Instruction manual

C 8825.4 - C 8325.5 - C 8520.5

TOROIDAL CONDUCTIVITY - TDS PROBES
4-20 mA – RS485 – Modbus RTU

EC scales
20.00 - 200.0 - 2000 mS
4.000 - 40.00 . 400.0 mS

TDS scales
10.00 - 100.0 - 1000 ppt
2.000 - 20.00 - 200.0 ppt

Option
S/N
REP N°

Power supply: 9 ÷ 36 Vdc
Installed firmware: R 3.1x

C 8825.4 C8325.5 C8520.5

Cod. 289358825 - Rev. 02

INDEX

1 GENERAL WARNINGS AND INFORMATION FOR ALL USERS

1.1 WARRANTY

This product is guaranteed for 5 years from the date of purchase for all manufacturing defects.
Please take a look at the terms and conditions described on the warranty certificate at the end of the manual.

1.2 AFTER SALES SERVICE

B&C Electronics offers to all of its customers the following services:

- a free of charge technical assistance over the phone and email for problems regarding installation, calibration and regular maintenance;
- a repairing service in our Carnate (Italy) headquarter for all types of damages, calibration or for a scheduled maintenance.

Please take a look at the technical support data sheet at the end of the manual for more details.

1.3 CE MARKING

This instrument is manufactured according to the following european community directives:

- 2011/65/EU "Restriction of the use of certain hazardous substances in electrical and electronic equipment"
- 2014/30/EU "Electromagnetic compatibility" EMC

- EN 61326-2-3/2013 "Electromagnetic compatibility" EMC
  - Industrial electromagnetic environment
- EN 55011/2009 "Radio-frequency disturbance characteristics"
  - Class A (devices for usage in all establishment other than domestic)
  - Group 1 (Industrial equipment that do not exceed 9kHz)

The CE marking is placed on the packaging and on the S/N label of the instrument.

1.4 SAFETY WARNINGS

It is important to underline the fact that electronic instruments are subject to accidental failure. For this, it is important to take all necessary precautions to avoid damages caused by malfunctions.

Any operation must be performed by authorized and trained staff.

The use must comply with the parameters described in chapter "Specifications and technical data (page 8)", in order to avoid potential damages and a reduction of its operating life.

1.5 SPECIAL WARNINGS

In order to ensure a reliable operation and to prevent irreversible damage:

- avoid unscrewing or loosening the cable gland;
- during immersion use, protect the cable using an adapter and an extension pipe of adequate length.

1.6 MANUAL REVISIONS

This chapter shortly describes the differences between previously released versions of the same manual, so to help users that are already familiar with the product.

Rev. A	Emission

2 PRODUCT OVERVIEW

2.1 FUNCTIONAL PURPOSE OF THE DEVICE

This probes have been designed to measure conductivity and TDS (total dissolved solids) according to the inductive method.

Applications

The main applications include the measurement of conductivity and TDS in very dirty and aggressive liquids such as industrial sewage, concentrated acidic acids, brines, salt and encrusting solutions, sea water.

Models

C 8825.4 for immersion or pipe application, PVCC body.

C 8325.5 for immersion or in flow application, PVDF body.

C 8520.5 for in flow application, PVDF body.

Probe composition

The measuring system consists of:

- two toroidal coils;
- temperature sensor;
- built-in 2-wire 4-20 mA transmitter;
- RS 485 output with B&C protocol for data transmission, calibration and configuration procedures.

The probe can operate in analog or digital mode (see chapter "Operating procedure (page 19)").

The probe can work connected as a slave to the MC 6587 and MC 7687 instruments that function as master.

2.2 ACCESSORIES

Sensors and accessories for different applications are available, to be ordered separately.
Our staff is always available to help costumers select the most appropriate and suitable solution for their specific needs.

Accessories

BC 8701 RS485/USB converter with Vdc output

Accessories for C 8825.4

SZ 7531 adapter for 1 "GAS threaded pipe

Accessories for C 8325.5

YBP75M0011 flow mounting adapter

SZ 724 adapter for mounting on conic DN 40 fitting

3 INSTRUCTION MANUAL CONTENTS

This chapter describes the manual and gives suggestions to all users on how to read it and use it.

The manual is written according to the following norms:

- UNI 10893 "Instructions for use";
- UNI 10653 "Quality of product technical documentation".

The terminologies indicated in the international metrology vocabulary (VIM) are respected as far as possible.

3.1 SYMBOLS

Throughout the manual you may find the following symbols, which are both dictated by a norm or that are simply conventional.

WARNINGS: this symbol is used to warn users that if the instructions are ignored or not correctly followed, damage to the instrument can be caused.

NOTE: this symbol is to invite the user to pay particular attention to a specific section of the manual.

3.2 HOW TO READ THE INSTRUCTION MANUAL

The manual contains all the information needed to acquire full knowledge of the product, to ensure a proper installation, proper use and maintenance in order to achieve the desired result at the time of its choice.

The manual is addressed to personnel with knowledge and experience, appropriate to the operations to be performed, in the field of electronic measurement and regulation instrumentation through the use of sensors in the field, in the context of industrial plants operating in analogue mode and / or with interface digital.

The index of the manual refers the reader to the chapters on aspects that want to learn and develop.

In particular, the first chapters show general topics and allow the user to become familiar with the product, with its functional purpose and with the necessary accessories or options for its use.

The user can then check whether he knows all the elements necessary for the use of the instrument and of the measuring/control.

4 SPECIFICATIONS AND TECHNICAL DATA

4.1 FUNCTIONAL SPECIFICATION

Inputs

The probe is able to perform the measurement of electric conductivity, TDS and temperature.

Scale

The instrument allows the selection of the following scales:

20.00 / 200.0 / 2000 mS;

4.000 / 40.00 / 400.0 mS;

10.00 / 100.0 / 1000 ppt;

2.000 / 20.00 / 200.0 ppt.

For all it is possible to set the scalability factor to obtain different full scale values on the analogue output.

Temperature

The probe carries out the temperature measurement by sending the value detected on the digital output.

Internally it performs temperature compensation by applying the set TC coefficient.

The reference temperature can be chosen between 20 ° C or 25 ° C.

During conductivity calibration the user can select the TC value of the standard KCl solution used.

Analog output

The probe operates in current loop 4-20 mA proportional to the value of the principal measure.

The output current can be addressed to the conductivity or TDS value in the probe configuration.

The output is galvanically isolated, so to be interfaced directly to a PLC, data acquisition cards or B&C Electronics instruments with 4-20 mA input.

Serial interface

Through the isolated RS485 interface, the user can connect the probe to a terminal or to a PC using a simple terminal emulation program. A RS485/RS232 or RS485/USB converter can be necessary.

In use with the B & C protocol, measurements, parameter settings and calibration management can be received.

In use with the Modbus protocol, functions 03, 06 and 16 are implemented for reading the measurements, changing the operating parameters and calibrating.

The MC 6587 and MC 7687 controllers from B&C Electronics allow complete management of the probe.

Conductivity measurements, TDS and temperature are always transmitted.

The bootloader function allows the user to update the firmware.

Filter software

The input signal has a filter with two selectable response time.

The user can separately set the response time relative to signals of small or large variation in order to obtain good reading stability and fast response to the variations of the measurement in the process.

In digital mode, the software filter acts only if the time interval between queries is significantly lower than the set filter time.

Power supply

The instrument is powered (min. 9 Vdc ÷ max. 36 Vdc) through the current loop, directly from a PLC or data acquisition boards that provide the power, or by a power supply in series between the analog output and the apparatus of acquisition.

When operating in digital mode the instrument is powered using the terminals of the current loop.

Configuration and calibration of the probe

Configuration and calibration of the probe are made via serial interface (see chapter "Digital mode (page 20)") or by using the MC 6587 or MC 7685 controllers.

4.2 TECHNICAL DATA

4.2.1 GENERAL SPECIFICATIONS

Common specification

Relative humidity	maximum non-condensing humidity 95%
Storage temperature	-5 °C ÷ +50 °C
Protection	IP68
Immunity performance loss	< 1 % full scale

C 8825.4 specification

Operating temperature	-5 °C ÷ +50 °C
Operating pressure	max 10 bar at 25 °C / max 5 bar at 50 °C
Body	PVCC
Diameter / Length	60 mm / 165 mm
Thread	1 1/2" NPT
Cable	5 x 0.25 mmq, L= 10 m, sheath in PVC
Weight	body 270 g, cable 640 g

C 8325.5 specification

Operating temperature	-5 °C ÷ +60 °C
Operating pressure	max 10 bar at 25 °C / max 5 bar at 50 °C
Body	PVDF
Diameter / Length	40 mm / 264 mm
Thread	conic DN40 with SZ724
Cable	5 x 0.25 mmq, L= 10 m, sheath in PVC
Weight	body 310 g, cable 640 g

C 8520.5 specification

Operating temperature	-5 °C ÷ +60 °C
Operating pressure	max 10 bar at 25 °C / max 5 bar at 50 °C
Body	PVDF
Diameter / Length	50 mm / 250 mm
Thread	conic DN32
Connector	7 pin
Weight	body 310 g

