ASCON TECNOLOGIC

ASCOMB

Ascomb Combustion control system Oxygen “Trim” controller Series OX - R

INSTRUCTION MANUAL
M.I.U. OXR – 3a/ 12.06
Cod. J30 – 154 –1AOXR - ING

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GENERAL INDEX

1. INTRODUCTION TO COMBUSTION THEORY

1.1 The chemistry and physics of combustion

From the chemical point of view, combustion is an exothermic oxidizing process in which certain substances react, more or less violently, when combining with oxygen in the free state and producing a great quantity of heat and, frequently, light.
Substances which react in this way are called **fuels** and the reaction is called **combustion**. The oxygen, without which combustion cannot take place, is called a *supporter of combustion.*

The main components that are present in the commonly used combustibles are: Carbon (C), Hydrogen (H_2.), Carbon monoxide (CO), Methane (CH_4), Hydrocarbons other than methane (CmHn), Oxygen (O_2), Nitrogen (N_2), Carbon dioxide (CO_2), and Water (H_2O).
Among these components, the combustible ones react according to the following chemical reactions:

$C + O = CO_2 + 394$ kJ/mol

$S + O_2 = SO_2 + 297$ kJ/mol

$2\ H_2 + O_2 = 2\ H_2O + 242$ kJ/mol

$CO + ½\ O_2 = CO_2 + 283$ kJ/mol

$CH_4 + 2\ O_2 = 2\ H_2O + CO_2 + 803$ kJ/mol

$C_mH_n + (m+n/4)\ O_2 = n/2\ H_2O + m\ CO_2 +$ xxx kJ/mol (*)

The oxygen necessary for the combustion reactions is given by atmospheric air, which average composition is given in the following table.

1.2 AVERAGE COMPOSITION OF ATMOSPHERIC AIR

(Dry Air at 273°K, 1013 mbar)

	Molecular Weight MW	% Volume (m^3/m^3)	% weight (kg/kg)
Nitrogen, N_2	28	78,08	75,52
Oxygen, O_2	32	20,95	23,15
Argon, A	40	0,93	1,28
Carbon Dioxide, CO_2	44	0,03	0,046
Others		0,01	0,004

In calculations of combustion reactions it is assumed the following air composition:

$N_2 = 79$ % (volume percent)

$O_2 = 21$ %

The possibility of each combustible to release its thermal energy is defined by its specific combustion heat. In general we can say that the heating value represents the amount of heat that is released in the combustion process by 1 kg of a solid or liquid combustible, or by 1 Nm^3 of a gaseous combustible.

There are two different heating values :
The upper heating value
The lower heating value.

The difference between these two values represents the latent heat of condensation of water produced during combustion.
Since water is always present in the products of combustion, it is necessary to release this water vapor in the condensate form (i.e. as liquid water) in order to get the maximum amount of heat that any combustible is potentially able to generate (upper heating value),.
In general in the combustion process the water produced is released to the atmosphere as vapor in the flue gas, (therefore the heat produced by the condensation of water is lost and the heat available is only the low heating value of that combustible).
Let's consider the reaction of combustion of methane :

$CH_4 + 2\ O_2 = 2\ H_2O + CO_2 +$ heat

For a "perfect gas" one mole of gas at normal conditions (0°C , 1 ATM) has always the same volume of 22.414 liters.
Therefore it is possible to consider a chemical reaction of gaseous substances as a reaction between volumes of those substances.
If we remember that in the air there is 21 % vol. of oxygen, we have:

$1\ m^3\ CH_4 + (2\ m^3\ O_2 + 7{,}52\ m^3\ N_2) = 2\ m^3\ H_2O + 1\ m^3\ CO_2 + 7{,}52\ m^3\ N_2 +$ heat

That is, for each m^3 of methane the amount of theoretic air that is necessary to allow this reaction to take place is (2+7.52) = 9.52 m^3

Considering the chemical equations of combustion mentioned above:

1 m^3 CH_4 requires 2 m^3 O_2

1 m^3 H_2 requires 0,5 m^3 O_2

1 m^3 CO requires 0,5 m^3 O_2

1 m^3 CmHn requires (m+n/4) m^3 O_2

And referring to the volume of air, the necessary amount of stoichiometric air is respectively:

9,52 m^3 of stoichiometric air for 1 m^3 CH_4

2,38 m^3 of stoichiometric air for 1 m^3 H_2

2,38 m^3 of stoichiometric air for 1 m^3 CO

4,76 (m+n/4) m^3 of stoichiometric air for 1 m^3 C_mH_n

For combustibles in the gas form, if we define :

[CO], [H_2], [CH_4] , [CmHn], [O_2], the volume percent of each component that is present in the combustible gas mixture, we have :

Theoretic Air Volume Atv = [CO] x 2,38/100 + [H_2] x 2,38/100 + [CH_4] x 9,52/100 + 4,76 x [$\sum_i$ (mi + ni/4) x C_mH_n]/100 - 4,76 x [O_2]/100

Where the last term takes into account the amount of oxygen eventually present in the fuel.

In practice it will never be possible to operate with the stoichiometric air quantity, but it will be necessary to use an amount of effective air that is always higher than the theoretic air.
The essential elements for combustion are:

- The fuel
- The combustion air (oxygen)
- The combustion primer

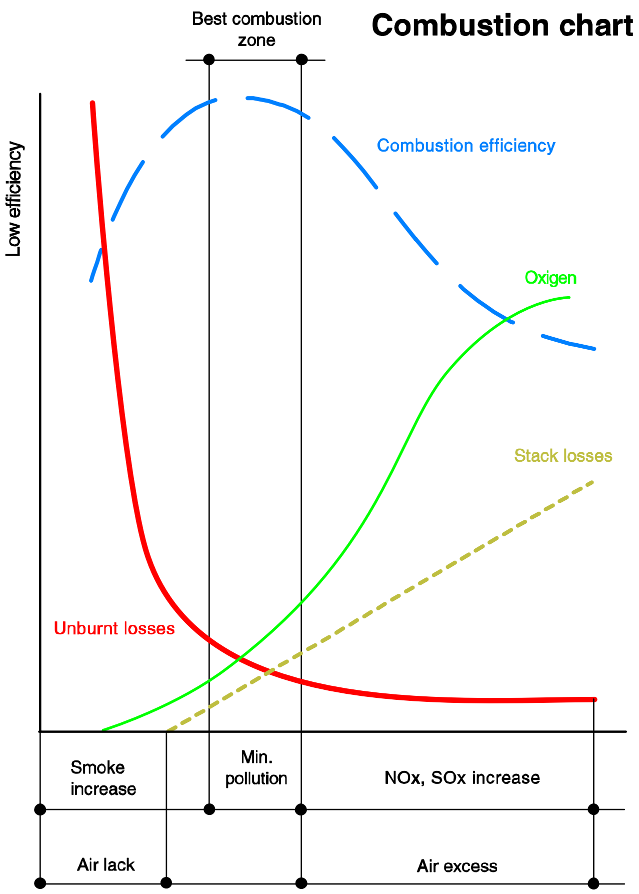
In order to establish combustion it is necessary to have a contact between the fuel and the air, but there must also be a reaction primer. This means that a part of the fuel shall be at a temperature higher than its ignition point. Combustion shall meet the "*3T" rule, i.e.*:

- **T**ime (Short)
- **T**emperature (High)
- **T**urbulence (Great)

Considerable turbulence is a requirement for optimum contact between fuel and air to achieve complete burning of the fuel, to provide a high temperature flame and a brief combustion time.
Low turbulence causes poor mixing of fuel and air so that combustion may not be complete providing a very low temperature flame with the fuel taking a long time to burn (therefore some unburnt hydrocarbons are present).

1.3 Combustion in practice

Perfect mixing of fuel and air does not always occur even in good mixing conditions. Sometimes the mixing takes too long time so that the mixture reaches a zone where the temperature is too low to supply enough heat to complete the combustion.
If only the stoichiometric air quantity is supplied, part of the fuel does not burn and combustion remains incomplete. In order to ensure complete combustion, air in excess to the stoichiometric amount is supplied. In such a way, each fuel molecule finds the correct number of oxygen molecules necessary to complete its combustion. This added air is called excess air, the effective air is then the theoretical air plus the excess of air.
The amount of excess air used for practical combustion depends on several factors (nature and physical status of the fuel, shape of the combustion chamber, type of burner, etc.) generally, the required excess of air is high for solid fuels and decreases for liquid and gas fuels.
Therefore the condition to guarantee complete combustion of large quantities of fuel in a limited space and in a short time is to operate with air in excess to the theoretical air requirement.
We want now to point out that the best combustion must be achieved with the least possible excess of air.
Stack losses are related to flue gas temperature and volume.
Part of the oxygen supplied plus the nitrogen of the air, not being used, will become part of the flue gas with a consequent increase of its total volume. There is then an optimum value for excess air.
If air quantity is too low, unburnt hydrocarbons will be present due to incomplete combustion (with a waste of fuel and the danger of polluting the atmosphere), while too much air produces complete combustion but there will be greater losses in the stack (reducing the efficiency and increasing the emission of nitrogen oxides). The optimum zone is the one which combines the minimum pollution with the lowest levels of unburnt fuel and stack losses.



1.4 Excess air and oxygen % in flue gas

The control of the excess air is important to guarantee good combustion. By measuring the oxygen present in the flue gas, it is possible to determine the correct percentage of excess air. The measurement of the percentage of oxygen in flue gas has superseded the systems based on the measurement of the CO_2 percentage. This is due to the following reasons :

- Oxygen is part of the air, if oxygen content is zero the air excess is zero;
- When we operate in defect of air the percentage of CO_2 increases proportionally with the amount of air, reaching a maximum which is related to the type of fuel. This means that the same percentage of CO_2 corresponds to two different levels of combustion air quantity; using different fuels.
- The great operational flexibility and accuracy at low concentrations of the zirconium oxide probe has revolutionized and simplified the oxygen measurement.

1.5 Wet gas and dry gas

Water is present in the flue gas in the form of steam which is produced by the combustion of hydrogen, by the water present in the fuel and by the humidity of the combustion air. Such a gas is said Wet.
If the gas is cooled to the ambient temperature the humidity condenses into liquid form. After the condensate has been removed the gas is considered Dry.

