Instruction Manual

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Model 14 Dissolved Oxygen Transmitter

BROADLEY TECHNOLOGIES

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Chapter 1: Introduction

1.1 Introduction

The Model 14 Dissolved Oxygen Analyzer is a single-channel analyzer for the measurement of dissolved oxygen in fermentation vessels and bioreactors, as well as in municipal applications.

1.2 Principle of Operation

The measurement of dissolved oxygen is based on the well-known Clark cell principle. An oxygen-permeable membrane isolates the electrodes from the sample, thus eliminating the need for sample conditioning. Other reducible or oxidizable ions do not interfere, because they cannot pass through the gas-permeable membrane.

A constant voltage supply powers two electrodes, maintaining each at a constant potential. A platinum working electrode (cathode) reduces the dissolved oxygen to hydroxyl ions :

$$O_2 + 2H_2O + 4e^- \leftrightharpoons 4OH^-$$

A large silver counter electrode (anode) provides the oxidation reaction:

$$4Ag^+ + 4Cl^- \leftrightharpoons 4AgCl + 4e^-$$

The reduction of oxygen is the current limiting reaction, thus making the cell current linearly proportional to the dissolved oxygen concentration.

Electrochemical reactions and diffusion rates are temperature-sensitive. The measuring cell, therefore, is equipped with a temperature sensor which allows an automatic temperature compensation.

1.3 Main Characteristics

- Range: 0 - 299.99% saturation; 0 - 29.99 ppm
- Calibration in the air
- Temperature compensation
- Programmable alarm levels, outputs on relays
- 4-20 mA, 0-20 mA analog outputs (standard)
- Wall- , panel- and pipe mounting

1.4 Technical Specifications

Electrical Characteristics	
Power Supply	90 – 265 VAC , 50/60 Hz, Self-adjusting
Power Consumption	25 VA
Connections	Terminal blocks
Fuse	5x20 mm cartridge - T2AL - 250V

Analysis	
Number of Inputs	1
Measuring Range	0 – 299.99% saturation
Accuracy	± 1% full scale
Reproducibility	± 0.1% of range
Response Time (90 %)	0 – 95% full scale, <45 seconds
Ambient Temperature	-20 – 60 °C (-4 … 140°F)
Relative Humidity	10 – 90%

Transmitter

Display	Display in concentration units or % saturation Display of the direct cell current in nA Display of the sample temperature in °C/°F Programming via menus
Units	nA, ppm-mg/l, °C, °F, % saturation
Calibration	Electrical zero, chemical zero, slope calibration in the air, slope process calibration by comparison with a laboratory measurement
Analog Outputs	2 x 0/4 - 20 mA isolated from input signal, 800 ohms load maximum - Measurement or temperature - Mode : linear, bi-linear - Accuracy : 0.1 mA Alarms - Number : 4 - Functions : alarm - system alarm - timer - Hysteresis : 0 - 10% - Delay : 0 - 999 seconds - Breaking power : 250 VAC, 3A maximum 30 VDC, 0.5A maximum
Temperature Compensation	Automatic in the range of 0 - 80 °C
RS485 (option)	Speed : 300 - 9600 bauds Insulation : galvanic Station number : 32 maximum
Transmitter Protection	IP 65 and NEMA 4X
Error Reports	Cell current > 999 nA Sample temperature > 80 °C Ambient temperature > 80 °C Slope calibration error Zero calibration error (offset)

Electromagnetic Compatibility

Immunity Against Electromagnetic Interferences	EN 50082-2 and EN 50082-1
Electromagnetic Emission	EN 50081-1 and EN 50081-2
Low Voltage Standard	IEC61010-1

Materials

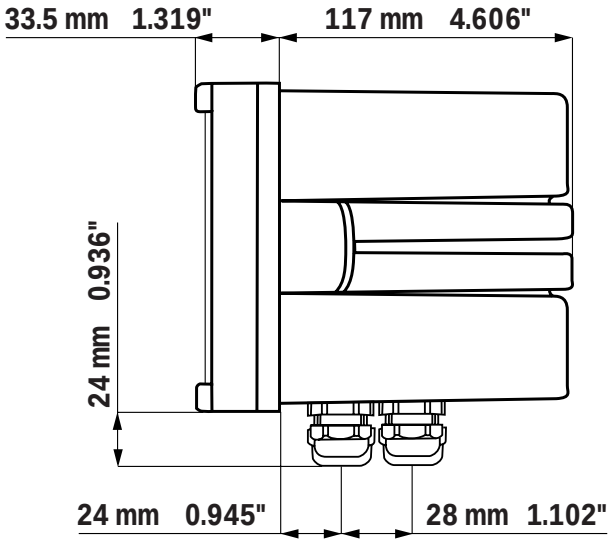
Working Electrode	Cathode : platinum
Counter Electrode	Anode : silver
Membrane Holder	PPS & silicone
Membrane	PTFE
Transmitter	Epoxy coated aluminum
Probe Body	Stainless steel 316L

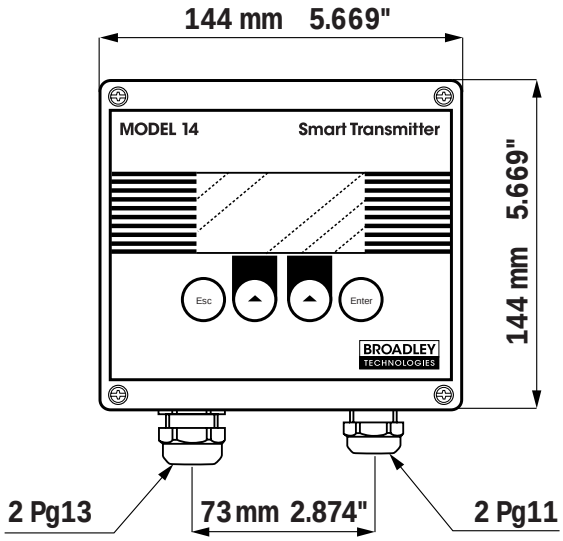
Maintenanace

Cleaning	Clean the instrument with a soft tissue. DO NOT use any aggressive agent.

1.5 Dimensions

(Dimensions are in mm and inches)





Chapter 2: Description of the Analyzer

2.1 Transmitter

2.1.1 Presentation of the Transmitter

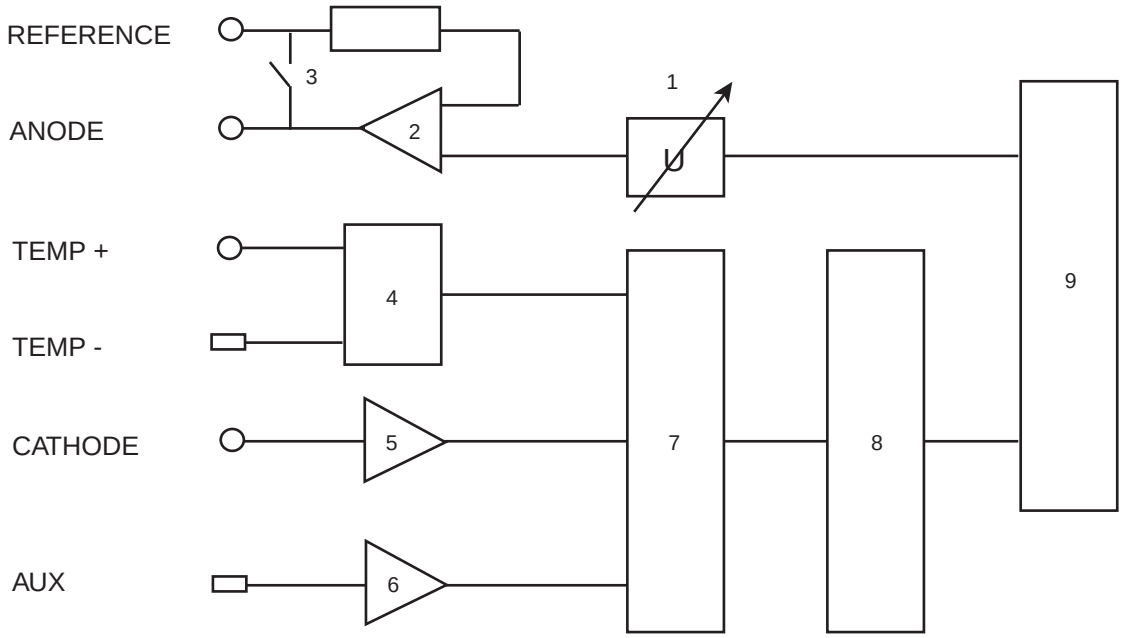
The electronic unit amplifies the signal of the amperometric measuring cell and converts it into a direct digital readout in ppm, mg/l or % saturation. The transmitter is comprised of the following items:

- Potentiostat which maintains the working electrode potential constant
- Amperometric measuring module
- Analog multiplexer
- Microprocessor unit

The analog multiplexer allows measurement inputs from the measuring cell, temperature sensor and internal checkpoints. Furthermore, the microprocessor operates the relays, the RS485 interface (optional) and the analog outputs.

The unit has an internal concentration auto-ranging feature and a microprocessor-operated calibration routine. The output of the potentiostat is monitored for possible overdriving of the potentiostat-output stage. This condition can occur when the connections to the measuring cell are due to an inoperable electrode or a defective reference electrode.

2.1.2 Transmitter Schematic:



1 : Programmable potentiostat	**6 : Auxiliary input**
2 : Polarization voltage amplifier	**7 : Multiplexer**
3 : Reversing switch for a 2 or 3 electrode operation.	**8 : A/D converter**
4 : Temperature measurement circuit	**9 : Microprocessor**
5 : Measurement circuit current amplifier	

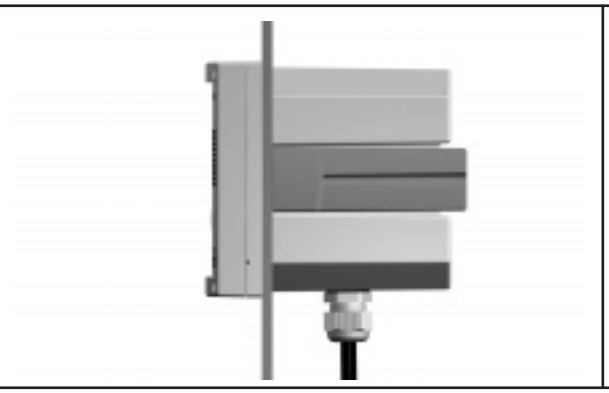
2.2 Application Fields

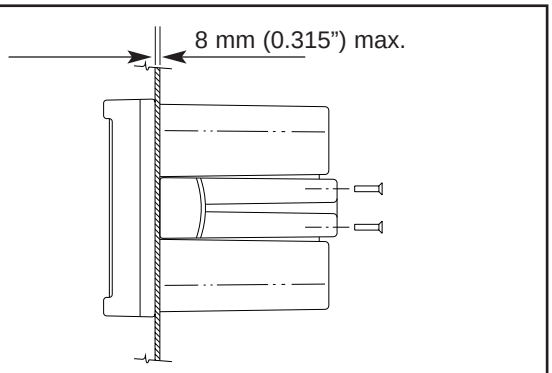
Easy to use, install and program, this instrument is suitable for the following applications:

- Fermentation / biotech
- Municipal

2.3 Standard Mounting Options (using the red clamping bow)

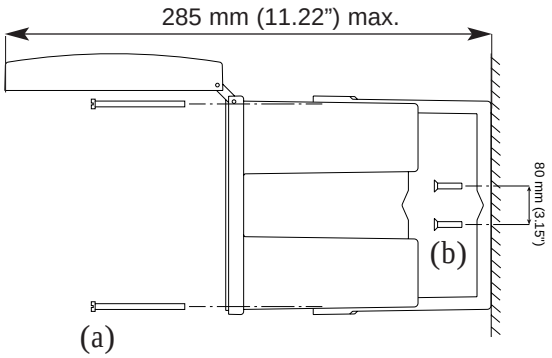
The transmitter housing conforms to norm DIN 43700.





Panel mounting

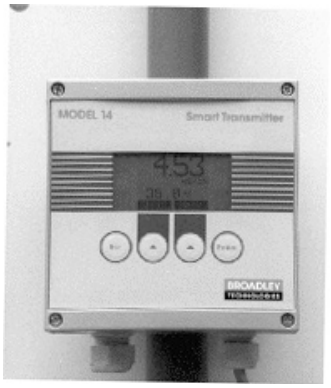
Panel cut-out: 138 mm x 138 mm (5.4" x 5.4")
Front panel dimensions: 144 mm x 144 mm (5.7" x 5.7")
Included hardware: 2 flat head screws, 4 mm x 18 mm long, for panels up to 6 mm thick



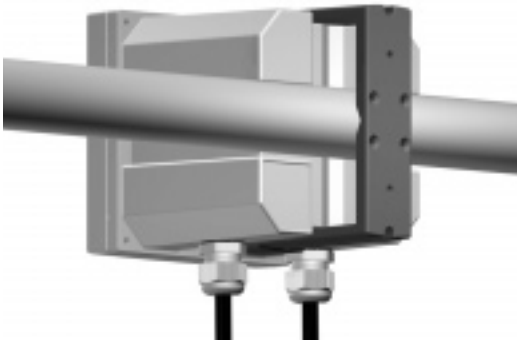
Wall mounting

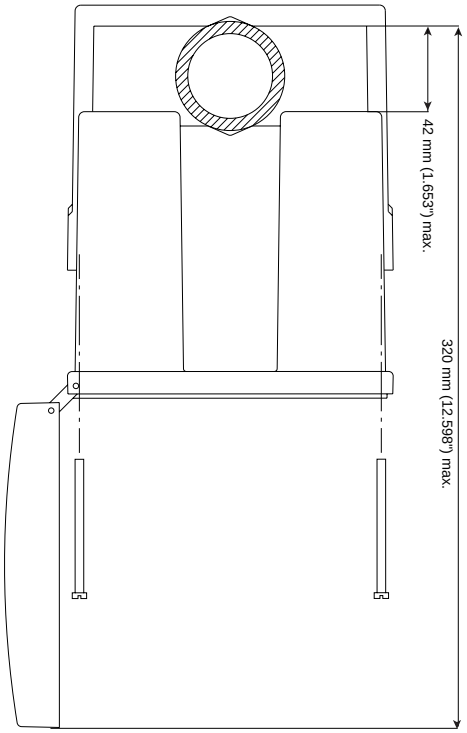
Included hardware: 2 pan head screws, 4 mm x 60 mm long for red clamping bow (a)
Additional required hardware: 2 flat head screws, 4 mm x 60 mm long (b)
Placed 3.15 " (80 mm) on center

Vertical pipe mounting
Included hardware: 2 pan head screws,
4 mm x 60 mm long for red clamping bow



Horizontal pipe mounting
Included hardware: 2 pan head screws,
4 mm x 60 mm long for red clamping bow





Chapter 3: Installation of the Instrument

3.1 Unpacking

The analyzer should be unpacked with great care. Watch for any loose accessories.

