OSC

Analyzer for determining residual oxygen content in gases V1.1

Table of Contents

List of Figures

1 OSC

1.1 General Information

1.1.1 Measuring principle

The OSC device is an analyzer for determining the residual oxygen content in gases. The device allows the measurement of the oxygen partial pressure in different atmospheres with a solid-state electrolyte of stabilized zirconium dioxide (zirconium probe). Stabilized zirconium dioxide is an oxygen ionic conductor with a transport number for oxygen ions equal 1. The ionic conduction becomes interesting for the practical application with a temperature of about 600°C. An oven and a temperature probe attached to the zirconium probe keep the probe temperature constantly at 735°C. If different oxygen partial pressures are determined on both sides of the solid-state electrolyte at these temperatures this results in a voltage (electromotive force, e.m.f.) according to Nernst. If one of these partial pressures is known the relation contains only known and measurable values beside the unknown oxygen partial pressure. As reference oxygen partial pressure the O_2 partial pressure of the air is used. The gas to be measured flows with a built-in pump as a constant flow through a solid-state electrolyte tube. Purging of the tube from extern with air is done by means of convection. The voltage is tapped off with two platinum electrodes and converted in relation to the O2 value.

1.1.2 Measuring gases

The only condition the gas to be measured has to meet is that it does not contain solid matters which may obstruct supply line, pump, flowmeter or the solid-state electrolyte probe. Such a soiling or a too large amount of steam has to be absorbed with a filter before it reaches the device. An effect of the measuring gases on the platinum electrode could not be recognized although in theory a ”intoxication” of the electrodes because of different components (carbon, sulfur) might be possible. Since, however, measurement takes place more or less de-energized, this setup is distinguished by a large resistance against contamination.
If the measuring gas contains matters that react with oxygen at a probe temperature of 735°C as it applies to e.g. hydrogen or carbon monoxide it has to be expected that a part of the oxygen in the measuring gas is consumed by this reaction. For the small amount of reducing gases in relation to the oxygen content this can be neglected in most of the cases.
If the measuring gas contains matters that decay in reducing gases at this probe temperature (e.g. organic steams), it is recommended to conduct the measuring gas through a cold trap before it enters the OSC analyzer. Such steams can normally be eliminated to a large amount or reduced so far that the oxygen measurement will not be influenced essentially.

1.1.3 Flowmeter

The gas flow can be regulated with a flowmeter. The flow rate has to be adjusted to about 5 l/h to guarantee a correct measurement. Larger flow rates can result in changed pressure and temperature relations in the measuring cell. In case of smaller flow rates the measuring cell will show a delayed reaction when the composition of the measuring gas changes.
If only a small amount of the gas to be measured is available the connection from the gas room to the analyzer should be as short as possible.

1.1.4 Analog output

The OSC analyzer is provided with a 0/4 - 20mA power output. A 12 bit D/A converter resolves the measured value linear as analog value among two freely programmable values. The analog signal is applied to the rear 5-pole DIN socket and can be led to a recording input e.g. for recording the measuring results over a longer period.

1.1.5 Digital outputs

The OSC analyzer can be provided with a relay output card (option). The three relay outputs can be assigned to the configurable limit values, warning or to the release.

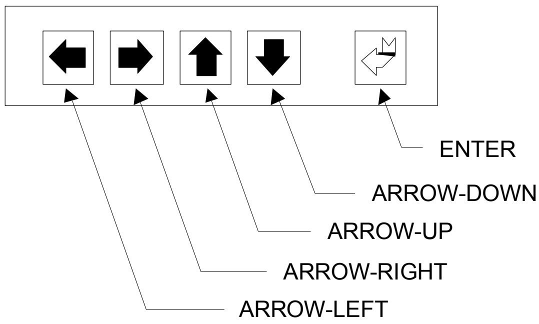
1.1.6 Power fail-safe memory

All operating parameters are stored fail-safe and are available after turn-on of the device.

1.1.7 Operation

The user can operate the menu shown on the graphic display with a Foil keyboard. The keyboard has five keys (see Figure 1).

Figure 1: Foil keyboard



Use the keys ”ARROW LEFT”, ”ARROW RIGHT”, ”ARROR UP” and ”ARROW DOWN” to position the select cursor on the graphic display. Up to six cursor positions are possible (see Figure 2).

