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CERT. N. 9115 BCEL

INSTRUCTION MANUAL

OD 8325

AUTOCLEAN OPTICAL D.OXYGEN 4-20 mA CURRENT LOOP RS 485

Range: 0/20 PPM
0/200 % air saturation

Power: 9/36 Vdc

Firmware: R 1.0x

Option _____

S/N _____

REP N° _____

Cod. 280168325 – Rev. A

BC3531-A - Rev.01

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1 DESCRIPTION

This unique submersible probe has been designed to measure dissolved oxygen based on fluorescent technology.

The measuring system consists of:

- optical device complete with a layer of fluorescent material,
- electronic circuit with an exciting beam and fluorescence detection,
- built-in 2-wire 4/20 mA transmitter,
- RS 485 output with B&C protocol for data transmission, calibration and configuration procedures,
- nozzle for the sensor autoclean by external pressure air.

The automatic temperature compensation is done internally by means of a built-in sensor.

Thanks to its 4/20 mA isolated output, the probe can be directly connected to a PLC or data logger, without using amplifiers or other devices.

The probe can be connected to B&C Electronics controller BC 7635 or BC 7335, which provide the power to the probe, the measuring readout, 2 set-points and an alarm.
The digital input of those controllers may keep in hold the functions during the autoclean cycle.

The most common applications of this probe include: water quality monitoring, municipal and industrial water treatment and aquaculture.

1.1 PRINCIPLE OF OPERATION

A light beam of a specific wavelength is sent to a special fluorescent layer in contact with the sample.
The absorbed light energy is partially released as a light pulse with an higher wavelength.
This phenomena is called fluorescence.

If oxygen molecules are in contact with the sensing layer, the fluorescing is reduced (quenching).

By measuring the amount of quenching it is possible to determine the oxygen concentration.

The advantages of this measuring method are the absence of electrolyte and membrane, the possibility to measure the oxygen concentration in water or in air, and a good sensitivity in a low oxygen concentration.

1.2 ACCESSORIES

The installation of the probe needs few accessories to be selected among the following:

0012.450043	Extension pipe adapter.
0012.000624	Swivel mounting (it includes the 0012.450043 adapter)
0012.440040	33 m PVC tubing for pressure air.

2 TECHNICAL SPECIFICATIONS

MAIN MEASUREMENT	**DEFAULT**
CURRENT LOOP Current loop proportional to main measuring Output range: 4/20 mA Not calibrated probe: 3.50/21.0 mA every 8 seconds	

SENSOR TYPE		**DEFAULT**
B&C optical DO sensor composed by: - Sensing replaceable element - Emitting Led - Photo detector diode		
SCALES		
Scales:	200.0 %sat 20.00 ppm	 20.00 ppm
Scale in %sat: ID %sat:: Resolution: Accuracy:	0.0/200.00 %sat 12 mA for 8” at power on 0.1 %sat ± 1.0 %sat a < 10.0 %sat ± 2.0 %sat a > 10.0 %sat	
Scale in ppm: ID ppm: Resolution: Accuracy:	0.00/20.00 ppm 10 mA for 8” at power on 0.01 ppm ± 0.1 ppm a < 1.00 ppm ± 0.2 ppm a > 1.00 ppm	
Repeatability: Drift:	± 0.5% of the scale < 1% year (typical)	
Response time:	95% < 60s	
Automatic Temperature Compensation:	- B&C table - ppm/% conversion table	
Measuring update:	every 8 seconds	
Software Filter: Response time to 90% small signal(<3%air): 120 seconds Response time to 90% large signal(>3%air): 40 seconds		

SECONDARY PARAMETERS		**DEFAULT**
Salinity (chloride): Pressure: Relative Humidity:	0/600 x 100 ppm (100 ppm step) 500/800 mmHg 0/100 %	0 ppm 760 mmHg 50 %

TEMPERATURE		DEFAULT
Sensor for %air compensation:	RTD Pt100 (built-in)	
Compensation range:	0.0/50.0°C	
Temperature Comp. Coefficient:	internal table	

SERIAL INTERFACE		DEFAULT
Interface:	R485 not terminated Isolated from the sample Not isolated from the loop/power supply	
Distance:	1000 / 500 / 250 / 125 m	
Baud rate:	2400/4800/9600/19200 bit/s	9600 bit
Probes in network:	up to 32	
Protocol:	B&C ASCII	