3.2 Inspection

The analyzer has been factory checked and tested prior to shipment. It is advisable, however, to inspect all parts immediately upon receipt for any damage which may have occurred during shipping. A damaged shipping container may indicate internal damage, which may not be immediately obvious. If there is any evidence of damage, keep the shipping container and refer to your local agent or to:

Broadley Technologies Corporation
19 Thomas, Irvine, CA 92618 USA
949-452-1112
Toll Free in the US and Canada 877-246-7900

3.3 Mounting

CAUTION!
Mounting should be done by qualified service personnel only. No power should be applied until the installation is complete.

3.4 Location

The analyzer should be located in an accessible site. The site should permit access for any inspection or maintenance operation.

3.5 Power Connection

For safety reasons, it is required to observe the precautions below:

1. The instrument should be connected to the power supply by means of a breaker located close to the instrument and clearly identified.

2. This breaker should switch off phase and neutral in case of electrical problems or to service the instrument. However, the earth ground must always be connected.

3.6 Starting the Transmitter

Before switching on the transmitter, make sure the site voltage corresponds to the instrument voltage indicated on the identification plate.

3.7 Adjusting the Display Contrast

If the display contrast is not sufficient, adjust the potentiometer P1 (blue color, see figure on page 3-2), which is located on the top left of the CPU board (after opening the enclosure).

Before servicing the instrument, confirm the power supply is "off".

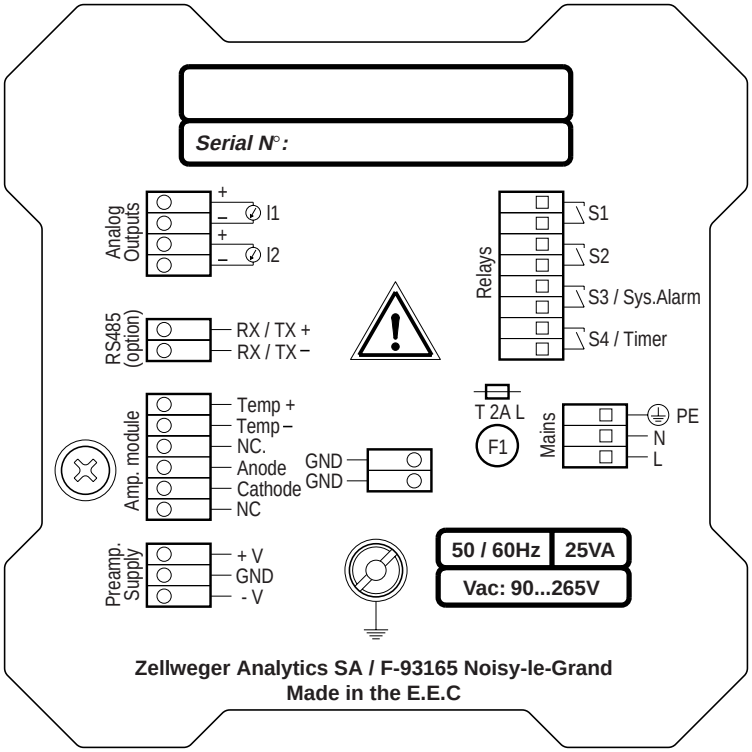
3.8 Electrical Connections

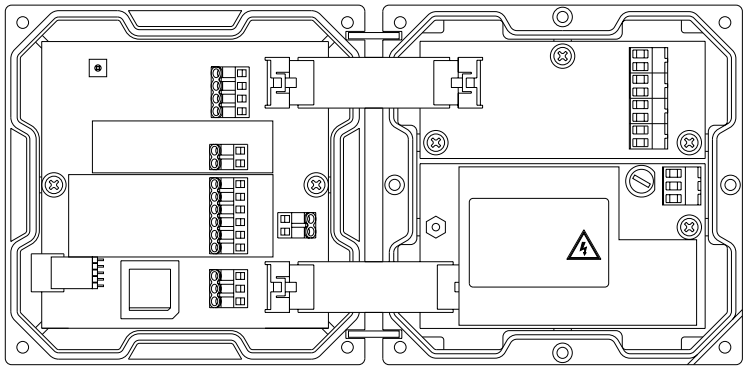
■ Model 14

Do not switch the instrument on until completion of the installation.

An aluminum armor plate inside the Model 14 gives a detailed description of the different terminals and their connections:

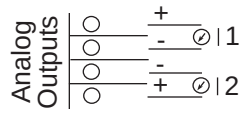
⇨ *The Relays and Main Power Supply terminals represented on the right side are accessible by removing the armor plate.*



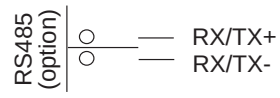


3.9 Terminal Descriptions

0/4 - 20 mA outputs galvanic insulation

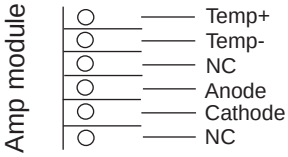


DESCRIPTION	CONNECTION
0 - 20 mA or 4 - 20 mA (n°1) [+]	user
0 - 20 mA or 4 - 20 mA (n°1) [-]	user
0 - 20 mA or 4 - 20 mA (n°2) [-]	user
0 - 20 mA or 4 - 20 mA (n°2) [+]	user

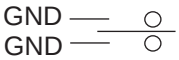


RS485 Option	user
	user

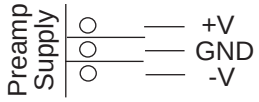
amperometric module



DESCRIPTION	COLOR	CONNECTION
Temperature sensor [+]	black	temp +
Temperature sensor [-]	blue	temp -
Reference if using 3 electrodes	not used on the Model 14 oxygen analyzer	
Anode	red	Anode
Cathode	white	Cathode
Auxiliary		N.C.
External shield	braid	armor plate

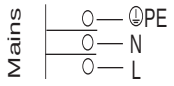


Internal shield	brown	GND

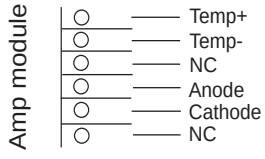


Not used for the oxygen measurement	N.C.

Behind aluminum plate



Main power supply, 90...265 VAC 50/60 Hz or 24 V AC/DC (special version)	Ground

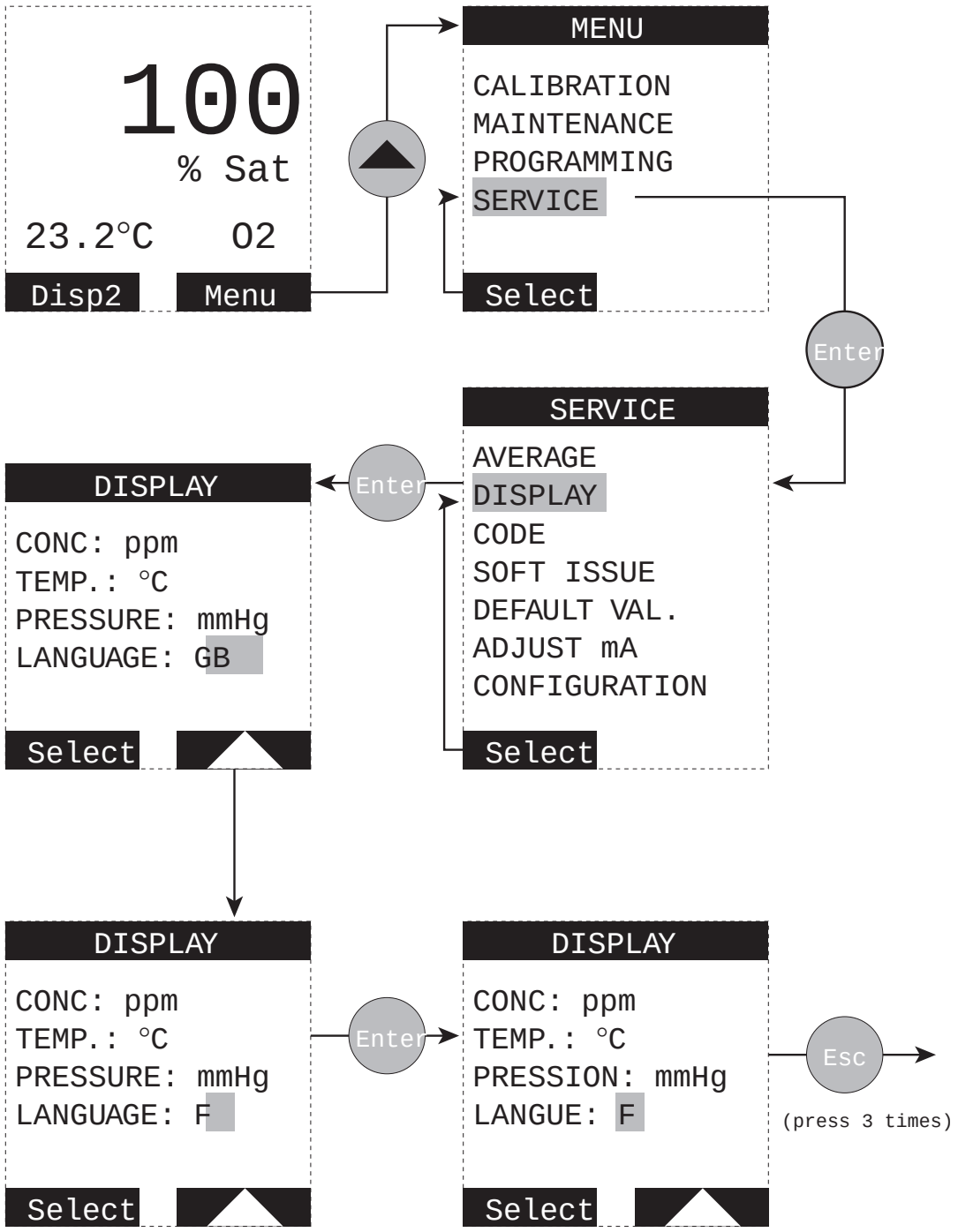


DESCRIPTION	CONNECTION
Alarm 1, simple contact	user
Alarm 2, simple contact	user
Alarm 3 or alarm system, simple contact	user
Alarm 4 or timer, simple contact	user

⇨ Electrical connections should remain dry to ensure proper operation of the instrument. Check the creeping of the cables when opening the transmitter.
⇨ Shielded cables are recommended. This shielding should be connected to the earth central shielding.

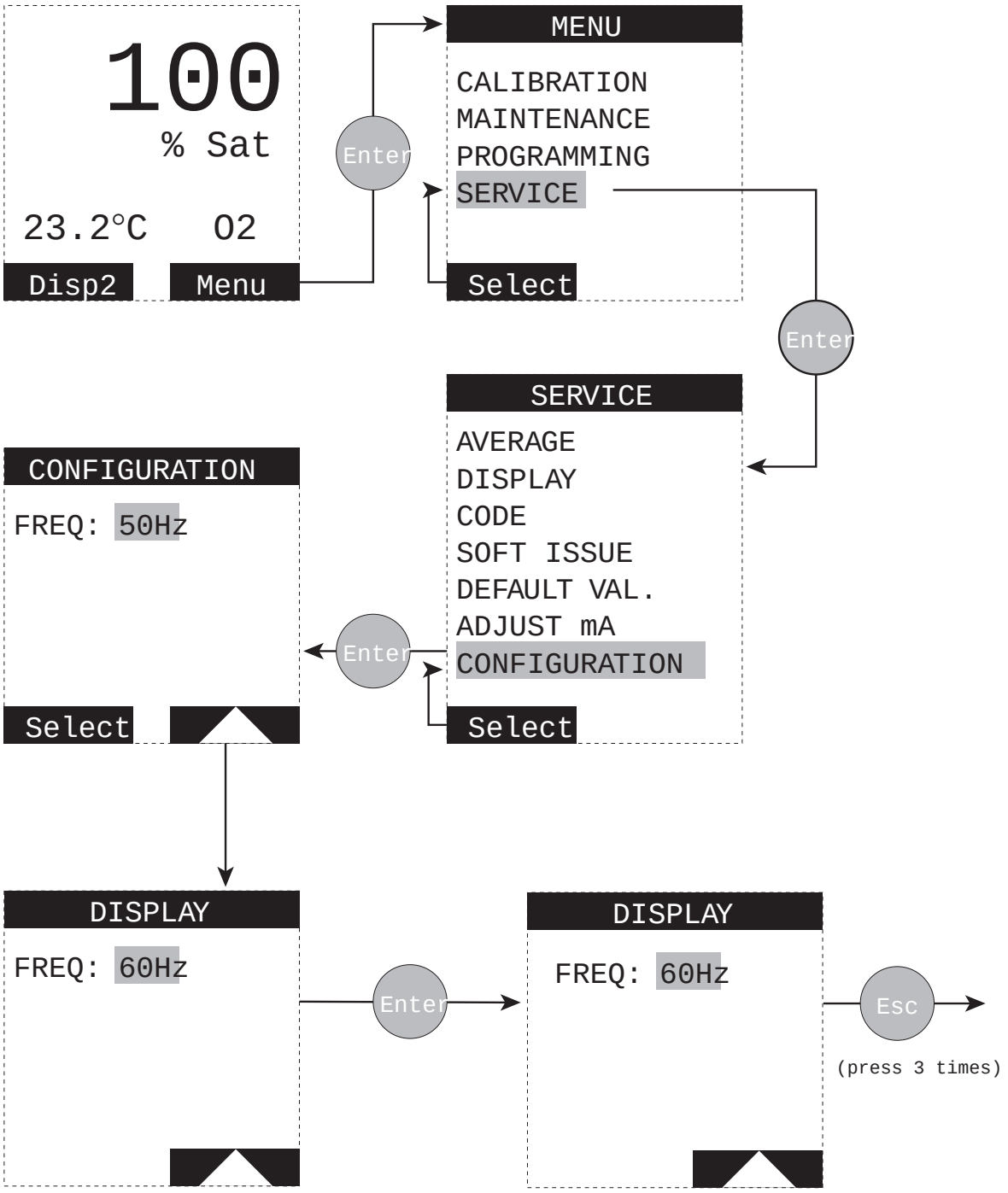
3.10 Changing the Programming Language

The default programming language is English. To change the language, follow the procedure below (example for French):



3.11 Programming the Power Supply Frequency

The power supply frequency can be changed if necessary. This change occurs at the initial start-up and after resetting the instrument. Follow the procedure below.



