

ABB MEASUREMENT & ANALYTICS | DATA SHEET

## **AV450 and AV455**

Single and dual input UV nitrate monitor



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## **Measurement made easy**

A robust, easy-to-use range of continuous on-line monitors

### **Dual input gives two measurements in one instrument**

- cost-effective

### **Reagentless operation**

- significant savings in operational expenditure costs

### **Automatic cleaning**

- maintains the integrity of the measurement with minimal intervention

### **Annual replacement of wiper blades is only planned maintenance**

- virtually zero maintenance

### **Dual wavelength measurement compensates for both turbidity and organics content**

- no expensive filtration required

### **Long lamp life**

- up to 10 years operation keeping cost-of-ownership to a minimum

### **Automatic on-line diagnostics**

- maintains the integrity of the measurement

## AV400 Series nitrate monitor

The AV450 and AV455 Nitrate Monitors are designed for use on potable water treatment plants to determine the quality of the final treated water. They can also be used for blending of high and low nitrate waters and borehole water. The monitor provides continuous analysis with the minimum of manual intervention and extremely low running costs – no expensive chemical reagents are required.

The flow-through system is supplied complete with inlet isolating valve, drain and a wall-mount bracket as standard.

### Dual-wavelength measurement

In addition to the measurement of nitrate at 220nm another measurement at a different wavelength compensates for interference from both turbidity up to 100NTU or Dissolved Organics (as Humic Acids) up to 20mg/l. This sophisticated advanced technology ensures a superior compensation providing greater security of performance in applications when there are widely fluctuating sample conditions. It also removes the need for expensive and maintenance-prone filtration systems, significantly reducing maintenance demands and simplifying the measurement.

### Reagentless operation

The monitor is a straight-through system requiring no consumable reagents or pump tubes, keeping the cost of ownership to an absolute minimum.

### Maintenance

Minimal maintenance is required due to the simplicity of the monitor. Apart from periodic validation of the calibration of the monitor and annual replacement of the wiper blades, there is no need for manual intervention.

### Calibration

Calibration is a simple procedure using high-quality demineralized water for zero and sodium nitrate as the standard solution to adjust the span.

The monitor design ensures that the system is extremely stable and calibration needs to be performed only once or twice a year.

### Installation of the sensor

A wall-mount bracket is supplied as standard to enable the flow-through sensor to be mounted on the back-plate.



Adding demineralized water

### Alarms

Three alarms are supplied as standard. These can be configured as high or low programmable alarms or as a status alarm.

### Light source

The light source is monitored continuously for correct operation and is operated at a fraction of the normal frequency of the operating voltage intended by the manufacturer. Only 13% of the rated lamp life is used in 10 years. This results in a very stable light source, keeping operating costs to a minimum.

### Auto-cleaning

Optical cleaning is a key feature, ensuring optimum performance with the minimum of manual intervention. The cleaning interval is programmable to accommodate varying sample conditions.



Auto-cleaning mechanism

## AV400 Series transmitter

The transmitter incorporates the latest technology to provide a highly reliable, yet flexible, feature-packed device designed to satisfy a diverse range of process monitoring and control applications. On dual-input monitors both measured parameters are displayed simultaneously.

### High functionality as standard

All versions are supplied with two fully isolated current outputs as standard. Both outputs can be ranged independently on single input versions. Each one can be assigned to either sensor input on dual input versions. Three programmable relay set points are available that 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.



Dual nitrate display

### Significantly reduced maintenance costs

The transmitters are supplied as standard for 85 to 265V AC operation. There are no inner switches to be set. The transmitters can also be provided for 9 to 36V DC operation that reduces maintenance costs significantly by removing the need for costly, annual 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.