ALIMENTAZIONE		DEFAULT
Voltage:	9/36 Vcc	
Current:	22 mA max	
In digital mode the current will be 10/12 mA and max value during the communication		

GENERAL SPECIFICATIONS

Cable:	5x0,25 L=10m built in
Room temperature:	-5°C/+50 °C
Relative humidity:	0/95% not condensate
Storage temperature :	-5°C/50°C
Protection:	IP68
Body:	PVC silicon
Pressure:	1 bar max (cable 10 m)
Operating pressure:	1 bar max
Diameter:	60 mm
Total length:	165 mm
Thread:	2” NPT
Auto clean:	built in nozzle
Connection to pressure air:	tubing 1/4” int - 3/8” ext
Air pressure:	3 bar
Weight:	body 400g, cable 760g
Sensing part lifetime:	average 3 years if not exposed to sun light
Conformity EMC/RFI:	EN61326

3 INSTALLATION

3.1 HOW TO USE THE AUTO CLEAN SENSOR ASSEMBLING

See the typical installation described in Fig. 2.
Before the immersion of the probe it is necessary to make the following:

- Provide an extension pipe with suitable length.
- Provide the PVC tubing 0012.440040 with suitable length.
- Prepare the 0012.450043 adapter.
- Insert the flexible tubing in the air connector.
- Insert the cable and the tubing in the adapter 0012.540043 and screw it on the probe.
- Insert the extension pipe and screw it on the adapter.

The pressure air provided by the customer must be a clean air at 3 bar max.
The typical cleaning time is 15 seconds and the typical cleaning frequency is 2 times/day, but it is depending of the application and the actual efficiency of the cleaning action.

WARNINGS

Higher cleaning frequency could reduce the lifetime of the DO sensing element.
Avoid a long exposure to sun light, which will reduce the life of the DO sensing element.

3.2 HOW TO USE THE PROBE WITHOUT THE CLEANER

Before the immersion of the probe, follow the above procedure but:

- Do not install the flexible tubing.
- Install a stopper on the air line connector in order to avoid the water entering into the room between the adapter and the probe when the probe is submersed.

WARNINGS

Without the stopper the water will damage the cable and it may leak inside the probe.

3.3 CONNECTIONS

Connect the probe to the meter by following the marked wire of the cable.
The normal operation needs just the connection of green and white wires, which are protected against accidental inversion.
The shield is not connected to the probe but it must be connected to the ground.

Wires colors	**Function**
Shield	not connected
Yellow	A (+) RS485
Gray	B (-) RS485
Brown	not connected
Green	**+ current loop**
White	**- current loop / COM RS485**

Avoid the cable interruptions.
If necessary use high isolation junction box and the extension cable p/n 2423405 (5x0.25 – D 5.70
Keep the cable far from power cables even inside of the switch board.

3.4 CONNECTION TO BC 7635 OR BC 7335 CONTROLLERS

Connect the optical DO probe to the BC 7635 or BC 7335 in order to make easier the application because of the following features of the controllers:

- scale selection flexibility
- digital inputs to keep in hold the unit during the autoclean cycle
- easy zero and sensitivity adjustment
- easy calibration of the dual set point
- min max alarm relay
- 0/20 mA or 4/20 mA isolated output

Connect the probe to the controller as follow:

wires color	**BC 7635 terminals**	**BC 7335 terminals**
Green	20	20
White	22	22

Calibration

When the probe is connected to the above instruments, the zero and sensitivity calibration can be done through the dedicated keys in the front panel as described in the controller instruction manual.
In this way it in not necessary to calibrate the probe through the digital connection to the PC as described in the following chapters, unless the optical sensing element of the probe has lost the efficiency or it has been replaced.

4 OPERATING MODE

The probe can be configured for analog or digital operating mode.
4/20 mA current loop (digital mode=0) or digital (digital mode=1)

When configured as 4/20 mA current loop mode the probe can be connected
directly to a PLC or to the BC7635/BC7335 B&C Electronics general purpose controllers, providing the measuring readout, two set point and the min/max alarm relays.
When configured in digital mode the probe is considered as slave to be connected to a master with B&C protocol (ASCII).

4.1 ANALOG OPERATING MODE

The probe is delivered with analog factory configuration
(digital mode=0).

After 8 seconds approx from the switching on, the current loop will provide for the next 8 seconds
10 mA if the selected scale is in ppm, or 12 mA if the selected scale is in % air saturation.

