Quick Reference
for End-Users

CarboSen1000

INNOVATIONSPREIS
2007
initiative mittelstand
AUSZEICHNUNG
Umwelttechnik

Sensors and Systems
for Combustion Engineering

LAMTEC

Table of Contents

1 GENERAL INFORMATION 5

1.1 Validity of these instructions 5

2 SAFETY 6

2.1 Attention to the German Law on Device Safety 6

2.2 For Your Safety 7

2.3 Safety Measurements when using CarboSen 1000 8

3 TECHNICAL DESCRIPTION 9

3.1 The Sensor 9

3.2 Sensor Types and Versions 10

3.3 Sensor Electronics XC 164 11

4 INSTALLATION AND COMMISSIONING 12

4.1 General Information 12

4.2 Installation 12
4.2.1 CarboSen1.000ST 12
4.2.2 CarboSen ST and in Clip- and Rod Housing 13

4.3 Installations Instructions 14
4.3.1 CarboSen ST and in Clip- and Rod Housing 14
4.3.2 CarboSen in Clip Housing 15

4.4 Programming unit for CarboSen 658R0932 (Option) 15
4.4.1 Brief Description 16
4.4.2 Connection to the CarboSen ST 16

5 MENU 17

5.1 Switching on the Operating Unit 17

5.2 Main Menu 18
5.2.1 Help Window 19

5.3 Menu Selection 19
5.3.1 Password Entry 20
5.3.2 Select Language 20
5.3.3 Measurement 20
5.3.4 Control Values 21
5.3.5 Configuration Sensor 22
5.3.6 COe Curves 23
5.3.7 LSB Configuration 25
5.3.8 Parameter Configuration 26
5.3.9 Contrast 27

Table of Contents

6 OPERATION 28

6.1 Operation / Measurement Value Display 28
6.1.1 Operation 28
6.1.2 Measurement Value 28
6.1.3 Status Signals 28

6.2 General Instructions for Operation 28
6.2.1 Operational Failure, Switching On and Off 28
6.2.2 Liquid Purification 28
6.2.3 Performing Sensor Change-Over 29
6.2.4 Calibration of the COe-Curves 30
6.2.5 Initiate the Cold Resistance Determination 31
6.2.6 Changing the Sensor Temperature (RI) 33
6.2.7 Analogue Output 1 34
6.2.8 Setting the Limit Values 35

7 SERVICE AND MAINTENANCE 36

7.1 Exchanging the Sensor 36
7.1.1 CarboSen ST and in Clip- and Rod Housing 36
7.1.2 CarboSen1.000ST 36

8 ACCESSORIES 37

8.1 Programming Unit 37
8.1.1 Panel Installation option 37

8.2 Analogue Output Module with address 19 for Display of Measurement Signals 38

8.3 Digital Output Module with module address 03 38

8.4 Digital Input Module with module address 11 39

8.5 Power Pack 39

9 TECHNICAL DATA 41

10 ORDERING INFORMATION 43

11 FAQ 44

12 ERROR DETECTION AND MEASUREMENTS 46

12.1 Green LEDs do not flash 46

12.2 LED Status 46

12.3 Fluctuating Sensor Voltage without Distinguishable Pattern 46

12.4 Constant Sensor Voltage, independent of Measuring Gas 46

12.5 Faults 47

Table of Contents

12.6 Warnings 47

13 SUPPORT 48

14 DECLARATION OF CONFORMITY 49

1 General Information

1.1 Validity of these instructions

This manual is only valid in conjunction with the software version 1V12 or higher.

2 Safety

2.1 Attention to the German Law on Device Safety

Note the instructions for use!

The German Law on Device Safety regulates the following:
Observe these instructions!
Use the device only in compliance with the instructions contained in this document for CarboSen1000 (Publication No. DLT5813-10-aEN-001).
If this document is a supplement, use it only in combination with the basic manuals.

Use the devices only for the purpose described in this documentation.

Used by trained personnel only. The device may only be operated and serviced by persons whose knowledge and training qualifies them to do so. Observe the safety provisions of the burner manufacturer.

To be used only in a grounded power line network!

Electrical connection with devices that are not mentioned in these operating instructions

Liability for the function of the device shall be transferred to the owner or user.

Liability for the function of the device shall be borne by the owner or user insofar as the device has been used by persons without the necessary knowledge, has been improperly used, serviced or repaired or has been handled in a manner that does not conform to proper use. Modifications to the device render the type approval null and void. Inputs and outputs of the device and associated modules may only be connected as indicated in this manual.

LAMTEC GmbH & Co KG is **not** liable for damages occurring as a result of non-compliance with the above instructions. Compliance with the above instructions shall **not** entail any **extension** to the warranty and liability provisions of LAMTEC GmbH & Co KG's terms of sale and delivery.

Insofar as reference is made to laws, regulations and standards, the basis for these shall be the law of the Federal Republic of Germany.

2 Safety

2.2 For Your Safety

In this operating instructions, the following symbols are used as important safety instructions to the user. These symbols appear wherever there is a need for this information in a particular section.
It is essential to note and comply with the safety instructions, particularly the warnings.

DANGER!

Indicates possible danger to personnel, particularly with regard to electrical equipment

WARNING!

Indicates possible danger to personnel if the system components are not handled correctly.

CAUTION!

Indicates danger to system components or possible impairment of functionality.

NOTICE!

Contains important additional information for the user concerning the system or system components and provides helpful tips

Contained in texts that provide information on how to perform tasks.
In performing all tasks, the operator is requested to observe all statutory safety regulations and to do everything possible, according to the circumstances, to prevent injury to persons or damage to equipment

2.3 Safety Measurements when using CarboSen 1000

Due to its operating temperature of 630°C, the sensor is not suitable for measurement in explosive mixtures.

The sensor housing is heated up during operation. There is a risk of burning danger.

Do not knock or bump the housing. This could irreparably damage the sensor.

Do not use silicon-based materials close to the sensor. Keep in mind that the flue gas or the test gas has no silicon in it.

Otherwise the sensor will lose its function.

WARNING!

To make sure that the sensor system is working correctly, please bear in mind that in the sensor needs a minimum oxygen level of 0,5% to 1% in the gas measurement.

CAUTION!

For a safe operation of the sensor systems, please make sure that the electrical power is at least 6W minimum (at 24V, 0,3A minimum).

Please make sure that the electrical power is at least 6W minimum (at 24V, 0,3A minimum). Otherwise the electronics are not working correctly.If you use the HT- version of CarboSen1000 ST, please make sure that the water steam could not condense at the sensor. The flue gas temperature for long term measurement has to be over 150°C up to 400°C.

Please do not clean the sensor housing with contaminated compressed air, because there could be oil or noxious silicon in it.

3 Technical Description

3.1 The Sensor

The CarboSen1000 is a sensor system for the detection of flammable gases such as CO, H_2 or C_xH_y. In this manual, these gases are also referred to as CO equivalent (CO_e).

The sensor system consists of the sensor and the sensor electronics. The unit, comprising the sensor element, sensor housing and sensor signal cable, forms the sensor, which is used to detect the measured variable. The sensor electronics enable temperature compensation during operation, flexible control of the sensor and the acquisition of all sensor signals.

The CarboSen1000 1000 is a high-resolution measuring system for the detection of small CO_e concentrations in the range of 0 - 3000 ppm (ideally up to 1000 ppm). In the ST version, the electronics are integrated in the head of the sensor.

The CarboSen1000 functions on the principle of solid-state electrolysis. The technology used for this method is well known and widely used in the form of the lambda sensor. However, unlike the lambda sensor, which measures oxygen on the basis of the Nernst principle, the CarboSen1000 functions according to the Non-Nernst principle. By varying the geometry, material and electrical wiring, sensors working according to the Non-Nernst principle can also detect other gases such as CO, H_2, and HC.

To operate the sensor, it first has to be heated to operating temperature. This is achieved by means of a heating structure, which is affixed to the back of the sensor element. The resistance of the platinum heating spiral has a defined temperature dependence. This enables the operating temperature of the sensor to be set. This temperature is 630°C and is set automatically by the electronics and kept constant during operation. To this aim, the electronics automatically determine a cold resistance of 20°C when the sensor system is commissioned.

The sensor temperature can be varied for special applications. For this purpose, the relevant parameters have to be reprogrammed. Upon customers' request, this can be carried out either at LAMTEC or on site (with the appropriate programming unit). If the operating temperature is changed, so is the sensor characteristic. Increasing the temperature of the sensor results in reduced sensitivity, i.e. the sensor is less sensitive to CO_e and the curve is flatter. The sensor dynamics become faster, i.e. the response and decay times are accelerated.

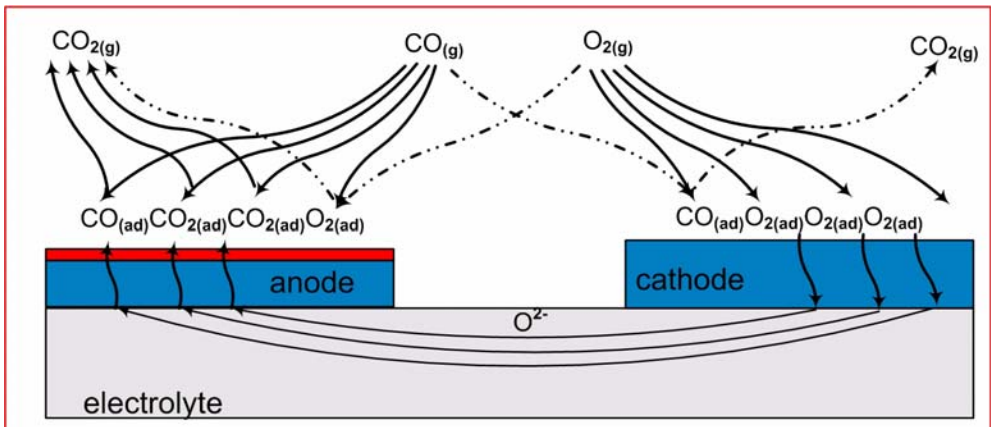


Fig. 3-1 Principle of the Non-Nernst sensor

3.2 Sensor Types and Versions

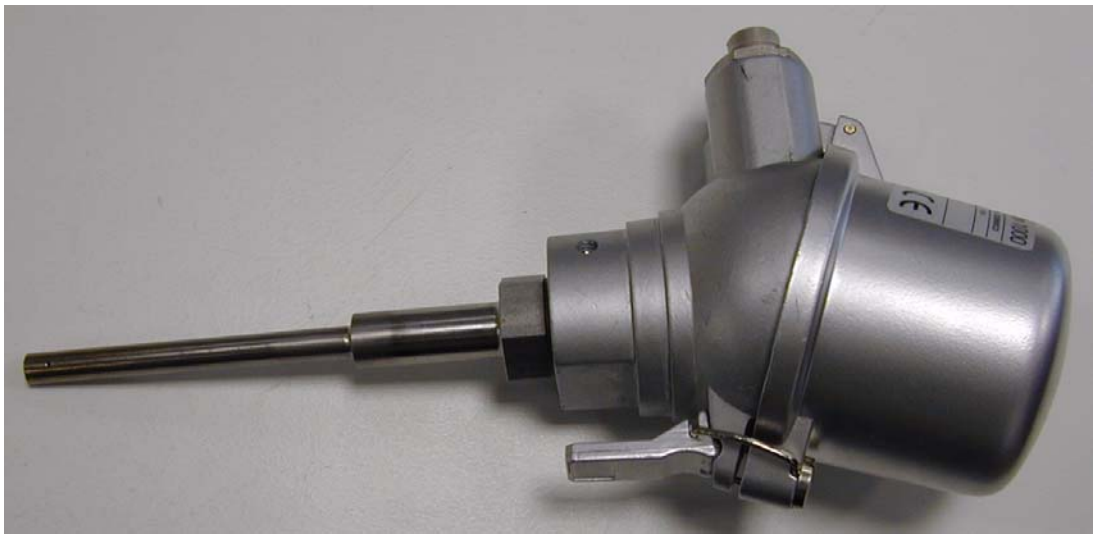


Fig. 3-2 CarboSen10001.000 ST with electronics in adapter housing

Fig. 3-3 CarboSen10001.000 in clip housing

Fig. 3-4 CarboSen10001.000 in rod housing

3.3 Sensor Electronics XC 164

The microprocessor-controlled sensor electronics perform the following functions in the system:

- Heating the sensor and regulating the heater spiral to a constant heating resistance
- Acquisition of the sensor voltages in mV
- Conversion of measured sensor voltages and output to the analogue output (0/4-20mA)
- Monitoring of both sensor voltages
- Checking the analogue outputs
- Output of measured values on USB CAN bus.

