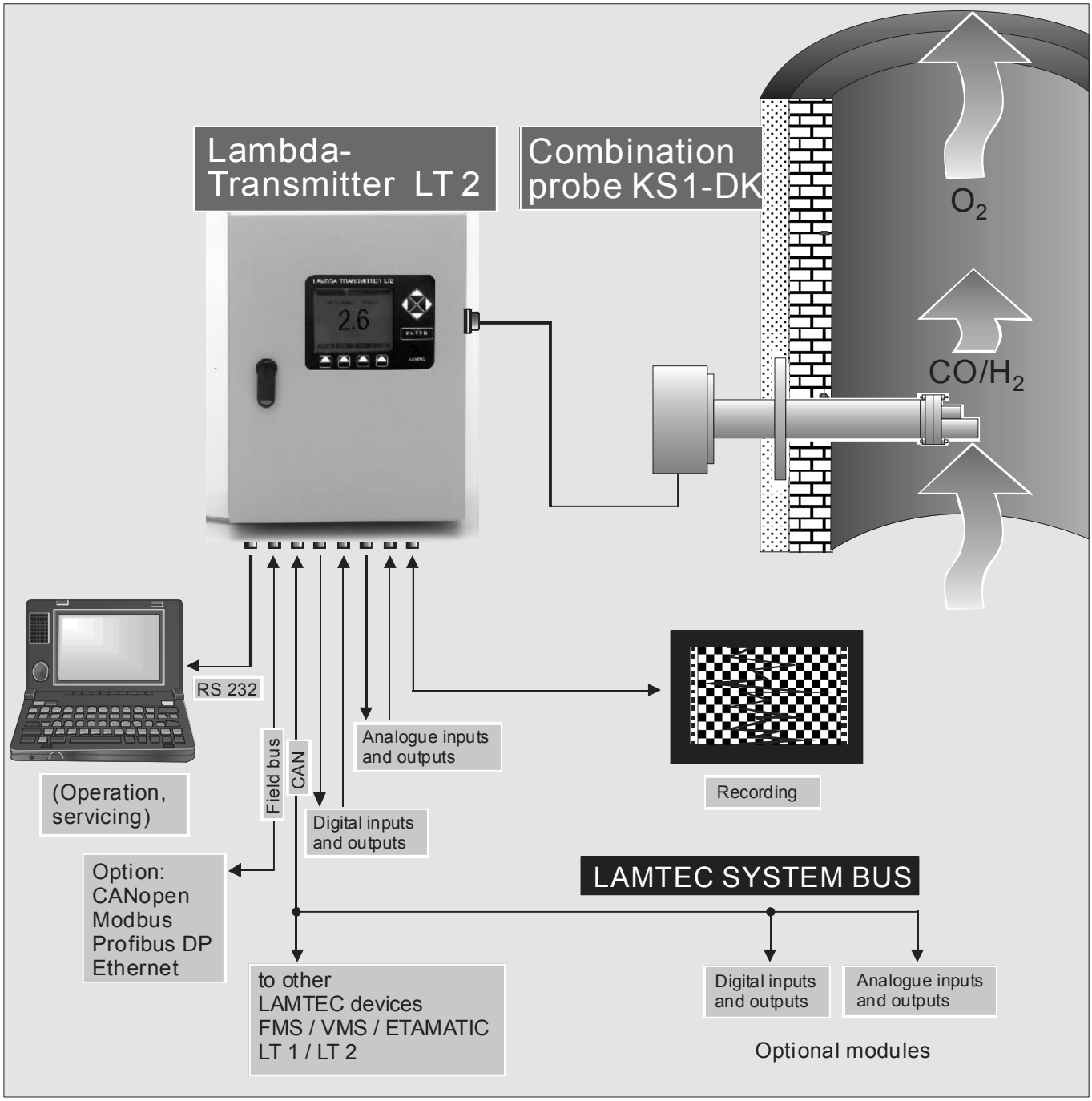
Assembly and
Commissioning Manual

Lambda Transmitter LT 2/KS1-DK
Combination Probe KS1-DK

Simultaneous measurement of Oxygen (O_2)
and oxidizing components (CO/H_2)



Sensors and Systems
for Combustion Engineering

LAMTEC

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1 General Information

1.1 Compliance with the German law on device safety

The German law on device safety stipulates the following:

Note the instructions for use!

Proceed only in compliance with the present technical documentation (Publication No. DLT3015).

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

Use by trained personnel only. The device may only be operated and serviced by persons whose knowledge and training qualifies them to do so.

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

Liability for the function of the device shall be borne by the owner or plant operator 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.

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, decrees and standards, the basis for these shall be the law of the Federal Republic of Germany.

2 Safety Information

The symbols below are used in this Manual as important safety notes for the user. They are located in the sections of the Manual wherever the information is needed. The safety information - and warnings, in particular - must be read and observed.

WARNING
This draws attention to possible dangers to persons, particularly from electrical equipment.

WARNING
This indicates possible danger to persons in the event of improper handling of system parts.

CAUTION!
This indicates danger to system parts or possible adverse effects on function.

NOTE:
This provides the user with important additional information about the system or system parts, and supplies more in-depth tips.

This appears in texts containing instructions on how to proceed.

In this connection, the plant operator is requested to comply with legal accident prevention regulations during all work, and to do everything in his power to prevent harm to persons or property, as the situation dictates.

2.1 Proper use, conditions for use

Use

The LT 2/KS 1D lambda transmitter is a universal, microprocessor-based measuring device for the direct measurement of the concentration of O2 and flammable, oxidising gas constituents (CO/H_2), referred to as CO equivalent (COe), in the superstoichiometric range in combustion systems (λ >1), in connection with the KS1-DK combination probe.

The system is designed for semi-automatic calibration with air and test gas.

If you are contemplating employing the measuring system for other purposes, and cannot assess with certainty whether the device will function without problem in this application, please first contact the manufacturer.

Preconditions

The preconditions for use are that system planning, assembly, installation, commissioning, maintenance and repair work are carried out by adequately trained personnel, and such work is checked by responsible expert members of staff.

Expert handling

In particular, please ensure that:

- Use of the device conforms to the technical data and stipulations regarding permitted use and assembly, connection, ambient and operating conditions (contained in the order documents, user information, nameplates, etc.) and the supplied documentation
- Local, system-specific circumstances and risks and regulations pertaining to technical operation of the device are taken into consideration
- All necessary measures to preserve the value of the device, e.g. for transport and storage, maintenance and inspection, are carried out.

Proper use

The product described herein left the factory in perfect condition, conforming to technical safety regulations and having undergone inspections. In order to maintain this condition, it may only be employed in the manner described by the manufacturer. Likewise, suitable transport, storage and erection and careful operation and maintenance are prerequisites for the perfect, safe operation of the device.

This product must be installed and operated by appropriately qualified personnel, who are familiar with this safety information and warnings and are able to act on them faultlessly. Unqualified tampering with the device or non-compliance with warnings herein or affixed to the device may result in severe bodily harm and/or material damages.

Proper use of the device constitutes its use only for the applications referred to in the technical description. Consequently, additional devices or devices from other manufacturers must be recommended or approved by Lamtec.

Provided that the technical safety instructions and specifications for operation contained in this Manual are observed, in normal circumstances this device does not carry any risk of material damages or harm to health.

2.2 Permitted users

Qualified personnel

Staff responsible for safety must ensure that

- Only qualified persons undertake work on system parts. Qualified persons have been authorised by staff who are responsible for the safety of people and equipment to perform the above activities on the basis of their training, experience or instruction pertaining to the device and their knowledge of relevant standards, provisions, accident prevention regulations and system behaviour. The deciding factor is that these persons can recognise and avoid possible dangers in good time when performing the above activities.

  Expert staff are persons who conform to DIN VDE 0105 or IEC 364, or directly comparable standards such as DIN 0832.
- The above persons have the supplied manuals and associated order-related documentation at their disposal at all times during their work and heed these documents in respect of the avoidance of risk and damages.

User groups

The following three groups of users are permitted to handle the LT 2/KS 1D lambda transmitter:

- **A** Service engineers from LAMTEC or their OEM customers, or trained customer personnel:
- Qualified engineers / technicians
- With very good knowledge of the device.
- “SERVICE” access level - password-protected

- **B** Operators, the customer’s fitters, engineers for measuring and control technology, electrical engineers, electronics engineers
- With introductory knowledge of the device.
- “CUSTOMER” access level – password-protected

- **C** Operating personnel with basic knowledge
- “OPERATION” access level – no password required

2.3 Safety equipment / protective measures

Danger posed by electrical equipment

The LT 2/KS1-DK system parts constitute equipment for use in industrial power installations. Switch off the supply voltage to the mains cables when working on mains connections or parts that conduct mains voltage. Refit any protection against electric shock that has been removed before switching on the supply voltage.

Unskilled use or inexpert handling can result in risks to health or material damages. Therefore, always observe the relevant safety notes to prevent damage.

Preventive measures to improve operational safety

If the LT 2/KS1-DK is employed as a sensor in combination with closed and open-loop control systems, the plant operator must ensure that a failure or fault in the LT 2/KS1-DK cannot result in impermissible damages or dangerous operating states.

In order to prevent faults that may themselves result in direct or indirect personal injury or material damages, the plant operator must ensure that:

- The responsible maintenance personnel can be notified at any time and as quickly as possible
- Maintenance personnel are trained to react appropriately to faults in the LT 2/KS1-DK and associated system malfunctions
- The faulty equipment is switched off immediately in cases of uncertainty
- Switching off equipment does not result in direct consequential faults

Avoidance of consequential damages

In order to prevent faults that may themselves result in direct or indirect personal injury or material damages, take care to ensure that qualified personnel evaluate the faults and initiate the appropriate measures.

Protection against escaping gas from the gas-bearing duct

The KS1-DK combination probe is mounted directly on the gas-bearing duct by means of a counter-flange. If the probe is detached, depending on the system - and particularly in the case of excess pressure - aggressive and/or hot gas may flow out of the duct and severely harm the health of unprotected operators, if suitable protective measures have not previously been introduced.

WARNING

In the event of excess pressure and temperatures higher than 200 °C in the gas duct, gas escapes when the KS1-DK combination probe is removed.

- Switch off the system before opening; if this is not possible, wear protective clothing and a protective mask.
- Set up warning signs to this effect in the vicinity of the probe mounting point.
- Seal the opening immediately after the work.

Shutdown / bringing back into service

The LT 2/KS1-DK lambda transmitter and KS1-DK combination probe constitute a high-quality electronic measuring system. Prudent behaviour is therefore essential during all measures, on shutdown, transport and storage.

CAUTION!

Do not switch off the LT 2/KS1-DK lambda transmitter while the KS1-DK combination probe is still mounted, even if the associated system has been shut down. Residual gases lead to corrosion and may damage system parts.

Do not store devices in the open air without protection! Always store in a dry place and, if possible, in the original packaging.

Upon deinstallation, protect cable ends and connectors against corrosion and dirt. Corroded connectors can lead to malfunctions.

Transport in the original packaging when possible

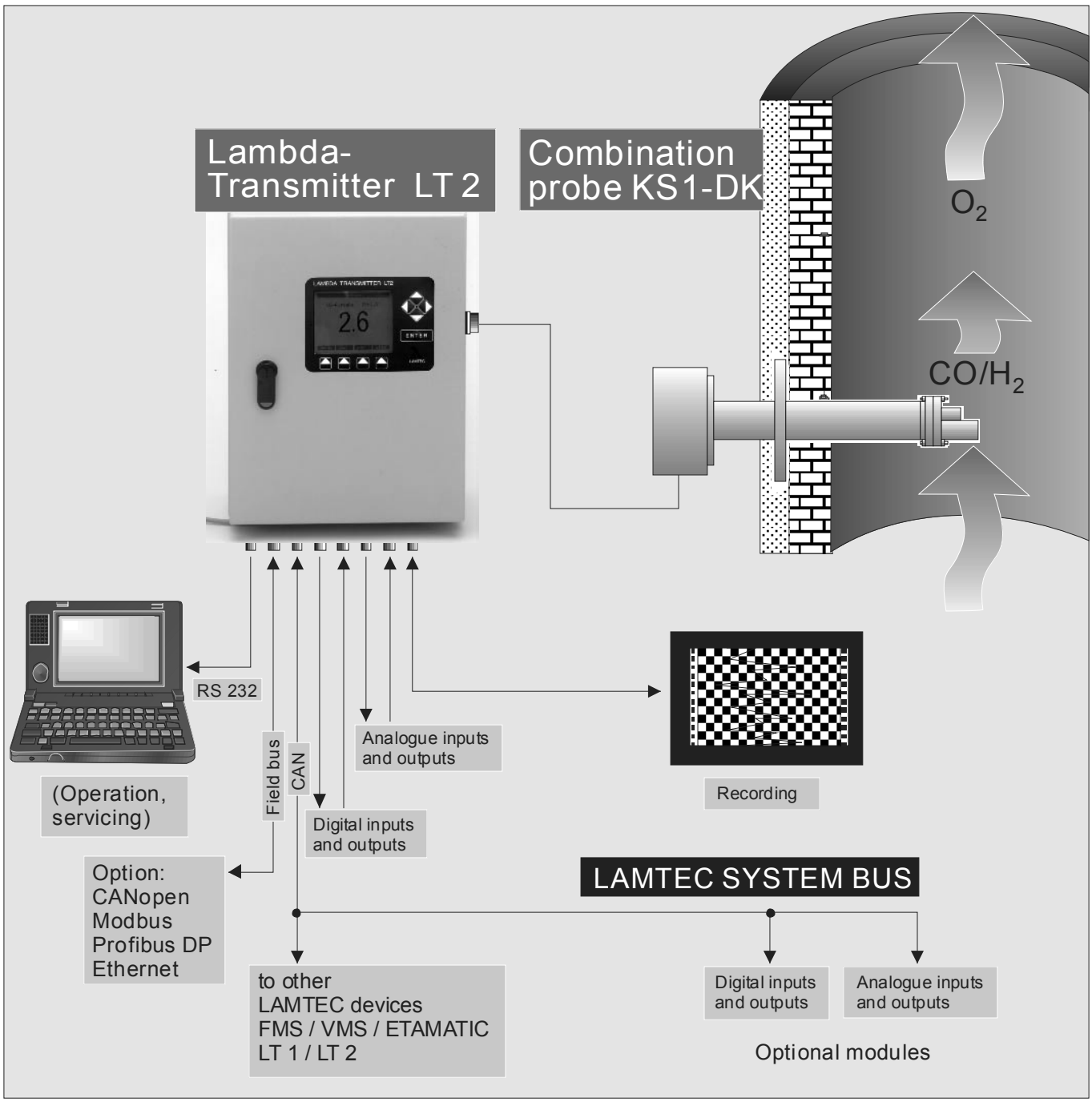
2.4 Environmentally responsible behaviour, disposal instructions

The LT 2/KS1-DK lambda transmitter has also been designed under consideration of ecological aspects. The assemblies can easily be separated from each other into different material types, and therefore put aside for recycling in this sorted condition.

3 Introduction

The LT 2/KS1-DK lambda transmitter is a universal, microprocessor-based measuring device for the simultaneous measurement of the concentration of O_2 and oxidising gas constituents (CO/H_2), referred to as CO equivalent (COe), most commonly in the exhaust gases of combustion systems in the superstoichiometric range (λ >1), in connection with the KS1-DK combination probe.

3.1 System overview

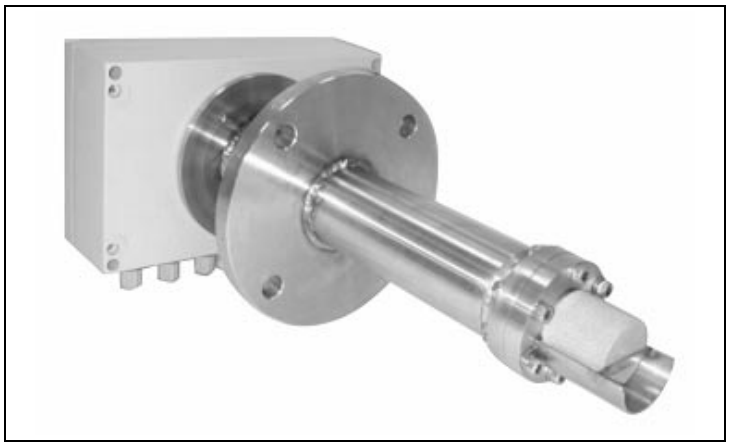


3 Introduction

3.1.1 KS1-DK combination probe

In the version for exhaust gas temperatures up to 450°C

The KS1-DK and KS1-DK-E combination probes enable in situ (directly in the exhaust gas), simultaneous measurement of the concentration of O_2 and flammable, oxidising gas constituents (CO/H_2), referred to as CO equivalent (COe), in combustion exhaust gases in the superstoichiometric range (λ>1).

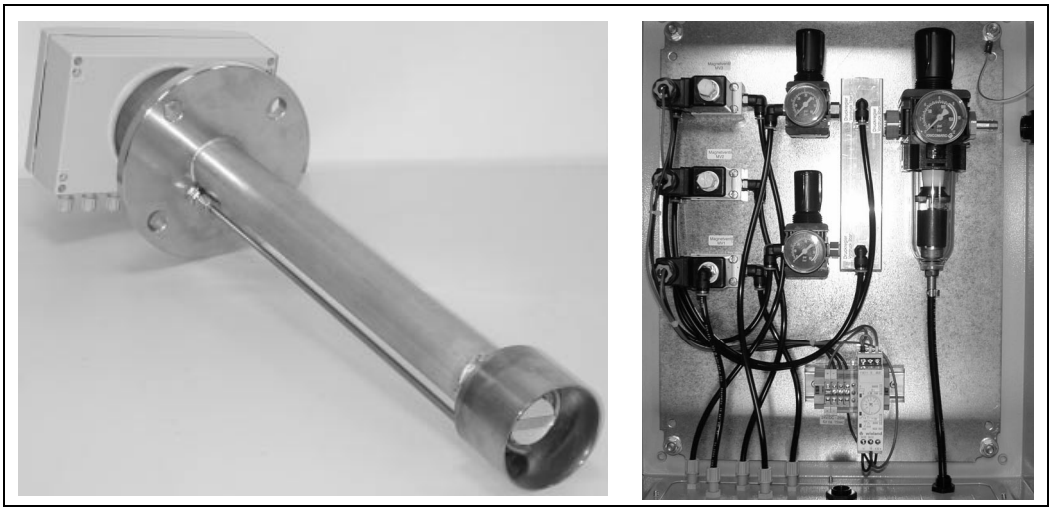


KS1-DK

With calibrating gas connection for air / test gas – for semi-automatic calibration:

Length:	500mm	Type 656 R 2030
	1000mm	Type 656 R 2031
	1500mm	Type 656 R 2032

In version for exhaust gas temperatures up to 450°C incl. Blow-out device as an additional option



KS1-DK-A
with option
„blow-out device“

With calibrating gas connection for air / test gas – for semi-automatic calibration:

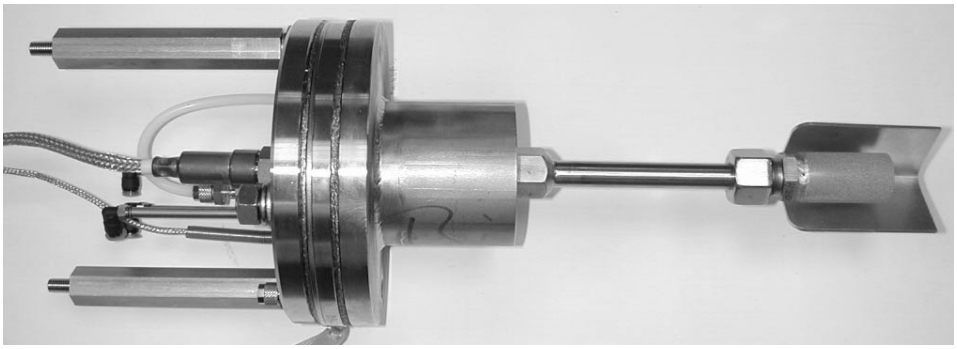
Lenght:	500mm	Type 656 R 2030A
	1000mm	Type 656 R 2031A
	1500mm	Type 656 R 2032A
Solenoid valve device 24VDC		Type 650 R 2080

- See separate publication DLT3018

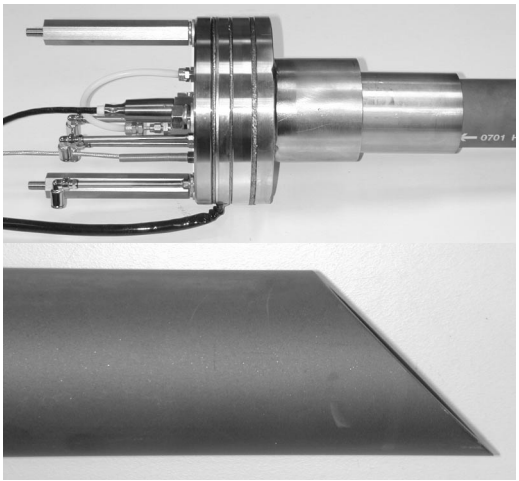
3 Introduction

In ejector version for exhaust gas temperatures up to 1400°C (on request)

- With standard GED (stainless steel 1.4571), suitable for exhaust gas temperatures from 400°C...700°C.
- With ceramic GED, suitable for exhaust gas temperatures up to 1400°C.
- Optional extras:
  - High dust guard
  - Transmitter protective box with housing heater
  - Plug & Play
- Can only be connected to LT2/KS1-DK-E via probe connection box
- See separate publication DLT3010



KS1-DK-E with standard GED



With option „high dust guard“

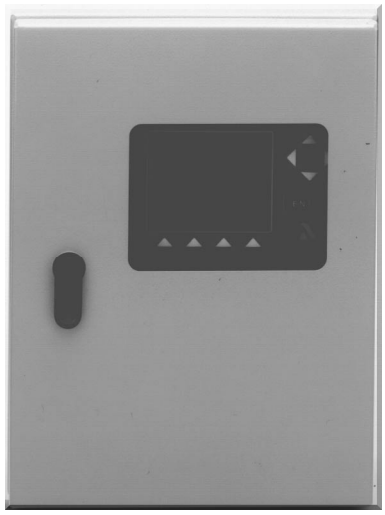
3.1.2 LT 2 lambda transmitter

In the version for KS1-DK

Two basic versions are available:

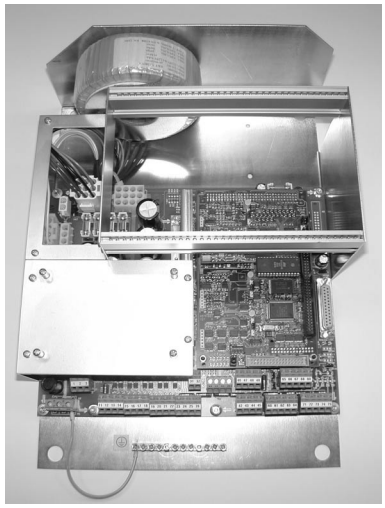
LT 2/KS1-DK lambda transmitter in IP65 wall-mounted housing

- Sheet steel H400 x W300 x D150 mm
- With display and operating unit
- With two analogue outputs 0/4...20mA
  Type 657 R 1028
- Optionally with integrated reference air pump
  Type 657 R 1060
  This increases the housing size to
  500 x 300 x 200 mm (HWD)
- Also see section 4.4.1



LT 2/KS1-DK lambda transmitter on mounting plate

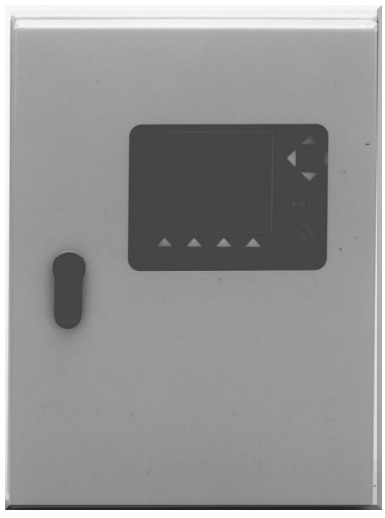
- 350 x 258 x 132 mm (HWD)
- Without display and operating unit
- Type 657 R 1032
- With two analogue outputs 0/4...20mA
- Also see section 4.4.2



In the version for KS1-DK_E

LT 2/KS1-DK-E lambda transmitter in IP65 wall-mounted housing

- Sheet steel H400 x W300 x D150 mm
- With display and operating unit
- With two analogue outputs 0/4...20mA
  Type 657 R 1033
- Can only be connected to KS1-DK-E via PCB
- See separate publication DLT3010



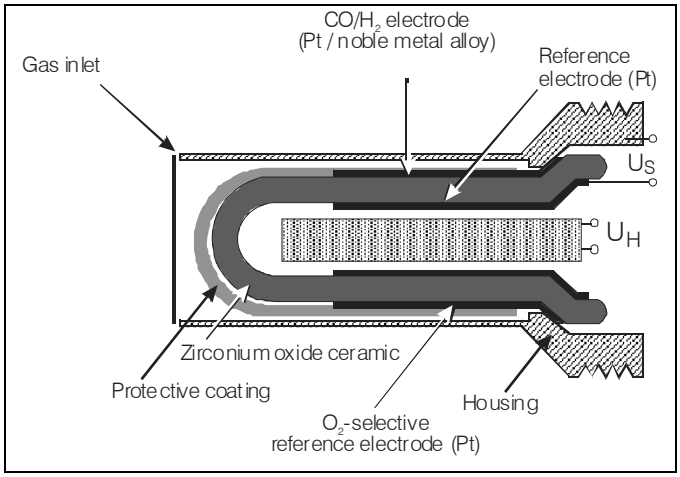
3.2 Theoretical principles of measurement

The KS1-DK combination probe basically consists of an electrochemical cell of zirconium dioxide ceramic.

It has three electrodes:

- O_2-sensitive platinum electrode
- CO/H_2-sensitive electrode of a platinum/precious metal alloy
- Platinum reference electrode

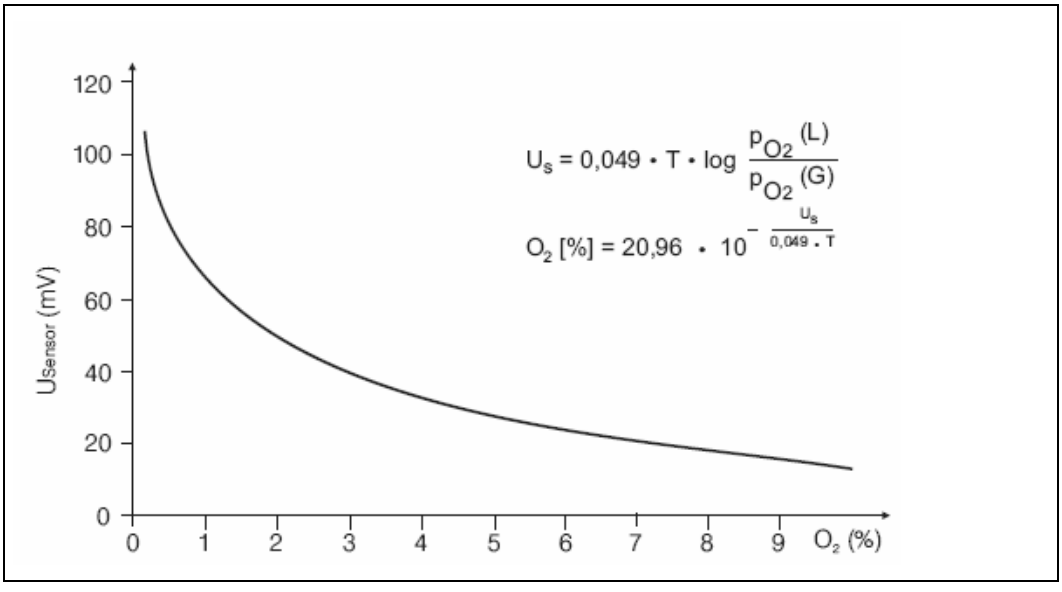
3.3 Probe method of functioning - O_2-sensitive electrode



Schematic diagram of the structure of the KS1-DK combination probe

The O_2 measuring cell functions as an electrochemical concentration cell and generates a direct voltage, which depends upon the absolute temperature T and the logarithm of the O_2 concentration ratio or O_2 partial pressure ratio on the reference electrode and O_2 outer electrode.

If specimen gas is fed to the outer electrode and a reference gas with a known O_2 concentration, such as air (20.96 %), to the inner electrode, at a constant temperature the logarithmic relationship illustrated below occurs between the probe voltage U and the oxygen concentration of the specimen gas.



Sensor characteristic U = f (O_2)

3.4 Probe method of functioning - CO/H_2-sensitive electrode

Flammable constituents are, like oxygen molecules, adsorbed on the electrode and diffuse to the “three-phase limit” formed by measuring gas, the electrode and zirconium dioxide. In addition to the Nernst voltage U_{O2} determined on the basis of the oxygen content, the flammable constituents in the measuring gas also generate an additional direct voltage $U_{CO/H2}$ through the sensor. The sensor voltage is the sum total of the two voltages $U_S = U_{O2} + U_{CO/H2}$ (Fig. 1). Even at low concentrations of oxidising gases, such as H_2 or CO, the mixed potential is considerably higher than the O_2 signal. The formation of the mixed potential takes place very rapidly, t_{60} times under 2s are achieved.

Sensitivity to O_2 and flammable constituents is influenced by the sensor temperature. A lower sensor temperature results in greater sensitivity to CO/H_2 and lower sensitivity to O_2 (Fig. 2).

Likewise, the oxygen concentration has an influence on the sensor voltage U_{COe}. As the O_2 content increases, the sensor voltage drops off slightly in the high CO range (Fig. 3).

However, the KS1-DK combination probe must never be operated when too cold, as otherwise the oxidising constituents will influence the O_2 measurement (falsification of measurement values produces lower values due to the oxidation of unburned flue gas constituents on the O_2 electrode).

