OXY4400 Oxygen Analyzer
Operator’s Manual

P/N 4900002060 rev C
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1 - INTRODUCTION

SpectraSensors’ OXY4400 product is a stand-alone fiber optic oxygen meter based on fluorescence quenching technology that creates very stable, internally referenced measured values. This technology enables a more flexible use of oxygen sensors (also called optodes) in a variety of sensor fittings, if required.

Who Should Read This Manual

This manual should be read and referenced by anyone installing, operating or having direct contact with the analyzer.

How to Use This Manual

Take a moment to familiarize yourself with this Operator’s Manual by reading the "Table of Contents".

There are a number of options and accessories available for the OXY4400 analyzers. This manual has been written to address the most common options and accessories. Images, tables and charts have been included to provide a visual understanding of the analyzer and its functions. Special symbols are also used to provide the user with key information regarding the system configuration and/or operation. Pay close attention to this information.

General Warnings and Cautions

Instructional icons are provided in this manual to alert the user of potential hazards, important information and valuable tips. Following are the symbols and associated warning and caution types to observe when servicing the analyzer.

General notes and important information concerning the installation and operation of the analyzer.

Warning statement for hazardous voltage. Contact may cause electric shock or burn. Turn off and lock out system before servicing.

Failure to follow all directions may result in damage or malfunction of the analyzer.
Conventions Used in this Manual

In addition to the symbols and instructional information, this manual is created with “hot links” to enable the user to quickly navigate between different sections within the manual. These links include table, figure and section references and are identified by a pointing finger cursor when rolling over the text. Simply click on the link to navigate to the associated reference.

SpectraSensors Overview

SpectraSensors, Inc. is a leading manufacturer of technologically advanced electro-optic gas analyzers for the industrial process, gas distribution and environmental monitoring markets. Headquartered in Houston, Texas, SpectraSensors was incorporated in 1999 as a spin-off of the NASA/Caltech Jet Propulsion Laboratory (JPL) for the purpose of commercializing space-proven measurement technologies initially developed at JPL. SpectraSensors was acquired by the Endress + Hauser Group in 2012 and remains a USA-based technology manufacturer.

About the OXY4400 Analyzer

The OXY4400 is a stand-alone precision, temperature compensated system enclosed in a NEMA 4X stainless steel case. The rugged design and low power consumption makes the OXY4400 ready for an indoor or outdoor application in Class 1, Division II, Groups A, B, C and D environments.

The OXY4400 is designed for three types of sensor ranges; 0 to 5% v/v, 0 to 50% v/v or 0 to 1000 ppm. This system was specifically designed for natural gas measurements using a flow through fiber-optic oxygen sensor mounted in a 1/4” compression tee. The instrument LCD and data-logger are integrated into the system. The analog outputs are programmable to provide data for oxygen, temperature, phase angle or signal amplitude. The digital interface (RS-232) and PC software (included) are used for data storage and external data logging that can store up to 26,000 data samples. Complete control, including all calibration and adjustments, can be completed through the PC.

Sensor Characteristics of Oxygen-Sensitive Sensors

The operation principle of the optical oxygen sensor is based on the fluorescence quenching of luminescence caused by a collision between molecular oxygen and luminescent dye molecules in the excited state. Figure 1–1 shows a typical response curve of the oxygen-sensitive sensor. In the presence of oxygen, the signal (in this case, the phase angle $\Phi$) decreases.
Temperature

SpectraSensors’ optical oxygen sensors must be used with a PT1000 temperature sensor in the temperature range between -10 to 50°C. Each instrument is supplied with the PT1000 temperature sensor for compensation and to record temperature variations.

Cross-sensitivity

There exists no cross-sensitivity for carbon dioxide (CO₂), hydrogen sulfide (H₂S), sulfur dioxide (SO₂), pH, any iconic species like sulfide (S₂⁻), sulfate (SO₄²⁻), chloride (Cl⁻) or salinity. Turbidity and changes in the flow rate (DO) have little or no influence on the measurement.

The sensors can also be used in methanol- and ethanol-water mixtures, as well as in pure methanol and ethanol.

SpectraSensors recommends avoiding other organic solvents, such as acetone, chloroform or methylene chloride, which may swell the sensor matrix rendering it unusable.

Response Time

The response time to t₉₀ (90% of full scale) in the gas phase for the oxygen sensor is less than eight seconds.
Housing for Oxygen in Natural Gas (DP-BOS3-L5-ST5-NOP)

SpectraSensors’ fiber-optic oxygen sensors are based on 2 mm polymer optical fibers. The sensing portion is a 4 mm stainless steel probe. Depending on the application, SpectraSensors offers a set of different standard fitting designs. Refer to Figure 1–2. Custom designs are also available. Please contact your sales representative.

Trace Oxygen Probe

The oxygen sensor consists of a polymer optical fiber (POF) with a polished distal tip that is coated with a planar oxygen-sensitive foil. The end of the polymer optical fiber is covered with a high-grade steel tube to protect both the sensor material and the POF. Refer to Figure 1–3. Typically, the fiber is coated with an optical isolated sensor material in order to exclude ambient light from the fiber tip.
**Schematic drawing for the Trace Oxygen Probe**

Refer to Figure 1–4 for a schematic of the trace oxygen probe.

![Trace oxygen probe schematic](image)

**Figure 1–4 Trace oxygen probe schematic**

This probe has a very rugged sensor with excellent long-term stability (more than 100000 data points without drift) and is usable for process applications.

**Safety Guidelines**

*Please read these instructions carefully before working with this instrument.*

This device has been carefully tested of all functions, complying with safety requirements, prior to leaving the factory. The correct functional and operational safety of this instrument can only be ensured if the user observes the necessary safety precautions and specific guidelines presented in this manual. Refer to Appendix A, Specifications, and the list outlined below.

- Before connecting the device to the electrical supply network, ensure that the operating voltage stated on the power supply corresponds to the main voltage input as described on page A–1.
- If the instrument is moved from cold to warm surroundings, condensation may form and interfere with the functioning of the system. In this event, wait until the instrument temperature reaches room temperature before putting the analyzer back into operation.
- Calibration, maintenance and repair work must only be completed by a qualified technician, trained by SpectraSensors, Inc.
- In the case of any damage to current-carrying parts, such as power supply cable or the power supply itself, take the device out of operation and protect it against being returned to operation.
- If there is any reason to assume that the instrument can no longer be operated without a risk, it must be set aside and appropriately marked to prevent further use.
- The safety of the user may be endangered if:
Oxygen Analyzer

- the instrument is visibly damaged,
- no longer operates as specified,
- has been stored under adverse conditions for a lengthy period of time,
- has been damaged in transport.

• If there is any doubt as to the working condition of the analyzer, return the instrument to SpectraSensors for repair and maintenance.
• The operator of this measuring instrument must ensure that the following laws and guidelines are observed when using dangerous substances:
  - National protective labor legislation,
  - safety regulations for accident prevention,
  - safety data sheets from the chemical manufacturer.

The OXY4400 transmitter assembly is not for use in atmospheres containing an oxygen concentration greater than 50% by volume.

Getting Familiar with the Analyzer

Figure 1–5 shows a sample OXY4400 analyzer from a front view. Signal wiring and analyzer power are connected from the right side of the analyzer (facing the unit). On the front panel of the analyzer, the LCD serves as the user interface to the analyzer. The analyzer control electronics drive the sensor, collect the signal and provide measurement output signals.

The sample conditioning system (SCS) contains flow devices for the bypass loop and to control the flow to the oxygen sensor. A pressure reducing device is also installed to reduce the pressure of the sample going to the oxygen sensor. Depending on the application and/or ambient conditions, the SCS may also contain a heater and thermostat to maintain the interior of the enclosure at a constant temperature. Refer to Appendix A for specifications and system drawings.
**Introduction**

**Required Basic Equipment**

The following are the basic requirements for installing and operating the OXY4400:

- OXY4400 oxygen instrument
- Flow-through Tee fitting with probe
- PC / Laptop (optional). Refer to “PC Operations” on page 5-1.
- RS-232 cable (optional)
2 - INSTALLATION

This section describes the processes used to install and setup your OXY4400. Once the analyzer arrives, you should take a few minutes to examine the contents before installing the unit.

What Should be Included in the Shipping Box

The contents of the crates should include:

- The SpectraSensors OXY4400 analyzer
- A document CD, which includes this manual and other system documents
- One external serial cable
- Additional accessories or options as ordered

If any of these contents are missing, contact your sales representative.

Inspecting the Analyzer

Unpack and place the unit on a flat surface. Carefully inspect all enclosures for dents, dings, or general damage. Inspect the supply and return connections for damage, such as bent tubing. Report any damage to the carrier.

Avoid jolting the instrument by dropping it or banging it against a hard surface which may disturb the optical alignment.

Each analyzer is custom configured with various accessories and options. If there is any discrepancy, please contact your sales representative.

Installing the Analyzer

Installing the analyzer is relatively easy requiring only a few steps that, when carefully followed, will ensure proper mounting and connection. This section includes information regarding:

- Hardware and Tools for Installation
- Mounting the Analyzer
- Connecting Electrical Power to the Analyzer
- Connecting Electrical Power to the Enclosure Heater
- Connecting the Analog Outputs/Analog Inputs
- Connecting the Gas Lines
Hardware and Tools for Installation

Depending on the particular configuration of accessories and options ordered, you may need the following hardware and tools to complete the installation process.

**Hardware:**

- 3/8” Unistrut® (or equivalent) bolts and spring nuts
- Stainless steel tubing (SpectraSensors recommends using 1/4” O.D. x 0.035” wall thickness, seamless stainless steel tubing)
- 3/4” conduit
- Source of plant nitrogen gas (4 SCFH) for purge unit(s), if applicable
- 3/8” x 1-1/2” machine screws and nuts

**Tools:**

- Hand drill and bits
- Tape measure
- Level
- Pencil
- 9/16” socket wrench
- Screw driver
- 9/16” open-end wrench
- Needle-nose pliers
- Crescent wrench

**Mounting the Analyzer**

The OXY4400 analyzer is manufactured for wall or Unistrut® (or equivalent) metal framing installations. Depending on your application and configuration, the analyzer will come mounted on a plate or Unistrut frame. Refer to Appendix A for drawings with detailed mounting dimensions.

