

FCML 412 N

FCML 412 N-S

pH-INDEPENDENT SENSOR FOR FREE CHLORINE



a xylem brand

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1 Overview

The FCML 412 N(-S) is a membrane-covered, amperometric sensor for the determination of free chlorine.

Structure

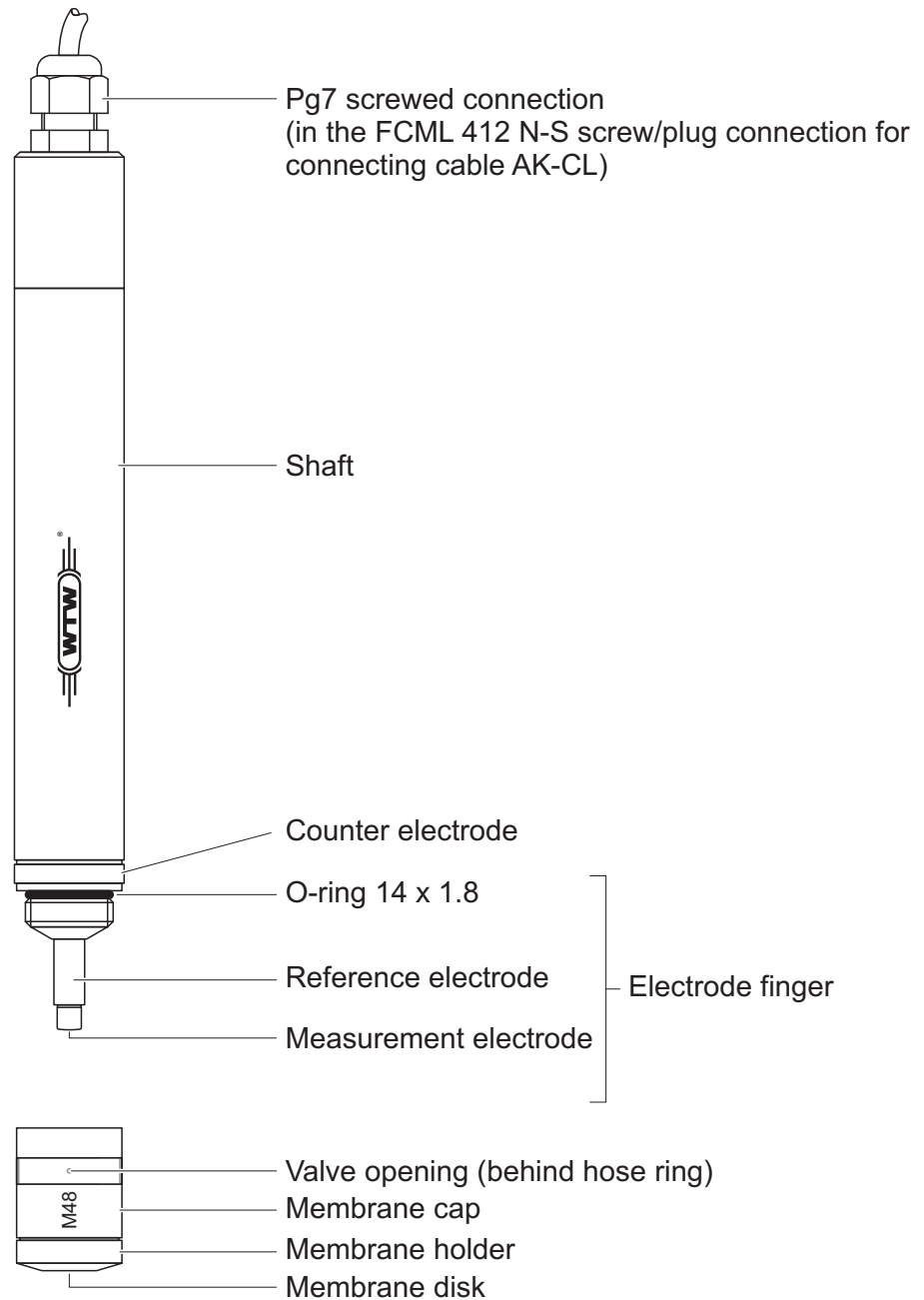


figure 1-1 Structure: Example showing FCML 412 N

With its special design (potentiostatic three-electrode system), the sensor measures all the free chlorine present (sum of gaseous dissolved chlorine, hypochloric acid and hypochlorite) and the chlorine

that is bonded to isocyanuric acid. The sensor is distinguished by a greatly reduced dependency on the pH value.