4.2.2 TECHNICAL SPECIFICATIONS

MAIN MEASURING				**Default**
Sensor type		Toroidal		
Measure		Conductivity		
Measuring method		Inductive		
Conductivity scales		20.00 / 200.0 / 2000 mS 4.000 / 40.00 / 400.0 mS		200.0 mS
Scale	Resolution	Under range	Over range	
0.00 ÷ 20.00 mS	0.01 mS	-2.00	22.00	
0.0 ÷ 200.0 mS	0.1 mS	-20.0	220.0	
0 ÷ 2000 mS	1 mS	-200	2200	
0.000 ÷ 4.000 mS	0.001 mS	-0.400	4.400	
0.00 ÷ 40.00 mS	0.01 mS	-4.00	44.00	
0.0 ÷ 400.0 mS	0.1 mS	-40.0	440.0	
Measurement update		2 seconds		
Filter software				
Response time at 90 % small signal		2 ÷ 220 seconds		10 s
Response time at 90 % large signal		2 ÷ 220 seconds		2 s
Zero		± 10 % full scale Automatic calibration on all scales		0 %
Sensitivity		60 ÷ 160 %		100 %
TC during calibration		TC setted / TC KCl TC KCl (momentary) for sensitivity calibration. Automatic reset to TC set after 20 seconds from calibration or after restarting the probe.		TC setted
Sensitivity calibration solution		0.000 ÷ 2000 mS		102.1 mS
TDS scales		ON / OFF		OFF
TDS/EC conversion factor		0.450 ÷ 1.000 1/S		0.670
	Scale	Conductivity	TDS scales	
	1	20.00 mS	10.00 ppt	
	2	200.0 mS	100.0 ppt	
	3	2000 mS	1000 ppt	
	4	4.000 mS	2.000 ppt	

MAIN MEASURING			Default
5	40.00 mS	20.00 ppt	
6	400.0 mS	200.0 ppt	

TEMPERATURE		Default
Sensor for thermocompensation	RTD Pt100 (built-in)	
Compensation range	0.0 ÷ 100.0 °C (TC=3.5%, Tref=25°C) -20.0 ÷ 100.0 °C (TC=2.2%, Tref=25°C)	
Zero	± 5.0 °C	0.0 °C
Reference temperature	20 °C / 25 °C	20 °C
Temperature coefficient	0.00 ÷ 3.50 %/°C	2.00 %/°C

CURRENT LOOP (DIGITAL MODE = 0)			Default
Current loop proportional to the measuring	4-20 mA		
Output scale factor	10 ÷ 100 %		100 %
Under / Over range	3.80 mA / 20.80 mA		
ID of the selected scale at the switching-on			
		(if TDS=ON)	
1- 20.00 mS scale	11 mA for 16 s	11,5 mA for 16 s	
2- 200.0 mS scale	12 mA for 16 s	12,5 mA for 16 s	
3- 2000 mS scale	13 mA for 16 s	13,5 mA for 16 s	
4- 4.000 mS scale	14 mA for 16 s	14,5 mA for 16 s	
5- 40.00 mS scale	15 mA for 16 s	15,5 mA for 16 s	
6- 400.0 mS scale	16 mA for 16 s	16,5 mA for 16 s	

DIGITAL FUNCTION		Default
Protocols	B&C protocol ASCII Modbus RTU The two protocols can coexist	
B&C ID protocol	ID = 01 ÷ 99 * last s/n digit, if 0 ID=10	01 ÷ 10 *
Modbus address	ID = 01 ÷ 243 * last s/n digit, if 0 ID=10	01 ÷ 10 *
Measures and parameters are provided under interrogation (see protocols B&C ASCII and Modbus RTU function 03 - 06 -16)		

SERIAL INTERFACE		Default
Interface	RS 485 not terminated	
	Isolated from the sample	
	Not isolated from the loop/power supply	
Baud rate	2400 / 4800 / 9600 / 19200 baud	9600 baud
Distance	1000 / 500 / 250 / 125 m	
Probes in network	32 probes max	

POWER SUPPLY		Default
Power supply	9/36 Vdc	
Absorptions		
• Digital mode = 0 • Digital mode = 1 • Digital mode = 2	Typical 4-20 mA, max 22 mA 11 ÷ 16 mA according to the scale 8.5 mA	
	The absorption may be higher during transmission	

5 INSTALLATION

5.1 PACKING LIST

The instrument package contains:

- N° 1 toroidal EC probe;
- N° 1 instruction manual.

5.2 UNPACKING AND REPACKING OF THE UNIT

1 Open the carton box and keep it.
2 Remove the probe wrapped in clear plastic guard.
3 Remove the plastic cap.

⚠ Handle the probe with care.

If repackaging do the reverse.

5.3 STORAGE AND TRANSPORT

For prolonged storage, keep the product in dry places.
In the case of transportation, pack the product in the carton box.

5.4 INSTALLATION OF C 8825.4

When used in immersion, the probe must be immersed at least up to cover of the horizontal window (about 8 cm) and positioned a few cm away from the bottom.

An extension tube, not included in the supply and fixed in the upper part with 1 1/2 "NPT thread, protects the cable in deep dives; it is also possible to use the SZ 7531 accessory which allows the use of 1 "GAS threaded pipes.

When using piping, use a 1 1/2 "FNPT thread fitting taking care to maintain a few cm distance between the pipe walls and the lower part of the probe.

It is recommended to install the probe horizontally in a pipe elbow.

Do not install the probe vertically upwards to avoid deposits in the measuring area of the probe.

5.5 INSTALLATION OF C 8325.5

When used in immersion, the probe must be immersed at least up to cover the window (about 8 cm) and positioned a few cm away from the bottom.

An extension tube, not included in the supply and fixed in the upper part, protects the cable in deep dives.

When used in flow, the accessory SZ 724 can be used for mounting on a DN40 conic fitting, taking care to maintain a few cm distance between the pipe walls and the lower part of the probe.

It is recommended to install the probe horizontally in a pipe elbow.

The probe can also be installed in flow using the accessory YBP75M0011 (for more information contact our Sales Department).

Do not install the probe vertically upwards to avoid deposits in the measuring area of the probe.

5.6 INSTALLATION OF C 8520.5

The probe is designed for mounting on a DN32 conic fitting, taking care to maintain a few cm distance between the pipe walls and the lower part of the probe.

It is recommended to install the probe horizontally in a pipe elbow.

Do not install the probe vertically upwards to avoid deposits in the measuring area of the probe.

5.7 ELECTRICAL INSTALLATION

Connect the probe to the meter by following the color of the wires of the cable.

The normal operation mode via the current loop uses the white and green wires which are protected against reversed connection.

The shield of the cable is not connected inside the probe but must be connected to the system ground.

Wire colour	Function
Shield	not connected
Yellow	RS485 A (+)
Grey	RS485 B (-)
Brown	not connected
Green	+ current loop
White	- current loop / COM RS485

⚠ Do not connect the power supply on the RS485 interface wires (yellow and gray) to prevent breakage.

Avoid interruptions of the cable. If needed, use junction boxes with high insulation and the extension cable p/n 2423405 (5x0.25 - D 5.70 mm).

Keep the cable away from the power cables also inside the electrical panel.

5.7.1 CONNECTION IN ANALOG MODE TO B&C INSTRUMENTS

In analog mode is possible to connect the conductivity probe to instruments BC 7335 - BC 7635 - BC 7687 - BC 6587 of B&C Electronics in order to simplify their use by their characteristics listed below:

- configuration of the scale corresponding to 4-20 mA input signal;
- zero adjustment and sensitivity;
- two independent set points;
- alarm relay min / max;
- isolated output 0-20 mA or 4-20 mA;
- digital input to maintain the instrument in terms of hold during calibration or in the cycle of self cleaning.

Connect the sensor to the controller as follows:

Wire color	BC 7335	BC 7635	BC 7687	BC 6587
Green	20	20	20	25
White	22	22	22	23

Calibration

When the probe is connected to the mentioned instruments in analogue mode, small corrections can be made on the calibration of the conductivity or TDS measurement using the zero and sensitivity adjustment available in the instruments and described in the specific instruction manuals.

By doing so, you avoid carrying out the calibration of the probe by means of the digital connection that will be performed only in the installation for the change of scale or the use of the scale factor for an intermediate and more adequate scale of the analog output.

5.7.2 NETWORK CONNECTION (RS485)

These digital probes use a RS485 driver with slow switching fronts.

This implies that it is not necessary to complete the termination of the transmission line even for long distances.

The following directions are to be considered as examples.

If the driver of the master device has very fast switching fronts, it may be necessary to terminate the beginning and end of the transmission line. In this case it should be inserted in the transmission line a pull-up and pull-down Rp resistors to keep the line polarized and to ensure the starting condition (start bit).

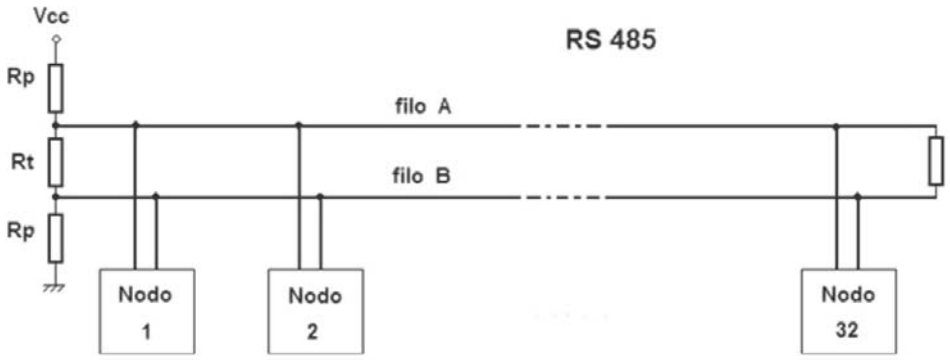


Fig. 1 Pull-up and pull-down resistors termination

If no power supply is available to insert the pull-up and pull-down resistances on the line, or to not overload the driver increasing the consumption of the sensors and devices, make an AC termination by inserting a capacitor in series with the terminating resistor.