Figure 2: Cursor positions a) to f)

```
      <Example>
---------------------
f)
e)
d)
c)
---------------------
a)            b)
```

The activation of the corresponding menu items or editable values depends on the display mode. Change to another menu (sub-menu or BACK was pressed) or to the edit mode (editable value was selected) or change back from the edit mode to the selection mode (editable value was confirmed with ENTER) with the ENTER key.
The edit mode is indicated with the edit-Cursor . In the edit mode an editable value can be increased or decreased with the keys ”ARROW UP” and ”ARROW DOWN”. The less significant digit of the value is changed when you shortly press the respective key. Holding the key pressed for a longer time activates the cascade-type control. This means that at the beginning the less significant digit is edited. If there is a change of the next higher potency by holding the key it will continue the edit. This cascade runs through all available powers, depending on the type of value.

1.1.8 Note

The OSC analyzer should not be exposed to strong vibrations or shocks. This could result in a damage to the zirconium probe.
Just at higher temperatures (operating temperature 735°C) the zirconium probe is highly sensitive. After the operation allow the OSC analyzer to cool down for at least 30 – 60 minutes before you transport it.

1.2 Technical data

• Measuring range (O_2):	10^{-22}% (10^{-24}) to 100% (1)	
• Display range (automatic switch-over):	1,00 E-24 to 9,99 E-07	
	1,00 PPM to 9990 PPM	
	1,00 % to 100 %	
• Resolution of the display ranges:	0,01 per range	(1,00 E-24 to 9,99 E-07)
	0,01	(1,00 PPM to 9,99 PPM)
	0,1	(10,0 PPM to 99,9 PPM)
	1	(100 PPM to 999 PPM)
	10	(1000 PPM to 9990 PPM)
	0,01	(1,00 % to 9,99 %)
	0,1	(10,0 % to 100 %)
• Measuring scatterband:	max.	±2mV
• Analog output:	Power output	0/4 - 20mA
	Resolution	12 Bit
	Load max.	500 Ohm
• Digital outputs:	3 x 230V / 2A	
• LCD graphic display (with back lighting):	Resolution	128 x 64 pixel
	Dimensions	70mm(B) x 35mm(H)
• Sensor:	Zirconium probe (platinum electrode) with oven	
• Flow-meter with control valve:	0 - 10 l/h	(setting 5 l/h)
• Measuring gas connections:	4mm stainless vanadium steel tube	
	(19'' slide-in module on the rear)	
	(desktop device and service case on front)	
• Foil keyboard:	← → ↑ ↓ ↵	
• Power supply:	230VAC / 50Hz / 200VA	
• On/Off-switch:	Toggle switch	
• Case/design:	19' slide-in module	
	Desktop device	
	Service case	
	Wall-mounting case	
• optional interface:	RS-232 or RS-422 for cyclic output of measurement values „emk“, „temperature“ and „O2-value“	
	Output format: 9600, 8, N, 1 (without handshakes)	

ATTENTION:
The OSC analyzer for determining residual oxygen content in gases is not checked by the German Technical Inspectorate. Process Informatic cannot be held liable for damage due to improper handling.

1.3 Optional interface (RS-232 or RS-422)

The oxygen-device OSC-II can be optionally equipped with a serial interface for cyclic output of measurement values "emk", "temperature" and "O2-value".
The output cycle amounts to 60s. If you need another cycle, please consult the manufacturer of the device.

The measured values would be outputed with the following parameters:

baudrate:	9600
count of databits:	8
parity:	none
count of stopbits:	1
handshake:	none
emulation:	VT100J

The measured values can then be shown on the PC, for example using a terminal program "Hyperterminal".

```
O2   =    21,8 %
EMK  = +0,0625 mV
Temp =      735 °C
```

When the measurement range of the O2 changes, the unit value changes automatically. This option should be ordered when ordering the device. Retrofitting is possible, but the device needs to be sent to the factory.