*When mounting the analyzer, be sure not to position the instrument so that it is difficult to operate adjacent devices. Allow 3 feet (1 m) of room in front of the analyzer and any switches.*

*It is critical to mount the analyzer so that the supply and return lines reach the supply and return connections on the chassis while still maintaining flexibility so that the sample lines are not under excessive stress.*
To mount the analyzer:

1. Select a suitable location to mount the analyzer. Choose a shaded area or use an optional analyzer hood (or equivalent) to minimize sun exposure.

   *SpectraSensors analyzers are designed for operation within the specified ambient temperature range. Intense sun exposure in some areas may cause the analyzer temperature to exceed the maximum.*

2. Locate the mounting holes on your unit.
3. For wall installations, mark the centers of the top mounting holes. Mounting dimensions are shown in Appendix A.
4. Drill the appropriate size holes for the screws you are using.
5. Hold the analyzer in place and fasten with the top screws.
6. Repeat for the bottom mounting holes.

Once all four screws are tightened the analyzer should be very secure and ready for the electrical connections.

**Connecting Electrical Power to the Analyzer**

Depending on your configuration, your analyzer will be configured for 120VAC/240VAC @ 50/60 Hz single-phase input, or optionally 24VDC input. Check the manufacturing data label or the terminal block labels to determine the power input requirements. All work must be performed by personnel qualified in electrical conduit installation. Conduit seals should be used where appropriate in compliance with local regulations.

*Hazardous voltage and risk of electric shock.* Before attaching the wiring to the analyzer, make sure all power to the wires is off.

*Careful consideration should be taken when grounding. Properly ground the unit by connecting ground leads to the grounding studs provided throughout the system that are labeled with the ground symbol ⚡.*

*Do not exceed the 24VDC power rating or electronics will be damaged.*

Depending on your configuration, the electrical wiring can be connected to the analyzer through an opening located at the right of the electronics enclosure (facing the front). Refer to Figure 1–5 on page 1–7.
Units with an enclosure heater in the sample conditioning system (SCS) will have an additional power connection through a conduit hub located at the bottom right of the heater enclosure (refer to Appendix A).

To connect electrical power to the analyzer:

1. Open the OXY4400 analyzer electronics enclosure door. Take care not to disturb the electrical assembly inside.

   **Hazardous voltage and risk of electric shock.** Failure to properly ground the analyzer may create a high-voltage shock hazard.

2. Run conduit from the power distribution panel to the conduit hub on the analyzer electronics enclosure labeled for power input.

   **Conduit seals should be used where appropriate in compliance with local regulations.**

   Because the breaker in the power distribution panel or switch will be the primary means of disconnecting the power from the analyzer, the power distribution panel should be located in close proximity to the equipment and within easy reach of the operator, or within 10 feet of the analyzer.

   **An approved switch or circuit breaker rated for 15 amps should be used and clearly marked as the disconnecting device for the analyzer.**

3. For AC systems, pull ground, neutral and hot wires into the electronics enclosure.

   For DC systems, pull ground, plus and minus wires.

4. Strip back the jacket and/or insulation of the wires just enough to connect to the power terminal block.

5. For single phase power connections, attach the neutral and hot wires to the power terminal block by connecting the neutral wire to the terminal marked “N” and the hot wire to the terminal marked “L.” Refer to Table 2–1.

6. For AC split phase systems, attach the two hot legs to the terminal block by connecting one of the hot wires to the terminal marked “L1” and the other hot wire to the terminal marked “L2.”

   For DC systems, connect the minus wire to the terminal marked “-,” and the positive wire to the terminal marked “+.” Refer to Table 2–1.

7. Connect the ground wire to the ground terminal marked .
8. Close and tighten the analyzer electronics enclosure door.

**Table 2–1  Terminal layout and description**

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<td>Connect the fiber optic oxygen cable to SMA connector located on the bottom of the OXY4400</td>
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<td>Wire to Power Supply</td>
<td>Line adaptor for power supply</td>
<td>110/220 VAC power supply</td>
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<td>9-24 VDC supply</td>
<td>9-24 VDC supply</td>
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<tr>
<td>TxD (23), RxD (24), Gnd (22)</td>
<td>RS-232 interface</td>
<td>Connect the device with a RS-232 data cable to the PC/Laptop here (optional)</td>
</tr>
<tr>
<td>Ch1 +10/-7, Ch2 -13/-14</td>
<td>Analog out/input (channel 1/2)</td>
<td>Voltage output (0-10 V) from terminal board to external recording device or DCS system</td>
</tr>
<tr>
<td>Ch1 +19/-17, Ch2 -18/-20</td>
<td>Analog out (channel 1/2)</td>
<td>Current output (4-20 mA) from terminal board to external recording device or DCS system. <strong>NOTE:</strong> This is a powered output.</td>
</tr>
</tbody>
</table>

**Connecting Electrical Power to the Enclosure Heater**

Analyzers configured with an optional sample conditioning system (SCS) in a heated enclosure will have an additional power connection for the heater through a conduit hub located at the lower right of the enclosure. Refer to Figure A–7 on page A–10.

**To connect electrical power to the enclosure heater:**

1. Open the heated enclosure door. Take care not to disturb anything inside.
2. Open the power terminal box inside the heated enclosure.
3. Run conduit from the power distribution panel to the conduit hub on the lower right side of the heated enclosure labeled for power input.

Conduit seals should be used where appropriate in compliance with local regulations.

Because the breaker in the power distribution panel or switch will be the primary means of disconnecting the power from the analyzer, the power distribution panel or switch should be located in close proximity to the equipment and within easy reach of the operator.

An approved switch or circuit breaker rated for 15 amps should be used and clearly marked as the disconnecting device for the analyzer.

4. Pull ground, neutral and hot wires (#14 AWG minimum) into the power terminal box inside the heated enclosure.

5. Strip back the jacket and/or insulation of the wires just enough to connect to the power terminal block.

6. For AC systems, attach the neutral and hot wires to the power terminal by connecting the neutral wire to the terminal marked “N,” the hot wire to the terminal marked “L.”

7. Connect the ground wire to the ground terminal marked .

8. Close and latch the heated enclosure door.

Connecting the Analog Outputs/Analog Inputs

The OXY4400 is equipped with four independent analog outputs and two analog inputs. The 4–20 mA current loop and serial output are connected to a mating terminal block located inside the analyzer electronics enclosure. By default, the 4–20 mA current loop analog inputs (I1/I2) are set to inactive.

The analog outputs are programmable to oxygen temperature, phase shift or signal amplitude. To allow external data collection, two input ports are available (i.e., external pressure sensor).

Connections can be made with customer-supplied cables for the current loop and alarms and factory-supplied cable for the serial connection. Consult the wiring diagram in Figure A–1 on page A–4.

Certified glands and cables should be used where appropriate in compliance with local regulations.
To connect the analog outputs/analog inputs:

1. Disconnect power from the analyzer and open the electronics enclosure cover. Take care not to disturb the electrical assembly inside.

2. Run conduit from the analog outputs/inputs receiving station to the conduit hub in the right outside corner of the electronics enclosure.

3. Pull the customer-supplied cables for the source outputs and the SpectraSensors external serial cable (included in the shipping box) through the conduit into the electronics enclosure.

4. Strip back the jacket and insulation of the current loop output and serial cables just enough to connect to the mating terminal block.

5. Connect the 4-20 mA current loop I1/I2 output wires to the appropriate terminals, as indicated in Table 2–1 on page 2–5.

6. Connect the serial cable wires to the appropriate terminals according to Table 2–1. For reference, Table 2–1 also shows the corresponding pin numbers for configuring a nine-pin Sub-D connector for connection to a computer serial port.

7. To complete the connection, connect the other end of the current loop wires to a current loop receiver and the external serial cable to a serial port on your computer.

Connecting the Gas Lines

Once you have verified that the analyzer is wired correctly, you are ready to connect the sample supply, sample bypass and sample return lines. Consult the layout and flow diagrams in Appendix A for guidance on connections for a SpectraSensors provided sample conditioning system (SCS). All work must be performed by qualified technicians.

Process samples may contain hazardous material in potentially flammable and/or toxic concentrations. Personnel should have a thorough knowledge and understanding of the physical properties and safety precautions for the sample contents before installing the sample conditioning system (SCS).

SpectraSensors recommends using 1/4” O.D x 0.035” wall thickness, seamless stainless steel tubing.
To connect the sample supply line:

1. Install sample supply line to the inlet on the SCS panel. Refer to Appendix A.

   All valves, regulators, switches, etc. should be operated in accordance with site lock-out/tag-out procedures.

2. Adjust the pressure regulator to 8 PSIG. Refer to drawings in Appendix A for recommended settings.

3. Adjust flowmeter to 1 SLPM. Refer to drawings in Appendix A for recommended settings.

4. Tighten all input/output fittings 1-1/4 turns with a wrench from finger tight.


   Do not exceed 20 PSIG to sample conditioning system. Damage to the oxygen sensor may result.

To connect the sample bypass/sample return:

1. Confirm that the atmospheric vent header shut-off valve is closed.

   All valves, regulators, switches, etc. should be operated in accordance with site lock-out/tag-out procedures.

2. Determine appropriate tubing route from the SCS to the atmospheric vent header.

3. Run stainless steel tubing from the bypass/sample return port to the atmospheric vent header connection. Bend tubing using industrial grade benders, check tubing fit to ensure proper seating between the tubing and fittings. Fully ream all tubing ends. Blow out the lines for 10–15 seconds with clean, dry nitrogen or air prior to making the connection.

4. Connect the sample return tube to the SCS using the 1/4” stainless steel compression-type fitting provided.

5. Tighten all new fittings 1-1/4 turns with a wrench from finger tight. Secure tubing to appropriate structural supports as required.

\[\text{Do not exceed 20 PSIG to the sample conditioning system. Damage to the oxygen sensor may result.}\]

**Installing the Temperature (RTD) Probe**

Most configurations include an installed RTD (Resistance Temperature Device) probe. If the OXY4400 is provided without an accompanying sample conditioning system (SCS), use the following procedure to connect the RTD probe to the SCS.

