SIGNUX COA05

Water quality — RS485 · 4-20 mA

SX-COA05

DESCRIPTION

Digital conductivity probe with the electronics inside and five cell constants, from k = 0.01 to k = 30, covering everything from ultrapure water to 300 mS/cm. RS485 and 4-20 mA outputs, automatic temperature compensation and a replaceable sensing element. PPS body, IP68, up to 6 bar.

FEATURES

- The cell rules: Five constants, from k = 0.01 to k = 30. Chosen when ordering, and it sets the range: ultrapure water and brine are not measured with the same probe.
- It works on its own: The electronics are inside. It connects straight to the PLC, the computer or the gateway over RS485, or to any 4-20 mA input. No separate transmitter.
- The electrode is replaceable: You renew the part that wears out, not the whole device. Calibration and settings are done over the bus, in place.
- Up to 6 bar: Submersible, IP68 and up to 6 bar, with G 3/4" threads at both ends: it measures inside the line, not in a beaker.

AT A GLANCE

Measures	Conductivity · Temperature
Output	RS485 · 4-20 mA
Protection	IP68
Operating	0 to +60 °C

CONTENTS

1 Introduction

The SX-COA05 is a digital conductivity probe for continuous water quality monitoring. The measuring electronics are inside the probe, so it connects directly to a PLC, a computer or an IoT gateway over RS485, or to any analogue input through its 4-20 mA output, with no separate controller or transmitter.

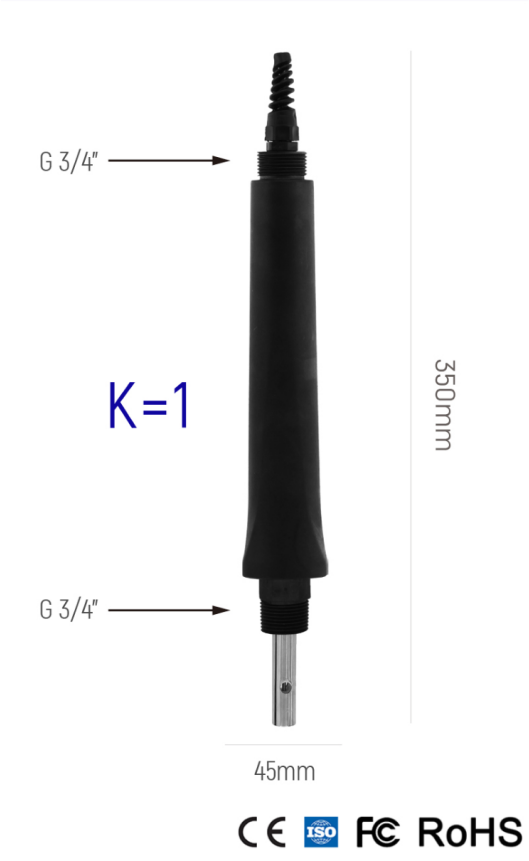
The cell constant is chosen when ordering, from k = 0.01 to k = 30, and it sets the measuring range: from 0-20 µS/cm for ultrapure water to 0-300 mS/cm for brines. A built-in NTC provides automatic temperature compensation. The sensing element can be replaced without changing the probe.

Typical applications: thermal power, fertiliser and chemical plants, metallurgy, environmental monitoring, pharmaceutical and biochemical processes, food and drinking water.

- Continuous, unattended online measurement
- High accuracy, high stability and strong immunity to interference
- Automatic temperature compensation
- Works on its own, without a controller or transmitter
- RS485 (Modbus RTU) and 4-20 mA outputs
- All settings over RS485: address, baud rate, calibration, analogue range
- Replaceable sensing element
- Settings kept for more than 10 years without power

