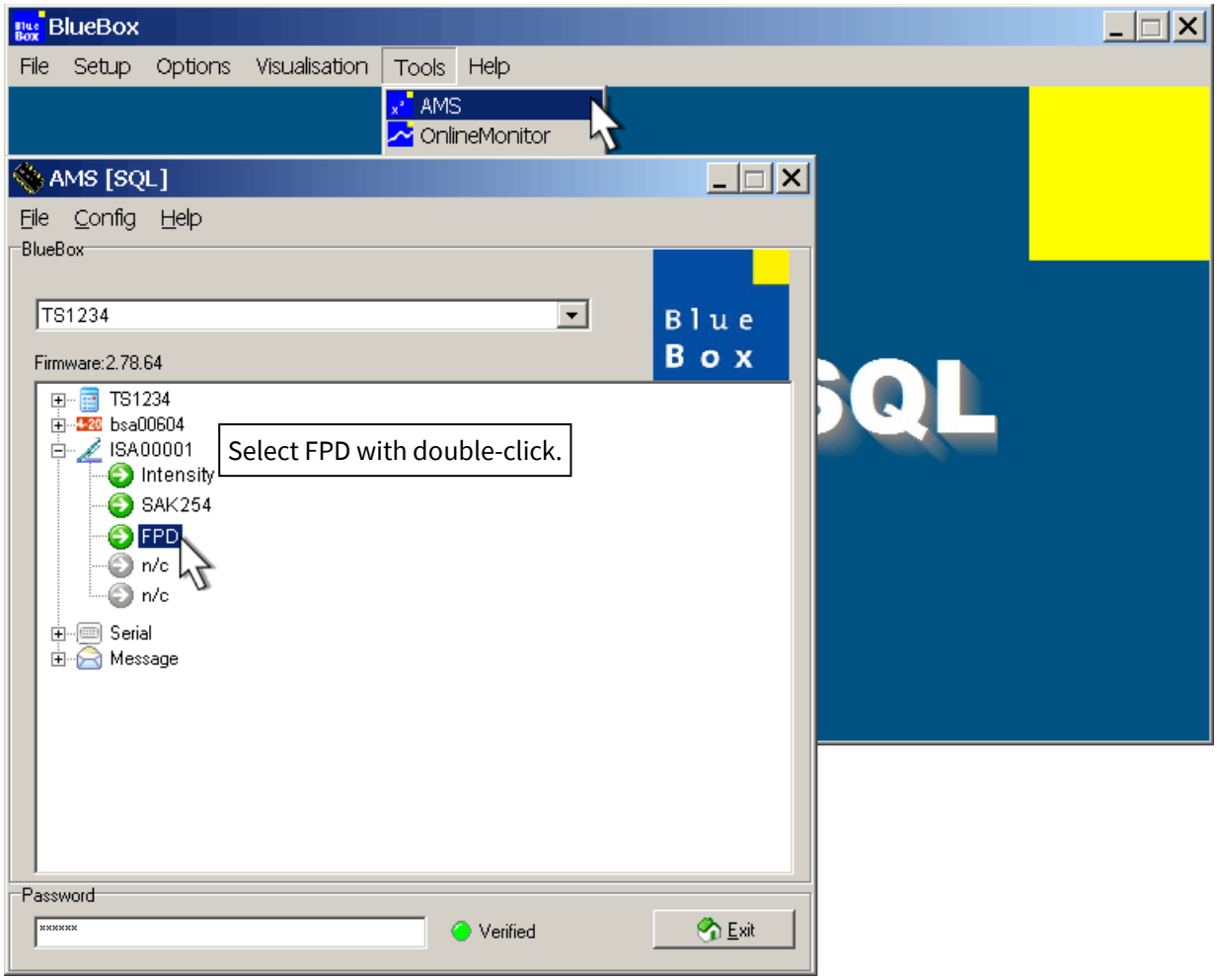
13 Virtual Sensors

The BlueBox PC Software offers with AMS (Advanced Managing Software) the possibility to set up virtual (calculated) sensors. In combination with the ISA there are numerous possible applications.
A description of the software AMS with its formula language AMS Formula can be found in the *Manual BlueBox PC Software*.

