ABB

AX460, AX466 and AX416
Single and dual input analyzers for pH/Redox (ORP)

Measurement made easy
More processing power,
higher performance

Cost effective
- select one or two pH/Redox (ORP) inputs or combine pH/Redox (ORP) and conductivity in one analyzer

Reduced installation cost
- easy access terminations; reduced panel space

High functionality at minimum cost
- three alarms and two fully isolated current outputs
- integral water / chemical sensor cleaner control
- integral PID controller (AX460)

Expanded monitoring and control
- add-on option board provides a total of five alarm relays and four current outputs
- service logbook providing historical data

On line assurance of reliability
- comprehensive sensor and instrument self-checking

Energy saving
- high visibility, backlit display with auto switch-off function

Reduced yearly maintenance costs
- 12 to 30 V DC option negates the need for costly safety tests

Wide range of applicability
- water and waste water treatment
- power, pure water
- semiconductors
- chemicals
- pharmaceuticals
- pulp & paper

The AX400 series

AX400 analyzers incorporate the latest technology to provide highly reliable, flexible, feature-packed devices that satisfy a diverse range of process monitoring and control applications. The complete range encompasses solutions for pH/Redox (ORP), conductivity and dissolved oxygen.

AX46x analyzers enable continuous measurements of one or two pH or Redox (ORP) points with simultaneous local display and retransmission. AX46x is used with glass, enamel and antimony pH electrodes and metal Redox sensors, providing measurements with exceptional accuracy and performance.

AX400 series analyzers are available for either wall-/pipe- or panel-mounting and are rated to IP65.

High functionality as standard

All versions are supplied with two, fully isolated current outputs as standard, that can be assigned to the measured parameter, sample temperature or any appropriate calculated variables.

Three programmable relay set points are available that can also be assigned as required.

Innovative features such as power-saving display and a diagnostic current output option all contribute to a low cost of ownership.

Plug-and-produce expanded control

An advanced function card provides an additional two current outputs and two further alarm relays that can be assigned to either measured values or sample temperature.

ABB plug-and-produce software automatically reconfigures the analyzer if an option board is added later. No user programming is necessary.

A real-time clock and logbook are also included, making the full-facility versions extremely powerful and versatile.
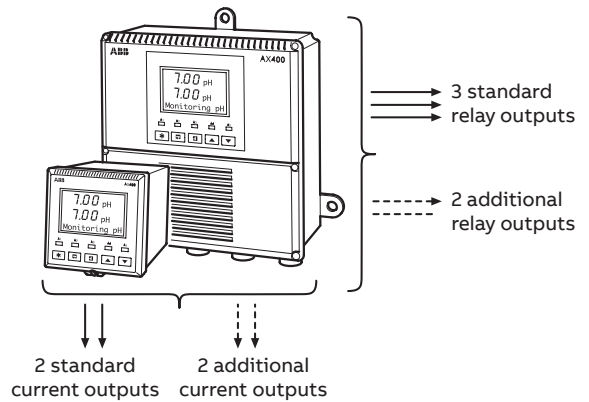
AX400 outputs

Significantly reduced maintenance costs

The AX400 analyzers are supplied as standard for 85 to 265 V AC operation. There are no inner switches to set.

They can also be provided for 24 V AC or 12 to 30 V DC supply and recognize automatically which of the two supplies is being used. 24 V DC operation reduces maintenance costs significantly by negating the need for costly, yearly safety tests to ensure compliance with safety procedures.

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Energy saving display

The backlit display has been designed to operate in all types of environments and shows both the measured parameter(s) and, on a separate 16-character display line, diagnostic and computed information.

On dual-input analyzers both measured parameters are displayed simultaneously.

For conservation of energy, the backlight can be set to switch off automatically after 60 s of inactivity.