This clarification is important because some methods of analysis work on dry gas, while the *Ascomb System is based on wet gas measurement.*

2. DESCRIPTION OF THE ASCOMB SYSTEM

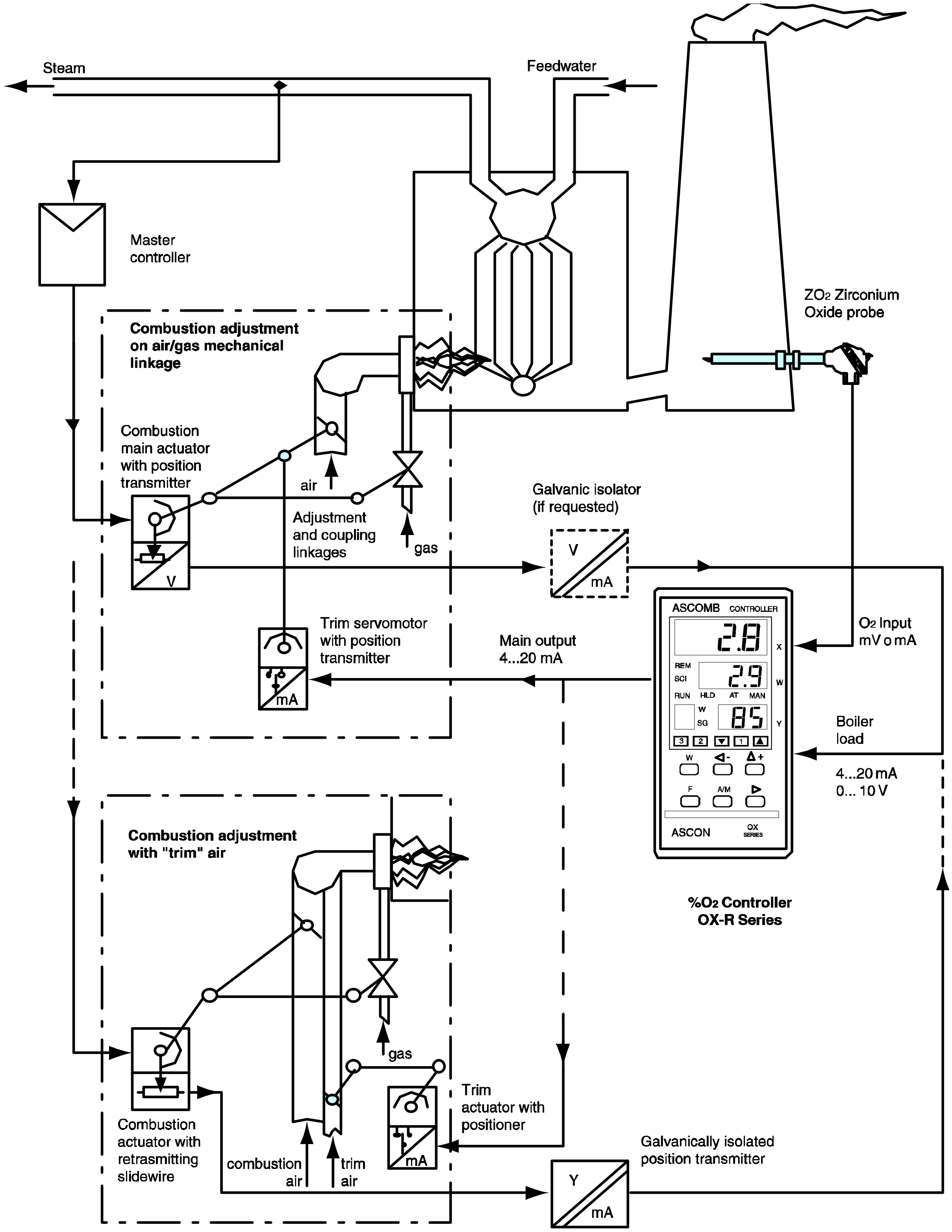
ASCOMB is a compact and low cost system for the monitoring of the oxygen content in flue gas. The system is based on an in-situ zirconium oxide probe that ensures a continuous measurement, fast response and accurate readout. The probe is generally positioned at the exit of the combustion chamber or at the base of the stack. A reference air circuit is not required since one side of the zirconium oxide sensor is in contact with the fuel gas and the other side is in contact with the ambient air present inside the probe head. Since the mV signal generated by the sensor is also influenced by the temperature, the probe is provided with a built-in heater with an external power supply unit suitable to maintain the sensor at a constant temperature. Therefore ASCOMB represents the ideal solution for small and medium size boilers.

The OX-R Controller optimises the air/combustion ratio by correcting (trimming) the amount of air requested by the main combustion controller. Since the air/combustion ratio is directly related to the boiler load, in addition the system can receive an external analogue (0... 10V or 4.... 20 mA) signal representing the load from which a profile of the desired oxygen set point is generated. This allows the continuous and automatic correction of the air/combustion ratio optimising the conditions and increasing the efficiency at the different load levels of the boiler. This signal can be characterised with a 4 segment curve. Two different curves can be stored (for two different types of fuel) which can be selected through the keys, the logic inputs or the serial communication SCI. Each curve is programmed in accordance with the various loads of the boiler and the relative desired levels of excess air (and therefore %O_2). It is also possible to work with a local set point or one of the two stored set points, inputted with the keys, and selected by the logic inputs or the serial line SCI.
The mV signal coming from the probe is accepted and linearized by the OX-R controller. It is also possible to apply a 4... 20 mA linearized signal coming from a transmitter.
The controller displays the O_2 value (in the range 0.0... 20.9%), the set point and its operating mode (1st or 2nd local set point or remote set point for the “a” or the second fuel “b” and the automatic or manual mode).
The direct mV signal from the probe can also be shown in the display.

- The control output is an isolated analogue signal (4...20 mA or 0...10 V). It is possible to impose two limits, maximum and minimum, on control signal as well as a <safety> output level (zero “trim”, excess air or other) for fault conditions (O_2% off scale).
- The controller is also equipped with 3 configurable alarms which can be introduced in the range 0.0… 20.9% O_2. These alarms have a delay time that can be set from 0...120 seconds; they may be independently configured as:
  - Bypassed
  - Deviation with inhibition at switch on
  - Deviation
  - Band
  - Independent
- The controller is (optionally) provided with a galvanically isolated output (4... 20 mA or 0... 10 V) for the retransmission of the % O_2 level with a configurable range 0.0… 20.9% O_2.
- The instrument has 3 logic inputs (IL1, IL2, IL3), which combination permits the change of operational mode from automatic to manual and vice versa or the switch from remote set point of fuel 1 to fuel 2 or the selection of the stored set points or put the controller into a Hold state when required (for instance during probe air purging phase). In addition the fourth logic input (IL4) permits, in case of probe failure, the activation of the Fail function that can be used to activate an external safety device through the apposite digital output.

- Procedure has to be carried on. Two calibrations are required, one in free air (20.9% O_2) and the other at a known % O_2 level between 0.3… 3.0% O_2. However the site calibration can be avoided by the manual introduction of the two calibration coefficients printed in the label on the head of the ZO_2 probe itself.
- In addition the controller is (optionally) provided with serial communication for connection to a computer or a supervision control system.

2.1 Application example



3. MODEL IDENTIFICATION AND CONFIGURATION

Configuration is the particular set-up operation necessary to adapt the instrument inputs and control output to the plant characteristics and requirements.

When the instrument is already configured it is still necessary to check the programmed functions correspond to those required for that particular installation.

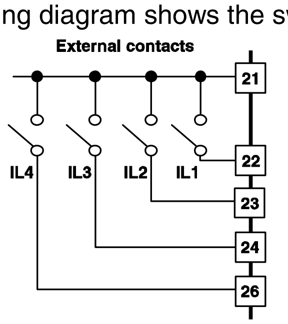
An important is the identification of the model. The first configuration code defines the hardware setting of the instrument. It is virtually impossible to configure the controller with a hardware function that is not available.
This operation has to be carried out in the set-up phase of the instrument.
The identification of the model is obtained from the following table:

3.1 Model Identification

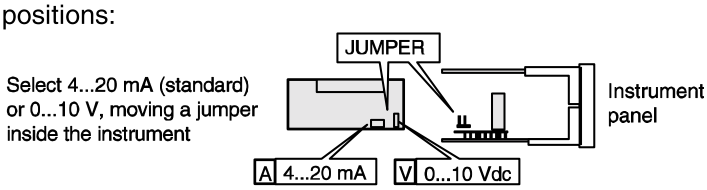
Controller : OX -R [A][B][C][D]

	A	B	C	D
Power supply				
100 ...240 Vac, 50/60 Hz	3			
21...27 Vac, 50/60 Hz and 20...30 Vdc	5			
Serial communication (optional)				
Not provided		0		
Provided		1		
Control output Y1				
In current 4...20 mA (1)			1	
In voltage 0...10 V (1)			2	
Retransmission output Y2 (optional)				
Not provided				0
In current 4...20 mA				1
In voltage 0...10 V				2

1) It is possible to change the control output Y1 from 4... 20 mA to 0... 10V by moving a small switch located inside the controller. The switch is accessed by removing the controller from its housing using the screw on the front cover under the flap. The following diagram shows the switch positions:



2) It is possible to change the retransmission output Y2 from 4... 20 mA to 0... 10 V by moving a small jumper located on a daughter board inside the controller. The jumper is accessed by removing the controller from its housing using the screw on the front cover under the flap. The following diagram shows the jumper positions:



The software configuration of the instrument may be done at any time by the operator or by the serial line SCI and can be achieved by inserting two series of codes called Con. 1 and Con.2.

The first part (Con. 1) sets the O_2 input functions, the boiler load input, the type of control and retransmission outputs.

The second part (Con.2) selects the type and mode of operation of the alarms AL1, AL2, AL3.

3.2 Configuration

Configuration : Con. 1 [E] [F] [G] [H]

Input from the O_2 probe	E
Direct in mV from the ZO_2 probe	**0**
Not Used	**1**
From transmitter 4... 20 mA linearized	**2**

Boiler load input	F
In current 4...20 mA	**0**
In voltage 0...10 V	**1**

Type of operation control output Y1	G
Inverse	**0**
Direct	**1**

Retransmission output Y2	H
Not provided	**0**
Retransmission % O_2	**1**

Configuration : Con.2 [0] [I] [L] [M]

Mode of operation of the alarms		-	I AL1	L AL2	M AL3
Disabled		-	**0**	**0**	**0**
Deviation with inhibition at start	Active high	-	**1**	**1**	**1**
	Active low	-	**2**	**2**	**2**
Band	Active outside	-	**3**	**3**	**3**
	Active inside	-	**4**	**4**	**4**
Independent	Active high	-	**5**	**5**	**5**
	Active low	-	**6**	**6**	**6**
Deviation	Active high	-	**7**	**7**	**7**
	Active low	-	**8**	**8**	**8**
Loop Break Alarm		-	-	-	**9**

Example of the composition of a code number: **OX-R 3111/ 0001-663**

The model code number is printed in a label on the front cover, while the complete code (model and configuration) is printed in the label on the side of the instrument.
With a working instrument it is possible to display the configuration code through the mnemonic ConF located in the main menu of the instrument (for more details refer to the programming sheet).
The controller is normally dispatched configured and ready for use.

If at switch on of the instrument the numbers 9999 appear in the displays X and W and Co is shown in the display Y, the controller **is not configured** and all its functions are inhibited.

For correct operation, it is necessary to enter the configuration codes Con1 and Con2 as described above. (Refer to the programming sheet for more details).

3.3 Linear input scaling

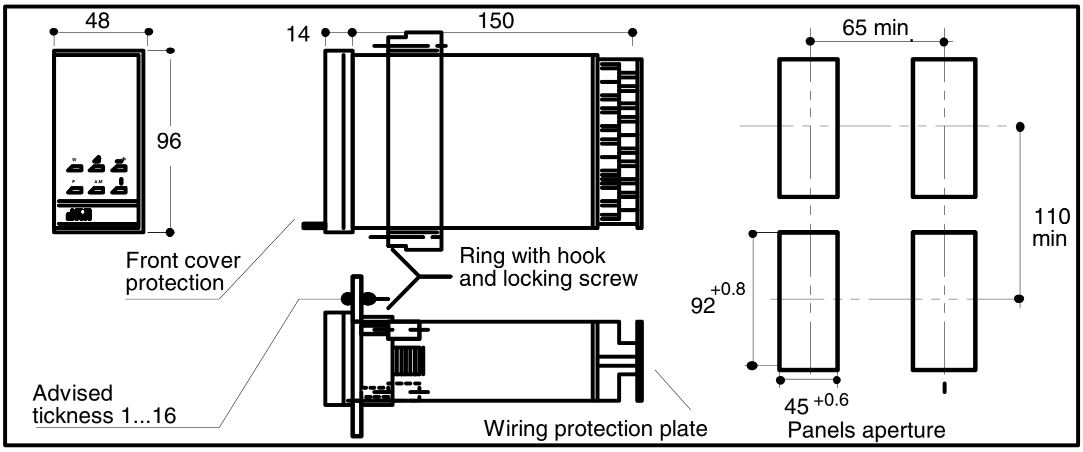
If the oxygen input has a linear configuration (code E = 2), two further parameters will appear during the configuration sequence:

Mnemonic code	Description	Range	SCI mnemonic
I.O. lo	Lower limit of oxygen input scale	0.0... I.O.H i%	"IOL"
I.O.H i	Upper limit of oxygen input scale	I.O. lo...20.9%	"IOH"

The linearized input signal 4… 20 mA will be automatically located between the IO lo and IOH i parameters.

