METROTEC

Systems for oxygen measurement

Operating Handbook

A15-N

Oxygen Sensor

Type A15-N

*** Version 1.7 ***

EC Declaration of Conformity

for

Oxygen Sensor

Type A15-N

This device has been designed for industrial purposes in accordance with:

EN 61000-6-4
EN 61000-6-2

It is compliant with the directives:
EMC Directive: 2014/30/EU
Low Voltage Directive: 2014/35/EU
RoHS: 2011/65/EU

This device complies with following standards:
EN 61010-1
EN 61000-6-4
EN 61000-6-2
EN 6300

Description of measures taken to assure compliance:
Quality management system DIN EN ISO 9001:2015, No. 12 100 27736 TMS

This declaration becomes invalid if changes are made without our consent.

Kirchheim/Teck, 07/10/2019

Place, Date | Signature

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1 Safety instructions

Please read through this operating manual very carefully before installing and commissioning the unit.
Incorrect utilisation will invalidate the guarantee!

Correct functioning and the operating safety of the unit can only be guaranteed if the ambient conditions specified in the Specifications chapter are maintained.

Only qualified specialists are permitted to commission and operate the unit. The owner of the unit must ensure that the installation complies with the relevant laws and directives. These include, for example, the EU Directives covering safety in the workplace, national safety in the workplace regulations and the prevention of accidents regulations, etc.

You must ensure that the power supplies concur with the details listed on the nameplate. All of the covers needed to ensure that the unit cannot be touched when operating must always be fitted. You must consider the effects of the overall operation and take the necessary precautions if the unit will be linked up with other equipment and/or devices before you switch on.

Parts and surfaces will occasionally become and remain hot during the installation or de-installation. Suitable precautions must be taken in order to prevent injuries or damage to the unit from occurring.

If the unit shows signs of having been damaged and you are of the opinion that that safe operation is no longer possible then you must not run the unit. We recommend that periodical inspections are carried out at our factory or by our customer service department at least once a year.

Future disposal must always comply with the legal regulations.

2 Introduction

The oxygen monitor and its accessories were subjected to constant quality control and tests in the course of their construction.
All locally applicable regulations and codes of practice should be complied with in the course of their installation and use. In Germany these particularly include VDE and DVGW codes of practice.
The function and accuracy of the measurement system needs to be checked regularly at intervals depending on the application concerned. Such a check must be effected when the system is installed and put into operation for the first time.

3 Measurement principle

The Type A15 Oxygen Measurement Unit is designed to process signals from a stabilized zirconium oxide sensor. Zirconium oxide is a ceramic material, also characterized as a solid-state electrolyte, that has outstanding properties as an oxygen-ion conductor at high temperatures.
Within a certain temperature range, that depends on how the material is doped, such ionic conductors are able to fill the open spaces in their crystal grating with oxygen ions. The oxygen ions form on a conductive contact surface, generally of platinum, and thus the degree of oxygen activity is determined by the concentration of oxygen in the gas that is measured.
In principle, the sensor is in the form of a solid-state electrolyte that is contacted on both sides, on the one side by a reference gas such as air and on the other by the gas to be measured. The sensor is so formed mechanically that the two gases are kept apart so that there is no possibility of them mixing.
Depending on the application concerned, the sensor may be heated or unheated. Unheated sensors are chiefly used within furnaces while heated sensors are used where the gas to be measured has a temperature below 650 degrees Celsius, since the measurement principle necessitates the sensor being at a temperature of at least around 650 degrees.
Heated sensors are provided with electronic temperature regulators to keep them at a predetermined temperature. The electronically measured temperature of both heated and unheated sensors is an important factor in the calculation of the oxygen content (oxygen partial pressure).
Calculation is effected in accordance with the equation:

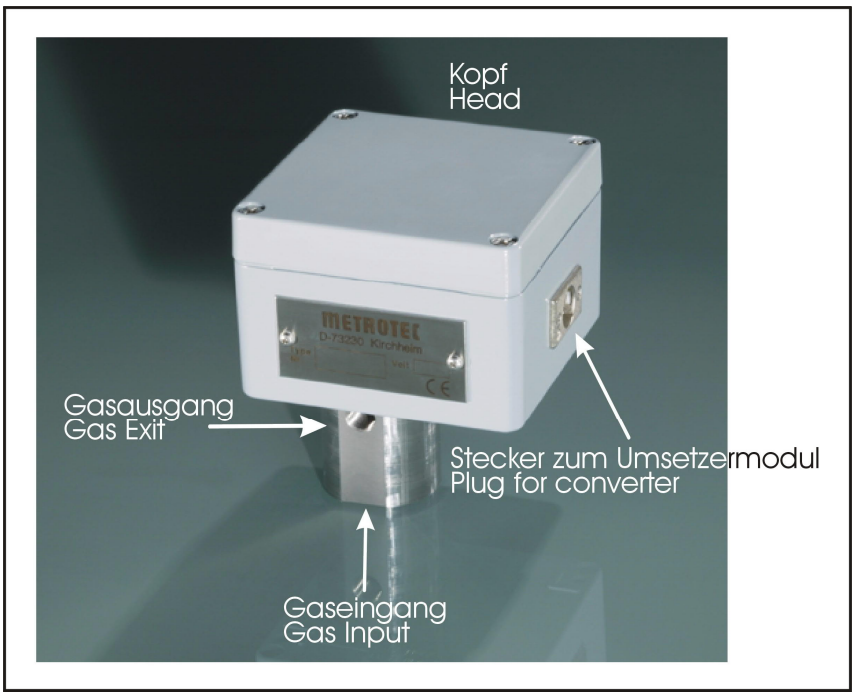
$$EMF = \frac{R \cdot T}{4 \cdot F} \cdot \ln(\frac{P_1}{P_2})$$

whereby:

R	=	8.31J/mol K
T	=	Temperature in Kelvin
F	=	96493 As/mol
P_1	=	Oxygen partial pressure on reference side at 0.20946 bar
P_2	=	Oxygen partial pressure on the measurement gas side
EMF	=	Electromotive force in Volts

4 Construction

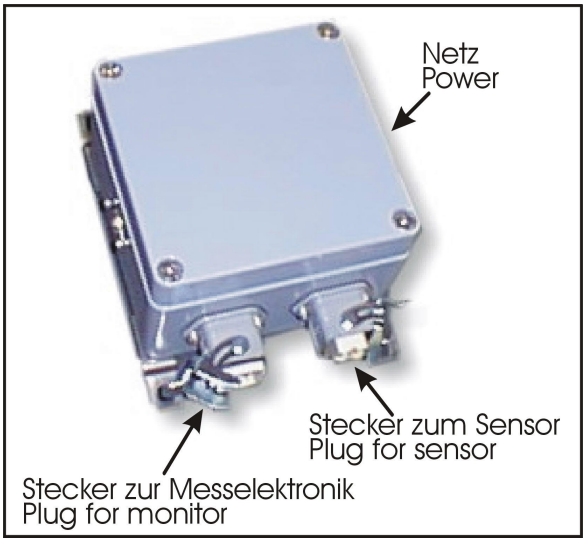
4.1 Sensor



Sensor A15-N

The sensor is contained in a stainless steel body that is mounted in a cast aluminium housing with a connection socket to provide for its connection to the converter module.
Although the sensor can be fitted in any attitude, it is preferable for it to be fitted vertically with the connection head above. The gas to be measured is then fed into the stainless steel body from below and is discharged horizontally.
When connecting the gas supply tubing it should always be inclined downwards away from the sensor to avoid any condensate flowing into the sensor.
The connection head is provided with a multi-pin connection socket to provide for its connection to the converter module.

