

# WHITE FOX 1.2

## Instruction manual

### Issue 6



## WHITE FOX Instruction Manual Part I, Issue 6

Version control.

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4	October 2022	Review after software improvements.	HUF
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6	September 2024	Review of regulations in general + implementation of US regulations	JDEL

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# 1 Introduction

## 1.1 WHITE FOx



Figure 1. WHITE FOx device

WHITE FOx is an analytical benchtop detection instrument based on Fiber Optic Surface Plasmon Resonance (FO-SPR) technology. The device is a robust, low maintenance and high-performance system for kinetic and quantitative measurement of biomolecules and large particles. The detection process is monitored over time allowing characterization of the target interaction. WHITE FOx can also be used to detect a target in solution with a very short time to result, typically between 3 to 20 minutes.

WHITE FOx system includes the WHITE FOx instrument, the FOx software modules (FOx SPR for data acquisition; FOx Biosystems data processor for data handling; Tracedrawer software for data analysis and kinetic / concentration determination (optional)) and its consumables: sensor probes (upon order). Computer can also be provided upon request. (See section 5.3 of this manual for computer requirements).

FOx Biosystems offers instruments and services to improve biomolecular interaction analysis in life science research and industry.

## 1.2 Technology

Surface plasmon resonance (SPR) is a powerful biosensing technology which offers real-time measurements. Since the measurement is mass-dependent, it can detect the binding and interaction of biomolecules label-free. WHITE FOx applies fiber optic SPR (FO-SPR), which is similar to the traditional SPR technology, but it measures the wavelength shift (change in wavelength of the resonance condition) that occurs at the gold surface rather than the shift in angle of reflected light (Figure 2). Shifts in the refractive index caused by mass that binds to the surface of the sensor probes will result in a shift over of the wavelength of the absorption spectrum.

WHITE FOx employs gold-coated optical fiber sensor probes which enable the SPR effect. By dipping the sensors in vials with different solutions placed inside the device, they can be subjected to different steps of the desired assay. These sensors are available with different surface chemistries. Through specific (chemical) characteristics of the surface they can bind and immobilize a wide scale of different biomolecules and are suitable for a wide range of applications.

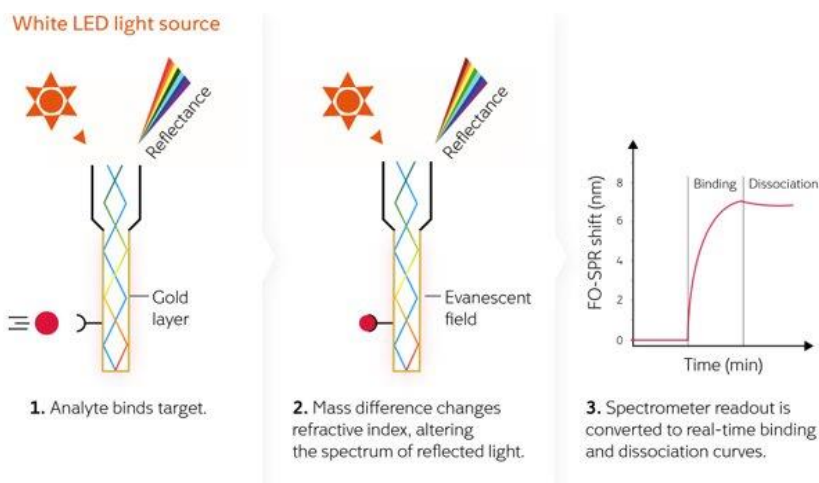


Figure 2: FO-SPR technology.

## 1.3 Applications



Thanks to the multiple available sensor surfaces, a wide range of applications can be performed with WHITE FOx. Real-time detection of mass on the surface, allows monitoring of the interactions between sample and immobilized molecules. Besides classic interactions, such as protein-protein, antigen-antibody/nanobody interactions, WHITE FOx is capable of measuring smaller analytes (>1000 Da), DNA, aptamers and larger molecules such as extracellular vesicles, bacteriophage, VLP's,... .

Through the non-fluidic, dip-in method of detection, WHITE FOx is compatible with a broad scale of sample matrices, ranging from purified to crude sample matrices such as whole blood. Additionally, this method of detection is non-destructive which enables the recovery of precious samples.

The real-time nature of the measurement allows for precise affinity, even in crude matrices, at equilibrium and kinetic studies of an interaction, fast contaminant quantification, activity monitoring of therapeutic antibodies and selection. These applications share the benefit of SPR in terms of speed, accuracy, and low detection limit.

Other than the powerful label-free detection method, a labeled sandwich assay can also be applied by means of conjugated gold-nanoparticles (AuNP). These AuNP's provide a direct amplification of the SPR effect (enzyme free), increasing the limit of detection and sensitivity of an assay if required. AuNP's can also provide additional specificity of detection thus enabling a multiplexing setup.

More information regarding possible applications and expected results can be found on: <https://foxbiosystems.com/fo-spr-applications-fox-biosystems/>.

Key applications on WHITE FOx are listed in Table 1:

Sample	App. Field	Application	Analysis
Purified, Cell lysates, Liquid body fluids, whole blood	Biologicals	Ab's	Kinetic Characterization
		VHH/ Fab	
		Peptides	Affinity Ranking
		Bispecifics	
		ADC's	Quantitation
		Phages	
	Cell & Gene	EV's	Detection
		Viruses - AAV's	
		VLP's	Isolation

Table 1: sample types, applications and analysis that can be developed with WHITE FOx.



## 2 Important user information

### 2.1 Read this before using WHITE FOx

In order to ensure users operate WHITE FOx safely and according to the intended purpose, the following conditions must be met:

- The user must read the instructions, including all safety information, in this manual.
- The device should be installed according to the instructions in Section 5.
- The user should have a general understanding of the use of a PC running the specific operating system version of Microsoft Windows as specified in this manual.
- The user should respect the laboratory safety.

Do not operate WHITE FOx in any other way than described in this manual. If you do, you may be exposed to hazards that can lead to personal injury and you may cause damage to the device and lab facilities.

### 2.2 Intended Use

WHITE FOx is a laboratory instrument that enables kinetic and affinity characterization, and sensitive quantitative measurements of small to large molecules. **The device is intended for research use only and should not be used for diagnostic purposes.**



## 2.3 Safety notice

This manual and WHITE FOx device contain the following safety symbols <sup>(1)</sup> concerning the use of the product. The meaning of these symbols is defined below:



### **General warning sign, Caution**

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.  
Do not make any mechanical or electrical modifications to the equipment.  
Two people should be lifting and carrying WHITE FOx during installation.



### **Warning, hot surface**

The heater can heat the plate surface up to 100 °C. Touching the hot surface can result in burns. Pay attention when replacing the sample tubes. Never touch the plate unless you are sure it is cold.



### **Warning, crushing of hands**

Never put a hand inside WHITE FOx instrument if the step motor is moving.  
DO NOT operate with door open or removed.



### **Warning, Biological hazard**

In case of encountering a biohazard sample WHITE FOx must be decontaminated following instructions below.



**Read instructions before installation and use of WHITE FOx!**

(1) ISO 7010:2020 W001 / W017 / W024 / W009





## 2.4 Regulatory information

### 2.4.1 Regulatory Compliance Overview

This instrument complies with the following regulatory standards:

#### European Union (EU) Compliance

- **EMC Directive (2014/30/EU)**: Electromagnetic Compatibility
- **Low Voltage Directive (2014/35/EU)**: Electrical Safety
- **RoHS Directive (2011/65/EU)**: Restriction of Hazardous Substances
- **WEEE Directive (2012/19/EU)**: Waste Electrical and Electronic Equipment

#### United States (US) Compliance

- **FCC (47 CFR Part 15)**: Electromagnetic Compatibility for Unintentional Radiators
- **Electrical Safety (21 CFR 1020.30)**: Compliance with electrical safety regulations for laboratory equipment
- **FDA RUO (21 CFR 809.10(c)(2))**: Research Use Only, not for diagnostic use

### 2.4.2 Electromagnetic Compatibility (EMC) Compliance

#### EU EMC Directive (2014/30/EU)

This instrument has been tested and conforms to the **Electromagnetic Compatibility Directive** of the European Union.

