

AW400 series

Chlorine transmitter



Measurement made easy

—
AW400 series
chlorine transmitter

For more information

Further publications are available for free download from:

www.abb.com/analytical

or by scanning this code:



Search for or click on

Data Sheet [DS/AW400-EN](#)
AW400
Residual chlorine monitor

Instruction Manual [IM/AW4SR](#)
AW400 cell
Chlorine/Chlorine dioxide/Ozone

Electrical safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

Symbols

One or more of the following symbols may appear on the equipment labelling:

	Warning – refer to the manual for instructions
	Caution – risk of electric shock
	Protective earth (ground) terminal
	Earth (ground) terminal
	Direct current supply only
	Alternating current supply
	Both direct and alternating current supply
	The equipment is protected through double insulation

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

Health and safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

TABLE OF CONTENTS

Page N.

1	MODEL NUMBER BREAKDOWN	3
1.1	Ordering Guide	3
2	INTRODUCTION.....	4
2.1	Classification.....	4
2.2	Glossary.....	4
2.3	General Description	4
2.4	Technical Specifications	5
2.5	Hardware structure of the system.....	7
2.6	Instrument operating block diagram.....	9
3	INSTALLATION.....	10
3.1	Dimensions and mounting	10
3.2	Mounting	11
3.2.1	Wall mounting	11
3.2.2	2" Pipe mounting without sunshade.....	12
3.3	Location	13
3.4	Electrical connections	14
3.4.1	Power supply p.c. board	14
3.4.1.1	Power cable	15
3.4.1.2	Installation of cables for power supply.....	15
3.4.2	Cable gland.....	16
3.4.3	Digital I/O pc board	17
3.4.3.1	Digital Outputs	17
3.4.3.2	Digital input.....	18
3.4.4	Analog input/output pc board.....	18
3.4.4.1	Temperature compensation.....	19
3.4.5	Serial communication board	19
4	SET-UP AND CONFIGURATION	20
4.1	Keyboard functionality.....	20
4.2	Display	22
4.3	Channel definition -This menu allows to select the type of sensor associated to each channel:	23
4.4	Set-up menu	25
4.4.1	Configuration.....	26
4.4.1.1	Configuration parameters	26
4.4.1.2	Configuration menu flowchart	27
4.4.1.3	Cleaning functionality.....	28
4.4.1.4	Instrument test.....	29
4.4.2	Output setting.....	31
4.4.2.1	Output signal hardware modification 4 to 20 and 0 to 20 mA	32
4.4.3	Alarms	33
4.4.3.1	Alarm Display.....	33
4.4.3.2	Alarm setting Menu.....	34
5	FUNCTIONALITY.....	35
5.1	Transmitter (AW401).....	35
5.2	Controller (AW402)	36
5.2.1	General description.....	36
5.2.2	Controller's Parameters	36
5.2.2.1	PID Parameters	38
5.2.2.2	Feed Forward (FF) Configuration	39
5.2.2.3	Sampling and/or Flow Pacing Controller.....	39
5.2.2.4	Error Squared Controller (pH Applications)	40
5.2.2.5	Contacts Output Controller	40
5.2.3	Standard Controller.....	41
5.2.3.1	Std Controller Display	41
5.2.3.2	Std Controller Analog Output assignment.....	42
5.2.3.3	Std Controller Digital Input assignment.....	42
5.2.3.4	Std Controller Digital Output assignment.....	43

6	CALIBRATION	44
6.1	Calibration Procedure	44
6.1.1	Calibration Menu	44
6.1.2	Calibration Menu Flow Chart	45
6.1.3	pH Sensor Calibration	45
6.1.3.1	Double point calibration	45
6.1.3.2	Single point calibration (S.P.C.)	46
6.1.4	ORP Sensor Calibration	47
6.1.4.1	"OXIDATION potential with NEGATIVE values" arrangement	48
6.1.4.2	"OXIDATION potential with POSITIVE values" arrangement	48
6.1.5	Chlorine / Chlorine Dioxide / Ozone	49
7	START UP	51
7.1	Preliminary operations	51
7.1.1	Getting started	51
7.1.2	Personalization of Parameters	52
7.2	Controller PID tuning	52
8	MAINTENANCE	53
8.1	Periodical operations	53
8.1.1	Automatic sensitivity check during dual point calibration	53
8.1.2	Sensor signal check	53
8.1.3	Other checks	53
9	ERROR MESSAGES & TROUBLESHOOTING	54
9.1	Messages	54
9.1.1	Operation messages	54
9.1.2	Error messages	54
9.1.3	Alarms page	55
10	SERIAL COMMUNICATION	56
10.1	Standard of Communications	56
10.1.1	Software characteristics	56
10.1.2	Communication Protocol	57
10.1.3	Message Types and Commands Description	58
10.2	Communication Transaction Examples	59
10.2.1	Transaction A Example	59
10.2.2	Transaction B Example	59
10.3	Serial link signal connection	60
10.4	Data-link Terminator	61
10.5	AW400 Memory Map	62
11	APPENDICES	65
11.1	EC Declaration	65
11.2	APPENDIX B – WEEE Compliant	65
12	Spare Parts	66

1 MODEL NUMBER BREAKDOWN

1.1 Ordering Guide

Residual Chlorine Monitor	AW4	XX	X	X	X	X
Transmitter Type						
Transmitter		01				
Transmitter with PID Control (Channel 1 only)		02				
Sensor Type Channel 1						
Chlorine Cell			1			
Sensor Type Channel 2						
No second input channel				0		
Chlorine Cell				1		
pH				6		
ORP				7		
Additional 4-20mA input/output (re-transmission or flow input)				8		
Sensor Type Channel 3						
No third input channel					0	
Chlorine Cell					1	
pH					6	
ORP					7	
Transmitter Voltage						
115V AC ± 10%, 50/60 Hz						1
230V AC ± 10%, 50/60 Hz						2

2 INTRODUCTION

2.1 Classification

According to EN61010-1, AW400 is classified as:

- electrical equipment for measurement and control
- electrical equipment for process control
- electrical equipment designed to be safe at least in the following conditions:
 - altitude lower than 2000 m
 - operation temperature limits -10 to + 50 °C (15°F to 122°F)
 - storage temperature limits -40 to + 65 °C (-40°F to 150°F)
 - maximum relative humidity: 80 % with temperature up to 31 °C, with linear decrease down to 50% with temperature 40 °C
 - supply voltage allowed variations: 115 or 230 V AC \pm 10 %
 - over voltage class (installation class): II
 - pollution degree: 2

2.2 Glossary

PARAMETER	SYMBOL
pH	pH
ORP (oxidation reduction potential)	mV
Dissolved Oxygen*	O2
Residual Chlorine	Cl
Chlorine Dioxide	CD
Ozone	O3
Temperature	T

These symbols are also used in displayed indications.

* Not supported at this time.

2.3 General Description

AW400 Monitor/Controller Family includes 2 Types of instrument:

- **Transmitter** (Instrument Type 1)

A group of transmitters, both single channel and dual channels and three channels.

- **Controller** (Instrument Type 2)

PID controller for the installed Sensor, with specific algorithms for each type of measured parameter. It can accept an optional 4–20 mA signal from a flow-meter on channel 2. This second input can be used as Feed Forward input in the PID algorithm.

2.4 Technical Specifications

- Display: digital LCD display, dot matrix, 16 + 16 characters, with back light.
- Power supply, selectable through a soldered jumper on the rear of the power supply pc board (see Sect. 3.4.1):
 - 115 V AC, $\pm 10\%$, 50/60 Hz
 - 230 V AC, $\pm 10\%$, 50/60 Hz
- Maximum consumption: 20 VA
- Electrical classification: for non hazardous area
- Fuses: T100mAL 250V @ 230 V AC
T200mAL 125V @ 115 V AC
- Enclosure classification: IP65, suitable for outdoor mounting
- Casing: NEMA 4X, material GREENLAC reinforced with fiberglass (17%), White RAL 9010, Class VØ (in accordance to UL94)
- IP protection: IP65 whether power and signal cables respect the indications in the following section 3.4.1.1
- Mounting: hardware is supplied for the following mounting options
 - wall mounting
 - 2" pipe mounting
- Isolating level: Signal inlet isolated at 2224Vrms referring to the power supply.
- Analog outputs: one for each installed channel (analog I/O pc board); separately selectable for each channel as 0–20 mA or 4–20 mA.
- Outputs are galvanically isolated from inputs. Load 0–1000 Ω , protected against short circuits.
- Digital outputs:
 - 7 relay outputs: 24 V / 230 V~; 3 A max.
 - Individually settable as Normally Open (NO) or Normally Closed (NC)
- Digital inputs: 2 free contacts
- Serial communication port: RS232, RS422 and RS485 with RJ45 plug-in sockets. The protocol used is illustrated in a dedicated section at the end of this manual.
- Alarm level setting: High and Low alarm for channel 1, High and Low alarm for channel 2. Separate levels for each channel, freely selectable. Dead band freely selectable for each channel.

- Measuring ranges: freely selectable for each channel within the limits indicated for each parameter, as follows:

PARAMETER	MINIMUM SPAN	MAXIMUM RANGE	DEFAULT SETTING
pH	1.00 pH	0.00 to 14.00 pH	2.00 to 12.00 pH
mV	100 mV	-1500 to +1500 mV	-500 to +500 mV
O3	0.25 ppm	0.00 to 10.00 ppm	0.00 to 1.00 ppm
Cl	0.25 ppm	0.00 to 10.00 ppm	0.00 to 1.00 ppm
CD	0.25 ppm	0.00 to 10.00 ppm	0.00 to 1.00 ppm
T	5 °C	0 to +100 °C	0 to +100 °C
mA	2 mA	0/4 to 20 mA	4 to 20 mA

- **Measure sensitivity:**

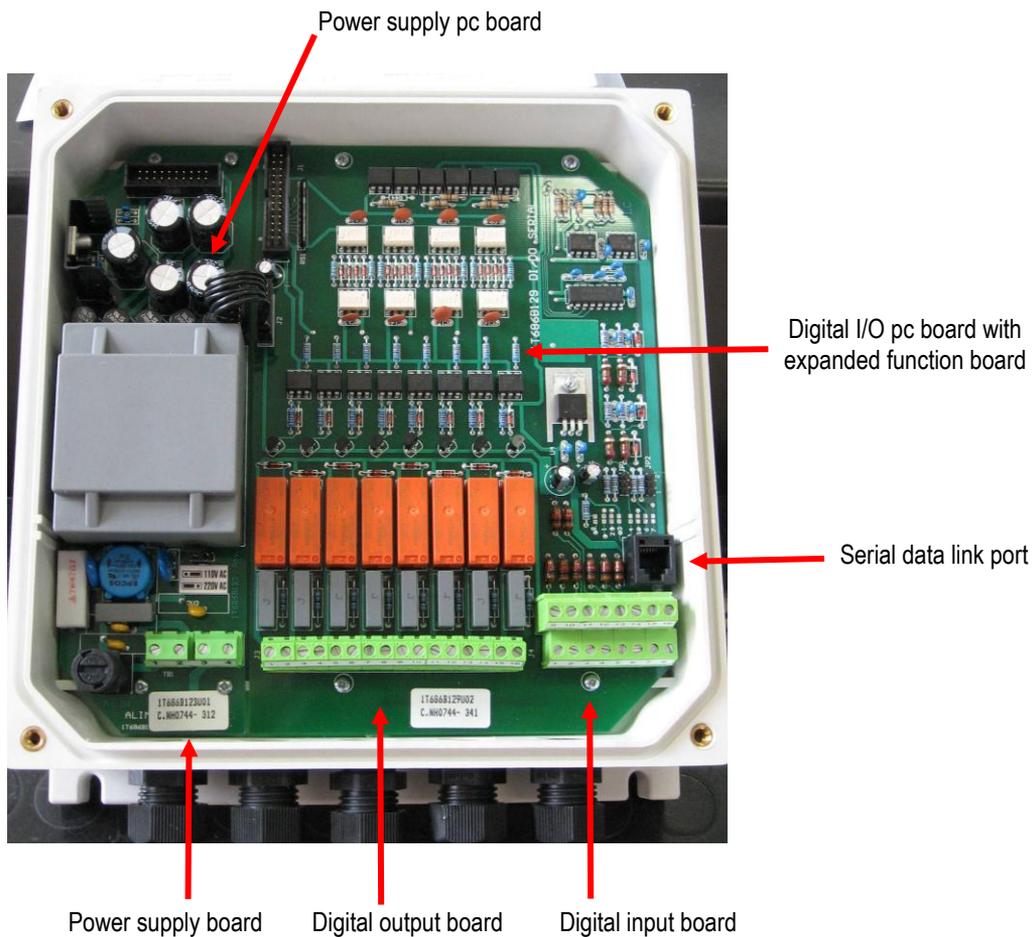
Parameter	Sensitivity
pH	0.0002 unit pH
ORP	0.0045 mV
chlorine	0.33 µg/l (ppb)
chlorine dioxide	0.33 µg/l (ppb)
ozone	0.15 µg/l (ppb)

- Analogue Input: up to 3 sensors (any of pH, ORP, Dissolved Oxygen, Residual Chlorine, Chlorine Dioxide, Ozone, 0/4÷20 mA analogue signal and temperature (Pt100))
- Weight: 3 kg
- Outline dimensions: 250 mm x 250 mm x 120 mm. See Fig.1 for detailed outline dimensions
- Ambient temperature limits for stocking: -40 °C to +65 °C (-40 °F to 150 °F).
- Ambient temperature limits during operation: -10 °C to +50 °C (15 °F to 122 °F) (if the instrument is expected to be installed in the sunlight, a sunshade protection is strongly recommended)
- Thermal drift: within 0.2% of f.s. for a 10 °C temperature variation.
- Relative humidity: 80 % with temperature up to 31 °C, with linear decrease down to 50% with temperature 40 °C
- Accuracy: within ± 0.2 % of f.s.
- Transmitter response time: measure is refreshed at each microprocessor scan cycle (100 msec)
- Microprocessor scan cycle: 100 msec
- Smoothing: separately set for each channel inside Configuration menu.

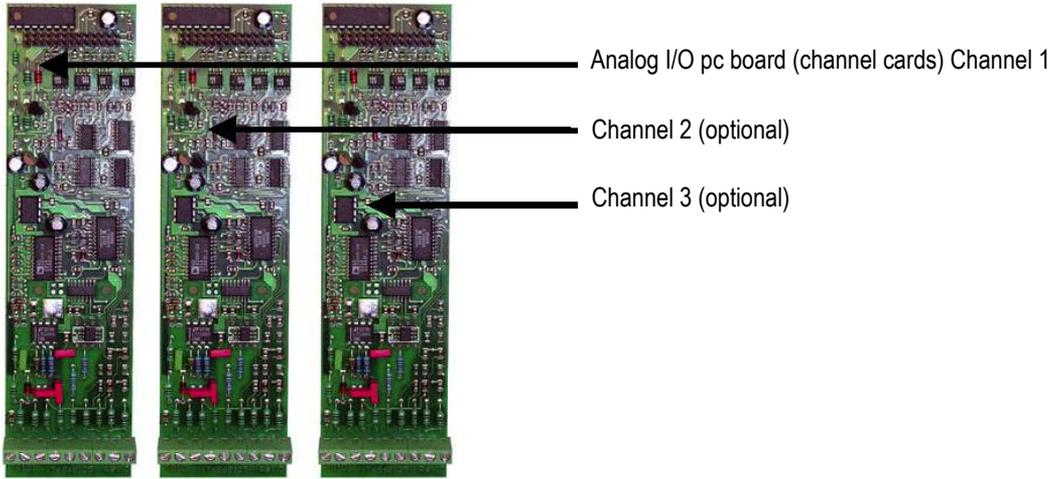
2.5 Hardware structure of the system

The AW400 hardware is structured in a modular system, whereby only the electronic p.c. boards requested for the specific application needs to be installed, thus achieving great flexibility and relevant cost benefits for the user. The different p.c. boards are mounted in four separate layers, according to the following scheme:

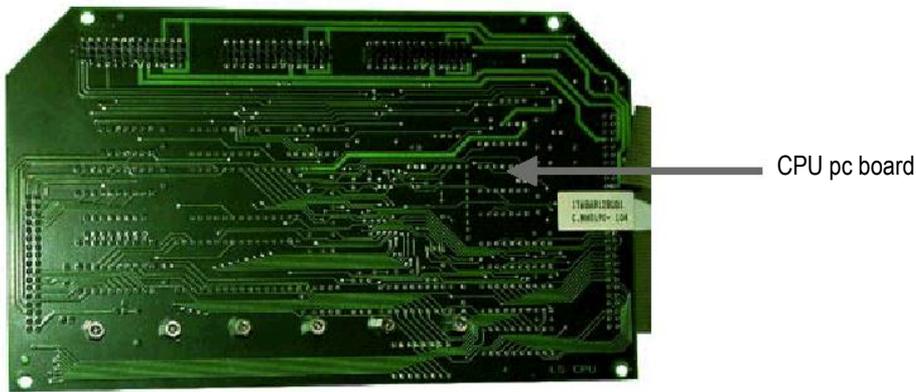
FIRST LAYER OF P.C. BOARDS (bottom):



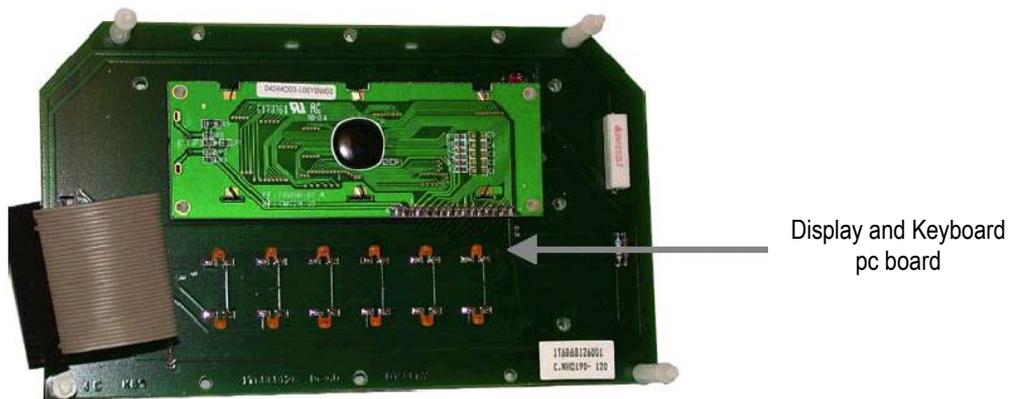
SECOND LAYER OF P.C. BOARDS (Analog Input/Output)



