UNI EN ISO 9001:2000
CERT. N. 9115 BCEL

INSTRUCTION MANUAL

SA8060.10x

MULTIPARAMETER WATER QUALITY PROBE with built-in data logger

S/N _____

REP N° _____

Release: R 2.7x

Cod. 28015800 - Rev. E - 08/16

B&C Electronics Srl - Via per Villanova 3 - 20866 Carnate (MB) - Italy - P.IVA 00729030965
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1 DESCRIPTION

This probe allows the following measuring:

* Level
* Temperature
* Conductivity
* pH
* O.R.P.
* Dissolved oxygen

Available options:
* Turbidity (option 091.181)
* Optical dissolved oxygen (option 091.161)

Applications:
- Well water
- Underground aquifers
- Rivers & Lakes
- Estuaries & Oceans
- Wastewater treatment
- Industrial effluents

The probe is watertight and it contains:
- sensors
- electronic circuits
- microprocessor
- data logger
- recharging battery
- RS485 serial interface

This probe provides the following additional features not present in previous software releases:

- possibility to use the Modbus protocol for sending the commands and for the transmission of the measuring values;

- possibility to configure the baud rate.

The sensors calibration and the configuration of the probe can be done through the B&C Electronics protocol or the B&C Electronics connecting softwares.

TECHNICAL SUPPORT

Data sheet

In case of damage, we suggest You to contact our Technical Support by email or phone. If it is necessary for the instrument to be repaired, we recommend to photocopy and fill out this data sheet to be sent along with the instrument, so to help us identifying the problem and therefore accelerate the repairing process.

□ *ESTIMATE* □ *REPAIR*

COMPANY NAME

ADDRESS ZIP CITY

REFER TO MR./MISS. PHONE

MODEL S/N DATE

Please check the operator's manual to better identify the area where the problem seems to be and please provide a brief description of the damage:

□ SENSOR
□ POWER SUPPLY
□ CALIBRATION
□ DISPLAY
□ ANALOG OUTPUT
□ SET POINT
□ RELAY CONTACTS
□ PERIODICAL MALFUNCTIONING

➢ *DESCRIPTION*

.....
.....
.....
.....
.....
.....
.....
.....

1.1 ACCESSORIES

The following accessories are available, to be ordered separately:

SA 8000	Connecting software (DOS or WINDOWS XP emulation required)
SA 8900	Connecting software (Internet Explorer required)
BC 8582	Automatic battery charger
BC 8611	RS232/RS485 converter
BC 8701	USB/RS485 converter
SZ 9409	Stopper
SZ 929	Cable
SA 9491	Probe/PC connecting cable
SA 9431	30 m cable + 2 connectors
SA 9411 + SZ 929	2 connectors assembling kit + Cable
SA 9419 + SZ 929	Connector assembling kit + Cable

1.2 OPERATIONS MODE

The probe can be configured to work in 3 possible ways:

- Continues supervised mode

In this operation mode the probe is connected to the terminal or the P.C..
The probe will provide the measuring in a real time by sending data through the serial port.

- Unattended time interval acquisition mode

In this mode the probe turns ON and OFF according to the pre-programmed time intervals and logs all data on the internal memory.

- Unattended level interval acquisition mode

This is particularly indicated for sea and lakes measuring profile.
Just like with the time acquisition, the probe logs the data only according to the level interval that the user has pre-configured.

Unattended acquisition modes must be programmed by connecting the probes to a PC and through one of the software supplied with the same probe.

2 GENERAL WARNINGS AND INFORMATION FOR ALL USERS

2.1 WARRANTY

This product is guaranteed for all manufacturing defects.
Please take a look at the terms and conditions described on the Warranty Certificate at the end of the manual.

2.2 AFTER SALES SERVICE

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

- a free of charge Technical Assistance over the phone or 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.

2.3 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"

Until 19/04/2016:
- 2004/108/EC "Electromagnetic compatibility"

From 20/04/2016:
- 2014/30/EU "Electromagnetic compatibility"

- EN 61326-2-3/2013 "Electromagnetic compatibility"
  • Industrial use
- 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.

2.4 SAFETY WARNINGS

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

All types of operations must be performed by authorized and trained staff.

The use of this controller must respect the parameters described in the "Technical Specification" chapter, so to avoid potential damages and a reduction of its operating life.

WARRANTY CERTIFICATE

1) Your product is covered by B&C Electronics Warranty for 5 years 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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SOLUBILITY OF THE OXYGEN INTO AIR SATURATED WATER (mg/l)

	PRESSURE (mm Hg)								
	715	730	745	750	755	760	765	770	775
TEMP (°C)									
0	13.70	13.99	14.28	14.37	14.47	14.57	14.66	14.76	14.86
1	13.33	13.61	13.89	13.98	14.08	14.17	14.27	14.36	14.45
2	12.97	13.24	13.52	13.61	13.70	13.79	13.88	13.97	14.07
3	12.63	12.89	13.16	13.25	13.34	13.43	13.52	13.61	13.69
4	12.30	12.56	12.82	12.90	12.99	13.08	13.16	13.25	13.34
5	11.98	12.23	12.49	12.57	12.66	12.74	12.83	12.91	13.00
6	11.68	11.93	12.17	12.25	12.34	12.42	12.50	12.58	12.67
7	11.39	11.63	11.87	11.95	12.03	12.11	12.19	12.27	12.35
8	11.11	11.34	11.58	11.66	11.74	11.81	11.89	11.97	12.05
9	10.84	11.07	11.30	11.38	11.45	11.53	11.61	11.68	11.76
10	10.58	10.81	11.03	11.11	11.18	11.26	11.33	11.41	11.48
11	10.33	10.55	10.77	10.85	10.92	10.99	11.07	11.14	11.21
12	10.10	10.31	10.53	10.60	10.67	10.74	10.81	10.89	10.96
13	9.87	10.08	10.29	10.36	10.43	10.50	10.57	10.64	10.71
14	9.65	9.86	10.06	10.13	10.20	10.27	10.34	10.41	10.48
15	9.44	9.64	9.84	9.91	9.98	10.05	10.11	10.18	10.25
16	9.24	9.44	9.64	9.70	9.77	9.83	9.90	9.96	10.03
17	9.05	9.24	9.43	9.50	9.56	9.63	9.69	9.76	9.82
18	8.86	9.05	9.24	9.30	9.37	9.43	9.49	9.56	9.62
19	8.68	8.87	9.05	9.12	9.18	9.24	9.30	9.36	9.43
20	8.51	8.69	8.87	8.93	9.00	9.06	9.12	9.18	9.24
21	8.34	8.52	8.70	8.76	8.82	8.88	8.94	9.00	9.06
22	8.18	8.36	8.53	8.59	8.65	8.71	8.77	8.83	8.89
23	8.03	8.20	8.37	8.43	8.49	8.55	8.61	8.66	8.72
24	7.88	8.05	8.22	8.28	8.33	8.39	8.45	8.50	8.56
25	7.73	7.90	8.07	8.13	8.18	8.24	8.29	8.35	8.41
26	7.60	7.76	7.93	7.98	8.04	8.09	8.15	8.20	8.26
27	7.46	7.62	7.79	7.84	7.89	7.95	8.00	8.06	8.11
28	7.33	7.49	7.65	7.70	7.76	7.81	7.86	7.92	7.97
29	7.20	7.36	7.52	7.57	7.63	7.68	7.73	7.78	7.84
30	7.08	7.24	7.39	7.44	7.50	7.55	7.60	7.65	7.70
31	6.96	7.12	7.27	7.32	7.37	7.42	7.47	7.52	7.58
32	6.85	7.00	7.15	7.20	7.25	7.30	7.35	7.40	7.45
33	6.73	6.88	7.03	7.08	7.13	7.18	7.23	7.28	7.33
34	6.62	6.77	6.92	6.97	7.02	7.07	7.11	7.16	7.21
35	6.52	6.66	6.81	6.86	6.90	6.95	7.00	7.05	7.10
36	6.41	6.55	6.70	6.75	6.79	6.84	6.89	6.94	6.98
37	6.31	6.45	6.59	6.64	6.69	6.73	6.78	6.83	6.88
38	6.21	6.35	6.49	6.53	6.58	6.63	6.67	6.72	6.77
39	6.11	6.25	6.39	6.43	6.48	6.52	6.57	6.62	6.66
40	6.01	6.15	6.29	6.33	6.38	6.42	6.47	6.51	6.56

3 SPECIFICATIONS

(at Temp. = 20 °C and 3.9 V)
The Default values are taken by the probe after sending R (Reset) command.