*No other temperature sensor than the one supplied with the unit or ordered from the factory should be used. Refer to “Spare Parts” on page A-13. The use of any other temperature sensor can affect the oxygen compensation and can even damage the oxygen meter.*

1. With power disconnected to the analyzer, insert the cable end of the RTD probe into the lower right opening on the side of the analyzer or the opening at the base of the analyzer, depending on your configuration. Refer to Figure 1–5 on page 1–7.

2. The RTD probe will either contain (2) red wires and (1) white wire, or (2) black wires and (1) red wire. Twist together the (2) red or black wires and connect to terminal 6.

3. Connect the (1) white or red wire and connect to terminal 5. Refer to Figure 2–1.

![RTD probe terminal connection](image)
4. Insert the opposite end of the probe into the RTD probe inlet on the SCS panel. The final installation is reflected in Figure 2–2.

![RTD probe installed](Image)

**Figure 2–2** RTD probe installed

## Installing the Oxygen Probe

If the OXY4400 is provided without an accompanying sample conditioning systems (SCS), use the following procedure to connect the oxygen probe to the SCS. Analyzers provided with an accompanying SCS will have this probe already installed.

*Handle the probe with care and do not remove the cap before installation. Improper handling can cause damage to the oxygen probe.*

1. Verify that power is disconnected to the analyzer.
2. Remove the new oxygen probe cable from the package.

*Refer to "Spare Parts" on page A-13 for a complete list of replaceable probe parts and part numbers.*
3. Carefully remove the protective plunger from the end of the probe taking care not to touch the optical fiber tip. Refer to Figure 2–3.

![Warning: Touching the optical fiber tip will cause damage to the probe.]

4. Insert the probe tip into the analyzer opening at the base of the unit. Refer to Figure 2–4.

![Warning: Take care not to bump the probe tip against the sides of the opening or damage will occur.]
5. Secure the probe nut with needle nose pliers by turning clockwise.

Verify that the probe is fully inserted while tightening the probe nut or the analyzer may provide a faulty reading.

6. Hand-tighten the strain relief holder to the analyzer unit.

7. Using a crescent wrench, complete tightening until the probe is secured.

Do not overtighten or the plastic strain relief holder may crack.
8. Insert the opposite end of the probe into the OXY probe inlet on the SCS panel following the diagram below.

The final installation is reflected in Figure 2–5.

Figure 2–5 Oxygen probe installed
Connecting the Calibration Gas (Optional)

For systems with a manual calibration port, an appropriate calibration gas source will need to be connected to the SCS. For more information, refer to the drawings in Appendix A.

Conditioning the SCS Tubing

Newly installed systems invariably have some trace contaminants and/or are intended for measuring trace amounts of gas constituents that tend to cling to system walls resulting in erroneous readings if the constituents are not in equilibrium with the system walls. Therefore, once the analyzer and SCS are completely connected, the entire system (i.e., from the sample source valve to the vent or return) should be conditioned by flowing sample gas through the system for up to 12 hours (or until reading stabilizes) after the system is powered up and before actual readings are taken. Progress of the system conditioning can be monitored via the gas concentration readings. Once the gas constituents have reached equilibrium with the system walls, the readings should stabilize.
3 - Sample Conditioning System (SCS) Operation

Personnel should have a thorough understanding of the procedures presented here before operating the sample conditioning system.

The process sample at the sample tap may be at a high pressure. Make sure that the field pressure reducing regulator is equipped with an appropriate pressure relief valve. Use extreme caution when operating the sample probe isolation valve and field pressure reducing regulator.

Each SCS has been specifically designed to deliver a sample stream to the analyzer that is representative of the process stream at the time of sampling. Refer to Appendix A for configuration drawings. To ensure the integrity of the sample stream and its analysis, care must be taken to install and operate the SCS properly. Therefore, any personnel intending to operate or service the SCS should have a thorough understanding of the process application and the design of the SCS.

Most problems experienced with sample systems tend to result from operating the system differently than intended. In some cases, the actual process conditions may be different than originally specified (e.g., flow rates, presence of contaminants, particulates, or condensables that may only exist under upset conditions). By establishing understanding of the application and the design of the system, most issues can be avoided altogether or easily diagnosed and corrected ensuring successful normal operation.

If there are any remaining questions concerning the design, operation, or maintenance of the SCS, contact “Customer Service” on page B-7.

About the SCS

For a typical full-featured SCS, refer to Figure A–1, sample gas enters the sample conditioning unit [at the specified supply pressure set by a customer-supplied upstream regulator] via the sample supply port, passes through a shut-off valve, pressure regulator that maintains constant pressure in the measurement cell, and membrane separator where any liquid in the stream is removed. Liquid removed by the membrane separator passes through the bypass loop and collects in a filter housing. A continuous flow (set to the specified level by a metering valve and flowmeter) not only flushes the liquid from the membrane separator but also maintains flow through the sample lines, which reduces sample variation.

The flow exiting the bypass loop should be vented to a safe location.
Checking the SCS Installation

Before operating the system for the first time, a careful check of the installation of the entire SCS from the sample probe to the vent is recommended.

To perform SCS installation checks:

1. Confirm that the sample probe is correctly installed at the process supply tap and that the sample probe isolation valve is closed.
2. Confirm that the field pressure reducing station is installed properly at the sample probe.
3. Confirm that the relief valve at the field pressure reducing station has been set to the specified setpoint.
4. Confirm that all valves are closed.
5. Confirm that the atmospheric vent is properly connected.
6. Confirm that the analyzer house atmospheric vent is properly installed, if applicable.
7. Confirm that all sample system tubing has been thoroughly leak checked.

Starting up the SCS

After the SCS installation has been thoroughly checked, you are ready to begin preparing for initial SCS startup.

To prepare for SCS startup:

8. If applicable, confirm proper heating of the sample supply tubing.
9. Confirm that all sample system shut-off valves are closed.
10. Confirm that the sample bypass and analyzer flowmeter control valves are gently closed (adjustment knob turned clockwise).

\[ \text{Do not overtighten the control valves or damage could occur.} \]

To start up the sample bypass stream on process sample:

1. Open the atmospheric vent header shut-off valve for the sample bypass effluent from the SCS, if applicable.
2. Open the sample supply port shut-off valve and slowly open the pressure regulator (turning knob clockwise).
3. Set the inlet pressure regulator on the panel to a setting that will maintain the specified flowmeter settings and provide good control using the analyzer and bypass flow control valves.

4. Open the bypass flowmeter control valve to establish sample flow from the sample probe and set the flowmeter to the specified value.

Do not exceed 10 PSIG at any time in the cell.

To start up the analyzer on process sample:

1. Open the sample flowmeter control valve to approximately the specified flow.

2. Adjust the sample flowmeter control valve to the specified flow.

The adjustment setpoints of the analyzer flowmeter and pressure regulator will be interactive and may require multiple adjustments until the final setpoints are obtained.

The analyzer system has been designed for the sample flow rate specified. A lower than specified sample flow rate may adversely affect analyzer performance. If you are unable to attain the specified sample flow rate, contact your factory sales representative.

3. Confirm the sample flow and pressure setpoints and readjust the control valves and pressure regulator to the specified setpoints, if necessary.

4. Confirm the sample bypass flow and readjust the bypass control valve to the specified setpoint, if necessary. The SCS is now operating with the process sample.

5. Power up the analyzer according to the procedure given in the analyzer operator’s manual.

Shutting Down the SCS

The process sample at the sample tap is at a high pressure. A pressure reducing regulator is located at the sample tap to reduce the sample pressure and enable operation of the SCS at a low pressure. Use extreme caution when operating the sample probe isolation valve.
1. Close the sample supply shut-off valve.

2. Allow the sample to flow until all residual gas has dissipated from the lines as indicated by no flow on the sample and sample bypass flowmeters.

3. Close the atmospheric vent header shut-off valve for the combined sample bypass and measurement cell effluent from the SCS.
4 - CONFIGURATION

The instructions provided in this chapter should be used to start-up and configure the OXY4400. On the face of the analyzer is an LCD with programming and data readouts. Refer to Figure 1–5.

Powering up the Instrument

Before powering up the OXY4400, refer to Appendix A, Specifications, to confirm the proper power connections to the power supply, temperature sensor and oxygen sensor. After power has been connected, power on the OXY4400 by pressing the POWER button to the far right below the LCD. Refer to Figure 4–1. The instrument will power up and begin to measure with the settings of the last readings.

To achieve a highest accuracy, the OXY4400 should be warmed up for approximately five minutes before taking a measurement.

Warm-up time may be extended up to 15 minutes if the optode has been exposed to high concentrations of oxygen.

Press the VIEW button (second from the left) to select one of two different display options. Refer to Figure 4–2 for a view of the main display and Figure 4–3 for the alternate display view.
Menu Selection

Operation and maintenance of the OXY4400 is controlled using the built-in menu structure. Press the MENU button to the far left under the LCD to enter the main menu. Refer to Figure 4–1. Use the up and down arrow buttons located under the display to select the desired menu item. Refer to Figure 4–4 to change the settings on the analyzer. Use the BACK button to move back to the previous menu item.
Pre-Calibration Procedure

Before starting the measurement, perform the standard pre-calibration procedure.

1. Set the flow to 1.5 SLPM on the analyzer with a N2 bottle.
2. Set the pressure as specified.
3. Select Menu/Measurement/Temperature to verify that the temperature compensation is set to PT1000 (RTD probe).
4. Adjust the sensor type based on the sensor specified for the unit. Follow the instructions for "Sensor Type" below.
5. Select Menu/Measurement/Oxygen Unit and set accordingly.
6. Allow 99.99% pure N2 flow through the system for 30 minutes to purge the system.

Sensor Type

The OXY4400 has been pre-programmed for the BOS3 sensor (0-1000 ppm). If a different measurement range is required, the sensor type will need to be adjusted. To set or change the sensor type, use the following steps.

1. Press the MENU button followed by the CALIBRATION button.
2. Scroll through the Calibration menu using the up and down arrow buttons until the ‘Sensor type’ option displays as shown below.
3. Press the ENTER button to change the sensor. The SENSOR SELECTION screen displays with the current setting.

4. Press the BACK button if the correct sensor is already adjusted.
5. Press the EDIT button to change the sensor type. Use the up/down arrows to select the correct sensor type.
6. Press ENTER to confirm the sensor type. The following sensor types are available.

