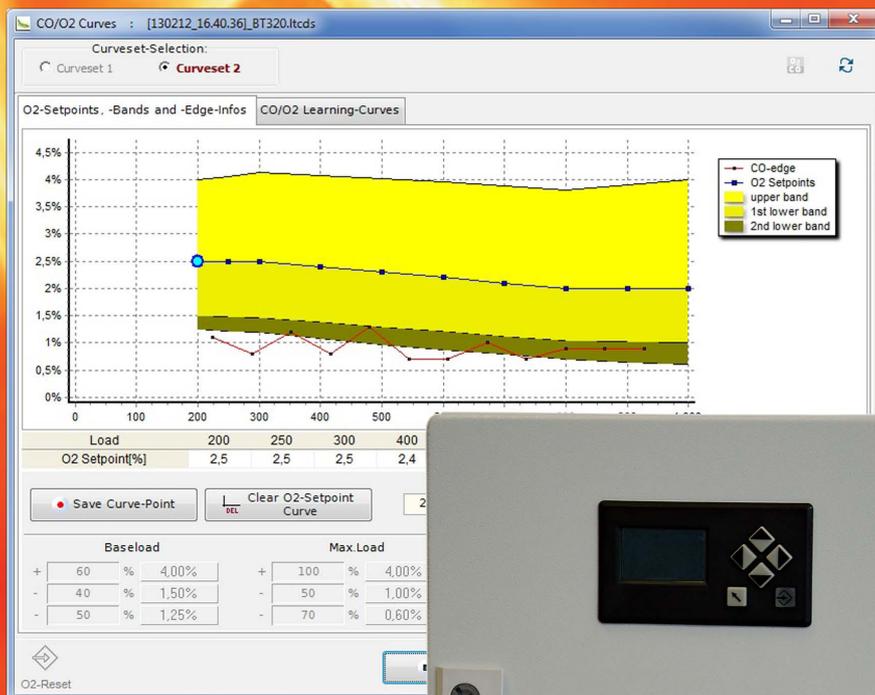


# Lambda Transmitter LT3-F Combination Probe KS1D



Application only in Connection with  
BT300/ETAMATIC/FMS/VMS to CO/O<sub>2</sub>-Control



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# 1 Important Information about the Manual

## 1 Important Information about the Manual

### 1.1 Validity of these Instructions

---

This manual describes the Lambda Transmitter LT3-F with all required components. The information in this document applies to the software version 1.0.0.0. If you utilise a different version, this can lead to other effects to your device than those described in this manual.

The CO/O<sub>2</sub> control described in this document must be activated in the burner control units stated above and the required measurement equipment must be connected.

The basic documentation to this commissioning supplement is:

- Manual of BurnerTronic BT300, BT320 ... BT340 (publication no. DLT1201)
- Manual of Lambda Transmitter LT3-F KS1D (publication no. DLT3140)

The lambda transmitter LT3-F must be operated with the CO/O<sub>2</sub> control option.

For this purpose, the following LAMTEC burner control systems can be used:

- BT300
- ETAMATIC/ETAMATIC S
- ETAMATIC OEM/ETAMATIC S OEM
- ETAMATIC V/ETAMATIC VS
- FMS
- VMS

The description of the CO/O<sub>2</sub> control can be found in the following documents:

- Commissioning supplement for the CO/O<sub>2</sub> control in connection with BT300 (publication no. DLT1209)
- Commissioning supplement for the CO/O<sub>2</sub> control in connection with FMS/VMS/ETAMATIC (publication no. DLT5015)

#### **NOTICE**

The current publications are available for download from the LAMTEC Website, [www.lamtec.de](http://www.lamtec.de).

---

# 1 Important Information about the Manual

## 1.2 Information on Using this Operating Manual

---

### **NOTICE**

Before starting work, you absolutely must read these instructions!  
Carefully observe all warning notes!

---

They contain important data and information, the compliance with which will ensure the function of the device and, in turn, reliable measurement results.

The device described here corresponds with the standard configuration.

Particular attention must be paid to **information** and **warnings**. These are indicated by respective pictograms. They serve to safeguard your personal safety and help you to avoid operating errors.

This operating manual contains the information required for the product to be used in a manner that is compliant with its intended use. It is intended for technically qualified personnel who are appropriately trained and who possess the relevant knowledge in the area of measurement, control and steering technology.

This operating manual is an inherent part of the delivery. For reasons of clarity, it is not possible to cover all possible designs of the described system. Please contact us if you wish to set up, operate, or maintain the device differently from the instructions given here.

## 2 General Safety Instructions

## 2 General Safety Instructions

### 2.1 Classification of the Safety Instructions and Warnings

---

The following symbols are used in this document to draw the user's attention to important safety information. They are located at points where the information is required. It is essential that the safety information is observed and followed, and that applies, in particular, to the warnings.

#### **DANGER!**

This draws the user's attention to imminent danger. If it is not avoided, it will result in death or very serious injury. The plant or something in its surroundings could be damaged.

---

#### **WARNING!**

This draws the user's attention to the possibility of imminent danger. If it is not avoided, it may result in death or very serious injury. The plant or something in its surroundings could be damaged.

---

#### **CAUTION!**

This draws the user's attention to the possibility of imminent danger. If it is not avoided, it may result in minor injuries. The plant or something in its surroundings could be damaged.

---

#### **NOTICE**

This draws the user's attention to important additional information about the system or system components and offers further tips.

---

The safety information described above is incorporated into the instructions.

In this connection, the operator is requested to:

- 1 Comply with the accident prevention regulations whenever work is being carried out.
- 2 Do everything possible in the circumstances to prevent personal injury and damage to property.

## 2 General Safety Instructions

### 2.2 Proper Use - Conditions of Use

---

#### Operation

The LT3-F lambda transmitter is an electronic data interpreting device which is used in conjunction with the KS1D combination probe for the continuous measurement of the O<sub>2</sub> concentration and the oxidising components (CO/H<sub>2</sub>) in non-combustible gases in the superstoichiometric area.

#### Prerequisites

It is assumed that plant planning, mounting, installation, commissioning, maintenance, and service work will be carried out by sufficiently trained personnel and that this work will be checked by responsible skilled personnel. It must be particularly noted that

- the operation complies with the technical data and specifications regarding permissible use, mounting, connection, and environment and operating conditions (refer to the contract documents, the device user information, rating plates, etc.).
- work will be carried out in accordance with the local, plant-specific circumstances and with regard to the operational risks and directives.
- all the measures required to preserve the value, e.g. for transportation and storage as well as maintenance and service, are maintained.

#### Intended use

The product described here has left the factory in a flawless, safe and checked condition and it must be maintained exclusively in the manner that is described by the manufacturer. Equally, the proper transportation, correct storage and setup as well as the careful operation and maintenance, are critical for the flawless and safe operation of the device. Sufficiently qualified personnel must be used to install and operate this product. They must be familiar with the security advice and warnings specified here and ensure they can be implemented flawlessly. Unqualified persons working on the device or the warning information provided here or on the device not being observed could result in serious personal injury and / or damage to property. The device is being used as intended if the device is being used solely for the application specified in the technical description. Auxiliary devices or those from other manufacturers must be recommended or authorised by LAMTEC. Provided the safety information and operating directives specified in this manual are observed, this device should not present any risks in terms of damage to property or the health of personnel.

### 2.3 Permissible Users

---

#### Qualified personnel

The person responsible for safety absolutely must guarantee that

- only qualified personnel perform work on the system parts.  
Due to their training, education, experience, or instruction and due to their knowledge of pertinent standards, provisions, accident prevention regulations, and system conditions, qualified personnel are authorized to perform these tasks by the person responsible for the safety of people and the system. It is decisive that this personnel must be able to recognise and prevent risks on time.  
Experts are considered to be people according to DIN VDE 0105 or IEC 364 or directly comparable standards like DIN 0832.
- These persons must have access to the provided operating manual and any pertinent order-related documentation during all work and observe these documents within the scope of preventing risks and damage.

#### User groups

For the handling of the lambda transmitter LT3-F, three user groups are required:

- Service technicians of LAMTEC or its OEM customers and/or trained customer personnel:
  - Qualified technicians/engineers → have very good knowledge of the device.
  - SERVICE access level - password-protected
- Operators, customer fitters, technicians for instrumentation and control technology, electricians, and electronic engineers → have introductory knowledge of the device.
  - CUSTOMER access level - password-protected
- Operating personnel with basic knowledge
  - OPERATION access level - no password

## 2 General Safety Instructions

### 2.4 Safety Equipment/Safety Measures

#### Hazards from electrical equipment

The Lambda Transmitter LT3-F combination probe is equipment for use in industrial electrical power installations. Always switch off the power when working on mains connections or mains voltage. If contact protection has been removed, reattach it before switching on the power supply again. Damage to health or equipment may result from improper use or improper handling.

#### NOTICE

To avoid damage, always observe the respective security notices.

#### Preventive measures for improving operating safety

If the LT3-F is used in conjunction with control and steering technology, the operator must ensure that any breakdown or failure of the LT3-F device does not cause inadmissible damage or dangerous operating states. To avoid faults which could cause direct or indirect personal or material damage, the operator must ensure that:

- the responsible maintenance personnel can be reached at any time and as quickly as possible
- the maintenance personnel are trained to correctly respond to faults with the Lambda Transmitter LT3-F and the associated malfunctions
- in the case of doubt, the faulty equipment can be switched off immediately
- A switch-off does not lead to direct follow-up problems.

#### Avoiding consequential damages

To avoid consequential damages in the event of failure, which could cause direct or indirect personal or material damage, the owner must ensure that qualified personnel can assess the faults and initiate appropriate measures to tackle them.

#### Protect against gas leakage from the gas-bearing channel

The combination probe KS1D is fitted directly to the gas-bearing channel via the probe installation fitting (PIF). If the combination probe KS1D or the probe installation fitting (PIF) are dismantled, depending on the plant but particularly in the case of excess pressure, aggressive and / or hot gas can seep out of the channel and this could pose a serious health hazard to an unprotected operator if suitable safety measures have not been taken previously. For prevention, suitable protective measures must be taken in advance.

#### WARNING!

In the case of excess pressure and temperatures in excess of 200 °C in the gas channel, gases could escape when dismantling the combination probe KS1D or the probe installation fitting (PIF).

- ▶ Always switch off the plant prior to opening. If this is not possible, wear protective clothing and a mask.
- ▶ Fix respective warning information in close proximity to the mounting site.
- ▶ Immediately seal the opening again.

#### WARNING!

#### Danger from electrical shock

The device contains live parts and touching these parts could cause electric shock.

- ▶ Before opening the housing, disconnect the mains plug!

## 2 General Safety Instructions

### Decommissioning/recommissioning

The LT3-F Lambda Transmitter and the KS1D combination probe are a high-quality, electronic measuring system. It therefore requires careful handling in all situations - decommissioning, transport, and storage.

#### **NOTICE**

Do not switch off the LT3-F Lambda Transmitter as long as the KS1D combination probe is mounted. Not even if the associated plant has been brought to a standstill. Residual gases will cause corrosion and could damage the probe.

- ▶ Do not store the device outside without any protection!
  - ▶ Always store in a dry location and, if possible, keep in the original packaging.
  - ▶ When uninstalling, protect the ends of cables and the connectors from corrosion and soiling. Corroded connectors can cause malfunctions.
  - ▶ If possible, always transport in the original packaging.
-

## 3 Product Description

### 3 Product Description

#### 3.1 Applications

---

The LT3-F lambda transmitter has been developed to use in conjunction with the KS1D combination probe for the simultaneous measurement of the O<sub>2</sub> concentration and oxidising components (CO/H<sub>2</sub>), displayed as CO equivalents (CO<sub>e</sub>), usually in the flue gases from combustion systems in the superstoichiometric area ( $\lambda > 1$ ).

Application only in connection with CO/O<sub>2</sub> control. The fail-safe function is only valid for the hole system, not for single components.

### 3.2 Declaration of Conformity



## EU-Konformitätserklärung

EU Declaration of Conformity  
Déclaration de Conformité UE

**Wir**  
We / Nous

**LAMTEC Meß- und Regeltechnik für Feuerungen GmbH & Co. KG**  
**Wiesenstraße 6**  
**D-69190 Walldorf (Baden)**

**erklären,**  
dass das Produkt  
declare that product /  
déclarons que produit

**LT3F – Lambda Transmitter**

**inklusive**  
inclusive / y compris

**Varianten**  
variants / variantes

**LT3F im Wandaufbaugeschäuse**

LT3F in wall mounting housing / LT3F coffret mural

**mit User Interface UI300 (IP54)**

With User Interface UI300 / avec User Interface UI300

657R50

657R50-20...

**Sonden**

probes / sondes

**KS1D**

656R2000

656R2010

**KS1D-HT**

656R2015

**mit Optionen**

with options / avec options

**Sondenanschlusskasten SAK**

Probe connection box PCB /

Bâtiment de raccordement de sondes BRS

656R3025

auf welche sich diese Erklärung bezieht, mit den folgenden Norm(en) übereinstimmt  
to which this declaration relates conforms to the following standard(s)  
sur laquelle cette déclaration se réfère, et conformément aux dispositions de la norme(s)

DIN EN 16340: 2014-10

DIN EN 13611: 2011-12

DIN EN 60730-1: 2012-10

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E-Mail: [info@lamtec.de](mailto:info@lamtec.de)



gemäß den Bestimmungen der folgenden Richtlinie(n).  
according to the provisions of the following directive(s) / conformément aux dispositions de la directive(s)

| Nummer (Number / Numéro)                         | Text (Text / Texte)   |
|--|---|
| <b>2014/35/EU</b><br>2014/35/EU/<br>2014/35/UE   | <b>Niederspannungsrichtlinie</b><br>Low Voltage Directive<br>Directive basse tension      |
| <b>2014/30/EU</b><br>2014/30/EU/<br>2014/30/UE   | <b>EMV-Richtlinie</b><br>EMC Directive<br>Directive CEM                                   |
| <b>2011/65/EU</b><br>2011/65/EU/<br>2011/65/UE   | <b>RoHS</b><br>RoHS<br>RoHS   |
| <b>2009/142/EG</b><br>2009/142/EC<br>2009/142/CE | <b>Gasverbrauchseinrichtungen</b><br>Gas Appliance Directive<br>Directive appareils à gaz |

Das Datenblatt und gegebenenfalls die Basisdokumentation sind zu beachten.  
The data sheet and basic documentation, if any, have to be considered.  
La consultation de la fiche technique, et éventuellement de la documentation technique de base, est requise.

Hinweise zur Anwendung der Richtlinie 2014/35/EU und 2014/30/EU:

Die Konformität mit 2009/142/EG setzt die Übereinstimmung mit 2014/35/EU voraus und beinhaltet diese.  
Die Konformität mit 2014/30/EU ist nach Einbau des Bauteils in das Endgerät nachzuweisen und zu erklären.

Remarks regarding the application of directive 2014/35/EU and 2014/30/EU:  
Conformity with 2009/142/EC presupposes that requirements of 2014/35/EU are fulfilled and includes these.  
Conformity with 2014/30/EU has to be proved and declared after installation of the component.

Remarques sur l'application des directives 2014/35/UE et 2014/30/UE:  
La conformité avec la 2009/142/CE intègre la conformité avec la 2014/35/UE.  
La conformité avec la 2014/30/UE après l'installation de l'appareil est à prouver et à déclarer.

Anbringung der CE-Kennzeichnung: **ja**  
Placing of the CE marking / L'apposition du marquage CE

|                             |                       |
|-----------------------------|-----------------------|
| Produkt (product / produit) | Text (Text / Texte)   |
| <b>LT3-F + KS1D</b>         | <b>CE-0085 CQ0150</b> |

Rechtsverbindliche Unterschrift  
Authorized signature / Signature autorisée

Waldorf, 20.04.2016  
H. Weber, General Manager

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## 4 Mounting and Functions

### 4 Mounting and Functions

#### 4.1 Designs and Accessories of the KS1D Combination Probe

The KS1D combination probe permits a simultaneous measurement of the O<sub>2</sub> concentration and combustible, oxidising gas components (CO/H<sub>2</sub>) displayed as CO equivalent (CO<sub>e</sub>), in the flue gases from combustion systems in the superstoichiometric area ( $\lambda > 1$ ) in situ (directly in the flue gas).



Fig. 4-1 Standard design of the KS1D combination probe

- 1 KS1D combination probe in standard housing  
Standard cable length 2 m, PTFE, with connecting plug
- 2 Probe installation fitting (PIF)
- 3 Measuring gas extraction device (GED)



Fig. 4-2 KS1D combination probe without housing

**Alternatively:**



Fig. 4-3 KS1D combination probe in HT design

- 1 KS1D combination probe in high-temperature housing  
Standard cable length 2 m, PTFE, with connecting plug
- 2 Flue gas bypass tube

## 4 Mounting and Functions

### 4.2 Connection Extension

---

#### **Extension via probe terminal box**

In preparation.

#### **Extension via extension cable**

For distances > 2 m, extension cables in lengths of 2 m and 5 m are available.

#### **NOTICE**

The maximum distance between LT3-F and combination probe KS1D may not exceed 10 m. With longer distances the approval of the system for continuous operation expires.

For distances longer than 10 m the risk of EMC increases.

LAMTEC assumes no responsibility for correct, error-free functions.

---

### 5 Display and Operational Controls

To display and operate LT3-F, the user interface is integrated into the front door of LT3-F (included in the standard scope of supply).

**Functions:**

- Reading of the O<sub>2</sub> and CO<sub>e</sub> measured values
- Password entry
- Information → regarding the probe, fuel, warnings, faults, software version, CRC, and serial number
- Calibration of measurement
- Settings → maintenance, filter time, analogue output, probe replacement, display, limit values, and digital outputs



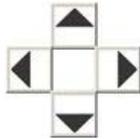
*Fig. 5-1 LT3-F user interface*



*Fig. 5-2 Housing with user interface*

## 5 Display and Operational Controls

### 5.1 Operation



Using the arrow keys you can navigate within the menus.

In the process, move the keys and to the right or left by one to make a selection.

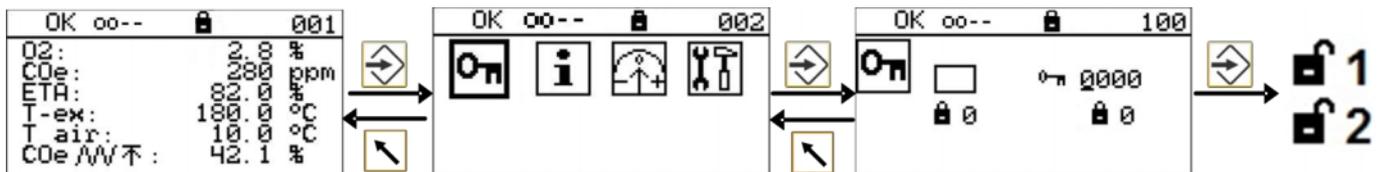
ENTER ENTER takes you to menu entries or to the edit mode in the case of selected parameters or values.

With the keys and the currently selected value can be changed accordingly. Hold down the respective key and the value will count automatically up or down.

BACK BACK leaves the window, menu, or edit mode.

