FireSting®-O₂
Optical Oxygen Meter

USER MANUAL

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The FireSting®-O₂ is released by:

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1   OVERVIEW

The compact USB-powered fiber-optic meter **FireSting®-O2** with 1, 2, or 4 channels for multiple analytes and sensor heads features:

- freely configurable channels for O_2 and temperature

- broad optical sensor portfolio (multiple fiber-based and contactless sensor heads)

- with (ultra-)high speed sampling

- zero-noise and zero-latency temperature compensation

- improved ambient light suppression and

- smart measuring modes for prolonged sensor lifetime

- oxygen and temperature determination simultaneously in one sample
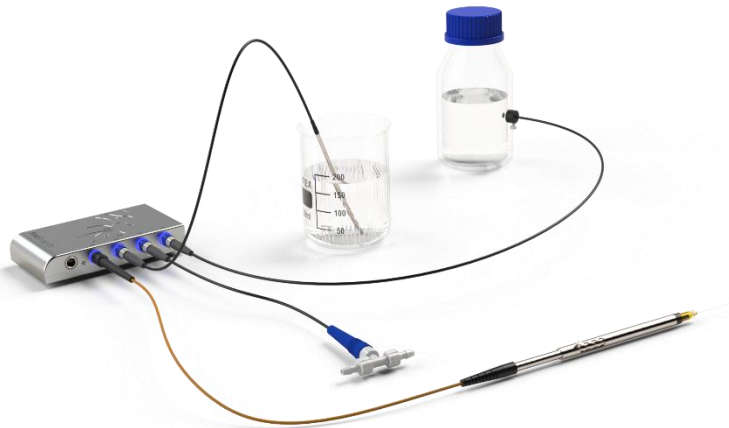
This optical oxygen meter has integrated atmospheric pressure and humidity sensors for precise and easy oxygen sensor calibration, but also for automatic pressure compensation of the oxygen measurements. Furthermore, the **FireSting®-O2** offers 4 analog outputs and a broadcast-mode.

The new innovative and user-friendly **Pyro Workbench** allows operation of several **FireSting®-O2** meters in parallel as a scalable multi-channel system.

2 INTRODUCTION

The **FireSting®-O₂** comes with 1, 2, or 4 channels (optical sensor ST-connectors **1** to **4**) for up to 4 fiber-optic sensors and one connector (**T**) for an external Pt100 temperature probe. The optical channel connectors are color coded, indicating the analyte (oxygen or temperature), which is currently measured and can be changed for each channel. The air inlet equilibrates the internal temperature, pressure and humidity sensors with the surrounding. Avoid covering these holes to ensure free air circulation towards the internal sensors.

optical sensor
connectors **1**-**4**

Pt₁₀₀
connector

air inlet
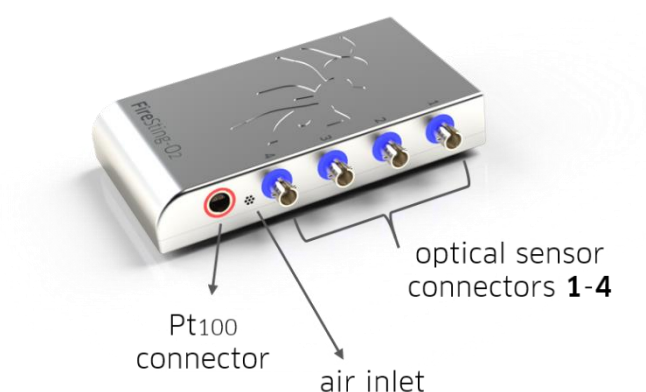
The micro-USB connector on the left side panel provides energy supply and data exchange with the PC. Right-hand side of it, a connector **X1** for power and digital interface (7-pins) and a connector **X2** for analog output (5 pins) is located.

micro-USB
connector (PC)

extension port
connector X₁ & X₂
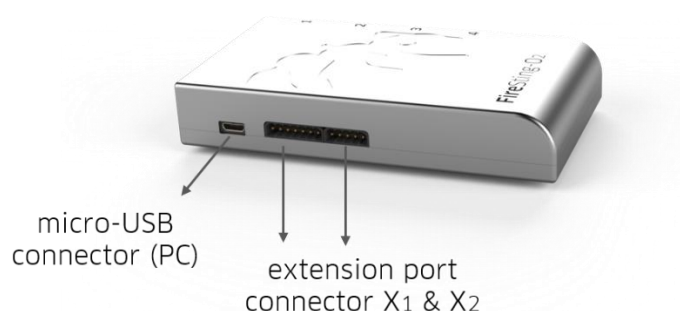
3   QUICK START

Step 1: Download the correct software and manual from the downloads tab of your purchased device on www.pyroscience.com

Step 2: Connect the **FireSting®-O₂** meter with the micro-USB cable to the Windows PC/laptop (Windows 7, 8, 10).