Chapter 4: Using the Instrument

4.1 Front Panel Keys

The display may be programmed to indicate :

- Sample concentration
- Sample temperature
- Diffusion current
- Programming codes
- Programming features

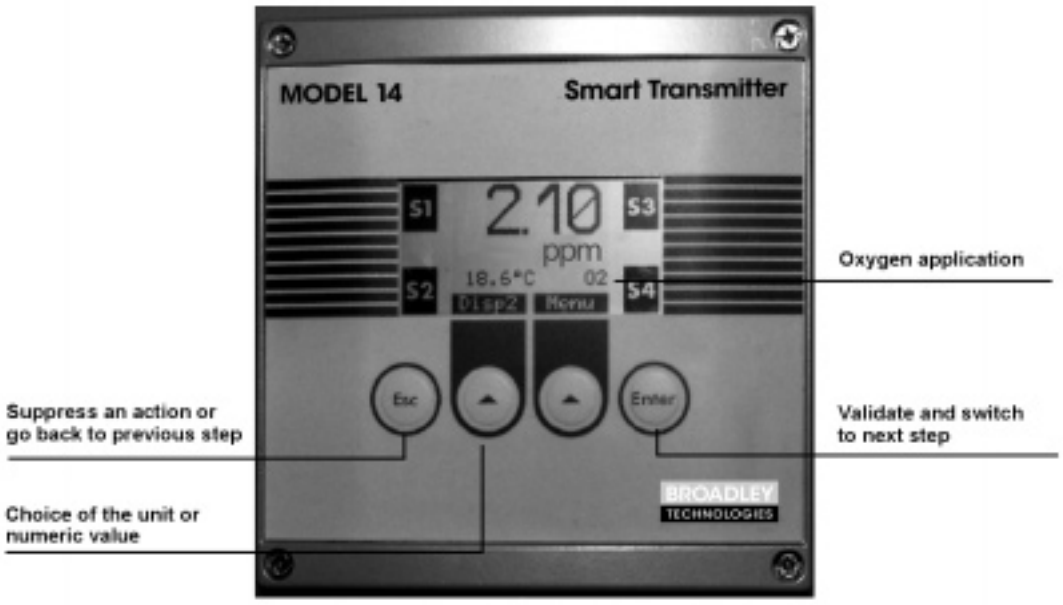
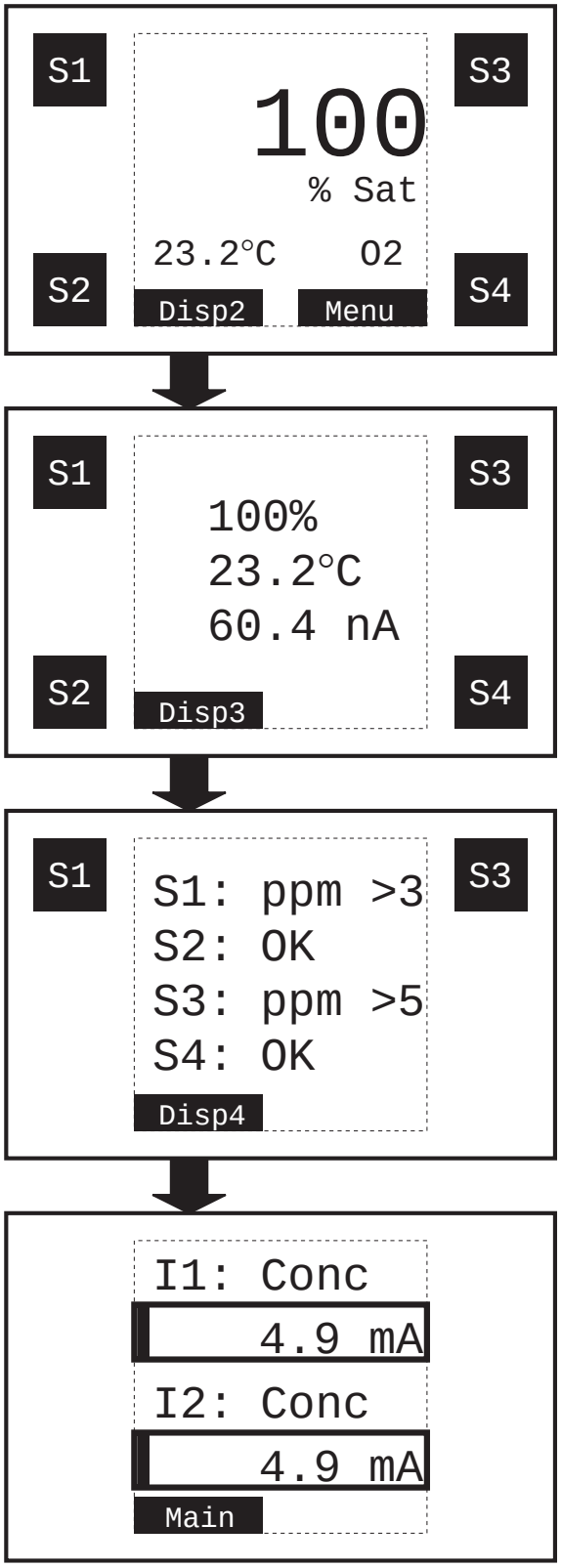


Figure 4-1 : Front Panel

4.2 Displays 1 to 4 (live displays)



100% : Dissolved Oxygen measurement

23.2°C : Temperature measurement
O2 : Application
S1...S4 : Alarm status
(invisible if alarm is inactive)

Display of the parameters measured :
% Saturation
Temperature
Cell current

S1...S4 : alarm status
In this case relays S1 and S3 are active

Analog output allocation and level
Numeric and bargraph indication

4.3 Description of the Function Keys

The function keys below will be highlighted at the bottom of the screen :

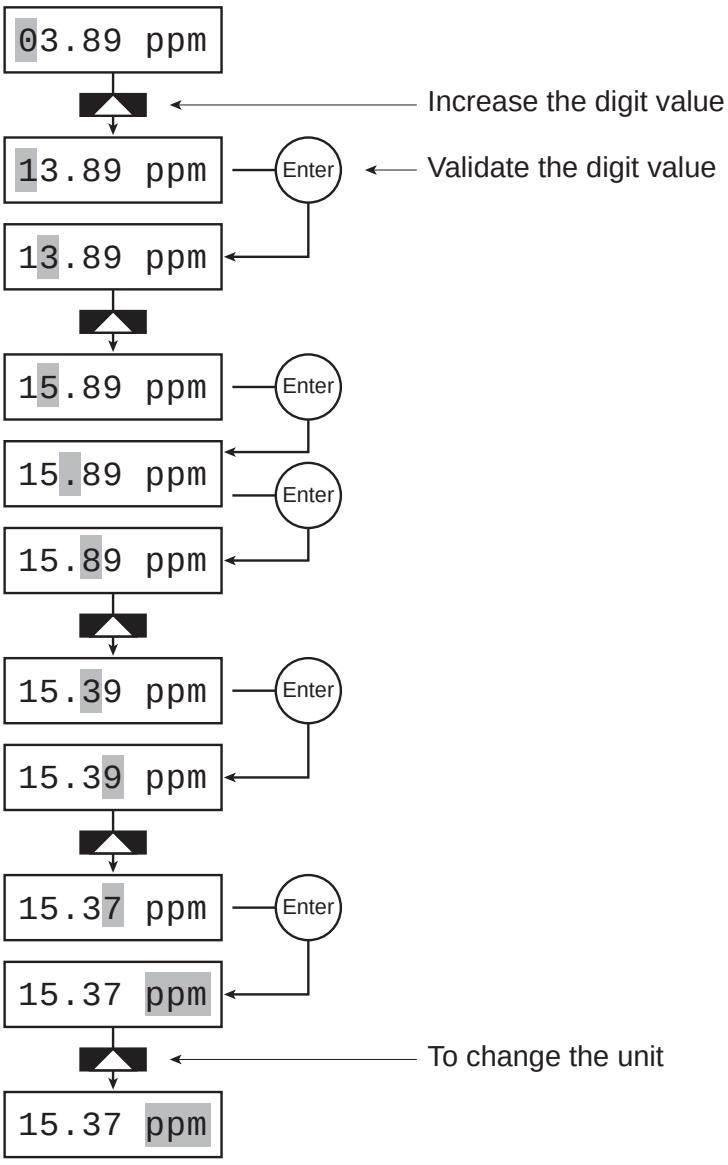
	Modify a parameter
Select	Scrolling in a list of menus
Main	Return to the main display
Menu	Display the main menu
Disp2	Display screen 2
Disp3	Display screen 3
Disp4	Display screen 4
OK	Validate the measure during calibration
Yes	Confirm a command
-	Decrease a value
+	Increase a value

4.4 Icons

	Wait for instrument to reset
	Alarm system for relay S3
	Timer symbol : countdown for relay S4
P	Controller symbol

4.5 Enter or Modify a Value

The highlighted digit can be modified with the key ▲.
Each digit can be validated by pressing ENTER. Repeat both operations for each digit.



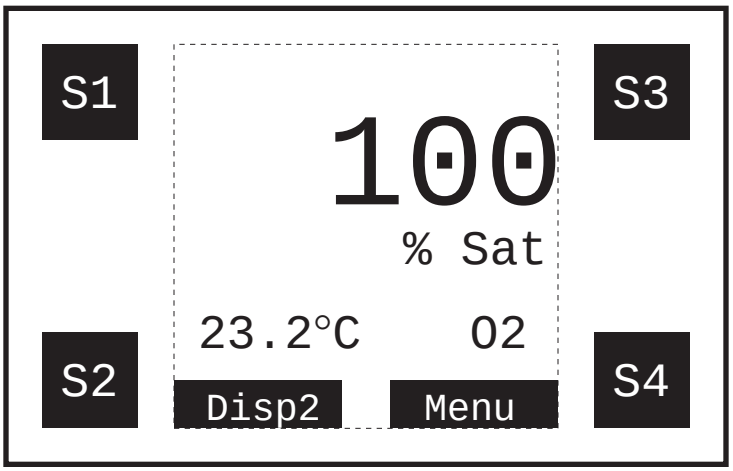
WARNINGS!

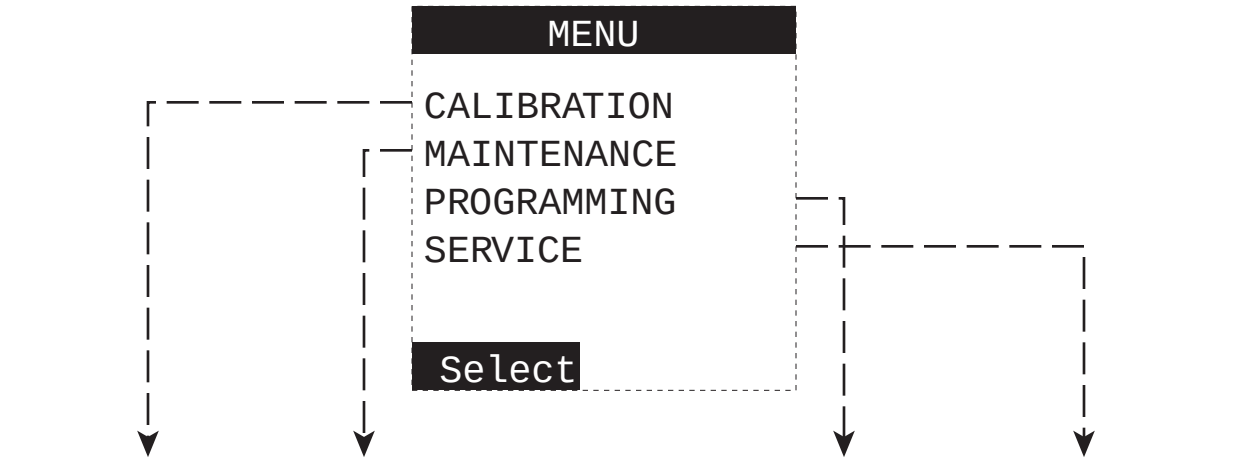
Note 1 : If you do not use the keyboard for at least 10 minutes, the instrument returns to the measuring mode.
Note 2 : An access code may be required for the CALIBRATION, PROGRAMMING or SERVICE menus (see CODE menu).

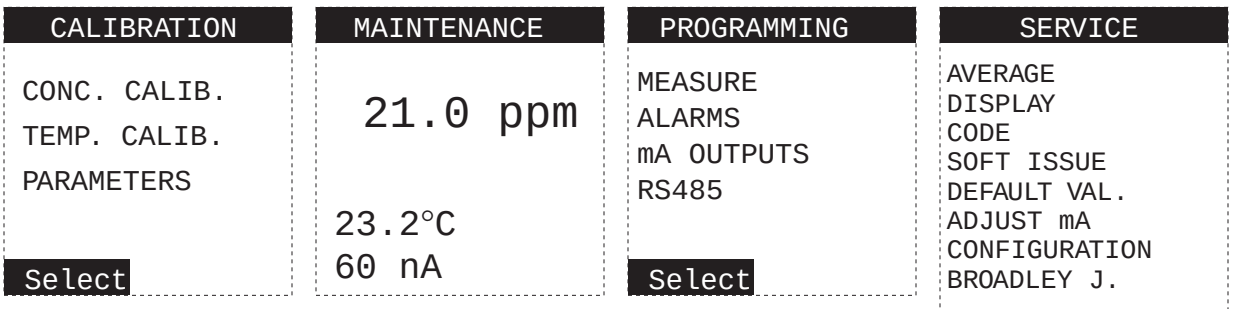
It is possible to display a negative first digit "-"
It is possible to display a "." for the other digits.