### 5.2 Menu Structure

#### 5.2.1 Password Entry Menu Structure



Without access level

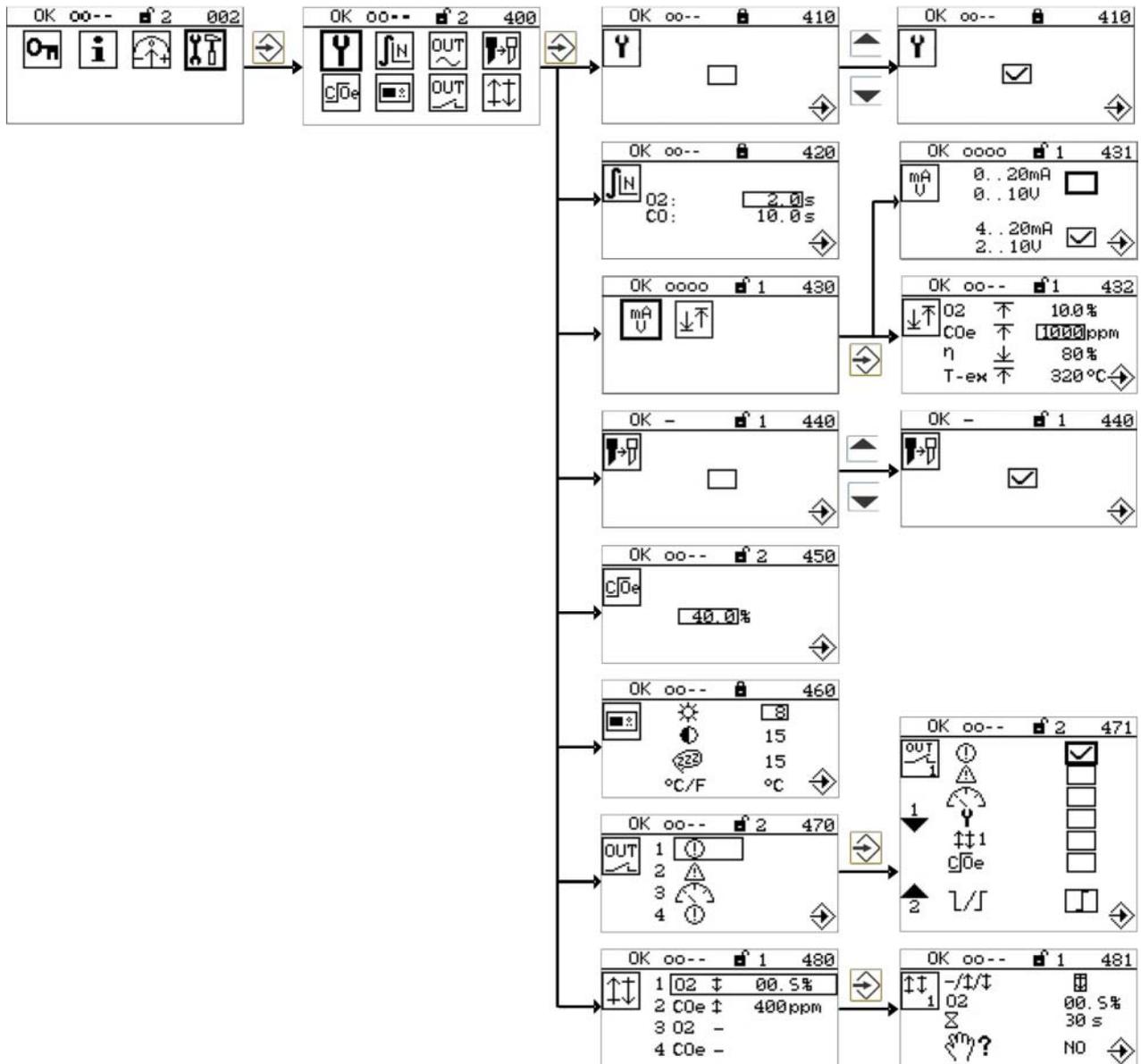
Customer access level

Service access level



## 5 Display and Operational Controls

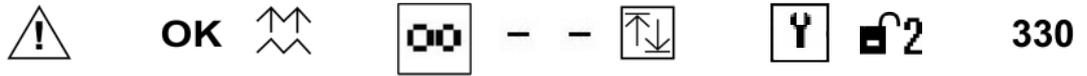
### 5.2.4 Settings Menu Structure



## 5 Display and Operational Controls

### 5.3 Status Line

The status line contains information about LT3-F, including the device family.



#### Description status line:

-  Active fault/warning
- OK** Operating mode OK
-  Heat-up (cold start)
-    Status of limit values 1-4
-  Active limit value not triggered
-  Non-active limit value (off)
-  Active limit value undershot/exceeded
-  Active maintenance mode
-  Without access level
-  Access level 1 - Customer
-  Access level 2 - Service
- 330** Window number

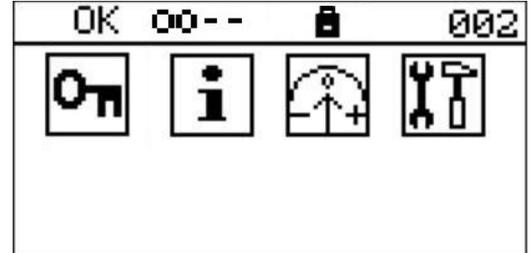
## 5 Display and Operational Controls

### 5.4 Main Menu

Main display

|   |      |     |     |
|---|------|-----|-----|
| OK  | oo-- | 🔒   | 001 |
| O <sub>2</sub> :  | 2.8  | %   |     |
| CO <sub>e</sub> :   | 280  | ppm |     |
| CO <sub>e</sub> $\overline{\wedge}$ $\overline{\nabla}$ : | 42.1 | %   |     |

Main menu



The following values are displayed:

- O<sub>2</sub> value, resolution 0.1%
- CO<sub>e</sub> value (recommended 1,000 ppm), resolution 1 ppm
- CO<sub>e</sub>:  Probe signal dynamics
- $\overline{\nabla}$  CO edge signal reached/exceeded

The factory-set reaction threshold lies at 40%. The display shows whether the reaction threshold is reached. When the reaction threshold is reached, the CO edge signal is present and the CO control becomes active. This is shown through a symbol in the display  $\overline{\nabla}$  or can be read via the LSB remote software in Parameter 444. The desired response threshold be set on the display or using Parameter 453 of the LSB remote software. Access level 2 is required for service!

Press ENTER  to access the main menu.

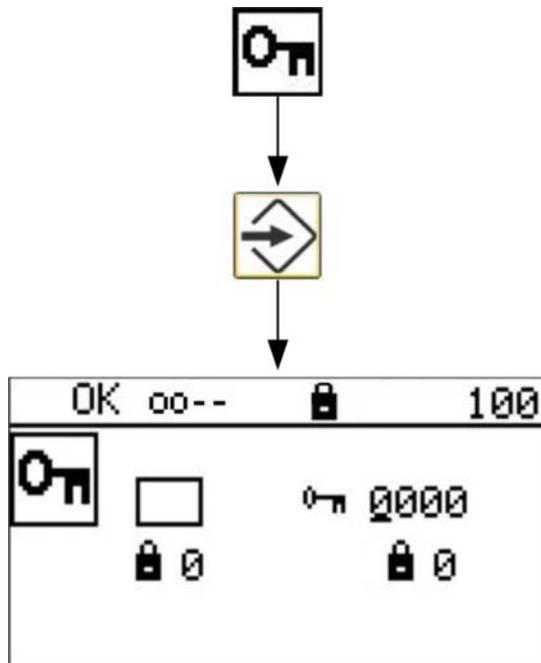
Meaning of the symbols:

-  Password entry
-  Information regarding the probe and fuel, warnings and faults, software version, CRC, and serial number
-  Calibration of measurement
-  Settings (maintenance, filter time, analogue output, probe replacement, display, limit values and digital outputs)

## 5 Display and Operational Controls

### 5.4.1 Main Menu - Password Entry

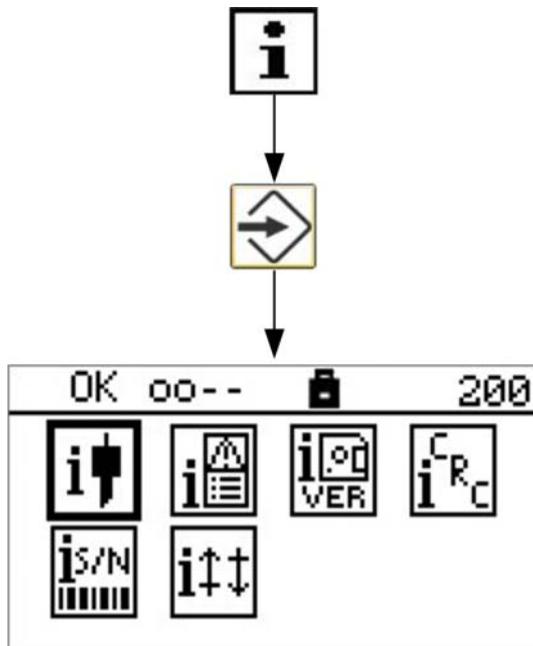
---



## 5 Display and Operational Controls

### 5.4.2 Main Menu - Information

---

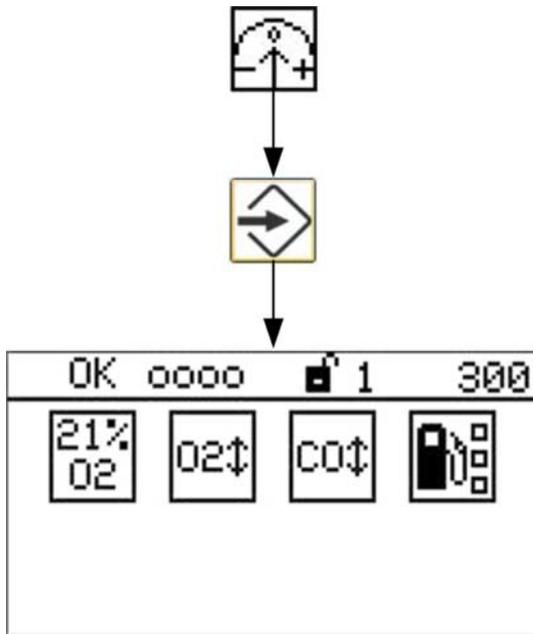


#### Meaning of the symbols:

-  Measured values and probe data
-  Fault/warning history
-  Software version of LT3-F and display
-  CRC checksums
-  Serial number
-  Manual reset of the limit values if they are set to manual reset

## 5 Display and Operational Controls

### 5.4.3 Main Menu - Calibration



#### Meaning of the symbols:



Offset of calibration to 21% O<sub>2</sub> (air calibration)



CO<sub>e</sub> calibration



O<sub>2</sub> calibration



Fuel changeover

#### Required access level

Without

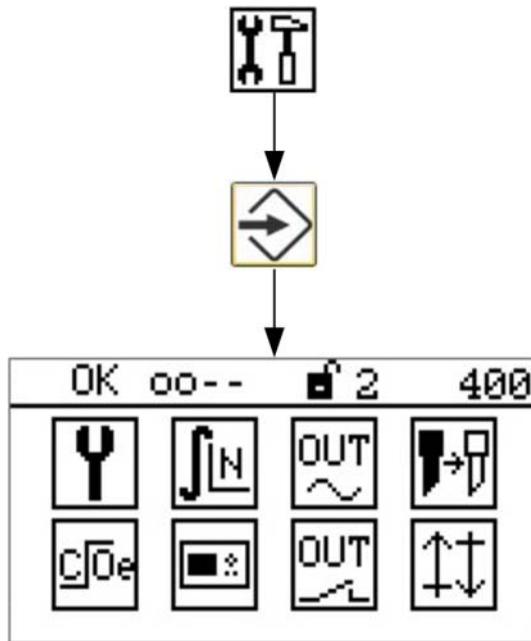
At least 1 (Customer) or higher

At least 1 (Customer) or higher

At least 1 (Customer) or higher

## 5 Display and Operational Controls

### 5.4.4 Main Menu - Settings



#### Meaning of the symbols:

|   |                                    | Required access level           |
|---|------------------------------------|---------------------------------|
|  | Maintenance mode                   | Without                         |
|  | Filter time of the measured values | Without                         |
|  | Analogue outputs                   | At least 1 (Customer) or higher |
|  | Triggering of probe replacement    | At least 1 (Customer) or higher |
|  | CO <sub>e</sub> trigger threshold  | At least 2 (Service)            |
|  | Display parameters                 | Without                         |
|  | Digital outputs                    | At least 2 (Service)            |
|  | Limit values                       | At least 1 (Customer) or higher |

### 6 Commissioning

 **WARNING!**

Prior to commissioning, carefully read the manual and heed the instructions.

The measuring system may be operated only by trained and instructed personnel!

Improper working/operation can cause death, serious bodily injury and/or considerable material damage.

---

**NOTICE**

Before commissioning, the KS1D combination probe and all alarm/signal outputs are connected, as described in Chapter 6.2 *Installation* in these operating instructions, to the LT3-F Lambda Transmitter.

---

 **WARNING!**

**Before actuating the main switch for the voltage supply, ensure all housings (evaluation electronics and terminal boxes, electrical connection of the probe) are sealed in accordance with the instructions!**

---

### 6.1 Operating Conditions

---

#### NOTICE

If the LT3 is being used for O<sub>2</sub> control or the LT3-F for CO/O<sub>2</sub> control, it may happen, that the connected LSB-modules are not be controlled correctly. The LSB modules start to flash red and the output values are disturbed.

To avoid this, the ETAMATIC or when FMS/VMS then the connected communications processor board/fieldbus module requires a software update to the latest version.

Please check the version before commissioning.

Shown on the ETAMATIC:      Using PC software for remote control → view → version →  
„Software Version Communication Processor“  
Software-EPROM on processor board in ETAMATIC

Shown on the FMS/VMS:      Check on the label 'Software' printed on the outside of the  
housing of communications processor board / fieldbus mod-  
or                                      ule

Using PC software for remote control → view → version →

"Software Version Secondary Communication Processor"  
Software-EPROM in communications processor board/field-  
bus

Function up from software version for communication processor for LSB:

|  |                              |
|--|------------------------------|
| When ETAMATIC / ETAMATIC OEM:                                  | B9w001, up from April 2015   |
| When communication processor / PROFIBUS connection for FMS/VMS | A9xxx, up from November 2011 |
| When MODBUS connection RTU for FMS/VMS:                        | M9xxx, up from April 2015    |
| When MODBUS connection TCP for FMS/VMS:                        | E9xxx, up from June 2011     |

If you have any questions, please contact [support@lamtec.de](mailto:support@lamtec.de) or phone +49 6227 605233.

## 6 Commissioning

### 6.2 Installation

---

#### **WARNING!**

##### **Danger of falling!**

The mounted probe may not be used as a step. The maximum permissible bending moment lies at 100 kg. In case of non-observance, the probe can be destroyed.

A fall can result in severe injury or death.

- ▶ Do not step on the probe! Use appropriate work equipment.
- 

#### **NOTICE**

Do not pull on cables or pneumatic connections. The maximum permissible tensile force lies at 10 kg.

---

#### **NOTICE**

The maximum distance between LT3-F and combination probe KS1D may not exceed 10 m. With longer distances the approval of the system for continuous operation expires.

For distances longer than 10 m the risk of EMC increases.

LAMTEC assumes no responsibility for correct, error-free functions.

---

### 6.3 Measurement Start-up

---

#### **NOTICE**

If it is not possible to switch off the system, the probe can be installed only after a successful offset calibration and the GED has been aligned.

---

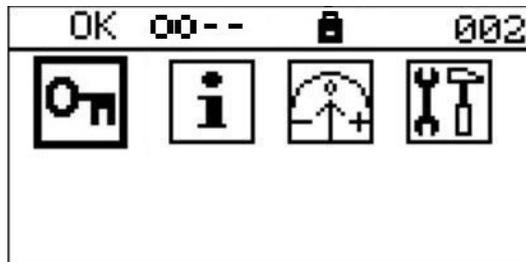
##### ***Commissioning the probe***

1. Connect the probe electrically.
2. Switch on the voltage.
3. Enter the password for access level 2 (Service); see Chapter 6.3.1 *Enter the Password for the Access Level*.
4. Activate maintenance mode; see Chapter 6.3.2 *Activate/deactivate Maintenance Mode*.
5. Heat up the probe (10 min. cold start and 30 min. faultless measurement operation)
6. Cold start is displayed.
7. The device automatically changes over to measurement operation.
8. The probe voltages stabilised to (-20 ... + 10mV).
9. The internal resistance stabilised to 15 ... 25 W
10. Calibrate the probe; see Chapter 6.4 *Calibrating the Probe*.

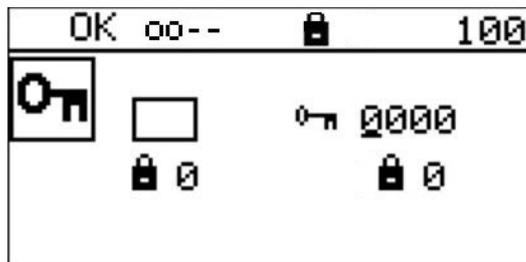
## 6 Commissioning

### 6.3.1 Enter the Password for the Access Level

---



In the main menu PASSWORD ENTRY select .



Enter password via     and ENTER .

Access level 1: Customer Level  
Factory setting: 0000 – access to customer functions only

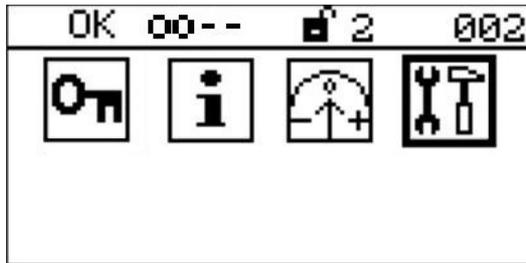
Customers can change the password for access level 1. For details ask the burner manufacturer/supplier

Access level 2: Service level  
Password: customer specific  
Access to customer and service functions

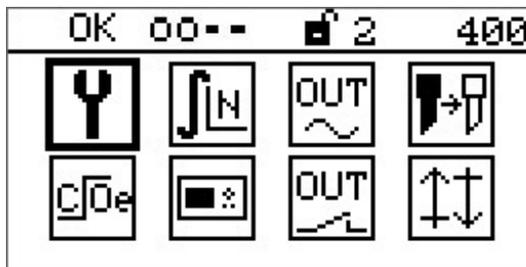
## 6 Commissioning

### 6.3.2 Activate/deactivate Maintenance Mode

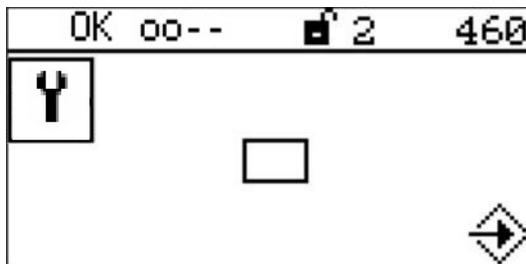
In maintenance mode, the majority of test routines are disabled. It is advantageous to activate the maintenance mode during probe calibration. Substitute values can be given as an output during active maintenance mode.