Backlight can be set to switch off when inactive

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Easy access installation terminals

Easy access to the terminations ensures rapid and cost-effective installation. The wall-/pipe-mount version has been designed to ensure that cable connection is simple and convenient. Ingress protection of the electronics section is retained even when the terminal compartment is opened.
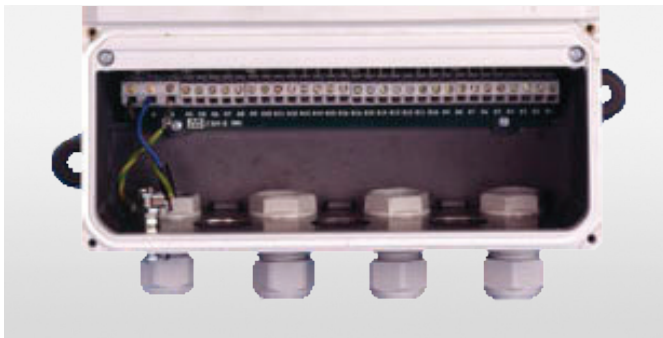

AX400 termination chamber makes access easy

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## Dual input measurement for critical duties

The AX400 enables two continuous measurements with simultaneous local display and retransmission. This capability provides an on-line validation of the process measurement.

Making two simultaneous measurements and configuring one of the set points as a difference alarm provides continuous on-line checking and early warning of an invalid measurement.
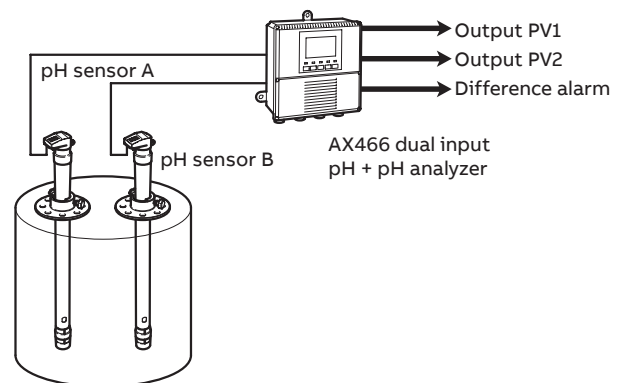

Dual-input comparator for critical measurements

Detecting breakthrough of ammonia in a chiller unit is made possible with dual measurement. Comparison before and after the chiller ensures extremely rapid leakage detection, preventing damage to the system.
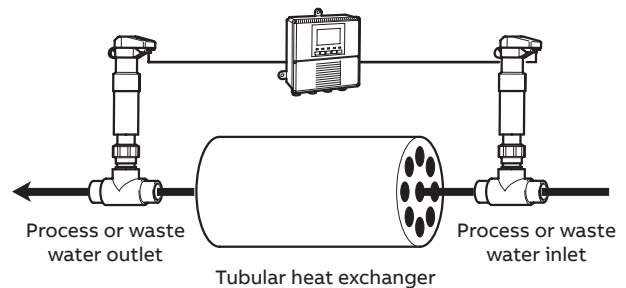
Ammonia leakage detection in a chiller unit

Waste treatment pH and Redox (ORP)

pH and Redox (ORP) are essential control parameters when removing toxic chromium ions from waste water in metal-finishing applications. Dual pH and Redox analyzers and integral control simplifies installation and reduces investment costs.
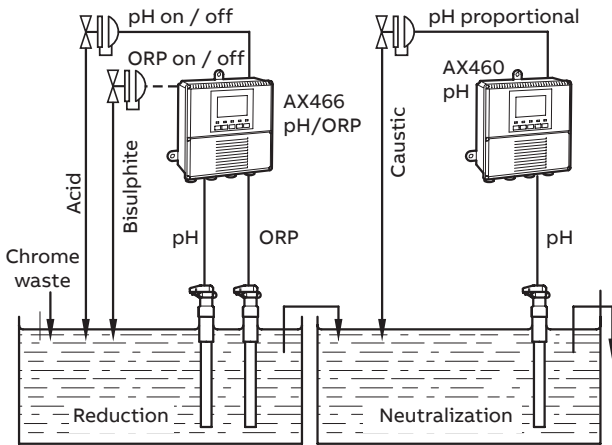
Waste treatment pH and Redox (ORP)