Step 3: Connect appropriate **PyroScience** sensor(s) to the optical sensor connectors **1** to **4** at the device (see 4).

Step 4: Connect an external temperature sensor (item no. **TDIP15** or **TSUB21**) to the Pt100 connector or, alternatively, an optical temperature sensor (see 5) to one of the optical sensor connectors **1** to **4** for automatic temperature compensation.

Step 5: Prepare appropriate calibration standards, as described in the respective sensor manuals (see 8).

Step 6: Start the logger software by clicking on the short-cut "**Pyro Workbench**" on your desktop.

Step 7: Open the **Settings Wizard** by clicking on the **FireSting®-O₂** picture**.** Select the **respective analyte** and enter all sensor settings for each sensor, including an appropriate mode of temperature compensation.

Step 8: Open the **Calibration Wizard** and follow the calibration instructions for each sensor. Measurements with the respective sensors will start automatically after all required sensor calibrations have been performed.

Step 9: Configure the **Graphs** according to your preferences.

Step 10: Activate **Data Logging**.

4   CONNECTING SENSORS

The fiber-optic oxygen and temperature sensors, as well as optical fibers needed for read-out of contactless sensors are connected to the ST-connectors of the **FireSting®-O2** (**1** to **4**) with a male fiber plug.

- Remove the black caps from the plug of the sensor / fiber.

- Remove the red caps from the sensor ports at the **FireSting®-O2** (the red caps should be put on again if it is not in use anymore to protect the optics).

- Insert the male fiber plug of the sensor cable into the ST-port (female fiber connector) of the **FireSting®-O2** and turn the bayonet coupling gently clockwise until the plug is locked firmly.

5 OPTICAL SENSORS

The **FireSting®-O₂** is compatible with a broad range of optical oxygen and temperature sensors from **PyroScience.** For an overview of available optical sensor types, please see the **PyroScience** website.

5.1 Fiber-optic Sensors

Sensor	Item	Analyte	Application
Robust Probes	**OXROB…**	**O₂**	stirred water, gas
Retractable Tip Minisensors	***OXR…**	**O₂**	water, gas & semi-solid samples
	TPR…	**Temp.**	
Fixed Tip Minisensors	***OXF…**	**O₂**	water, gas & semi-solid samples (esp. sea water)
	TPF…	**Temp.**	
	OXF…-PT	**O₂**	gas (puncturing septa/packaging)
Bare Fiber Sensors Minisensors	***OXB…**	**O₂**	water, gas & custom
	TPB…	**Temp.**	
Solvent-Resistant Probes	**OXSOLV**	**O₂**	approved polar and non-polar solvents
	OXSOLV-PTS	**O₂**	approved solvent vapors

* also available as Microsensor; **water**=water, seawater, aqueous solutions

5.2   Contactless Oxygen Sensors

Sensor	Item	Analyte	Application
Nanoprobes	**OXNANO**	**O₂**	aqueous solutions & microfluidics
Sensor Spots	OXSP5	**O₂**	water & gas
	TPSP5	**Temp.**	
Sensor Vials	OXVIAL...	**O₂**	water & gas
	TOVIAL...	**Temp.** & **O₂**	
Flow-Through Cells	OXFLOW...	**O₂**	water & gas
	OXFTC...		
	TPFLOW	**Temp.**	
	TOFTC2	**Temp.** & **O₂**	

