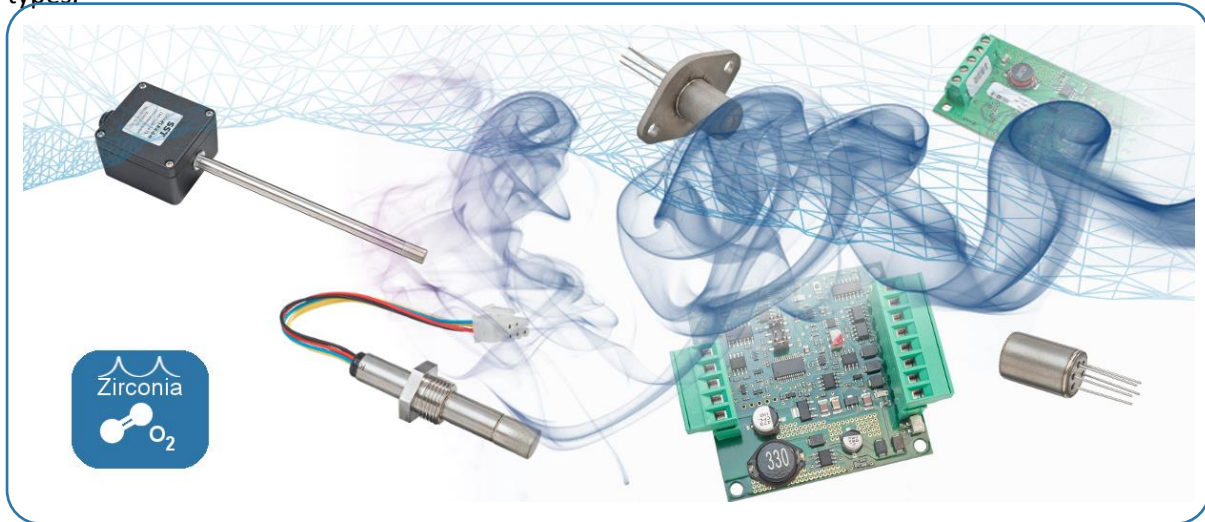


O₂ SENSORS – Zirconium Dioxide (ZrO₂) Sensor and Interface Selection Guide

This document provides an overview of CO2Meter's zirconium dioxide sensors and interface components; you will find information regarding important features such as housing types, response times, gas temperatures, heater voltages and best suited applications of particular sensor types.



NOTE: This document is not intended to replace the product datasheets which are referenced within. For ordering information and detailed specifications please refer to the datasheets or contact sales@CO2Meter.com.

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1 THINGS TO CONSIDER

There are a number of things to consider when choosing a zirconium dioxide sensor or electronic interface:

1.1 Sensors

All of CO2Meter's zirconium dioxide sensors have an identical sensing cell, however the housing and specification varies. When choosing your sensor, consider the following:

Cap type; the cap type determines the sensor $T_{10-90\%}$ response time. CO2Meter offers a choice of two different filters:

- Full porous cap type which allows gas to enter the sensor from any direction resulting in a fast response time of <4 seconds
- Porous lid type where only the top (lid) part of the sensing enclosure is porous. The response time of this variant is <15 seconds

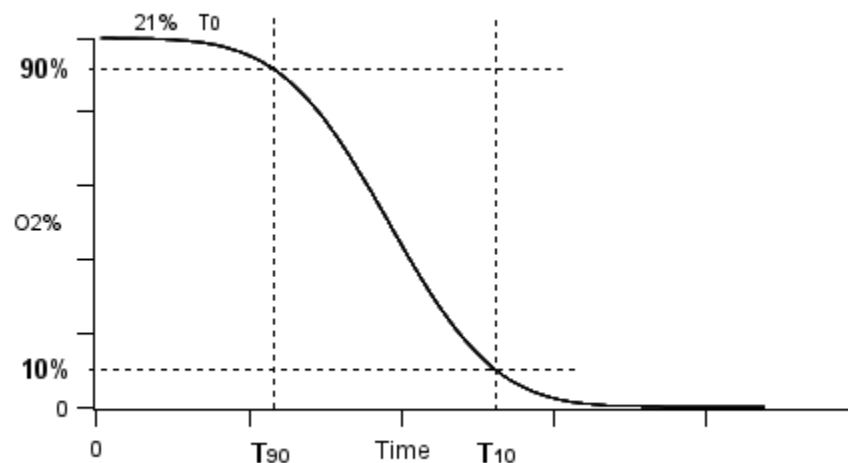


Figure 1-1 $T_{10} - T_{90}$ Response Time vs O₂%

Housing style; the housing style you chose will vary depending on your application. CO2Meter offer four basic sensor types, refer to [2.1 Types](#) on [page 2-1](#) for further information.

1.2 Interface Boards and Instrumentation

CO2Meter can supply an interface board which provides the electronics necessary to power and control the zirconium dioxide oxygen sensors. Alternatively, if you would rather have a complete solution, the Oxygen Measurement System, OXY-Flex or OXY-COMM may better suit your needs. When choosing the option you require, consider the following:

- **O₂ measurement range;** 0.1 – 25% or 0.1 – 100%
- **Output requirements;** digital (RS485 Modbus or RS232) or analogue (4 – 20mA or 0 – 10V_{DC})
- **Location;** cable length is important; to maintain the correct sensor heater voltage and minimize noise pickup, CO2Meter recommends keeping the cable length between the sensor and interface board as short as possible
- **Convenience;** do you want an “off-the-shelf” solution or configure the equipment yourself? Refer to [3.1 Types](#) on [page 3-1](#) for further information.

1.3 Application

Consider the environment in which your sensor will be working:

Environmental factors; gas mixture, temperature, humidity and pressure levels have a direct bearing on the product you should select; for example, is the gas corrosive; high temperature; high moisture content; do you require barometric pressure compensation?

Mounting; where the sensor and interface board is to be mounted can narrow the selection field:

- Does the sensor need to be sealed; is space a restrictive factor; if mounting in a flue, how thick is the flue wall?
- Where will the interface board be mounted; do you need a housing; will it be accessible for calibration/maintenance?

Note: Typical applications are listed throughout this document; they are given as examples only; they are NOT the only applications in which the sensors operate. Contact support@CO2Meter.com if you require assistance identifying the most suitable sensor and/or interface to suit your needs.



2 SENSORS

2.1 Types

There are four basic sensor types within the ZrO_2 family; Flange Mounted, Miniature, Probe Type and Screw Fit. The following gives a brief overview of the sensor, refer to [2.2 Specifications](#) on page 2-3 for further details:



2.1.1 Flange Mounted Range

Response time: $T_{10-90} < 4$ seconds (fast response sensor)

Heater voltage: $4.35V_{DC}$

Gas temperature range: $-100^{\circ}C$ to $+400^{\circ}C$

Mounting style: Flange mounted for easy sealing into a manifold or sampling chamber.

Typical applications: Favored by CO2Meter's aerospace customers, and those requiring high temperature and high pressure integrity.

2.1.2 Miniature Range

Response time:

- $T_{10-90} < 15$ seconds (standard response sensor)
- $T_{10-90} < 4$ seconds (fast response sensor)

Heater voltage:

- 4V (standard response sensor)
- $4.35V_{DC}$ (fast response sensor)

Gas temperature range: $-100^{\circ}C$ to $+250^{\circ}C$

Mounting style: Can be PCB mounted.