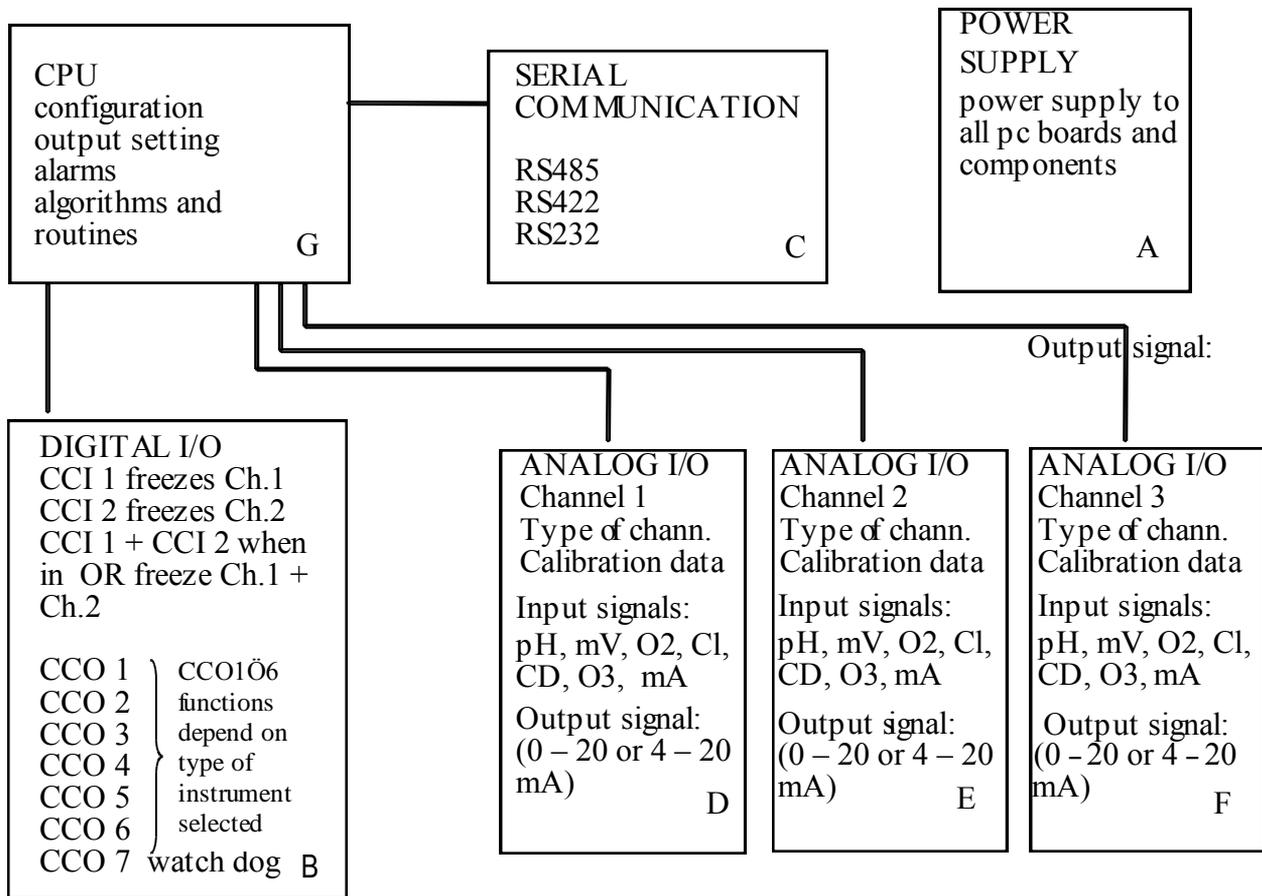
THIRD LAYER OF P.C. BOARD (Main Board):



FOURTH LAYER OF P.C. BOARDS (Top):

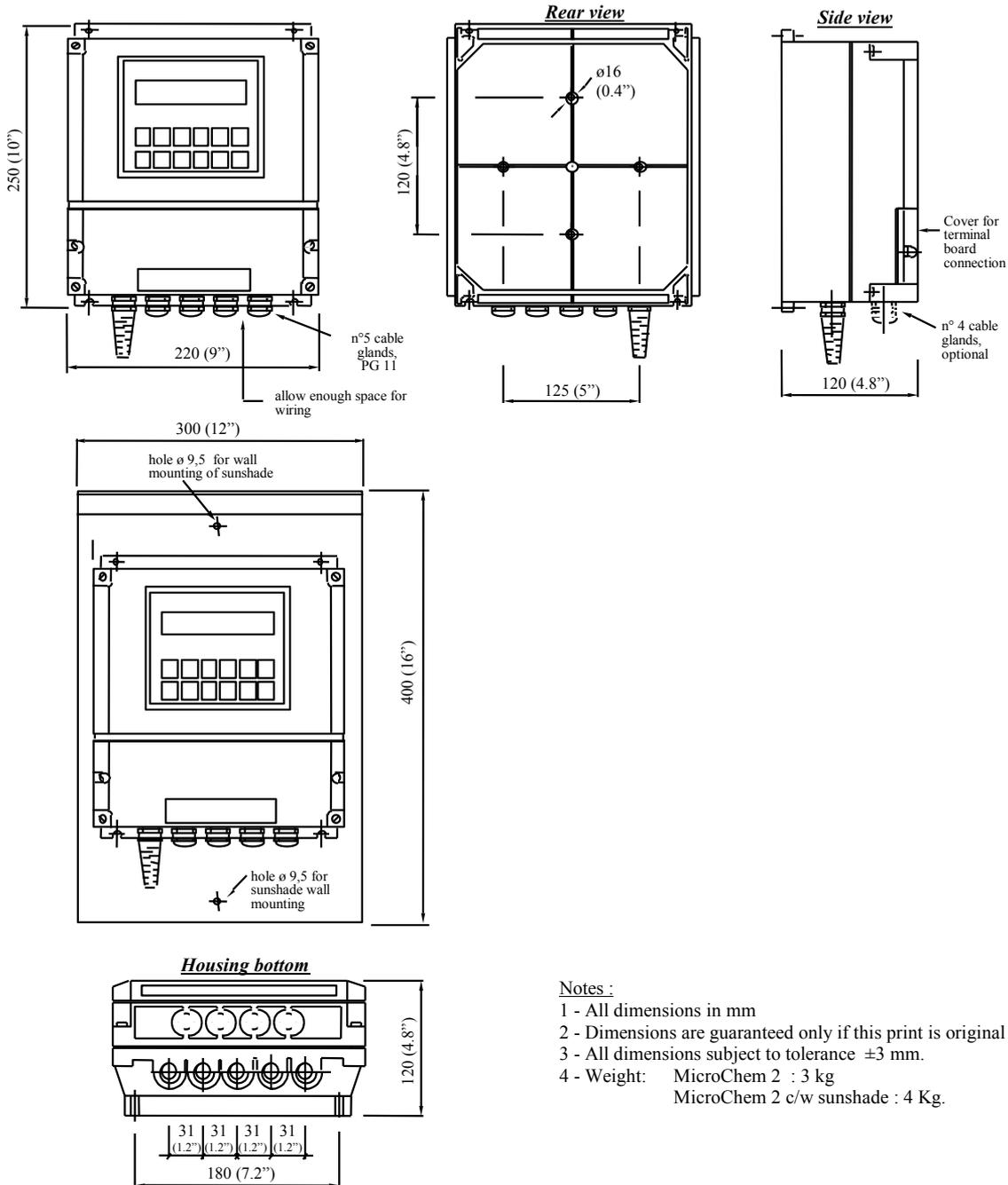


2.6 Instrument operating block diagram



3 INSTALLATION

3.1 Dimensions and mounting



- Notes :
- 1 - All dimensions in mm
 - 2 - Dimensions are guaranteed only if this print is original
 - 3 - All dimensions subject to tolerance ± 3 mm.
 - 4 - Weight: MicroChem 2 : 3 kg
MicroChem 2 c/w sunshade : 4 Kg.

Fig. 1 - AW400 dimensions



WARNING!
recommended.

When installing AW400 outdoors, the use of a sunshade is strongly

3.2 Mounting

AW400 is available with the hardware for the following types of mountings:

- Wall mounting (Fig. 2)
- 2" pipe mounting (Fig. 3)

3.2.1 Wall mounting

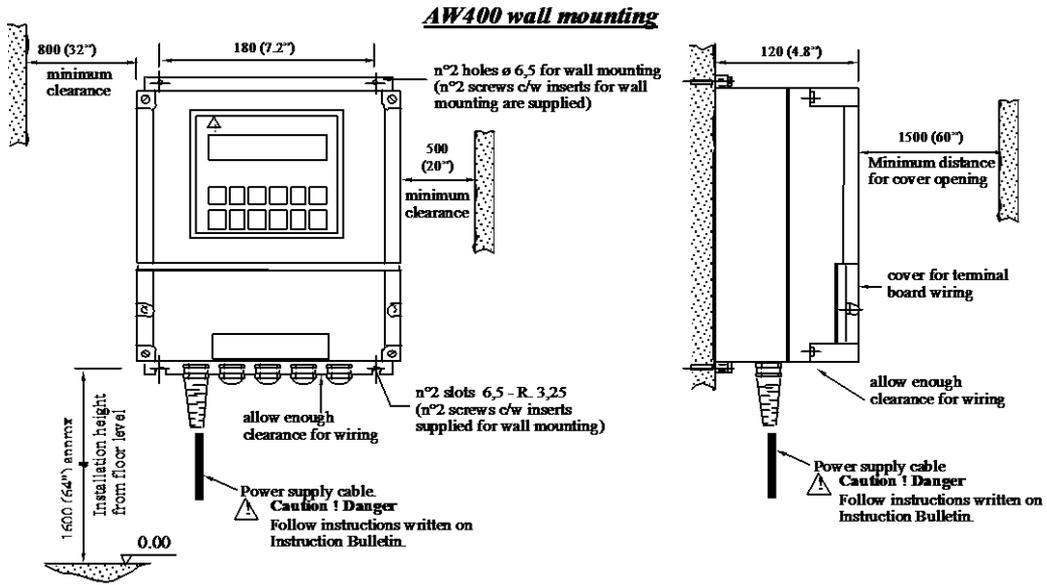
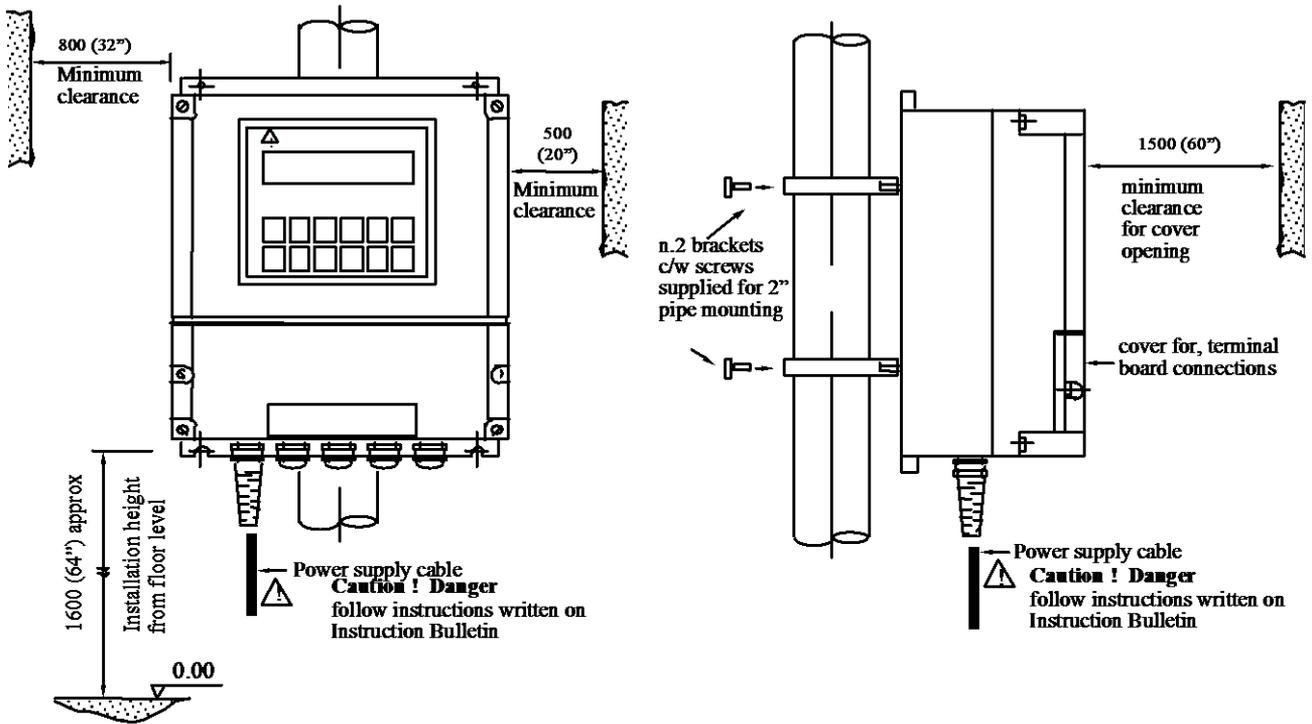


Fig. 2 - Typical Wall-mounting Installations of AW400

3.2.2 2" Pipe mounting without sunshade

AW400 2" vertical pipe mounting



AW400 2" horizontal pipe mounting

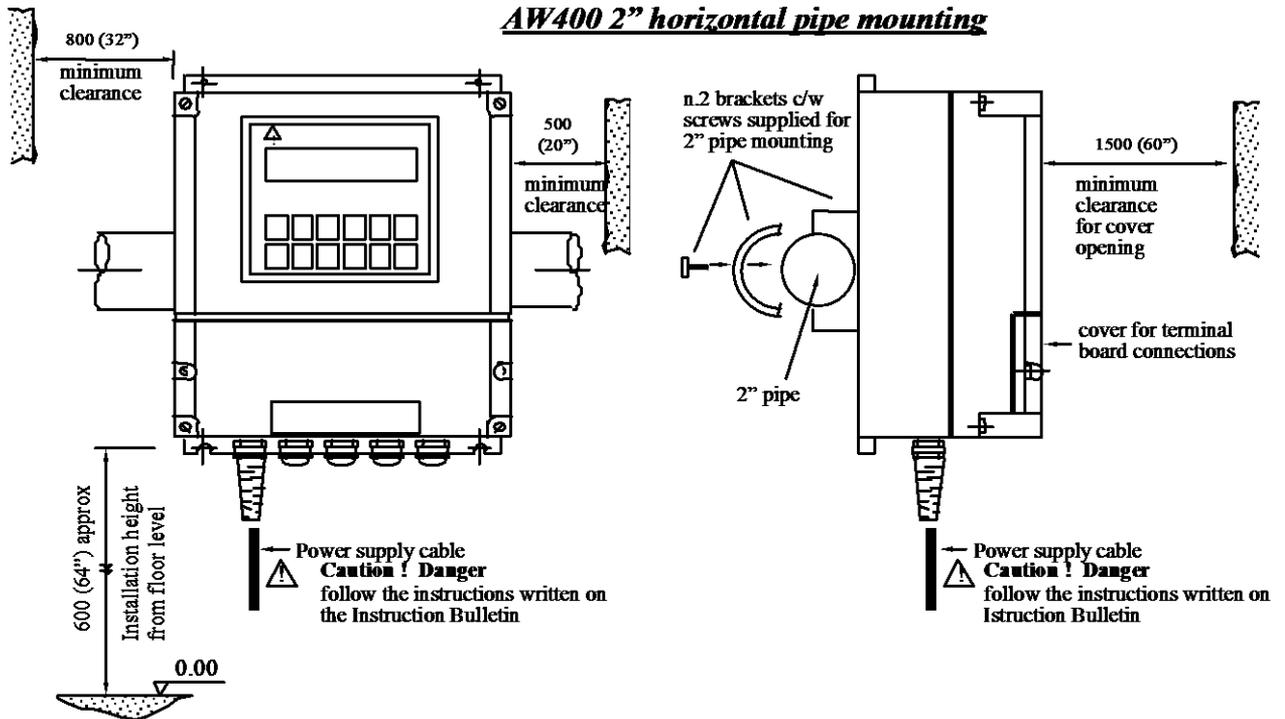


Fig. 3 - Typical 2" pipe mounting of AW400

3.3 Location

The transmitter location should meet the following requirements:

- the site of installation should be free of vibrations
- the atmosphere should be free of corrosive substances
- enough space has to be left around the transmitter to allow easy operation and maintenance
- the transmitter should be mounted at a height of 1.6 - 1.7 m from floor level to make normal reading, maintenance and calibration operations easier
- in outdoors installations a sunshade is strongly recommended
- power supply according to instrument tag should be available

3.4 Electrical connections

3.4.1 Power supply p.c. board



WARNING!

Only qualified personnel should conduct the tasks described in this section of the manual.

The transmitter is not fitted with a switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the transmitter within easy reach of the operator and must be marked clearly as the disconnection device for the transmitter.

Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.

Route signal leads and power cables separately, preferably in an earthed (grounded) flexible conduit.

The power supply is connected to the terminal board TB1 (See Fig. 4).

The selection between the 115 V AC and 230 V AC power settings can be changed by moving a jumper (in position JP1) on the power supply pc board. Jumpers are represented in Fig. 4. Power supply (230 V AC) is factory set. Should any modification be needed, proceed as per the following steps:

See Figure 4 to change the jumper setting.

1. disconnect the power supply
2. open the upper enclosed cover
3. locate the JP1 jumper on the power board (Fig. 4)
4. move the jumper to the correct position
5. close the cover and reconnect the power

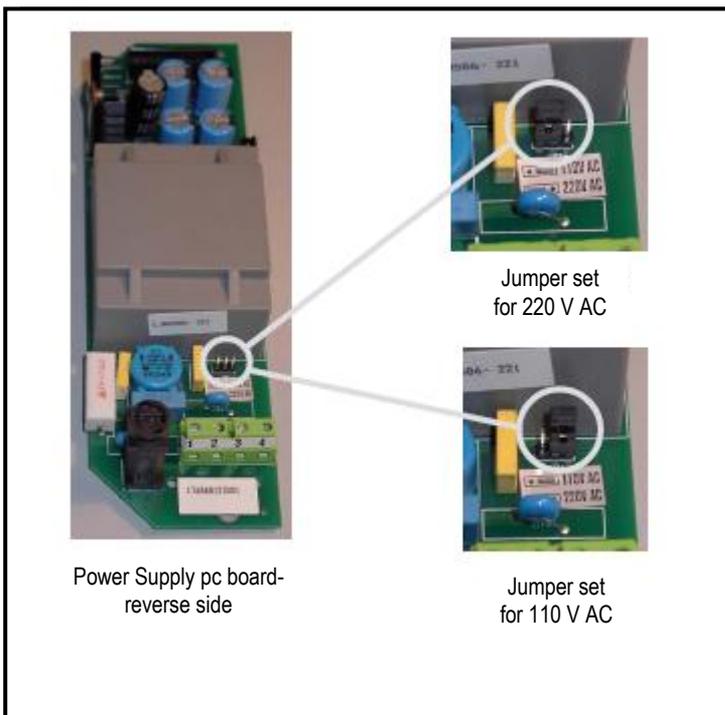


Figure 4 - Power supply jumper position 110 V AC or 220 V AC

3.4.1.1 Power cable

Power supply cable has to be supplied by the Customer and installed by qualified personnel. In accordance to EN61010-1 power supply cable has to satisfy the following requirements:

- must be certified or approved by an official national/international testing bureau (IMQ, UL, CSA...) and according to the local law.
- three-cores cable, each core with section 1 mm² or 1.5 mm² and with specific colours required by local requirements.
- must be suitable for ambient temperature up to 75°C (167°F)
- must have a section of 6-10mm to guarantee the casing IP65 protection.
- must include ground wire that has to be properly connected.

3.4.1.2 Installation of cables for power supply



DANGER!