**water**=water, seawater, aqueous solutions
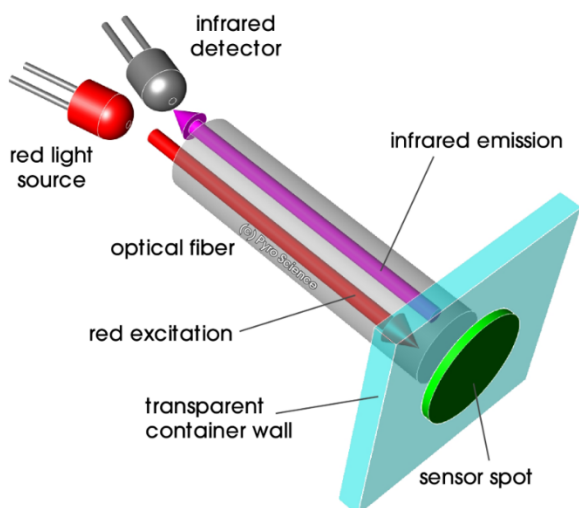
Principle of contactless read-out of sensor spots and sensor vials
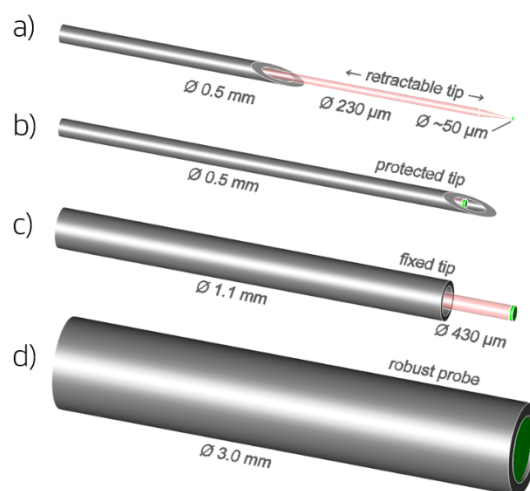
Examples of available sensor tips:
a) retractable microsensor **b)** fixed minisensor with protected tip and with **c)** protruding sensor tip, **d)** robust probe

6   EXTENSION PORT

The extension port of the **FireSting®-O₂** consists of the two connectors **X1** and **X2** (fitting connector plugs can be obtained from **Phoenix Contact** item **no. 1778887** and **1778861**).

connector **X1**   pin 1   connector **X2**
- power   • analog output
- digital interface
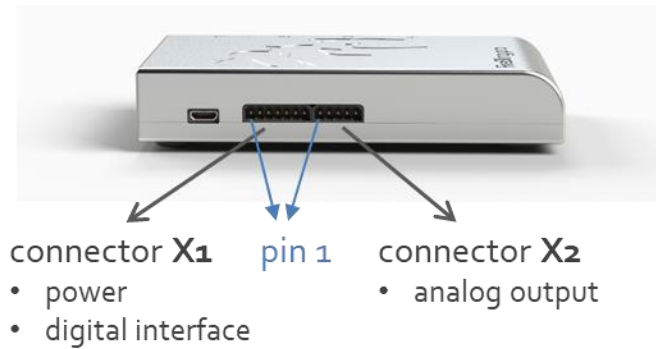
6.1   Connector X1 (Power, Digital Interface, Analog In)

The pin configuration of the connector **X1** is given in the table below. Pins 1-2 (GND and VCC) can be used for providing an external power supply (3.5…5.0 VDC), if the **FireSting®-O₂** should not be powered via the USB port. The transmit and receive pins of the UART-interface are given at pins 4 (TXD) and 5 (RXD) (communication protocol on request). When using the UART-interface it is recommended to connect pin 3 (/USB_DISABLE) to pin 1 (GND), which disables the USB interface.

Pin 6 (/PAUSE_BROADCAST) and Pin 7 (/TRIGIN) are related to the so called "broadcast mode" which can be configured in the PC control software (e.g., **Pyro Workbench** or **Pyro Developer Tool**). During broadcast mode, the device triggers itself periodic measurements which can be read out from the analog outputs or from a text message transmitted via the USB/UART interface. For more details refer to the manual of the respective control software are to the communication protocol (available on request).

Pin 7 (/TRIGIN) acts as a trigger input for the broadcast mode. Note, the option "Enable Trigin" must be enabled in the broadcast settings in the control software. Every time this pin is connected to pin 1 (GND) then an additional broadcast measurement is triggered.