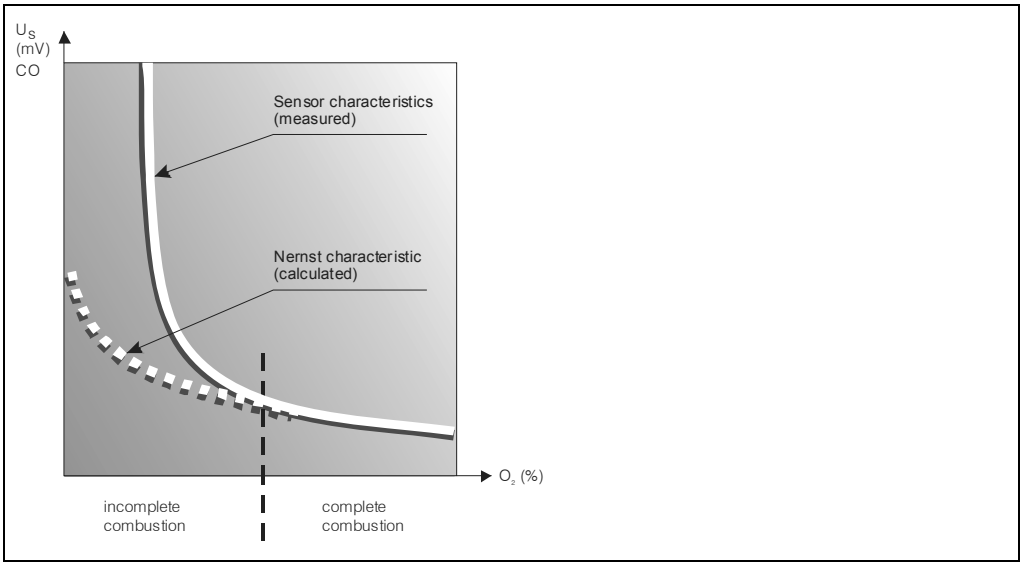


Fig. 1: Characteristic of a gas burner

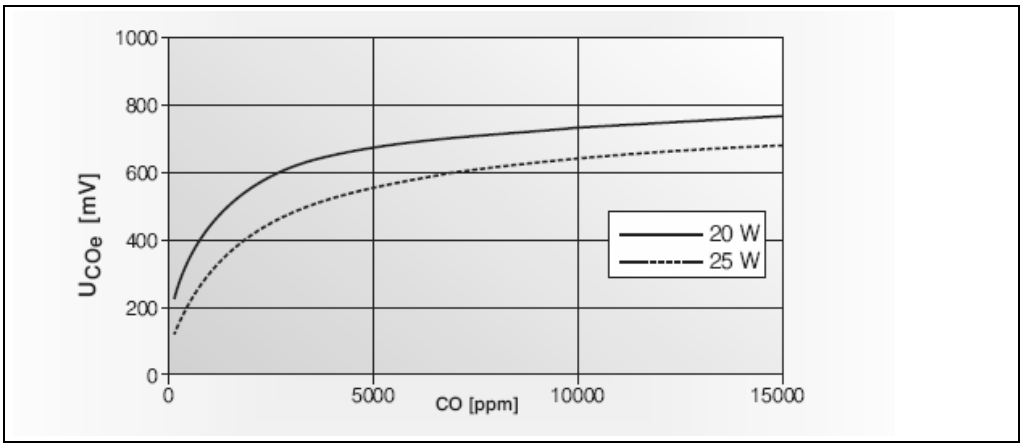


Fig. 2: Sensor voltage U_{COe} as a function of sensor temperature (heating power)

If concentrations of O_2 are higher, more unburned residues (CO/H_2) oxidise before the 3-phase limit is reached. The graph below shows the influence of the sensor voltage U_{COe} as a function of the O_2 content.

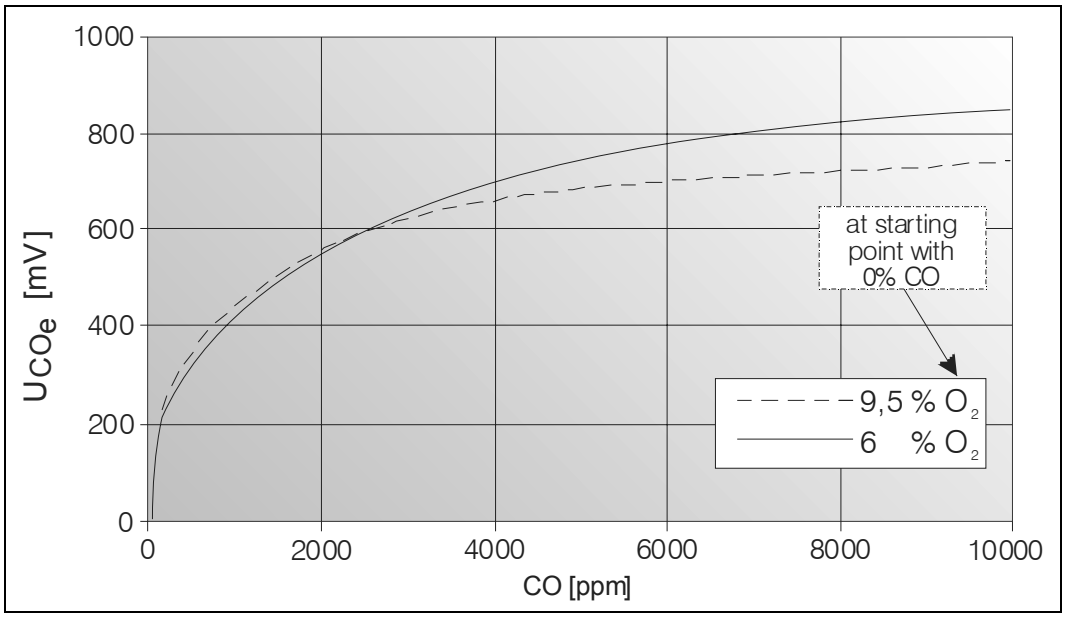


Fig. 3: Sensor voltage U_{COe} as a function of O_2 content

We therefore recommend calibrating the characteristic in line with the specific system by performing a CO reference measurement.

A further indicator for unburned residues (CO/H_2) in combustion systems is the dynamics of the sensor signal (Us). As the content of unburned residues increases, so do the dynamics. Figure 4 below plots the rise of the sensor signal versus the measured O_2 value in a reference system (12 MW gas combustion) at low load.

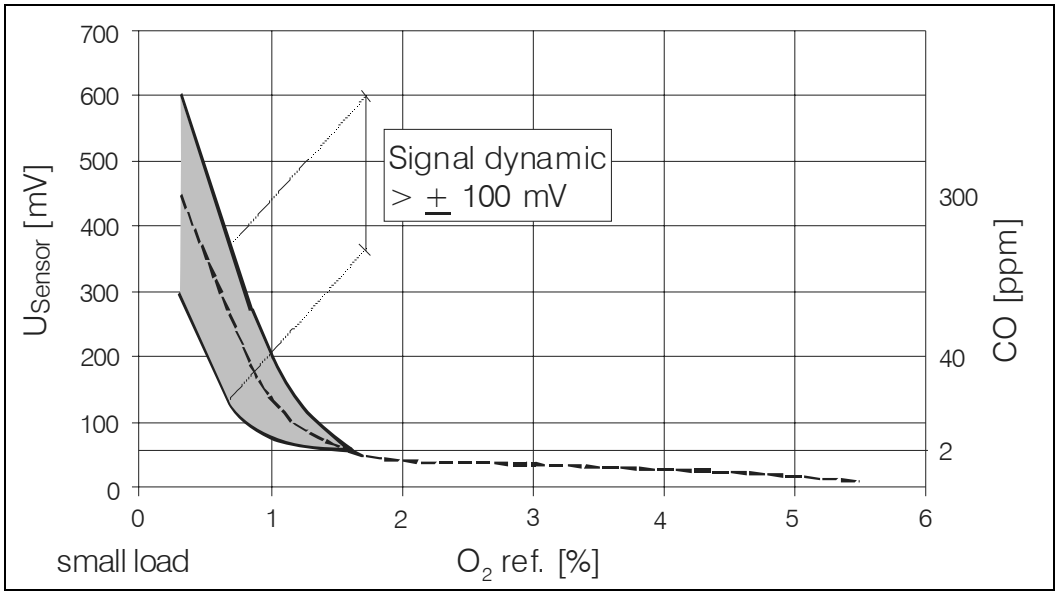


Fig. 4: Sensor voltage U_{COe} plotted versus the O_2 value of 12MW gas combustion

4 Technical Description

4.1 Advantages of the LAMTEC measurement principle

- Direct (in situ) measurement of oxygen (O_2) and oxidising exhaust gas constituents (CO/H_2) in crude gas up to 450°C

  O_2 measuring range: 0 to 21 vol.%
  CO_e measuring range: 0 to 10,000 ppm
  } in conjunction with LT 2/KS1-DK
- Uninfluenced by infiltrated air (CO_e)
- No treatment of the gas required,
  measurement directly in the damp flue gas
- Setting time to 60 % value (T90) <10 seconds with standard sampling
  CO_e < 2 seconds
- Measuring gas temperature up to 450°C
- Up to 1400°C possible with ejector pump
- Low heating power 20...25 watts
  depending on the exhaust gas temperature
- Universal
- Easy to use
- Low-maintenance

4.2 Necessary components

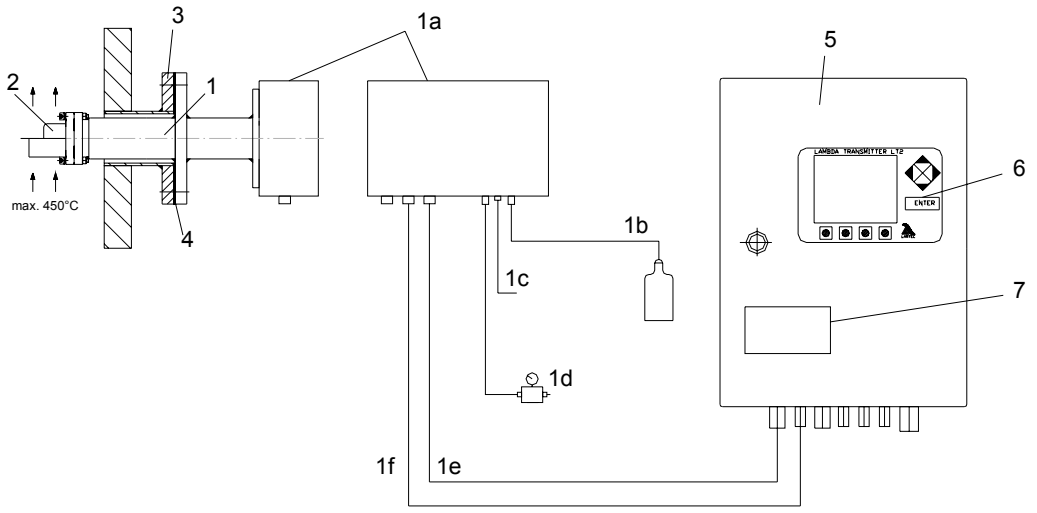
- KS1-DK combination probe
- Flange gasket
- Internal/external reference air pump or compressed air connection
- LT 2/KS1-DK lambda transmitter in IP65 wall-mounted housing
  incl. display and operating unit, or
- on IP00 mounting plate for installation in control cabinet, without display and operating unit

  (optional display and operating unit for installation in the control cabinet door, cable length 1m, Type 657R0831T) or

  Remote display software for Windows PCs Type 657R1101

4.3 Basic design of the LT 2/KS1-DK

Semi-automatic calibration system



Pos.		Pos.	
1	Combination probe KS1-DK with semi-automatic calibration system Type 656 R 2030 / R2031 / R2032	**2**	Pre filter Type 650 R 2055
1a	Probe connection box (PCB)	**3**	Counter flange DN65 Type 655 R 0137 / R 0138
1b	Hose connector „Test Gas” Instrument air for offset calibration or Test gas - pre pressure 0,3bar	**4**	Flange gasket Klinger Sil C-4400 Type 655 P 4209
1c	Outlet for reference air	**5**	Lambda Transmitter LT2-K / KS1-DK with semi-automatic calibration system Type 657 R 1028 / R 1032
1d	Hose connector „reference air” - Instrument air (pre pressure 0,3bar) or - Reference air pump ** - Air consumption 40...60l/h	**6**	Display and operation unit - built-in in LT2
1e	Cable glant M16 - Probe heating	**7**	Relay module 660R0017 for output of status of operation and limits - 6 relais with 1 change-over contakt - built-in in LT2 Type 657 R 0857
1f	Cable glant M20 - Absolut pressure sensor - Difference pressure sensor - Probe signals		

To use the semi-automatic calibration system, connect the compressed air (instrument air) for offset calibration and the test gas manually to the probe one after the other and set the required quantity.

** If no instrument air is available for the reference air, an optional pump unit is available.

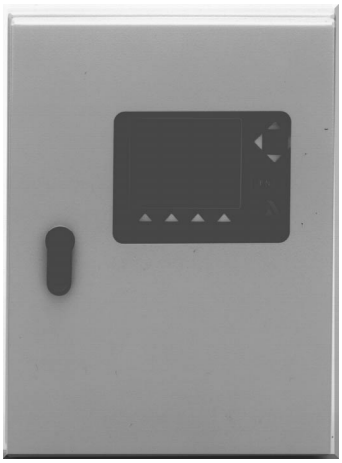
The pressure sensors are integrated in the probe connection box on the head of the probe. The differential pressure sensor monitors the reference air, the absolute pressure sensor monitors the rise in pressure in the preliminary filter during calibration.

Electrical und pneumatic connections see chapter 10.3 and 10.4.

4.4 LT 2/KS1-DK

4.4.1 In wall-mounted housing

The LT 2/KS1-DK lambda transmitter is the data interpreting device for the KS1-DK combination probe. It incorporates all the necessary components for the operation of the KS1-DK combination probe and the evaluation of the measurement signal. Furthermore, it features additional analogue inputs and outputs, digital inputs and outputs for process status signals, status signals and limit value signals, as well as serial interfaces and a universal bus interface (optional extra) for connection with the customer's control systems.



Without reference air pump:
Type 657 R 1028

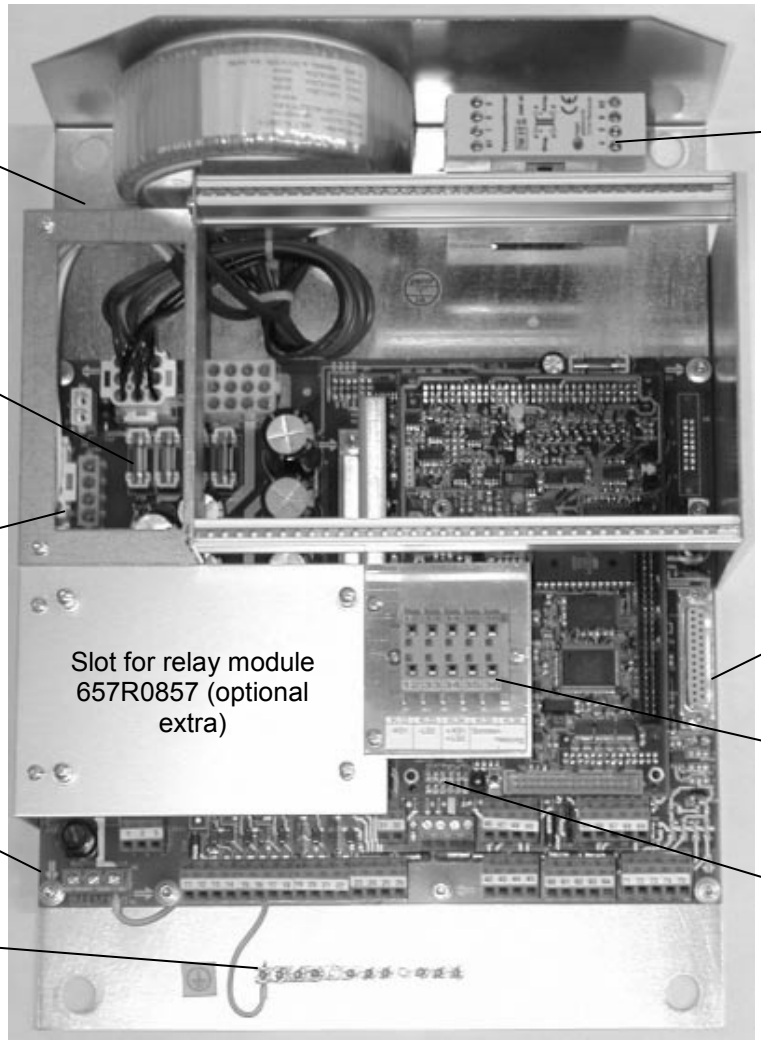
400 x 300 x 150 (HWD)

With reference air pump:
Type 657 R 1060

When the optional reference air pump is used, the size of the wall-mounted housing changes

500 x 300 x 200 (HWD)

4.4.2 On mounting pate Type 657 R 1032



4.4.3 Display and operating unit for panel installation

For use with the LT2-KS1D-K on mounting pate.

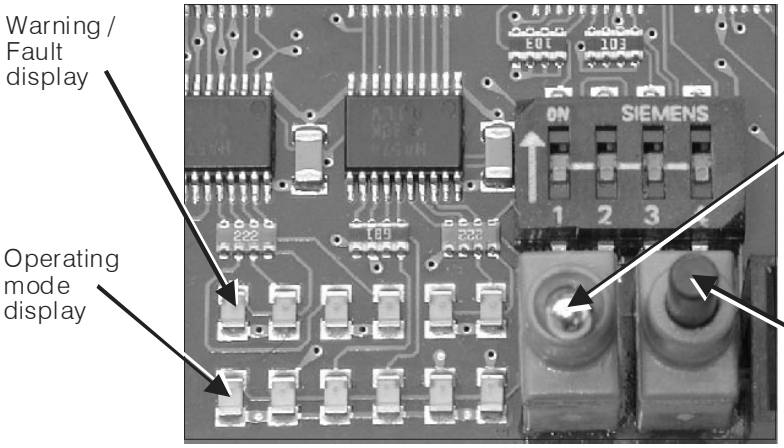
For installation in the control cabinet door.

Max. cable length 1m.

Type 657R0831T

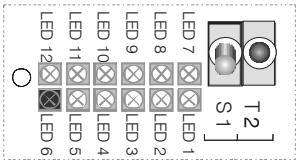
4.5 Internal display and control elements of the LT 2/KS1-DK lambda transmitter

The LT 2/KS1-DK is operated and the measurement values, process status and fault status signals are displayed via the display and operating unit (see section **4.6**), or via PC in conjunction with the remote display software. The LT 2/KS1-DK itself features only limited operator controls, which nevertheless permit the initiation or display of all functions necessary for operation, maintenance and service directly on the LT 2/KS1-DK as well.



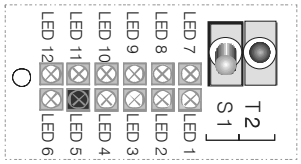
Display- and operating elements on processor card

5.1.3 Display and operating elements



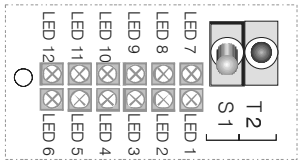
Operational display (green) LED 6

● - Operation (lights up)

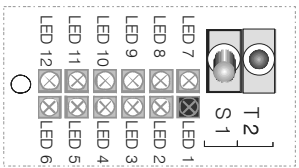


Operational status display (green) LED 5

● - Measurement (lights up)
⊗ - Calibration (flashes)
- Offset compensation (flashes slowly)
- With test gas / comparative measurement (flashes rapidly)

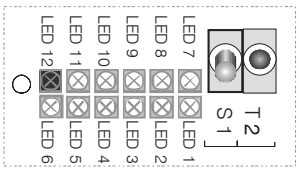


Maintenance switch S 1



Maintenance (orange) LED 1

● - Maintenance mode active (lights up)
⊗ - Normal operation (off)

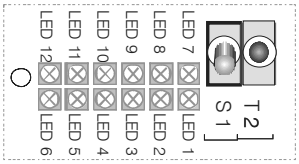


Warning/
fault display (red) LED 12

⊗ - No warning / fault
● - At least one warning present (lights up)
⊗ - At least one fault present (flashes)

- Maintenance mode off

- Maintenance mode on



4.5.1 Multifunction push button T1

NOTE:

Function	Button assignment
Change the displayed warning/fault	Press briefly
Reset the displayed warning/fault	Press for more than 3s *
Quick start measuring gas pump, abort cold start	Press for more than 3s **
Initiate offset calibration or test gas calibration	Press button for more than 3s ** in measurement mode

* Some warnings and faults cannot be reset as long as the fault is still present or the routine is still in progress.

** If at least one warning or fault is present, the button must be pressed for more than 6 seconds.

4.5.2 Monitor output

The monitor output [terminal 31 (-), 32 (+)] allows a multimeter to be connected, for example. Via the monitor output, the following measurement values can be obtained in situ on the LT 2/KS1-DK:

- O_2 measurement value
- Probe voltage [U-O2] of O_2 sensor
- AC internal resistance [R_i probe] of O_2 sensor

Processor board micro-switches

SW 1	SW 2	Function of monitor output		
off	off	O_2 measurement value	0...2.5 V ≡ 0…25 vol.% O_2	
on	off	Probe voltage (U-O2) of O_2 sensor	0...2.5 V ≡ 0…250 mV	
off	on	Cell internal resistance (Ri probe) of O_2 sensor	0...2.5 V ≡ 0…250 Ω	

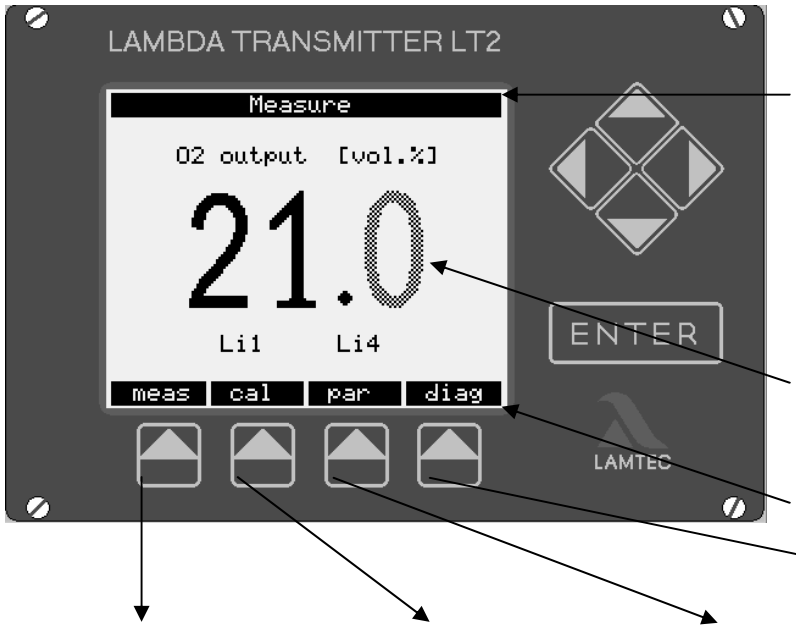
Input resistance of connected measuring device > 10 kΩ

4.6 Display and operating unit

The display and operating unit of the LT 2/KS1-DK consists of an LCD, the cursor keys, the Enter key and the menu keys.

- The cursor keys enable you to select measurement values, parameters or functions in the viewing window of the display. These keys also allow you to position the cursor to input and edit (Change) data.
- The Enter key activates, confirms and exits Edit mode

The menu keys are assigned to the menu items shown above them in the display.

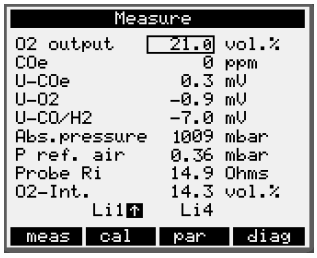


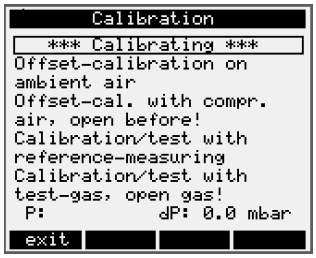
The screen is divided into three sections:

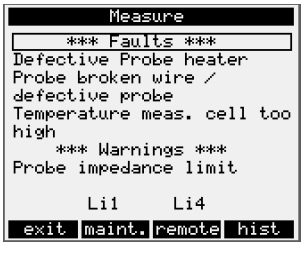
1. The status bar at the upper edge of the screen. This shows:
Whether Maintenance mode is active (left).
The current operating state (centre).
Whether any warnings or faults are present (right).
The status bar also flashes to indicate faults.

2. The measurement value is shown in the middle of the screen.

3. The menu bar, in which entries are made using the menu key below.







The menu keys feature functions for the LT 2/KS1-DK in abbreviated English:

measurement, **cal**ibration

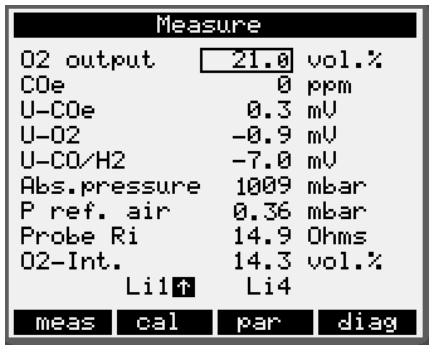
Parameter setup, **dia**gnosis

NOTE:

The limit values are only displayed if they have been activated via the parameters 930/940/950/960 (“Service” access level) (see section **4.12.8**)

4.6.1 Menu function meas

When the [meas] key is pressed, the screen switches to a large display of the measurement value, which is selected using the cursor keys (up, down). By pressing the [meas] key several times, you can return to the display of all measurement values.



4.6.2 Menu function cal

When the [cal] menu key is pressed, “Start calibration” appears in the display. When calibration has been activated, a choice of four calibration functions is available:

- **Offset calibration on ambient air**
- **Offset calibration with compressed air, open before**
- **Calibration with reference measuring**
- **O_2 calibration with test gas, open gas**
- **CO calibration with test gas, open gas**

You can select the required calibration function using the cursor keys (up, down). Pressing the ENTER key confirms the selected calibration function and initiates this calibration process.

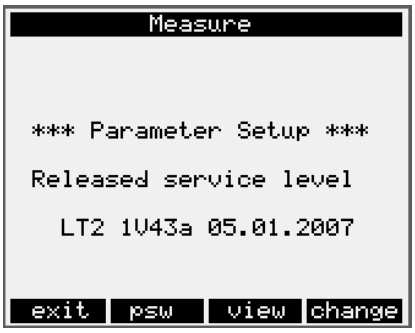
You can interrupt the calibration modes using the menu function:
“Abort calibration, return to measurement mode”.

An O_2 default value is displayed during the calibration process. It only makes sense to measure or display the O_2 value in the measuring operating state, that is, when calibration is over.

See also chapter 6.5.

4.6.3 Menu function par

Opening the [par] menu opens the menu for the parameters.



The Parameter menu is available to the following access levels:

- Operation level
- Customer level
- Service level
- Factory level

} (only accessible via password)

NOTE:
The password for Customer level can be assigned individually by the customer.

The screen displays the current access level. The menu bar contains a choice of menu functions:

- **[exit]** returns to Start menu
- **[psw]** changes the access level to enable password entry
- **[view]**shows the parameter settings. All parameters are displayed, irrespective of the access level.
- **[change]** allows you to change parameters, but here only the parameters available to this access level are displayed.

NOTE:
Over 3000 parameters can be changed in the various access levels. To avoid confusion, we therefore recommend that you use the [change] function.

4.6.4 Menu function psw

[psw] opens the sub-menu for password entry, and the Operation* access level is displayed. The functions shown in the menu bar are as follows:

- **[exit]** returns to the [par] menu
- **[clear]** resets the access level to Operation level*
- **[----]** moves to the previous password input letter of the alphabet**.**
- **[++++]** moves to the next password input letter of the alphabet.

The cursor keys (up, down) have the same function as **[++++]** and **[----]**. Use right and left to move the input sign along the password. If the correct password is entered, the appropriate access level is displayed and is maintained when the menu is exited with [exit]. If no keys are pressed for a longer period, the access level resets itself to Operation level.*

* If the password for Customer level is still at the factory setting, the systems goes to Customer level instead.

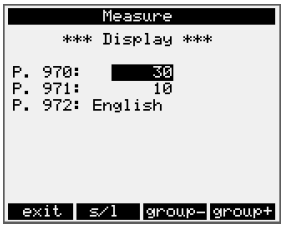
4.6.5 Menu function view

[view] opens the Parameter menu. The functions of the menu bar are as follows:

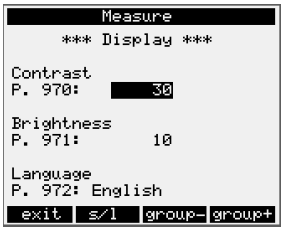
[exit] returns to the [par] menu function.

[s/l] changes the display format:

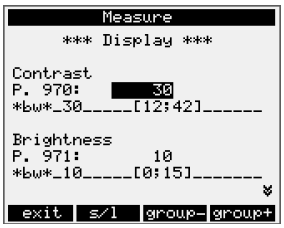
Short: Only the number of the parameter and the current value are displayed.



Medium: A brief description is displayed in addition to the parameter number and the current value.



Long: In addition to the Medium display, a status bar for the parameters is shown.



[group -] pages back by one parameter group.

[group+] pages forwards by one parameter group.

All the available parameter groups are set out in the appendix. The cursor keys (left, right) correspond to the key function: **[group-]** or **[group+]**

If not all parameters of a group are displayed in the viewing window, this situation is indicated by flashing arrows in the right-hand margin. You can move and view the parameters using the cursor keys (up, down).

Here is an example of the status bar shown with the Long display:

- *kw*_30_[12 ,42]_____
  The asterisks ' * ' or '__' are fill characters.
- **"k"** indicates Customer access level (o = Operation, c = Customer, s = Service, f = Factory)
- **"w"** shows the type of parameter (write = can be edited, read = read only)
- **"30"** is the 'default' value (basic value in EPROM)
- **"[12 ; 42]"** is the possible range within which the parameters can be changed

With some parameters, no 'default' value or interval is shown!

4.6.6 Menu function change

[change] allows you to change parameter values. The sub-menu in the menu bar is the same as the **[view]** menu.

But unlike this, the parameter to be changed is shown inverted (pale font on dark background). Select the parameter using the cursor keys (up, down). Then press [ENTER] to activate Edit (Change) mode. The parameter value flashes while it is being edited.