Sensors		Default
1) Level		
P/N:	SA8060.106	
Scale:	2 bar (relative pressure)	
Level:	0.000/20.000 m	
Resolution of data:	0.001 m	
Zero adjustment:	±2.000 m	0.000 m
Sensitivity of sensor:	65.0/135.0 %	100.0 %
P/N:	SA8060.104	
Scale:	35 bar	
Level:	0.00/350.00 m	
Resolution of data:	0.01 m	
Zero adjustment:	±35.00 m	0.000 m
Sensitivity of sensor:	65.0/135.0 %	100.0 %
2) Temperature		
Sensor:	RTD Pt1000	
Scale:	-5.00/+55.00 °C	
Resolution:	0.01 °C	
Zero:	±2.00 °C	0.00 °C
Manual temperature:	-5.00/55.00 °C	20.00 °C
3) Conductivity		
Sensor:	Cell K=1.00	
Scale:	6.000/60.000 mS	6.000 mS
Autoranging:	On/Off	On
Scale:	6.000 mS	
Resolution:	0.001 mS	
Zero:	±0.600 mS	0.000 mS
Scale:	60.000 mS	
Resolution:	0.001 mS	
Zero:	±6.000 mS	0.000 mS
Sensitivity:	60.0/160.0 %	100.0 %
ATC coefficient:	0.00/3.50 %/°C	2.10 %/°C
Temperature reference:	10/30 °C	20 °C

Calibration solution auto recognized:

KCl	0.01 N	0.02 N	0.1 N	0.5 N
(25 °C)	1.413 mS	2.765 mS	12.880 mS	58.570 mS
(20 °C)	1.278 mS	2.501 mS	11.670 mS	53.280 mS

4) pH

Scale pH:	-2.000/16.000 pH	
Resolution:	0.001 pH	
Zero:	±2.000 pH	0.000 pH
Sensitivity:	80.0/110.0 %	100.0 %
Buffer solution auto recognized:		
BDH 4.00 pH/7.00 pH/9.00 pH		

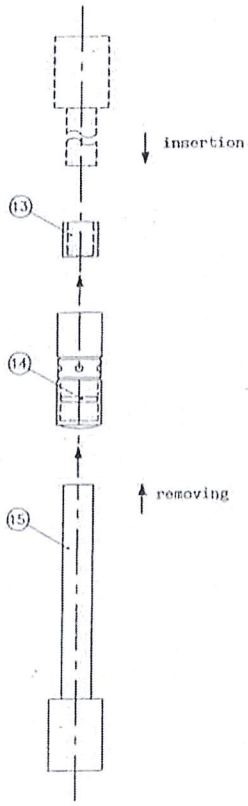
5) O.R.P.

Scale:	-1100.0/1100.0 mV	
Resolution:	0.1 mV	
Zero:	±100.0 mV	0.0 mV
Sensitivity:	80.0/110.0 %	100.0 %
Buffer solution auto recognized:		
Mettler 220 mV/468 mV		

6) Dissolved Oxygen

Sensor:	polarographic cell	
Unit of measure:	mmHg, %air, ppm, mg/l	%air
Unit of measure:	mmHg	
Scale:	0.00/200.00 mmHg	
Resolution:	0.01 mmHg	
Unit of measure:	%air	
Scale:	0.00/200.00 %air	
Resolution:	0.01 %air	
Unit of measure:	ppm	
Scale:	0.000/20.000 ppm	
Resolution:	0.001 ppm	
Unit of measure:	mg/l	
Scale:	0.000/20.000 mg/l	
Resolution:	0.001 mg/l	
Zero:	±3.0 nA	0.0 nA
Sensitivity:	60.0/170.0 %	100.0 %
Barometric pressure:	500/800 mmHg	760 mmHg
Salinity:	0/60000 ppm Cl-	0 ppm
Relative humidity:	0/100 %	50 %

SA9160
DISSOLVED OXYGEN ELECTRODE



Membrane replacement

- Replace membrane when:
  * it is broken
  * the sensitivity is low

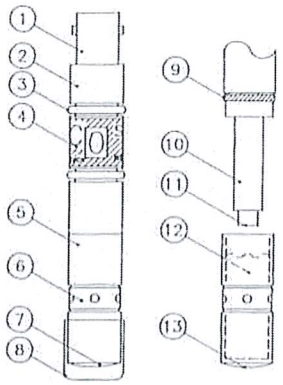
Operations

- Remove the electrolyte
- Lean the tool 15 to the bottom of the cartridge
- Push up gently to remove the cartrige from the internal O ring
- Check the O ring condition and replace if necessary
- Position the new cartridge
- Push by tool the new cartridge in the original position. Be careful so that the membrane will protrude from the reservoir
- Proceed by following the instruction C) on pag. 1/2

13. Cartridge
14. Cartridge O ring
15. Tool

Fig. 2/2

SA9160
DISSOLVED OXYGEN ELECTRODE



Specifications

- Cell: polarographic
- Current: 30 nA in air
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. Electrolyte reservoir
6. Silicon tube
7. Sensing membrane
8. Protecting cap
9. Internal O ring
10. Anode Ag
11. Cathode Pt
12. Electrolyte
13. Membrane cartridge
14. Cartridge O ring
15. Tool for extracting the cartridge

Accessories

a. Electrolyte bottle
b. Cartridge
c. Tool
a. Electrolyte bottle
b. Internal O ring
c. Silicon tube

Instructions

A) Start up:
- Remove the cap
- Dip in water for 1 day before calibrating
- Eliminate air bubbles by following the procedure C)

B) Maintenance:
- Clean the membrane with 2% HCl solution
- Follow procedure C)

C) Electrolyte refilling
- Unscrew the reservoir
- Fill the electrolyte
- Remove eventual air bubbles in reservoir
- Fasten the reservoir and let run out the liquid in excess

D) Storage
- Fill the cap with water and install it

Fig. 1/2

General parameter

Filter Response time continuous acq.:	1/60 seconds	10 s
Filter Response time programmed acq.:	1/60 seconds - not active	10 s
ID number	0/32	0

Serial interface

Type:	RS485 isolated	
Connecting distance:	4000' (1300 m)	
Probes in network:	up to 16	
Speed:	1200/2400/4800/9600/19200 baud	2400 baud
Length:	8 bit	
Bit of stop:	1	
Parity:	None	

Supported protocols

ASCII B&C Electronics protocol
Modbus (RTU) protocol (Function 03)

Power

Internal recharging battery:	3 x Ni/Cd 1800 mAh
Recharging:	fast I=800 mA 3/4 h
	standard I=180 mA 16h
Signal LOW BAT:	at 20 % of residual energy
Charge life at 20 °C:	
- In continuous acquisition:	24 h approx.
- In stand by:	> 6 months
- In programmed acquisition:	> 240 acquisitions

Data Logger

Acquisition:	On time/On level	On time
Acquisition:	On/Off	Off
Acquisition interval (time):		
- Step:	on hours/on minutes	hours
- On hours:	1/24 hours	24 h
- On minutes:	1/59 minutes	59 m
Acquisition interval: (level):		
- Level scale 2 bar:	0.10 / 2.00 m	1.00 m
- Level scale 35 bar:	1.0 / 20.0 m	10.0 m
Timeout of start profile:	5/60 minutes	10'
Acquisition number capability:		
- Memory Ram 32 Kbyte: 1108 record (1 record=117 byte)		

Physical specifications

Diameter:	70 mm
Length (probe)	410 mm
Length (total):	510 mm

Materials in contact with the liquid

PVC body
Sea water bronze connector
O-ring NBR (Acrylat Nitrile)
Hook in AISI 316L
Sensors in PVC, stainless steel, graphite, glass, Pt, silicon

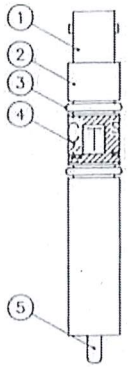
Factory calibration report
On request

Dimensions
See Fig. 1

Options

091.161	optical dissolved oxygen
091.181	turbidity

SA9150
TEMPERATURE SENSOR



Specifications

- RTD sensor: Pt1000
- Class: B
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. RTD

Accessories

//

Instructions

A) Start up:
//

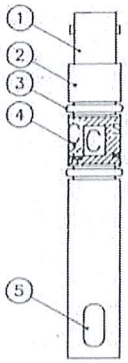
B) Maintenance:
- clean the dirty sensor with 2% HCl solution

C) Regeneration:
//

D) Storage:
- in a dry room

Fig. 1/1

SA9130
E.CONDUCTIVITY SENSOR



Specifications

- Electrodes: graphite
- Cell constant: 1
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. Measuring electrodes

Accessories

//

Instructions

A) Start up:
//

B) Maintenance:
- Clean the dirty sensor with 2% HCl solution

C) Regeneration:
//

D) Storage:
- In a dry room

Fig. 1/1

4 COMMUNICATION PROTOCOL

4.1 B&C ELECTRONICS PROTOCOL

Serial interface

Baud rate: 1200/2400/4800/9600/19200 baud selectable
Bit length: 8 bit
Nbr. of stop bit: 1
Parity: none

Command format

2 byte of ID (00 - 32)
1 byte of command
CR (ASCII 13)

The probe will recognize own ID and the ID 00.

