

User Manual

PolyGard®2 Analog-Relay-Board ARB2

Warning-Sensor-Board for Analog Sensor Series MC2 and AS2

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Imprint

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Technical changes, misprints and errors excepted.
In case of arbitration only the German wording shall be valid and binding.

Made in Germany

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1 General

It is important to read this user manual thoroughly and clearly in order to understand the information and instructions. The PolyGard®2 devices must be used within product specification capabilities.
Due to on-going product development, MSR-Electronic GmbH reserves the right to change specifications without notice. The information contained herein is based upon data considered to be accurate. However, no guarantee is expressed or implied regarding the accuracy of these data.

1.1 Applicability

PolyGard®2 ARB2 Board-Serie ARB2-002

1.2 Intended Use

The PolyGard®2 Analog-Relay-Board ARB2 is a controlling and supply board for sensor units of the analog MC2 and AS2 series for measuring and warning of toxic and combustible environment as well as refrigerant gases.
The ARB2 must only be employed in areas within the environmental conditions as specified in the Technical Data (indoor application). The intended sites are all areas being directly connected to the public low voltage supply, e.g. residential, commercial and industrial environments as well as small enterprises (according to EN 50082).
The PolyGard®2 ARB2 must not be used in potentially explosive atmospheres.

1.3 Safety

The operating instructions must be carefully read and followed by all persons who install, use, maintain and check the product.
The product can only fulfil its intended functions if it is installed, used, maintained, serviced and checked in accordance with the instructions provided by MSR-Electronic GmbH.

1.4 Installers‘ and Operators‘ Responsibilities

It is the installer’s responsibility to ensure that all PolyGard®2 devices are installed in compliance with all national and local codes and OSHA requirements. The device must be checked for correct installation and functionality by a qualified person before measurement operation is started. In Germany, BGR 500 Chapter 2.33 must be applied for this purpose.
The PolyGard®2 devices are tested for function by the manufacturer before delivery. During commissioning, a documented functional test is also required. The installation should only be carried out by trained installation technicians, taking into account the current safety procedures for control installations.
The equipotential bonding required (also e.g. secondary potential to earth) or grounding measures must be carried out in accordance with the respective project requirements. It is important to ensure that no ground loops are formed to avoid unwanted interference in the electronic measuring equipment.
It is also essential to follow strictly all instructions as provided in the user manual.

1.5 Services

It is recommended to check the PolyGard®2 devices regularly. Due to regular maintenance any performance deviations may easily be corrected. Recalibration and part replacement in the field may be implemented by a qualified technician and with the appropriate tools.
Alternatively, the easily removable plug-in sensor with the sensor element may be returned for service to MSR-Electronic GmbH.
Regular maintenance must be carried out in accordance with the instructions.

1.6 Limited Warranty

MSR-Electronic GmbH warrants the PolyGard®2 devices for a period of two (2) years (1 year for sensors) from the date of shipment against defects in material or workmanship. Should any evidence of defects in material or workmanship occur during the warranty period, MSR-Electronic GmbH will repair or replace the product at their own discretion. This warranty does not apply to units that have been altered, had attempted repair, or been subject to abuse, accidental or otherwise. The warranty also does not apply to units in which the sensor element has been overexposed or gas poisoned. The above warranty is in lieu of all other express warranties, obligations or liabilities.
This warranty applies only to the PolyGard®2 devices. MSR-Electronic GmbH shall not be liable for any incidental or consequential damages arising out of or related to the use of the PolyGard®2 devices.

1.7 Part Disposal

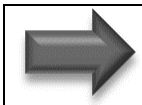


In accordance with Directive 2012/19/EU, the device must not be disposed of as municipal waste. Return the device for disposal to your national sales organisation, which you can contact if you have any questions about disposal.
Outside the EU, you have to consider the corresponding directives.

2 Functional Description

The function of the sensor units MC2 and AS2 is not subject of this manual but can be read in the User Manual of MC2 or AS2.
The ARB2 board is equipped with a 4–20 mA input for connecting one analog MC2 or AS2 sensor unit. The device compares the analog value with 2 alarm thresholds that can be adjusted via potentiometers and, if exceeded, activates the associated alarm relays and - if available – a visual and audible alarm. If the value falls again below the threshold by more than 5 % (internal switching hysteresis), the alarm will be cleared again.
The analog input signal is monitored for < 3 mA and activates the visual and audible alarm if there is no signal. The analog signal of the sensor unit connected to the input is available at the terminals for the control of external actuators. As an option, the PolyGard®2 device comes with a display for showing the current measured value.