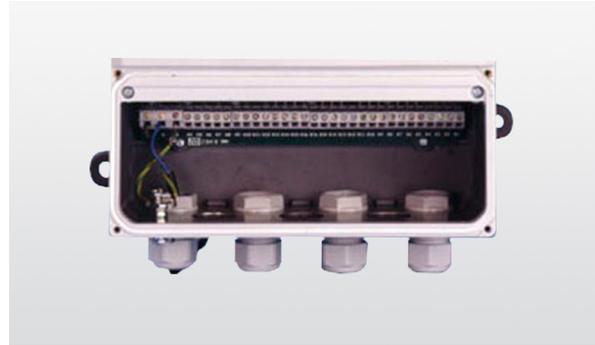
For conservation of energy, the backlight can be set to switch off automatically after 60s of inactivity.



Backlight can be set to switch-off when inactive

### 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.



AV400 Termination chamber makes access easy

## Applications

There are a number of applications within Potable Water Treatment where the AV450 Series UV Nitrate monitor can be used.

### Intake protection

Monitoring the nitrate levels at the point of abstraction, from either river or bore hole sources, enables the plant to control the nitrate throughout the plant.

### Nitrate reduction

Complete removal of nitrate is not a practical and cost effective option. Reducing the nitrate levels to below the consent limits is the preferred method.

The consent limits for nitrates are:

- EU and WHO –50mg<sup>l</sup><sup>-1</sup> as NO<sub>3</sub><sup>-</sup>
- US –10mg<sup>l</sup><sup>-1</sup> as N (45mg<sup>l</sup><sup>-1</sup> NO<sub>3</sub><sup>-</sup>)

De-nitrification is the process of reducing the nitrate levels. A mixture of physical and chemical processes are used for de-nitrification.

Four de-nitrification methods in common use, making use of reliable on-line monitoring, are:

#### 1 Blending

This method is really nitrate reduction. Water with a low nitrate level from another source is added to the raw water to bring the nitrate level down below the maximum value. Nitrate monitoring is required to control the blending process.

#### 2 Ion-exchange

The process involves drawing-off a percentage of the water, passing it through an ion-exchange bed that removes the nitrate and returning the water back into the main stream. By adjusting the ratio of the two streams, the nitrate level in the final blended water is reduced to the required level.

Monitoring the outlet of the ion-exchange bed enables automatic control of the regeneration process (also monitored here) and the blended water enables accurate control of the final nitrate concentration going to distribution.

#### 3 Reverse osmosis

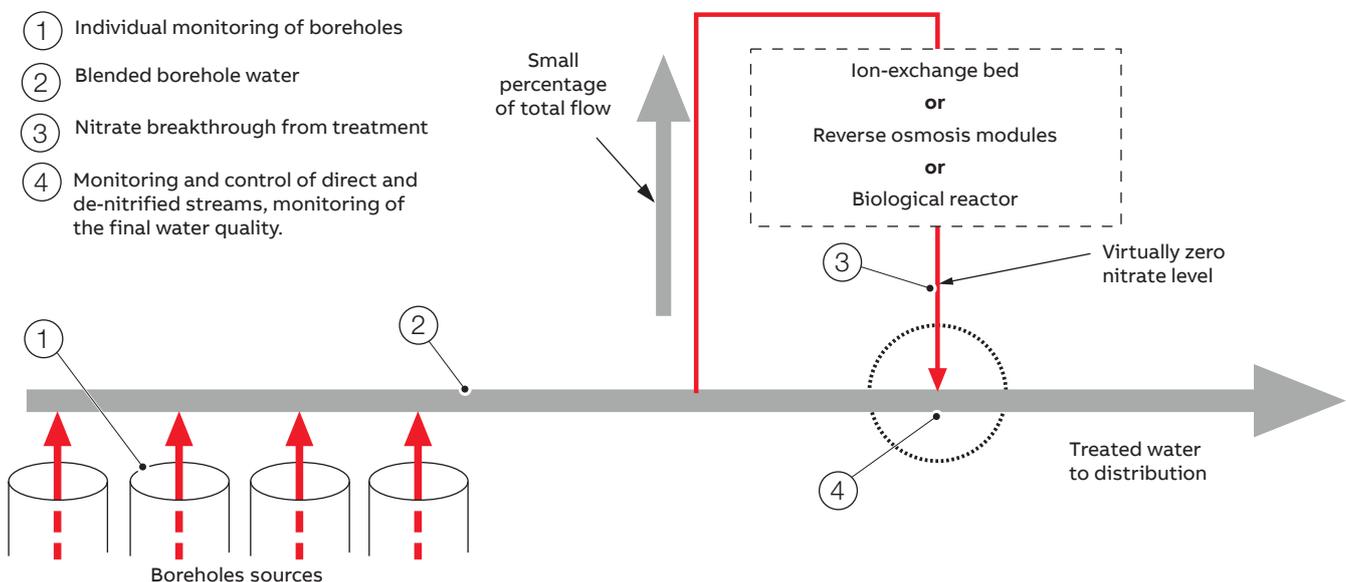
In reverse osmosis processes, raw water is forced through thin film membranes of synthetic polymeric material. Dissolved and suspended solids do not permeate the membrane. Treating only part of the total water flow and blending this back into the main flow achieves the reduction of nitrate concentration of borehole water.