Set of commands

The probe switches ON automatically when any activity on the serial port will be present.

A after receiving the command the probe will send the data on the serial port.
E after receiving the command the probe may accept the calibration by sending related data and/or messages
T after receiving the command the probe is ready to download the memorized data
O this command will switch OFF the probe

L, F are reserved commands

After receiving the command A, the probe will send data in the following format:

```
SA806x- 01 0.0 01/01/01 01:01:01 ±300.00m     ±20.00°C   ±40.000mS   ±
....+....|....+....|....+....|....+....|....+....|....+....|....+....|
12.000pH   ±1000.0mV   ±100.00%air ±1000.0mV
```

where:

SA806x:	P/N of the probe
01:	ID of the probe
0.0:	voltage of the power supply
01/01/01:	date (only for models SA8060.x0x with data logger)
01:01:01:	hour (only for models SA8060.x0x with data logger)

After the data, the probe will send measuring data in the following format:

Measure:	- sign (+ or -)
	- measuring value (ranging of 6 characters on the right)
Unit of measure:	- unit of measure (ranging of 4 character on the left)
	- 1 blank (ASCII 32)

To the end of the record:

00/00/00	non applicable
xx	2 bytes containing the BCC of the sent record
CR LF	end of transmission of the record

When receiving the command E, the probe will send data with the following format:

SA806x- 01 | . . . . . | xx

SA806x:	P/N of the probe
01:	ID of the probe
| . . . . . | :	32 characters of a message
xx:	2 bytes BCC
CR LF	end of transmission of the record

After command E being received, the following commands are active:

Command	Function
M	the command selects the parameter to be calibrated
C	the command starts the calibration sequences
U	the command increments the values or changes the selections
D	the command decrements the values or changes the selections
I	the command confirms the values or the selections
R	the command resets to the factory calibration /selection.

After the command the probe performs the related internal operations, then it will send a record of data or messages concerning the new setting or status.

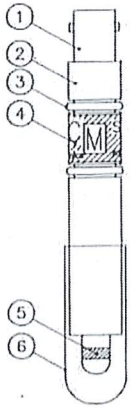
Transferring data

When the probe receives the command T it answers with the message "READY" to indicate that data transferring is ready.
After that it waits for the command N to respond by sending data memorized since last download.

The operator has now three different choices:

A the command cancel the download of data, and turns to continuous operation
G the command sets for downloading of all memorized data
L the command sets for downloading of memorized data since last one

SA9120
O.R.P. ELECTRODE



Specifications

- Electrode: Platinum
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. Platinum ring
6. Protecting cap

Accessories

//

Instructions

A) Start up:
- Remove the cap
- Dip in water for 1 day if sensor is dry

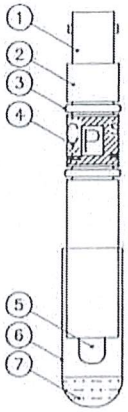
B) Maintenance:
- Clean the Platinum ring with 2% HCl solution

C) Regeneration
//

D) Storage
- Fill the cap with water and install it

Fig. 1/1

SA9110
pH ELECTRODE



Specifications

- Electrode: Glass
- Range: 0-14 pH
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. Glass bulb
6. Protecting cap
7. Storage liquid

Accessories

//

Instructions

A) Start up:
- Remove the cap
- Dip in water for one day if sensor is dry

B) Maintenance:
- Clean the bulb with 2% HCl solution

C) Regeneration
//

D) Storage
- Fill the cap with water and install it

Fig. 1/1

It is now possible downloading data which are memorized in the data logger.

After receiving the command N the probe answers by sending the next record.

After receiving the command P the probe transmits last record.

The records sent during downloading have the same format as the ones transmitted in continuous working.
After receiving the command A the probe stops downloading, turns to the continuous operation.

After sending all records the probe will send the message "STOP".

At this time:

- the command Z will reset the counter of records;

- the command A will turn the probe to by unchanging the record counting.

BCC calculation

The BCC of the messages sent by the probe is calculated as the XOR of all bytes contained in the message (CR and LF excluded) divided by 2 nibble. The two nibble are then transformed in the corresponding ASCII codes.

NOTE: The probe turns off automatically after more than 2 minutes without receiving any commands since the last one sent.

4.2 MODBUS COMMUNICATION PROTOCOL

In the Modbus network the probe is like a slave device.

RTU transmission mode

- System coding	8-bit binary
- Bits nbr per character	
start bits	1
data bits (significant minus sign before)	8
parity	no parity
stop bits	1
- Errors check	CRC-16

RTU messages format

The RTU message is format by:

- Transmission pause	duration 3,5 bytes
- Address	1 byte (8 bits)
- Function	1 byte (8 bits)
- Data	N bytes (N x 8 bits)
- Errors check	2 bytes (16 bits)
- Transmission pause	duration 3,5 bytes

For a correct synchronization of the transmission the receiving unit recognize the end of the message when it is not receiving characters for a time corresponding to the 3.5 characters transmission (bytes).

Modbus functions available

Function 03 interrogation

- Address	1 byte	01-32 (ID probe)
- Function	1 byte	03 (read holding register)
- Start data address HI	1 byte	Initial address of registers
- Start data address LO	1 byte	
- Number of data HI	1 byte	Number of registers
- Number of data LO	1 byte	
- Errors check	2 bytes	CRC-16

- The probe considers valid the message if CRC-16 is valid, ID is valid and function=03.
- The probe has 8 Holding Register starting from the address 0.
- Each register contains the value of the effected measuring
  (Example. 1=level, 2=temperature ...etc. see data format).
- The registers for not installed sensors contain a 0 value.

Function 03 answer

- Address	1 byte	01-32 (ID probe)
- Function	1 byte	03 (read holding register)
- Number of byte sent	1 byte	2x number of registers sent
- N byte data	N byte	Values registers
- Errors check	2 bytes	CRC-16

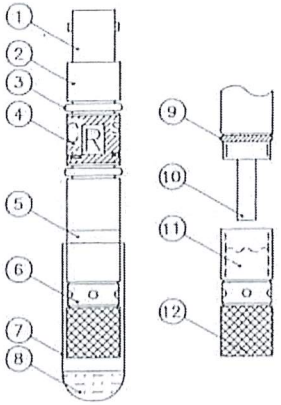
Data format

#	Modbus Address	Parameter		Range from	Range to	Unit	Scale
1	0x0000	Level	(SA8XXX.XX1)	0	2000	0.01	0.00/20.00m
			(SA8XXX.XX4)	0	3500	0.1	0.0/350.0 m
2	0x0001	Temperature		-500	5500	0.01	-5.00/55.00 °C
3	0x0002	Conductivity		0	6000	0.01	6.00/60.00 mS
4	0x0003	pH		-2000	16000	0.001	-2.000/16.000 pH
5	0x0004	ORP		-11000	11000	0.1	-1100.0/1100.0 mV
6	0x0005	Dissolved Oxygen	(mmHg, %air)	0	20000	0.01	0.00/200.00 mmHg, %air
			(ppm, mg/l)	0	20000	0.001	0.000/20.000 ppm, mg/l
7	0x0006	ISE		-11000	11000	0.1	-1100.0/1100.0 mV
8	0x0007	Turbidity		0	4000	1	0/4000 NTU

- The data format is Integer signed (-32768/+32767)
- One register is equivalent to 2 bytes.