A selected parameter is displayed in three ways:

Inverse display → Parameter can be changed

Bordered display → Parameter cannot be changed

Blinking display → Edit (Change) mode is active

You can now change the parameter value using the cursor keys (up, down, and left and right for values with several characters). The functions in the menu bar are as follows:

- **[esc]** returns to the **[change]** menu without confirming the changed parameter.
- **[dflt]** resets the 'default' (factory-set) value.
- **[OK]** confirms the changed value and returns to the **[change]** or **[ENTER]** menu.

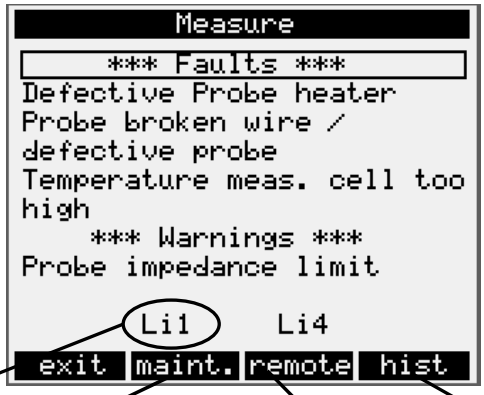
This takes you back to the **[change]** menu. You can then open and change other parameters.

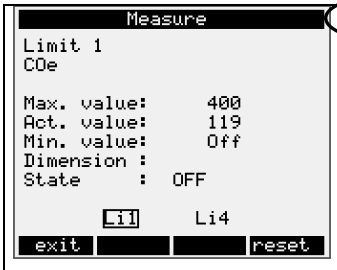
4.6.7 Menu function diag

The **[diag]** key switches the screen to the display of warnings and faults. You can select individual warnings, faults or limit values using the cursor keys (up, down).

NOTE:
Limit values are only displayed if they have been activated via the parameters 930/940/950/960 (Service level).

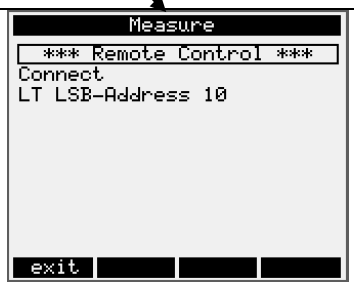
The selected warning or fault, which is displayed inverted, can now be acknowledged or reset with ENTER.



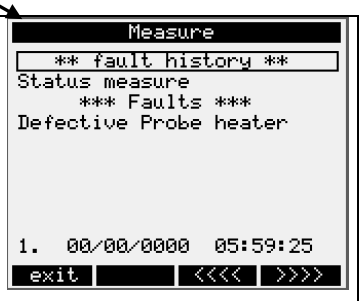


When you select a limit value with the cursor and then press Enter, the display switches to the Limit Value menu.

If you select “maint.”, the LT 2/KS1-DK can be switched to Maintenance mode, as an alternative to using the maintenance switch on the processor board.



If you select “remote”, remote display is possible via LSB with a 2nd LT. To achieve this, the master LT must have the LSB address 10, the slave LT the LSB address 9 (param. 3801).



If you select “hist”, a fault and warning history is displayed. Setting, date and time param. 70...72.

NOTE:
Not all warnings and faults can be reset by acknowledging them - the cause of the warning or fault may have to be corrected first.

4.6.8 Display parameters 970 / 971 / 972

The ***Display*** parameter group is responsible for the display and operating unit for the LT 2/KS1-DK, with the following parameters:

- P. 970 Contrast

This parameter allows you to adjust the contrast of the display.

- P. 971 Brightness

This parameter regulates the brightness of the display's background illumination.

- P. 972 Language

With this parameter, you can set the language (English, German) of the displayed texts.

4.6.9 Brightness and contrast

Alternatively, the brightness and contrast can be altered using the Display parameters (see 3.1) or cursor keys as follows:

Contrast + → Keys 1 & 2

Contrast - → Keys 3 & 4

Brightness + → Keys 1 & 4

Brightness - → Keys 2 & 3

Press the above keys simultaneously.

4.6.10 Entering the customer password

The password for Customer level can be assigned individually by the customer. To enter a new password, the Customer access level or higher must be activated.
The new password must be entered in parameter 1472, (see figure below).

CAUTION!
A few seconds after the password is entered, it is accepted by the device and "####" is displayed. Thus, once a password has been entered, it can never be read out again.

NOTE:
The factory-set password is "0000". Since this is the default setting for password entry, you can activate Customer level by changing briefly to password entry and then exiting again without making any changes.

4.7 Analogue output

Analogue output 1 - terminal 42 (-), 43 (+)
Output of O_2 value 0...10% → 4...20mA, or alternatively 0/2...10V

Analogue output 2 - terminal 44 (-), 45 (+)
Output of COe value 0...1000ppm → 4...20mA, or alternatively 0/2...10V

Optional modules 3 and 4

Parameters 530 / 540 / 550 / 560 → Setting the function:

- OFF /diagnosis
- O_2 measurement value
- Configured measurement value 1...6
- Ri probe
- O2 probe voltage (U-O2)
- COe
- U-COe

Parameters 531 / 541 / 551 / 561 → Setting the output value:

- 4...20mA / error 20mA
- 4...20mA / error 0mA
- 4...20mA
- 0...20mA / 0...10V
- 4…20mA / maintenance 0mA

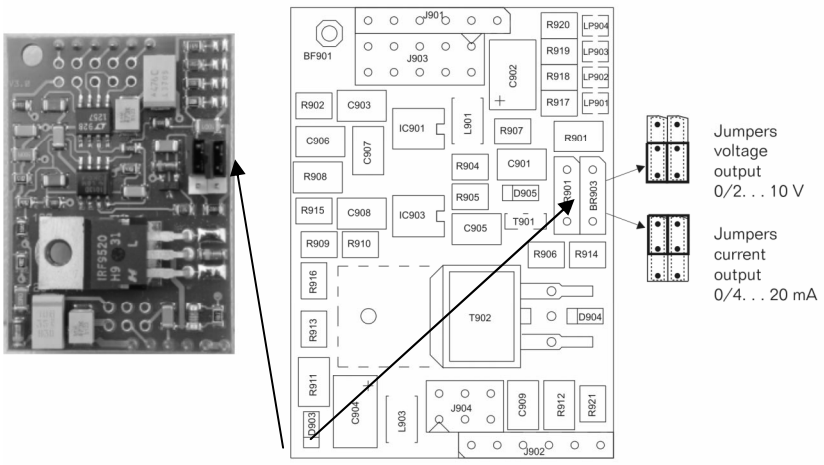
Parameters 532 / 542 / 552 / 562 → Lower range limit

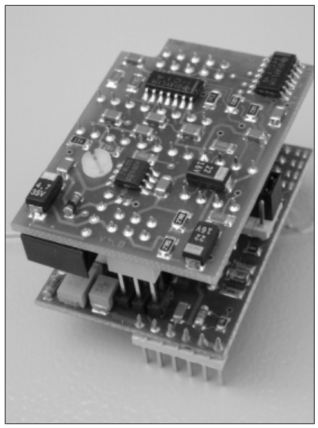
Parameters 533 / 543 / 553 / 563 → Upper range limit

Can be retrofitted at any time by means of plug-in cards on the LT 2/KS1-DK processor board (max. 4)

Type 6 57 R 0050 non-floating

Type 6 57 R 0051 floating, maximum possible potential difference ± 20 V (only possible with outputs 1 and 2)





Floating output card 657R0051

The jumpers only switch between the current and voltage outputs in terms of hardware.
The choice between 0 or 4...20mA is made using the parameters 531/541/551/561.

4.8 Digital inputs

Eight digital inputs can be configured for the LT 2/KS1-DK lambda transmitter. Depending on the supplied voltage, the digital inputs take on the setting High (supplied voltage 24 V) or Low (input open or supplied voltage 0 V).

Parameter groups 1170...1245

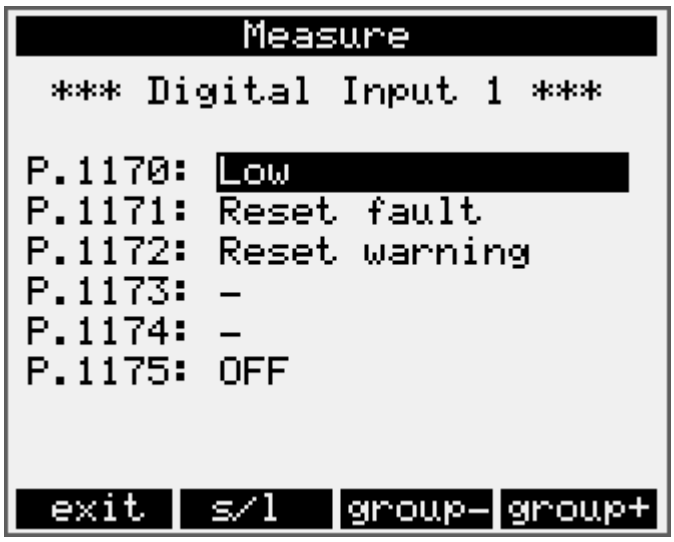
Depending on this setting, the LT 2/KS1-DK lambda transmitter can execute certain functions. All eight digital inputs are identical in terms of structure and functionality. The digital inputs are configured by means of the parameters listed below.

Factory-set assignment of digital inputs

- Input 1 → Reset fault/warning
- Input 2 → Reset limit value signal (also see 5.4)
- Input 3 → Offset calibration
- Input 4 → PID controller Off
- Input 5 → Maintenance On/Off (ab1v33a)
- Input 6 → (1) Fuel 2 (gas)
- Input 7 → (1) Fuel 3
- Input 8 → (1) Fuel 4

(1) Parameter 836 – Service level – must be set to “Digital inputs”.

Without preset signal → Fuel oil EL



4.8.1 Parameters of digital inputs

Idle state

Parameters:
1170/1180/1190/1200/
1210/1220/1230/1240

Here you can set the idle state of the digital input. If the state differs from the one set here, the actions predefined for the functions (A, B, C, D) are executed. If Diagnostic mode is set here, the functions (A, B, C, D) can be initiated for the corresponding digital input by means of the State parameter.

- LOW (normal open contacts)
- HIGH (idle)
- Diagnostic mode

Functions A,B,C,D

Parameters:
1171….1244

The four functions are very similar in structure, but the assignment of the limit values LV 1 - 4 or fuels to the individual functions

(A, B, C, D) is limited. Reset limit value 1 and Fuel 1 are only possible with function A; Reset limit value 2 and Test gas 2 only with function B, etc.

The following actions are possible:

- None
- Offset calibration — Initiates offset calibration.
- Fault reset — Acknowledges present faults.
- Warning reset — Acknowledges present warnings.
- Reset LV 1 — (Function A) resets limit value 1, functions B, C and D reset the limit values 2, 3 and 4 respectively. Therefore, the corresponding LVs must be set to Acknowledge” in Reset mode
- Fuel 1 — (Function A only) selects fuel 1, functions B, C and D select fuels 2, 3 and 4 respectively.
- Probe 1 — (Function A) selects probe 1, functions B, C and D select probes 2, 3 and 4
- No cal. — Calibration disabled
- PID controller On/Off — If the PID controller option is enabled, here you can switch off the PID controller.
- Maintenance — Switches the device to “Maintenance”
- Deactivate — Limit value x (also see section 4.13)

State

Parameters:
1175/1185/1195/1205/
1215/1225/1235/1245

This parameter indicates the state of the digital input. The three possible states are inactive (idle state) and active; the set functions (A, B, C, D) are initiated. The state of the digital input can be set manually with this parameter, provided that the idle level parameter is set to **Diagnostic mode**.

4.9 LAMTEC SYSTEM BUS

NOTE:

Data transmission in the LT 2 via the LAMTEC SYSTEM BUS only functions if the device is set to “MEASUREMENT” and is not in “MAINTENANCE MODE” or “FAULT”.

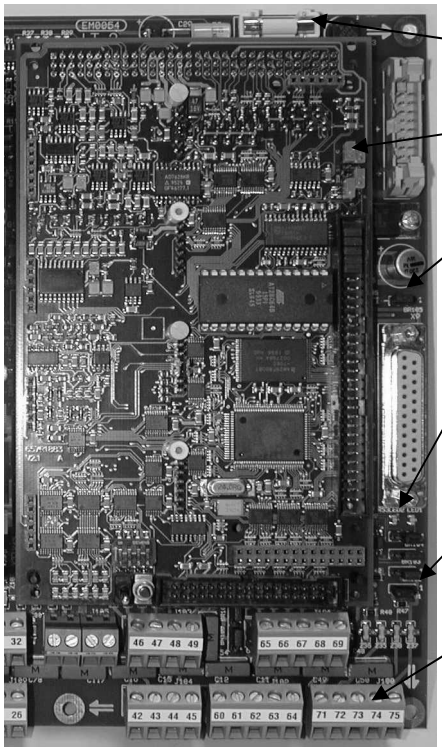
When communication is taking place correctly, the two LEDs 1 and 2 flash.

For connecting the field bus module, please see section **10.4**

4.9.1 Parameter setting (from software version 1V14)

- P3800 – **Value 1** (default)
  LAMTEC SYSTEM BUS – Version 1
- P3801 - Devices ID9 (default)
  If there is more than one LT in a family, they must have different IDs. These are set from ID9...ID16.
- P3802 – **Device family** 1 (default)
  All devices that exchange values with one another must be set to the same family.
- P3803 – **O2 OUTPUT VALUE** (default)
  The LT transmits its O2 value for all devices of the same family.
  NO: The LT does not transmit an O2 value for devices of the family.
- P3804 - Transmit CO value for family
  NO (default): The LT does not transmit a CO value for devices of the family.
  CO MEASUREMENT VALUE: The LT transmits its CO measurement value for all devices of the same family.

4.9.2 Jumpers, LEDs, fuses and terminals



F6 – T315mA → DC5V-LSB

BR12, BR13 → setting “C”

BR105 → setting 2-3 (clockwise)

LED1 – green → RxD of LSB
LED2 – yellow → TxD of LSB

BR101 → setting 1-2 (clockwise)
Without LSB termination resistor
BR101 → setting 2-3 (anti-clockwise)
With LSB-termination resistor

Term.71 → CAN-GND
Term.74 → CAN-H
Term.75 → CAN-L

4.10 RS 232 interface

Device address 1

9600 bauds

Parity none

4.11 Cold start delay

This function is used to suppress false measurement values while the probe is warming up. A cold start delay is always activated after “Power off” and probe replacement. The cold start delay can be interrupted at any time:

- using the multi-function starter
- using the display and operating unit
- using remote display software, see separate publication

During the cold start delay or a fault:

- a default value (factory setting)
  $O_2 \rightarrow$ 0 vol. % (P361), COe → 0 ppm (P371) can be output.
- In P362 for O_2,
  in P372 for CO_e
  the “Type of default value” can be set:

OFF: No default value is output.

ON: The default value set in the parameter in front is output.

+Maintenance (factory setting): The default value set in the parameter in front is output during “MAINTENANCE” as well.

+Maint.froz.: With this setting, the default value set in the parameter in front is output during cold start and fault, as before, but in addition the previous measurement value is frozen as long as Maintenance mode is active.

During cold start/fault, the default value has priority over the freezing of the measurement value during maintenance.

After a heating phase of 10 minutes, the probe voltage U-O2 stabilises to values between -20 mV…+20mV and the internal cell resistance Ri settles at values below 100 Ω.

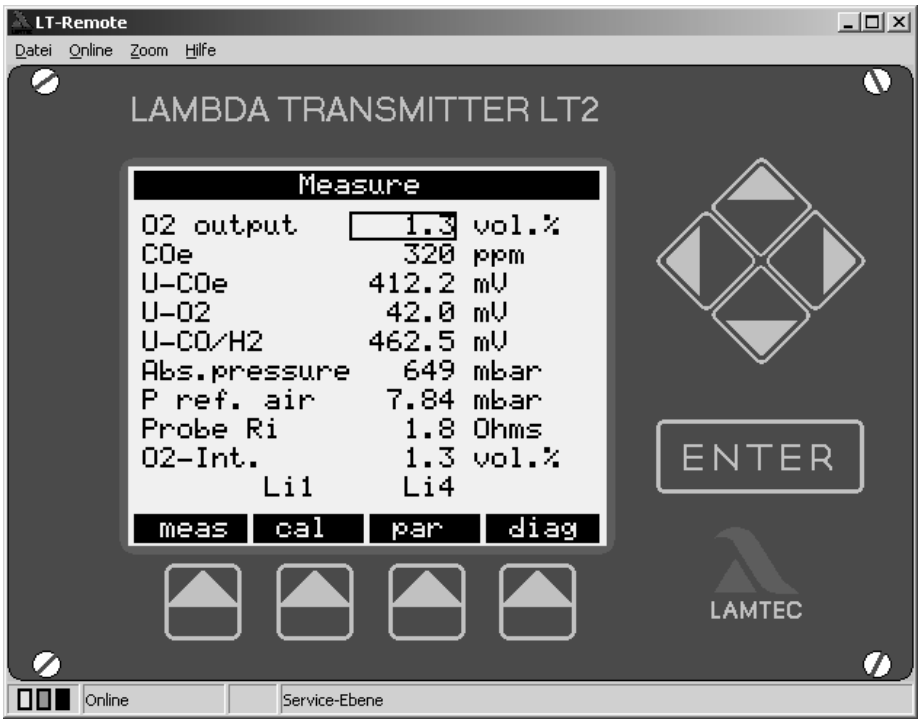
4.12 Optional extras

- Remote display software
- Measurement of flue gas and intake air temperature, and calculation of the efficiency of combustion
- Calculation and display of the concentration of CO2, calculated for the specific fuel on the basis of the measured O2 value and the max. CO2 value
- Load-dependent and fuel-specific limit values/limit curves
- Integrated PID/O2 controller
- (Outputs 1 and 2) max. potential difference 20 V configurable as desired
  Direct current 0/4...20 mA, burden 0...600Ω
- Digital outputs in conjunction with relay module 657R0857
- Field bus connection
- Heating for wall mounting case

4.12.1 Remote display software

PC software for configuring the LT 2/KS1-DK as an alternative to the display and operating unit, and for saving and restoring the data record.

- Remote display software incl. interface module RS 232 for PC
  Type 6 57 R 1101
- Further licences for remote display software
  Type 6 57 R 1102



For Windows PCs. Connection to the LT 2/KS1-DK via RS 232 interface.

See separate manual DLT1004.

4.12.2 Measurement of flue gas and intake air temperature and calculation of the efficiency of combustion Type 6 57 R 0895K

NOTE:
Since three of the four analogue inputs are assigned in the LT 2 / KS1 DK, the differential pressure sensor, which monitors the reference air, is removed and replaced with a flow meter with limit value signal. This signal is fed to a digital input and monitored as the warning “No reference air”.
This frees up an analogue input for the intake air temperature.
See overleaf for electrical connection diagrams.
If the intake air temperature can be set as default beforehand, the above measure is superfluous.

The calculation is based on the formula:

$n_F = 100 (q_{Af} + q_{Ag}) \%$

q_{Af} = loss of exhaust gas due to free heat

q_{Ag} = loss of exhaust gas due to latent heat

$q_{Af} = (t_A - t_L) * [A_2 / 21 – O_2 + B]$

The calculation of exhaust gas losses is based on the following mean fuel values:

Oil $A_2 = 0.68$ $B = 0.007$

Gas $A_2 = 0.66$ $B = 0.009$

It is assumed that the combustion of CO and black smoke takes place freely. The exhaust gas losses due to latent heat Ag are ignored.

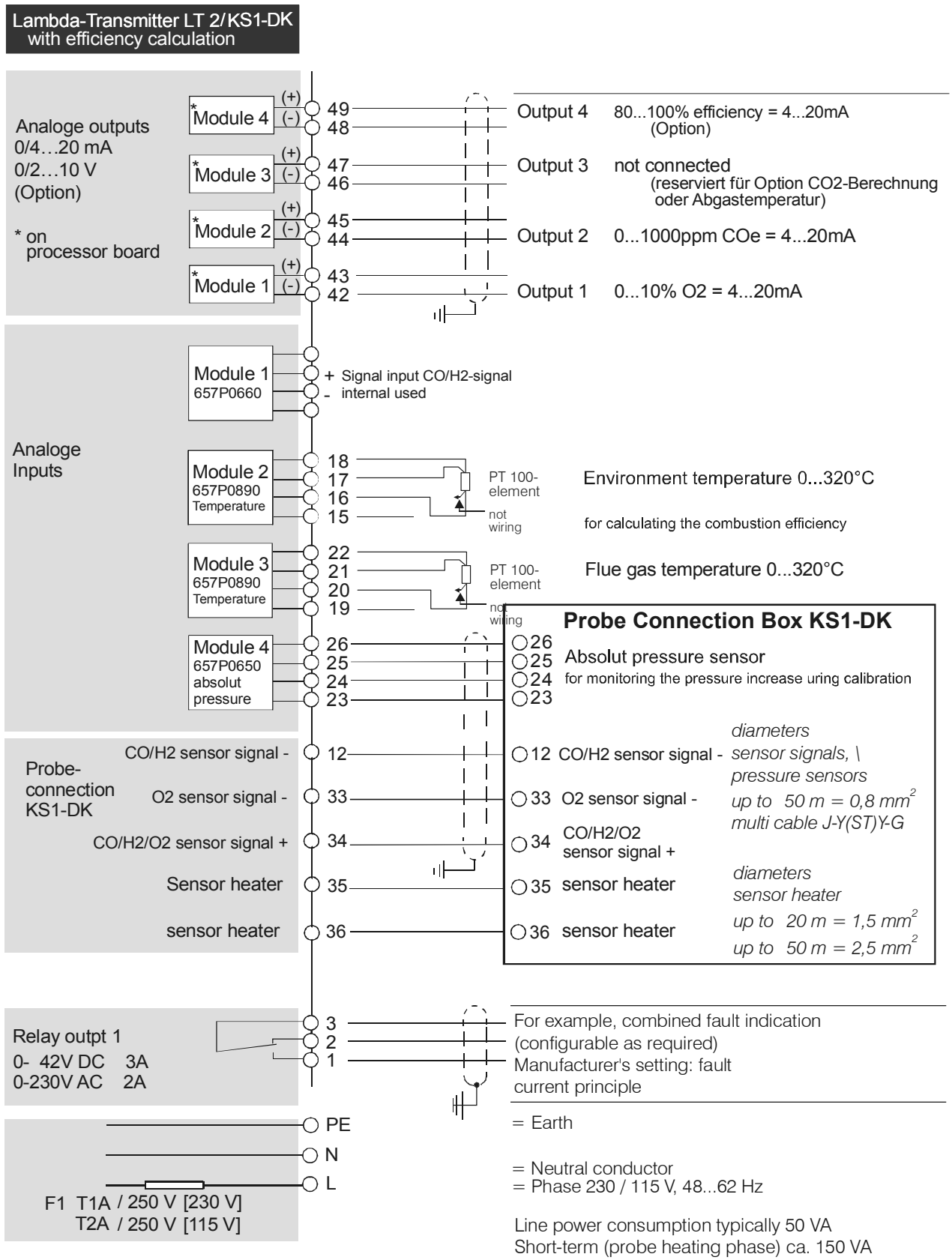
Display:

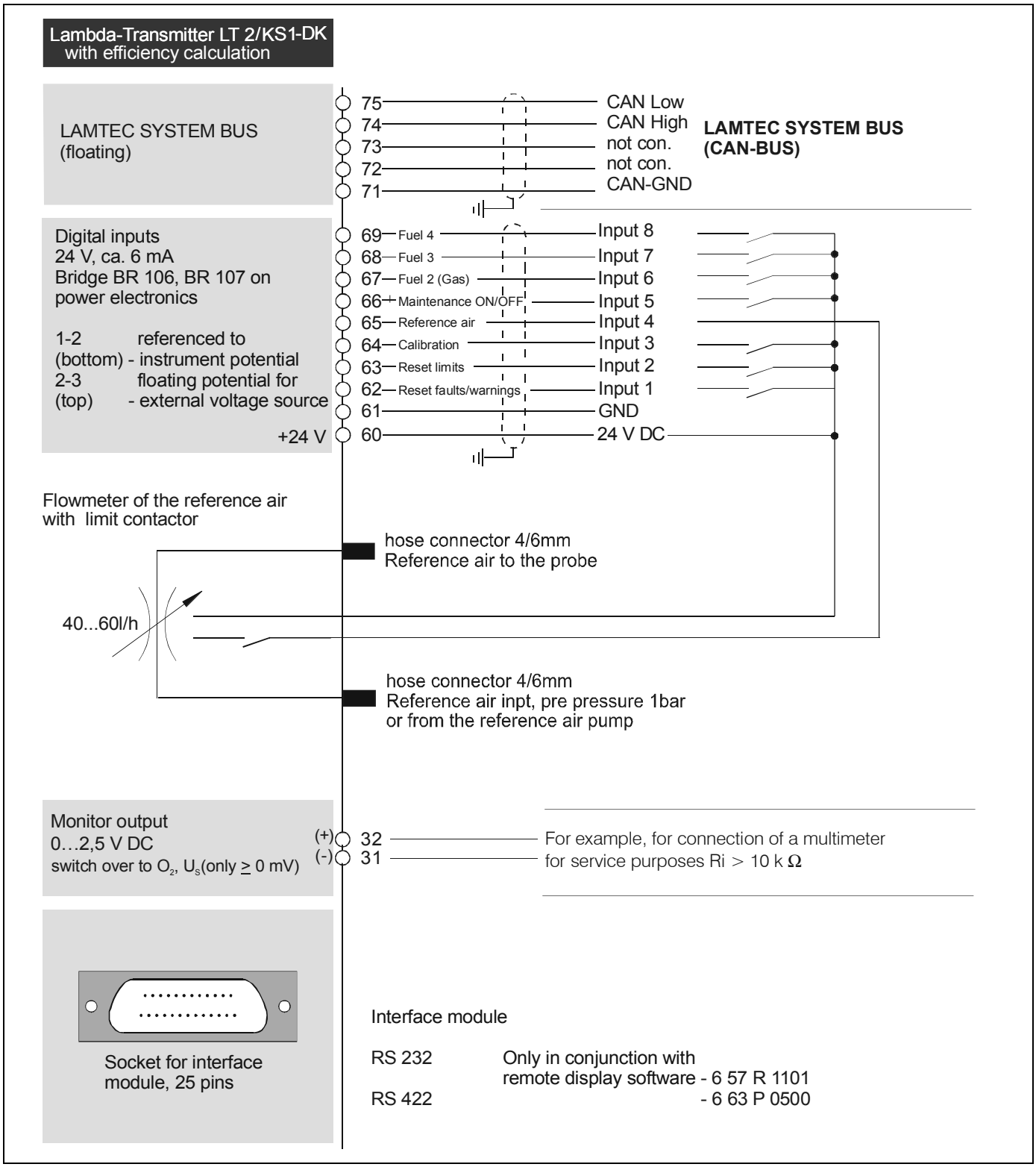
Efficiency	0...100%
Exhaust gas losses	0...100%
Exhaust gas temperature	0...320°C (measuring card at analogue input 3)
Intake air temperature	0...320°C (measuring card at analogue input 2)
Other ranges on request	
Measurement accuracy:	Temperature better than 2K
	Efficiency/exhaust gas losses better than 0.2 %

In the 6 57 R 0896 version, the intake air is fixed as default. The intake air temperature is therefore not measured. This is only recommended if the intake air temperature remains virtually constant the entire year round. The average intake air temperature can be defined in parameter 1450.

For electrical connections, see the following two pages.

Electrical connection of the LT2/KS1-DK with efficiency calculation




Lambda-Transmitter LT 2/KS1-DK
with efficiency calculation
LAMTEC SYSTEM BUS
(floating)
75 CAN Low
74 CAN High
73 not con.
72 not con.
71 CAN-GND
LAMTEC SYSTEM BUS
(CAN-BUS)
Digital inputs
24 V, ca. 6 mA
Bridge BR 106, BR 107 on
power electronics
1-2 referenced to
(bottom) - instrument potential
2-3 floating potential for
(top) - external voltage source
+24 V
69 Fuel 4 Input 8
68 Fuel 3 Input 7
67 Fuel 2 (Gas) Input 6
66 Maintenance ON/OFF Input 5
65 Reference air Input 4
64 Calibration Input 3
63 Reset limits Input 2
62 Reset faults/warnings Input 1
61 GND
60 24 V DC
Flowmeter of the reference air
with limit contactor
40...60l/h
hose connector 4/6mm
Reference air to the probe
hose connector 4/6mm
Reference air inpt, pre pressure 1bar
or from the reference air pump
Monitor output
0…2,5 V DC
switch over to O2, Us(only ≥ 0 mV)
(+) 32
(-) 31
For example, for connection of a multimeter
for service purposes Ri > 10 k Ω
Socket for interface
module, 25 pins
Interface module
RS 232 Only in conjunction with
remote display software - 6 57 R 1101
RS 422 - 6 63 P 0500

4.12.3 Calculation of the concentration of CO_2, calculated for the specific fuel on the basis of the measured O_2 value and the max. CO_2 value Type 6 57 R 0910

The calculation takes place according to the following formula:

$CO_2 = CO_2max – (21\ \% - O_2 / 21\%)$

The calculation is based on the following maximum CO_2 contents at $\lambda = 1 = O_2 = 0$ vol. % with **dry** exhaust gas

Fuel oil EL	15.4 vol. %
Natural gas H	12.0 vol. %
Fuel oil S	15.9 vol. %
Natural gas L	11.7 vol. %

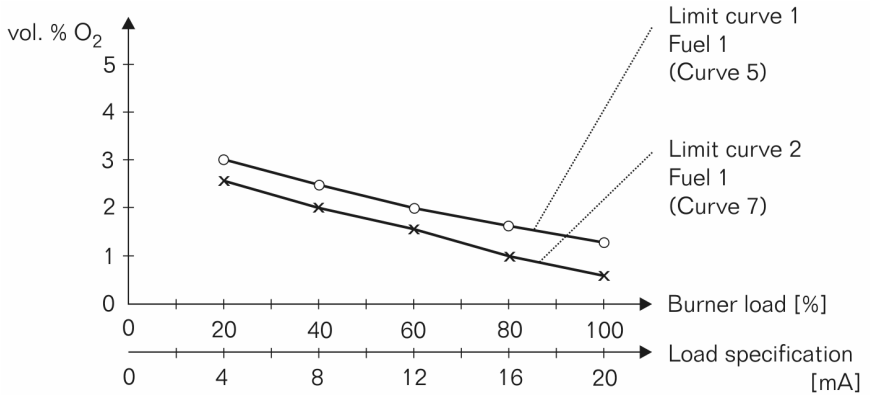
CO_2max can be preset individually via the parameters 846, 862, 878 and 894.