#### US FCC (Part 47 CFR Part 15)

This instrument complies with Part 15 of the FCC Rules for **unintentional radiators**. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

#### **FCC Warning Statement:**

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### **FCC Interference Statement (Class B Devices):**

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into a different circuit.
- Consult the dealer or an experienced technician for help.



### 2.4.3 Electrical Safety Compliance

#### EU Low Voltage Directive (2014/35/EU)

This product complies with the **Low Voltage Directive (LVD)**, ensuring it meets the essential health and safety requirements for electrical equipment used in specific voltage ranges.

##### **Electrical Safety Warning:**

**WARNING:** This instrument operates at high voltage. To prevent the risk of electrical shock:

- Ensure the device is connected to a properly grounded electrical outlet.
- Disconnect the power before performing any maintenance.
- Only qualified personnel should attempt repairs.

#### US Electrical Safety (21 CFR 1020.30)

This instrument complies with **21 CFR 1020.30**, which outlines requirements for electrical safety of laboratory equipment in the United States, including design specifications to prevent hazards such as electric shock, radiation leakage, and overheating.

##### **Electrical Safety Warning (US)**

**WARNING:** This device must be properly grounded and connected according to the installation instructions to comply with US electrical safety standards. Use only specified power sources. Disconnect power before servicing.

### 2.4.4 Research Use Only (RUO) Compliance

This instrument is labelled for **Research Use Only (RUO)** and is not intended for clinical or diagnostic applications.

#### US FDA RUO (21 CFR 809.10(c)(2))

This product is for **Research Use Only (RUO)** and is not cleared or approved by the FDA for diagnostic use. It is intended for use in laboratory research settings by qualified personnel.

### 2.4.5 Disposal instructions

This product complies with the **2011/65/EU** (RoHS) and **2012/19/EU** (WEEE) Directives. Disposal of the product must be done in accordance with local environmental regulations. Please do not dispose of this product with general household waste. Consult your local waste authority for appropriate disposal methods.

### 2.4.6 Labeling and Marking Information

The instrument contains the following regulatory labels:

- **CE Mark:** Indicates compliance with EU Directives, including **EMC**, **LVD**, and **RoHS**.
- **FCC ID:** Indicates compliance with **FCC Part 15** regulations for unintentional radiators.
- **RUO Label:** Clearly indicates that the instrument is for research purposes only.

### 2.4.7 Declaration of Conformity (DoC)

A **Declaration of Conformity** certifying compliance with the relevant EU and US regulations is available upon request. To obtain a copy, please contact us.



#### 2.4.8 List of harmonized standards

This product has been tested and conforms to the following harmonized European standards:

- **EN 61010-1:** Safety requirements for electrical equipment for measurement, control, and laboratory use.
- **EN 61326-1:** Electrical equipment for measurement, control, and laboratory use – EMC requirements.



