



**Neutronics**  
Gas Analysis Solutions

# Instruction manual

## Model EC150

For pn: 8-01-1001-42-0  
(packaged pn: 8-01-1001-42-1)

Electrochemical oxygen sensor with current output



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A	040864	12JAN2018	Initial release
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# Welcome

The Model EC150 Oxygen Sensor is a compact microprocessor augmented sensor designed for percent oxygen measurement. This manual provides detailed information on how to operate and maintain the EC150 Sensor.

For additional information regarding the maintenance and service of the Model EC150 Sensor, please contact the technical support team at Neutronics. If you have questions or comments, we would like to hear from you.

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## Notice

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# Safety instructions

## WARNING

- ▶ Installation, operation, and maintenance of the unit must be performed by trained technical personnel.
- ▶ Technical personnel must be authorized to perform the tasks by the owner-operator.
- ▶ Electrical connections must be established by an electrical technician.
- ▶ To prevent personal injury, technical personnel must read, understand, and follow all warnings and instructions in this manual before attempting installation or operation of the unit.
- ▶ If the operator cannot read these instructions, operating instructions and safety precautions must be read and discussed in the operator's native language.
  - Si el operador no puede leer las instrucciones, las instrucciones de operación y las precauciones de seguridad deberán leerse y comentarse en el idioma nativo del operador.
  - Si l'utilisateur ne peut lire les instructions, les instructions et les consignes de sécurité doivent lui être expliquées dans sa langue maternelle.
- ▶ No operator access is permitted inside the sensor. Repairs not described in the Operating Instructions may only be performed by the manufacturer or authorized service team.
- ▶ WARNING - Do Not Open In Hazardous Area.
  - AVERTISSEMENT – Ne Pas Ouvrir En Atmosphère Présentant Des Dangers.

# Designated use

- ▶ The sensor is a microprocessor-based instrument for oxygen measurement in clean gas applications. It is designed to minimize all effects of static discharges and interference from RFI and EMI emissions.
- ▶ If the equipment is used in a manner other than as described, the protection provided by the equipment may be impaired and may pose a threat to the safety of personnel.
- ▶ The manufacturer does not accept liability for damage caused by improper or non-designated use.

# Operational safety

## CAUTION

- ▶ Follow all local standards, safety regulations, and installation guidelines. Observe proper safety procedures when working with pressurized gases.
- ▶ Mount the sensor in a manner that will guard against excessive vibration, and exposure to liquids, flames, or high temperatures.
- ▶ Do not block the white round pressure equalization port on the top of the sensor incorrect measurements may result.
- ▶ The EC150 sensor cover must be attached to the base.
- ▶ Do not expose the Model EC150 sensor to water, high humidity or moisture. The sensor is rated to IP64 which is splash resistant.
- ▶ Do not expose the Model EC150 sensor to solvents, gas port and external surfaces see section 2.
- ▶ The sensor is rated intrinsically safe refer to section 5.
- ▶ Ensure that the pressure of gas entering the EC150 sensor unit is compatible with the operating instruction. Do not exceed pressure rating listed in the specifications section of this manual.
- ▶ Do not expose the unit directly to an unregulated gas supply. High gas pressures may cause a failure.
- ▶ The sensor is internally battery powered refer to the specifications section.
- ▶ Prior to commissioning, check that all connections are correct.

# 1 Introduction

## 1.1 Functional overview

This manual describes the Neutronics Model: EC150, part number: 8-01-1001-42-0. The EC150 sensor will be referred to as the “sensor” for the remainder of this manual.

The electrochemical sensor designed for the measurement of oxygen. The Oxygen measurement range is 0 to 25%V/V oxygen.

## 1.2 Features

The sensor is designed to provide long-life expectancy and lower environmental impact. Key features include:

- 0% to 25% measurement range
- Fail safe: When the O<sub>2</sub> sensor or the battery is depleted the output does not go to zero refer to section 4.3
- rapid response time – T<sub>90</sub> < 5 seconds
- long-life expectancy – sensor life is up to 5 years @ ambient air (with annual factory battery replacement)
- RoHS lead-free compliant design
- suitable for use in solvent-based applications – fully CO<sub>2</sub> and most solvents resistant
- The internal sensor contains a neutral electrolyte, non-poisonous based oxygen cell
- low-drift -- < 1% signal/month
- O<sub>2</sub> %V/V indicated by a 0-1.2 mA current conveyed by a 2 wire connection (+Iout, Ireturn).
- No earth grounding connection.