1.3.1 Pinning

Pin-Nr	description RS-232	description RS-422
1	N.C.	N.C.
2	RxD	N.C.
3	TxD	N.C.
4	N.C.	Rx+
5	GND	Rx-
6	N.C.	N.C.
7	N.C.	N.C.
8	N.C.	Tx+
9	N.C.	Tx-

1.4 Unit survey

Figure 3: Front view of the device

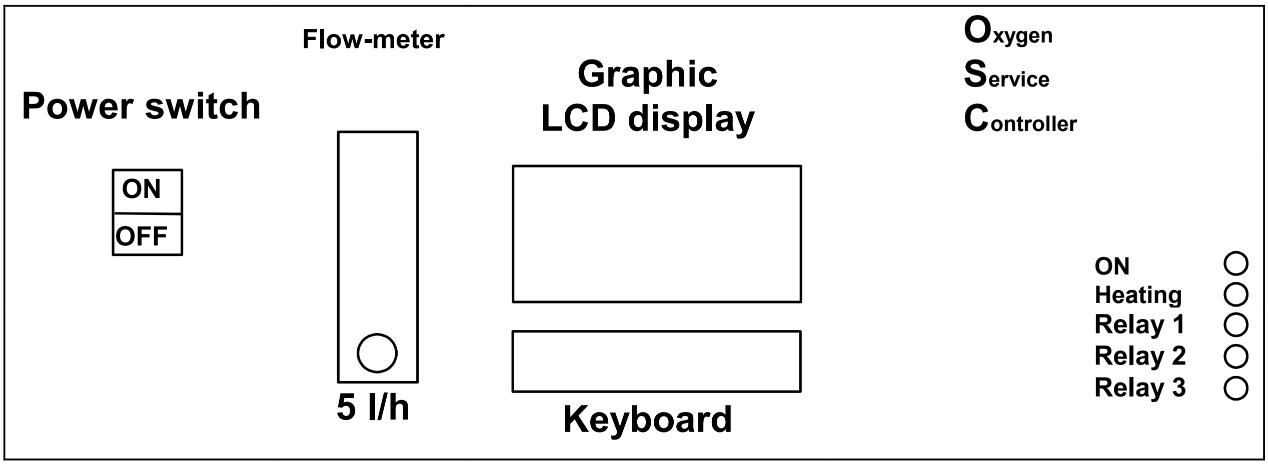
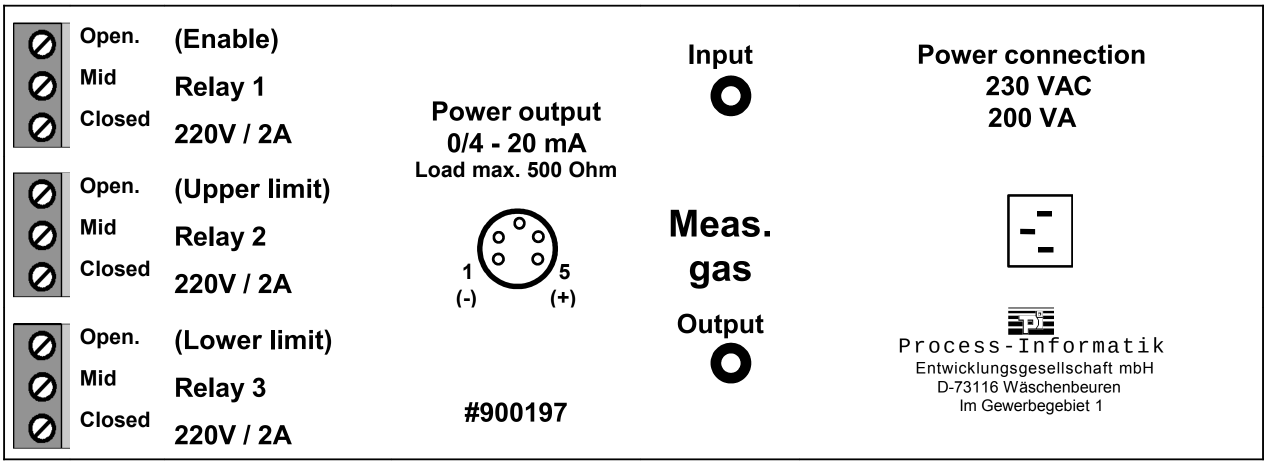
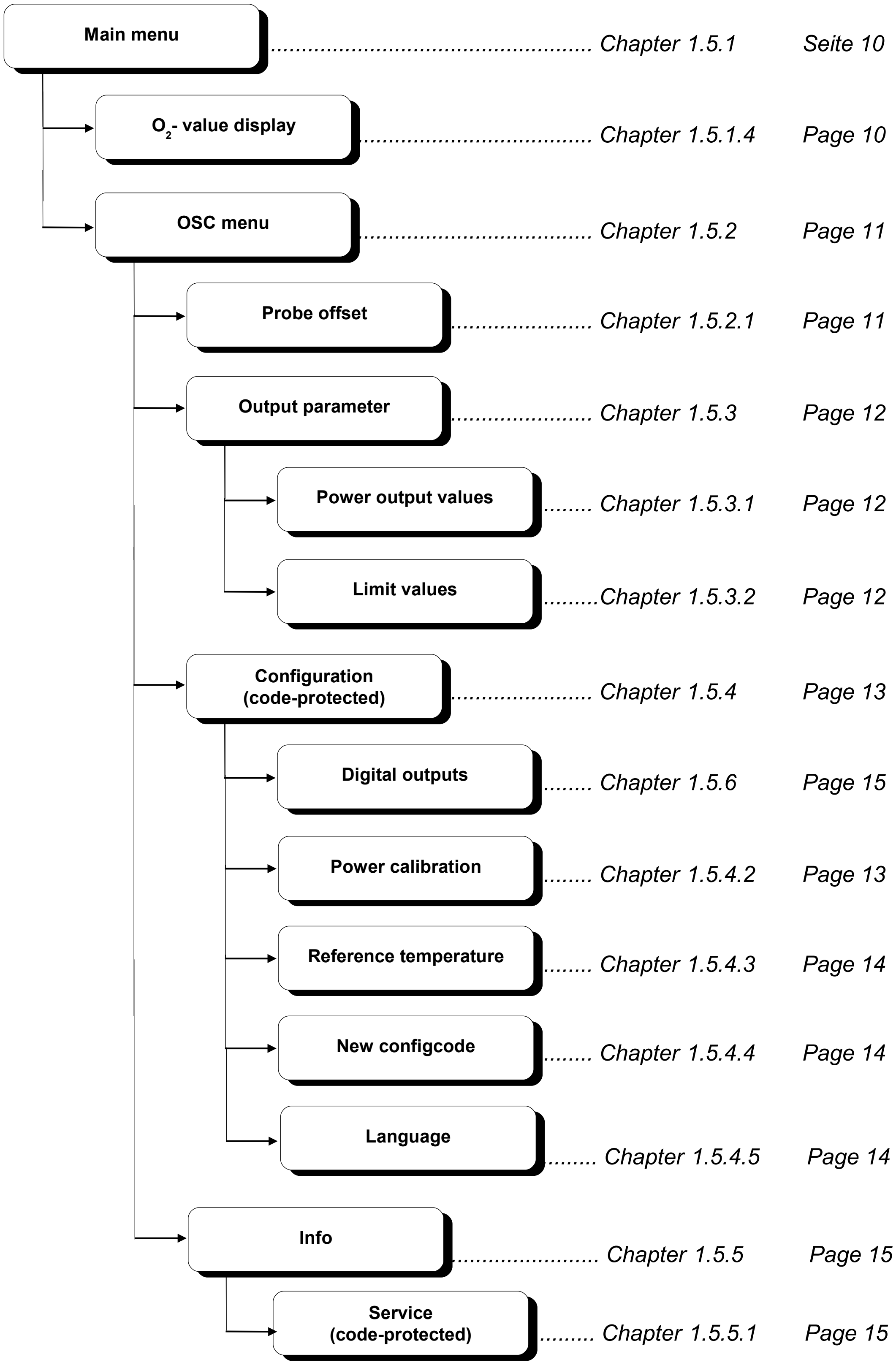