## 3 Technical Specifications

### 3.1 WHITE FOx

#### 3.1.1 Drawings

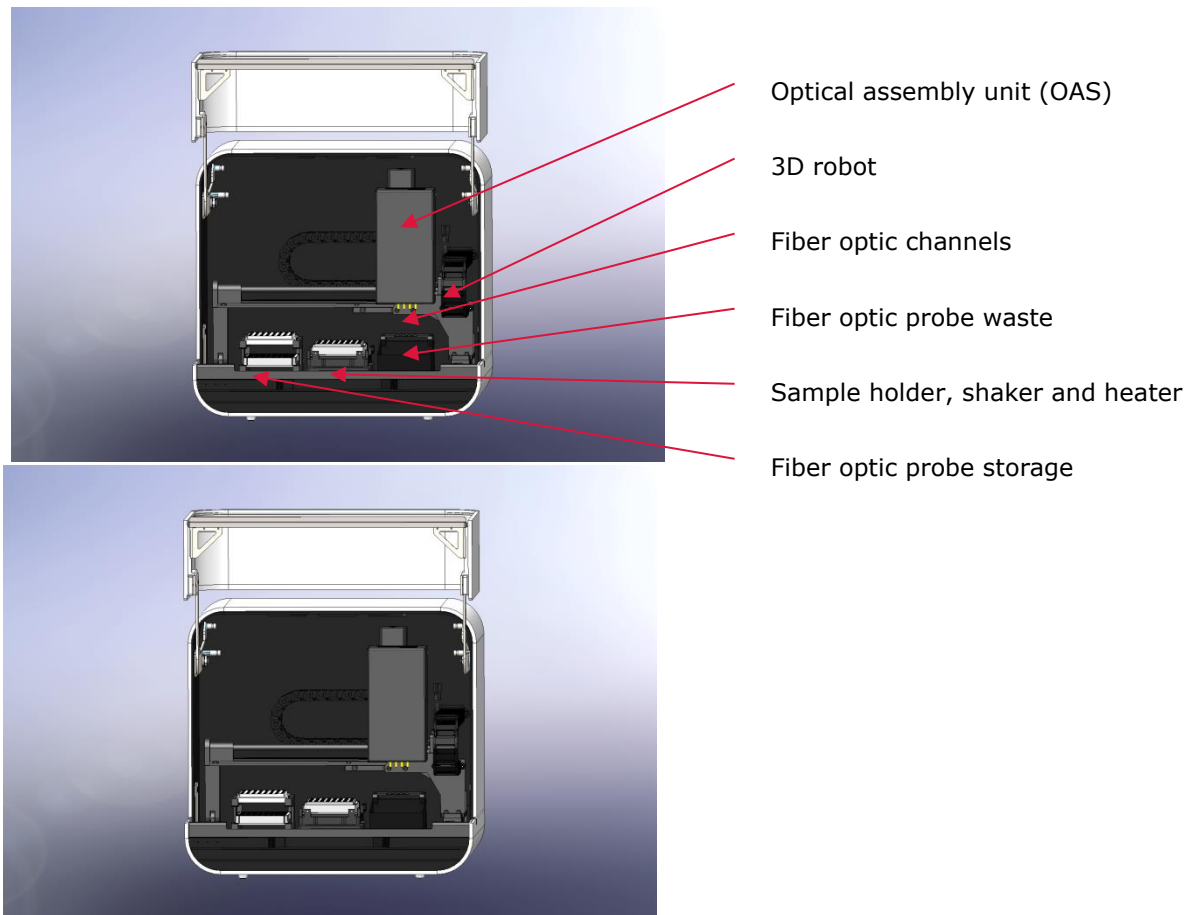


Figure 3. Front view of WHITE FOx

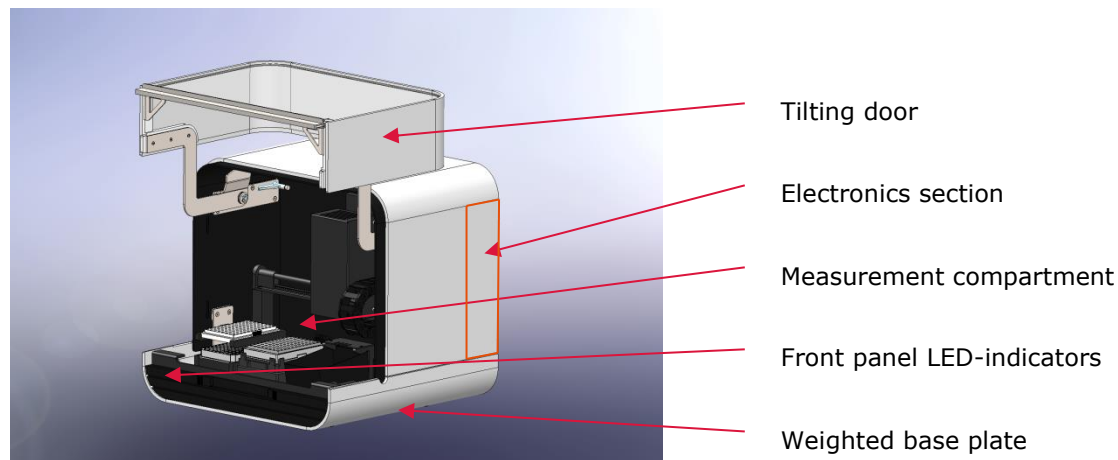


Figure 4. Side view of WHITE FOx

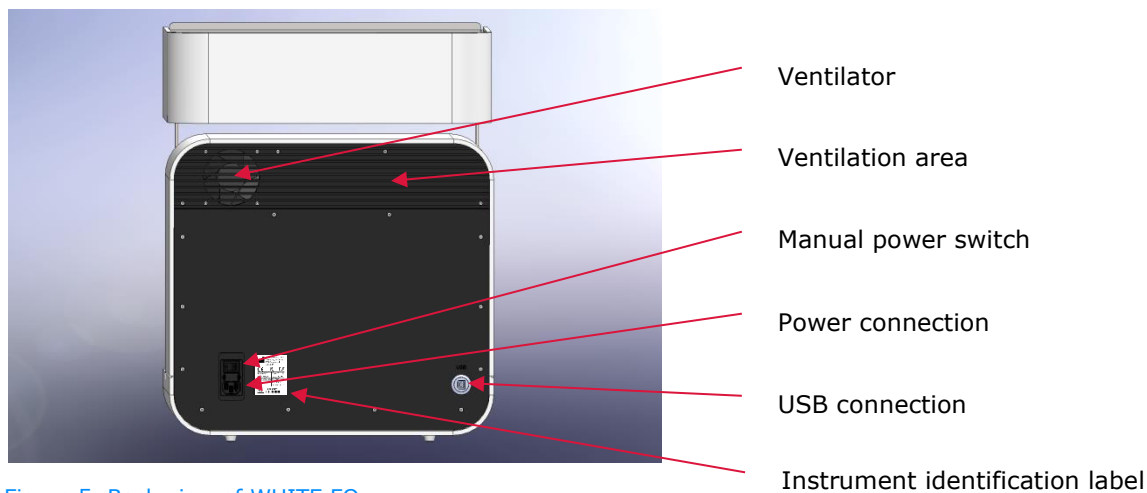


Figure 5. Back view of WHITE FOX

### 3.1.2 Instrument Identification Label

Table 2: Label elements description

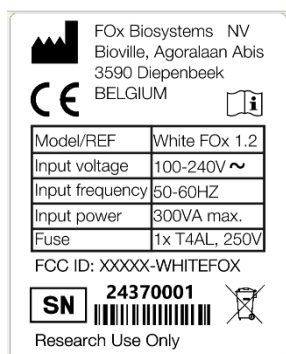








Figure 6. Instrument Identification Label

Label Element	Description										
 FOx Biosystems NV Bioville, Agoralaan Abis 3590 Diepenbeek BELGIUM	FOx Biosystems NV Address										
	CE Mark										
	Read operational instruction										
<table border="1"><tr><td>Model/REF</td><td>White FOX 1.2</td></tr><tr><td>Input voltage</td><td>100-240V ~</td></tr><tr><td>Input frequency</td><td>50-60HZ</td></tr><tr><td>Input power</td><td>300VA max.</td></tr><tr><td>Fuse</td><td>1x T4AL, 250V</td></tr></table>	Model/REF	White FOX 1.2	Input voltage	100-240V ~	Input frequency	50-60HZ	Input power	300VA max.	Fuse	1x T4AL, 250V	Electrical specifications table (See more details in the next table)
Model/REF	White FOX 1.2										
Input voltage	100-240V ~										
Input frequency	50-60HZ										
Input power	300VA max.										
Fuse	1x T4AL, 250V										
FCC ID	FCC ID code										
 21250001 	Device serial number & barcode										
	WEEE bin symbol / Waste care										
Research Use Only	For research use only. Not for use in diagnostic procedures.										



### 3.1.3 Technical Specifications

Table 3: Technical specifications of WHITE FOx

General Specification		
Model	WHITE FOx	
Product dimensions	450mm (W) x 435mm (L) x 415mm (H)	
Weight	24.5 kg	
Pollution degree	Degree 2	
Enclosure protection degree	IP20	
Operating condition	Continuous	
EMC Compliance	Tested according to IEC 61326-1 Ed.2.0: 2012 Emission: CISPR 11: 2009, IEC 61000-3-2 & 3. Immunity: IEC 61000-4-2,3,4,5 & 6.	
Main power supply	100-240 V ( $\pm 10\%$ ) / 50-60 Hz Norms: IEC-/ AS/NZS- /UL-/ BS EN/EN-62368-1	
Max. power	300 VA max	
Fuses	1x T4AL, 250V (spare fuse included in fuse holder)	
Electric protection class	Class I	
Overvoltage category	Cat. II	
Detachable 3 prong power cord	Standard: (1.8 m) - 3 wire 16 A CEE 7/7 straight plug to IEC 320 IEC C13 (Main EU) Optional: - 3 wire 13 A UK Type G plug to IEC 320 IEC C13 (UK) - 3 wire 10 A Type J plug to IEC 320 IEC C13 (CH)	
PC communication	USB connection to PC for control by FOx PC application	
USB interface	Type	2.0 high-speed
	Cable length	Standard 1.8 m
Working wavelength	560 to 680 nm	
System and software maximum runtime	Maximum runtime should be 8h. If the assay is longer that 4h: - Restart the computer and software before starting your experiment. - Avoid interacting with the sensorgram area (using graphical	



	tools: zooming or scrolling the image; or data export options: to clipboard or Excel).
Environmental	<ul style="list-style-type: none"><li>- Indoor use only, preferably with a HVAC system to control environment conditions.</li><li>- Operating Altitude: 0 to 2,000 m</li><li>- Environmental operating temperature range: +18°C to +23°C</li><li>- Optimum operating temperature: 22 ± 1°C</li><li>- Relative Humidity: Non-condensing, 20% to 80% RH</li><li>- No abrupt temperature or humidity changes.</li><li>- Not for use in an environment with an explosive atmosphere</li></ul>
Warning	In case there is a power cut, shut down the instrument. Restart the software after the power cut.

Table 4: Capabilities of WHITE FOx

<b>Capabilities</b>
Protein quantitation
Kinetic and affinity analyses ( $k_{on}$ , $k_{off}$ , KD)
Binding specificity
Kinetic screening of proteins, peptides, and other biomolecules
Fragments screening and kinetic analysis
Recommended analyte molecular weight of 1000 Da or higher
<b>Sampling format</b>
96-well PCR plates (e.g., Thermo Scientific™ cat# 11550274), or 0.2 mL PCR strip tubes (Thermo Scientific™ cat# 10475353)
<b>Sampling volume</b>
125 – 200 µl/well (96-well plate)
<b>Sample types</b>
Purified samples, common culture media, crude lysates, serum, plasma, whole undiluted blood
<b>Biosensor Type</b>
Disposable, single-use fiber optic biosensors with optional reuse by regeneration-
<b>Biosensor Tray</b>
Type 8 x 12 format 96-biosensor tray.
<b>Optics and Mechanics</b>
<ul style="list-style-type: none"><li>• 4-channel biosensor</li><li>• Fiber optic SPR</li><li>• 4 spectrometers and 4 LEDs (one dedicated spectrometer and LED per biosensor)</li></ul>
<b>Throughput</b>
<ul style="list-style-type: none"><li>• Up to 4 biosensors in parallel, maximum of 96 dip-in positions unattended</li><li>• One 96-well plate with samples, buffers and reagents, and up to one biosensor tray per run</li></ul>



## 3.2 Embedded Shaker

Table 5: Technical specifications of the embedded shaker

General	
Model	BioShake 3000-T
Mains supply	100-240 V ( $\pm 10\%$ ) / 50-60 Hz
Max. power	24 V DC input, 100 Watt
Housing material	Aluminum anodized
Size	142 mm x 99mm x 57.5mm
Weight	1.5 kg
Ingress protection rating	IP20
Temperature controls	
Temperature range	26 °C to 42°C, 0.5°C increments. (Operating advice: minimum T = room T + 3°C)
Temperature accuracy	$\pm 0.1^\circ\text{C}$
Temperature uniformity	$\pm 0.5^\circ\text{C}$ at 45°C
Heat-up time	ca. 7°C/min
Mixing	
Mixing frequency:	No mixing / from 200 to 2000 rpm
Mixing regulation accuracy	$\pm 25$ rpm





## 4 Accessories and Disposables

### 4.1 Accessories

#### 4.1.1 BioShake 3000-T (10-101 – standard setup)

The shaker is designed for reliable mixing of vials and tubes. It provides ease of use features and maximum safety. The BioShake 3000-T provides high-speed mixing action and temperature control for the most robotics applications. This uniquely designed heater shaker combines heating from 26°C to 99°C (42°C software limit for operator safety). The module is only slightly larger than a standard microplate, and with its patented vibration-free shaking.