Typical applications: Used when measuring ambient gas (i.e. when the complete product is immersed in the atmosphere to be measured), etc.

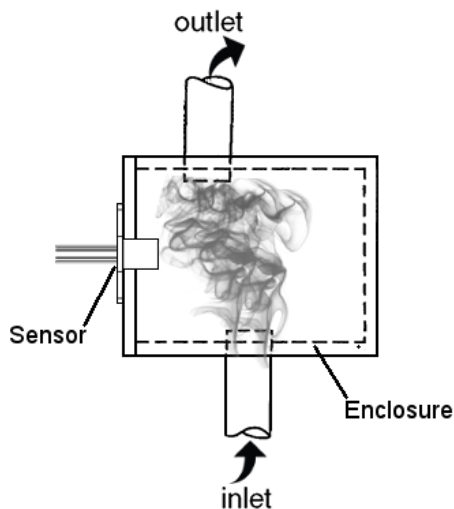


Figure 2-1 Flange Mount Installed in an Enclosure

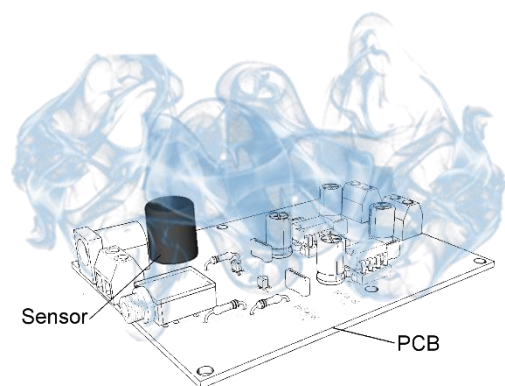


Figure 2-2 Miniature Mount Installed on a PCB



2.1.3 Probe Type Range

Response time:

- $T_{10-90} < 15$ seconds (standard response sensor)
- $T_{10-90} < 4$ seconds (fast response sensor)^a

Heater voltage:

- 4V (standard response sensor)
- 4.35V_{DC} (fast response sensor)^a

Gas temperature range: -100°C to +250°C or -100°C to +400°C^b

Mounting style: Probe comes in three lengths; 80mm, 220mm and 400mm.

Typical applications: Longer probes are ideal for thicker walled flues.

2.1.4 Screw Fit Range

Response time: $T_{10-90} < 4$ seconds (fast response sensor)

Heater voltage: 4.35V_{DC} (4.55V_{DC} on BM range)

Gas temperature range: -100°C to +250°C

Probe insertion distance: 28mm, 45mm or 55mm (relative to mounting nut).

Mounting style: M18 x 1.5 thread. Total probe length 75mm.

Typical applications: Boiler/furnace efficiency optimisation for coal/oil/gas/biomass; controlled atmosphere monitoring, etc.

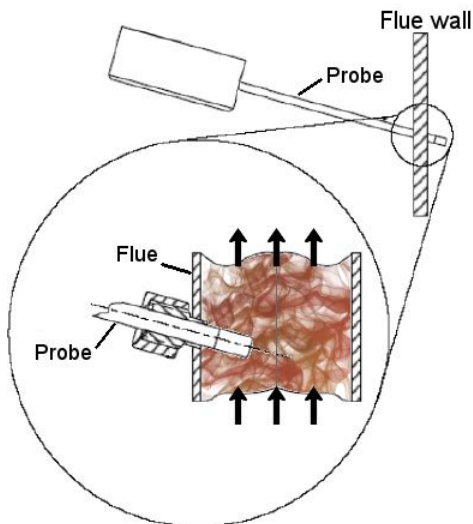


Figure 2-3 Probe Style Installed in a Flue

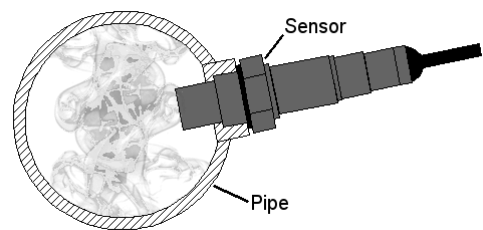


Figure 2-4 Screw Fit Style Installed in a Pipe

^a Fast response option available in 80mm probe length only.

^b High temperature option available in 220mm and 400mm probe lengths only.

2.2 Specifications

The following section provides high-level sensor specifications; for full details, refer to the product datasheet (see [REFERENCE DOCUMENTS](#) for details).

2.2.1 Flange Mounted Range

For full specification details, refer to the datasheet.

2.2.1.1 Technical Specifications

	O2S-FR-T4-4P	O2S-FR-T4-5P
Response Time	4 seconds	
Heater Voltage	4.35V	
Gas Temperature	-100°C to +400°C	
Termination	4 pins	5 pins
	Ø0.64 nickel plated pins	

2.2.1.2 Product Dimensions

Dimensions in mm unless otherwise stated.

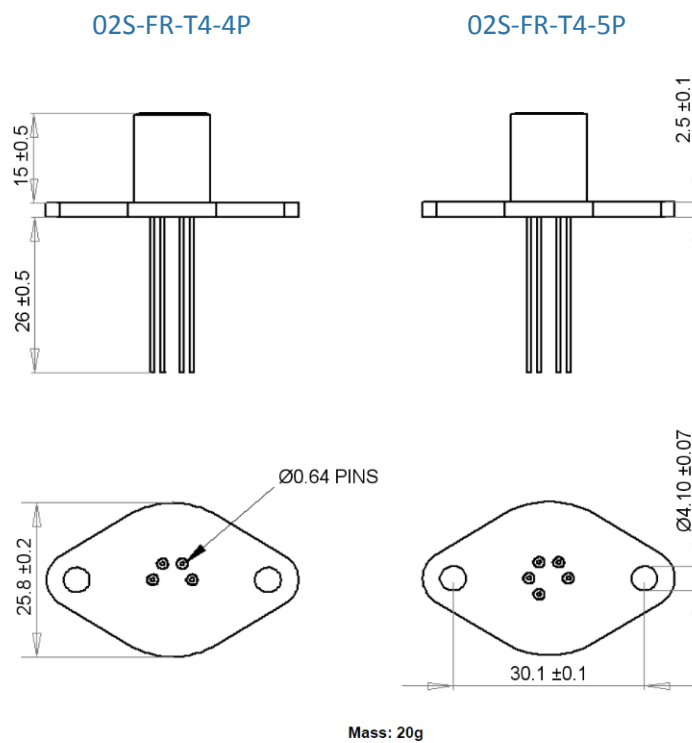


Figure 2-5 Product Dimensions – Flange Mounted Range

2.2.2 Miniature Range

For full specification details, refer to the datasheet.

2.2.2.1 Technical Specifications

	O2S-T3	O2S-FR-T3
Response Time	15 seconds	4 seconds
Heater Voltage	4.0V	4.35V
Gas Temperature	-100°C to +250°C	
Termination	5 pins	
	Ø0.64 nickel plated pins	

2.2.2.2 Product Dimensions

Dimensions in mm unless otherwise stated.