- **BOS1**: Measurement range: 0-5% oxygen  
  Limit of detection: 0.03%

- **BOS2**: Measurement range: 0-50% oxygen  
  Limit of detection: 25 ppm

- **BOS3**: Measurement range: 0-300 ppm (1000 ppm maximum  
  Limit of detection: 0.5 ppm

**Sensor Constants**

After adjusting the analyzer to the correct sensor type (BOS1, BOS2, BOS3), confirm the sensor constants.

1. Press the MENU button followed by the CALIBRATION button.
2. Scroll through the Calibration menu using the up and down arrow buttons until the ‘Sensor const.’ option displays.
3. Press the ENTER button to confirm. The ‘Sensor Constants BOSx’ and the corresponding sensor constants screen displays (BOS3 is shown in the example below).

Verify that the correct sensor type was adjusted. Refer to “Pre-Calibration Procedure” on page 4-3.

The sensor constants can be located on the calibration report that was provided with the analyzer. If sensor constants are not provided on the calibration report, use the default values shown in Table 4–1.
Table 4–1 Default sensor constants

<table>
<thead>
<tr>
<th></th>
<th>f1</th>
<th>KSV</th>
<th>delta Phi</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOS3</td>
<td>0.786</td>
<td>0</td>
<td>-0.02400</td>
<td>15.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOS1</td>
<td>0.869</td>
<td>0.00877</td>
<td>-0.03796</td>
<td>28.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOS2</td>
<td>0.808</td>
<td>0.000433</td>
<td>0.0803</td>
<td>29.87</td>
</tr>
</tbody>
</table>

4. Press the EDIT button to enter new sensor constants.

Measurement

System measurements can be adjusted using the LCD and keypad. Under this menu it is possible to adjust the sampling rate, temperature, pressure, sensor protection, signal averaging, oxygen unit and signal intensity.

Sampling Rate

Use the following steps to change the sampling rate:

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Adjust the sampling rate using the up/down arrow buttons to select the unit.
4. Press ENTER.

Temperature

To change the temperature compensation, use the following steps:

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Select one of the following modes:
   - **PT1000**: The temperature compensation has a temperature sensor connected.
• **Manual**: This setting allows the manual input of a constant temperature. Use the up/down arrow buttons to select the desired temperature and confirm by pressing the ENTER button.

• **External**: This allows the user to enter the temperature signal by analog inputs. In the analog input channels are already configured (see Analog Inputs), the user can activate the temperature compensation by mean of externally.

4. Press ENTER.

**Sensor Protect**

To adjust the sensor operating temperature range, follow the steps below:

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Change the oxygen unit displayed by pressing the up/down arrows to select the desired unit
4. Confirm by pressing ENTER.

**Signal Averaging**

Adjust the signal averaging using the following steps:

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Select one of the following modes:
   - **Auto**: The instrument selects the best setting (default).
   - **Manual**: The higher the running average, the longer the sampling time that is used for averaging. The higher the running average is set, the smoother the measurement signal.
4. Press EDIT.

**Oxygen Unit**

This procedure is used to change the oxygen units.

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Change the oxygen unit displayed by pressing the up/down arrows to select the desired unit.
4. Confirm by pressing ENTER.

Signal Intensity

Use this procedure to adjust the signal LED intensity.

1. From the Main menu, press Measurement and ENTER.
2. Press EDIT.
3. Changes are made by pressing the up/down arrows to adjust the settings. Values between 10 and 100% are possible.
4. Press SET to confirm the settings.

The calibration will not be valid after changing the Sig. Intensity parameter.

Calibration

The following procedure is the same for all sensor types and ranges. The sensor type must be set during the initial configuration of the unit and only modified if a different range sensor is installed in the field.

For accurate measurements of oxygen in the Natural Gas stream, SpectraSensors recommends completing a calibration on the unit upon installation and verify at least every three months.

The OXY4400 uses a two-point calibration, zero and span. The zero calibration point should always be performed using a zero grade of nitrogen comparable to the range of measurement. For ppm oxygen measurement, a minimum of 99.999% pure or oxygen-free nitrogen should be used. The span calibration point should be an oxygen/nitrogen mixture with a concentration of 80-100% of the measuring range and greater than the expected normal concentration (i.e., 100ppm full-scale oxygen measurement, span calibration 80-100ppm).
To enter the Calibration menu from the Main menu, press MENU then select Calibration. Refer to Figure 4–5 for the Calibration menu options.

**Calibration menu**

- **Status**
- **Calibrate**
- **Sensor Type**
- **Sensor Const.**

**Figure 4–5 Calibration menu**

**Status**

This sub-menu displays the settings of the last calibration. Press any button to return to the Main menu.

**Calibrate**

Use this sub-menu to select the calibration mode. Refer to the image below.

![Calibration menu](image)

- **Temperature ON**: Calibration with the actual temperature reading (either PT1000 [RTD probe], external or manual, which is defined under “Temperature” on page 4-6). This is the preferred method of calibration.
The oxygen reading is affected by temperature. If the temperature of the gas is not considered, then accuracy can be affected.

- **Temperature OFF:** Calibration is completed without a temperature sensor, but with manual input. Use this method if a PT1000 probe is not connected to the unit, or if the temperature is different than the active measured temperature.

- **Manual:** Manual input of phase and temperature values. A manual calibration can be used to reset the unit to a previous calibration or when replacing a sensor. Phase angles and temperature **MUST** be known if using this option.

**Calibration of the oxygen sensor with Temperature compensation (Preferred Method)**

1. From the Calibration menu, select TEMPERATURE ON.

2. Set the calibration pressure.
   The luminescence detection method for oxygen can be used for liquid or gas streams. When the unit is measuring dissolved oxygen in a liquid, the barometric pressure must be considered during calibration. Gaseous streams are virtually unaffected by barometric pressure, so no adjustment needs to be made to this value.

3. Press the SET button to continue. The following screen displays.

4. Adjust the concentration of the second calibration gas using the -/+ buttons to match the value of the calibration mixture.

   Calibration can be in the range between 10 and 300 ppm.
5. Press the SET button to confirm. The following screen display shows an example of what is viewed for BOS3 sensor type.

![Screen Display Example](image)

The screen display will vary depending on the sensor type selected.

- BOS1 shows percent of air saturation (% a.s.)
- BOS2 will not have this screen display.

6. Insert the sensor into the CAL0 solution when the following screen displays.

![Sensor Insertion Reminder](image)

7. Connect the nitrogen (99.99%) calibration test gas to the Calibration inlet port on the sample system panel. Ensure that the flow is set to 1.5 l/min.

8. Select OK.

![Warning]

*Take care not to create an overpressure and ensure that no traces of oxygen can diffuse into your measuring system.*

9. For the first calibration point, wait approximately three minutes until the phase angle and temperature are constant. The variation of the phase angle and the temperature should be smaller than ±0.1° and ±0.1°C.
10. Press the STORE button shown in the screen below.

If the sensor has been exposed to high levels of oxygen (open to atmosphere for BOS3 [ppm] probe). It may take up to 15 minutes to reach a stable value.

11. Insert the sensor into the CAL2nd solution when the screen below displays.

a. Turn off the zero calibration gas and disconnect from the sample system.

b. Connect the “Span” calibration test gas (80-100% of range oxygen) and confirm 1.5 l/min. of flow to start the second calibration point.

Take care not to create an overpressure or contaminate the calibration chamber with air.

12. For the second calibration point, wait approximately three minutes until the phase angle and temperature are constant. The variation of
the phase angle and the temperature should be smaller than ±0.1° and ±0.1°C.

13. Press the STORE button as shown in the screen display below.

![Screen display showing calibration points](image)

The calibration is now complete.

14. Turn off the regulator, disconnect the calibration gases, switch the sample system back to the sample position and begin the online measurement. The following screens will display.

![Screen display showing wait and done](image)

15. Press the BACK button twice to return to the Main Menu display to view the gas readings.

**Calibration of the oxygen sensor without Temperature compensation**

The procedure for calibration without Temperature compensation is very similar to the process described above. Reference the procedure above with the following exceptions.

1. From the Calibration menu, select Temperature OFF. Refer to the image below.

![Calibration menu image](image)
2. Adjust the temperature (in °C) of the calibration standards and confirm it by pressing the SET button.

3. Follow the remaining steps from the “Calibration of the oxygen sensor with Temperature compensation (Preferred Method)” on page 4-11.

Calibration of the oxygen sensor with Manual Temperature compensation

• Manual Calibration
  User-defined calibration should be applied if there is no possibility for adjusting the second calibration value via calibration test gas or if recalibration of the sensor is not desired. SpectraSensors delivers a calibration report with each oxygen analyzer that provides two calibration values, which can be entered into the user-defined calibration mode.

1. From the Calibration menu, select Manual.

2. Adjust the Cal0 phase angle.

3. Adjust the concentration of the 2nd calibration gas in parts per million (ppm)

4. Confirm by pressing the SET button. The following screen display shows an example of what is viewed for BOS3 sensor type.

The screen display will vary depending on the sensor type selected.

• BOS1 shows percent of air saturation (% a.s.)

• BOS2 will not have this screen display.
5. Adjust the second calibration phase angle using the -/+ arrow buttons. A sample display is shown below.

6. Adjust the temperature for the Cal0 calibration value using the -/+ arrow buttons and confirm by pressing the SET button.

7. Adjust the temperature for the second calibration value using the -/+ arrow buttons and confirm by pressing the SET button.
8. To finish the manual calibration, adjust the atmospheric pressure using the -/+ arrow buttons and confirm by pressing the SET button.

**Data Logging**

By default, the data logger is turned off. To start data logging, select Data Logging from the Main menu and START.

To stop the recording, select Data Logging and STOP.

The data logger status is available in Data Logging and Status, and shows details such as starting time and date, sampling rate, saved records and free memory space. The maximum recording time possible depends on the selected sampling rate. This is shown on the display after selecting START.

> During the recording (Data Logger activated), other functions cannot be selected from the Main menu.

It is possible to turn off and restart the oxygen instrument with the Data Logger still activated. The data recording will continue immediately after the restart.

> When the data logging function is stopped and restarted, the previous records are overwritten.