## 1.3 System hardware overview

### 1.3.1 Sensor module

The sensor is a lead-free galvanic oxygen sensor that features RoHS compliant construction. This partial pressure type electrochemical sensor includes integrated temperature and pressure compensation circuits designed to enhance the stability of the current output. Extensive testing has proven the sensor to be resistant to a wide range of solvents and corrosives.

#### 1.3.1.1 Oxygen sensor

The sensor housing is a 2-piece injection molded design (see Figure 1). The housing MOC is POM (polyoxymethylene) acetal copolymer grade M90, also known as Celcon M90, Delrin, or Hostaform. The housing protects the sensor, electronics, and internal lithium thionyl chloride (Li/SOCl<sub>2</sub>) safety-certified battery. It shields the sensor from dust and external heat sources and includes a threaded connection for mounting on the sample gas end cap fitting. The enclosure must be fully assembled for proper safety certified operation. The round white circle on top of the housing (see Figure 1) is a permeable membrane vent that maintains the sensor internal micro-environment by equalizing the internal and external pressures and preventing humidity ingress.

**CAUTION**

Do not block the white permeable membrane on top of the sensor housing.

Permeable membrane vent



Figure 1, Top view

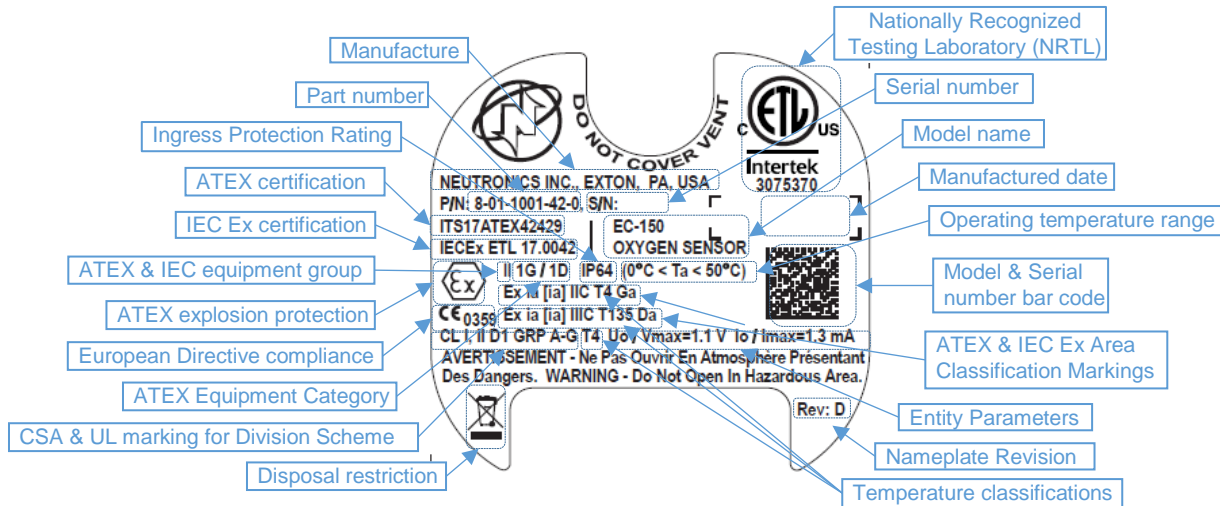


Figure 2, EC150 Markings

**1.3.2 Sensor**

The Neutronics EC150 is an intrinsically safe lead-free oxygen sensor designed to provide long-life expectancy and lower environmental impact. A self-powered, diffusion limited, galvanic type cell, it features RoHS compliant construction with a tin anode, fully CO<sub>2</sub> and solvent resistant neutral electrolyte, and a precious metal cathode. Additionally, extensive testing has proven the EC150 sensor to be resistant to a wide range of solvents and corrosives such as acetone, methanol, MEK, and toluene.