The time from the end of the interrogation and the beginning of the answer is 500 msecond approx.

SA9100
REFERENCE ELECTRODE



Specifications

- Electrode: Ag/AgCl
- Pressure: 30 bar max.

Description

1. Connector
2. Body
3. O ring
4. ID label
5. Reservoir
6. Silicon tube
7. Protecting cap
8. Storage liquid
9. Internal O ring
10. Sensing part
11. Electrolyte
12. Ceramic junction

a. Electrolyte bottle
b. Internal O ring
c. Silicon tube

Instructions

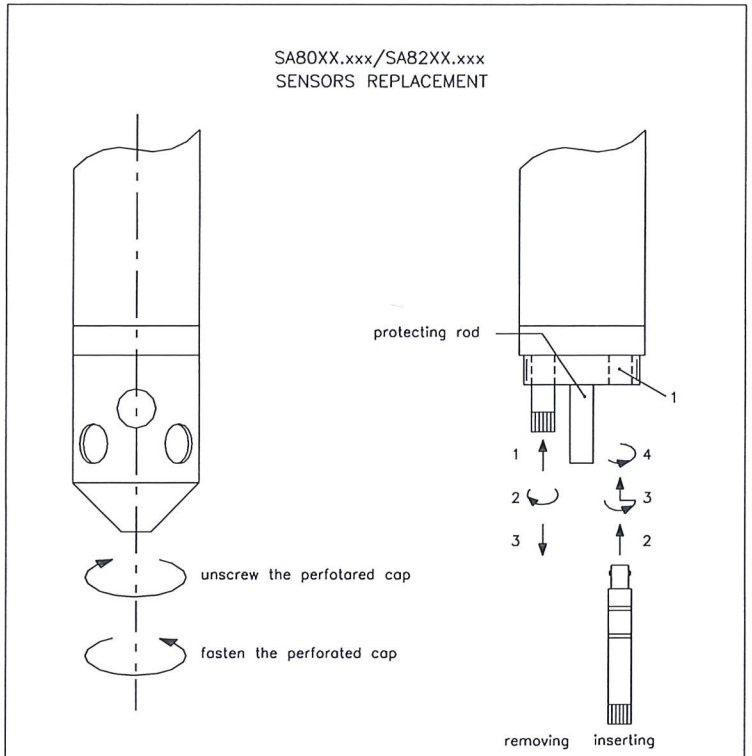
A) Start up:
- Remove the cap
- Dip in water for 1 day if sensor is dry
- Eliminate air bubbles by following the procedure C)

B) Maintenance:
- Clean the ceramic junction with 2% HCl
- Follow procedure C)

C) Electrolyte refilling
- Unscrew the reservoir
- Fill the electrolyte
- Remove eventual air bubbles in reservoir
- Fasten the reservoir and let run out the liquid in excess

D) Storage
- Fill the cap with water and install it

Fig. 1/1



REMOVING THE SENSOR

1. Pull the sensor up
2. Rotate 1/4 turn counterclockwise
3. Pull the sonsor down

INSERTING THE SENSOR

1. Grease with vaseline inside the sensor seat
2. Insert the sensor and pull up gently
3. Rotate the sensor to match the BNC guide
4. Rotate 1/4 turn clockwise to fasten the BNC

NOTE
The sonsor replacement is easier if the protecting rod is removed and reinstalled after the operation

FIG. 6

5 OPERATION

5.1 PACKING AND UNPACKING

The probe is delivered in a safe package for transportation.

Keep the packaging materials for eventual shipment of the probe to the factory for maintenance.

5.2 CONNECTIONS

The probe is operating with the following minimum devices:

- BC8582 battery charger. Power 220 Vac;
- connecting cable with connector provided with socket for battery charger;
- a terminal suitable to send commands and to receive data and messages.

In alternative to the Terminal, a P.C. provided with RS485 interface (see chapter "Accessories").

It is available a connecting software (P/N SA8000 or SA8900 of B&C Electronics) designed for the continuous operation of the probe by sending commands and receiving data.

The same software allows easy calibration and setting of the probe.

The received characters are inserted in a virtual display of 2x16 characters on the screen of the P.C.

The probe should be connected to the external power supplier and to network by means of a cable depending of the application.

The probe is provided with a 5 pin connector described in Fig. 1.

The connections of the cable/connector are the following:

pin nbr. 1: wire a	interface	RS485
pin nbr. 2: wire b	interface	RS485
pin nbr. 3: wire Ground	interface	RS485

pin nbr. 4: Power +
pin nbr. 5: Power -

Internal battery charge check

It is possible to check the battery charge status by sending the command A or E.
The probe will answer with related messages.

In case of message "LO" the battery needs to be recharged as follow:

- insert the connector of the battery charger in the special socket installed in the connector of the cable;
- connect the battery charger to the 220 volt line;
- the battery is charged within 2.5 hours approx.;
- follow the detailed instruction of the automatic battery charger BC8582.

WARNINGS

The best way to recharge the battery is to use the BC8582 automatic battery charger and the SA9491 cable or an alternative cable with 15 m max length.
If so the charger will deliver the maximum current value automatically followed by the trickle charge.
Contact our Service department for different options based on constant current battery chargers.
The use of a Vdc power supply instead of a battery charger will damage the internal battery and the electronic circuits.

5.3 INSTALLATION

The probe is supplied with a default 2400 baud rate. In case of different speed the user must consider that the cable is not terminated in order to reduce the power consumption.

We suggest to choose the baud rate in function of the cable length as follow:

baud	1200	2400	4800	9600	19200
meter	2000	1000	500	250	125

Contact our Service department in case of special application.

- Plug carefully the connector of the cable to the connector of the probe and fasten manually.

- Fasten the cable to the security hook of the probe. (See Fig. 1)

- Avoid immersion deeper than the max. value on the specifications.

- Check the power voltage conforming to the specifications.

- The communication speed must be selected according to the max. cable length connected to the probe.

5.4 PRE-OPERATION

Before the regular operation, refer to Fig. 2 and Fig. 3 in order to:

- unscrew the perforated cap protecting the sensors;

- remove the protective cap from the reference, pH, ORP and dissolved oxygen sensors. Keep the caps to be reinstalled for a long period of storage;

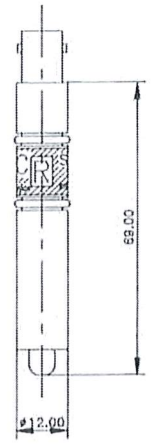
- tighten the perforated cap;

- immerse the probe in tap water for 30 minutes if sensors have been stored dry;

- immerse the probe in the liquid being measured for 5 minutes in order to reach the thermal equilibrium;

- switch on the probe for 5 minutes in order to polarize properly the dissolved oxygen sensor;

EXTRACTABLE SENSOR
Dimensions (mm)



P/N	Description	Symbol
SA9100	Reference	R
SA9110	pH	P
SA9120	Redox	M
SA9130	Conductivity	C
SA9150	Temperature	T
SA9160	D.Oxygen	O