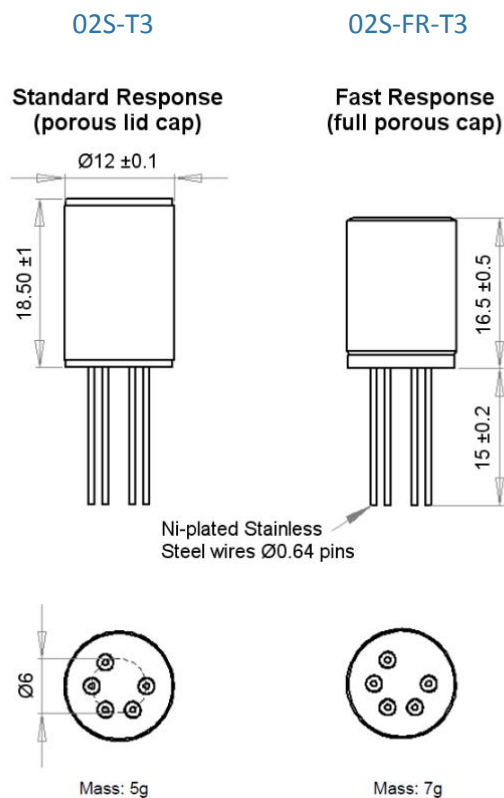


Figure 2-6 Product Dimensions – Miniature Range

2.2.3 Probe Type Range

For full specification details, refer to the datasheet.

2.2.3.1 Technical Specifications

	O2S-T2	O2S-FR-T2	O2S-T6-SH	O2S-T6
Probe Length	80mm		220mm	400mm
Response Time	15 seconds	4 seconds	15 seconds	
Heater Voltage	4.0V	4.35V	4.0V	
Gas Temperature	-100°C to +250°C		-100°C to +250°C and -100°C to +400°C options Refer to datasheet for details	
Termination	Molex connector; 0.15m, 0.3m and 1.1m cable options Refer to datasheet for details		Lead wires; 0.15m, 0.3m and 1.1m cable options Refer to datasheet for details	

2.2.3.2 Product Dimensions

Dimensions in mm unless otherwise stated.

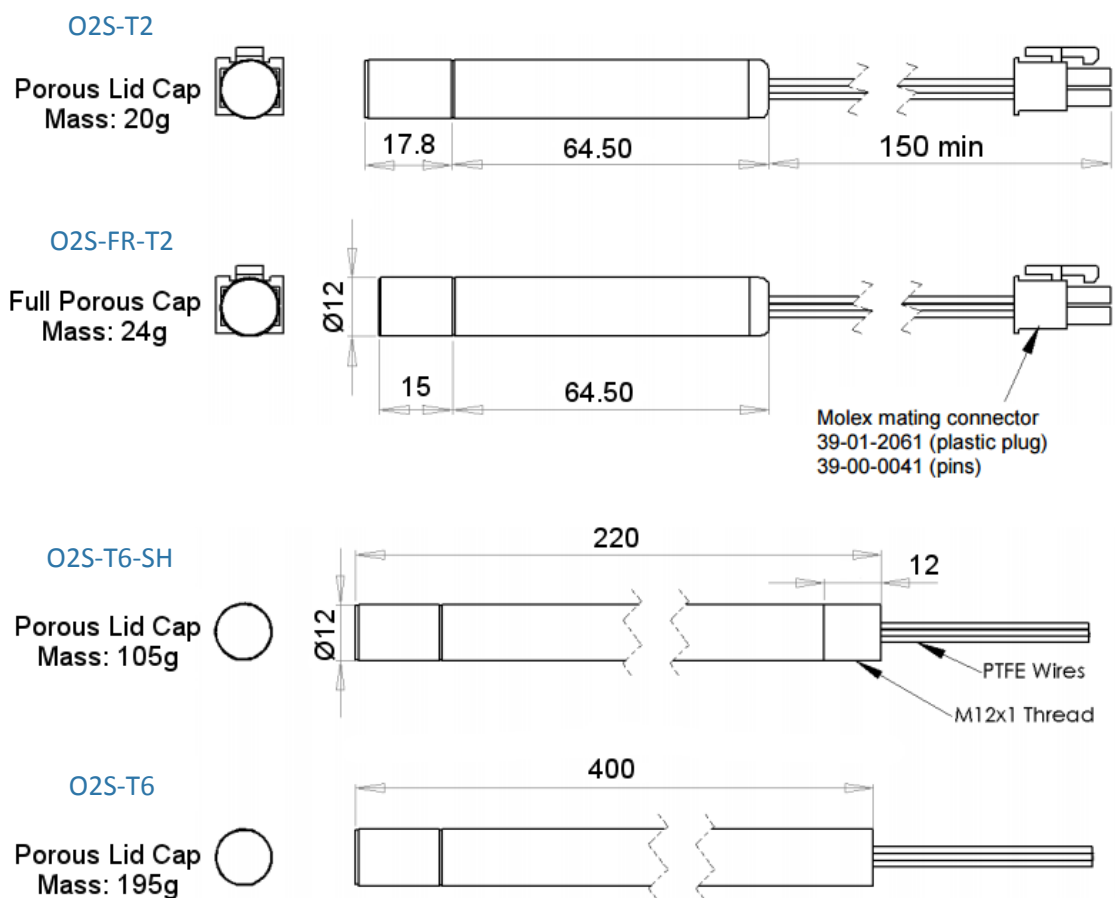


Figure 2-7 Product Dimensions – Probe Type Range

2.2.4 Screw Fit Range

For full specification details, refer to the datasheet.

2.2.4.1 Technical Specifications – Standard Range

	O2S-FR-T2-18A	O2S-FR-T2-18B	O2S-FR-T2-18C
Insertion Length	55mm	45mm	28mm
Response Time	4 seconds		
Heater Voltage	4.35V		
Gas Temperature	-100°C to +250°C		
Termination	Molex connector; 0.15m, 0.3m and 1.1m cable options Refer to datasheet for details		

2.2.4.2 Product Dimensions – Standard Range

Dimensions in mm unless otherwise stated.

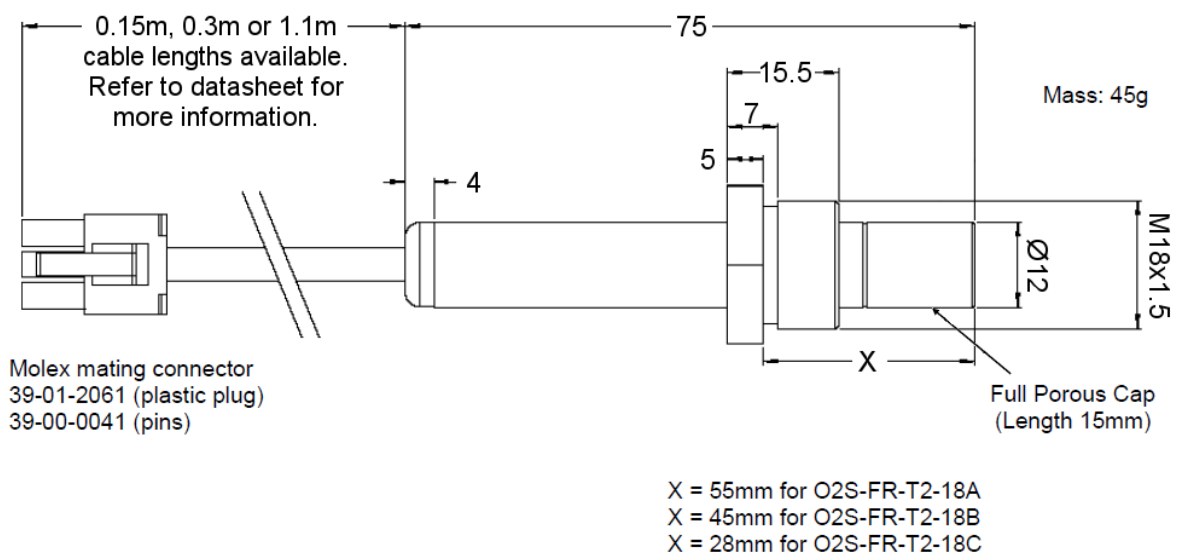


Figure 2-8 Product Dimensions – Screw Fit Range

2.2.4.3 Technical Specifications – BM Range

	O2S-FR-T2-18BM-A	O2S-FR-T2-18BM-B	O2S-FR-T2-18BM-C
Insertion Length	55mm	45mm	28mm
Response Time	4 seconds		
Heater Voltage	4.55V		
Gas Temperature	-100°C to +250°C		
Termination	1000mm (± 50mm), 5-core cable		

2.2.4.4 Product Dimensions - BM Range

Dimensions in mm unless otherwise stated.