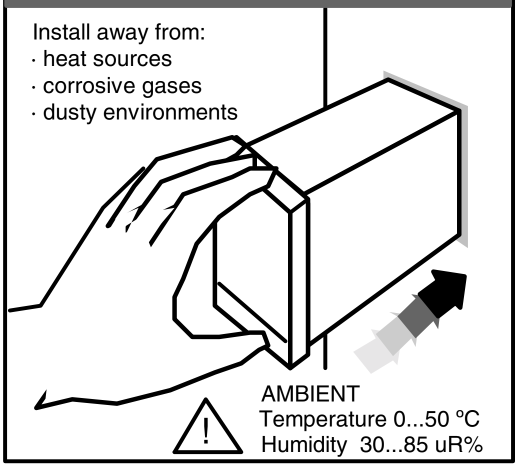
4. DIMENSIONS AND INSTALLAT ION

Overall dimension (in compliance with DIN 43700)

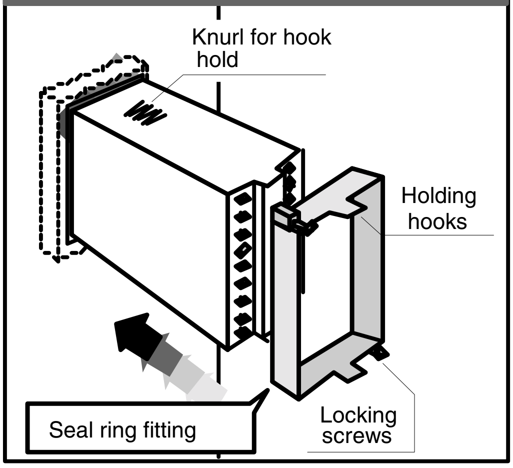


Panel installation

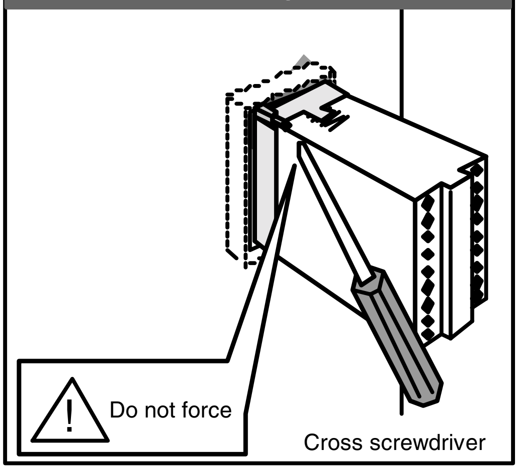
A · Panel fitting



B · Fixing with ring

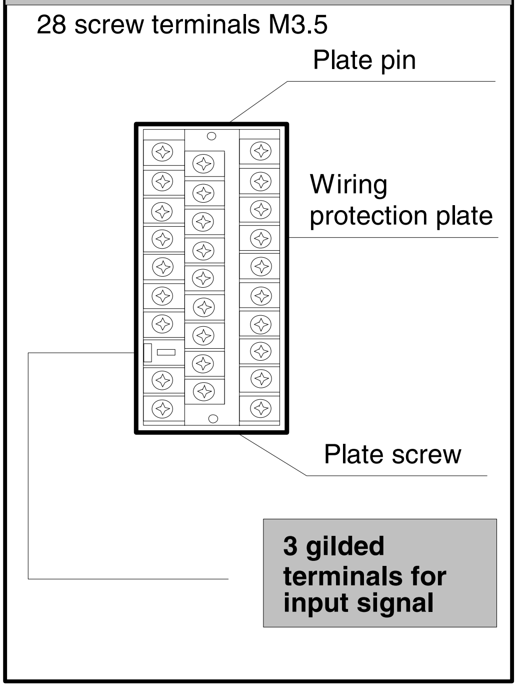


C · Screw locking

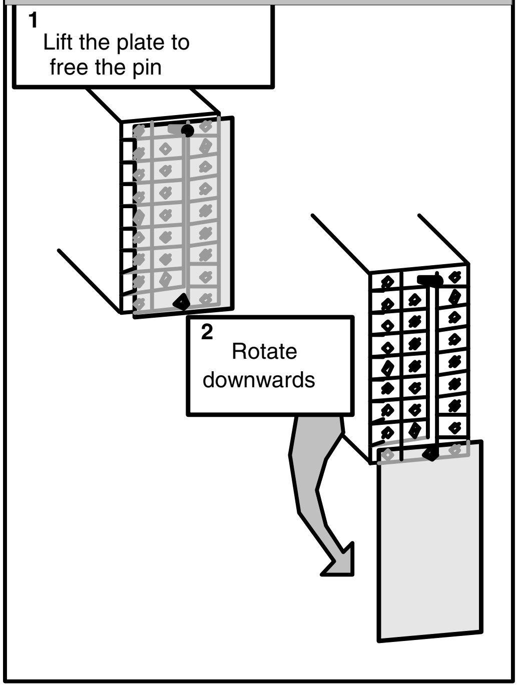


5. ELECTRICAL CONNECTIONS

A · Terminal board



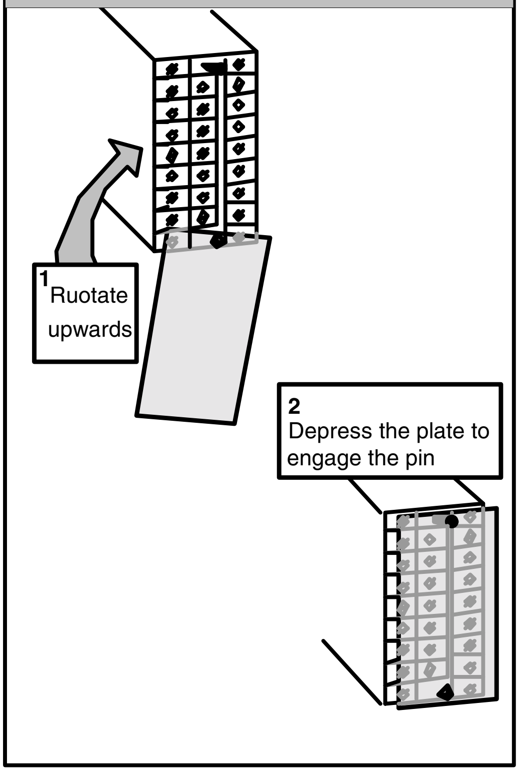
B · Freeing the terminals



C · Effetting the connection

	Cable section	wires N°
With eyelet terminals (6.9 max.)	0.25..2.5 AWG 22..14	2
With fork terminals (6.9 max.)		1
With tinned wire (6 - 7) Preferential		2

D · Protecting the terminal board



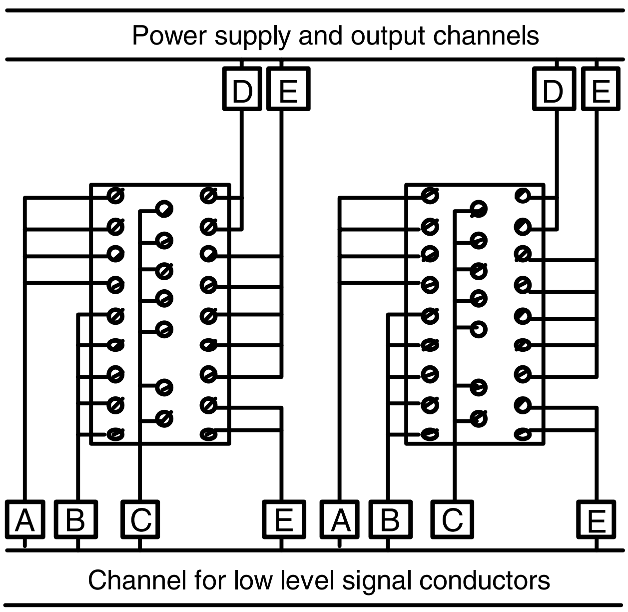
Precautions

Single out supply line from power line

Keep away from teleruptors electromagnetic contactors and powerful motors

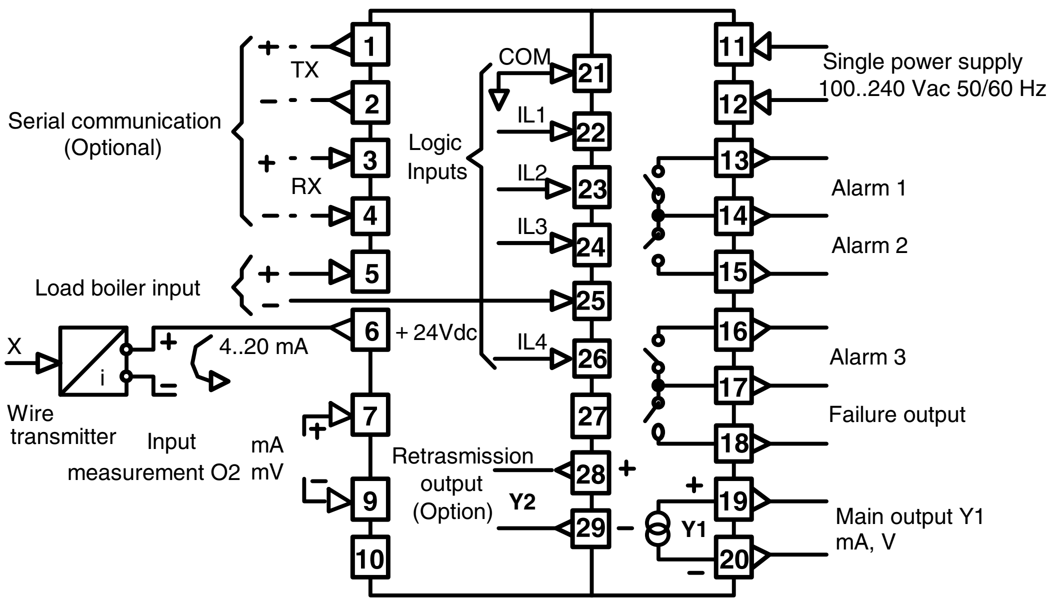
Keep away from power groups in particular if with phase control

Advised conductor course



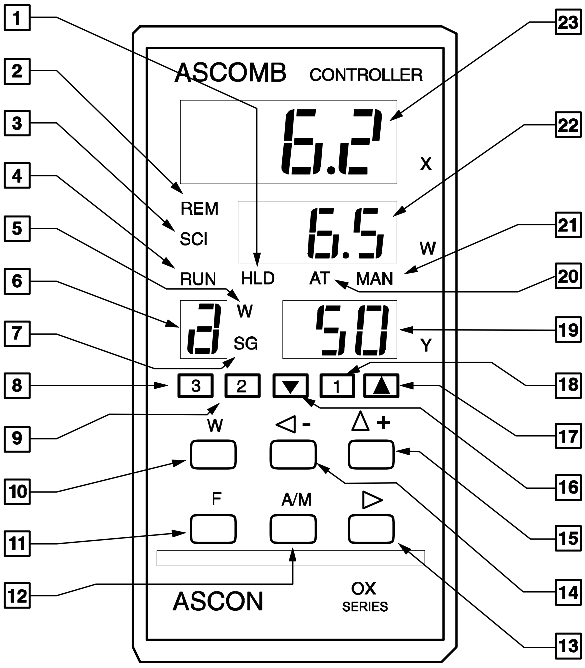
- Serial communication A
- Analogic inputs B
- Logic input and analogic signals C
- Input D
- Outputs E

Wiring diagram



All the instrument outputs relay contacts are internally connected, in parallel, with one 2,2 nF / 2 kV capacitor and one 300 V varistor.