Fig. 5

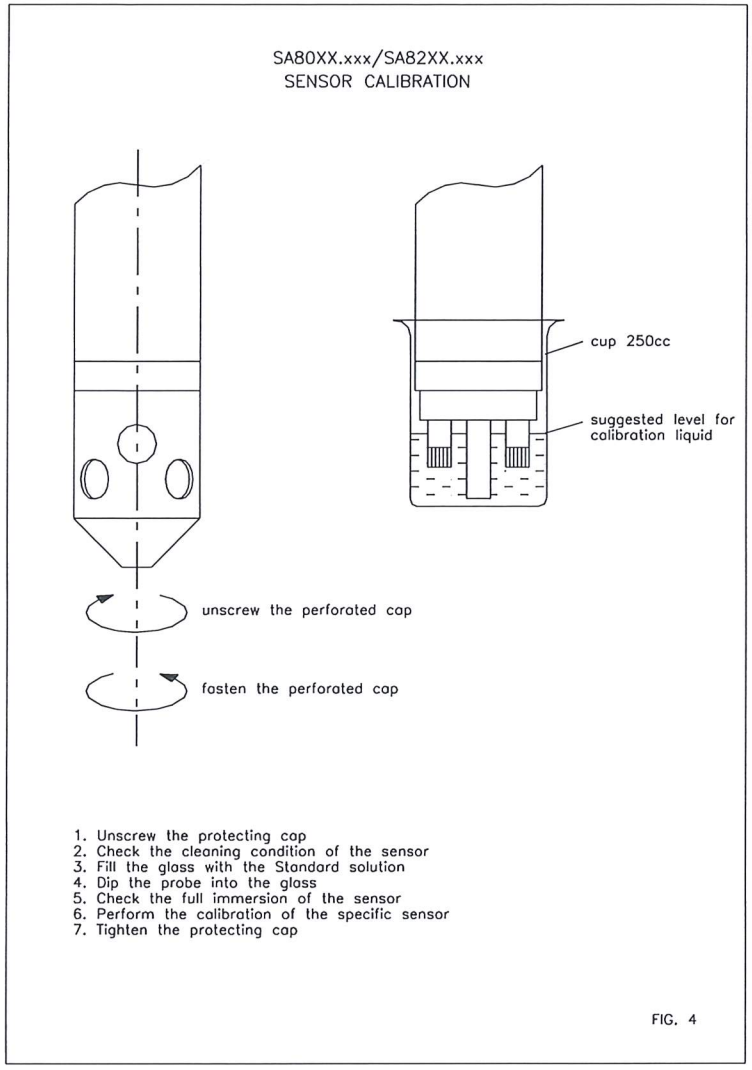


FIG. 4

- verify if the factory calibrated parameters are suitable for the application.
(See the chapter CALIBRATIONS for the new setting).

5.5 OPERATIONS AFTER THE MEASURING CYCLE

Refer to Fig. 2 and 3 for the operation suggested after using of the probe:

- check the cleaning condition and rinse the sensors with tap water, using eventually a soft brush in order to remove residual scales;

- install the plastic caps filled with tap water on the sensors for a long period of storage.

If the use of the probe is not continuous we suggest the following:

- keep the probe in vertical position with sensors at the bottom;
- preserve the probe dry at room temperature.

6 CALIBRATIONS

Calibrations include the standardization of the sensors and the selection of the operating parameters of the probe.

Probes are delivered with factory calibration and parameter setting as described in the default Specifications.

The following chapter shows operation, adjustment and selections for each measuring parameter.

The operating parameter selection is a special operation to do during the installation only.

The sensor calibration is a periodical operation to do regularly.

Refer to Fig. 4 for the operations to perform during the calibration of the sensors by means of Standard solutions.

Repeat the same operation for each measure to be calibrated.

When a specific sensor must be replaced, refer to Fig. 5 and Fig. 6.

During the calibration the probe may send messages for exceeding of the calibration limits of the specific parameter.

In general these messages show an anomaly on the calibration due to:

- sensor to be cleaned or replaced
- wrong buffer solution

When the error message appears, the calibration is not performed and the probe maintains the previous calibration.

Messages are available for 5 minutes.
By sending the I command the probe turns to the next function.

Measuring stability check

During the calibration the software controls the stability of the measuring value, sending the message 'WAIT*'.
When the stability of the reading is reached, the probe send the message 'READY'.

The operator may skip the stability check by sending the command I.
In this way the probe memorizes the reading value and it sends the message 'Skip stability'.

Suggested buffer solutions

The specifications chapter shows the particular buffer solutions of pH, ORP and conductivity whose values are memorized into the probe.
We suggest to use those solutions to make easy the calibration procedure, because the probe will show the value automatically by sending the message BS.

In order to simplify the instruction manual, the following description will show the 32 characters sent after receiving the command E.
As described those characters follow the ID characters and are followed by BCC and CR LF.

6.1 DATA LOGGER CALIBRATION

The probe can carry out acquisitions at time or level intervals (vertical profile).

M after receiving this command the probe answers:

```
|LOG ON TIME 24h STOP  14h 01/09 |
```

Acquisition programmed on time (HOUR/MINUTES) - Data Logger STOP
Last acquisition effected at 14.00 of 01/09

or

```
|LOG ON LEVEL 1. 0STOP   15.00 m |
```

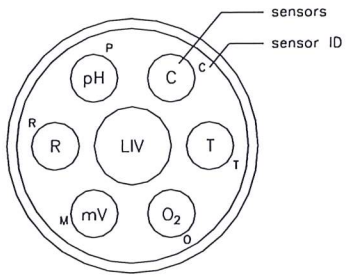
Acquisition programmed on level (LEVEL) - Data Logger STOP
Last acquisition effected at 15.00 m.

```
|LOG ON TIME 24h START            |
```

Acquisition programmed on time (HOUR/MINUTES) - Data logger START

Active commands: M C U/D I

SA80XX.xxx/SA82XX.xxx
POSITION OF THE SENSORS



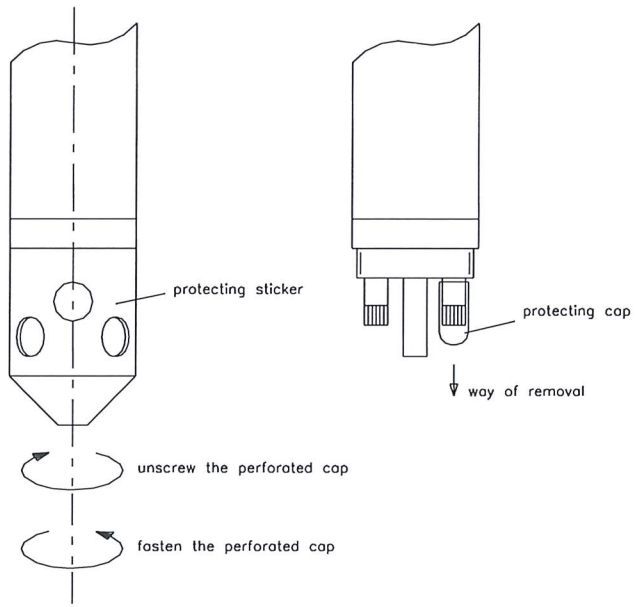
view from bottom

SENSOR	DESCRIPTION	SYMBOL
LIV	level	
pH	pH	P
R	reference	R
mV	redox	M
O_2	d. oxygen	O
T	temperature	T
C	conductivity	C

The position of the sensor is shown by the symbol printed on the sensor holder

FIG. 3

SA80XX.xxx / SA82XX.xxx
PREPARATION OF THE PROBE



1. Remove the protecting sticker
2. Unscrew the protecting cap
3. Remove the storage cap from Reference and D.Oxygen electrode
4. Tighten the protecting cap

FIG. 2

Selection of the acquisition type (ON TIME/ON LEVEL)

C after receiving this command probe answers:

|CAL LOG: ON LEVEL | (ON TIME)

ON LEVEL/ON TIME: type of selected acquisition

Active commands: M U/D I

Acquisition on time basis (if ON TIME has been selected)

It is possible to carry out the selection of the acquisition interval:

|CAL LOG: T.INT MINUTES | (HOURS)

MINUTES/HOURS: Interval of acquisition

Active commands : M U/D I

|CAL LOG: T.INT 59m | (24h)

XXm/XXh: interval of acquisition

Start of programming acquisition on time basis

|LOG ON TIME 24h STOP 14H 01/09 |

| LOG START |

Active commands: M C U/D I

By selecting START it begins the programming acquisition on time basis.
Once switched off, the probe will do automatic acquisition as programmed
By selecting STOP the probe does not effect any acquisition.

Execution of a profile (if ON LEVEL has been selected)

Select the depth step to effect measurement on a vertical profile.

```
|CAL LOG: L. INT          10.0M      |
```

10.0 m: depth interval of the acquisition

Active commands: M U/D I

```
|LOG ON LEVEL 1 . 0STOP 15 m         |
```

Select START to begins the execution of a profile

```
|LOG START                           |
```

Active commands: M C U/D I

Start profile messages

The probe is effecting a zero level calibration.

In this period the probe must be kept out of water for zero depth value.

```
|READY FOR LOG                       |
```

The probe is waiting to be immersed.

Now it is possible to disconnect the probe from the P.C. or terminal to begin the immersion.
(Remember to insert the stopper SA 9409 to the probe).

When removed from the water, the probe automatically switches off, once it will reach a level same as the penultimate memorized.