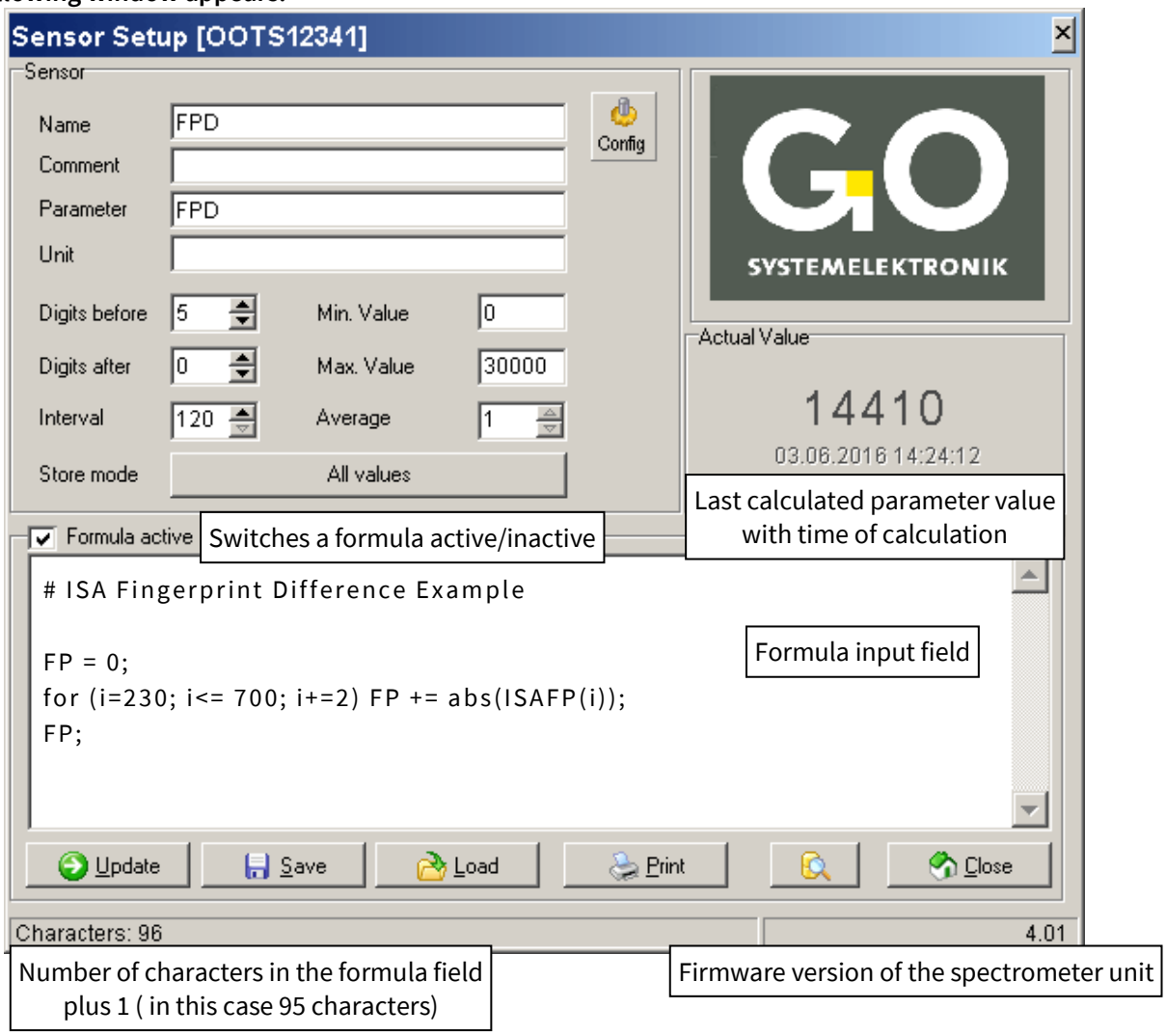
If more than one spectrometer is connected to the BlueBox, a spectrometer must be determined in the formula field with the entry **ISA "CAN-ID";** to which the following ISA-specific formula elements refer.
CAN-ID = CAN-ID of a spectrometer

13.1 Example Calculation of a Fingerprint Difference

A fingerprint can be used as a reference to detect contamination in the measurement medium. In this formula, the sum of the absolute values of the differences between the current absorbance spectrum and a fingerprint is calculated at all even wavelengths from 230 nm to 700 nm. The frequency range can of course be freely selected.



The following window appears:



Opens the calibration window of the parameter.
see *Manual BlueBox PC Software* there *5.4.1.2.5 Multi-Point Calibration*

Name	Name of the virtual sensor, is queried by other BlueBox programs.	max. 20 characters
Comment	Any comment text for AMS and BlueBox SQL software*	max. 20 characters
Parameter	Name of the measured parameter	max. 20 characters
Unit	Unit of the output value More than 5 characters can't be displayed at the BlueBox display.	
Digits before	Number of displayed pre-decimal places	
Digits after	Number of displayed decimal places	

* In older software versions, here it was also possible to determine how a measurement value is stored in the database. The setting is now made via the <All values> button.

Interval Time period in seconds between the calculations
The minimum interval is the spectrometer interval.
The interval of a virtual sensor can only be an integer multiple of the spectrometer interval, in this example 120, i.e. in case of a spectrometer interval of 60 the calculation of the sensor value takes place at every second spectrum capture.
Other values are taken as the next largest integer multiple of the spectrometer interval.

Min. Value Lower value limit

Max. Value Upper value limit

Average The number of single measurements from which the arithmetic mean is derived.

Opens a menu where you can define how the parameter values are stored in the database. see *Manual BlueBox PC Software* there *5.4.1 Sensor Setup* there *Display and save mode*

Transfers the formula from the input field to the BlueBox.

Opens a window to save the formula on the PC.

Opens a window to load a saved formula from the PC.

Opens a window for to print these sensor-settings.

Opens a list of the current variables with their current values.

13.2 ISA Formula Examples

Here are a few examples of how to calculate spectral data in virtual sensors.

ISA NO_3 example

In this formula the absorbance values at frequencies 284nm, 332nm and 628nm are used to generate a NO3 value. A lower limit is also implemented. The exact coefficients are derived from ISA Soft software calculations.

```
# ISA NO3 (example)

Value = -0.06347;
Value += ISA(284) * 28.547863;
Value += ISA(332) * - 51.927711;
Value += ISA(628) * 30.110743;

if (Value < 0) Value = 0;
Value;
```

ISA SAK254

The formula calculates the Spectral Absorbance Coefficient (SAC) at 254 nm.

```
# ISA SAC254

SAC = ISA(254)*(1000 / ISA.Pathlength);
if (SAC < 0) SAC = 0;
SAC;
```

ISA SAK254 with turbidity compensation

```
# ISA SAC254 with turbidity compensation

offset = 0;
for(i=600; i<700; i+=2) offset += ISA(i);
offset /= 50;
# calculates the average of the absorbance spectrum drift
# in the range 600nm to 700nm

SAC = (ISA(254)-offset)*( 1000.0 / ISA.Pathlength );
if ( SAC < 0 ) SAC = 0;
SAC;
```

ISA Modbus export

This formula makes spectral data retrievable for a Modbus master device.

```
# ISA Spectrum Modbus-Export

for (i=0; i<=255; i++) MODR(i) = ISA0(i);
```

14 Parameter Accuracy

Parameters, calculated with ISA spectral data can achieve the accuracy of 5% (typical 5 % - 10 %). In detail the accuracy can vary by the change of the water matrix. If the water matrix has higher variability, for example day/night or seasonal changes, this has to be analysed and a special calibration must be performed. In general, calibrations adapted to specific conditions can provide reliable measurements even under difficult conditions. Changes in the water matrix can be detected by other parameters (conductivity, pH value, temperature etc).