6. FUNCTIONS OF KEYS AND INDICATORS



6.1 Indicators and operational status

The status indicators inform the operator of the operational state of the controller.
The **HLD (1)**, **RUN (4), SG(7)**, **∇ (16) and ∆ (17)** indicators remain switched OFF since their representing functions are not used in the OX-R instrument.

- The **MAN (21)** indicator. This indicator is illuminated when the controller operates in Manual; it is switched off in any other case.
- The **REM (2)** indicator. This indicator is illuminated when working with a remote analogue set point. The indication of which remote linearisation curve has been selected appears in the small display on the left **(6)**.
- The **AT (20)** indicator is normally switched off and comes on when the automatic calculation of PID control parameters function is activated. It automatically switches off when that process is completed.
- The **SCI (3)** indicator. This indicator illuminates only when the serial port is enabled through the apposite parameter SCI, located in the fifth group of parameters. It flashes when the controller *receives and* recognises a message in transit on the serial port.

Note! This function is optional and if not selected in the setting up phase the SCI indicator remains switched off in any case.

- The **W (5)** indicator. This indicator illuminates when one of two stored local set points is selected and remains in operation. The number of the activated set 1 or 2, appears on the small display on the left **(6)**.

6.2 Keys

The six keys on the instrument allow editing, configuration, calibration and modification of the parameters as well as changing the mode of the instrument.

- The **W (10)** key. The 'set' key permits modification of the local set point, the selection of one of the two stored set points and the changeover of the operating state Loc./Rem or Rem/Loc.
  By pressing it the value of the set point flashes and it is possible to modify the set point value through the 14 and 15 keys. Confirmation is done by the 13 key.

Pressing the W key repeatedly causes the digit to flash , in their respective displays, and then in succession the mnemonic codes of the various operating states are shown. Once the desired operating state has been selected this is confirmed with the 13 key. The mnemonic codes of the operating states appearing in sequence are :

- S.P.r..a Functioning with the linearized remote set point in accordance with curve "a".
- S.P.r..b Functioning with the linearized remote set point in accordance with curve "b".
- S.P. lo Functioning with local set point.
- S.P. 1 Functioning with stored local set point 1.
- S.P.2 Functioning with stored local set point 2.

- The ◁ **- (14)** key. The 'shift' key has a double function :
  A) If the controller is in *manual* mode, this key can be used to *reduce* the output level of the main control output Y1.
  B) In parameter display phases, this key serves to move the cursor (the modifiable digit that flashes) by one digit to the left.
- The Δ **+ (15)** key. The 'plus' key has a double function:
  A) If the controller is in *manual* mode, this key can be used to *increase* the output level of the main control output Y1.
  B) In parameter display phases, this key serves to increment the flashing digit.
- The **F (11)** key. The 'functions' key permits access to the main menu of functions for programming or activation. Once inside the parameter groups it permits jumping from one group to the next.
- The ▷ **(13)** key. The 'enter' key allows the confirmation of the operating modes of the instrument selected with the W key, the confirmation of a function selected with the F key, the access to parameters and to pass from one parameter to the next in the same group.
- The **A/M (12)** key. The Auto/Man or Man/Auto station of the instrument is represented by this key. With the controller in manual mode it is possible to modify the level of the main output through the 14 and 15 keys.

6.3 Display

- The display **(23)** is normally dedicated to the oxygen percent value. If the oxygen percentage moves outside the limits of the 0.0...20.9 ±5% of scale the following will be displayed:
  - - - - under range
  - oooo over range

  When visualisation or modification of parameters is requested, the value of the desired parameter is shown in this display.
  - With **IL4** activate (closed contact) Fail is displayed.
- The **(22)** display is normally dedicated to the display of the set point (local or remote) in use, while during visualisation or modification of parameters phase it displays the mnemonic code of the desired parameter.
  - With **IL1** activated (closed contact) Hold is displayed.
  - With **IL4** activated (closed contact) it switches off completely.

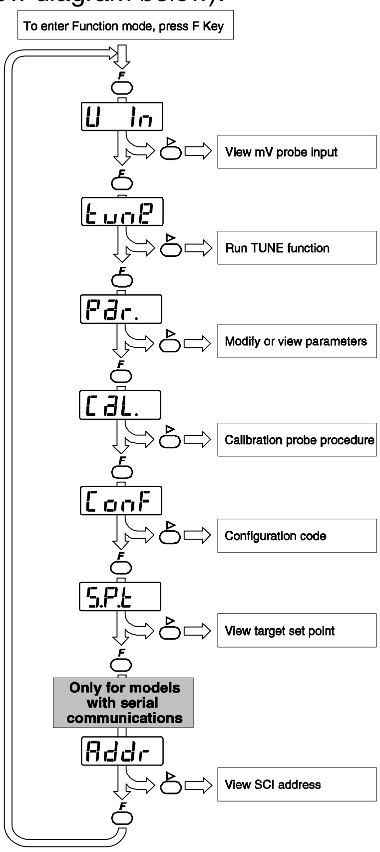
- The **(19)** display shows the current level of the control output Y1.
- The **(6)** is normally switched OFF. It is switched on in conjunction with the **5** (W) indicator to indicate the number 1 or 2 of the selected stored set point. Likewise it is switched on in conjunction with the **2** (REM) indicator to indicate with the letter **a** or **b** which of the two remote linearisations has been selected and is still operating.
- The 6 display and the 2 and 5 indicators remain completely switched off during the time the controller is working in local mode.

6.4 Alarm indicators

- The **3 (8)** indicator switches on when the limit of alarm AL3 has been reached. When the **3 (8)** indicator is connected, the AL3 output contact is closed.
- The **2 (9)** indicator switches on when the limit of alarm AL2 has been reached. When the **2 (9)** indicator is connected, the AL2 output contact is closed.
- The **1 (18)** indicator switches on when the limit of alarm AL1 has been reached. When the **1 (18)** indicator is connected, the AL1 output contact is closed.

7. PARAMETERS

All the parameters of the instrument are organised into groups of homogeneous functions. In order to be able to access all the instrument's parameters a simple, but efficient selection menu is provided with the "F" key being used to display the name of the functions groups and the "Enter" key permitting access to the desired functions (see flow diagram below).



Note:
If the input has a linear configuration (E = 2) then the items U 1n and Cal. will not be present in the menu. For more information refer to the attached programming sheet.

7.1 Arrangements of groups and parameters

Parameter code	Description	Range	SCI code	Note	Group
AL 1	Set point alarm 1	(Note 1)	"SA1"	2	**1st**
AL 2	Set point alarm 2	(Note 1)	"SA2"	3	
AL 3	Set point alarm 3	(Note 1)	"SA3"	4	
A.1HY	Hysteresis alarm 1	0.01...10.00%	"HY1"	2	
A.2HY	Hysteresis alarm 2	0.01...10.00%	"HY2"	3	
A.3HY	Hysteresis alarm 3	0.01...10.00%	"HY3"	4	
t.dEl	Operating delay of alarms	0...120 s	"DEL"	5	
P.b.	Proportional band	0.5...999.9%	"PB1"		**2nd**
t.i.	Integral time	0.0...100.0 min.	"TI1"		
t.d.	Derivative time	0.00..10.00 min.	"TD1"		
AP.h	High approach	0.01...2.00 P.b.	"APH"		**3rd**
AP.l	Low approach	0.01...2.00 P.b.	"APL"		
F.F.	Feed Forward	0...500%	"FF_"		
S.P. 1	1st. stored set point	S.P.L.l... S.P.L.h	"SP1"		**4th**
S.P. 2	2nd stored set point	S.P.L.l... S.P.L.h	"SP2"		
Sl. u	Upward slope of Set point	0.0...120.0%/min.	"SLU"		
Sl. d	Downward slope of Set point	0.0...120.0%/min.	"SLD"		
S.P.L.l	Lower limit of Set point	0.0...S.P.L.h%	"MIN"	6	**5th**
S.P.L.h	Upper limit of Set point	S.P.L.l...20.9%	"MAX"	6	
Y1 l	Minimum level output Y1	0...Y1 h%	"Y1L"		
Y1 h	Maximum level output Y1	Y1 l...100%	"Y1H"		
Y1SA	Safety level output Y1	0...100%	"Y1S"		
t.Fil	Time constant of input filter	0...30seconds	"FIL"		
Y2lo	Lower limit for oxygen retransmission	0.0...Y2Hi%	"O2L"	6,7	
Y2Hi	Upper limit for oxygen retransmission	Y2lo...20.9%	"O2H"	6,7	
C.C1	1st calibration constant U1	-9.99...10.00mV	"CC1"	8	
C.C2	2nd calibration constant T.	-200...200°K	"CC2"	8	
a S0	Set point at 0% of signal Remote curve "a"	0.0...20.9%	"AS0"	6	
a L1	Remote signal percentage 1st point curve "a"	0.0...100.0%	"AL1"		
a S1	Set point at 1st point of remote signal curve "a"	0.0...20.9%	"AS1"	6	
a L2	Remote signal percentage 2nd point curve "a"	0.0...100.0%	"AL2"		
a S2	Set point at 2nd point of remote signal curve "a"	0.0...20.9%	"AS2"	6	
a L3	Remote signal percentage 3rd point curve "a"	0.0...100.0%	"AL3"		
a S3	Set point at 3rd point of remote signal curve "a"	0.0...20.9%	"AS3"	6	
a SF	Set point at 100% of remote signal curve "a"	0.0...20.9%	"ASF"	6	
b S0	Set point at 0% of remote signal curve "b"	0.0...20.9%	"BS0"	6	
b L1	Remote signal percentage 1st point curve "b"	0.0...100.0%	"BL1"		
b S1	Set point at 1st point of remote signal curve "b"	0.0...20.9%	"BS1"	6	

Parameter code	Description	Range	SCI Code	Note	Group
b L2	Remote signal percentage 2nd point curve "b"	0.0...100.0%	"BL2"		**5th**
b S2	Set point at 2nd point of remote signal curve "b"	0.0...20.9%	"BS2"	6	
b L3	Remote signal percentage 3rd point curve "b"	0.0...100.0%	"BL3"		
b S3	Set point at 3rd point of remote signal curve "b"	0.0...20.9%	"BS3"	6	
b SF	Set point at 100% of remote signal curve "b"	0.0...20.9%	"BSF"	6	
A.PAr	Access index to parameters	0000...2222	"ACC"		
A.t.u	Tune enable index	0...1	"ATU"		
S.C. I.	Serial communication enable index	0 = OFF 1 = ON		9	
Addr	Address	0...63	"ADR"	9	
S.C.b.r	Baud rate	1...4	"BDR"	9	
S.C.PA	Parity	0...2	"PAR"	9	

Note:

1. The allowable range of the alarms Set Point varies in relation to the configuration
- Deviation: -20.9... +20.9
- Band and independent 0.0... 0.9

2. If not present in the configuration the alarm **AL 1** is disabled (**I** = 0).
3. If not present in the configuration the alarm **AL 2** is disabled (**L** = 0).
4. If not present in the configuration the alarm **AL 3** is disabled (**M** = 0).
5. If not present in the configuration the alarms are all disabled (**I**, **L** & **M** = 0)
6. If in the configuration the **X** input is linear (**E** = 2) the range for its introduction is limited from I.O. lo to I.O.H i.
7. The retransmission output Y2 is only available if it is included in the configuration.
8. Unless configured otherwise the **X** input is linear (**E** = 2).
9. Serial communication is only available if provided with the instrument.