Stored records can be uploaded with the OXY4400 software that is supplied with the analyzer. For information on operating Data Logger through a PC terminal, refer to “PC Operations” on page 5-1.
Configuration

Using the display panel on the front of the analyzer, press Menu from the Main menu and Configuration to access the Configuration menu. From this menu, most of the instrument parameters can be set. Refer to Figure 3-6.

Status

The status function displays the main settings of the instrument. Press any button to return to the Main menu.

Analog Out

From this menu, the user can choose which data are exported via the analog outputs. The OXY4400 has two voltage outputs (U1, U2) and two current output channels (I1, I2). The desired data sources (oxygen, temperature, amplitude or phase) can be selected via the dialog box. All four output channels work independently of one another and are programmable. Refer to Figure 3-7.

Figure 4–6 Configuration menu
### Analog Out

- **Voltage U1/U2**: Select the parameter to activate as a voltage analog output for port 1 and port 2 using the up/down arrow buttons. The following output selections are available:
  - Inactive
  - Oxygen
  - Temperature
  - Phase
  - Amplitude

- **Current I1/I2**: Select the parameter to activate as a current mA analog output for port 1 and port 2 using the up/down arrow buttons. The following selections are available:
  - Inactive
  - Oxygen
  - Temperature
  - Phase
  - Amplitude

- **20 mA/10V value**: Use this parameter to program the correlation of the 10V/20 mA to the exported value.

*If 10V is set to 100% air-saturation (20.95% v/v), then 1V corresponds to 10% air-saturation; i.e., if 10V is set to 200 ppm gaseous oxygen, then 1V corresponds to 20 ppm.*
Use the following procedure to configure the 4-20 mA.

1. From the Configuration menu, press Analog Output.
2. Select Current I1.
3. Press ENTER.
4. Press EDIT.
5. Choose the measurement; Inactive, Oxygen, Temperature, Phase or Amplitude.
6. Press ENTER.
7. Select Current I2.
8. Select 20mA/10V Value.
9. Press ENTER.
10. Press EDIT.
11. Press the +/- buttons to select the applicable 4-20 mA range.
12. Press SET.

**Analog In**

At this parameter the user can select the data that is imported via the analog inputs. The OXY4400 has two voltage input channels. The desired data source for temperature and optionally for pressure can be selected via the dialog box.

The purpose of the input channels is to compensate the oxygen value with externally measured temperature or pressure (for liquid measurements only). It is useful for a measurement set-up that originally integrated temperature and/or pressure sensor. The user has the ability to export the analog data from the external sensor into the OXY4400 via input channels. In order to initialize the input channels correctly, a proper measurement range must be set. Once set, the input voltage is used for oxygen calculation correction.

“**Higher value**” is the input voltage upper limit and is equal to 10V for the OXY4400. For example, if the input signal of 10V corresponds to a temperature of 60° C, set the value in the “higher value” control window to 60.

“**Lower value**” is the input voltage lower limit and is equal to 0V for the OXY4400. For example, if the input signal of 0V corresponds to a temperature of 10° C, set the value in the “lower value” control window to 10.

- **Example 1**: Using the values given in the first note for the “higher value” above, the temperature correction upon the input voltage is:

  By input voltage = 5V, the imported temperature is 35° C
  By input voltage = 7.5V, the imported temperature is 47.5° C
**Example 2**: Suppose that the input voltage of 0V is equal to 500hPa, and 10V is equal to 2000hPa.

By input voltage = 3.5V, the imported pressure is 1025hPa
By input voltage = 5V, the imported pressure is 1250hPa
By input voltage = 7.5V, the imported pressure is 1625hPa

**Clock/Date**

Use the “+” and NEXT button to adjust the clock and date information. Complete the change by pressing the SET button.

**Display**

Changes the backlight illumination of the display. The ‘Auto’ function turns on the illumination after pressing any button, and after a few seconds switches it back off.

**Reset Config.**

Sets all parameters defined in this sub-menu to default.

**Diag & Test**

This menu enables the user to test the analog in and out ports. From the Main menu, select Menu followed by Diag & Test. Refer to Figure 3-8 for options of the Diag & Test menu.

![Diagnostics and Test](image-url)

*Figure 4–8  Diagnostic and test menu*
System
This menu displays the most important information of the instrument. Press any key to return to the Main menu.

Outputs
Select the channel to be tested using the up/down arrow buttons. Confirm the selection by pressing ENTER. Adjust the test output value and check the value with the external data logger or voltmeter.

Inputs
Select the channel to be tested using the up/down arrow buttons. Confirm the selection by pressing ENTER. The actual reading of the channel is displayed based on the input value.
The OXY4400 PC software is compatible with the following operating systems:

- Windows 98
- Windows 2000
- Windows Millennium
- Windows NT 4.0
- Windows XP
- Vista
- Windows 7

### Installing the Software

The software will be provided with the system on CD.

1. Insert the supplied CD into the respective drive.
2. Copy the software file (*.exe) onto your hard drive.

   The executable file may also be copied as a link (icon) on the desktop.

3. Connect the OXY4400 via the supplied serial cable to a serial port on the computer.
4. Secure the cable and connect the cable wire pins as follows:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Ground</td>
</tr>
<tr>
<td>23</td>
<td>TxD</td>
</tr>
<tr>
<td>24</td>
<td>RxD</td>
</tr>
</tbody>
</table>

5. Apply power to the OXY4400.

   Close any open applications as they may interfere with the software.
6. Start the software by double-clicking on the *.exe file. The following window displays.

If the correct COM port is selected, this information window closes within a few seconds. If the wrong COM port is selected, the software will prompt for a change.

a. Left-click the mouse on the down arrow to the right of the field showing the COM port assignment.

b. Select the COM port.

c. Confirm setting and click the OK button. The window closes when the correct COM port is selected. The program launches.

Function and Description

The window shown in displays after launching the OXY4400 software. The program has four main areas:

- Menu bar
- Graphical window
- Status bar
- Control bar; divided into numerical display, control buttons and warning lights
Menu Bar

The following actions are available under the Menu bar.

<table>
<thead>
<tr>
<th>File</th>
<th>Charts</th>
<th>Display</th>
<th>Print</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>-&gt; Exit</td>
<td>-&gt; Oxygen</td>
<td>-&gt; Zoom</td>
<td>-&gt; Charts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-&gt; Phase</td>
<td>-&gt; Auto ScaleY1</td>
<td></td>
<td>-&gt; COM port</td>
</tr>
<tr>
<td></td>
<td>-&gt; Amplitude</td>
<td>-&gt; Undo Zoom</td>
<td></td>
<td>-&gt; Instrument Info</td>
</tr>
<tr>
<td></td>
<td>-&gt; Temperature</td>
<td>-&gt; Clear Charts</td>
<td></td>
<td>-&gt; Analog Output</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-&gt; Dimensions</td>
<td></td>
<td>-&gt; Analog Input</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-&gt; LED Intensity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-&gt; Sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BOS3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BOS1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BOS2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-&gt; Oxygen Unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>% air saturation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>% oxygen</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>hPa (mBar)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Torr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>μmol/L</td>
</tr>
</tbody>
</table>
Menu Bar Definitions

• File
  – Exit: Closes the program.

• Charts
  – Oxygen: Oxygen content in the selected unit.
  – Phase: Phase angle, raw data.
  – Amplitude: Magnitude of the sensor signal.
  – Temperature: Measured temperature.

• Display
  – Zoom/AutoScaleY: AutoScaleY1 is the default setting, which means the y-axis is scaled automatically.
  – Zoom/Undo Zoom: Original display is recovered. Also see Graphical display.
  – Clear Charts: Graphs shown on the display are cleared.
  – Dimensions: Used to adjust the number of measurement points (x/y). When used, the autoScaleY1 function is off.

• Print
  – Charts: Displayed charts can be printed.

• Settings
  – ComPort: The serial COM port (com1-com20) for the serial interface (RS-232) can be selected. COM 1 is the default. If the wrong COM port is selected, a pop-up window will display with instructions to select the correct COM port.
  – Instrument Info: Displays the software version and additional setting information for the instrument.

If a problem arises with the OXY4400 oxygen meter, refer to “Service Contact” on page B-7.
Control Bar

The actual content in the chosen unit is displayed in the oxygen field at the top left of the Main window (refer to Figure 5–1).

The actual temperature value of the sample is displayed in the Temperature window. If measurement is performed without temperature compensation, the manually entered temperature is displayed and that temperature measurement is shown offline. Refer to Figure 5–2.

![Control Bar Image](image)

*Figure 5–2* Control bar

Control Buttons

Located at the top center of the Main window (refer to Figure 5–1), the Control buttons provide the user access to the device functions.

To begin a system measurement, use the following procedure:

1. Calibrate the instrument with the Calibration Assistant.
2. Start the measurement with the Measurement Assistant.
3. Read-out Data Logger.

![Control Buttons Image](image)
Measurement Assistant

1. From the Main window (refer to Figure 5–1), click on the MEASUREMENT tab. The Measurement Assistant window opens, as shown in Figure 5–3.

![Measurement Assistant](image)

**Figure 5–3 Measurement assistant**

2. Select the desired measurement mode in the drop-down menu of the Sampling field by clicking on the down-arrow. The choices range from 30 seconds to 60 minutes where a measurement point is recorded each hour. Selecting ‘Other’ allows the user to enter a sample time.

The sensor shelf life can be increased using a slower sampling rate since the effect of photo-bleaching is reduced. The illumination light is turned off between sampling. Another advantage of using a higher measuring mode is that huge amounts of data for long-time measurements can be avoided.
If the settings have not yet been entered, the following pop-up window displays:

The date of the last calibration displays in the window.

3. To measure with the last sensor calibration, click the CONTINUE button.

4. To perform a sensor measurement before calibration, click the NEW CALIBRATION button.

SpectraSensors strongly recommends performing a new sensor calibration to obtain reliable results.

5. Refer to “Calibration” on page 4-9 for calibration process instructions.

6. To exit from this menu, click on the CANCEL button.

**Calibration Assistant**

1. Click on the CALIBRATION tab and the Calibration Assistant window will open.

2. Refer to the section on “Pre-Calibration Procedure” on page 4-3 for calibration instructions.

**Data Logging**

Stored records can be uploaded with the supplied software by clicking on the DATA LOGGER tab. Refer to Figure 5–1.

