

User Manual for O2-Converter 3.0

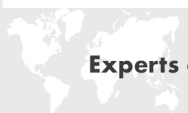
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1 Disclaimer

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2 Introduction

The O₂-converter 3.0 acts as an I²C to 4-20mA converter for PO₂ES-103PD and PO₂ES-103D Oxygen sensors. In addition to converting the raw signal, the converter allows the user to calibrate the output based on a two-point linearisation. The two points can be set at any two different oxygen concentrations, which makes the calibration process much more flexible. The calibration can also be adjusted at just one point at a time, which may simplify calibration under appropriate conditions.

3 Setup of the converter

3.1 Sensor side

The Converter comes with a cable attached. The oxygen sensor can directly be connected to the Converter with the attached connector.

3.2 Output side

The supply and output have to be connected through an M12 connector with the pinout provided in Figure 1. The GND and VSupply pins have to be supplied with 12-24VDC. The IOU^T pin delivers the output current. The shield should be connected to either GND or a dedicated shielding circuit, if not explicitly specified otherwise. This shielding pin covers the Converter 3.0 housing as well as the shielding of the cable connecting to the sensor.

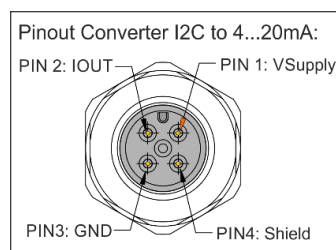


Figure 1: Pinout of the M12 connector.

4 User Interface

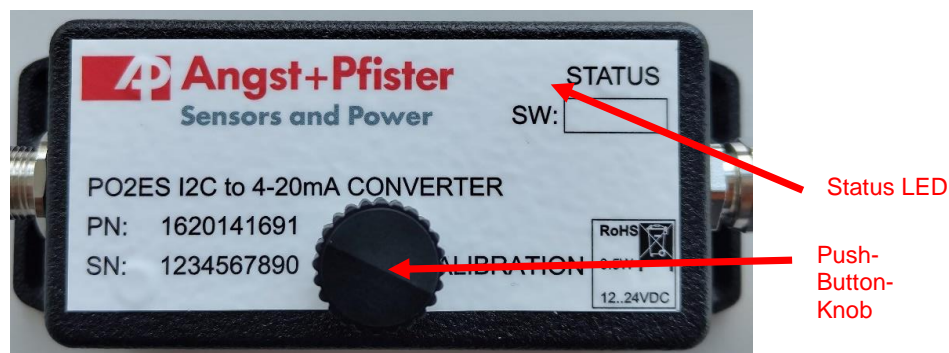


Figure 2: User interface with status LED and Push-Button-Knob.

4.1 Status LED

The status LED can show the following status:

- Green:** Green mode: Running normally, i. e. sensor connected, output corresponds to O₂ concentration.
- Blue:** Blue mode: Point blue can be adjusted. The output can be manipulated with the knob.
- Purple:** Purple mode: Point purple can be adjusted. The output can be manipulated with the knob.
- Red (static):** The oxygen concentration is above the oxygen sensors measuring range.
- Red (blinking):** The Converter could not establish a connection with the oxygen sensor.
- (Flashing white):** The Converter confirms the successful execution of the desired function (saving a calibration point or resetting to factory settings).

4.2 Push-button-knob

The push-button-knob is used to switch between operating modes as well as to adjust the calibration points. When the converter is in Green mode, pushing the button will switch it to Blue mode. Pushing it again will switch to Purple mode. When pushed again, it will switch back to Green mode.

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If the Converter is in either Blue or Purple mode, the respective calibration points can be adjusted. To change the calibration points, the output can be adjusted by twisting the knob in either direction until it corresponds to the oxygen concentration. When the output is correctly adjusted, the calibration point can be saved by pressing the push-button-knob for ~3 seconds. The status LED will confirm the successful saving of the blue point by flashing white twice. If the calibration point is not to be saved, the user can either switch to the next mode, otherwise the mode will be switched back to Green mode after a 20 seconds timeout. The Push-button-knob can also be used to reset the Converter 3.0 to factory settings by pressing the button continuously for ~15 seconds. The successful reset is confirmed by the LED flashing white twice. When resetting, two default calibration points are loaded that. They should never be used without executing a correct calibration.