Status of the data logger memory

M send this command to get the following answer:

```
|REC INST.    500 REC UTIL.      0 |
```

REC INST.: number of memorizing acquisition
REC UTIL.: number of acquisition utilized

Active commands: M I

Status of the battery charge

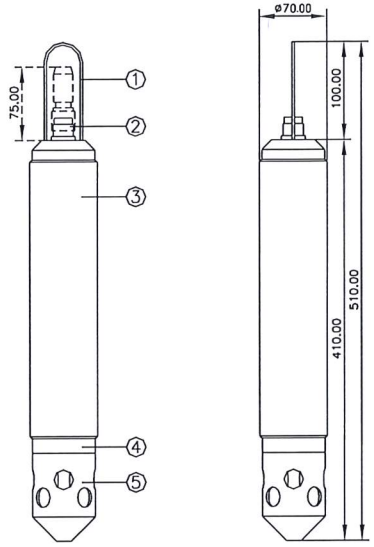
M send this command to get the following answer:

```
|MAIN B. 3.7V  OK                    |
```

MAIN B. 3. 7V: Value of principal power.
OK: batteries charged
LO: batteries need to be recharged

Active commands: M I

SA806X.xxx
DIMENSIONS (mm)



1. SECURITY HOOK
2. CONNECTOR
3. BODY OF THE PROBE
4. SENSORS HOLDER
5. SENSORS PROTECTION

FIG. 1

Dry the probe and operate in a dry room.
Remove and insert the sensors by following instruction of Fig. 6.

Sensors instruction

The operator's instruction for sensors SA9100 - SA9110 - SA9120 - SA9130 - SA9150 - SA9160 are shown in the corresponding figures enclosed in this manual.
Each figure shows the technical specifications and accessories provided with the sensor.

8 ATTACHMENTS

This manual includes the following attachments:

Fig. 1	Dimensions of the probe
Fig. 2	Preparation of the probe
Fig. 3	Position of the sensors
Fig. 4	Calibration of the sensors
Fig. 5	Dimensions of the extractable sensors
Fig. 6	Replacement of the sensors

Pag.1/1	SA9100
Pag.1/1	SA9110
Pag.1/1	SA9120
Pag.1/1	SA9130
Pag.1/1	SA9150
Pag.1/2	SA9160
Pag.2/2	SA9160

Table of the dissolved oxygen solubility

Clock calibration

It is possible to calibrate date, hour, minute.

Note: the probe send new data to its internal clock only at the end of calibration so it is necessary to select all parameters (day, month, year, hour, minute) so that they can be memorized.

M send this command to get the following answer:

```
|TIME 15/02/97     22:00:28      |
```

TIME: date and hour

Active commands: M C I

Day calibration

After receiving the command C the probe answers:

```
|CAL TIME                DAY 15      |
```

Active commands: M U/D I

Month calibration

After receiving the command C the probe answers:

```
|CAL TIME                MON. 02 |
```

Active commands: M U/D I

Year calibration

```
|CAL TIME              YEAR 97     |
```

Active commands: M U/D I

Time calibration

```
|CAL TIME                HOUR 22 |
```

Active commands: M U/D I

Minutes calibration

```
|CAL TIME                MIN. 00     |
```

Active commands M U/D I

I this command allows the probe to send new data to its internal clock.

6.2 LEVEL CALIBRATION

The following calibration are allowed:

1. Zero adjustment
2. Sensitivity adjustment

The probe is factory calibrated but it needs a field calibration considering that level measuring is based on hydrostatic pressure which is depending of the liquid density.
The zero adjustment must be done regularly, while the sensitivity adjustment must be done seldom.

M send the command to get the following answer:

```
|LEVEL 200.00m                    |
```

200.00m: actual value of level

Active commands: M C I

Visualization and adjustment of zero level

C the probe will answer the command with:

```
|CAL LEVEL          ZERO   0.50m  |
```

0.50 m: actual zero in memory

Active commands: M C I

C send the command to activate the zero adjustment.

```
|CAL L. READY                0.72m  |
```

READY: the message shows the stability of the level value
0.72 m: measuring value of the level

Active commands: M I R

Keep the probe in air and send the command:

I - the command performs the zero level adjustment
- the probe send the following record for level calibration:

Level calibration

It is possible to calibrate in two ways:

1) by adjusting the sensor sensitivity value
2) by adjusting the level readout

```
|CAL LEVEL SENS          100.0%   |
```


7 PREVENTIVE MAINTENANCE

Periodically and depending of the application we suggest to check the cleaning status of the sensors and to perform the following preventive maintenance.

- Remove the probe from the liquid being measured and remove the connecting cable.

- Unscrew and remove carefully the protective terminal of the sensors and take note of the kind of dirt on the sensors.

- Rinse the sensor with clean or distilled water and soft brush.

- Reinstall the protective cap fastening by hand.

NOTE:
If sensors are very dirty it is necessary to increase the frequency of this preventive maintenance.

WARNINGS

The preventive maintenance does not require the access to the internal electronic circuits.
If the probe is opened it is necessary to pay attention to the O-ring status and place while fastening the probe in order to maintain the watertight.
Any malfunctioning due to an imperfect fastening of the body by the operator is not covered by warranty.

Exceptional maintenance

This maintenance may be necessary when the probe is damaged or not working in some functions.
It may be requested as yearly preventive maintenance as well.

The relative operations may require the internal inspection of the probe to be done in our laboratory.

Sensors identification

The sensors identification is done by means of Fig. 3 and Fig. 5 describing their position in the probe.

The symbol is printed on the label placed between the 2 O-rings of the sensor.

Sensors maintenance

The level sensor does not require any kind of maintenance.
It may be replaced only in factory.

All the other sensors are extractable and they may be replaced by the operator.
We suggest to clean carefully the probe by rinsing in water, before proceeding to replace a sensor.

2400: actual baud rate
Active Commands: M U/D I

By pressing ↑↓ the BAUD RATE can be set to 1200 – 2400 – 4800 – 9600 – 19200.

Note: if the baud rate is changed, the new speed will be active only after the next power on.

100.0%: actual sensitivity in memory

Active commands: M U/D I

1. Modify the sensitivity value and send the command I.
or
2. Send the command I without modifying the % value.
The probe is now ready to adjust the sensitivity by modifying the level measuring value.

Dip the probe at a known depth and adjust as follows:

```
|CAL L. READY          100.20m   |
```

READY: message of reached stability
100.20 m: level value as measured/inserted

Active commands: M U/D I R

- Dip the probe to a known depth
- Modify the measuring value
- Send the command I to confirm the new value

6.3 TEMPERATURE CALIBRATION

It is possible to adjust one point of temperature.

The probe is factory calibrated but the operator may calibrate the measuring value as follows:

M send the command in order to get the following answer:

```
|TEMP.  20.00°C                  |
```

20.00°C: actual temperature value

Active commands: M C I

Dip the probe in a liquid at known temperature and wait for the stability:

C send the command in order to get the following answer:

```
|CAL TEMP. ZERO          2.00°C  |
```

2.00°C: actual zero value in memory

Active commands: M C I

C send the command to modify the value.

```
|CAL T. READY           20.00°C  |
```

READY: the message shows the reached stability of the readout.
20.00°C: value as measured/inserted.

Active commands: M U/D I R

- Modify the temperature value
- Send the command I to enter the new value.

Note: the probe turns automatically to the manual temperature if the temperature sensor is not installed or it is damaged.
In manual temperature mode, the inserted value will be considered as new manual temperature value, and the symbol °CM appears.

6.4 CONDUCTIVITY CALIBRATION

The following sequence is available:

1. measuring scale selection
2. autoranging ON/OFF selection

3. Zero adjustment
4. Sensitivity adjustment

5. Reference temperature selection
6. Temperature coefficient selection

The calibration must be performed only after the above selection are done.

M send the command in order to get the following answer:

```
|COND. 25.000mS  T.REF:20 TC:2.20|
```

25.000mS: actual conductivity value
20 °C: Reference temperature
2.20%/°C: temperature compensation coefficient

Active commands: M C I

C send the command to activate the calibration sequence.

```
|CAL COND.          FS:60.000mS  |
```

60.000 mS (6.000 mS): full scale as selected

Active commands: M U/D I

```
|CAL COND.       AUTORANGING: OFF|
```

ON(OFF): autoranging activated (deactivated).


```
|    POWER ON                    |
```

POWER ON: probe in operation.
POWER OFF: select to turn off the probe
Active commands: M U/D I

Probe turning off

I send the command to confirm the turn off of the probe (OFF).

```
|    POWER OFF        **WAIT**    |
```

The probe turns off automatically after about 5 seconds.