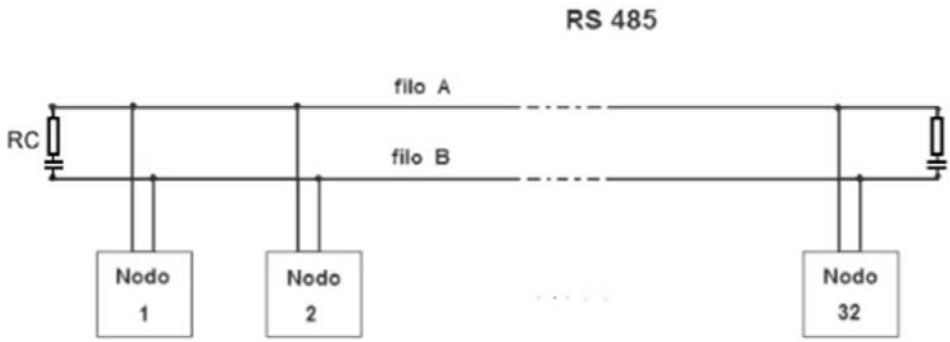


Fig. 2 AC termination

The capacitors to be used depend on the length of the cables and as an indication they are the following:

10 nF (150 m) - 22 nF (300 m) - 47 nF (600 m) - 100 nF (1200 m).

5.7.3 CONNECTION IN DIGITAL MODE TO B&C INSTRUMENTS

In digital mode is possible to connect the turbidity probe to instruments MC 7687 and MC 6587 of B&C Electronics.

For the available functions, refer to the instruments specific manuals.

Connect the sensor to the controller as follows:

Wires color	MC 7687 terminals	MC 6587 terminals
Green	40	35
White	37	32
Yellow	39	34
Grey	38	33

5.8 DISPOSAL

In the case of disposal of the instrument, apply the terms of the law provided for the disposal of electronic devices.

6 OPERATING PROCEDURE

6.1 MEASURING PRINCIPLE

The inductive conductivity sensor consists of two toroidal cores side by side, embedded in the plastic material and therefore not in contact with the sample.

A through hole allows the sample to close an imaginary electromagnetic circuit around them.

An alternating current is applied to the emitter toroid while on the receiver a current is detected proportional to the conductivity of the sample.

The TDS value is calculated from the conductivity value by applying a programmable conversion factor.

6.2 OPERATING MODE

The probe can be configured to operate in analog or digital mode.

For operation in analog mode you must configure "digital mode = 0".

For operation in digital mode you must configure "digital mode = 1 or 2".

To change the operating mode, set the new parameter, turn the probe off and on again.

6.3 ANALOG MODE

In analog mode, the probe provides a 4-20 mA output current loop isolated from the sample for direct connection to a PLC or to a data logger.

The probe in the analog mode can be connected to BC 7335 - BC 7635 - BC 7687 - BC 6587 B&C Electronics instruments, which allow the visualization of the measure and have two set point on/off and an alarm window.

The probe is supplied with the factory configuration in analogue mode (digital mode = 0).

The probe requires 2 seconds from the switching on to stabilize the operation of the internal circuits.

After 2 seconds, the current loop settles for the next 16 seconds to set current values that allow the operator to identify the scale of measurement selected in the configuration:

- the value 11 mA indicates the scale 0.00 ÷ 20.00 mS;
- the value 12 mA indicates the scale 0.0 ÷ 200.0 mS;
- the value 13 mA indicates the scale 0 ÷ 2000 mS;
- the value 14 mA indicates the scale 0.000 ÷ 4.000 mS;
- the value 15 mA indicates the scale 0.00 ÷ 40.00 mS;
- the value 16 mA indicates the scale 0.0 ÷ 400.0 mS.

If during the time interval from 2 to 18 seconds from the switching on any RS485 serial interface activity was detected, the probe will enter definitively in analog mode with 4-20 mA current loop ignoring any subsequent activity present on the serial.

If during this interval an RS485 serial interface activities is detected, the probe will go into digital mode (typical absorption 8.5 mA, may be higher during transmission) until the next restart..

6.4 DIGITAL MODE

In digital mode the probe is a slave device that interacts with a master device through the RS485 serial interface.

In case of connection to a PC, a RS485/RS232 or RS485/USB (as BC 8701) converter can be required.

The communication is via the RS485 connection with the B&C protocol (ASCII) and Modbus RTU (function 03 - 06 -16) protocol described in the following chapters.

When switched on the probe requires 2 seconds to stabilize its internal circuits.

After that period, if configured for digital mode with the parameter "digital mode = 1" or "digital mode = 2", the probe is ready to receive commands from the master device or manually through the Hyperterminal program or similar.

After switching on, for digital mode = 1 the current loop will provide 11 / 12 / 13 / 14 / 15 / 16 mA in function of the selected scale.

For digital mode = 2 the current loop will provide 8.5 mA.

6.4.1 B&C COMMUNICATION PROTOCOL

Connect the probe to a PC for data management and calibration, using a simple terminal emulation program (example Hyperteminal).

Mode of transmission

Code system	ASCII
Number of bits per character:	
- start bits	1
- data bits	8
- parity	no parity
- stop bits	1
Error check (only A command)	BCC
Speed	9600 baud (default)

Commands format using ID (01 ÷ 99) o (1 ÷ 99)

1 or 2 byte ID probe (01 ÷ 99 or 1 ÷ 99)

1 or 2 byte of command

n byte to be inserted if required by the command

1 byte <cr> (carriage return) end command

The probe transmits only if the ID sent is correct or is 00.

> ⚠ Do not use 00 ID if more than one probe is connected, to avoid overlap of the communication.

Commands format using ID + SNxxxxxx

1 or 2 byte ID probe (01 ÷ 99 or 1 ÷ 99)

8 byte serial number (SNxxxxxx)

1 or 2 byte of command

n byte to be inserted if required by the command

1 byte <cr> (carriage return) end command

The probe transmits only if the ID + serial number sent is correct or if it is 00 + serial number.

> ⚠ If the communication port is set to a different speed the probe will not communicate.

> 💡 *All the available commands are listed in the following pages.*

> 💡 *The list of commands implemented in the transmitter is always available by sending the command Help.*

COMMANDS USING ID

HELP

Command format: **ID + H <cr>**

Example: if ID=14 type 14H <cr> or 00H <cr>

By sending the command **H** the probe responds by sending a record containing the list of available commands with a brief description of their meaning.

```
-------------------------------------------------------------------------------
HELP MENU, COMMAND LIST       B&C ELECTRONICS
-------------------------------------------------------------------------------
 C8X25  CONDUCTIVITY PROBE 4-2000mS Rev.fw:3.10  S/N:192589

00H  <cr>  Help menu
00A  <cr>  Acquisition
00Mx <cr>  Digital mode:      0000             (0=analog 1=digital 2=dig.LP)
00Ox <cr>  Analog out 4-20mA: 0001             (1=20mS 2=200mS 3=2000mS)
                                               (4=4mS  5=40mS  6=400mS)
00Kx <cr>  Analog out EC,TDS: 0000             (0=EC 1=TDS)
00Fx <cr>  TDS/EC factor:     0.670            (0.450-1.000)
00Xx <cr>  Scalable output %: 0100             (10-100% full scale)
00RLx<cr>  RT90% large signal 0002.s           (2-220s)
00RSx<cr>  RT90% small signal 0010 s           (2-220s)
00Jx <cr>  Temp. adjust       not done    0.0  (5.0°C max) (00JR reset)
00Gx <cr>  Tref               0001             (1=20°C 2=25°C)
00Cx <cr>  TC                 2.00 %/°C        (0.00-3.50%/°C)
00Vx <cr>  Meas. with KCl TC: 0000             (0=no 1=yes momentary)
00Tx <cr>  Standard solution: 102.1 mS         (0.000-2000 mS)
00Z  <cr>  Zero  calibration: OK         0.02  (10% fs max) (00ZR reset zero)
00S  <cr>  Sens. calibration: not done 100.0% (60-160%)    (00SR reset sens)
00SK <cr>  Sens. cal. KCl
00Dx <cr>  Last cal date:     00/00/00         (XX/XX/XX, XX=00-99)
00Ix <cr>  ID B&C:            0002             (01-99)or(1-99)
00Ex <cr>  ID modbus:         0002             (1-243)
00Bx <cr>  Baud rate:         0003             (1=2400 2=4800 3=9600 4=19200)

Type ID number or 00 before command. Example, if ID=15 type 15A or 00A <cr>
Use 00A <cr> if only one probe is connected
Query commands: 00H?,00Z?,00S?,00J?
-------------------------------------------------------------------------------
```

PARAMETERS QUERY

Command format: **ID + H? <cr>**

Example: if ID=14 type 14H? <cr> or 00H? <cr>

By sending the command **H?** displays a record containing the code and the identifier followed by all parameters including the results of calibrations.

The record transmitted uses the "," as separator.

Record format:

```
 C8X25- 09,FW:3.10,SN:192589,M:0000,O:0001,K:0000,F: 0.500,X:0100,RL:0
....+....|....+....|....+....|....+....|....+....|....+....|....+....|
002,RS:0010,J:not done ±   0.0°C  ,G:0001,C: 2.00,V:0001,T: 102.1,Z:no
....+....|....+....|....+....|....+....|....+....|....+....|....+....|
t done    0.02mS  ,S:not done   100.0%   ,D:00/00/00,IA:0002,EA:0002,B
....+....|....+....|....+....|....+....|....+....|....+....|....+....|
A:0003,BCC:4BB8,xx
```

C8X25	Probe code
02	Probe identification number (for ID < 10 visualization with blank/zero as first character according to the mode used in setting the ID)

Below are transmitted parameter values measured by the probe with the format NAME PARAMETER: VALUE.