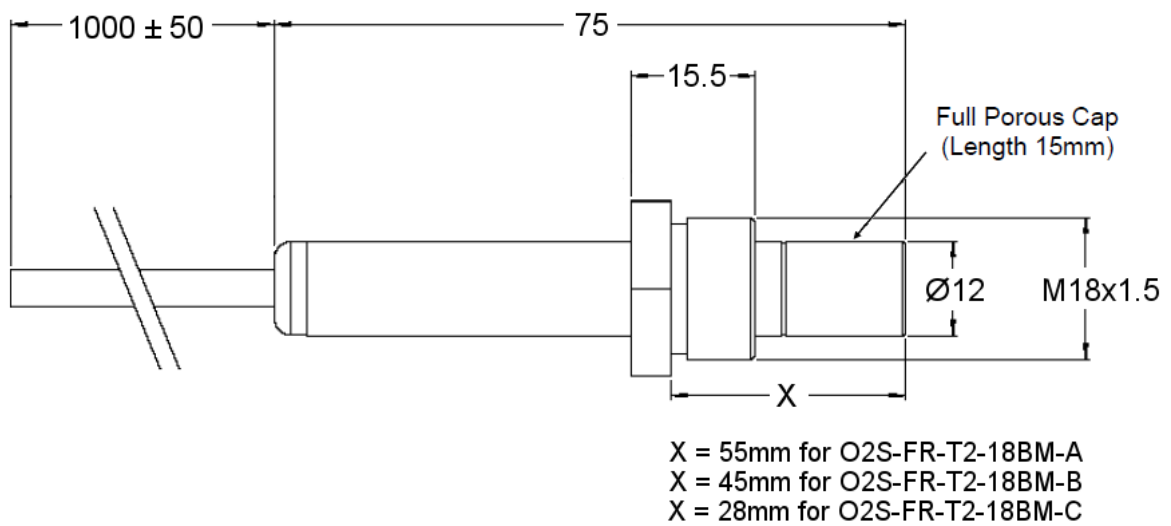


Figure 2-9 Product Dimensions – BM Probe Range

3 INTERFACE ELECTRONICS

3.1 Types

There are a number of options available which enable you to power and control CO2Meter's range of zirconium dioxide oxygen sensors; interface board or a complete solution. The following gives a brief overview of the components, refer to [3.2 Specifications](#) on [page 3-3](#) for further details:



3.1.1 Interface Board – OXY-LC

Supply voltage:

- 8 – 28V_{DC} (RS485 variant)
- 20 – 28V_{DC} (analogue variants)

O₂ measurement range:

- 0.1 – 100% (RS485 variant)
- 0.1 – 25% or 0.1 – 100% (analogue variants)

Operating temperature range: -30°C to +70°C

Output options: RS485 or 0 – 10V_{DC} or 4 – 20mA

Termination: PCB screw terminals.

Features: Built in pressure sensor for barometric pressure compensation.



3.1.2 Interface Board – O2I-Flex

Supply voltage: 24V_{DC} ± 10%

O₂ measurement range:

- 0.1 – 100% (RS232 variant)
- 0.1 – 25% or 0.1 – 100% (analogue variants)

Operating temperature range: -10°C to +70°C

Output options: RS232, 0 – 10V_{DC} and 4 – 20mA

Termination: Removable polarised screw terminals.

Features: Externally triggered automatic or manual calibration.

Calibration can also be initiated via an on-board push button switch.



3.1.3 Complete Solution – Oxygen Measurement System

Supply voltage:

- 8 – 28V_{DC} (RS485 variant)
- 20 – 28V_{DC} (analogue variants)

O₂ measurement range:

- 0.1 – 100% (RS485 variant)
- 0.1 – 25% or 0.1 – 100% (analogue variants)

Operating temperature range: -30°C to +70°C

Gas temperature range: -100°C to +250°C

Output options: RS485 or 0 – 10V_{DC} or 4 – 20mA

Termination: PCB screw terminals.

Features: Built in pressure sensor for barometric pressure compensation.

Typical applications: Combustion control including oil, gas and biomass boiler applications.



3.1.4 Complete Solution – OXY-Flex

Supply voltage: 24V_{DC} ± 10%

O₂ measurement range:

- 0.1 – 100% (RS232 variant)
- 0.1 – 25% or 0.1 – 100% (analogue variants)

Operating Temperature Range (electronics): -10°C to +85°C

Gas temperature range (at probe tip):

- -100°C to +250°C (standard variant)
- -100°C to +400°C (high temp variant)

Output options: RS232, 0 – 10V_{DC} and 4 – 20mA

Termination: Amphenol Ecomate C016 30C006 100 12.

Features: Externally triggered automatic or manual calibration. IP65 rated housing.

Typical applications: Combustion control including oil, gas and biomass boiler applications. Long probe lengths are ideal for thicker walled flues.

3.1.5 Complete Solution – OXY-COMM

Supply voltage: 8 – 15V_{DC}

O₂ measurement range: 0.1 – 100%

Operating Temperature Range: -40°C to +60°C

Output options: RS485

Termination: Brad Harrison style 4-pin M12 connector

Features: Calibration through Modbus. IP65 rated housing. Built in pressure sensor for barometric pressure compensation.

Typical applications: Refrigerated/controlled atmosphere transportation (“Reefer”) containers. Fire prevention in facilities such as server rooms, or document storage. Protecting historical artefacts against oxidation.

Alternatively, if you are not using one of CO2Meter’s interface boards for sensor control and conditioning, refer to [AN-0113, Zirconia O₂ Sensor Software and Hardware Design Guide](#).

3.2 Specifications

The following section provides high-level interface specifications; for full details, refer to the product datasheet (see [REFERENCE DOCUMENTS](#) for details).

3.2.1 OXY-LC

For full specification details, refer to the datasheet.

3.2.1.1 Technical Specifications

		Sensor Response Time T10 – 90	Heater Voltage	Supply Voltage	Digital Output	Analogue Output	O ₂ % Measure Range
OXY-LC-A25-	400	15 secs	4.00V ^c	20 – 28V _{DC}	PWM (for diagnostics & calibration)	4 – 20mA	0.1–25%
	420		4.20V ^d				
	435	4 secs	4.35V ^c				
	455		4.55V ^d				
OXY-LC-A100-	400	15 secs	4.00V ^c				
	420		4.20V ^d				
	435	4 secs	4.35V ^c				
	455		4.55V ^d				
OXY-LC-V25-	400	15 secs	4.00V ^c			0 – 10V	0.1–25%
	420		4.20V ^d				
	435	4 secs	4.35V ^c				
	455		4.55V ^d				
OXY-LC-V100-	400	15 secs	4.00V ^c	0.1–100%			
	420		4.20V ^d				
	435	4 secs	4.35V ^c				
	455		4.55V ^d				
OXY-LC-485		15 secs	Adjustable (4.35V default) ^e	8 – 28V _{DC}	RS485	N/A	0.1–100%
		4 secs					

^c Short cable length (<150mm).