6.10 ID CALIBRATION

M send the command in order to get the following answer:

```
|SA8060 R2.7x    ID: 27          |
```

SA8060: p/n of the probe
R2.7x: software release
27: identification number of the probe

Active commands: M C

C send the command to activate the modification of the ID number of the probe.

```
|SA8060 R2.7x    CAL ID: 27      |
```

27: actual ID number of the probe

Active commands: M U/D I

NOTE: If the ID number has been modified, the new one will be active only after the next switching on.

6.11 BAUD RATE CALIBRATION

M send the command in order to get the following answer:

```
|TRANSMISSION    BAUD RATE:  2400|
```

2400: transmission speed in baud

Active Commands: M C

C the probe will answer as follow:

```
|CAL TRANSMISSION BAUD RATE  2400|
```

Active commands: M C I

C send the command to activate the response time calibration.
|CAL RT CONT.: 10 s|

CONT. : 10 s: response time during the continuous operation

Active commands: M U/D I

|CAL RT PROG.: 15 s|

PROG.15 s: response time during the programmed operation

Active commands: M U/D I

6.9 TIMEOUT CALIBRATION

The settings and calibrations are made by modifying the values with the U/D commands and a confirmation with I command.

M send the command in order to get the following answer:

|TIMEOUT ON STARTPROFILE: 10' |

TIMEOUT 10': maximum waiting time in immersion after the probe has received the START PROFILE command.

This function prevents the probe remains unnecessarily powered if not immersed after a start-profile command.

NOTE: Insert an appropriate time to prevent unwanted shutdowns and consequent disruption of acquisitions.

Active commands: M C U/D I

C send the command to modify the timeout time value.

|CAL TIMEOUT: 10' |

Active commands: M U/D I

Power On/Off

The settings and calibrations are made by modifying the values with the U/D commands and a confirmation with I command.

M send the command in order to get the following answer:

Active commands: M U/D I

The Autoranging allows the automatic jump to the upper scale, if the lower scale (6 mS) has been selected.

|CAL COND. ZERO 0.080mS |

0.080mS: zero value of the selected scale.

Active commands: M C I

If the sensor is not immersed the conductivity value should be zero.

C send the command to activate the zero adjustment sequence.

Zero adjustment

|CAL COND. ZERO 1 0.008mS |

0.008mS: conductivity measuring value.
If confirmed it will become the new zero of the scale 1
(lower scale)

Active commands: M I R

The probe will wait for the stability; when it is reached the probe will turn to the next scale 2.
When the stability is reached, send the command I to enter the new zero.

|CAL COND. ZERO 2 0.080mS |

0.008mS: conductivity measuring value.
If confirmed it will become the new zero of the scale 2
(upper scale)

Active commands: M I R

The probe waits for the stability; when reached it turns automatically to the sensitivity visualization.
If the stability is not reached, it is possible to enter manually the new zero value by sending the command I.

Conductivity adjustment

|CAL COND. SENS:100.0% |

100.0 %: sensitivity value.

Active commands: M C I

C the command activates the sensitivity calibration sequence:

Calibration mode selection

By using the KCl Standard solution with value: 1,278mS - 2,501 mS - 11,670 mS - 53,280 mS it is possible to select the automatic calibration mode.

Actually their conductivity values at 20°C are internally memorized together with the corresponding temperature coefficient.

```
|CAL COND.  SENS      AUTO BS      |
```

AUTO BS(MANUAL): calibration mode as selected

Active commands: M U/D I

- Select AUTO if the following KCl standards are used:
  1,278mS - 2,501 mS - 11,670 mS - 53,280 mS

- Select MANUAL if other standard solutions are used.

Calibration by means of recognized solutions

During this kind of calibration the probe uses the following values, related to the specifications of the solutions:

- Temperature of reference: 20,0°C
- Temperature coefficient: 2,10 %/°C for the scale 6 mS, 2,05 %/°C for the scale 60 mS.

The probe measures the value of the standard solutions and checks the stability of the readout.
When the stability is reached, the probe send the message 'READY'.

If the stability is not reached, the operator may send the command I.
The probe will send the message 'Skip Stability' in order to allow the manual calibration.
After the stability check, the probe will evaluate the compatibility of the readout with the memorized values.

If the measuring is compatible the probe will send the message 'BS' (Buffer Solution) and the measuring value will be replaced by the value of the standard solution at 20°C.

```
|CAL C. READY BS    11.670mS |
```

s < 70 %
s > 130 %

READY: the stability has been reached.
BS: the message shows the display value of the standard solution.
11.670mS: value of the standard solution as recognized

Active commands: M U/D I R

Secondary parameter insertion

Barometric Pressure

```
|CAL D.O.                  p: 760 mmHg|
```

760 mmHg: pressure value as inserted

Active commands: M U/D I

Salinity

```
|CAL D.O.                sal:10000ppm |
```

10000ppm: salinity value as inserted (steps of 100 ppm)

Active commands: M U/D I

Relative Humidity

```
|CAL D.O.                  RH: 100 %   |
```

100 %: R.H. value as inserted

Active commands: M U/D I

6.8 SOFTWARE FILTER CALIBRATION

The software filter response is the time to reach the 90% of the input signal variation.

The action of the filter will improve the stability of the readout but it will reduce the speed of the response.

During calibration the probe will use automatically the filter response equal to 10 seconds.

It is possible to perform the following operations:

1. Selection of the response time during the acquisition
2. Selection of the response time during the programmed acquisition

M send the command in order to get the following answer:

```
|RT CONT.:   10 sRT PROG.:   15 s|
```

10s: response time during the continuous operation
15s: response time during the programmed operation

Calibration method selection

|CAL D.O. SENS AUTO/air |

AUTO(MANUAL): calibration method as selected

Active commands: M U/D I

Automatic sensitivity calibration in air

It is available only if the "AUTO" mode has been selected.

- Remove the probe from the liquid and make sure the cell is dry and the temperature readout is steady.

- Keep the probe in air with a known R.H. or with a H2O saturated vapour (RH=100%)

- Wait for the readout stabilization (message 'READY').

- Send the command I to confirm the value.

|CAL O2 READY A 100.00%air|

READY: the message shows the reached stability of the readout
A: the message shows the calibration method in air
100.00%: dissolved oxygen measuring value

Active commands: M I R

Manual sensitivity calibration

It is available only if the "MANUAL" mode has been selected.

- Keep the probe immersed into the liquid being measured.
- Perform the D.O. measuring by means of a laboratory instrument.
- Insert the value and send the command I.

|CAL O2 READY M 100.00%air|

READY: the message shows the reached stability
M: the message shows the MANUAL method as selected
100.0 %: dissolved oxygen measuring/inserted value

Active commands: M U/D I R

Calibration by means of standard solutions not memorized

Before using those solutions not recognized by the probe, make sure the temperature coefficient of the probe is same as the coefficient of the standard solution to be used for calibrating.

The probe is configured in MANUAL, and it may be calibrated only after the stability of the conductivity readout confirmed by the message 'READY'.
If the stability has not reached send the command I in order to skip the stability by sending the message 'Skip Stability'.

|CAL C. READY 10.000mS |

READY: the stability has been reached.
10.000mS: measuring conductivity value.

Active commands: M U/D I R

Reference temperature for the automatic compensation

The reference temperature is normally set to 20 °C.

The conductivity values, at any temperature, will be transformed at the corresponding value at 20 °C through the selected temperature coefficient.

|CAL COND. T.REF:20 °C |

20 °C: value of the reference temperature.

Active commands: M U/D I

Temperature coefficient

|CAL COND. TC: 2.20 %/°C|

2.20%/°C: value of the temperature coefficient.

Active commands: M U/D I

Select the temperature coefficient as desired.
(For drinking water select the value 2,2 %/°C.)

How to calculate the unknown temperature coefficient

It is necessary to measure the conductivity value of the liquid at two different temperature values.
Operate as follows:

- set the TC = 0
- set the reference temperature 20 °C
- measure the conductivity value C1 at temperature T1
- measure the conductivity value C2 at temperature T2

Calculate the temperature coefficient TC as follows:

$$TC = \frac{C2 - C1}{C1\,(T2 - 20) - C2\,(T1 - 20)} \times 100$$

The temperature values may be taken from the probe readout on the D1 Display.
The measuring accuracy is depending of the accuracy of the standard solutions used for the calibration.