Chapter 5: Programming the Transmitter

5.1 Main Menu







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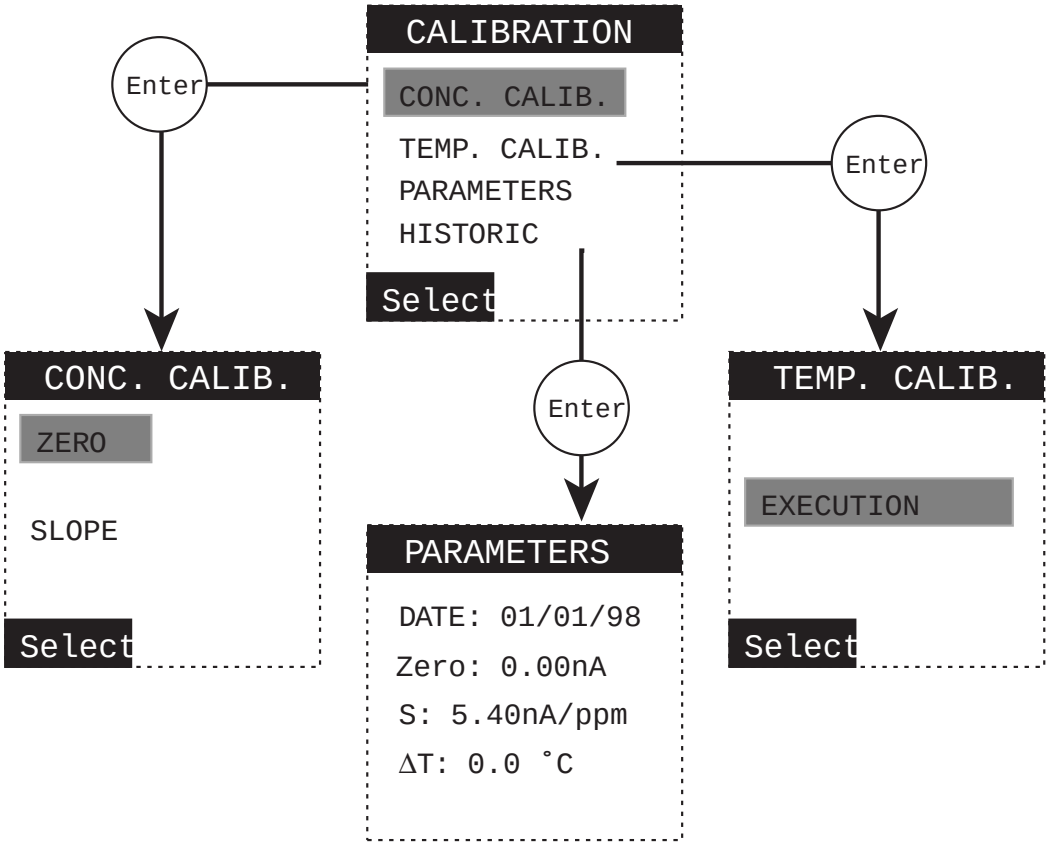
5.1.1 CALIBRATION Menus

⇨ Any calibration should follow the procedure below:
1. Configure the calibration characteristics in the "PROGRAMMING" menu.
2. Perform the calibration via the "EXECUTION" menu.

An access code may be required if one has been programmed, see page 5-14 for CODE Menu.
The Temp. Calib. menu will not appear when instrument is set for manual temperature compensation.



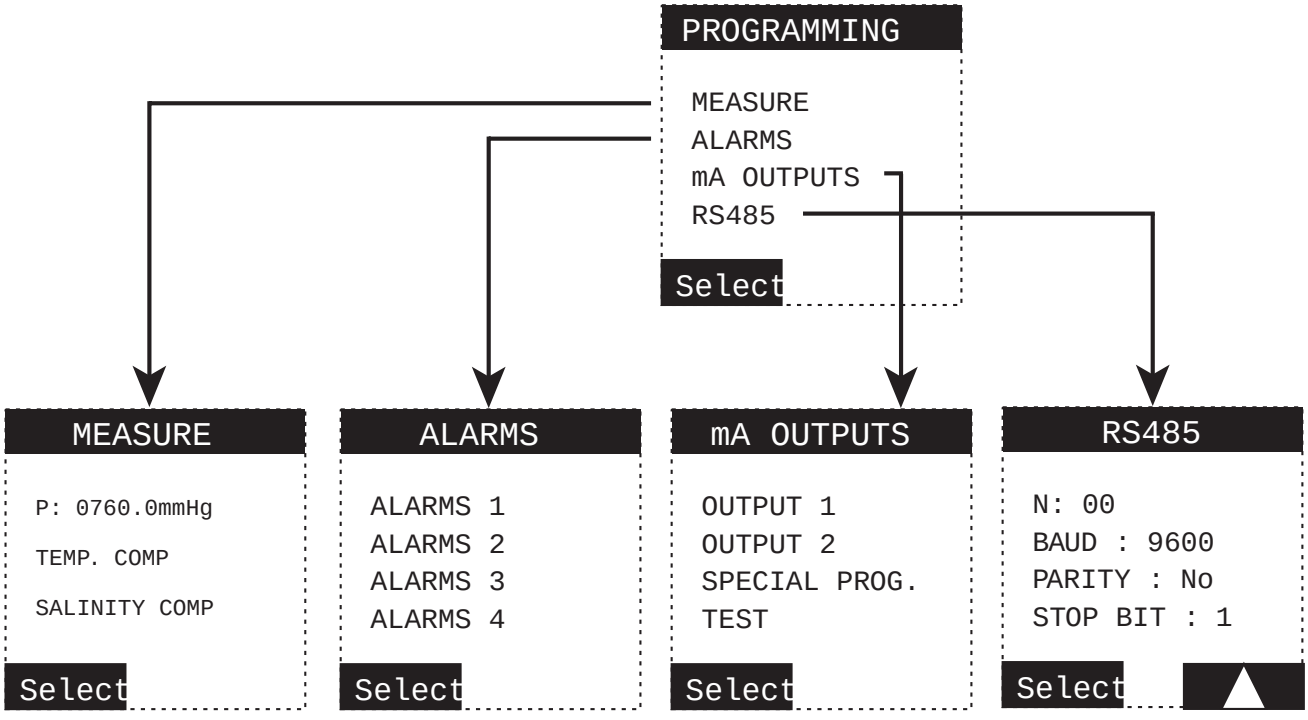
Parameters		
DATE	mm/dd/yy	Date of the last calibration. The date programmed is not updated automatically.
S	x.xxx nA/ppm	Slope value
ΔT	x.x°C	Drift between the theoretical temperature (sensor curve) T_h and the temperature measured T_m :DT = T_h - T_m

5.1.2 MAINTENANCE Menu

MAINTENANCE 21.0 ppm 21.6°C 60.5 nA	Used for any maintenance operation in the instrument; the transmitter continues to display the variables measured. The relay status is not modified. The analog output value depends on the configuration in the mA OUTPUTS/SPECIAL PROG. /MAINTENANCE menu.

5.1.3 PROGRAMMING Menu

An access code may be required.
See page 5-14 for CODE menu.



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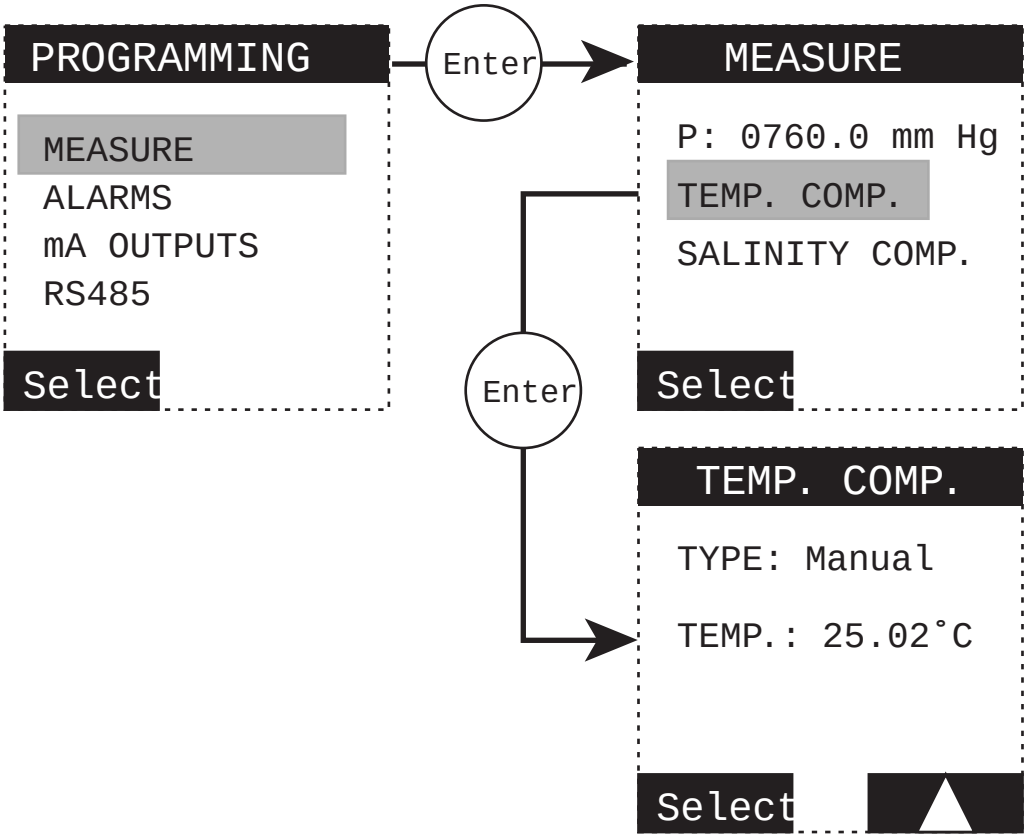
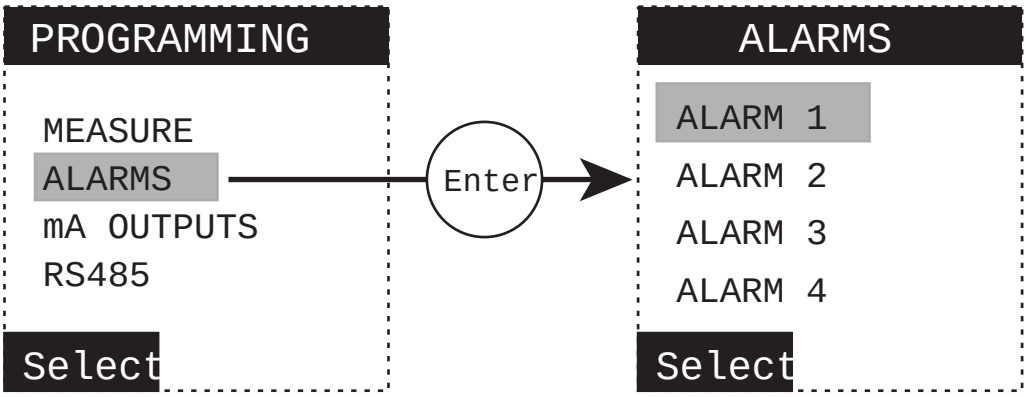
5.1.3.1 MEASURE Menu



Temperature Compensation		
TYPE	- Auto - Manual	Choice of a temperature measurement with automatic compensation or manual compensation ⚠ ***When manual temperature compensation is selected, the TEMP.CALIB. menu is no longer accessible!***
TEMP.	- XX.X°C	In the case of manual compensation, enter the sample temperature

5.1.3.2 ALARMS Menu

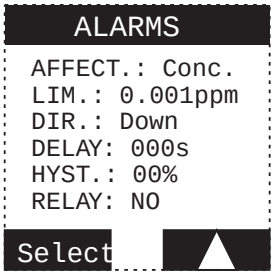
Relays S1 through S4 may be allocated to the limit, alarm system or timer functions.



⇨ LIMIT FUNCTION:

The alarm relays are activated when the comparison between the measured value and the programmed limits meets the alarm function condition (up or down). The limits are programmed according to the following programming variables:

Limit Alarm Function



AFFECT	-Conc. - No -°C/°F	Programmed for a concentration or temperature limit or not active.
LIM DIR.	XXXX -Up -Down	Enter a limit value Choice of the direction
DELAY	XXXs	Time before the relay is executed (in seconds)
HYST.	XX%	Definition of the hysteresis limit in % (10% max.). The hysteresis operates on only one side of the limit. The hysteresis is below the limit for the high alarm (up) and above the limit for the low alarm (down).
RELAY	-NO -NC	Relay normally open or normally closed

⇨ SYSTEM ALARM FUNCTION:

Relays S3 and S4 may be used as a fault indicater. To control the faults traced by the analyzer, connect the specific relay to an external alarm system. The relay is activated as soon as a default appears.

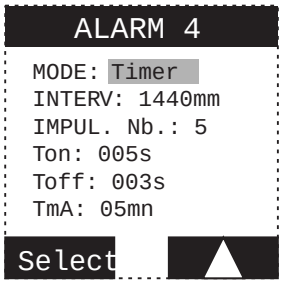
In the case of a manual acknowledgment, the relay remains activated even if the default disappears. Press ENTER to deactivate the relay and the error message. In the case of an automatic acknowledgment, the relay and the error message are deactivated when the default disappears.

System Alarm			
ALARM 3 MODE: System ACCEPT.: Auto RELAY: NC Select ▲	MODE	-No -Limit -System	The alarm S3 may be programmed to be a limit function (see paragraph above) or an alarm system function
	ACCEPT	-Auto -Manu.	In the case of an alarm system, choose between a manual (key ENTER) or an automatic acknowledgment
	RELAY	-NO -NC	Alarm S3 can be normally open or normally closed

⇨ TIMER FUNCTION:

Relays S3 and S4 may be programmed to a timer function.