- Mixing orbit: constant 2.0 mm diameter
- Mixing regulation accuracy:  $\pm 25$  rpm
- Weight: 1.5 kg (3.3 lbs)

#### 4.1.2 96-well PCR Plate Adapter (10-201 – standard setup)

This adapter is designed to hold 96-well PCR plates (e.g., Thermo Scientific™ cat# 11550274), or 0.2 mL PCR strip tubes (Thermo Scientific™ cat# 10475353).

The use of any other format should first be validated by FOx service personnel.

#### 4.1.3 Probe pickup plate

The probe pickup plate is required to perform auto pickup of sensor probes. It can hold up to 96 sensor probes and is designed in a 96-well plate format.

### 4.2 Disposables

#### 4.2.1 Sensor Probes

Available sensor probes can be found on FOx Biosystems website (<https://www.foxbiosystems.com>).

Only FOx Biosystems sensor probes can be used on the device. The use of other probes might cause serious damage to the measuring setup.



## 5 Installation

The device is intended to be used in pharmaceutical and life science research laboratories. Consider the environmental technical specifications for the location and device operation conditions to obtain optimal results.

### 5.1 Requirements & precautions

- Bench space of 100cm (W) x 60cm (L) x 60cm (H) (Device +operating laptop/PC) with access to backside on/off switch
- 2 direct power sockets (device + laptop); In case a PC is used, 3 power sockets are required with protective earthing.
- Always use the power cord supplied with WHITE FOx. In case replacement is needed, please contact our service desk via [cs@foxbiosystems.com](mailto:cs@foxbiosystems.com)
- Avoid placement of heavy objects on WHITE FOx power cords and connecting USB cable.

### 5.2 Environmental conditions

- Do not expose the device to excessive sunlight, chemicals, or vibration.
- Allow adequate ventilation around WHITE FOx so that heat can properly dissipate.
- Keep WHITE FOx away from high-capacity transformers, electric motors and other devices that may create strong magnetic fields.
- Portable or mobile RF communications equipment and other RF equipment may affect the functioning of WHITE FOx.

### 5.3 WHITE FOx Installation

The installation and verification of WHITE FOx device is exclusively performed by trained service personnel. Contact our customer service via [cs@foxbiosystems.com](mailto:cs@foxbiosystems.com) if you require more information.

### 5.4 Required equipment and software for WHITE FOX operation

For operation of WHITE FOx a PC is required with the following minimum specifications:

- Intel® Core™ i5 processors (minimum 8<sup>th</sup> generation) with 8GB RAM (16 GB RAM recommend). It is advised to select an upgradeable computer (hardware and software).
- Windows 10 or higher operating system.
- MS Office and adobe Acrobat software.

A qualified PC can be provided by FOX BIOSYSTEMS if required. All above described third party licensed software must be provided by the customer.



## 5.5 Software installation

All accompanying software of WHITE FOx device can be installed by the user. The FOxSPR software (operating software), the FOx data processing software and optionally, the third party analysis software, Tracedrawer, setup files are provided via a download link by the responsible Field Application Specialist of FOx Biosystems.

In instances where Tracedrawer is ordered and installed, a license key will also be provided.

### 5.5.1 FOxSPR Install

The FOx SPR software installation is compliant with these two basic principles of most of the Software Installation Policies:

- In case the software is to be installed on company-owned computers, installation should be supervised by IT staff. Admin rights are required upon installation.
- Once the software is installed, it can be run by any user profile without requiring administrator rights.

Follow the steps below to install the software:

1. Double click the 'setup.exe' application file
2. Select the installation directories. If ok with the prefilled default directories, click 'next'. If needed, a different directory can be chosen before clicking 'next'. (See fig. 5)

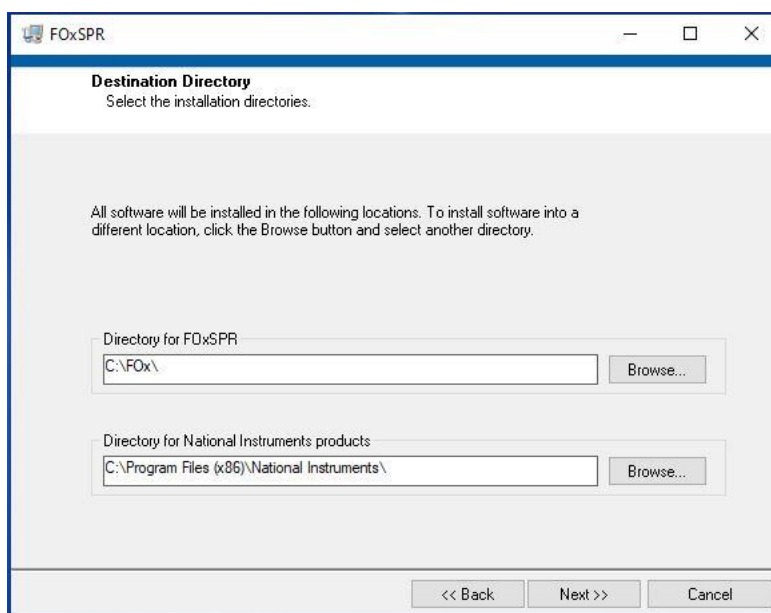


Figure 7. Screenshot of the FOx SPR data acquisition software installation wizard

3. Accept the presented license agreements.
4. The next screen prompts you to disable the windows fast startup. It is recommended to do so.
5. A summary box will be shown. Click 'Next' to begin installation.
6. When the installation of the FOx SPR data acquisition software is completed, click 'Next' to install FTDI CDM Drivers.
7. The FTDI CDM Drivers must be extracted first by clicking 'Extract'.
8. Click 'Next' to start installation.
9. Accept the license agreement.
10. Click 'Finish' to complete the installation.
11. The computer must be restarted before using the software.



**Note:**

Upon first use of the software, the light source current (in the settings tab) should be adjusted to **60 mA** for each user account in Windows, unless explicitly different indicated by FOx service personnel.

FOx SPR

FOx BIOSYSTEMS

SEQUENCE MEASURE DETAILS SETTINGS

TINT WHITE REF DARK REF XYZ STAGE STATUS: Off MEASUREMENT MODE: Idle WAVELENGTH: 500

PROBE 1: 3 PROBE 2: 3 PROBE 3: 3 PROBE 4: 3

CONNECTED CTRL BOARD SHAKER SDCMs

STAGE X: 500 Y: 500 Z: 500

**ADVANCED SETTINGS**

WHITE REFERENCE

START Tint: 3 STEP SIZE (ms): 1 TRIGGER DELAY: 50 MAX Tint: 25 REQUIRED INTENSITY: 50000

REGION FIT

RIGHT PERCENTAGE: 0.3 MAX Y FIT REGION: 15 MIN Y FIT REGION: -15 AVERAGE LENGTH: 10 SAMPLE PERIOD (ms): 50

**LIGHT SOURCE (mA)**

LIGHT SOURCE 1: 60  
LIGHT SOURCE 2: 60  
LIGHT SOURCE 3: 60  
LIGHT SOURCE 4: 60

NOT CONNECTED DOOR OPEN TEMP: 0 C TIME: STATUS: Not Connected DONE

White FOx  
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## 6 WHITE FOx Operation

### 6.1 Start-up procedure

1. The USB cord should be connected to the operating computer and the power cord needs to be plugged in.
2. Power on the device by pushing the power switch on the right bottom corner at the back of the device in the 'ON' position.
3. Start up the FOx SPR software by double clicking on its software icon.
4. When the device is turned on, the red front panel LED will light up.
5. After initialization of the device and connection of the FOxSPR software the green and red LEDs are on.

#### NOTES PRIOR TO USE:

- The instrument requires a minimum warm-up time of **one hour** with the LEDs on (LEDs turn on as soon as WHITE FOx is connected to the FOxSPR software).
- It is recommended to climatize the equipment when exposed to varying ambient temperature (for 60 minutes)
- Consider an ambient temperature of 3 °C less than the setpoint temperature of your assay to ensure stable temperature.