FW:3.10	Firmware version
SN:192589	Probe's serial number
M:0000	Operating mode
O:0001	Analog output/scale setting
K:0000	TDS scale (OFF/ON)
F:0.500	TDS/conductivity factor
X:0100	Scalable output
RL:0002	Large software filter value
RS:0010	Small software filter value
J:not done 0.0°C	Temperature calibration outcome (not done, ok, error)
G:0001	Reference temperature
C: 2.00	Temperature coefficient value
V:0000	Measure with TC setted (0) or with KCl TC (1)
T:102.1	Sensitivity calibration solution value
Z:not done 0.02mS	Zero calibration outcome (not done, ok, error)
S:not done 100.0%	Sensitivity calibration outcome (not done, ok, error)
D:00/00/00	Last calibration date
IA:0002	ID B&C protocol
EA:0002	ID Modbus protocol

BA:0003	Baud rate
BCC:4BB8	BCC EEPROM check
xx	2 byte BCC of transmitted record

The record transmission is ended by <cr> <lf>.

EEPROM BCC check use

The EEPROM BCC check is a summary of the probe configuration state. When the parameters are set and calibration has been done, the value of the BCC remains constant until the next change of parameters or calibration. A variation of the BCC value without changing any parameters means the probe's configuration data has been altered.

BCC calculation

The BCC messages sent by the probe is calculated as the XOR of all the bytes making up the message (excluding <cr> and <lf>) and divided into 2 nibble.

The two nibbles are then transformed into their ASCII codes.

The BCC transmitted at the end of record is used to check the validity of records received.

ACQUISITION

Command format: **ID + A <cr>**

Example: if ID=14 type 14A <cr> or 00A <cr>

By sending the command **A**, the probe responds by sending a record containing the code, the ID, date, time, and the value of all the measures.

Record format

```
C8X25- 09  0.0 01/01/01 00:00:00 ± 200.0mS   ± 100.0ppt  ±  18.5°C   ±
....+....|....+....|....+....|....+....|....+....|....+....|....+....|....+....|
0.500     ±    20°C   ±  2.00%/°C 18/11/10xx
```

C8x25	Probe code
09	Probe ID
0.0	Power voltage (not implemented)
01/01/01	Date (not implemented)
00:00:00	Time (not implemented)

Below are transmitted the parameter values measured by the transmitter with the following format:

Measuring	- Sign of measure (if positive is sent a blank) - Value of measure (6 characters - right alignment)
Measuring unit	- 4 characters - left alignment - 1 blank (ASCII 32)
± 200.0 mS	Conductivity value

± 100.0 ppt	TDS value
± 18.5 °C	Temperature
± 0.500	TDS/conductivity factor
± 20 °C	Reference temperature
± 2.00 %/°C	Temperature coefficient

At the end of the record, the probe sends the date the last calibration procedure, then 2 bytes containing the BCC of the string sent.

18/11/10	Last calibration date
xx	2 byte BCC

The record transmission is ended by <cr> <lf>.

BCC calculation

The BCC messages sent by the transmitter is calculated as the XOR of all the bytes of the message (excluding <cr> and <lf>) and divided into two nibbles.

The two nibbles are then transformed into their ASCII codes.

BCC use

The BCC can be used if you want to create a master program that interrogates the probe.

The BCC is used to check the validity of records received.

DIGITAL MODE

Command format: **ID + M + x <cr>**

Example: if ID=14 and digital mode = 1 type 14M1 <cr> or 00M1 <cr>

Response of the unit:	**<cr> <lf> ID + M + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

The probe can be configured to operate in digital mode (digital mode = 1 or 2) or in analog 4-20 mA mode (digital mode = 0).

For this command, and for all the following commands the response of the sensor is a replica of the command received with the addition of a <lf> line feed (head) at the beginning and end of the response.

ANALOG OUTPUT

Command format: **ID + O + x <cr>**

Example: if ID=14 and analog out = 40.00 mS scale type 14O5 <cr> or 00O5 <cr>

Response of the unit:	**<cr> <lf> ID + O + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

The 4-20 mA analog output can be combined with one of the 6 conductivity or TDS scales.
Set parameter:
x = 1 for 20.00 mS or 10.00 ppt scale
x = 2 for 200.0 mS or 100.0 ppt scale
x = 3 for 2000 mS or 1000 ppt scale
x = 4 for 4,000 mS or 2,000 ppt scale
x = 5 for 40.00 mS or 20.00 ppt scale
x = 6 for 400.0 mS or 200.0 ppt scale

CONDUCTIVITY / TDS ANALOG OUTPUT

Command format: **ID + K + x <cr>**
Example: if ID=14 and analog out TDS scale type 14K1 <cr> or 00K1 <cr>

Response of the unit:	**<cr> <lf> ID + K + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Set parameter:
x=0 for conductivity
x=1 for TDS
To check if the entered value has been received, enter command **H**.
The enabling of the TDS measurement acts on the 4-20mA analogue retransmission.

SCALE FACTOR EC / TDS

Command format: **ID + F + x <cr>**
Example: if ID=14 and scale factor is 0.550 type 14X0.550 <cr> or 00X0.550 <cr>

Response of the unit:	**<cr> <lf> ID + F + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

To check whether the entered value has been received type command **H**.

OUTPUT SCALE FACTOR

Command format: **ID + X + x <cr>**
Example: if ID=14 and scale factor is 50 % type 14X50 <cr> or 00X50 <cr>

Response of the unit:	**<cr> <lf> ID + X + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

To check whether the entered value has been received type command **H**.

Example of scale factors:

Scale factor	**Full scale value**
100 %	20/200/2000/4/40/400 mS 10/100/1000/2/20/200 ppt
75 %	15/150/1500/3/30/300 mS 7.5/75/750/1.5/15/150 ppt
50 %	10/100/1000/2/20/200 mS 5/50/500/1/10/100 ppt
25 %	5/50/500/1/10/100 mS 2.5/25/250/0.5/5/50 ppt

LARGE FILTER (Response time 90 % large signal)

Command format: **ID + RL + x <cr>**

Example: if ID=14 and the response time relative to signals of large variation is 100 s type 14RL100 <cr> or 00RL100 <cr>

Response of the unit:	**<cr> <lf> ID + RL + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

The large filter can be set from 2 to 220 seconds.

To check whether the entered value has been received type command **H?** or **H**.

SMALL FILTER (Response time 90 % small signal)

Command format: **ID + RS + x <cr>**

Example: if ID=14 and the response time relative to signals of small variation is 100 s type 14RL100 <cr> or 00RL100 <cr>

Response of the unit:	**<cr> <lf> ID + RS + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

The small filter can be set from 2 to 220 seconds.

To check whether the entered value has been received type command **H?** or **H**.

TEMPERATURE CALIBRATION

Command format: **ID + J +x <cr>**

Example: if ID=14 and the temperature value is 23.2°C typredigitare 14J23.2 <cr> oppure 00J23.2 <cr>

Response of the unit:	**<cr> <lf> ID + J + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Possible results:

'ok'	calibration done

'error'	error during calibration
'not done'	default factory calibration value

To check the result of the sensitivity calibration using the **ID + J?** or **ID + H**.
In the event of a successful test with the **ID + A**, the reading must be about the one entered.

If the operation has failed (error) is kept the value of the previous zero.

TEMPERATURE CALIBRATION RESET

Command format: **ID + JR <cr>**
Example: if ID=14 type 14SR <cr> or 00SR <cr>

Response of the unit:	**<cr> <lf> ID + JR <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

This command allows to return to the default temperature zero value.
Verify the outcome of the operation through the command **ID + H** and check the line "Temp. adjust: not done".

TEMPERATURE CALIBRATION TEST

Command format: **ID + J? <cr>**
Example: if ID=14 type 14J? <cr> or 00J? <cr>

Response of the unit:	**<8 characters outcome> >blank> <7 characters value> <4 characters measure unit><cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Record format

```
ok       ±   0.2°C
....+....|....+....|....+....|....+....|....+....|....+....|....+....|....+....|
```

Possible results: ok / not done / error.

REFERENCE TEMPERATURE

Command format: **ID + G + x <cr>**
Example: if ID=14 and reference temperature 25 °C type 14O2 <cr> or 00O2 <cr>

Response of the unit:	**<cr> <lf> ID + G + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Set parameter:
x=1 for Tref = 20 °C
x=2 for Tref = 25 °C
To check whether the entered value has been received type command **H?** or **H**.

TEMPERATURE COEFFICIENT

Command format: **ID + C + x <cr>**
Example: if ID=14 and temperature coefficient 2.10 %/°C type 14C2.10 <cr> or 00C2.10 <cr>

Response of the unit:	**<cr> <lf> ID + C + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

To check whether the entered value has been received type command **H?** or **H**.

TEMPORARY MEASUREMENT WITH KCL TC

Command format: **ID + V + x <cr>**
Example: if ID=14 and you need to measure using KCl TC type 14V1 <cr> or 00V1 <cr>

Response of the unit:	**<cr> <lf> ID + V + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Set parameter:
x=0 for setted TC
x=1 for KCL TC
The command allows to calibrate the sensitivity (using the command **ID + S <cr>**) with a standard KCl solution in order to read the conductivity value before and after calibration by applying the TC of the KCl and not the one set.
To check whether the entered value has been received type command **H?** or **H**.
Once the sensitivity calibration is completed, the TC of the KCl will be maintained for the next 20 seconds to allow verification of the correct calibration carried out with the KCl standard. After 20 seconds the TC will be automatically reset to the set use TC.
Also the reset sensitivity operation resets to the use CT after the expected 20 seconds.
If the request to measure with the TC of the KCl is activated and within 30 minutes the sensitivity calibration is not performed, the TC is automatically returned to the user TC.
To instantly go back to measuring with the TC setting you need to perform the sensitivity calibration type 14V0 <cr> or 00V0 <cr>.

STANDARD SOLUTION VALUE

Command format: **ID + T + x <cr>**
Example: if ID=14 and the calibration solution is102.1 mS type 14T102.1 <cr> or 00T102.1 <cr>

Response of the unit:	**<cr> <lf> ID + T + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

To check whether the entered value has been received type command **H?** or **H**.