1. After choosing the folder where the data will be stored (file location), click the SCAN button. The software will show the stored number of data and the estimated download time.

2. Click the YES button to start the download automatically after confirming the displayed details.
Settings

The following settings can be accessed from the Main menu at the top of the screen. Refer to Figure 5–1.

Instrument Info

1. From the menu bar at the top of the Main window, click SETTINGS and “Instrument Info”. The Instrument Info displays. Refer to Figure 5–4 for a sample system display.

![Figure 5–4 Instrument info display](image)

To revert to the graphical window, click on the MEASURE CHART button.

Analog Output

In this window, the type of data exported via the analog outputs is determined. The OXY4400 device has two voltage outputs and two current output channels. The desired data sources (oxygen, temperature, amplitude, phase) can be selected. All four output channels work independent of one another.

1. From the Main menu bar, click SETTINGS and “Analog Output”. The Analog Output Choice window displays. Refer to Figure 5–5.

2. Make the appropriate selection for each Voltage channel.
3. Enter the “Oxygen (Max Scale)”. This field provides an entry by the user for the correlation of the 10 V/20 mA value to the exported value. For example:

- if 10 V is set to 500% oxygen, then 1 V corresponds to 50%
- if 10 V is set to 200 ppm oxygen, then 1 V corresponds to 20 ppm

4. When complete, click the OK button.

**Analog Input**

Use these fields to select the data that is imported via the analog inputs. The OXY4400 device has two voltage input channels. The desired data sources temperature and pressure (*option) can be chosen via the dialog box.

1. From the menu bar at the top of the Main window, click SETTINGS and "Analog Input". The Analog Input Configuration window displays. Refer to Figure 5–6.

![Figure 5–5 Analog Output choice](image)
The amount of light illuminating the sensor spot can be adjusted with the current of the LED. Adjustments can be made automatically by selecting “Auto Adjust,” which adjusts the OXY4400 LED to the optimal LED current, or manually by selecting “Advanced”.

If the LED current is increased, the signal amplitude increases, since a higher light density illuminates the sensor spot.

**LED Intensity**

**Auto Adjust**

To make the adjustment of the LED intensity automatically, use the following procedure:

1. Verify that the oxygen sensor has been connected to the instrument.
2. From the menu bar on the Main window (Figure 5–1), click SETTINGS and “LED Intensity.”
3. Click the START AUTO ADJUST button.
4. The automatic adjustment of the LED intensity is completed when the Status window displays the message “Auto adjustment finished”.

5. Click the CLOSE button to confirm the settings.

**Advanced**

Use the following procedures to adjust the LED intensity manually.

1. Click the ‘Advanced’ tab for manual LED settings. Enter a value between 10 and 100%.

2. Click the CONFIRM button. The setting displays in the LED Intensity field.

   After changing the LED intensity, SpectraSensors recommends re-calibrating the oxygen micro-sensor.

   A warning window displays to prompt the user to re-calibrate the sensor.

3. Click on the CALIBRATION button to re-calibrate or the I WILL RECALIBRATE LATER button to bypass the operation.

4. Click the CLOSE button to complete the change.

   The amplitude of the oxygen sensor is increased by increasing the light intensity. This leads to smoother signals. However, increasing the light intensity can increase photo-bleaching, which decreases the shelf-life of the sensor.
Oxygen Analyzer

Oxygen Unit
This is used to adjust the desired oxygen unit.

1. From the Main menu bar, click SETTINGS and “Oxygen Unit.”
2. Click on the down-arrow to the right of the field to select the unit to be used.

Temperature compensated oxygen measurements
To measure with temperature compensation, use the following procedure:

1. Verify that the temperature sensor PT1000 (RTD probe) is connected to the OXY4400.
2. Click on the ON radio button in the Temperature Compensation fields of the Oxygen Unit window.

![Warning: The field for entering a measurement temperature will be disabled if this function is selected.]

3. Click the START button to begin measurement.

To measure without temperature compensation, follow the steps below:

1. Click on the OFF radio button in the Temperature Compensation fields of the Oxygen Unit window.
2. Manually enter the temperature during the measurement in the field.

![Warning: The temperature will be measured in degrees Celsius.]

3. Click the START button to begin measurement.

External Temperature Compensation
If the analog input channels are already configured (refer to “Analog Input” on page 5-9), the user can activate temperature compensation by externally importing the value. Here, channel 1 or 2 can be selected.

Before starting the external compensation, check the quality of the electrical signals. This can be done when the OXY4400 is NOT in PC mode. The input voltage can be controlled directly on the LCD by entering "Diag & Test/Analog In."
Logging Setup
To start the measurement without logging data, use the following procedure:

1. Click on the MEASURE radio button in the Logging Setup fields of the Oxygen Unit window.
2. Click on the START button.

To store the measurement data, follow the steps below:

1. Click on the MEASURE & LOG radio button in the Logging Setup fields of the Oxygen Unit window.
2. Click the CHOOSE FILE button. The Data File Selection pop-up window displays. Browse the folders to select the file location to store the data.
3. Select “.txt” for the file extension and create a file name.
4. Click the SAVE button to confirm the settings. The pop-up window closes.
5. In the Logging Setup field, enter a file description for the text file.
6. To begin the measurement, click the START button.

Stopping the Measurement
The measurement is ended by a left-click of the mouse on the STOP button in the Control Bar of the Main window.

Warning Lights
At the top right corner of the Main window (refer to Figure 5–1), the warning lights are viewable. These lights are defined as follows:

- **Amplitude:**
  - **Red**: Amplitude is too low, the sensor tip may be damaged or sensor cable may not be connected.
  - **Yellow**: Amplitude is critically low. Replacement of the sensor is recommended.
  - **Green**: Amplitude level is good.

- **Phase:**
  - **Red**: Phase angle is out of limits.
  - **Green**: Phase angle is in normal range.
Oxygen Analyzer

- **Ambient light:**
  - **Red** Background light (e.g., direct light, lamp) is too high. Decrease background light.
  - **Green** Ratio of sensor signal to false light is acceptable.

Click on the DISPLAY RAW VALUES button to display on the screen the data next to the warning lights.

**Graphical Display Window**

The respective sensor signal is displayed according to the selection of the four control radio buttons; oxygen, phase, amplitude and temperature (menu chart). The oxygen content is displayed in the chosen unit and the temperature is shown in degrees Celsius. The raw values (the phase angle in degrees and the sensor amplitude in mV) can also be displayed by clicking the DISPLAY RAW VALUES button.

**Zoom function**

1. Left-click and hold the mouse button, and drag from left to right to enlarge a certain area of the graphical window. The graphical window displays the selected data points and is not actualized with new data.

2. Left-click and hold the mouse button, and drag from right to left to recover the original display. The UNDO ZOOM button can also be clicked in the Display menu under Zoom.

**Status Bar**

Refer to the definitions below of the features on the status bar.

<table>
<thead>
<tr>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>start: 10:44:28</td>
<td>10:44:37</td>
</tr>
</tbody>
</table>

- **SW1**: Displays the serial port, which is used for communication of the OXY4400 device with the PC.
- **SW2**: Displays the file name in which the measurement data are stored. “No storage file selected” is displayed when no file was selected (no data storage).
- **SW3**: Displays the start time of the measurement.
- **SW4**: Displays the actual time.
# Appendix A: Specifications

## Table A-1  OXY4400 analyzer specifications

<table>
<thead>
<tr>
<th>Instrument OXY4400</th>
<th>Channels 1x optical channel (SMA connector), designed for mini-sensors 1x PT1000 connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (PT1000)</td>
<td>Range</td>
</tr>
<tr>
<td></td>
<td>0-50° C</td>
</tr>
<tr>
<td>Digital Interfaced</td>
<td>RS-232 interface with galvanic isolation (19200 Baud, Data-bits 8), (Tinned leads to SUB-D9 cable for RS-232 PC)</td>
</tr>
<tr>
<td>Analog Outputs</td>
<td>Four independent, programmable 12-bit analog I/O channels with galvanic isolation (2x voltage output 0-10 V, 2x current output 4-20mA)</td>
</tr>
<tr>
<td>Analog Inputs</td>
<td>Two independent, programmable 12-bit analog I/O channels with galvanic isolation (voltage input 0-10 V)</td>
</tr>
<tr>
<td>Analog Output (Temperature, PT1000)</td>
<td>0-50° C</td>
</tr>
<tr>
<td>Sample Flow Rate</td>
<td>1.5 slpm (0.05 scfm)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>120/240 VAC, 50/60 Hz 24 VDC/max 0.83 Amps at 24 VDC</td>
</tr>
</tbody>
</table>

## Software OxyView

- **Oxygen Units**: User selectable from oxygen saturation, ppm, %
- **Compatibility**: Windows 95/98/2000/Millennium/NT4.0/XP/Vista/Windows 7
- **Calibration**: Conventional two-point calibration in oxygen-free environment (nitrogen) and a second calibration value of 80-100% of range

## Environmental Conditions

- **Operating Temperature (°C)**: 0-50°
- **Storage Temperature (°C)**: -10 to 65°
- **Relative Humidity (%)**: up to 95%, non-condensing (IP 64)
- **Dimensions (not including sample conditioning system)**: 10"H x 8"W x 6"D (inches) 254 H x 203 W x 152 D (mm)
- **Weight (not including sample conditioning system)**: 2.2 (kg)

## Trace Oxygen Sensor Type

- **Measurement Range**: 0-300 ppm nominal (maximum range 1000 ppm)
- **Limit of Detection (LOD)**: 0.5 ppm
- **Resolution**: <10 ppm X.XX, >10 ppm XXXX.X ppm
- **Accuracy (20° C)**: 5% of the oxygen concentration
**Table A-1  Oxy4400 analyzer specifications (Continued)**

<table>
<thead>
<tr>
<th>Oxygen Sensor Type BOS3</th>
<th>Measurement Range</th>
<th>0-1000 ppmv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of Detection (LOD)</td>
<td>0.5 ppmv</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01%</td>
<td></td>
</tr>
<tr>
<td>Accuracy (20° C)</td>
<td>± 5% of Reading</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oxygen Sensor Type BOS2</th>
<th>Measurement Range</th>
<th>0-50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of Detection (LOD)</td>
<td>0.03%</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01%</td>
<td></td>
</tr>
<tr>
<td>Accuracy (20° C)</td>
<td>± 2% of Reading</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oxygen Sensor Type BOS2</th>
<th>Measurement Range</th>
<th>0-5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of Detection (LOD)</td>
<td>25 ppm</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01%</td>
<td></td>
</tr>
<tr>
<td>Accuracy (20° C)</td>
<td>± 3% of Reading</td>
<td></td>
</tr>
</tbody>
</table>

**Technical Notes**

- **Power**: OXY4400 is available in power from 80-253 VAC or 9-24 VDC. The OXY4400 can be powered by an external battery via connection directly to the terminal board. AC powered is wired directly to the power supply mounted to the back plate.