The contamination and the evaporation change the conductivity value of the standard solution.

6.5 PH CALIBRATION

It is possible to perform the following operations:

1) Zero and sensitivity adjustment by means of two buffer solutions
2) Zero adjustment by means of one buffer solution

Suggestions

If the protective cap of the electrode is empty and the electrode is dry, dip the sensor into tap water for 3 hours before starting the calibration.

Follow the instructions of the pH and reference electrodes SA9100 and SA9110.
The temperature sensor performs the temperature compensation.

Calibrate by using the buffer solutions pH=4 pH=7 pH=9, as they are recognized by the software of the probe.

- dip the pH and reference electrodes in the buffer pH=7 to adjust the 1st point.

- dip the pH and reference electrodes in the buffer pH=4 or pH=9 to adjust the 2nd point.

It is possible to calibrate the 2 points with buffers pH=4 and pH=9 as well.

Rinse in clean water before dipping the sensor in the new buffer solution in order to avoid the contamination.

Unit of measure selection

```
|CAL D.O.     %air                    |
```

%air (ppm - mg/l - mmHg): unit of measure as selected.

Active commands: M U/D I

Zero visualization

```
|CAL D.O.            ZERO  0.30 nA   |
```

0.3 nA: actual zero in memory

Active commands: M C I

C send the command to activate the zero adjustment

Zero adjustment

Perform this operation during the probe installation or after the replacement of the dissolved oxygen sensor.

- Dip the D.O. cell for few minutes in the fresh 2% anhydrous sodium (potassium) metabisulphite solution.
- Wait for the stabilization of the value close to zero and proceed the calibration.
- Rinse the cell in clean water.

The zero solution is not steady. It may be stored just for few days in a fulfilled dark bottle.

```
|CAL O2 READY              -0.02nA   |
```

READY: the message shows the reached stability of the zero current
-0.02 nA: actual current value
By confirming this value it will be the new zero of the cell.

Active commands: M I R

Sensitivity visualization

```
|CAL D.O.            SENS:100.0 %    |
```

100.0 %: actual cell sensitivity

Active commands: M C I

C send the command to activate the sensitivity calibration sequence after the selection of the calibration method.

Calibration of the 1st point

```
|CAL Rx READY BS   P1*    220.0mV   |
```

READY: the message shows the reached stability
BS: the message shows the value of the memorized buffer solution
P1*: 1st point
220.0mV: redox value of the memorized buffer

Calibration of the 2nd point

```
|CAL Rx READY BS   P2*    468.0mV   |
```

READY: the message shows the reached stability
BS: the message shows the value of the memorized buffer solution
P2*: 2nd point
468.0mV: redox value of the memorized buffer.

If the difference between the 1st and 2nd point is smaller than 10.00 mV, the probe will perform only the asymmetry adjustment.
The calibration results as one point calibration (zero calibration).

6.7 DISSOLVED OXYGEN CALIBRATION

It is possible to perform the following operations:

1) Unit of measure selection
2) Zero adjustment
3) Sensitivity adjustment
4) Barometric pressure selection
5) Salinity selection
6) Relative humidity selection

The calibration must be performed only after the selection of the above parameters.

M send the command in order to get the following answer:

```
|D.O.    9.200ppm p:760 sal: 10000|
```

9.200ppm: actual D.O. value and unit of measure
760: pressure value in mmHg
10000: salinity value

Active commands: M C I

C send the command to activate the selection and calibration sequences.

Because of the good quality of the sensor, the user may calibrate the first point and the second point with the same buffer solution.

In this case the probe will not modify the sensitivity.
We suggest to do the one point calibration by means of a buffer solution with the pH value as close as possible to the liquid being measured.

The probe does not perform the calibration if the zero deviation is more than ± 2 pH.
This means the reference electrode must be replaced or regenerated.

The probe does not perform the calibration if the sensitivity deviation is < 80 %.
This means the pH electrode must be replaced.

The probe does not perform the calibration if the sensitivity deviation is > 110 %.
This means the buffer solution is wrong.

NOTE 1
Send the command R to turn the probe to the factory calibration.

NOTE 2
If the reference electrode is replaced, the ORP calibration is required as well.

Calibration sequence

M send the command in order to get the following answer:

```
|pH     14.000pH  A:-0.30pH S:100%|
```

14.000pH: actual pH value
-0.30 pH: asymmetric potential of the sensor
100%: slope of the sensor

Active commands: M C I

C the command activates the calibration sequence

The probe measures the value of the buffer solution and checks the stability of the readout.
When stability is reached, the probe send the message 'READY'.

If the stability is not reached, the operator may send the command I.
The probe will send the message 'Skip Stability' in order to allow the manual calibration.

After the stability check, the probe will evaluate the compatibility of the readout with the memorized values.
If the measuring is compatible the probe will send the message 'BS' (Buffer Solution) and the measuring value will be replaced by the value of the standard solution at 20 °C.

- If the operator is using the memorized solutions it is enough to send the command I.
- If the operator is using solutions not memorized, it is necessary to insert the value after the stability message ' READY ', by means of the commands U/D and confirming by the command I.

Calibration of the 1st point

```
|CAL pH READY BS  P1*   4.010pH  |
```

READY: the message shows the reached stability
BS: the message shows the value of the memorized buffer solution
P1*: 1st point
4.010pH: pH value of the memorized buffer.

Calibration of the 2nd point

```
|CAL pH READY BS  P2*   7.000pH  |
```

READY: the message shows the reached stability
BS: the message shows the value of the memorized buffer solution
P2*: 2nd point
7.000pH: pH value of the memorized buffer

If the difference between the 1st and 2nd point is smaller than 0.100 pH, the probe will perform only the asymmetry adjustment.
The calibration results as one point calibration (zero calibration).

6.6 ORP CALIBRATION

It is possible to perform the following operations:

1) Zero and sensitivity adjustment by means of two buffer solutions
2) Zero adjustment by means of one buffer solution

Suggestions

If the protective cap of the electrode is empty and the electrode is dry, dip the sensor into the tap water for 3 hours before start the calibration.

Follow the instructions of the ORP and reference electrodes SA9100 and SA9120.

Calibrate by using the buffer solutions 220 mV and 468 mV, as they are recognized by the software of the probe.

- dip the ORP and reference electrodes in the buffer 220 mV to adjust the 1st point.

- dip the ORP and reference electrodes in the buffer 468 mV to adjust the 2nd point.

Rinse in clean water before dipping the sensor in the new buffer solution in order to avoid the contamination.

Because of the good quality of the sensor, the user may calibrate the first point and the second point with the same buffer solution.
In this case the probe will not modify the sensitivity.

The probe does not perform the calibration if the zero deviation is more than ± 100 mV.
This means the Reference electrode must be replaced or regenerated.

The probe does not perform the calibration if the sensitivity deviation is < 80 %.
This means the ORP electrode must be replaced.

The probe does not perform the calibration if the sensitivity deviation is > 110 %.
This means the buffer solution is wrong.

NOTE 1
Send the command R to turn the probe to the factory calibration.

NOTE 2
If the reference electrode is replaced, the pH calibration is required as well.
Calibration sequence

M send the command in order to get the following answer:

The allowed selections and calibration are done modifying values by commands U/D and confirmation by command I.

```
|REDOX  210.0mV  A:   10mV S:100%|
```

210.0mV: actual redox value
10mV: asymmetric potential of the sensor
100%: slope of the sensor

Active commands: M C I

C the command activates the calibration sequences.

The probe measures the value of the buffer solution and checks the stability of the readout.
When the stability is reached, the probe send the message 'READY'.

If the stability is not reached, the operator may send the command I.
The probe will send the message 'Skip Stability' in order to allow the manual calibration.

After the stability check, the probe will evaluate the compatibility of the readout with the memorized values.
If the measuring is compatible the probe will send the message 'BS' (Buffer Solution) and the measuring value will be replaced by the value of the standard solution at 20 °C.

- If the operator is using the memorized solutions it is enough to send the command I.

- If the operator is using solutions not memorized, it is necessary to insert the value after the stability message ' READY ', by means of the commands U/D and confirming by the command I.