Note

Those current values will remain for the next 8 seconds, unless the probe will detect an activity on the serial line RS 485.

This function will allow the user to identify the scale of the probe in case of removed or damaged label.

If no activity is detected in the above mentioned period of 8 to 16 seconds from the switch-on, the probe will keep the analog operating mode till the next switching off.

If the activity on the RS 485 is detected in this period, the probe will switch to the digital operating mode and the basic current absorption will be 10/12 mA plus the absorption due to the communication.
Into the digital operating mode, the user can modify the parameters and perform the calibrations.
Additionally the user can configure the probe for the analog operation (digital mode=0) or digital operation (digital mode=1)
The probe will maintain the digital operating mode till the next switching on.

4.2 DIGITAL OPERATING MODE

If the probe has been configured for the digital operating mode (digital mode=1), after 8 seconds approx from the switching on, the current loop will provide

- 10 mA if the selected scale is in ppm,
or
- 12 mA if the selected scale is in % air saturation.

The probe is then ready to receive the commands from the master device or manually through the Hyperterminal program or similar.

The user can modify the operating mode from digital to analog by setting the digital mode=0, switching off and then switching on the probe.

4.3 COMMUNICATION PROTOCOL

Through the RS485 interface the probe can be connected to a PC for data management and calibration.

It needs a RS485/RS232 or RS485/USB converter.
It uses a simple terminal emulation program (example Hyperteminal)

The protocol adopted is similar to the protocol of the multiparameter probe with some variations. It maintains the command **A** so it is possible to query the probe with a software like SA8000.

Mode of transmission

- Code system	ASCII
- Number of bits per character	
start bit	1
data bits	8
parity	none
Stop bits	1
- Check-errors (only for A)	BCC

Command Format

2 byte ID probe (00 - 32)
1 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.
If the communication port is set to a different speed the probe will not communicate.

5 COMMANDS

Through the Help command is possible to get a list of commands implemented in the probe

5.1 HELP

Command Format: **ID + H <cr>**
For example, if ID = 14, type 14H <cr> or 00H <cr>

By sending the command **'H'** the probe responds with a list of available commands with a brief description

```
-------------------------------------------------------------------------------------------
HELP MENU, COMMAND LIST
-------------------------------------------------------------------------------------------
OD 8325 OPTICAL D.O. PROBE   Release fw:1.00  S/N:156463

00H <cr>    Help menu
00A <cr>    Acquisition
00Mx <cr>   Digital mode:          0000                 (0=analog mode  1=digital mode)
00Ox <cr>   Analog out:            0000                 (0=ppm 1=%sat)
00Cx <cr>   Chloride salinity:     0000 x 100ppm        (0-600 x 100ppm)
00Px <cr>   Atm. pressure:         0760 mmHg            (500-800mmHg)
00Ux <cr>   Relative humidity:     0050 %RH             (0-100%RH)
00S <cr>    Sens. calibration:     OK                   (point cal 1)
00Z <cr>    Zero  calibration:     OK                   (point cal 2)
00Dx <cr>   Last cal date:                              (max 8 characters)
00Ix <cr>   ID value:              Actual 0001          Config 0001 (01-32)
00Bx <cr>   Baud rate:             Actual 0003          Config 0003 (1=2400 2=4800 3=9600
                                                                    4=19200)

Type ID number or 00 before command
       example, if ID=15 type 15A <cr> or 00A <cr>
Use 00A <cr> if only one probe is connected
-------------------------------------------------------------------------------------------
```

5.2 ACQUISITION

Command Format: **ID + A <cr>**
For example, if ID = 14, type 14A <cr> or 00A <cr>

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

Record format:

```
OD8325- 10 0.0 01/01/01 00:00:00 ± 200.0%sat ± 20.00ppm  ±  20.0°C   ±
....+....|....+....|....+....|....+....|....+....|....+....|....+....|
 60000ppm  ± 760mmHg ±    50%RH  13/11/10xx
```

OD8325: Probe type
01: Probe ID
0.0: Power supply (not implemented)
01/01/01: Date (not implemented)
00:00:00: Time (not implemented)

Then the measured values with the following format:
Measure field - Sign of the measure (if positive will be sent a space) - Value of the measure (6 characters - right-aligned)

Unit of measurement field - Unit of measurement of the parameter (4 ch. - Left aligned) - A space (ASCII 32)

± 20.00ppm: d.oxygen concentration ppm
± 200.0% sat: d.oxygen concentration %sat
± 20.0 °C: temperature value
± 60000ppm: chloride salinity
± 760mmHg: atmospheric pressure
± 50% RH: relative humidity

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

13/11/10: Date of Last Calibration
xx: 2 byte BCC

The transmission of the record is terminated by CR LF characters.