1. The accuracy of spectral data calculated parameters always is influenced by the quality of calibration. A higher number of calibration points will have the result of a more accurate calibration!

2. The range of the reference value pairs* must cover the entire measuring range evenly distributed as possible. The minimum number of reference value pairs is 25, a smaller number reduces the quality of the calibration and may subsequently lead to erroneous measurements.

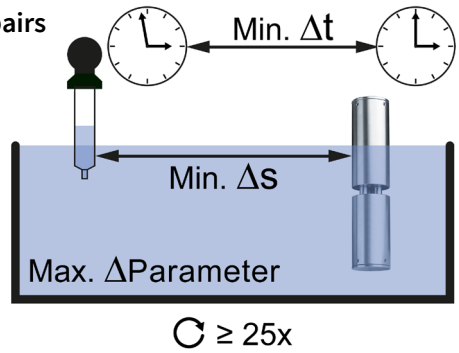
3. The right choice of the analytical method and the care in the procedure are the most important requirements for the accuracy of the calculation. The accuracy of the ISA parameter calibration is depending upon the specific accuracy of the chemical method for the parameter.

4. After the calibration, the calibration has to be checked and (when appropriate) adjusted over a longer period (for example, one week). This increases the stability of the measurement.

5. Measurements with high accuracy over a longer period are only possible with correspondingly adapted maintenance, a maintenance schedule is highly recommended here.

In general, periodic cleaning and recalibration increases the measurement quality. The interval of the maintenance is determined by the measurement conditions and can last from several weeks to several months.
see *Manual ISA and Process Spectrometer Commissioning – Maintenance – Service*

Determining the reference value pairs



* For the calculation and calibration to the desired parameter of a specific application, it is necessary that for each parameter reference values from chemical laboratory analysis and the corresponding spectral values are provided.
In case of a one-parameter calibration a spectrum is assigned to one reference value, in a multi-parameter calibration there is more than one reference value assigned. The spectral data of a spectrum plus one or more corresponding measurement values are called **reference value pair**.

Appendix A – The Configuration Data Sheet

The configuration data sheet contains the necessary settings to run the BlueBox.
Example BlueBox RS:

Configuration Data Sheet
Product: BlueBox
Page: 1/1
Date: 2023-02-07

1. BlueBox R1:

Serial Number	RS1234
Display PIN	xxx
Storage Device	8 GB

2. Network:

IP Address	192.168.1.167
Netmask [CDIR]	24
Gateway	0.0.0.0
Port	14111
Login Name	bluebox
Password	xxx

3. Hardware

LAN MAC-Address	xx-xx-xx-xx-xx-xx
WLAN MAC-Address	xx-xx-xx-xx-xx-xx

4. BlueBox BlueGate Settings:

Host	bluegate.go-sys.de
Password BlueGate	xxx

5. BlueBox PC Software - BlueGate Settings:

Host	datagateway.go-sys.de
Username	xxx
Password Windows	xxx

This document contains confidential information.

© GO Systemelektronik GmbH
Faluner Weg 1 D 24109 Kiel Telephone: +49 431 58080-0 Fax: +49 431 58080-11 Internet: www.go-sys.de

1. BlueBox R1:

Serial Number	R11234
BlueBox Password (PIN)	xxx
Storage Device	8 GB

Serial Number
Serial number of the BlueBox
With this serial number the BlueBox is identified by the BlueBox PC Software.
⇨ set at the factory, not changeable

BlueBox Password (PIN)
Password of the BlueBox
Is required to change the BlueBox system settings.
⇨ set at the factory, not changeable

Storage Device
Size of the internal BlueBox memory, here 8 GB
⇨ set at the factory, changeable by replacing

2. Network:

IP Address	192.168.1.167
Netmask [CDIR]	24
Gateway	0.0.0.0
Port	14111
Login Name	bluebox
Password	xxxxx

IP Address IP address of the BlueBox
At this address, the BlueBox is addressed on the network.
⇨ set at the factory, changeable

Netmask [CDIR] Netmask of the BlueBox
⇨ set at the factory, changeable

Gateway Standard gateway of the BlueBox
⇨ set at the factory, changeable

Port Default gateway of the Blue Box
⇨ set at the factory, not changeable

Login Name User name for a modem connection
⇨ set at the factory, not changeable

Password Network password of the BlueBox
Is needed to access the BlueBox via the AMS software.
⇨ set at the factory, not changeable

3. Hardware:

LAN MAC-Address	xx-xx-xx-xx-xx-xx
WLAN MAC-Address	xx-xx-xx-xx-xx-xx

LAN MAC-Address ⇨ set at the factory, not changeable

WLAN MAC-Address ⇨ set at the factory, not changeable

4. BlueBox BlueGate Settings:

IP Address	bluegate.go-sys.de[1]
Password BlueGate	xxxxx

IP Address IP address of an Internet Gateway
⇨ can be configured at the factory, changeable [2]

Password BlueGate Password of an Internet Gateway
⇨ can be configured at the factory, changeable