The electronics have a power supply of 13V to 30V DC.
Ideally with 24V / 1.5A.

The standard configuration CO_e is calculated from the sensor voltage and would be given in the analogue output. Internally, both sensor signals are compared and checked on the basis of the following failure criteria (standard parameterisation):

- Difference greater than 25mV, or
- Difference greater than 25% from the current measured value.

Fig. 3-5 Electronics with adapter housing

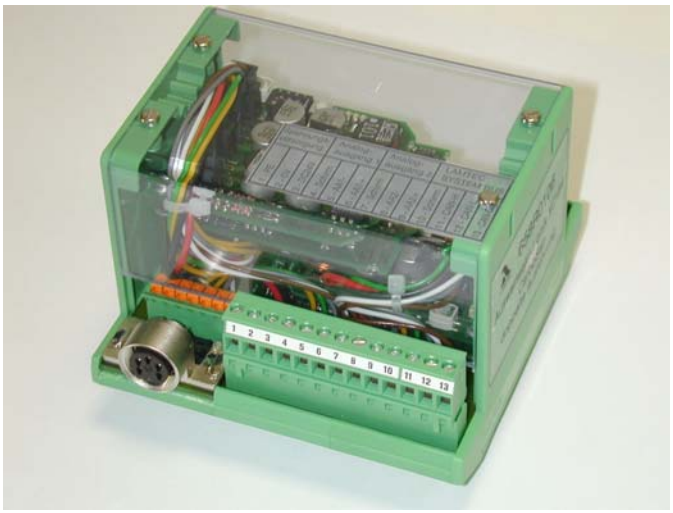


Fig. 3-6 Electronics for top hat rail mounting

4 Installation and Commissioning

4.1 General Information

Measuring temperature:	Type NT and clip housing 150°C Type HT: 150°.... 400°C
Performance and average lifespan for the following fuel:	
Blue flame burner (oil / gas):	approx. 3 years
Wood combustion (neat stock wood / pellets):	approx. 2 years
Other fuel for wood combustion, according to contamination concentration (e.g. woodchip, bark)	< 1 year
Measuring point:	The measuring point should have the complete mixture of representative exhaust gases
Mounting position:	The mounting position of the sensor should be as perpendicular as possible to the connection cable or the connection head, at least 10° over the horizontal level.

4.2 Installation

4.2.1 CarboSen1.000ST

The sensor system with CarboSen1000 ST electronics is set up and connected as described in the following steps:

- Connect the 4-pin plug (power supply (13V-30V) / analogue output). Make sure that the power supply is switched off.
  Connection cable schielded, max. cable cross section 1mm^2.
  The maximum cable length of 100m should not be exceeded.
- If required, connect to LAMTEC SYSTEM BUS 5-pin, for connection of LSB-Modules and/or programming unit.
  Connection cable schielded, max. cable cross section 1mm^2.
  The maximum cable length of 100m should not be exceeded.
- After the plug has been connected, the power supply can be switched on.

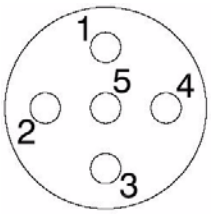
First, the sensor is heated to operating temperature. This process is complete when only the green LED is continuously lit. This cold start phase then lasts approximately 2min.

Plug A1

Round plug connector, 4-pin

- Pin 1 Supply voltage 0V
- Pin 2 Supply voltage 24VDC
- Pin 3 Analogue output -
- Pin 4 Analogue output +

Plug A2



Round plug connector, 5-pin

- Pin 1 24VDC output + (only for programming unit)
- Pin 2 24VDC output - (only for programming unit)
- Pin 3 CAN-GND (LSB)
- Pin 4 CAN-L (LSB)
- Pin 5 CAN-H (LSB)

4.2.2 CarboSen ST and in Clip- and Rod Housing

The microprocessor-controlled sensor electronics perform the following functions in the system:

- Put the electronics on a top hat rail and make sure it does not slip in both directions.
- Connect the analogue output .
- Connect the power supply (13 V – 30 V). This is to ensure that the power supply is disconnected.
- Connect the CAN-Busses (only necessary in servicing). After a proper connection, the power supply can be turned on. Some of the LEDs may flash or blinks (for detailed description, see Chapter). Remark: it is normal for the electronics to show a fault indication, as there are no sensors connected. To connect the sensors, the following steps should be performed:
- Switch on the power supply.
- Hold for 60s. During this time, the electronics would secure that no sensors are connected, the green LED would blink with a frequency of 0.25 Hz.
- Insert and screw the sensor plug into the DIN-socket. The heating resistance would be defined.The green LED blinks with a frequency of 4 Hz.
- Please hold until the nominal operation. The green LED blinks with a frequency of 1 Hz.

CAUTION!

For an accurate determination of heating resistance, it is necessary that the sensor is cooled down to room temperature (20°C) and no air supply air is exposed.

For the determination of cold resistance, a short heat impulse would be applied to the sensor and the resistance would be measured. This measurement should be carried out in intervals of 16 seconds until either three successive measurements occur in a tolerance band of 0.1 Ω or ten measurements are completed. The average of the last three values is used to calculate the resistance at 20°C by applying a factor. This determination of the cold resistance should be completed in 90 seconds.

The determined value of the heating resistance at 20°C would be saved in the electronics and must be taken into consideration on the first commissioning. In subsequent operations, the electronics can be turned on with the plugged sensor.

After the resistance is saved, the heating up process of the sensors begins. This heating up process is based on the preset target temperature. The measurements of the ohmic internal resistance of the alternating current R_{ki} would be determined between the electrodes. This determination is completed either when three successive measurements occur within the tolerance band or when ten measurements are completed. As standard parameter, the average of the last three measurements would be saved and used for temperature stabilisation.

Should re-determination of the resistance become a necessity; the sensor should be removed from the activated electronics. After 30 seconds, the electronics would detect the absence of the probe and signal a fault. Re-plugging of the sensor should only take place when the room temperature is cooled down.

4 Installation and Commissioning

If the electronics are connected to the attached sensor, the saved resistance R_{ki} in the memory would be drawn up for heating control. The cold start phase takes approx. 30s. During the operation, this resistance would be monitored. Furthermore, the heating resistance of the heater would be verified permanently. If this exceeds 35Ω, a circuit failure would be assumed and a failure message would be shown.

No.	General terms	Assignments
1	Power supply	PE
2		0V
3		24V DC
4	Analogue output 1	Screen
5		Minus
6		Plus
7	Analogue output 2 (only with 2-board type)	Screen
8		Minus
9		Plus
10	LAMTEC SYSTEM BUS	Screen
11		CAN-High
12		CAN-Low
13		CAN-GND

Fig. 4-1 X164 with connection diagram

4.3 Installations Instructions

4.3.1 CarboSen ST and in Clip- and Rod Housing

Drill a bore hole (the size of the bore hole depends on the size of the sensor bracket) on the flue gas duct and attach the sensor bracket to the flue gas duct.

For a better flow of the housing, older versions as well as special versions should have two bore holes, which are opposite each other and with a flow direction of 90°C as possible.

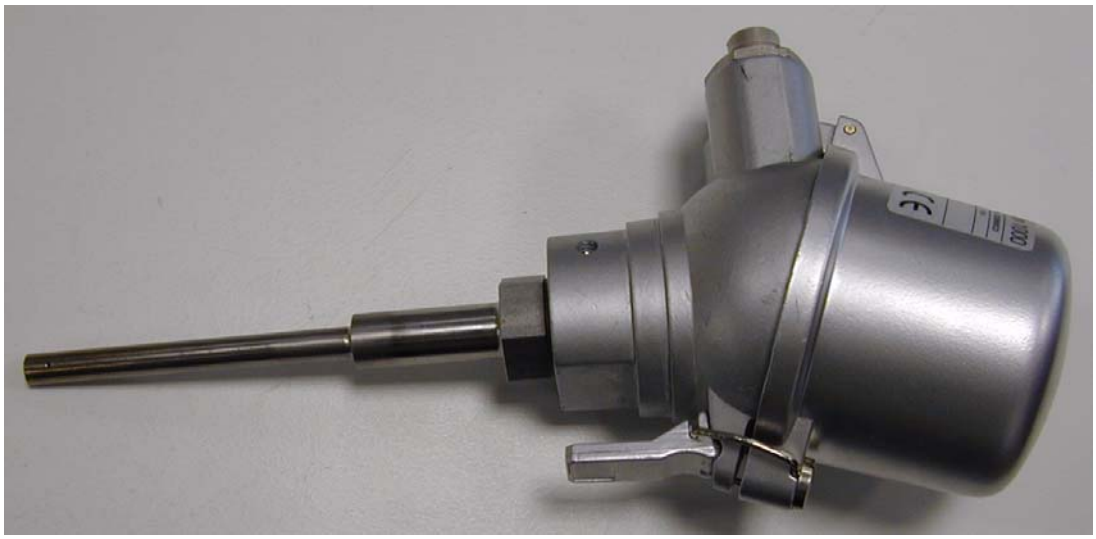


Fig. 4-2 CarboSen1000ST

4.3.2 CarboSen in Clip Housing

Drill a boring/hole with a diameter of 11.5mm in the exhaust gas duct and plug in the CarboSen1000 as far as it will go until a stop.

NOTICE!

CarboSen1000 should be installed directly before commissioning!

In an installed condition, the CarboSen1000 should always be heated up. This is to avoid the moisture from setting into the measuring cell, which could lead to measurement error and deterioration of the CarboSen1000.

CAUTION!

When setting up the openings, there could be falling parts caused by damages. Make sure the parts to be isolated are secured by wire tack-weld!

Take appropriate safety precautions against emerging hot, explosive or health-damaging exhaust gases.

CAUTION!

The mounting position of the sensor should be as perpendicular as possible to the connection cable or connection head, at least 10° above the horizontal line.

A mounting position that falls below the horizontal limit can damage the sensor.

4.4 Programming unit for CarboSen 658R0932 (Option)

Fig. 4-3 Programming unit

4.4.1 Brief Description

The operating unit consists of a configuration software and an operational guide software, which were specially designed for CarboSen1000 ST.

The operator will be given the inputs and activities in a sequence, which will be performed.

The operating unit runs during the first commissioning of CarboSen1000 ST as well as during individual sections of the configuration possibilities. In the following document, the individual steps of commissioning and configuration is described with the help of the display window of the programming unit.

NOTICE!

Software version of CarboSen1000 ST for commissioning and configuration:
at least V1_10 or higher.

Update CarboSen1000 ST Software, where applicable!

- Programming unit, including connection cable Item Number 658 R 0932
- Power supply voltage 24VDC / 2,5W (from CarboSen1000 ST)
- Protection class according to EN 60529IP40

4.4.2 Connection to the CarboSen ST

Please connect the programming unit to the CarboSen1000 using the connection cable and the adapter cable provided. The power supply takes place from CarboSen1000 ST.