#### NOTE:

The start-up of FOx SPR software without WHITE FOx instrument limits the use of the FOx SPR to the Offline mode. The user can work offline by confirming the Ignore button on the pop-up message.

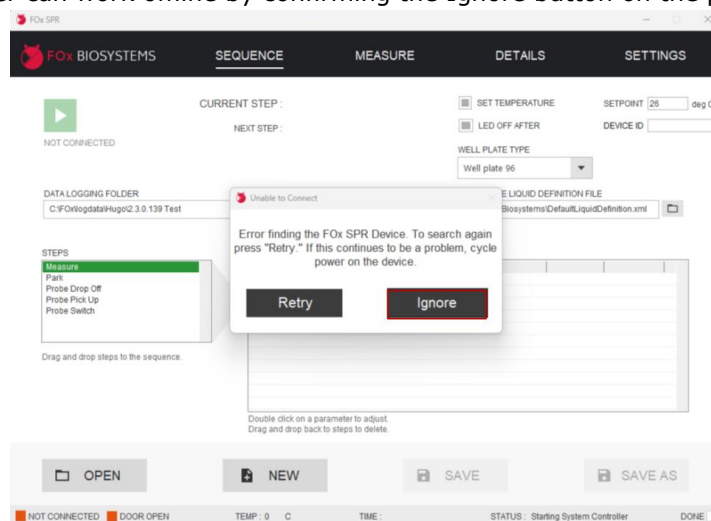


Figure 8: Offline modus start up



## 6.2 Reagent & sample placement

Instructions for placement of sample tubes into the bio-shaker plate:

1. Pipette the reagents and samples into the PCR tubes or well-plate prior to placing them into WHITE FOX.
2. Manually place the sample tubes or well-plate on the measurement position as programmed in the sequence.  
Note: Be careful not to spill samples during this operation.
3. Make sure to remove all caps, seals, or lids, etc., from the sample container before starting the measurement to ensure the sensor probes have free access to the sample.

## 6.3 Auto pickup of sensor probes to the measuring head

The probes can be attached to the optical head automatically with the "Probe pickup" function. Follow the next steps:

1. Manually place the sensor probes on the probe pickup position.  
Note: Be careful not to damage the sensor probes.
2. Start the measurement sequence with a probe pick up operation.
3. Select position on the grid (A-E)(1-12) where to pick-up the probe.
4. The optical head will attach the probe.

## 6.4 Manual attachment of sensor probes to the measuring head

The probes can also be attached to the measuring head manually instead of automatically. Follow the next steps:

1. Start the measurement sequence with a "Probe switch" step.
2. The optical head will move to the front and a pop-up asking to attach the probes will appear.
3. Open the door and attach the probes manually.
4. The prober connector should be completely slid over the measuring head ferrule so that there is no gap between the ferrule and the connector base.
5. Close the door and click the pop-up to confirm the door is closed and click the pop-up to confirm the probes are attached.
6. The device will take the White and Dark reference spectra and start the measurement.



## 6.5 FOx SPR data acquisition software

The software consists of four tabs. Hereby, the functionality is split in four parts:

1. **Sequence:** Allows composing or loading a measuring sequence and starting the measurement.
2. **Measure:** Enables viewing the real-time sensorgram and the current and next sequence step.
3. **Details:** Shows the status of the hardware components and probes, together with their integration time. The real-time spectra and dip fits are also presented.
4. **Settings:** This is a servicing tab to set various parameters related to the measurement and data storage. These settings should only be changed by the service engineer. The status of the hardware and sensor probes, with their integration time is also presented.

### 6.5.1 Sequence tab

The Sequence tab allows the user to build a measurement sequence as well as saving sequences and loading previously saved sequences.

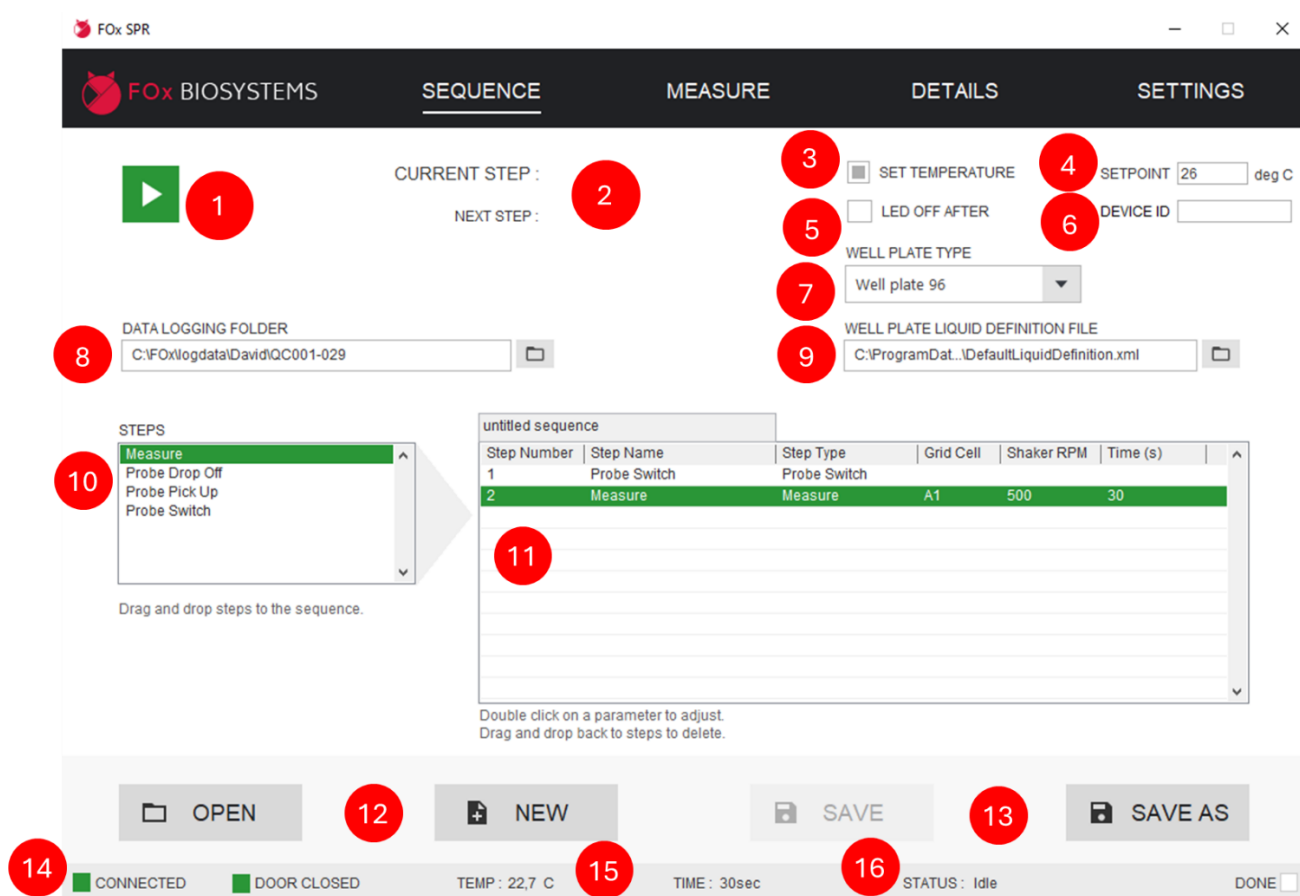


Figure 8. Screenshot of the FOx SPR data acquisition software - Sequence tab

1. Button to start the sequence. Buttons to pause, stop or skip sequence steps appear during the run.
2. Indicators of the current and next sequence step.
3. Checkbox to set the incubation temperature. The input field (4) to set the value will appear upon ticking the 'Control Temp' box.
4. Set point temperature for the samples.