#### 4 Biological

Biological de-nitrification relies on the ability of certain naturally occurring bacteria that use nitrate for respiration which, in the absence of dissolved oxygen, convert the nitrate to nitrogen gas.



The biological reactor is operated under anaerobic conditions, the essential nutrient is provided by the addition of phosphate and carbon in form of methanol, ethanol, or acetic acid. The sludge is removed by conventional coagulation followed by sand filtration. Again, a percentage of the water is treated and returned to the main stream. By adjusting the ratio of the two streams the nitrate in the final blended water is reduced to the required value. See diagram below.



Typical nitrate reduction processes

## Specification

### General

#### Sensor range

AV450 / 455 operating ranges:

As NO<sub>3</sub> 0 to 100 mg l<sup>-1</sup>

As N 0 to 20 mg l<sup>-1</sup>

#### Accuracy:

As NO<sub>3</sub> ±2 % of reading or 0.5 mg l<sup>-1</sup>,  
whichever is the greater

As N ±2 % of reading or 0.15 mg l<sup>-1</sup>,  
whichever is the greater

#### Reproducibility

As NO<sub>3</sub> ±0.5 mg l<sup>-1</sup>

As N ±0.15 mg l<sup>-1</sup>

#### Interference compensation

Turbidity <100 NTU

or

Dissolved Organics as Humic Acid <20 mg l<sup>-1</sup>

#### Maximum current output scale expansion

As NO<sub>3</sub> minimum range 0 to 20 mg l<sup>-1</sup>

As N minimum range 0 to 4 mg l<sup>-1</sup>

#### Response time

Normally three minutes for 90 % step change depending on damping factor

#### Lamp life

Rated by the manufacturer at 1.2 x 10<sup>9</sup> flashes (10 years continuous operation at the rate of one flash at 2 s intervals [typical] equates to 13 % of the rated lamp life)

#### Internal wiper cleaning system

Programmable, operation frequency 15, 30, 45 and 60 minutes, 2, 4, 6, 12 and 24 hours

#### Maximum distance between transmitter and sensor

750 mm (29.5 in.)

### Sample

#### Flow rate

0.5 to 5 l min<sup>-1</sup> (free of air bubbles).

A higher minimum flow rate is required at high turbidity levels

#### Temperature

0 to 40 °C (32 to 104 °F)

#### Pressure

The sensor should be operated at atmospheric pressure but can withstand 3 bar (43.5 psi) max.

### Display

#### Type

Dual 4½-digit, 7-segment backlit LCD

#### Information

16-character, single line dot matrix

#### Resolution

As NO<sub>3</sub> 0.1 mg l<sup>-1</sup>

As N 0.01 mg l<sup>-1</sup>

#### Energy saving function

Backlit LCD configurable as ON or Auto Off after 60 s

#### Logbook

Electronic record of major events and calibration data

#### Real-time clock

Records time for logbook and auto cleaning

#### Diagnostics

Out of sample

Lamp disabled

Loss of signal

Electronic failure

#### Languages

English

French

German

Italian

Spanish

### Outputs

#### Current Outputs

##### Number of signals

2 fully isolated current outputs supplied as standard, configurable to one or both sensor outputs

Current outputs also programmable to any value between 0 and 22 mA to indicate system failure