^d Long cable length (>150mm).

^e Standard and fast response time sensors with any cable length up to 1m.

3.2.1.2 Product Dimensions

Dimensions in mm unless otherwise stated.

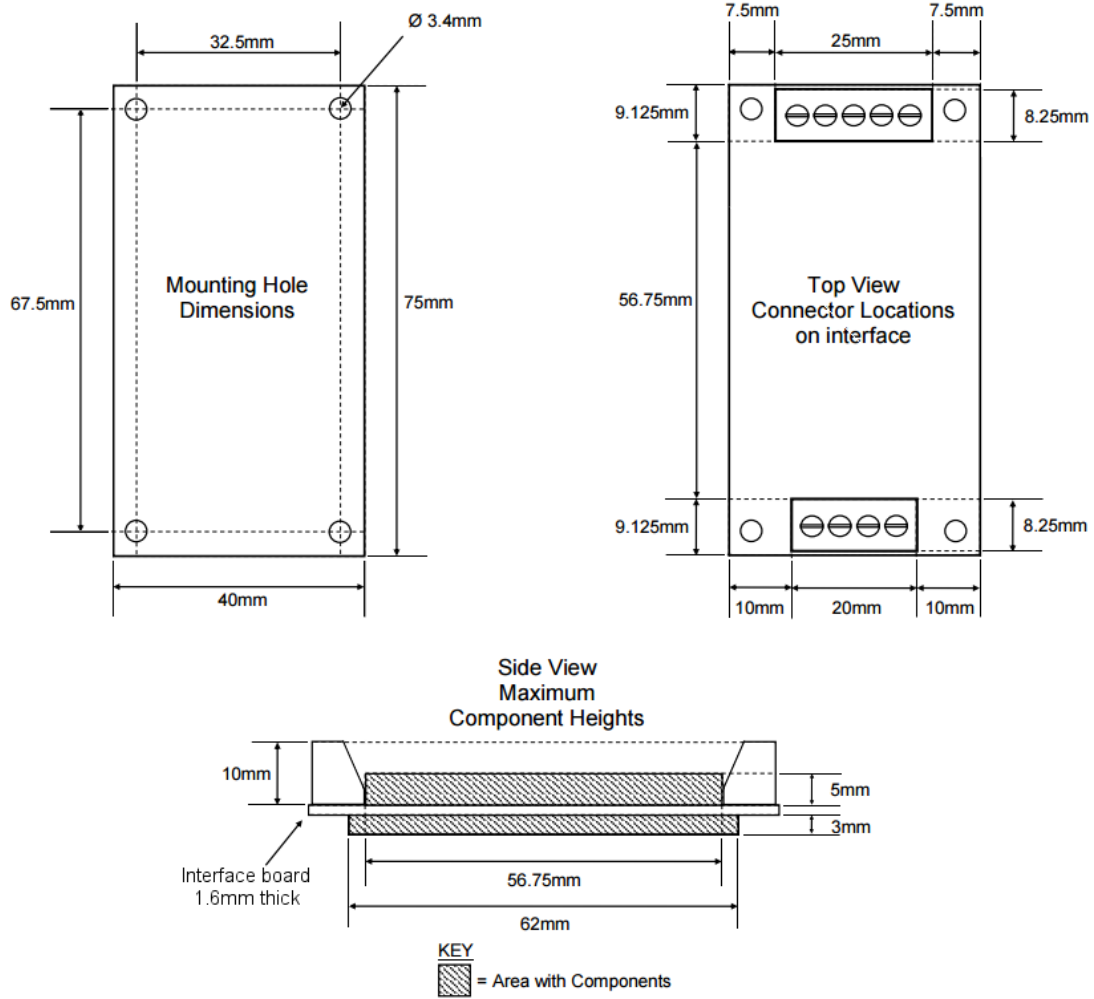


Figure 3-1 Product Dimensions - OXY-LC

3.2.2 O2I-Flex

For full specification details, refer to the datasheet.

3.2.2.1 Technical Specifications

	Sensor Response Time	Heater Voltage	Supply Voltage	Digital Output	Analogue Output	O ₂ % Measure Range
O2I-FLEX	15 secs	4.00V	24V _{DC}	RS232	4 – 20mA and 0 – 10V	0.1–25% (analogue output)
	4 secs	4.35V (default)				0.1–100% (digital output)

3.2.2.2 Product Dimensions

Dimensions in mm unless otherwise stated.

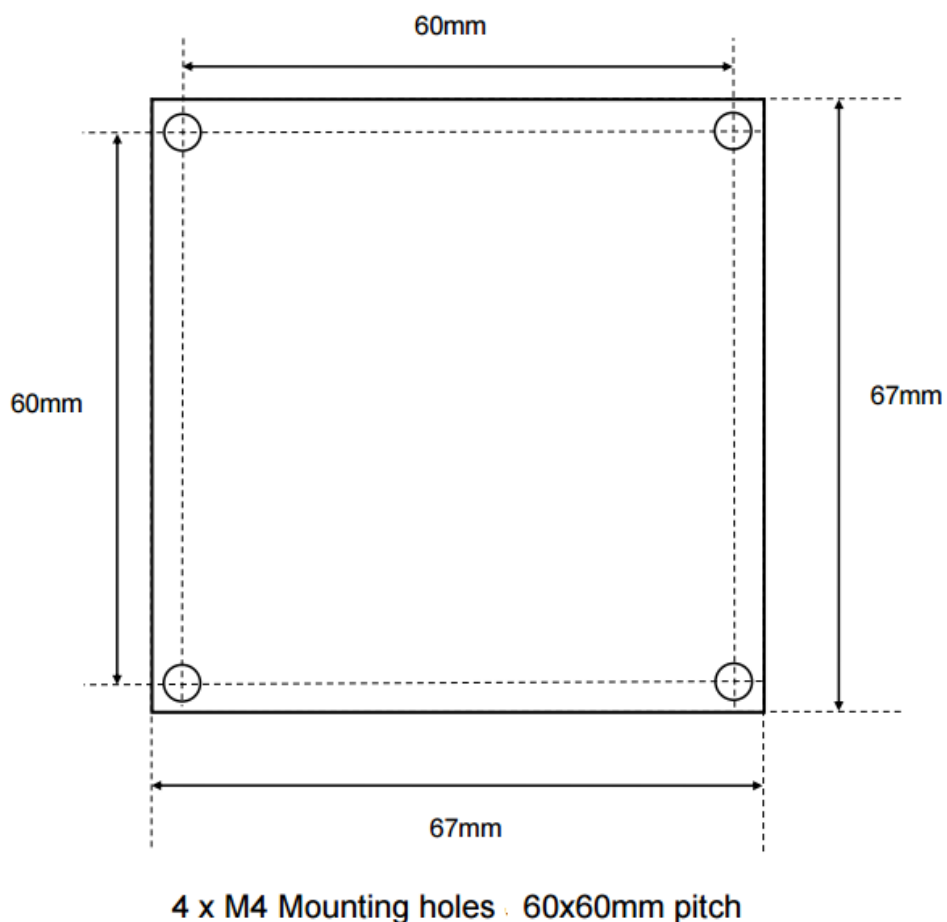


Figure 3-2 Product Dimensions - O2I-Flex

3.2.3 Oxygen Measurement System

The oxygen measurement system is a complete solution consisting of a zirconium dioxide sensor and an interface board.