3 Installation



Check for completeness and accuracy using the delivery documents and the identification label on the device.



Electronics can be destroyed by electrostatic discharge (ESD). Therefore, the installation work should be done only by persons connected to ground, e. g. by standing on a conductive floor or by taking appropriate grounding measures (acc. to DIN EN 100015).

3.1 Mounting Instructions

When choosing the mounting location, you have to consider the ambient conditions in order to get representative measurement results. Please pay special attention to the following factors:

- External heat sources are not allowed on the installation site.
- Choose mounting location according to the local regulations.
- Consider ventilation conditions! Do not mount next to air passages or suction holes.
- The sample gas must pass the sensor even under adverse flow conditions. A flow test can be performed for instance with smoke tubes.
- If the flow conditions are > 6 m/s, it is advisable to use a wind shield.
- Mount the device at a location with minimum vibration and minimum variation in temperature
- Provide adequate space around the sensor for maintenance and calibration work.
- **The installation height depends on the relative gas density of the monitored gas type and can be read in the User Manual of the MC2 or AS2.**

3.2 Installation Work



Assembly work must only be carried out under gas-free conditions.
The housing must neither be spot-drilled nor drilled through outside the knockouts.
The installation position of the gas detector is always with the sensor head downwards.

The mounting is done through the pre-embossed holes at the backside by means of suitable screws. The exact dimensions are shown at the backside of the housing

4 Electrical Connection



Assembly work must only be carried out under gas-free conditions!
Consider static electricity instructions (ESD)!

4.1 General Notes

- Installation and connection of the electrical installation should only be performed by a professional when de-energized, according to the connection diagram and in accordance with the relevant regulations!
- The technical requirements and regulations for wiring, electrical security, as well as project specific and environmental and local conditions etc. must be observed when mounting.
- All terminals are screw type. The permissible conductor cross section can be read from the Technical Data.
- Avoid any influence of external interferences by using a shielded cable for the 4–20 mA signal, but do not connect the shield.
- Strip the wires as shortly as possible. It is important to ensure that bare wires, e.g. wire shields do not come into contact with the mounted PCB (risk of short-circuit).
- Low voltage wire and mains connected wire must be fixed separately by cable ties or similar to secure against looseness.
- It is recommended to use the following cable types[1]:

Recommendations for	Europe	USA/Canada
Analog signal	J-Y(St)Y 2x2x0,8 LG (20 AWG), loop resistance 73 Ω/km (20,8 Ω/1000 ft.)	min. 300 V
Power supply 230 V	NYM-J 3 x 1,5 mm²	14 AWG / 300 V
Alarm message 230 V (also possible together with power supply)	NYM-J 3 x 1,5 mm²	14 AWG / 300 V

Tabelle 1: Recommended cable types

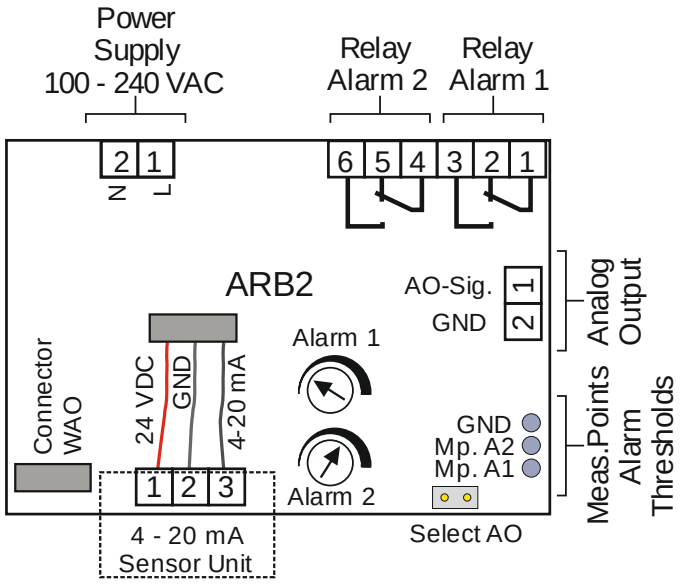
[1] Our recommendation don't consider any local conditions, like fire protection, national regulations etc.

- Use copper conductors only if the terminal is only for connection to copper wire.