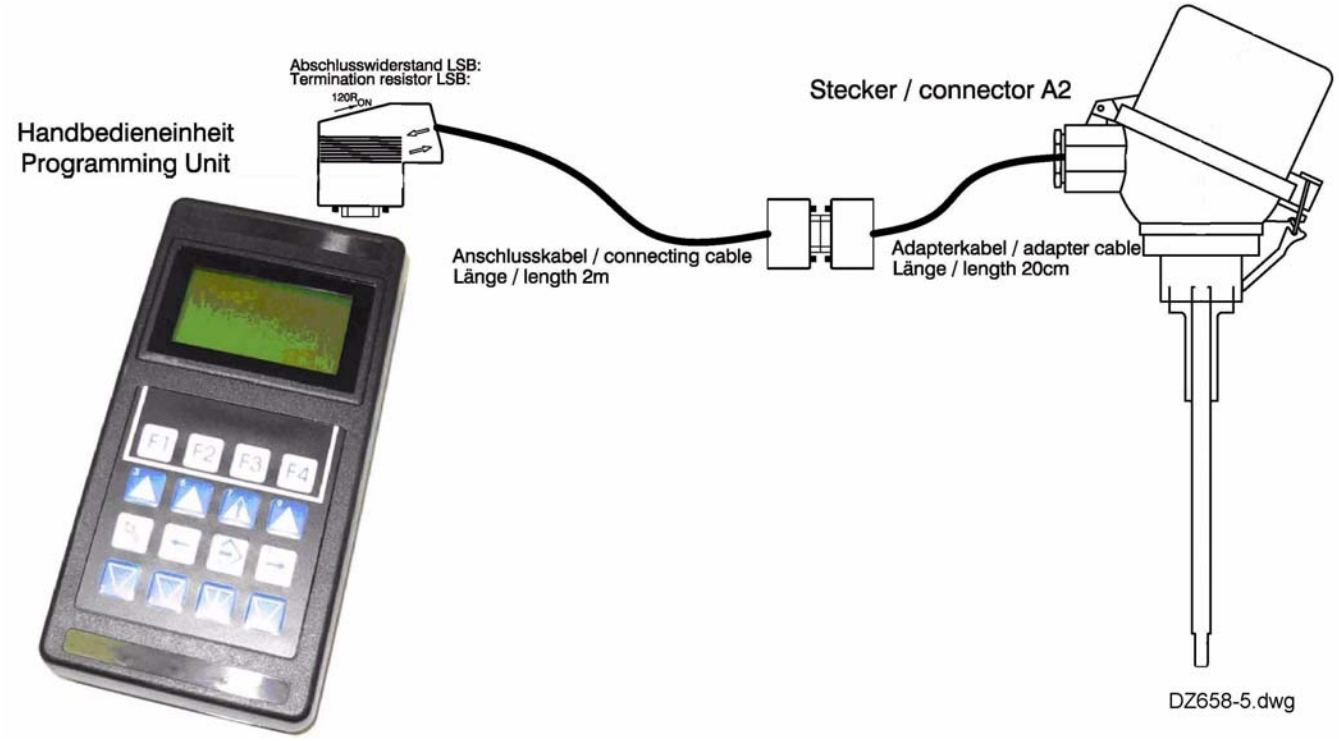


Fig. 4-4 Connection between CarboSen1000 and the programming unit

5 Menu

5.1 Switching on the Operating Unit

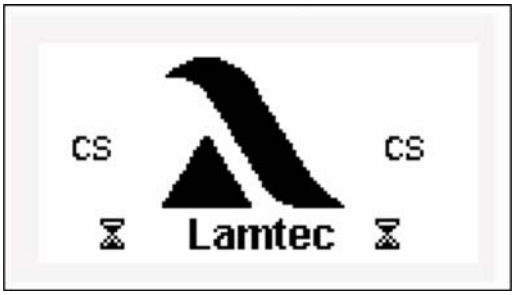
The display of the programming unit shows the following starting sequence after the system is switched on:

The display shows the start window.

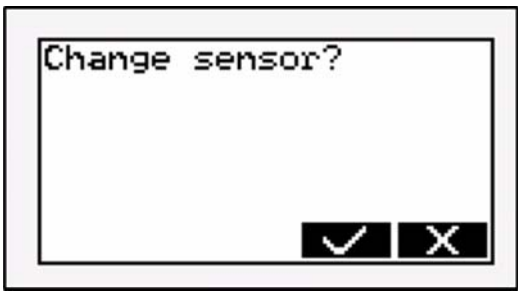
The starting sequence runs automatically.

The display shows the version (an example here) of the loaded software.

The starting sequence runs automatically.



.Program loading.

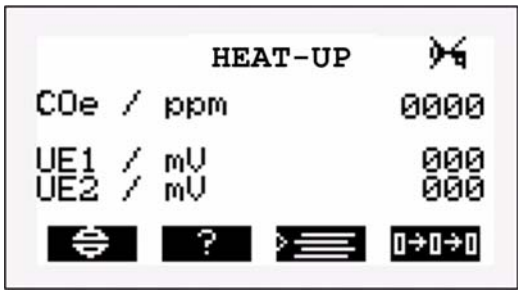


Please confirm the question. If you would like to change the sensor or the control parameter(s), you should proceed with the installation routine.

Alternatively, you can acknowledge the question and skip the installation routine.

For an accurate execution of the installation routine, the CarboSen1000 must be cooled down to approximately 20°C (take note of cooling time). In addition, the sensor is not allowed to be exposed to supply air.

5 Menu



After completion of the installation routine or rather after skipping the installation routine, the sensor would be heated up to operating temperature.

Please use the F3 , keys to switch to the selection menu.

5.2 Main Menu

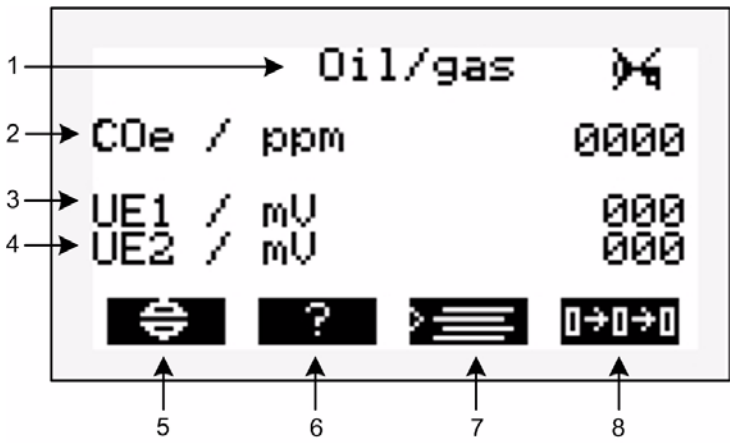


Fig. 5-1 Main Menu

1 preset reference characteristic line for fuels, Release Level
2 CO_e-Display in ppm (with calculated characteristic curve)
3 Sensor voltage of electrode 1
4 Sensor voltage of electrode 2
5 Open window
6 Help
7 Menu
8 Switch to another window (Measuring Values -> Limit Values -> LSB)

F1 → 0—X Remote - Shutdown

F2 → ? Help

F3 → Menu

F4 → Switch to another window

→ Back → one level before

→ Release Level 0 - no password necessary

→ Release Level = a digit after the key icon shows that password entry is needed

5 Menu

5.2.1 Help Window

To switch to the Help window, press the F2 key. The Help window will pop-up to your current display window.

F1 fault-RESET

F2 Open Help

F3 Switch to menu selection

F4 switch to the following menu window

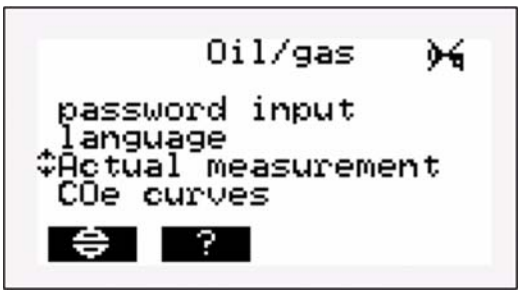
The parameter details correlate to the parameter from the previous window which was used to call the Help window.

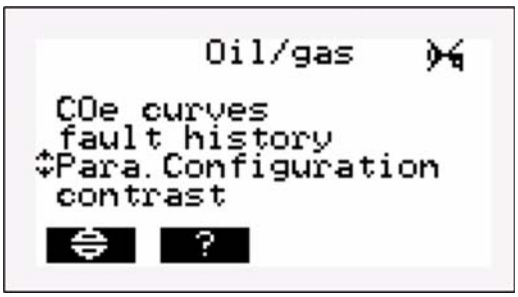
5.3 Menu Selection

Please use the F3 , key to switch to the selection menu.

The following sub-menu are available for selection in the release level 0:

Password Input ⇔ Language ⇔ Actual measurement ⇔ CO_e-Curves ⇔ Fault History Parameter Configuration ⇔ Contrast





In order to make changes, you must find yourselves in one of the following release levels. Your release level shall determine if you are allowed to change parameters or if you are only allowed to retrieve them.

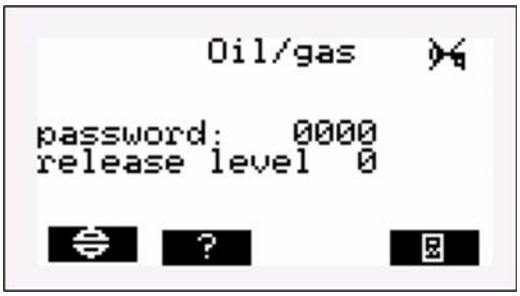
Release Level 0 : Service

Release Level 1 : Customer

The description of the release levels 0 and 1 can be found in the next chapters.

Use the and keys to navigate.

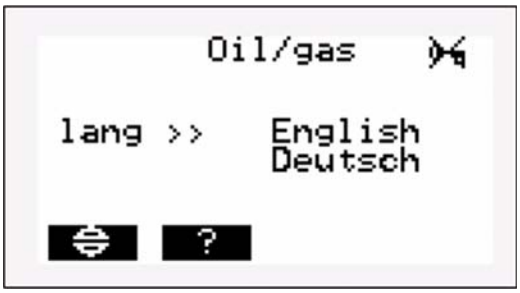
5.3.1 Password Entry



Password input with 3, 5,7, and 9 keys (upward count) and 2, 4, 6 and 8 keys (downward count).

Please confirm password with key.

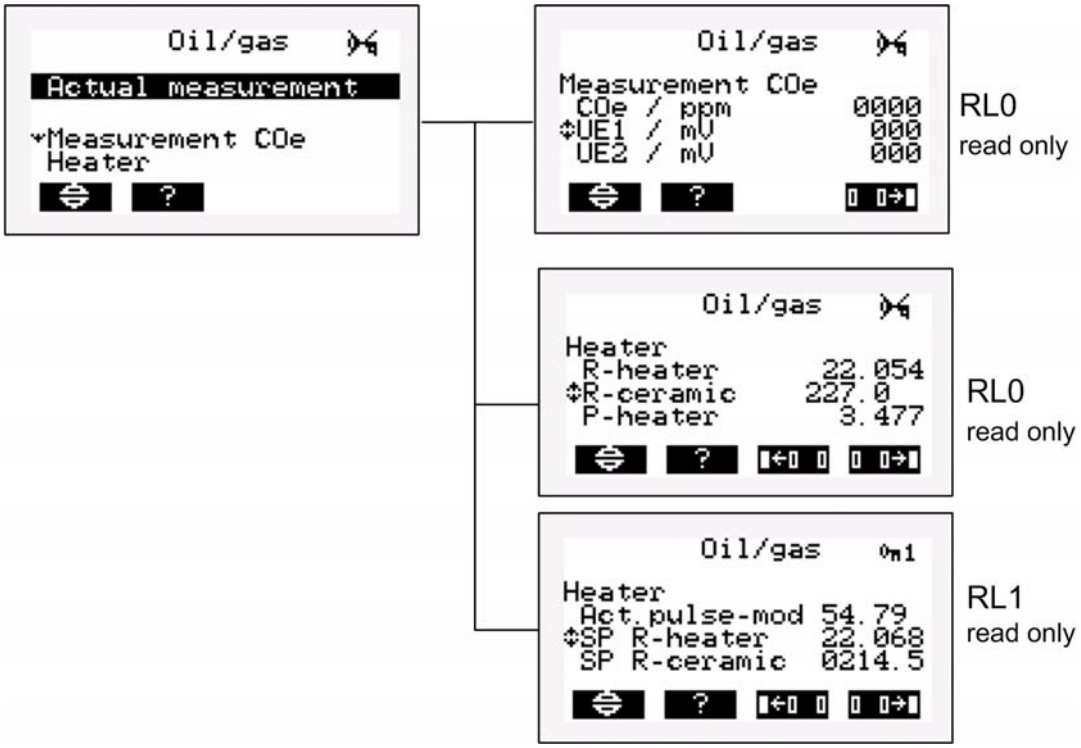
5.3.2 Select Language



Please use the and keys to select the language of your choice.