BCC calculation

The BCC of messages sent by the probe is calculated as the XOR of all bytes of the message (excluding CR and LF) and divided into 2 nibbles.
The two nibbles are then transformed into their ASCII codes.

5.3 DIGITAL MODE

Command Format: **ID** + M + **x <cr>**
For example, if ID = 14, and analog out = ppm type 14M1 <cr> or 00M1 <cr>

Probe response: **<lf> ID + M + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

The probe can be configured for digital mode (digital mode=1) or analog 4/20 mA (digital mode=0).

Note:
For this command and for following commands, the probe answer will be a replica of the command itself with the addition of <lf> line feed (at beginning and end of the answer)

5.4 ANALOG OUTPUT

Command Format: **ID** + O + **x <cr>**
For example, if ID = 14, and analog out = ppm type 14O1 <cr> or 00O1 <cr>

Probe response: **<lf> ID + O + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

The analog output 4 / 20 mA can be linked to the scale %sat or ppm.
Set the parameter x = 0 for ppm or x = 1 for %sat scale.

5.5 CHLORIDE SALINITY

Format command: **ID + C + x <cr>**
For example, if ID = 14, and salinity 20000ppm type 14C200 <cr> or 00C200 <cr>

Probe response: **<lf> ID + C + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

To check whether the entered value was received, type the **command 'A'**

5.6 ATMOSPHERIC PRESSURE

Format command: **ID + P + x + <cr>**
For example, if ID = 14, and the pressure 780mmHg, type 14P780 <cr> or 00P780 <cr>

Probe response: **<lf> ID + U + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

To check whether the entered value was received, type the **command 'A'**

5.7 RELATIVE HUMIDITY

Command Format: **ID + U + x <cr>**
For example, if ID = 14, and humidity 50% type 14U50 <cr> or 00U50 <cr>

Probe response: **<lf> ID + U + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly
To check whether the entered value was received, type the **command 'A'**

5.8 SENSITIVITY CALIBRATION

Command Format: **ID + S <cr>**
For example, if ID = 14, type 14S <cr> or 00S <cr>

Probe response: **<lf> ID + S + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

Note:
Sensitivity calibration in saturated water or in air must be performed before the zero calibration.

The probe executes automatically the following operation:
- Restore of the excitation current of the LED at 15 mA.
- Reset the sensitivity and zero
- Optical efficiency-calibration
- The sensitivity calibration

This operation is done in a time of about 5 seconds
The probe will be able to receive new commands just after the ending of the above operations.

To verify the effected calibration, send the command **ID + A**, and read approx 100 % air saturation.
The probe readout will have approx the following values depending of the temperature of the liquid.

Temperature	**DO concentration**	
15 °C	100,0 %sat	10.15 ppm
20 °C	100.0 %sat	9.17 ppm
25 °C	100.0 %sat	8.38 ppm

The values will depend of salinity, atmospheric pressure, Relative Humidity.
Send the command **ID + H** to check the line "Sens cal : ok/error"

Note:
If the calibration has been performed successfully (ok) the customer must effect the zero calibration of the probe.
If the zero calibration is not effected, the probe will not work in the analogical mode 4/20 mA, and the output will flash from 3.5 mA to 21 mA every 8 seconds.
If the calibration has not been performed successfully (error), verify if the probe has been really immersed in air saturated solution.
Inspect the sensing element. If it is damaged, proceed to replace it and to perform the new calibration.
If the calibration is not accepted (error), the probe will keep the previous optical efficiency, sensitivity and zero values.

5.9 ZERO CALIBRATION

Command Format: **ID + Z <cr>**
For example, if ID = 14, type 14Z <cr> or 00Z <cr>

Probe response: **<lf> ID + Z + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

The zero calibration in water without oxygen, must be carried out after sensitivity calibration
It is possible to repeat the zero calibration without performing the sensitivity calibration.

To verify the effected calibration, send the command **ID + A**, and read approx 0 % air saturation.