SPECIFICATIONS

Measuring range	k = 0.01: 0-20 µS/cm k = 0.1: 0-200 µS/cm k = 1: 0-2000 µS/cm k = 10: 0-20 mS/cm k = 30: 0-300 mS/cm
Resolution	0.01 µS/cm, 0.1 µS/cm, 1 µS/cm, 0.01 mS/cm or 0.1 mS/cm, depending on the cell
Accuracy	±2 % FS
Temperature compensation	Automatic, 0-60 °C, NTC 10K (PT1000 on request)
Correction	Three-point method
Input resistance	≥ 1×10^{12} Ω
Outputs	RS485 (Modbus RTU) and 4-20 mA; at 5 V supply, RS485 only
Analogue output load	< 750 Ω
Power supply	5 V DC, 12 V DC or 24 V DC
Operating conditions	0-60 °C, up to 6 bar
Protection rating	IP68
Material	PPS
Dimensions	350 mm long, 45 mm diameter, G 3/4" threads at both ends
Cable length	5 m by default
Weight	0.33 kg


G 3/4"
K=1
350mm
G 3/4"
45mm
CE ISO FC RoHS

2 Wiring

The probe is supplied with a fixed cable with labelled, ferruled ends. The number of wires depends on the version: the 12/24 V version has six wires and also provides the 4-20 mA output; the 5 V version has four wires and RS485 only.

12 V OR 24 V VERSION, RS485 AND 4-20 MA

FUNCTION	WIRE COLOUR	LABEL AND DESCRIPTION
Power supply	Red	DC12V+ / DC24V+ · Power supply positive
Power supply	Brown	DC12V- / DC24V- · Power supply negative
Communication	Yellow	RS-485 A
Communication	Green	RS-485 B
Analogue output	White	4-20 mA +
Analogue output	Black	4-20 mA -

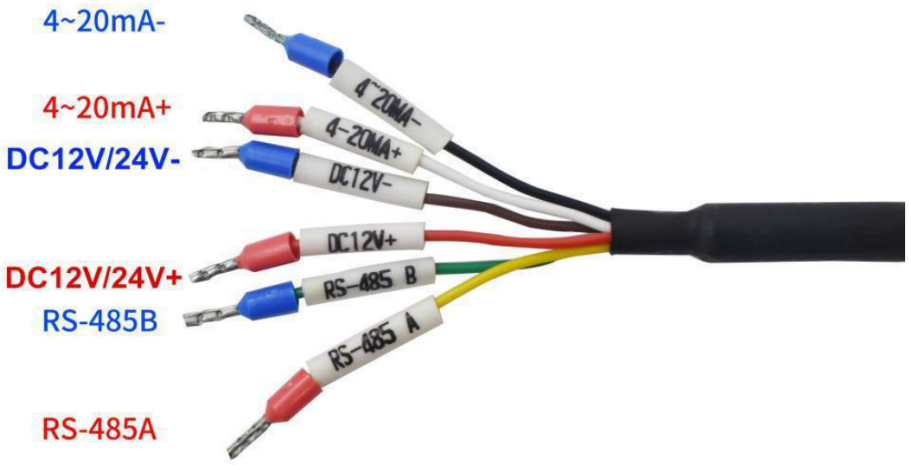


Fig. 2.1 · Wires of the 12/24 V version

5 V VERSION, RS485 ONLY

FUNCTION	WIRE COLOUR	LABEL AND DESCRIPTION
Power supply	Red	DC5V+ · Power supply positive
Power supply	Black	DC5V- · Power supply negative
Communication	Yellow	RS-485 A
Communication	Green	RS-485 B

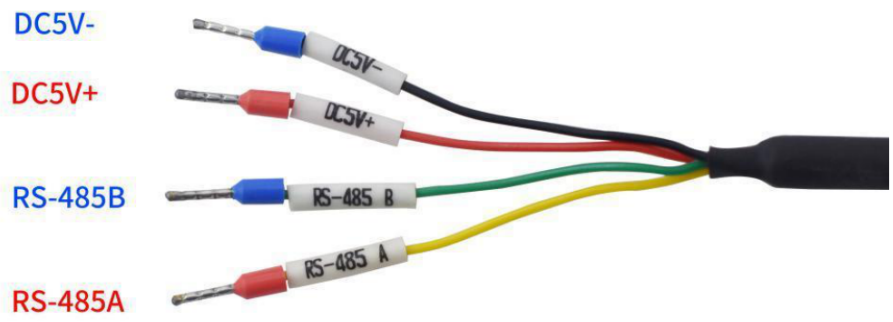


Fig. 2.2 · Wires of the 5 V version

Every wire carries a printed label with its function. Check the label rather than the colour: the label is what identifies the wire. The 4-20 mA output is a passive current output; its load must stay below 750 Ω.