Output via analogue output 3:

0...20% CO2 = 4...20mA

4.12.4 Load-dependent, fuel-specific limit curves (optional extra) Type 6 57 R 0920

The load rating (burner load) or another measured variable is activated via analogue input 4 or the LAMTEC SYSTEM BUS. Instead of fixed limit values, fuel-specific curves with two to maximum 18 interpolation points can be entered.



Limit curves (factory setting) parameterised to undershoot, or alternatively

two fuels with four limit curves each/two limit values per fuel

4.12.5 Integrated PID/O_2 controller Type 6 57R1120

See separate manual DLT4002.

4.12.6 Output of internal load via analogue output (only in conjunction with ETAMATIC/FMS/VMS) Type 6 57 R 1124

Forwarding of internal load via current input or LAMTEC SYSTEM BUS.

0...1000digits load → 0/4...20mA

4.12.7 Digital outputs

Digital output 1 (standard):

Included as standard in LT 2/KS1-DK basic electronics via internal relay (1 change-over contact) (terminals 1, 2 and 3, also see 10.3).

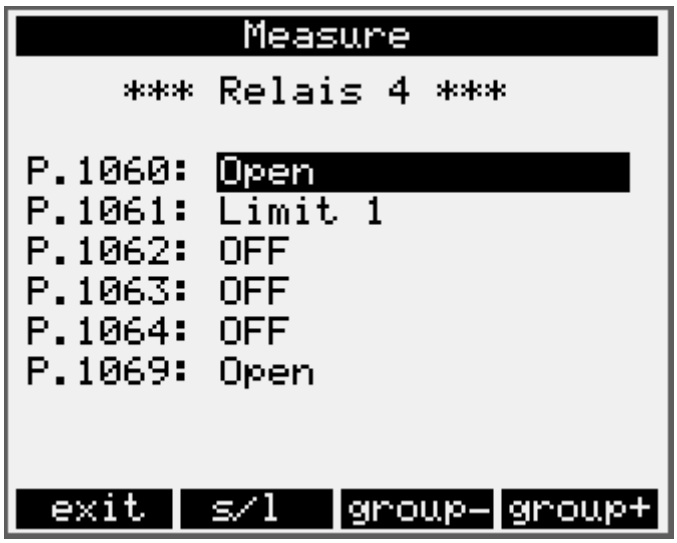
Switching capacity 230VAC / 2A and 42VDC / 3A

Digital outputs 2 to 7 (optional extra):

Via internal relay module Type 657 R 0857 (6 relays - 1 changeover switch)

Switching capacity 230VAC / 4A and 48VDC / 3A

Digital outputs can be configured as desired using the display and operating unit and remote display software. Parameter groups 1030 to 1099.



Factory setting:

- Relay output 1: Collective fault quiescent current method
- Relay output 2: Warning and maintenance
- Relay output 3: Measurement
- Relay output 4: Limit value 1
- Relay output 5: Limit value 2
- Relay output 6: Limit value 3
- Relay output 7: Limit value 4

Parameters of digital inputs

Idle state

Here, the idle state is set. This state is present when none of the functions triggers a switching operation. The Diagnostic mode setting allows the idle state to be changed via the State parameter (see below).

Parameters: 1030/1040/.../1090

- LOW (normal open contacts)
- HIGH (idle state)
- Diagnostic mode

Functions A,B,C,D

Parameters: 1031 to 1034
1041 to 1044
…..
1091 to 1094

The four functions have virtually the same structure, and an operating state can act as a switching criterion. If a limit value (LV 1-4) is selected as a switching criterion, the output switches when the limit value output is enabled. If, for example, maintenance is chosen as the switching criterion, the output is not in the idle state during maintenance.

Each function (A, B, C, D) may have all operating states as the switching criterion, but the assignment of the limit values LV 1-4 or test gases to the individual functions is limited. Limit value 1 and test gas 1 are only possible with function A, limit value 2 and test gas 2 with function B, etc. Nevertheless, thanks to the OR logic of the four functions, all combinations can be set.

The following operating states can be selected as switching criteria:

- Off
- Warning
- Fault
- Calibration
- Check
- Cold start
- Measurement
- Standby
- Maintenance
- Limit values 1 – 4
- Probe 1
- No measurement
- CO signal

State

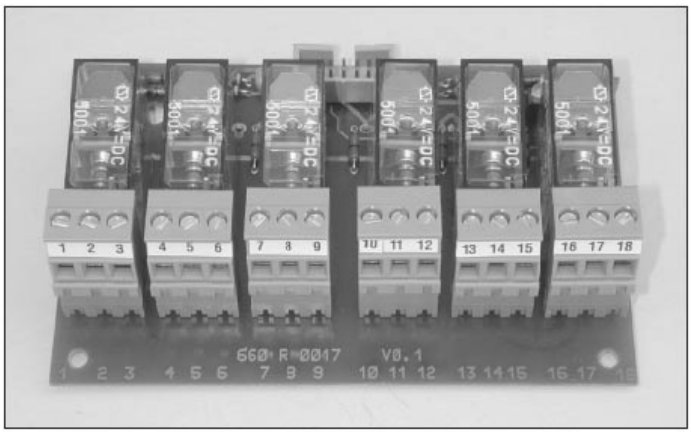
Parameters:
1039/1049/…/1099

This parameter indicates the current switching state. Changing the parameter in Diagnostic mode allows the output to be switched manually.

Relay module for the output of the digital outputs

Relay module
Type 657 R 0857

For electrical connection diagram, see section 10.3.1.



The following optional equipment is included with delivery:

- Load-dependent and fuel-specific limit values/limit curves
- PID/O2 controller
- Blow-out device
- Ejector version

4.12.8 Field bus connection

For the systems

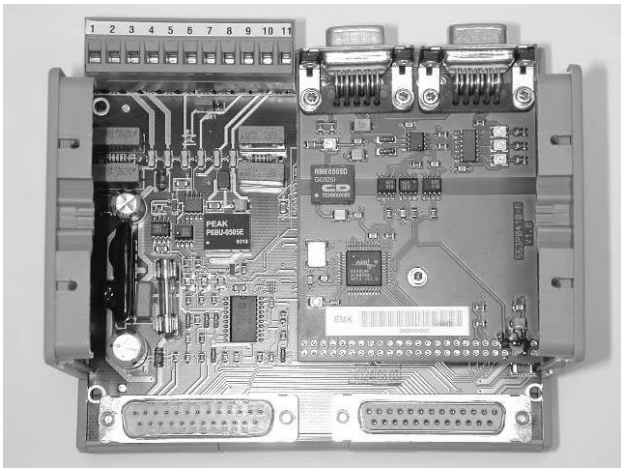
- Profibus DP (Siemens) Type 6 63 R 0401LT

NOTE:

PROFIBUS parameters in LT 2: P1300 – P1318.

See separate publication, “Profibus for LT”.

Profibus module
Electrical connection to LAMTEC SYSTEM BUS via terminal bar.
See section 10.4.



- Modbus Type 6 63 R 0403LT
- CANopen Type 6 63 R 0402LT
- Ethernet Type 6 63 R 0406LT

For details, see separate publication DLT4002.

Dimensions: W130mm x H85mm x D115mm

The option „Field bus connection“ (Modbus/Profibus) via communication processor board is included in LT2 ex software version 1V30 (08.10.2003).

4.12.9 Option “heating for wall mounting case”

For low environment temperatures (<0°C) a heating for the wall mounting case is available.

- Type 657 R 0367
- 230V / 120W
- Switching point +15°C

NOTE

When option “heating for wall mounting case“ the value of the main fuse F1 is changing from 1A to 1,6A slow-blow.

4.13 Limit values

Measurement data can be monitored with the aid of the limit values. The LT 2/KS1-DK is equipped as standard with four fixed limit values, which can be freely configured.

Limit values (factory setting)

- Limit value 1: > 400ppm exceeds COe limit
- Limit value 2: Disabled
- Limit value 3: Disabled
- Limit value 4: < -5 mV probe voltage below threshold,
  3 seconds trigger delay
  Reset mode “automatic”,
  (for monitoring the probe; air value)

Monitoring is effected by comparing the reference value with a lower comparative value (Min. comparative value) or with an upper comparative value (Max. comparative value).
If the reference value that you wish to monitor is outside the range (window), this indicates that the reference value is lower than the Min. comparative value or higher than the Max. comparative value, and so the limit value output is enabled.
Parameters 910 to 914 indicate whether the limit value is enabled.
The relay outputs of the LT 2KS1-DK lambda transmitter can be switched with the aid of limit values 1 - 4. The necessary settings are explained in section 4.13.7. “Digital outputs”. Here, we go on to describe the configuration, display and resetting of limit values. If the display is used, these points can be found in the limit value configuration or limit values parameter groups.

Seven parameters are available for each of the four limit values (e.g. for limit value 1):

1. LV 1 affects:
2. Max. comparative value
3. Min. comparative value
4. Max. LV const.
5. Min. LV const.
6. Reset mode
7. Trigger delay

Limit value 1 (2,3,4) affects (parameters: 930/940/950/960)

This parameter indicates which reference value is to be monitored. The following reference values are available for monitoring:

- Off - The limit value is momentarily not in use.
- O_2 measurement value
- Configurable measurement values: one of six possible measurement values defined by the user is monitored.
- Probe internal resistance Ri probe
- Probe voltage U-O_2

Max. comparative value (param. 931/941/951/961) / Min. comparative value (param. 932/942/952/962)

Three possible settings are available for the upper and lower comparative value:

Off: The comparative value is not active.

Constant value: A constant reference value is chosen as the comparative value.

Calculated analogue value: A value calculated from the O_2 actual value or an analogue input is employed as the reference value. In the LT 2/KS1-DK lambda transmitter, one of 12 different available reference values may be selected. Configuration of the analogue values to be calculated.

Max. LV constant (param. 933/943/953/963) / Min. LV constant (param. 934/944/954/964)

If a constant value is selected as the reference value, this constant is defined in Max. or Min. LV. Please note that only integer values can be entered here. If the constant reference value is shown in the display with decimal places, the sequence of numbers in the reference value must be entered with the decimal point omitted.

Example 1: The O_2 measurement value is to be monitored, the limit value output must be set as follows:
Undershoot at 5.5% and exceeded at 15.6 vol.% O_2
A constant value is set as default for the Min. or Max. reference value:
- For the Max. LV constant: 156
- For the Min. LV constant: 55

NOTE:
If you wish to monitor the measurement value only for instances where it exceeds or undershoots the limit values, set the switching threshold in such a way that it never responds.
Example: You wish to monitor the O_2 measurement value only to ascertain if it undershoots the minimum limit. Set max. limit value to 30,0% (300).

Example 2: You wish to monitor the probe voltage U-O_2. The voltage value is shown in the display in mV without decimal places. You must enter the limit values as integers in mV. Thus, entering 100 corresponds to 100 mV.

Reset mode (param. 935/945/955/965)

If the limit value was enabled by the reference value being undershot or exceeded, this parameter describes the mode for resetting the limit value. There are three possible ways of doing this:

Automatic: If the monitored reference value changes so that it reaches the GOOD state once more, the limit value output is automatically reset.

Manual: The limit value must be reset manually via the display, via one of the digital inputs or via the remote software. In this Reset mode, limit values can only be reset when the monitored reference value has returned to the GOOD state

Acknowledge: The limit value output must be reset manually via the display, via one of the digital inputs (Reset LVx) or via the remote software. If the monitored reference value is still outside the Good range, it is only acknowledged at first, and disappears on reaching the Good state.

Each individual limit value can now be deactivated with the "Deact. LVx" function via the digital inputs (x = { 1, 2, 3, 4 }).

Trigger delay (param. 936/946/956/966)

This parameter allows you to set a trigger delay in a time range from 0 to 600 seconds. In this case, the limit value output is only enabled if the monitored reference value remains outside the Min. LV or Max. LV range for longer than the pre-defined time interval. Once the reference value has returned within the limits of Min. LV and Max. LV, the time counter is reset. When the value goes beyond the Min. LV or Max. LV value, the trigger delay starts counting again from the time 0.

Deactivation of limit value (param. 967)

All limit values can be deactivated together depending on the operating mode.

Possible settings: Limit values are deactivated in the following states

- 0=Never
- 1=Cold start (default)
- 2=Coldstart+maintenance
- 3=No measurement.

Faults and warnings have no influence on the limit values!

Display and reset of limit values

The current state of the limit values and resetting them takes place using the display in the Limit Values group.

Parameters: 910 ... 914 The parameters Limit Value 1, Limit Value 2, Limit Value 3 and Limit Value 4 indicate the current settings and state of the limit values. 0 = off, 1 = enabled, 2 = acknowledged, 3 = deactivated. The “Deactivated” state is displayed if the LV has not been parameterised or if it has been deactivated via the digital inputs or an operating mode (param.967). “Off” indicates either that the limit value in question is not being used, or the monitored reference value is within the limits of Min. LV and Max. LV. If “enabled” is displayed for a limit value, the monitored reference value is or was outside the limits of Min. LV and Max. LV.

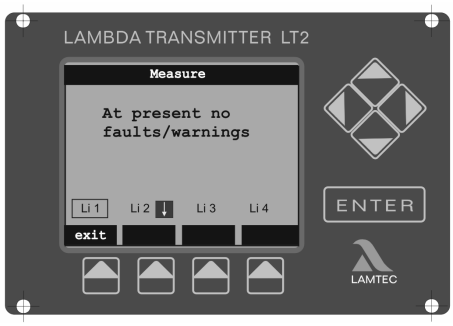
Parameters: 914 ... 917 The parameters Reset LV 1, Reset LV 2, Reset LV 3 and Reset LV 4 enable the limit value output to be reset if Manual or Acknowledge has been selected as the Reset mode. To reset a limit value, you must enter “Reset” in the respective parameter. In Manual reset mode, however, a reset is only possible if the monitored reference value is within the limits of Min. LV and Max. LV.

Off: This indicates either that the limit value in question is not being used, or the monitored reference value is within the limits of Min. LV and Max. LV.

Acknowledged: If “acknowledged” is displayed for a limit value, the monitored reference value is outside the Good range and the exceeding of the limit value has already been acknowledged.

Enabled: If “enabled” is displayed for a limit value, the monitored reference value is outside the limits of Min. LV and Max. LV.

Display of excess/undershot limit values



The limit values are displayed by means of the softkey designations. When limit value parameter 930/940/950/960 is activated in the “Service” access level, LV1, LV2, LV3 and LV4 appear on the display, depending on which limit value is currently active.

Exceeded or undershot limits are displayed as follows:

- LV 1 ↑ means limit value 1 has been exceeded
- LV 2 ↓ means limit value 2 has been undershot

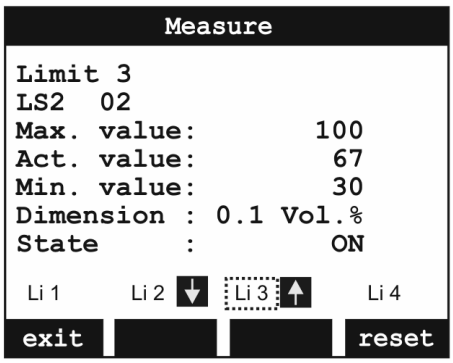
Retrieval of limit value settings

- Press the "diag" (diagnosis) key
  Select the required limit value using the cursor keys
  The selected limit value is indicated by a border

GW 1 ↑ GW 2 ↓ GW 3 GW 4

Limit value has
been selected

- Press ENTER
  The limit value setting of the selected limit value is shown in the display, see screenshot



1. Limit value 3 has been parameterised to the O_2 measurement value.
2. Switching points: Limit exceeded 10.0 vol.% O_2
   Limit undershot 3.0 vol.% O_2
3. Current O_2 measurement value 6.7 vol.% O_2
4. Possible states:

- enabled Limit value has been triggered
- off Measurement value is in Good range
- acknowledged Exceeded/undershot limit value has already been acknowledged

4.14 Analogue inputs

Four analogue inputs via plug-in cards on the LT 2/KS1-DK basic electronics.

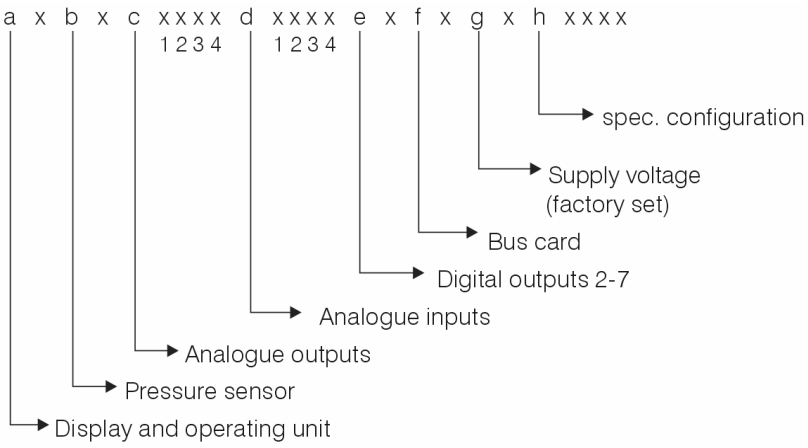
Freely configurable using the display and operating unit or remote display software, parameter groups 570 to 609.

- From January 2007
  Analogue input card for voltage -200...1000mV
  for activating the CO/H2 sensor signal
  Type 6 57 P 0660
- Analogue input card for current 0/4...20mA
  Type 6 63 P 6001
- Analogue input card for current 0/4...20 mA
  with 24 V DC supply for transducer for LT1 / LT 2
  Type 6 63 P 6002
- Analogue input card for potentiometer 1...5 kΩ
  Type 6 57 P 6000
- Temperature input for PT 100
  Alternative measuring range 0...320 °C
  0...850 °C
  Type 6 57 R 0890

4.15 Device configuration and factory settings

The configuration and factory setting of the device can be seen from the configuration number. This number is located on the inside of the door of the housing, or on the side in the case of the LT 2/KS1-DK for panel installation. The configuration number has 17 characters and is formulated according to the following code:

Configuration numbers for the LT 2/KS1-DK



a: Display and operating unit

0 → Without

1 → With

b: Pressure sensor
(via analogue input, see d)

0 → Without

1 → Absolute pressure

2 → Differential pressure

c: Analogue outputs

Output 1 2 3 4

0 → Not assigned

1 → 4...20 mA

2 → 0...20 mA

3 → 0...10 V

4 → 4...20 mA floating

5 → 0...20 mA floating

6 → 0...10 V floating

Only possible with outputs 1 and 2, maximum potential difference ± 20V

7 → 0…100% ejector controlling

8 → isolated

d: Analogue inputs

Input
1 2 3 4

0 → Not assigned

1 → Potentiometer 1kΩ

2 → Current 0/4...20 mA

3 → Three-point step (TPS)

4 → Pulse input (Namur)

5 → Temperature input PT 100 range 0…320°C

6 → Temperature input PT 100 range 0…850°C

7 → Current 0/4...20 mA with +24 V DC supply

8 → Pressure sensor Type (see b)

9 → Voltage -200...+1000mV

e: Digital outputs

0 → Open collector

2 → 2 to 7 relays (1 changeover switch)

f: Not assigned

g: Power supply voltage
(factory setting)

1 → 230 V AC

2 → 115 V AC

h: Special configurations

---

5 Installation

5.1 General Information

Measuring gas temperature

Max. 450°C

Fuel

Suitable:

- Light hydrocarbons such as natural gas, propane, butane
- Light fuel oil
- Fuel oil S, coal
- Other fuels, such as pyrolysis gases, refuse, etc., to only a limited extent, and with a considerably shorter life

Measuring point

Select the measuring point in such a way that representative exhaust gas (completely mixed) is measured.

Exhaust gas temperature at measuring point max. 450°C

Cable cross-sections

Recommended cable cross-sections between probe connection box (PCB) and data interpreting device (LT 2/KS1-DK)

Measuring cell heater (shielded) Terminal 35 / 36	Other connecting cables (shielded) Probe signals Pressure sensors
up to max. 20m ≥ 1.5 mm^2 up to max. 50m ≥ 2.5 mm^2	≥ 0.8 mm^2 Multicable 11 x 0.8 (S-Y(ST)Y..LG)

5.2 Installing the electronic evaluation unit of the LT 2/KS1-DK lambda transmitter

Ambient temperature

Operation:	- 20 °C to + 60 °C
Transport and storage	- 40 °C to + 85 °C

NOTE:
Cold electronics = good electronics!
This maxim is crucial when determining the installation location for the LT 2/KS1-DK lambda transmitter.

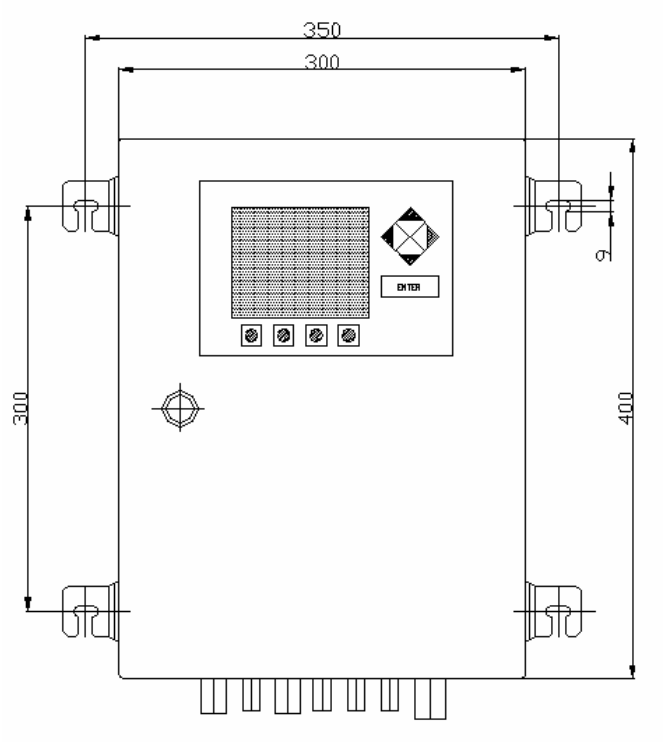
5.2.1 LT 2/KS1-DK wall-mounted housing

Mount the LT 2/KS1-DK lambda transmitter in a suitable location. For electrical connections and the probe connection, see below.

Ensure a suitable spot for wall mounting. Ensure that the wall has a sufficient load-carrying capacity and that the measuring system is easily accessible.

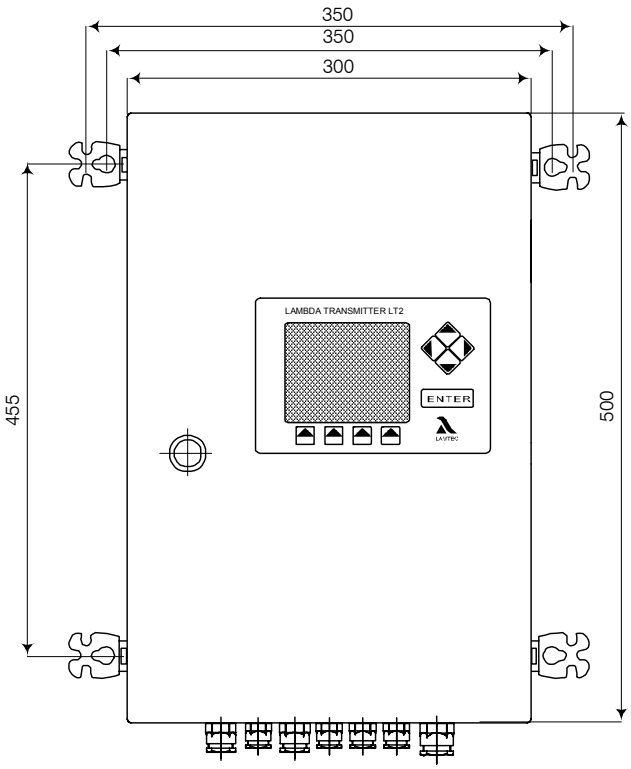
For electrical connection, see section **10.3**.

Without reference air pump



Housing depth: 150mm
Weight: approx.10kg

With reference air pump

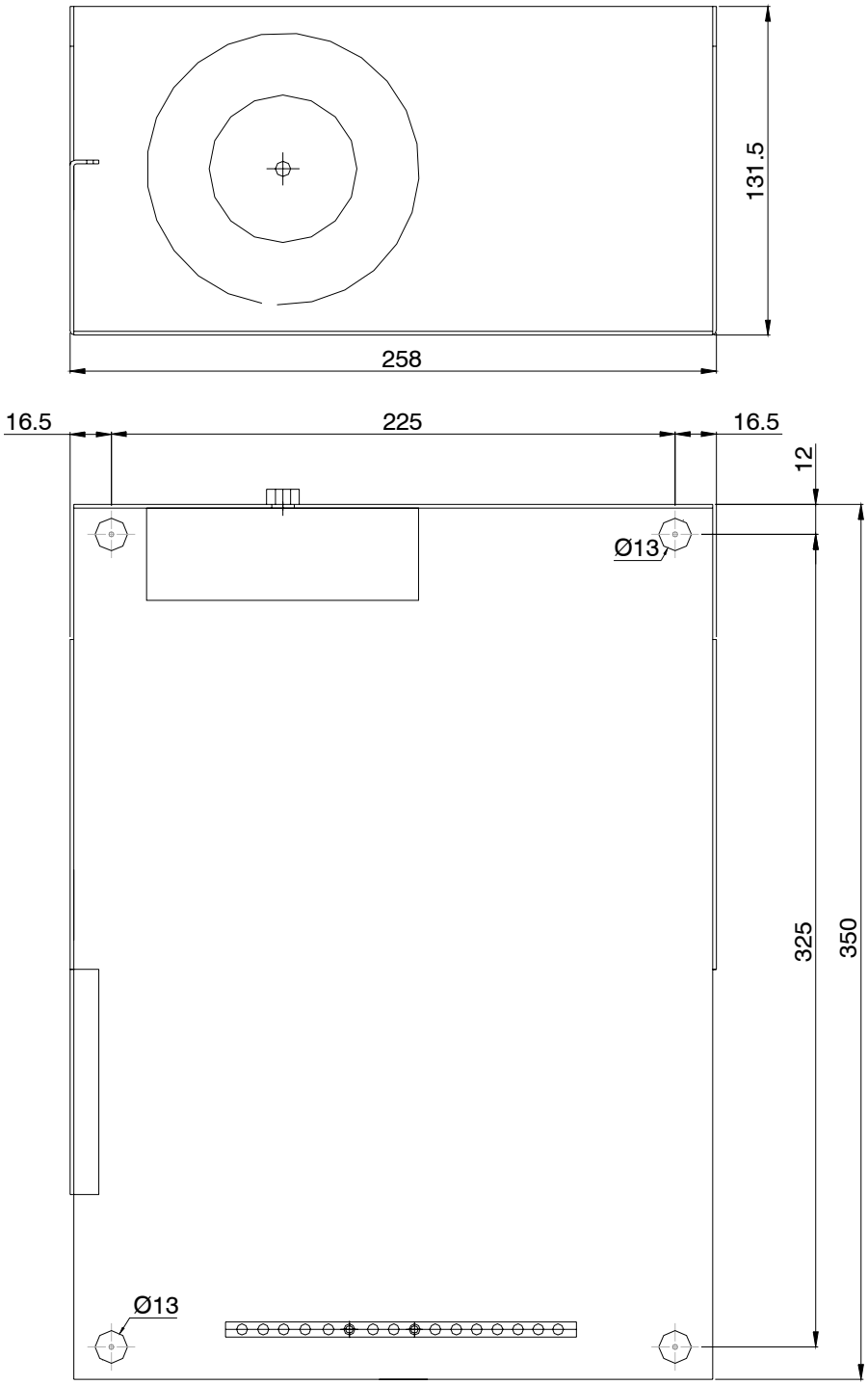


Housing depth: 200mm
Weight: approx.13kg

5.2.2 LT 2/KS1-DK mounting plate

For installation in the control cabinet (protection class IP00). Ensure sufficient ventilation, provide forced ventilation if necessary. Internal control cabinet temperature max. 60°C. For electrical connections and the probe connection, see below.

For electrical connection, see section **10.3**.

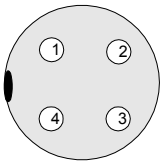


Weight: approx. 6kg

5.2.3 Electrical connection of the LT 2/KS1-DK lambda transmitter

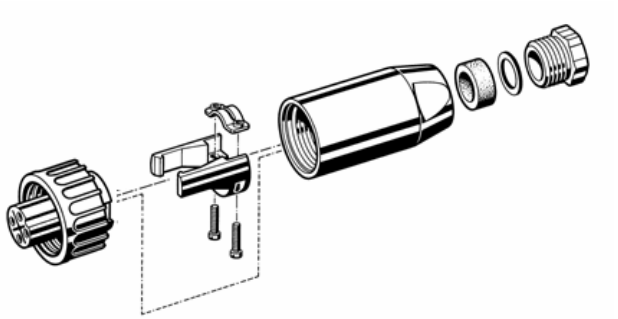
DANGER
Before all work on electrical equipment, switch off the power supply voltage to the equipment and check that it has been isolated. Compliance with the relevant safety provisions is essential.

Mains connection



1 - L
2 - N
3 -
4 - PE

Fitting cable coupler



For electrical connection, see section **10.3**.

Cable cross-sections

Recommended cable cross-sections between probe connection box and LT 2/KS1-DK

Probe heater (shielded) Terminal 35 / 36	Other connecting cables (shielded) Probe signals Pressure sensors
up to 20m ≥ 1.5 mm^2 up to 50m ≥ 2.5 mm^2	≥ 0.8 mm^2 Multicable 11 x 0.8 (S-Y(ST)Y..LG)

WARNING
Take care to ensure that cable routing and screening confirms to regulations.
Probe connection:
The signal line of the LT 2/KS1-DK, terminals 12, 33 and 34, must not be routed together with mains cables, particularly cables of frequency converters for speed control. Any connection with the power circuit must be avoided.

Lines may be routed together with pressure sensor cables, however.