Figure 4: Rear view of the device



1.5 Menu structure

Figure 5: Menu structure



1.5.1 Main menu

Figure 6: Main menu

```
--------------------
--     OSC-II     --
--------------------
  O₂   =    XXXX XXXX
  EMF  = ±XXXXXX mV
  TEMP =     XXX °C
--------------------
  MENU       O₂-VALUE
```

1.5.1.1 Displayed value: Measured O_2 value (O_2)

Display range:	1,00 E-24 to 9,99 E-07	
	1,00 PPM to 9990 PPM	
	1,00 % to 100 %	
Resolution of the display ranges:	0,01 per range	(1,00 E-24 to 9,99 E-07)
	0,01	(1,00 PPM to 9,99 PPM)
	0,1	(10,0 PPM to 99,9 PPM)
	1	(100 PPM to 999 PPM)
	10	(1000 PPM to 9990 PPM)
	0,01	(1,00 % to 9,99 %)
	0,1	(10,0 % to 100 %)

ATTENTION:
"TEMP LOW" is indicated for a probe temperature < 650 ºC, since the zirconium probe delivers usable values only at a temperature of about 600°C and higher!

1.5.1.2 Displayed value: Electromotive force (e.m.f.)

Electromotive force (e.m.f.) of the probe (with probe offset voltage taken into account, see chapter 1.5.2.1 Menu: Probe offset). The measured O_2 value is determined from this force (electromotive force, e.m.f.), the probe temperature and the terminal temperature.

1.5.1.3 Displayed value: Probe temperature (TEMP)

Current probe temperature (with the terminal temperature taken into account for temperature compensation). The zirconium probe is kept at a constant temperature of 735°C by an oven and a corresponding heating.

1.5.1.4 Menu: O_2 value display (O_2 value)

As shown in Figure 7 with a variable (X), the current O_2 value and the corresponding unit is indicated here with larger letters so that it is readable even at a greater distance.

Figure 7: O_2 value display

```
      O₂-Value
--------------------

  XXXX  XXXX

--------------------
  BACK
```

1.5.1.5 Menu: OSC menu

Choose ”Menu” to get to the OSC menu. Here you can choose different submenus (see chapter 1.5.2 OSC menu).

1.5.2 OSC menu

Several submenu items are available on the OSC main menu. Configuration of the OSC analyzer is done with these submenu items.

Figure 8: OSC menu display

```
       OSC-MENU
---------------------
  SENSOROFFSET
  OUTPUTPARAMETERS
  CONFIGURATION

---------------------
  BACK        INFO
```

1.5.2.1 Menu: Probe offset

The OSC analyzer was calibrated and tested for linearity during the manufacturing and the final acceptance. But as the zirconium probe is subject to a certain aging, the sensitivity and measuring characteristics of the probe can change during a longer period. This results from deposits on the probe surface. Gases and their contamination cause the deposits. This aging process can be avoided or at least reduced by an appropriate cleaning of the gases to be measured.
A displacement of the probe offset can be adjusted in this menu. A test gas with a known O_2 content is necessary to adjust the probe offset. An oxygen content of the test gas should be chosen that it is within the application range of the OSC analyzer. This has the benefit that a more exact adjustment of the probe offset is achieved for the corresponding application.
”Probe offset” shows the current O_2 value and the electromotive force (see Figure 9). Move the select cursor in front of the ”U_{OFF}” value to edit the probe offset and confirm with the ”ENTER” key. The edit mode is indicated by the changed cursor type (edit cursor). Use the keys ”ARROW UP” and ”ARROW DOWN” to change the value. Confirm with the ”ENTER” key to accept the value and to change back to the selection mode (see chapter 1.1.7 Operation).

Figure 9: Sensor offset

```
     SENSOROFFSET
---------------------
  O2   =    XXXX XXXX
  EMK  = ±XXXXXX mV
---------------------
  VOFF = ±XXXX mV
---------------------
  BACK
```

1.5.2.2 Menu: Output parameter

The submenus ”CURRENTOUTPUT” for the analog output and the ”LIMITING-VALUES” for the allocation of digital outputs can be chosen from this menu (see chapter 1.5.3 Output parameter).

1.5.2.3 Menu: Configuration

Different setting like configuration of the digital outputs, calibration of the analog output, display of the reference temperature, language and definition of a new code for the configuration can be done here by calling up the corresponding menu item (see chapter 1.5.4 Configuration (Access-protection)).

1.5.2.4 Menu: Info

Version number of the firmware and the copyright is indicated on the info display (see chapter 1.5.5 Info display).

1.5.3 Output parameter

The submenus "CURRENTOUTPUT" for the analog output and "LIMIT VALUES" for the allocation are available in this menu for the analog output configuration and limit setting (see Figure 10).