3 Dimensions and ordering information

3.1 Dimensions

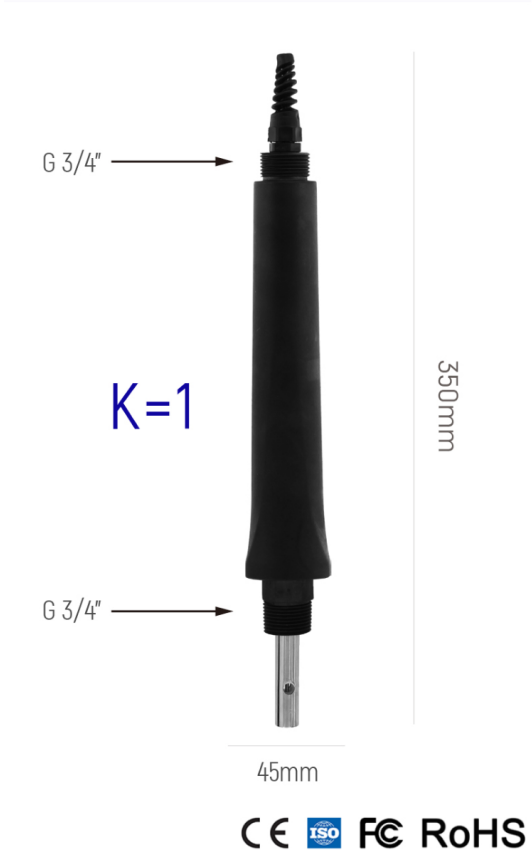


Fig. 3.1.1 · Overall length 350 mm, diameter 45 mm, G 3/4" thread at both ends (k = 1 version shown)

3.2 Ordering information

The order code states the cell constant and the supply and output version. The cell constant cannot be changed afterwards: choose it from the conductivity to be measured.

ORDER CODE	CELL CONSTANT AND RANGE	SUPPLY AND OUTPUTS
SX-COA05-001-R	k = 0.01 · 0–20 µS/cm	5 V DC · RS485
SX-COA05-001-A	k = 0.01 · 0–20 µS/cm	12–24 V DC · RS485 + 4–20 mA
SX-COA05-01-R	k = 0.1 · 0–200 µS/cm	5 V DC · RS485
SX-COA05-01-A	k = 0.1 · 0–200 µS/cm	12–24 V DC · RS485 + 4–20 mA
SX-COA05-1-R	k = 1 · 0–2000 µS/cm	5 V DC · RS485
SX-COA05-1-A	k = 1 · 0–2000 µS/cm	12–24 V DC · RS485 + 4–20 mA
SX-COA05-10-R	k = 10 · 0–20 mS/cm	5 V DC · RS485
SX-COA05-10-A	k = 10 · 0–20 mS/cm	12–24 V DC · RS485 + 4–20 mA
SX-COA05-30-R	k = 30 · 0–300 mS/cm	5 V DC · RS485
SX-COA05-30-A	k = 30 · 0–300 mS/cm	12–24 V DC · RS485 + 4–20 mA

Optional accessories: mounting bracket and flow cell. Cable lengths other than 5 m on request.