When choosing the option "Power Supply ≥ 90 V AC" you have to make sure that a switch or a circuit breaker is provided in the building automation especially for the unit. It must be installed easily accessible near the unit. It has to be marked as a disconnecting device for the unit and shall meet the relevant requirements of IEC/UL 60947-1 and IEC/UL 60947-3.

4.2 Terminal Connection

- Open the cover.
- Insert the cable from above and strip it.
- Remove terminal socket X7, connect cable according to connection diagram
- Figure 1: Figure 2:.
- Replug terminal socket carefully at X7.
- Non-pluggable terminals are available for the other inputs and outputs.
- Close cover.



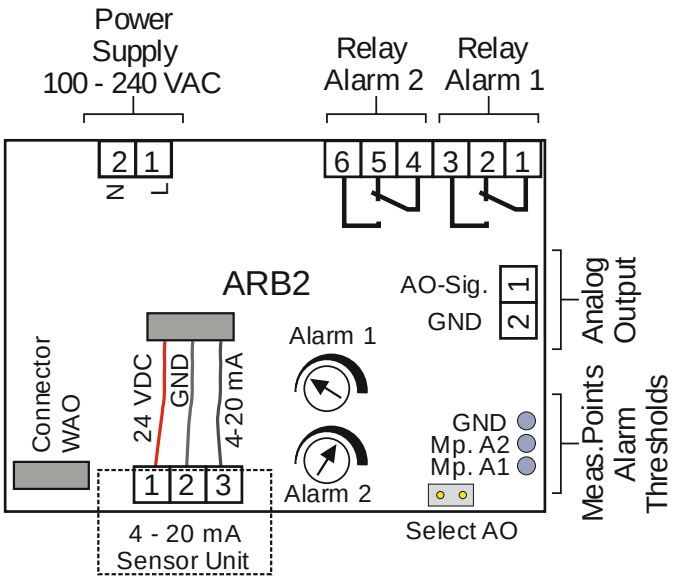


Figure 1: Figure 2:
Electrical Connection 24 V AC/DC Electrical Connection 90–230 V AC

5 Commissioning

5.1 General Notes

All devices without exception run through a complete functional test before delivery.
However, transportation, storage, installation or special environmental conditions may lead to (mostly small) deviations. It is therefore necessary that a person authorized by the manufacturer or alternatively an expert puts the device properly into operation and performs a functional test.
Only trained technicians should perform the following when commissioning:

- Check for correct mounting location.
- Check if connection is correct according to connection diagram.
- Check power voltage.
- Install and connect the MC2/AS2 sensor unit on the housing if not already installed ex works.
- Adjust thresholds.
- Select analog output signal.
- Calibrate MC2/AS2 sensor unit (if not already factory-calibrated) according to user manual of MC2 or AS2.
- Functional tests according to chapter 6.2

External self-holding with catalytic bead sensors
In the case of the catalytic heat of reaction measurement, the high oxygen concentration in the sensor can be used up by a high gas concentration outside of the measuring range, with the result of a decreasing measuring signal due to a reduction in gas combustion in the sensor, even though a high gas concentration is still present. In this state, it cannot be guaranteed that the measured signal is still correct, sensor signal = ambiguous. For this reason, in the case of catalytic bead sensors for combustible gases, an external "self-holding" of the alarm relay has to be provided if the measuring range may possibly be exceeded.

5.2 Installation and Connection of Sensor MC2/AS2

If the sensor unit is already installed ex works, you can skip this paragraph.

- Mount and connect the sensor unit only in a voltage-free state!
- Check gas type, range and calibration date of the sensor unit.
- For housing type A: Define installation place on the housing and break out knockouts.
- Insert sensor unit and tighten it with M32 hexagon lock nut.
- Connection of sensor unit MC2: The 3-pin connector of the ribbon cable is directly connected to the plug at the MC2.
- Connection of Sensor Unit AS2: Connect the 2 wires of the AS2 directly at the side of the ribbon cable (observe polarity): See Figure 3: Figure **4**:.
  - Red wire (+24 V) at pin 1
  - Blue wire (4–20 mA) at pin 3
- Terminal connection for remote sensor unit: See Figure 3: Figure **4**:.
- Remove the red protective cap on the sensor unit only during commissioning in order to avoid damaging the sensor unit due to moisture, dirt, dust or chemical substances.