Send the command **ID + H** to check the line "Zero cal : ok/error"

If the calibration has not been performed successfully (error), verify if the probe has been really immersed in the water without dissolved oxygen.
Inspect the sensing element. If it is damaged, proceed to replace it and to perform the new sensitivity and zero calibration

5.10 LAST CALIBRATION DATE

Command Format: **ID + D + cccccccc <cr>**
For example, if ID = 14, and date to be inserted is 13/11/10, type 14D13/11/10 <cr> or 00D13/11/10 <cr>

Probe response: <**lf> ID + D + cccccccc <cr> <lf>** command executed correctly
Probe response: none command does not run properly
Command to store the date of last calibration.
The field of the data is of 8 characters to be used in a free way by customer (no syntaxes limits)

5.11 ID VALUE

Command Format: **ID + I + xx <cr>**
For example, if ID = 14, and the new ID (identification) to be inserted is 07, type 14I07 <cr> or 00I07 <cr>

Probe response: **<lf> ID + I + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly
The new ID will be active at the next restart of the probe.

5.12 BAUD RATE

Command Format: **ID + B + xxxxx <cr>**
For example, if ID = 14, and the new speed is 4800 baud, type 14B4800 <cr> or 00B4800 <cr>
Probe response: **<lf> ID + B + x <cr> <lf>** command executed correctly
Probe response: none command does not run properly

The new baud rate will be active at the next restart of the probe.

6 CALIBRATION

The probe is factory calibrated and it is ready for use.
The customer can calibrate the ppm or % values on the PLC or external controller by using the regular zero and sensitivity calibration, without modifying the internal response of the probe unless the optical element is replaced because of aging or damage.

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

Sensing element (replaceable) and optical elements (LEDs, photodiodes) may have small changes over time.

Replace the sensing element if:
- Mechanically damaged
- After the calibration procedure it does not produce the expected values

The calibration of the probe must satisfy this sequence:

1) Calibration of sensitivity in water-saturated air or air
2) Calibration of the zero in the water with sodium bisulfite

Note:
It is not possible to perform only the sensitivity calibration

Before the zero and sensitivity calibration it is necessary to allow the internal temperature sensor to reach the thermal equilibrium.
This time could be equal to 5 or 10 minutes depending of the difference between the sensor and the room temperature.

Sensitivity calibration

It is effected in air saturated water or in air (see the procedure in chapter 5.8)

Zero calibration

It is effected in fresh bisulphite solution or through a nitrogen/argon saturated ambient. (see the procedure in chapter 5.9)

Note:
In case of salt water application contact B&C Electronics for technical assistance on the procedures to be followed during the zero/sensitivity calibration.

7 MAINTENANCE

When the auto clean system is installed, the cleaning of the optical sensing element is done automatically.
Just remove periodically any external scales from the probe if necessary.

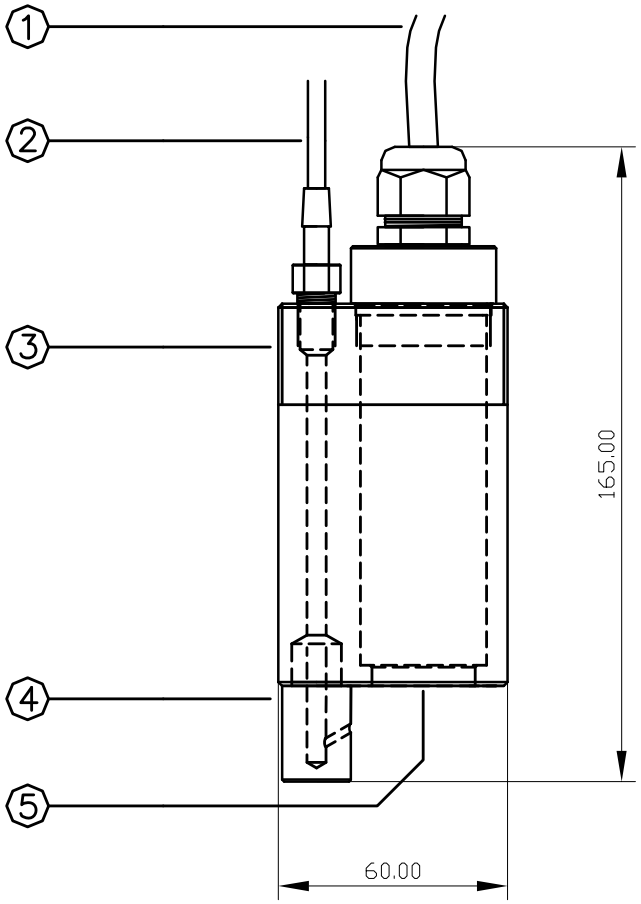
If the auto clean system is not installed, clean periodically the optical sensing element on the bottom of the probe.