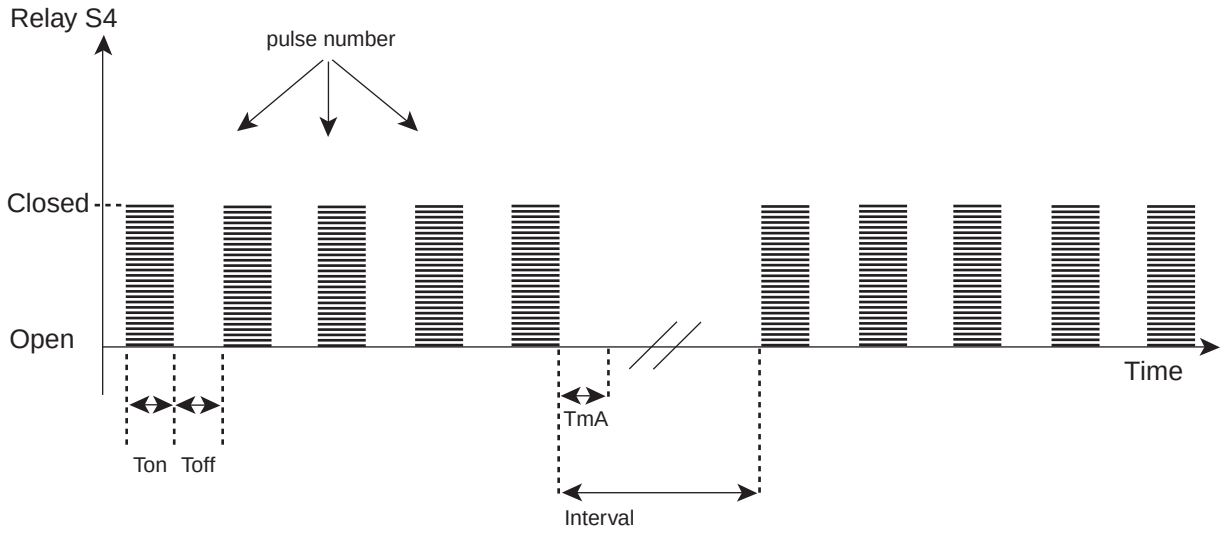
Timer Function



MODE	-No -Limit -Timer	The Alarm 4 may be a limit (see parameters above) or a timer function
INTERV	XXXXmn	Interval between 2 active cycles (in minutes)
IMPUL.Nb:	X	Number of pulses during an active cycle
Ton	XXXs	Adjustment of the relay active time (in seconds) for each pulse
Toff	XXXs	Adjustment of the relay inactive time (in seconds) for each pulse
TmA	XXmn	Hold time for the analog outputs after each cycle ⇨ *The analog output status depends on the configuration of the menu mA OUTPUTS/ SPECIAL PROG./TIMER*

The measurement cycle lasts 4 seconds.

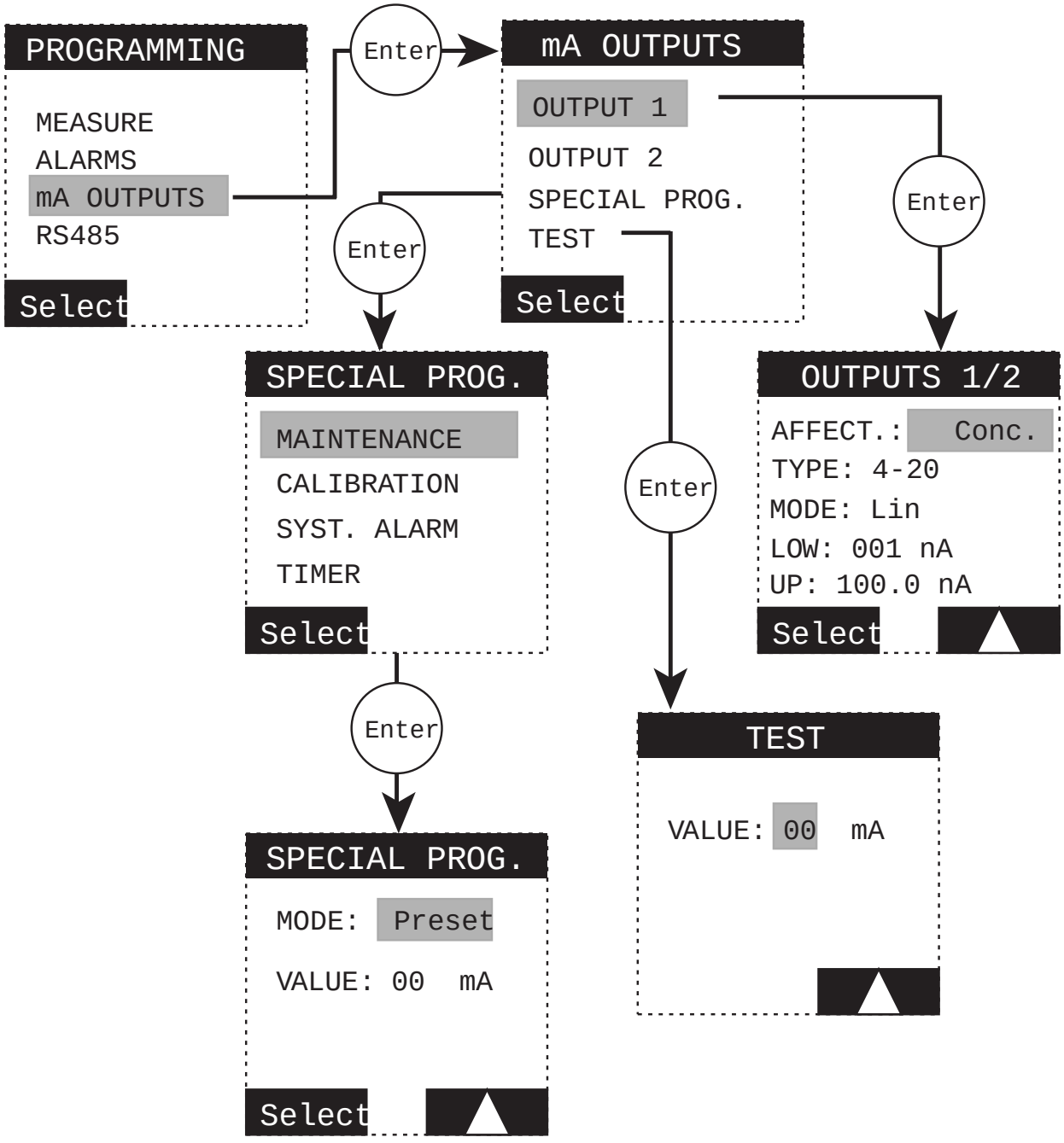
Example of a timer operating cycle :



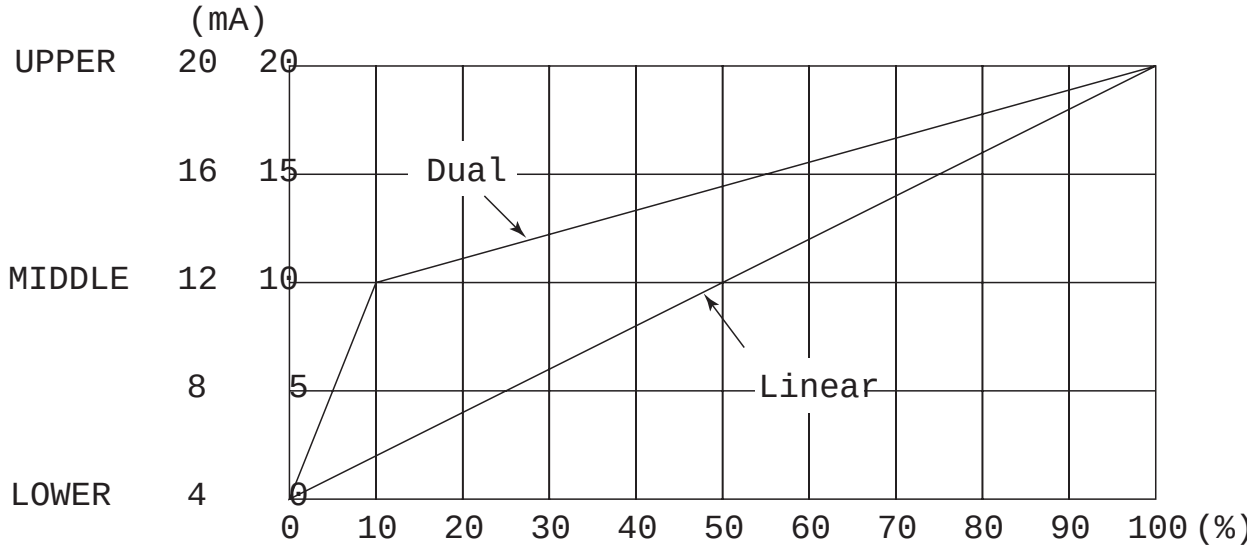
5.1.3.3 mA OUTPUTS Menu

The analog output signals allow the transmission of the measurements from the analyzer to any external control system.

It is highly recommended to use shielded cables for the output signals. This shielding should be connected to the earth terminal on the armor plate.

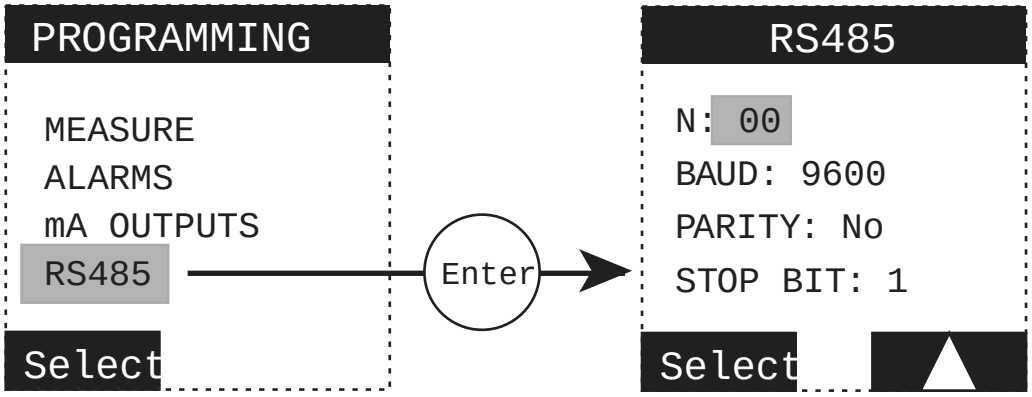


Output 1/2		
AFFECT	- Conc. - nA - °C/°F	To set the choice of analog output to the concentration or temperature measurement
TYPE	- 0/20 - 4/20	Choice of the analog output type
MODE	- Lin - Dual	Choice between a linear or dual range (see drawing below)
LOWER	XXXX	Bottom scale value
MIDD.	XXXX	Mid-scale value (only in ***dual mode***)
UPPER	XXXX	Top of the scale value
Special Prog.		
MODE	- last - preset - live	Characteristics of the analog output during calibration, alarm system, maintenance or timer active cycles. Display and output will be last stored value, a preset value, or a live measurement
VALUE	XX	Preset value (0 to 21 mA)
Test		Test the analog outputs in 1 mA increments (0 to 21 mA)



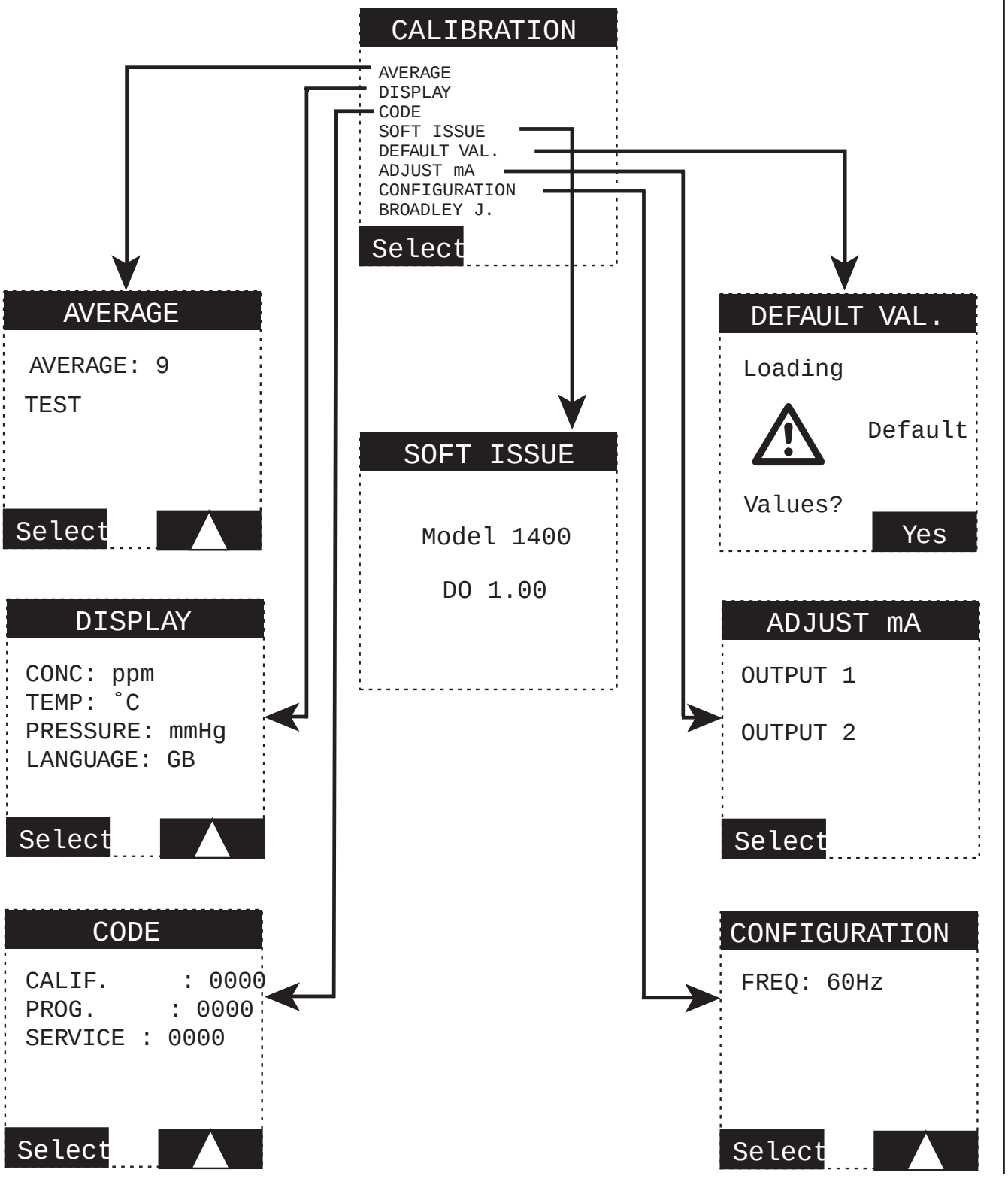
5.1.3.4 RS485 Menu (optional)

If the RS485 optional board is installed, program the parameters of the menu below.
The optional RS485 board enables a connection between the analyzer and a digital communication system. The communication protocol is JBUS/MODBUS. Call Broadley Technologies for more information.