Just-in-time maintenance

One of the most vulnerable times for a pH electrode is during reintroduction into the line. If used with a solution earth rod, AX46x analyzers with advanced diagnostic facilities can detect sensor breakages as they occur. In addition, they can detect sensors out-of-process and several reference faults for fault diagnosis and reduced downtime.
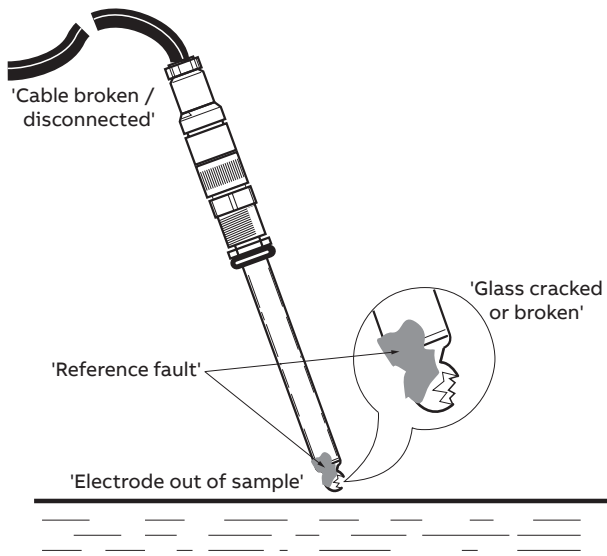

Just-in-time maintenance.

Reduced maintenance through in-line cleaning

Many installed pH sensors benefit from regular cleaning. When carried out manually, this can be laborious and costly – so is often ignored. Advanced AX400 pH analyzers make it possible to automate sensor cleaning by using a programmable wash-timer contact to activate a cleaning agent valve or pump.

Pulsed water-wash and jet-wash chemical clean actions are standard, user-selectable functions. The frequency and duration of the wash can be tuned to meet the requirements of the application.

For chemical cleaning a 60 liter (13 gallon) sensor cleaning station can be supplied (model no. AA0010), complete with delivery pump and low level alarm. Chemical cleaning has proved particularly successful on potable drinking water plants where manganese and iron in the sample can create unacceptably high levels of maintenance. Effective cleaning reduces cost of ownership.
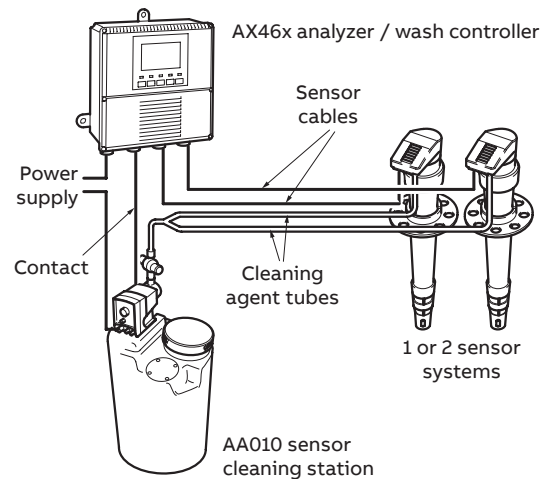
Efficient auto-cleaning control for one or two sensor systems
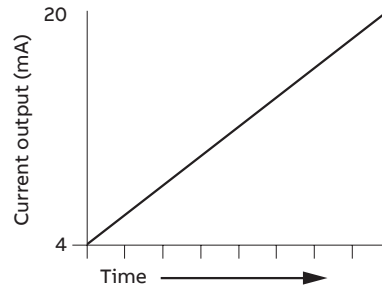
Combined conductivity and pH

The AX416 version measures conductivity and pH with the same analyzer. The option board provides the capability to retransmit pH, conductivity and both sample temperatures. Five programmable alarms can be assigned to suit the needs of the application, enabling even the most demanding requirements to be met.

Simultaneous conductivity and pH measurement

AX460 integral P, PI and PID control

The single input AX460 analyzers incorporate three-term PID Control, offering three modes of sophisticated control: analog, pulse length (time proportional) and pulse frequency. These are supplied as standard and can be operated in direct- or reverse-acting mode, dependent upon the application.

Auto / Manual and bumpless transfer
An auto / manual feature is incorporated for rapid manual access to the control functions. The controller facilitates bumpless transfer between manual and auto modes, providing the measured variable is within the proportional band and some integral action time has been programmed.