4 Installation, care and maintenance

4.1 Installation

- In-line: screw the probe into the pipe or tee through either G 3/4" thread. Seal the thread with PTFE tape.
- Submerged: hang the probe from a rigid pipe screwed onto the upper thread, with the cable running inside the pipe, or use the mounting bracket. Keep the cable entry and the top of the probe above water or fully sealed.
- Flow cell: for low flows or sampling lines, mount the probe in the optional flow cell.
- Keep the electrode fully immersed and away from air bubbles; bubbles trapped on the electrode read as low conductivity.
- Do not exceed 6 bar or 60 °C.

4.2 Care and maintenance

- When not in use, store the probe in a dark, dry and ventilated place.
- The sensing element is a precision part and cannot be dismantled. Do not clean it with strong acids or alkalis: they alter the cell constant and the accuracy of the measurement.
- Before measuring, rinse the electrode with distilled or deionised water and dry it with filter paper, so that no impurities are carried into the sample. Check that the connections are dry; clean dirt with pure alcohol and let it dry before use.
- After long use, or when readings drift, recalibrate the probe with standard solutions (see Calibration).
- If calibration is no longer possible after cleaning, the sensing element has reached the end of its life: replace it. The measuring cable is dedicated to the probe and cannot be replaced by another one.

5 Calibration

The probe uses a three-point correction: zero, slope and compensation. Calibration is done over RS485 with the function-call registers R12 to R14 (0x000C to 0x000E), either from the SIGNUX tool or from any Modbus master.

A function call takes three writes: parameter 1 into R13, parameter 2 into R14 and, last, the function number into R12. Writing the three registers at once with function code 16 starting at R12 has the same effect. When the call succeeds, R12, R13 and R14 return to 0; if it fails or a parameter is wrong, R14 reads -1.

FUNCTION	PARAMETER 1 (R13)	PARAMETER 2 (R14)	FUNCTION NUMBER (R12)
Zero calibration	Standard value × 10	1	1
Slope calibration	Standard value × 10	2	1
Compensation calibration	Standard value × 10	3	1
Manual temperature compensation	Temperature × 100	Any value	2
Change 4-20 mA output range	Value at 4 mA	Value at 20 mA	3
Change correction factor	Scale factor	Display increment	5
Change slave configuration	New slave address	New baud rate	6
Restore factory settings	20034 (password)	Any value	7

Procedure: rinse the electrode, immerse it in the standard solution, stir gently and wait for the reading to settle. Then send the call with the value of the standard multiplied by 10. Use a low standard (for example 73 µS/cm) for the zero point and a high one (for example 1413 µS/cm) for the slope. Examples 2 and 3 in the Modbus chapter show the exact frames.

6 Modbus RS485 protocol

6.1 Communication parameters

Protocol	Modbus RTU (partial implementation: function codes 03, 06 and 16)
Baud rate	9600 bit/s by default (1200 to 57600 configurable)
Device address	1 by default (1 to 127)
Data bits	8
Parity	None
Stop bits	1
Error check	CRC-16

6.2 Frame format

READ REGISTERS (03): REQUEST

Address	Function 0x03	Start register	Number of registers	CRC-16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

READ REGISTERS (03): RESPONSE

Address	Function 0x03	Number of data bytes	Data	CRC-16
1 byte	1 byte	1 byte	2 bytes per register	2 bytes

WRITE ONE REGISTER (06): REQUEST AND RESPONSE ARE IDENTICAL

Address	Function 0x06	Register address	Value	CRC-16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

WRITE SEVERAL REGISTERS (16): REQUEST

Address	Function 0x10	Start register	Number of registers	Number of bytes	Values	CRC-16
1 byte	1 byte	2 bytes	2 bytes	1 byte	2 bytes per register	2 bytes

WRITE SEVERAL REGISTERS (16): RESPONSE

Address	Function 0x10	Start register	Number of registers	CRC-16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

All values are 16-bit, high byte first. Decimals are implied: a register marked «1 decimal» holds 10 times the value, and one marked «2 decimals» holds 100 times the value.