8. PASSWORD

In order to prevent unwanted operations by unauthorized persons the series OX controllers are provided with passwords (codes) to permit different levels of access to the parameters.

All the instrument’s parameters are organised into groups of homogeneous functions. The instrument has three important groups of functions selectable from a main menu. These groups are:

1. Configuration;
2. Working parameters;
3. Calibration of the probe.

In order to access *configuration* it is necessary to introduce the password (PASS) then insert the code 3333 followed by the insertion of either Con1 or Con2.

The *working parameters* of the instrument are divided into four groups plus a fifth group which is always protected by the password 1111 because it contains the most important parameters which are: the limits of the working set point, the output limits, the safety conditions and the *Password* to access the first four groups APar. Through this “sub password” (secondary key) consisting of four digits it is possible to conceal (0), make the group visible, but not modifiable (1) or visible and modifiable (2). The first digit on the left is associated with the first group, the second digit from the left is associated with the second group, the third digit from the left is associated with the third group and the fourth digit from the left is associated with the fourth group.

In order to access the calibration of the ZO2 probe it is necessary to introduce the password (PASS) then insert the code 1111. Then follow the procedure described in chapter 9 of this manual.

9. ZO2 PROBE CALIBRATION PROCEDURE

This procedure refers to the calculation and automatic insertion of two calibration constants, in the relative codes CC1 and CC2 located in the fifth group of parameters and protected by the password 1111.

Selecting the item Cal. from the main menu and after introducing the password 1111 following the PASS request, initiate the calibration procedure which consists of three phases:

- CAL appears on display W. Send free air (20.9% O_2) to the probe at the correct flow rate and pressure (20 l/h atm pressure). In the display X the difference in mV between the offset of the probe and the value currently imposed will appear. Press the ▷ key to zero the difference. The calibration factor CC1 is automatically updated. If after a few seconds the readout moves away from zero repeat the operation or alternatively use the F button.
- O_2 C. appears on display W. Input the known oxygen content (in the range 0.30...3.00%) of the calibration gas to which the second calibration constant is to be set. Then press either the ▷ key or the F key.
- CAL2 appears on display W. The calibration gas with the O2 concentration previously inputted (O_2. C) is sent to the probe. On display X appears the difference in °C between the working temperature and the currently imposed value. Press the ▷ key to zero the difference. The calibration factor CC2 is automatically updated. If after a few seconds the readout moves from zero repeat the operation otherwise terminate the procedure with the F key.

In the setting up or substitution phases of the ZO_2 probe it is possible to avoid this procedure by manually inserting the values of the two constants CC1 and CC2 found on the probe head itself.

10. CHANGES OF STATE AND LOGIC INPUTS

A change of state can be brought about in three ways :

- Keys;
- Logic inputs;
- Serial communication.

With the *keyboard* it is possible to change the state of the controller using the **W** key on the front. Repeatedly pressing it the different operating states available SPr-a, SPr-b, SP lo, SP 1, SP 2, are displayed in the display W. When the desired state appears confirm the new condition with the front key Enter (>).

SPr-a Boiler load remote set point curve “ a “

SPr-b Boiler load remote set point curve “ b “

SP lo Local set point

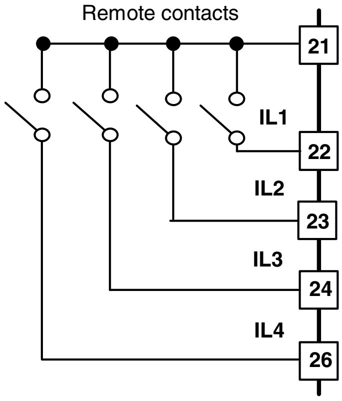
SP 1 Stored set point 1

SP 2 Stored set point 2

With the *serial line* SCI it is possible to change the operating state of the controller by sending the apposite commands (see chapter 13).

The permanent or fleeting closing (at least two seconds) of a combination of the logic inputs IL1, IL2, IL3 will impose the following operating states :

IL1	IL2	IL3	IL4	Type of modification
				No action
On				Hold state (**1**)
	On			Aut. with Remote Set Point linearized "**a**"
		On		Aut. with Remote Set Point linearized "**b**"
	On	On		Aut. with Local Set Point
On	On			Aut. with Local Set Point memorised **1°**
On		On		Aut. with Local Set Point memorised **2°**
On	On	On		Manual
-	-	-	On	Failure (**2**)



The logic inputs have priority over serial communication commands and the keys. If the logic inputs stay closed the functioning of the W key will be inhibited, with the exception of the mode change from Auto > Man or Man > Auto.

Note:

1) The Hold state has the following actions :

- Puts the main output Y1 to its safety level.
- Disables the alarms.
- Causes the message “Hold” to appear in the W display leaving the O_2 indication on the X display and the safety value of output Y1 on the Y display.

Logic input **IL4** is a particular command *dedicated* to faults of the system and is not combinable with the first three. When activated (closed contact) it :

- Puts the main output Y1 at its safety value.
- Disables the alarms and opens the Failure contact.
- Puts the retransmission output to Main Scale.
- Causes the message "Fail" to appear on the X display, the W display to switch off and the level taken up by Y1 to appear on the Y display.
- In the event of a simultaneous closing of all three logic inputs, IL4 has riority over the others.

11. BOILER LOAD PROFILE

Due to plant design and target specifications of boiler and burner, the optimum amount of excess air is different at different thermal loads and with different fuels. The remote set point involves one of the most interesting functions of the instrument: it represents the boiler load in relation to the oxygen set point. signal, taken as part of a boiler load level factor, is collected from a potentiometer located on the fuel servomotor and is converted into a standard 4… 20 o 0… 10 This is used as the basis for the automatic correction of the oxygen set point in the combustion process. Generally the data in this curve is supplied by the manufacturer of the burner.
The remote set point or boiler load is fixed in accordance with a curve between the two available and defined sets of parameters

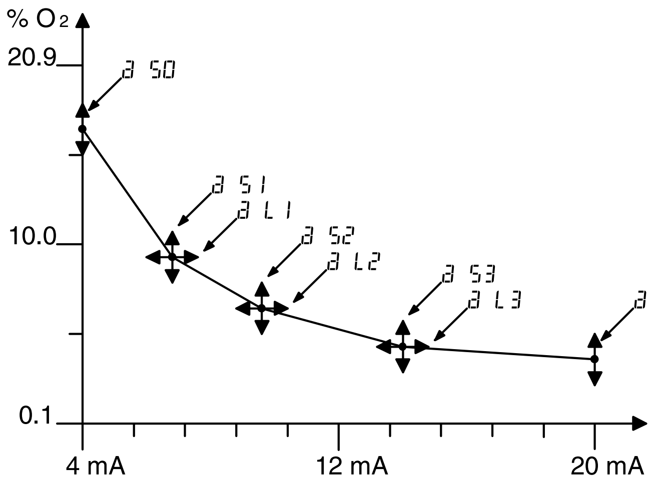
a S0	Scale start set point, Remote Set input
a L1	Remote Set percentage for the 1st point
a S1	Set point 1st point
a L2	Remote Set percentage for the 2nd point
a S2	Set point 2nd point
a L3	Remote Set percentage for the 3rd point
a S3	Set point 3rd point
a SF	Scale end set point, Remote Set input

for the "a" curve (e.g. Methane) and the given parameters

b S0	Scale start set point, Remote Set input
b L1	Remote Set Percentage for the 1st point
b S1	Set point 1st point
b L2	Remote Set percentage for the 2nd point
b S2	Set point 2nd point
b L3	Remote Set percentage for the 3rd point
b S3	Set point 3rd point
b SF	Scale end set point, Remote Set input

for the "b" curve (e.g. diesel fuel)

These curves consists of four segments obtained from 5 points:
The set points at the beginning and at the end of the scale, and three other points in between connected by stright lines :



Example of Remote Set point linearisation in accordance with a pre-established load.

12. SERIAL COMMUNICATION

The instrument is optionally provided with serial communication in the standard Ascon Current Loop. This however is not directly connectable to the ports of all supervisors or hosts. The connection is made using the traffic concentrator and serial adapter model ALS. In this way three types of interface are available and can be used RS-232, RS-422, RS-485 selectable through a series of micro switches inside the ALS instrument.
In order to carry out dialogue with the controller it is necessary to set it through three dedicated parameters Addr, SCbr, SCPa in the fifth group of parameters and protected with the password 1111.

Addr represents the address of the controller which may be set from 0 to 63 and **must be different from all other controllers connected to the line!**

SCbr represents the data transfer speed in bits/s, **it must be imposed in an identical mode to all the other components connected to the line** and may be set from 1… 4 with the following meaning:

SCbr	Baud Rate
1	4800
2	2400
3	1200
4	600

SCPa represents the parity control of messages transferred in line and **must be imposed in an identical mode to all the other components connected on line** and may be set from 0 to 2 with the following significance:

SCPa	Number of characters	Parity
0	8	Excluded
1	7	Odd
2	7	Even

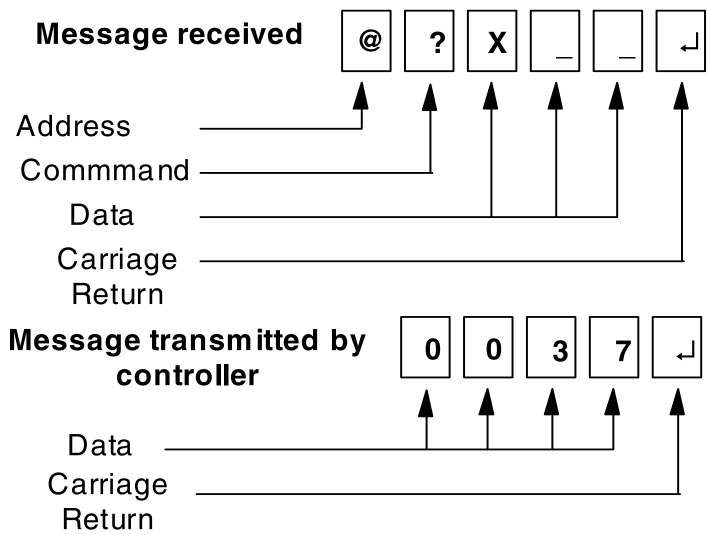
12.1 Conversion Table ASCII character/controller address (Ad.)

ASCII	Ad.	ASCII	Ad.	ASCII	Ad.	ASCII	Ad.
A	0	Q	16	a	32	q	48
B	1	R	17	b	33	r	49
C	2	S	18	c	34	s	50
D	3	T	19	d	35	t	51
E	4	U	20	e	36	u	52
F	5	V	21	f	37	v	53
G	6	W	22	g	38	w	54
H	7	X	23	h	39	x	55
I	8	Y	24	i	40	y	56
J	9	Z	25	j	41	z	57
K	10	[	26	k	42	{	58
L	11	\	27	l	43	|	59
M	12	]	28	m	44	}	60
N	13	^	29	n	45	~	61
O	14	_	30	o	46	DEL	62
P	15	'	31	p	47	@	63

12.2 SPECIAL CONTROL CHARACTERS

Description	Character	Hex Code
Space	_	20
Carriage return	↲	0D
Minus sign	**-**	2D
Question mark	**?**	3F
Question mark	**!**	21
Decimal point	**.**	2E
Asterisk	*	2A
Number	**0**	30
Number	**1**	31
Number	**2**	32
Number	**3**	33
Number	**4**	34
Number	**5**	35
Number	**6**	36
Number	**7**	37
Number	**8**	38
Number	**9**	39

12.3 Structure of message strings



The serial messages consists of a fixed number of ASCII characters.
The string has **6 characters**: the first is the instrument address and the following four characters are the information (request, assignment or command) and the last one is the carriage return character used to end the message.
An incorrect message received by the instrument will have no effect.
For the OX-R controller the message is ended when it receives the "CR" character; therefore in case of message error it is enough to send one or more times the "CR" and transmit the correct message again. Before starting any transmission is a good rule to send some "CR" to clean the buffers of the instruments.