ZERO CALIBRATION

Perform the zero calibration operation with the dry cell.
Zero calibration is performed on all scales from the lowest scale.

> *Zero calibration should be performed before sensitivity calibration.*

Command format: **ID + Z <cr>**
Example: if ID=14 type 14Z <cr> or 00Z <cr>

Response of the unit:	**<cr> <lf> ID + Z <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Calibration messages:

'ok'	calibration done
'error'	error during calibration
'not done'	default factory calibration value

To check the result of the zero calibration using the **Z?**, **H?** or **H**.

> *If the operation has failed (error) is kept the value of the previous zero.*
> *Verify that the cell is perfectly dry and clean.*

ZERO CALIBRATION RESET

Command format: **ID + ZR <cr>**
Example: if ID=14 type 14ZR <cr> or 00ZR <cr>

Response of the unit:	**<cr> <lf> ID + ZR <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

This command allows you to restore the zero value to the default values.
Verify the outcome of the operation with the command **Z?**, **H?** or **H** and check the line "Zero calibration: not done".

ZERO CALIBRATION TEST

Command format: **ID + Z? <cr>**
Example: if ID=14 type 14Z? <cr> or 00Z? <cr>

Response of the unit:	**<8 characters outcome> >blank> <7 characters value> <4 characters measure unit><cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Record format

```
ok       ±  0.10mS
....+....|....+....|....+....|....+....|....+....|....+....|....+....|....+....|
```

Possible results: ok / not done / error.

SENSITIVITY CALIBRATION

Sensitivity calibration operation in a standard solution or in a known conductivity solution.

The value of the solution must be entered using the "Value of the calibration solution" command.

The TC (temperature coefficient) used during calibration is that of the KCl if the parameter **V** is set to 1, if **V** is equal to 0, the use TC is used.

The use of the TC of the KCl is temporary and after 20 seconds from the calibration the user TC is automatically reset.

The zero calibration is performed on all scales.

Command format: **ID + S <cr>**

Example: if ID=14 type 14S <cr> or 00S <cr>

Response of the unit:	**<cr> <lf> ID + S <cr> <lf>**	Command executed correctly
Response of the unit:	none	Command failed

Calibration messages:

'ok'	calibration done
'error'	error during calibration
'not done'	default factory calibration value

To check the result of the sensitivity calibration using the **S?**, **H?** or **H**.

Send a command **A** to test if calibration was successful. The reading should be as close as possible to the value of the solution used for calibration.

If the operation has failed (error) check that the probe is actually immersed in the standard solution.

Inspect the state of the surface of the sensor, if necessary, clean the surface with a soft cloth.

In the case of a negative result, the probe restores the previous sensitivity value.

SENSITIVITY CALIBRATION WITH KCl

Sensitivity calibration operation in standard KCl solution.

The value of the solution must be entered using the "Value of the calibration solution" command.

The TC (temperature coefficient) used during calibration is that of KCl.

> ⚠ This command allows to calibrate directly applying the TC of the KCl without setting the reading with the KCl (Measurement with TC of the KCl). The value then measured before calibration will not be the correct value of the standard but a different value due to the use of the TC of use instead of the TC of the KCl.
>
> Once the sensitivity calibration is completed, the TC of the KCl will be maintained for the next 20 seconds to allow verification of the correct calibration carried out with the KCl standard. After 20 seconds the TC will be automatically returned to the user TC.

The zero calibration is performed on all scales.

Command format: **ID + SK <cr>**

Example: if ID=14 type 14SK <cr> or 00SK <cr>

Response of the unit:	**<cr> <lf> ID + SK <cr> <lf>**	Command executed correctly
Response of the unit:	none	Command failed

Calibration messages:

'ok'	calibration done
'error'	error during calibration
'not done'	default factory calibration value

To check the result of the sensitivity calibration using the **S?**, **H?** or **H**.

Send a command **A** to test if calibration was successful. The reading should be as close as possible to the value of the solution used for calibration.

> 💡 *If the operation has failed (error) check that the probe is actually immersed in the standard solution.*
>
> *Inspect the state of the surface of the lenses and, if necessary, clean the surface with a soft cloth.*
>
> *In the case of a negative result the probe restores the previous values of sensitivity.*

SENSITIVITY RESET

Command format: **ID + SR <cr>**

Example: if ID=14 type 14SR <cr> or 00SR <cr>

Response of the unit:	**<cr> <lf> ID + SR <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

This command allows to return to the default sensitivity value of 100.0 %.

Verify the outcome of the operation through the command **S?**, **H?** o **H** and check the line "Sens. calibration: not done".

SENSITIVITY CALIBRATION TEST

Command format: **ID + S? <cr>**

Example: if ID=14 type 14S? <cr> or 00S? <cr>

Response of the unit:	**<8 characters outcome> >blank> <7 characters value> <4 characters measure unit><cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Record format

```
ok       ± 100.0%
....+....|....+....|....+....|....+....|....+....|....+....|....+....|....+....|
```

Possible results: ok / not done / error.

LAST CALIBRATION DATE

Command format**: ID + D + XX/XX/XX <cr>** (XX = 00 ÷ 99)

Example: if ID=14 and the date to be inserted is 11/05/18 type 14D11/05/18 <cr> or 00D11/05/18 <cr>

Response of the unit:	**<cr> <lf> ID + D + XX/XX/XX <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

This command allows to store the last calibration date.

The date field is 8 characters to be written in the proposed format.

ID OF THE B&C PROTOCOL

Command format: **ID + I + x <cr>**

Example: if ID=14 and the new ID (identification) to enter is 07 type 14I07 <cr> or 00I07 <cr>

Response of the unit:	**<cr> <lf> ID + I + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

If ID is less than 10 depending on the input mode the first digit will then be displayed as blank or zero in controls **00A** and **00H?**.

If you want a view with a zero first you must enter the ID with 0 as 00I07 but if you want it with the blank you have to type it without 0 example 00I7.

The probe activates the new ID immediately after the response to the command.

ID OF THE MODBUS PROTOCOL

Command format: **ID + E + x <cr>**

Example: if ID=14 and the new ID (identification) to enter is 07 type 14E07 <cr> or 00E07 <cr>

Response of the unit:	**<cr> <lf> ID + E + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

The probe activates the new ID immediately after the response to the command.

BAUD RATE

Command format: **ID + B + x <cr>**

Example: if ID=14 and the new speed is 2 = 4800 baud type 14B2 <cr> or 00B2 <cr>

Response of the unit:	**<cr> <lf> ID + B + x <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Set parameter:

x=1 for 2400 baud

x=2 for 4800 baud

x=3 for 9600 baud

x=4 for 19200 baud

The probe activates the new baud rate immediately after the response to the command.

COMMANDS USING ID + SNxxxxxx

From release R3.00 it has been added the possibility to query the probes by inserting the serial number of the probe in addition to the ID for **all the commands provided**.

Example: the command to acquire the measurement of a probe with ID=14 and SN123456 can be performed with:

interrogation using ID	14A <cr> or 00A <cr>
interrogation using ID+SNxxxxxx	14SN123456A <cr> or 00SN123456A <cr>

The interrogation with ID + SNxxxxxx becomes a unique command thus allowing to be able to insert more than 99 devices on the network, limit imposed by the commands with ID.

A command is also provided with serial number broadcast ID + SN000000 to which all the probes respond.

SEARCH PROBE TYPE, ID AND SERIAL NUMBER

Command format: **ID + SN? <cr>**

Example: if the ID is known (ID=14) type 14SN? <cr> to know code and serial number or type 00SN? <cr> to search all the probes in the network.

Response of the unit:	**<6 characters code> <2 characters ID> <6 characters serial number> <2 characters BCC> <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Record format

```
TU8325,14,123456,xx
....+....|....+....|
```

This command allows to search all the probes in a network.

The probes respond by providing their identity: code, ID, serial number.

The probe response occurs after a random time chosen by the probe itself between 8 time intervals: 0 ms, 200 ms, 400 ms, 600 ms, 800 ms, 1000 ms, 1200 ms, 1400 ms to avoid as much as possible an overlap of the answers when there are more probes on the network.

If there are more probes, some overlap of communication will be unavoidable.

The master device must manage the probes search by disabling the commands of the probes it has found, repeating the search command several times until it has found all the probes in the network.

At this point the master can re-enable the commands of the probes he has found.

To disable and re-enable the probe commands, see the command **ID + SNxxxxxx + MUx <cr>**.

The automatic management of probe probes is implemented in the MC 6587 and MC 7687 instruments of the B&C Electronics.

DISABLE/ENABLE COMMANDS USING ID

Command format: **ID + SNxxxxxx + MUx <cr>**

Example: to disable commands using ID of a probe with ID=14 and serial number 123456 type 14SN123456MU1 <cr> or 00SN123456MU1 <cr>

Response of the unit:	**<cr> <lf> ID + SNxxxxxx + MUx <cr> <lf>**	command executed correctly
Response of the unit:	none	command failed

Set parameter:

x=0 to enable commands using ID

x=1 to disable the commands using ID

When the probe is disabled to commands using ID:

- can only execute commands with **ID + SNxxxxxx**;
- does not run the probe search command **ID + SN?**.

6.4.2 MODBUS PROTOCOL

On the probe, in addition to the ASCII B&C protocol, is implemented the Modbus RTU protocol limited to the function 03, 06, and 16.

In Modbus communication network the probe operates as a slave device.