In the main SETTINGS menu, select 



In the MAINTENANCE MODE settings, select 



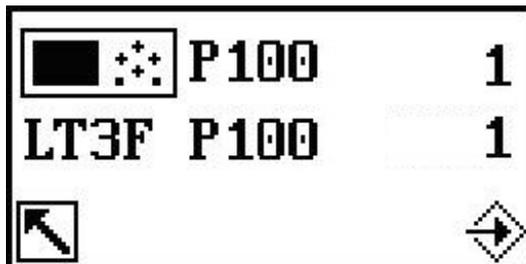
Menu 460 ACTIVATE/DEACTIVATE MAINTENANCE MODE is opened.



Select with the key  and ENTER  to activate/deactivate the maintenance mode.

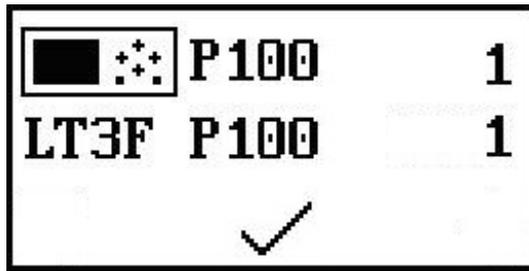
Activate maintenance mode

Deactivate maintenance mode

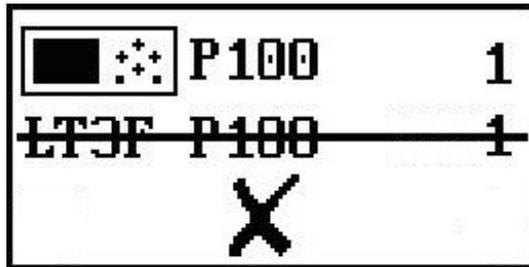


If both parameters (LT3 and UI300) are equal confirm the procedure with ENTER 

## 6 Commissioning



Wait for transmission end indication. Return to the SETTINGS menu with the BACK  and repeat the procedure.



In case of cancelling or timeout, this display appears. Return to the SETTINGS menu with the BACK .

- The symbol  appears in the status line.
- The probe heats up (approx. 10 min.).
- LD 603 green OPERATION lights up.
- COLD START  is displayed.  
The cold start serves to suppress incorrect measured values while the probe is heating up. A cold start delay is always activated after MAINS ON and a fault reset. Premature termination via the CALIBRATION menu possible (see Chapter 6.3.4 *Premature Cold Start Termination*).
- After a concluded COLD START (approx. 10 minutes), the device switches to measuring mode.
- The probe voltages U-O<sub>2</sub> and U-CO<sub>e</sub> stabilise to values between +10 ... -20 mV.
- The internal resistances of the sensor R<sub>ki</sub> O<sub>2</sub> and R<sub>ki</sub> CO stabilise to values between 15 ... 25 Ω.

For the analogue outputs, a replacement value can be set via the LSB remote software while the maintenance mode is active.

Parameter 2035 and Parameter 2042 for analogue output 1

Parameter 2075 and Parameter 2082 for analogue output 2



### WARNING!

#### Danger of burns!

Probe becomes hot during operation.

If the probe is operated when removed, there is a danger of burns on the probe housing.

- ▶ Never lay the probe on flammable material and heat it up.
- ▶ Wear protective gloves

### 6.3.3 Response of the Internal Resistance Regulation

---

The internal ceramic resistance between the reference and O<sub>2</sub> electrodes ( $R_{ki\ O_2}$ ) is a function of the sensor temperature, which is constantly regulated for a perfect function of the probe.

#### NOTICE

The optimum operating point of the KS1D probe lies at a  $R_{ki\ O_2}$  of about 20  $\Omega$ .

This value must be reached before the first offset calibration or after a probe replacement is triggered.

---

If the measured  $R_{ki\ O_2}$  deviates too strongly from the optimum setpoint value  $R_{ki\ S} = 20\ \Omega$ . (see Menu 213), the installation situation of the probe must be changed for optimum operation:

$R_{ki\ O_2} > 25\ \Omega$ .

- The probe does not become hot enough:
  - The probe was installed in a cold spot and is thus cooled.  
Determine a new installation site.
  - If necessary, check whether a  $R_{ki\ O_2}$  of 20  $\Omega$ . is reached when it is disassembled.  
If a too high  $R_{ki\ O_2}$  is assumed by the internal resistance regulation, the probe functions outside of its optimum operating point.

$R_{ki\ O_2} < 20\ \Omega$ .

- The internal resistance regulation automatically sets the  $R_{ki}$  setpoint value to 20  $\Omega$ :
  - After 30 minutes in fault-free measurement operation and subsequent offset calibration
  - After 120 minutes in fault-free measurement operation without an offset calibration

### 6.3.4 Premature Cold Start Termination

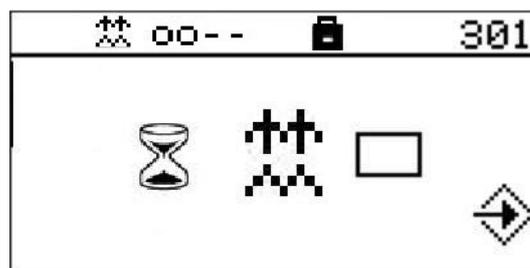
Occasionally, it might be necessary to terminate the COLD START prematurely, e.g., after a short-term power failure, but not before a minimum waiting period of 120 seconds has expired.

#### NOTICE

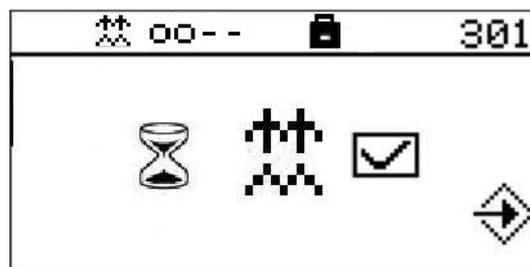
**A premature cold start termination leads directly into measurement operation without an additional prompt. If the probe does not reach its optimum operating point, falsified measured values and, possibly, faults and warnings are the result.**



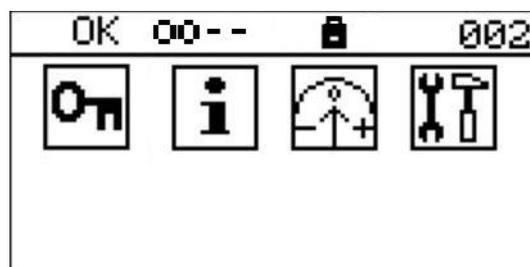
In the main menu, select  for the calibration of the probe.



Terminating the cold start prematurely.



By selecting with the cursor key  and ENTER  the cold start is terminated prematurely.



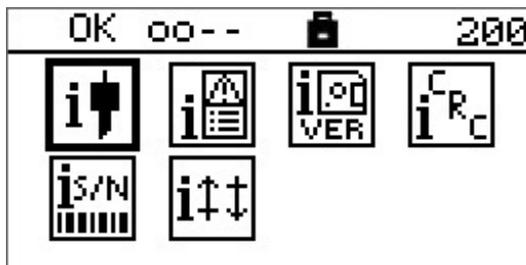
The system returns to the main menu automatically.

## 6 Commissioning

### 6.3.5 Reading the Measured Values



In the main menu, select the INFORMATION menu with **i**.

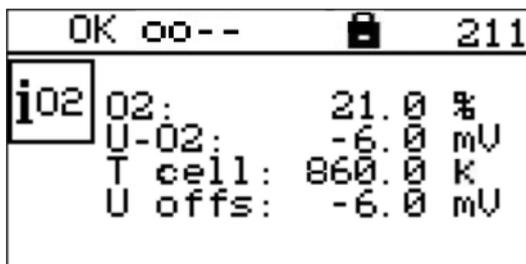


In the INFORMATION menu, select measured values and probe data with **i**.

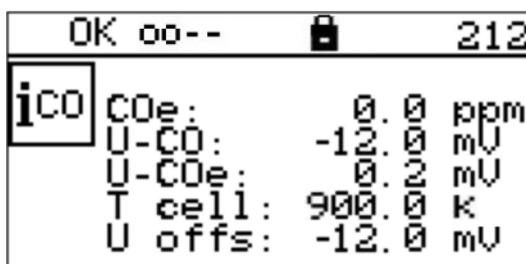


In measured values and probe data, select:

- i02** Display of the O<sub>2</sub> measured values
- iCO** Display of the CO<sub>e</sub> measured values
- iRki** Display of the R<sub>ki</sub> internal probe resistances
- i** Display of the current fuel selection



The O<sub>2</sub> probe voltage U-O<sub>2</sub> stabilises to values between +10 ...-20 mV.



The CO probe voltage U-CO stabilises to values between +10 ...-20 mV.

## 6 Commissioning

|         |         |      |     |     |
|---------|---------|------|-----|-----|
| OK oo-- |         | 🔒    |     | 213 |
| iRki    | Ph:     | 20.6 | W   |     |
|         | Rki O2: | 20.0 | Ohm |     |
|         | Rki CO: | 23.0 | Ohm |     |
|         | O2-CO:  | 6.0  | %   |     |
| Rki     | Rki S:  | 20.0 | Ohm |     |

The  $R_{ki}$  internal probe resistance values lie between 15 ... 25  $\Omega$ .

 Display of whether the internal probe resistance regulation is active!

$P_h$  Display of the current heating capacity

$R_{ki} S$  Display of the setpoint value for the internal resistance regulation.

**O<sub>2</sub>-CO:** Evaluates the cross-talk response between the O<sub>2</sub> and CO electrodes. If the influence is too large (>15 %), the sensor signals overwrite each other. This leads to measurement faults and triggers Fault FH007/10 after 30 seconds. A basic influence always exists due to the common GND of the electrodes.

|         |        |   |  |     |
|---------|--------|---|--|-----|
| OK oo-- |        | 🔒 |  | 214 |
| i🚰      | Fuel 2 |   |  |     |
|         | GAS    |   |  |     |

Currently selected fuel.

### 6.4 Calibrating the Probe

---

A correct and regular probe calibration increases measuring precision.

The probes can be calibrated by

- reference measurement or
- test gas

For calibration using a reference measurement, an flue gas analyser is required. The probes can then be calibrated when installed / whilst combustion is taking place.

For the test gas calibration, the KS1D-HT is be provided with a test gas connection. It can then be calibrated when installed / whilst combustion is taking place. A testing device is available for the test gas calibration of the KS1D standard (type 656R2000)(see Chapter 7.1 *Checking/Calibrating the KS1D Combination Probe*). Calibration must take place when the probe is disassembled.

The following calibrations must be performed with the probe after commissioning and/or probe replacement:

- 1 Offset calibration (required; see Chapter 6.4.1 *Offset Calibration*)
  - Adapts the O<sub>2</sub> measured value to the ambient conditions. In the process, a known environment with 21 vol.% O<sub>2</sub> must be present.
- 2 O<sub>2</sub> calibration (recommended; see Chapter 6.4.2 *Calibrating the O<sub>2</sub> Electrode*)
  - Adapts the O<sub>2</sub> measured value to the operating conditions around a typical operating point.
- 3 CO<sub>e</sub> calibration (recommended; see Chapter 6.4.3 *Perform a Calibration of the CO/H<sub>2</sub> Electrode*)
  - Adapts the CO<sub>e</sub> measured value to the operating conditions of the combustion system.

#### NOTICE

For good measuring precision, it must be guaranteed that the correct fuel curve is set for the system (e.g., BS1 = light fuel oil EL or BS2 = natural gas) during operation and for calibration with a reference measurement. The factory set fuel curve is natural gas.

---

#### NOTICE

For the greatest possible measuring precision, an own burner and fuel specific characteristic curve can be determined and stored. In order for the generally valid fuel curves BS1 and BS2 not to have to be changed, BS3 is unassigned for this purpose.

---

Before start the calibration you have to activate maintenance mode. This prevents mishandling faults and deactivate probe faults. The maintenance mode have to be disabled after successful calibration.

## 6 Commissioning

### 6.4.1 Offset Calibration

Before offset calibration, check whether Rki O<sub>2</sub> value is equivalent to 20 Ω (see chapter 6.3.5 *Reading the Measured Values*).

Otherwise, proceed as described in chapter 6.3.3 *Response of the Internal Resistance Regulation*

Also check the probe voltage U-O<sub>2</sub>. It must be in the range of +10 ... -20 mV.

To perform an offset calibration, the probe must be located in the ambient air and should run for at least 30 minutes in a fault-free measuring mode.

No access level is required!

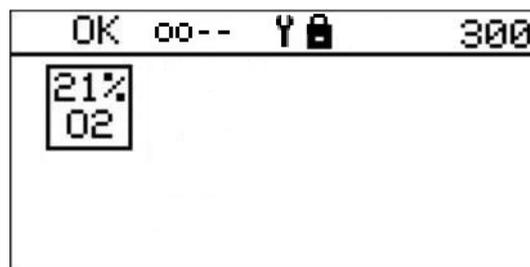
#### NOTICE

In case of the KS1D-HT (type 656R2015), the offset calibration can also be performed in an installed state whilst combustion is running. For this purpose, air (dry and oil-free air, instrument air or ambient air) must be fed at connection 10 with a volume of 40 ... 60 l/h for the duration of the calibration.

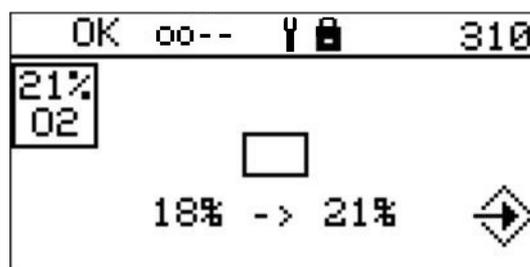
#### Activate maintenance!



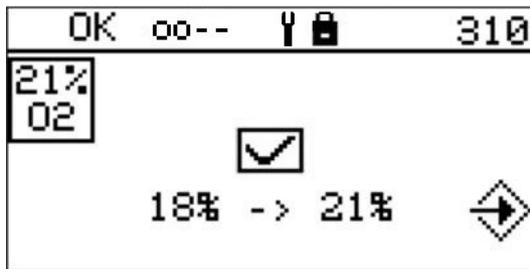
In the MAIN MENU, select  for the calibration of the probe.



In PROBE CALIBRATION, select  for the offset calibration.

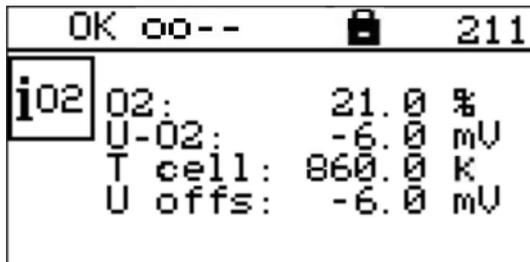


## 6 Commissioning

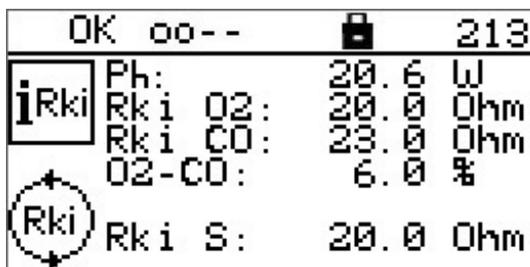


Selecting with the cursor key and ENTER triggers an offset calibration.

Within 10 s, confirm the setting with ENTER otherwise the value is not assumed.



The U-O<sub>2</sub> value stabilises to values between +10 ... -20 mV.



The R<sub>ki</sub> internal probe resistance values lie between 15 ... 25 Ω.

Display of whether the internal probe resistance regulation is active!

**P<sub>h</sub>** Display of the current heating capacity

**R<sub>ki</sub> S** Display of the setpoint value for the internal resistance regulation.

**O<sub>2</sub>-CO:** Evaluates the cross-talk response between the O<sub>2</sub> and CO electrodes. If the influence is too large (>15 %), the sensor signals overwrite each other. This leads to measurement faults and triggers Fault FH007/10 after 30 seconds. A basic influence always exists due to the common GND of the electrodes.

- The offset calibration takes place automatically once triggered
- After a successful calibration, the O<sub>2</sub> value is at 21 vol.% O<sub>2</sub>, whilst the CO<sub>e</sub> value is at 0 ppm.
- Deactivate maintenance mode; see Chapter 6.3.2 *Activate/deactivate Maintenance Mode*.

## 6 Commissioning

### 6.4.2 Calibrating the O<sub>2</sub> Electrode

- Activate Maintenance mode.

#### NOTICE

Access level 1 or 2 required!

#### NOTICE

When calibrating the O<sub>2</sub> electrode in CO containing flue gas the O<sub>2</sub> sensors' Kelvin value moves outside the permissible range (< 800 ... >1200 K). The warning WH004 or WH104 is indicated → CO temperature is too high/too low.

The calibration have to be repeated on another point of O<sub>2</sub> without CO in the flue gas.

The calibration can be performed by reference measurement using an external measuring device or by using test gas at a known O<sub>2</sub> concentration. For KS1D type 656R2000 a special test gas adapter is required.

For the KS1D-HT (Type 656R2015), a hose connection for calibration gas through which the test gas (40 ... 60 l/h) can be input is available.

A special test gas adapter is not required for this type.

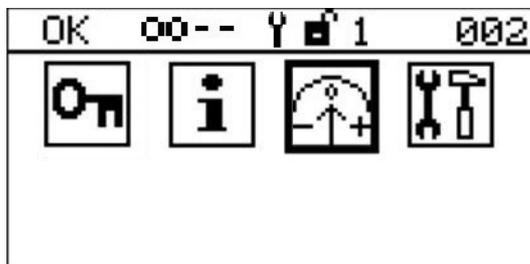
Recommended test gas: 3 vol.% O<sub>2</sub> in N<sub>2</sub>.

#### NOTICE

When performing a reference measurement using an external measuring device, check if the measuring device is measuring wet or dry. In the case of devices with an upstream measuring gas cooler, it always concerns a dry measurement. This also applies to devices which remove the moisture by means of a chemical substance. The KS1D probe measures wet. The difference between a wet to dry measurement is evident from the graphic in the appendix under *13.5 Wet/Dry Measurement Deviations, Conversion Table*.

#### NOTICE

Calibration / checking with a reference measurement functions only with O<sub>2</sub> values < 15 vol. % and > 1 vol. %.

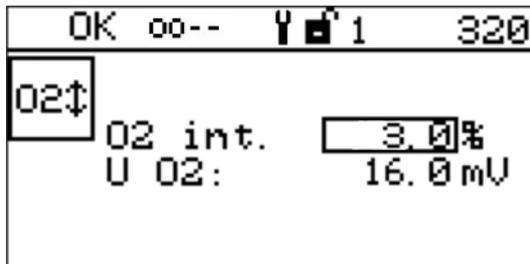


In the Main Menu, select  for probe calibration.

## 6 Commissioning



In Probe Calibration, select  for O<sub>2</sub> calibration.



With , , ,  change the O<sub>2</sub> values of the probe.

Within 5 s, confirm the calibration with  otherwise the calibration is not assumed.