5. BlueBox PC Software – BlueGate Settings:

Host	datagateway.go-sys.de[1]
Username	xxxxx
Password Windows	xxxxx

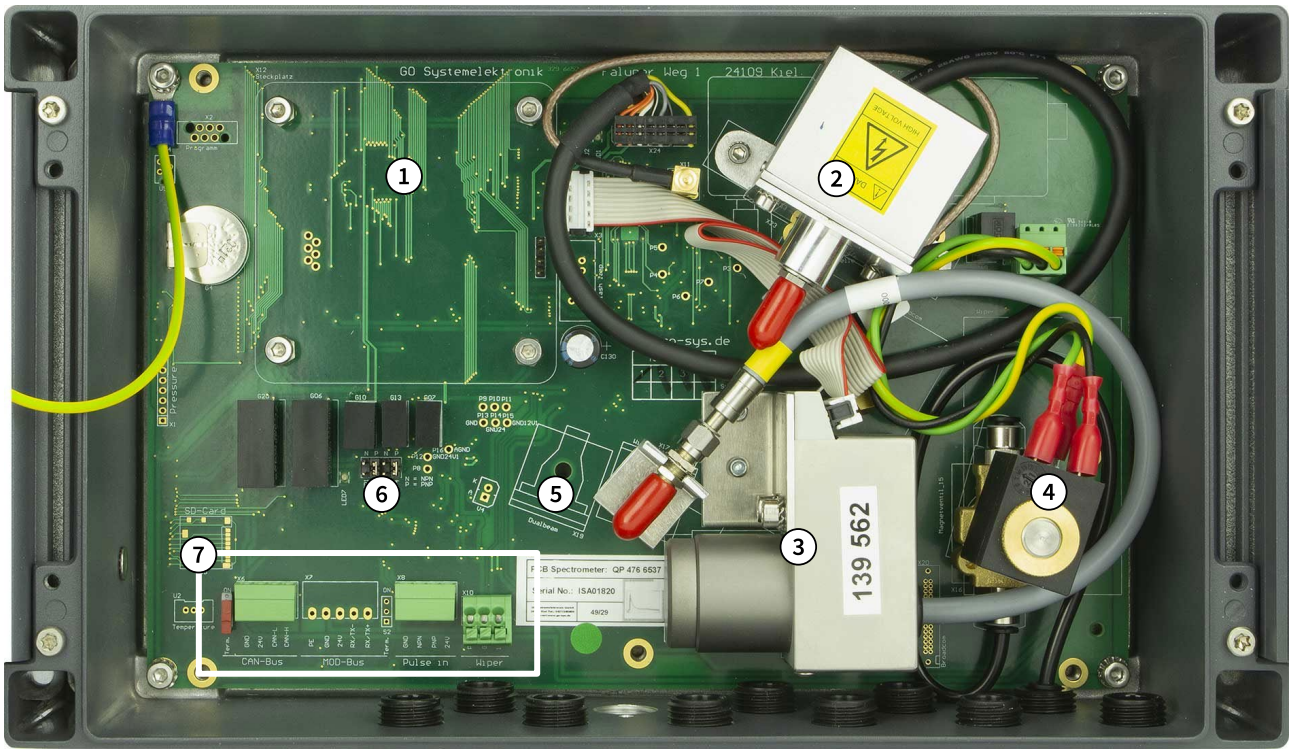
If the BlueBox is accessed via a gateway (e.g. with an UMTS connection), you have to enter these access data in the BlueBox SQL Software.

[1] default address of GO Systemelektronik
[2] changeable only at the default address

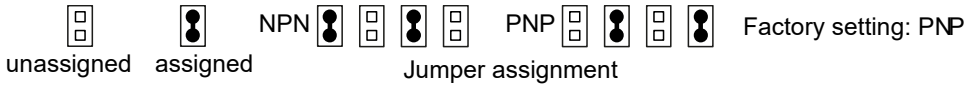
Appendix B – The Spectrometer Board

The spectrometer board is located in the BlueBox RS and in the Spectrometer Sensor Module.

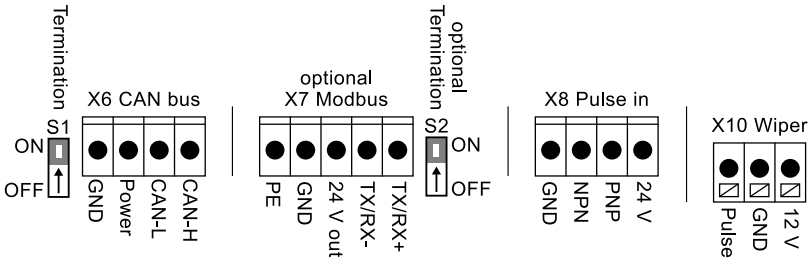
Example Spectrometer Sensor Module:



1. Mounting place for an optional BlueConnect board
2. Xenon flash lamp with fibre optic cable connector OUT
3. Spectrometer with fibre optic connector cable IN
4. Compressed air valve with electric switch. Alternatively, a wiper module can be mounted here.
5. Mounting place for the photometer of the optional DualBeam version
6. Jumper slots of the pulse input

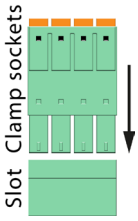


7. Cable connections and termination slide switches



Slot X6, X7 and X8: The cables are connected to the slots by means of clamp sockets. Note that the slots lie flat, i.e. the clamp socket strips are plugged onto the slots from "above".

X10: There are cable clamps on the slot ex works. 



Appendix C –Connections at the BlueBox RS

Housing Connections

Earth the BlueBox. This is the only way to ensure trouble-free measuring operation.
The earth connection is located on the left side of the housing.

LAN connection

USB Connection (MDI crossover)
Please note:
The USB port at the BlueBox is designed for data export and for firmware and license update.