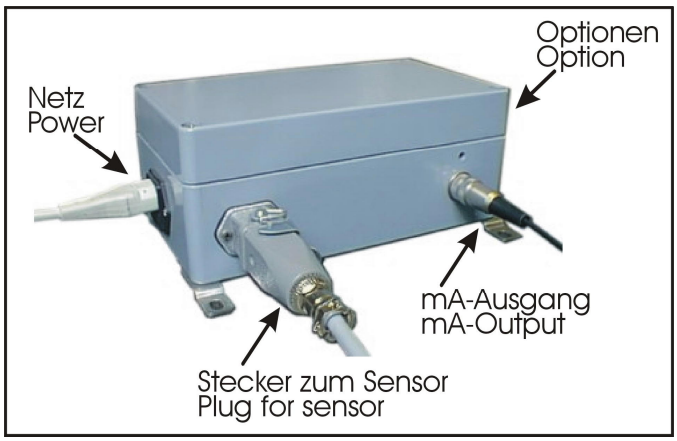
4.2 Converter module Z15



Converter module Z15

The converter module Z15 is housed in a diecast aluminium housing that is provided with lugs to facilitate wall mounting and with two connector sockets, one for the cable that connects it with the sensor A15-N to provide for the heating power and data transmission, another for the cable that connects it to the measurement electronics. The permanently connected power cable has to be connected to a power socket or be permanently connected to a power supply**. (see type lable for correct power voltage; versions are: 230 VAC, 115 VAC, 24 VDC)**
The module contains an electronic circuit that provides for the heating of the sensor and for processing the signal output from the sensor in accordance with the equation detailed in the section headed Measurement principle.

4.3 Converter module Z15-L/-LP



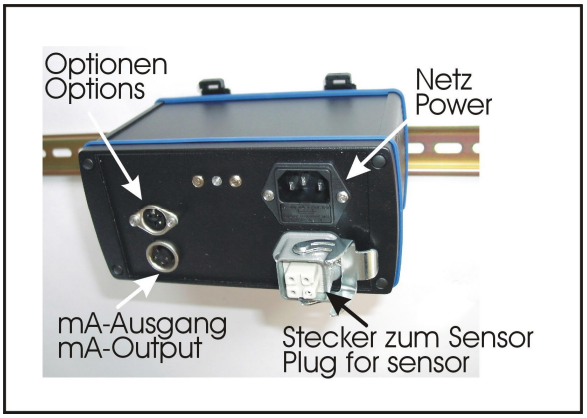
Converter module Z15-L/-LP

The converter module Z15-L/-LP is housed in a diecast aluminium housing that is provided with lugs to facilitate wall mounting. The module is provided with a connector socket for the cable that connects it with the A15-N sensor to provide for heating power and data transmission.
The permanently connected power cable has to be connected to a power socket or be permanently connected to a power supply.
The module contains an electronic circuit that provides for the heating of the sensor and for converting the EMF value output from the sensor to a linearized milliampere signal in accordance with the equation detailed in the section headed Measurement principle.
The standard range is 0 - 20 mA for 0 - 20% oxygen. This milliamp signal is fed to the circular connection socket for output to a milliammeter, controller or chart recorder.
The standard range is deliberately established as 0 to 20 mA so that with a standard unit the mA value exactly equals the oxygen percentage, thus avoiding the need for an additional scale on the milliammeter, regulator or chart recorder.
Special measurement ranges can be provided if required.

Adjacent to the mA output socket there is a potentiometer that facilitates calibration.
The following calibration procedure is recommended:
1. Connect a supply of calibration gas to the sensor
2. Apply the prescribed amount of calibration gas to the sensor
3. Adjust the indicated value by means of the potentiometer
4. Disconnect the supply of calibration gas
5. Restore the original connection to the sensor.

Before calibration verify that the sensor EMF will be 0 mV in case of purging with air.
You need a standard shop type millivoltmeter to connect with the 5-pin socket "Option" with Pin 1 and Pin 3. If necessary adjust to 0 mV by using the adjacent potentiometer .

4.4 Converter module U15



Converter module U15

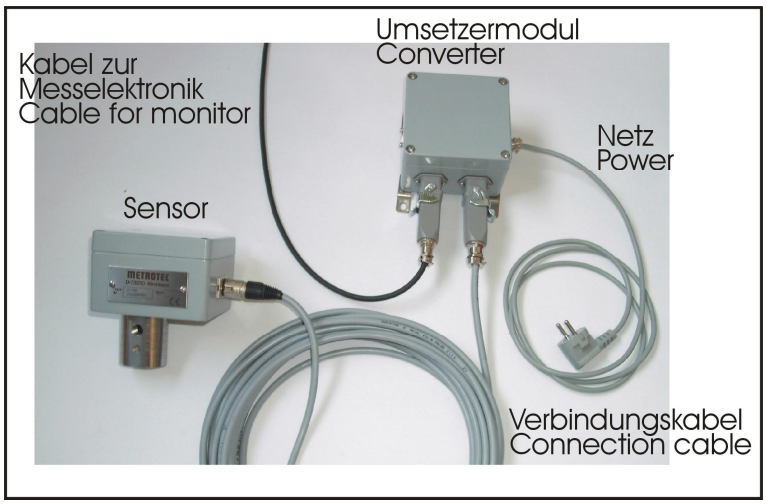
The converter module U15 is housed in a diecast aluminium housing that is provided with lugs to facilitate wall mounting. The module is provided with a connector socket for the cable that connects it with the A15-N sensor to provide for heating power and data transmission.
The permanently connected power cable has to be connected to a power socket or be permanently connected to a power supply.
The module contains an electronic circuit that provides for the heating of the sensor and for converting the EMF value output from the sensor to a linearized milliampere signal in accordance with the equation detailed in the section headed Measurement principle.
The standard range is 0 - 20 mA for 0 - 20% oxygen. This milliamp signal is fed to the circular connection socket for output to a milliammeter, controller or chart recorder.
The standard range is deliberately established as 0 to 20 mA so that with a standard unit the mA value exactly equals the oxygen percentage, thus avoiding the need for an additional scale on the milliammeter, regulator or chart recorder.
Special measurement ranges can be provided if required.