- **Requests (?):**
  These are the requests to the instrument to know a parameter value or an input variable or something else.
- **Assignments (!):**
  These are used only to assign a new value to a specific parameter.

They cause the change of the operation mode for instance from automatic to manual or the activation/deactivation of specific functions of the instrument.

The answer of the instrument to the received message consists of **5 characters**, the first **four** are the information and the last one is again the “CR” character used to end the message.

- **Answers:**
  At any command, assignment or request, the controller sends back a confirm (AKN_) or the requested value.

The useful part of any message, transmitted or received consists always of four characters. Therefore any information shorter than four characters shall be completed filling with blanks after the alphabetic characters or zero before the numeric values. The negative numbers have the minus sign (-) as first character. In addition to the requests and the assignments of all the parameters through the mnemonic codes (listed in the parameter table), the instrument permits through serial communication the following requests:

- Oxygen concentration “X _ _"
- Working set point "W _ _"
- Target set point "WT _"
- Local set point "WL _"
- Y1 output "Y _ _"
- Operating mode "O _ _" (1)
- Alarms status "A _ _" (2)
- List "? _ _" (3)

Note:

(1) The request for the operating mode will receive back one of the following messages:

"LOC _" Local Mode
"MAN _" Local Manual Mode
"MANR" Remote Manual Mode
"REMA" Remote Mode on curve "a" (methane)
"REMB" Remote Mode on curve "b" (Diesel fuel)

2) The alarms status is given in coded form as:

Reply	AL 1	AL 2	AL 3
"0000"	OFF	OFF	OFF
"0001"	OFF	OFF	ON
"0002"	OFF	ON	OFF
"0003"	OFF	ON	ON
"0004"	ON	OFF	OFF
"0005"	ON	OFF	ON
"0006"	ON	ON	OFF
"0007"	ON	ON	ON

(3) When the “List” request is used, the answer message of the instrument will return in sequence:

1. Oxygen concentration
2. Working set point
3. Y1 output
4. Operating mode
5. Alarms status
6. "END_"

The serial communication readout of the variable **O_2%** (oxygen input), will have the same display format. If the value of the variable should fall below -5% or climb above 105% of the range displayed the instrument will respond respectively “UNDR” and “OVRR”. In the event of the IL4 logic input being activated the instrument will respond “FAIL”.

12.4 GENERAL FORMAT OF REQUESTS

Field	no. of characters	Description	Note
Address	1	ASCII character in the range from "@" to "DEL", corresponding to the address from 0="A" to 62=<DEL> and 63="@"	
Operation	1	ASCII character representing the current operation: i.e. "? " for the request.	
Mnemonic	3	String of ASCII characters containing the mnemonic code of the parameter. i.e. "X _ _" value of variable O2	
End of Message	1	Carriage return ↵	

12.5 ANSWER MESSAGE FROM CONTROLLER

The controller answers the request message with the numeric value of the variable or parameter or with the code of the alarms state.

Field	no. of characters	Description
Message	4	Four ASCII characters in the range between " " and "z" and from "0" to "9"
End of Message	1	Carriage return ↵

12.6 GENERAL FORMAT OF ASSIGNEMENTS

Field	no. of characters	Description	Notes
Address	1	ASCII character in the range from "@" to "DEL", correspondding to the address from 0="A" to 62=<DEL> and 63="@"	
Operation	1	ASCII character representing the current operation: i. e. " ! " for assignment and " ? " for request.	
Mnemonic	3	String of ASCII characters containing the mnemonic code of the parameter: i.e. "SA1" means set point alarm 1	
End mnemonic	1	Carriage return ↵	
Time Delay	50 ms	A delay or many times the ↵ character to form 50mS i.e. 25 times at 4800 Baud (see note)	
Address	1	ASCII character in the range from "@" to "DEL", corresponding to the address from 0="A" to 62=<DEL> and 63="@"	
Value to be assigned	4	Four ASCII characters in the range between 0… 9	
End of Message	1	Carriage return ↵	

In the OXR instrument, there is the possibility to merge two consecutive strings in only one deleting the "CR" character from the first and the delay and address from the second therefore reducing the total time of the assignment of a new value.

The OXR instrument accepts any of the following assignment methods :
1. Two strings separated by a delay;
2. Two strings merged together;
3. One string.

12.7 ANSWER MESSAGE FROM CONTROLLER

The controller answers an assignment message in two different ways:
- It returns an acknowledge message (usually "AKN ").
- Or it returns the same assigned value.

Field	N° of characters	Description
Message	4	Four ASCII characters in the range between " " and "z" and from "0" to "9"
End of Message	1	Carriage return ↵

Note
In order to simplify the exposition, the following symbols will be used to identify the instrument address, the space character, and the Carriage return character :

- @ address of the instrument in ASCII format
- _ < blank > character
- ↵ < Carriage return > character

12.7.1 Examples:

Assignment of alarm 1 set point = 1.5% to OX-R

Assignment	Answer
@ ! S A 1 ↵	
50 ms Delay	
@ 0 0 1 5 ↵	A K N _ ↵

Assignment of alarm 1 set point = 1.5% to OX-R

Assignment	Answer
@ ! S A 1 0 0 15 ↵	A K N _ ↵

Assignment of slope up value = 10.0

Assignment	Answer
@ ! S L U ↵	
50 ms Delay	
@ 0 1 0 0 ↵	A K N _ ↵

Assignment of slope up value = 10.0

Assignment	Answer
@ ^ S L U ↵	
@ 0 1 0 0 ↵	0 1 0 0 ↵

Assignment of slope up value = 10.0

Assignment	Answer
@ ! S L U 0 1 0 0 ↵	A K N _ ↵

Assignment of slope up value = 10.0

Assignment	Answer
@ ^ S L U 0 1 0 0 ↵	0 1 0 0 ↵

Request of the Oxygen value to OXR controller

Request	Answer
@ ? X _ _ ↵	0 0 0 4 ↵

Assignment of the calibration constant C.C1

Assignment	Answer
@ ! C C 1 - 0 2 5 ↵	A K N _ ↵

Request of the actual value of the calibration constant C.C1

Request	Answer
@ ? C C 1 _ ↵	- 0 0 2 ↵

12.8 GENERAL FORMAT OF COMMANDS

Field	No. of characters	Description	Notes
Address	1	ASCII character in the range from "@" to "DEL", corresponding to the address from 0="A" to 62=<DEL> and 63="@"	
Operation	1	ASCII character representing the current operation: i.e. " ! " for assignment and " ? " for request or "*" for a command	
Mnemonic	3	String of ASCII characters containing the mnemonic code of the parameter: i.e. "MAN" to force the instrument in manual mode	
End of Message	1	Carriage return ↵	

12.9 ANSWER MESSAGE FROM CONTROLLER

The controller can replies as follows:

- acknowledge message ("AKN ").
- echo of the done command

Field	No. of characters	Description
Message	4	Four ASCII characters in the range between " " and "z" and from "0" to "9"
End of Message	1	Carriage return ↵

12.9.2Example :

To send the command of changeover from AUTO to MANUAL:

Command	Answer
@ * M A N ↵	A K N _ ↵
@ > M A N ↵	M A N _ ↵

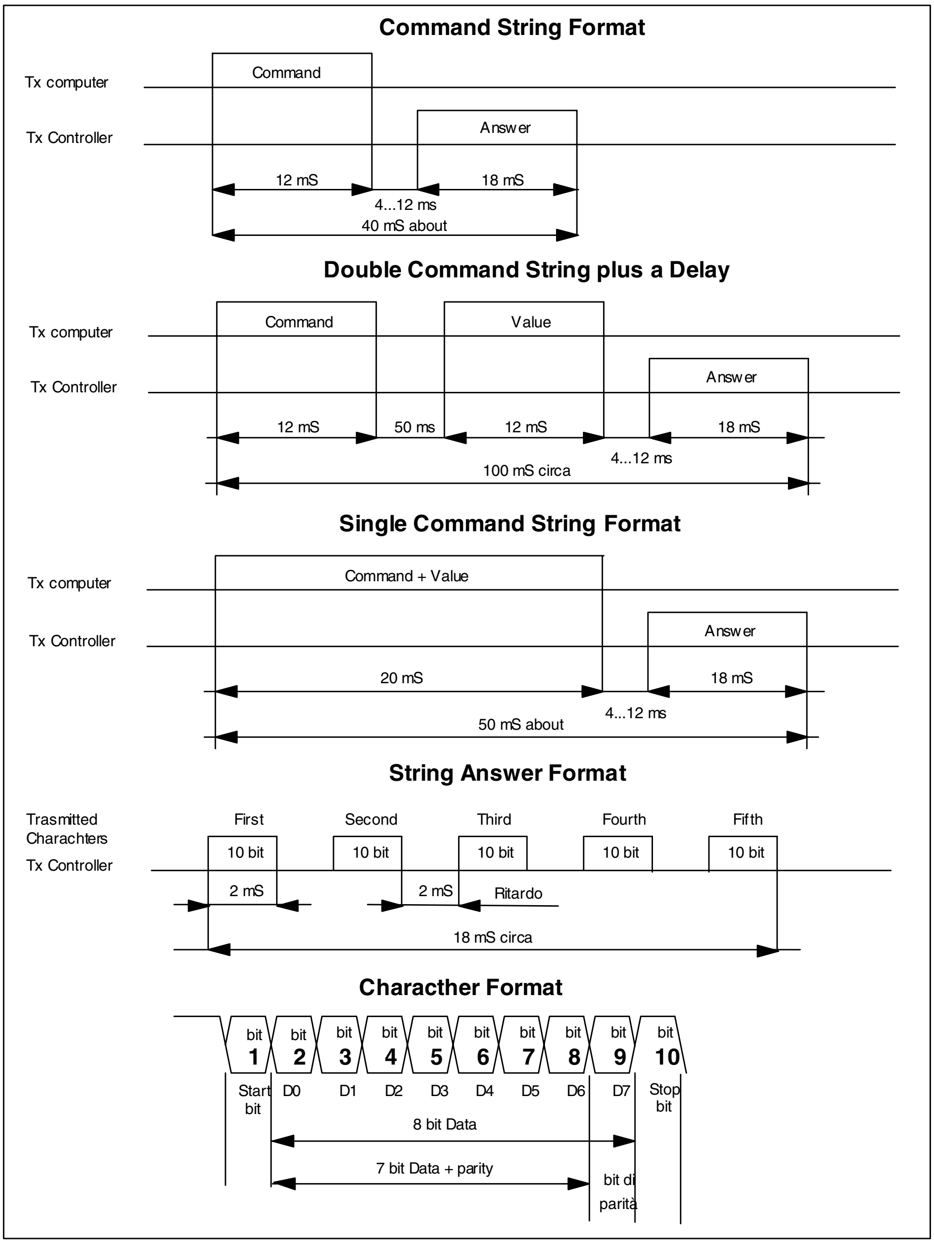
12.10 Serial Commands

The commands that may be assigned by serial line are:

"AUT" Go to Automatic
"MAN" Go to Manual
"LOC" Local set point ➔ Target set point
"RMA" Go to remote working on curve "a"
"RMB" Go to remote working on curve "b"
"SP1" Call for 1st stored set point
"SP2" Call for 2nd stored set point

N.B. If the logic inputs IL1..IL3 remain closed, serial commands will not be executed except for Man > Auto and Auto > Man changeovers.