Electrical shock hazard. Power supply cables are connected to 115 or 230 V AC voltage.

Power cable inlet

The three-core power supply cable, as described in section 3.4.1.1, has to be wired to the board passing through the specific gland. deve essere inserito attraverso il pressa cavo posto in corrispondenza della morsettiera TB1. The gland itself can not be removed as its specific action is to avoid cable abrasions and damages and to guarantee the IP protection.

The external wire sheathed shell be removed for at least 3-4 cm from the termination to allow the three cores separation into the instrument while shell be kept in correspondence of the gland. Each wire shell be stripped for about 1cm to allow the lugs crimping.

Cable anchorage (Customer Care)

Cable anchorage must be designed to avoid stresses, included torsion stresses to the conductors at the point where they enter the transmitter. Cable anchorage has to satisfy the following requirements:

- cable has not be fixed through a screw acting directly on the cable itself
- never make knots on the cable itself
- cable anchoring must be designed to make cable replacement easy and safe
- cable has to be protected from any possible mechanical stress that may damage it or making it directly or indirectly dangerous.

Plug (not supplied)

The plug shall be certified and approved (IMQ, UL, CSA...) and have the ground connection.

Circuit breaker (Customer care)

The instrument shall be equipped with a specific circuit breaker which have two main functions:

1. Main power supply disconnection
2. Over voltage protection.

Shall have the following characteristics:

- Shall be easily identifiable, easy to access and operate and shall be installed nearby the instrument
- Shall be a certified and approved model according to the standard in use in the country where the instrument will be installed
- Shall clearly indicate if the power is activated and present or not
- Shall be specific characteristics for protective action (10A curve “C” type)
- Whether installed outdoor, shall have the appropriate IP protection rating.

Unauthorised personnel must not be able to open the instrument. AW400 is defined as an instrument "with no accessible parts under dangerous voltage".

ABB can, on request, provide the specific item (part number 1T154E001U01).

3.4.2 Cable gland

Microchem is capable up to 9 holes that can be opened for electrical wires connection.

As standard 5 cable glands are installed on each unit.

Below, is an example of how to use the different cable glands (see pic.8).

- 1 cable with three wires for power supply
- Cables from wet-end
- Cable for 4-20mA signal retransmission
- 10 cables for digital output (CCO1÷7)
- Cables with two wires for digital input (CCI1÷2)
- 1 cable RJ11 type for serial communication option.

RECOMMENDED: Do not put beside the power supply cable with other cables.

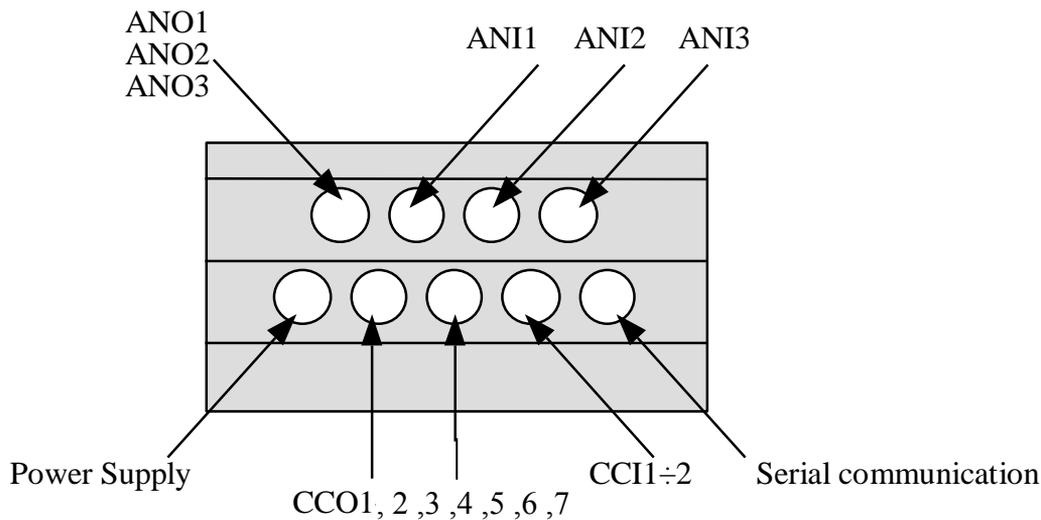


Figure 5 - Recommended use of cable glands

3.4.3 Digital I/O pc board

3.4.3.1 Digital Outputs

AW400 digital outputs are provided by seven 7 relays (physically 8 relays are installed but only 7 are available). The function of each output contact depends on the type of instrument selected and its configuration. The different possibilities are detailed in the sections dedicated to each specific type of instrument, as detailed under each specific instrument section.

Fig. 6 shows how the terminal number assigned to each CCO on the I/O pc board.

The maximum rating of the relays are:

- Maximum Voltage: 24V DC / 230 V AC;
- Maximum Current: 3A

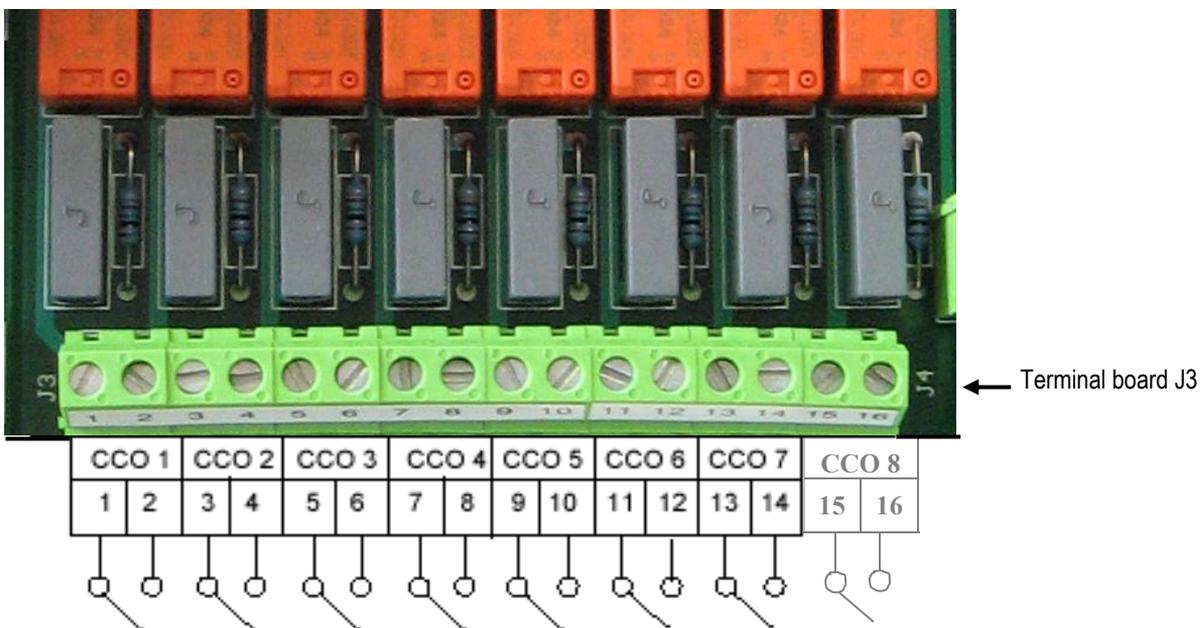


Figure 6 - Relays interconnection terminal barrier

3.4.3.2 Digital input

AW400 digital input (free contacts) are represented in Figure 7.

- Two wires shielded cable
- two-cores, section 0.5 to 1.0 mm²
- the shields has to be connected to ground shield terminal strip (⊕) on the AW400 power supply board (see Fig. 7).
- Cables for digital outputs shall have a 80°C (176°F) rating.

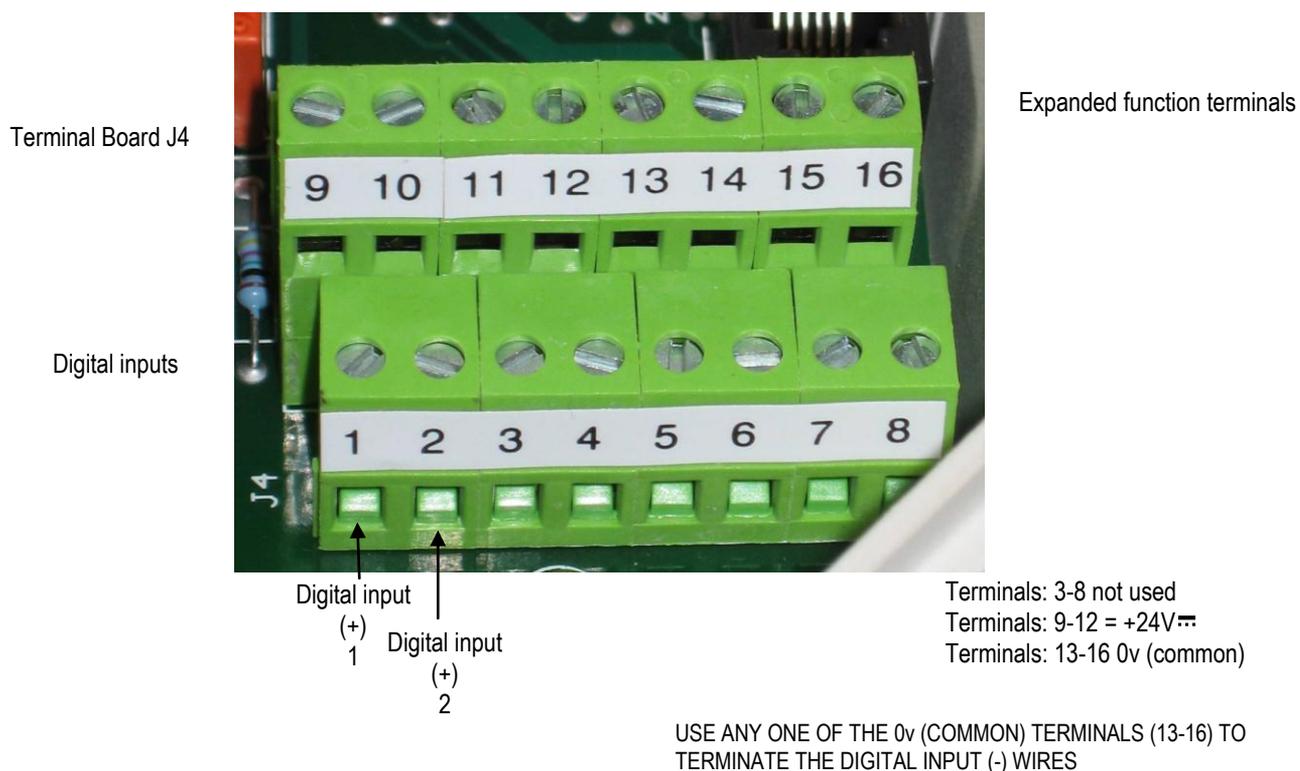


Figure 7 - Digital inputs terminal barrier

3.4.4 Analog input/output pc board

Refer to each sensor I.B. for the colour/number codification of the sensors wires. The Pt100 shield and the sensor shield, if present, has to be connected to ground shield terminal strip, inside AW400. Please notice that, for pH and ORP sensors it is recommended to fix the cable near the sensor so that it doesn't move at the outlet of the cable gland. The wear of the cable at that point is thus prevented.

The 0–20 mA or 4–20 mA signal INPUT is on terminals 5 and 6: when these terminals are used for the 0/4–20 mA INPUT, install a 100 Ω resistor (0.1 % accuracy) across terminals 5 and 6.

Use two cores shielded cables for 4–20 mA output signals, section of each conductor 0.5 – 1.0 mm²; connect shields to the shield ground terminal strip inside AW400.

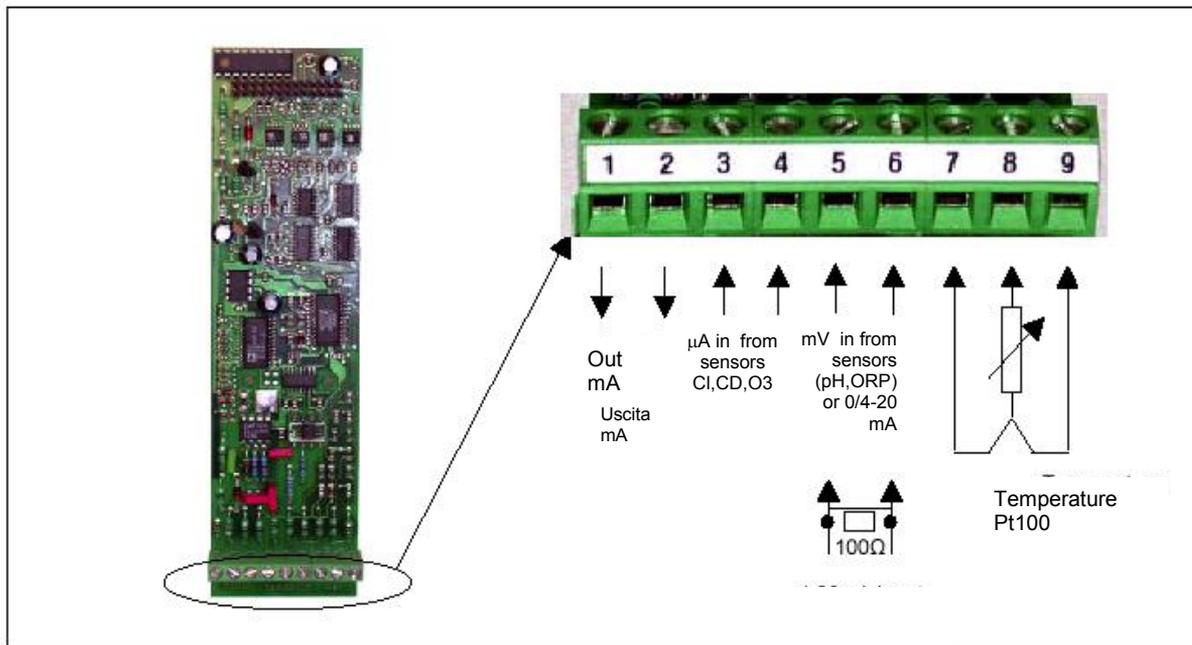


Fig. 8 – Analog Input /Output terminal barrier

3.4.4.1 Temperature compensation

The thermo-compensation Pt100 is not necessarily present in each sensor, in fact in some installations the different sensors are installed in the same cell, and therefore the reference temperature can be read from one input only, namely from the sensor connected to channel 1.

In the installation menu, when configuring channel 2 and 3, after the choice of the type of sensor, it is requested to specify if the reference temperature is to be "equal to first channel" or "independent". In the first case the reference temperature for that channel is taken from channel 1, in the second case it is read from its own Pt thermo-resistance which in this case must be present.

This option is not applicable for mA, ORP or Chlorine in CL4000 mode inputs measurements, as these parameters are not influenced by operating temperature or already compensated.

3.4.5 Serial communication board

AW400 supports serial communication standards RS232 and RS422/485 by connection of a modular telephone jack RJ45.

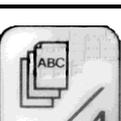
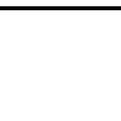
The 9 poles terminal board supports all three standards.

The pin-out of the RJ45 connectors and 9-pin terminal board is illustrated in Section 11.3 in this manual, dealing with the serial communication option.

4 SET-UP AND CONFIGURATION

4.1 Keyboard functionality

All the keys have dual functionality, except the ENTER key. Blue background keys are the ones whose second function is only used in Controller option (AW402). The selection between numbers and functions is automatically recognised by the instrument.

KEY	PRIMARY FUNCTION	SECONDARY FUNCTION
	MANUAL SELECTOR Selects manual mode in Controllers (AW402).	0: digit zero when allowed
	DECREASE OUTPUT Decreases output in Controller (AW402) when in manual mode.	1: digit 1 when allowed
	INCREASE OUTPUT Increases output in Controller (AW402) when in manual mode.	2: digit 2 when allowed
	LIGHT Light up / down the display.	3: digit 3 when allowed
	MENU Calls for the menu and, inside a menu, cycles the parameters.	4: digit 4 when allowed
	ENTER: decimal point is not used, any parameter needing it already includes the decimal point in the correct position. Enter function: allows the user to enter the displayed menu or parameter; once entered, allows parameter to be modified. A parameter can be changed (set) when the cursor appears on the display. Once the cursor has appeared, whether or not the parameter has been changed, the Enter key confirms the displayed value. In display mode Enter key allows to call the Warnings & Messages page.	None
	AUTOMATIC SELECTOR Selects Automatic/Manual operation mode in Controllers (AW402).	5: digit 5 when allowed
	SETPOINT DOWN ARROW Decreases Set Point in Controllers (AW402).	6: digit 6 when allowed
	SETPOINT UP ARROW Increases Set Point in Controllers (AW402)	7: digit 7 when allowed

	WASH Starts a cleaning sequence when this option is activated and allowed (timers set at any value different from zero).	8: digit 8 when allowed
	CANCEL Cancel is used to load default parameters (power the instrument down and power it up while keeping the Cancel key pressed) Cancel is also used to modify a parameter wrongly written: when a parameter can be modified the cursor appears on the display; when the cursor is in the last right position pressing the Cancel key will delete the newly introduced value and allow to re-write a new one	9: digit 9 when allowed
	END End key allows to exit a parameter or a menu and return to upper menu.	-: negative sign when allowed

Table 1 - Keyboard functionality

Use of MENU, ENTER and END keys to move inside menus and change parameters:

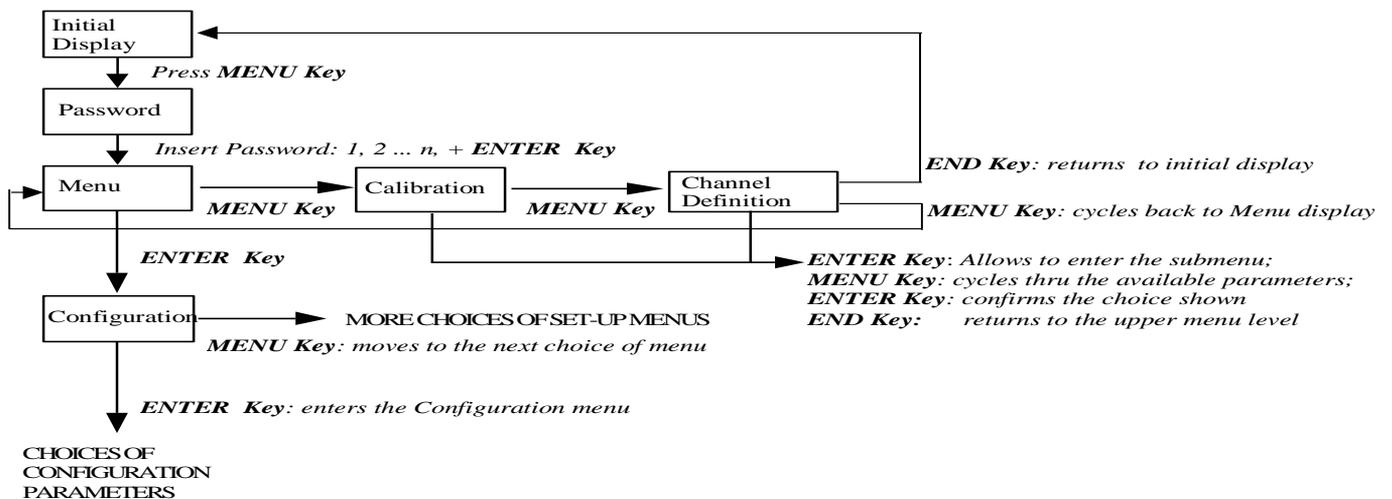


Fig. 9 – Example of menus navigation

4.2 Display

The AW400 display shows the instantaneous value of the parameter measured, its identification symbol and the temperature of the sampled liquid. Here is an example of the standard one-channel display:

1	2	.	5	2	p	H	1	5	.	5	°	C

If the instrument is configured to support two sensors, the display shows on the top line the metered value and the temperature of parameter installed on Channel 1, and on the bottom line the metered value and the temperature of parameter installed on Channel 2. When three sensors are installed, the process values are displayed on two different pages. Press END key to toggle from one page to the other.