This partial pressure type sensor measures the concentration of oxygen in gas through a homogenous PTFE membrane without a pinhole (see Figure 2). The rate of gas diffusion through the membrane is linearly proportional to the partial pressure of the oxygen across the membrane. Since the oxygen is reduced at the cathode, the partial pressure on the cathodic side of the membrane is virtually zero, creating a driving force that is linearly dependent on the oxygen partial pressure gradient. As a result, the rate of gas diffusion (and sensor output) is linearly dependent on the oxygen partial pressure difference.



## 1.4 Sensor inputs and outputs

### 1.4.1 Sample input port

The female base thread is: 1 $\frac{3}{4}$  -5 UNC-2B (inch), see Figure 2.

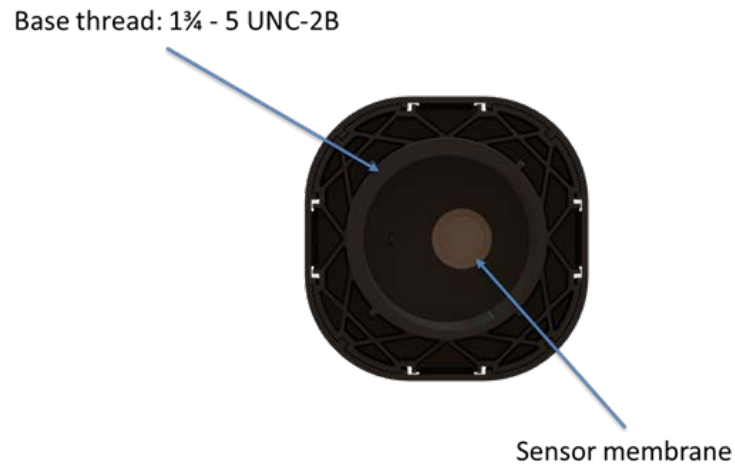


Figure 3, Bottom view

### 1.4.2 Internal Power

An internal lithium thionyl-chloride battery is located inside the housing and used to power the sensor. The battery is hermetically-sealed and corrosion resistant. It is not user replaceable. The battery can only be replaced by a Neutronics, Inc.



# 2 Installation and start-up

## 2.1 Step 1 – Install the EC150 sensor

The sensor is a galvanic type oxygen cell. At the end of its typical life of 12 months, the output of the cell will have a preprogrammed FAULT indication refer to section 4.3. If the sensor will no longer recalibrate, it should be replaced. It is recommended that sensors be replaced regularly at 11 to 12-month intervals. See also the installation instruction sheet Neutronics PN: 5-06-0900-01-0.

The gas sensing area facing downward is the optimal mounting position. A horizontal position is acceptable. The gas sensing area facing upward is not recommended.



### SENSOR HANDLING WARNINGS

1. Sensor handling.
  - Do not expose the open end of the sensor housing to liquids, particulate, grease, or other contaminants.
  - Do not touch the sensor cell opening.
  - Do not allow O-ring grease to touch the sensor cell opening.
  - Do not expose the sensor housing to sudden impact, mechanical shock, or electrical shock.
  - Do not expose the sensor housing to temperature extremes for any extended period of time below 5° F / -15°C or above 140°F / 60°C

**Note: Refer to section 7 for the Oxygen Sensor warranty information.**

2. Make sure that the replacement O-ring is properly seated in the end cap groove before installing the replacement sensor.
3. When replacing the sensor the existing sensor and O-ring should be immediately discarded to guard against errant re-use. The O-ring must always be replaced when replacing the sensor.
4. The sensor has been reviewed for electrical safety features only.
5. The sensor is suitable for use in areas classified as hazardous ( refer section 5 ) when properly interfaced with approved associated apparatus barrier devices.