- Deactivate MAINTENANCE mode.

### 6.4.3 Perform a Calibration of the CO/H<sub>2</sub> Electrode

- Activate maintenance mode.

#### NOTICE

Access level 1 or 2 required!

The calibration can be performed by reference measurement using an external measuring device or using test gas in combination with a testing device (type 650R1015) of test gas at a known CO<sub>e</sub> concentration.

For KS1D type 656R2000, a special adapter for test gas is necessary. (For the required test gas adapter for the KS1D (Type 656R2000), see Chapter 7.1.4 *Checking/Calibrating with Test Gas*).

Recommended test gas: 3 vol.% O<sub>2</sub>, 200 ppm CO, 100 ppm H<sub>2</sub>, in N<sub>2</sub>

CO<sub>e</sub> value to be set: 300 ppm

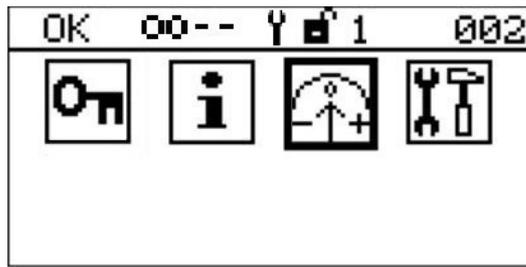
A test gas without O<sub>2</sub> cannot be used for the calibration. The test gas must always contain O<sub>2</sub> in the % area.

For the KS1D-HT (Type 656R2015), a hose connection for calibration gas through which the test gas (40 ... 60 l/h) can be input is available.

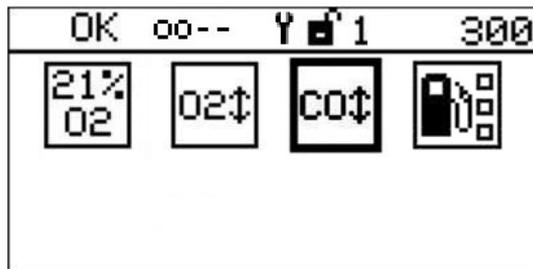
#### NOTICE

Calibration / checking with a reference measurement functions only with CO<sub>e</sub> values >100 ppm.

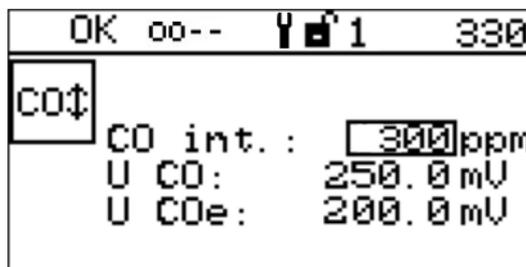
## 6 Commissioning



In the MAIN MENU, select  for the calibration of the probe.



In PROBE CALIBRATION select  for CO<sub>e</sub> calibration.



With the keys , , ,  change the CO<sub>e</sub> values.

Within 5 s, confirm the calibration with  otherwise the calibration is not assumed.

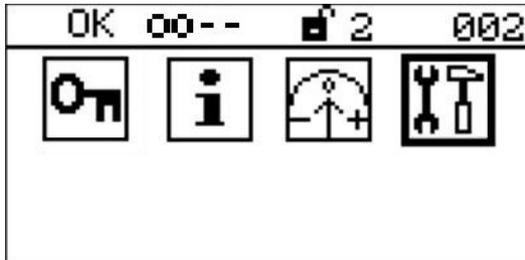
The probe is now ready for operation.

Deactivate maintenance mode; see Chapter 6.3.2 *Activate/deactivate Maintenance Mode*.

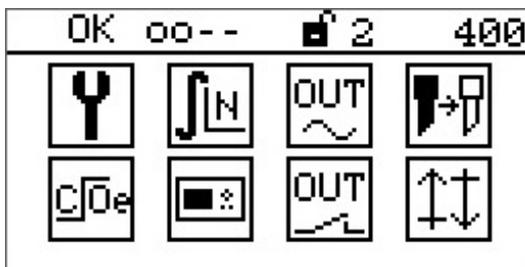
## 6 Commissioning

### 6.5 Settings

According to which access level you are located, you can make various settings. In access level 2 (Service), all settings can be made.



In the MAIN MENU, select  to make settings.



SETTINGS, offers the following setting possibilities:

 Maintenance mode (Level 0); see Chapter

6.5.1 *Maintenance Mode*

 Filter time of the measured values (Level 0).

 Analogue outputs (Level 1); see Chapter 5 *Display and Operational Controls*

 Probe replacement (level 1).

 CO<sub>e</sub> response threshold (Level 2).

 Display (Level 0).

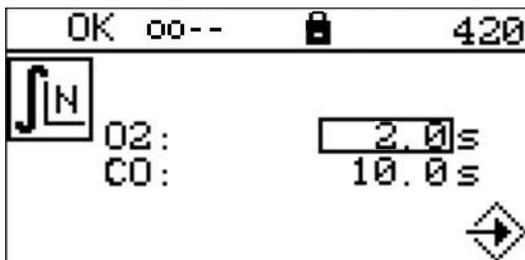
 Limit values (Level 1).

 Digital outputs (Level 2).

#### 6.5.1 Maintenance Mode

In SETTINGS select  (see Chapter 6.3.2 *Activate/deactivate Maintenance Mode.*)

#### 6.5.2 Filter Time



Filter time of the measured values:

No access level is required to make this setting.

Time over which the measured values are determined (in an integrated manner).

Factory setting:

O<sub>2</sub> measured value 2 seconds

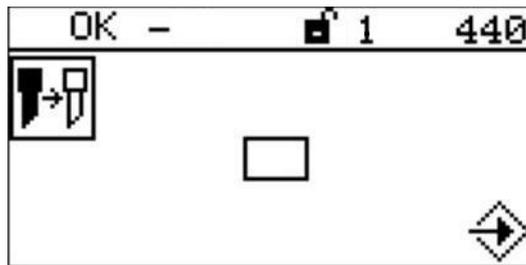
CO<sub>e</sub> measured value 10 seconds

## 6 Commissioning

### 6.5.3 Analogue Outputs

In SETTINGS select  for analogue outputs (see Chapter 10.1.3 *Conversion of the Output Range via the User Interface*).

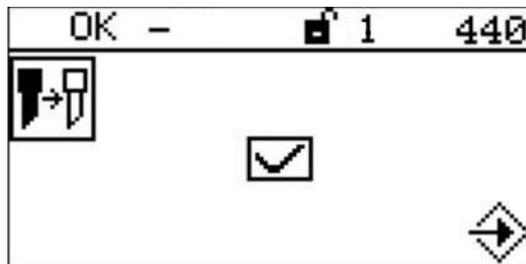
### 6.5.4 Replacing a Probe



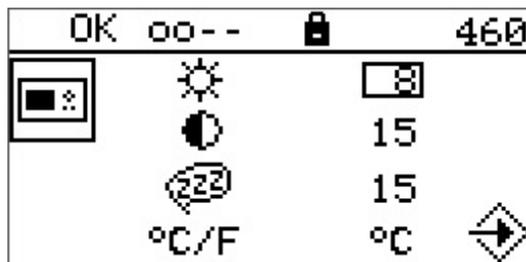
Probe replacement:

A minimum of access level 1 is required for triggering.

(See Chapter 7.2 *Replacing a Probe*.)



### 6.5.5 Display



Display:

No access level is required to make this setting.

Brightness

Contrast

Time in seconds until the background lighting extinguishes

Switchover °C/°F

## 6 Commissioning

### 6.5.6 Limit Values

#### NOTICE

Access level 1 or 2 required!

|    |      |       |        |
|----|------|-------|--------|
| OK | oo-- | 1     | 480    |
| ↑↓ | 1    | O2 ↓  | 00.5%  |
|    | 2    | COe ↑ | 400ppm |
|    | 3    | O2 -  |        |
|    | 4    | COe - |        |

Limit values

Proceed with the  key.

|    |       |       |  |
|----|-------|-------|--|
| OK | oo--  | 1     | 481  |
| ↑↓ | -/↑/↓ |       |  |
| 1  | O2    | 00.5% |  |
|    | ⌘     | 30 s  |  |
|    | 👉?    | NO    |  |

Control of the entry with the following key sequence:

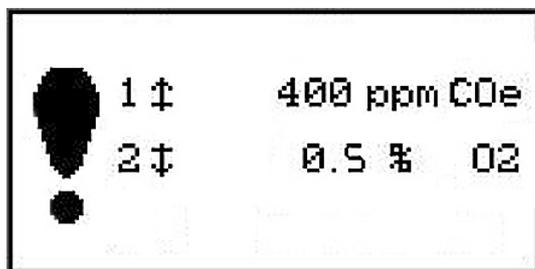
, , , .

|       |   |
|-------|---|
| -/↑/↓ | - Limit value off<br>↑ Monitoring of exceeding<br>↓ Monitoring of undershooting   |
| O2    | Setting of limit value  |
| ⌘     | Setting of trigger time of limit value  |
| 👉     | NO - limit value resets automatically<br>YES - manual acknowledgement of limit value required (see Chapter 5.4 Main Menu) |

## 6 Commissioning

If a limit value is undershot/exceeded, this is indicated in the status line by a down/up arrow (see Chapter 5.3 *Status Line*).

In addition, the following message appears on the display:



Key  returns to the main display

Limit value 1:

- Factory setting: Exceeding of 400 ppm CO<sub>e</sub>, 60 s

Limit value 2:

- Factory setting: Undershooting of 0.5% O<sub>2</sub>, 30 s

## 6.6 Test Certificate

Each probe is accompanied with a test certificate. This means that you can compare the current measured values against test bench values at any time.

### Test Certificate Flue Gas Probe KS1D

Prüfprotokoll/ Abgassonde KS1D / certificat de test de la sonde KS1D

|  |               |   |                           |
|--|---------------|---|---------------------------|
| <b>Item No.</b> / Artikelnr. / no. d'article   | 656R2010      | <b>Fuel</b> / Brennstoff / combustible            | Natural gas / gaz naturel |
| <b>Probe No.</b> / Sondennr. / no. de la sonde | 2164          | <b>Flue gas temp.</b> / Abgastemp. / temp. du gaz | 170 °C                    |
| <b>Sensor No.</b> / Sensornr. / no. du capteur | 2164          |   |                           |
| <b>Device ID.</b> / Messplatz/ ID du mesure    | LT_02         | <b>Date</b> / Datum / date                        | 21.08.14                  |
| <b>Inspector</b> / Prüfer/ rapporteur          | A. Wisniowski | <b>File</b> / Datei / fichier                     | 20140821_1028.dat         |

#### Heater data

Heizerdaten / données du chauff.

| Voltage $U_H$ | Current $I_H$ | Resistor $R_H$ | Power $P_H$ |
|---------------|---------------|----------------|-------------|
| 12,0 V        | 1,60 A        | 7,5 $\Omega$   | 19,2 W      |

#### Sensor electrode offset

Sensoroffset / offset de la sonde

|       | before  | vor / avant | after   | nach / après |
|-------|---------|-------------|---------|--------------|
| U COe | -4,6 mV | -4,6 mV     | -4,2 mV | -4,2 mV      |
| U O2  | -3,1 mV | -3,1 mV     | -2,7 mV | -2,7 mV      |

#### Calculated values

Berechnete Werte / données calculée

|  |       | electrode to measure |                |
|--|-------|----------------------|----------------|
|  |       | CO <sub>e</sub>      | O <sub>2</sub> |
| <b>Sensor temp.</b> / Sensortemp. / temp. du capteur | 889 K | 889 K                | 871 K          |
| <b>rel. diff. at bei / á 5,6% O<sub>2</sub></b>      | 4,3 % | 4,3 %                | 3,1 %          |

## 6 Commissioning

### 6.7 Probe Certificate

A probe certificate is included with each probe. This should be completed during commissioning. The probe certificate must always be enclosed in the event of complaints and for repairs.

#### NOTICE

No probe certificate included with the probe, no goodwill!

#### Sondenpass

*Probe certificate / Certificat de la sonde*

#### Kombi-Sonde KS1D

*Combi-Probe KS1D*



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

Wiesenstr. 6, D-69190 Walldorf  
Tel.-Nr.: 06227/6052-0  
Fax-Nr.: 06227/6052-57  
E-mail: info@lamtec.de

**Sonden-Nr.** *Probe no: / No. de la sonde:* **092**

**Artikel-Nr.** *Article no: / No. d'article:* **656R2000**

**Auftrags-Nr.** *Order no. / No. de commande:*

Sondenpass bei Inbetriebnahme ausfüllen und im Falle einer Reparatur der Sonde beilegen.  
Keine Kulanz ohne ausgefüllten Sondenpass!

*Please return the 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!*

#### Kunde

*Customer / Client:*

#### 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*

Fig. 6-1 Probe certificate for the KS1D probe

## 7 Maintenance

As a result of extensive self-diagnosis, the measuring system is essentially maintenance-free. Maintenance is restricted to the calibration and the cleaning of dust or other deposits; as well as the cyclic replacement of the  $ZrO_2$  measuring element.

### 7.1 Checking/Calibrating the KS1D Combination Probe

---

The checking / calibration should (advantageously installed) be built in at normal operating temperature and carried out under operating conditions.

Recommended time spans (cycles):

- 6 hours after commissioning
- 12 months for natural gas combustion systems

#### 7.1.1 Checking/Calibrating the Air Voltage (Offset)

---

1. Switch off the plant.  
If you cannot switch off the plant, the probe must be dismantled. Observe the safety notices!
2. Pre-ventilate, until there is no longer any flue gas at the measuring point (about 1 minute).
3. End the pre-purge.
4. Perform the offset calibration of the  $O_2$  (U- $O_2$ ) and  $CO/H_2$  (U-CO) electrodes.  
See Chapter 6.4.1 *Offset Calibration*.

#### 7.1.2 Checking/Calibrating the $O_2$ Electrode

---

See Chapter 6.4.2 *Calibrating the  $O_2$  Electrode*.

#### 7.1.3 Checking/Calibrating the $CO/H_2$ Electrode

---

See Chapter 6.4.3 *Perform a Calibration of the  $CO/H_2$  Electrode*.

### 7.1.4 Checking/Calibrating with Test Gas

---



#### **WARNING!**

##### **Danger of burns!**

Probe becomes hot during operation.

If the probe is operated when removed, there is a danger of burns on the probe housing.

- ▶ Never lay the probe on flammable material and heat it up.
- ▶ Wear protective gloves

---

#### **Description of the Testing Device**

##### **General Information:**

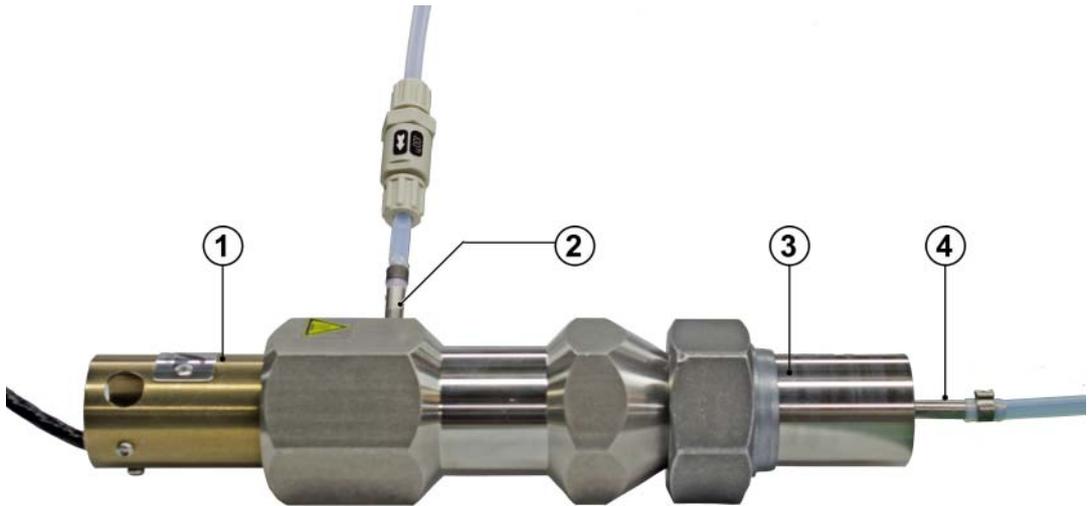
The probe signals are pressure-dependent so they must be tested in a pressure-free environment. The testing device takes this into consideration and guarantees the best results in specific ranges. In exceptional cases, the pressure of the testing device must be adjusted to the pressure of the measuring point through an additional device.

Choose a test gas combination so that O<sub>2</sub> or CO<sub>e</sub> content lies in the usual plant specific range and within the specified measuring range of the probe. In standard applications in the combustion technology, O<sub>2</sub> concentration lies at 2-5 vol.% and CO<sub>e</sub> concentration lies between 100 ... 500 ppm. The following indicated test gas composition guarantees best results.

##### **Description:**

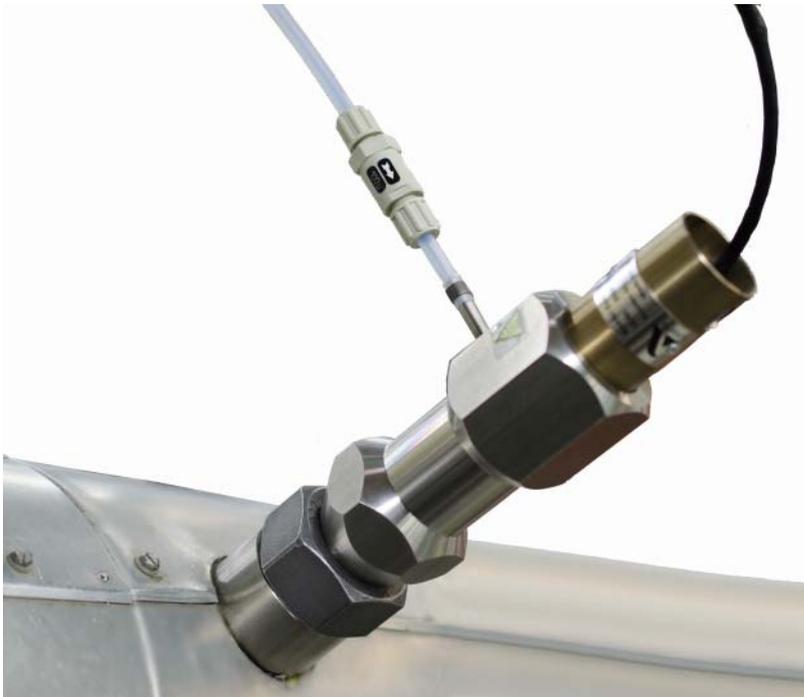
The testing device is a device for the task of testing gases on the probes LS1/KS1/KS1D in standard housing. The probe can be tested or calibrated by means of test gas function.

The testing device can be used lying on the table or plugged into the flue gas channel (*Fig. 7-1 Testing device laying on the table* and *Fig. 7-2 Testing device plugged into flue gas channel*). For gas-tight fixing at the flue gas channel, the probe screw joints (clamping ring/screw cap) can be attached to the plug in nozzle for flue gas channel.