The frequency of the cleaning is depending of the application and the nature and the concentration of the suspended solids.

Clean the optical sensing element before the calibration of the meter.
Clean by using a soft and wet paper filter or similar.
Press gently on the optical sensing element in order to avoid scratches.
Use eventually a low concentration acid.

In case of malfunctioning, send back the probe to the factory for the replacement of the optical sensing disk.

DIMENSIONS



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Description

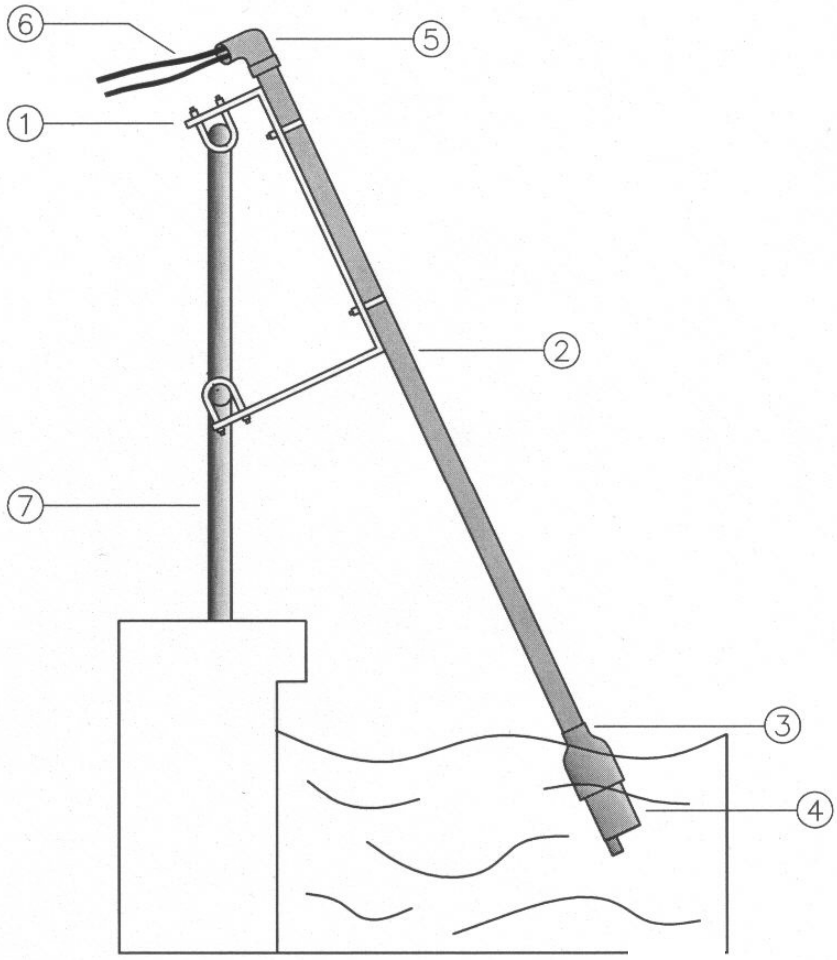
1.	Cable
2.	Air input
3.	Thread
4.	Air nozzle
5.	Sensing element

Connections

Shield	not connected
Yellow	A (+) RS485
Grey	B (-) RS485
Brown	not connected
Green	+ current loop
White	- current loop/com RS485

Fig. 1

TIPICAL INSTALLATION



1. Swivel mounting (0012.000624)
2. Extension pipe
3. Adapter (0012.450043)
4. DO sensor with autoclean nozzle
5. Rain protection
6. Cable and air tubing
7. Rail

