AX430, AX433, AX413 and AX436
Single and dual input analyzers for high level conductivity
Measurement made easy
More processing power, higher performance

Cost effective
• select one or two conductivity inputs or combine pH/Redox (ORP) with conductivity in one analyzer
• integral PID controller (AX430)

Advanced measuring capabilities
• conductivity range up to 1,999 mS cm\(^{-1}\)
• selectable concentration ranges:
  0 to 15 % NaOH, 0 to 18 % HCl, 0 to 20 % H\(_2\)SO\(_4\),
  0 to 40 % H\(_3\)PO\(_4\), 0 to 20 % NaCl and user-defined

Dosing control functionality
• long dose diagnostic alarm
• initial charge function

Reduced installation cost
• easy access terminations; reduced panel space

High functionality at minimum cost
• three alarms and two fully-isolated current outputs
• direct linear, reverse acting or bi-linear output

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

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

Wide range of applicability
• regeneration of ion exchangers
• municipal water phosphoric acid control
• food & beverage product / water interface detection
• clean-in-place concentration monitoring
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.

AX43x analyzers enable continuous measurements of one or two conductivity points with simultaneous local display and retransmission. AX43x is used with the TB4 and AC400* Series of insertion, immersion and flow-through, four-electrode conductivity cells providing measurements with exceptional accuracy and performance.

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

* Check with factory for availability.

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 which can also be assigned as required.

Innovative features such as a 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.

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.
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 seconds of inactivity.

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
Advanced conductivity and concentration monitoring

AX43x conductivity analyzers measure up to 1,999 mS cm⁻¹, enabling operation in the majority of high concentration processes. Automatic and manual temperature compensations enable effective measurements up to 300 °C (572 °F).

In addition, these analyzers enable operation directly in terms of concentration: 0 to 15 % NaOH, 18 % HCl, 20 % H₂SO₄, 40 % H₃PO₄, 20 % NaCl and user-defined. This is particularly suited for strength-monitoring of ion exchange regenerant acid and alkali.

Dosing control functionality

The analyzer controls phosphoric acid strength in water treatment plants. In food and beverage CIP and bottle-washing processes plant, AX43x analyzers provide cost-effective control for the strength of caustic and acid detergents. It can be used to detect the presence of detergent, rinse water or product, safely protecting the product from detergent ingress. It also optimizes product yield, ensuring that the maximum quantity of product is retained rather than sent to drain.

In addition, the analyzers provide the freedom to program a user’s own conductivity-to-concentration curve. This enables configuration for non-standard CIP detergents or specific reagent mixtures.

Detection of detergent in rinse water reduces costs by recovering lost cleaning agents and reducing the load on the effluent treatment plant.
AX436 combined conductivity and pH

The AX436 version measures conductivity and pH with the same analyzer. The option board provides the capability to retransmit conductivity, pH and both sample temperatures. This is particularly useful in the paper industry, reducing the investment in separate instruments, for example, when used on white water or the head box.
### Long-dose alarm function

An important diagnostic capability incorporated in AX43x analyzers is the long-dose alarm function. This is useful for occasions when faults occur in the dosing system.

The analyzers can be configured to provide an alarm if a set point has not been reached within a specified time. This valuable facility provides a warning that could indicate a loss of dosing chemicals, a leakage or a costly pump failure.

![Diagram of long-dose alarm function](image)

#### Initial charge function

In some applications, fresh dosing chemical reagent is made up every few days. For example, in bottle-washing plants the caustic solution can become dirty and must be replaced regularly. In the case of a new charge, i.e. making up a fresh reagent dilution, a general long-dose alarm could be initiated before the reagent had attained the correct concentration.

AX43x analyzers provide a simple solution by having a pre-configurable initial charge function. A simple button press from the operator page disables the general long-dose alarm until the conductivity or concentration reaches 90% of the set point. The initial charge period is also user-programmable.

![Diagram of initial charge function](image)
AX430 integral P, PI and PID control

The single input AX430 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.

Current output proportional control
In this case, the control signal is provided by the 4 to 20 mA output of the AX430 analyzer 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.

Time proportioning control (pulse length)
With time proportioning control, the AX430 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 generally used to control dosing by low-cost solenoid valves or metering pumps and is also known as pulse-length proportional or ‘mark space’ control.