RTU transmission mode

Coding system	8-bit binary
Number of bits per character:	
- start bits	1
- data bits (menus sign before)	8
- parity	no parity
- stop bits	1
Errors verification	CRC-16

RTU messages format

Pause transmission	duration 3,5 bytes
Address	1 byte (8 bits)
Function	1 byte (8 bits)
Data	N bytes (N x 8 bits)
Errors verification	2 bytes (16 bits)
Pause transmission	duration 3,5 bytes

For a correct synchronization of the transmission the receiving unit interprets the end of a message when it doesn't receive any characters (bytes) for a time equivalent to the transmission of 3.5 characters (bytes).

MODBUS FUNCTION 03 (0x03)

Function 03 (MASTER QUERY)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	03 (read holding register)
Start address data HI	1 byte	Start address of registers
Start address data LO	1 byte	
Number of registers HI	1 byte	Number of registers (2 byte x register)
Number of registers LO	1 byte	
Errors verification	2 bytes	CRC-16

The transmitter considers valid the message if CRC-16 valid, ID valid and function=03.
Function 03 (SLAVE ANSWER)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	03 (read holding register)
Number of byte of sent data	1 byte	2x number of sent registers
N byte of data	N byte	Values of registers
Error verification	2 bytes	CRC-16

If you query requesting registers outside the defined limits, the probe answers assigning zero to all of the registers out of range.
If an error occurs in the request, the response takes the following form:

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	0x83 (read holding register + error)
Error	1 byte	2 = illegal data address 3 = illegal data value
Error verification	2 bytes	CRC-16

Time between the end of the query and the beginning of the response about 100 ms.

MODBUS FUNCTION 06 (0x06)

Function 06 (MASTER QUERY)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	06 (write single register)
Address data HI	1 byte	Address of the register
Address data LO	1 byte	
Value of the register HI	1 byte	Value to be written
Value of the register LO	1 byte	
Errors verification	2 bytes	CRC-16

The probe considers valid the message if CRC-16 valid, ID valid and function=06.

Function 06 (SLAVE ANSWER)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	06 (write single register)
Address data HI	1 byte	Address of the register
Address data LO	1 byte	
Value of the register HI	1 byte	Value to be written
Value of the register LO	1 byte	
Errors verification	2 bytes	CRC-16

When writing some calibration commands (eg zero calibration), the probe responds to the request and then remains silent for the time necessary to perform the operation.

If an error occurs in the request, the response takes the following format:

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	0x86 (write single register + error)
Error	1 byte	2 = illegal data address 4 = slave device failure
Error verification	2 bytes	CRC-16

Time between the end of the query and the beginning of the response about 100 ms.

MODBUS FUNCTION 16 (0x10)

Function 16 (MASTER QUERY)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	16 (write multiple registers)
Start address data HI	1 byte	Start address of registers
Start address data LO	1 byte	
Number of registers HI	1 byte	Number of registers (2 byte x register)
Number of registers LO	1 byte	
Number of byte	1 byte	2 byte per register
Value of registers	n byte	n = 2 byte x number of registers
Errors verification	2 bytes	CRC-16

The transmitter considers valid the message if CRC-16 valid, ID valid and function=16.

Function 16 (SLAVE ANSWER)

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	16 (write multiple registers)
Start address data HI	1 byte	Start address of registers
Start address data LO	1 byte	
Number of registers HI	1 byte	Number of registers (2 byte x register)
Number of registers LO	1 byte	
Errors verification	2 bytes	CRC-16

When writing some calibration commands (i.e. zero calibration), the probe responds to the request and then remains silent for the time necessary to perform the operation.

If an error occurs in the request, the response takes the following format:

Address	1 byte	1 ÷ 243 (probe ID)
Function	1 byte	0x90 (write multiple registers + error)
Error	1 byte	2 = illegal data address 3 = illegal data value 4 = slave device failure
Error verification	2 bytes	CRC-16

Time between the end of the query and the beginning of the response about 100 ms.

BROADCAST COMMANDS

Modbus 06 and 16 queries can be made by the master in broadcast mode.

The broadcast mode consists in sending the message with the identifier 0, all the probes perceive the message and execute the command but do not respond to the master in order not to create conflicts.

DATA THROUGH MODBUS FUNCTION 03

MEASURE AND STATE (address 0x00xx)

	Mod-bus address	Parameter	Range	Unit	Scale	Data type	R/W
1	0x0000	Conductivity - scale 1/2/3 - scale 4/5/6	 0 ÷ 2000 0 ÷ 4000	mS	 [a] [a]	IS	R
2	0x0001	TDS - scale 1/2/3 - scale 4/5/6	 0 ÷ 1000 0 ÷ 2000	ppt	 [a] [a]	IS	R
3	0x0002	Scale	1 ÷ 6 [b]			IS	R
4	0x0003	Temperature °C	0 ÷ 1000	0.1	0.0 ÷ 100.0 °C	IS	R
5	0x0004	TDS/conductivity conversion factor	450 ÷ 1000	0.001	0.450 ÷ 1.000	IS	R
6	0x0005	Reference temperature	20 / 25	1		IS	R
7	0x0006	Temperature coefficient	0 ÷ 350	0.01	0.00 ÷ 3.50 %/°C	IS	R
8	0x0007	BCC EEPROM	0 ÷ 65535	1	0 ÷ 65535	I	R

[a] = depend on the configurated scale

[b] = 1: 0.00 ÷ 20.00 mS scale / 2: 0.0 ÷ 200.0 mS scale / 3: 0 ÷ 2000 mS scale / 4: 0.000 ÷ 4.000 mS scale / 5: 0.00 ÷ 40.00 mS scale / 6: 0.0 ÷ 400.0 mS scale

IS = integer signed / I = integer

R = read / W = write

ZERO CALIBRATION (address 0x010x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
9	0x0102	Zero command/flag - zero cal - reset zero - flag zero cal	 0x5A00 0x5A52 0 = not done 1 = ok 2 = error	 1 1 1		IS	 W W R
10	0x0103	Zero value - scala 1/2/3 - scala 4/5/6	 -200 ÷ 200 -400 ÷ 400		 a a	IS	R

[a] = depend on the configurated scale

IS = integer signed / I = integer
R = read / W = write

SENSIBILITY CALIBRATION (address 0x011x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
11	0x0110	Measure with TC of KCl	0 ÷ 1	1		IS	R/W
12	0x0112	Decimal point standard sens.	1 ÷ 3	1		IS	R/W
13	0x0113	Standard sens - decimal point = 0 - decimal point = 1 - decimal point = 2 - decimal point = 3	 0 ÷ 4000 0 ÷ 4000 0 ÷ 4000 0 ÷ 4000	 0.1 0.01 0.001	 0.0 ÷ 400.0 NTU 0.00 ÷ 40.00 NTU 0.000 ÷ 4.000 NTU	IS	R/W
14	0x0114	Sens command/flag - sens cal - sens cal KCl - reset sens - flag sens cal	 0x5300 0x534B 0x5352 0 = not done 1 = ok 2 = error	 1 1 1		IS	 W W W R
15	0x0115	Sens value	600 ÷ 1600 %	0.1	60.0 ÷ 160.0	IS	R

IS = integer signed / I = integer
R = read / W = write

CHECK CALIBRATION (address 0x012x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
16	0x0120	Temp command/flagl - reset temp - flag temp cal	 0x4A52 0 = not done 1 = OK 2 = error	 1 1	IS	I	 W R
17	0x0121	Temp. adj Temp zero value	-50 ÷ 500 -50 ÷ 50	0.1 0.1	-5.0 ÷ 50.0 °C -5.0 ÷ 5.0 °C	IS	 W R

IS = integer signed / I = integer
R = read / W = write

SETUP (address 0x020x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
18	0x0200	Large filter	2 ÷ 220	1 s	2 ÷ 220 s	IS	R/W
19	0x0201	Small filter	2 ÷ 220	1 s	2 ÷ 220 s	IS	R/W

IS = integer signed / I = integer
R = read / W = write

C 8X2X SETUP (address 0x021x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
20	0x0212	Temperature coefficient	0 ÷ 350	1	0 ÷ 3.50 %/°C	IS	R/W
21	0x0213	Reference temperature	20 / 25			IS	R/W

IS = integer signed / I = integer
R = read / W = write

CONFIGURATION (address 0x030x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
22	0x0300	Digital mode	0 = analog 1 = digital 2 = dig. low power	1		IS	R/W
23	0x0301	Scales	1 ÷ 6	1		IS	R/W
24	0x0302	Scalable output	10 ÷ 100	1	10 ÷ 100 %	IS	R/W
25	0x0303	Baud rate	1 = 2400 2 = 4800 3 = 9600 4 = 19200	1		IS	R/W
26	0x0304	ID B&C	1 ÷ 99	1		IS	R/W
27	0x0305	ID Modbus RTU	1 ÷ 243	1		IS	R/W

IS = integer signed / I = integer
R = read / W = write

SPECIFIC CONFIGUARATION C 8X2X (address 0x031x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
28	0x0310	TDS	0=off / 1=on	1		IS	R/W
29	0x0311	TDS factor	450 ÷ 1000		0.450 ÷ 1.000 1/S	IS	R/W

IS = integer signed / I = integer
R = read / W = write

INFO PROBE (address 0x040x)

	Modbus address	Parameter	Range	Unit	Scale	Data type	R/W
30	0x0401	Codice	6 characters			I	R
31	0x0404	Serial number	6 characters			I	R
32	0x0407	Rev. fw	4 characters			I	R
33	0x0409	Last cal date (1)	00 ÷ 99	1		IS	R/W
34	0x040A	Last cal date (2)	00 ÷ 99	1		IS	R/W
35	0x040B	Last cal date (3)	00 ÷ 99	1		IS	R/W

IS = integer signed / I = integer

R = read / W = write

Use of BCC EEPROM

The EEPROM BCC check is the probe configuration state synthesis. After setting the parameters and carry out the calibration the value of the BCC remains constant until the next change of parameters or calibration.