AX460 – integral P, PI, and PID control

Current output proportional control
In this case, the control signal is provided by the 4 to 20 mA output of the AX460 analyzers rather than using the alarm / control contacts. The magnitude of the current output changes in proportion to the deviation from set point. This method is used generally with motorized valves or when controlling the speed of dosing pumps with a 4 to 20 mA proportional input.
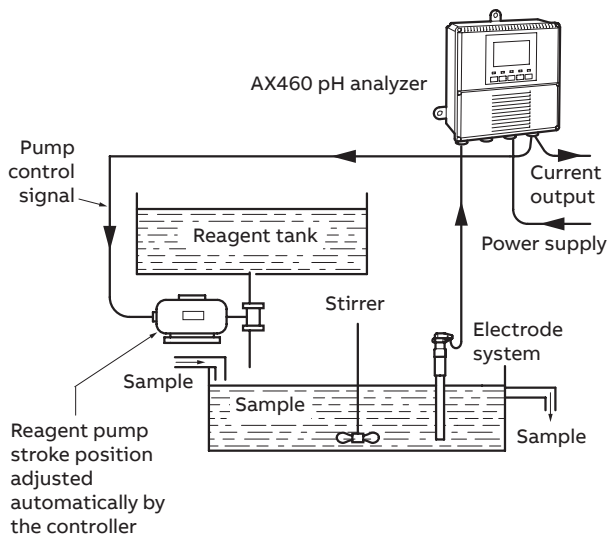

Current acting control

Time proportioning control (pulse length)
With time proportioning control, the AX460 analyzer's control signal output is in pulses, the duration of which changes in proportion to the system error. The pulses are delivered by varying the length of time that the alarm / control contact is activated.

Time proportioning control is used generally to control dosing by low-cost solenoid valves or metering pumps and is also known as pulse-length proportional or 'Mark Space' control.
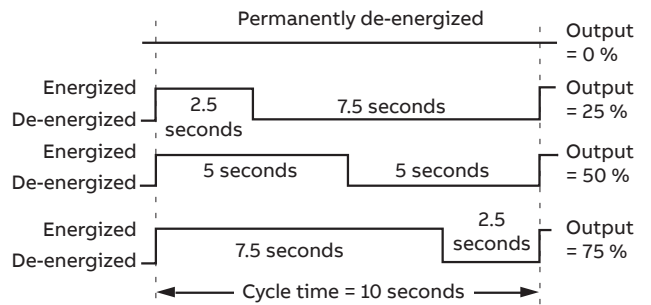

Time proportioning control

Bi-directional control
As well as single set point control for both acid and base addition, the AX460 analyzer can be configured with independent controllers.

To avoid control overlap, a minimum of 0.5 pH difference (or deadband) between the set points is essential. The difference between the set points varies depending upon the application.

Control of each set point can be configured independently as either P or PI control in this mode. The setting of proportional band or integral action can also be different for each set point.
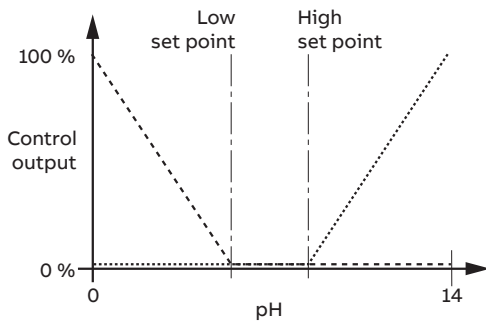

Bi-directional control

Pulse-frequency proportional control
Impulse pumps dosing chemical reagents are controlled easily by the AX460 analyzer's pulse-frequency proportional control output. In this case, the pulse length of the alarm / control contact is fixed and the frequency of the delivered pulses increases in proportion to the system error, as set by the proportional band. Diaphragm metering pumps must have a remote pulse input capability in order to utilize this function.

Pulse-frequency control in the AX460 analyzer operates by pulsing a relay on for 300ms and off for a period of time determined by the pulse frequency. The pulse frequency (PFr) is adjustable between 1 and 120 pulses per minute. The greater the difference between the measured variable and the set point the greater the pulse frequency.

Example
If the pulse frequency is set at 120 pulses per minute and the percentage output is 100 % then the pulse rate is 2 pulses per second. If the percentage output is reduced to 50 %, the pulse rate falls to one pulse per second.
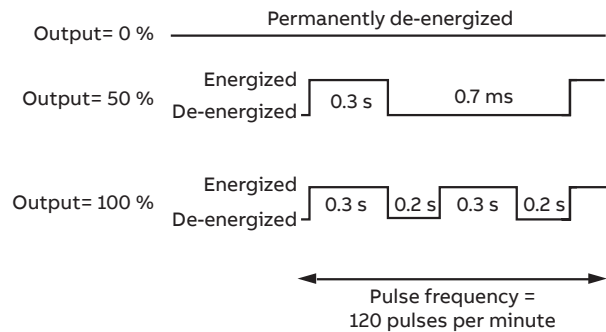
Pulse-frequency proportional control

Power failure recovery
In the event of a power failure the user can configure the control mode to be Auto, Manual or Last. This optimizes control conditions on power-up to ensure rapid recovery of process control.