DANGER
A faulty probe connection may result in the probe being damaged beyond repair. Before commissioning,
check probe connection terminals 12 to 36

12 (-) Probe signal CO/H_2
33 (-) Probe signal O_2
34 (+) Probe signal CO/H_2 / O_2 (shared inner electrode)
35 Probe heater
36 Probe heater

5 Installation

5.3 Installing the probe

CAUTION:

The first commissioning / first calibration must be carried out in environment temperatures of -20...+40°C with air (offset calibration).

If this should not be ensured in the inserted condition, the first caliration of the probe must be carried out in developed condition and may be inserted thereafter.

A first calibration uring too high flue gas temperatures is leading to storing wrong datas of the probe, which can be affected the accuracy and the durability of the probe.

Bevor calibration, after setting the internal cell resistance (chapter 6.2), you have to trigger an exchange of the probe via parameter 109. So all stored datas of the probe will be deleted and uring offset calibration be refreshed.

CAUTION:

When installing the probe and during subsequent operation, take care to ensure that the probe does not come into contact with oil, grease or boiler cleaning agents.

Contaminated or dirty probes can be recognised by their potential difference across air gap U-O2 of
<–20mV, or >+20mV. Furthermore, the probe must always be kept in operation once installed. This prevents humidity from settling on the measuring cell, which in certain circumstances may lead to measurement errors and the destruction of the probe!

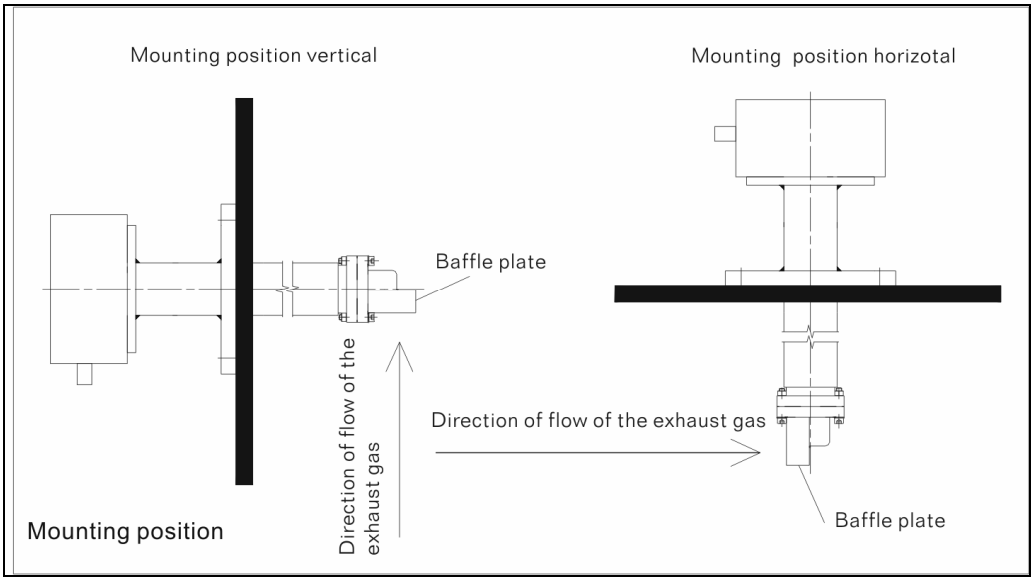
- Install and align the probe

  Counter flange standard DN65

  Counter flange in version “blow-out device” DN80

CAUTION!

Don’t forget the seal between the counter-flange and the probe flange.



- Connect the probe electrically (wiring diagram chapter 10.3)
- Connect the probe pneumatically (connecting diagram chapter 10.4)

NOTE:
In the PCB of the probe there is a shut-off plug valve, Which must be opened uring calibration with compressed air or test gas.
Should be the probe installed in a inaccessibly location, a additional shut-off plug valve can be installed in the near of the LT2.
In such a case, the internal valve can be always opened.

CAUTION!
After calibration, the compressed air or test gas must be closed.
The reference air must be always connected and be opened.

6 Commissioning / Shutdown

The commissioning relates to the software version 1V52 in the LT2, recognizeable at the indentification plate of the LT2.

6.1 Switch on measurement

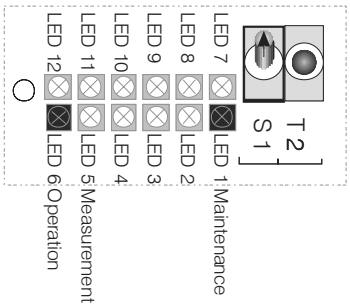
- Switch on the LT2

Maintenance switch S1

- Maintenance mode off

- Maintenance mode on

- You can switch to maintenance either using the display and operating unit under “diag” or using the maintenance switch S1. Maintenance switch S1 always has priority over the software switch under “diag”.



- “Maintenance” is displayed (LED1 lights up orange)
- The probe heats up (10 min.)
- “COLD START” is displayed (LED 5 “Measurement” off)
- “Operation” is displayed (LED 6 lights up green)

NOTE:
During “COLD START”, “MAINTENANCE” or “FAULT”, a default value is displayed:

- (Factory setting) $O_2 \rightarrow$ 0 vol. % (P361)
- (Factory setting) COe → 0 ppm (P371)

In P362 for O_2, P372 for CO, the type of default value can be set:
OFF: No default value is output.
ON: The default value set in the parameter in front is output.
+Maintenance (factory setting): The default value set in the parameter in front is output during “MAINTENANCE” as well.
+Maint.froz.: With this setting, the default value set in the parameter in front is output during cold start and fault, as before, but in addition the previous measurement value is frozen as long as Maintenance mode is active.
During cold start/fault, the default value has priority over the freezing of the measurement value during maintenance.
During cold start, the cell internal resistance $R_{I\ probe}$ of the O_2 electrode is displayed or output on the display and operating unit or the monitor output.
The cold start delay can be interrupted by pressing the “cal” button of the display and operating unit, then proceeding according to the menu guidance, or by pressing multi-function pushbutton T2 (for more than 3 seconds, or for more than 6 seconds if a warning or fault is present).

6.1.1 Possible warning / faults

Warning “Internal resistance of probe 1 too high”

Fault “Probe broken wire/faulty probe”

- Trigger of the Warning:
  The internal cell resistance has the limit of 200 Ohm exceeded
  (in mode “MEASURE”)
- Trigger of the fault:
  The internal cell resistance has the limit of 300 Ohm exceeded
  (in mode “MEASURE”)

Possible causes:

- Aborting cold start uring heating up phase
- Cable diameter of the probe heating to small
- Probe aged → use a replacement probe and exchange it
- Fuse F2 defective

6.2 Setting the cell internal resistance $R_{I\ probe}$

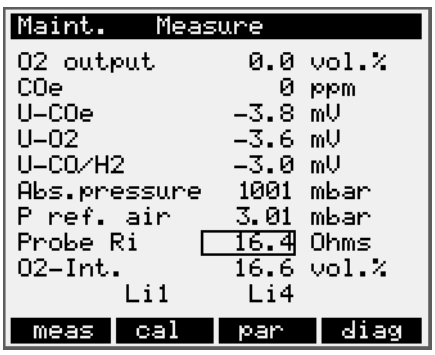
Note the cell internal resistance $R_{I\ probe}$ and read off the probe voltage U-O2 using these alternatives:

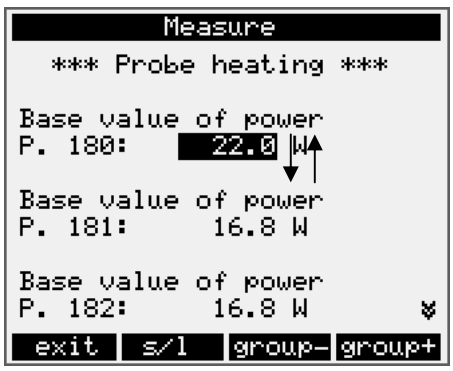
- Display and operating unit
- Remote display software
- Monitor output

When heated to operating temperature (approx. 30 minutes after switch-on), the measured internal resistance $R_{I\ probe}$ of the O_2 electrode should equal 20 ohms (+/-5 ohms). If the measured internal resistance is higher, increase the power of the probe heater by 0.5 watts (parameter 180). If it is lower, reduce the heating power by 0.5 watts. Repeat this process until the internal resistance reaches 18 ohms (+/-5 ohms). Wait approx. 10 minutes before repeating the process, to allow time for the internal resistance to adapt to the new heating power.

The probe voltage U-O2 stabilises to values between -20...+20mV.

NOTE:
To read off the cell internal resistance $R_{I\ probe}$ and the probe voltage U-O2 → press “meas”.





LT2 display

P180 is only available in the service level.

If it is not possible to get an internal cell resistance lower then 25 Ohm, check the cabel diameter aof the probe heating (see chapter 5.2.3).

6.3 Setting the reference air quantity

NOTE:

Only compressed air that is free from oil and water may be used as reference air. We recommend using instrument air, where this is available.

If neither compressed air nor instrument air is available, an optional pump unit can be employed in the external housing Type 657 R 1061. This pump unit cannot be retrofitted in the LT 2 housing

NOTE:

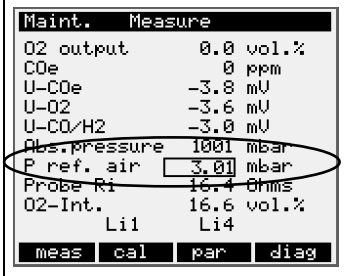
The reference air is monitored continuously by a differential pressure sensor, which is installed in the probe connection box of the KS1-DK.
The reference air is monitored with the fault “No reference air”.
Initiation time: 1 hour

1.) Calibrate the differential pressure sensor to 0.

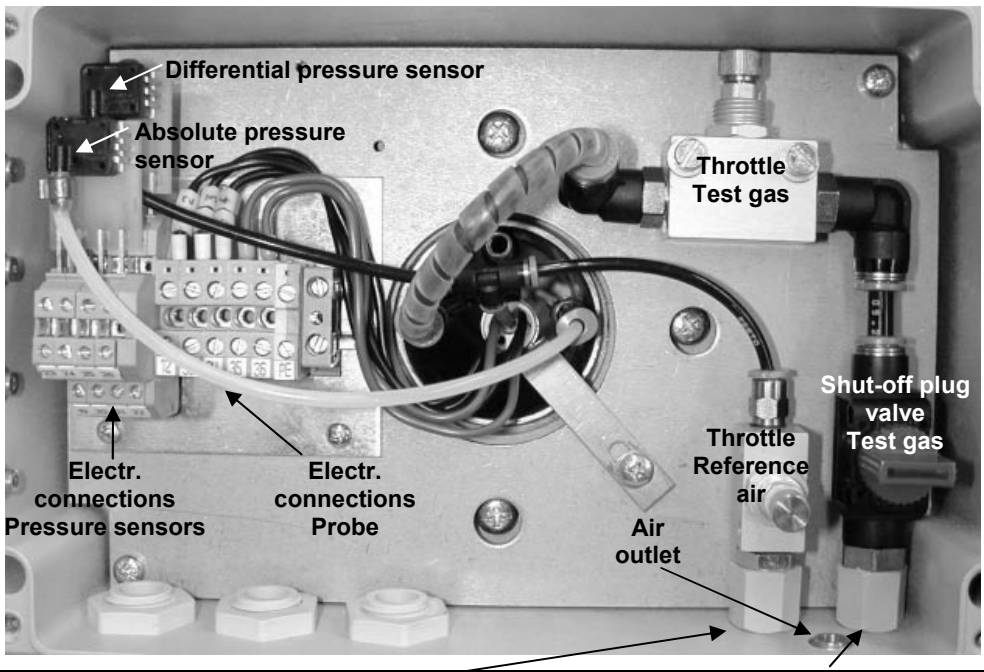
To do so, close the reference air throttle completely and set parameter 108 in the LT 2/KS1-DK to “initiate”.

2.) Next, open the reference air throttle until a differential pressure of 2 to 3 mbar is reached (see display in the LT2 “P ref.air”).

2.) Check calibration after a few hours of operation, maybe repeat it.



LT2 display

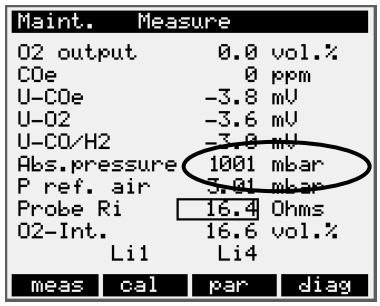


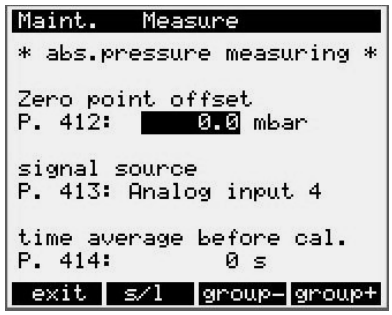
PCB interior view of KS1-DK probe

6.4 Calibration of the probe KS1-DK via menu function cal

Note:
The pressure increase of the calibration with compressed air or testgas is monitored by a absolut pressure sensor. Befor starting calibration, the value of the absolute pressure must be adjusted to the actuell environment pressure.

Via a zero point offset in parameter 412 the value of the absolut pressure can be increased or decreased.





CAUTION!
Befor first calibration, the probe must be at least 30 minutes operated in „MEASURE“ without a fault, otherwise the new probe datas will not be refreshed.
Trigger parameter 109 „exchange probe“. Stored datas of the probe will be deleted.

Several possibilities exist for calibrating both sensors of the probe.

- Offset calibration on ambient air → chapter 6.5.1
  The probe must be located at ambient air

alternativ

- Offset calibration with compressed air, open before → chapter 6.5.2
  - pre pressure compressed air 0,3bar
  - Pressure increase “dP” 2…3mbar
- Calibration with reference measuring → chapter 6.5.3
  - Reference measuring device

alternativ

- O_2 calibration with test gas, open gas → chapter 6.5.4
  - Test gas containing O_2, pre pressure 0,3bar
  - Pressure increase “dP” 2…3mbar
- CO calibration with test gas, open gas → chapter 6.5.5
  - Test gas containing CO, pre pressure 0,3bar
  - Pressure increase “dP” 2…3mbar

With param. 270, you can define which access level is required in order to initiate calibration. The following settings are possible:

- “Off” (default):
- “Customer”, “Service”
- “Maintenance”, “Customer+Maintenance”
- “Service+Maintenance”

6.4.1 Offset calibration of both sensors on ambient air

The first commissioning / first calibration must be carried out in environment temperatures of -20...+40°C with air (offset calibration).

If this should not be ensured in the inserted condition, the first caliration of the probe must be carried out in developed condition and may be inserted thereafter.

A first calibration uring too high flue gas temperatures is leading to storing wrong datas of the probe, which can be affected the accuracy and the durability of the probe.

Uring offset calibration in ambient air the

- O_2 sensor will be calibrated to 21%
- U-COe voltage will be calibrated to “0”

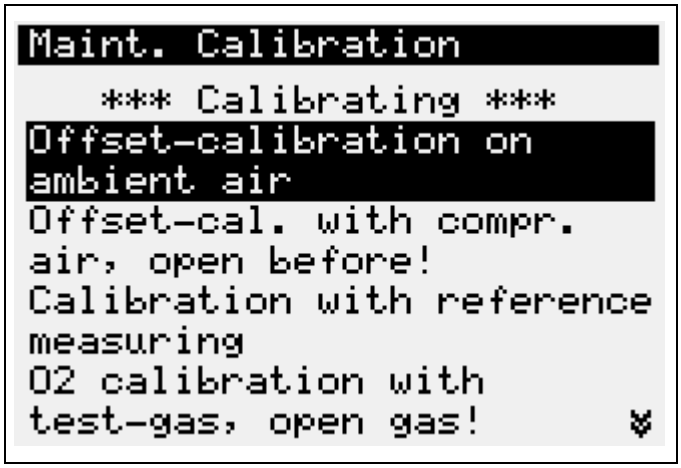
NOTE:
Offset calibration on ambient air only works with O2 values > 18%.

Menu function cal

When you press the **[cal]** menu key, “Start calibration” appears in the display. After you have activated calibration select:

Offset calibration on ambient air

- Uring calibration LED 5 is flashing slowly
- Length of calibration time max. 5 minutes



Possible warning / faults

Offset voltage outside the limits

Probe voltage U-O_2 < -20mV

- Trigger of the warning:
  - Probe voltage U-O_2 in ambient air is outside the range of -20…+20mV
- Resolution:
  - Probe is not in ambient air
  - Reverse polarity swap probe connection terminals 33-34
  - Change the probe / sensor

6.4.2 Offset calibration of both sensors with compressed air

Uring offset calibration compressed air air the

- O_2 value will be calibrated to 21%
- U-COe voltage will be calibrated to “0”

NOTE:
Offset calibration on ambient air only works with O2 values > 18%.

For offset calibration, compressed air with a pre-pressure of 0,3bar must be connected to the “Test gas” hose connection on the PCB.

Menu function cal

When you press the **[cal]** menu key, “Start calibration” appears in the display. After you have activated calibration:

- Open the shut-off plug valve in the PCB
- Set the pressure rise “dp” to 2...3mbar via the test gas throttle in the PCB
- Start calibration
- Following successful calibration, close the shut-off plug valve

Possible warning / faults

Offset voltage outside the limits

Probe voltage U-O_2 < -20mV

- Trigger of the warning:
  - Probe voltage U-O_2 in ambient air is outside the range of -20…+20mV
- Resolution:
  - Probe is not in ambient air
  - Reverse polarity swap probe connection terminals 33-34
  - Change the probe / sensor

∆-P offset calibration too low, not enough gas (compressed air)

- Trigger of the warning:
  Rise in pressure in preliminary filter during offset calibration with insufficient compressed air (<0.5mbar).
- Possible causes:
  - There is no instrument air (compressed air) at the test gas connection of the probe, or inadequate pre-pressure (0,3bar)
  - The shut-off plug valve in the PCB is not open.
  - The test gas throttle in the PCB is not open sufficiently.
  - The signal from the differential pressure sensor has drifted (recalibrate to “0”).
  - Probe preliminary filter cracked or broken (replace)

∆-P offset calibration too high, dirty preliminary filter

- Trigger of the warning:
  Rise in pressure in preliminary filter during offset calibration with excessive compressed air.
- Possible causes:
  - Instrument air (compressed air) at the probe test gas connection has excessive pre-pressure.
  - The signal from the differential pressure sensor has drifted (recalibrate to “0”).
  - Probe preliminary filter is dirty (clean it)

6.4.3 Calibration of the O_2 value with reference measurement

Alternatively, calibration may also be performed with test gas.

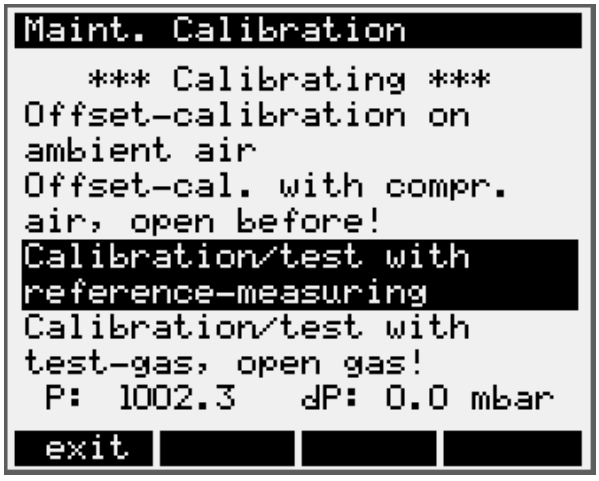
NOTE:
During reference measurement, take into consideration whether the measuring device is measuring wet or dry. In devices with an upstream measuring gas cooler, the measurement is always dry. The same applies to devices that draw out the humidity using a chemical substance. The KS1-D probe measures damp. The difference between wet and dry measurement can be seen in the graph in the appendix.

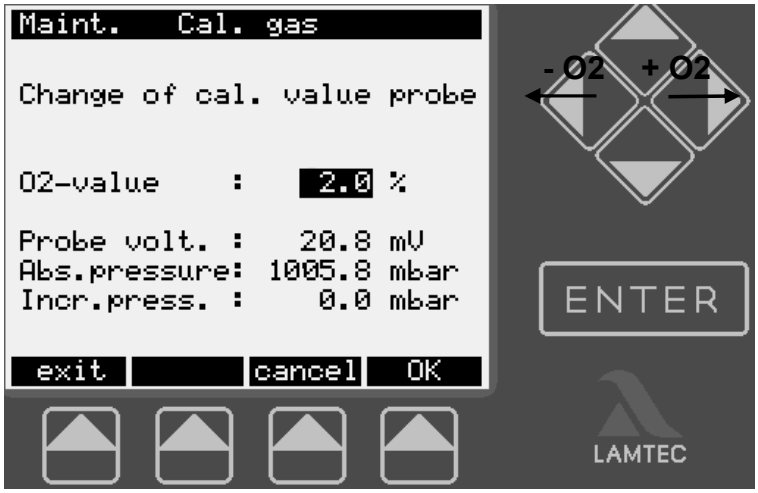
NOTE:
The calibration/check with reference measurement only works with O2 values < 18%.

Menu function cal

When you press the **[cal]** menu key, “Start calibration” appears in the display.
After you have activated calibration, select
Calibration/check with reference measurement

- When calibration with reference measurement starts, there is a waiting time of 5 seconds before the values are displayed.
- Change the O2-value with the cursor keys
- Press OK





Change the values using the Right and Left keys.

CAUTION:
If you are calibrating the measurement value using the display and operating unit → cal, you must confirm the new calibration value with “ENTER” or “OK”. Otherwise, the menu ends automatically after 15 seconds, and the new calibration value is rejected.

NOTE:
If there is no possibility for a reference measurement or for tes gas, you have to enter the probe temperature of the test report in parameter 141,to get a correct measurement value.
But this method functions only with a new probe / sensor.

6.4.4 O_2 calibration with test gas

Connect test gas at the hose connector “test gas” of the PCB, with a prepressure of 0,3bar.

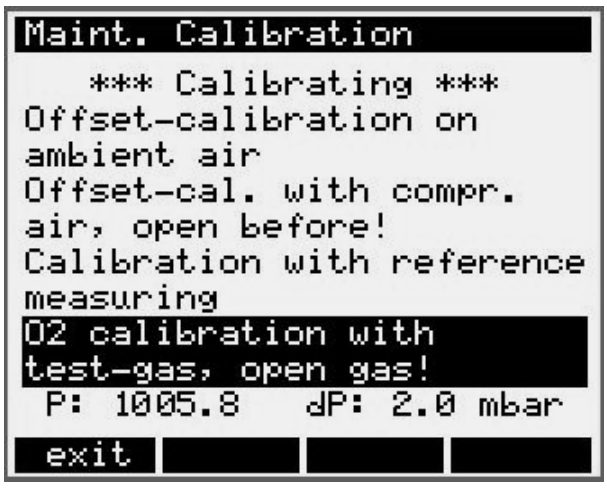
Example for test gas: 3 Vol.% O_2 in N_2

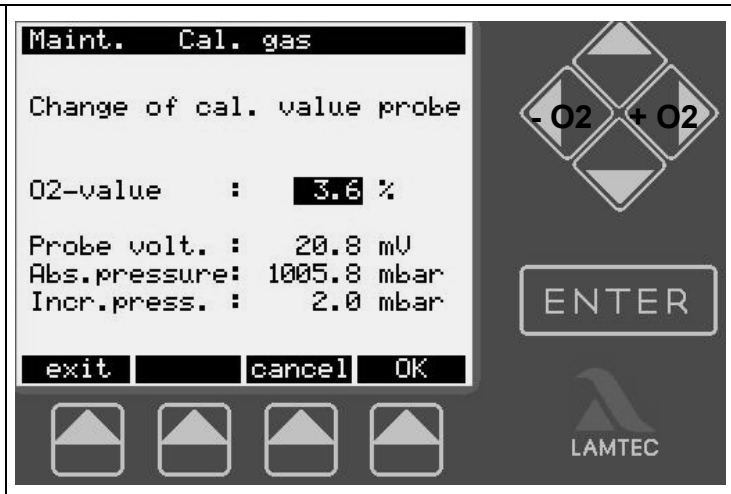
NOTE:
The calibration/check with O2- test gas only works with O2 values < 18%.

Menu function cal

When you press the **[cal]** menu key, “Start calibration” appears in the display.

- Open the shut-off plug valve in the PCB
- Set the pressure rise “dp” to 2...3mbar via the test gas throttle in the PCB
- Start calibration
- When calibration starts, there is a waiting time of 5 seconds before the values are displayed.
- Change the O2-value with the cursor keys
- Press OK
- Following successful calibration, close the shut-off plug valve





CAUTION:
If you are calibrating the measurement value using the display and operating unit → cal, you must confirm the new calibration value with “ENTER” or “OK”. Otherwise, the menu ends automatically after 15 seconds, and the new calibration value is rejected.

NOTE:
If there is no possibility for a reference measurement or for tes gas, you have to enter the probe temperature of the test report in parameter 141,to get a correct measurement value.
But this method functions only with a new probe / sensor.

6.4.5 CO calibration with test gas

Connect test gas at the hose connector “test gas” of the PCB, with a prepressure of 0,3bar.

Example for test gas: 3 Vol.% O_2, 100ppm CO, 100ppm H_2, in N_2

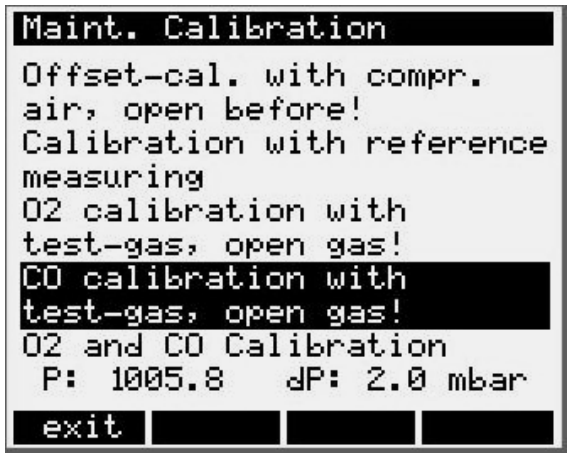
A test gas CO in N_2 is not suitable for calibration. A test gas must always contents O_2 in the range of %.

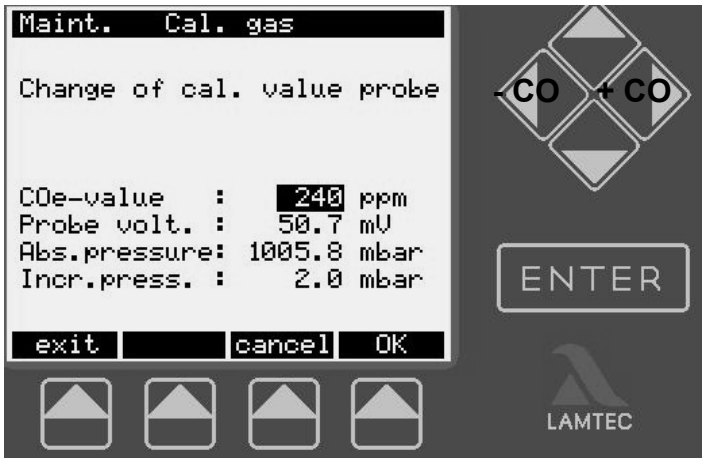
NOTE:
The calibration/check with CO- test gas only works with CO values > 0ppm.

Menu function cal

When you press the **[cal]** menu key, “Start calibration” appears in the display.

- Open the shut-off plug valve in the PCB
- Set the pressure rise “dp” to 2...3mbar via the test gas throttle in the PCB
- Start calibration
- When calibration starts, there is a waiting time of 5 seconds before the values are displayed.
- Change the COe-value with the cursor keys
- Press OK
- Following successful calibration, close the shut-off plug valve





CAUTION:
If you are calibrating the measurement value using the display and operating unit → cal, you must confirm the new calibration value with “ENTER” or “OK”. Otherwise, the menu ends automatically after 15 seconds, and the new calibration value is rejected.

NOTE:
The KS1-DK combination probe does not measure CO selectively, but measures the sum total of oxidising exhaust gas constituents (CO/H_2). In the case of fuels the composition of which remains constant, the CO content in the exhaust gas can be estimated with limited accuracy (+/- 25% of the respective measurement value, not better than +/-20ppm) on the basis of the oxidising exhaust gas constituents..

6.5 Ending calibration

- Leave the menu with EXIT
- Switch off MAINTENANCE

6.6 Test report

A test report is supplied with each probe. It is therefore possible to compare the current measurement values with the values from the test stand.

Test Certificate

Combi - Probe KS 1-DK

from

LAMTEC

LAMTEC Mess- u. Regeltechnik
für Feuerungen GmbH & Co KG

Impexstr.5, D-69190 Walldorf/Baden
Tel.Nr.: 06227/6052-0
Fax.Nr.:06227/6052-57
E-Mail: info@lamtec.de

Probe: **0033** **Article:** **656R2031**

Sensor: 1506-08

Measurement 1: Heater element specification

P - Heater: 22,3 W

Measurement 2: Impedance
Sensor stationary at 100 kHz

R_i - Sensor: 17.4 Ω

Measurement 3: Offset voltage on ambient air

U - O_2: -4,2 mV
U - CO/H_2: -4,1 mV

Measurement 4: Measured accuracy at 5% O_2 calibrated

Test gas concentration:	10,1 Vol-% O_2	3,0 Vol-% O_2
Display reading:	10,1 Vol-% O_2	3,1 Vol-% O_2

O2-sensor temperature 953 Kelvin

Measurement 5: Measured accuracy at 3% O_2, 100ppm H_2 and 100ppm CO

Test gas concentration:	3,0 Vol-% O_2
Display reading:	3,0 Vol-% O_2

U-COe: 275 mV

6.7 Probe certificate

Every probe comes with a passport, which must be filled out during commissioning. The probe passport must always be enclosed in the case of complaints and repairs.

NOTE:
The settlement of problems on the basis of goodwill requires the submission of the passport.

Sondenpass
Probe certificate / Certificat de la sonde

Combi - Probe KS 1-DK

LAMTEC

LAMTEC Mess- u. Regeltechnik
für Feuerungsanlagen GmbH & Co.KG

Impexstr. 5
D-69190 Walldorf/Baden
Tel.-Nr.: 06227/6052-0
Fax-Nr.: 06227/6052-57
E-mail: info@lamtec.de

Sonden-Nr. *Probe no: / No. de la sonde:* **0032**

Artikel-Nr: *Article no: / No. d'article:* **656R2031**

Kunde *Customer / Client:* **MUSTERMANN**
Kunden-Nr. *Customer no. / Code client:* **5833**
Auftrags-Nr. *Order no. / No. de commande:* **DB0xxxxx**

Sondenpass bei Inbetriebnahme ausfüllen und im Falle einer Reparatur der Sonde beilegen.
Keine Kulanz ohne ausgefüllten Sondenpass!
Please return probe with certificate. No warranty claim without certificate.
Joindre le certificat de la sonde rempli au cas de renvoi. Sans certificat rempli, pas de réparation amiable.