Note:
Within the first weeks after commissioning, the sensor behaviour may deviate.

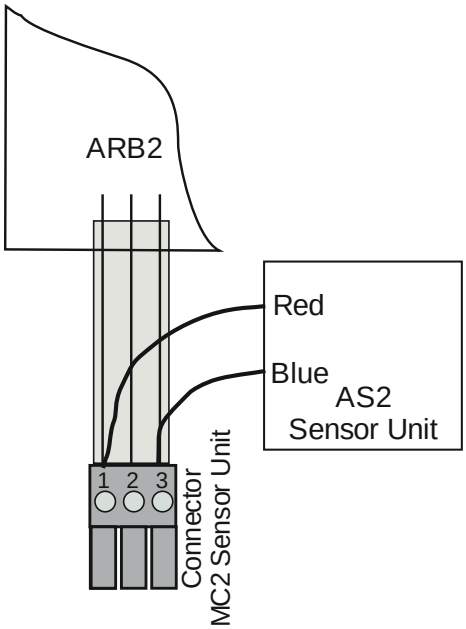


Figure 3:
Connection of sensor unit AS2

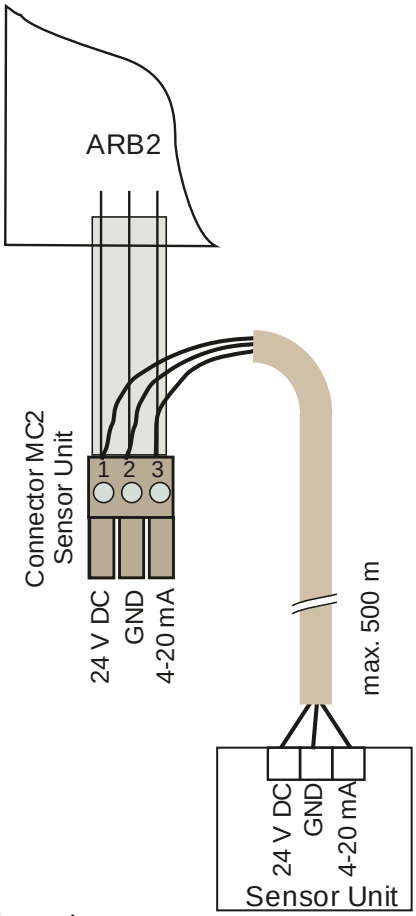


Figure 4:
Connection of sensor unit for remote installation

5.3 Set Alarm Thresholds

The alarm thresholds for controlling the alarm relays are set with the 2 potentiometers AS1 for alarm 1 and AS2 for alarm 2. The scale of the potentiometers indicates the permissible setting range of 10–90 % of the respective measuring range.
If the accuracy of the scale for setting the alarm thresholds is not sufficient, you can use the following formula for calculating the threshold voltage:

$$U_{threshold}\ (mV) = (\%_{alarm\ threshold} * 8\ (mV)) + 200\ (mV)$$

Example:

Sensor unit MC2-0-E1110-FX (carbon monoxide, measuring range MR 300 ppm)
Alarm threshold 1 = 30 ppm (10 % of MR) $U_{threshold}$ = 280 mV
Alarm threshold 2 = 80 ppm (26.66 % of MR) $U_{threshold}$ = 413 mV

This calculated threshold voltage can exactly be set with the potentiometers at the measuring points MP A1 and MP A2 and with the aid of a voltmeter. See Figure 5.