### 2.1.1 Removal and Installation

Disconnect Remove Sensor cable from the existing sensor refer to Figure 4

1. Depress both lock tabs then grip the connector and pull straight back.

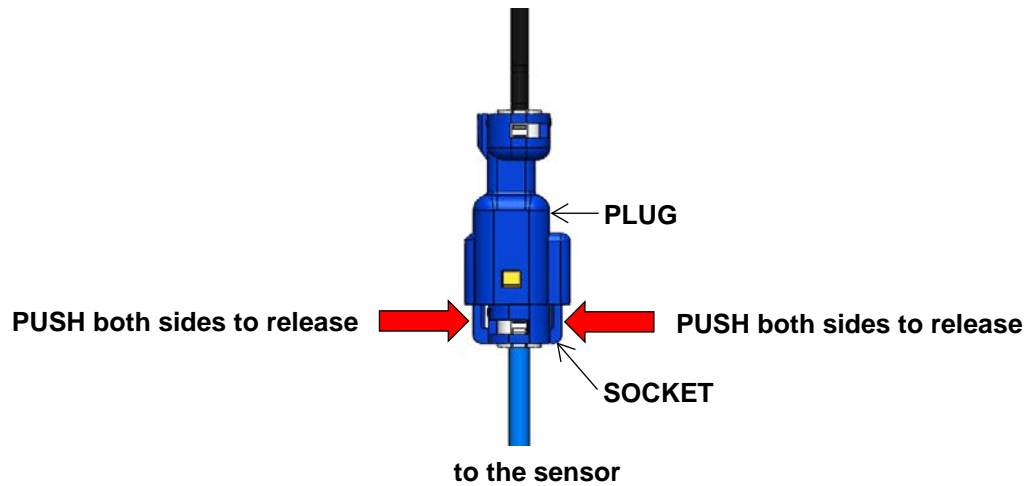


Figure 4, Sensor connector disconnect

2. Remove the existing sensor by turning it in a counterclockwise rotation. Discard the existing sensor refer to Figure 5 to prevent accidental reuse.

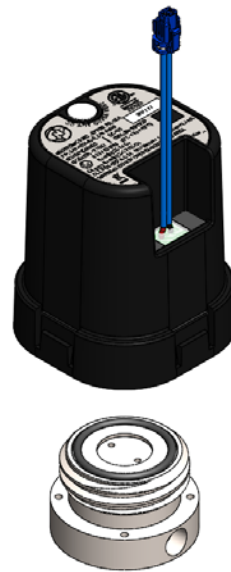


Figure 5, Sensor removal

3. Remove and discard the existing O-ring from end cap refer to Figure 6.

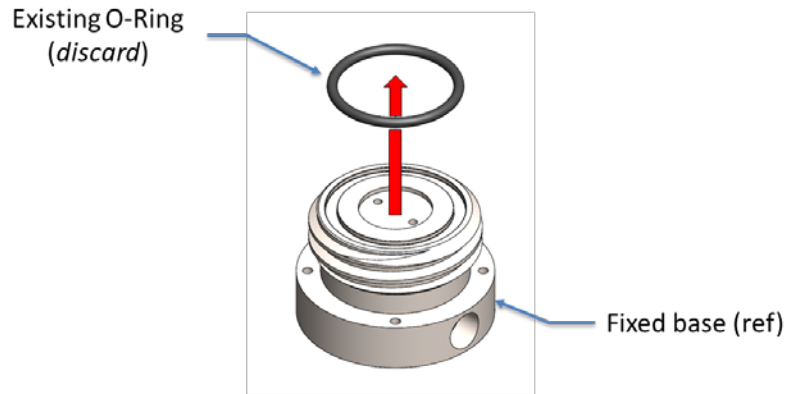


Figure 6, O-ring removal

4. Lightly grease the replacement O-ring with silicon vacuum grease. (Note: New O-rings are pre-greased at the factory) Install greased O-ring groove on end cap. Make sure O-ring is properly seated refer to Figure 7.

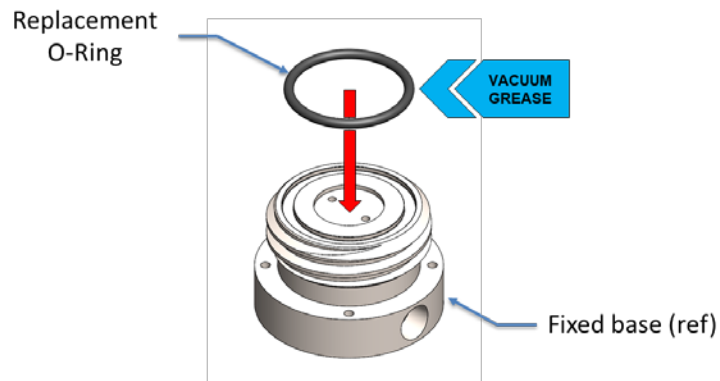


Figure 7, O-ring installation

5. Install the replacement sensor onto the end cap by threading on clockwise. Fully hand tighten sensor to ensure O-ring compression refer to Figure 8.