- **Analog Outputs**:

  *Hazardous voltage and risk of electric shock*. The analog outputs are not protected against any input voltage. Any voltage applied to the analog outputs can cause irreversible damage to the circuit.

- **RS-232 Interface**: The unit uses crossed interface cable. The use of anything other than the serial cable provided with the instrument can cause the unit’s malfunction.

- **Optical Output**: The SMA connector is high precision optical component. Please keep it dry and clean. Always use rubber cap to close the output when not in use.

- **Waterproof Enclosure**: The OXY4400 enclosure meets NEMA 4X standards. However, make sure that all cable plugs are installed in the enclosure cable grips if not used (Analog I/O). Care should be taken to avoid water ingress into the enclosure via the unused cable grips to cause device failure. OXY4400 has no internal dew fuse.
• **Approvals:** The OXY4400 has been approved for use in Hazardous locations by FM and tested according to the NEC standards for Class 1, Division 2, Groups A, B, C and D for use in the U.S. and Canada.

For a complete listing of new or updated certificates, please visit the product page at [www.spectrasensors.com](http://www.spectrasensors.com).
Figure A–1 Outline and mounting dimensions - panel mount
Figure A–2  Sample system schematic - panel mount
Figure A–3  Power and signal wiring diagram - panel mount
Figure A-4  Outline and mounting dimensions - Unheated enclosure mounted
**Figure A-5** Sample system schematic - Unheated enclosure mounted
Figure A–6  Power and signal wiring diagram - Unheated enclosure mounted
Figure A–7  Outline and mounting dimension - Heated enclosure mounted
Figure A–8  Sample system schematic - Heated enclosure mounted
Figure A–9  Power and signal wiring diagram - Unheated enclosure mounted
Spare Parts

Below is a list of spare parts for the Oxygen Analyzer analyzer with recommended quantities for 2 years of operation. Due to a policy of continuous improvement, parts and part numbers may change without notice. Not all parts listed are included on every analyzer. When ordering, please specify the system serial number to ensure that the correct parts are identified.

Table A–2  Replacement parts for OXY4400 analyzer

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>2 YR QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>3100002157</td>
<td>BOS3 Sensor Probe 0.7 meter</td>
<td>-</td>
</tr>
<tr>
<td>3100002156</td>
<td>BOS3 Sensor Probe 2.5 meter</td>
<td>-</td>
</tr>
<tr>
<td>3100002213</td>
<td>BOS2 Sensor Probe 0.7 meter</td>
<td>-</td>
</tr>
<tr>
<td>3100002201</td>
<td>BOS2 Sensor Probe 2.5 meter</td>
<td>-</td>
</tr>
<tr>
<td>3100002214</td>
<td>BOS1 Sensor Probe 0.7 meter</td>
<td>-</td>
</tr>
<tr>
<td>3100002177</td>
<td>BOS1 Sensor Probe 2.5 meter</td>
<td>-</td>
</tr>
<tr>
<td>0190217106</td>
<td>RS-232 Serial Data Cable</td>
<td>-</td>
</tr>
<tr>
<td>4000002042</td>
<td>Power Supply 100-240 VAC input 15 VDC output</td>
<td>-</td>
</tr>
<tr>
<td>6100002186</td>
<td>Filter Element, 7μm Swagelok SS-4F-K4-7</td>
<td>-</td>
</tr>
<tr>
<td>6134100274</td>
<td>Flowmeter w/ Valve 0-2 SLPM 1/4” NPTF (SS) King 74C123G081123810</td>
<td>-</td>
</tr>
<tr>
<td>6100002373</td>
<td>Flowmeter ARM, w/ Valve, 2.6 SLPM, 1/4” FNPT (SS) King 7101361003A</td>
<td>-</td>
</tr>
<tr>
<td>6101671208</td>
<td>Membrane Separator, 1/4” NPTF (SS) A+ Corp 120-005-SS</td>
<td>-</td>
</tr>
<tr>
<td>61016120X5</td>
<td>Membrane Replacement Filter A+ Corp 120-5X5</td>
<td>-</td>
</tr>
<tr>
<td>6101510004</td>
<td>Liquid Trap (Glass Filter Bowl) 1/4” NPTF (SS) UFS/Headline 117G</td>
<td>-</td>
</tr>
<tr>
<td>6101614001</td>
<td>Liquid Trap Filter Element UFS/Headline 12-32-70K</td>
<td>-</td>
</tr>
<tr>
<td>61322-10102</td>
<td>Pressure Regulator, 10psig, 18” NPTF (SS) GO CPR1-1A01A3C111</td>
<td>-</td>
</tr>
</tbody>
</table>
Table A-2  Replacement parts for OXY4400 analyzer (Continued)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>2 YR QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Sample Conditioning System (Continued)</strong></td>
<td></td>
</tr>
<tr>
<td>1400420310</td>
<td>Heater, Div. 1, 200W, 120 VAC Intertec CPA 200T3100-120V</td>
<td>-</td>
</tr>
<tr>
<td>5300000230</td>
<td>Thermostat, Div. 1, Preset 40° C Intertec AT-40/Z</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>11000002129</td>
<td>100 ppm O2 balance N2 Cal Gas Bottle 103 liters @ 1000 psi</td>
<td>-</td>
</tr>
<tr>
<td>11000002130</td>
<td>99.9999% N2 UHP Cal Gas Bottle 103 liters @ 1000 psi</td>
<td>-</td>
</tr>
<tr>
<td>11000002131</td>
<td>Regulator, Calibration Gas 1.5 LPM</td>
<td>-</td>
</tr>
<tr>
<td>49000002060</td>
<td>OXY4400 Operator’s Manual, additional copies</td>
<td>-</td>
</tr>
</tbody>
</table>
Appendix B: Troubleshooting

The OXY4400 is a maintenance-free instrument. The housing should be cleaned only with a moist cloth. Never use benzene, acetone, alcohol or other organic solvents. The SMA-fiber connector of the sensor can be cleaned only with a lint-free cloth. The sensor tip may be rinsed only with distilled water or ethanol.

Refer to Table B–1 for frequently asked questions related to troubleshooting the OXY4400 before contacting the service department. To contact the service department, refer to “Service Contact” on page B-7.

<table>
<thead>
<tr>
<th>Indication</th>
<th>Suspected Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sensor detected</td>
<td>Fiber optic cable is not con-</td>
<td>Make sure that the SMA connector is connected properly to the connector.</td>
</tr>
<tr>
<td></td>
<td>nected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oxygen sensor damaged</td>
<td>Check the amplitude (signal) of the sensor; it must read above 1500.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the flow to make sure that the line is not plugged, preventing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the sample from reaching the sensor.</td>
</tr>
<tr>
<td>Oxygen readings incorrect</td>
<td>Incorrect sensor selected</td>
<td>Check to make sure that the proper sensor is selected: BOS1, 0-5%;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BOS2, 0-50%; BOS3, 0-1000 ppm</td>
</tr>
<tr>
<td>Oxygen reading unstable</td>
<td>Oxygen sensor</td>
<td>Check for Low Amplitude (signal) to make sure that it is &gt;1500. Check</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for low or unstable flow on sensor.</td>
</tr>
<tr>
<td>Temp sensor not detected</td>
<td>PT1000 sensor (RTD probe)</td>
<td>Check to make sure that the temperature sensor is connected.</td>
</tr>
<tr>
<td>Out of range</td>
<td>Oxygen sensor</td>
<td>Sensor flow is blocked. Clear the sample line and reset flow to 1.0 LPM</td>
</tr>
<tr>
<td>Phase value too low</td>
<td>Oxygen sensor out of range</td>
<td>Check for blockage on the sample line and reset flow to 1.0 LPM</td>
</tr>
<tr>
<td>Unable to read oxygen</td>
<td>Current loop open</td>
<td>Connect current loop to recording or monitoring device.</td>
</tr>
</tbody>
</table>
Error Codes

The error value is binary coded. This means each bit corresponds to a specific error or warning. Refer to Table B–2 for a summary of error bits.

Table B–2  Error value definitions

<table>
<thead>
<tr>
<th>Error Value</th>
<th>Bit</th>
<th>Error Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
<td>Bit 7</td>
<td>System restart</td>
</tr>
<tr>
<td>128</td>
<td>Bit 6</td>
<td>Overheat</td>
</tr>
<tr>
<td>32</td>
<td>Bit 5</td>
<td>Current output 2 open loop error</td>
</tr>
<tr>
<td>16</td>
<td>Bit 4</td>
<td>Current output 1 open loop error</td>
</tr>
<tr>
<td>8</td>
<td>Bit 3</td>
<td>No temperature sensor</td>
</tr>
<tr>
<td>4</td>
<td>Bit 2</td>
<td>No oxygen sensor</td>
</tr>
<tr>
<td>2</td>
<td>Bit 1</td>
<td>Ambient light</td>
</tr>
<tr>
<td>1</td>
<td>Bit 0</td>
<td>ADC overflow</td>
</tr>
</tbody>
</table>

Decoding example

If the Error Value received from a device is 10, the error bits can be determined by using Table B–2 to locate the entry for a value less than or equal to the error value received. For example:

- \( 8 \leq 10 = \) No temperature sensor
  Subtract the error value and repeat the process.
  \( 10 - 8 = 2, \) “Ambient light”

In this example, Bit 1 (ambient light) and Bit 3 (no temperature sensor) are “1”. This error code would display if there was too much ambient light (sun illuminating the sensor) and the temperature sensor PT1000 is not connected to the device.