5. LED OFF AFTER to switch off the LEDs after the assay. When unticked the LEDs stay on after finishing a run and thereby keeping the device heated for a next run.
6. DEVICE ID allows to add a custom reference note to the output file to log the device used during the assay.
7. Area to select plate format.
8. Folder to save the resulting data files. All the measurement output files with the resulting data and measurement info are saved in this Data logging folder. Use the default log data folder or browse to your preferred location.
9. Location of the Liquid definition file which defines the sample plate layout (96 well type).
10. List of possible actions that can be used in a measurement sequence. These actions can be dragged into table (11) to build a sequence.
11. Table showing the measurement sequence steps.
12. Buttons to open or create new sequences.
13. Button to save the newly created sequences or modifications in an already existing sequence.
14. Device connection status Indicator (CONNECTED / NOT CONNECTED) and Door status indicator (DOOR OPEN/ DOOR CLOSED).
15. Current temperature of the sample block and the total remaining time of the measurement.
16. Status of the device.

#### 6.5.1.1 BUILD A NEW SEQUENCE

To be able to run a measurement a sequential order of steps needs to be defined.

1. The temperature can be set by ticking the 'Set Temperature' box (3). Ticking the box will enable another field where the desired temperature can be entered.
2. Click 'New' (12).
3. Select one of the steps (10) and drag it onto the sequence box (11).

Note: Every sequence needs to start with a 'Probe Pick Up' or a 'Probe Switch' step

Steps can also be copy-pasted within section 7 of the Sequence tab. This can be done for single as well as multiple steps. To copy & paste, select the steps you want to copy, right-mouse click and copy. To paste, first select the step above the position where you want to paste, and right-mouse click paste. The step(s) will be pasted below the selected position.

Step Functions:

- **"Measure"** – Function to define the grid positions in the reagent plate where the Optical Head will measure the SPR signal. For each "measure" step the step-timing and shaking speed needs to be defined.
  - **"Park"** – Function to define a grid position where the probes will remain stationary and hydrated, without time definition and no shaking by default. This is a final function in the sequence. The function can be stopped by selecting the 'stop' button, whereafter the Optical Head will move to the 'Probe Switch' position;
  - **"Probe Drop Off"** – This function allows to automatically discard the probes in the waste compartment. This can be a final function in the sequence or another "Pick up" or "Probe Switch" step can be configured afterwards.
  - **"Probe Pick Up"** – This function allows to automatically mount the probes on the Optical Head from a defined grid position on the Probe plate.
  - **"Probe Switch"** – This function moves the Optical Head to an accessible position at the front of the device that allows the manual mounting of probes.
4. The step name can be altered by double clicking on the step name (11)





5. Select the well position under 'Grid Cell' (11). Since 4 Sensor probes are measured simultaneously the software shows a preselection of four adjacent positions. The position of the left-most sensor probe must be selected, and the software will automatically select the remaining 3 adjacent positions.
6. If shaking is required for a certain step, enter the desired rpm value under 'Shaker RPM' for that step (11).
7. Enter the measurement duration in seconds for each step under 'Time (s)'

The sequence editor validates every sequence, only valid sequence can be executed or saved.

**NOTE:** Pay attention to inserting a 'Probe Drop Off' or 'Probe Switch' sequence step before a new 'Probe Pick Up' step is inserted. Always make sure there are no Sensor probes attached to the optical unit before a Probe Pick Up will be performed.

#### 6.5.1.2 SAVE AND OPEN SEQUENCES

Once a sequence is built, it can be saved by using the 'Save as' button in section of the Sequence tab. The software will ask for a name to save the sequence. These saved sequences can be loaded by clicking the 'Open' button in section 13. The saved sequences are automatically stored in the default location 'C:\Users\UserAccount\AppData\Local\FOXBIOSYSTEMS\sequences' as Excel CSV file. (Note: This can be a hidden folder. If hidden, type the folder path in the address bar of windows explorer.)

#### 6.5.1.3 STARTING, PAUSING, STOPPING A MEASUREMENT AND SKIPPING A SEQUENCE

The measurement can be started with the 'Start' button in section 1 of the Sequence tab. You will be prompted to enter a test name upon clicking 'Start'. Enter an experiment name. The date and time of the measurement will be added automatically to the filename of the datafile.

In case a temperature is set, the device will first heat up to the set temperature and only start the measurement sequence when the temperature is reached.

**Note:** Please keep the door closed during the software initialization. Do not open the device door while the sample plate is heating or passively cooling as this can result in startup issues!

The software will automatically switch to the Measure tab after starting. Once started, the measurement buttons to pause or stop the measurement and to skip a sequence step will become active. Hitting the 'Stop' button will stop the "Measure" or the "Park" function, and move the robot to the 'Probe Switch' position. The 'Pause' button will pause the progression of the sequence while continuing to measure in the current sequence step. The 'Skip sequence' button is meant to jump immediately to the next sequence step without completing the current step time.

#### 6.5.1.4 STATUS BAR

The status bar shown at the bottom of the Sequence tab presents the following items:

- Connection indicator: This box indicates whether all connections between hardware and software are ok. Green color indicates that all connections are made.
- Door indicator: If the door is open, the indicator is red, and the measurement cannot be started or will be paused if already initiated. In fact, opening the door will pause the sequence or any movement of the robot. If opened during a measuring step, the sequence will be paused while data is still being collected.
- Current temperature: The measured temperature of the sample block is presented here.
- Time remaining: This represents the total remaining time of the measurement.
- Status: Detailed actions within a sequence step are presented.
- Complete: Turns green when the measurement is finished.



### 6.5.2 Measure tab

The measure tab allows to look at the data measurement in real-time.

Different options are available to zoom in/out on the sensorgrams. These can be found in (6) of the Measure tab. Number (2) shows which sequence step is currently being measured as well as the next sequence step. The option to pause, stop the measurement and skip a sequence can also be controlled from the measure tab (1). The sensorgram, presented in (7) of the Measure tab, shows the wavelength positions for the 4 sensor probes. Each sensor probe is presented with a specific color, as shown in the legend in the top part of the sensorgram. It is also possible to hide certain sensor probes in the sensorgram. This can be done by right-clicking on the sensor probe in the legend (5) and unticking the 'Plot Visible' option. To make the curve visible again, tick the 'Plot Visible' option again. The sensorgram is updated in real-time during the measurement.

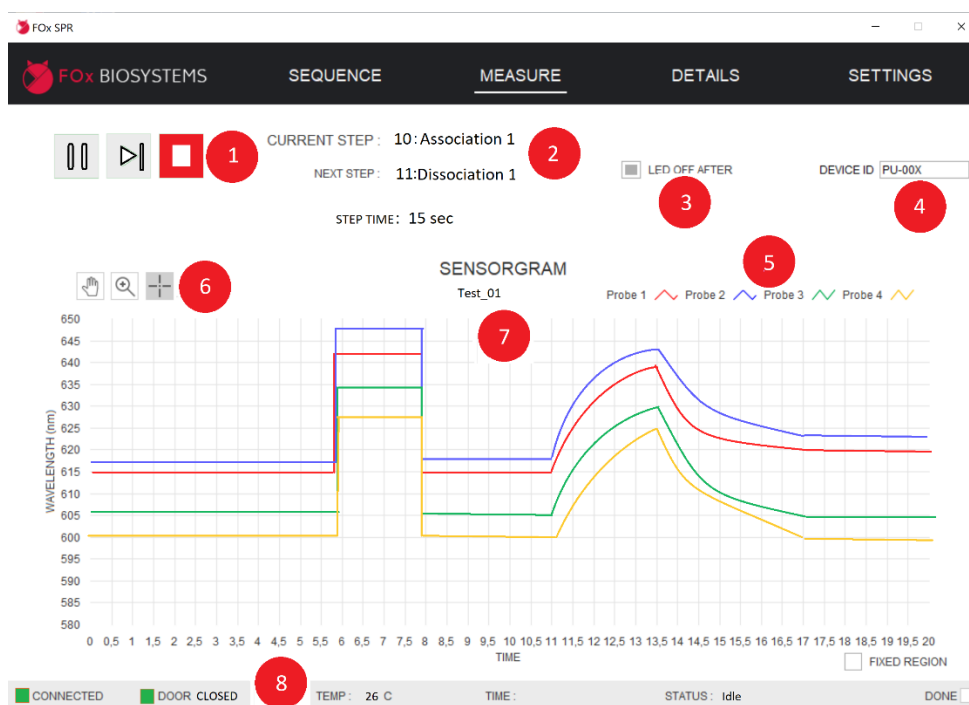


Figure 9: Screenshot of the FOx SPR data acquisition software - Measure tab

1. Buttons to start, pause, stop the measurement and to skip sequence steps.
2. Indicators of the current and next sequence step.
3. LED OFF AFTER run checkbox can also be toggled ON/OFF in this menu. Environmental advice: switch LED OFF AFTER the last run of the day to limit unnecessary power consumption.
4. DEVICE ID can be also specified in this menu.
5. Curve legends.
6. Tools to zoom in and out on the sensorgram.
7. Area presenting the sensorgram. This graph shows the signal over time. More specifically the sensorgram shows the spectral position of the SPR dip over time.
8. Status bar presenting the remaining measurement time, sample block temperature and status of the door.