Pulse-frequency proportional control
Impulse pumps dosing chemical reagents are controlled easily by the AX430 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 AX430 analyzer operates by pulsing a relay on for 300 ms 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.
**Specification**

**Conductivity**

**Range**

- **Conductivity** programmable
  - 0.000 to 1999 mS cm⁻¹ (uncompensated)
- **Concentration**
  - 0.000 to 1.999 digits (user configurable)
- **Selectable concentration ranges**
  - 0 to 15 % NaOH
  - 0 to 18 % HCl
  - 0 to 20 % H₂SO₄
  - 0 to 40 % H₃PO₄
  - 0 to 20 % NaCl
- **User-defined table**

**Temperature**

- –20 to 300 °C
  - (–4 to 572 °F)

**(Sensor full scale measurement ranges)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Measurement Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; AC400 cells</td>
<td>0 to 1,999 mS cm⁻¹ (uncompensated)</td>
</tr>
<tr>
<td>Group B cells</td>
<td>0 to 1,999 µS cm⁻¹ (uncompensated)</td>
</tr>
</tbody>
</table>

**Minimum span**

<table>
<thead>
<tr>
<th>Group</th>
<th>Minimum span</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; AC400 cells</td>
<td>100.0 µS cm⁻¹</td>
</tr>
<tr>
<td>Group B cells</td>
<td>10.00 µS cm⁻¹</td>
</tr>
</tbody>
</table>

**Concentration**

- 5% of the maximum set concentration range

**Temperature**

- 10 °C (50 °F)

**Note.** Refer to corresponding data sheets for process limit specifications of TB4 and AC400 cells.

**Resolution, display**

- **Conductivity**
  - (a) TB4 Group A and AC400 cells: 0.1 µS cm⁻¹
  - (b) TB4 Group B cells: 0.01 µS cm⁻¹
- **Concentration**: 0.001 digits (configuration dependent)

**Accuracy, display**

- **Conductivity**: ±0.5 % measurement range per decade
- **Temperature**: ±0.1 °C (0.1 °F)

**Display temperature range**

- –20 to 300 °C (4 to 572 °F)

**Temperature sensor**

- Pt1000 or 3k Balco

**Temperature coefficient**

- Programmable 0 to 9.99 %/°C and fixed temperature compensation curves (programmable) for acids and neutral salt

**Reference temperature**

- 25 °C (77 °F)

**Dosing control functions**

- Long-dose alarm: 0 to 10 mins. (user-configurable)
- Initial charge function: 0 to 30 mins. (user-configurable)

**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

**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, bandwidth alarm (composite 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 range**

- 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**

- 750 Ω at 20 mA

**Configuration**

- Can be assigned to either measured variable or either sample temperature

*Available if option board is fitted.*
...Specification

Digital communications
Communications
  Profibus DP (with option board fitted)

Control function – AX430 only
Controller type
  P, PI, PID (configurable)
Control outputs
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
  Direct or reverse
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 –
  available only for single set point control
Auto / Manual
  User-programmable

Access to functions
Direct keypad access
  • Measurement, maintenance, configuration,
    diagnostics or service functions
  • Performed without external equipment
    or internal jumpers

Mechanical data
Wall- / Pipe-mount versions
  • IP65 (not evaluated under UL certification)
  • Dimensions (height, width, depth)
    192 x 230 x 94 mm (7.56 x 9.06 x 3.7 in.)
  • Weight 1 kg (2.2 lb.)
Panel-mount versions
  • IP65 (front only)
  • Dimensions (height, width, depth)
    96 x 96 x 162 mm (3.78 x 3.78 x 6.38 in.)
  • 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

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
Overall dimensions

Dimensions in mm (in.)

Wall- / Pipe-mount version

Panel-mount version
Electrical connections

Wall- / Pipe-mount version

Panel-mount version

Terminal block A

Earth (ground) stud

Terminal block A

Terminal block B

Terminal block C
(analog option board)

Terminal block C
(analog option board)

Terminal block A

Terminal block B

Common

Third lead

Temperature compensator

---

Electrical connections

<table>
<thead>
<tr>
<th>Sensor B</th>
<th>Sensor A</th>
<th>TB4 series connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>B9</td>
<td>Blue</td>
</tr>
<tr>
<td>B2</td>
<td>B10</td>
<td>None*</td>
</tr>
<tr>
<td>B3</td>
<td>B11</td>
<td>Yellow</td>
</tr>
<tr>
<td>B4</td>
<td>B12</td>
<td>Dark green</td>
</tr>
<tr>
<td>B5</td>
<td>B13</td>
<td>Green</td>
</tr>
<tr>
<td>B6</td>
<td>B14</td>
<td>Red</td>
</tr>
<tr>
<td>B7</td>
<td>B15</td>
<td>White</td>
</tr>
<tr>
<td>B8</td>
<td>B16</td>
<td>Black</td>
</tr>
</tbody>
</table>