Channel 1 Measure	1	2	.	5	2	p	H	1	5	.	5	°	C	Channel 1 Temperature	
Channel 2 Measure	0	.	1	1	4	O	3	0	.	1	5	8	C	I	Channel 3 measure

On the second page appears:

Channel 1 Measure	1	2	.	5	2	p	H	1	5	.	5	°	C	Channel 1 Temperature
Channel 2 Temperature	1	6	.	4	°	C	1	1	.	2	°	C	Channel 3 Temperature	

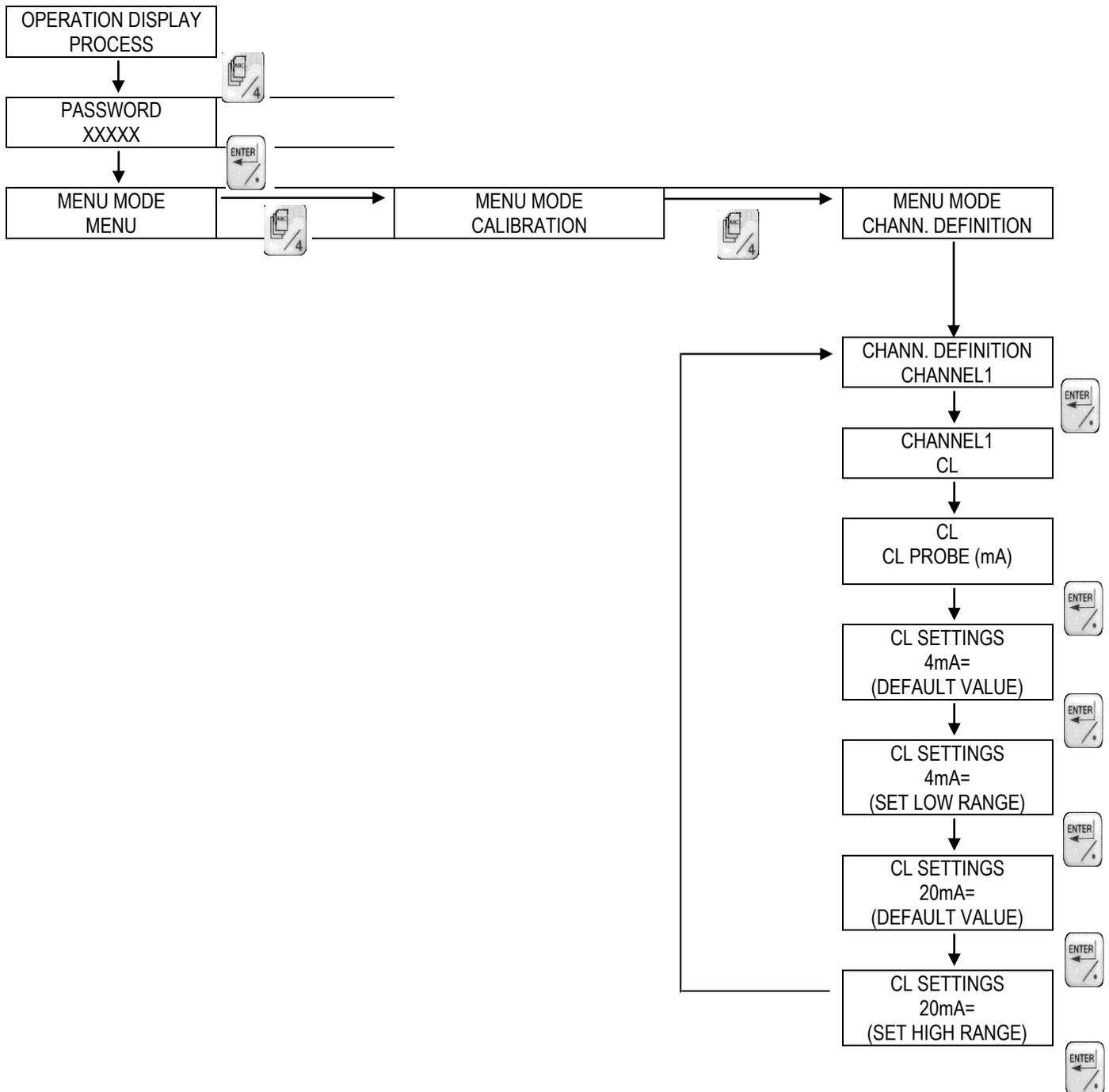
When AW400 is configured as a Controller (AW402), the process information are displayed on a dedicated page, as per following example:

Channel 1 measure (Process variable)	1	0	.	1	2	p	H	1	0	.	4	°	C	Channel 1 Temperature	
Setpoint	1	2	.	0	0	S	P	1	6	%	O	U	T	A	Output (%) - Aut./Man.

Notes:

1. When changing channel definition from one parameter to another, the AW400 transmitter/controller will set the alarm outputs and the PID parameters to the default values.
2. If chlorine (CL) is selected, the type of CL measurement must be defined as either a cell (KC4000AB) or a probe (CL4000AB). When CL4000AB probes are selected, you will be prompted to enter the (4mA and 20mA) probe settings to match the range of the probe supplied with the system (i.e. 0-2 or 0-10 ppm).
3. Sensors with a 4 to 20 mA output can be attached to the transmitter and the units and range can be set within the channel configuration software and then the sensor output can be displayed on the screen – see section 2.2 for the range of units that can be selected.

* Not available



The Channel definition menus are in accordance to the number of the channels installed (e.g. if only Channel 1 is installed, only Channel 1 definition menu appears; if two channels are installed, both Channel 1 definition menu and Channel 2 definition menu will appear. The same principle applies for Channel 3).
 Select the type of channel according to the sensor installed (see glossary 2.2 for the symbols used).

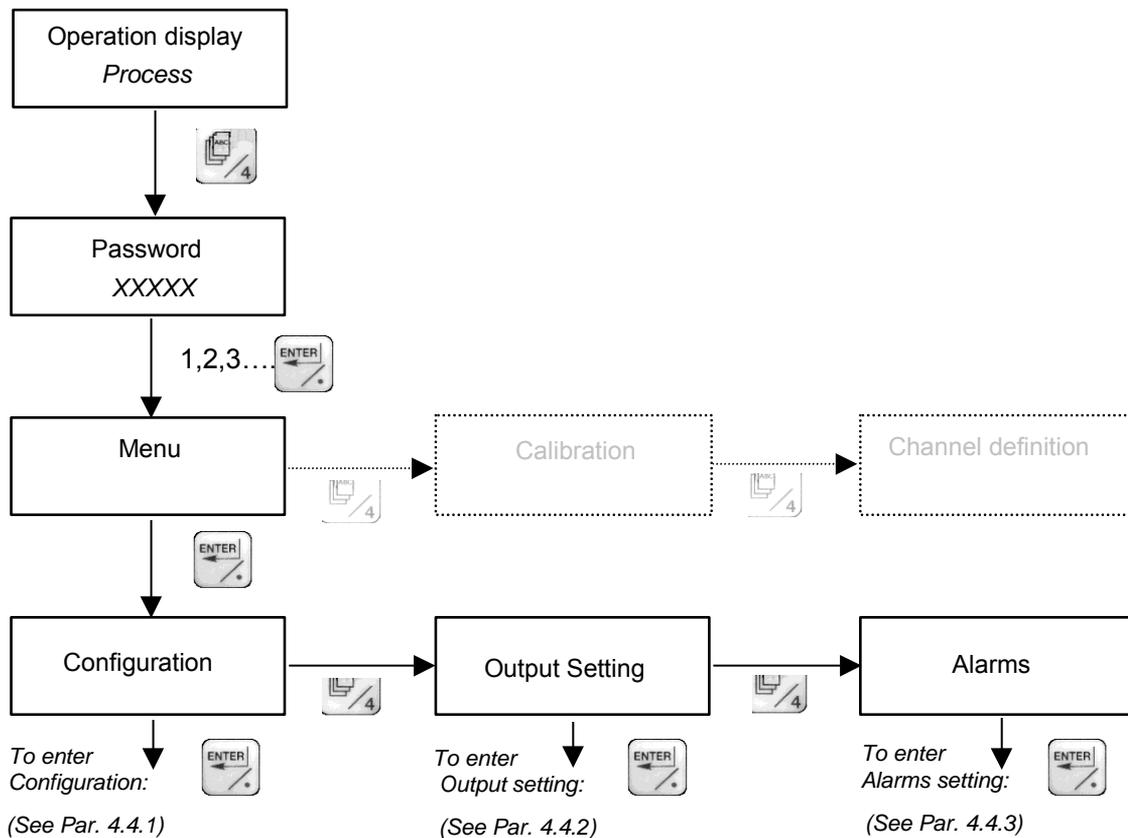
NOTE: At power-up, the instrument loads data in memory according to the last channel definition. When the Channel definition is modified, in order to have the new data properly stored, it is necessary to exit the Channel definition menu and return to the operation menu (END key), switch-off power to the instrument, then power it up again while keeping key 9 (CANCEL) pressed.
 If the language selected was different from Italian, it is necessary to select again the desired language, as this operation sets back instrument to default English language.

4.4 Set-up menu

The set-up menu is structured in three different submenus and namely:

- Configuration to set the general operating parameters of the instrument, see 4.4.1;
- Output settings to select 4–20 mA or 0–20 mA output for each channel, see 4.4.2;
- Alarms to set alarms level; see 4.4.3.

Each of them will be discussed in detail in the following pages.



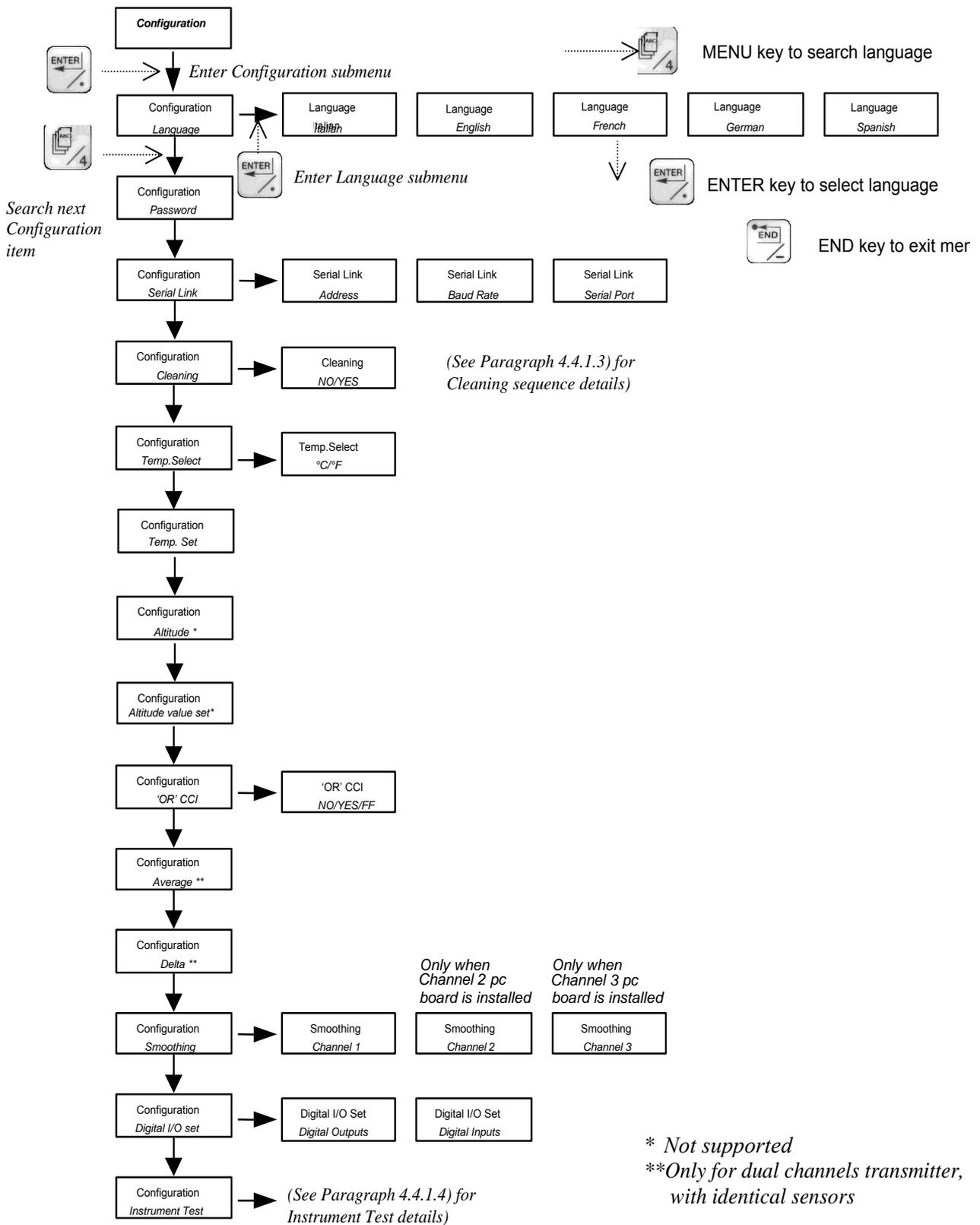
4.4.1 Configuration

The configuration menu consents to set the general parameters of the instrument. Only those parameters which are pertinent to the selection made and to the hardware installed will appear in the menu. When a digital value is requested, pressing the ENTER key will cause a cursor to appear in the display: at this point a numeric value may be entered using the second function of the keyboard pushbuttons. When ENTER key is pressed again, the value shown on the display will be confirmed, whether the latter has been modified or not. Here is a description of the parameters appearing in the menu. A summary of the configuration menu flowchart follows in the next page.

4.4.1.1 Configuration parameters

- Language:* select the language of the displayed messages. Available languages: Italian, English, French, German, Spanish. Default: English
- Password:* set the password, that is an alphanumerical code composed of up to 5 characters. Default setting by Factory: 00000
- Serial link:* optional serial communication link.
See Section 11.3 "Serial Communication" for detailed instructions
- Cleaning:* logical sequence for periodical cleaning of the sensors.
See paragraph 4.4.1.3 for details
- Temperature select:* select measuring units for displayed temperature value: °C or °F; default is °C.
- Temperature set:* define temperature at which operate temperature compensation when the thermo-resistance is faulty; default is 20 °C.
- Altitude:* not supported.
- CCI in 'OR':* when AW400 is installed on a water analytical unit and another Micro2Chem is driving the cleaning sequence for all the sensor installed on the water analytical unit, the AW400 that is not driving the cleaning needs to be "informed" that its sensors are being cleaned: this information comes through its CCI that are connected to the CCO driving the cleaning on the other AW400. When CCI in OR option is chosen, if one or the other or both the CCI is/are closed the AW400 "knows" that it has to freeze output signals.
- Average:* for dual channels transmitters, with identical sensors installed; the transmitter computes the average of the two input signals. The choice is Average NO or Average YES; default is NO (the average is not computed).
- Delta:* for dual channels transmitters, same installed parameter; the transmitter displays an alarm when the difference between the two measured values is higher than the set value allowed for the deviation. Default = 0.0 (the delta is not active).
- Smoothing:* The number is the smoothing in seconds on the input signal. It can be separately set for the three channels. Allowed values are 0.00 – 10.00. Default is 1.00
- Digital I/O Setting:* allows to set the status of digital input and digital outputs.
- Instrument test:* see paragraph 4.4.1.4

4.4.1.2 Configuration menu flowchart



4.4.1.3 Cleaning functionality

The cleaning functionality implemented in the AW400 supports a sequence of operations necessary to perform a periodical cleaning of the sensors. This function is always present in the software and can be enabled or disabled by a YES/NO selection in the configuration menu (default setting is NO).

When the selection is set to "YES", the instruments activates the cleaning sequence and operates the output contact relays associated to CCO5 and CCO6 to drive the solenoid valves for the washing and rinsing lines (see Fig. 10). Each phase of the cleaning sequence requires a different timing, and this can be freely configured in parameters T1, T2, T3 and T4 (see table 2 below for details). During the cleaning sequence active phases, the measure is frozen to the last valid value, and when instrument is operating as a Controller, the latter is automatically forced in manual mode.

The cleaning sequence can be started locally with a manual command by pressing Key 8 / WASHING, or it can be triggered automatically by setting proper values in the timers T1–T4.

There are two cleaning sequences designed to work in conjunction with optional ABB devices: sequence "A" (Water Analytic Unit) and sequence "B" (Sequential Cleaning Unit). If the hydraulic cleaning system used is different from the a above specified devices, then select "B" option and use the output contacts as directed in Figure 10 to drive the solenoid valves.

The cleaning sequence consists of the following four phases:

- T1 - Analysis:** Normal operation phase of the sensor, that is the time period between the end of a cleaning sequence and the start of the next one in automatic mode. Allowed time values are 1 sec. to 30 hours. Typical value is 23,5 hours.
- T2 – Washing:** Phase to be used to wash the sensor with chemical detergent. Allowed values are 0–30 minutes. Typical value is 10 min.
- T3 – Rinsing:** Phase to be used to rinse the sensor with pressurized clean water. Allowed values are 0–30 minutes. Typical value is 10 min.
- T4 – Pause:** Pause period usually allowed to consent the sensor to recover sensibility before starting a new measure. Allowed values are 0–30 minutes. Typical value is 10 min.