**NOTE:** During the Park step function there is no generation of measurement data. The data output file is closed and ready for processing at the end of the last Measure step before the Park step function.



### 6.5.3 Details tab

A more detailed view of the device status and data point extraction can be seen in the details tab.

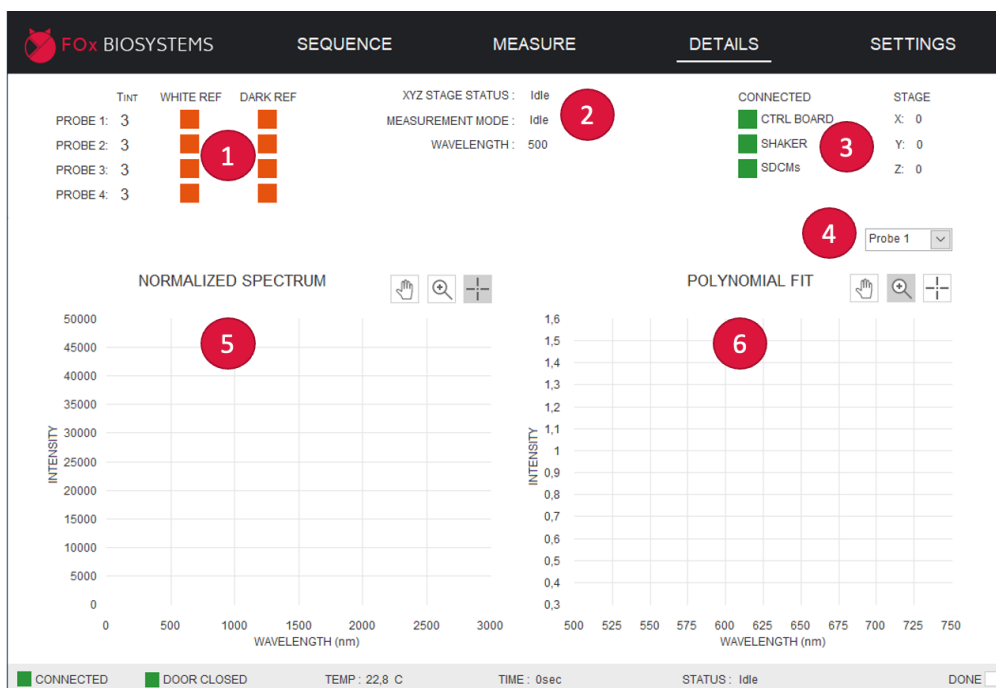


Figure 10. Screenshot of the FOX SPR data acquisition software - Details tab

1. Indicators showing if White and Dark references are ok for the 4 probes. Integration time is also presented. The integration time shows per optical fiber the integration time that is needed for the spectrometer to reach the set threshold value.

**NOTE:** If a color box does not turn green upon measuring the integration times, there is an issue with that probe or the attachment of that probe to the device. Check if the probe is properly attached to the device. If this does not solve the problem, replace the probe.

2. Indicators of device status and dip wavelength of the selected probe in 4.
3. Indicators showing if device components are connected or not. The coordinates of the measurement head are also given.
4. Probe channel selector for graphs 5 and 6.
5. Graph showing the white and dark reference spectra during the calibrating phase of a measurement. During the measurement itself the real-time normalized spectrum of the selected probe (4) is presented.
6. Dip area of the normalized and stabilized spectrum of probe selected in 4. It shows a detailed view of the SPR dip region from the spectrum. It also shows the curve fitting to determine the exact position of the dip minimum. The green curve is the measured dip in the normalized spectrum and the fitting curve is shown in blue. The position of the dip minimum is in fact the actual signal that is presented in the sensorgram on the measure tab.



### 6.5.4 Settings tab

This tab is meant as a servicing tab and we recommend users not to change any of the settings on this tab.

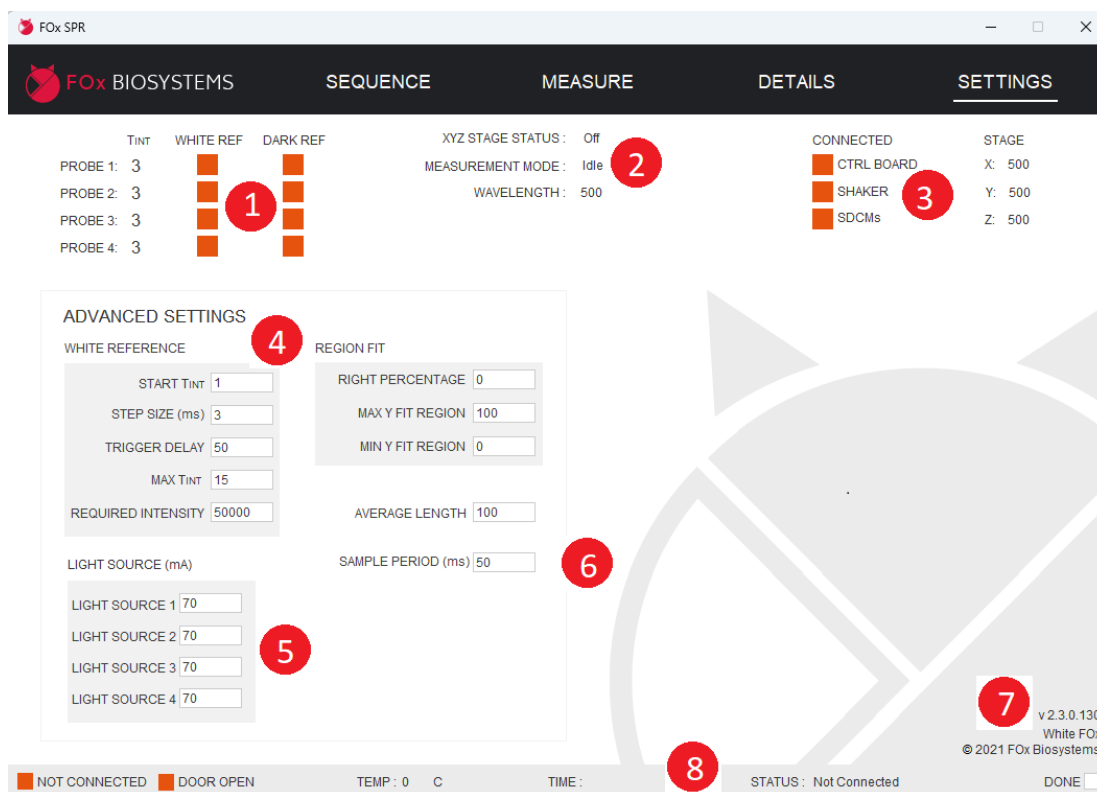


Figure 11 Screenshot of the FOx SPR data acquisition software – Settings tab

1. Indicators showing if White and Dark reference are ok. Integration time is also presented
2. Indicators of device status and dip wavelength of probe selected in DETAILS tab (4).
3. Indicators showing if device components are connected or not. The coordinates of the robot are also given.
4. Settings regarding White reference taking and dip fitting.
5. Area to set the power of the LED light source per channel.
6. Area to set the Sampling period.
7. The specific version of the software used.
8. Status bar presenting the remaining measurement time and status of the door for example.

The intensity of the light source can be set separately for each channel in section 5. The set value should always fall within the 50 – 150 mA range. The sampling period or time between 2 measurements can be set in section 6 of this tab. The sampling period should never be set lower than 50 ms.