Figure 10: Output parameter

```
   OUTPUTPARAMETERS
---------------------
  CURRENTOUTPUT
  LIMITING-VALUES


---------------------
  BACK
```

1.5.3.1 Menu: CURRENTOUTPUT (analog output)

The analog output can be operated either as 0 - 20mA or as 4 - 20mA power output. As shown in Figure 11 setting can be done with the "Outp" (output). To do so, place the cursor on this point, switch over to the edit mode with "ENTER" and change the value between "0" and "4" with "ARROW UP" and "ARROW DOWN". Press "ENTER" to accept the value and to switch back to the selection mode (see chapter 1.1.7 Operation).

By selecting "0/4mA" and "20mA" the corresponding power value can be assigned to a certain O_2 value. Depending on the definition of the values, the output power of 0/4 - 20mA is converted to this range and indicated according to the measured O_2 value. The complete measuring range can be used.

Figure 11: Power output values

```
    CURRENTOUTPUT
---------------------
  Outp  =  X - 20 mA
  20mA =    XXXX XXXX
   XmA =    XXXX XXXX

---------------------
  BACK
```

1.5.3.2 Menu: Limiting-Values

The values shown in Figure 12 are different limit values which can be assigned to the digital outputs with a graphic selection menu (see chapter 1.5.6 Digital outputs).
A certain O_2 value can be assigned to each values "UPPER LIMIT (UL)", "UPPER LIMIT WARNING (UW)", "LOWER LIMIT WARNING (LW)" and "LOWER LIMIT (LL)". The complete measuring range can be used.

Figure 12: Limiting values

```
   LIMITING-VALUES
---------------------
  UL   =    XXXX XXXX
  UW   =    XXXX XXXX
  LW   =    XXXX XXXX
  LL   =    XXXX XXXX
---------------------
  BACK
```

1.5.4 Configuration (Access-protection)

The configuration menu is code-protected to avoid an unauthorized data access (see Figure 13). The code is normally set to ”000”. This code can be set to any number from 000 - 999 (see chapter 1.5.4.4 Menu: New configcode).

Figure 13: Code protection for configuration

```
  ACCESSPROTECTION
   CONFIGURATION
---------------------
      *********
      * X X X *
      *********
---------------------
  BACK
```

You do not get access to the configuration menu unless the code was entered correctly and confirmed. The configuration menu allows functions like configuration of the digital outputs, calibration of the analog output, indication of the reference temperature and setting of a new code for the configuration.

Figure 14: Configuration

```
    CONFIGURATION
---------------------
  DIGITAL-OUTPUTS
  CURRENT-ALIGNMENT
  REFERENCE-TEMP
  NEW CONFIGCODE

  ... next page
```

```
   LANGUAGE




---------------------
  BACK
```

1.5.4.1 Menu: Digital outputs

Use this submenu to select the digital outputs and to assign them as range-specific graphics to the set limits (see chapter ”1.5.3.2 Menu: Limiting-Values”. Furthermore an allocation of the outputs for release or no allocation can be done (see chapter 1.5.6 Digital outputs).

1.5.4.2 Menu: Current-Alignment

With the selection shown in Figure 15 the limit range of the analog power output can be calibrated and by this adapted to the 20mA output power. The calibration value is an adjustment value without unit which can be adjusted between 0 and 999 .

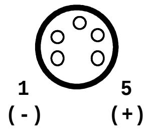
Figure 15: CURRENT ALIGNMENT

```
 Current-Alignment
     Max-Value
---------------------

            XXX

---------------------
  BACK
```

As current Alignment means an adjustment of the hardware you need an ammeter. This ammeter has to be adjusted to the measuring current range. The measuring lines have to be connected according to the pin assignment shown in Figure 16 to the 5-pole DIN socket on the rear. Furthermore the maximum value has to be applied to the power output for the calibration. This requires that the allocation of the power output values described in chapter ”1.5.3.1 Menu: CURRENTOUTPUT (analog output)” are set in a way that the currently measured and possible constant O_2 value results in the maximum power output. The adjustment value (0 - 999) is then to be edited accordingly so that the maximum output power measured with the ammeter corresponds to the required current value (20mA).

To edit this value place the cursor with the ”ARROW UP” key to the line of the value. Change to the edit mode with the ”ENTER” key and edit the value with the ”ARROW UP” and ”ARROW DOWN” keys. Confirm and accept the edited value with the ”ENTER” key (see chapter 1.1.7 Operation).