5 Calibration

The Converter 3.0 allows calibration using two calibration points. The calibration is needed because the PO2ES-103(P)D cannot convert the oxygen concentration into an absolute signal. Each sensor has a unique offset and gain. These effects can be compensated by using the calibration feature. To achieve the best calibration result, the calibration should be done at 0% O₂ concentration (zero offset point) and at close to the maximum measuring range of the sensor for the span offset point. For the 25% O₂ Sensor, this means ideally having the span offset point at 25% O₂, or in air at 20.95% O₂. For the 100% O₂ Sensor, a span offset calibration at 95% is suggested.

5.1 Standard calibration procedure

The standard calibration procedure looks as follows:

1. Make sure the Converter is in **Green mode**
2. Apply 0% O₂ concentration to the sensor
3. Push the knob to switch to **blue mode**.
4. Twist the knob, until the output is at 4mA
5. Push the knob for about 3s until the status LED indicates the successful save by **flashing white twice**. (If the LED flashes red, please refer to "5.2 Error when saving calibration point")
6. Apply O₂ concentration of the span offset point (20.95%/25%/95%) to the sensor
7. Push the knob twice to switch to **purple mode**.
8. Twist the knob, until the output corresponds to the oxygen concentration present at the sensor. (e. g. 17.41mA in case of 25% sensor at 20.95% O₂)
9. Push the knob until the status LED indicates the successful save by **flashing white twice**. (If the LED flashes red, please refer to "5.2 Error when saving calibration point")

To calculate the output corresponding with the respective oxygen concentration, the following formulas should be used:

PO2ES-103PD:

$$I_{out} = \frac{\text{concentration}}{25\%} * 16mA + 4mA$$

PO2ES-103D:

$$I_{out} = \frac{\text{concentration}}{100\%} * 16mA + 4mA$$

Other points for zero offset point and span offset point may be chosen, but they should always be as far apart from each other, while still being in the measuring range.

5.2 Error when saving calibration point

When saving a calibration point, the LED will normally flash white twice. If it flashes red twice, the calibration point was not saved. This is due to the two calibration points being too close together. For

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calibration, two oxygen concentrations as far apart as possible should be chosen. If two concentrations close together are used for calibration, minor inaccuracies in the most recent reading of the sensor can result in increasing errors across the whole measuring range of the sensor.

5.3 One point calibration

One point calibration can be used for a simplified calibration procedure. The use of one point calibration is suggested only under the following circumstances:

1. A two-point calibration has been executed at least once in this exact setup (same sensor, same converter, same cables, ...)
2. The Sensor accuracy is only critical around the calibration point, but not across the whole measuring range.
3. The approximate oxygen concentration of each of the two calibration points currently active is known.

If these conditions are met, a one-point calibration can be executed. For a successful one-point calibration, of the currently active calibration points, only the one closer to the new calibration point will be overwritten. To adjust the calibration point, the standard calibration procedure can be applied to just one of the two calibration points.

Example:

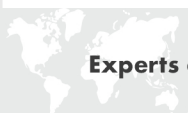
The sensor has been calibrated with 0% O₂ at the blue calibration point and with 25% O₂ at the purple calibration point. The sensor is mostly used at ~21% O₂. A one point calibration is to be performed at 20% O₂. Since the purple calibration point (25%) is closer to the new calibration point (20%), this calibration point will be overwritten using the following procedure:

1. Make sure the Converter is in **Green mode**
2. Set known concentration of oxygen
3. Push the knob twice to switch to **purple mode**.
4. Twist the knob, until the output is at 16.8mA ($20/25 \cdot 16\text{mA} + 4\text{mA}$)
5. Push the knob until the status LED indicates the successful save by **flashing white twice**.
(If the LED flashes red, please refer to "5.2 Error when saving calibration point")

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6 Revision History

Rev. #	Date of change	Author	Changes made
1.0	09.05.2023	Janosch Dusoczky	Document created



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