PHASES	TIME	CCO5 ¹	CCO6 ¹	MESSAGE
T1 Analysis	T1	•	•	
T2 Washing	T2	O	•	WASH!
T3 Rinsing	T3	•	O	WASH!
T4 Pause	T4	•	•	WASH!
T1 Analysis	T1	•	•	

Legend
 O = open
 • = closed

Table 2 - Sequence of cleaning phases

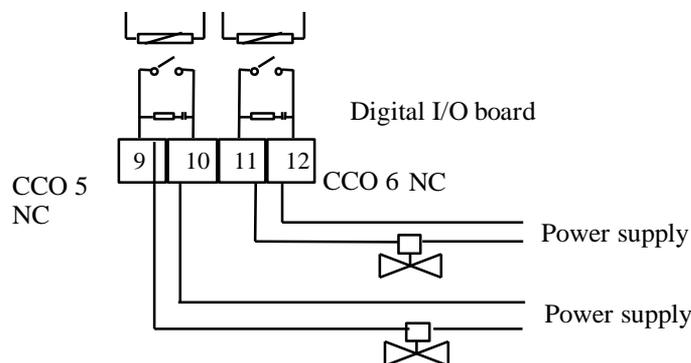
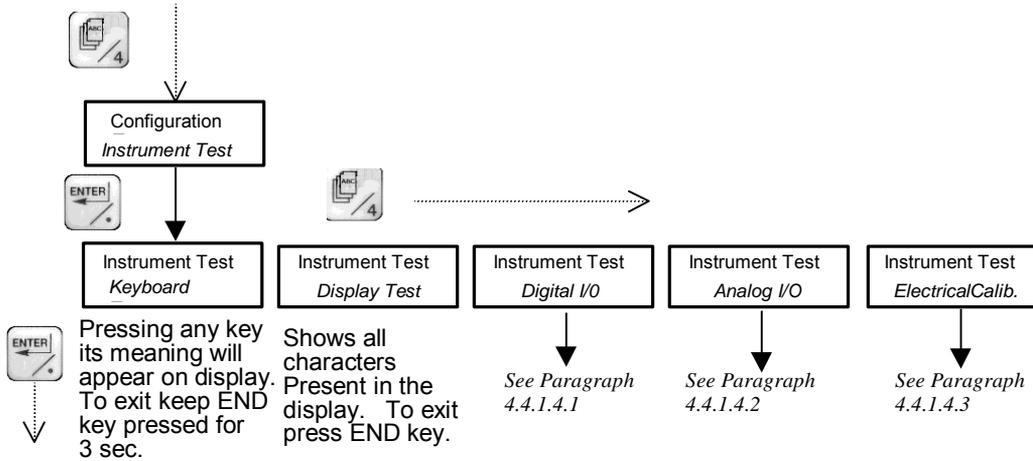


Fig. 10 - Connection of solenoid valves

4.4.1.4 Instrument test

This submenu which is part of the Configuration menu, allows to perform self diagnostic routines on AW400 basic functions, sensor check and AW400 electrical calibration.



Keyboard test: pressing any key the display will show the corresponding number (0...9) or function (ENTER, END). To exit this submenu press END key and keep it pressed for 3 seconds, until the display shows - - -.

Display test: once entered this submenu the display shows cyclically in all the 32 writing locations of the display all the characters present. To exit press END key.

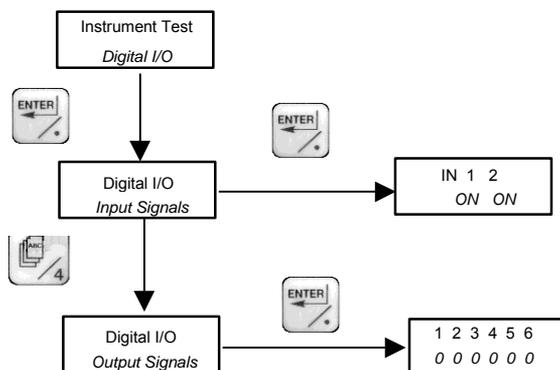
Digital I/O: see below

Analog I/O: see below

Electrical Calibration I/O: see below

Digital I/O Test

This submenu allows to verify the status and the correct functionality of the digital inputs and outputs:



Digital Input: Input signals submenu the display shows

```
" 1 2 "
```

```
" OFF OFF "
```

changing the status of one of the CCI by shorting the associated terminals (1-3 or 2-4) the display shows ON below the number of the associated CCI.

Digital Output: the display will show the status of the 7 output contacts (relay):

```
" 1 2 3 4 5 6 7 "
```

```
" 0 0 0 0 0 0 0 "
```

pressing the key corresponding to displayed number (from 1 to 7) the display will change the "0" in "1" or vice versa and the contact output status will be changed accordingly form "OPEN" to "CLOSE": verify with an ohmmeter the status of the pertinent CCO (see table 3).

Contact Number (CCO)	CCO1		CCO2		CCO3		CCO4		CCO5		CCO6		CCO7	
Terminal identification	1	2	3	4	5	6	7	8	9	10	11	12	13	14

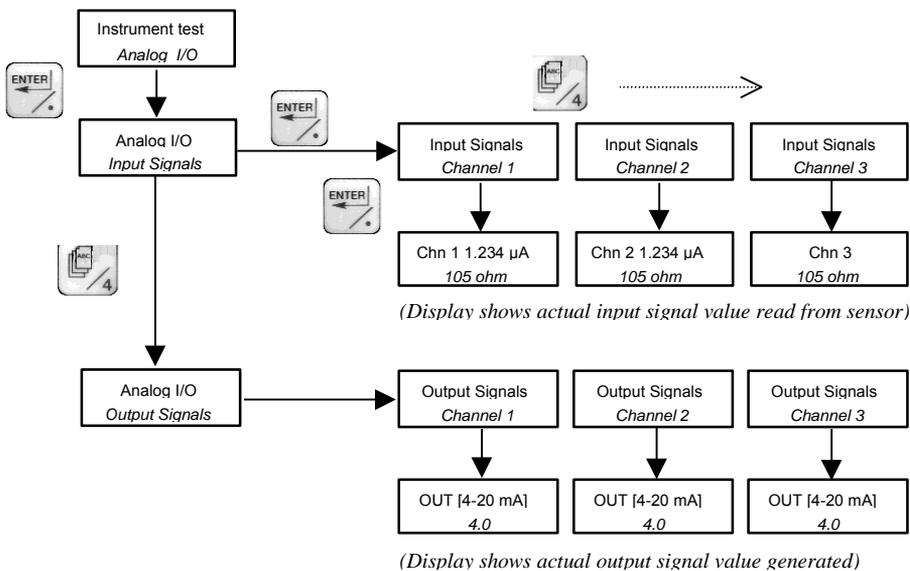
Table 3 - CCO Terminal identification

Analog I/O Test

The Analog I/O test allows you to verify the correct value of the input and output signals.

In the analog "Input" mode, the display shows the value of the signal generated by the sensor and the pertinent Pt100, in order to verify the correct sensor operation in an easy and fast way.

In analog output mode the instrument allows to check correct functionality of the 4–20 mA output: operating the OUT increase and OUT decrease keys the output value indicated on display can be changed and with a multimeter connected to the pertinent channel output [terminals 1(-), 2(+)] it can be verified that the current output changes accordingly.



Electrical calibration

The access to this menu is protected by a password that is only known to factory personnel, because the included parameters must never be tampered with.

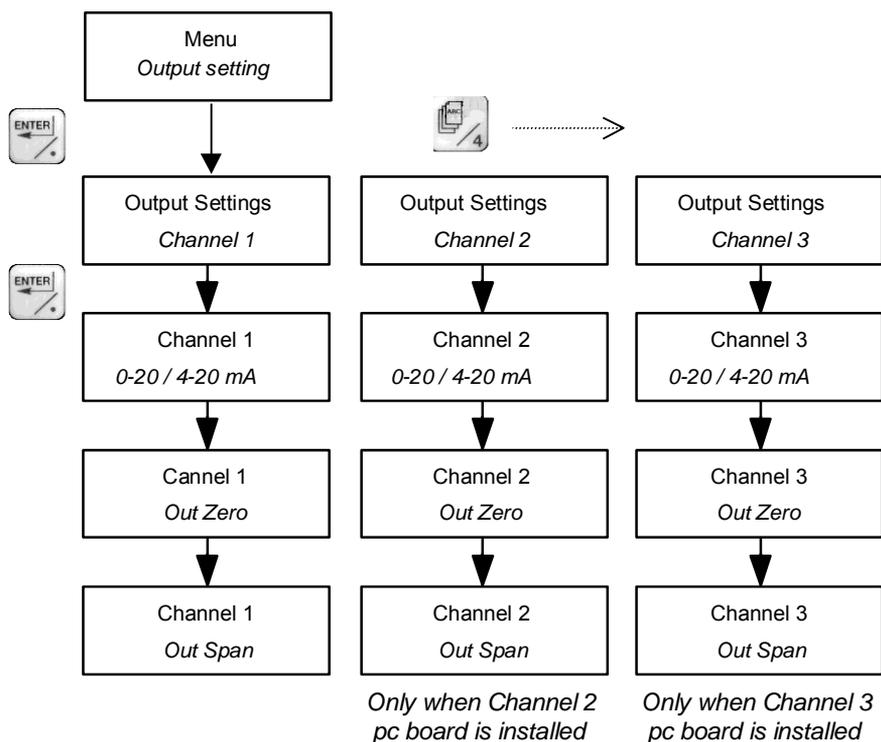
The electrical calibration is only performed in the Factory at the end of manufacturing process.

4.4.2 Output setting

The Output Settings menu allows to set current output (0–20 or 4–20 mA), zero (Out Zero) and full scale (Out Max) values, in engineering units. Out Zero value corresponds to 0 mA or 4 mA (according to the output chosen) and the Out Full Scale value to 20 mA.

WARNING! Set 0–20 mA or 4–20 mA accordingly. To modify output signal change Jumper JP1-JP2 as shown in Par. 4.4.2.1 – Fig. 11

(See Section 4.4 to get here)



In the following table the default values of Out Zero and Out Max are presented. Minimum span and maximum ranges are also presented.

Parameter	Unit	Out Zero	Out Max	Minimum Span	Maximum range
pH	pH	2.00	12.00	1.00	0.00–14.00
mV	mV	-500	+500	100	-1500–+1500
O3	ppm	0.00	1.00	0.25	0.00–10.00
Cl	ppm	0.00	1.00	0.25	0.00–10.00
CD	ppm	0.00	1.00	0.25	0.00–10.00
T	°C	-10.0	100.0	5	-20–+100
mA	mA	4.00	20.0	2	(0) 4–20.0

4.4.2.1 Output signal hardware modification 4 to 20 and 0 to 20 mA

To modify output signal from 4 to 20 and 0 to 20 mA make following hardware modification on Analog Input/Output board:

- Identify Jumper JP1 and JP2 on board (see figure 11);
- Remove JP1 (cut copper, this jumper is factory-made by default);
- Install Jumper in JP2 position.

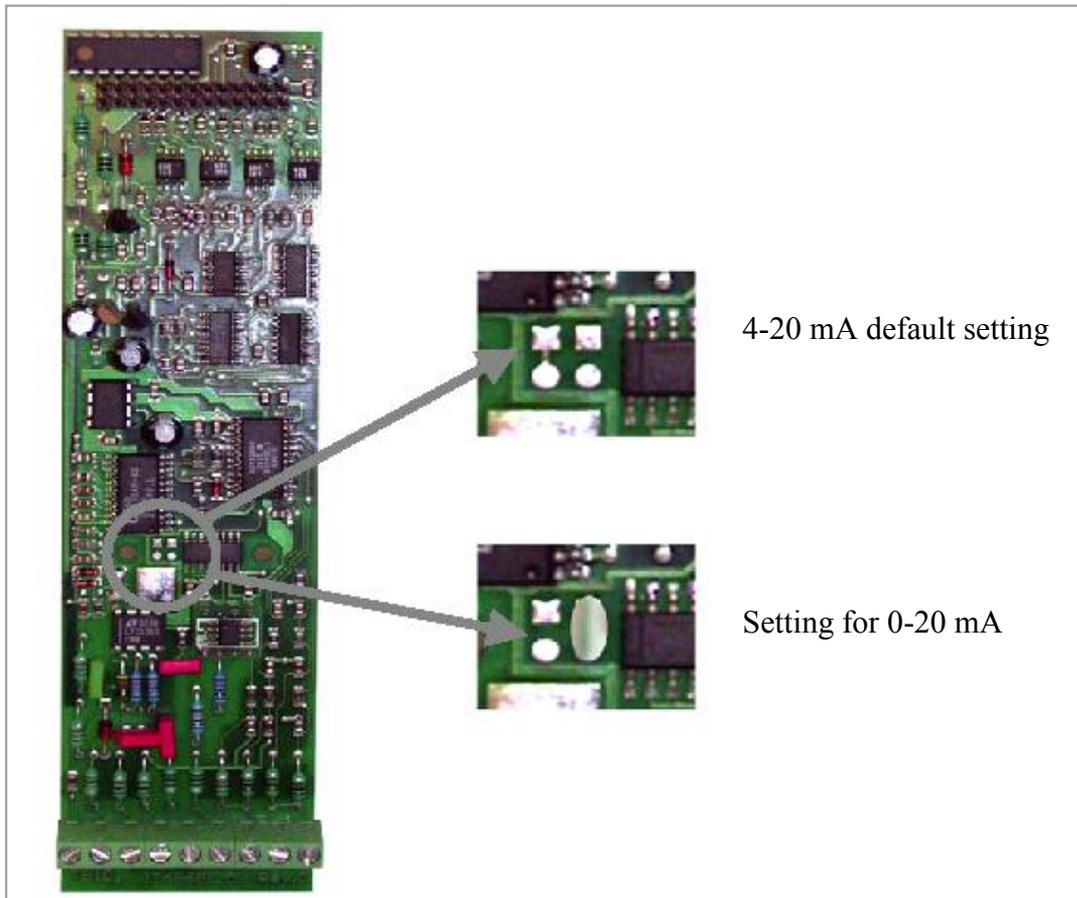


Fig. 11 - Jumper position for 4–20 to 0–20 mA output signal modification

4.4.3 Alarms

This menu allows to set high and low alarm levels and the dead band. The alarm levels are freely selectable by the user. Select the channel and press Enter to select alarms and dead band. Default levels are automatically related to the set range of output: low alarm is set at 10 % of Out Zero and high alarm is set at 90 % of Out Max (see the following table for default alarm setting values).

Parameter	Unit	Alarm		
		low	high	dead band
pH	pH	3.00	11.00	0.00
mV	mV	-450	+450	0.00
O3	ppm	0.10	0.90	0.00
Cl	ppm	0.10	0.90	0.00
CD	ppm	0.10	0.90	0.00
T	°C	10.0	90.0	0.00
mA	mA	6.40	17.60	0.00

Dead band is useful to avoid a repeated switch on and off of an alarm condition. The operation principle is represented in figure 12 below: if the measured value reaches the high alarm level, AW400 generates an alarm message, but a second alarm condition is triggered only after the measure lowers below the set dead band, and then rises again above the HI alarm level. A similar procedure of opposite sign is performed for low alarm.

To identify contacts for alarm retransmission, see the operation description for each instrument type in the following chapters.

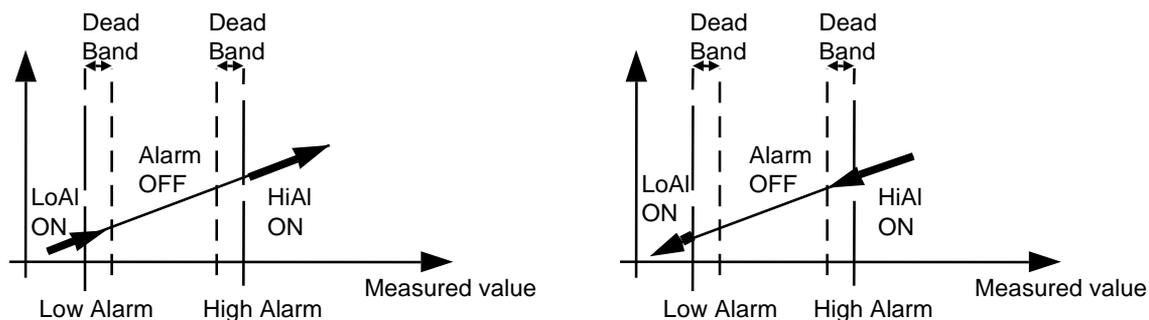


Fig. 12 - HI and LO alarm dead-band

4.4.3.1 Alarm Display

When an alarm occurs, the display indication will flash on and off to signal the alarm condition. By pressing the ENTER key, the alarm page will be called on display, and it will be possible to identify the channel and the alarm type. See Par. 9.1.3 for details.

5 FUNCTIONALITY

The different functionality of the instrument depends on the Model Number selected, and it can be classified in two main groups: Monitor-Indicator-**Transmitter** (AW401) or Monitor-Indicator-Transmitter-**Controller** (AW402).

5.1 Transmitter (AW401)

The transmitter can support up to three sensors, and the association of input/output signals depend on the configuration selected as per following tables.

Digital inputs:

CCI in 'OR' SELECTION	CC11	CC12
CCI in 'OR' = NO	Freezes measured value of Channel 1	Freezes measured value of Channel 2 (Channel 3 alone cannot be frozen)
CCI in 'OR' = YES	Freezes measured value of all Channels installed	Freezes measured value of all Channels installed

Table 4 - Digital Inputs Funcionality for Transmitter

Digital outputs:

Transmitter Type	CCO1	CCO2	CCO3	CCO4	CCO5	CCO6	CCO7
Without Cleaning	HI Alarm Ch. 1	LO Alarm Ch 1	HI Alarm Ch. 2 (1)	LO Alarm Ch. 2 (1)	HI Alarm Ch. 3 (2)	HI Alarm Ch. 3 (2)	Watch dog
With Cleaning	HI Alarm Ch. 1	LO Alarm Ch 1	HI Alarm Ch. 2 (1)	LO Alarm Ch. 2 (1)	Washing command	Washing command	Watch dog

Table 5 - Digital Output Funcionality for Transmitter

Analog Signal output 0/4-20 mA:

Instrument	Channel 1	Channel 2	Channel 3
Transmitter	Retransmission of analysis value for Sensor on Ch 1	Retransmission of analysis value for Sensor on Ch 2 (1)	Retransmission of analysis value for Sensor on Ch 3 (2)

Table 6 - Analog Output Funcionality for Transmitter

- (1) – Only when Channel 2 is installed
- (2) – Only when Channel 3 is installed

5.2 Controller (AW402)

The control strategies offered by the AW400 are:

- Standard PID Controller, with Feed Forward option
- Average Controller

These will be discussed in detail in the following paragraphs.