Anlage
Installation

Adresse
Address / Adresse

Datum der Inbetriebnahme
Startup date / Mise en service, le

Brennstoff
Fuel / Combustible

Bitte vor Rücksendung ausfüllen *Fill in please before return / Remplir avant retour:*

Betriebsstunden
Operating hours / Heures de marche

Bemerkungen
Remarks / Remarques

6.8 Setting service warnings

Service warnings 1 and 2 draw attention to the need for regular servicing. The plant operator can define service warnings as required, e.g.

- Service warning 1 → Check probe
- Service warning 2 → Remove and clean probe

The appropriate cycle times can be pre-defined in the range of 1 to 65535 hours by means of parameters 1260 and 1261.

The factory setting is with service warnings deactivated.

6.9 Practical information for operation

6.9.1 Measurement with pronounced pressure surges at the measuring point

If the display jumps dramatically, damping can be increased (i.e. by increasing the time constant of measurement value integration) and the display settled using the display and operating unit or the remote display software (optional extra) parameter 360 for O_2 display, P370 for CO_e display - Operation access level. However, this slows down the rate at which the display reaches a final value.

NOTE:
Increased damping also results in the artificial slowing down of the measurement signal.

6.9.2 Shutdown, switching on and off

In the case of longer shutdowns of approx. three months or more, we recommend switching off the measurement. To prevent damage to the probe, it must be removed. For shorter shutdowns, however, we recommend that you leave the measurement running.

6.10 Taking out of operation

To reliably exclude the possibility of damage to the KS1-DK combination probe, the latter must be removed before taking the measurement out of operation, or immediately after the mains voltage is switched off.

CAUTION:
Remove the probe before taking the measurement out of operation.

Danger, hot!

NOTE:

Once removed, the KS1-DK combination probe can be stored for an unlimited duration. The zirconium dioxide measuring element only becomes worn during operation (measuring cell at operating temperature). This is also the case if the probe has already been in operation.

7 Service and Maintenance

If the boiler is to be wet-cleaned, please note the following:

Only carry out wet cleaning after the probe has been removed. If wet cleaning is performed with the probe installed, it will be damaged. Trouble-free operation is then no longer possible.

NOTE:

The probe must always be removed before wet cleaning. Wet cleaning with the probe installed causes damage to the probe.

7.1 Checking/calibrating the KS1-DK combination probe

Checking/calibration (when installed in an appropriate location) should be carried out at normal operating temperature and under operating conditions.

Recommended intervals (cycles):

- 6 hours after commissioning
- 3 to 6 months for natural gas combustion
- See section 6 “Commissioning the measurement”

CAUTION: Don’t forget!

After replacing the probe, perform a new offset calibration in air and a new test gas calibration.

Limit value 4 is factory-set in such a way that an automatic check of the probe is possible when the system is stationary and during pre-ventilation.

Limit value 4 → -5 mV U-O2 undershoot, automatic reset trigger delay 3 seconds - 20mV undershoot is monitored by fault 1

Fault 1 must never be triggered when the probe is inactive. If fault 1 " Probe voltage < -20mV " is triggered, it must be reset manually.

NOTE:

After a power failure (and thus the failure of the probe heater), the probe voltage U-O2 may briefly drop below the value -20 mV while the probe is heating up again.

We recommend that you retain the factory setting of limit value 4 for safety reasons.

7.2 Checking the LT 2/KS1-DK

7.2.1 Checking the measurement input of the LT2/KS1-D

Connect a digital voltmeter to terminals 33 (-) and 34 (+) parallel to the probe.
Compare the measured O_2 voltage with the displayed probe voltage (U-O2).

Range: -20 mV … +300 mV.
If the deviation is less than 1 mV, the LT2/KS1-D is in good working order.
If the deviation is greater than 1 mV, repeat the measurement with another digital voltmeter.

Connect a digital voltmeter to terminals 12 (-) and 34 (+) parallel to the probe.
Compare the measured CO/H2 voltage with the displayed CO/H2 voltage (U-CO/H2).

Range: -50 mV … +950 mV.
If the deviation is less than 10 mV, the LT2/KS1-D and the buffer amplifier are in good working order.
If the deviation is greater than 10 mV, repeat the measurement with another digital voltmeter.

CAUTION:
Check the measurement accuracy of the connected digital voltmeter.

If there is still a deviation → check the buffer amplifier or replace the device.
Measuring range of buffer amplifier: Input -50...+950mV, output 0...20mA

From January 2007, the buffer amplifier is no longer installed and is replaced by a special input card. Measuring range -200...+1000mV.

7.2.2 Checking the probe: internal resistance measurement Ri probe

Only possible with probe simulator LS 2 Order No. 655 R 1030.

Connect the probe simulator to terminals 33 (-) and 34 (+).

With the R_I probe potentiometer, set an internal resistance of < 200 Ω.

Check using the voltmeter as follows:
Measure the alternating voltage between terminals 33 (-) and 34 (+).
The display in mV roughly corresponds to half the probe internal resistance. If R_I - >200 , a warning “LS 2 internal resistance too high” is displayed after 10 seconds, if R_I > 300 Ω, a fault
”Probe broken wire/faulty probe”
appears
Example: 75 mV = 150 Ω

NOTE:

Probe internal resistance monitoring is deactivated during “cold start”.

7.3 Maintenance

Due to the extensive self-diagnosis, the LT2/KS1-DK measurement system is largely maintenance-free. Maintenance is restricted to calibration and, when necessary, cleaning the preliminary filter from dust and other deposits, and the replacement of the ZrO_2 measuring element at the given intervals.

7.3.1 Checking the measurement

Check the measurement monthly, quarterly or six-monthly, depending on the application, see section 7.1

7.3.2 Wearing parts

KS1-DK combination probe
Average service life 3-5 years (depending on the fuel).

7.3.3 Cleaning the sintered metal preliminary filter

Cleaning the filter is only necessary if permeability is impaired.

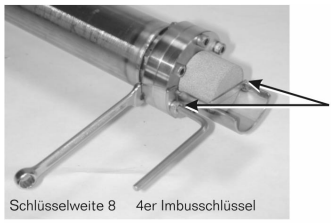
In this case, one of the two following error messages is displayed:

“Delta-P offset calibration too high, dirty filter”

“Delta-P offset calibration insufficient, not enough gas”

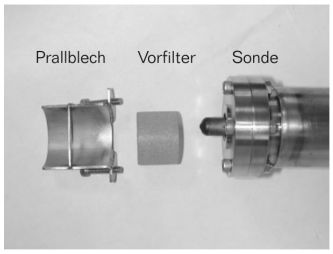
This fault is also noticeable in the sluggish response of the probe to changes in measurement values during offset calibration, and in a sharper rise in pressure (absolute pressure) during calibration.

To clean the filter, you will need the CO/H_2 measuring cell repair kit Type 656 R 2060...2062.
To replace the CO/H_2 measuring cell, dismantle the probe as follows:



Detach the baffle plate

To do so, slacken the two Allen screws



Carefully pull the baffle plate to the front and off, as the preliminary filter is inserted in the plate. If you cannot loosen the two Allen screws, cut off the heads and knock the pins out. The repair kit contains new screws and anti-seize paste.
Clean the sintered metal preliminary filter:
Brush and blow out.
On installation, ensure that the baffle plate is oriented so that it is against the flow of exhaust gas.

7.3.4 Replacing the CO/H_2 measuring cell

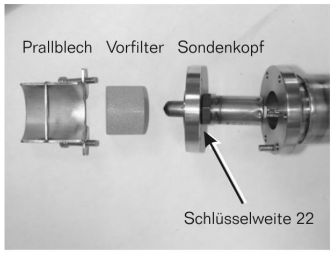
To do this, you will need the CO/H_2 measuring cell repair kit Type 656 R 2060…2062

- Disconnect the gas lines and electric cables of the KS1-DK combination probe and remove it
- Replace the CO/H_2 measuring cell. To do so, detach the probe as follows

1. Disconnect the probe (terminals 12/33/34/35/36)
2. Remove the baffle plate (section 7.3.3)
3. Remove the probe head by slackening all six Allen screws

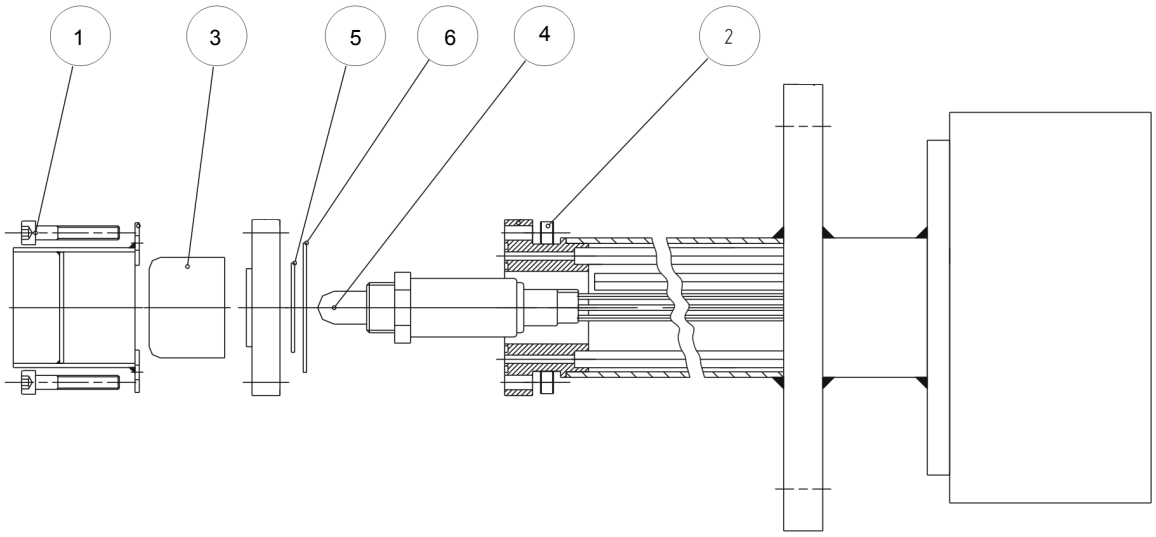
If you cannot loosen the Allen screws, cut off the heads and knock the pins out.

The repair kit contains new screws and anti-seize paste.



4. Pull the probe head and probe to the front and out
5. Unscrew the probe from the probe head
6. Remove the metal O-ring and discard it, the repair kit contains new metal O-rings.
7. Install in reverse order

Don’t forget anti-seize paste!
Ensure that the baffle plate is against the flow!



element	pieces	description	item-no.	material
6	1	metal O-ring	650 P 2057	Inconell 600
5	1	metal O-ring	650 P 2058	Inconell 600
4	1	CO/H2 sensor incl. adapter	656 P 2030	ZrO2-ceramic
3	1	filter	650 P 2055	SIKA H 20
2	6	hex-nut	650 P 2066	1.4571
1	6	hexagon socket head screw	650 P 2065	1.4571

3.) Reinstall the KS1-DK combination probe and connect up the gas lines and electric cables. Don't forget the seal

4.) Commission the measurement as described in section 6.

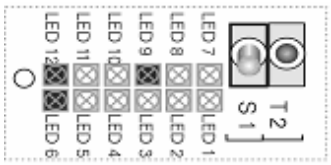
CO/H_2 measuring cell repair kit	500 mm	656 R 2060
	1000 mm	656 R 2061
	1500 mm	656 R 2062

8 Fault Analysis/Trouble-shooting

Messages in plain text:

- Via display and operating unit, under “diag”
- Via remote display software (optional extra)
- Indication via LED line, LEDs 7 to 12, on the processor board in the LT 2/KS1-DK

8.1 Fault indicator via LED line in the LT 2/KS1-DK



Anzeige der aktiven Störungen (rot) blinkend

Indication via LED line, LEDs 7 to 12, LED 12 flashes (faults flash)

LED 12 11 10 9 8 7	Faults
☐☐☐☐☐☐	No fault active
■☐☐☐☐■	Probe voltage U-O_2 < -20mV
■☐☐☐■☐	Faulty probe heater
■☐☐■☐■	Probe broken wire/faulty probe
■☐■☐☐■	No probe dynamics
■☐■☐■■	Fault in analogue outputs

(1) – Only relevant when used with integrated O2 control

8.1.1 Probe voltage U-O_2 < -20mV

- Probe + / - reversed polarity → swap probe connection terminals 33-34
- Probe contaminated → replace

NOTE:

Probe voltage U-O_2 in air -20 to +20 mV

8.1.2 Faulty probe heater

- Check fuse F 5 (see section 10.6)
- Inspect the probe heater. If the heater is intact, measure between the two pins of the probe heater connector (recognisable by the two white wires), approx. 2 ohms cold, approx. 10 ohms at operating temperature. If this is not the case (infinite resistance) → faulty heater - replace probe.
- If the measurement is successful, check the power supply voltage (with an effective measuring device or oscilloscope). The probe heater should be supplied with approx. 13 V DC with cyclical polarity reversal.
- Electromagnetic disturbance through wrong cable routing. Maybe parallel to frequency converter, actuators, gates.

NOTE:

The probe heater receives power in the form of a direct voltage of approx. 13V, with cyclical polarity reversal. Measurement with a multimeter is therefore problematic.

- If the above voltage is not received, check the wiring terminal connections and tighten if necessary.

NOTE:

The current heater data can be read out via the operating data parameters 41/42/43.

8.1.3 Probe broken wire/faulty probe

This message appears if the AC internal resistance (R_I) of the ZrO_2 measuring cell exceeds the permitted limit value of 300 Ω in measurement mode. The warning "Internal resistance too high" generally appears before or after the above message.

- Possible causes:
- The probe (measurement signal terminals 33 – 34) has been disconnected
- Loose contact → check terminal connections, tighten if necessary
- Check the wiring, if it is OK → replace the probe

8.1.4 No probe dynamics

No probe dynamics were registered. Check the probe

NOTE:

The test is disabled on delivery.
Activate it via parameter groups 1330 to 1334.
A check takes place to determine whether the measurement value changes by more than the parameterised threshold value within a time that is to be defined.

8.1.5 Fault in analogue outputs

- Check the parameter assignments of the analogue outputs (P530...P569).
- Check the computer electronics of the analogue outputs and replace if necessary. It is possible that an analogue output that is not installed has been activated (check installed outputs)
- See sections 4.7 and 10.7
- Influence exerted upon the ribbon cable of the display due to electromagnetic interference
  (order a ferrite core)

8.1.6 Incorrect O_2 value

If a control measurement produces a different O_2 value from the one displayed

- Have you taken the wet/dry measurement factor into consideration? See graph in section 10.14. of the appendix
- Check/calibrate the O_2 measuring probe, see 7.1
- Replace the CO/H_2 measuring cell, see section 7.3.4
- Commission the new probe as described in 6
- Measurement value too high? Infiltrated air - check tightness of seal and hose connections.

NOTE:

During counter-measurement, take note of whether the measuring device is measuring wet or dry. In devices with an upstream measuring gas cooler, the measurement is always dry. The same applies to devices that draw out the humidity using a chemical substance. The combination probe measures damp. The difference between wet and dry measurement can be seen in the graph in the appendix (section 10.14).

8.1.7 No reference air (can be output as a warning via P395, initiation time 1 hour)

This fault also appears if the reference air is monitored by a flow meter with limit transducer (e.g. with the efficiency calculation optional extra 657R0895K, see section 4.12.2)

The reference air does not reach the quantity required for flowing around the reference electrode.
This can result in the falsification of the measurement value.

Possible causes:

- There is no instrument air (compressed air, reference air pump) at the reference air connection of the probe.
- The reference air throttle is not open sufficiently.
- The signal from the differential pressure sensor has drifted.

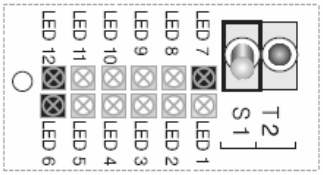
Measures:

- Check electrical and pneumatic connections
- Reset the reference air quantity, see 6.1.2
- Faulty differential pressure sensor? → replace
- Faulty pressure input card → replace

8.2 Warning indicator via LED line in the LT 2/KS1-DK

As a rule, warnings do not have any influence on measurement function.

Indication via LED line, LEDs 7 to 12, LED 12 lights up



Anzeige der aktiven Warnungen (rot)
LED leuchtet permanent

LED 12	11	10	9	8	7	Warnings
☒	☒	☒	☒	☒	☒	No warning active
■	☒	☒	☒	☒	■	Internal resistance too high
■	☒	☒	☒	■	☒	Offset outside limits
■	☒	☒	☒	■	■	No reference air
■	☒	☒	■	☒	☒	∆-P offset calibration too low, not enough gas
■	☒	☒	■	☒	■	∆-P offset calibration too high, dirty filter
■	☒	☒	■	■	☒	∆-P test gas calibration too low, not enough gas
■	☒	☒	■	■	■	∆-P test gas calibration too high, dirty filter
■	☒	■	☒	☒	☒	Insufficient quantity of calibrating gas(2)
■	☒	■	☒	☒	■	Probe absolute pressure too high/too low(2)
■	☒	■	☒	■	☒	Probe temperature too high/too low
■	☒	■	■	☒	☒	Faulty probe temperature sensor (2)
■	☒	■	■	☒	■	Invalid test gas calibration (2)
■	☒	■	■	■	☒	Implausible test gas calibration, repeat
■	■	☒	☒	■	■	Analogue input 1: Input value too high/too low
■	■	☒	■	☒	☒	Analogue input 2: Input value too high/too low
■	■	☒	■	☒	■	Analogue input 3: Input value too high/too low
■	■	☒	■	■	☒	Analogue input 4: Input value too high/too low
■	■	☒	■	■	■	Analogue outputs configuration error
■	■	■	☒	☒	☒	Service warning 1
■	■	■	☒	☒	■	Service warning 2
■	■	■	☒	■	☒	No probe dynamics (1)
■	■	■	☒	■	■	Dynamics test initiated (1)

(1) – Only relevant when used with integrated O2 control
(2) – Not relevant to the version described here

8.2.1 Internal resistance of probe 1 too high

This message appears if the AC internal resistance (R_I) of the ZrO_2 measuring cell exceeds the permitted limit value of 200 Ω in measurement mode.

Possible causes:

Probe has aged (worn) → purchase replacement probe and replace old probe

Measurement can only continue to operate with reservations. Check measurement accuracy, see section 7.

- Check F2 fuses, see section 10.6 of appendix
- Fault in power pack electronics → replace

Checking the LT 2K electronics:

Measure the alternating voltage over terminals 33-34 of the LT 2 using a multimeter. The display in mV roughly corresponds to the display of half the AC internal resistance

8.2.2 Offset voltage outside the limits

An impermissible voltage U-O_2 was discovered during offset calibration. Check whether the O_2 measuring cell has been supplied with air.

- Sufficient flow of compressed air/instrument air
  Pressure rise greater than 1...2 mbar; see 6.1.2
- Cracked filter insert?
  If OK, check the probe voltage U-O_2 in air.
  Permitted voltage range -20…+20mV.
  Reversed polarity of probe terminals 33/34

8.2.3 No reference air (can be output as a fault via P395, initiation time 1 hour)

This warning also appears if the reference air is monitored by a flow meter with limit transducer (e.g. with the efficiency calculation optional extra 657R0895K, see section 4.12.2)

The reference air does not reach the quantity required for flowing around the reference electrode.
This can result in the falsification of the measurement value.

Possible causes:

- There is no instrument air (compressed air, reference air pump) at the reference air connection of the probe.
- The reference air throttle is not open sufficiently.
- The signal from the differential pressure sensor has drifted.

Measures:

- Check electrical and pneumatic connections
- Reset the reference air quantity, see 10.4
- Faulty differential pressure sensor? → replace
- Faulty pressure input card → replace

8.2.4 ∆-P offset calibration too low, not enough gas (compressed air)

Rise in pressure in preliminary filter during offset calibration with insufficient compressed air (<0.5mbar).

Possible causes:

- There is no instrument air (compressed air) at the test gas connection of the probe, or inadequate pre-pressure (0,3bar)
- The shut-off plug valve in the PCB is not open.
- The test gas throttle in the PCB is not open sufficiently.
- The signal from the differential pressure sensor has drifted (recalibrate to “0”).
- Probe preliminary filter cracked or broken (replace)

8.2.5 ∆-P offset calibration too high, dirty preliminary filter

Rise in pressure in preliminary filter during offset calibration with excessive compressed air.

Possible causes:

- Instrument air (compressed air) at the probe test gas connection has excessive pre-pressure.
- The signal from the differential pressure sensor has drifted (recalibrate to “0”).
- Probe preliminary filter is dirty (clean it)

8.2.6 ∆-P test gas calibration too low, not enough gas

Inadequate rise in pressure in preliminary filter during test calibration (<0.5mbar).

Possible causes:

- There is no test gas at the test gas connection of the probe, or inadequate pre-pressure (0.3bar)
- The shut-off plug valve in the PCB is not open.
- The test gas throttle in the PCB is not open sufficiently.
- The signal from the differential pressure sensor has drifted (recalibrate to “0”).
- Probe preliminary filter cracked or broken (replace)

8.2.7 ∆-P test gas calibration too high, dirty filter

Excessive rise in pressure in preliminary filter during test gas calibration.

Possible causes:

- Test gas at the probe test gas connection has excessive pre-pressure.
- The signal from the differential pressure sensor has drifted (recalibrate to “0”).
- Probe preliminary filter is dirty (clean)

8.2.8 Insufficient quantity of calibrating gas

An insufficient rise in pressure is discovered during manual offset or test gas calibration of the KS1-DK.

Possible causes:

- There is no test gas or compressed air at the test gas connection of the probe, or inadequate pre-pressure (0,3bar)
- The shut-off plug valve in the PCB is not open.
- The test gas throttle in the PCB is not open sufficiently.
- The signal from the differential pressure sensor has drifted (recalibrate to “0”).
- Probe preliminary filter cracked or broken (replace)

8.2.9 Implausible test gas calibration, please repeat

This message occurs when the probe temperature calculated from the probe voltage and the concentration of gas lies outside the range of 800° - 1200° Kelvin.

Possible causes:

- The O_2 concentration entered under parameter 301 does not correspond to that of the connected calibrating gas
- Ageing/contaminated sensor? → replace.
- Infiltrated air - check tightness of seals and hose connections.

8.2.10 Analogue input 1/2/3/4 input value too high/too low

The input value at the analogue input in question is outside the permitted range.
Range limits: parameters 574/584/594/604 (min. value) and 578/585/595/605 (max. value).
The current input value can be read out via parameters 570/580/590/600.

Measures:

- Check wiring → reversed polarity?
- Check source (connected device)
- Faulty input card? → replace

8.2.11 Analogue outputs configuration error

Analogue outputs are parameterised that cannot physically be found. Check parameters 539, 549, 559, 569 and 530, 540, 550,560 and compare with the inserted cards. If necessary, replace analogue output cards and/or the processor board.

8.2.12 Service warning 1 / service warning 2

The service warning draws attention to the need for regular servicing. The user can define service warnings as required, e.g.

Service warning 1 → check probe

Service warning 2 → replace probe

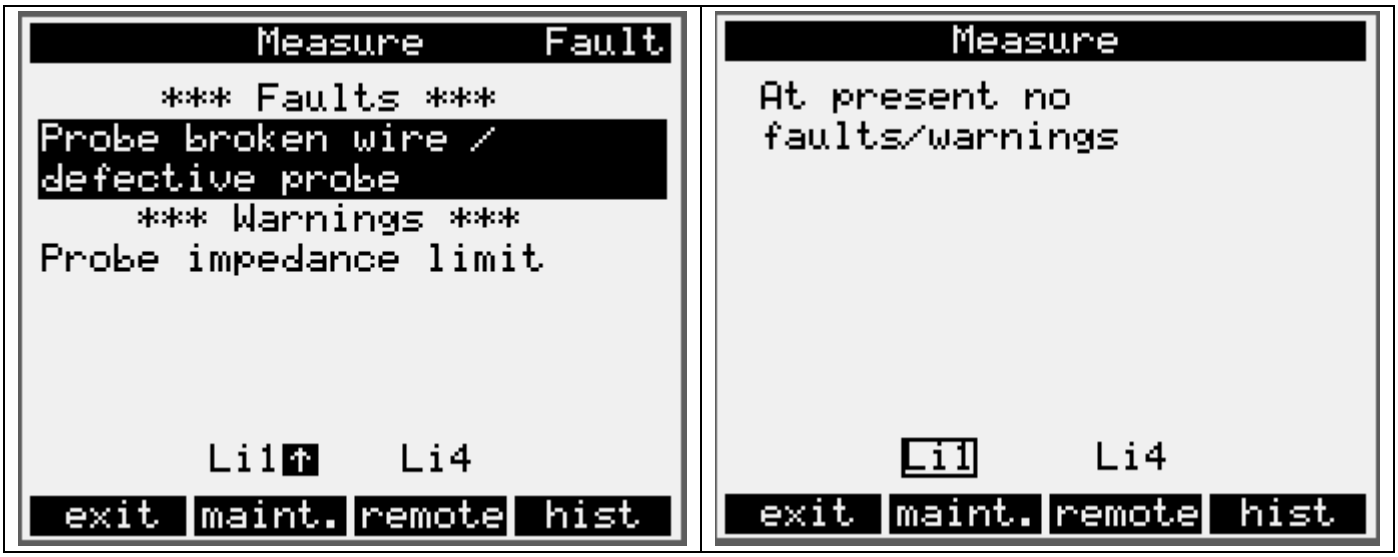
The appropriate cycle times can be configured as desired by means of parameters 1260 and 1261.

8.3 Resetting faults/warnings

- Menu-guided via “diag” in the display and operating unit (optional extra)
- Menu-guided via “Status” using remote display software

The **[diag]** key switches the screen to the display of warnings and faults. You can select individual warnings, faults or limit values using the cursor keys (up, down).

The selected warning or fault, which is displayed inverted, can now be acknowledged or reset with ENTER.



- Via digital inputs - input 1
- By pressing the multi-function pushbutton T2

(for more than 3 seconds for each fault)

If several faults are present at the same time, you must press the multi-function pushbutton T2 several times.

NOTE:
Not all warnings and faults can be reset by acknowledging them - the cause of the warning or fault may have to be corrected first.

9 Spare Parts

Below is a list of the relevant spare parts.

We recommend that you stock up on wearing parts.

The stocking of spare parts with footnote (1) is a matter for your own judgement.

The stocking of spare parts with footnote (2) only makes sense if the measurement system is equipped with the optional extra in question.