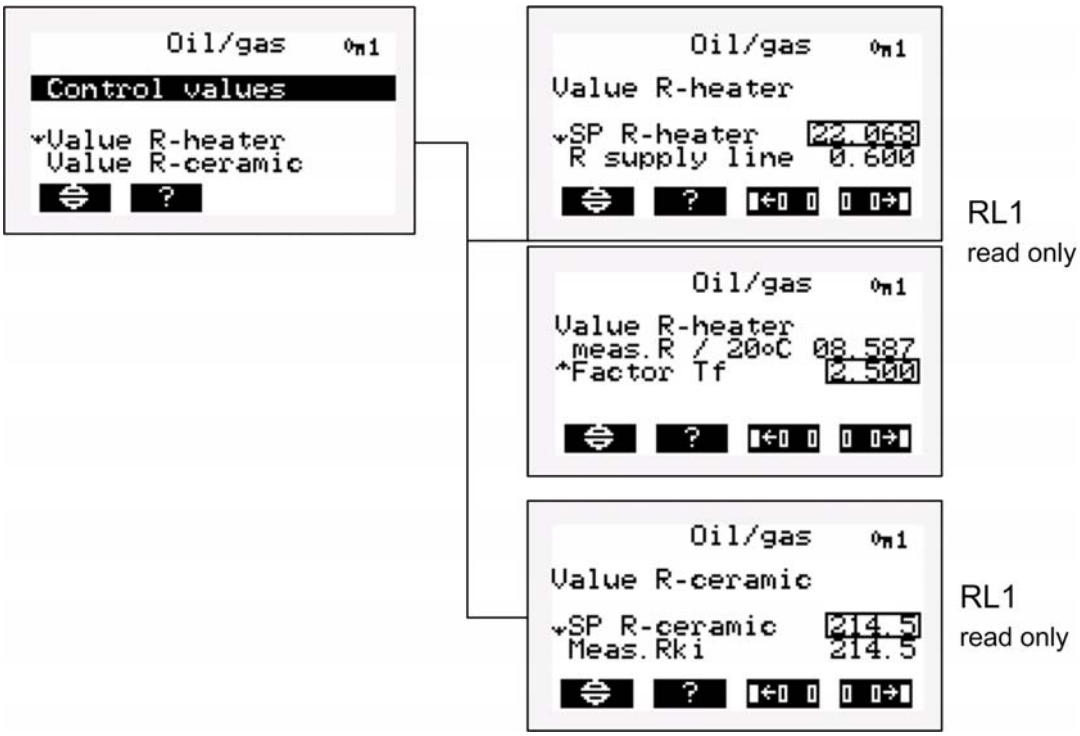
Please confirm password with key.

5.3.3 Measurement



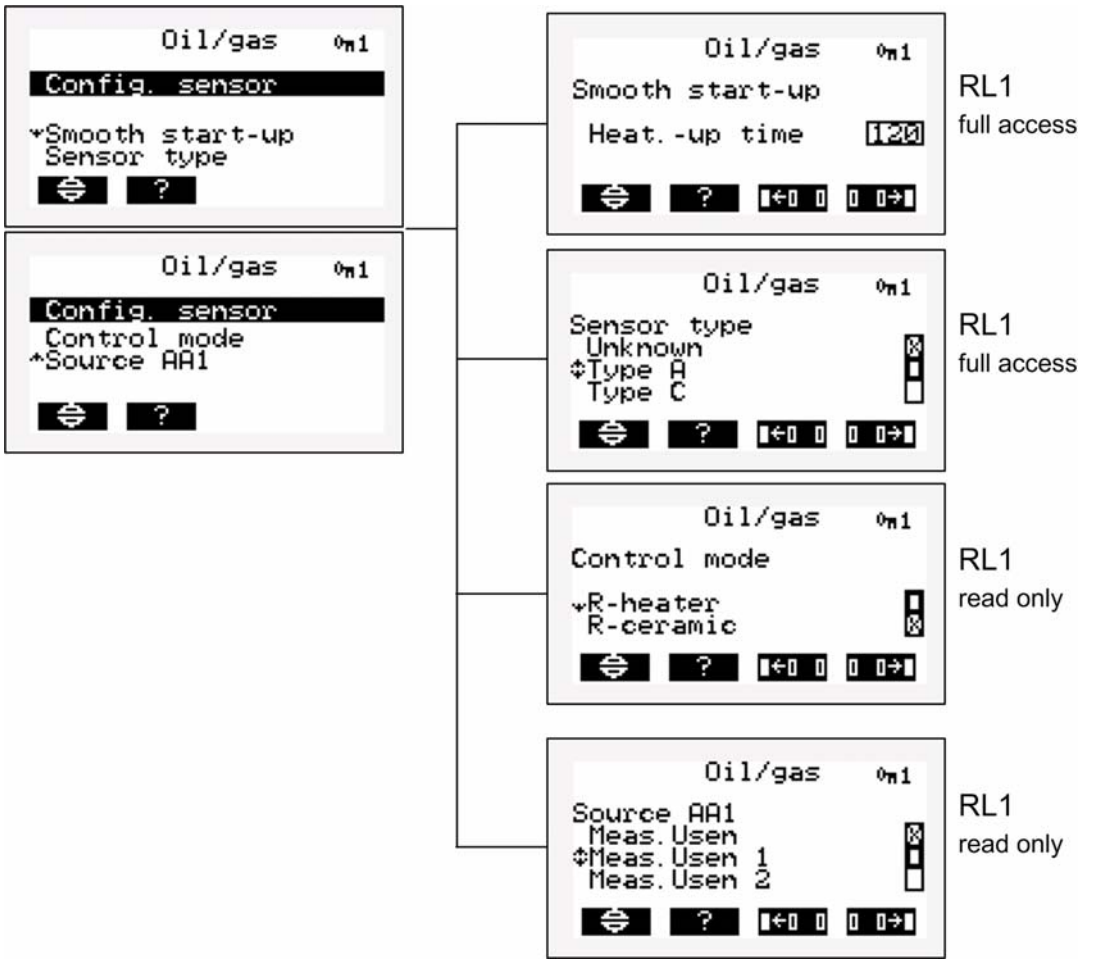
Please use the and keys to navigate. The displayed values cannot be changed. (RL0 = Release Level 0, RL1 = Release Level 1).

5.3.4 Control Values



Please use the and keys to navigate. The displayed values cannot be changed. You can only read these entries, when you are categorized under the corresponding release level (Release Level 1).

5.3.5 Configuration Sensor



Please use the and to navigate. The displayed value cannot be changed. Please confirm the entry with key. You can only change the values, when you are categorized under the corresponding release level.
(RL0 = Release Level 0, RL1 = Release Level 1)

Smooth start-up:

The value that you entered here would be defined by the time frame as a value where the heating power would raise from 0 to the setpoint.

WARNING!

Values smaller than 30 sec are critical!

You could damage the heating structure, if you enter values smaller than 30 sec.

Sensor type:

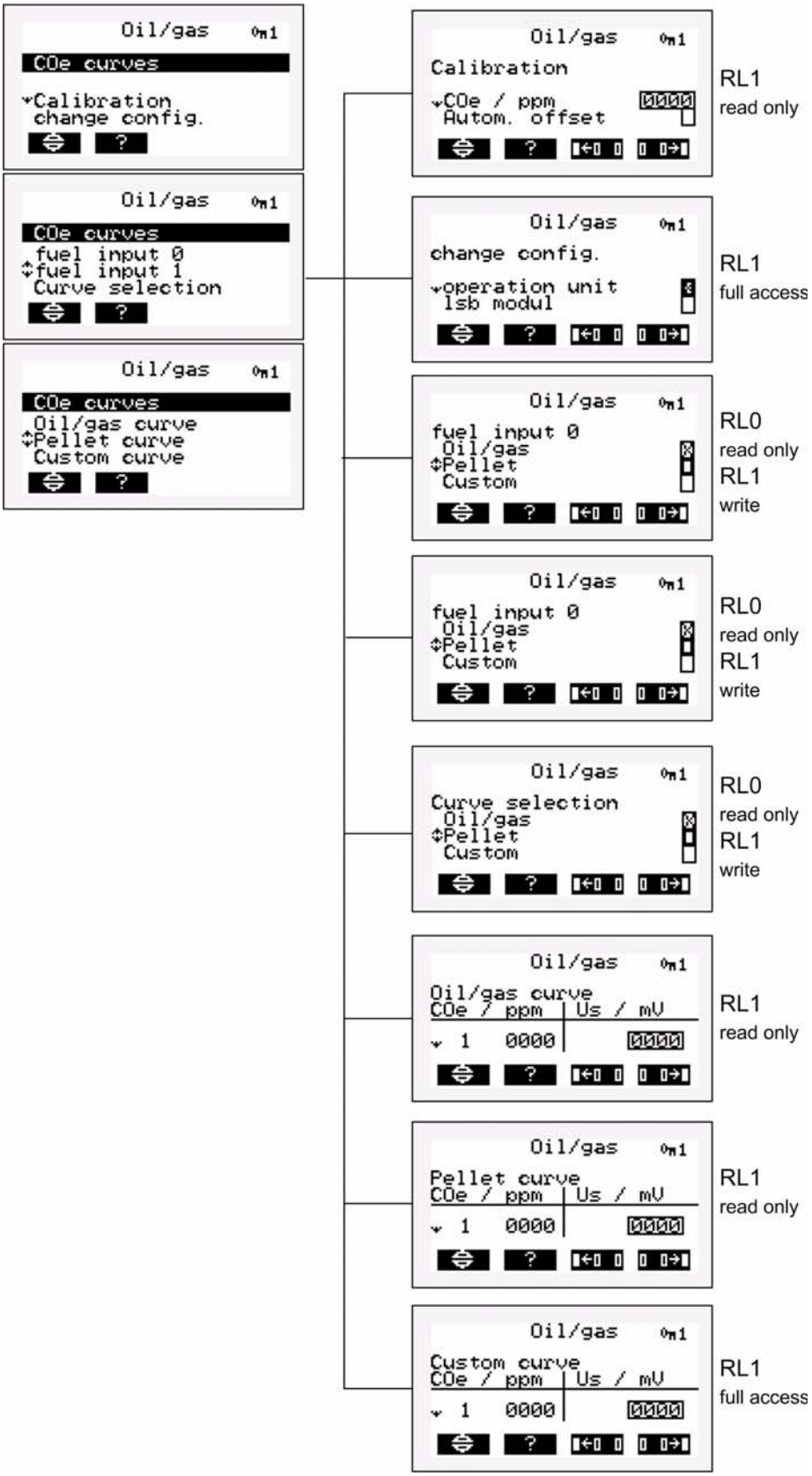
Type A = Clip housing

Type C = Rod housing / CarboSen1000 ST

NOTICE!

The false selection of sensor type would affect the heating control.

5.3.6 COe Curves



Please use the ▼ and ▲ keys to navigate. The displayed values cannot be changed. Please confirm the entry with ⇨ key. You can only change the values, when you are catego-

rised under the corresponding release level.
(RL0 = Release Level 0, RL1 = Release Level 1)

Calibration:

Please activate the device for selection of fuel characteristic line. With the activated device, you could switch between fuel input 0 and fuel input 1.

Fuel Input 0 / Fuel Input 1:

Please select the characteristic line for sensor voltage conversion (fuel input 1 as well as fuel input 2).

A false setting would lead to false values.