RS485		
N°	XX	Enter number (0 – 32)
BAUD	- 300 - 600 - 1200 - 2400 - 4800 - 9600	Transmission speed in baud
PARITY	- No - Odd - Even	Without parity bit With odd parity bit With even parity bit
BIT STOP	- 1 - 2	1 bit stop 2 bit stop

5.1.4 SERVICE Menu

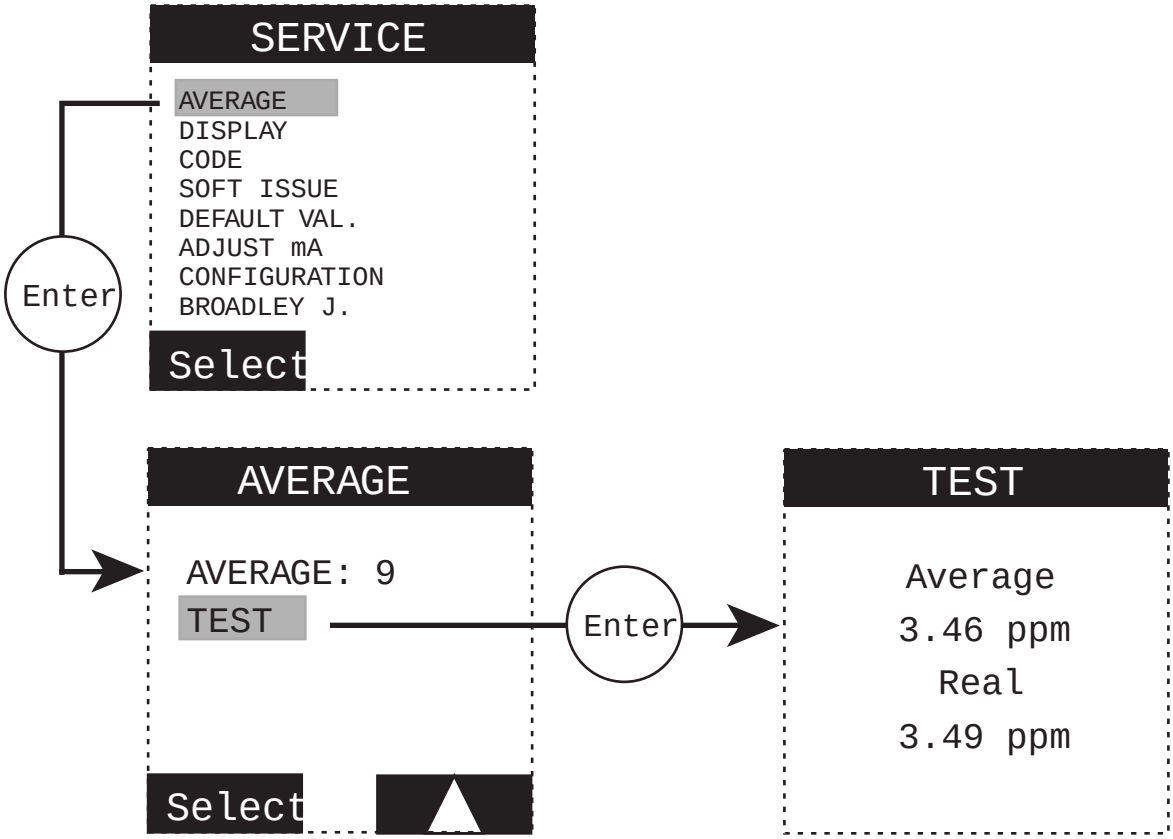


5.1.4.1 AVERAGE Menu

An access code may be required.
See page 5-14 for CODE menu.

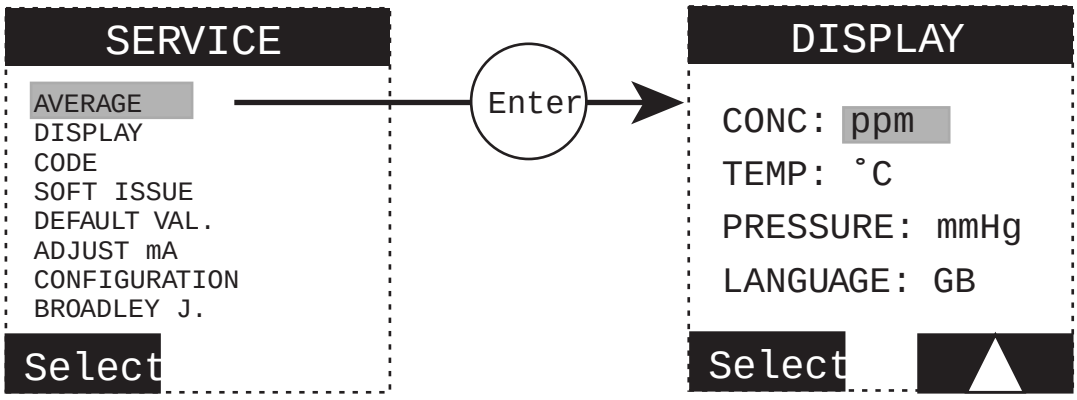
Program a moving average on the concentration measurement.

The measurement cycle lasts 4 seconds.



Average		
AVERAGE	X	Define the number of measurements to calculate the average (1-10)
Test		Display the difference between a measurement obtained with and without averaging

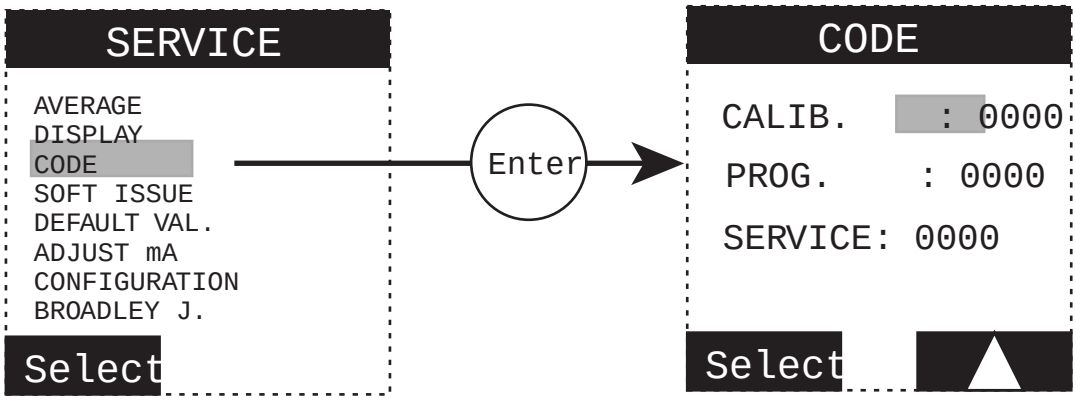
5.1.4.2 DISPLAY Menu



Display		
CONC	- % sat - ppm - mg/l	Choice of measurement units
TEMP.	- °C - °F	Choice of temperature units
PRESSURE	- mmHg - mbar - inHg	Choice of atmospheric pressure units
LANGUAGE	 - F - GB - D - Sp - I	Choice of languages : - French - English - German - Spanish - Italian

5.1.4.3 CODE Menu

Protection codes may be programmed for access to the PROGRAMMING, CALIBRATION, and SERVICE menus. This code is deactivated by entering 0000.

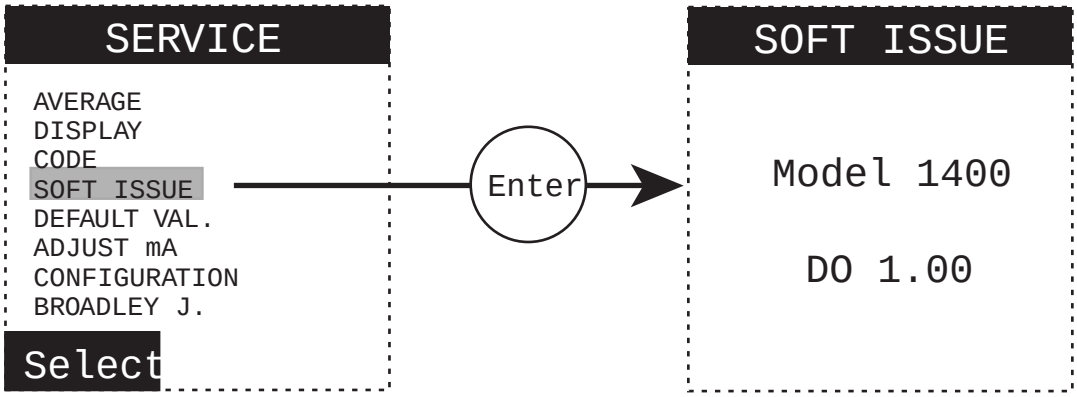


Code		
CALIB.	XXXX	Access code to the "CALIBRATION " menu
PROG.	XXXX	Access code to the "PROGRAMMING" menu
SERVICE	XXXX	Access code to the "SERVICE" menu

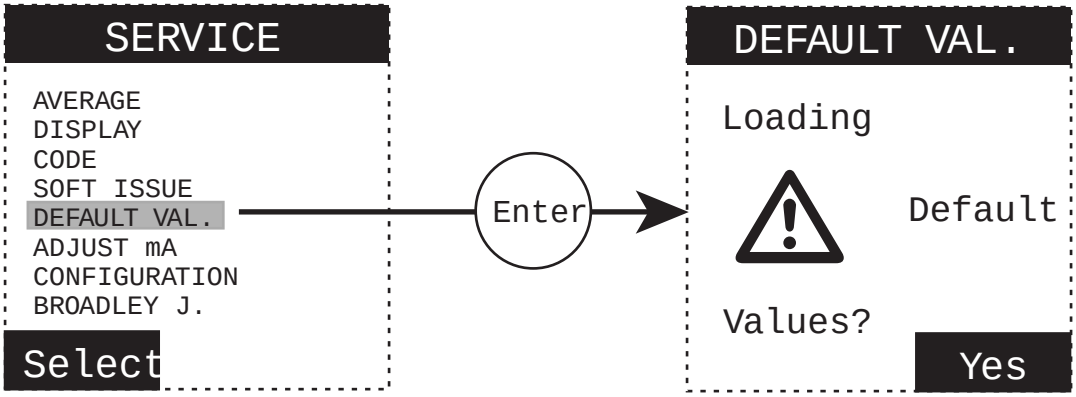
To override the access code, press ESC and ENTER simultaneously to enter the menu selected.

5.1.4.4 SOFT ISSUE Menu

This menu displays the software version installed in the instrument.



5.1.4.5 DEFAULT Menu

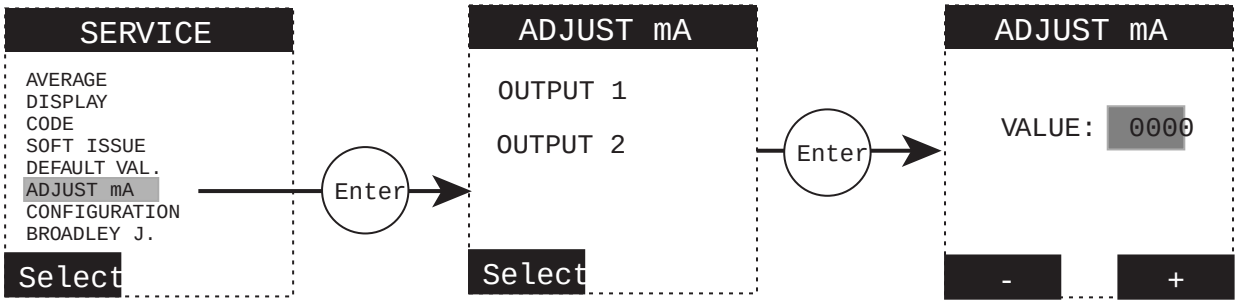


Pressing YES will load the default values. The current programmed values, historic values and calibration parameters will be lost.

5.1.4.6 mA ADJUST Menu

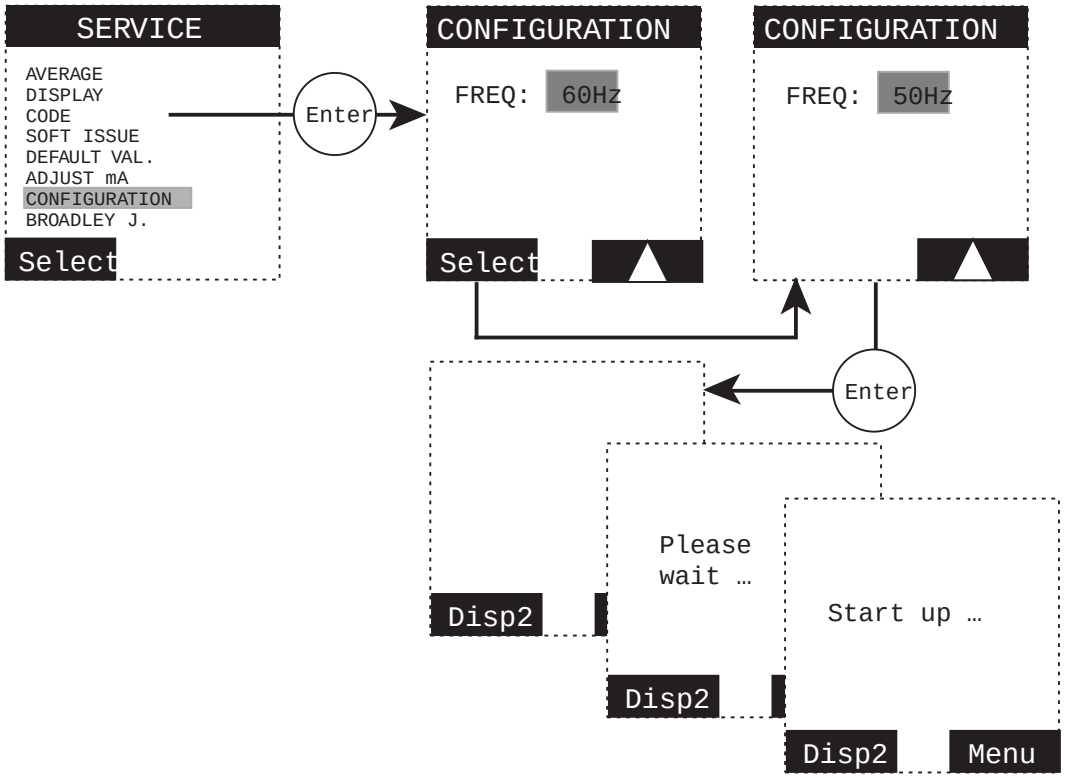
The analog output signals are factory-adjusted (upper limit: 20mA). However, if the upper limit of one of the outputs, drifts, the span value can be adjusted with the mA ADJUST menu. Connect an ampere meter in series to the analog output terminals. Adjust the value until the ampere meter displays 20mA.