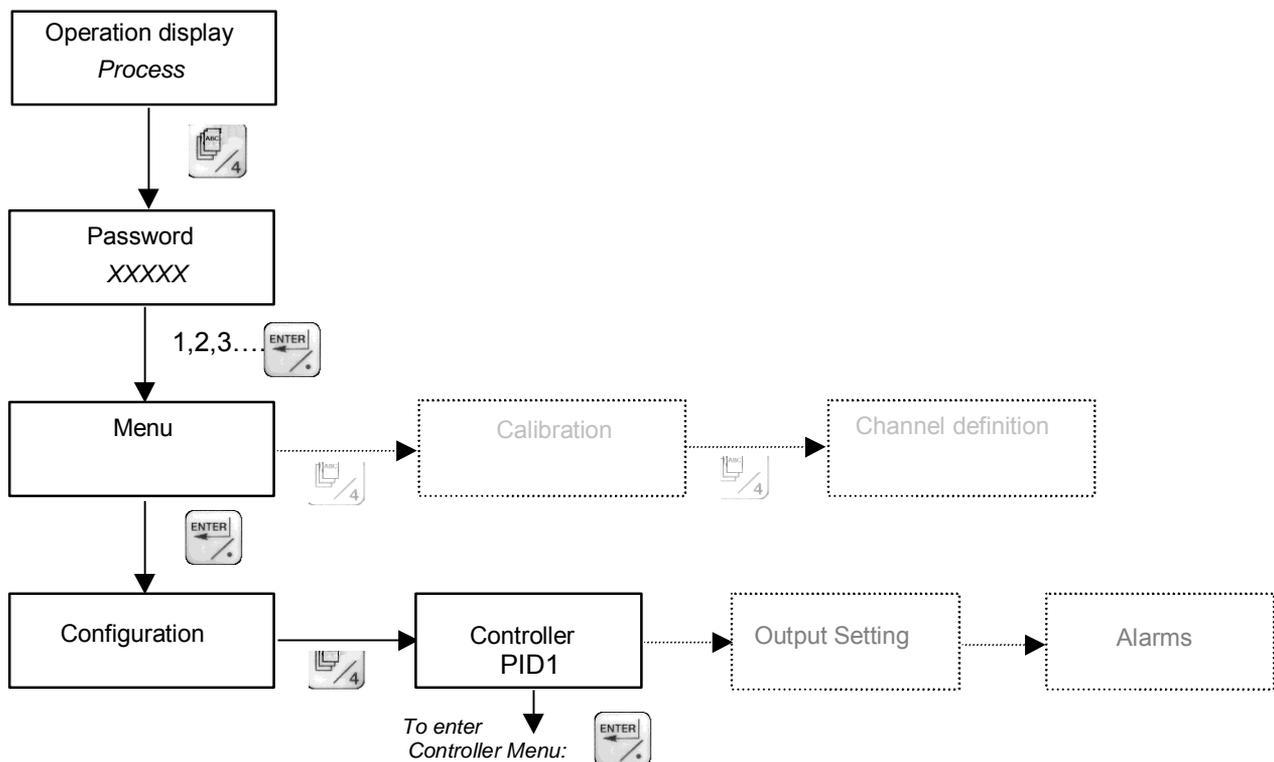
5.2.1 General description

The PID Controller of the AW400 is usable in the majority of process applications. In function of the difference between the analytic measure (Process Variable, PV), and a Set-point (SP) value, it calculates an Output (OUT), that is applied to a final control element (f.e. dosing pump) to restore actual process value to the set-point demand. The output is calculated with the PID algorithm, which has Proportional, Integral and Derivative actions. The effect these terms have on the calculated output is determined by the PID configuration.

The Controller can work in Automatic or Manual mode, pushing number 0 (zero). The Manual mode let the user modify the output manually, whereby the PID calculated output is not used. The output is driven with push-bottoms 1 (decrease) and 2 (increase). The Automatic mode is selected pushing button 5. The set-point is modified with the push-bottoms 6 (decrease) and 7 (increase). The output signal to drive the control element can be either a 4-20 mA analog signal or two contacts (increase-decrease). The user can choose to control the final element according to the characteristics of the device used. The END key consents to change the display to that of a different function.

5.2.2 Controller's Parameters

When the instrument is operating as a controller (AW402), the following menu become accessible:



Entering the Controller Menu the accessible parameters are presented as per the following table:

1 - General Parameters (valid for all control strategies)		
Description	Symbol	Configuration
4/20 mA / Contacts	-	Selection of controller output as analog 4/20 mA signal or Contact closure (See 5.2.2.5)
Proportional Band	PB	Numeric entry in % (Integer positive) Default: 100 - Range: 2% – 500%
Time Reset or Integral action	TR	Numeric Entry in minutes per repetition

		Default: 0 min/rep. – Range 0–30 min
Manual Reset (Active when TR=0)	MR	Numeric entry in % Default: 0 - Range 0–100%
Derivative	TD	Numeric Entry in minutes Default: 0 min – Range 0–10 min
Process Variable (display only)	PV	Engineering units
Set Point	SP	Engineering units Default: 0
Control zone	CZ	Numeric entry in Engineering units Default: 0
Direct/Reverse Action	RSW	D = Direct; R = Reverse
Span	SPAN	Value configured in output setting
<i>(Feed Forward parameters appear here if this option has been selected. - See Section 2 below)</i>		
High limit on controller's output	OH	Numeric entry in % Default: 100 - Range 0–100%
Low limit on controller's output	OL	Numeric entry in % Default: 0 - Range 0–100%

2 - Feed Forward action (this menu available only when option is activated – See Par. 5.2.2.2)		
Limit output as function of flowrate?	OHLF	Enter No/Yes Default: No
Factor to compute Max output based on Flowrate value	FFH	Numeric entry in %/100 Default: 1 (=100%)
Factor to compute Min output based on Flowrate value	FFL	Numeric entry in %/100 Default: 0 (=0%)
Absolute High limit on output when limits based on flowrate are active	MAX ABS.	Numeric entry in % Default: 100 - Range 0–100%
Gain factor applied on flowrate signal	GAIN	Numeric entry in % Default: 100 - Range 0–100%

3 - Sampling and/or Flow Pacing Controller (Process with dead time - this menu available only when Chlorine input Channel is selected – See Par. 5.2.2.3)		
Sampling based on flow?	TATP	Enter No/Yes Default: No
Scaling factor for flow	K	Numeric entry in Engineering units Default: 0
Active time	Att	Numeric Entry in minutes Default: 0 min – Range 0–10 min
Total Cycle time (or volume)	Cycle	Numeric Entry in minutes (or units sample) Default: 0

4 - pH/ORP control (this parameter compares when pH/ORP is selected – See Par. 5.2.2.4)		
Squared error control band	BAND	Numeric entry in % Default: 0 - Range 0–100%

5 - Contact output controller – (this menu available when option is selected - See Par. 5.2.2.5)		
Frequency / Relay	-	Function not supported at this time, leave always the selection "Relay"
Gain	GAIN	Numeric entry in %/100 Default: 1 (=100%)
Dead Zone	DZ	Numeric entry in Engineering units Default: 0
Cycle time	CYCLE	Numeric Entry in seconds Default: 0 sec

Table 7 – Controller Parameters

5.2.2.1 PID Parameters

Variations in controller action are obtained by adjusting of parameters associated with the control modes. These modes of control action that are combined to adjust the controller output signal are known as Proportional, Integral (Reset) and Derivative.

Proportional Action (PB)

Percent proportional band is the full scale though which the error signal must vary to cause full scale output variation due only to proportional control mode response. In Proportional Action there is a comparative relationship between the controller loop output signal magnitude and the calculated error, which is the difference between the process variable and the set-point. To properly use the proportional action follow these indications: if it is desired that a small percentage of deviation of the process variable causes a full scale output, the proportional band (PB) has to be set at a small value (high gain); on the contrary if it is required that a large percentage of deviation causes a small scale output the proportional band has to be set to a high value (low gain). Minimum value is 2%, maximum is 500%.

Integral Action (TR)

Integral action augments proportional action to cause a controller PID loop to drive its final control element until the deviation is completely eliminated. It produces a corrective signal proportional to the error and the length of time the controlled variable has been different from set-point. Integral action is expressed as the length of time in minutes required for it to produce an output change equal in magnitude to that produced by proportional action. The set of TR has to be in the following range: 0.02 minutes/repetition for the fastest action, 30 minutes/repetition for the slowest action.

Derivative Action (TD)

Derivative action augments proportional action by responding to the rate of change of the process variable. It is used to make each controller PID loop more responsive to sudden process disturbances. The derivative time in minutes is the amount of time by which the proportional action (or proportional plus integral action) is advanced. The minimum value for derivative action is 0.01 minutes for the fastest response, and the maximum value is 8 minutes for the slowest response.

Control Zone

This parameter is used to avoid continuous control adjustments for small fluctuation from set-point. If for example set-point is set to 7 and CZ = 1, control action is not active in the range 6.5 –7.5.

Manual Reset

This parameter represents the integral action set manually. It is activated by setting TR parameter to "0".

Direct/Reverse action

This parameter has to be set according to the final control element: select Direct if to an output increase has to correspond an increase in the final control element, select Reverse if to an output decrease has to correspond a increase in the final control element and vice versa.

Span

Is the measuring range used by controller.

Output High and Low limits

These parameters represent the absolute high and low limits allowed for the controller output. The output limits have to be set if required by the process. Default factory setting are: High Limit 100%, Low Limit 0%.

5.2.2.2 Feed Forward (FF) Configuration

The instrument will activate this function only if it detects the presence of a 4-20 mA input signal connected to Channel 2.

If flow rate is variable, proper control action has to take into consideration this variable, and this strategy is achieved with the Feed Forward action, which is calculated from a flow rate measure and it acts directly on the controller's output, anticipating the correction eventually generated by the controller's PID algorithm.

Flow rate measure is a 4-20 mA analog signal coming from an external flowmeter connected to channel 2. AW400 gives the possibility to calculate output limits as a function of the instantaneous flow rate. If this functionality is active the standard High and Low limits on the controller's output are automatically disabled. This functionality is useful when control action is aimed at the dosage of a reagent, as it prevents excess dosages in the case of low flow rate. High limit is calculated by the multiplication of FFH (Feed Forward High factor) and the instantaneous flow rate, low limit is calculated by the multiplication of FFL (Feed Forward Low factor) and the instantaneous flow rate.

Example:

Flow rate is 20 %; FFH is 1.5 and FFL is 0.5. Limits are 30% and 10% of the controller's output range. Absolute maximum limit of the control output is set with the parameter Abs. Max.

The Gain is multiplication factor of FF term.

5.2.2.3 Sampling and/or Flow Pacing Controller

Process with dead time, which is often the case for Chlorine dosage, can be best controlled with this strategy. Therefore this menu is made available automatically when the instrument detects that Chlorine input Channel has been selected, and it can be activated or deactivated at choice by the user.

Sampling control updates the PID function on a periodic basis (cycle) for a specified length of time (active time). The sampling rate is determined by time (time sampling) or the amount of product measured (adaptive sampling), the latter solution possible only when an external flowmeter is connected to Channel 2. To select "time sampling" set TATP parameter to "NO", to select "volume sampling (adaptive)" set TATP parameter to "YES". When volume sampling is selected, the parameter "K" becomes available: this is a factor corresponding to the flowmeter full scale value expressed in cubic meters (m³), and it can be set between 0 and 17000 m³.

The CYCLE parameters represent the complete control cycle and it has to be set in minutes (for time sampling) or m³ (for volume sampling), depending on TATP setting.

Active time parameter represent the period during which the PID parameters are updated in the cycle, and it must be set in minutes (for time sampling) or m³ (for volume sampling), depending on TATP setting.

Feed Forward action can be activated with this strategy, and it is operating regardless of the cycle phase, that is also when the controller is not in the active phase.

5.2.2.4 Error Squared Controller (pH Applications)

When the instrument detects that pH sensor has been selected for the controller, it enables a special PID algorithm with an “Error Squared” function. The error squared function is applied only within a band defined in the “BAND” parameter of the controller’s configuration menu. When the error is outside this band, the effective error is a linear response (see Fig. 13).

If “BAND” parameter is set to “0”, then the controller operates like a standard PID controller

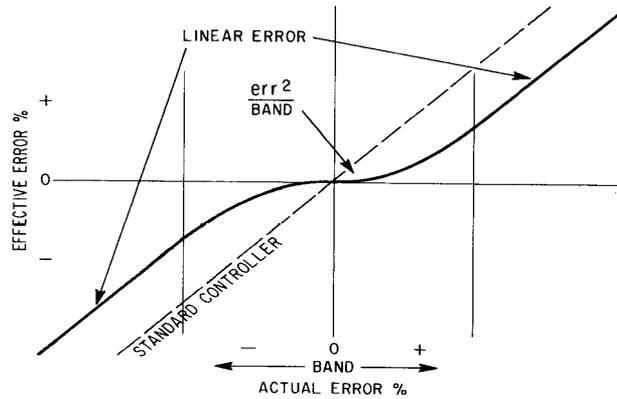


Fig. 13 - Error versus control band

5.2.2.5 Contacts Output Controller

This controller, also known as Proportional Speed Floating Controller, is particularly suitable for operation with an electrically motorised control valve, or dosing pump, and it actuates the final control element through output contacts closure rather than 4–20 analog signal. The controller performs process control through the velocity algorithm, a term that describes a control action in which the direction and rate of motion of the final control element is proportional to the deviation of the controlled variable from the set point.

In the control with contacts the PID algorithm is not active. and the output is calculated in function of the Gain parameter. The Gain parameter is functionally similar to the Proportional Action; explaining with an example, considering constant the difference between set-point and process variable, contact will be closed longer if Gain parameter is low , while it will be closed shorter time if Gain parameter is high.

Gain is defined as:
$$\frac{\% \text{ output duty cycle}}{\% \text{ input deviation}}$$

Time cycle parameter represents the duty cycle of the contact output. Its action is similar to the Integral Action (TR) , in fact it represents time (expressed in seconds) of a cycle of control. Considering the difference constant, if it is set to a high value the control action will be slow, while if it is set to a low value the control action will be faster.

Dead Zone parameter represents the range around set-point where control action has no effect. So, when the difference between process variable and set-point is lower than this value contacts are kept open.

The contacts used by the controller to drive the final element are assigned as per the following table:

PID 1		PID 2 (optional)	
CCO 3	CCO 4	CCO 5	CCO 6
Decrease	Increase	Decrease	Increase

Table 8 - Contacts Output Controller assignment

5.2.3 Standard Controller

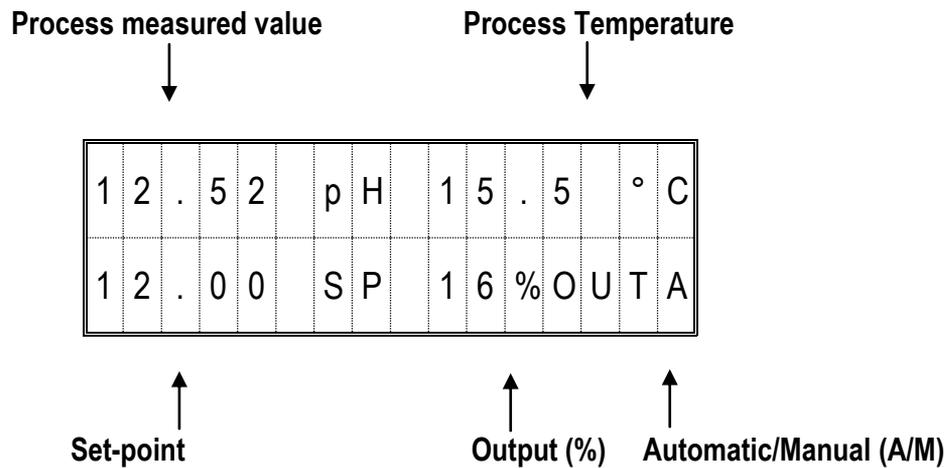
This section deals with the functionality which is specific of the standard controller.

5.2.3.1 Std Controller Display

The standard controller display shows the following values:

- Instantaneous value of process variable measure
- process variable temperature (not present for ORP sensor)
- set-point
- output signal value
- Controller status: A/M (A = Automatic, M = Manual).

Fields of display are configured as in the following draft:



If the instrument is configured to perform additional functions beside operating as a controller, for example to monitor another parameter with a second or third sensor installed on channel 2 or 3, the indication of these values can be called on display by pressing the key END, which will cycle through the different displays available, and eventually back to the controller display

5.2.3.2 Std Controller Analog Output assignment

The assignment of the analog output signals depends on the number of channels installed and on the type of configuration selected for the controller output, whether it is to operate on a 4–20 analog signal or on contacts closure, as per the following table:

Type of Controller	Output option	4–20 mA Channel 1	4–20 mA Channel 2	4–20 mA Channel 3
Controller AW402 With 1 Channel installed	Analog output	PID Control output	---	---
	Contacts output	Measured value retransmission of Channel 1 analysis		
Controller Mod AW402 With 2 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	---
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	
Controller Mod AW402 With 3 Channels installed	Analog output	PID Control output	Measured value retransmission of Channel 1 analysis (1)	Measured value retransmission of Channel 3 analysis
	Contacts output	Measured value retransmission of Channel 1 analysis	Measured value retransmission of Channel 2 analysis (1)	

(1) If the two sensors/channels are identical, and the PID option is selected on Channel 2, the output becomes the average of the two measured values

Table 9 - Std Controller Analog Outputs

5.2.3.3 Std Controller Digital Input assignment

The Digital Input functionality is identical for all type of instrument selected, as per following table:

CCI in 'OR' SELECTION	CCI1	CCI2
CCI in 'OR' = NO	Freezes measured value of Channel 1	Freezes measured value of Channel 2 (Channel 3 alone cannot be frozen)
CCI in 'OR' = YES	Freezes measured value of all Channels installed	Forces to 0 PID1 output signal

Table 10 - Digital Input Functionality for Controller

5.2.3.4 Std Controller Digital Output assignment

The assignment of the digital output signals depends on the number of channels installed, on the type of configuration selected, for the controller output, whether it is to operate on a 4–20 analog signal or on contacts closure, and on the cleaning option configuration, as per the following table:

Controller Type	CC01	CC02	CC03	CC04	CC05	CC06	CC07
Controller Model AW402 Without Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	HI Alarm Ch. 3 (if Ch. 3 installed)	LO Alarm Ch. 3 (if Ch. 3 installed)	Watch dog
Controller Model AW402 Without Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch 1 (1)	PID control output (decrease)	PID control output (increase)	HI Alarm Ch. 3 (if Ch. 3 installed)	LO Alarm Ch. 3 (if Ch. 3 installed)	Watch dog
Controller Model AW402 With Cleaning Analog output PID	HI Alarm Ch. 1 (1)	LO Alarm Ch 1 (1)	HI Alarm Ch. 2 (2)	LO Alarm Ch. 2 (2)	Washing command (See Par. 4.4.1.3)	Washing command (See Par. 4.4.1.3)	Watch dog
Controller Model AW402 With Cleaning Contacts out PID	HI Alarm Ch. 1 (1)	LO Alarm Ch 1 (1)	PID control output (decrease)	PID control output (increase)	Washing command (See Par. 4.4.1.3)	Washing command (See Par. 4.4.1.3)	Watch dog

(1) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is based on the average of the two/three measured values

(2) If two/three identical sensors/channels are installed, and PID option is selected on Channel 2/3, the alarm is triggered by the first of the two/three measured values that reaches the alarm level configured (first-out functionality).

Table 11 – Std. Controller Digital Output assignments

6 CALIBRATION

Calibration is required to align the sensor sensitivity. This operation is necessary at the start-up of the instrument and at periodical intervals. New sensors have to be let in operation for at least 24 hours, to allow the electrode to recover complete sensitivity, before performing the calibration procedure.

6.1 Calibration Procedure

When the instrument is powered up or when a channel is changed, the following message is displayed:

-calib-

To access the calibration procedure press the button MENU and insert the password, as shown in the diagram at Paragraph 6.1.2. If the password is not correct, the access to the menu is refused and the following message is displayed: **-Access denied!**

If the code is the one previously set, it is possible to access to the Menu.

If problems are encountered during the calibration procedure, pressing the END key the calibration procedure is aborted and the display returns to the main menu.

WARNING !



If the calibration procedure is aborted, the read out value may become unpredictable.