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Specification

pH/Redox (ORP) – AX460 and AX466

Inputs
- One or two* pH or mV inputs and solution earth
- One or two* temperature sensors
- Enables connection to glass or enamel pH and reference sensors and Redox (ORP) sensors

Input resistance
- Glass >1 x $10^{13}\Omega$
- Reference 1 x $10^{13}\Omega$

Range
- –2 to 16 pH or –1200 to +1200 mV

Minimum span
- Any 2 pH span or 100 mV

Resolution
- 0.01 pH

Accuracy
- 0.01 pH

Temperature compensation modes
- Automatic or manual Nernstian compensation
  - Range –10 to 200 °C (14 to 392 °F)
- Process solution compensation with configurable coefficient
  - Range –10 to 200 °C (14 to 392 °F) adjustable –0.05 to 0.02 %/°C (–0.02 to 0.009 %/°F)

Temperature sensor
- Programmable Pt100, Pt1000 or Balco 3kΩ

Calibration ranges

Check value (zero point)
- 0 to 14 pH

Slope
- Between 40 and 105 % (low limit user configurable)

Electrode calibration modes

Calibration with auto-stability checking
- Automatic 1 or 2 point calibration selectable from:
  - ABB
  - DIN
  - Merck
  - NIST
  - US Tech
- 2 x User-defined buffer tables for manual entry, 2-point calibration or one-point process calibration

Conductivity – AX416 only

Range
- Programmable 0 to 0.5 to 0 to 10,000 µS cm^{-1} (with various cell constants)

Minimum span
- 10 x cell constant

Maximum span
- 10,000 x cell constant

Units of measure
- µS cm^{-1}, µS m^{-1}, mS cm^{-1}, mS m^{-1}, MΩ-cm and TDS

Accuracy
- Better than ±0.01 % of span (0 to 100 µS cm^{-1})
- Better than ±1 % of reading (10,000 µS cm^{-1})

Operating temperature range
- –10 to 200 °C (14 to 392 °F)

Temperature compensation
- –10 to 200 °C (14 to 392 °F)

Temperature coefficient
- Programmable 0 to 5 %/°C and fixed temperature compensation curves (programmable) for acids, neutral salts and ammonia

Temperature sensor
- Programmable Pt100 or Pt1000

Reference temperature
- 25 °C (77 °F)

Display

Type
- Dual 5-digit, 7-segment backlit LCD

Information
- 16-character, single line dot-matrix

Energy-saving function
- Backlit LCD configurable as ON or Auto-Off after 60 s

Logbook**
- Electronic record of major process events and calibration data

Real-time clock**
- Records time for logbook and auto-manual functions

*AX466 only

**Available if option board is fitted.

Relay outputs – on/off

Number of relays

Three supplied as standard or five
with option board fitted

Number of set points

Three supplied as standard or five
with option board fitted

Set point adjustment

Configurable as normal or failsafe high / low
or diagnostic alert

Hysteresis of reading

Programmable 0 to 5 % in 0.1 % increments

Delay

Programmable 0 to 60 s in 1 s intervals

Relay contacts

Single-pole changeover
Rating 5 A, 115 / 230 V AC, 5 A DC

Insulation

2 kV RMS contacts to earth / ground

Analog outputs

Number of current outputs (fully isolated)

Two supplied as standard or four with option board fitted

Output ranges

- 0 to 10, 0 to 20 or 4 to 20 mA
- Analog output programmable to any value between
  0 and 22 mA to indicate system failure

Accuracy

±0.25 % FSD, ±0.5 % of reading (whichever is the greater)

Resolution

0.1 % at 10 mA , 0.05 % at 20 mA

Maximum load resistance

750Ω at 20 mA

Configuration

Can be assigned to either measured variable or
either sample temperature

Digital communications

Communications

Profibus DP (with option board fitted)

Control function – AX460 only

Controller type

P, PI, PID (configurable)

Control outputs

Output

Can be assigned a maximum of two relays,
two analog outputs, or one of each

Analog

Current output control (0 to 100 %)