For full specification details, refer to the datasheet.

3.2.3.1 Technical Specifications - Sensor

	O2S-FR-T2-18BM-A	O2S-FR-T2-18BM-B	O2S-FR-T2-18BM-C
Insertion Length	55mm	45mm	28mm
Response Time	4 seconds		
Heater Voltage	4.55V		
Gas Temperature	-100°C to +250°C		
Termination	1000mm (± 50mm) cable		

3.2.3.2 Product Dimensions – Sensor

Dimensions in mm unless otherwise stated.

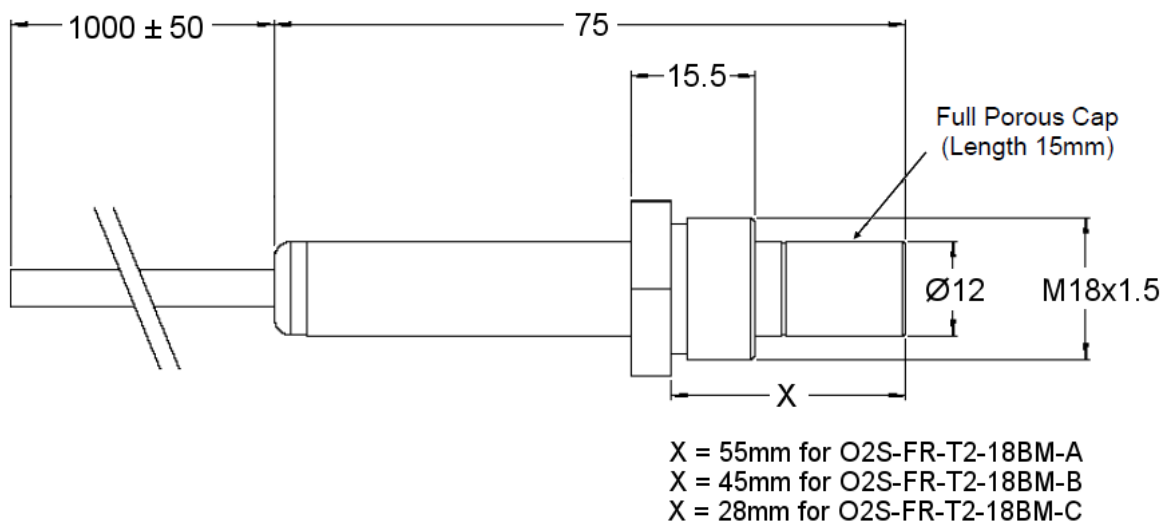


Figure 3-3 Product Dimensions – BM Probe Range

3.2.3.3 Technical Specifications – Interface Board

	Heater Voltage	Supply Voltage	Digital Output	Analogue Output	O ₂ % Measure Range
OXY-LC-A25-455	4.55V	20 – 28V _{DC}	PWM (for diagnostics & calibration)	4 – 20mA	0.1–25%
OXY-LC-A100-455					0.1–100%
OXY-LC-V25-455				0 – 10V	0.1–25%
OXY-LC-V100-455					0.1–100%
OXY-LC-485	Adjustable (4.35V default)	8 – 28V _{DC}	RS485	N/A	0.1–100%

3.2.3.4 Product Dimensions – Interface Board

Dimensions in mm unless otherwise stated.

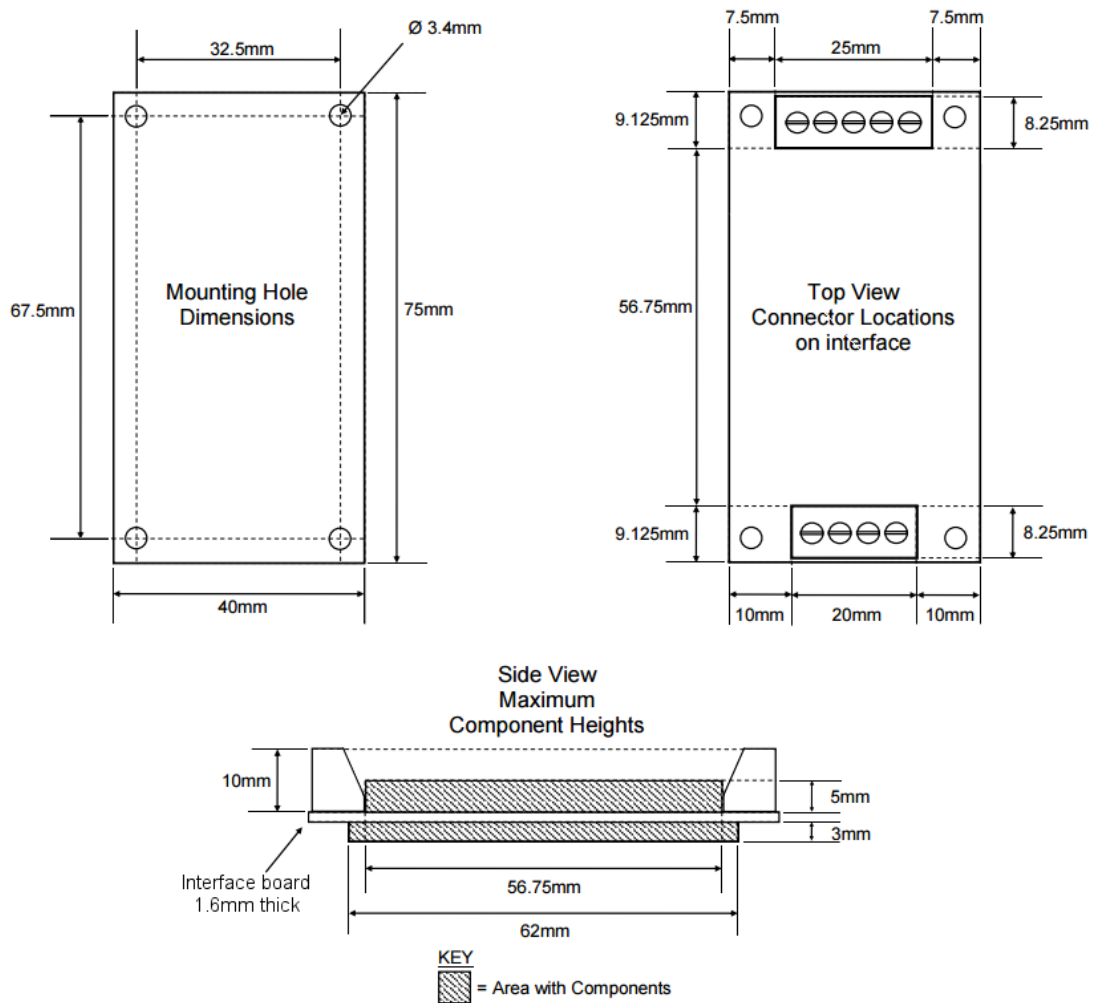


Figure 3-4 Product Dimensions – Interface Board

3.2.4 OXY-Flex

For full specification details, refer to the datasheet.