Fig. 2

ANALOG MODE WIRING

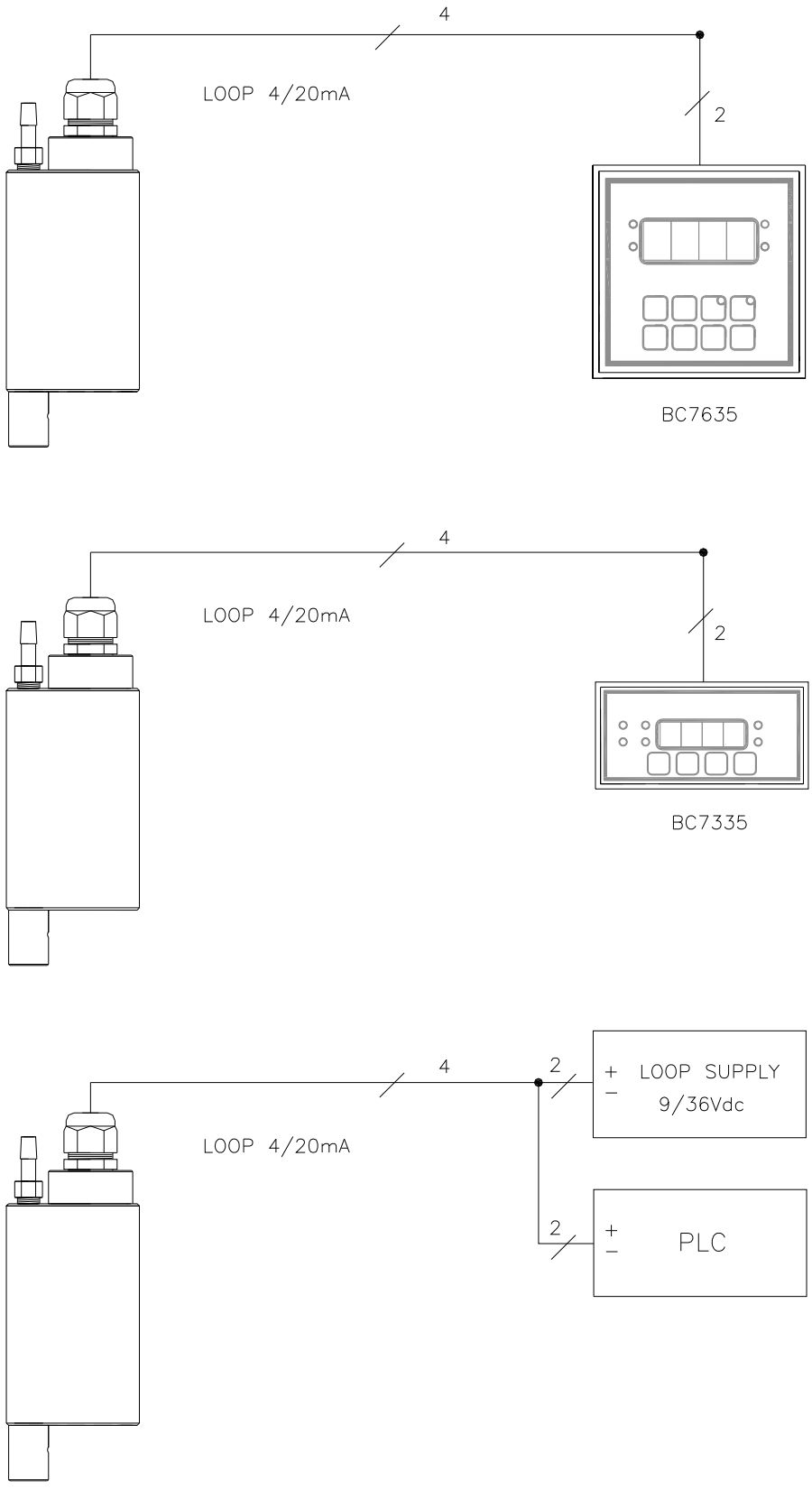


Fig. 3

DIGITAL MODE WIRING

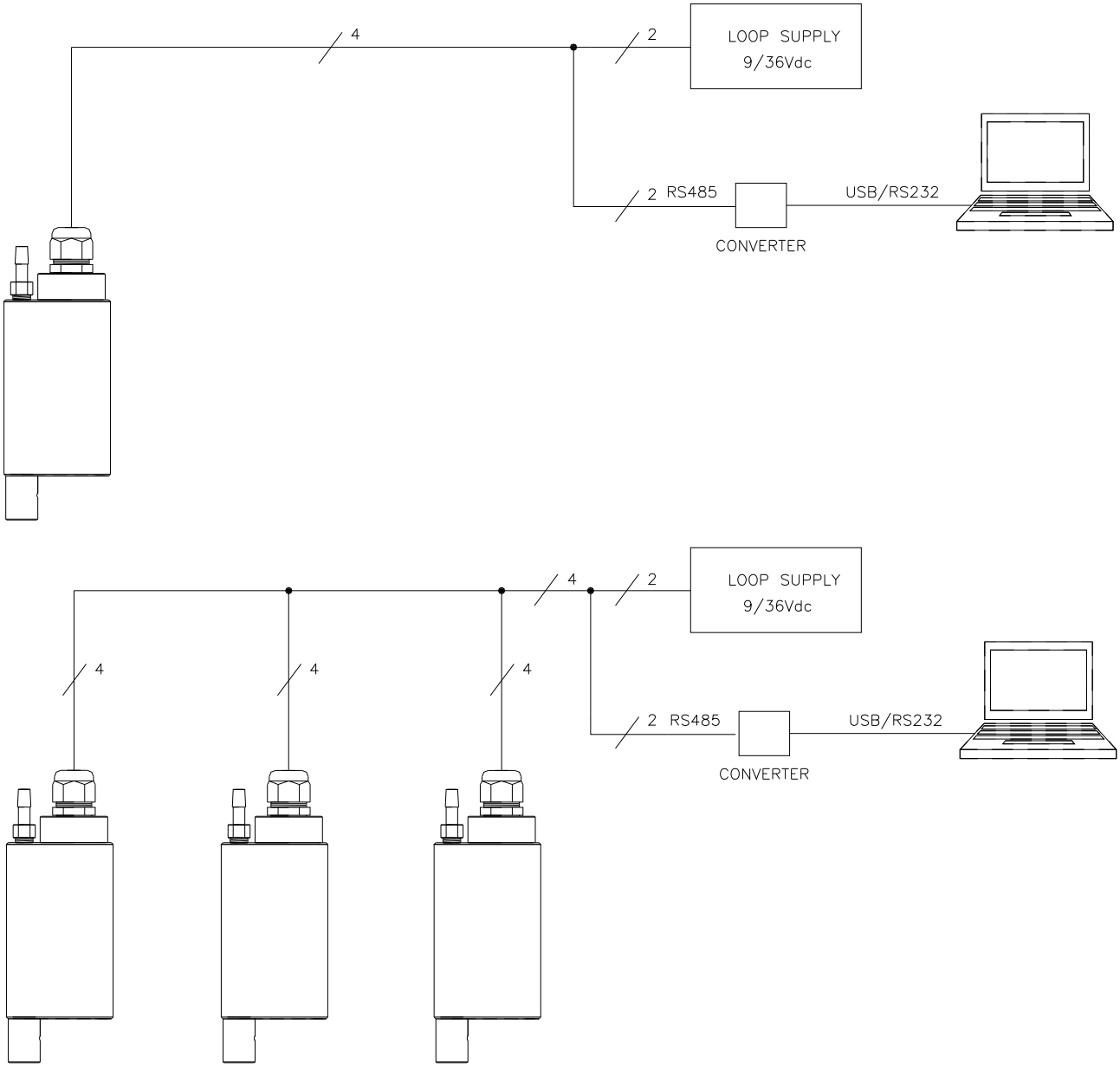


Fig. 4

WARRANTY CERTIFICATE

1) Your product is covered by B&C Electronics Warranty for 5 years (sensing element excluded) from the date of shipment.
In order for this Warranty to be valid, the Manufacturer must determine that the instrument failed due to defective materials or workmanship.

2) The Warranty is void if the product has been subject to misuse and abuse, or if the damage is caused by a faulty installation or maintenance.

3) The Warranty includes the repair of the instrument at no charge. All repairs will be completed at the Manufacturer's facilities in Carnate, Italy.

4) B&C Electronics assumes no liability for consequential damages of any kind, and the buyer by accepting this equipment will assume all liability for the consequences of its use by the Customer, his employees, or others.

REPAIRS

1) In order to efficiently solve your problem, we suggest You to ship the instrument along with the Technical Support's Data Sheet (following page) and a Repair Order.

2) The estimate, if requested by the Customer, is free of charge when it is followed by the Customer confirmation for repair. As opposite, if the Customer shall not decide to have the instrument repaired, he will be charged to cover labor and other expenses needed.

3) All instruments that need to be repaired must be shipped pre-paid to B&C Electronics. All other expenses that have not been previously discussed will be charged to Customer.

4) Our Sales Dept. will contact You to inform You about the estimate or to offer you an alternative, in particular when:
- the repairing cost is too high compared to the cost of a new instrument,
- the repairing results being technically impossible or unreliable

5) In order to quickly return the repaired instrument, unless differently required by the Customer, the shipment will be freight collect and through the Customer's usual forwarder.

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