9.1 Wearing parts

1 CO/H_2 measuring cell repair kit
Length 500 mm
Type 6 56 R 2060

1 CO/H_2 measuring cell repair kit
Length 1000 mm
Type 6 56 R 2061

1 CO/H_2 measuring cell repair kit
Length 1500 mm
Type 6 56 R 2062

1 Sintered metal filter repair kit Type 6 50 R 2065

1 Assembly paste (anti-seize paste) 5-pack Type 6 50 R 1090

1 Flange gasket DN65 3mm Klinger Sil C-4400 Type 6 57 P 4209

1 Assorted small accessories box KS1-DK Type 650 R 2070

1 Shut-off valve, Type 6 57 P 0556

1 Absolute pressure sensor on board Type 650 R 2066

1 Differential pressure sensor on board Type 650 R 2067

9.2 Spare parts

Probe KS1-DK	(1) 1	Replacement probe complete, average service life approx. 2...5 years (depending on fuel) for measuring gas temperatures up to 450°C Length 500 mm Type 6 56 R 2030
	(1) 1	Replacement probe complete, average service life approx. 2...5 years (depending on fuel) for measuring gas temperatures up to 450°C Length 1000 mm Type 6 56 R 2031
	(1) 1	Replacement probe complete, average service life approx. 2...5 years (depending on fuel) for measuring gas temperatures up to 450°C Length 1500 mm Type 6 56 R 2032
	(1) 1	Test gas throttle Type 6 57 P 0525
	(1) 1	Reference air throttle Type 6 57 P 0436
	(1) 1	PUN hose 6x1 black Type 6 57 P 0547

LT2

(1) 1 Mainboard LT2
Type 6 57 R 1882

(1) 1 Processor board LT2 LT2
Type 6 57 R 1874

(1) 1 isplay and operating unit LT2
Type 6 57 R 0833

(1) 1 power pack (transformer) LT2
Type 6 57 P 0342

(1) 1 Spare fuse box LT 2
Type 65 7 R 1310

(1) 1 Analogue input card -200...+1000mV (from January 2007)
Type 6 57 P 0660

(1) 1 Analogue output card 0/4...20 mA; 0...10 V (1 channel) LT2
Type 6 57 R 0050

(1) 1 Pressure sensor input card LT2
Type6 57 R 0650

(2) 1 Analogue input card 0/4...20 mA LT2
Type 6 63 P 6001

(2) 1 Analogue output card 0/4...20 mA; 0...10 V floating, LT2
Max. potential difference ± 20 V
Type 6 57 R 0051

(2) 1 Analogue input card LT1/LT 2 potentiometer 1...5 kΩ LT2
Type 6 57 P 6000

(2) 1 Analogue input card 0/4...20 mA
Type 6 63 P 6001

(2) 1 Analogue input card 0/2...10 V LT2
Type 6 57 P 6005

(2) 1 Temperature input for PT 100 LT2
Type 6 57 R 0890

(2) 1 Relay card 660R0017 for digital outputs, 6 relays each with 1 changeover switch LT2
Type 6 60 R 0857

(2) 1 Pump for reference air
Type 6 57 R 1062

10 Appendix

10.1 Technical data of the LT 2/KS1-DK lambda transmitter

Version:	**Wall-mounted housing Type 657 R 1028**	**Wall-mounted housing with reference air pump Type 657 R 1060**	**Mounting pate Type 657 R 1032**
Housing:	Sheet steel, powder-coated surface-mounted housing	Electrogalvanized sheet steel	Electrogalvanized sheet steel
Protection class to DIN 40050	IP 65	IP 65	IP 00
Dimensions (HxWxD) mm	400 x 300 x 150	500 x 300 x 200	350 x 258 x 131.5
Colour	Grey RAL 7032	-----	-----
Weight	approx. 10 kg	approx. 13 kg	approx. 6 kg
plus display and operating unit	approx. 0.5 kg	approx. 0.5 kg	approx. 0.5 kg
Ambient temperature:			
Operation	-20 °C ... + 60 °C		
Transport and storage	-40 °C ... + 85 °C		
Power supply voltage:	230 V AC and 115 V AC + 10 % / -15 %, 48 Hz...62 Hz		
	To be used only in grounded power line networks !		
Power consumption:	Typically 50 VA, briefly 150 VA (probe heating-up phase)		
Display:	Graphic LCD 100 x 80 mm (W x H)		
Resolution:	O2: 0.1 vol. % O_2 in the range 0...18 vol. % O_2 1 vol. % O_2 in the range 18...30 vol. % O_2 CO: 1ppm in CO range		
Measurement accuracy: (with KS1-DK combination probe)	O2: ± 10 % of measurement value No better than ± 0.3 vol. % O_2 CO: ± 25 % of measurement value No better than +/- 10 ppm in exhaust gases from natural gas combustion following previous calibration under operating conditions with a CO reference measurement in the measuring range 0...100 ppm :. 10 ppm		
Setting time (60 % time):	O2: T 60 < 10 s COe: T 60 < 2 s		
Time until ready for operation with KS1-DK (cold start)	Approx. 10 minutes after “POWER ON”		

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Analogue outputs:

Monitor output	0...2.55 V DC, burden > 10 kΩ, ≤ 100nF	
Accuracy	2 % of measurement value, no better than 0.2 vol. % O_2	
Resolution	10 mV	
Factory settings	0...2.55 V DC ≈ 0...25.5 vol. % O_2	
	Can be switched to probe voltage U-O2 0...2.55 V DC ≈ 0...255mV U-O2 using DIP-switches	
1...4 current / voltage outputs **2 standard, 3...4 optional**	Direct current	0 / 4...20 mA (default)
	Burden	0...600 Ω
	Direct voltage	0...10 V
	Burden	≥ 10 kΩ
	Not floating (optional electrical isolation)	
Accuracy:	Measuring ranges and physical size can be configured 0.5 % output value, no better than 0.01mA	
Resolution:	0.1 vol. % O_2	
Factory setting:	Output 1	0...10 vol. % O_2 → 4...20 mA,
	Output 2	0…1000ppm → 4…20mA

Analogue input: 2

Optional
Via plug-in cards on the LT 2/KS1-DK power pack electronics

- Analogue input card voltage -200…+1000mV
  6 57 P 0660
- Analogue input card potentiometer 1...5 kΩ
  6 57 P 6000
- Analogue input card current 0 / 4...20 mA
  6 63 P 6001
- Analogue input card 0 / 4...20 mA with 24 V DC supply for transducer
  6 57 P 6002
- Temperature input for PT 100 sensor
  6 57 R 0890
  Temperature range 0...320°C / 0...850°C
  Resolution 1°C

Control elements:

Wall-mounted housing/mounting plate

- Multi-function pushbutton, maintenance switch and 2 LED lines each with 6 LEDs
- Display and operating unit with graphic LCD
- Remote display software (optional extra)

Interface:

- LAMTEC SYSTEM BUS
- RS 232 only in conjunction with interface module 6 63 P 0500

10 Appendix

Digital outputs:

1 as standard
Relay output (collective fault indicator)
0...230 V AC, 4A / 0... 42 V DC, 3A

Optional extra:
Relay module with 6 relays (1 changeover switch)
Switching capacity
0...230 V AC, 4A / 0... 48 V DC, 3A
657 R 0857

Configurable as desired for process status, status and limit value signals

Digital inputs:

8 inputs – configurable as desired
Factory settings: 24 V DC based on device potential
Can be switched over for external voltage sources (floating) via jumper

Calculation options:

- Calculation of efficiency of combustion
  Range 0...100%, resolution 0.1%
- Calculation of concentration of CO2
  Range 0...20%, resolution 0.1 %
- PID controller
- Customised measurement values
  Fuel quantity, steam pressure, etc.

Field bus connection:

Optional for the systems:
- Profibus DP (Siemens)
- Modbus
- CANopen – on request
- Ethernet – on request

Conformity with the following European Directives:

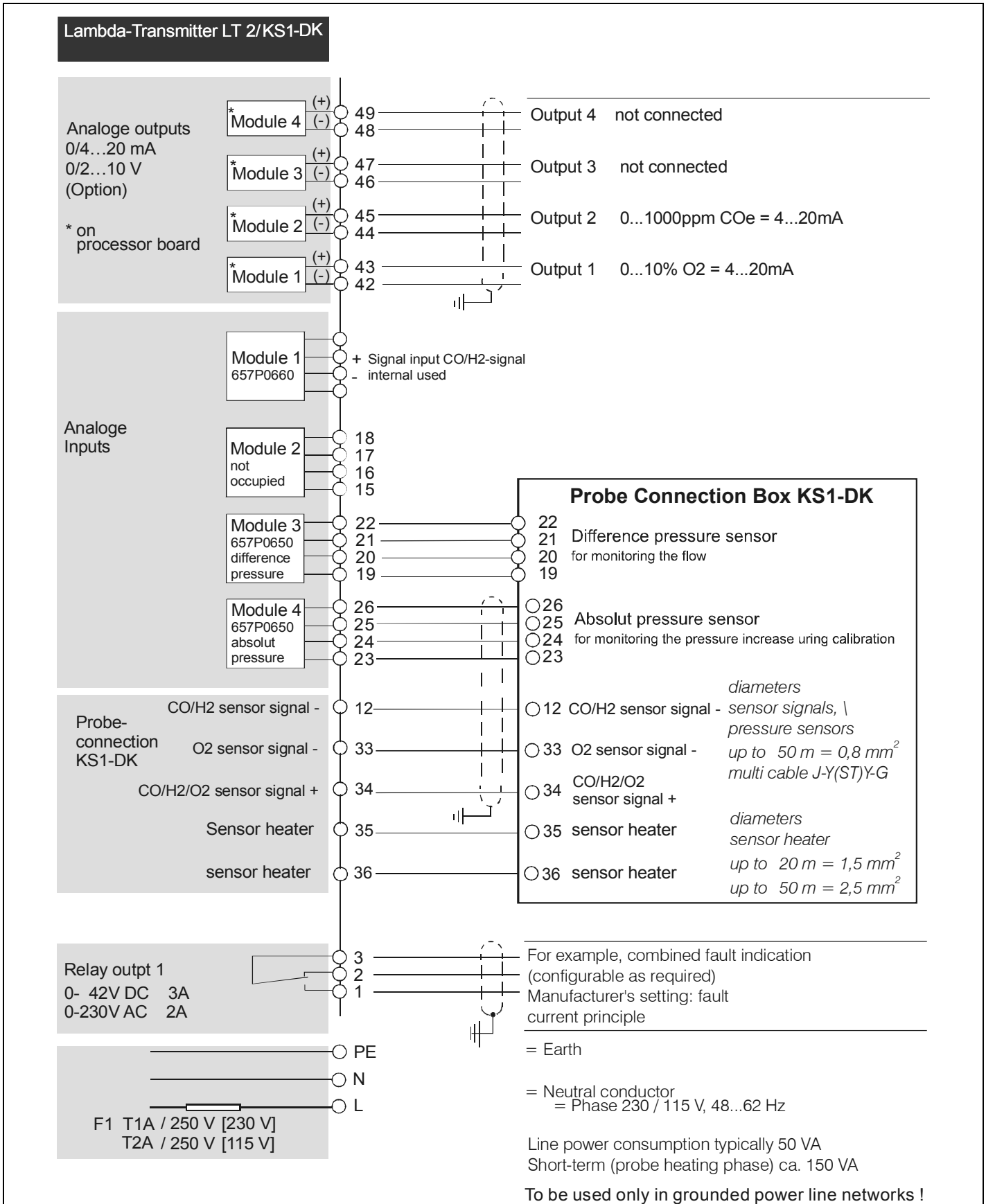
89 / 336 / EEC	Electromagnetic Compatibility
73 / 23 / EEC	Low Voltage Directive

10 Appendix

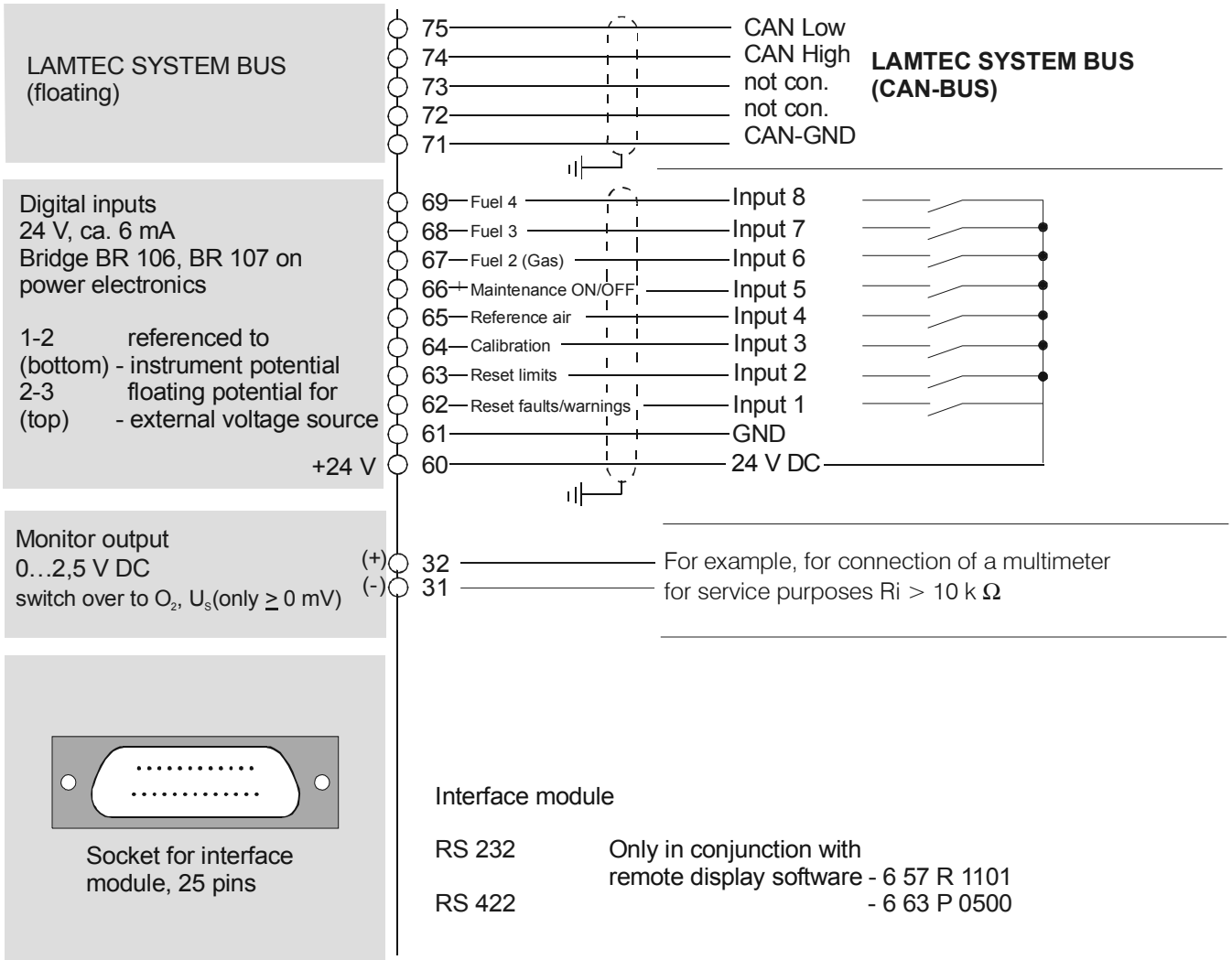
10.2 Technical data of the KS1-DK combination probe

Measuring range:	O_2: 0...18 vol. % O2 with limitation 0...21 vol. % O_2 COe: 0...1000ppm COe
Measurement accuracy:	O2: ± 10 % of measurement value No better than ± 0.3 vol. % O_2 CO: ± 25 % of measurement value No better than +/- 10 ppm in exhaust gases from natural gas combustion following previous calibration under operating conditions with a CO reference measurement in the measuring range 0...100 ppm :. 10 ppm
Probe output voltage:	O_2 electrode: -100mV...+1000mV Resolution: 0.1mV CO/H_2 electrode: -50...+950mV Resolution: 1mV
Error-influencing factors:	Temperature Other unburned hydrocarbons
Cross-sensitivity:	To SO_2, NH_3, NO, propane, aromatic hydrocarbons
Probe internal resistance of ZrO_2 measuring cell in air and 22W heating power:	15...25 ohms
Permitted fuels:	Residue-free, gaseous hydrocarbons Light fuel oil Coal Wood
Permitted continuous exhaust gas temperature:	< 450 °C
Life:	≥ 3 years with natural gas
Heating power:	20...25 watts, depending on the version and the measuring gas temperature
Heating current:	Approx. 1.3 A
Insulation resistance between heater and probe connection:	> 30 MΩ
Mounting position:	Horizontal to vertical
Protection class:	IP42
Counter flange:	In version standard → DN65 In version blow.out device → DN85

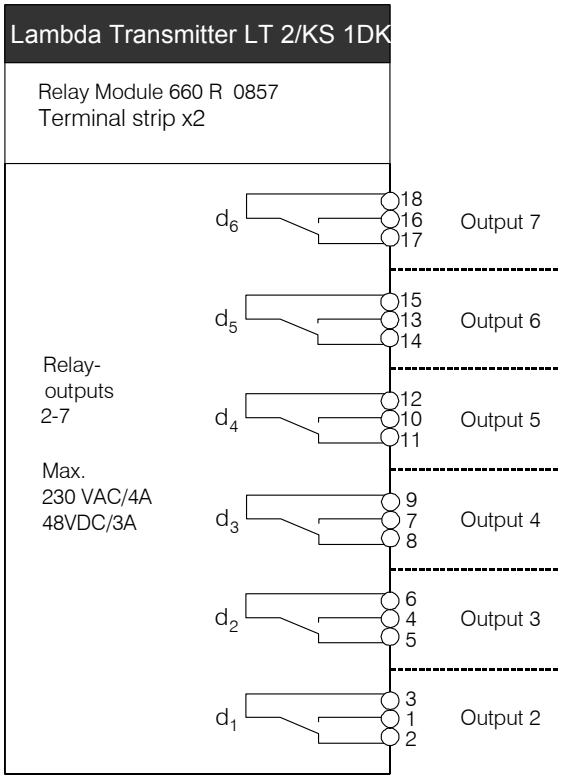
10.3 Electrical connection



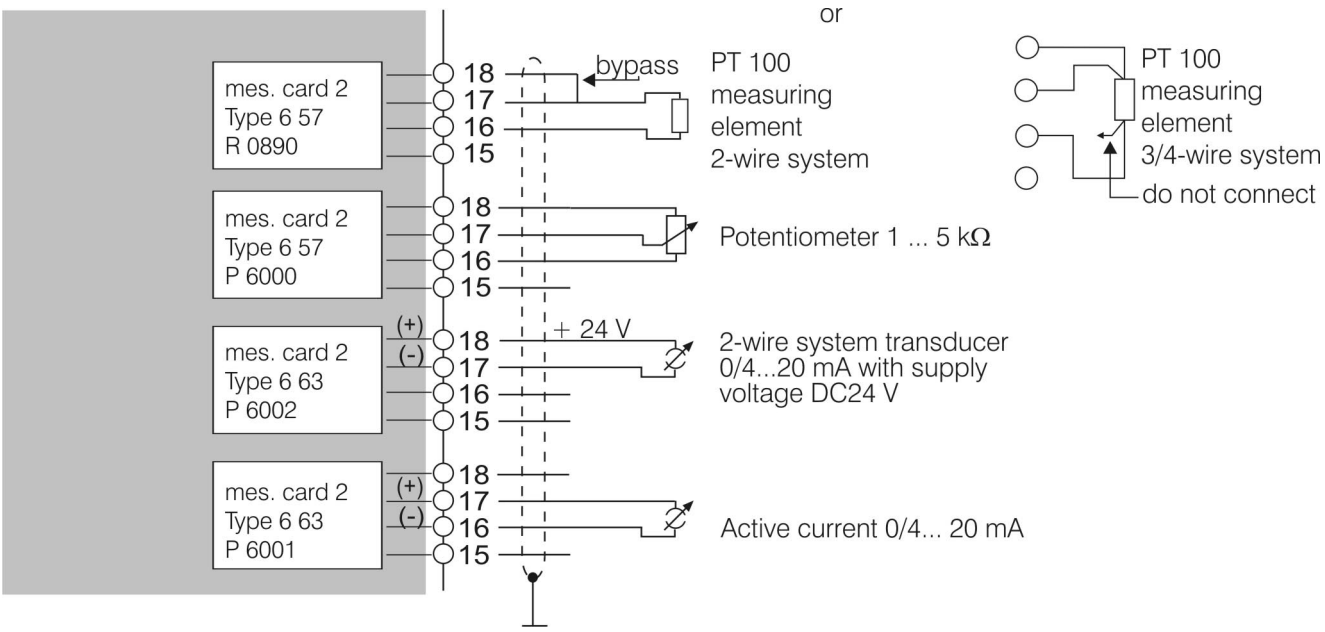
Lambda-Transmitter LT 2/KS1-DK



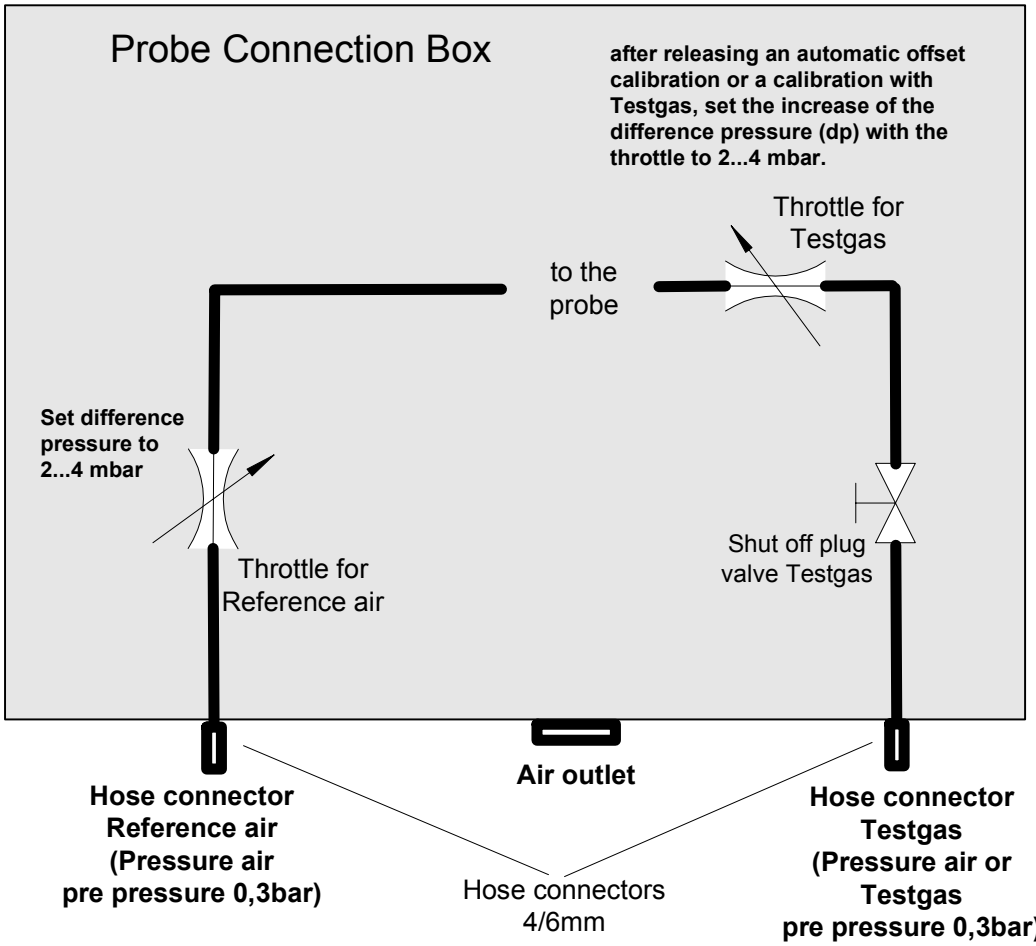
10.3.1 Relay module for digital outputs (optional extra)

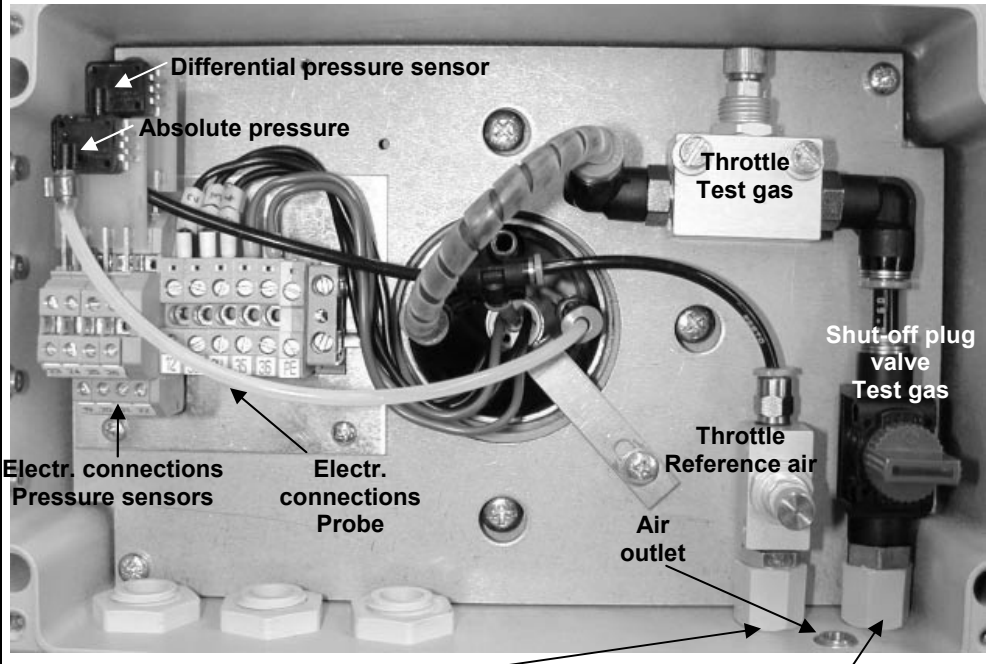


10.3.2 Analogue input 2 terminals 15...18 - connection variations



10.4 Pneumatic connection





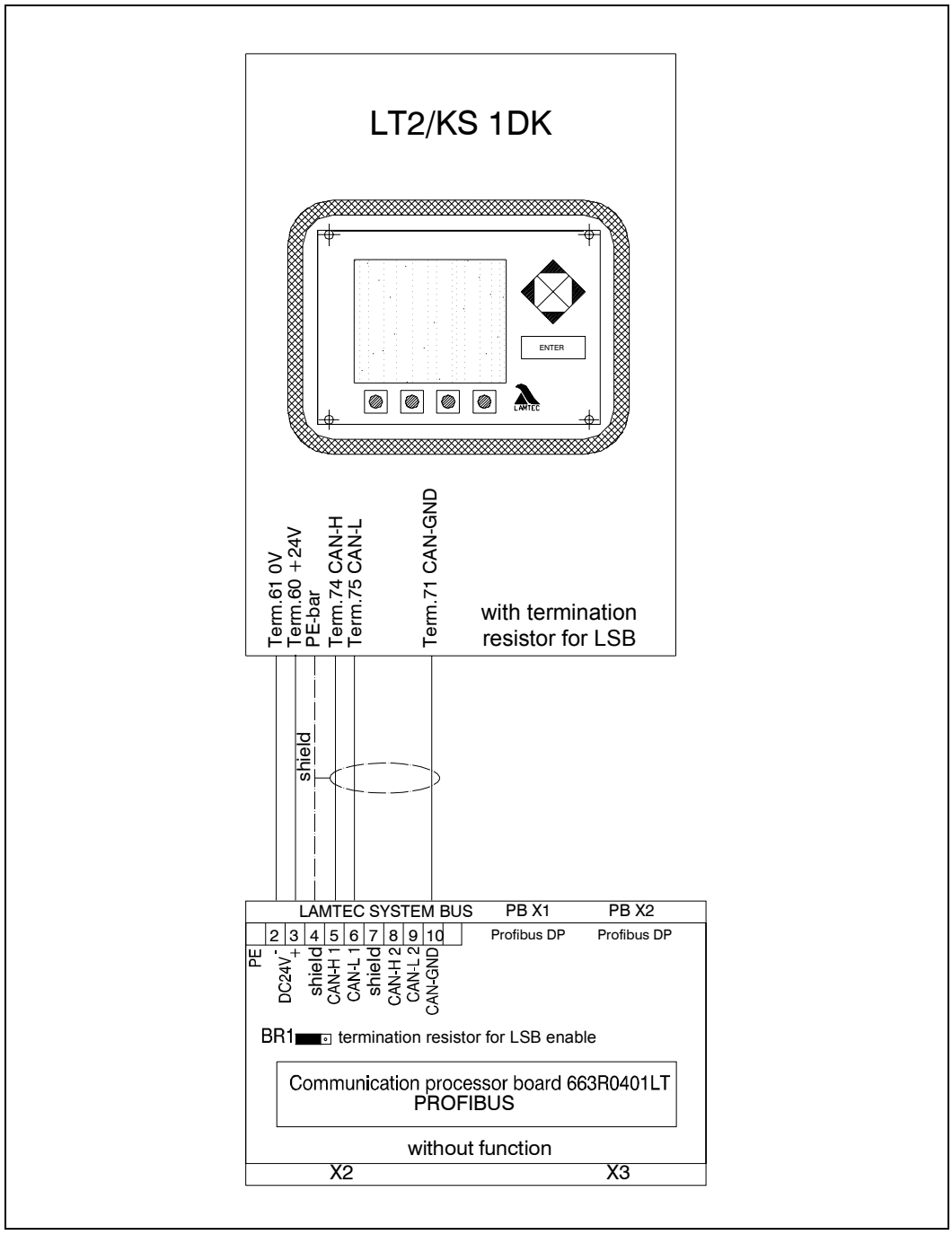
Hose connection for reference air (instrument air pre-pressure 0,3bar)
Hose connection for test gas (instrument air or calibrating gas pre-pressure 0,3bar)

10 Appendix

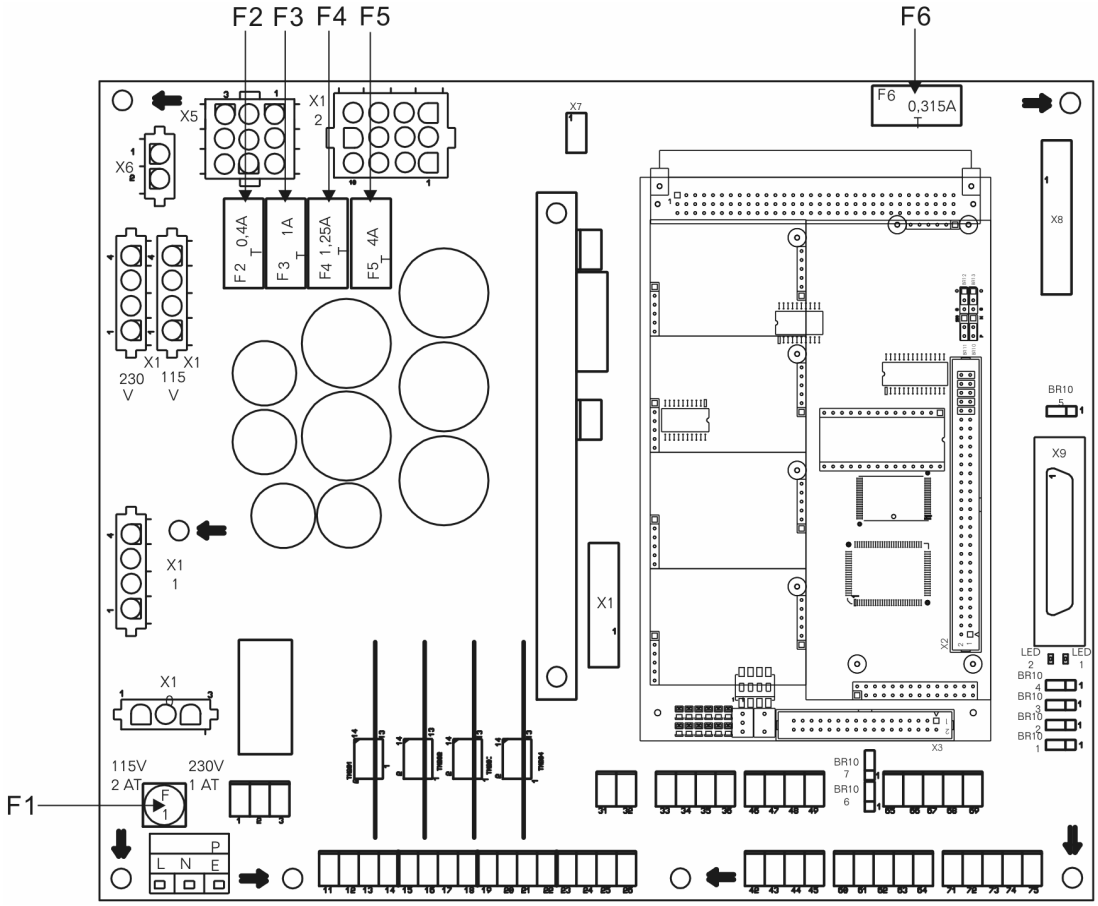
NOTE:
In the PCB of the probe there is a shut-off plug valve, Which must be opened uring calibration with compressed air or test gas.
Should be the probe installed in a inaccessibly location, a additional shut-off plug valve can be installed in the near of the LT2.
In such a case, the internal valve can be always opened.

CAUTION!
After calibration, the compressed air or test gas must be closed.
The reference air must be always connected and be opened.