Figure 16: Power output 0/4 - 20mA (load max. 500 Ohm)



ATTENTION:
The analog output of the OSC analyzer is already calibrated on delivery. The power output should only be calibrated if it is necessary. Calibration should not be done unless the output signal is decoupled from other applications and is not processed. Process-Informatik cannot be held liable for any damage resulting from improper handling.

1.5.4.3 Menu: Reference temperature

The reference temperature indicated here corresponds to the terminal temperature of the OSC analyzer. This terminal temperature is considered as temperature compensation for determining the measuring value.

Figure 17: Reference temperature

```
   Reference-Temp
---------------------

            ±XXX °C


---------------------
  BACK
```

1.5.4.4 Menu: New configcode

The configuration menu is code-protected to avoid an unauthorized data access (see 1.5.4 Configuration (Access-protection)). The code is normally set to ”000”. In this menu this code can be set to any value from 000 - 999 (see Figure 18).

Figure 18: New configcode

```
   NEW CONFIGCODE
---------------------

      *********
      * X X X *
      *********
---------------------
  BACK
```

1.5.4.5 Menu: Language

Figure 19: Language

```
   LANGUAGE
---------------------

   German

---------------------
   BACK
```

In the menu language the user can switch between English and German menu navigation.

1.5.5 Info display

The info display shows the current version number of the firmware of the OSC analyzer and the copyright.

Figure 20: Info display

```
---------------------
     VERSION 1.33
---------------------
  (c) 1997 - 2011 by
  Process-Informatik
  Entwicklungs  GmbH
---------------------
  BACK     SERVICE
```

1.5.5.1 Menu: Service (code-protected)

ATTENTION:
Only trained staff of Process-Informatik is allowed to do settings in the service menu as these settings directly influence the function of the device!
Wrong settings can effect the function of the device or damage the device!

Figure 21: Code-protection for service

```
   ACCESSPROTECTION
       SERVICE
---------------------



---------------------
  BACK
```

1.5.6 Digital outputs

Every available digital output can be selected from the menu shown in Figure 22 and assigned to the limit values with a graphic selection described in chapter ”1.5.6.1 Menu: Digital output 1 - 3 (Digitout 1 - 3)”. Furthermore this menu indicates which outputs are already assigned ”[X]” and not ”[ ]”.
To select an output move the cursor with the ”ARROW UP” and ”ARROW DOWN” keys to the corresponding line. Confirm with the ”ENTER” key (see chapter 1.1.7 Operation).

Figure 22: Digital outputs

```
     Digital-Outputs
 ------------------        „Allocated“
  DIGITOUT 1 [X]           DIGITOUT 1
  DIGITOUT 2 [X]
  DIGITOUT 3 [ ]           „Not allocated“
 ------------------
  BACK
```

1.5.6.1 Menu: Digital output 1 - 3 (Digitout 1 - 3)

One menu is available for each digital output in which the current allocation to the set limit values is shown by graphs (see chapter ”1.5.3.2 Menu: Limiting-Values” (see 3).

In order to change the allocation place the cursor with the ”ARROW RIGHT” to the menu item ”Auswahl???” and confirm with ”ENTER”. In the edit mode the selection can be changed from ”No selection” to ”Selection 1 - 8” with the ”ARROW UP” and ”ARROW DOWN ” key (see to Figure). The selected allocation is confirmed with the ”ENTER” key (see chapter 1.1.7 Operation).

Figure 23: Digital output 1 - 3

```
      DIGIT-OUT X
---------------------

       <Current
       settings>

---------------------
  BACK       CHOICE
```

1.5.6.1.1 Allocation of digital outputs [NO]

There is no digital output allocated with this selection that means the output is not active.

Figure 24: Allocation [NO]

```
---------------------

   (NO CHOICE)

---------------------
```

1.5.6.1.2 Allocation of the digital outputs [OW>O_2>UW]

This selection causes that the output is activated if an O_2 value is ”SMALLER” than the ”upper warning ” ”AND” ”LARGER” than the ”lower warning”.