A variation of BCC in the absence of changes warns that an alteration has taken place in the probe configuration data.

7 MAINTENANCE

The lower end part of the probe must be inspected and cleaned periodically. The encrustations reduce the volume of the sample subject to measurement, altering the probe sensitivity.

Remove any deposits using a damp cloth, or use a soft detergent or a highly diluted acid if the deposits are of a calcareous type. The frequency of cleaning depends on the type of use, the nature and the concentration of the measurement sample.

Cleaning is recommended before zero and sensitivity calibration.

⚠ During these operations avoid removing the cable gland.
This removal is reserved to the manufacturer and if carried out by the operator it will damage the internal circuits voiding the warranty.

7.1 CALIBRATION

The probe is supplied with a factory calibration of the zero and sensitivity done with known standard solutions.

Checking and periodic calibration of the probe is always necessary to ensure the accuracy of the measure.

The degree of cleaning of the measuring cell is an important element to check before making a new calibration. If necessary, wipe the measuring windows with a soft cloth.

Is suggested to run the zero calibration before the sensitivity calibration.

Zero calibration

The zero calibration operation must be performed by placing the probe clean and dry in the air.

Calibration is performed within +/- 10% of the selected scale and performed on all scales automatically following the procedures described in chapter "ZERO CALIBRATION (page 30)".

Sensitivity calibration

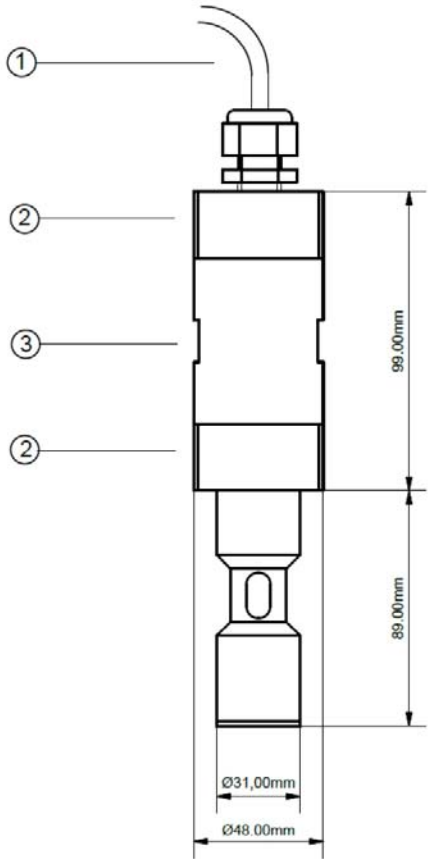
It is done in the KCl standard solutions following the procedure in chapters "SENSITIVITY CALIBRATION (page 31)" and "SENSITIVITY CALIBRATION WITH KCl (page 32)".

Reset of zero and sensitivity calibration

To reset the zero and the sensitivity to factory settings follow the procedures described in chapters "ZERO CALIBRATION RESET (page 30)" and "SENSITIVITY RESET (page 32)".

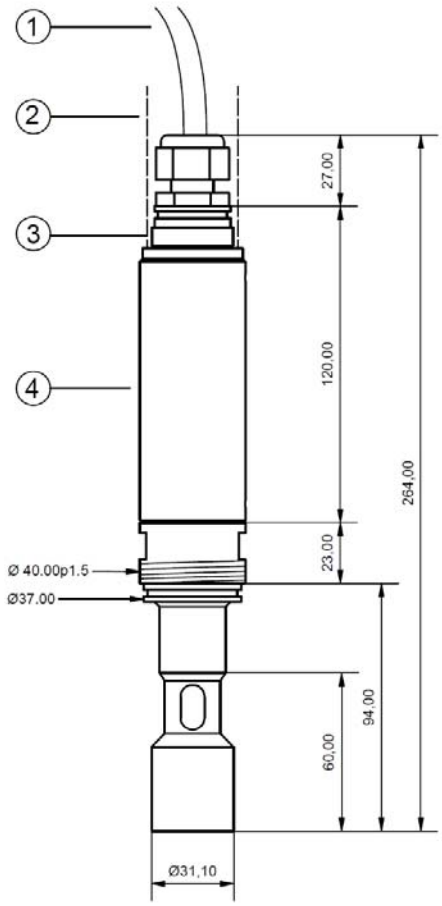
8 INSTALLATION DRAWINGS

8.1 C 8825.4 - DIMENSIONS



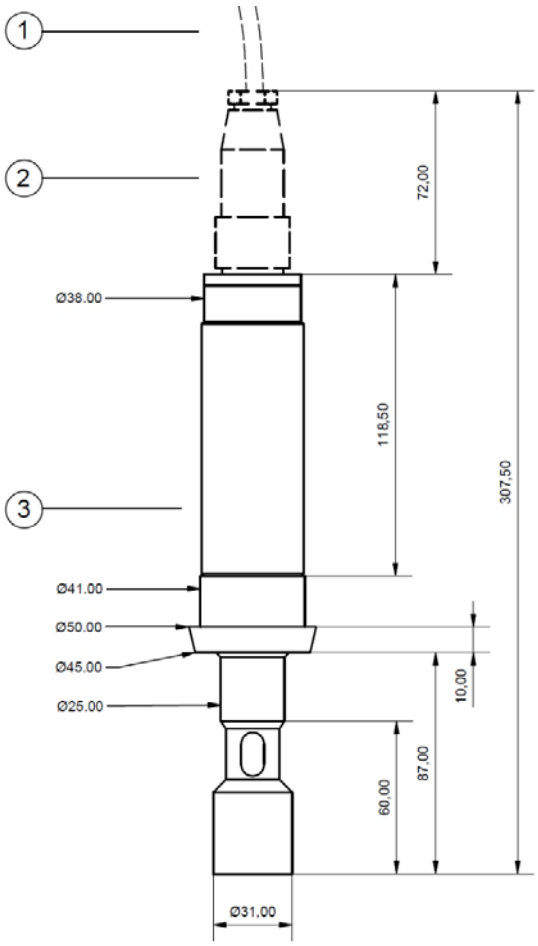
Description		Connections	
1	Cable	Shield	not connected
2	1 1/2" NPT thread	Yellow	RS485 A (+)
3	Body	Grey	RS485 B (-)
		Brown	not connected
		Green	+ current loop
		White	- current loop / COM RS485

8.2 C 8325.5 - DIMENSIONS



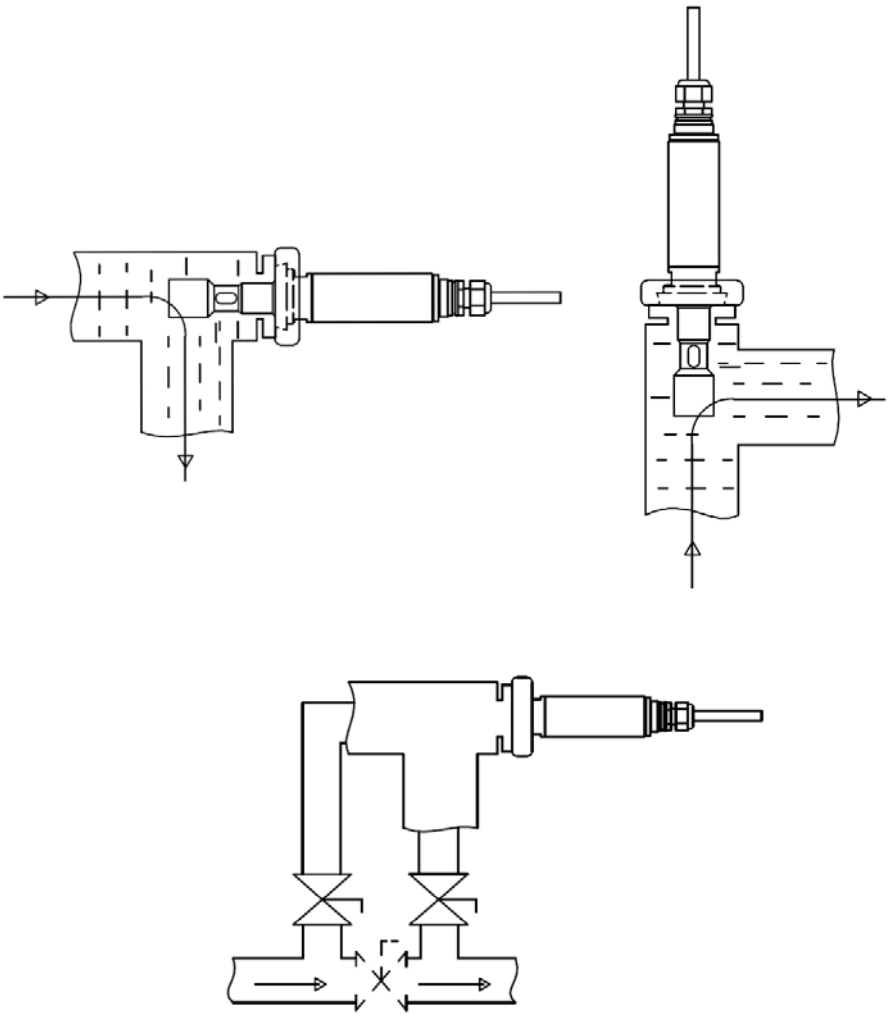
Description		Connections	
1	Cable	Shield	not connected
2	Extension tube (optional)	Yellow	RS485 A (+)
3	Thread	Grey	RS485 B (-)
4	Body	Brown	not connected
		Green	+ current loop
		White	- current loop / COM RS485