Note: The value displayed does not correspond to an actual mA value.



5.1.4.7 CONFIGURATION Menu

The operating frequency must be programmed to match the power supply. When the frequency is changed, the instrument is automatically reset.



Chapter 6: Calibrating the Instrument

NOTE
See Chapter 5 for programming commands.

REMARK
Any result (calibration or measurement) is always brought back to the reference temperature (25˚C, 77˚F). If the sample temperature is different from the reference temperature, manual or automatic temperature compensation must be used.

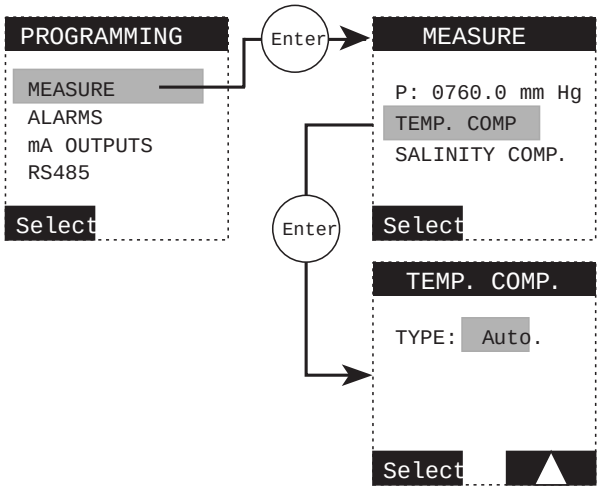
6.1. Calibrating the Temperature Sensor

The temperature sensor is located in the dissolved oxygen measurement probe. It is pre-set by the factory, but needs to be calibrated in the sample, on-site. The temperature sensor must be calibrated before calibrating the sensor's slope and zero.

6.1.1. Automatic Temperature Compensation

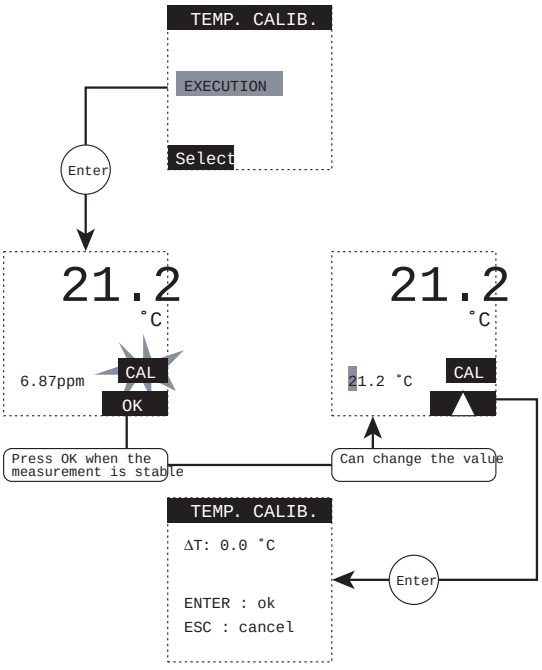
The sensor continuously measures the sample temperature. The concentration values are automatically calculated using the algorithms programmed in the transmitter.

1. Programming



Choose **automatic** temperature compensation.

2. Execution

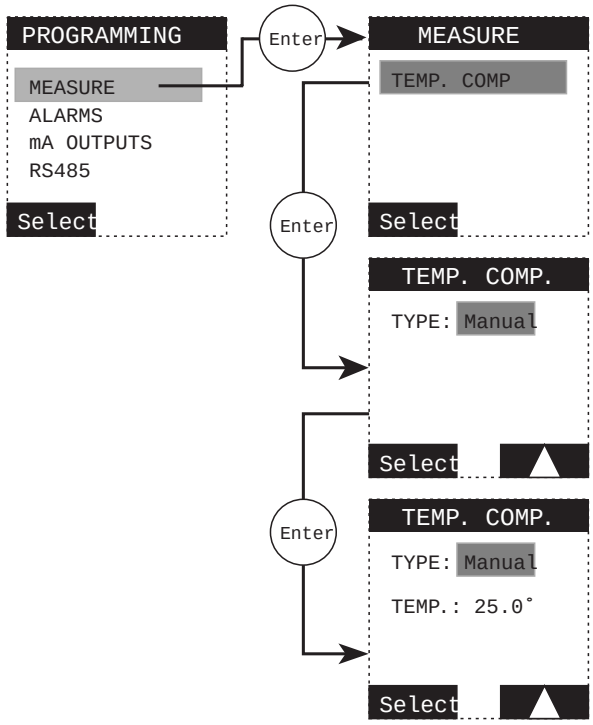


The execution is begun in the CALIBRATION menu.

Enter the sample temperature value in °C. Press OK to adjust the temperature displayed to the actual value of the sample temperature measured with a precise thermometer. The gap between the calibration and the theoretical response curve of the sensor is given for information.

6.1.2. Manual Temperature Compensation

Manual temperature compensation should be used only when the sample temperature is constant.

1. Programming	
	Select **manual** temperature compensation. Enter the sample temperature.
2. Execution	
	Not applicable when manual temperature compensation is selected.

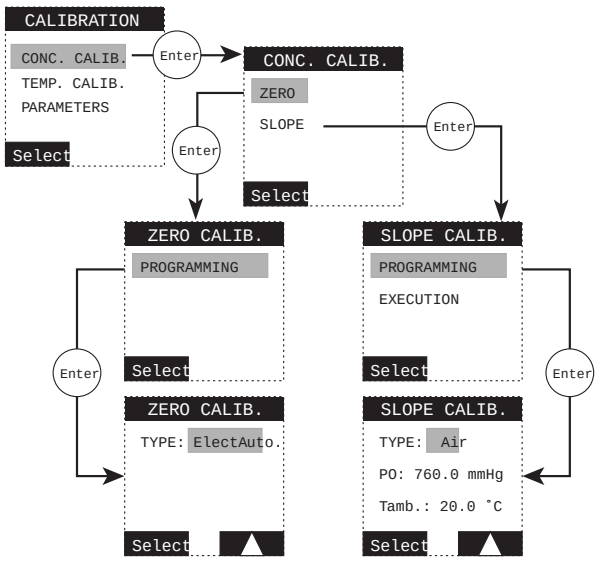
6.2. Measurement Calibration

The slope calibration can be done in air or water. The zero can be set with an electronic zero or a chemical zero. A chemical zero uses Nitrogen gas or oxygen-free solution.

6.2.1. Slope Calibration in Air with an Electronic Zero

Temperature compensation must be set to "auto."

1. Programming



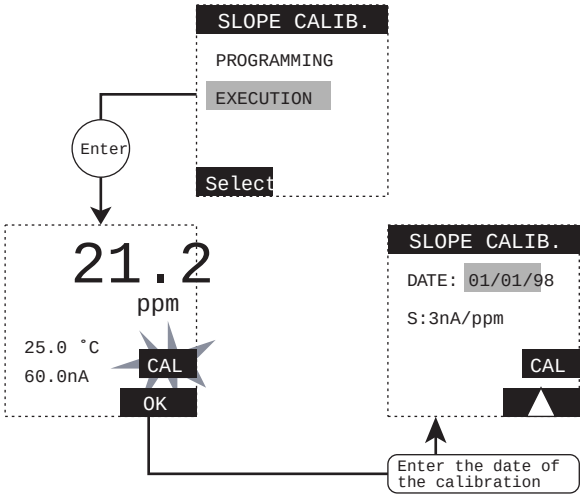
ZERO :
Select an electrical zero. The electrical zero is carried out automatically by the transmitter at regular intervals.

Select slope in air.

SLOPE :
Enter the atmospheric pressure in mmHg

Enter the ambient temperature in °C

2. Execution



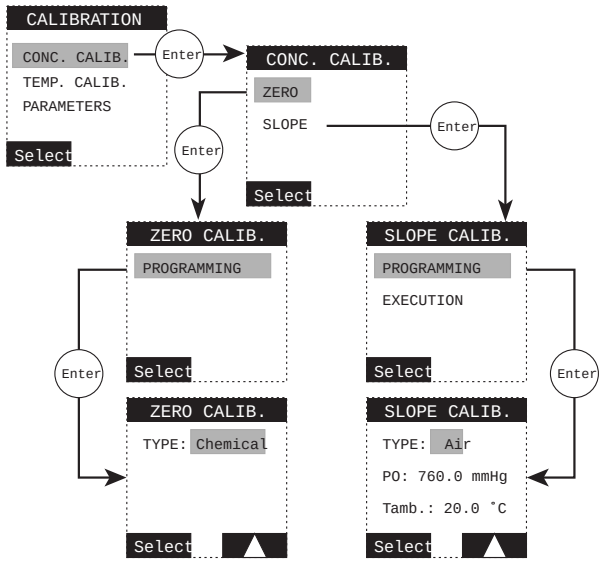
SLOPE : Remove the probe from the sample and press ENTER. The probe should be positioned with the membrane downward.

The flashing "CAL" message indicates that the instrument is in calibration mode. **Wait for the current to stabilize** (approximately 1-2 min.) and press OK to validate the calibration. The oxygen concentration value flashes for 3 seconds.

The analyzer displays the date of the last calibration and the new slope calculated. The date can be modify. Put the electrode back into service.

6.2.2. Slope Calibration in Air with a Chemical Zero

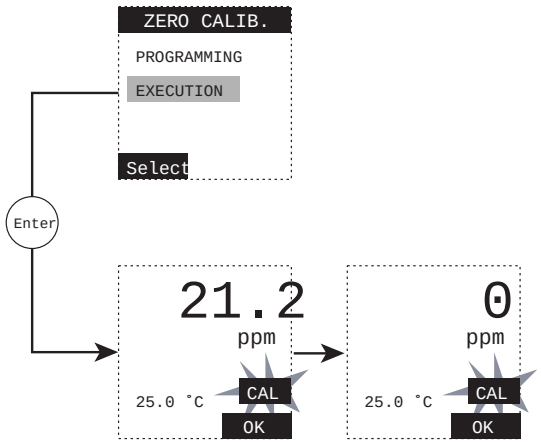
1. Programming



ZERO :
Select a chemical zero
Select slope in air

SLOPE :
Enter the atmospheric pressure in mmHg
Enter the value of the ambient temperature

2. Execution

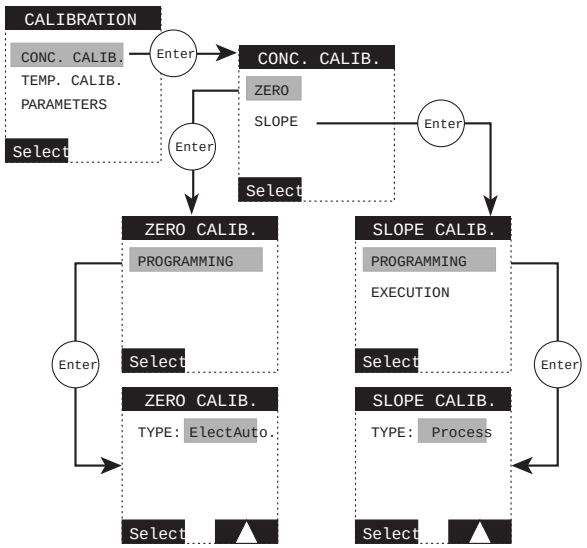


ZERO :
Place the sensor in 99.999% Nitrogen gas.

Press ENTER, the "CAL" message flashes and indicates the instrument is in calibration mode. **Wait for the current to stabilize** (approximately 1-2 min.) and press OK to validate the calibration. The oxygen concentration value flashes for 3 seconds. The instrument displays zero.

6.2.3. Slope Calibration in Process with an Electronic Zero

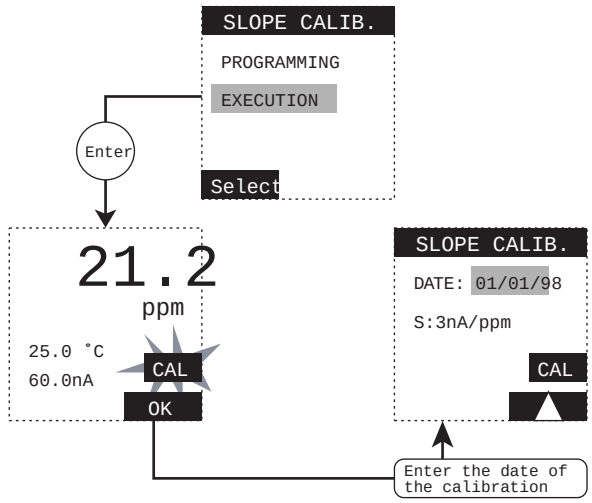
1. Programming



ZERO :
Select the electrical zero. The electrical zero is carried out automatically by the transmitter at a regular frequency.

Select process slope.

2. Execution

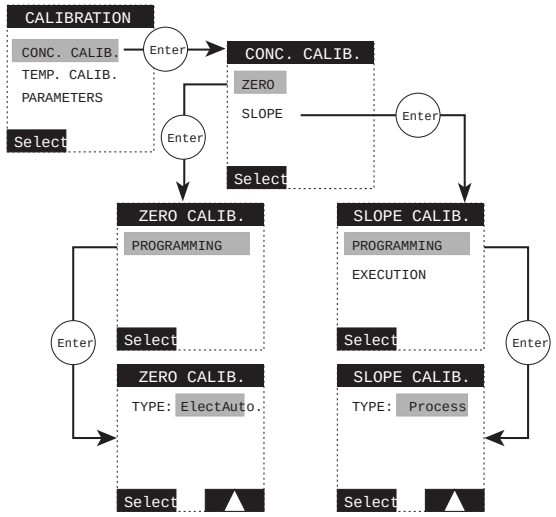


SLOPE :
The "CAL" message flashes and indicates the instrument is in calibration mode. **Wait for the current to stabilize** and press OK.
It is possible to adjust the concentration value digit by digit with the function key to the desired value.

The analyzer displays the date of the last calibration and the new slope calculated. This date can be modified.