*Fig. 7-1 Testing device laying on the table*

- 1 Probe LS2, KS1, KS1D
- 2 Test gas connection
- 3 Plug in nozzle for flue gas channel
- 4 Test gas outlet



*Fig. 7-2 Testing device plugged into flue gas channel*

### Test probe

1. Install probe:  
Push probe into the testing device until stop.
2. Heat up probe:  
A cold probe should be heated up for at least 45 minutes in the installed condition. Should an already heated up probe be installed in the testing device, then wait for 15 minutes.

### CAUTION!

The testing device with plugged in heated probe would get hot.

Risk of burning!

3. Test gas function:  
The test gas connection would be connected to the pressure reducer or the compressed air supply of the test gas bottle using hose or hose clamp ( $D_i=4$ ;  $D_a=6$ mm). The corresponding test gas is to be given up with  $2 \pm 1$  bar (pressure behind the bottle pressure reducer). After 2 minutes, the probe calibration and testing can take place.

### NOTICE

For test gas usage of 2 bar, test gas pressure lies at 1.6 l/min and increases at 0.6 l/min per bar increase in pressure.

### CAUTION!

With the usage of CO containing test gases C, these must be removed from the test gas outlet e.g. by the exhaust hose.

4. Calibration/probe testing:  
According to table 4, LS2 is to be tested within 2 steps while KS1/KS1D in 3 steps.
  - a) Offset testing/calibration  
Compare oxygen values of probe and test gas A.  
Should the deviation of oxygen value be less than or equal to 0.2 vol.% of 21 vol.%, the probe is fine.  
Should the deviation of oxygen value be more than 0.2 vol.%, the probe must be calibrated according to the manual.
  - b) O<sub>2</sub> testing/calibration  
Compare oxygen values of probe and test gas B.  
Should the deviation of oxygen value be less than or equal to 0.1 vol.% of 3 vol.%, the probe is fine.  
Should the deviation of oxygen value be more than 0.1 vol.%, the probe must be calibrated according to the manual.
  - c) CO/H<sub>2</sub> testing/calibration  
If the probe reacts to an increase in probe voltage on test gas C, then the probe is fine.  
If the probe does not react, it has to be changed.  
Compare CO value of the probe and CO<sub>e</sub>-value of test gas C.  
If CO<sub>e</sub> value of the probe lies between 275 ... 375 ppm, the estimation of CO<sub>e</sub> value is fine. Otherwise, calibrate a more precise estimation of the probe according to the manual. calibrate on 300ppm.

### NOTICE

CO/H<sub>2</sub> calibration with test gas C has the advantage of determining and compensating the long term drift of sensitivity. The sensitivity of the CO/H<sub>2</sub> electrode usually increases over time → safe direction!

### NOTICE

With KS1D HT (item no. 656R2015), the test gas to be tested/calibrated can be connected directly at the hose connection for calibration gas. A special testing device is not necessary. The required test gas quantity lies between 40 ... 60 l/h.

*Probe calibrated*

### Test gas matrix for testing or calibrating the respective probe

| Functional check/calibration with test gas | Probe                          |                    |                                 |
|--|--------------------------------|--------------------|---------------------------------|
|  | Probe voltage U-O <sub>2</sub> | Probe voltage U-CO | probe voltage U-CO <sub>e</sub> |
| 1 → Offset                                 | A                              | A                  | A                               |
| 2 → O                                      | B                              | B                  | B                               |
| 3 → CO/H <sub>2</sub>                      | C                              | C                  | C                               |

### Test gas composition

| Test gas        | Composition            |                                    |                        |
|-----------------|------------------------|------------------------------------|------------------------|
|                 | O <sub>2</sub> [Vol.%] | CO <sub>e</sub> [ppm] <sup>*</sup> | N <sub>2</sub> [Vol.%] |
| A <sup>**</sup> | 21                     | 0                                  | Rest                   |
| B               | 3                      | 0                                  | Rest                   |
| C               | 3                      | 300                                | Rest                   |

\* CO Equivalent CO<sub>e</sub> is the sum of all components in the exhaust gas. In test gases, it is represented by CO and H<sub>2</sub> in proportion of 2:1, e.g. 300ppm CO<sub>e</sub> = 200 ppm CO +100 ppm H<sub>2</sub>.

\*\* In the test gas device, the probe can be calibrated/tested with oil-free pressure air or synthetic air from test gas bottle. In a CO<sub>e</sub>-free and defined surrounding, the probe can also be tested/calibrated outside of the test gas device.

### Recommendation:

To check the O<sub>2</sub> electrode, use a test gas with 3 vol. % O<sub>2</sub> in N<sub>2</sub>.

### NOTICE

It is not possible to calibrate the CO/H<sub>2</sub> electrode using hydrogen free test gas containing CO.

### Recommendation:

To check the CO/H<sub>2</sub>, use a test gas with 100 ppm H<sub>2</sub>, 200 ppm CO, and 3 % O<sub>2</sub> in N<sub>2</sub>. Calibrate to 300 ppm.

For the standard design of the KS1D combination probe, a special testing device is required (type 650R1015). For calibration adjust the pressure on the pressure gauge between 40 ... 60 mbar.

### NOTICE

The pressure gauge is a very sensitive measuring device. Protect it against overload. Pay attention to the pressure range!

### WARNING!

#### **Risk of poisoning by carbon monoxide!**

Carbon monoxide is a poisonous gas. Inhalation can cause severe poisoning symptoms and can be fatal.

- ▶ Perform the calibration quickly and only in open, well-ventilated rooms, ideally underneath an exhaust hood.
- ▶ Do not open the valve on the test gas cylinder until shortly before calibration and close it immediately after calibration!



### WARNING!

#### **Danger of burns!**

Probe becomes hot during operation.

If the probe is operated when removed, there is a danger of burns on the probe housing.

- ▶ Never lay the probe on flammable material and heat it up.
- ▶ Wear protective gloves

### 7.1.5 Checking/Calibrating with Reference Measurement

- The system must be in operation (ideally at the desired operating point).
- Perform the calibration as described in Chapters 6.4.2 *Calibrating the O<sub>2</sub> Electrode* and 6.4.3 *Perform a Calibration of the CO/H<sub>2</sub> Electrode*.

### 7.1.6 Simple Function Test of the CO/H<sub>2</sub> Electrode



### WARNING!

#### **Danger of burns!**

If a dismantled probe is operated, there is a danger of burns if touching the probe's housing.

- ▶ Never lay the probe on flammable material and heat it up.
- ▶ Wear protective gloves

1. Dismantle the probe
2. Fill isopropyl alcohol in a glass (approx. 1 cm)  
Alternatively, use brandy/perfume / etc.
3. Hold the probe without the GED upside down into the glass.  
Do not immerse!

### **NOTICE**

An additional possibility is to purge the probe with test gas containing CO, NO, H<sub>2</sub>, etc. Some ppm are enough.

*If the probe is OK, this immediately reacts with a considerable increase in the probe voltage (CO<sub>e</sub> value) respective to the probe dynamic response.*

## 7 Maintenance

|             |       |     |     |
|-------------|-------|-----|-----|
| OK          | oo--  | 🔒   | 001 |
| O2:         | 2.8   | %   |     |
| COe:        | 280   | ppm |     |
| ETA:        | 82.0  | %   |     |
| T-ex:       | 180.0 | °C  |     |
| T air:      | 10.0  | °C  |     |
| COe /V/V 不: | 42.1  | %   |     |

← Probe dynamic response

### 7.1.7 Wear-and-Tear Parts of the KS1D Combination Probe

Average life cycle = 2 - 3 years (depending on fuel).

**Recommendation:**

Exchange the ZrO<sub>2</sub> measuring cell after 5 years at the latest.

A worn measuring gauge could cause errors while calibrating and therefore impede the precision of measurement.

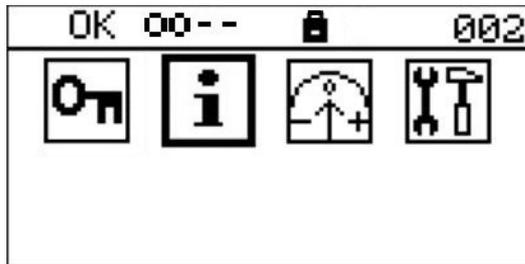
The combination probe KS1D type 656R2000 with housing and type 656R2010 without housing can only be replaced completely

.For combination probe KS1D HT (high temperature) type 656R2015, a replacement kit is available. Order no. 656R2065.

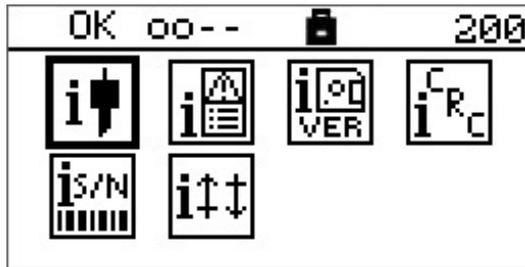
## 7.2 Replacing a Probe

A probe must be replaced if:

- The internal resistances  $R_{ki-O_2}$  and  $R_{ki-CO}$  can no longer be set to values of  $20 \Omega$  (+/-  $5 \Omega$ ).  
To be read at the probe data (Menu 213).
- The probe offset voltages  $U-O_2$  and  $U-CO$  in the air assume values above +20 mV or below -30 mV.  
To be read at the probe data (Menus 211 and 212).
- The  $CO/H_2$  electrode does not response



In the MAIN MENU, select **i** for information.



In INFORMATION select **i** for measured values and probe data.



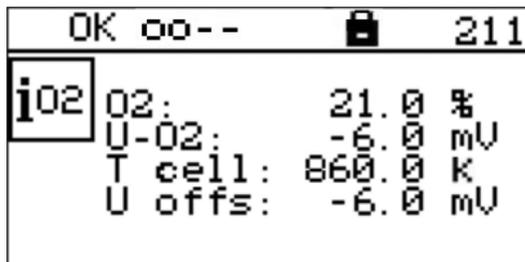
In MEASURED VALUES and Probe Data the following is available for selection:

**iO<sub>2</sub>** Display of the O<sub>2</sub> measured values (menu 211)

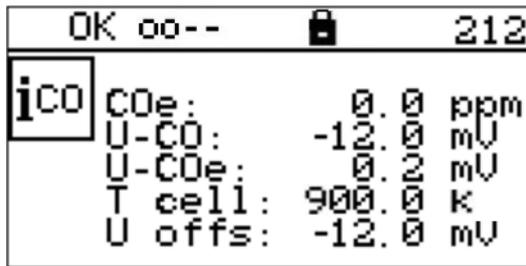
**iCO** Display of the CO measured values (menu 212)

**iR<sub>ki</sub>** Display of the R<sub>ki</sub> internal probe resistances (menu 213)

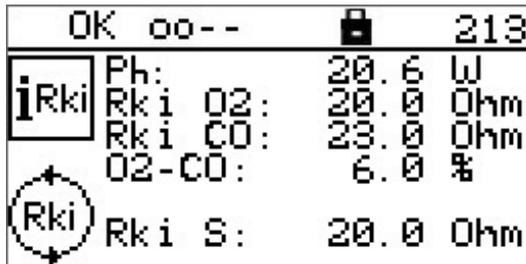
**i** Display of the current fuel selection



Reading of O<sub>2</sub> measured values.



Reading of CO<sub>e</sub> measured values.

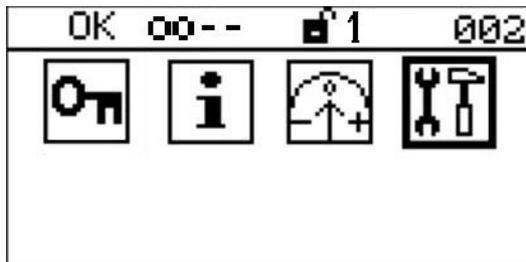


Reading of the R<sub>ki</sub> internal probe resistances.

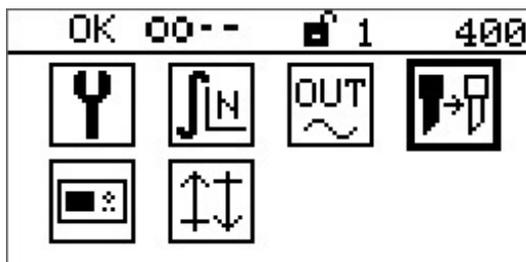
### NOTICE

After the exchange of the probe, a probe replacement must be triggered **immediately** after reactivation!

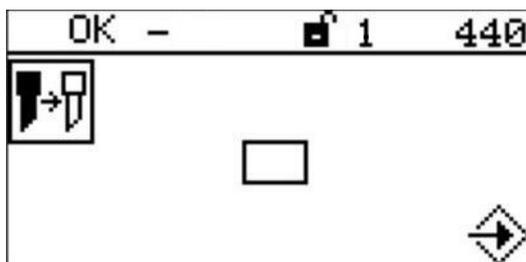
- A minimum of access level 1 is required

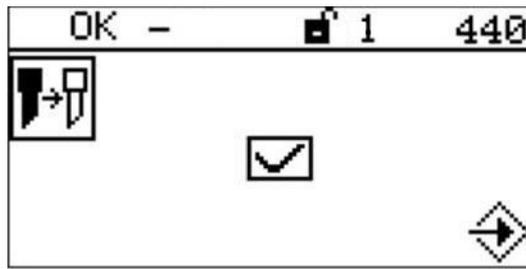


In the MAIN MENU, select  to make settings.



In SETTINGS, select  for probe replacement.





By selecting with the cursor key  and ENTER  a probe replacement is triggered.

After the successful triggering of a probe exchange, the heating capacity and  $R_{ki}$  are reset to the standard values and can be learnt by the system again.

After that, start up the probe as in the initial start-up, as described in Chapter 6 *Commissioning*.

### 7.3 Sensor Replacement KS1D-HT

To replace the sensor in the KS1D-HT probe a replacement kit type 656R2065 is available. The replacement kit includes:

- KS1D-HT probe
- Seal for probe
- Filter disc
- Seal Novaphit

#### **Sensor replacement KS1D-HT (replacement kit 656R2065)**

- ✓ Disconnect the probe and check the connection  
Check temperature of probe/sensor and if necessary cool down
  - ✘ Insulation slot screwdriver size 0,4 x 8 x 100 mm  
Torque wrench 3,5 Nm with attachment for Allan key  
Open-end wrench 24 mm
  - ✘ Allan key 3 mm
1. Loose the connection cable in the probe head *Fig. 7-3 Probe head*.
  2. Loose Allan key and remove them → remove probe head *Fig. 7-4 Sensor without probe head*
  3. Remove sensor and seal *Fig. 7-5 Sensor Ein-/Ausbau installation/dismounting* and *Fig. 7-6 Ausgebauter Sensor mit Dichtring Dismounted sensor with seal*.
  4. Unscrew filter cap and remove filter *Fig. 7-7 Sensorhalter mit Filterkappe und Filter sensor holder with filter cap and filter*.
  5. Replace filter, screw on filter cap.
  6. Insert sensor with seal.
  7. Put on the probe head and fasten with screws (tightening torque 3.5 Nm)

#### **NOTICE**

Please note the tightening torque 3.5 Nm!

8. Reconnect connecting cable, see *Fig. 7-8 Klemmsockel bei KS1D-HT terminal socket KS1D-HT*

### NOTICE

Note the connection diagram and markings on terminal socket!

9. Close probe head.

*The probe with a new sensor is ready to use.*



Fig. 7-3 Probe head



Fig. 7-4 Sensor without probe head

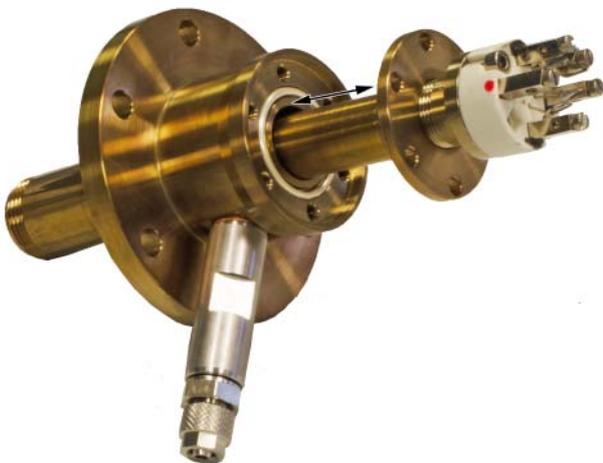


Fig. 7-5 Mounting/dismounting the sensor



Fig. 7-6 Dismounted sensor with seal



Fig. 7-7 Sensor holder with filter cap and filter

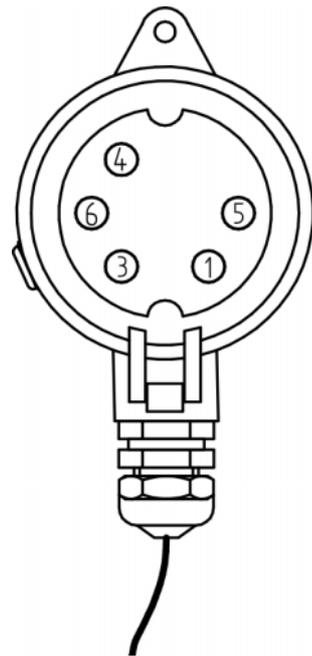


Fig. 7-8 Terminal socket KS1D-HT

- 1 (-) probe signal O<sub>2</sub> (red)
- 3 (-) probe signal CO (grey)
- 4 (+) probe signal CO/O<sub>2</sub> (black)
- 5 probe heater (white)
- 6 probe heater (white)

## 8 Correcting Faults

## 8 Correcting Faults

### 8.1 Faults and Warnings

Faults are indicated by the red flashing of the ENTER key and shown in the display. After the ENTER key is pressed, faults can be reset.



- F Fault
- W Warning
- H Main processor
- U Monitoring processor
- 001 Fault number  
Probe/probe voltage fault
- /1 Trigger 1

#### NOTICE

In the case of faults that cannot be allocated, data records can be read with LSB remote software and sent to LAMTEC for analysis!

#### NOTICE

Each fault can occur as a temporary or permanent fault. Temporary faults reset themselves automatically when the corresponding values lie within the permissible range again.