Beside to the mA output socket there is a potentiometer “Gain” that facilitates calibration.
The following calibration procedure is recommended:
1. Connect a supply of calibration gas to the sensor
2. Apply the prescribed amount of calibration gas to the sensor
3. Adjust the indicated value by means of the potentiometer
4. Disconnect the supply of calibration gas
5. Restore the original connection to the sensor.

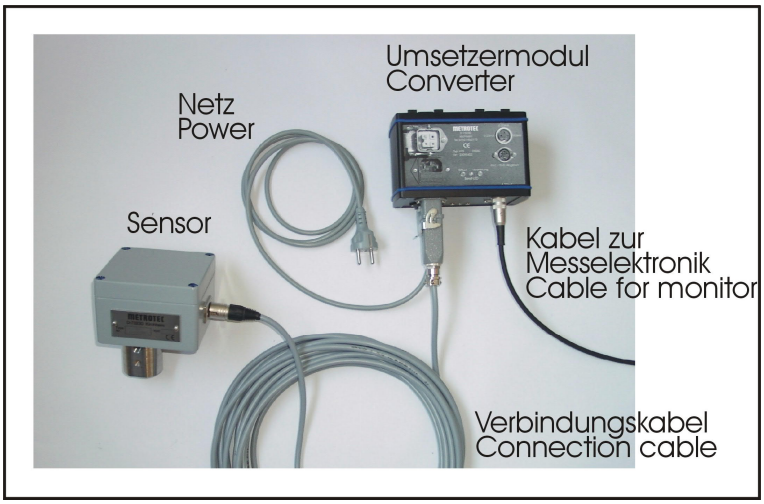
Before calibration verify that the sensor EMF will be 0 mV in case of purging with air.
You need a standard shop type millivoltmeter to connect with the 5-pin socket “Adjust” with Pin 1 and Pin 3. If necessary adjust to 0 mV by using the potentiometer “Offset”.

5 Assembly

5.1 Electrical



Connections to the A15-N sensor with converter module Z15



Connections to the A15-N sensor with converter module U15

The provision of cables ready assembled with connectors makes it easy to effect the electrical connections. The standard version has provision for connection to a computer for further data processing.
In the case of the Z15 version, one cable to monitoring system is needed. (e.g. type GSM)
In the case of the Z15L and U15 version, it is only the 0 to 20 mA output signal that is connected to the peripheral equipment.
The power supply unit is contained in the converter module. (Connect to 230V)

5.2 Mechanical

The sensor is incorporated in the plant with the aid of the cast aluminium housing. In some cases it is necessary for the gas that is to be measured to pass through a wall or insulation material. Where this is necessary, metal or ceramic piping can be used. The use of such piping ensures that the gas is drawn from the required position and that its character will not alter, possibly through admixture with infiltrated air, on its way to the sensor.
If there is a possibility of condensate forming, the piping must slope upwards towards the sensor.
The second connection on the sensor housing has to be connected to the position to which the gas leaving the sensor has to flow. At this position the pressure must be somewhat lower than the gas inlet pressure so that the gas will flow through the sensor from the gas inlet to the gas outlet.
There are various ways in which such a flow of gas can be ensured:
1. Advantage can be taken of positive pressure on the measurement gas side.
2. Advantage can be taken of differential pressure existing within the plant.
3. A gas pump can be used to draw or force the gas through the sensor.