Antenna connections
- WiFi Panel plug
- LTE Panel socket

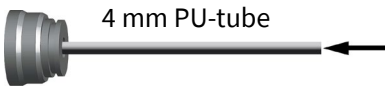
In case of doubt, differentiate the antenna connector as follows:
Panel plug = WiFi Panel socket = LTE

PG glands M16
Via these glands the cables are lead to the connections on the main board.
Ensure proper execution.

Socket of the sensor head cable

Compressed air line connection
Quick connector for 4 mm PU-tube, 4 – 6 bar

Tube in



Push the PU-tube into the plug connector until it stops (approx. 5 mm).

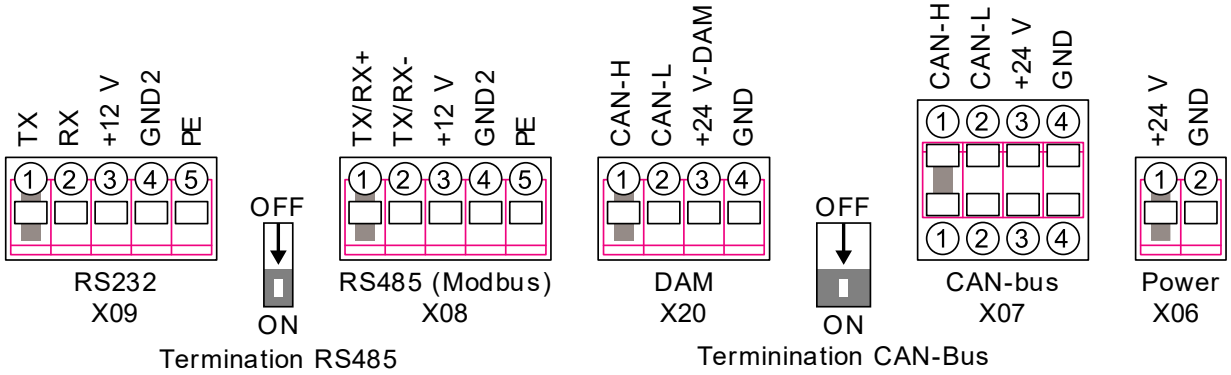
Tube out

Press with a suitable tool on the outer ring of the plug connector and remove the PU-tube.

Mainboard PIN Assignment and Termination

The internal spectrometer board is connected to DAM X20.

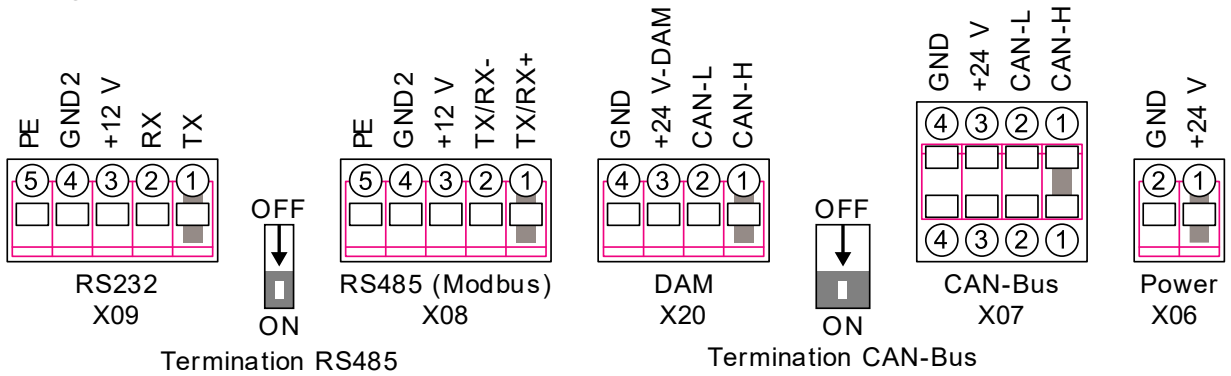
First generation mainboard



> ⓘ The difference between the first- and second-generation mainboards is that the assignment of all slots has been "rotated".
> **You can see the difference in the assignment by looking at the mainboard labelling.**

> ⚠ **Caution:** Reverse polarity can destroy the device.

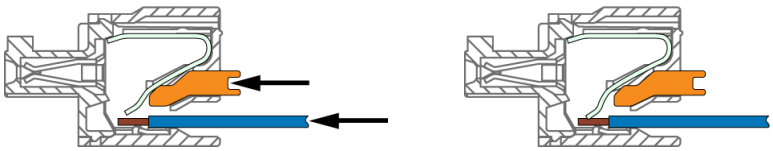
Second generation mainboard



> **Note RS232 X09 and RS485 X08:**
> Only one of the two connections can be active, toggling is done via the AMS program. see *Manual BlueBox PC Software* there *5.3.3.2 Custom Protocol Setup*

> **Note DAM X20:**
> Internal DAM connection to an internal BlueConnect Plus board or an internal spectrometer board.

Functionality of the cable clamp



Appendix D – The External Spectrometer Sensor Module

The Spectrometer Sensor Module is a CAN-bus module. It is connected to a BlueBox with a CAN-bus cable via the CAN-bus interface.

The current Spectrometer Sensor Modules have the
Article-No. 486 6000

The type plate is located at the right-hand side of the housing.

Note on older versions of the Spectrometer Sensor Module
Second generation Spectrometer Sensor Modules (Article-No. 486 6002 and 486 6004) are compatible to the current BlueBox System.
see *6.2 Notes on Current and Old Spectrometers*
see also *4.2 ATEX Notes*

Housing Connections

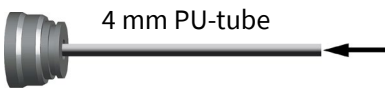
Earth the Spectrometer Sensor Module.
This is the only way to ensure trouble-free measuring operation.
The earth connection is located on the left side of the housing.