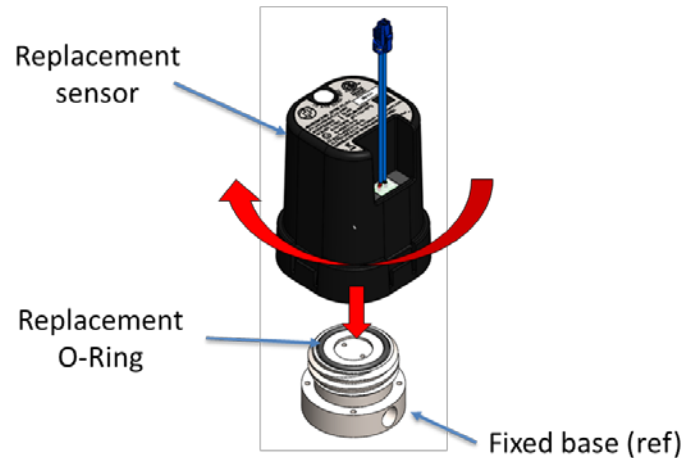


Figure 8, Sensor installation

6. Connect the sensor cable to the sensor housing by pressing the connector straight in as shown refer to Figure 9. The plug and socket connectors are keyed and will only connect in the correct orientation. **DO NOT FORCE THE PLUG AND SOCKET TOGETHER.**

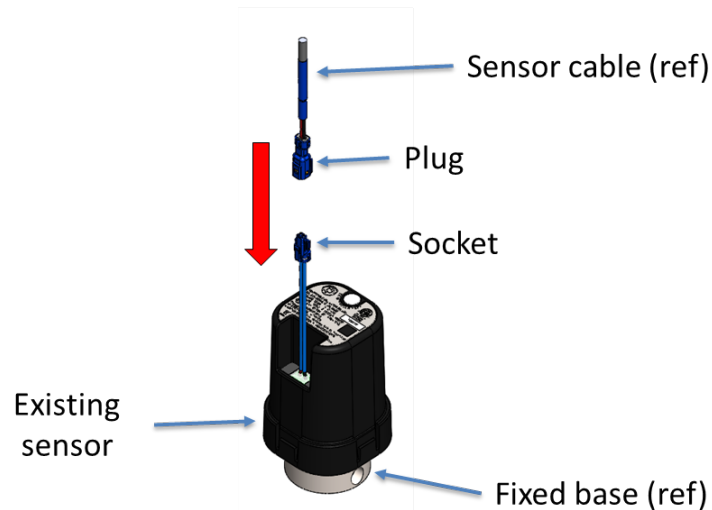


Figure 9, Connector engagement

7. Perform leak test, reference TBD system start-up.
8. TBD Disposal: ITG I-01 application note: " 2.6 How to dispose cells  
At the end of the I-01's lifetime the sensor should not be disposed of in normal public waste as it contains some lead and acid electrolyte. Please contact your local authorities for environmental legislation to relevant local waste disposal."

ITG's web site:

The sensors contain a toxic compound and are classified as special waste by European law.

Please do not burn them, and please do not include them with normal waste materials. Dispose of them in an environmentally safer manner, and in accordance with local law or, if the sensors were manufactured by us, we will take them back.

### 2.1.1 Power up check list

- No flammable vapors are present in the area
- No exposure to rain, dripping water, or hose down
- Wiring correctly installed
- Plumbing connections are gas-tight
- Ambient temperature is between 0°C to +50°C (32°F to 122°F)

### 2.1.2 Power up the unit

When the sensor connected to the analyser for the first time there will be a delay of 60 seconds before fully operational. When the sensor is in storage and before first time use the sensor is in a low power consumption standby mode to extend battery life.

### 2.1.3 Calibrate

Before calibrating the analyser system that the sensor is connected to, expose the sample gas inlet port to clean, dry ambient air. Allow the reading to stabilize. It should take up to 60 seconds for the gas to sweep out of the sample lines. Verify that the current output is stable (+/- 0.2%) before proceeding.