If temporary faults are present for longer than 30 minutes or repeat several times within an hour, they become permanent faults. A permanent fault remains even after switching voltage off and on again. Permanent faults must be reset manually. After a fault reset, the device resets and starts again in COLD START mode.

|                               | Fault 001              | Fault 002 - 008       | Fault 015 - 016 |
|-------------------------------|------------------------|-----------------------|-----------------|
| Number of triggers, temporary | 10 x for at least 10 s | 3 x for at least 10 s | Immediately     |
| Time window                   | 60 min                 | 60 min                | 60 min          |
| Permanent time                | 30 min                 | 30 min                | 30 min          |

## 8 Correcting Faults

### 8.1.1 Faults

**Deactivation during maintenance: Safety transfer O<sub>2</sub>, limit values, fault 001, 002, 004, 005, 007, 008.**

| Fault no.                   | Fault text  |
|-----------------------------|---|
| <b>001 (HP)</b><br>101 (ÜP) | <b>Probe/probe voltage fault</b>  |
| /1                          | Voltage range of O <sub>2</sub> electrode outside of the permissible range. U-O <sub>2</sub> must always lie within a range of -25 mV ... +300 mV during measurement operation; tolerance time of 30 seconds.   |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- The cold start might have been interrupted therefore the probe is not yet ready for operation.</li> <li>- Remove the probe and check with ambient air and test gas. Compare the values with the test report. Exchange the probe if required.</li> <li>- If the O<sub>2</sub> electrode reacts to CO, the sensor is defective; exchange the probe.</li> </ul> |
| /2                          | Voltage range of CO electrode outside of the permissible range. U-CO must always lie within a range of -25 mV ... +800 mV during measurement operation; tolerance time of 30 seconds.   |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- The cold start might have been interrupted therefore the probe is not yet ready for operation.</li> <li>- Remove the probe and check with ambient air and test gas. Compare the values with the test report. Exchange the probe as required.</li> </ul>  |
| /3                          | O <sub>2</sub> offset voltage outside of the permissible range during pre-purge. The offset voltage of the O <sub>2</sub> electrode must always lie within a range of -25 mV ... +5 mV during pre-purge.  |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- The cold start might have been interrupted therefore the probe is not yet ready for operation.</li> <li>- Remove the probe and check with ambient air and test gas. Compare the values with the test report. Exchange the probe if required.</li> <li>- The probe is blown "cold": unfavourable installation site.</li> </ul>                                |
| /4                          | CO offset voltage outside of the permissible range during pre-purge. The offset voltage of the CO electrode must always lie within a range of -25 mV ... +10 mV during pre-purge.   |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- The cold start might have been interrupted therefore the probe is not yet ready for operation.</li> <li>- Remove the probe and check with ambient air and test gas. Compare the values with the test report. Exchange the probe if required.</li> <li>- The probe is blown "cold": unfavourable installation site.</li> </ul>                                |
| /5                          | Both offset voltages outside of the permissible range during pre-purge; see triggers /3 and /4.   |

## 8 Correcting Faults

|     |  |
|-----|--|
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- The cold start might have been interrupted therefore the probe is not yet ready for operation.</li> <li>- Remove the probe and check with ambient air and test gas. Compare the values with the test report. Exchange the probe if required.</li> <li>- The probe is blown "cold": unfavourable installation site.</li> </ul>   |
| /6  | <p>CO voltage smaller than O<sub>2</sub> voltage<br/>Offset-adjusted CO probe voltage more than 10 mV smaller than offset-adjusted O<sub>2</sub> probe voltage; tolerance time of 28 seconds.</p>  |
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Exchange the probe.</li> <li>- Check the wiring of the sensors, maybe O<sub>2</sub> and CO are inverted</li> </ul>  |
| /7  | <p>O<sub>2</sub> value over 25%<br/>The O<sub>2</sub> value rises to over 25% after the deactivation of the burner; tolerance time of 15 seconds.</p>  |
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Wait to see whether the value stabilises at 21%.</li> <li>- If not, remove the probe and perform an offset calibration in the air.</li> <li>- Installation site possibly unfavourable; the probe is possibly blown "cold."</li> </ul>   |
| /8  | <p>Dynamism only at O<sub>2</sub> electrode<br/>The O<sub>2</sub> electrode demonstrate dynamism without the CO electrode showing dynamism; tolerance time of 30 seconds.</p>  |
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Monitoring active only in case of values &lt; 16 vol. % O<sub>2</sub></li> <li>- The probe no longer reacts to changes.</li> <li>- Remove the probe and check for soiling of the grille.</li> <li>- Check the O<sub>2</sub> value in the ambient air and/or with test gas.</li> <li>- If the O<sub>2</sub> value is &lt;16% in the ambient air, perform an offset calibration.</li> <li>- In case of no changes, exchange the probe.</li> </ul> |
| /9  | <p>Missing CO dynamism or U-CO<sub>e</sub><br/>U-O<sub>2</sub> over 200 mV longer than 15 seconds without CO dynamism or UCO<sub>e</sub> ≤ 20 mV</p>   |
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Monitoring active only in case of values &lt; 16 vol. % O<sub>2</sub></li> <li>- The probe no longer reacts to changes.</li> <li>- Remove the probe and check for soiling of the grille.</li> <li>- Check with ambient air and test gas if pertinent.</li> <li>- In case of no changes, exchange the probe.</li> </ul>  |
| /10 | <p>O<sub>2</sub> voltage limit value<br/>O<sub>2</sub>voltage U- O<sub>2</sub> &gt; 100 mV for more than 60 seconds.</p>   |
| /11 | <p>CO voltage limit value<br/>CO voltage U- CO &gt; 200 mV for more than 120 seconds.</p>  |
| /14 | <p>UCO<sub>e</sub> monitoring<br/>CO<sub>e</sub> voltage U-CO<sub>e</sub> &gt; 300 mV, tolerance time of 27 seconds, up to 117 seconds in case of dropping voltage.</p>  |
|     | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Activate maintenance mode in case of a test gas connection.</li> </ul>  |
| /15 | <p>The O<sub>2</sub> voltage does not demonstrate the required dynamism.<br/>Change in the O<sub>2</sub> voltage U-O<sub>2</sub> less than 2.5% within 24 hours whilst the O<sub>2</sub> or CO controller is running.</p>  |

## 8 Correcting Faults

|                             |   |
|-----------------------------|---|
| /16                         | The CO voltage does not demonstrate the required dynamism.<br>Change in the CO voltage U-CO less than 2.5% or 8 mV within 24 hours whilst the O <sub>2</sub> or CO controller is running.   |
| <b>002 (HP)</b><br>102 (ÜP) | <b>Probe heating fault</b>  |
| /1                          | The heater is short-circuited or has a high resistance; tolerance time of 10 seconds  |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Check the wiring.<br/>LT3-F Term. 13 and 14 → disconnect the probe - probe heating at LT3-Ex or in SAK<br/>and measure the heater resistance between wire nos. 13 and 14 on the probe side.<br/>Resistance approx. 9 ... 10 Ω in heated state.</li> <li>- If not OK, exchange the probe and restart.</li> <li>- If OK, the fault presumably lies on the motherboard of LT3-F.<br/>If the lines of the probe heating and probe signal are mixed up during connection (possible in the case of the SAK wiring), the motherboard is destroyed. Disconnect the probe and measure the heating voltage: approx. 11V</li> </ul>   |
| /2                          | Heating power more than 15 s outside of the permitted range (8W ... 25 W)   |
|                             | <p><b>Help:</b></p> <p>Installation site too hot: the heating capacity cannot be further reduced (current actual value of <math>R_i &lt; 20 \Omega</math>) to reached the setpoint value of the internal resistance <math>R_{ki}</math> of 20 Ω or</p> <p>Installation site too cold: the heating capacity cannot be further increased (current actual value of <math>R_i &gt; 20 \Omega</math>) to reached the setpoint value of the internal resistance <math>R_{ki}</math> of 20 Ω. Check the value of the internal resistance <math>R_{ki}</math> in the display.</p> <ul style="list-style-type: none"> <li>- Trigger the probe exchange and restart the probe so that the <math>R_{ki}</math> of 20 Ω can be learnt again.</li> <li>- Check the system temperature at the installation site.</li> <li>- Check the probe when removed if pertinent.</li> <li>- Exchange → the worn probe if pertinent.</li> <li>- As a follow-up fault, 002/3 Heater <math>R_i</math> outside of 5 ... 15 Ω might be displayed.</li> </ul> |
| /3                          | Heater $R_i$ outside of 5 ... 15 Ω<br>Internal resistance of heater outside of the interval 5 Ω ... 15 Ω  |
|                             | <p><b>Help:</b></p> <p>Installation site too hot: the heating capacity cannot be further reduced (current actual value of <math>R_i &lt; 20 \Omega</math>) to reached the setpoint value of the internal resistance <math>R_{ki}</math> of 20 Ω. Check the value of the internal resistance <math>R_{ki}</math> in the display.</p> <ul style="list-style-type: none"> <li>- Trigger the probe exchange and restart the probe so that the <math>R_{ki}</math> of 20 Ω can be learnt again.</li> <li>- Check the system temperature at the installation site.</li> <li>- Check the probe when removed if pertinent.</li> <li>- Exchange → the worn probe if pertinent.</li> </ul> <p>As a follow-up fault, 002/2 Heating capacity outside of permissible interval (8 W ... 25 W) for longer than 15 s might be displayed.</p>  |
| /4                          | OFF current too high  |

## 8 Correcting Faults

|                             |  |
|-----------------------------|--|
| /5                          | <p>Heating control circuit open<br/>Heater controller at limit stop for longer than 30 seconds.</p> <p><b>Help:</b><br/>Check wiring between probe and LT3-F (check probe signals terminals 10/11/12)</p>  |
| /6                          | <p>Temperature of the O<sub>2</sub> sensor too high (R<sub>ki</sub>-O<sub>2</sub> too low)<br/>For longer than 10 seconds, R<sub>ki</sub>-O<sub>2</sub> is under 10 Ω<br/>Heater R<sub>i</sub> outside of 5 Ω ... 15 Ω<br/>Internal resistance of heater outside of the interval 5 Ω ... 15 Ω</p>  |
| /7                          | <p>Temperature of the CO sensor too high (R<sub>ki</sub>-CO too low)<br/>For longer than 10 seconds, R<sub>ki</sub>-CO is under 10 Ω</p>   |
| <b>003 (HP)</b><br>103 (ÜP) | <p><b>Internal fault of analogue signal processing</b><br/>Device defective<br/>- Contact the manufacturer. Specify the trigger for diagnostic purposes.</p>   |
| <b>004 (HP)</b><br>104 (ÜP) | <p><b>Internal resistance of ceramics of the O<sub>2</sub> electrode</b></p>   |
| /1                          | <p>R<sub>ki</sub> O<sub>2</sub> too high. Internal resistance of ceramics of O<sub>2</sub> for LT3-F over 50 Ω, and/or for LT3 over 100 Ω, tolerance time of 30 seconds.</p>   |
| /2                          | <p>R<sub>ki</sub> O<sub>2</sub> too low. Internal resistance of ceramics of O<sub>2</sub> under 10 Ω, tolerance time of 30 seconds.</p>  |
|                             | <p><b>Help:</b><br/>If R<sub>ki</sub>-O<sub>2</sub> for LT3-F over 50 Ω, and/or for LT3 over 100 Ω, then<br/>- Probe too cold.<br/>- Internal resistance regulation not active or incorrect setpoint value.<br/>- The probe is stuck in a cold spot and the heating capacity does not suffice.<br/>  Look for a new installation position.<br/>- Flow speed too high.<br/>- Heating defective and probe cold.<br/>- Sensor breakage.<br/>- Check wiring between probe and LT3-F<br/>  (signal terminals 10/11/12)<br/>If R<sub>ki</sub>-O<sub>2</sub> under 10 Ω, probe is too hot, internal resistance regulation is not active, or incorrect setpoint value.<br/><br/>The optimum operating point (setpoint value) lies at 20 Ω.</p> |
| <b>005 (HP)</b><br>105 (ÜP) | <p><b>Internal resistance of ceramics of the CO/H<sub>2</sub> electrode</b></p>  |
| /1                          | <p>R<sub>ki</sub>-CO too high. Internal resistance of ceramics of CO for LT3-F over 50 Ω, and/or for LT3 over 100 Ω, tolerance time of 30 seconds.</p>   |
| /2                          | <p>R<sub>ki</sub>-CO too low. Internal resistance of ceramics of O<sub>2</sub> under 10 Ω, tolerance time of 30 seconds.</p>   |

## 8 Correcting Faults

|                             |   |
|-----------------------------|---|
|                             | <p><b>Help:</b><br/>           If <math>R_{ki-CO}</math> for LT3-F over 50 <math>\Omega</math>, and/or for LT3 over 100 <math>\Omega</math>, then</p> <ul style="list-style-type: none"> <li>- Probe too cold.</li> <li>- Internal resistance regulation not active or incorrect setpoint value.</li> <li>- The probe is stuck in a cold spot and the heating capacity does not suffice.</li> </ul> <p>Look for a new installation position.</p> <ul style="list-style-type: none"> <li>- Heating defective and probe cold.</li> <li>- Sensor breakage.</li> </ul> <p>If <math>R_{ki-CO}</math> under 10 <math>\Omega</math>, then probe too hot.</p> <ul style="list-style-type: none"> <li>- Internal resistance regulation not active or incorrect setpoint value.</li> </ul> <p>The optimum operating point (setpoint value) lies at 20 <math>\Omega</math></p> |
| <b>007 (HP)</b><br>107 (ÜP) | <p><b>Probe insulation</b><br/>           Device or probe defective.<br/>           Contact the manufacturer and specify the trigger for diagnostic purposes.</p>   |
|                             | <p><b>Help:</b></p> <ul style="list-style-type: none"> <li>- Remove the probe and check it in ambient air.</li> <li>- Check the wiring between LT3-F and probe (sensor signal and terminals 10/11/12)</li> <li>- Probe and LT3-F at the same potential?</li> <li>- Exchange the probe.</li> </ul>   |
| <b>008 (HP)</b><br>108 (ÜP) | <p><b>Intern fault: measured value comparison HP/UP</b><br/>           Device defective; contact the manufacturer and specify the trigger for diagnostic purposes.</p>  |
| <b>014 (HP)</b><br>114 (ÜP) | <p><b>Write the data record</b></p>   |
| <b>015 (HP)</b><br>115 (ÜP) | <p><b>Parameter/EEPROM fault</b><br/>           Device defective. Contact the manufacturer and specify the trigger for diagnostic purposes.</p>   |
| <b>016 (HP)</b><br>116 (HP) | <p><b>Internal fault/self tests</b><br/>           Device defective. Contact the manufacturer and specify the trigger for diagnostic purposes.</p>  |

## 8 Correcting Faults

### 8.1.2 Warnings

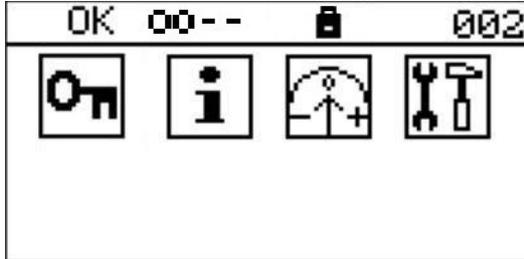
| Warning no.                 | Warning text  |
|-----------------------------|---|
| <b>001 (HP)</b><br>101 (ÜP) | <b>O<sub>2</sub> offset voltage in the air too large or too small</b>   |
| /1 - 29999                  | Trigger value of the O <sub>2</sub> offset voltage in the air (x0.1 mV)   |
| <b>002 (HP)</b><br>102 (ÜP) | <b>CO offset voltage in the air too large or too small</b>  |
| /1 - 29999                  | Trigger value of the CO offset voltage in the air (x0.1mV)  |
| <b>003 (HP)</b><br>103 (ÜP) | <b>O<sub>2</sub> temperature too large or too small, was not assumed</b>  |
| /1 - 29999                  | Trigger value of the O <sub>2</sub> temperature (x0.1 K)  |
| <b>004 (HP)</b><br>104 ÜP   | <b>CO temperature too large or too small, was not assumed</b>   |
| /1 - 29999                  | Trigger value of the CO temperature (x0.1 K)<br><b>Help:</b><br>When calibrating the O <sub>2</sub> electrode in CO containing flue gas the O <sub>2</sub> sensors' Kelvin value moves outside the permissible range (< 800 ... >1200 K). The warning WH004 or WH104 is indicated → CO temperature is too high/too low.<br>The calibration have to be repeated on another point of O <sub>2</sub> without CO in the flue gas. |
| <b>005 (HP)</b><br>105 (ÜP) | <b>CO scaling</b>   |
| /1                          | CO value not assumed, CO setpoint value too small   |
| /2                          | CO value not assumed, division by zero  |
| /3                          | CO value not assumed, calibration scaling factor outside of the valid range   |
|                             | <b>Help:</b><br>CO sensor worn/poisoned. Exchange the probe.  |
| /4                          | CO value not assumed, value is zero   |
| <b>010 (HP)</b><br>110 (ÜP) | <b>For LT3-F: Internal resistance of ceramics of the O<sub>2</sub> electrode over 45 Ω</b><br><b>For LT3: Internal resistance of ceramics of the O<sub>2</sub> electrode over 80 Ω</b>  |
| /0 - 65535                  | Trigger value of current internal resistance (x0.1 Ω), tolerance time of 3 seconds.   |
| <b>011 (HP)</b><br>111(ÜP)  | <b>For LT3-F: Internal resistance of ceramics of the CO electrode over 45 Ω</b><br><b>For LT3: Internal resistance of ceramics of the CO electrode over 80 Ω</b>  |
| /0 - 65535                  | Trigger value of current internal resistance (x0.1 Ω), tolerance time of 3 seconds.   |
| <b>016 (HP)</b><br>116 (ÜP) | <b>Internal warning</b>   |

## 8 Correcting Faults

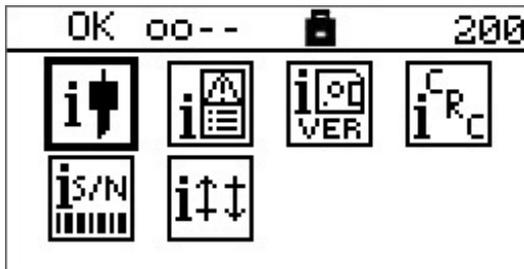
| Warning no. | Warning text   |
|-------------|--|
| /1          | <p data-bbox="635 282 1279 342">Serial number, customer ID or service password reset.<br/>Contact the manufacturer.</p> <div data-bbox="635 367 1165 631" style="border: 1px solid black; padding: 5px;"><p data-bbox="635 645 1292 674">Display if customer ID in LT3 and UI do not correspond.</p></div> |

## 8 Correcting Faults

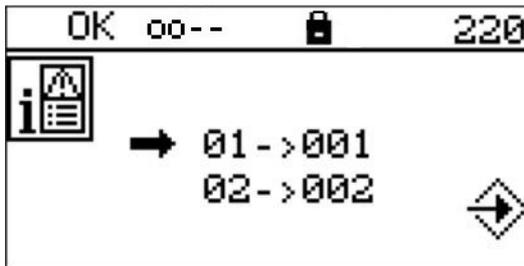
### 8.1.3 Call of the Fault History



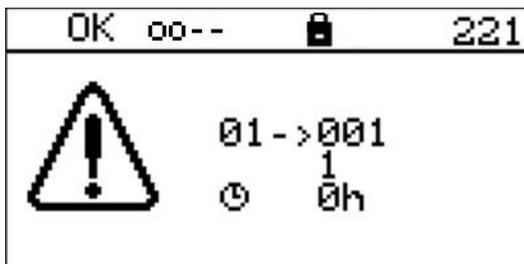
In the MAIN MENU select  for information.



In INFORMATION select  for the fault history.



Fault history



**01** Number of the entry

**001** Fault number of the main processor  
If the fault number is displayed as "101" (+100), there is a fault in the monitoring processor.

**1** Trigger 1

**0h** Occurs in case of ... Operating hours

For fault numbers, see Chapter 8.1.1 *Faults*.