6.3 Modbus registers

REGISTER	R/W	TYPE	DESCRIPTION
R0 · 0x0000	R	UINT16	Conductivity, in the unit of the range (1 decimal)
R1 · 0x0001	R	UINT16	Temperature, °C (2 decimals)
R2 · 0x0002	R	UINT16	Value represented by 4 mA (1 decimal)
R3 · 0x0003	R	UINT16	Value represented by 20 mA (1 decimal)
R4 · 0x0004	R	UINT16	Range lower limit (default 0)
R5 · 0x0005	R	UINT16	Range upper limit (default 20000, 1 decimal)
R6 · 0x0006	R	UINT16	Scale factor (1 decimal)
R7 · 0x0007	R	INT16	Increment added to the reading (1 decimal)
R8 · 0x0008	R	INT16	Resolution (default 1)
R9 · 0x0009	R	INT16	Product identification (3)
R10 · 0x000A	R	UINT16	Slave address, 1 to 127
R11 · 0x000B	R	UINT16	Baud rate: 1200, 2400, 4800, 9600, 19200, 38400 or 57600
R12 · 0x000C	W	UINT16	Function number (see Calibration)
R13 · 0x000D	W	UINT16	Parameter 1
R14 · 0x000E	W	UINT16	Parameter 2

UINT16: 16-bit unsigned integer

INT16: 16-bit signed integer

Settings are read from R2 to R11 and changed only through function calls on R12 to R14.

6.4 Communication examples

6.4.1 Example 1: read conductivity and temperature

```
MASTER REQUEST: 01 03 0000 0002 C4 0B |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x03
Start register	2 bytes	0x0000
Number of registers	2 bytes	0x0002
CRC	2 bytes	0xC4 0x0B

```
SLAVE RESPONSE: 01 03 04 1ACC 09C4 3A D7 |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x03
Number of data bytes	1 byte	0x04
Conductivity	2 bytes	0x1ACC
Temperature	2 bytes	0x09C4
CRC	2 bytes	0x3A 0xD7

0x1ACC is 6860 in decimal, so the conductivity is 6860 / 10 = 686.0 µS/cm. 0x09C4 is 2500, so the temperature is 2500 / 100 = 25.00 °C.

6.4.2 Example 2: zero calibration with a 73.0 µS/cm standard

73.0 × 10 = 730 = 0x02DA. Function number 1, parameter 1 = 0x02DA, parameter 2 = 1 (zero point). The three registers are written at once from R12 with function code 16.

```
MASTER REQUEST: 01 10 000C 0003 06 0001 02DA 0001 FA FC |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x10
Start register	2 bytes	0x000C
Number of registers	2 bytes	0x0003
Number of bytes	1 byte	0x06
R12 · function number	2 bytes	0x0001
R13 · parameter 1	2 bytes	0x02DA
R14 · parameter 2	2 bytes	0x0001
CRC	2 bytes	0xFA 0xFC

```
SLAVE RESPONSE: 01 10 000C 0003 40 0B |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x10
Start register	2 bytes	0x000C
Number of registers	2 bytes	0x0003
CRC	2 bytes	0x40 0x0B

6.4.3 Example 3: slope calibration with a 1413.0 µS/cm standard

1413.0 × 10 = 14130 = 0x3732. Function number 1, parameter 1 = 0x3732, parameter 2 = 2 (slope point).

```
MASTER REQUEST: 01 10 000C 0003 06 0001 3732 0002 35 05 |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x10
Start register	2 bytes	0x000C
Number of registers	2 bytes	0x0003
Number of bytes	1 byte	0x06
R12 · function number	2 bytes	0x0001
R13 · parameter 1	2 bytes	0x3732
R14 · parameter 2	2 bytes	0x0002
CRC	2 bytes	0x35 0x05

```
SLAVE RESPONSE: 01 10 000C 0003 40 0B |||
```

Slave address	1 byte	0x01
Function code	1 byte	0x10
Start register	2 bytes	0x000C
Number of registers	2 bytes	0x0003
CRC	2 bytes	0x40 0x0B

After a successful call, R12, R13 and R14 read 0. If R14 reads -1 (0xFFFF), the call was rejected: check the function number and the parameters.