# 3 Operation

## 3.1 Overview

*Figure 10, TBD*

## 3.2 Measurement

### 3.2.1 %O<sub>2</sub> to current output relationship

### 3.2.2 Temperature compensation

### 3.2.3 Pressure compensation

### 3.2.4 Volatile fumes

TBD .

### 3.2.5 TBD

## 3.3 Calibration procedure

Calibration verifies the oxygen sensor to gases of known oxygen concentration to ensure the most accurate readings.

### 3.3.1 Reference calibration using ambient air

- ▶ When new, allow the sensor to stabilize by running it for 24 hours before initiating the calibration procedure.

# 4 Setup, maintenance, and troubleshooting

## 4.1 Basic setup

The sensor is factory configured, tested, and shipped ready to install and operate.

## 4.2 Routine periodic maintenance

The unit does not require any major periodic servicing. Use the chart below as a general guide.

Task	Recommended frequency		
	At commissioning	Annually	As required
Calibrate the sensor	✓ Using room air	Monthly use measured room air	✓
Clean the sensor		Verify top vent is clear	✓

## 4.3 Troubleshooting

The sensor output signal, sensor output connection (load resistance), and battery are monitored in continuously. Faults are reported as they occur if readings fall outside of the specified tolerances.

### 4.3.1 Low Battery

When the current output toggles between 0.1 mA for 5 seconds / 1.0 mA for 25 seconds the internal battery voltage is low and sensor cannot provide accurate oxygen information. The battery requires replacement. The output will toggle for a minimum of 3 days.

Descriptions of faults are given below, with indication of common causes. Refer to the appropriate sections of this manual for more details as needed.

## 4.4 Spare parts

Description	Neutronics Part Number
Instruction Manual	5-06-0900-00-0 (this document)
Installation Sheet	5-06-0900-01-0 Included in the sensor shipping box
Model EC150 O2 O-Ring	4-04-4060-08-0, O-RING (Viton)1.37" OD,1.18"ID
Mating connector	Part of the Neutronics cable assembly PN: reference information; Plug Housing (1): EDAC PN: 560-002-000-311, Crimp contact pins for 20 AWG wire (2): EDAC PN: 565-290-711.

# 5 Specifications

Intrinsic Safety Certification			
Models		EC150 (no packaging)	8-01-1001-42-0
		EC150 (packaged)	8-01-1001-42-1
Explosion protection			
ATEX	EN 60079-0: 2012		Explosive Atmospheres – Part 0: Equipment – General Requirements
	EN 60079-11: 2012		Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety “i”
CAN / CSA	C22.2 No 157 (R2012)		Intrinsically safe and non-incendive equipment of use in hazardous locations
	C22.2 No. 60079-0, Ed: 2, 2002/03/01		Explosive Atmospheres – Part 0: Equipment – General Requirements
	C22.2 No. 60079-11:14 February 2014		Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety “i”
IEC Ex	IEC 60079-0: 2011		Explosive Atmospheres – Part 0: Equipment – General Requirements
	IEC 60079-11: 2011 Edition 6.0		Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety “i”
UL	UL 913 Issued 2013/12/06		Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III Division 1 Hazardous (Classified) Locations
Certification			
Certificates	Authority	ATEX	ITS17ATEX42429
		IEC Ex	IEC Ex ETL 17.0042
Protections	Equipment	Group	II
		Category	1
		Environment	GD
	Area Classifications	Explosion protection	Ex
		Protection type	Ia [ia]
		Atmosphere Groups	IIC and IIIC
		Temperature classes	T4 and T135
Equipment protection level	Ga and Da		
Enclosure	Ingress protection	Water and Dust	IP-64
CSA / UL		Class	I

	Groups	A, B, C, D
	Class	II
	Groups	E, F, G
ESD / EMC	In line with EN61326-1:ed2.0:2012-07	
	IEC 61000-3-2:2000	±4.0 kV (contact discharge)
		±4.0 kV (air discharge)
	IEC 61000-4-3:2002	3 V/M (80 MHz to 1 GHz)
		3 V/M (1.4 GHz to 2 GHz)
IEC 61000-3-2:	1 V/M (2.0 GHz to 2.7 GHz)	