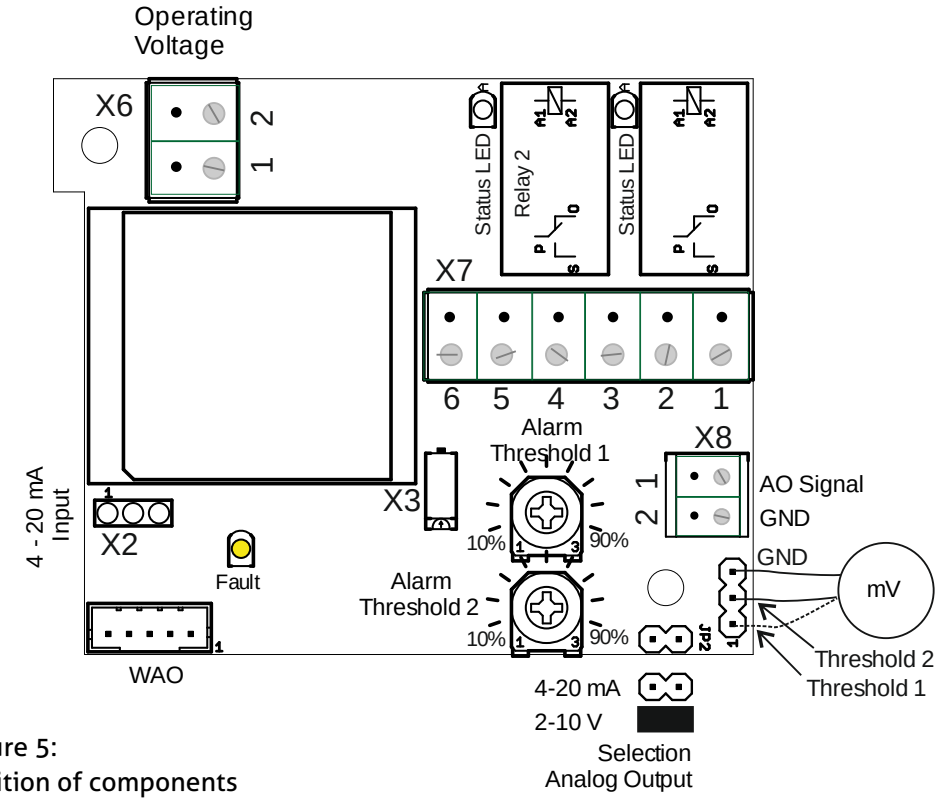


Figure 5:
Position of components

5.4 Selection of Analog Output Signal

The 4–20 mA signal supplied by the sensor unit is evaluated in the ARB2 board and is then available at output terminal X8 for external actuators, etc. In the delivery state, the jumper JP2 is plugged in order that the circuit is closed even without an external actuator. In this mode, X8 has a 2–10 V signal proportional to the 4–20 mA signal.
Jumper JP2:

Plugged in: 2–10 V output signal (delivery state)
Not plugged in: 4–20 mA output signal (only if actuator connected)

5.5 Running-in Characteristics

The connected sensor unit requires a warm-up time after switching on, so that the sensor element assumes a stable state. During this run-in period, the sensor unit only outputs 2 mA. This is detected by the ARB2 as a fault status. The fault LED lights up in yellow during this time. The duration of the run-in time depends on the sensor unit used and the type of gas. See respective user manual of the connected sensor unit.

5.6 Functional Test

The functional test must be carried out and documented in accordance with chapter 6.2.

5.7 Calibration of MC2/AS2

Calibration of the sensor unit during commissioning is only required if the calibration date is no longer current. See User Manual MC2/AS2.

5.8 Table of Functions

Action:	**Reaction relay 1 (alarm 1)**	**Reaction relay 2 (alarm2)**	**Reaction WAO LED buzzer**	**Analog output signal**
Gas signal < alarm threshold 1 and 2	OFF	OFF	GREEN OFF	= Measured value
Gas signal ≥ alarm threshold 1 and < alarm threshold 2	ON	OFF	RED OFF	= Measured value
Gas signal ≥ alarm threshold 2 and < alarm threshold 1	AUS	ON	RED ON	= Measured value
Gas signal ≥ alarm threshold 1 and 2	ON	ON	RED ON	= Measured value
Gas signal < (alarm threshold 2 - hys-teresis) but ≥ alarm threshold 1	ON	OFF	RED OFF	= Measured value
No alarm, no fault	OFF	OFF	GREEN OFF	= Measured value
Run-in period (signal of current 2 mA)	OFF	OFF	YELLOW OFF	= 2 mA
Signal of sensor unit < 3 mA	OFF	OFF	YELLOW OFF	= < 3 mA

Table 2: Functions

Note for alarm threshold:
The 2 alarm thresholds work independently of each other. Alarm threshold 1 activates only alarm relay 1, alarm threshold 2 activates only alarm relay 2. The level of alarm thresholds can also be set independently of each other.

5.9 Faults

In the ARB2, the analog signal of the sensor unit is monitored for < 3 mA. In case of < 3 mA, the internal LED and the status LED on the WAO are lit in yellow.