Whatever means is used, a flow of around 50 litres per hour should be maintained. The fitting of a flow meter and a needle valve in the gas piping is helpful and may indeed be necessary. In some installations it will be necessary to fit a flow meter with limit contacts.

6 Options

Special measurement range with converter module Z15-L, Z15-LP, U15:
The standard measurement range is 0 - 20 mA for 0 - 20% oxygen content. This resolution is inadequate for applications calling for the measurement of concentrations of around 1% and so a version is offered in which the 0 - 20 mA output covers a range of 0 - 2% oxygen. This option can only be achieved through modifications made by Metrotec.

7 Wiring plan

Sensor A15-N	
Pin 1	Sensor -
Pin 2	Sensor +
Pin 3	Heating
Pin 4	Heating

Converter module Z15; cable to sensor	
Male connector half	Pins
Pin 1	Heating
Pin 2	Heating
Pin 3	Sensor +
Pin 4	Sensor -
Converter module Z15; cable to monitor	
Female connector half	Sockets
Pin 1	Temperature +
Pin 2	Temperature -
Pin 3	Sensor +
Pin 4	Sensor -

Converter module Z15-L/-LP; cable to sensor	
Male connector half	Pins
Pin 1	Heating
Pin 2	Heating
Pin 3	Sensor +
Pin 4	Sensor -
Converter module Z15-L/-LP cable to monitor	
Female connector half	Pins
Pin 1	mA output +
Pin 3	mA output -

Converter module U15; cable to sensor	
Male connector half	Pins
Pin 1	Heating
Pin 2	Heating
Pin 3	Sensor +
Pin 4	Sensor -
Converter module U15 cable to monitor	
Female connector half	Pins
Pin 1	mA output + for 0-20mA
Pin 3	mA output -
Pin 2	mA output + for 4-20 mA

Note:

- All "Sensor" leads have potential to ground (earth).
- The cable connecting the sensor to the converter has four conductors, each 1.5 mm² If necessary, the screen can be connected at the converter end to PIN 4
- The cable connecting the converter module to the monitor has compensating leads for the Pt 10 thermocouple and two 1 mm² conductors for the sensor signal
  If necessary, the screen can be connected at the converter end to PIN 4

8 Technical Data

Sensor A15-N	
Measurement range	100% to 10 Exp. -31 bar O_2
Ambient temperature	-10 to 70 degrees Celsius
Measurement accuracy	plus/minus 1 mV of sensor EMF
Heating up time for sensor	approx. 5 minutes
Time taken for measurement	approx. 2 seconds
Weight	approx. 2 kg
Dimensions of mounting head	120 mm square x 80 mm deep
Dimensions of sensor body	70 mm long x 50 mm diameter
Gas inlet thread	G 3/8 inch
Gas outlet thread	G 1/4 inch

Converter module Z15	
Ambient temperature	10 to 45 degrees Celsius
Power supply	230 V, 50 Hz
Power	approx. 50 VA
Weight	approx. 2 kg
Dimensions exclusive mounting lugs	120mm square x 80 mm deep
Space needed for mounting lugs and connectors	200x260 mm

Converter module Z15-24V	
Ambient temperature	10 to 45 degrees Celsius
Power supply	24 VDC, PIN 1 = +24; PIN 2 = -24V
Power	approx. 50 VA
Weight	approx. 2 kg
Dimensions exclusive mounting lugs	120mm square x 80 mm deep
Space needed for mounting lugs and connectors	200x260 mm

Converter module Z15-L/-LP	
Ambient temperature	10 to 45 degrees Celsius
Power supply	230 V, 50 Hz
Power	approx.50 VA
Weight	approx. 2,5 kg
Dimensions excluding mounting lugs	120 mm square x 80 mm deep
Space needed for mounting lugs and connectors	300x260 mm
Output	0/4 to 20 mA
Burden	less than 300 Ohm

Converter module U15	
Ambient temperature	10 to 45 degrees Celsius
Power supply	230 V, 50 Hz
Power	approx.50 VA
Weight	approx. 2,0 kg
Dimensions excluding mounting lugs	HxWxD 110x170x80 mm
Space needed for mounting	170x80 mm
Output	0/4 bis 20 mA
Burden	less than 300 Ohm