The sensor has integrated measuring electronics and delivers a measuring signal that is already temperature compensated. It does not require a zero point adjustment. The routine calibration is carried out through comparison with the photometric DPD method according to DIN 38408.

**Electrical
connection of
FCML 412 N**

The FCML 412 N sensor is connected with the monitor (e.g. MULTILINE 1000) via a two line connection. The wires are used for the power supply of the monitor and for the transmission of measurement signals (4 - 20 mA current signal).

**Electrical
connection of
FCML 412 N-S**

The FCML 412 N-S sensor has a four-pin socket for connecting with the monitor (e.g. CL 7010) via the AK-CL cable (not included in the scope of delivery). The power supply and the transmission of the measured signal (0 to -1500 mV voltage signal) are carried out separately over two lines.



Apart from their different electrical connections, the FCML 412 N and FCML 412 N-S sensors are identical. For simplification, the designation FCML 412 N(-S) used in this operating manual refers equally to both variants.

2 Safety instructions

2.1 Safety information

2.1.1 Safety information in the operating manual

This operating manual provides important information on the safe operation of the product. Read this operating manual thoroughly and make yourself familiar with the product before putting it into operation or working with it. The operating manual must be kept in the vicinity of the sensor so you can always find the information you need.

Important safety instructions are highlighted in this operating manual. They are indicated by the warning symbol (triangle) in the left column. The signal word (e.g. "CAUTION") indicates the level of danger:

**WARNING**

indicates a possibly dangerous situation that can lead to serious (irreversible) injury or death if the safety instruction is not followed.

**CAUTION**

indicates a possibly dangerous situation that can lead to slight (reversible) injury if the safety instruction is not followed.

NOTE

indicates a situation where goods might be damaged if the actions mentioned are not taken.

2.1.2 Safety signs on the product

Note all labels, information signs and safety symbols on the product. A warning symbol (triangle) without text refers to safety information in this operating manual.

2.1.3 Further documents providing safety information

The following documents provide additional information, which you should observe for your safety when working with the measuring system:

- Operating manuals of other components of the FCML 412 N(-S) system (power packs, controller, accessories)
- Safety datasheets of calibration and maintenance equipment (e.g. cleaning solutions).

2.2 Safe operation

2.2.1 Authorized use

The authorized use of the FCML 412 N(-S) is the stationary measurement of chlorine in drinking water, swimming pool water and process water.. Only the operation and running of the sensor according to the instructions and technical specifications given in this operating manual is authorized (see chapter 6 TECHNICAL DATA). Any other use is considered unauthorized.

2.2.2 Requirements for safe operation

Note the following points for safe operation:

- The product may only be operated according to the authorized use specified above.
- The product may only be supplied with power by the energy sources mentioned in this operating manual.
- The product may only be operated under the environmental conditions mentioned in this operating manual.
- The product may not be opened.

2.2.3 Unauthorized use

The product must not be put into operation if:

- it is visibly damaged (e.g. after being transported)
- it was stored under adverse conditions for a lengthy period of time (storing conditions, see chapter 6 TECHNICAL DATA).

3 Commissioning

3.1 Scope of delivery

- FCML 412 N(-S) sensor with membrane cap M48
- Dropping bottle with 100 ml ELY-FCML 412 electrolyte solution
- Polishing strip
- Operating manual

3.2 Filling the membrane cap with electrolyte solution

NOTE

*Risk of damage for the sensor in the case of improper handling.
Do not touch the electrode finger with your fingers.
Do not apply pressure to the membrane disk.
Do not unscrew the membrane holder.*

NOTE

When it is delivered, the membrane cap is not filled with electrolyte and is loosely screwed onto the shaft. In order to put the sensor into operation, fill the membrane head as follows:.

Filling the membrane cap

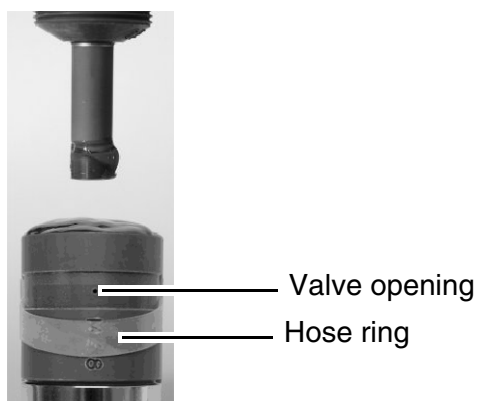
- 1 | Unscrew the membrane cap from the shaft of the electrode. Place the membrane cap on a clean (non absorbent) surface.



- 2 | Cut off the tip of the dropping bottle until the opening in the tip is visible, then fill the membrane cap completely with electrolyte solution making sure it is bubble free.