Default = Factory characteristic line

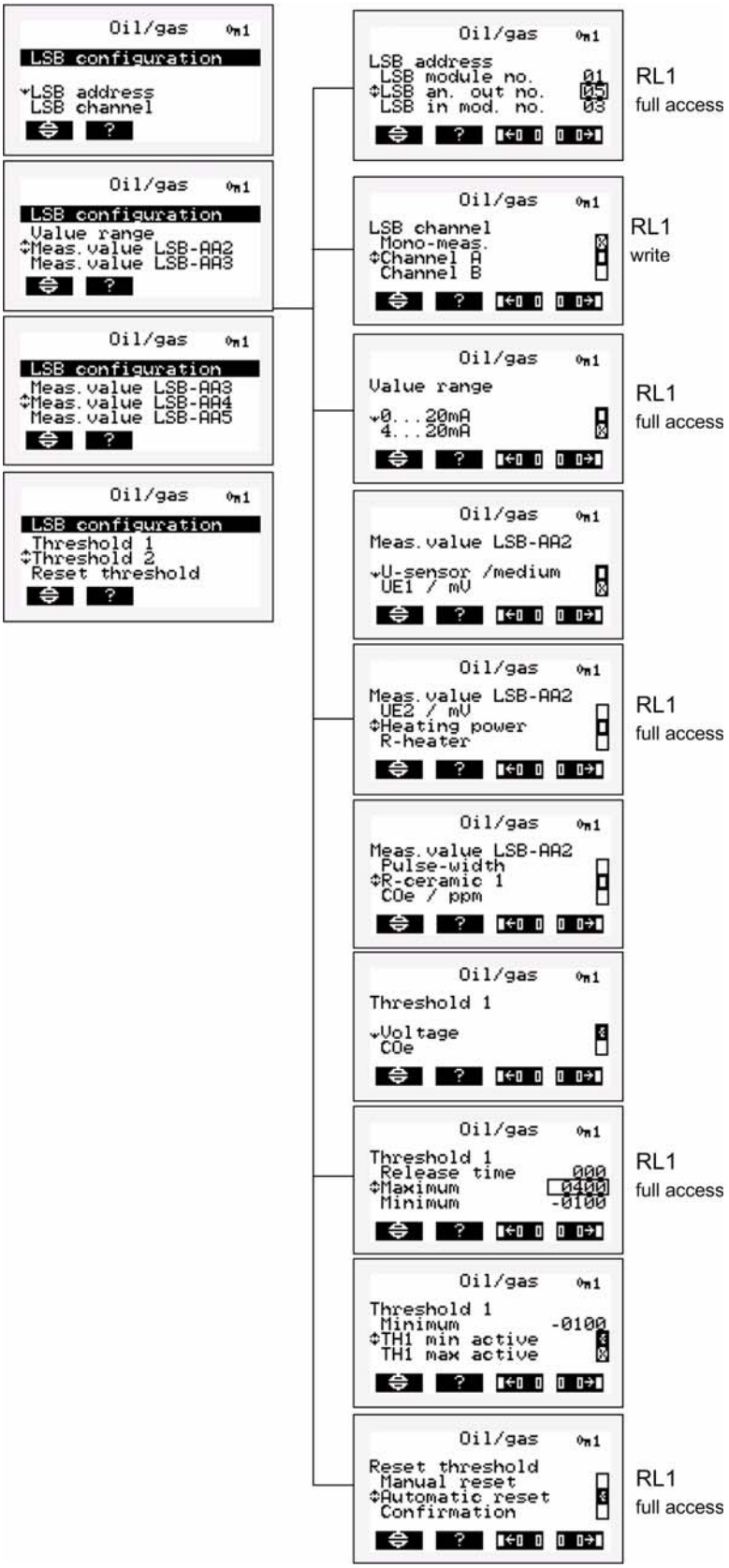
Curve selection:

You can use this selection, when you have not used any control system for fuel input 0.

Custom curve:

Please post a maximum of 10 points for the programming of a customised curve. The points must be numerically sorted (ascending/descending). If the values are not numerically sorted, this would lead to a false display of CO_e-values.

5.3.7 LSB Configuration



Please use the and keys to navigate. The displayed values cannot be changed. Please confirm the entry with key. You can only change the values, when you are categorised under the corresponding release level.
(RL0 = Release Level 0, RL1 = Release Level 1)

LSB-Address:

Please set the address of your LSB module(s) here. A false entry would lead to a communication failure to the LSB module.

Value range:

Please set the value range for analogue output to 0...20mA or 4...20mA.

0mA would generate an error message in the value range of 4...20mA.

Measurement Values LSBAA2 - LSBAA5:

Please set the measurement of which the sensor should emit in the analogue output 2-5.

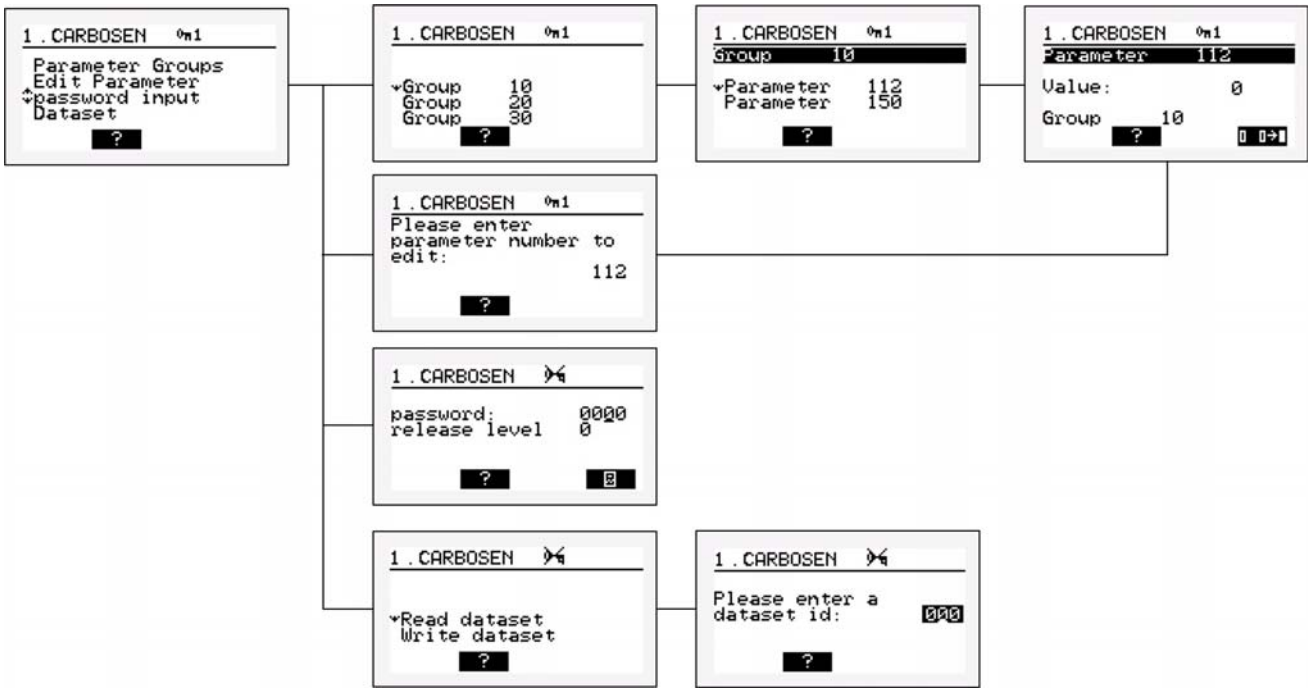
Threshold 1:

Please set the thresholds for digital output; when the relay opens and closes respectively.

Reset threshold:

Please select how the limit values should be set back to its default status.

5.3.8 Parameter Configuration



Please use the and keys to navigate. The displayed values cannot be changed. Please confirm the entry with key. You can only change the values, when you are categorised under the corresponding release level.

Read and write dataset:

You can read and write set of parameters through the dataset from the device.

NOTICE!

You can upload import parameters in sets only. Individual parameters cannot be uploaded or imported.

5.3.9 Contrast

Please use the key for the setting of the contrast. To set a value lower than the displayed value, you need to increase the value to its highest limit. By exceeding the upper limit, the display would be set back to the value which is the lowest limit value.

6 Operation

6.1 Operation / Measurement Value Display

6.1.1 Operation

- via programming unit (optional)

6.1.2 Measurement Value

Probe voltage	-100…+900 mV, transmission via analogue output 1 (0/4...20mA) ST-Tap version: Pin3 and Pin4 of circular plug. Electronic XC164-Tap: Terminal 4 and Terminal 5

Other measurement values can be transmitted via an analogue output module (optional).

6.1.3 Status Signals

Transmission via digital output module (optional)

6.2 General Instructions for Operation

6.2.1 Operational Failure, Switching On and Off

With a longer period of failure, from approximately 3 months onwards, we recommend the measurement to be shut down. In order to avoid the probe sensor from being damaged, the probe sensor must be dismantled

We recommend you to leave the measurement to run during periods of short failure.

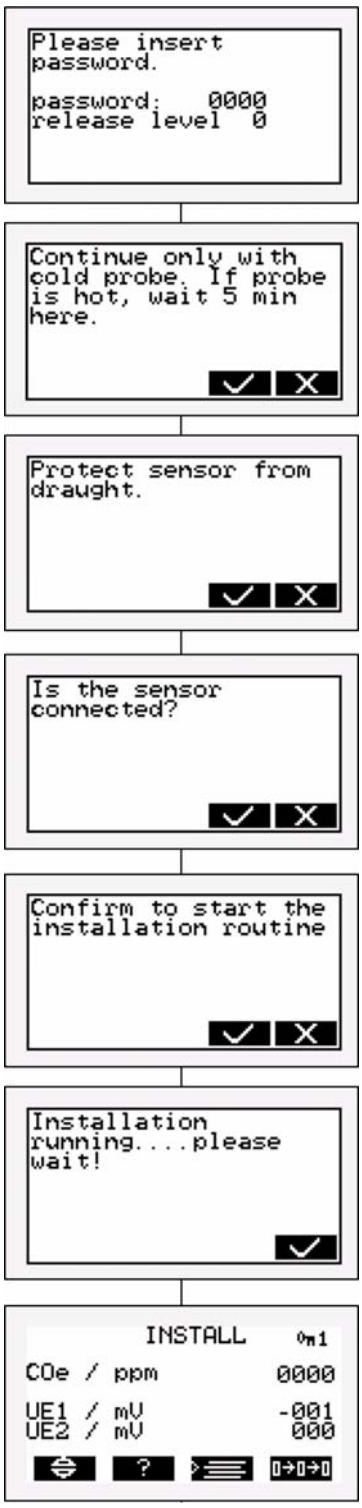
6.2.2 Liquid Purification

You are allowed to perform a wet cleaning of the boiler, when you dismantle the probe beforehand. If you perform a wet cleaning to an installed probe, this could lead to damaging of the probe. An error free operation is then no longer possible.

CAUTION!

For the wet cleaning, the probe must be dismantled by all means. A wet cleaning of an installed probe will lead to damaging of the probe.

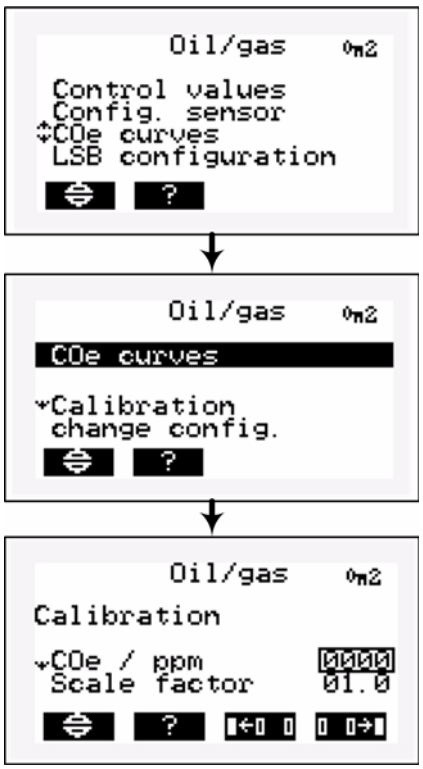
6.2.3 Performing Sensor Change-Over



If the sensor is still warmer than ambient temperature after 5 min, then you should wait until the sensor is cooler and not warmer than the ambient temperature anymore.