5.10 Visual and Audible Alarm Message (WAO)

The optional status display with a 3-color LED and a buzzer indicate the operating status.
Green: = Operating voltage OK, no alarm, no fault
Red: = Alarm 1 and / or alarm 2 active
Yellow: = Fault
Buzzer: = Alarm 2 active

5.11 Display

In conjunction with the sensor unit MC2, the display shows the current measured value. The gas type, the unit and the measuring range are automatically taken over by the sensor unit MC2. Settings on the display are not possible.

6 Inspection and Service

It is obligatory to perform maintenance regularly in order to maintain safety, measuring and warning functions of the device. The maintenance includes visual, functional and system inspections and must only be carried out by appropriately qualified personnel.
When carrying out maintenance and repair work according to the user manual, only use original spare parts from MSR-Electronic. Repairs or changes on the warning device not complying with the maintenance manual or carried out by unauthorized persons can affect proper device and safety functions and always result in a termination of the manufacturer's warranty and certificates.
For regular maintenance und calibration of the sensor by trained technicians we recommend concluding a service contract with MSR or one of their authorized partners.
According to EN 45544-4, inspection and maintenance has to be executed at regular intervals. The maximum intervals have to be determined and observed by the person responsible for the gas warning system according to the legal requirements. MSR-E recommends applying the inspection and maintenance intervals as prescribed in the general regulations of the gas measuring technique like EN50545, VDI-2053, EN 60079-29-1 etc. The inspection interval normally is 3 months. The recommended service intervals are listed in the User Manual of the AS2/MC2 sensor unit.
Inspections and services must be documented. The date for the next maintenance has to be affixed to the sensor.

6.1 Inspection

Gas sensors should be controlled regularly by a competent person according to EN 45544-4. The following has to be checked in particular:

- Maintenance/calibration interval not exceeded.
- Visual inspection of the sensor including cable for damage, vandalism etc.
- Remove dust deposits etc. with a dry cloth, especially at the gas inlet.
- The filter at the gas inlet has to be replaced if extremely dirty.

6.2 Service and Calibration

When performing the maintenance, you have to do the calibration and the functional test in addition to the inspection. The procedure for the calibration and test gas application can be found in the User Manual for the MC2/AS2 Sensor used.
Functional check alarm relay:

- Apply test gas with a concentration ≥ of the set alarm threshold. The alarm relay must change into the alarm status and the actuated device must go into alarm status.

Functional check analog output (only necessary if the analog output is used):

- Apply test gas. Check the proper reaction of the connected actuator.

The functional control must be documented by a protocol stating at least:
Identification of the gas detector, type and concentration of the zero gas and test gases used, display before and after calibration with zero and test gas, response time, deficiencies fixed and measures started with the date and name of the person responsible for the functional check.

6.3 Repairs

Please always apply the operating and maintenance instructions when repairing and replacing parts of the gas warning device. For safety reasons replace parts only by original spare parts from the manufacturer.
Appropriate technical qualification is necessary for further repair work, which may only be carried out by the manufacturer or by trained and authorized service partners.
The responsibility for proper operation and condition of the gas detection device after repair lies with the technician who has done the work and/or with the entrepreneur.
After repair before restart, you have to check the function and the system depending on the type of repair.

6.4 Exchange of Sensor

Instead of the on-site calibration, the used sensor unit can be replaced easily and conveniently by a calibrated one.

- Exchange the sensor unit only in a voltage-free state
- Sensor unit MC2: Unplug the 3-pin connector of the MC2. Unplug the display communication cable if available.
- Sensor unit AS2: Disconnect the red and blue connecting wires at the 3-pin connector.
- Loosen the locknut and remove the sensor unit.
- Take the calibrated sensor unit out of the original packaging, check it for gas type, measuring range and valid calibration date.
- Insert the sensor unit and retighten it with the locknut.
- Sensor unit AS2: Connect the red and blue connecting wires to the 3-pin connector, observe the polarity. See Figure 3.
- Sensor unit MC2: Replug 3-pin connector at the MC2. Replug the display communication cable, if available.

After switching on the operating voltage, the measuring mode starts automatically.
A functional test is required according to the commissioning instructions, chapter 5.