3.2.4.1 Technical Specifications

	Sensor Response Time	Probe Length	Gas Temp	Supply Voltage	Digital Output	Analogue Output	O ₂ % Measure Range
OXY-FLEX-0	15 secs	220mm	-100°C to +250°C	24V _{DC}	RS232	4 – 20mA and 0 – 10V	0.1–25% or 0.1–100% (analogue output)
OXY-FLEX-0H			-100°C to +400°C				
OXY-FLEX-1		400mm	-100°C to +250°C				0.1–100% (RS232 output)
OXY-FLEX-1H			-100°C to +400°C				

3.2.4.2 Product Dimensions

Dimensions in mm unless otherwise stated.

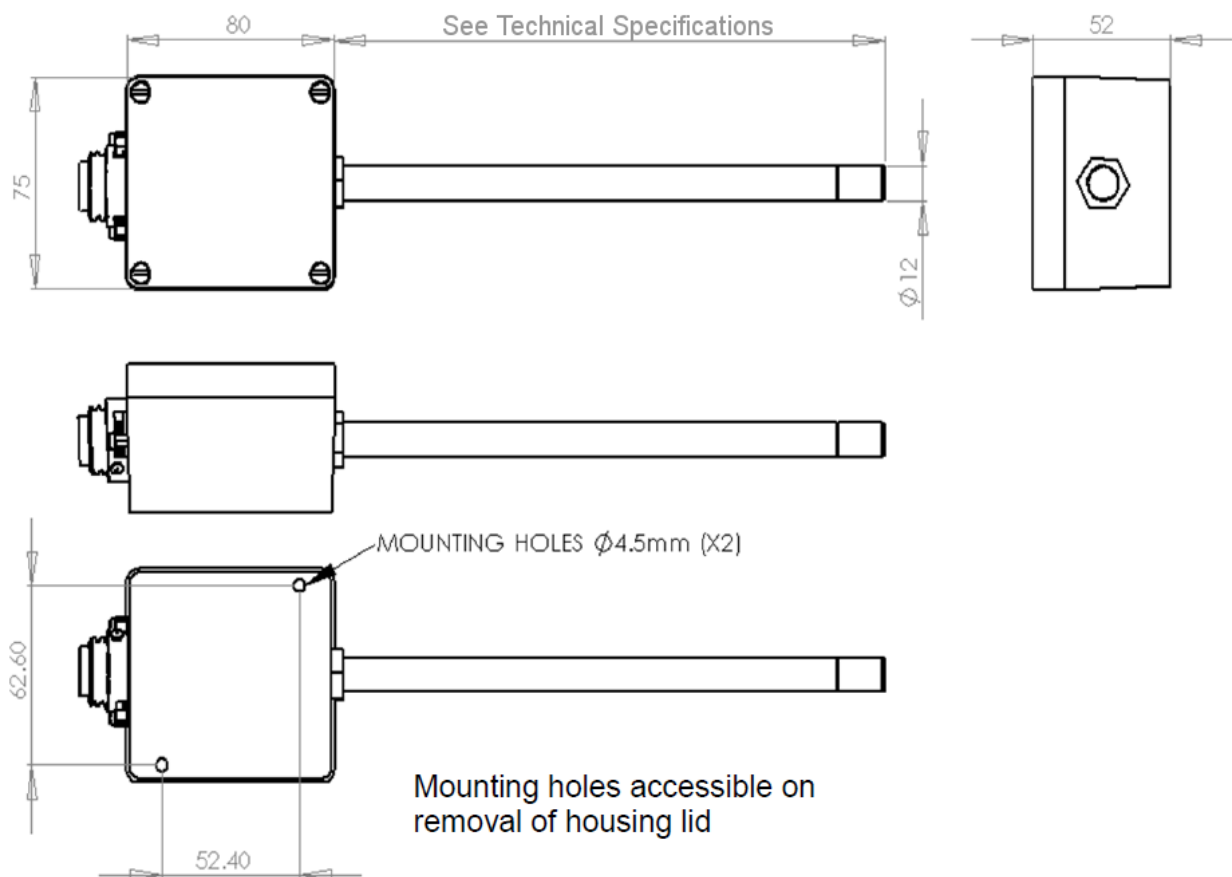


Figure 3-5 Product Dimensions - OXY-Flex

3.2.5 OXY-COMM

For full specification details, refer to the datasheet.

3.2.5.1 Technical Specifications

	Sensor Response Time	Operating Temp	Supply Voltage	Digital Output	O ₂ % Measure Range
OXY-COMM	15 secs	-40°C to +60°C	8 – 15V _{DC}	RS485	0.1–100%

3.2.5.2 Product Dimensions

Dimensions in mm unless otherwise stated.

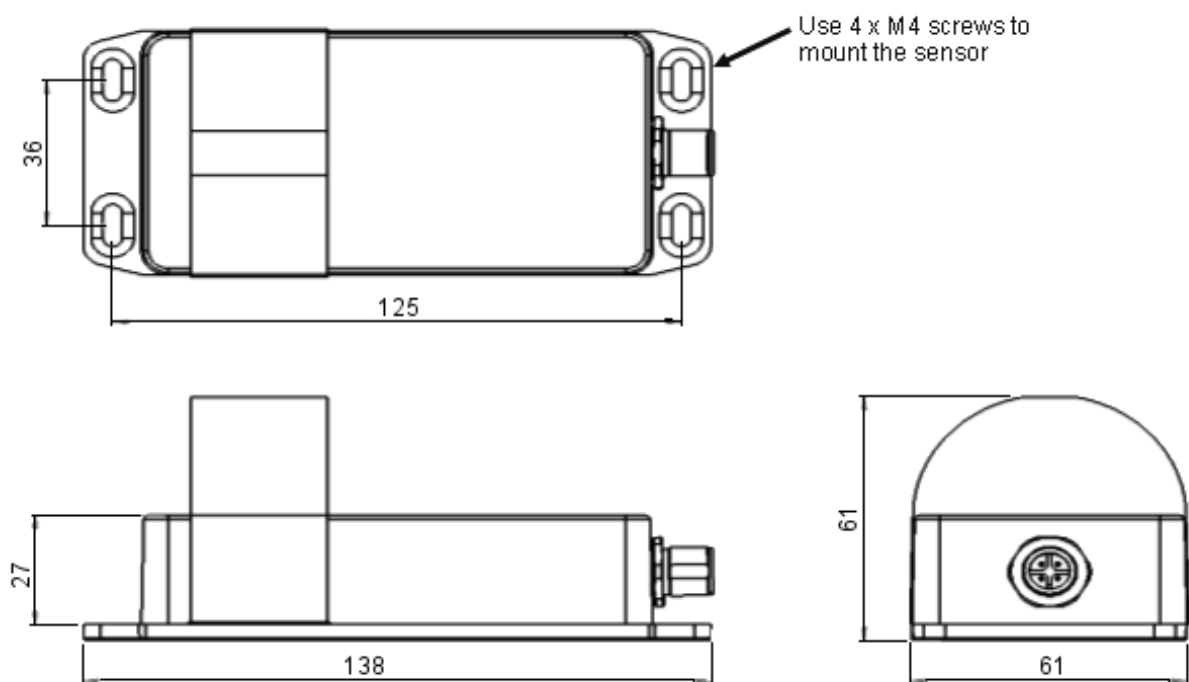








Figure 3-6 Product Dimensions - OXY-COMM

APPENDIX A – SENSOR QUICK COMPARISON TABLE

The following table provides a quick comparison of the sensor's key attributes:





Part Number	Type	Gas Temp Range		Response Time		Cable Length (m)				Insertion Length (mm)			Probe length (mm)		
		Std	High	Std	Fast	0.15	0.3	1.0	1.1	28	45	55	80	220	400
 O2S-T2	PS	✓		✓		✓							✓		
O2S-FR-T2	PS	✓			✓	✓							✓		
O2S-T2-002	PS	✓					✓						✓		
O2S-FR-T2-002	PS	✓			✓		✓						✓		
O2S-T2-003	PS	✓							✓				✓		
O2S-FR-T2-003	PS	✓			✓				✓				✓		
 O2S-T6	PL	✓		✓											✓
O2S-T6-H	PL		✓	✓											✓
O2S-T6-SH	PL	✓		✓										✓	
O2S-T6-SH-H	PL		✓	✓										✓	
 O2S-FR-T2-18A	SF	✓			✓	✓				✓					
O2S-FR-T2-18A-002	SF	✓			✓		✓			✓					
O2S-FR-T2-18A-003	SF	✓			✓				✓	✓					
O2S-FR-T2-18B	SF	✓			✓	✓					✓				
O2S-FR-T2-18B-002	SF	✓			✓		✓				✓				
O2S-FR-T2-18B-003	SF	✓			✓				✓		✓				
O2S-FR-T2-18A	SF	✓			✓	✓						✓			
O2S-FR-T2-18A-002	SF	✓			✓		✓					✓			
O2S-FR-T2-18A-003	SF	✓			✓				✓			✓			
 O2S-FR-T4-4P	FL		✓		✓										
O2S-FR-T4-5P	FL		✓		✓										
 O2S-T3	M	✓		✓											
O2S-FR-T3	M	✓			✓										
 O2S-FR-T2-18BM-A	SFB	✓			✓			✓				✓			
O2S-FR-T2-18BM-B	SFB	✓			✓			✓			✓				
O2S-FR-T2-18BM-C	SFB	✓			✓			✓		✓					

Key:

- PS: Probe Short
- PL: Probe Long
- SF: Screw Fit
- FL: Flange Mount
- M: Miniature
- SFB: Screw Fit BM
- Std Temp: -100 to +250°C
- High Temp: -100 to +400°C
- Std Response: T_{10-90} <15 seconds
- Fast Response: T_{10-90} <4 seconds

APPENDIX B – INTERFACE ELECTRONICS QUICK COMPARISON TABLE

The following table provides a quick comparison of the interface electronics key attributes:

Part Number	Supply Voltage (V _{DC})				Response Time		Digital Output		Analogue Output		O ₂ Measure Range (%)	
	8-15	8-28	20-28	24	Std	Fast	232	485	mA	V	0.1-25	0.1-100
 OXY-LC-A25-400			✓		✓				✓		✓	
OXY-LC-A25-420			✓		✓				✓		✓	
OXY-LC-A25-435			✓			✓			✓		✓	
OXY-LC-A25-455			✓			✓			✓		✓	
OXY-LC-A100-400			✓		✓				✓			✓
OXY-LC-A100-420			✓		✓				✓			✓
OXY-LC-A100-435			✓			✓			✓			✓
OXY-LC-A100-455			✓			✓			✓			✓
OXY-LC-V25-400			✓		✓					✓	✓	
OXY-LC-V25-420			✓		✓					✓	✓	
OXY-LC-V25-435			✓			✓				✓	✓	
OXY-LC-V25-455			✓			✓				✓	✓	
OXY-LC-V100-400			✓		✓					✓		✓
OXY-LC-V100-420			✓		✓					✓		✓
OXY-LC-V100-435			✓			✓				✓		✓
OXY-LC-V100-455			✓			✓				✓		✓
OXY-LC-485		✓				✓		✓				✓
 O2I-FLEX				✓	✓	✓	✓		✓	✓	✓	✓
 OXY-FLEX-0 ^f				✓	✓		✓		✓	✓	✓	✓
OXY-FLEX-0H ^g				✓	✓		✓		✓	✓	✓	✓
OXY-FLEX-1 ^h				✓	✓		✓		✓	✓	✓	✓
OXY-FLEX-1H ⁱ				✓	✓		✓		✓	✓	✓	✓
 OXY-COMM	✓				✓			✓				✓

Key:

Std Response: T₁₀₋₉₀ <15 seconds

Fast Response: T₁₀₋₉₀ <4 seconds

232: RS232

485: RS485 Modbus RTU

mA: 4 – 20mA

V: 0 – 10V_{DC}

^f Standard temperature (-100 to +250°C) at probe tip; probe length 220mm.

^g High temperature (-100 to +400°C) at probe tip; probe length 220mm.

^h Standard temperature (-100 to +250°C) at probe tip; probe length 400mm.

ⁱ High temperature (-100 to +400°C) at probe tip; probe length 400mm.

REFERENCE DOCUMENTS

Other documents in the zirconium dioxide product range are listed below; this list is not exhaustive, always refer to the [CO2Meter website](#) for the latest information.

Part Number	Title
AN-0043	O ₂ Sensors – ZrO ₂ Sensor Operating Principle and Construction Guide
AN-0050	O ₂ Sensors – ZrO ₂ Sensor Operation and Compatibility Guide
AN-0113	O ₂ Sensors – ZrO ₂ Sensor Software and Hardware Design Guide
DS-0044	Zirconia O ₂ Sensors Flange Mounted Series – Datasheet
DS-0051	Zirconia O ₂ Sensors Miniature Series – Datasheet
DS-0052	Zirconia O ₂ Sensors Probe Series - Short Housing – Datasheet
DS-0053	Zirconia O ₂ Sensors Probe Series - Screw Fit Housing – Datasheet
DS-0055	Zirconia O ₂ Sensors Oxygen Measurement System – Datasheet
DS-0058	OXY-LC Oxygen Sensor Interface Board – Datasheet
DS-0072	OXY-COMM-RS485 Oxygen Sensor – Datasheet
DS-0073	Zirconia O ₂ Sensors OXY-Flex Oxygen Analyser – Datasheet
DS-0074	O2I-Flex Oxygen Sensor Interface Board – Datasheet
DS-0122	Zirconia O ₂ Sensors Probe Series - BM Screw Fit Housing – Datasheet
DS-0131	Zirconia O ₂ Sensors Probe Series - Long Housing – Datasheet

CAUTION

Do not exceed maximum ratings and ensure sensor(s) are operated in accordance with their requirements.
Carefully follow all wiring instructions. Incorrect wiring can cause permanent damage to the device. Zirconium dioxide sensors are damaged by the presence of silicone. Vapours (organic silicone compounds) from RTV rubbers and sealants are known to poison oxygen sensors and MUST be avoided. Do NOT use chemical cleaning agents.

Failure to comply with these instructions may result in product damage.

INFORMATION

As customer applications are outside of CO2Meter's control, the information provided is given without legal responsibility. Customers should test under their own conditions to ensure that the equipment is suitable for their intended application.

For technical assistance or advice, please contact support@CO2Meter.com.

General Note: CO2Meter reserves the right to make changes to product specifications without notice or liability. All information is subject to CO2Meter's own data and considered accurate at time of going to print.

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