6.2.4. Slope Calibration in Process with a Chemical Zero

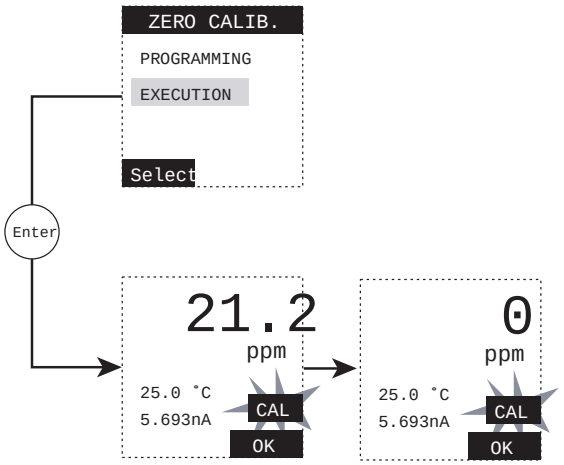
1. Programming



ZERO :
Select chemical zero.

Select slope process.

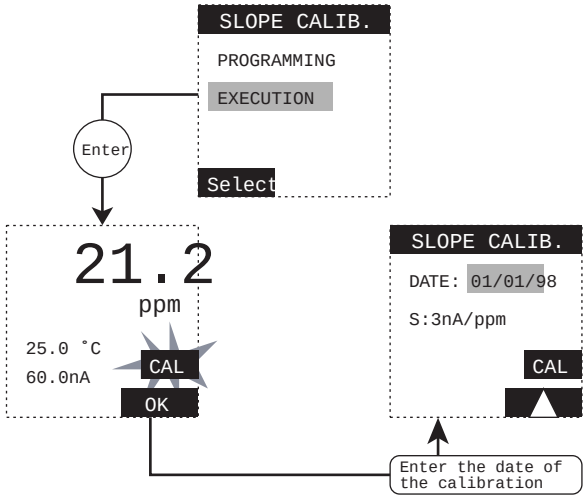
2. Execution



ZERO :
Place the sensor in 99.999% Nitrogen gas.

Press ENTER, the "CAL" message flashes and indicates the instrument is in calibration mode. **Wait for the current to stabilize** (approximately 10 min.) and press OK to validate the calibration. The oxygen concentration value flashes for 3 seconds.

The instrument will display zero.



SLOPE :
The flashing "CAL" message indicates that the instrument is in calibration mode. **Wait for the current to stabilize** (approximately 10 min.) and press OK to validate the calibration. The oxygen concentration value flashes for 3 seconds.

The analyzer displays the date of the last calibration and the new slope calculated. This date can be modified.

Chapter 7: Start-up and Troubleshooting

7.1 Start-up

7.1.1 Probe Connection

See page 3-3 for the terminal connection.

7.1.2 Main Power Supply Connection

Remove aluminum plate inside the Model 14. Power should be connected to the "Mains" terminal indicated on the plate. See Page 3-3 for terminal connections.

7.1.3 Starting the Analyzer

When switched on, the analyzer performs an automatic test of its electronics and displays a first value. Wait until the measurement has stabilized (max. 30 min). Do not calibrate the analyzer before the temperature and the concentration are stable. (See Chapter 6.)

Note 1: Never shake the probe during a calibration, it may provoke an introduction of oxygen in the electrolyte and temporarily increase the cell current.

7.2 Functional Troubleshooting

PROBLEM: Excessive time for stabilization or no stabilization during air calibration.

Causes and solutions:

A) There is an electrolyte leak (through the membrane). The current is too high because of an excessive penetration of oxygen.
⇨ **Change the membrane.**

B) The electrolyte is contaminated.
⇨ **Change the electrolyte.**

PROBLEM: No significant current increase when the probe is in the air during calibration

Causes and solutions:

A) The membrane has been torn.
⇨ **Change the membrane.**

B) Cable or connections have been damaged.
⇨ **Check the connection to the transmitter. If the connection is correct check the connections of the probe connector.**

PROBLEM: Significant instability in measuring mode

Causes and solutions:

A) There is humidity or water in the probe connector.
⇨ **Dry the connector. Check connections.**

B) Incorrect connection.
⇨ **Check the connections of the transmitter to the probe.**

C) Electromagnetic interferences close to the probe or transmitter cable.
⇨ **Find a better place for the cable and check the EMC level.**

PROBLEM: Inaccurate readings

Causes and solutions:

A) The membrane permeability has changed (coating).
⇨ **Calibrate the analyzer and check if the concentration is back to normal.**

B) Electrolyte contamination.
⇨ **Inspect probe components. Change the electrolyte.**

C) Leak of electrolyte.
⇨ **Inspect probe components. Change the electrolyte.**

D) Error during calibration or incorrect calibration.
⇨ **Calibrate again to check the parameters. If the error is confirmed, check the calibration current (too high, too low or unstable) and the concentration in the air. Refer to the problems described above.**

E) The temperature calibration has not been performed.
⇨ **Check the temperature given by the transmitter and calibrate it (see page 6-2). If manual compensation has been selected, confirm the value is correct.**

F) The sample temperature or pressure is out of the specifications.
⇨ **Change the probe location or modify the sample so that it meets the specifications.**

Other problems

Causes and solutions:

A) The probe current is zero.
⇨ **There is no electrolyte in the probe (leak). There may be a short-circuit in the connection.**

B) The probe current is negative.
⇨ **Connection problem to the anode circuit (loose contact).**
⇨ **Deposits on the anode.**

C) The sample temperature corresponds to the specifications, but there is an error on the temperature.
⇨ **There may be a short-circuit on the temperature connection.**

7.3 Troubleshooting the Electronics

WARNING!
Never attempt to service before disconnecting the instrument from the main power line.

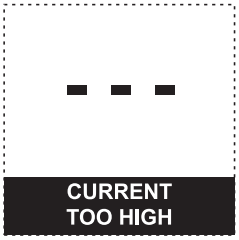
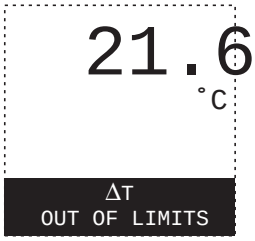
MALFUNCTION	POSSIBLE CAUSE	REMEDIES
No indication	No power; instrument is not connected correctly	Check for power, then check if connected properly
	Defective fuse	Check fuse
	Instrument's power supply set for wrong line voltage	Check jumpers on power supply board for correct voltage settings
	Ribbon cable connecting power with CPU board not properly plugged in	Verify that the ribbon plugs are connected properly
	Connection between CPU board and measurement module loose	Check plug connections
	Short circuit in power supply board	Visually check power supply board for shorts
	Hardware is defective	Call the Service Technician
LCD displays undefined characters	Malfunctioning CPU board or processor	Using the Instruction Manual, program the instrument to load the default values
	CPU hardware	RESET the instrument by temporarily interrupting the power (5-10 seconds)
		Call the Service Technician
Keyboard does not operate; all keys are inactive	CPU malfunctioning, external interferences	If there is no response, RESET the instrument by temporarily interrupting the power (5-10 seconds). Check each key again. If there is no change, call the Service Technician.
Measurement is not correct	Instrument was programmed incorrectly	Recheck programmed parameters. Do they agree with the probe's characteristics?
	System, including probe, not calibrated correctly	Calibrate the whole system (with probe connected)
	Probe connected wrong	Recheck all probe connections
	Probe malfunctioning, possibly incompatible with the application	Visually check the condition of the probe. Is the application within the probe's specifications?
	CPU board is defective	If error persists, call the Service Technician
Measurement is not stable	Faulty probe	Check the condition of the probe. Is it contaminated?
	Probe connected wrong	Verify the probe is connected properly

MALFUNCTION	POSSIBLE CAUSE	REMEDIES
	Interferences	Are there any sources of potential interference, chemical, external, temperature, pressure, etc.?
	Cable shield is not connected	Check and connect
	Defective CPU board	If problem persists, call the Service Technician
Temperature measurement is not correct	Probe connected wrong	Check probe connection
	Temperature not calibrated	Calibrate for temperature. Also check the T.C. for correct resistance (ohmmeter)
	CPU board is defective	If problem persists, call the Service Technician
Display reading static; cannot be changed in any way	CPU board is malfunctioning and/or some other transmitter hardware is defective	Check probe connection Initiate a software RESET If Steps 1-3 do not remedy the problem, make a cold start (RESET): interrupt the power for 5-10 seconds Reprogram the instrument If problem persists, call the Service Technician
Relays not energized	Instrument was programmed incorrectly	Check whether the correct relay parameters and set points have been programmed
	Hardware is defective	Check that the programmed set points are compatible with the programmed measuring range Check the relay characteristics for proper functioning using an ohmmeter If problem persists, contact the Service Technician
Wrong output current, output current remains locked at 0 or 20 mA	Instrument was incorrectly programmed	Check the programmed output-current parameters
	Connection of the Model 14 with peripherals (recorder, etc.) are faulty, loose or defective	Check the cables
	Hardware is defective	Compare the measured value with the output-current range If problem persists, call the Service Technician
Polarization voltage incorrect	Wrong configuration (3 electrode mode)	Check that the switches under the amperometric board are correctly positioned ("on")
Wrong programming	Check programmed parameters	

Chapter 8: Error Messages

During failure, the measurement is replaced by dashes " - - -."

Error Message	Description
Error messages during a measurement	
- - - CONCENTRATION TOO HIGH - - - STAND-BY 1.99 ppm	The concentration value exceeds the limits. Check the current value and the calibration parameters. ***Electrode protection*** If the measuring range displays "concentration too high" for more than 2 minutes, the error message "STAND-BY" appears. From this moment on, the electrode polarization voltage is switched off for 10 minutes before the voltage is switched on again. ***In STAND-BY the user may switch the voltage on at any time by pressing ENTER.***
- - - CONCENTRATION TOO LOW	The concentration value exceeds the limits. Check the current value and the calibration parameters.
- - - TEMPERATURE ERROR	The sample temperature exceeds the limits. Check the cable polarity. Check for a short-circuit or an open circuit.
- - - CURRENT TOO LOW	The current value exceeds the limits. Check the electrode (electrolyte and membrane).

	The current value exceeds the limits. Confirm there is no short-circuit in the measuring line. Check the polarization voltage.
Error messages during calibration	
	The temperature difference between the calibration temperature and the sensor's theoretical exceeds the limit programmed. Limits : ± 20°C

Appendix 1: Pressure Conversion Table

hPa or mbars	mm Hg	mm H_2O	psi	inches Hg	inches H_2O
920.00	690	9503.60	13.34	27.16	374.16
925.00	693.8	9555.25	13.42	27.31	376.19
930.00	697.5	9606.90	13.49	27.46	378.22
935.00	701.3	9658.55	13.56	27.61	380.26
940.00	705	9710.20	13.63	27.76	382.29
945.00	708.8	9761.85	13.71	27.90	384.32
950.00	712.5	9813.50	13.78	28.05	386.36
955.00	716.3	9865.15	13.85	28.20	388.39
960.00	720	9916.80	13.92	28.35	390.43
965.00	723.8	9968.45	14.00	28.50	392.46
970.00	727.5	10020.10	14.07	28.64	394.49
975.00	731.3	10071.75	11.14	28.79	396.53
980.00	735	10123.40	14.21	28.93	398.56
985.00	738.8	10175.05	14.29	29.08	400.59
990.00	742.5	10226.70	14.36	29.23	402.63
995.00	746.3	10278.35	14.43	29.38	404.66
1000.00	750	10330.00	14.50	29.53	406.69
1005.00	753.8	10381.65	14.58	29.68	408.73
1010.00	757.5	10433.30	14.65	29.82	410.76
1015.00	761.3	10484.95	14.72	29.97	412.79
1020.00	765	10536.60	14.79	30.12	414.83
1025.00	768.8	10588.25	14.87	30.27	416.86
1030.00	772.5	10639.90	14.94	30.42	418.89

Appendix 2: Temperature Conversion Table

- Conversion from ˚C into ˚F : ˚F = 1.8 * ˚C + 32
- Conversion from ˚C into ˚K : ˚K = ˚C + 273.15

˚C	˚F	˚K
0	32	273.15
1	33.8	274.15
2	35.6	275.15
3	37.4	276.15
4	39.2	277.15
5	41	278.15
6	42.8	279.15
7	44.6	280.15
8	46.4	281.15
9	48.2	282.15
10	50	283.15
11	51.8	284.15
12	53.6	285.15
13	55.4	286.15
14	57.2	287.15
15	59	288.15
16	60.8	289.15
17	62.6	290.15
18	64.4	291.15
19	66.2	292.15
20	68	293.15
21	69.8	294.15
22	71.6	295.15

˚C	˚F	˚K
23	73.4	296.15
24	75.2	297.15
25	77	298.15
26	78.8	299.15
27	80.6	300.15
28	82.4	301.15
29	84.2	302.15
30	86	303.15
31	87.8	304.15
32	89.6	305.15
33	91.4	306.15
34	93.2	307.15
35	95	308.15
36	96.8	309.15
37	98.6	310.15
38	100.4	311.15
39	102.2	312.15
40	104	313.15
41	105.8	314.15
42	107.6	315.15
43	109.4	316.15
44	111.2	317.15
45	113	318.15

Appendix 3: Default Values

Calibration

CONC. CALIB.
ZERO CALIB.
Type : Elec. Auto
SLOPE
Type : Air
PO: 0760.0 mm Hg

PARAMETERS
DATE :01/01/98
ZERO: 0.00 nA
S: 3.000 nA/ppm
ΔT: 0.0˚C

Programming

MEASURE

TEMP. COMP.

TYPE : Auto

ALARMS

ALARMS S1/S2/S4
AFFECT. : Conc.
DIR. : Down
LIMIT: 0.000 ppb
DELAY : 000 s
HYST. : 00%
RELAY : NO

ALARM S3
AFFECT. : System
ACQUIT : Auto
RELAY : NC

mA OUTPUTS

OUTPUT 1
AFFECT. : Conc.
TYPE : 4-20
MODE : Lin.
LOW : 0.000 ppb
UP : 01.00 ppm

OUTPUT 2
AFFECT. : Conc.
TYPE : 4-20
MODE : Lin.
LOW : 0.000 ppb
UP : 01.00 ppm

SPECIAL PROG.

MAINTENANCE
MODE : Last

CALIBRATION
MODE : Last

SYST. ALARM

MODE : Last

TIMER

MODE : Last

RS485

N^{O} : 00
BAUD : 9600
PARITY : No
STOP BIT : 1

Service

AVERAGE

AVERAGE : 1

DISPLAY

DISPLAY
CONC. : ppb/ppm
TEMP. : °C
PRESSURE : mmHg
LANGUAGE : GB

CODE

CODE
CALIB. : 0000
PROG. : 0000
SERVICE : 0000

CONFIGURATION

CONFIGURATION
FREQ. : 60 Hz

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