Figure 25: Allocation [OW>O_2>UW]

```
---------------------
  UL-----  |
  UW█████  | CHOICE
  LW█████  |    1
  LL-----  |
---------------------
```

1.5.6.1.3 Allocation of the digital outputs [OG>O_2>=OW]

This selection causes that the output is activated if an O_2 value is ”SMALLER” than the ”upper limit” ”AND” ”LARGER OR EQUAL” than the ”upper warning”.

Figure 26: Allocation [OG>O_2>=OW]

```
---------------------
  UL█████  |
  UW█████  | CHOICE
  LW-----  |    2
  LL-----  |
---------------------
```

1.5.6.1.4 Allocation of the digital outputs [UW>=O_2>UG]

This selection causes that the output is activated if an O_2 value is ”SMALLER OR EQUAL” than the ”lower warning” ”AND” ”LARGER” than the ”lower limit”.

Figure 27: Allocation [UW>=O_2>UG]

```
---------------------
  UL-----  |
  UW-----  | CHOICE
  LW█████  |    3
  LL█████  |
---------------------
```


1.5.6.1.5 Allocation of the digital outputs [OG>O_2>=OW or UW>=O_2>UG]

This selection causes that the output is activated if an O_2 value is ”SMALLER” than the ”upper limit” ”AND” ”LARGER OR EQUAL” than the ”upper warning” ”OR” ”SMALLER OR EQUAL” than the ”lower warning” ”AND” ”LARGER” than the ”lower limit”.

Figure 28: Allocation [OG>O_2>=OW or UW>=O_2>UG]

```
--------------------
 UL        |
 UW        | CHOICE
 LW        |    4
 LL        |
--------------------
```

1.5.6.1.6 Allocation of the digital outputs [O_2>=OG]

This selection causes that the output is activated if an O_2 value is ”LARGER OR EQUAL” than the ”upper limit”.

Figure 29: Allocation [O_2>=OG]

```
--------------------
 UL        |
 UW-----   | CHOICE
 LW-----   |    5
 LL-----   |
--------------------
```

1.5.6.1.7 Allocation of the digital outputs [O_2<=UG]

This selection causes that the output is activated if an O_2 value is ”SMALLER OR EQUAL” than the ”lower limit”.

Figure 30: Allocation [O_2<=UG]

```
--------------------
 UL-----   |
 UW-----   | CHOICE
 LW-----   |    6
 LL        |
--------------------
```

1.5.6.1.8 Allocation of the digital outputs [O_2>=OG or O_2<=UG]

This selection causes that the output is activated if an O_2 value is ”LARGER OR EQUAL” than the ”upper limit” ”OR” ”SMALLER OR EQUAL” than the ”lower limit”.

Figure 31: Allocation [O_2>=OG or O_2<=UG]

```
--------------------
 UL        |
 UW-----   | CHOICE
 LW-----   |    7
 LL        |
--------------------
```


1.5.6.1.9 Allocation of the digital outputs [RELEASE]

This selection causes that the output is activated as soon as the probe temperature is ”LARGER” than 650°C. The zirconium probe will not deliver usable O_2 values unless this temperature is reached (see chapter 1.1.1 Measuring principle).

Figure 32: Allocation [RELEASE]

```
--------------------
           |
  RELEASE  | CHOICE
           |    8
           |
--------------------
```

1.6 Maintenance- and test-instructions OSC

These instructions are for maintenance the OSC-device in case of inaccurate measured-values.

Please check following:

1. All external tubes fixed
2. All inflow tubes (with measuring gas) to the OSC fixed and tightness
3. All ports: DIN-Port, Relay output, serial interface fixed
4. Funktion of flow meters
5. Display contrast OK
6. Consider the free-running fan from underneath. Therefor switch off the device and let it cool down.

Please lead an probe offset if your measured-values change.
This is described in the manuals in chapter 1.5.2.1 Menu: Probe offset.

Please pay attention to extend the lifetime of your measuring probe:
The zirconium probe is subject to a certain aging, the sensitivity and measuring characteristics of the probe can change during a longer period. This results from deposits on the probe surface. Gases and their contamination cause the deposits. This aging process can be avoided or at least reduced by an appropriate cleaning of the gases to be measured.

1.7 Parts list OSC

Description	**Article number**
Connector for Relaisoutput	#9372-24
Analog power connection plug	#9111
Power cord D	#9107
Power cord US	#9107-US