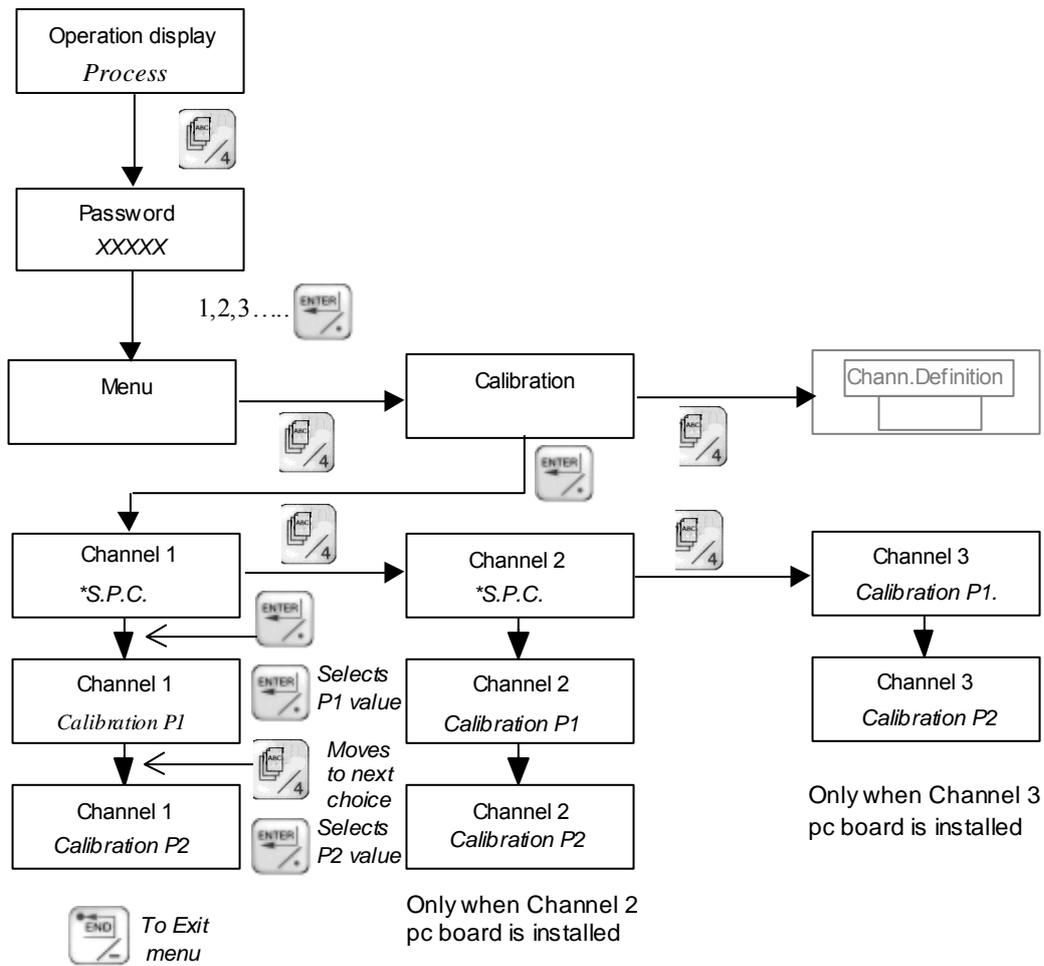
6.1.1 Calibration Menu

Calibration menu allows a dual point calibration procedure for the Monitors. In every dual point calibration, the first number (P1) is the lower value point, and the second (P2) is the higher value point. The instrument has P1 and P2 values assigned by default, as shown in the table 12. P1 and P2 values can be changed by the user and have to be distant enough. Single point calibration (S.P.C.) is available for pH Monitor.

Parameter	P1 point value	P2 point value
PH	7.00	4.00
MV	-500	+500
O3	0.00	1.00
Cl	0.00	1.00
CD	0.00	1.00
T	0.00	100.00
mA	4.00	20.00

Table 12 - Default calibration values

6.1.2 Calibration Menu Flow Chart



* Only when pH parameter is selected

6.1.3 pH Sensor Calibration

The calibration procedure is necessary to standardise the sensor sensitivity.

The double point calibration gives the maximum accuracy because it allows to set both the slope and the offset of the curve giving displayed pH value as a function of the mV from the probe (sensitivity), $pH = f(mV)$. The first point can be calibrated by 7 pH buffer solution (0mV) and the second point can be calibrated by 4pH buffer solution.

6.1.3.1 Double point calibration

The calibration procedure involves a series of operation on the pH probe and the transmitter. The following description explains indicates step by step the calibration procedure.

To operate the calibration the following material is necessary:

- two plastic or glass beakers
- standard buffer solution, pH 7 and pH 4 or other, (see paragraph 6.1.3)
- de-mineralised water
- a thermometer

Put the two standard buffer solutions in two beakers in a sufficient amount to cover the sensor. Wash the probe with de-mineralised water, dry it and dip it in the standard pH 7 buffer solution. Stir softly but continuously the probe: in this way a lower stabilisation time will be required.

Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the pH probe. The display will show:

X	X	.	X	X	p	H		2	3	.	5	°	C
P	1	:						Y	Y	.	Y		

P1 indicates the first point of calibration at HIGHER pH (pH 7). XX.XX is not a REAL pH value, but it shows when stability of measure has been reached. YY.Y is a value set at the last calibration and can be freely modified according to the chosen buffer solution. Press ENTER and insert the correct value. Wait 3 minutes after the measure in XX.XX has stabilised (XX.XX is stable), then press ENTER to save the value (press END if you don't want to save the value).

If the following message appears:

-Bad Input!

It means the buffer solution is bad since the mV generated are too close.

Pass on to the second point (P2) of calibration pressing the MENU key. Take the sensor out of the 7 standard buffer solution, rinse it thoroughly with de-mineralised water, dry it and immerse it in the 4 pH std buffer solution. Stir softly but continuously the probe: in this way a lower stabilisation time will be required. Wait till the value in XX.XX is stabilised (XX.XX is stable) and correct the pH value in YY.Y. Confirm by pressing the ENTER key. Previously stored values are overwritten in not volatile memory. To start the measure press the END key and the display will show the actual measured value.

6.1.3.2 Single point calibration (S.P.C.)

The single point calibration may be performed ONLY IF A DOUBLE POINT CALIBRATION HAS ALREADY BEEN PERFORMED. The single point calibration is a fast procedure to correct the sensitivity of an instrument leaving it working in field; however it's less accurate than the double point calibration and must be performed as near as possible to the pH value of the process liquid. The single point calibration corrects the intercept of the $pH = f(mV)$ curve, but doesn't vary its slope.

To perform the single point calibration, measure the pH value of the process fluid near the location of the sensor (if it is constant during the time interval needed for the calibration). Insert the pH value in YY.YY. Entering the Calibration menu the following display will appear:

X	X	.	X	X	p	H		2	3	.	5	°	C
p	H		S	P	C	:		Y	Y	.	Y	Y	

When a double point calibration is performed the S.P..C value is forced to 0.00.

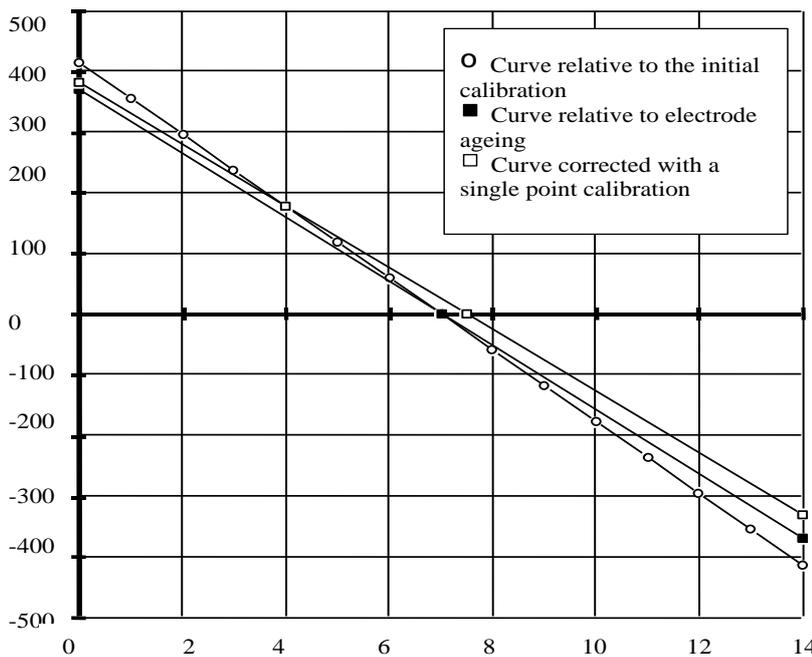


Fig. 14 - pH Calibration curves examples

NOTE :

Single point calibration corrects the sensitivity in the zone where the correction is made. It is therefore necessary to operate single point calibration as near as possible to the process fluid pH value.

IMPORTANT : THESE CURVES ARE ONLY A THEORETICAL REPRESENTATION, NOT BASED ON EXPERIMENTAL VALUES.

6.1.4 ORP Sensor Calibration

The calibration procedure is necessary to standardise the sensor sensitivity. The double point calibration gives the maximum accuracy because it allows to set both the slope and the offset of the curve giving displayed ORP value as a function of the mV from the probe (sensitivity).

The calibration of ORP Monitor is not usually required, however the two point calibration procedure is foreseen in the transmitter software.

NOTE: Calibration procedures are different if the arrangement "oxidation potential with negative value" or "oxidation potential with positive value" is used. Both are described in the following pages.

The calibration procedures involve both the electronic transmitter and the sensor. The following description indicates step by step the double point calibration procedure:

To operate the calibration the following material is necessary:

- two plastic or glass beakers
- standard ORP solutions.

Pour the two standard ORP solutions in two beakers in a sufficient amount to cover the sensor. Wash the probe with de-mineralised water, dry it and dip it in the first buffer solution. Stir softly but continuously the probe : in this way a shorter stabilisation time will be required.

6.1.4.1 "OXIDATION potential with NEGATIVE values" arrangement

P1 will be the value of the oxidant standard solution, and P2 the value of the reductant standard solution. In case both the standard solution have the same sign, P1 will be the standard solution with the lower value.

Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the ORP probe. The following display will appear:

X	X	.	X	X	R	X		2	3	.	5	°	C
P	1	:						Y	Y	.	Y		

P1 indicates the first point of calibration. XX.XX is not a REAL value, but it shows when stability of measure has been reached. YY.Y is a value set at the last calibration and can be freely modified according to the chosen buffer solution. Press ENTER and insert the correct value. Wait 3 minutes after the measure in XX.XX has stabilised (XX.XX is stable), then press ENTER to save the value (press END if you don't want to save the value).

Pass on to the second point (P2, higher value) of calibration pressing the button MENU. Take the sensor out of the first standard solution rinse it thoroughly with de-mineralised water, dry it and immerse it in the second standard solution. Stir softly but continuously the probe: in this way a shorter stabilisation time would be required.

Wait until the measurement is stabilised (no more variations of XXXX shown on the display). If needed, correct the ORP value pressing the ENTER key and inserting the correct value, according to the second buffer solution ORP value. If you want to save these values push the ENTER key. If you don't want to save above mentioned calibration parameters press END. If the ENTER key is pressed new calibration data are overwritten to previously stored values in not volatile memory.

To start the measure press the END key and the display will show the measured value.

NOTE:

The calibration procedure can be performed also at two values which are outside from the measuring range selected, depending on the buffer solutions which are available for the calibration.

6.1.4.2 "OXIDATION potential with POSITIVE values" arrangement

Calibration is similar to the previous one but P1 is the value of the reductant standard solution, and P2 the value of the oxidant standard solution. In case both the standard solution have the same sign, P1 will be the standard solution with the lower value.

6.1.5 Chlorine / Chlorine Dioxide / Ozone

The calibration procedure is necessary to standardise the sensor sensitivity. The calibration procedure allows to set both the slope and the offset of the curve giving the chlorine/chlorine dioxide/ozone concentration as a function of the μA from the cell (sensitivity).

The ABB Monitor allows an easy two point calibration and the two points can be freely chosen, provided they are distant enough and inside the selected measuring range. In this way the instrument is given all the parameters it needs to fix the calibration curve. The calibration procedures involve both the transmitter and the sensor.

The following description indicates step by step the calibration procedure:

If the sensor is a new one leave it working for 24 hours so that the electrodes can gain the correct sensitivity.

Press the MENU key to enter the Instrument Calibration submenu and enter the CALIBRATION menu and then the channel of the ORP probe. The following display will appear:

X	X	.	X	X	C	I		2	3	.	5	°	C
P	1	:						Y	Y	.	Y		

P1 (YY.Y) indicates the first point in calibration (the lower one), XX.XX is a chlorine/chlorine dioxide/ozone concentration reading. This reading, however is not a REAL value, but it's based upon calibration parameters previously stored. XX.XX serves as an indication of the stability of the measure. 0.000 is a default ppm value and can be freely changed. YY.Y is a value set at the last calibration and can be freely modified. Press ENTER and insert the correct value.

Open the sample flow to the cell, with a chlorine concentration zero or near zero. Let the system stabilise and then take a sample from the drain tube. Perform laboratory analysis of the chlorine species being measured (free or total) or of the chlorine dioxide concentration. Correct the 0.000 if needed according to the lab analysis. Confirm with the ENTER key.

If the following message appears:

-Bad Input!

It means the buffer solution is bad since the mV generated are too close. This message can be ignored by pressing the END key.

If ENTER is pressed new calibration data (e.g. μA corresponding to the displayed ppm value) are overwritten to previously stored values in not volatile memory

Pass on to the second point (P2) of calibration pressing the button MENU.

Allow a sample flow to the cell with a chlorine/chlorine dioxide concentration as near as possible to the chosen full-scale, let it stabilise for some minutes (it depends upon the plant configuration) and then take a sample from the drain tubing.

Analyse the solution for free or total chlorine or for chlorine dioxide, (depending upon the kind of measure the Monitor is operating).

Correct the displayed ppm value in YY.Y according to the lab analysis as previously explained. If you want to save these values (storing the values of μA corresponding to the measured chlorine concentration) push ENTER. If you don't want to save above mentioned calibration parameters push END. So forth, previously stored parameters aren't destroyed and they remain still valid for the computation (if the range setting has not been changed).

To start the measure press the END key and the display will show the measured value.

REMARK :

if the sample is a chlorine dioxide solution and the displayed indication is desired to be in "ppm ClO₂" multiply the DPD analysis reading by 1.9.

WARNING !



It is advisable to repeat the calibration after 24 hours and after 2 or 3 days.

7 START UP

WARNING !



Maintenance staff must be authorised by Customer and must know in details the content of the present Instructions Manual.



CAUTION!

Disconnect Power Supply before opening the transmitter covers.

Before start up it is recommended to verify the following points:

- Verify that the installation has been performed according to the section 3.3 of the present manual.
- Verify that the power supply is in accordance with the value indicated in the instrument label.
- Verify that the electrical wiring has been properly completed according to the recommendations mentioned in section 3.4 of the present document.
- Verify that power-up of the instrument will not cause any uncontrolled action related to the items eventually connected to the output signals (i.e. dosing pumps, operating valves, fume extractors).
- Verify that the probes connected to the instrument are properly installed and wired according to the instructions indicated in the specific manual.

7.1 Preliminary operations



CAUTION!

The transmitter must be closed before being powered up.

7.1.1 Getting started

Power the transmitter up and perform the following steps:

1. Turn on power supply;
2. Enter Configuration menu and set the desired language for the display messages;
3. If the displayed measured value is not in agreement with the connected sensor(s) enter the Channel Definition menu, and set, for each installed channel, the correct type of measure. Refer to Sect. 4.3;
4. Verify that the selected measuring ranges correspond to the desired values; if not, modify ranges as needed;

5. If the alarm levels are required at values that are not the 10 % and 90 % of measuring range, enter the Alarms menu and set Low Alarm and High Alarm level as required. Refer to Sect. 4.4.3;
6. Verify that all Configuration parameters are set as required (See Sect. 4);
7. Once the sensor(s) sensitivity is stabilised the calibration procedure(s) has to be performed to standardise the transmitter together with the connected sensor(s);
8. During the first 4 days of operation, it is suggested to verify every day the reading of the Monitor, and repeat calibration if necessary;
9. Now the Monitor is in operation. It is important repeat periodically the maintenance procedures detailed in the I.B. pertinent to each sensor.

7.1.2 Personalization of Parameters

1. If the Input / Output digital contacts are used, enter the Configuration menu and set the NO or NC status of the contact as desired;
2. It is important to remember that any device connected to the digital output must be arranged in order to operate in fail safe condition;
3. If the Serial Communication option has been selected, enter the Configuration menu and set the desired instrument address, baud rate and selected communication port ;
4. Select the desired engineering unit for the temperature indication;
5. If it is desired to operate the controller with the average value of 2 or 3 identical sensors, select PID in the Channel installation menu;
6. If it is desired that the transmitter calculates the difference between two identical sensors input values, set a value in the "Delta" parameter;
7. If required, select a dumping value for each channel input;
8. Modify the "Password" in the Configuration menu, if it is desired to set a personalised access code.

7.2 Controller PID tuning

The PB, TR, and TD constants are preset to the default values shown in Table 7. If desired the control action setting can be optimized by using a trial and error method as outlined below.

1. Set process to approximately normal conditions in MANUAL;
2. Preset constants to some acceptable starting point for the process. For example
 - PB = 500
 - TR = 100
 - TD = 0
3. Switch Controller to AUTO mode;
4. Decrease the PB setting to $\frac{1}{2}$ the previous value. Then, alter the set point 2% by pressing one of the set point pushbuttons;
5. Check that the process indication value does not oscillate;
6. Continue to decrease the PB setting by a factor of 2, altering the set point between steps until a point is reached where process cycling is just evident. Then increase the PB setting by a factor of 2;
7. Introduce Automatic Reset slowly by decreasing TR until cycling starts;
8. Increase TR to approximately 1,5 times the value obtained in 7) above;

When PID tuning constants have been selected, the controller is ready for on-stream operation. Optional PID tuning methods may be desired for slow response processes .

8 MAINTENANCE

AW400 housing can be externally cleaned with a cloth slightly wetted with alcohol and water, paying attention not to damage the keyboard.



CAUTION!

Do not use acids, chemicals solvents and organic substances for AW400 cleaning.

8.1 Periodical operations

All Monitors need cleaning of the sensors at periodical intervals, this depends on type of sensor and process characteristics. For further details refer to the specific sensor Instruction Manual. The Monitors also need periodical check of sensitivity and calibration if required.

8.1.1 Automatic sensitivity check during dual point calibration

During dual point calibration, and if no one of the two points is bypassed, AW400 performs an automatic sensor sensitivity check. If the sensitivity is too low the display will show the message Bad In. Refer to the I.B. pertinent to each specific sensor for details on how to fix the problem. If the message Fault appears the signal generated by the sensor is abnormally high. Refer to the I.B. pertinent to each specific sensor for details on how to fix the problem.

8.1.2 Sensor signal check

The signal generated by the sensor and by the temperature sensing element can be directly read (in μA or mV and in Ω) on AW400 display simply by entering the Analog I/O, input signals submenu, under Instrument Test submenu. This is a very easy way to define if the sensor is correctly working just verifying its signal and comparing it to a lab analysis of the measured value. See the pertinent I.B. for nominal signal to be expected from each type of sensor.

8.1.3 Other checks

Accessing to the menu at section INSTRUMENT TEST, is possible to verify the instrument features. Refer to section 4.4.1.4. for further details.

9 ERROR MESSAGES & TROUBLESHOOTING

Different levels of messages are generated by the instrument at need.

9.1 Messages

At power up, the AW400 instrument shows the following sequence of messages:

"MicroChem II"

"S.Rel...."