#### Output current

0 to 10 mA, 0 to 20 mA or 4 to 20 mA

#### Maximum load resistance

750 Ω at 20 mA

#### Accuracy

±0.25 % FSD ±5 % of reading

#### Resolution

0.1 % at 10 mA, 0.05 at 20 mA

#### Serial communication

PROFIBUS DP

## Relay outputs

### Number of relays

Three supplied as standard,  
configurable to one or both sensor inputs or status

### Set point adjustment

Fully programmable as normal or failsafe, high / low  
or status

### Hysteresis

Programmable 0 to 5 % in 0.1 % increments

### Delay

Programmable 0 to 100 minutes in 1 minute intervals

### Relay contacts

Single-pole changeover  
Rating 5 A 250 V max. non-inductive

### Insulation

2 kV RMS contacts to earth (ground)

## Power supply

### Voltage requirements

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

### Power consumption

20 W

### Insulation

Mains to earth (line to ground) 2 kV RMS

## Mechanical Data

### Transmitter

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

### Sensor

Low Range Dimensions 327 wide x 410 high x  
162 mm deep (12.87 wide x 16.14 high x  
6.38 in. deep)  
High Range Dimensions 405 wide x 373 high x  
136 mm deep (15.94 wide x 14.68 high  
x5.35 in. deep)  
Weight 6kg (13.2 lb)

### Cable entry types

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

## Environmental Data

### Operating temperature limits

0 to 50 °C (32 to 122 °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)

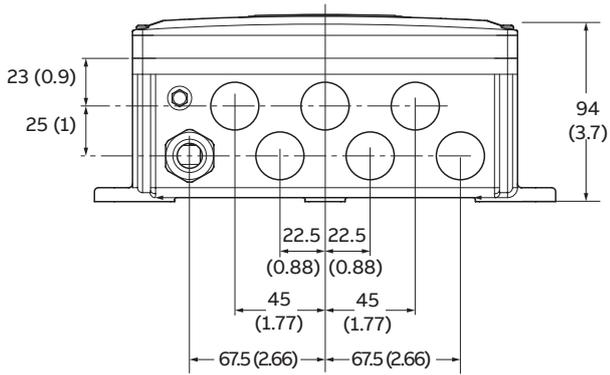
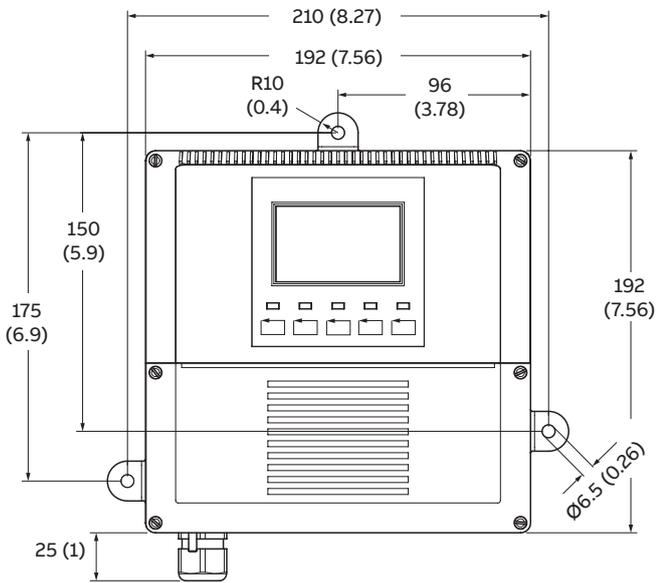
### General safety