10.5 Electrical connection to field bus module



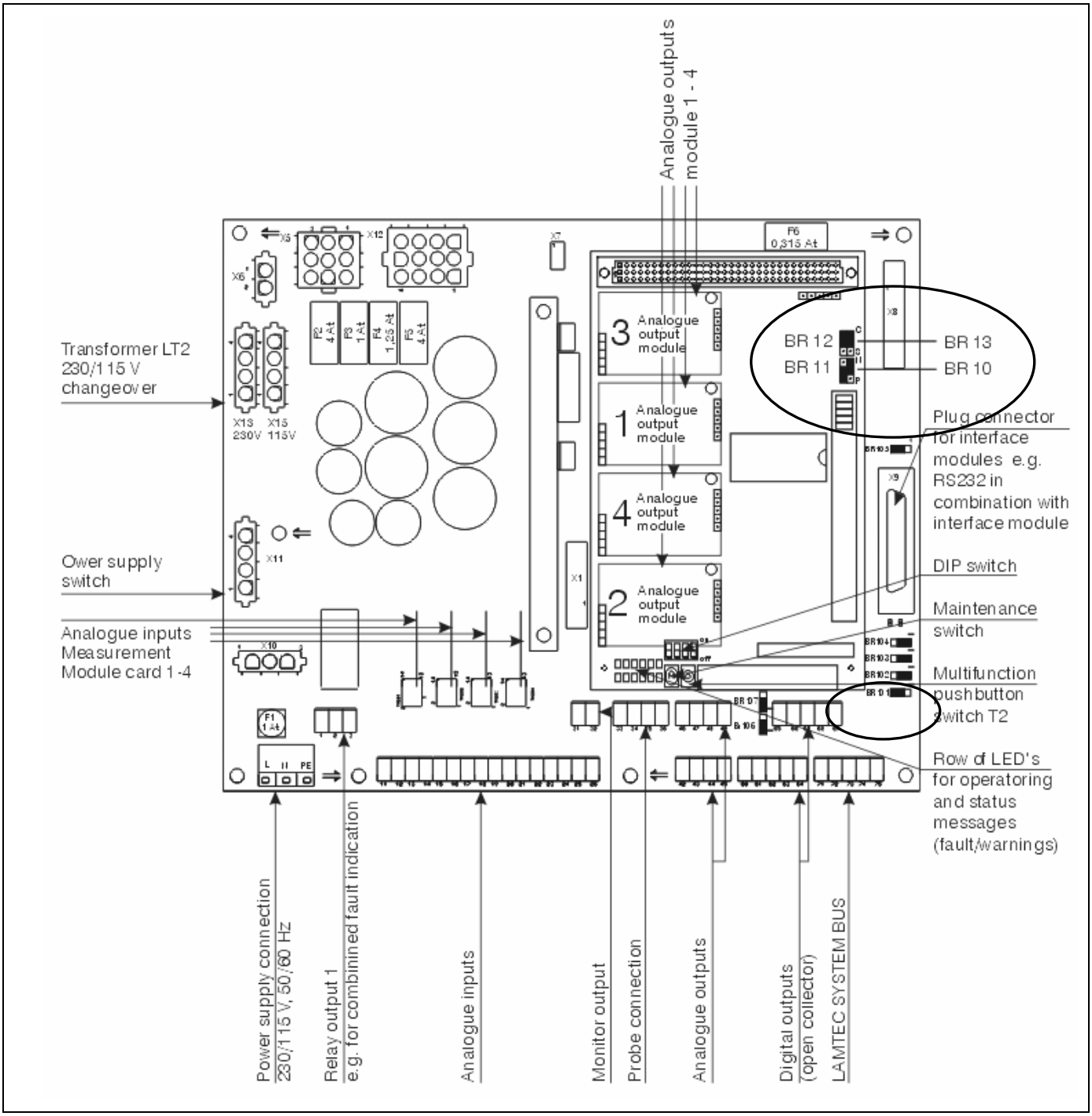
10.6 Fuses



Fuses:

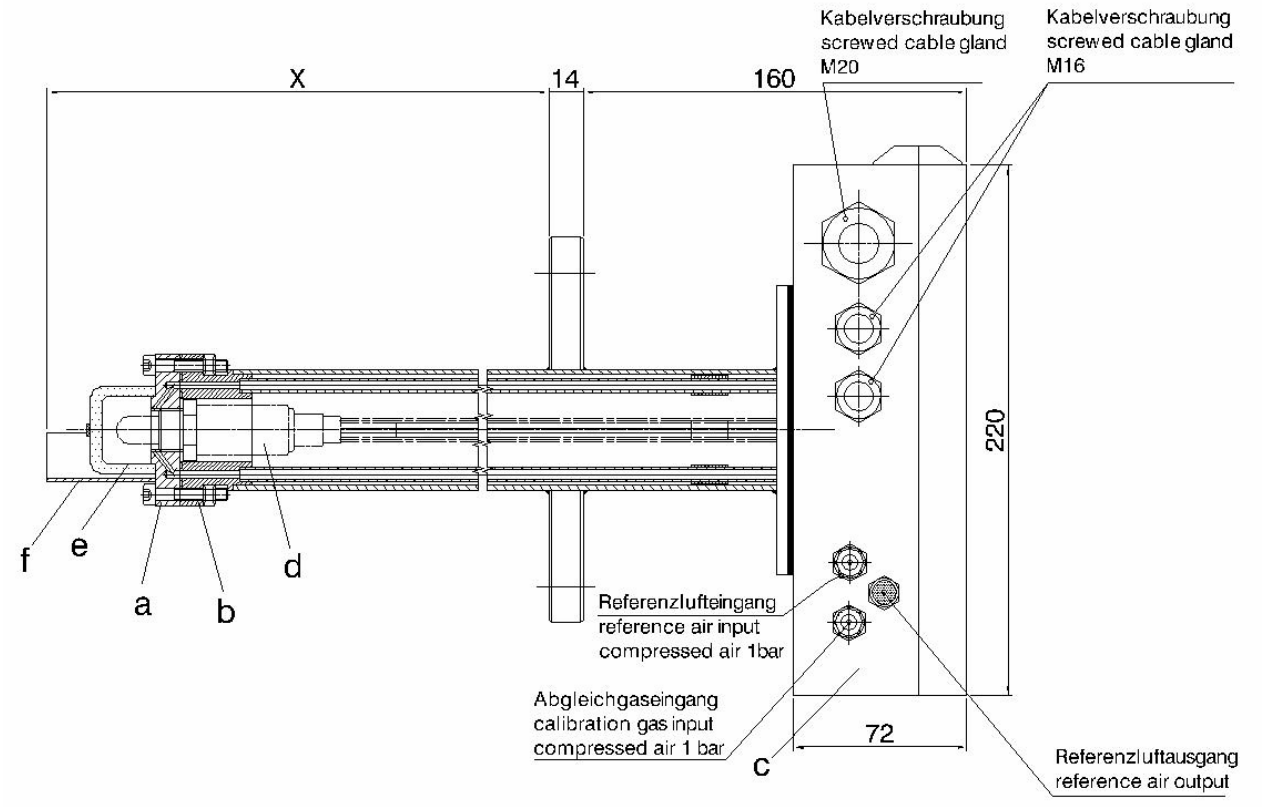
Designation	Value	Function
F1	1A slow-blow for 230 V, 2A slow-blow for 115 V 1,6A slow-blow for 230V when option “heating for wall mounting case”	Primary fuse
F2	0.4A slow-blow	Probe measurement electronics
F3	1A slow-blow	12 V for display background illumination
F4	1.25A slow-blow	± 5 V supply for processor board
F5	4A slow-blow	Probe heater and 24 V supply
F6	0.315A slow-blow	LAMTEC SYSTEM BUS

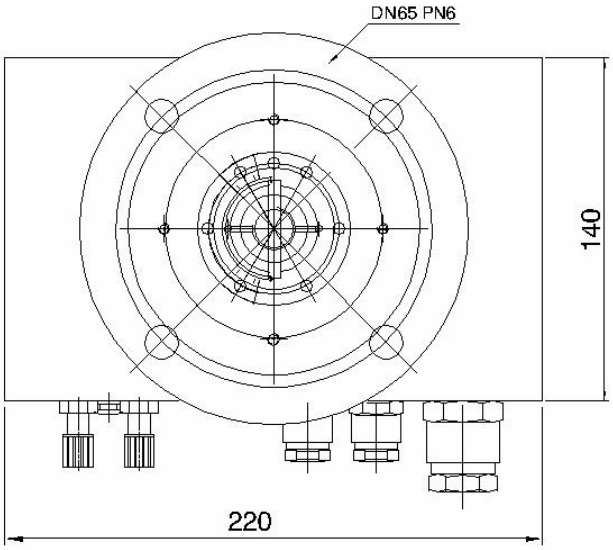
10.7 Jumpers



LAMTEC SYSTEM BUS	BR101 on mainboard:	Selection of LSB termination resistor : 1-2 disable 2-3 enable
	BR12 and BR13 on processor board: to position “C”	
Digital inputs:	BR106, 107:	Setting 1-2: Digital inputs based on device potential. Setting 2-3: Digital inputs electrically isolated.

10.8 Dimension drawing of KS1-DK combination probe

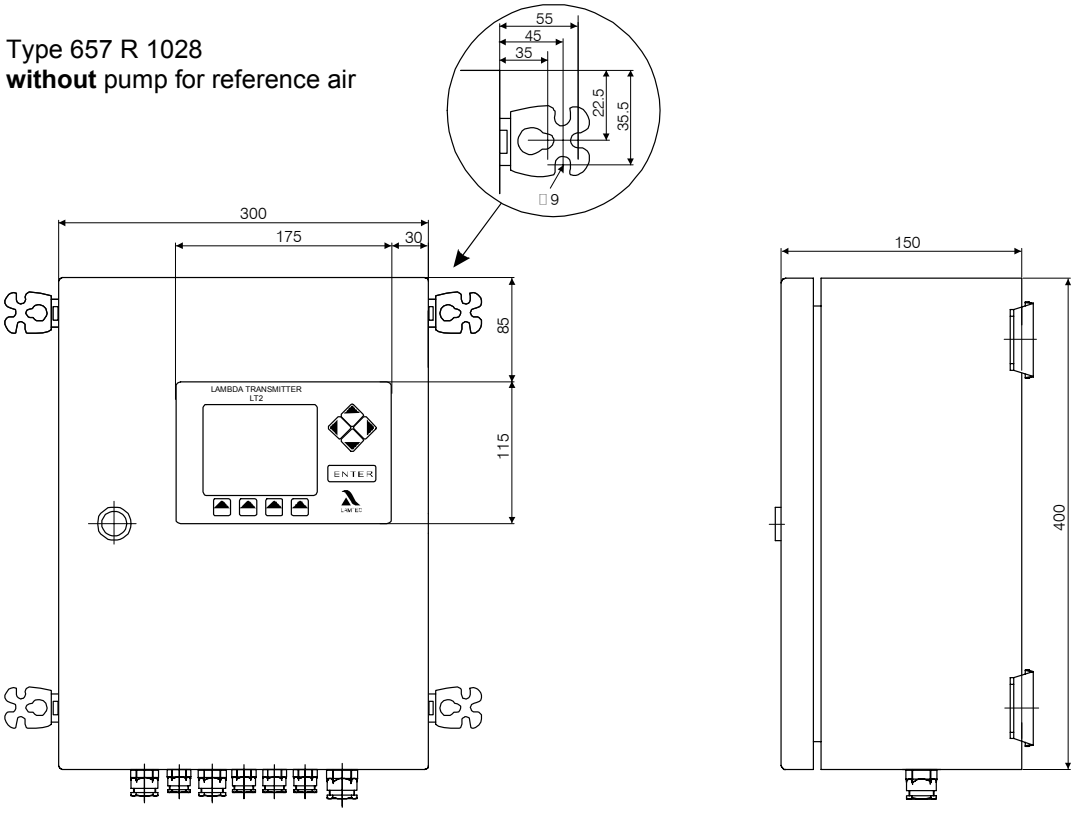




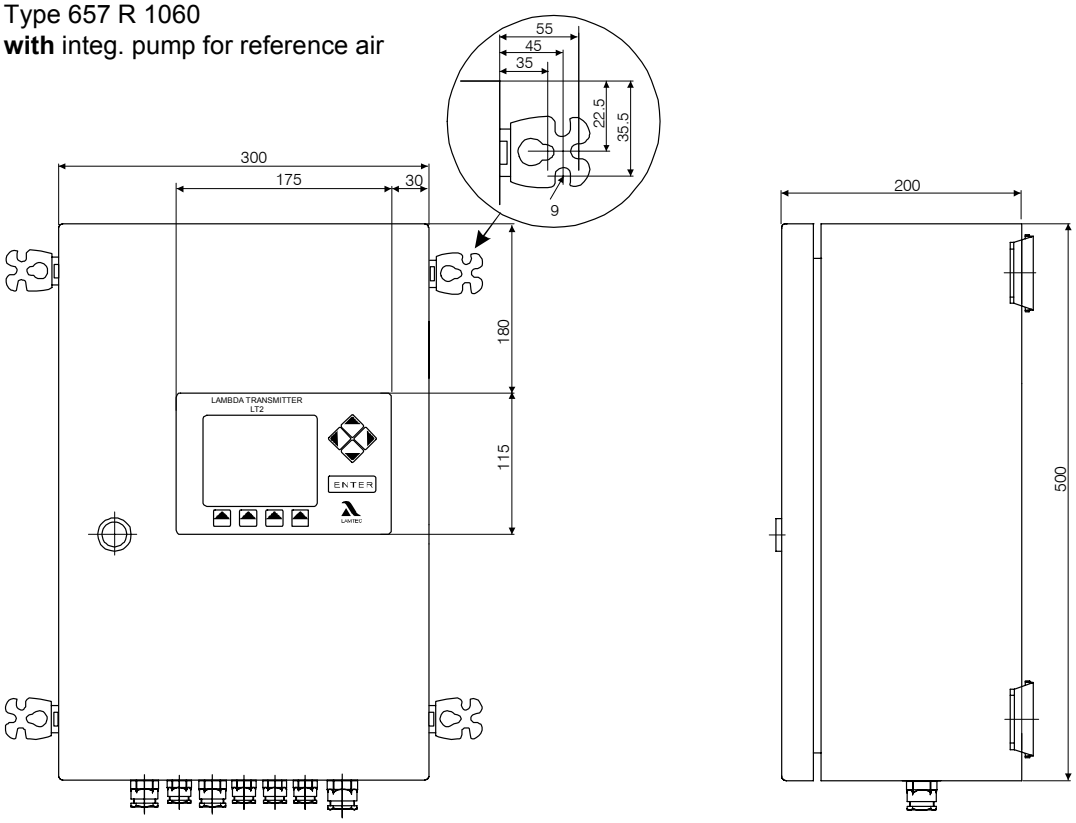
element	pieces	description	item number	material
a	1	Probe head	650 P 2055	1.4571
b	1	Reception tube with housing	650 P 2050...2052	1.4571
c	1	Probe connection box (PCB)	656 P 2034…2054	Die-cast AL
d	1	KS 1D probe	656 P 2030…2032	
e	1	Filter insert	650 R 2055	Hastelloy X
f	1	Baffle plate		

10.9 Dimension drawing of LT 2/KS1-DK in wall-mounted housing

Type 657 R 1028
without pump for reference air

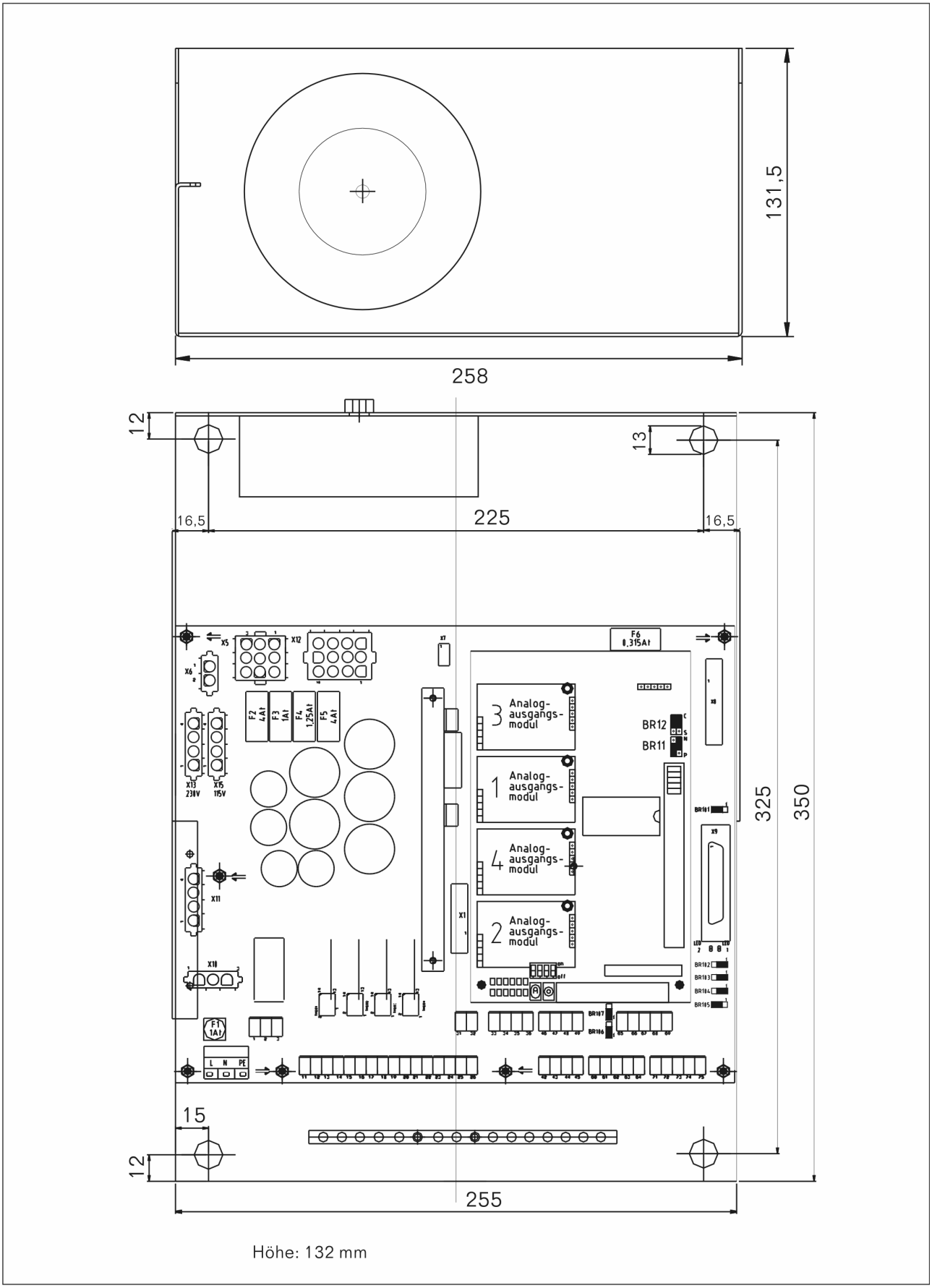


Type 657 R 1060
with integ. pump for reference air



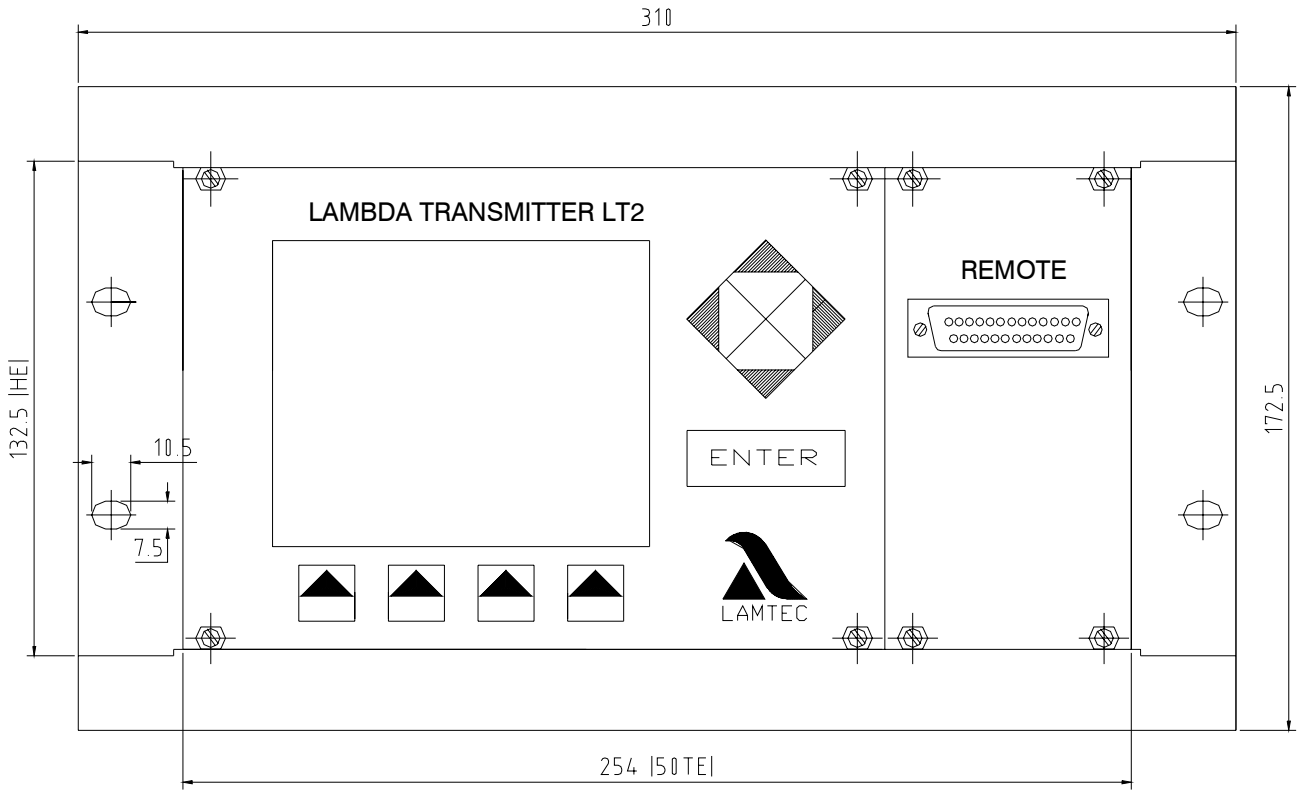
10 Appendix

10.10 Dimension drawing of LT 2/KS1-DK on mounting plate

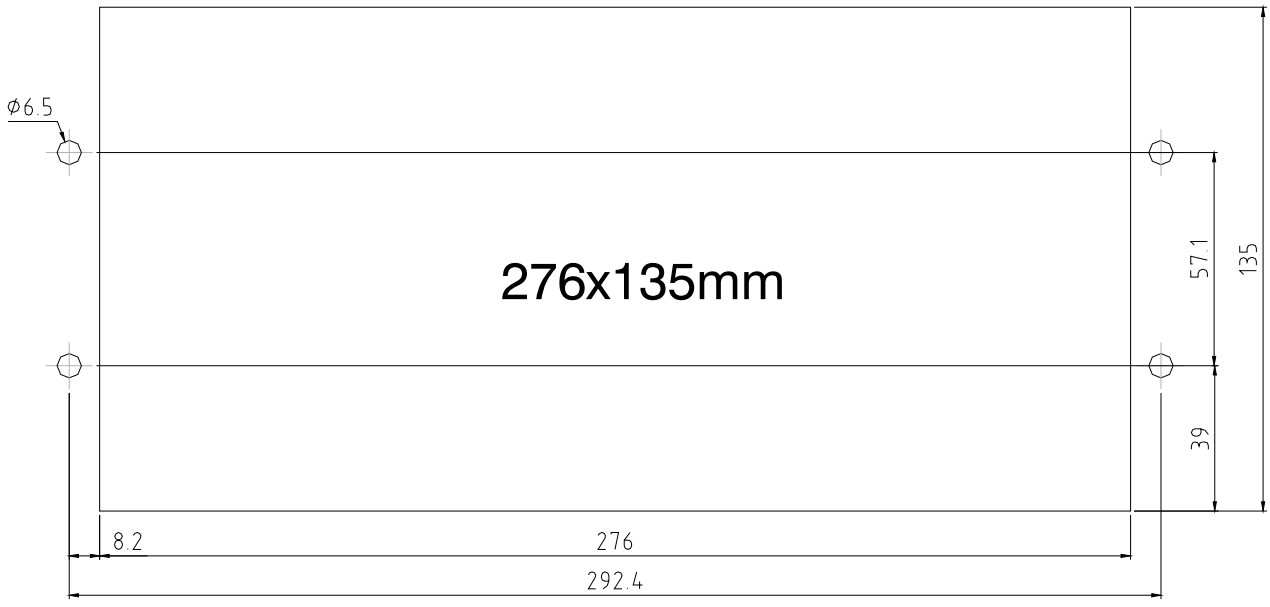


Höhe: 132 mm

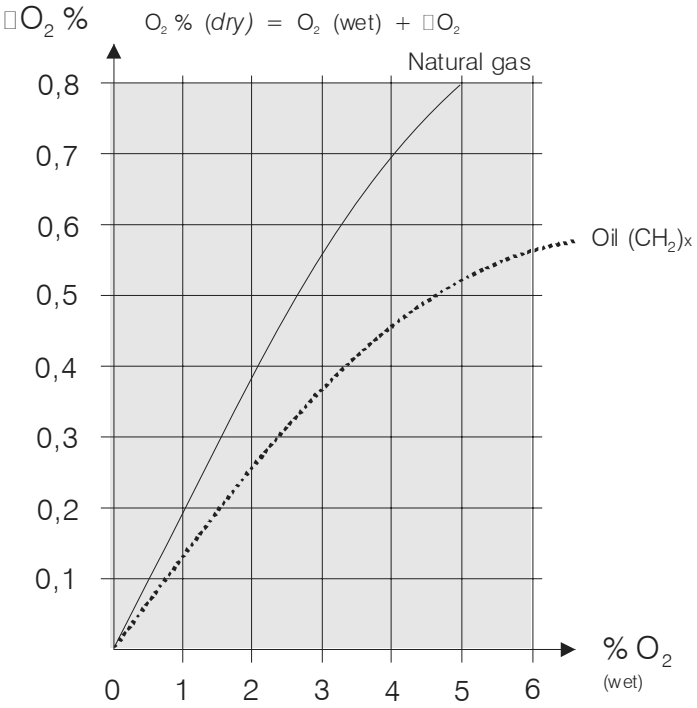
10.11 Dimension drawing of display and operating unit for panel installation



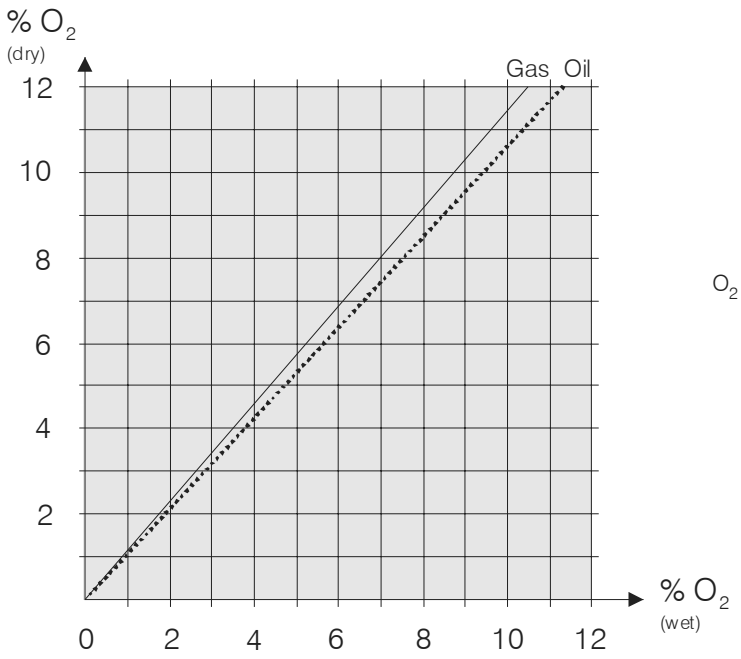
Tafelausschnitt / panel cutout / Découpe panneau



10.12 Wet/dry measurement – deviation, conversion table



Theoretical maximum deviations between wet/dry measurement of O_2 concentration with natural gas (CH_4) or oil $(CH_2)_x$ as fuel



O_2 (dry) = K • O_2 (wet)

O_2 concentration range	K constant Gas / CH_4	K constant Oil / $(CH_2)_x$
0 - 6 % O_2	1,18	1,115
6 - 12 % O_2	1,12	1,08
0 - 12 % O_2	1,15	1,10

Calibration diagram and conversion table for the concentration values of oxygen measured wet ($O_{2(n)}$) and dry ($O_{2(tr)}$).

11 EC Declaration of Conformity

11.1 LT 2/KS1-DK lambda transmitter

Month/year: .....November...../.....2003.....

Manufacturer: LAMTEC Meß- und Regeltechnik
für Feuerungen GmbH & Co KG
Address: Impexstraße 5, 69190 Walldorf, Germany

Product name: LT 2/KS1-DK lambda transmitter in wall-mounted housing
LT 2/KS1-DK on mounting plate
incl. all optional extras
Type 657R1028, 657R1032

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

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

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

Harmonised European Standards:

Reference number	Date of publication
DIN EN61326 (IEC 61326:1997 + IEC 61326-1/A1:1998 + IEC 61326-1/A2:2000 + Annexes 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	2004-05

The following basic standards have been adhered to:

Electrical Safety
DIN EN 61010-1

German Standards (according to NSR or MSR Article 5, Paragraph 1, Item 2:

Reference number	Date of publication
VDE 0110	September 1989
VDE 0100	

CE Mark displayed: Yes

Place, date: Walldorf, 17th November 2003

Legally binding signature: .....

The safety information in the supplied product documentation must be read and observed.

LAMTEC Meß- und Regeltechnik für Feuerungen GmbH & Co KG

Impexstraße 5
D-69190 Walldorf
Tel. (+49) 06227 6052-0
Fax (+49) 06227 6052-57
Internet: http://www.lamtec.de
e-mail: info@lamtec.de

LAMTEC Leipzig GmbH & Co KG

Schlesierstraße 55
D-04299 Leipzig
Tel. (+49) 0341 863294-00
Fax (+49) 0341 863294-10

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