Due to safety reasons, you should close down any other running programs or activities during the installation.

6.2.4 Calibration of the COe-Curves



You need release level 2 to do these settings.

Insert your password for release level 2. You will receive this password only after consulting LAMTEC support.

Phone: +49 (0) 6227 6052 33

E-mail: support@lamtec.de

CO_e / ppm shows the actual CO_e value (read only)

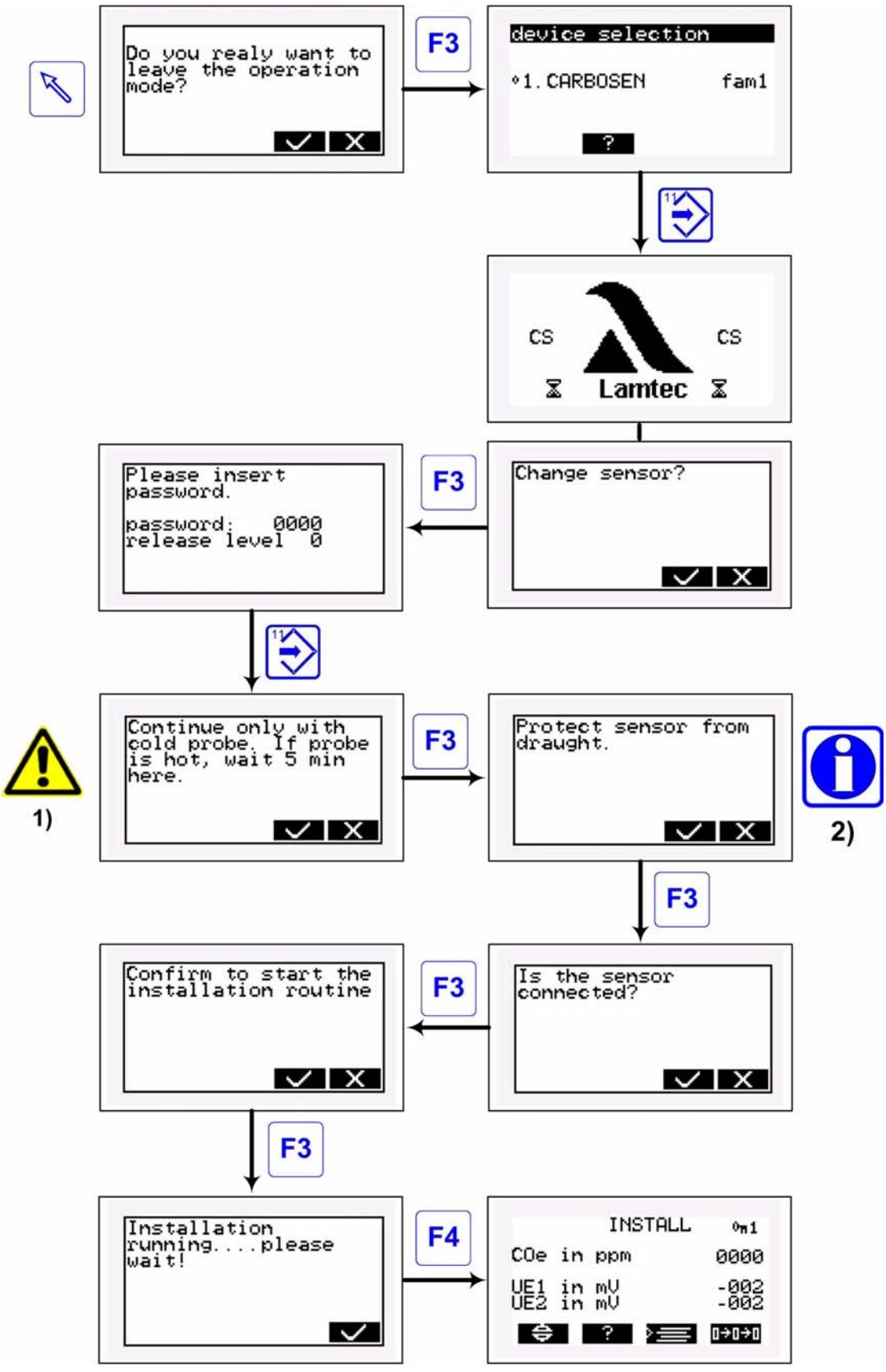
Scale factor - This scaling factor will be multiplied ba the CO_e value.

After you have inserted and acknowledged the scaling factor, the display shows the changes CO_e value in ppm, corresponding to the factor you have inserted.

Autom. Offset sets the offset to 0.

Offset = display value

6.2.5 Initiate the Cold Resistance Determination



If you want to start the definition of the cold resistance, proceed as described in chapter 5.1 and confirm a change of the sensor or start from the main menu with (see chapter 5.2).

1)

WARNING!

Watch the sensor's temperature!

Proceed the definition of the cold resistance only, if your sensor has cooled down to ambient temperature.

If the sensor is too warm, you will get a wrong result and the sensor may be damaged.

Let the sensor cool down for at least 5 min. A longer cool down period will be better.

Check the your sensor's temperature.

2)

NOTICE!

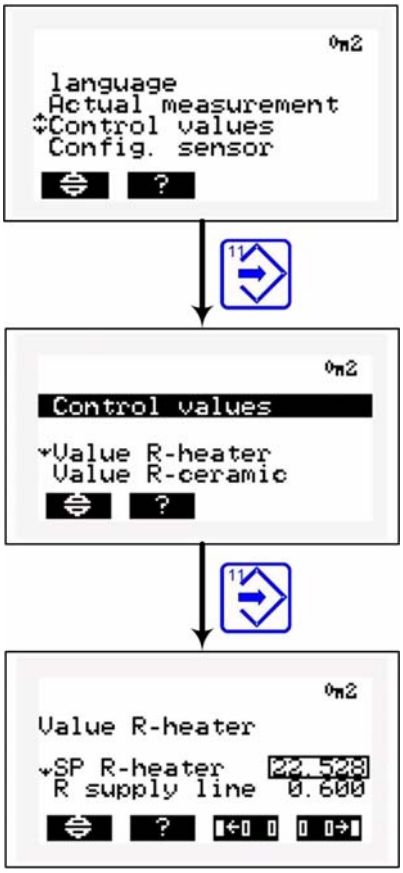
Protect your sensor from air drought.

If your sensor is exposed to air draught during the definition of the cold resistance, this may falsify the result or the measurement fails.

Take care for a air draught free environment.

Press key F4 to end the definition of the cold resistance. The installation starts.

6.2.6 Changing the Sensor Temperature (RI)



You need release level 2 to do these settings.

Insert your password for release level 2. You will get this password after consulting with LAMTEC support.

Phone: +49 (0) 6227 6052 33

E-mail: support@lamtec.de

the bigger the factor → the higher the temperature

the smaller the factor → the lower the temperature

The steps for changing the factor may have a maximum of 0,1.

Mind the following limit!

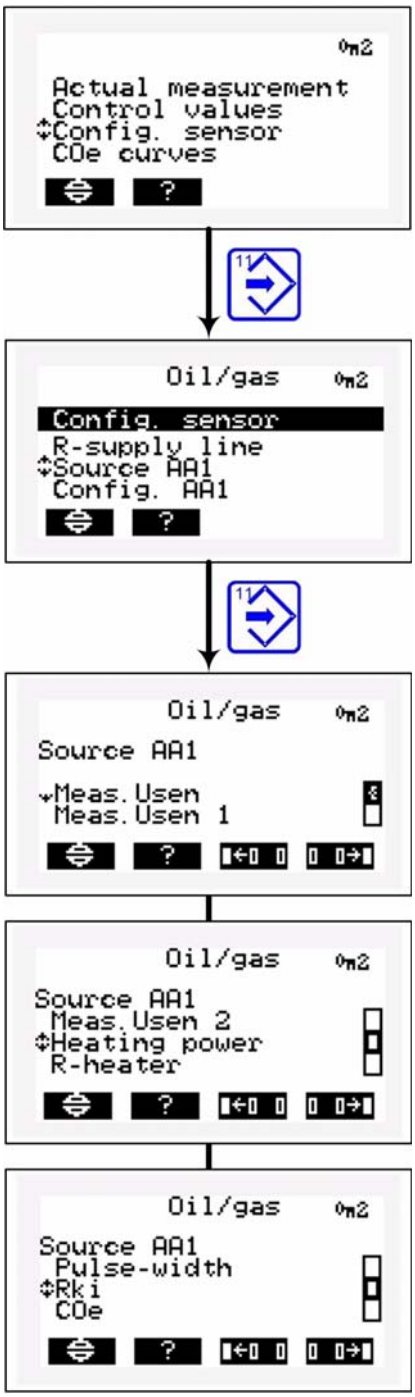
Never exceed the maximum factor of 2,8.

If you exceed the maximum this may disturb the sensor or minimises it's lifetime enormusly.

If the factor is smaller than 2,4, the sensor is too cold. This may lead to a false measurement and to a too high offset.

Change with key into the main menu and start the installation (refer to chapter 6.2.5 Initiate the Cold Resistance Determination).

6.2.7 Analogue Output 1



You need release level 1 to do these settings.

Insert the password for release level 1.If you have forgotten your password, contact LAMTEC support.

Phone: +49 (0) 6227 6052 33

E-mail: support@lamtec.de

In analogue output 1 choose, which value analogue output 1 shall output.

Meas. Usen = average sensor voltage

Meas. Usen 1 = single voltage, for calculating the average sensor voltage

Meas. Usen 2 = single voltage, for calculating the average sensor voltage

Heating power = the heater's wattage

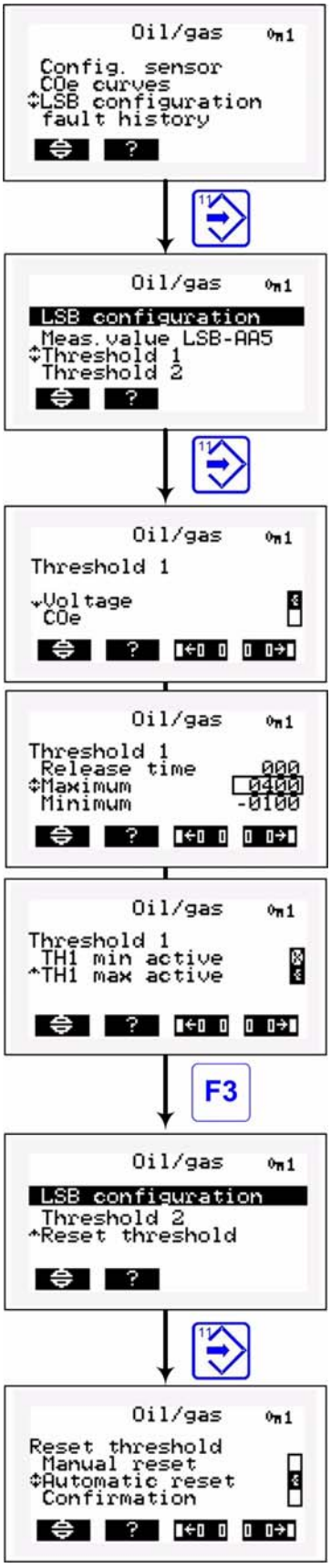
R-Heater = the heater's resistance

Pulse-width = the heater's pulse-width

Rki = ceramic inner resistance

COe = calculated CO_e value of the preset characteristic curve

6.2.8 Setting the Limit Values



You need release level 1 to do this settings.

Insert your password for release level1. If you forgot your password for this release level, contact LAMTEC support.

Phone: +49 (0) 6227 6052 33

E-mail: support@lamtec.de

choose in the LSB menu, wether you want to set limit value 1, limit value 2 or the way to reset the limit value.

Activate **voltage** (sensor voltage) or **COe** (calculated value) as the limit value.

If you choose CO_e , you must calibrate the characteristic curve regularly. You must do this with a reference device at least at commissioning.