12.11 4800 baud format time table



12.12 Communication Software

Writing the communication routines it is important to remember that the instruments are able to handle one message at time and therefore it is necessary to wait for the answer to the previous question/assignment/command message before sending further messages.

This example is a simple program in Qbasic to request several times the process variable and to display it in the screen.

```
DECLARE FUNCTION Receive$ ()                                        '
'---------------------------------------------------------------------------   '
OPEN "COM1:4800,N,8,1,RS,CS0,DS0,CD0" FOR RANDOM AS #1              ' It Opens the serial port  1 at 4800
'---------------------------------------------------------------------------   ' Baud, 8 Bit, no Parity
DO                                                                         ' Execute
'---------------------------------------------------------------------------   '
  PRINT #1, "A?X  "; CHR$(13);                                      ' Request for value
Rx$ = Receive                                                       ' Waiting for the answer
  PRINT Rx$                                                         ' Print the answer
'---------------------------------------------------------------------------   '
LOOP UNTIL INKEY$ = CHR$(27)                                        ' Until the  <ESC> key is pressed
                                                                    '
CLOSE                                                               ' Close the serial port
END                                                                 '
                                                                    '
FUNCTION Receive$                                                   ' Receiving routine
   T! = TIMER                                                       '
   DO                                                               '
                                                                    ' Wait until the max waiting  time
      Waiting! = TIMER - T!                                         ' of  (200 ms) has been reached and/or
   LOOP UNTIL (Waiting! > .2) OR LOC(1) >= 5                        ' until at least 5 characters have been
                                                                    ‘received
   IF LOC(1) = 5 AND (Waiting! <= .2) THEN                          ' If  5 characters are received and the
      Rx$ = INPUT$(5, 1)                                            ' max. timeout has not elapsed :

      IF RIGHT$(Rx$, 1) = CHR$(13) THEN                             ' If the character on the right is
                                                                    ‘ <CR> it is skipped and
                                                                    ‘the value is returned
            Receive = LEFT$(Rx$, 4)                                 '
      ELSE                                                          ' Otherwise :
            Receive = "Error"                                       ' an error message is returned
      END IF                                                        '
   ELSE                                                             ' If  the max. timeout has expired or
IF LOC(1)<>0 THEN                                                   ' the number of  characters is less
                                                                    ‘ than 5
Dummy$=INPUT$(LOC(1),1)                                             ' the receiving Buffer is cleaned and
END IF                                                              '
      Receive = "Error"                                             ' an error message is returned.
   END IF                                                           '
END FUNCTION                                                        '
```

13. TECHNICAL DATA

• Tolerance	0.2% ± 1 digit on O_2 signal
• Auxiliary inputs	4 logic type inputs
• Local set point	1 Local + 2 Stored
• Remote set point	current 4...20 mA or voltage 0...10V not isolated input
• Control	P, PI, PD, PID
• Auto tune	For the automatic search of tuning parameters (One shot)
• Auto/Man station	With bumpless action
• Outputs AL1 - AL2 -AL3	N/O relay contacts, 5A /250 Vac
• Main output Y1	current 4...20 mA or voltage 0...10V output
• Output failure	N/O relay contacts, 5A/250 Vac
• Retransmission output Y2	current 4...20 mA or voltage 0...10V output
• Serial communication	20 mA current loop, isolated
• Protection of parameters	Software password
• EMI suppression	Level 4, IEC 801-4 Standard
• Memory protection	With non volatile memory
• H.V. Power supply	100..240Vac, 48..63Hz, -1,5% +10%
• L..V. Power supply	24 Vac, 48...63Hz, -15% +10% or 24Vdc ± 15%
• Auxiliary supply	24Vdc ± 10% for transmitters
• Isolation group	C in accordance with VDE 0110
• Climatic category	KWF in accordance with DIN 40040
• Ambient temperature	0....50^{o}C
• Ambient humidity	35...85 % RH
• Frontal protection	IP 54 std.(IP 65 with F10-170-2A101)
• Housing protection	IP 30
• Terminal protection	IP 20
• Housing material	UL 94 V1
• Weight	480 gr. approx.
• Dimensions	48 x 96 x 150mm deep in accordance with DIN 43700

WARRANTY

We warrant that the products will be free from defects in material and workmanship for 18 months from the date of delivery.

Products and components that are subject to wear due to conditions of use, service life, and misuse are not covered by this warranty.

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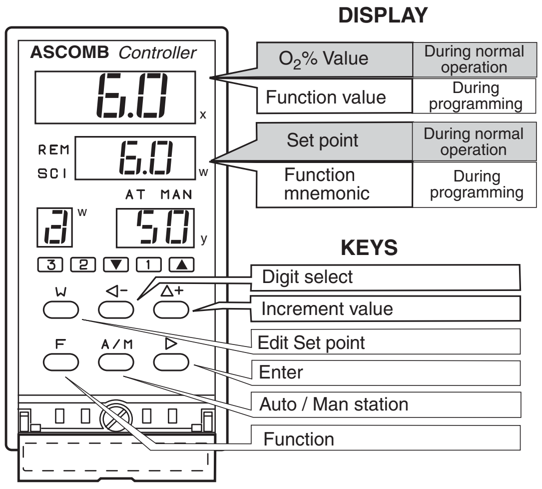
PROGRAMMING INSTRUCTION • OX-R SERIES CONTROLLER

FUNCTIONS MENU



To enter in function mode, press F

From normal working

- U In → View **probe mV input**
- tunE → Run **Auto-Tune** function
- Par → View or modify **Parameter**
- CAL → **Probe calibration** (See cap. 10)
- Con → View **configuration code** (0001 / 0658) → **Configuration modify**
- S.P.t. → View **target set point** (See note 2)
- Addr (Only for models with serial option) → View instrument **device number 0 … 63** (12 / Addr)

Menu exit

Note:
1 if F or ▷ is not pressed within 10 seconds, the instrument will time-out back to the process variable
2 If slu=0 or sld=0 will not appear.

CONFIGURATION

- PaSS — Enter correct password to start configuration process. (See cap. 9)
- No → Return to process variable display.
- Ok → Entering the configuration process straighty.
- Con.1 — Enter the first block of 4 configuration index codes **E, F, G, H**
- Con.2 — Enter the second block of 3 configuration codes **I, L, M**
- E = 2 → I.0.L.o — Engineering range low value for user configurable range (See cap. 3.1)
- I.0.H.i — Engineering range high value for user configurable range (See chap 3.1)
- E = 0, E = 1 → To 5° GROUP of parameters

If not configurated at the power-up the main display will show 9999 / 9999 / Co

The configuration code shall be continuosly shown. There is no time-out. Exiting the configuration process you will access straigthly the 3 group of parameters to modify, if necessary, set point limits, maximum power out etc.

PARAMETERS

1° GROUP

Display	Parameter	Factory value
AL 1	**AL 1** Set point (see note)	100
AL 2	**AL 2** Set point (see note)	100
AL 3	**AL 3** Set point (see note)	100
A.1HY	**AL 1** hysteresis (see note)	0.50
A.2HY	**AL 2** hysteresis (see note)	0.50
A.3HY	**AL 3** hysteresis (see note)	0.50
t.dEL	Alarm action delay 0...120 s — See note	0

Note:
The AL1, AL2, AL3 etc. parameters will not be available if they are disabled in configuration. (I=0,L=0,M=0)

2° GROUP

Display	Parameter	Factory value
P.b.	Proportional band 0.5 ..999.9%	5.0
t. i.	Integral time 0.0 ..100.0 min.	5.0
t.d.	Derivative time 0.00 ..10.00 min.	1.00

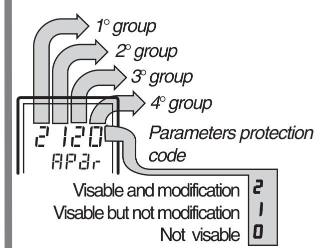
3° GROUP

Display	Parameter	Factory value
AP.h	Approach high 0.01 ..2.00 x Pb	0.50
AP.L	Approach low 0.01 ..2.00 x Pb	0.50
F.F.	Feed forward 0 ..500%	0

4° GROUP

Display	Parameter	Factory value
S.P. 1	1° memory set point	100
S.P.2	2° memory set point	200
S1. u	Slope up during transition of the set point (digit / min)	0.0
S1.d	Slope down during transition of the set point (digit / min)	0.0

Parameters protection code



5° GROUP

- PASS — Enter password (See chap.9)
- No → Return to process variable display
- Ok → Straighty from configuration process or from last parameterof the 5° group

Display	Parameter	Factory value
S.P.L.L	Set point limit low	00.1
S.P.L.h	Set point limit high	20.9 1
YL L	Y1 minimum power output	0
YL h	Y1 maximum power output	100
Y 1	Y1 Safety value	0
t.F. iL	Time constant of the input filter	0
Y2L o	%O2 retransm. start point	0.00
Y2H i	%O2 retransm. end point	20.9 1
C.C 1	Calibration constant 1 (See chap10)	8.00
C.C 2	Calibration constant (See chap10)	0
a S0	Scale start set point Remote Set input — Note 1	17.0
a L1	Remote Set % for the 1st point — Note 1	18.0
a S1	Set point 1st point — Note 1	9.0
a L2	Remote Set % for the 2nd point — Note 1	50.0
a S2	Set point 2nd point — Note 1	8.0
a L3	Remote Set % for the 3rd point — Note 1	80.0
a S3	Set point 3rd point — Note 1	4.0
a SF	Scale end set point Remote Set input — Note 1	3.0
b S0	Scale start set point Remote Set input — Note 1	17.0
b L1	Remote Set % for the 1st point — Note 1	18.0
b S1	Set point 1st point — Note 1	9.0
b L2	Remote Set % for the 2nd point — Note 1	50.0
b S2	Set point 2nd point — Note 1	8.0
b L3	Remote Set % for the 3rd point — Note 1	80.0
b S3	Set point 3rd point — Note 1	4.0
b SF	Scale end set point Remote Set input — Note 1	3.0
A.P.dr	Protection level code	2222
A.tu	Enabled tune operation — Note 2	1
S.C. I.	Enabled to write from SCI communication (See chap13)	1
Addr	SCI Address (See chap13)	0
S.C.b.r	Baud Rate (SCI) (See chap13)	1
S.C.P.d	Parity (See chap13)	0

Return to S.P.L. l

Note:
1) For more information on this function, see cap. 12
2) If A.tu. = 0, will not appear the tunE function in the main menu

MODIFICATION OF A NUMERIC FIELD

You may modify any numeric field by changing each digit in turn.

Example: to change 250 to 260

0250 — Press ◁ to select the required digit. Each successive pression of this button moves the flashing digit one place to the left: 0 ⇦ 0 ⇦ 5 ⇦ 0

0250 — Pressing △ increments the selected digit (for the most significant digit there is a - between 9 and 0): 0 ⇨ 9

0260 — Press ▷ to accept the change. In any case it will be accetted automaticlly after 10 second.