### 9 Decommissioning

#### 9.1 Decommissioning

##### 9.1.1 Protection Against Emissions from Gas Carrying Channels

Recommendation in case of breaks in operation:

- With longer breaks in operation, in excess of 3 months, switch off the measuring system.
- Removal prevents damage to the probe.
- In the case of briefer breaks in operation, it is recommended that you continue to allow the measuring system to run.

The KS1D combination probe is fitted directly to the gas-carrying channel via the probe installation fitting (PIF). If the KS1D combination probe or the probe installation fitting (PIF) are dismantled, depending on the plant but particularly in the case of excess pressure, aggressive and / or hot gas can seep out of the channel and pose a serious health hazard to an unprotected operator if suitable safety measures have not been taken previously.



#### **WARNING!**

##### **Risk of burning due to hot gases!**

In the case of excess pressure and temperatures in excess of 200 °C in the gas channel, gases could escape when dismantling the KS1D combination probe or the probe installation fitting (PIF).

- ▶ Before opening, shut down the system.
- ▶ Wear suitable protective clothing and a protective mask.
- ▶ Fix respective warning information in close proximity to the mounting site.
- ▶ Immediately seal the opening again.

The LT3-F lambda transmitter and the KS1D combination probe are a high-quality, electronic measuring system. It therefore requires careful handling in all situations - decommissioning, transport and storage.

#### **NOTICE**

Do not switch off the LT3-F lambda transmitter as long as the KS1D combination probe is mounted. Not even if the associated plant has been brought to a standstill. Residual gases will cause corrosion and could damage system components.

- ▶ Do not store the device outside without any protection!
- ▶ When uninstalling, protect the ends of cables and the connectors from corrosion and soiling. Corroded connectors can cause malfunctions.
- ▶ Always store in a dry location and, if possible, keep in the original packaging.
- ▶ If possible, always transport in the original packaging.

#### **NOTICE**

The KS1D combination probe is capable of being stored in a dismantled state. This also applies if a KS1D combination probe has already been in operation once.

## 10 Options

### 10.1 Analogue Outputs via LSB Module Current, alternative Voltage, LSB address 19

#### 10.1.1 Functional Description

---

- Current module: 4 analogue outputs 0/4 ... 20 mA
- Voltage module: 4 analogue outputs 0/2 ... 10 VDC
- Possible to quickly wire several modules by means of strapping plugs

The LSB modules are universally applicable output modules, which are controlled via the LSB SYSTEM BUS. In the process, the module is triggered by an adjustable address (1 - 99). The statuses of the outputs are transferred in the data bytes. If an analogue output module with the same address exists in the system, the voltage / current measured there is shown on the respective output.

#### **NOTICE**

All outgoing lines from the LSB module must be screened. The screens must be applied to the PE rail as short as possible.

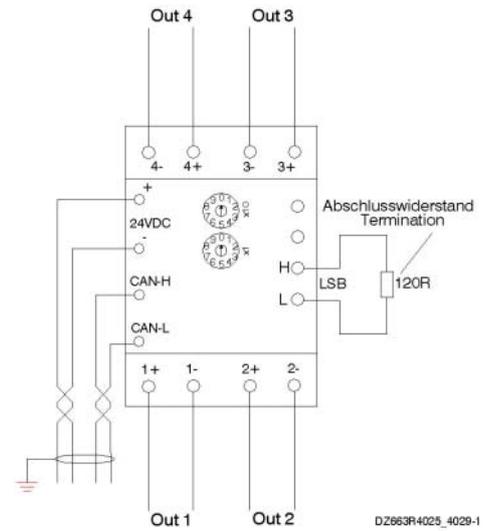
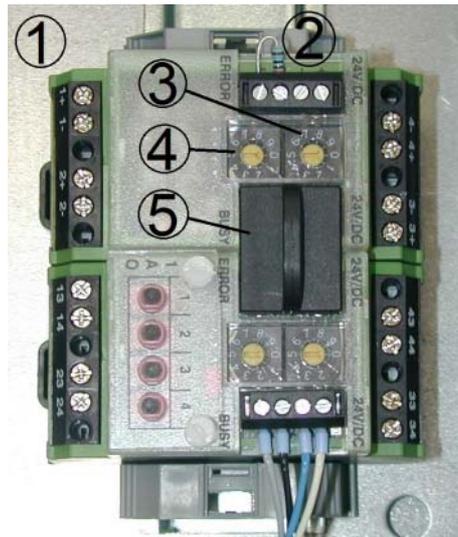
---

#### **NOTICE**

The termination resistor (120  $\Omega$ ) **must** be installed and activated on the first and the last BUS device.

Avoid transmission line!

---



- 1 Analogue output module
- 2 LSB terminal resistance, 120 Ω
- 3 Rotary switch for setting the tens LSB address
- 4 Rotary switch for setting the ones LSB address
- 5 Jumper plug

**Terminal assignment:**

- 1+ / 1-** Analogue output 1
- 2+ / 2-** Analogue output 2
- 3+ / 3-** Analogue output 3
- 4+ / 4-** Analogue output 4
- 24 VDC** Voltage supply for LT3-F Terminals 77-/78+
- CAN H/L** LAMTEC SYSTEM BUS for LT3-F Terminals 74 H/75 L

## 10.1.2 Factory Setting of Analogue Outputs via LSB Module

The module is activated at the factory.

In case of a later installation or exchange, the LSB address 19 must be set on the module using only 2 rotary switches.

Analogue output 1 (O<sub>2</sub> measured value)

- Setting range → adjustable between 0 ... 25% O<sub>2</sub>
- Factory setting: 0 ... 10 vol.% O<sub>2</sub> → 4 ... 20 mA

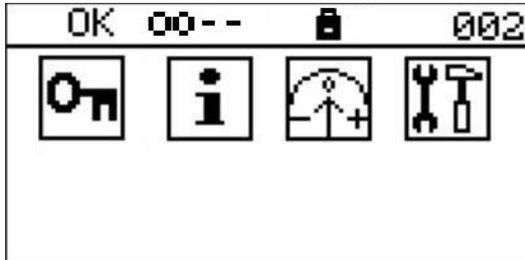
Analogue output 2 (CO<sub>e</sub> measured value)

- Setting range → adjustable between 0 ... 30,000 ppm
- Factory setting: 0 ... 1,000 ppm → 4 ... 20 mA

Analogue outputs 3 and 4 are currently deactivated at the factory and/or reserved for other values, such as flue gas temperature and efficiency.

## 10.1.3 Conversion of the Output Range via the User Interface

Access level 1 required.



In the MAIN MENU, select to make settings.

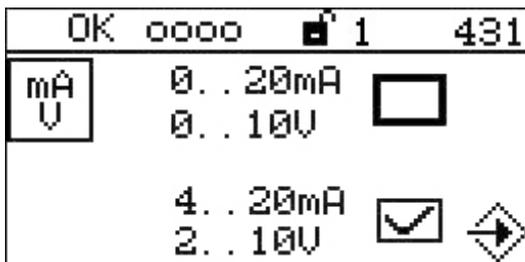


In SETTINGS, select for analogue outputs.

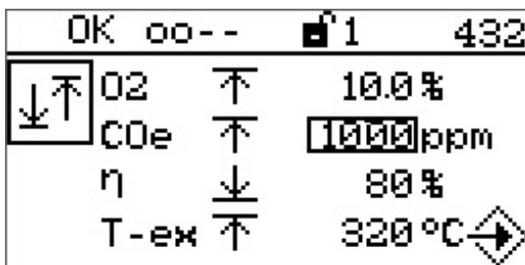


Analogue outputs offer setting possibilities for

- current range or voltage range.
- Output range.



Selection of the current or voltage range according to module.



Output ranges for:

- O<sub>2</sub> = O<sub>2</sub> measured value
- CO<sub>e</sub> = CO<sub>e</sub> measured value
- η = efficiency
- T-ex = flue gas temperature

### 10.2 Digital Outputs via LSB Module, LSB Address 03 and 51

#### 10.2.1 Functional Description

---

- 4 relay outputs 250 VAC, 6 A.
- Possible to quickly wire several modules by means of jumper plugs.
- The relay outputs are activated manually using switches.

LSB modules are universally applicable output modules for DIN rail mounting. They are actuated via the LSB. The module is addressed via a settable address (1 ... 99). The data bytes convey whether data is required or commands are to be executed.

#### **NOTICE**

All outgoing lines from the LSB module must be screened. The screens must be applied to the PE rail as short as possible.

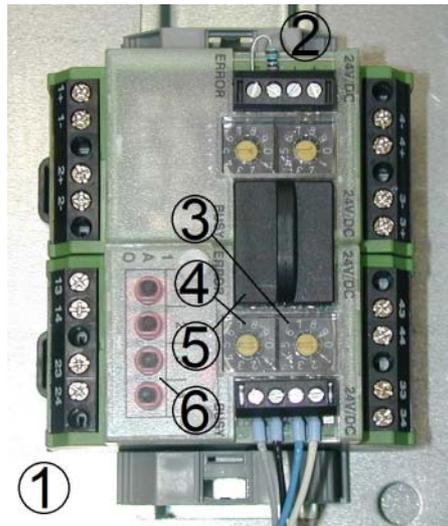
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#### **NOTICE**

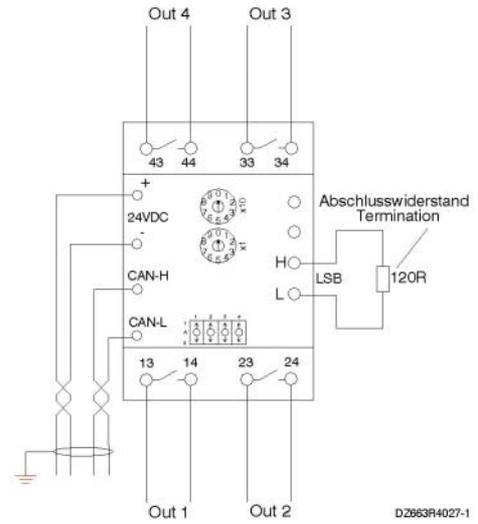
The termination resistor (120  $\Omega$ ) **must** be installed and activated on the first and the last BUS device.

Avoid transmission line!

---



- 1 Digital output module
- 2 LSB terminal resistance 120 Ω
- 3 Rotary switch for setting the tens LSB address
- 4 Rotary switch for setting the ones LSB address
- 5 Jumper plug
- 6 Manual activation



Terminal assignment:

- 13/14** Relay output 1
- 23/24** Relay output 2
- 33/34** Relay output 3
- 43/44** Relay output 4
- 24 VDC** Voltage supply for LT3-F Terminals 77-/78+
- CAN H/L** LAMTEC SYSTEM BUS for LT3-F Terminals 74 H/75 L

### 10.2.2 Factory Setting of the Digital Outputs

---

The LSB module for digital outputs 1 ... 4 is activated at the factory. In case of a later installation or exchange, the **LSB address 03** must be set on the module using only 2 rotary switches.

|                                 |   |
|---------------------------------|---|
| Digital output 1<br>Term. 13/14 | Locked faults   |
| Digital output 2<br>Term. 23/24 | Warning   |
| Digital output 3<br>Term. 33/34 | Limit value 1 (exceeding of 400 ppm CO <sub>e</sub> , 60 s)       |
| Digital output 4<br>Term. 43/44 | Limit value 2 (undershooting of 0.5 vol. % O <sub>2</sub> , 30 s) |

The LSB module for digital outputs 5 ... 8 is activated at the factory. In case of a later installation or exchange, the **LSB address 51** must be set on the module using only 2 rotary switches.

|                                 |             |
|---------------------------------|-------------|
| Digital output 5<br>Term. 13/14 | Calibration |
| Digital output 6<br>Term. 23/24 | Cold start  |
| Digital output 7<br>Term. 33/34 | Measure     |
| Digital output 8<br>Term. 43/44 | Warning     |

### 10.2.3 Diagnosis of the Digital Outputs

---

4 LED above the switches indicate the switching state of the digital outputs.

#### **NOTICE**

Manual activation of the relay outputs:  
Position 1 → output contact always closed  
Position A → output contact switches via LSB  
Position 0 → output contact always open

---

## 10.3 Digital Inputs via the LSB Module, LSB Address 11 and 55

### 10.3.1 Functional Description

- 4 floating digital inputs per module
- 8 digital inputs possible (2 modules)
- The digital inputs are activated manually using switches.

LSB modules are universally applicable output modules for DIN rail mounting. They are actuated via the LSB. The module is addressed via a settable address (1 ... 99). The data bytes convey whether data is required or commands are to be executed.

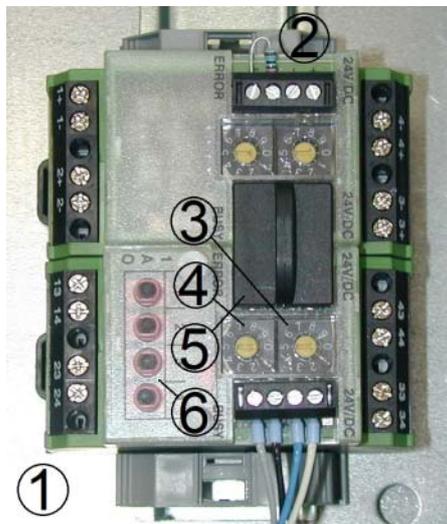
#### NOTICE

All outgoing lines from the LSB module must be screened. The screens must be applied to the PE rail as short as possible.

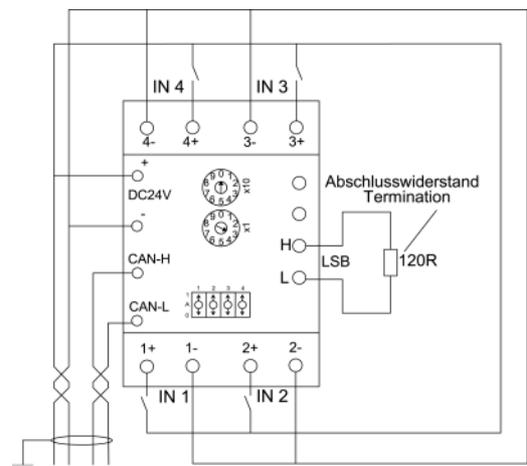
#### NOTICE

The termination resistor (120 Ω) **must** be installed and activated on the first and the last BUS device.

Avoid transmission line!



- 1 Digital input module  
Input 1 ... 4, address 11  
Input 5 ... 8, address 55
- 2 LSB terminal resistance, 120 Ω
- 3 Rotary switch for setting the tens LSB address
- 4 Rotary switch for setting the ones LSB address
- 5 Jumper plug
- 6 Manual activation



DZ663R4028-1

Terminal assignment:

- 1+/1-** Digital input 1
- 2+/2-** Digital input 2
- 3+/3-** Digital input 3
- 4+/4-** Digital input 4
- 24 VDC** Power supply  
for LT3-F Terminals 77-/78+
- CAN H/L** LAMTEC SYSTEM BUS  
for LT3-F Terminals 74 H/75 L

### 10.3.2 Factory Settings of the Digital Inputs

---

|                 |  |
|-----------------|--|
| Digital input 1 | Trigger OFFSET CALIBRATION                 |
| Digital input 2 | RESET FAULT                                |
| Digital input 3 | SWITCHOVER to CO <sub>e</sub> curve FUEL 1 |
| Digital input 4 | DEACTIVATION LIMIT VALUE 1 ... 4           |
| Digital input 5 | RESET LIMIT VALUE 1 ... 4                  |
| Digital input 6 | SWITCHOVER to CO <sub>e</sub> curve FUEL 3 |
| Digital input 7 | SWITCHOVER to CO <sub>e</sub> curve FUEL 4 |
| Digital input 8 | DEACTIVATION CALIBRATION                   |

#### **NOTICE**

Manual activation of the relay outputs:

Position 1 → input always activated

Position A → input switches via external contact with 24 VDC

Position 0 → input always deactivated

---

### 10.3.3 Diagnosis of the Digital Inputs

---

4 LEDs above the switches indicate the switching state of the digital outputs.

## 10.4 LSB Module for Calculating Combustion Efficiency

### 10.4.1 Functional Description

Properties:

- Two Pt100 temperature inputs to record the flue gas temperature and inlet temperature
- Two analogue outputs 0/4 ... 20 mA to emit the flue gas temperature and its efficiency
- Power supply 24 VDC / 50 mA (PELV)

#### NOTICE

All outgoing lines from the LSB module must be screened. The screens must be applied to the PE rail as short as possible.

#### Description of function

The calculation takes place according to the following formula:

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

$q_{Af}$  = flue gas loss due to free heat

$q_{Ag}$  = flue gas loss due to bound heat

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

The calculation of the flue 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 takes place free of CO and soot. The flue gas losses due to bound heat  $q_{Ag}$  are not taken into consideration.

Function not effective until  $< 14.9$  vol. %  $O_2$ .

**Display:**

|                           |       |     |     |
|---------------------------|-------|-----|-----|
| OK                        | oo--  |     | 001 |
| O2:                       | 2.0   | %   |     |
| COe:                      | 280   | ppm |     |
| ETA:                      | 82.0  | %   |     |
| T-ex:                     | 180.0 | °C  |     |
| T air:                    | 10.0  | °C  |     |
| COe $\Delta$ W $\nabla$ : | 42.1  | %   |     |

ETA efficiency 0 ... 100%

T-ex flue gas temperature 0 ... 400 °C

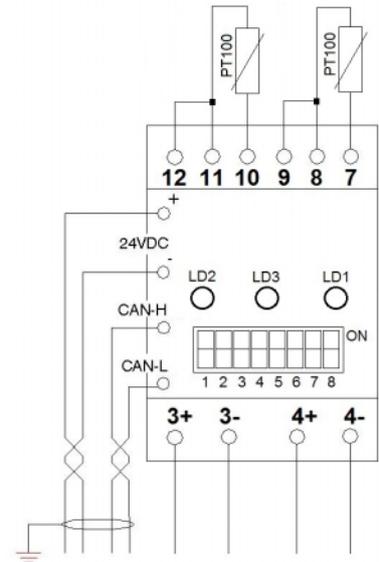
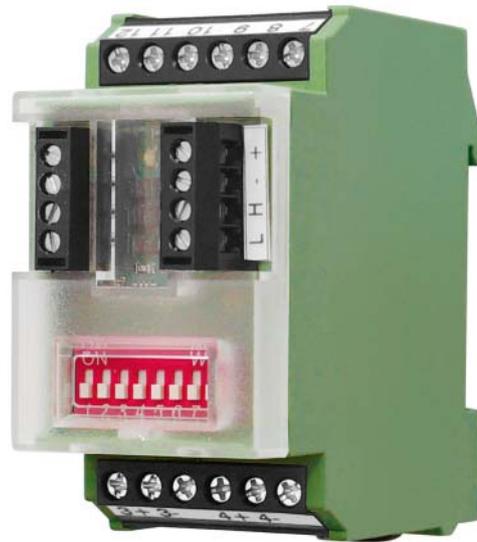
T air inlet air temperature 0 ... 400 °C

#### NOTICE

The termination resistor (120  $\Omega$ ) **must** be installed and activated on the first and the last BUS device.