- 3 | Raise the hose ring of the membrane cap that closes the valve opening at the side so that the valve opening is uncovered (see figure below). Hold the sensor shaft in an upright position and place it on the filled membrane cap. Some of the electrolyte solution will leak over the upper edge of the membrane cap while doing this. Then screw the electrode shaft into the membrane cap. To do this, first turn the electrode shaft anti-clockwise until the thread catches; then slowly screw in the electrode shaft as far as it will go until no gap can be seen between the sensor shaft and membrane cap.

**NOTE**

Overpressure in the membrane cap can destroy the membrane disk. Therefore, make sure the valve opening is not inadvertently closed by your fingers. Excess electrolyte solution must be able to escape freely at any time. Screw slowly so that no back pressure can develop.

- 4 | Using a blunt object, slide the hose ring over the valve opening and insert it evenly in the groove.
-
- 5 | Rinse off any electrolyte solution adhering on the outside.



3.3 Electrical connection

How to connect it to the monitor is described in the operating manual of the monitor.

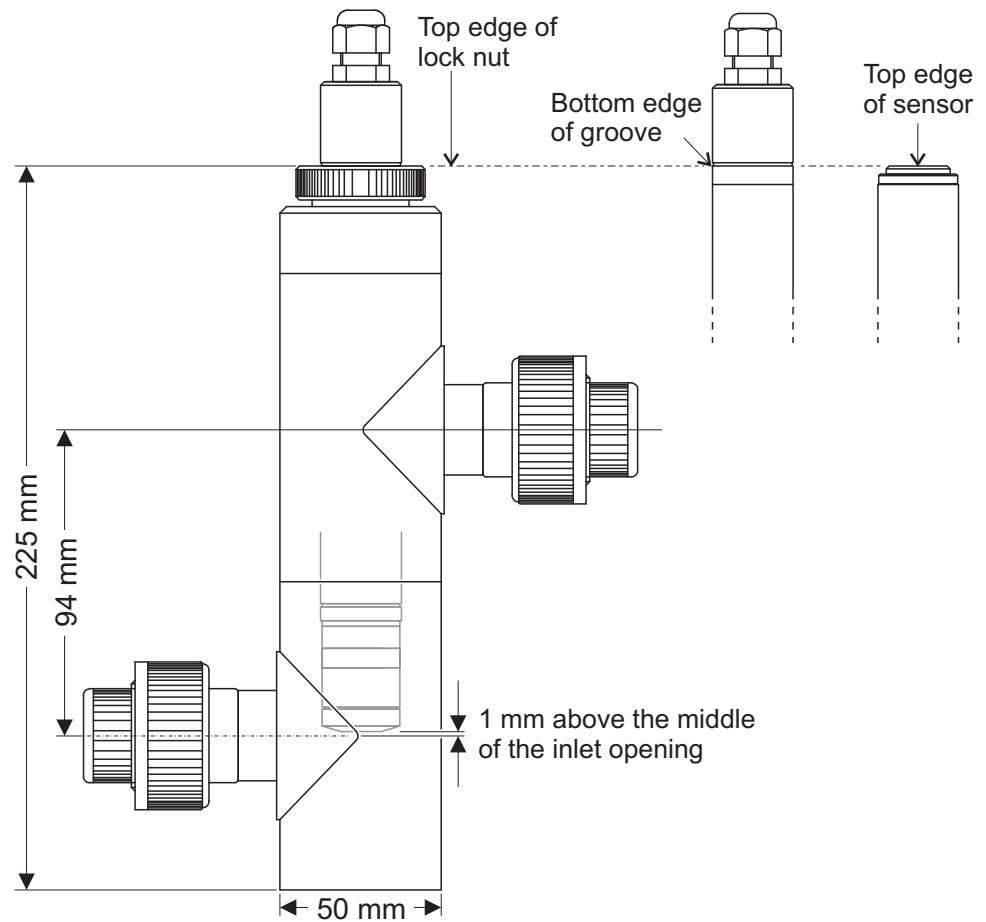
3.4 Installation in the flow through vessel D-CL



The position in the flow through vessel has a considerable effect on the approach flow and, hence, the measuring function of the sensor. Therefore carefully position the sensor as described below.

Proceed as follows to install the sensor:

- | | |
|---|---|
| 1 | Insert the black O-ring, then the PVC slide ring in the 1" installation opening of the flow through vessel. |
| 2 | Attach the coupling ring loosely. |
| 3 | <p>Slide in and position the sensor.</p> <p>For the optimum measuring position align the following parts of the sensor flush with the top edge of the lock nut:</p> <ul style="list-style-type: none"> ● FCML 412 N: The bottom edge of the groove on the connecting head. ● FCML 412 N-S: The top edge of the sensor. <p>In this position the sensor membrane is located approx. 1 mm above the middle of the inlet opening.</p> |



- 4 Tighten the lock nut by hand. Make sure the sensor is firmly attached. Otherwise, it can be pressed out of the flow through vessel by pressure.