"Transmitter"

9.1.1 Operation messages

Messages displayed during operation to clarify what AW400 is doing.

"Loading default database"

is shown when a reset has been performed. After some seconds the instrument goes to normal display mode.

"-calib-"

is shown when the instrument is powered up and when a Channel has been changed. After some seconds the instrument goes to normal display mode.

"---wash---

flashing is displayed when the instrument is performing a cleaning sequence. "---wash---" is alternated to a value that is the last measure before the starting of the cleaning sequence.

Both the displayed measure and the 4–20 mA output signal are frozen at that last value.

"Access denied"

is displayed when the inserted password is not correct.

"password"

is displayed when the menu key is pressed: the correct password must be entered in order to access the menu.

9.1.2 Error messages

These messages are displayed when something is not correct in the unit.

"Error, no analog input"

is displayed when analog I/O pc board are missing (or contact in their connectors is failing).

"BadIn"

is displayed if the input signal generated by the sensor is too low, that is the sensitivity is too low.

"Fault"

is displayed if the signal generated by the sensor is too high.

"RTFault"

is displayed when the Thermo resistance is faulty and the instrument is currently using the default temperature value

"Red LED lit (Watchdog)"

When Red LED watchdog is lit it means the microprocessor circuit is faulty.

9.1.3 Alarms page

It is accessed by pressing the Enter key in display mode.

If no alarm or no abnormal condition is present the display will show nothing.

The following messages are displayed with the indicated meaning:

A1L = low alarm on channel 1

A2L = low alarm on channel 2

A3L = low alarm on channel 3

A1H = high alarm on channel 1

A2H = high alarm on channel 2

A3H = high alarm on channel 3

=∂= = the value set for delta has been overcome

AVE = the instrument is computing the average of two measures (same parameter) and the averaged value is indicated on the first line of the display instead of the measure of the first channel

Stop = When CCI in OR parameter is set to YES it means that output(s) is(are) frozen because either CCI1 or CCI2 or both is(are) closed.

Run = When CCI in OR parameter is set to YES it means that output(s) is(are) working (not frozen) because CCI1 and CCI2 are both open.

10 SERIAL COMMUNICATION

Note: This section applies only to instruments equipped with the *optional* Serial Communication P.C. Board.

10.1 Standard of Communications

Two digital communication standard are supported by the serial communication board of AW400, one port is an RS232 serial interface and the other is an RS 422/485 serial interface. Only one port at a time can be activated, and the selection of the desired standard is made via software at the Configuration Menu.

The Factory default setting is RS 422/485, which allows up to a maximum of 32 instruments to be connected to the same Data-link, where each instrument must have a unique address number ranging from 00 to 31 (Factory setting is 00).

The RS 232 standard can be selected for a peer to peer communication mode.

Transmission speed can be adjusted between 1200 and 28800 baud in the Configuration Menu; default setting is 28800, asynchronous by character.

One character can be defined as either one of the following two modes:

Mode 1 - (Standard PC mode - Default setting by Factory):

- 1 Start bit;
- 8 Data Bits – the Least Significant Bit (LSB) is transmitted first;
- 1 Stop Bit.

Mode 2 - (Optional setting):

- 1 Start bit;
- 8 Data Bits – the Least Significant Bit (LSB) is transmitted first;
- 1 Even Parity bit
- 1 Stop Bit.

NOTE: When operating in RS232 mode, the character definition must be set as Mode 1.

Mode 2 is active optionally only when operating in RS485.

To modify this selection, enter the Configuration menu and select the RS585 mode: the menu will ask to select Mode 1 or Mode 2. When Mode 1 is selected and the communication is to work in RS232, remember to set RS232 again in the menu after having selected "Mode 1" from the RS485 menu.

10.1.1 Software characteristics

1. All transactions are initiated by the Host: The AW400 can only work as a **responder** to Host commands (Interrogate or Change).
2. All AW400 begin their response within 10 ms after the end of the transmission by the Host, otherwise a faulty transmission may be assumed.
3. The maximum number of data bytes per message is 32 (decimal).
4. Data type are made up of 1 (logical), 2 (integer), 4 (floating point) bytes or string type, with string length bytes, according to Intel Format.

10.1.2 Communication Protocol

The communication protocol requires the Host to initiate all transactions. There are two basic categories of message types: *Interrogate* , which is used to read data from an addressed AW400, and *Change* , which is used to alter a value in an addressed AW400. The addressed instrument decodes the message and provides an appropriate response. The protocol definitions for the message types are provided in the following table:

Message Field Definition		
Symbol	Title	Definition
SOH	Start of Header	This character, 7E, denotes the beginning of a message
I.A.	AW400 Address	The address of the AW400 responding to the transaction. It must be within a range of 00-1F (00-31 decimal).
CMD	Command	Is the operation to be performed or a description of the message that follows the Command-I.A. byte. The Command-I.A. byte has two fields: the Command field (3 bits), and the I.A. field (5 bits). There are the following commands type: Interrogate Change Acknowledge Response The command descriptions are covered in the following section.
NUM	Number	The number of data bytes transferred or requested. The NUM must be in a range of 00-32 decimal.
LO-ADD	Lower Address Bits	The least significant 8 bits of a 16 bit address in the AW400 database (*)
HI-ADD	Higher Address Bits	The most significant 8 bits of a 16 bit address in the AW400 database (*)
DATA		An 8 bit data type
XXXX		Represents a variable number of data bytes
LRC	Longitudinal Redundancy Character	Is a character written at the end of the message that represents the byte content of the message and is checked to ensure data was not lost in transmission. Is the sum of all bytes Modulo 256 of the message not including the SOH character or its own bit setting (LRC)

(*) The addresses of the single variables to be accessed in the AW400 database are listed in the following pages.

10.1.3 Message Types and Commands Description

The types of messages that are sent between the host and the AW400 are formatted as follows:

Host to AW400

1. Interrogate – This message requests up to 20H consecutively stored bytes, beginning at the specified memory address location of the addressed AW400.

01111110 E0H + I.A. NUM LO ADD HI ADD LRC

2. Change – This message sends up to 20H bytes of new data to the addressed AW400.

01111110 A0H + I.A. NUM LO ADD HI ADD Data 1 XXXXXXX Data N LRC

3. Acknowledge – This message signals the addressed AW400 that its last echoed change message was received correctly; the AW400 performs the change requested.

01111110 80H + I.A.

AW400 to Host

1. Response – This message furnishes the data requested by the INTERROGATE command of the Host. It is also used to echo back the previous CHANGE message of the Host.

01111110 20_H + I.A. NUM LOADD HIADD Data 1 XXXXXXX DataN LRC

10.2 Communication Transaction Examples

10.2.1 Transaction A Example

Host requests 9 bytes of data beginning at hexadecimal memory address 1000_H from the AW400 at data-link address 03:

1. Host sends **interrogate** message:

```
01111110 11100011 00001001 00000000 00010000 11111100
SOH      Command NUM      LO ADD  HI ADD      LRC
          + I.A.
```

2. AW400 sends **response** message:

```
01111110 00100011 00001001 00000000 00010000 XXXX XXXX XXXX LRC
SOH      Command NUM      LO ADD  HI ADD      Data 1 .....Data 9
          + I.A.
```

10.2.2 Transaction B Example

Host sends two bytes of new data, to be loaded into the AW400 at data-link address 03 beginning at hexadecimal memory address 1000_H:

1. Host sends **change** message:

```
01111110 10100011 00000010 00000000 00010000 00001000 00001100 11001001
SOH      Command NUM      LO ADD  HI ADD  Data1  Data2  LRC
          + I.A.
```

2. AW400 sends **response** message:

```
01111110 00100011 00000010 00000000 00010000 00001000 00001100 01001001
SOH      Command NUM      LO ADD  HI ADD  Data1  Data2  LRC
          + I.A.
```

3. Host sends **acknowledge** message:

```
01111110 10000011
SOH      Command
          + I.A.
```

4. AW400 performs the change requested at end of the current program scan.

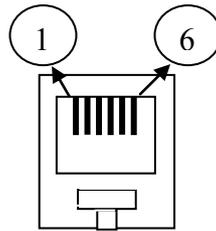
Note: Database address table is shown at the end of this section.

10.3 Serial link signal connection

The AW400 optional serial communication P.C. Board is equipped with modular telephone RJ45 type jack supporting both for RS 232 and RS 422/485 standards:

RJ45 TELEPHONE SIGNAL CONNECTION JACK LAY-OUT:			
Pin N.	RS 232	RS 422	RS 485
1	GND Ground	Tx + Data transmission to PC, +	-
2	Rx IN Data transmission from PC	Tx - Data transmission to PC, -	-
3	Tx OUT Data transmission to PC	GND Ground	-
4	-	Rx + Data transmission from PC, +	Data transmission to and from PC, -
5	-	Rx - Data transmission from PC, -	-
6	GND Ground	GND Ground	Data transmission to and from PC, +

Table 13 - RJ45 Jack serial Communication connector pin-out



RJ45 Jack

Fig. 16 - RJ45 Connector layout

For RS232 and RS485 use shielded cables, two-cores twisted pair wire, section $0.5 \div 1.0 \text{ mm}^2$.

For RS422 use shielded cable, 4 cores, twisted pairs wire, section $0.5 \div 1.0 \text{ mm}^2$.

Connect shields to the ground shield terminal strip inside AW400.

10.4 Data-link Terminator

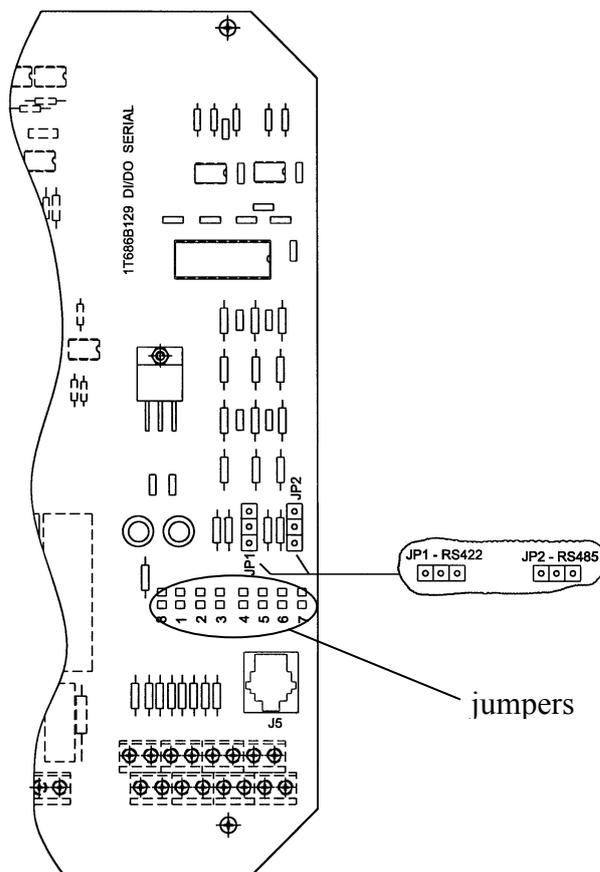
The datalink impedance should be 110 Ohm.

When the serial communication standard is selected as RS422 or RS485, and more than one AW400 are installed on the same datalink, it is necessary to activate a terminator resistance, which is available on the serial communication board.

This operation is to be made only on the last AW400 connected on the serial link.

If the host computer serial port is already equipped with a 220 Ohm resistor, then an identical resistor is to be activated in parallel to obtain a 110 Ohm loop impedance. If no such resistor is present on the Host side, then a 110 Ohm resistor is selected on the AW400 serial board.

The terminator resistance selection is made by installing a jumper on JP1 or JP2 for RS422 or RS485 respectively: the 110 Ohm resistor is selected by jumper between pin 1-2, while the 220 Ohm resistor is selected by jumper between pin 2-3.



Please note:

- to select RS232 weld jumpers onto position 1,2 and 3.
- to select RS485 weld jumpers onto position 6 and 8.
- to select RS422 weld jumpers onto position 4,5,6,7 and 8.

10.5 AW400 Memory Map

Increment: (figures between brackets '[x]' indicate the number of similar variables repeated).

Char type: 1 byte

int type: 2 bytes

float type: 4 bytes

string type: 1 byte x string length

Type	Hex addr.	Name	Description
int	0X0000	PgmMode	Program mode (0-4) Transmitter, Washing, Regulator...
int	0X0002	Lng	Language in use
char	0X0004	AccCode[6]	Miro2Chem Password
char	0X000A	TermAddr[4]	Serial line address
int	0X000E	SerSpeed	Serial line speed
int	0X0010	SerType	Serial line type
float	0X0012	Altitude	Altitude where AW400 is mounted
int	0X0016	CClinOR	Set for CCI in OR mode
int	0X0018	Average	Set for Average count
float	0X001A	Delta	Delta limit
float	0X001E	pH_offset[3]	Offset for PH (SPC), for 3 channels
float	0X002A	P1[3]	Calibration P1 value for 3 channels
float	0X0036	P2[3]	Calibration P2 value for 3 channels
float	0X0042	P1U[3]	User Calibration P1 value for 3 channels
float	0X00AE	P2U[3]	User Calibration P2 value for 3 channels
int	0X005A	Light	Set when back-light is ON
int	0X005C	T_Units	Temperature units
float	0X005E	DefTemp	Default temperature for termo-compensation
int	0X0062	AltUnits	Altitude Units meters/feet
int	0X0064	Sigma	Sigma enabled or not
float	0X0066	sK1	Sigma K1 parameter
float	0X006A	sK2	Sigma K2 parameter
float	0X006E	Hyst[3]	Smoothing for each channel
int	0X007A	wType	Wash Type T17AU / T17SU
char	0X007C	wT[4][9]	Wash Timers T1-T4
float	0X00A0	Out_LO[3]	Min. output value for 3 channels
float	0X00AC	Out_HI[3]	Max. output value for 3 channels
int	0X00B8	DacType[3]	Type of DAC output
float	0X00BE	AILO[3]	Alarms low level
float	0X00CA	AIHI[3]	Alarms high level
float	0X00D6	AIBA[3]	Alarms Band
int	0X00E2	DO_AIR[3]	Set when DO is in air
int	0X00E8	Reserved	Reserved
	0X0108	SerMode	Type of RS485/422 serial line
int	0X0110A	CIO	0 = No I/O Board, 1 = Yes I/O Board
char	0X0110C	DoWash	When set, TX has washing
char	0X0110D	PidType	Determine program PID mode
char	0X0110E	Temp. Mode Ch. 2	When 0 use its own Temp. - When 1 uses Temp. Ch 1
char	0X0110F	Temp. Mode Ch. 3	When 0 use its own Temp. - When 1 uses Temp. Ch 1
int	0X01110	Ena[3]	Channels enabled
int	0X01116	Type[3]	Channel types
float	0X0111C	Chn_Val[3]	Actual channel measurement
float	0X01128	Temperature[3]	Actual channel temperature measurement

Table 14 - General Data Memory Map

PID 1 DATA			
int	0X0134	Reserved	
float	0X0136	PB	Proportional Band
float	0X013A	TR	Reset Time
float	0X013E	MR	Manual Reset
float	0X0142	TD	Rate Time
float	0X0146	SETPOINT	Set Point
float	0X014A	CONTROLZONE	Control Zone
int	0X014E	RSW	Direct/Reverse Action
float	0X0150	SPAN	Span
int	0X0154	OHLP	
float	0X0156	FF HIGH	
float	0X015A	FF LOW	
float	0X015E	FF ABS MAX	
float	0X0162	FF GAIN	
float	0X0166	OH	
float	0X016A	OL	
int	0X016E	TATP	
float	0X0170	K	
float	0X0174	TATT	
float	0X0178	TCYC	
float	0X017C	LH	
float	0X0180	LL	
float	0X0184	PH BAND	
int	0X0188	TIME CYCLE	
float	0X018A	CONTACT GAIN	
float	0X018E	DZ	
int	0X0192	1C/2C	
int	0X0194	PA	

Table 15 - PID1 Data Memory Map

PID 2 DATA			
int	0X0196	Reserved	
float	0X0198	PB	Proportional Band
float	0X019C	TR	Reset Time
float	0X01A0	MR	Manual Reset
float	0X01A4	TD	Rate Time
float	0X01A8	SP	Set Point
float	0X01AC	CZ	Control Zone
int	0X01B0	RSW	Direct/Reverse Action
float	0X01B2	SPAN	Span
float	0X01B6	OH	High Limit
float	0X01BA	OL	Low Limit
int	0X01BE	TATP	Sampling on entire time or volume
float	0X01C0	K	Flowmeter span
float	0X01C4	TATT	
float	0X01C8	TCYC	
float	0X01CC	LH	
float	0X01D0	LL	
int	0X01D4	CT	
float	0X01D6	CG	
float	0X01DA	DZ	
int	0X01DE	CONTACT	
int	0X01E0	PA	

Table 16 - PID2 Data Memory Map

OUTPUTS			
int	0X01E2	WashSeq	Actual washing sequence
int	0X01E4	OUT_STATE[8]	CCO state
int	0X01F4	IN_STATE[8]	CCI state
float	0X0204	dev[2]	PID 1,2 DEV
float	0X020C	out[2]	PID 1,2 OUT
float	0X0214	ff[2]	PID 1,2 FF
...int	0X021C	HIAL Ch1-3 [3]	HI Alarm Channel 1-3
...int	0X0222	LOAL Ch1-3 [3]	LO Alarm Channel 1-3
...int	0X0228	PID1 A/M	PID1 Auto/Manual
...int	0X022A	PID2 A/M	PID2 Auto/Manual

Table 17 - Output Data Memory Map

11 APPENDICES

11.1 EC Declaration

EC Declaration 

AW400 line (T17M*4000) fulfils the compliance to the mandatory tests specified by the applicable harmonised generic rules to apply the CE Mark.

Specifically is compliant with:

- Low Voltage Directive **2006/95/EC**
- Harmonized Regulation **EN 61010-1:2001**
- Electromagnetic Compatibility **2004/108/EC**
- Harmonized Regulation: **EN 61326-1:2006; EN 61000-3-2:2006; EN 61000-3-3:2008**

11.2 APPENDIX B – WEEE Compliant

Severn Trent Water Purification S.p.A., as manufacturer of the electronic instrument described in the present manual (Micro2Chem line) is registered at the WEEE register (Waste Electric and Electronic Equipment).



Member registration WEEE number: **IT11040000007171**

12 SPARE PARTS

AW400 Transmitter Spare Parts

Power Supply Board	AW401054
Display Board	AW401115
CPU Board	AW401055
Analogue I/O Board	AW401015
Digital I/O & Serial Board	AW401119
Ribbon Cable CPU to PSU	AW401116
Ribbon Cable Digital I/O to CPU	AW401117
Interconnect Cable PSU to Digital I/O	AW401118
PG11 Cable Gland	AW401121
PG11 Blanking Disc	AW401122

Notes

Sales



Service



ABB Limited
Measurement & Analytics

Oldends Lane
Stonehouse
Gloucestershire
GL10 3TA
UK
Tel: +44 (0)1453 826 661
Fax: +44 (0)1453 829 671
Email: instrumentation@gb.abb.com

ABB Inc.
Measurement & Analytics

125 E County Line Road
Warminster
PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

abb.com/analytical



We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB.

© ABB 2018