Time proportioning cycle time

1.0 to 300.0 s, programmable in increments of 0.1 s

Pulse frequency

1 to 120 pulses per minute, programmable in increments
of 1 pulse per minute

Controller action

Reverse, direct or bi-directional (programmable)

Proportional band

0.1 to 999.9 %, programmable in increments of 0.1 %

Integral action time (Integral reset)

1 to 7200 s, programmable in increments of 1 s (0 = Off)

Derivative

0.1 to 999.9 s in increments of 0.1 s –
only available for single set point control

Auto / Manual

User-programmable

Access to functions

Direct keypad access

- Measurement, maintenance, configuration,
  diagnostics and service functions
- Performed without external equipment
  or internal jumpers

Sensor cleaning function

Configurable cleaning action relay contact

- Continuous
- Pulse in 1 s on and off times

Frequency

5 minutes to 24 hours, programmable in 15 minute
increments up to 1 hour then in 1 hour increments
for 1 to 24 hours

Duration

15 s to 10 minutes, programmable in 15 s increments up to
1 minute then in 1 minute increments up to 10 minutes

Recovery period

30 s to 5 minutes, programmable in 30 s increments

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...Specification

Mechanical data

Wall- / Pipe-mount versions
- IP65 (not evaluated under UL certification)
- Dimensions 192 mm high x 230 mm wide x 94 mm deep (7.56 in. high x 9.06 in. wide x 3.7 in. deep)
- Weight 1 kg (2.2 lb.)

Panel-mount versions
- IP65 (front only)
- Dimensions 96 mm x 96 mm x 162 mm deep (3.78 in. x 3.78 in. x 6.38 in. deep)
- Weight 0.6 kg (1.32 lb.)

Cable entry types

Standard	5 or 7 x M20 cable glands
North American	7 x knockouts suitable for ½ in. Hubble gland

Power supply

Voltage requirements
- 100 to 240 V AC, 50 / 60 Hz (90 V min. to 264 V max. AC)
- 12 to 30 V DC

Power consumption
10 W

Insulation
Mains to earth (line to ground) 2 kV RMS

Environmental data

Operating temperature limits
–20 to 55 °C (–4 to 131 °F)

Storage temperature limits
–25 to 75 °C (–13 to 167 °F)

Operating humidity limits
Up to 95 %RH non condensing

EMC

Emissions and immunity
Meets requirements of:
- EN61326 (for an industrial environment)
- EN50081-2
- EN50082-2

Approvals, certification and safety

Safety approval
UL

CE mark
Covers EMC & LV Directives
(including latest version EN 61010)

General safety
- EN61010-1
- Overvoltage Class II on inputs and outputs
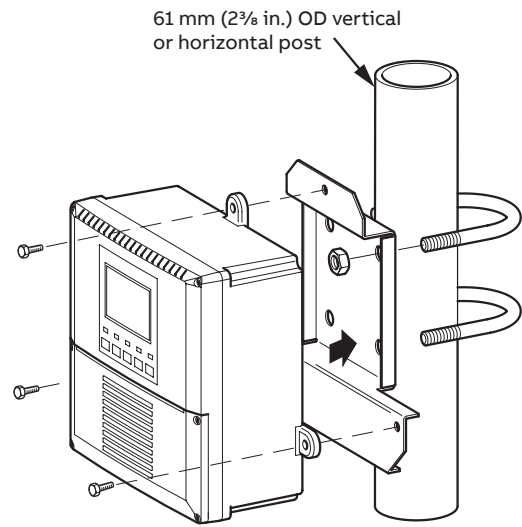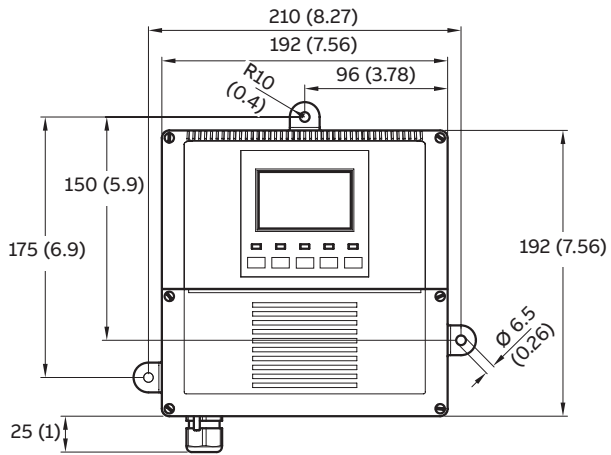- Pollution category 2
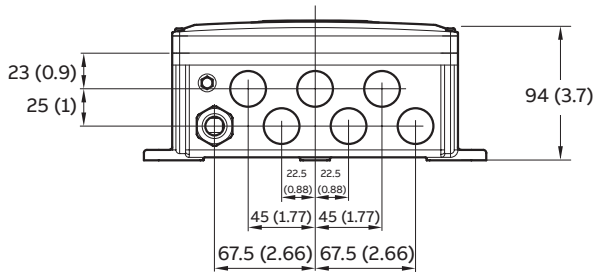
Languages