Pin 6 (/PAUSE_BROADCAST) acts as a master switch of the broadcast mode. As long this pin is tied to pin 1 (GND), then the broadcast mode is paused. Neither periodic broadcast measurements, nor triggered broadcast measurements are performed.

Pin	Name	Function	Description
1	GND	Power	Ground
2	VCC	Power	Power supply, 3.5V to 5.0V DC max. 70 mA (typ. 40 mA)
3	/USB_DISABLE	Digital Input	Connect to GND for disabling the USB interface
4	TXD	Digital Output (UART TX)	UART interface with 3.3V levels (5V tolerant), baud rate 115200, 8 data bits, 1 stop bit, no parity, no handshake
5	RXD	Digital Input (UART RX)	UART interface with 3.3V levels (5V tolerant), baud rate 115200, 8 data bits, 1 stop bit, no parity, no handshake
6	/PAUSE_BROADCAST	Digital Input (0V or 3.3V, internally pulled-up to 3.3V)	Connect to GND for pausing any broadcast-mode operation.
7	/TRIGIN	Digital Input (0V or 3.3V, internally pulled-up to 3.3V)	Triggers a broadcast measurement every time, when this pin is tied to GND.

6.2   Connector X2 (Analog Output)

The connector **X2** provides 4 analog outputs with a range of 0-2.5V DC at a resolution of 14 bits (see table below). Refer to the **Pyro Workbench** manual how to configure the analog outputs.

Pin	Name	Function	Description
1	GND		Ground
2	AO_A	Analog Output (0 – 2.5 V DC) (14-bit resolution)	Analog Output Port A (alternatively digital alarm output)
3	AO_B	Analog Output (0 – 2.5 V DC) (14-bit resolution)	Analog Output Port B (alternatively digital alarm output)
4	AO_C	Analog Output (0 – 2.5 V DC) (14-bit resolution)	Analog Output Port C (alternatively digital alarm output)
5	AO_D	Analog Output (0 – 2.5 V DC) (14-bit resolution)	Analog Output Port D (alternatively digital alarm output)

7   SPECIFICATIONS

Feature	Specification
Dimensions	68 x 120 x 22 mm (housing) 78 x 120 x 24 (total)
Weight	ca. 290 g
Interface	USB 2.0
Power supply	USB-powered (max 50mA at 5V)
Supported operating systems	Windows 7, 8, 10
Operating temperature	0 to 50°C
Max. relative humidity	non-condensing conditions
Optical sensor port	1, 2, or 4 (dependent on model)
Optical sensors	complete **PyroScience** sensor portfolio for O₂ & T
Optical sensor connector	fiber-optic ST-plug
Max. sample rate	ca. 10 samples per second (depending on Settings)
External temperature port Range, Resolution, Accuracy*	1 channel for 4-wire Pt100 -30°C to 150°C, 0.02°C, ±0.5°C
Internal temperature sensor Range, Resolution, Accuracy*	-40 to 125°C, 0.01°C, ±0.3°C
Internal pressure sensor Range, Resolution, Accuracy	300 to 1100 mbar, 0.1 mbar, typ. ±3 mbar
Internal humidity sensor Range, Resolution, Accuracy	0 to 100% rel. humidity (RH), 0.04% RH, typ. ±6% RH
Digital interface at extension port **X1** (7 pins)	UART with 3.3V levels (5V tolerant), 115 200 baud, 8 data bit, 1 stop bit, no parity, no handshake

Connector plug port **X1**	Phoenix Contact, item no. 1778887
Analog output (4 channels) at extension port **X2** (5 pins)	0 to 2.5 VDC 14-bit resolution
Connector plug port **X2**	Phoenix Contact, item no. 1778861