Avoid transmission line!

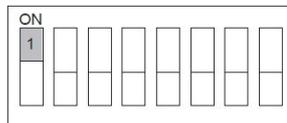
The terminal resistance can be set via DIP switch 1.



### Terminal assignment:

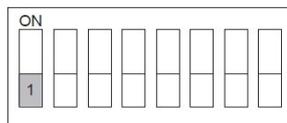
- 10 / 11 / 12** Pt100 temperature input for recording the flue gas temperature 0 ... 400 °C
- 7 / 8 / 9** Pt100 temperature input for recording the inlet temperature 0 ... 400 °C
- 3+ / 3-** Analogue output 3 efficiency  
Factory setting: 80 ... 100% → 4 ... 20 mA
- 4+ / 4-** Analogue output 4 (flue gas temperature)  
Factory setting: 0 ... 400°C → 4 ... 20 mA

### DIP switch settings



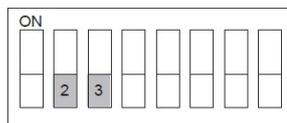
DIP switch 1  
LSB terminal resistance 120 ohm

ON active (terminal device)



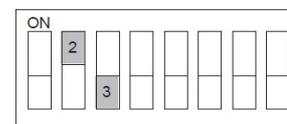
DIP switch 1  
LSB terminal resistance 120 ohm

OFF not active



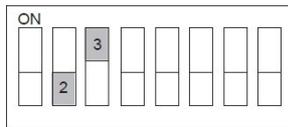
DIP switches 2 and 3  
LSB device family 2 (Standard)

2 OFF → 3 OFF



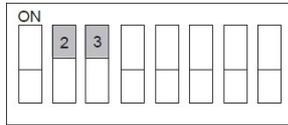
DIP switches 2 and 3  
LSB device family 2

2 ON → 3 OFF



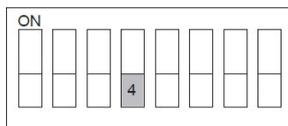
DIP switches 2 and 3  
LSB device family 3

2 OFF → 3 ON



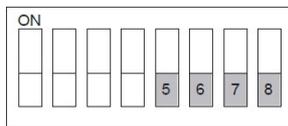
DIP switches 2 and 3  
LSB device family 4

2 ON → 3 ON



DIP switch 4  
Operating mode

OFF → normal mode ON  
→ Do not use the programming mode



DIP switch 5 - 8  
Not assigned

### LED status

#### LED 1 red → ERROR

OFF Normal mode

ON Initialisation not yet performed or not successfully ended (e.g., because the module could not be initialised).

No message has been received for at least 3 seconds.

#### LED 2 green → POWER

ON Module completely initialised and without error.

#### LED 3 green → CAN

OFF CAN controller in bus OFF. No communication possible.

FLASHING The CAN controller has discovered temporary faults. After the problem is remedied, the LED continues too flash for a while.

ON CAN is ready for operation.

## 10.5 External Connection

### NOTICE

With an external connection of the LSB modules, this must also be supplied with external voltage. The module can be stacked without clearance between each module. After stacking 15 modules, start again with the external supply voltage.

1. Fit the LSB module at the desired position.  
In the case of several modules, connect these with the help of the enclosed jumper plugs.
2. On the last module, connect the LSB connection resistance of 120 Ω.

## 10 Options

3. Connect the LSB module to the external voltage supply (24 VDC) and to LSB.  
Term. 72/74 → CAN-H  
Term. 73/75 → CAN-L
4. Set address at the module

LSB-Module with 4 analogue outputs, order no. 663R4025 or 663R4029  
LSB-Module address 19

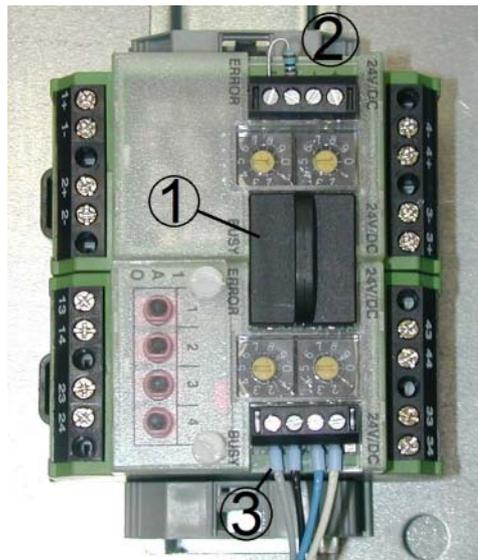
LSB-Module with 4 digital outputs, order no. 663R4027  
LSB-Module address 03 for output 1 ... 4  
LSB-Module address 51 for output 5 ... 8

LSB-Module with 4 digital inputs, order no. 663R4028  
LSB-Module address 11 for input 1 ... 4  
LSB-Module address 55 for input 5 ... 8

HART-Module with 2 analogue outputs, order no. 657R5930 (not LT3-F)  
Setting of the LSB-Module address not necessary

Efficiency-Module with 2 analogue in- and outputs, order no. 657R5940  
Setting of the LSB-Module address not necessary

PROFIBUS DP-Module, order no. 657R5950 (not LT3-F)  
Setting of the LSB-Module address not necessary



- 1 Jumper plug
- 2 LSB terminal resistance 120 Ω
- 3 Connecting terminals for  
- Power supply  
- LAMTEC SYSTEM BUS

### NOTICE

Max. line length between the lambda transmitter LT3-F and LSB modules = 500 m.

### Recommendation for line lengths and line cross-sections of the LAMTEC SYSTEM BUS:

- 0 ... 40 m 2 x 2 x 0.34 mm<sup>2</sup>, cabled in pairs with screening, impedance 120 Ω
- 40 ... 300 m 2 x 2 x 0.5 mm<sup>2</sup>, cabled in pairs with screening, impedance 120 Ω
- 300 ... 500 m 2 x 2 x 0.75 mm<sup>2</sup>, cabled in pairs with screening, impedance 120 Ω

### Example cable type for fixed installation:

- LAPP cable 2170267 (LAMTEC article no.: 05L05 2 x 2 x 0.5)
- HELUKABEL 800685

### 10.5.1 Commissioning of the Additional Modules

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#### Checking the module

- Ensure that the CAN LOW and CAN HIGH, as well as the 24V voltage supply, are connected correctly.
- Make sure that a terminal resistance of 120  $\Omega$   
is set at the free connecting point between CAN LOW and CAN HIGH.
- Setting the address on the module (tens at the top, ones at the bottom)
  - LSB module with 4 analogue outputs: LSB address 19
  - LSB module with 4 digital outputs: LSB address 03
  - LSB module with 4 digital inputs: LSB address 11 – Modules for calculating the efficiency or field bus connection do not require an own LSB address
- With digital modules, the switches of the manual operating levels must be set to "A."

#### After switching on, you should see the following status

- Red LED off on the LSB module
- Green LED flashes on the LSB module

#### If not, consider the following problem solutions

- No LED on the LSB module lit
  - No 24V supply
- Green LED on the LSB module constantly lit, red LED flashes
  - LSB module without address
  - No or incorrect parameters activated
- Green and red LED on the LSB module constantly lit
  - Incorrect address set on the LSB module

# 11 Storage

## 11.1 Storage Conditions

---

### **NOTICE**

- ▶ Do not store the device outside without any protection!
  - ▶ When uninstalling, protect the ends of cables and the connectors from corrosion and soiling. Corroded connectors can cause malfunctions.
  - ▶ Always store in a dry location and, if possible, keep in the original packaging.
  - ▶ If possible, always transport in the original packaging.
  - ▶ Transport and storage: - 20°C up to + 70°C.
-

## 12 Disposal Notes

### 12.1 Environmental Protection, Waste Disposal

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The LT3-F Lambda Transmitter was designed according to ecological viewpoints. The structural components can be separated easily from each other, sorted accordingly and then recycled.

The device contains electrical and electronic components and must not be disposed of as domestic waste. The local and currently valid legislation absolutely must be observed.

## 13 Appendix

### 13 Appendix

#### 13.1 LT3-F spare parts

| Description   | Type     |
|---|----------|
| LT3-F motherboard   | 657E5000 |
| LT3-F processor board main processor (specify the serial number of the LT3-F)       | 657R5010 |
| LT3-F processor board monitoring processor (specify the serial number of the LT3-F) | 657R5011 |
| LSB module with 4 analogue outputs, current   | 663R4029 |
| LSB module with 4 analogue outputs, voltage   | 663R4025 |
| LSB module with 4 digital outputs   | 663R4027 |
| LSB module with 4 digital inputs, 24 VDC  | 663R4028 |
| HART module   | 657R5930 |
| Module for efficiency calculation   | 657R5940 |
| Module for field bus connection, PROFIBUS DP  | 657R5950 |
| UI300 User Interface  | 657R5051 |

#### 13.2 Spare Parts Combination Probe KS1D in Housing

| Description   | Type                    |
|---|-------------------------|
| * 1 Replacement probe average lifetime ca. 2 ... 5 years (depending on fuel) with PTFE-connecting cable, in housing, for measuring gas temperature up to 300 °C, without Gas extraction device (GED), | 656R2000 <sup>(1)</sup> |
| <b>Spare parts</b>  | <b>Type</b>             |
| <b>Description/Type</b>   |                         |
| 1 Gas extraction device (GED),<br>length 150 mm   | 655R1001                |
| length 300 mm   | 655R1002                |
| length 450 mm   | 655R1003                |
| length 1000 mm (incl. safety washer)  | 655R1004                |
| 1 Mounting compound - Anti-seize-paste (5 pcs. per pack)  | 650R1090                |
| 1 Probe installation fitting (PIF), steel   | 655R1010                |
| Clamp ring for PIF (5 pcs. per pack), steel   | 650R1013                |

<sup>(1)</sup> Recommendation: Add these spare parts into stock

#### 13.3 Spare Parts Combination Probe KS1D without Housing

| Description  | Type                    |
|--|-------------------------|
| * 1 Replacement probe average lifetime ca. 2 ... 5 years (depending on fuel) with PTFE-connecting cable, without housing, for measuring gas temperature up to 300 °C | 656R2010 <sup>(1)</sup> |
| <b>Spare parts</b>   | <b>Type</b>             |
| <b>Description/Type</b>  |                         |
| 1 Mounting compound - Anti-seize-paste (5 pcs. per pack)   | 650R1090                |

<sup>(1)</sup> Recommendation: Add these spare parts into stock

## 13 Appendix

### 13.4 Spare Parts KS1D-HT Combination Probe

| Description   | Order no.               |
|---|-------------------------|
| 1 1 Replacement probe average lifetime ca. 2 ... 5 years (depending on fuel) with PTFE-connecting cable, in housing, in connection with flue gas bypass tube for measuring temperature up to 1200 °C, | 656R2015                |
| Replacement sensor, consists of sensor, seal for connecting head, filter discs and metal c-ring   | 656R2065 <sup>(1)</sup> |

| Spare parts  | Type     |
|--|----------|
| <b>Description/Type</b>  |          |
| 1 Mounting compound - Anti-seize-paste (5 pcs. per pack)             | 650R1090 |
| 1 Flange seal between counter flange/ flue gas bypass tube           | 655P4211 |
| 1 Flange seal between KS1D-HT high temperature/ flue gas bypass tube | 656P0263 |

<sup>(1)</sup> Recommendation: Add these spare parts into stock

13.5 Wet/Dry Measurement Deviations, Conversion Table

**NOTICE**

The LT3-F carries out measurements directly in the humid flue gases (wet measurement). When extractive devices are used, flue gases are removed and prepared. "Dry measurements" are normally used here, since the humidity has been extracted from the flue gas. As a result, O<sub>2</sub> measurement values vary (see diagrams below).

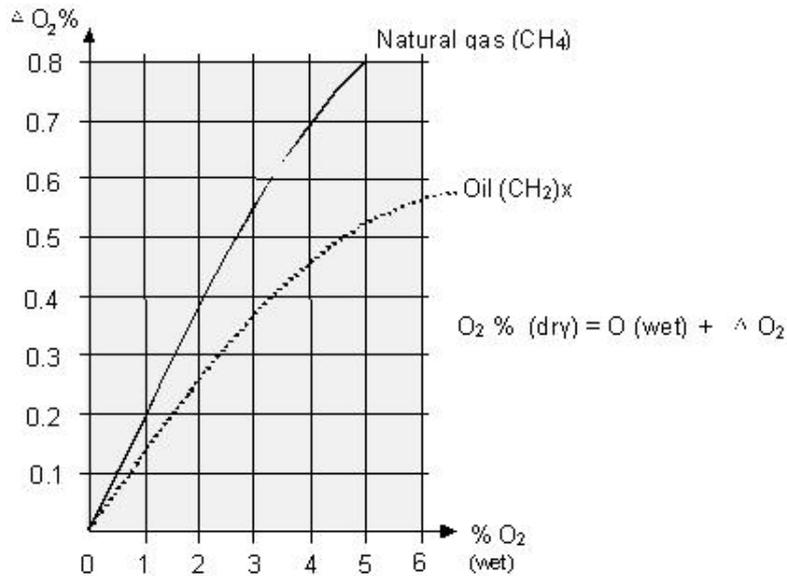


Fig. 13-1 Theoretical max. deviations of the O<sub>2</sub> concentration in wet and dry measurement. Fuel: natural gas or oil

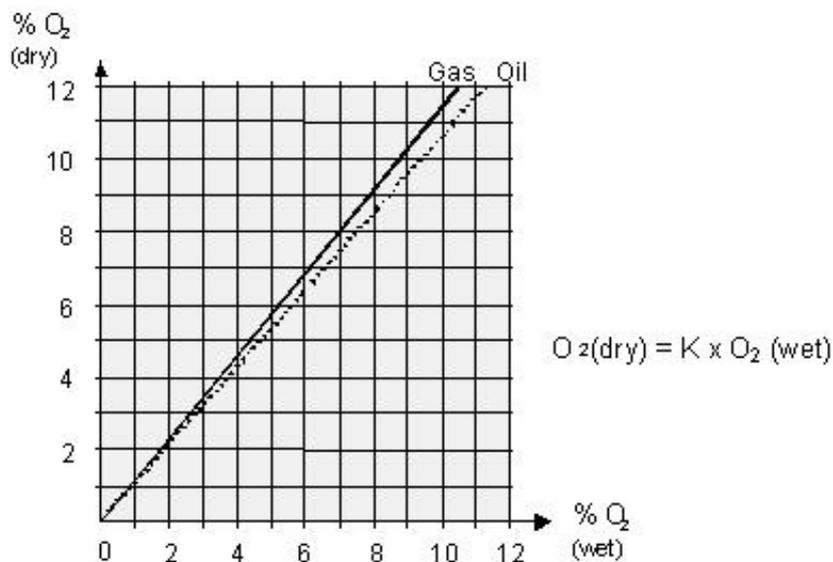
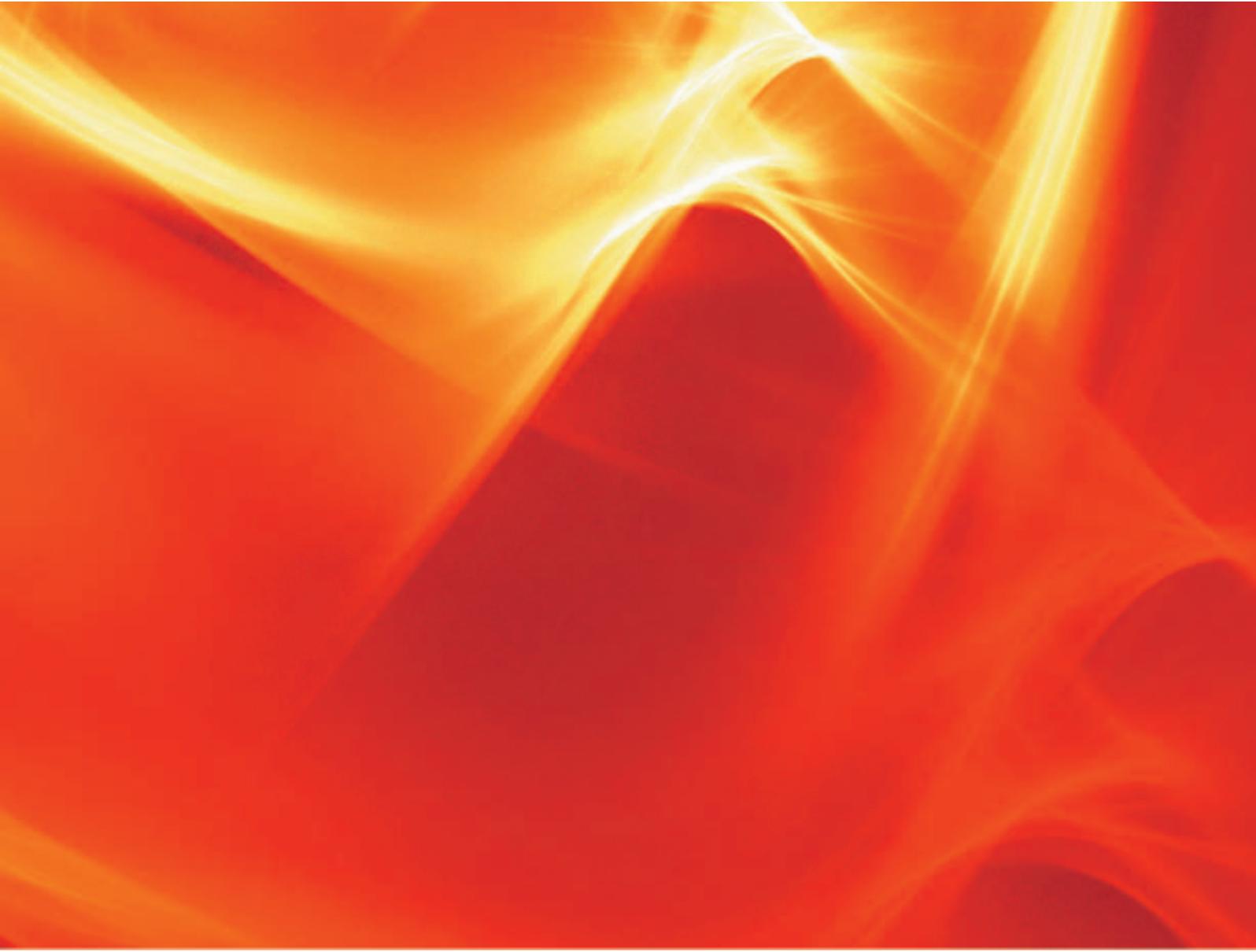


Fig. 13-2 Calibration plot for the concentration values of O<sub>2</sub> (dry) and O<sub>2</sub> (wet)

| O <sub>2</sub> concentration range | Constant C gas/CH <sub>4</sub> | Constant C oil/(CH <sub>2</sub> ) <sub>x</sub> |
|------------------------------------|--------------------------------|--|
| 0-6 % O <sub>2</sub>               | 1,18                           | 1,115  |
| 6-12 % O <sub>2</sub>              | 1,08                           | 1,08   |
| 0-12 % O <sub>2</sub>              | 1,15                           | 1,10   |



The information in this publication is subject to technical changes.



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