Languages configurable:
- English
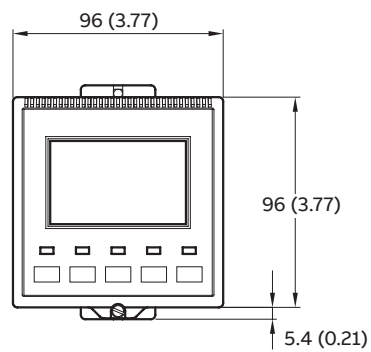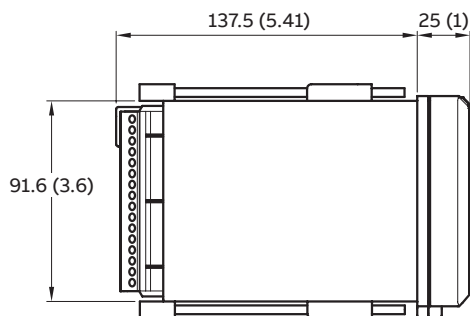- French
- German
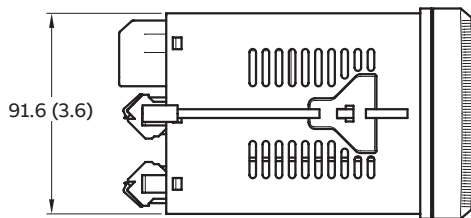- Italian
- Spanish

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Overall dimensions

Dimensions in mm (in.)

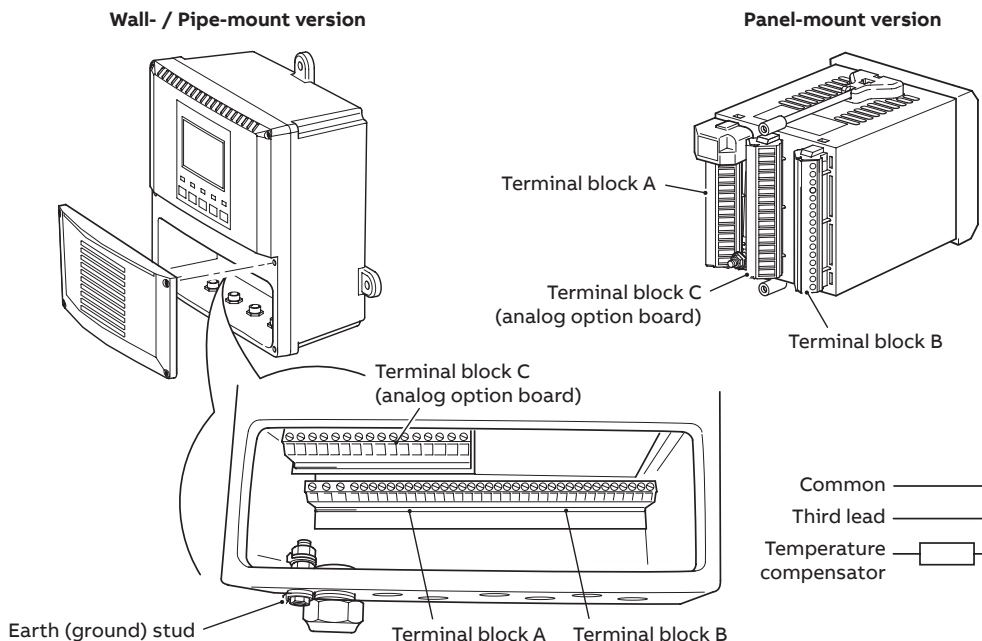**Wall- / Pipe-mount version**

Pipe-mount detail

Panel-mount version

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Electrical connections

Wall- / Pipe-mount version

Panel-mount version

Terminal block A

Terminal block C
(analog option board)