PG glands M16
Via these glands the cables are lead to the connections on the main board.
Ensure proper execution.

Socket of the sensor head cable

Compressed air line connection
Quick connector for 4 mm PU-tube, 4 – 6 bar

Tube in



Push the PU-tube into the plug connector until it stops (approx. 5 mm).

Tube out

Press with a suitable tool on the outer ring of the plug connector and remove the PU-tube.

PIN Assignment and Termination at the spectrometer board see *Appendix B – The Spectrometer Board*

Appendix E – SQI (Spectral Quality Index)

Precondition for the calculation of the SQI is a corresponding calculation, see *Manual ISA and Process Spectrometer Commissioning – Maintenance –Service.*

In Situ spectrometer are used for decisions in the fields of food processing, chemical process cycles, drinking water monitoring, as well as in the field of wastewater treatment plant control and flow control.

Functional principle: The measurement method of in situ spectrometer, like the ISA, is based on absorbance spectra. Multiple calibrations can be created with these spectra and so different chemical ingredients can be measured online by calculation. No chemicals are needed for this measurement method – it is not predicated on any laboratory test or an existing DIN standard.

Based on the time behaviour of the spectral data in combination with associated analytical laboratory tests, an algorithm is determined with a chemometrical process, to calculate the different parameters. This chemometrical process is a statistical method which can develop specific prediction algorithms for the particular parameters.
A statistical method specially developed for the ISA allows the progressive adaptation of the calibrations, **quality monitoring in the calculation of the algorithm** has been given special consideration. Thus an improvement of the algorithm by statistical parameters is already possible during the model development.

The aim is to expand a general algorithm by **on site specific** data and so to generate **user-specific** algorithms.

Every determination which is not DIN standard brings the risk of incorrect determinations. These failures cannot be eliminated completely by using statistically developed algorithms. When there are temporary situations which are not included in the statistical data set, the measurement reliability cannot be furthermore approved.

For this reason, **online quality detection** and thus **quality documentation** of these calculations are essential for the use of spectral sensors especially.

For this purpose, the Spectral Quality Index (SQI) is determined and saved for each calculated parameter by the ISA Spectrometer. The scaling of the SQI is as follows – under a value of 3.5 a measurement reliability of 95% can be assumed. Up to a value of 4.0 a certainty of 90 % is given. However, when there is a permanent SQI above 4 determined over a longer time, it must be assumed that the spectral data set present in the range of the used wavelengths is no longer sufficiently statistically proven.

In this case a warning is issued, it is not recommended to use the calculated results for the process control. The system can be shifted to “emergency control signals” automatically. This process is similar to the failure of the lambda probe signal in the control of internal combustion engines.

A deviation of the SQI to values higher than 4 can also be caused by defects in the measurement system or by contamination or blocking of the optical measurement path.

In Figure 1 below we show results of measurements in the supply of a wastewater treatment plant. The red lines show the concentration gradient of the COD measurements. The green line visualizes the characteristics of the corresponding SQI values for this COD measurement. The given scales are shown on the left and right side of the application. High values of the SQI correspond with extreme changes in the value of the COD.

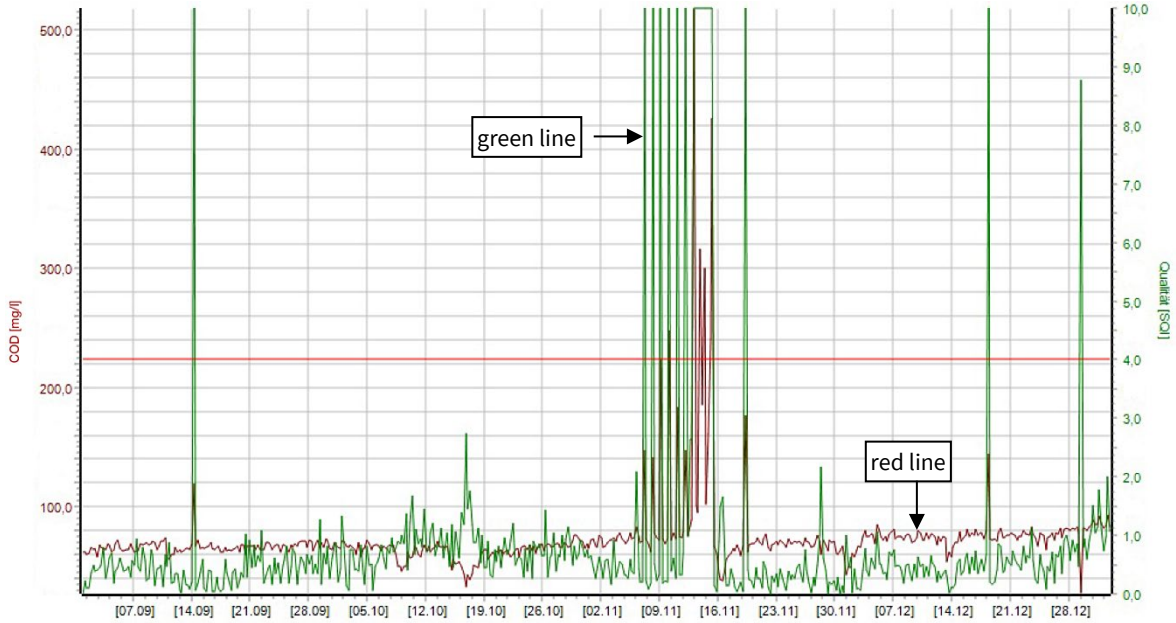


Figure 1* Concentration gradient of COD measurements (red) with the SQI (green)

Between the 12th and 16th of November a contamination could be determined, which was ascribed to a faulty compressor. By the use of the SQI the failure of the cleaning was detected very quickly and could be fixed without causing major damage. In October there was a brief single event – without recognized influences in the COD. At the end of the year, the water matrix varied due to strong temperature changes and caused a deterioration of the SQI values without leaving the acceptable range.