### General Specifications

Enclosure dimensions (L x W x H and Max base diagonal)	2.68 ±0.032" (68 ±0.8 mm) x 2.68 ±0.032" (68 ±0.8 mm) x 3.43 ±0.032" (87 ±0.8 mm) x 2.96 ±0.032" (75.2 ±0.8 mm)
Weight	6.7 oz (190 g)
Mounting	Single point mount on threaded gas port. Orientation restriction the gas port cannot point upwards as this will cause incorrect readings. 1-3/4-5 UNC-2B female threaded sample port.
Environmental protection level	IP64 rating, no hazardous moving parts or electrical hazard
Materials in contact with media	Housing-Acetal (POM) plastic with anti-static additives, Sensor-PA plastic, PTFE, stainless steel, Gaskets-Viton O-rings (3), silicon vacuum grease.
Operating Altitude	4900 m (16,000 ft) to -2120 m (-7000 ft)
Operating Pressure	74 kPa – 125 kPa (-4 PSIA to +18.2 PSIA) calibration from 74 – 125 kPa
Operating temperature	0°C to +50°C (32°F to 122°F)
Storage temperature	-15°C to +60°C (+5°F to 140°F)
Storage lifetime	< 9 months (recommended for service life, refer to item 12 below)
Expected sensor service life	5 years with annual battery replacements as required
Expected battery service life	1-year average, (output current level variation etc...) refer to section TBD for more information.
Power	Internal primary cell, Lithium-Thionyl Chloride (Li/SOCL <sub>2</sub> ) 3.6 V, 8.5 Ah battery. Not user replaceable.
Warm up	<60 seconds
Sensor type	Electrochemical Oxygen Sensor, weak alkaline electrolyte
Linearity error	0 to 2% volume % O <sub>2</sub> ; ± 0.1 % absolute
Linearity error	2.1 to 35% volume % O <sub>2</sub> ; ± 0.5 % absolute
Repeatability	± 1 % volume O <sub>2</sub> @ 25% O <sub>2</sub> , applied for 5 minutes
Response time	T <sub>90</sub> < 5 seconds
Alarms	Refer to section 4.3.
Warranty	9 months from date of shipment

# 6

## Material Safety Data Sheet

### 1. Hazardous ingredients of solution

Primary battery cell and Oxygen sensor

Furnished by Neutronics Inc.

Address: 456 Creamery Way • Exton, PA USA19341

Telephone: 610-524-8800 • Fax: 610-524-8807 • Email: [Info@NeutronicsInc.com](mailto:Info@NeutronicsInc.com)

### 2. Hazardous ingredients of solution

The material in this section may only represent a hazard if the integrity of the EC150 enclosure and the primary battery cell or the internal oxygen sensor is compromised.

- A. Primary battery cell, reference this table section 4 physical and chemical GHS codes.
- B. Oxygen sensor: TBD

### 3. Health hazard

The material in this section may only represent a hazard if the integrity of the EC150 enclosure and the primary battery cell or the internal oxygen sensor is compromised.

- A. Primary battery cell, reference this table section 4 physical and chemical H-phrases.
- B. Oxygen sensor: TBD

### 4. Physical and Chemical Data

The material in this section may only represent a hazard if the integrity of the EC150 enclosure and the primary battery cell or the internal oxygen sensor is compromised.

- A. Primary battery cell:

Manufacturer: Tadiran, Manufacturer part number: TL-5920, Tadiran MSDS datasheet: LTN-065-26-q (Revised 2015-06-12)

Composition / Information on Ingredients:

Substance	CAS No. (Chemical Abstracts Service)	Content w/w%	GHS Code (Globally Harmonized System)	Signal word	H-phrases (see below)
Lithium Metal	7439-93-2	2 - 6	GHS02 (Flame) GHS05 (Corrosion)	Danger	260, 314, EUH014
Thionyl Chloride	7719-09-7	18 - 47	GHS05 (Flame) GHS06 (Skull and crossbones)	Danger	302, 314, 331, 335

H-Phrases (Health Phrases):

- 260 In contact with water release flammable gases which may ignite spontaneously
- 302 Harmful if swallowed
- 314 Causes severe skin burns and eye damage
- 331 Toxic if inhaled
- 335 May cause respiratory irritation
- EUH014 Reacts violently with water

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B. Oxygen Sensor: TBD

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## 5. Unusual fire and/or explosion hazards

A. Primary battery cell:

Fire, explosion, and severe, burn hazard. Do not recharge, disassemble, heat above 100 °C, incinerate, or expose internal lithium metal contents to water which only applied if the battery case has been compromised.