Terminal block B

Terminal block C
(analog option board)

Common
Third lead
Temperature
compensator

Earth (ground) stud

Terminal block A   Terminal block B

Terminal block A

L	Live	
N	Neutral	
E	Earth	
A4	C	Relay 1
A5	NC	
A6	NO	
A7	C	Relay 2
A8	NC	
A9	NO	
A10	C	Relay 3
A11	NC	
A12	NO	
A13	+	Analog output 1
A14	–	
A15	+	Analog output 2
A16	–	

**Terminal block C
(analog option board)**

C1	Not used	
C2	Not used	
C3	Profibus – DP A	
C4	Profibus – DP B	
C5	Profibus earth	
C6	Not used	
C7	C	Relay 4
C8	NC	
C9	NO	
C10	C	Relay 5
C11	NC	
C12	NO	
C13	+	Analog output 3
C14	–	
C15	+	Analog output 4
C16	–	

Terminal block B
(see table below)

B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12
B13
B14
B15
B16

Terminal block B

Sensor B	Sensor A	pH/Redox (ORP) without solution earth‡	pH/Redox (ORP) with solution earth‡	Conductivity
1	9	Temperature compensator common* Link 1 & 2 / 9 & 10**	Temperature compensator common* Link 1 & 2 / 9 & 10**	Temperature compensator common Link 1 & 2 / 9 & 10**
2	10	Temperature compensator third lead*	Temperature compensator third lead*	Temperature compensator third lead
3	11	Temperature compensator*	Temperature compensator*	Temperature compensator
4	12	Not applicable	Reference electrode	Screen
5	13	Not used	Not used	Cell (cell electrode)
6	14	Reference electrode	Solution earth‡	Cell (earth electrode)
7	15	Screen*	Screen*	Not used
8	16	Glass / Metal electrode	Glass / Metal electrode	Not used

*If fitted.
**When a 2-wire Pt100, Pt1000 or BALCO temperature compensator is fitted.
‡Solution earth also referred to as ground rod.

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Ordering information

Single and dual input analyzers for pH/Redox (ORP) and conductivity models AX460, AX466 and AX416	AX4	X	X	X	X	X	0	X
First process variable (PV1)								
Conductivity 0 to 10,000 µS cm^{-1} for 2-electrode sensors		1						
Conductivity 0 to 1,999 mS cm^{-1} for 4-electrode sensors		3						
Conductivity USP<645> for 2-electrode sensors		5						
pH/Redox (ORP)		6						
Dissolved oxygen		8						
Second process variable (PV2)*								
No second process variable – select for PID control of PV1			0					
Conductivity 0 to 10,000 µS cm^{-1} for 2-electrode sensors			1					
Conductivity 0 to 1,999 mS cm^{-1} for 4-electrode sensors**			3					
Conductivity USP<645> for 2-electrode sensors			5					
pH/Redox (ORP)			6					
Dissolved oxygen			8					
Enclosure types								
Wall-mount IP65, general								
Wall-mount – cable glands fitted				1				
Pipe-mount				2				
Wall-mount IP65, North American								
Wall-mount				6				
Pipe-mount				7				
Panel-mount, universal								
Panel-mount**				5				
Advanced functions and communications								
Basic (2 current outputs + 3 relays)					0			
Advanced (4 current outputs + 5 relays + logbook)					1			
Profibus DP, basic (2 current outputs + 3 relays)**					2			
Profibus DP, advanced (4 current outputs + 5 relays + logbook)**					3			
Power supply								
100 to 240 V AC 50 / 60 Hz						0		
12 to 30 V DC						1		
Reserved							0	
Manual								
English								1
French								2
Italian								3
German								4
Spanish								5

*   When ordering units with a second process variable (PV2) the code digit for PV2 in the order code number must be equal to, or greater than, the code digit for PV1 (for example, AX416 is permissible, AX461 is not permissible).

** Profibus DP is not available in panel-mount housing when 0 to 1,999 mS/cm is selected as the second process variable (PV2).

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Acknowledgements

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Notes

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