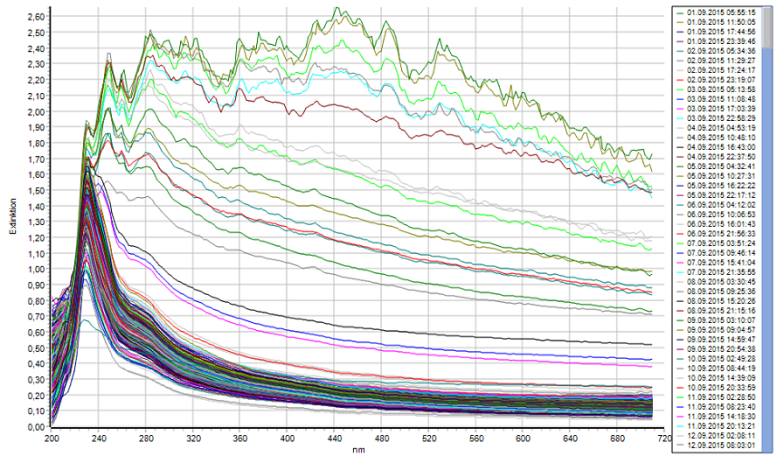


Figure 2* Absorbance spectra of the COD calibration

The function of the SQI as proof of quality and indication of malfunctions is easy to recognize in the Figure 1. The good performance of the SQI can also be ascribed to the high-quality calibration created by 54 reference values, taken over six months. The absorbance spectra of this calibration are shown in Figure 2.

For further information please contact GO Systemelektronik.

* The Graphic is generated with Spectrum Visual.

Appendix F – EU Declaration of Conformity ISA Sensor Head 461 6002

EU-Konformitätserklärung
EU Declaration of Conformity

Hersteller:
Manufacturer:

GO Systemelektronik GmbH
Faluner Weg 1
24109 Kiel Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
The sole responsibility for issuing this EU declaration of conformity is carried by the manufacturer.

Gegenstand dieser Erklärung:
Subject to this declaration:

ISA-Messkopf
ISA Sensor Head

Artikelnummer:
Article No.:

461 6002

Beschriftung des Produktes:
Product labeling:

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsvorschriften der Union.
The subject matter described above fulfills the relevant harmonization rules of the Union.

***Zugrunde liegende Normen:**
****Underlying standards:***

1. DIN EN 60079-0:2009 — Allgemeine Anforderungen — *General requirements*
2. DIN EN 60079-28:2007 — Optische Strahlung 'op is' — *Optical Radiation 'op is'*

Nach Prüfung durch den Hersteller entspricht das Gerät auch den folgenden Normen:
After verification by the manufacturer, the device also complies with the following standards:

1. DIN EN 60079-0:2014-06 — Allgemeine Anforderungen — *General requirements*
2. DIN EN 60079-28:2016-04 — Optische Strahlung 'op is' — *Optical Radiation 'op is'*

*(Falls zutreffend) **Gemäß den Bestimmungen der Richtlinie/den Dokumenten:**
(If applicable)* ***Following the provision of directive/the documents:*

1. 94/9/EG — ATEX-Richtlinie — *ATEX directive*
2. Fertigungs- und Prüfanweisung ISA-Messkopf
   Manufacturing and test instruction ISA Sensor Head
3. Bedienungsanleitung ISA-Spektrometer
   Manual ISA Spectrometer
4. Bedienungsanleitung ISA und Prozessspektrometer Inbetriebnahme – Wartung – Service
   Manual ISA and Process Spectrometer Commissioning – Maintenance – Service

Nach Prüfung durch den Hersteller entspricht das Gerät auch den folgenden Normen:
After verification by the manufacturer, the device also complies with the following standards:

1. 2014/34/EU — ATEX-Richtlinie — *ATEX directive*

* Prüfung erfolgt durch DEKRA EXAM GmbH Bochum – Kennnummer der benannten Stelle: 0158
* *Verification performed by DEKRA EXAM GmbH Bochum – Identification number of the notified body: 0158*

Kiel, 23.11.2021
Ort, Datum der Ausstellung
Place, date of issue

Dr. Thorsten Knutz
Geschäftsführer *Managing director*

GO Systemelektronik GmbH Faluner Weg 1 24109 Kiel Germany Tel.: +49 431 58080-0 Fax: -58080-11
www.go-sys.de info@go-sys.de **Seite Page 1 / 1**

Appendix G – EU Declaration of Conformity ISA Sensor Head SDU 461 6010

EU-Konformitätserklärung
EU Declaration of Conformity

Hersteller:
Manufacturer:

GO Systemelektronik GmbH
Faluner Weg 1
24109 Kiel Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
The sole responsibility for issuing this EU declaration of conformity is carried by the manufacturer.

Gegenstand dieser Erklärung:
Subject to this declaration:

ISA-Messkopf SDU
ISA Sensor Head SDU

Artikelnummer:
Article No.:

461 6010

Beschriftung des Produktes:
Product labeling:

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsvorschriften der Union.
The subject matter described above fulfills the relevant harmonization rules of the Union.