8.3 C 8520.5 - DIMENSIONS



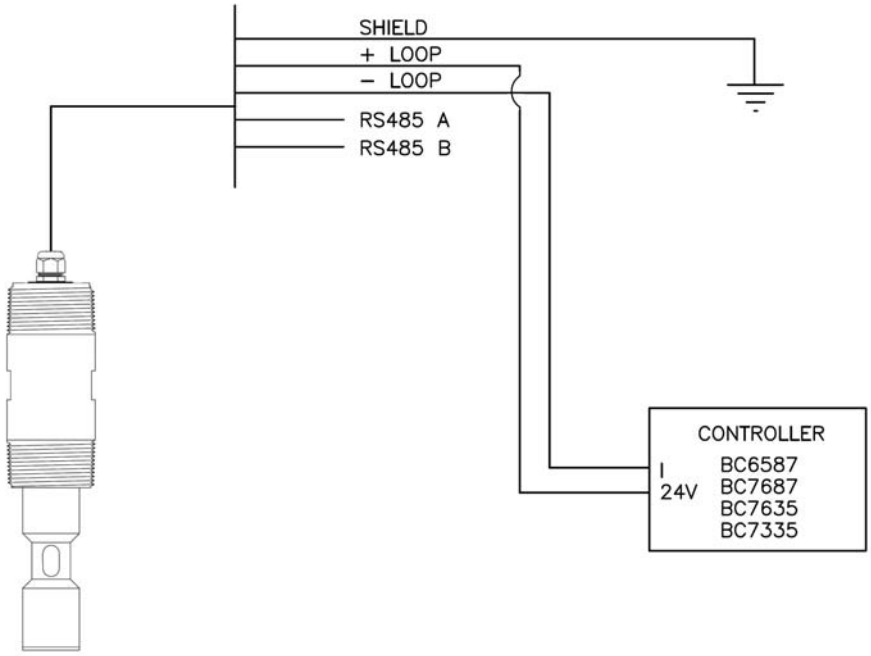
Description		Connections	
1	Cable	Shield	not connected
2	Connector	Yellow	RS485 A (+)
3	Body	Grey	RS485 B (-)
		Brown	not connected
		Green	+ current loop
		White	- current loop / COM RS485

8.4 C 8325.5 - C 8520.5 - INSTALLATION

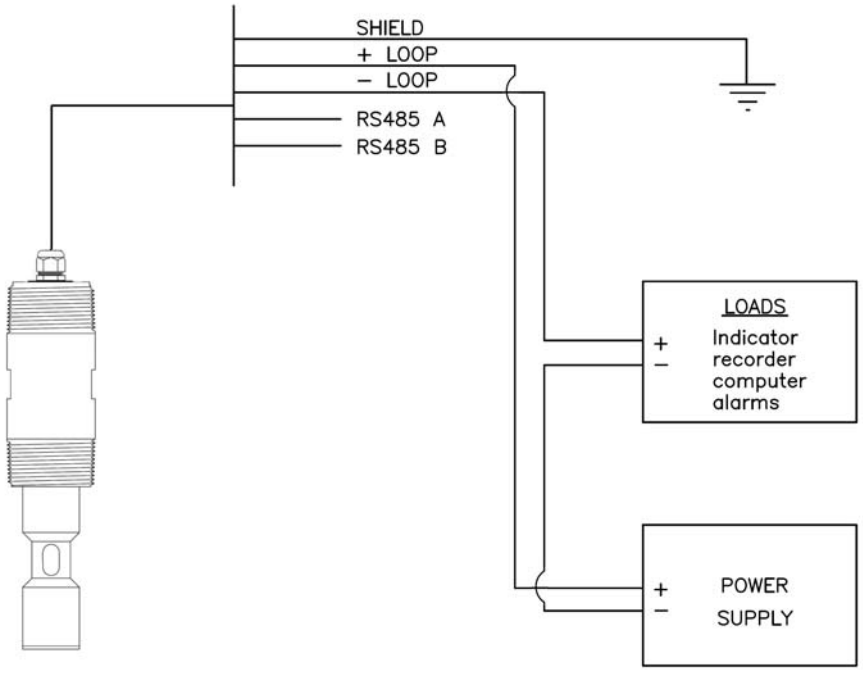


8.5 ANALOG MODE WIRING

The connection shown in the figure is possible for all models.



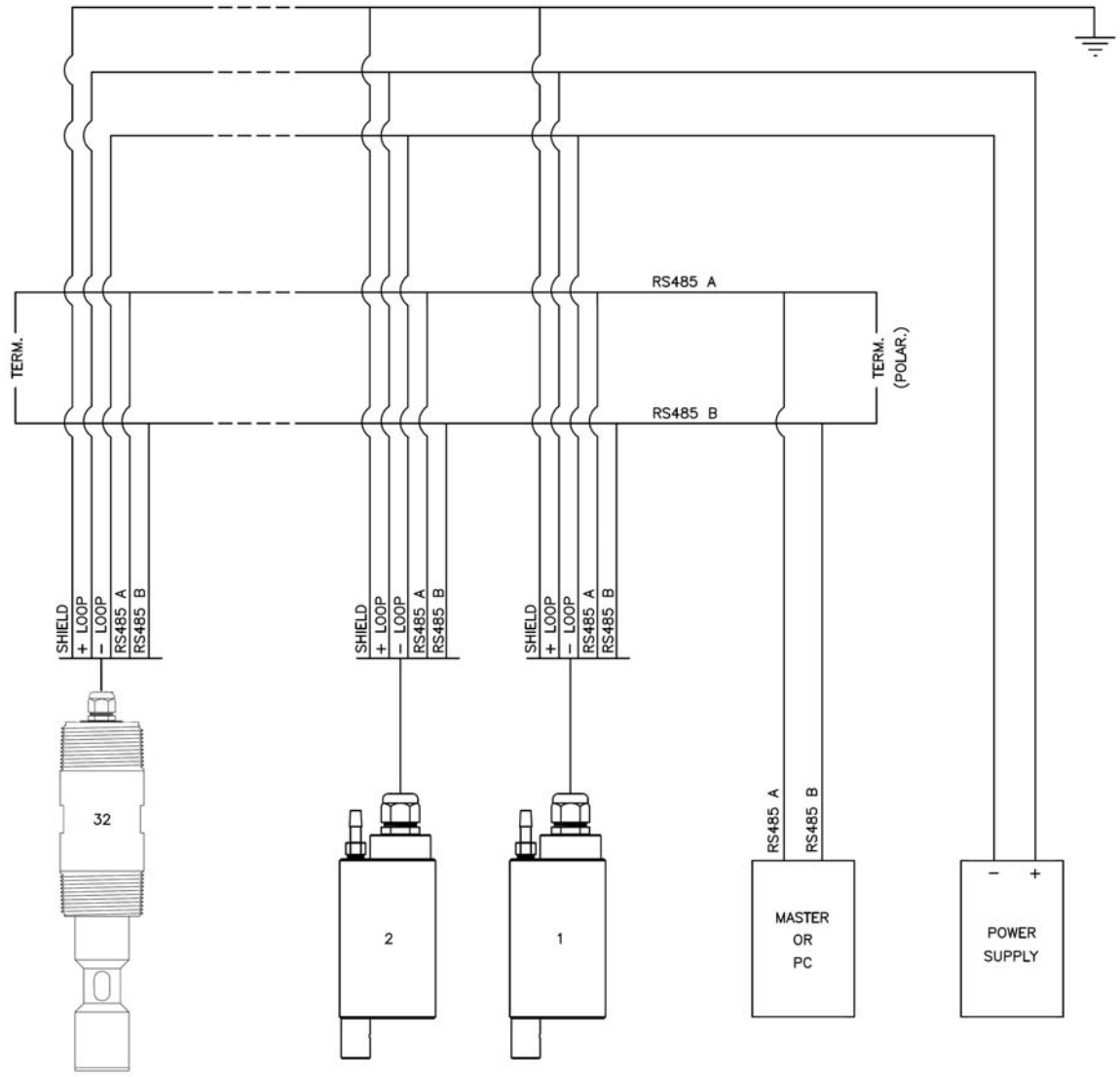
Connection to B&C Electronics' instruments



Connection to PLC or data logger

8.6 DIGITAL MODE WIRING

The connection shown in the figure is possible for all models.



9 WARRANTY

1 Your product is guaranteed for 5 years from the date of purchase, for failure due to manufacturing defects.

2 The warranty is void in case of tampering or deterioration due to improper installation or maintenance.

3 The warranty covers only free repair at the laboratories of the manufacturer.

4 B&C Electronics is not liable for any damage arising from misusing its instruments and products.

10 REPAIRS

For faster and efficient service it is recommended to fill in the "Information card" for the repair service and attach it to a "Repair order".

1 The estimated cost, if required by the customer, is free if the repair is confirmed. Otherwise flat rate results in a charge for the analytical work performed and expenses incurred.

2 The products to be repaired must be sent to B&C Electronics with freight prepaid. Any expenses incurred on behalf of the client and not previously agreed will be charged.

3 Our sales department will submit to the customer the repair estimate or offer a replacement in the following cases:

- repair cost is considered excessive in relation to the cost of the product;
- the repair is technically impossible or unreliable.

4 In order to reduce the time of delivery of the repaired products, unless otherwise offered or arranged by the customer, the shipment will be made with ex-factory, prepaid carriage by a courier.

INFORMATION SHEET

for service repairs

In the event of a fault, we recommend you contact our repair service, to photocopy and complete this information sheet to be attached to the product to be repaired.

□ ESTIMATE □ REPAIR

COMPANY NAME

ADDRESS ZIP TOWN

REFER TO MR/MRS TELEPHONE

MODEL S/N DATE

Consult the instruction manual to identify the area of the defect and/or describe it:

□ SENSOR
□ POWER SUPPLY
□ CALIBRATION
□ DISPLAY
□ ANALOG OUTPT
□ SET POINT
□ RELAYS CONTACTS
□ INTERMITTENT PROBLEM

DESCRIPTION OF THE DEFECT

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