*For conductivity sensors without a 3-wire temperature element, link terminals B1 and B2 and terminals B9 and B10.
## Ordering information

<table>
<thead>
<tr>
<th>Single and dual input analyzers for high level conductivity, models AX430, AX433, AX413 and AX436</th>
<th>AX4</th>
</tr>
</thead>
<tbody>
<tr>
<td>**AX430, AX433, AX413 AND AX436 CONDUCTIVITY ANALYZERS</td>
<td>DS/AX4CO4-EN REV. K**</td>
</tr>
<tr>
<td><strong>First process variable (PV1)</strong></td>
<td></td>
</tr>
<tr>
<td>Conductivity 0 to 10,000 µS cm⁻¹ for 2-electrode sensors</td>
<td>1</td>
</tr>
<tr>
<td>Conductivity 0 to 1,999 mS cm⁻¹ for 4-electrode sensors</td>
<td>3</td>
</tr>
<tr>
<td>Conductivity USP&lt;645&gt; for 2-electrode sensors</td>
<td>5</td>
</tr>
<tr>
<td>pH/Redox (ORP)</td>
<td>6</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>8</td>
</tr>
<tr>
<td><strong>Second process variable (PV2)</strong></td>
<td></td>
</tr>
<tr>
<td>No second process variable – select for PID control of PV1</td>
<td>0</td>
</tr>
<tr>
<td>Conductivity 0 to 10,000 µS cm⁻¹ for 2-electrode sensors</td>
<td>1</td>
</tr>
<tr>
<td>Conductivity 0 to 1,999 mS cm⁻¹ for 4-electrode sensors**</td>
<td>3</td>
</tr>
<tr>
<td>Conductivity USP&lt;645&gt; for 2-electrode sensors</td>
<td>5</td>
</tr>
<tr>
<td>pH/Redox (ORP)</td>
<td>6</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>8</td>
</tr>
<tr>
<td><strong>Enclosure types</strong></td>
<td></td>
</tr>
<tr>
<td>Wall-mount IP65, general</td>
<td></td>
</tr>
<tr>
<td>Wall-mount – cable glands fitted</td>
<td>1</td>
</tr>
<tr>
<td>Pipe-mount</td>
<td>2</td>
</tr>
<tr>
<td>Wall-mount IP65, North American</td>
<td></td>
</tr>
<tr>
<td>Wall-mount</td>
<td>6</td>
</tr>
<tr>
<td>Pipe-mount</td>
<td>7</td>
</tr>
<tr>
<td>Panel-mount, universal</td>
<td>5</td>
</tr>
<tr>
<td><strong>Advanced functions and communications</strong></td>
<td></td>
</tr>
<tr>
<td>Basic (2 current outputs + 3 relays)</td>
<td>0</td>
</tr>
<tr>
<td>Advanced (4 current outputs + 5 relays + logbook)</td>
<td>1</td>
</tr>
<tr>
<td>Profibus DP, basic (2 current outputs + 3 relays)**</td>
<td>2</td>
</tr>
<tr>
<td>Profibus DP, advanced (4 current outputs + 5 relays + logbook)**</td>
<td>3</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td></td>
</tr>
<tr>
<td>100 to 240 V AC 50 / 60 Hz</td>
<td>0</td>
</tr>
<tr>
<td>12 to 30 V DC</td>
<td>1</td>
</tr>
<tr>
<td><strong>Reserved</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Manual</strong></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>1</td>
</tr>
<tr>
<td>French</td>
<td>2</td>
</tr>
<tr>
<td>Italian</td>
<td>3</td>
</tr>
<tr>
<td>German</td>
<td>4</td>
</tr>
<tr>
<td>Spanish</td>
<td>5</td>
</tr>
</tbody>
</table>

---

* 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, AX436 is permissible, AX463 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).
Acknowledgements

PROFIBUS is a registered trademark of PROFIBUS and PROFINET International (PI).