***Zugrunde liegende Normen:**
****Underlying standards:***

1. DIN EN 60079-0:2009 Allgemeine Anforderungen *General requirements*
2. DIN EN 60079-28:2007 Optische Strahlung 'op is' *Optical Radiation 'op is'*

Nach Prüfung durch den Hersteller entspricht das Gerät auch den folgenden Normen:
After verification by the manufacturer, the device also complies with the following standards:

1. DIN EN 60079-0:2014-06 Allgemeine Anforderungen *General requirements*
2. DIN EN 60079-28:2016-04 Optische Strahlung 'op is' *Optical Radiation 'op is'*

*(Falls zutreffend) **Gemäß den Bestimmungen der Richtlinie/den Dokumenten:**
(If applicable)* ***Following the provision of directive/the documents:*

1. 94/9/EG ATEX-Richtlinie *ATEX directive*
2. Fertigungs- und Prüfanweisung ISA-Messkopf
   Manufacturing and test instruction ISA Sensor Head
3. Bedienungsanleitung ISA-Spektrometer
   Manual ISA Spectrometer
4. Bedienungsanleitung ISA und Prozessspektrometer Inbetriebnahme – Wartung – Service
   Manual ISA and Process Spectrometer Commissioning – Maintenance – Service

Nach Prüfung durch den Hersteller entspricht das Gerät auch den folgenden Normen:
After verification by the manufacturer, the device also complies with the following standards:

1. 2014/34/EU ATEX-Richtlinie *ATEX directive*

* Prüfung erfolgt durch DEKRA EXAM GmbH Bochum – Kennnummer der benannten Stelle: 0158
* *Verification performed by DEKRA EXAM GmbH Bochum – Identification number of the notified body: 0158*

Kiel, 23.11.2021
Ort, Datum der Ausstellung
Place, date of issue

Dr. Thorsten Knutz
Geschäftsführer *Managing director*

GO Systemelektronik GmbH Faluner Weg 1 24109 Kiel Germany Tel.: +49 431 58080-0 Fax: -58080-11
www.go-sys.de info@go-sys.de **Seite Page 1 / 1**

Appendix H – EU Declaration of Conformity ISA Spectrometer Sensor Module

EU-Konformitätserklärung
EU Declaration of Conformity

Hersteller:
Manufacturer:

GO Systemelektronik GmbH
Faluner Weg 1
24109 Kiel Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
The sole responsibility for issuing this EU declaration of conformity is carried by the manufacturer.

Gegenstand dieser Erklärung: ISA-Spektrometer-Sensormodul
Subject to this declaration: *ISA Spectrometer Sensor Module*

Artikelnummer: 486 6000
Article No.:

Typenschild des Produktes:
Type plate of the product:

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsvorschriften der Union.
The subject matter described above fulfills the relevant harmonization rules of the Union.

Zugrunde liegende Normen:
Underlying standards:

1. DIN EN 61000-6-3:2021 Störaussendung *Interference emission*
2. DIN EN 61000-6-1:2019 Störfestigkeit *Interference resistance*
3. DIN EN 60950-1:2006-04 Betriebssicherheit *Operation safety*

(Falls zutreffend) **Gemäß den Bestimmungen der Richtlinien/den Dokumenten:**
(If applicable) ***Following the provision of directives/the documents:***

1. 2014/30/EU EMV-Richtlinie *EMC directive*
2. DIN EN 60950-1:2006-04 Niederspannungsrichtlinie *Low voltage directive*
3. Fertigungs- und Prüfanweisung ISA-Spektrometer-Sensormodul
   Manufacturing and test instruction ISA Spectrometer Sensor Module
4. Bedienungsanleitung BlueBox R1 und Panel *Manual BlueBox R1 and Panel*
5. Bedienungsanleitung ISA-Spektrometer *Manual ISA Spectrometer*

Kiel, 17.01.2023
Ort, Datum der Ausstellung
Place, date of issue

Dr. Thorsten Knutz
Geschäftsführer *Managing director*

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Appendix I – EU Declaration of Conformity BlueBox RS

EU-Konformitätserklärung
EU Declaration of Conformity

Hersteller:
Manufacturer:

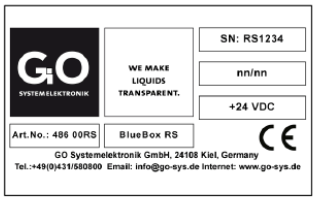
GO Systemelektronik GmbH
Faluner Weg 1
24109 Kiel Germany

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.
The sole responsibility for issuing this EU declaration of conformity is carried by the manufacturer.

Gegenstand dieser Erklärung: BlueBox RS (BlueBox mit integrierter Spektrometer-Sensoreinheit)
Subject to this declaration: *BlueBox RS (BlueBox with integrated spectrometer sensor unit)*

Artikelnummer: 486 00RS
Article No.:

Typenschild des Produktes:
Type plate of the product:



Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsvorschriften der Union.
The subject matter described above fulfills the relevant harmonization rules of the Union.

Zugrunde liegende Normen:
Underlying standards:

1.	DIN EN 61000-6-3:2021	Störaussendung	*Interference emission*
2.	DIN EN 61000-6-1:2019	Störfestigkeit	*Interference resistance*
3.	DIN EN 60950-1:2006-04	Betriebssicherheit	*Operation safety*

(Falls zutreffend) **Gemäß den Bestimmungen der Richtlinien/den Dokumenten:**
(If applicable) ***Following the provision of directives/the documents:***

1.	2014/30/EU	EMV-Richtlinie	*EMC directive*
2.	DIN EN 60950-1:2006-04	Niederspannungsrichtlinie	*Low voltage directive*
3.	Fertigungs- und Prüfanweisung BlueBox RS *Manufacturing and test instruction BlueBlueBox TS*		
4.	Bedienungsanleitung BlueBox R1 und Panel		*Manual BlueBox R1 and Panel*
5.	Bedienungsanleitung ISA Spektrometer		*Manual ISA Spectrometer*

Kiel, 17.01.2023
Ort, Datum der Ausstellung
Place, date of issue

Dr. Thorsten Knutz
Geschäftsführer *Managing director*

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