Release time = the limit value is triggered after this period

Maximum = limit value maximum of the measurement value

Minimum = minimum limit value of the measurement value

TH1 min active = lower threshold active

TH2 max active = upper threshold active

Manual reset = reset by pressing a key

Automatic reset = As soon as the value leaves the threshold, a reset will be triggered automatically.

Confirmation = A reset will be triggered automatically, but you have to confirm the reset additionally.

7 Service and Maintenance

7.1 Exchanging the Sensor

7.1.1 CarboSen ST and in Clip- and Rod Housing

For this type of CarboSen1000, the complete probe must be exchanged.

7.1.2 CarboSen1.000ST

For repairing the sensor system CarboSen1000 ST, it is possible to exchange the whole sensor. For the exchange, the following spare parts numbers should be provided:

Spare parts

Art. No.	Description
658 R 0013	Replacement sensor for 658 R 0010, 150mm (HT-Type*)
658 R 0022	Replacement sensor for 658 R 0012, 250mm
658 R 0031	Replacement sensor for 658 R 0030, 150mm (NT-Type*)
658 R 0105	Replacement electronics XC164 in CarboSen1000 ST

* T – high temperature (150°C to 400°C exhaust gas temperature),
T – low temperature (up to 150°C exhaust gas temperature)

Please follow the instructions step by step to exchange the sensor:

- Disconnect both DIN-plugs (4-pin / 5-pin) from the sensor system.
- Open the cover plate and remove the 6-pin plug from the board.
- Screw out the old sensor from the electronics. Please make sure that the cable does not hang on the electronic board and therefore not damaged.
- Screw in the new sensor with the new copper seal ring and fix it.
  Please do not plug the 6-pin connector to the electronics at this step!
- Attach and screw the DIN-plug.
- Connect the sensor system to the power supply and hold for 2 minutes (red LED flashes and green LED flash at 4 Hz)
- Plug the 6-pin connector to the electronics. The determination of resistance would be initiated. The sensor has to be outside high air flow and it has to be at ambient room temperature (approx. 20°C). When it comes to the end of this process, the resistance would be saved.
- Hold until the green LED flashes (frequency 1 Hz)
- Close the housing of the electronics. Please keep attention to the connector cable of the sensor (do not clamp it!)
- Exchange the label on the housing or change the serial number of the sensor on the old label.

The sensor system is now ready for use.

8 Accessories

8.1 Programming Unit

8.1.1 Panel Installation option

- Panel installation frame for programming unit
  Item no. 663 R 0932T
- Protection class according to EN 60529IP54

Fig. 8-1 Programming unit in panel installation frame

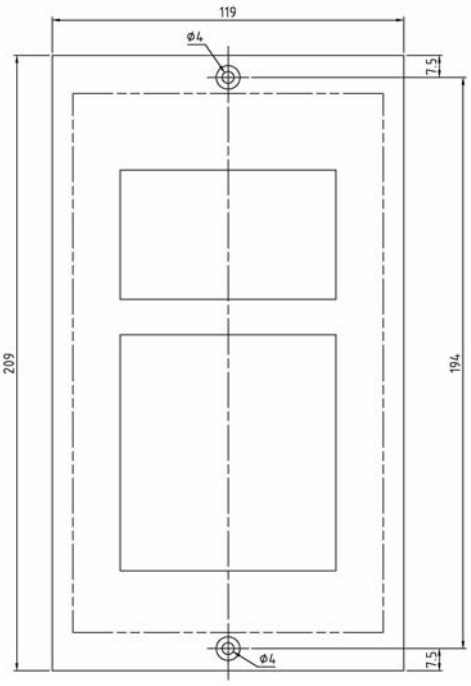


Fig. 8-2 Panel cutout 105 x 183

8 Accessories

8.2 Analogue Output Module with address 19 for Display of Measurement Signals

Fig. 8-3 analogue output module

- 4 analogue output 0...10VDC (non-floating) or item no. 663 R 4025

  or
- 4 analogue output (non-floating) item no. 663 R 4029
- for producing:
  - average sensor voltage
  - sensor voltage 1
  - sensor voltage 2
  - heating power
  - internal resistance of heating
  - pulse width heating
  - internal resistance of sensors
  - CO_e

Adjustable in parameter 810...825 of the CarboSen1000 ST

NOTICE!

Please check the accuracy of the preset module address!

8.3 Digital Output Module with module address 03

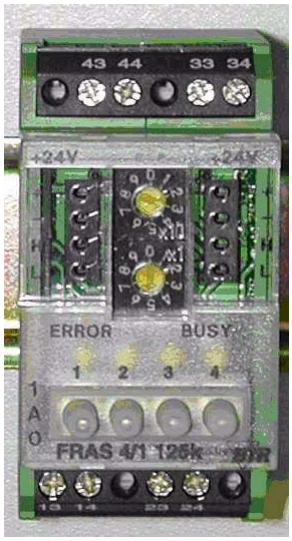


Fig. 8-4 digital output module

- 4 relay output 250 V, 6 A (floating) item no. 663 R 40275
- Output 1 – Limit value 1
  Output 2 – Limit value 2
  Output 3 – not measured
  Output 4 - fault
- Manually operated emergency menu
  Setting „1“→ Output contact closed at all times
  Setting „A“→ Output contact switch over to LSB
  Setting „0“→ Output contact opened at all times

NOTICE!

Please check the accuracy of the preset module address!

8 Accessories

8.4 Digital Input Module with module address 11

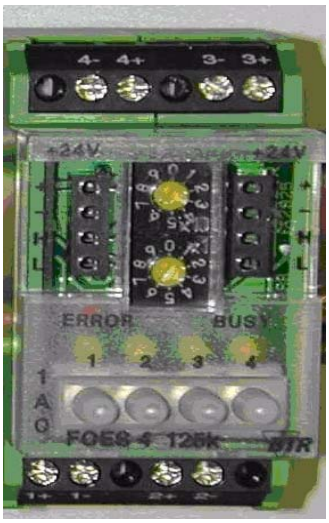


Fig. 8-5 digital input module

- 4 digital inputs 24V/DC
  The inputs are executed with an input voltage of 24V/DC with electrical isolation.
  Item no. 663 R 4028
- Input 1 – RESET limit values 1 & 2
  Input 2 – not assigned
  Input 3 – start sensor test
  Input 4 – RESET fault / warning
- Manually operated emergency menu
  Setting „1“ → Input is HIGH at all times
  Setting „A“ → Input switches over contact from outside
  Setting „0“ → Input is LOW at all times

NOTICE!

The input and output module can be mounted without any gap. After mounting 15 modules, the power supply should start externally.

With more than 15 modules, the bypass plug would be overloaded and burn out.

Please observe the fuse protection of the external power supply. Bear in mind that there is no line-side fuse available.

NOTICE!

Please check the accuracy of the preset module address!

8.5 Power Pack

Ext. power pack 230VAC/24VDC - 1.5A (35W) for power supply of CarboSen1000 ST, the programming unit and the module

- Item no. 658 R 01095
- Range of input voltage 85...264 VAC, 47...63 Hz
- Typical current consumption 0.48A
- Installing on mounting rail TS35
- Operational temperature range -20...+60°C
- Weight 270gr
- Protection class IP 20

8 Accessories

Fig. 8-6 Ext. Power Pack 230VAC/24VDC – 1,5A (35W) Type 658 R 01095

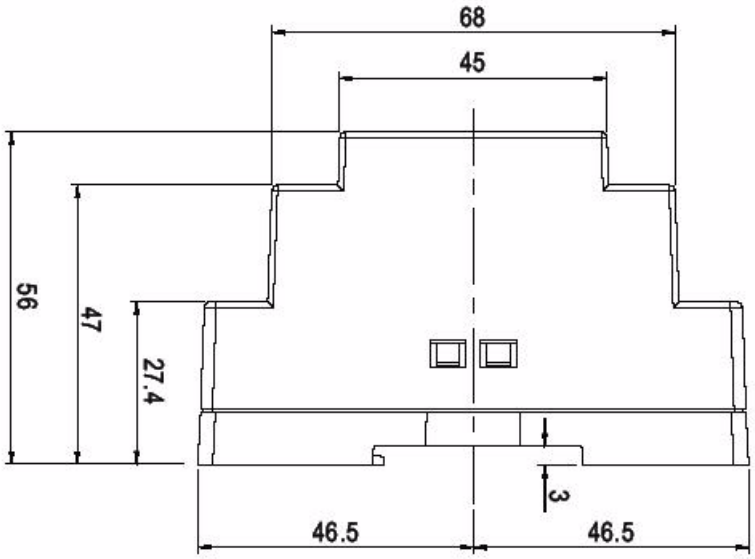


Fig. 8-7 Dimensional diagram ext. Power Pack Type 658 R 01095

9 Technical Data

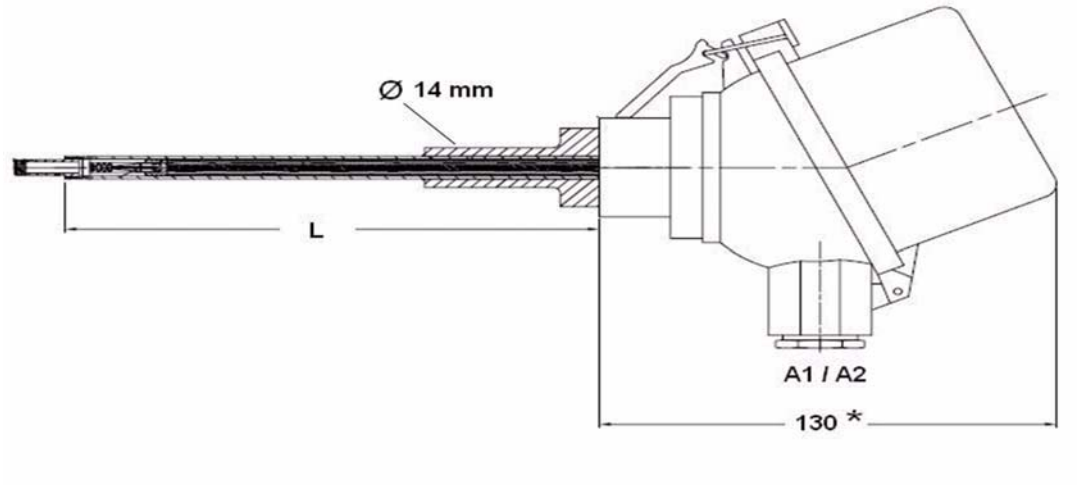
Electronics:		**Sensor:**	
Dimensions:		Measurement principle:	Solid state electrolysis (Non Nernst)
Type ST	111x111x87 mm³	Measurement range:	up to 3.000ppm CO/H_2
Type XC164	112x112x85 mm	Cross-sensitivity:	H_2O none Temperature very low Volume flow rate very low
Supply voltage:	13-30V	Response time t (sensor element):	<1s
Power consumption Electronics and probe	Max. 8W (without additional devices) (Sensor, up to 6W)	Temperature Field:	Type NT and Clip Housing: up to 150°C Type HT: 150°-400°C
Analogue output:	0/4 - 20mA, 0mA = error Burden 300 Ohm	Sensor temperature:	630°C
Scaling of analogue output:	-100mV up to +900mV	Sensor cold resistance:	7,0 Ω≤ $R_{20°C}$≥ 11Ω
		Resistance ratio $R_{heiß}$/ $R_{20°C}$:	2,5
ST Housing			
Material:	Die-casting aluminium	Maximum heating resistance:	35 Ohm (on the assumption of cable break)
Temperature:	-40°C... +100°C		
		Average lifespan:	
		Blue flame burner, Fuel: oil / gas	approx. 3 years
		Wood combustion, Fuel: neat stock wood or pellets	approx. 2 years
		Fuel for other wood combustion, according to contamination concentration (e.g. woodchips, bark)	< 1 year

Degree of protection according to EN 60529: IP 67

LED Coding of the electronics

Colour	**Appearance**	**Description**
Green	Flash frequency 1Hz	Nominal operation
	Flash frequency 0,25Hz	Sensor are not connected or faulty
	Flash frequency 4Hz	Determining the heating resistance
Yellow	Lit continuously	Sensor is heating up
Red	Flashing	Indicates a problem

9 Technical Data



* with an opened cover plate of 190 mm

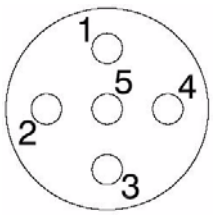
Art.No.	L/mm
658 R 0010	150
658 R 0012	250
658 R 0030	150

Plug A1

Round plug connector, 4-pin

- Pin 1 Power supply voltage 0V
- Pin 2 Power supply voltage 24VDC
- Pin 3 Analogue output –
- Pin 4 Analogue output +

Plug A2



Round plug connector, 5-pin

- Pin 1 24VDC-output +
- Pin 2 24VDC-output -
- Pin 3 CAN-GND (LSB)
- Pin 4 CAN-L (LSB)
- Pin 5 CAN-H (LSB)

Connection cable schielded, max. cable cross section of $1mm^2$.
Maximum cable length should not exceed 100m.