## 6.6 Shut down procedure

- Shut down the FOxSPR software by clicking the 'x' shutdown symbol in the left upper corner of the screen.
- Wait until the 'FOxSPR' icon in the lower windows toolbar is not highlighted anymore.
- Shut off the device by switching off the bottom in the right corner behind the device
- Shut down the operating computer at the end of the day.



## 6.7 Operating workflow example

Table 6. Interactions between the operator and the device.

Operator	Device	Action
X		Turn on the instrument
X		Open the FOf SPR data acquisition software
	X	Light source is switched on to warm up until measurement starts. Allow for minimum 1 hour before start of the first experiment run.
X		Fill microtiter plate according to guidelines
X		Program sensor probe positions, measurement time, shaker settings, and data export path
X		Open case, insert sensor probe tray, insert samples, and close case. Keep case closed during the run to maintain steady conditions inside.
X		Set temperature control to minimum 3°C above ambient. Advised minimum 26°C.
X		Start measurement
	X	Sensor probes are picked up from the tray
	X	Referencing is performed to calibrate the integration time for the optical path and to generate a processable spectrum containing the SPR dip.
	X	Move sensor probes to a sample or reagent.
	X	Measure in liquid sample or reagent to determine the wavelength position of the SPR dip minimum.
	X	Start measurement cycles and export data per measurement
	X	End measurement
	X	Move sensor probes to waste container position and drop off the probes
	X	Keep light source on or switch off if 'LED off after measurement' is ticked.
X		Check if sensorgrams look normal with smooth continuous lines, no drift or wave-like artefacts before proceeding with data processing.
X		Shut down the control software on the computer
	X	The LEDs switch off and the optical head moves to the homing position.
X		Turn off main power (if you have finished measurements)
X		Open case to remove samples and sensor probes



## 7 Maintenance

### 7.1 Daily maintenance

#### 7.1.1 Powercycle operating computer

In case the operating computer of WHITE FOx is not shut down at the end of each day, power cycle the computer before startup of the device.

### 7.2 Weekly maintenance

#### 7.2.1 Cleaning the optical connectors

The optical connectors on the bottom side of the optical head (to mount the sensor probes on) can be cleaned periodically (based on a regular use, weekly cleaning is advised) with a lens paper (e.g., Lens Cleaning Tissue, grade 105 from Whatman) wetted with pure ethanol or isopropanol. Gently wipe the bottom end of the connector making circular motions. Avoid rubbing dirt onto the connectors.

### 7.3 6 monthly maintenance

#### 7.3.1 Cleaning of WHITE FOx



Before cleaning WHITE FOx, always disconnect the power cord.

Inner and outer surfaces can be cleaned using a damp cloth with mild soap solution and water or 70 % ethanol or another alcohol-based disinfectant. Be careful not to excessively spill cleaning liquid on the inside of WHITE FOx and power supply inlet. Avoid cleaning of moveable parts. Do not use liquids to clean the top of the optical measuring head or the area of the power supply inlet. Avoid the use of dry raw paper to clean or dry the equipment to avoid scratches on the surfaces. [Figure 12](#) & [Figure 13](#) indicate the areas where contact with liquids must be avoided. Do not use other cleaning solutions.

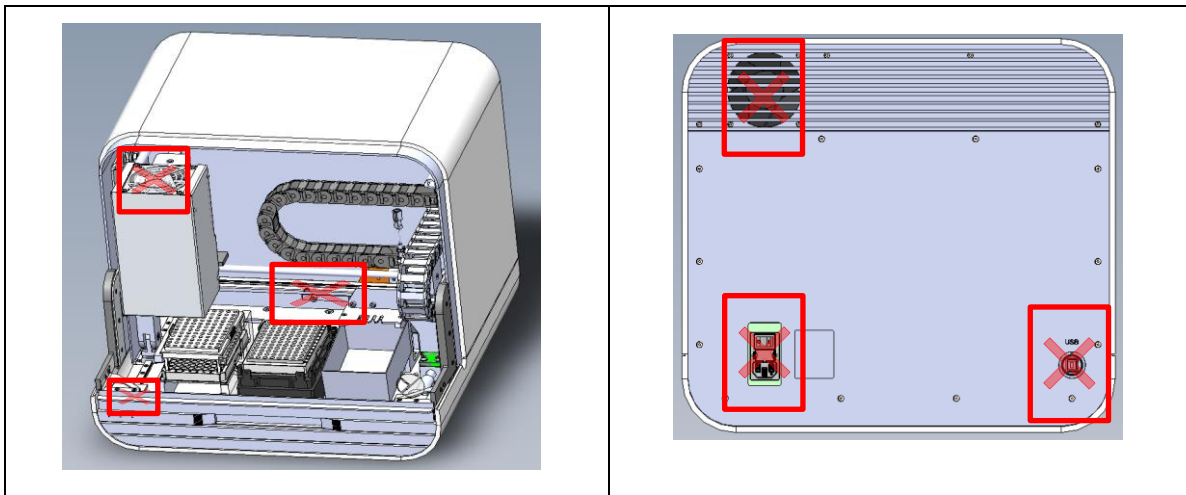




Figure 12. Open front view and back view of WHITE FOx with indications of the area where liquid must be avoided (electrical and moveable parts).

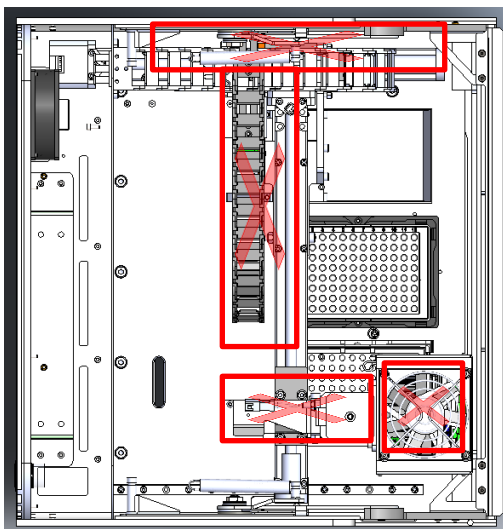


Figure 13. Top view of WHITE FOx mechanical layout with indications of the area where liquid must be avoided: the electrical and moveable parts.



If the device comes in contact with hazardous biological samples, the device has to be considered contaminated and hazardous.

If biohazardous samples are being studied with WHITE FOx, always follow the dedicated laboratory standard operating procedures.

The sample wells and probes used to study biohazardous samples should be disposed via the dedicated biohazard waste route.

**Note:** In case the device must leave the laboratory, make sure to thoroughly disinfect the device. The device can be disinfected according to the following instructions:

1. Unplug and remove all cables from the device.
2. Clean all surfaces (except the optical head and the power supply inlet as indicated in [Figure 12.](#) ), with a soft cloth which has been soaked in disinfecting solution, e.g., 70% ethanol or isopropanol.
3. Place the device in a large plastic bag together with the soft cloth that was soaked in disinfecting solution.
4. Seal the bag and keep it closed for at least 24 hours.
5. Take the device out of the bag and clean its surfaces one more time with 70% ethanol or isopropanol.



## **7.4 Annual preventative maintenance**

The preventative maintenance is annually performed by authorized trained service personnel. The annual preventative maintenance is advised to ensure the correct and proper functioning of the device throughout its usage period. During the time of warranty this is automatically included, after warranty the preventative maintenance can be requested upon order or is included if a full option warranty contract is in place.

## **8 Service and preventative maintenance**

WHITE FOx is designed to function reliably, and it meets or exceeds the specifications at the time of sale. Despite the care exercised during design and manufacture, it is impossible to eliminate malfunction due to ordinary wear and tear and random component failure.

Maintenance, repair, modifications, and calibration of WHITE FOx can only be performed by a FOx Biosystems engineer. To ensure safe and proper functioning of the system, it is recommended that the device should be serviced annually. To this end, we offer service agreements with our customers. Please contact us for more details. (See the service manual for further details)



## **9 Disposal of WHITE FOx**

WHITE FOx device is an electrical waste and should not be disposed among other regular waste. Local regulations on electronic waste must be respected.

The disposables used with WHITE FOx, namely probes and well-plates, should be disposed via standard laboratory waste routes and depend also on the used sample type.