Note: ■ *factory set parameters*

CONFIGURATION CODE

Display: 0001 / 0569

Boiler load input	F
4..20 mA	0
0..10 V	1

ZO2 probe input	E
Directly from probe (in mV)	0
From transmitter 4..20 mA - not linearized	1
From transmitter 4..20 mA - linearized	2

Type of action	G
Reverse	0
Direct	1

Retransmission output Y2	H
None	0
%O2 Retransmission	1

Type of set point and control mode output AL 1		I
Disabled		0
Deviation with startup inhibition	Active high	1
	Active low	2
Band	Active outside	3
	Active inside	4
Independent	Active high	5
	Active low	6
Deviation	Active high	7
	Active low	8

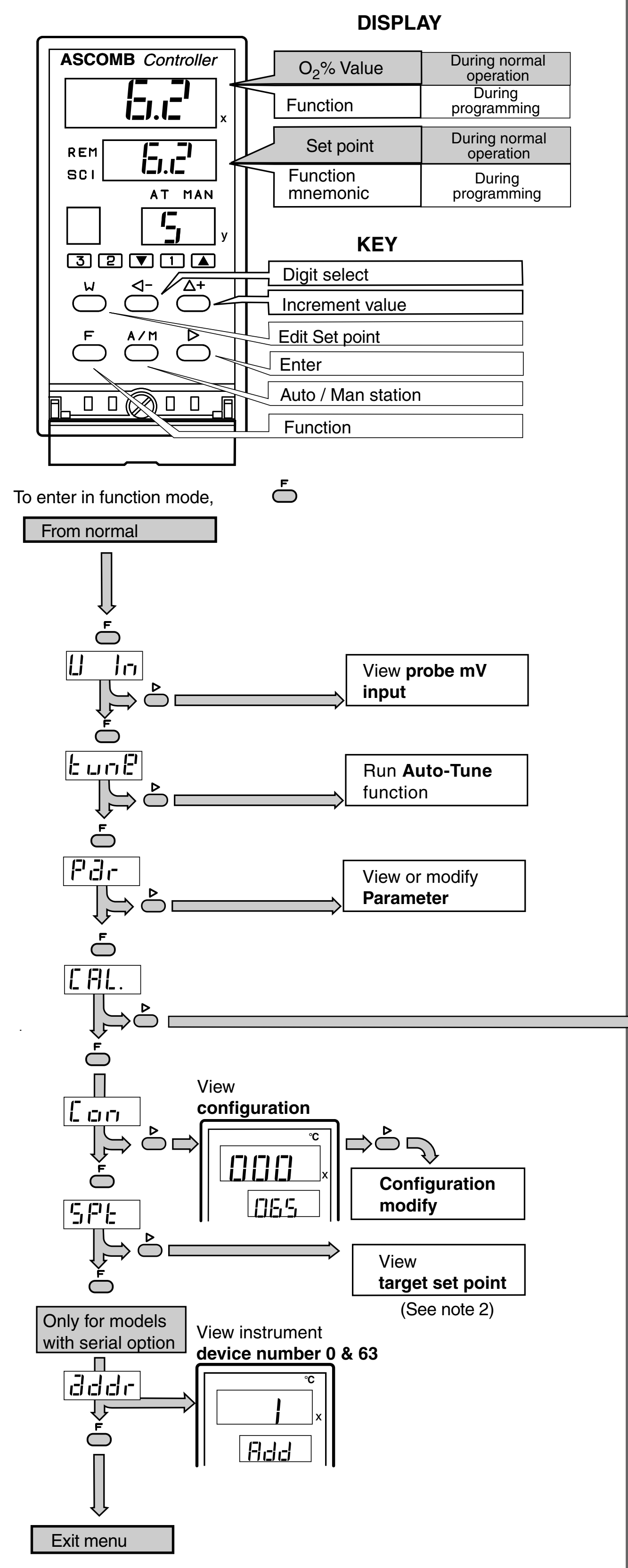
Type of set point and control mode output AL 2		L
Disabled		0
Deviation with startup inhibition	Active high	1
	Active low	2
Band	Active outside	3
	Active inside	4
Independent	Active high	5
	Active low	6
Deviation	Active high	7
	Active low	8

Type of set point and control mode output AL 3		M
Disabled		0
Deviation with startup inhibition	Active high	1
	Active low	2
Band	Active outside	3
	Active inside	4
Independent	Active high	5
	Active low	6
Deviation	Active high	7
	Active low	8
Loop Break Alarm		9

If at the power-up you will see 9999 the means the instrument **IS NOT CONFIGURED**

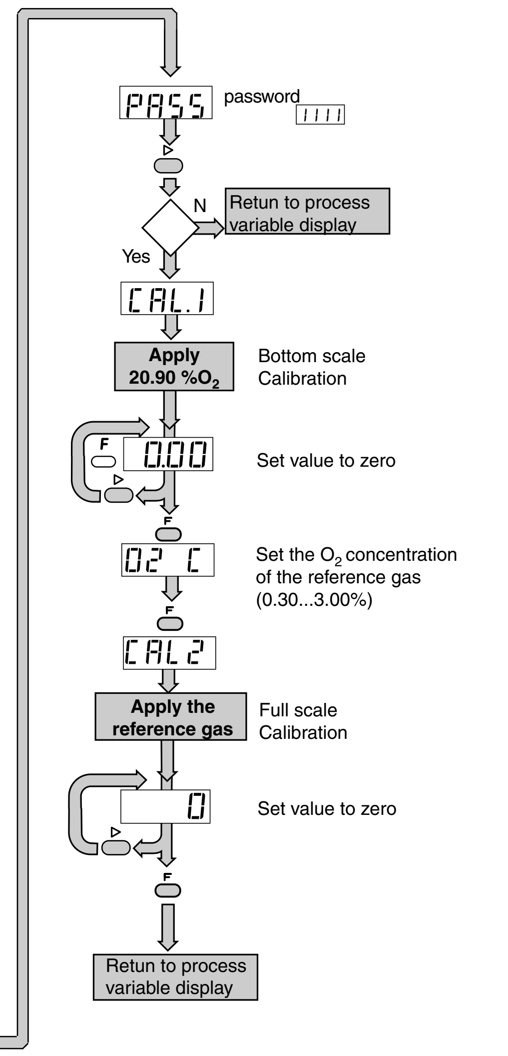
OPERATING INSTRUCTION • OX-R SERIES CONTROLLER

FUNCTIONS MENU



Note:
1 if F or ▷ is not pressed within 10 seconds, the instrument will time-out back to the process variable
2 If SLu=0 or SLd=0 will not appear.

PROBE CALIBRATION



Note:
For more information about the calibration procedure, see chap. 10.

LOGIC

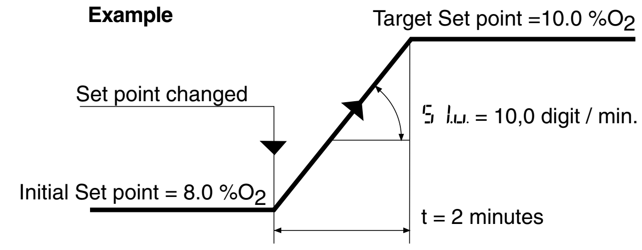
IL1	IL2	IL3	IL4	TYPE OF MODIFICATION
-	-	-	-	No action
ON	-	-		Hold
-	ON	-	-	Remote Set point
-	-	ON	-	Remote Set point
-	ON	ON	-	Local Set
ON	ON	-	-	1° Stored Set point
ON	-	ON	-	2° Stored Set point
ON	ON	ON	-	Manual
-	-	-	ON	Failure

Note:
For more information about the logic inputs, see chap. 11.

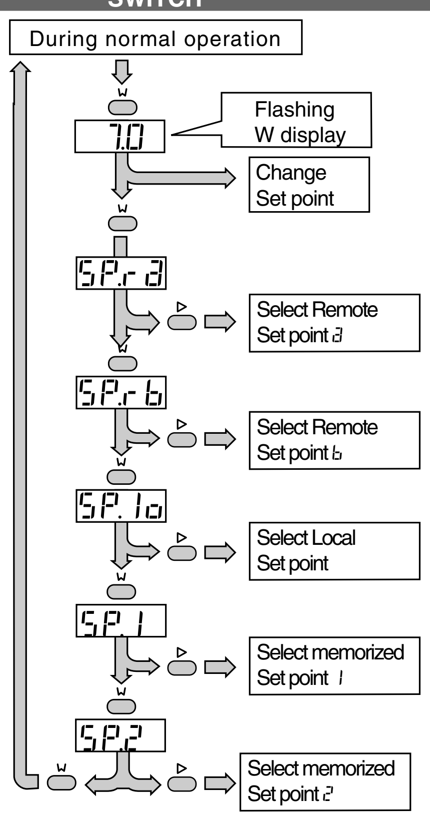
Notes:
After the Set point has been modified the new target Set point will be reached after a period of time, depending upon the values entered in the SLu *(Slope Up) and* SLd *(Slope Down) gradient parameters.*
Whith Remote Set point we suggest, to set SLu *and / or* SLd *to zero.*
The target Set point *can be viewed at any time from the function menu.*
F ⇨ SP.t **Target Set point**

If slope gradient is equal to zero there will be a step change

Example

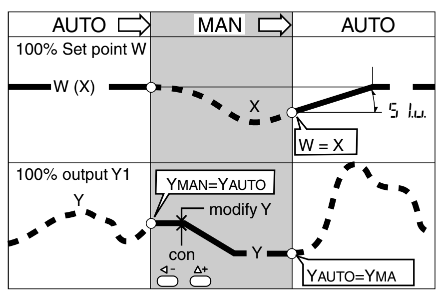


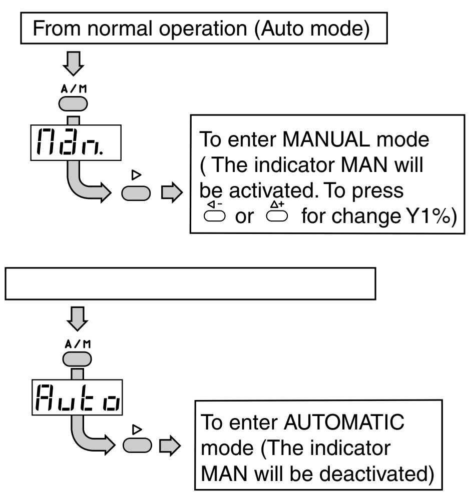
SWITCH



Note:
For more information see cap. 11 of this manual.

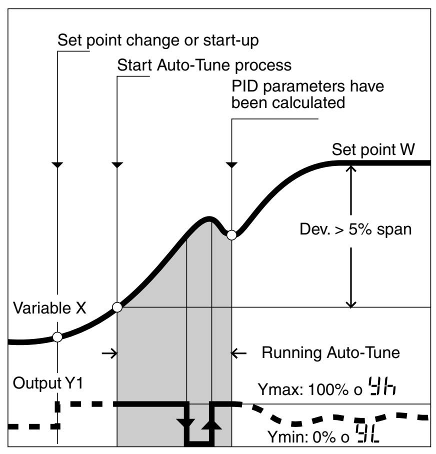
AUTO - MAN



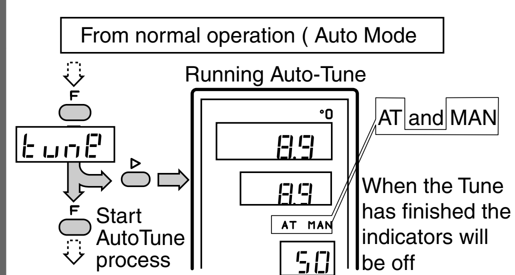


TUNING

Auto-Tune should be used when the instrument is first installed to provide approximate values for the PID algorithm.
When the Auto-Tune cycles has been completed the values for PID will be automatically entered.
It is possible to escape from the Auto-Tune procedure at any time by pressing any key.



The Auto-Tune function is available if the following requirements are met:
1. Parameter Atu = 1
2. The deviation > 5% span



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