NOTE

When commissioning, always open the feed slowly. A strong shock pressure can destroy the membrane.

4 Measuring / Operation

4.1 Run-in period

Polarization Each time the sensor is refilled it must be polarized. To do this, immerse the connected and voltage-supplied sensor in a well-stirred chlorine solution with at least 5 mg/l chlorine for an hour. Then put the sensor into use (measuring position). The sensor can be calibrated after a stabilizing time of approx. 20 minutes. After approx. one day a post-calibration should be performed.



The sensor filled with electrolyte must not become dry and has to be permanently supplied with electrical voltage. Otherwise the characteristics of the membrane cap, electrode finger and electrolyte will be changed (sometimes irreparably). The sensor may only be stored if it is not filled (see also section 5.3 STORAGE).

4.2 Check of the sensor / analysis

Calibration with the DPD method The chlorine sensor has a linear characteristic curve. Calibration of the chlorine sensor is carried out as a single-point calibration. The calibration value (nominal value) is usually determined photometrically. A common procedure for this is the DPD method for free chlorine. The photometer and test sets for this are described in the WTW catalog or on the Internet.

How to carry out the calibration is described in detail in the operating manual of the monitor.

4.3 Chlorine measurement with the FCML 412 N(-S)

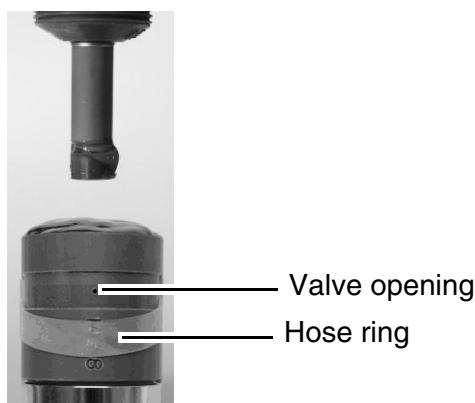
The chlorine sensor FCML 412 N(-S) detects anorganic chlorine compounds dissolved in water. The measured values determined with the photometer according to the DPD-1 method (free chlorine) are directly comparable to the values determined by the sensor.

5 Maintenance, cleaning, storage

5.1 Cleaning the measurement electrode / exchanging the membrane cap and electrolyte

We recommend disconnecting the sensor from the monitor before starting any maintenance work.

If calibration is not possible due to readings that are too low, the measurement electrode has to be cleaned with the enclosed polishing strip. To do so, proceed as follows:



- 1 Using a blunt object, lift the hose ring out of the guiding groove and push it to the side so that the valve opening is uncovered.

NOTE

Negative pressure in the membrane cap can destroy the membrane disk. Therefore, make sure the valve opening is not inadvertently closed by your fingers while unscrewing the membrane cap.

- 2 Unscrew the membrane cap from the sensor shaft and pour away the electrolyte solution.
- 3 Rinse the electrode finger and the membrane cap with clean water and dab them dry with a clean paper towel.
- 4 Clean the measurement electrode with the polishing strip. To do so, place the polishing strip on a paper towel and hold it by a corner. Then hold the electrode finger vertically with the tip down and run the tip over the polishing strip two or three times.

NOTE

The brown coating on the shell (reference electrode) of the electrode finger must not be polished off. This would destroy the sensor!

- | | |
|---|--|
| 5 | Fill the membrane cap with fresh electrolyte solution as described in section 3.2, screw it on the sensor shaft and make the sensor ready for measurement. |
|---|--|



After exchanging the electrolyte solution and/or membrane cap the sensor has to be repolarized (see section 4.1 RUN-IN PERIOD). If calibration is still not possible after cleaning, the measurement electrode change the membrane cap.

5.2 Cleaning

Removing lime deposits on the membrane cap

Remove lime deposits on the membrane cap as follows:

- | | |
|---|--|
| 1 | Unscrew the membrane cap from the sensor shaft and pour away the electrolyte solution (see section 5.1). |
| 2 | Put the membrane cap into 10 % acetic acid for several hours. |
| 3 | Then thoroughly rinse the membrane cap with clean water. |
| 4 | Fill the membrane cap with fresh electrolyte solution as described in section 3.2, screw it on the sensor shaft and make the sensor ready for measurement. |

5.3 Storage

NOTE

The sensor may only be stored in an unfilled condition.