B. Oxygen sensor - TBD

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## 6. Health hazard data

The material in this section may only represent a hazard if the integrity of the EC150 enclosure and the primary battery cell or the internal oxygen sensor is compromised.

A. Primary battery cell reference this table section 4 physical and chemical H-phrases.

B. Oxygen sensor - TBD

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## 7. Emergency and First-aid procedures

A. Primary battery cell:

Electrolyte Contact:

- Skin: Immediately flush with plenty of water for at least 15 minutes. If symptoms are present after flushing, get medical attention.
- Eyes: Immediately flush with plenty of water for at least 15 minutes and get medical attention.
- Respiratory system: With large quantities and irritation of the respiratory tract medical surveillance for 48 hours. Immediately inhale Cortisone spray, e.g. Pulmicort.

Lithium Metal Contact:

- Skin: Immediately flush with plenty of water for at least 15 minutes. If symptoms are present after flushing, get medical attention.
- Eyes: Immediately flush with plenty of water for at least 15 minutes and get medical attention.

B. Oxygen Sensor: TBD

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## 8. Handling

Returning a sensor TBD? Packaging for shipment back to Neutronics?

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**Note** The above data is based on MSDS provided by the manufacturers of components and by tests conducted by Neutronics. Neutronics believes that this information to be accurate and reliable. This information is supplied as reference only. Neutronics disclaims any liability for damage or injury which results from the use of the data and nothing contained therein shall constitute a guarantee, warranty, or merchantability or representation by Neutronics Inc. with respect to the data, the product described, or their use for any specific purpose, even if that purpose is known to Neutronics Inc.

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# 7 Limited warranty

1. Because of the many and varied circumstances and conditions under which NEUTRONICS, INC.'s products are used, and because NEUTRONICS, INC. has no control over this actual use, NEUTRONICS, INC. makes no warranties which extend beyond the express provisions herein. NEUTRONICS, INC. MAKES NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS. NEUTRONICS, INC. makes no express warranties beyond the following provisions, which only apply to the original purchaser. NEUTRONICS, INC. only warrants to the original purchaser as follows: When the products and their component parts are properly installed and maintained in accordance with the published NEUTRONICS, INC. manuals, and if the product has not been modified or tampered with, then only the products actually manufactured by NEUTRONICS, INC. shall be warranted to be free from defects in material and workmanship for a period of 9 months from shipment.
2. The original manufacturers' warranties apply to products and components not manufactured by NEUTRONICS, INC.

## NON-ASSIGNABILITY OF WARRANTY

3. The warranty as set forth in these terms and conditions may not be assigned, transferred, sold, or alienated in any other way and extends only to the original purchaser.

## PURCHASER'S EXCLUSIVE REMEDY

4. The original purchaser's sole and exclusive remedy, unless varied by written agreement with NEUTRONICS, INC., is that NEUTRONICS, INC. will, at NEUTRONICS, INC.'s option, repair or replace any defective part which is returned to NEUTRONICS, INC. within ninety (90) days of discovery of the defect.

## DISCLAIMER OF CONSEQUENTIAL DAMAGES

5. In no event shall NEUTRONICS, INC. be liable for consequential damages, including but not limited to damages for loss of use, damages for lost profits, and damages for resulting harm to property other than the NEUTRONICS, INC. assemblies and their component parts.

## Intended use for the Model EC150 sensor

The Model EC150 oxygen sensor was designed to provide the trained operator with useful information relating to the concentration of Oxygen. This information may be used in process control applications to detect oxygen contamination. Before implementation, the user must fully understand the operation and limitations of this instrument as well as the application for its use. The responsibility for the proper application, operation, installation, and maintenance of the Model EC150 oxygen sensor is the sole obligation of the trained operator. The purchaser is required to ensure operators are properly trained in the use of this unit as well as in the possible hazards associated with its use or with the intended application. The purchaser must ensure that all of the proper warnings, labels, instruction manuals, lock outs, redundant components, hazard analysis, and system validation have been completed and provided to the trained operator before implementation of the Model EC150 instrument.

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