7 Technical Data

Electrical		
Power supply	24 V DC ± 20 %, AC ± 15 %, reverse-polarity protected	
Power consumption (24 V)		
• Control Board	Max. 60 mA (1.5 VA), w/o sensor, w/o WAO	
• Sensor (MC2)	Max. 85 mA (2.1 VA)	
• WAO	Max. 40 mA (1.0 VA)	
Overvoltage category	I	
Alarm relays (2)	250 V AC, 5 A; 30 V DC, 2 A, potential-free, change-over contact (SPDT)	
Analog input	4–20 mA overload and short-circuit proof, input resistance 130 Ω	
Tension for analog sensor unit	24 V DC, max.100 mA	
Analog output signal	Proportional, overload and short-circuit proof, load ≤ 500 Ω (for 12 V DC supply max. 200 Ω) 4–20 mA or 2–10 V	
AMBIENT CONDITIONS		
Temperature range	-25 °C to +50 °C (-13 °F to +122 °F)	
Humidity range	15–95 % RH not-condensing	
Pressure range	90–110 kPa	
Pollution degree	2 (for indoor use only), not suitable for wet environment	
Permissible height above sea level	1500 m (approx. 5000 ft.)	
Storage temperature	-20 °C bis +65 °C (-40 °F to +149 °F)	
Storage time	6 months	
Physical		
Housing	**Type A**	**Type G**
Material	Polycarbonate	Polycarbonate
Combustion	UL 94 V2	UL 94 V2
Housing colour	Light grey RAL 7032	Light grey RAL 7032
Dimensions W x H x D in mm / (inch.)	94 x 130 x 57 / (3.70 x 5.12 x 2.24)	94 x 130 x 81 (3.70 x 5.12 x 3.18)
Weight ca. in kg / (lb.)	0.25 / (0.55)	0.3 (0.66)
Protection class (delivery status)*	NEMA 4X (IP65)	NEMA 4X (IP65)
Installation	Wall mounting, sensor downwards	
Knockouts for cable entry	2x M12 / 3x M20	2x M12 / 3x M20
Knockouts for MC2/AS2/WAO	2x	2x
Wire connection:		
• Power supply, field bus	Screw-type terminals 0.25–2.5 mm², 24–10 AWG	
• Analog in/output; dig. input	Screw-type terminals 0.25–2.5 mm², 24–10 AWG	
• Relays	Screw-type terminals 0.25–1.3 mm², 24–16 AWG	
Cable lengths for remote sensor	500 m (1640 ft.)	
REGULATIONS		
Directives	EMC directives 2014/30/EU Low voltage directive 2014/35/EU CE EN 61010-1:2010 Option: ANSI/UL 61010-1 CAN/CSA-C22.2 No. 61010-1	
Warranty	1 year on sensor (not if poisoned or overloaded), 2 years on device	

Table 3: Technical Data ARB2

[1] If there are changes on the housing it has to be re-evaluated.

OPTIONS	
DISPLAY	
Display	2 lines, 16 characters each
Consumption	5 V, 60 mA, 0.3 VA
WAO STATUS-LED/BUZZER	
LED colour / mode	Red / yellow / green (alarm – fault – operation)
Buzzer - acoustic pressure	> 85 dB (A)
Buzzer - frequency	2300 Hz ± 300 Hz
Protection class	IP65
POWER SUPPLY 110/230 V AC	
Wide range input	100–240 V AC, 50/60 Hz
Consumption	Max. 5 VA
Overvoltage category	II
POWER SUPPLY 12 V	
Power consumption (12 V DC)	
- Control Board	Max. 120 mA (1.5 VA), w/o sensor, w/o WAO
- Sensor	Max. 170 mA (2.1 VA)
- WAO	Max. 80 mA (1.0 VA)

Table 4: ARB2 Options

All specifications were collected under optimal test conditions.
We confirm compliance with the minimum requirements of the applicable standard.