Proceed as follows to store the sensor:

- | | |
|---|---|
| 1 | Unscrew the membrane cap from the sensor shaft and pour away the electrolyte solution (see section 5.1). |
| 2 | Thoroughly rinse the membrane cap and the electrode finger with clean water and dry them with a dust free cloth or paper. |
| 3 | <u>Loosely</u> screw the dry membrane cap on the sensor shaft. The membrane disk must not touch the electrode finger. |

Recommissioning

For recommissioning, clean the electrode tip with the polishing strip and use a new membrane cap (see section 5.1). The membrane cap can be put into 10 % acetic acid for several hours to remove any lime deposits (see section 5.2).

5.4 Maintenance equipment and replacement parts

Description	Model	Order no.
Accessory kit for chlorine sensor FCML 412 N(-S), including: <ul style="list-style-type: none">– 1x membrane cap M48– 100 ml ELY-FCML 412 N electrolyte solution– Polishing strip	ZBK-FCML 412 N	205 246

6 Technical data

6.1 Measuring characteristics

Measuring principle	Membrane-covered, amperometric sensor with potentiostatic three-electrode system and integrated measuring electronics	
Measuring range	FCML 412 N	0.01 ... 2.00 mg/L Cl ₂
	FCML 412 N-S	0.01 ... 10.00 mg/L Cl ₂ (upper limit depends on the slope)
Response time	t ₉₀ (90 % of the final value display after) approx. 120 s	
pH dependency	Approx. 10 % slope loss per increasing pH unit	
Temperature compensation	Automatic, by means of integrated temperature sensor	
Polarization time	Approx. 1 hour on commissioning or after exchanging the electrolyte	
Calibration procedure	Single-point calibration, e.g. with photometric measurement according to the DPD method as a reference	

6.2 Application characteristics

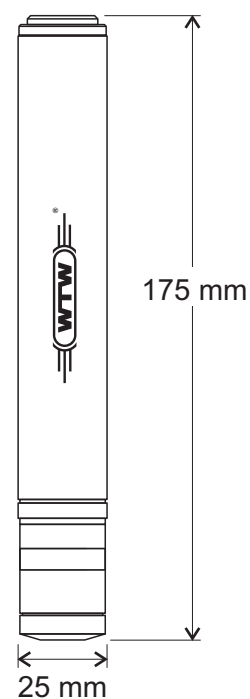
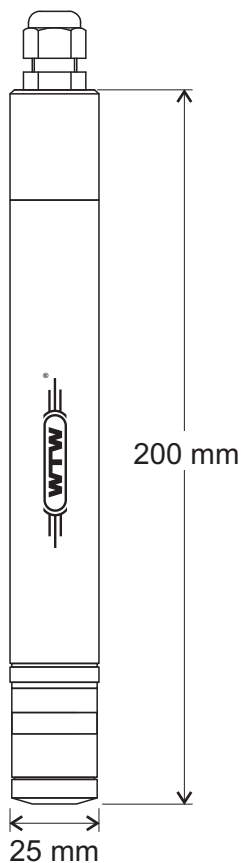
Temperature range	0... 45 °C (32 ... 113 °F) with automatic temperature compensation
pH application range	pH 4... 9
Max. allowed overpressure	30·10 ⁴ Pa (3.0 bar), pressure free operation in the D-Cl flow through vessel recommended
Working life of the membrane cap	Typically 1 year (depending on measuring medium)
Approach flow	Recommended minimum flow rate in the D-CL flow through vessel: > 30 l/h
Typical application range	Drinking water, swimming pool water and mains water in the flow through vessel

6.3 General data

Dimensions

FCML 412 N:

FCML 412 N-S:



Membrane cap	M48
Membrane type	Microporous, hydrophilic membrane
Electrolyte	ELY-FCML 412 N (from ZBK-FCML 412 N)

Material	
Shaft	PVC
Membrane cap	PVC
Membrane holder, auxiliary electrode	Stainless steel
Working electrode	Gold
Reference electrode	Ag/AgCl
Hose ring	Silicone
Cable gland	Polyamide

6.4 Electrical data

- FCML 412 N**
- 2-wire connection via permanently mounted AK-CL 298 cable
 - 12 ... 30 V DC power supply by the monitor
 - Output signal 4 ... 20 mA
- FCML 412 N-S**
- 4-wire connection via AK-CL cable by means of screwed connection/plug connection
 - +/- 6 ... 12 V DC power supply by the monitor
 - Output signal: approx. -100 mV per mg/l chlorine (0 ... -1500 mV)

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