10 Ordering Information

Accessories	
Product / Type	**Order No.**
Programming unit, for the setting of CarboSen1000 parameters in sets (connection cable included)	658 R 0932
Panel installation frame for programming unit	663 R 0932T
Analogue output module 0...10 V with the address 19	663 R 4025
Analogue output module 0...20 mA with the address 19	663 R 4029
Digital output module with the address 03	663 R 4027
Digital input module with the address 11	663 R 4028
Ext. power pack 230 V AC / 24 V DC - 1.5A, for the power supply of CarboSen1000 ST, the plug unit and the module	658 R 0109

Spare Parts	
Product / Type	**Order No.**
Replacement sensor 658 R 0010, 150mm	658 R 0013
CarboSen100010.000HT-ST-Mounting 150mm	658 R 0017
CarboSen10001.000HT-ST-Mounting 250mm	658 R 0018
CarboSen100010.000HT-ST-Mounting 250mm	658 R 0019
Replacement sensor for 658 R 0030, 150mm	658 R 0031
Replacement electronics XC164 on the head of CarboSen1000 ST	658 R 0105
Replacement connecting cable for the programming unit	663 R 0430
Replacement adapter cable for the programming unit	658 R 0426

Detailed explanation of terms
DS Top coat
HT High temperature (ceramic castings) 150°C - 400°C
NT Low temperature (epoxy resin castings) < 150°C
G Glass castings
ST with electronics on the head

11 FAQ

Can the sensor operate in condensed moisture?

At present, there are two versions of the rod housing. The first type (NT) is designed for applications up to 150°C and can be operated under condensed moisture as long as the sensor does not immerse into the condensation.
The second type (HT) is designed for applications with a constant measuring temperature of 150°C to 500°C.
The clip housing is designed only for applications with ambient temperature up to 150°C.

How should the sensor be installed?

The best mounting position is upright, with the head / connection cable facing up. Should there be a problem due to installation situation; the next best possible setting angle to choose from is min 10° horizontally. An installation position below this horizontal level is to be avoided, because this could damage the sensor.

What substances are considered to be harmful to CarboSen1000?

Sulphur oxide, fluorine and chlorine compounds as well as silicon could be harmful to CarboSen1000 and could cause a complete breakdown in extreme cases, depending on the concentration.
Also firm deposits on the sensor elements could affect the sensor characteristics, e.g. crystallised salt from condensation could interfere with the gas diffusion of the sensor.

What are the effects of solid particles such as carbon and ash on the sensor?

Carbon has no effect on the sensor and it does not contaminate the sensor. The sensor itself has a temperature of 630°C. Therefore, carbon combustion occurs instantly at this ambient temperature. Other solid particles in measuring gas such as ash would normally not end up in the housing.

Can I clean the sensor?

Should it be necessary, the sensor housing can be wiped with a piece of dry cloth. Please be aware that the contaminated dirt should not be pressed against the plastic foil on the head of the sensor. Any kind of detergent or dissolver is not allowed in the cleaning the sensor.

Does the temperature of the sensor drift?

No. The sensor has a firm zero-point of ambient temperature, which can be given 0mV 5mV.

What are the known effects of deterioration of the sensor?

Some small inlet effects are known, which may occur during the first few hours of sensor operation. This effect could increase the sensitivity of the sensor. Deterioration effects such as damage due to harmful substances depends very much on the type of substance used and its concentration (see above).

What are the cross-sensitivity effects of CarboSen1000?

CarboSen1000 is a mixed potential sensor. Hence, it could detect all kinds of oxidisable, gaseous substance (CO_e), as well as those with different sensitivity. With the existence of multiple components, this cannot be concluded selectively.
Furthermore, the sensor voltage is dependent on the oxygen content in measuring gas. The lower the oxygen content, the higher the sensor voltage while CO_e being held constant.
The CarboSen1000 has no cross-sensitivity effects on H_20-vapour, CO_2, inert gases.

What are the effects of the sensor temperature on the sensor voltage?

The sensor voltage is strongly temperature-dependent. The CarboSen1000 operates in a temperature of 630°C. Possible operating temperature lies between 450°C and 700°C. As a

basic principle, the lower the sensor temperature, the higher the sensitivity of CO_e and therefore sensor voltage increases while the composition of measuring gas is held constant.

Can the sensor operate in condensed moisture?

At present, there are two versions of the rod housing. The first type (NT) is designed for applications up to 150°C and can be operated under condensed moisture as long as the sensor does not immerse into the condensation.
The second type (HT) is designed for applications with a constant measuring temperature of 150°C to 500°C.
The clip housing is designed only for applications with ambient temperature up to 150°C.

Why does the sensor voltage decrease at a given point although COe increases?

The CarboSen1000 requires a minimum level of oxygen, depending on the CO_e concentration, to maintain the reaction kinetics of the electrodes. Should the oxygen level fall below the minimum level, the sensor voltage cannot be maintained and break altogether.

Is COe of the CarboSen1000 harmful to the oversaturation of the sensor?

No. As soon as the composition of the measuring gas lies in the correct range, the sensor would show the usual measurement procedure.

How do I recognise an error message from the sensor system?

The red LED flashes and the analogue output would be defined as 0mA.

12 Error Detection and Measurements

In the following overview, known errors and their recognition features as well as possible causes of these errors are discussed.

12.1 Green LEDs do not flash

- Is the power supply connected and switched on properly?
- Did the power supply fulfil the requirements (13-30V, at least 6W)?
- Are the plugs attached to the board?

12.2 LED Status

- *The red LED flashes:* An error exists.
- *The yellow LED lights up:* Heating phase.
- *The green LED flashes quickly with 4 Hz:* Installation routine is running
- *The green LED flashes slowly with 0.25 Hz:* There is no sensor connected or the sensor is defect.
- *The green LED Flashes normally with 1 Hz:* A non-heating specific error exists.

12.3 Fluctuating Sensor Voltage without Distinguishable Pattern

Possible errors are:

- Rapidly changing conditions in measuring gas. The sensor has an extremely low response time.
- External effect.
- Due to the high-resistant short-circuited heating, there may be influence on the sensor's side. Therefore, it should be verified if the sensor is designed for high temperature (HT) and if it is able to operate in a condensed moisture. Sensor heated at 100°C for repeated hours, where applicable.

12.4 Constant Sensor Voltage, independent of Measuring Gas

- Sensor voltage equals to null: sensor is defect or had totally lost its sensitivity
- Sensor voltage is not equal to null: external effects, e.g. through the heating

12 Error Detection and Measurements

12.5 Faults

No.	Output text	Cause of fault signal	Remarks
1	Heater defect	maximum heating power is exceeded	would be restrained during the heating phase
2	Heater defect	Connection to other channels aborted (timeout expired)	sensor may be fine but the control is not working
3	Analogue output defect	an error occur during initialisation of the analogue output	no measurement value from analogue output
4	Sensor voltage beyond the limits	one OR both sensor voltages beyond -30 to 700mV	not implemented yet
5	U_{sen} difference too high	maximum allowable voltage difference between the electrodes is exceeded.	would be restrained during the heating phase; warning when it is 1-channel, fault message when it is 2-channels

12.6 Warnings

No.	Output text	Cause of fault signal	Remarks
101	Ph_{max} achieved	maximum heating power is exceeded	would be restrained during the heating phase
	Ph_{min} achieved, over-heated ambience	falling below minimum heating power	would be restrained during the heating phase
103	Heating resistance beyond the limits	fixed cold resistance falls beyond specific limits	Sensor would be operated with default value R_{kalt}
104	U_{sen} difference too high	maximum allowable voltage difference between the electrodes is exceeded	would be restrained during the heating phase; warning when it is 1-channel, fault message when it is 2-channels
105	Ceramic resistance beyond the limits	fixed ceramic resistance falls beyond specific limits	Sensor would be operated with default value R_{kalt}
106	Deviation of R_h from setpoint value	the current measured value R_h deviates too far away from the saved set-point value	(only with R_{ki}-Control)
107	Sensor resistance drifts	the resistance values changes significantly (measured over a long period of time)	long-run testing of the discarded triple (R_h,R_{ki},U_s), Triple would be relocated back after every installation routine.

13 Support

LAMTEC Mess- und Regeltechnik
für Feuerungen GmbH & Co. KG
Wiesenstraße 6
69190 Walldorf

support@lamtec.de
Tel.: +49 6227 – 6052-33
Fax: +49 6227 – 6052-57

14 Declaration of Conformity

Month / Year: :.....December ../...2005.....

Manufacturer: **LAMTEC Meß- und Regeltechnik für Feuerungen GmbH & Co KG**
.....

Address: Wiesenstraße 6, D-69160 Walldorf
.....

Product name: CarboSen1000
Type 658 R 0106 /R 0107 /R 0010
.....

.....

The named product conforms to the stipulations of the following European Directives:

Number	Text
89/336/EWG	Electromagnetic Compatibility
73/23/EWG	Low Voltage Directive

More information about compliance with these Directives is contained in the annex

Display of CE-Marking: Yes

Place, Date Walldorf, 16 December 2005

Legally binding signature:

The annexes form part of this Declaration.
This Declaration certifies compliance with the above-mentioned Directives, but contains no assurances in respect of specifications.
The safety information in the supplied production documentation must be read and observed.

14 Declaration of Conformity

Appendix
to EC Declaration of Conformity
or EC Manufacturer's Declaration

:

Month / year: .....December../...2005.....

Product name: CarboSen1000 Type 658 R 0106 /R 0107 /R 0010

.....
.....

The adherence of the product named above with the stipulations of the above-mentioned Directives is proven by its compliance with the following standards and regulations:

Harmonised European Standards:

Reference-Number

DIN EN61326, issue 2004-05
(IEC 61326:1997 + IEC 61326-1/A1:1998 + IEC 61326-1/A2:2000 + Appendices E & F to IEC 61326:2002 + Corrigendum:2002); German version EN 61326:1997 + EN 61326/A1:1998 + EN 61326/A2:2001 + EN 61326/A3:2003

The following basic standards have been adhered to:

Interference Immunity:

DIN EN 61000-4-2
DIN EN 61000-4-3
DIN EN 61000-4-4
DIN EN 61000-4-5
DIN EN 61000-4-6

Emitted Immunity:

DIN EN 55011 Kl. B

Electrical Safety:

DIN EN 61010-1

14 Declaration of Conformity

LAMTEC Meß- und Regeltechnik
für Feuerungen GmbH & Co KG

Wiesenstraße 6
D-69190 Walldorf
Telefon (+49) 06227 / 6052-0
Telefax (+49) 06227 / 6052-5
Internet: http://www.lamtec.de
email: info@lamtec.de

LAMTEC Leipzig GmbH & Co KG

Schlesierstraße 55
D-04299 Leipzig
Telefon (+49) 0341 / 863294-00
Telefax (+49) 0341 / 863294-10

Überreicht durch:

Druckschrift-Nr. DLT5813-10-aEN-001
Printed in Germany