EN61010-1  
Overvoltage Class II on inputs and outputs  
Pollution Category 2

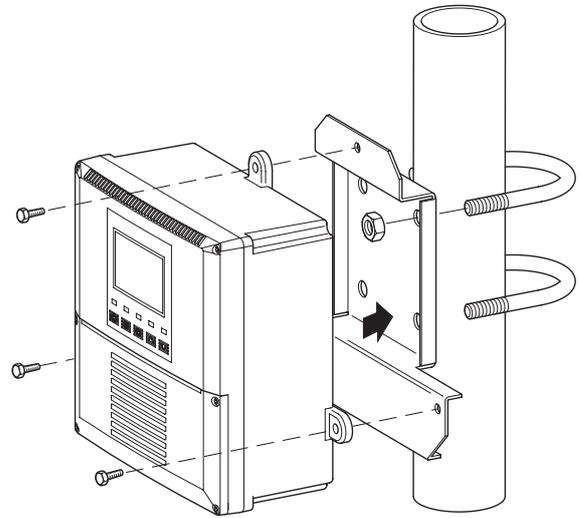
## Overall dimensions

### Transmitter

Dimensions in mm (in.)

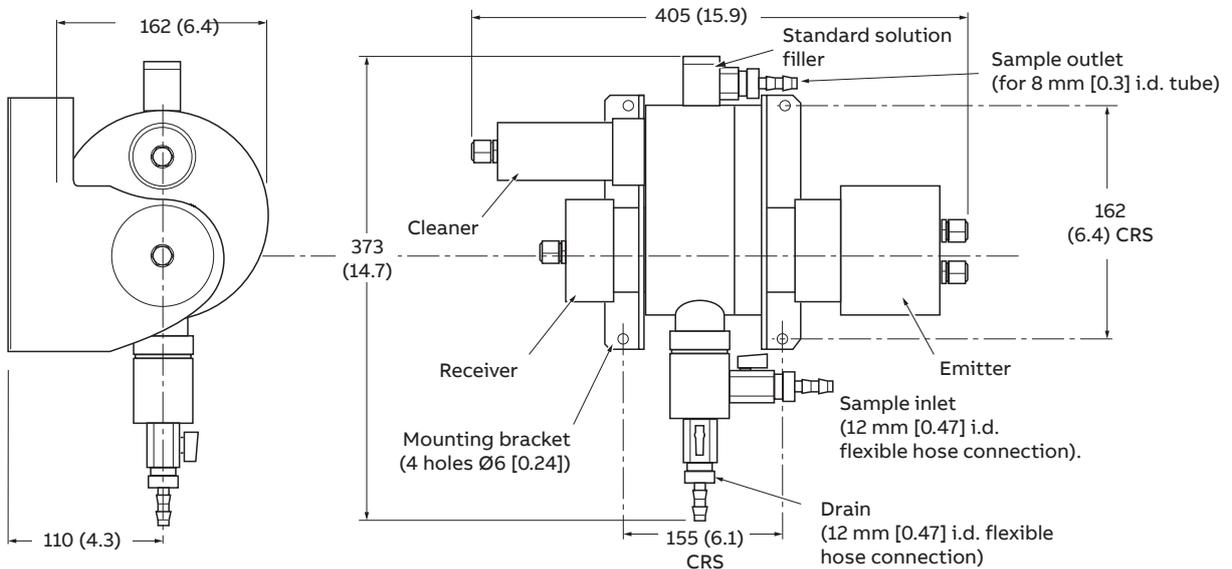


### Pipe-mount Details



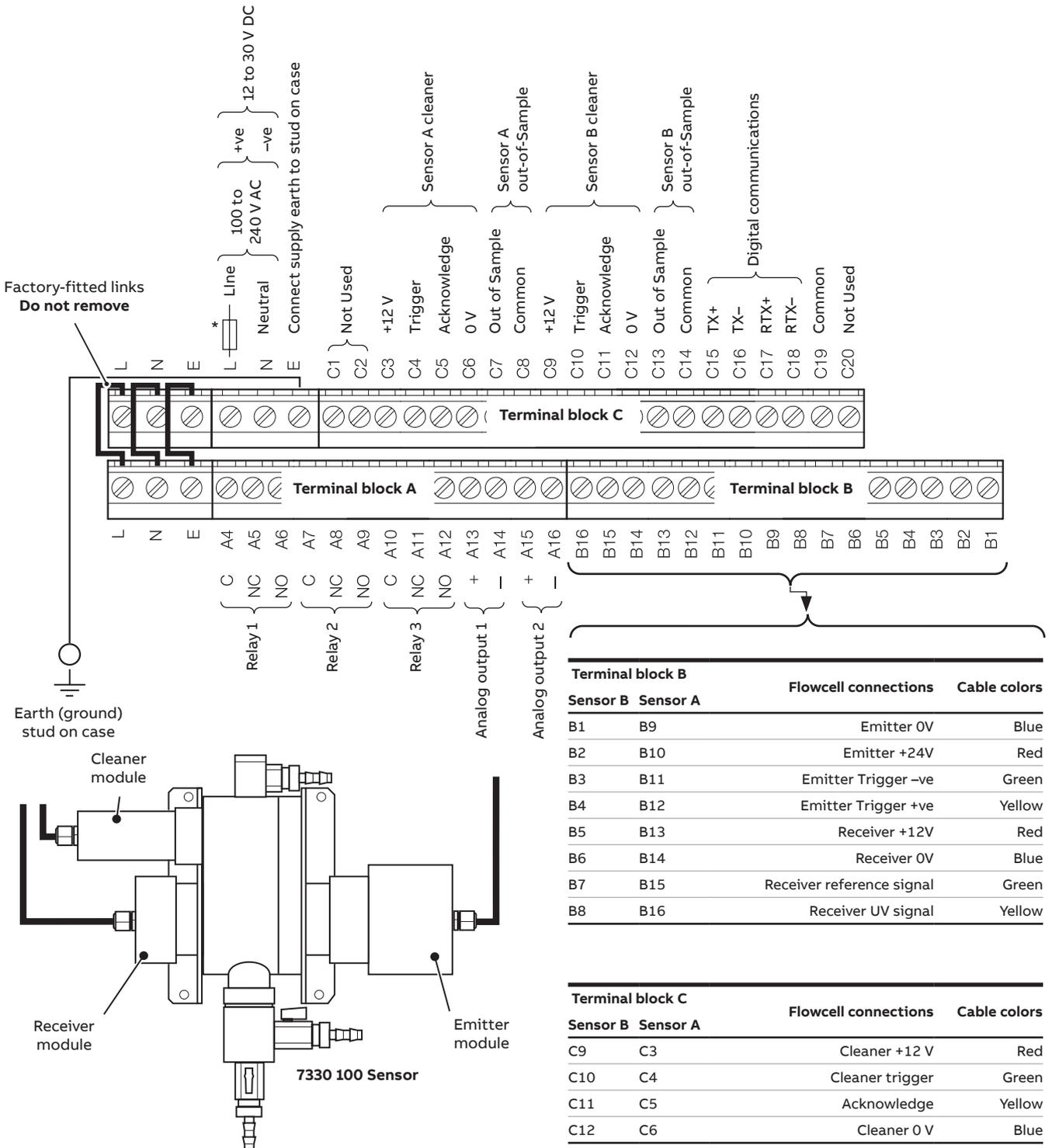
### Sensor Model 7330-100

Dimensions in mm (in.)



## Electrical connections

**Note.** Tighten the terminal screws to a torque of 0.60 Nm (5.3 lbf. in.).



\* 500 mA type T fuse (AC) or 4 A type T fuse (DC)

## Ordering information

Single and Dual UV nitrate monitors for potable water treatment AV450 and AV455	AV4	X	X	/X	X	X	0	X
<b>Primary process variable (PV 1)</b>								
Nitrate		5						
<b>Primary process variable (PV 2)</b>								
None			0					
Nitrate			5					
<b>Transmitter Enclosure Types</b>								
Wall – IP65 General								
Wall-mount				/1				
Wall-mount complete with pipe-mount bracket				/2				
Wall – IP65 N. American								
Wall-mount				/6				
Wall-mount complete with pipe-mount bracket				/7				
<b>Serial Communications</b>								
None						0		
PROFIBUS (pending)						2		
<b>Power supply</b>								
100 to 240 V AC, 50 to 60 Hz							0	
12 to 30 V DC							1	
<b>Reserved</b>								0
<b>Manual</b>								
English								1
French								2
Italian								3
German								4
Spanish								5

## Acknowledgements and Copyrights

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