Recommendations for Correct Measurement

Calibration of the sensor is recommended before each new application. As an alternative, the calibration values of the last measurement can be used. If temperature compensation is not used, ensure that the temperature of the sample is known and is constant during measurement. With temperature compensated measurements, the temperature sensor PT1000 (RTD probe) should be positioned as close as possible to the oxygen mini-sensor to avoid temperature differences. Refer to the SpectraSensors website at www.spectrasensors.com for more information.
Troubleshooting

Signal Drifts due to Oxygen Gradients

It is important to remember that the sensor only measures the oxygen content near its surface. The formation of a bio-film during long-term measurements, or the accumulation of other sample components like oil or solid substances, may lead to an oxygen gradient.

Signal Drifts due to Temperature Gradients

A further source of imprecise measurement is insufficient temperature compensation. If temperature compensation is used, ensure that no temperature gradients exist between the oxygen sensor and the temperature sensors. If measurement is conducted without temperature compensation, bear in mind that the OXY4400 only measures correctly if the sample temperature is constant during measurement and the temperature is the same as the entry at the beginning of the measurement. If the temperature is measured with a precision of $\pm 0.2^\circ C$, there is a variation in the measuring value at 100% air-saturation of $\pm 0.7\%$ air-saturation. Select the measurement with the temperature compensation to minimize temperature gradients.

Signal Drift due to Photo-decomposition

The oxygen-sensitive material may be subject to photo-decomposition resulting in a signal drift. Photo-decomposition takes place only during illumination of the sensor tip and depends on the intensity of the excitation light. Therefore, the excitation light should be minimized. Continuous illumination of a BOS2 oxygen sensor over a period of 24 hours may lead to a phase drift of up to $+0.4\%$ air-saturation measured at 100% air-saturation at $20^\circ C$. However, this effect of photo-decomposition can even be minimized by changing the measuring mode to the 30-second or minute interval mode. In these modes, the software switches off the excitation light after recording the data point and switches it on after the interval chosen. Use the interval method whenever possible to increase the operational life of the sensor. Refer to Table B–3 below.

![Table B–3](image)

Signal Drift due to Too Much Ambient Light

A source of error is the detector overload due to too much ambient light. A detector overload can be recognized by the display of the red warning light
“Overload” that can be found on the Main window of the PC program. Refer to See “Warning Lights” on page 5-13.

The measurement will not be reliable if the “Overload” warning light displays red. A detector overload causes a decrease in both amplitude and phase angle.

The sensor should be shielded from ambient light to obtain reliable data. A black overcoat, called optical isolation, is strongly recommended to reduce ambient light.

**Oxygen Conversion Formula**

These conversion formulas are only valid in aqueous solutions and humidified air. These formulas have to be modified if measurements have to be performed in organic solvents or solutions with high salinity.

% $O_2 = \% \text{air} - \text{saturation} \times \frac{20.95}{100}$

0.2095: volume content of oxygen in air

*ppm in gaseous phase:*

$\text{ppm}[O_2] = \% \text{air-saturation} \times \frac{20.95}{100} \times \frac{1}{10000} = \frac{\% O_2}{10000}$

$1\text{ppm} = \frac{1}{1000000} = \frac{1\text{mg}}{1\text{kg}} = \frac{1\text{µL}}{1\text{L}} = \frac{1}{10000} \%$

**Sensor Safety**

The oxygen-sensitive membrane can withstand gamma-sterilization, sterilization by ethylene oxide, steam autoclaving ($140^\circ \text{C}, 1.5 \text{ atm}$), CIP conditions (cleaning-in-place, 5% NaOH, $90^\circ \text{C}$), as well as 3% H$_2$O$_2$ (Hydrogen Peroxide) solution, if this is required for inline cleaning.

**Performance Improvement**

To improve the performance over past measurements, check the calibration values by using the calibration test gases for “0” (UHP Nitrogen 99.9999%) and the Span test gas (100 ppm oxygen/N2). This can be completed by using a 3-way valve connected to the test gas enabling the user to switch back and forth between bottles. This can assist in verifying proper operation.
Replacing the Oxygen Probe

These instructions can be used to replace the probe for BOS1, BOS2 or BOS3 when mounted independently or to a panel.

To replace the OXY4400 probe:

1. Close the sample conditioning panel (SCS) line and turn off power to the analyzer.
2. Disconnect the probe cable from SCS the panel.
3. Remove the existing probe and cable at the strain relief holder from the base of the analyzer.
   a. Using a standard crescent wrench, loosen the strain relief holder by turning counterclockwise.
   b. Complete the connector removal by turning the strain relief holder by hand until it separates from the analyzer.
5. Gently pull the probe out of the probe opening on the analyzer.

6. Remove the opposite end of the probe from the union tee on the SCS panel.

7. Install the new oxygen probe following the instructions provided in “Installing the Oxygen Probe” on page 2-10.

Periodic SCS Maintenance

The status of the SCS should be checked regularly to confirm proper operation (pressures, flows, etc.) and detect potential problems or failures before damage occurs. If maintenance is required, isolate the part of the system to be serviced by following the appropriate procedure under “Shutting Down the SCS” on page 3-3.

All filter elements should be checked periodically for loading. Obstruction of a filter element can be observed by a decreasing supply pressure or bypass flow. If loading of a filter is observed, the filter should be cleaned and the filter element replaced. After observation for some time, a regular schedule can be determined for replacement of filter elements.

No other regularly scheduled maintenance should be required for the system.

Preventive and On-Demand SCS Maintenance

Preventive and on-demand maintenance will be required when components and parts deteriorate or fail as a result of continuous use. The performance of the entire SCS and individual components should be monitored regularly so that maintenance may be performed on a scheduled basis in order to prevent a failure that could take the system out of operation.

The SCS is designed for convenient removal and replacement of component parts. Complete spare components should always be available. In general, if a problem or failure occurs, the complete part should be removed and replaced to limit system down time. Some components may be repaired (replacement of seats and seals, etc.) and then reused.

If the sample supply line does not appear to completely clear during normal operation, it may be necessary to clean the sample transport line to remove any liquid that may adhere to the wall of the tubing. The sample transport line should be purged dry with air or nitrogen before the system is placed back in operation.

![Warning Icon] The system must be taken out of service during any cleaning of the sample transport line.

If liquid makes it into the SCS, a filter element may become obstructed leading to a decreasing supply pressure or bypass flow. If obstruction of a filter is observed, the filter should be cleaned and the filter element replaced.
Regular SCS Status Check

1. Open the enclosure door, if analyzer is mounted in an enclosure.
2. Read and record the flowmeter settings while the gas is flowing.
3. Close the enclosure door, if applicable.

_If your SCS is contained within a heated cabinet, do not leave the door open any longer than absolutely necessary. SpectraSensors recommends no more than 60 seconds. Opening the door may affect the temperature reading until the temperature is stabilized._

4. Compare the current readings with the past readings to determine any variations. Reading levels should remain consistent.
5. If reading levels decrease, check the filters.

To check filters:

1. Shut down the system following the procedure in “Shutting Down the SCS” on page 3-3.
2. Inspect, repair or replace the filter as required.

_For additional information, contact SpectraSensors’ Technical Service Group at 800-619-2861._

3. Restart the system following the procedure in “Starting up the SCS” on page 3-2.

Service Contact

If the troubleshooting solutions do not resolve the problem, contact customer service. To return the unit for service or replacement, refer to "Return Material Authorization".

Customer Service

4333 W Sam Houston Pkwy N, Suite 100  
Houston, TX 77043-1223  
United States of America

_For SpectraSensors North America Service:_

Phone: 1-800-619-2861, and press 2 for Service  
Fax: 1-713-856-6623  
E-mail: service@spectrasensors.com
For SpectraSensors International Service, please contact the SpectraSensors distributor in your area, or contact:

Phone: +1-713-466-3172, and press 2 for Service
Fax: +1-713-856-6623
E-mail: techsupport@spectrasensors.com

Return Material Authorization

If returning the unit is required, obtain a Return Materials Authorization (RMA) Number from Customer Service before returning the analyzer to the factory. Your service representative can determine whether the analyzer can be serviced on site or should be returned to the factory. All returns should be shipped to:

11027 Arrow Rte.
Rancho Cucamonga, CA 91730-4866
United States of America
1-909-948-4100

Packing and Storage

SpectraSensors’ OXY4400 analyzers and auxiliary equipment are shipped from the factory in appropriate packaging. Depending on the size and weight, the packaging may consist of a cardboard-skinned container or a wooden crate. All inlets and vents are capped and protected when packaged for shipment.

If the equipment is to be shipped or stored for any length of time, it should be packed in the original packaging when shipped when shipped from the factory. If analyzer has been installed and or operated (even for purposes of a demonstration), the system should first be decontaminated (purged with an inert gas) before powering down the analyzer.

Process samples may contain hazardous material in potentially flammable and/or toxic concentrations. Personnel should have a thorough knowledge and understanding of the physical properties of the sample and prescribed safety precautions before installing, operating or maintaining the analyzer.

To prepare the analyzer for shipment or storage:

1. Shut off the process gas flow.
2. Allow all residual gas to dissipate from the lines.
3. Connect a purge supply, regulated to the specified sample supply pressure, to the sample supply port.
4. Confirm that any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent are open.
5. Turn on the purge supply and purge the system to clear any residual process gases.

6. Turn off the purge supply.

7. Allow all residual gas to dissipate from the lines.

8. Close any valves controlling the sample flow effluent to the low pressure flare or atmospheric vent.

9. Disconnect power to the system.

10. Disconnect all tubing and signal connections.

11. Cap all inlets and outlets to prevent foreign material such as dust or water from entering the system.

12. Pack the equipment in the original packaging in which it was shipped, if available. If the original packaging material is no longer available, the equipment should be adequately secured (to prevent excessive shock or vibration).

13. If returning the analyzer to the factory, complete the Decontamination Form provided by SpectraSensors "Customer Service" and attach to the outside of the shipping package as instructed before shipping.

Storage
The packaged analyzer should be stored in a sheltered environment that is temperature controlled between -20°C (-4°F) and 50°C (122°F), and should not be exposed to direct sun, rain, snow, condensing humidity or corrosive environments.

Disclaimers
SpectraSensors accepts no responsibility for consequential damages arising from the use of this equipment. Liability is limited to replacement and/or repair of defective components.

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