7.1 Mounting Hole Dimensions of the FireSting® meters
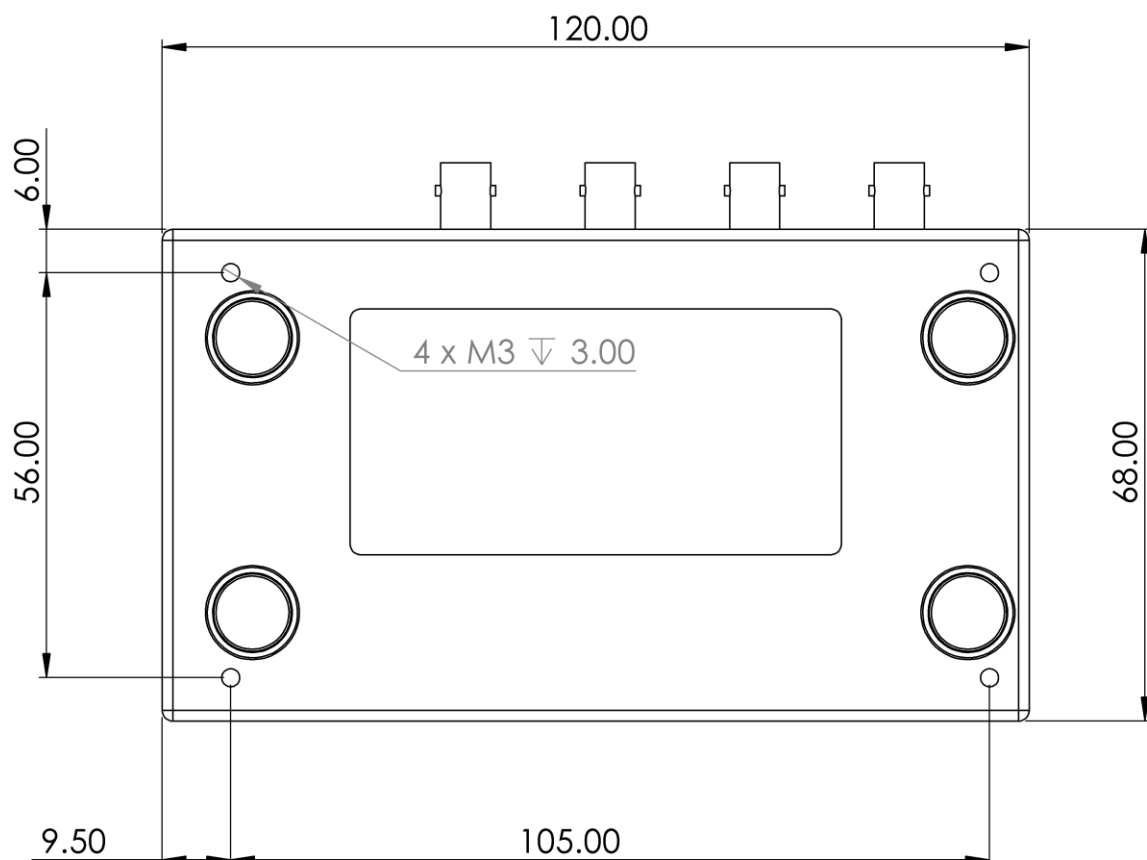
8   RELATED DOCUMENTS

Detailed instructions for using the **Pyro Workbench** and application of optical oxygen and temperature sensors:

- manual for logger software "**Pyro Workbench**" (Windows)

- manuals for optical sensors from **PyroScience** (oxygen, temperature)

9   WARNINGS & SAFETY GUIDELINES

Before using the FireSting®-O2 and its sensors, read carefully the instructions and user manuals.

In case of problems or damage, disconnect the instrument and mark it to prevent any further use! Consult **PyroScience** for advice! There are no serviceable parts inside the device. Please note that opening the housing will void the warranty!

The FireSting®-O2 is not watertight, is sensitive to corrosive conditions and to changes in temperature causing condensation. Avoid any condition (e.g. direct sun light) causing a heating of the device above 50°C (122°F) or below 0°C (32°F). Avoid any elevated humidity causing condensing conditions.

Handle the sensors with care especially after removal of the protective cap! Prevent mechanical stress to the fragile sensing tip! Prevent injuries with needle-type sensors!

Calibration and application of the sensors is on the user's authority, as well as data acquisition, treatment & publication!

The optical sensors and meter **FireSting®-O2** are **not** intended for medical, diagnostic, therapeutic, or military purposes or any other safety-critical applications. The sensors must **not** be used for applications in humans and must not be brought in direct contact with foods intended for consumption by humans.

The FireSting®-O2 and optical sensors should be used in the laboratory by qualified personnel only, following the user instructions and the safety guidelines of the manual, as well as the appropriate laws and guidelines for safety in the laboratory!

Keep the sensors and the fiber-optic meter **FireSting®-O2** out of reach of children!

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