8 Figures

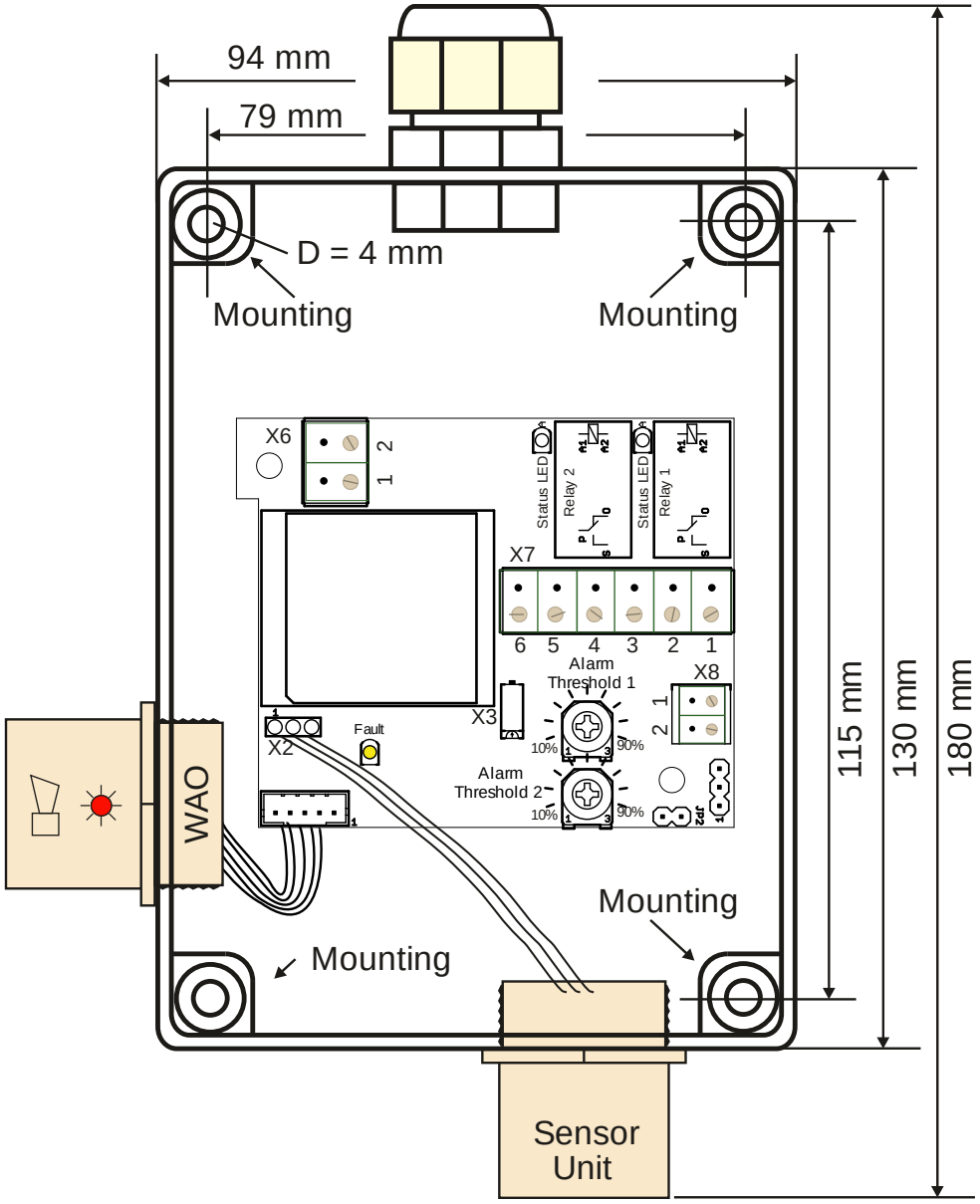


Figure 6:
Dimensions Housing A

List of Abbreviations

Units

Hz	Hertz
db	Dezibel
kPa	Kilopascal
in.	Inch
m	Metre
mA	Milliampere
mm^2	Square millimetre
mV	Millivolt
ppm	Parts per million
s	Second
VA	Voltampere
V AC	Volt for Alternating Current
V DC	Volt for Direct Current
°C	Degree Celsius
°F	Degree Fahrenheit

Products from MSR-Electronic

ARB2	PolyGard®2 Analog-Relay-Board ARB2
AS2	PolyGard®2 Sensor AS2 for Carbon Monoxide with Analog Output
MC2	PolyGard®2 Sensor MC2 with Analog Output

Others

DIN	Deutsches Institut für Normung (German standard)
EN	Europäische Norm (European standard)
EU	European Union
ESD	Electrostatic Discharge
LED	Light-emitting diode
max.	Maximum
min.	Minimum
RH	Relative Humidity
e.g.	Example given

Glossary

Run-in time
Time the sensor needs to be continuously supplied with the operating voltage for stabilisation before calibration.

Test gas
Gas mixture of known composition used for testing and calibrating the sensor

Revision List

Version	Date	Chapter	Reason for change / Notes
2021-11	17.11.2021		New format, µGard removed, AS2 added
2022-05	23.05.2022	7, 8	Housing N removed
2022-10	10.10.2022	4.2, 5.3	Update of connection diagrams, AO and GND interchanged