Assembly and
Commissioning instructions

Lambda Transmitter LT 2
Lambda Probe LS 2

**Sensors and systems
for combustion engineering**

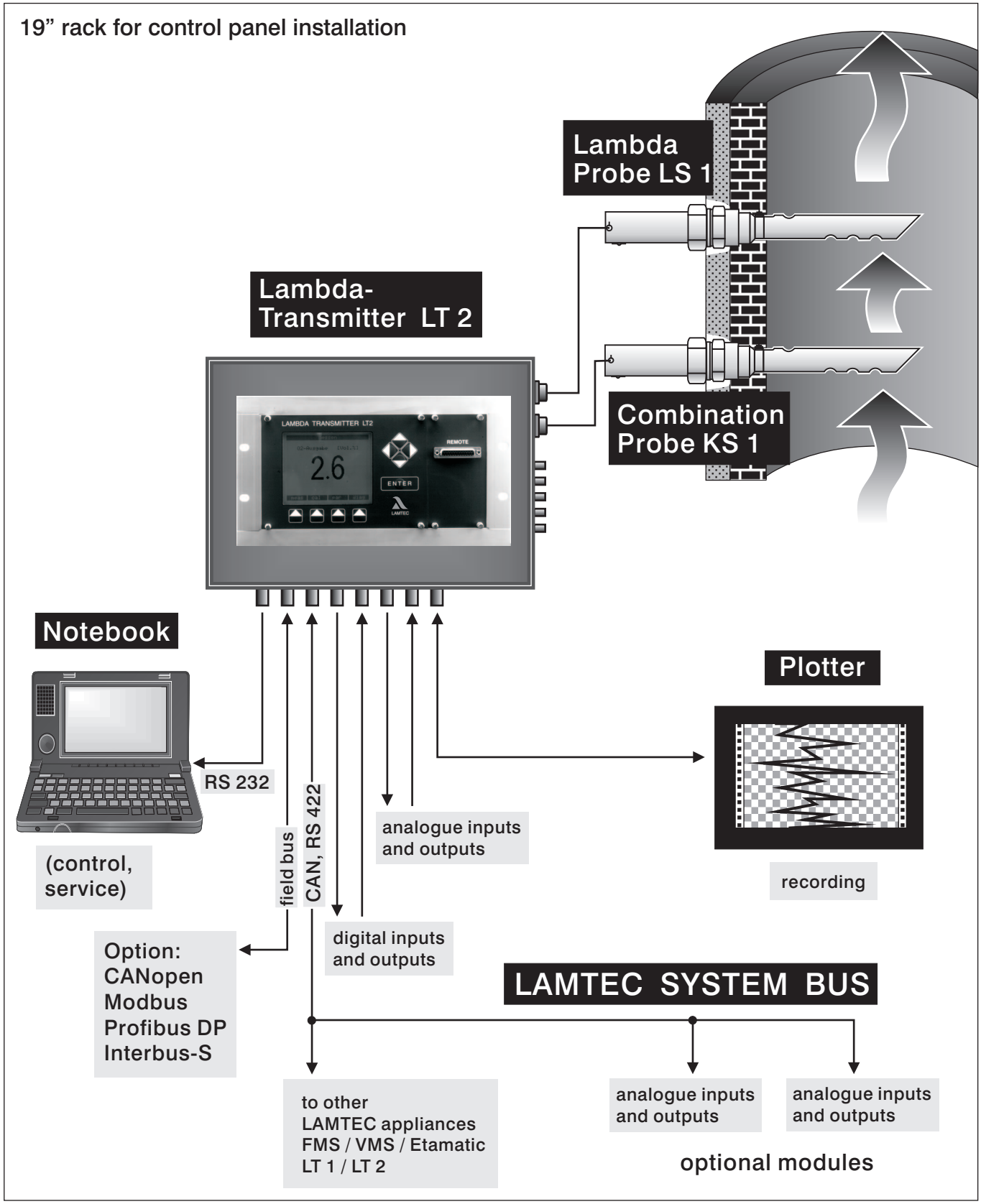
LAMTEC

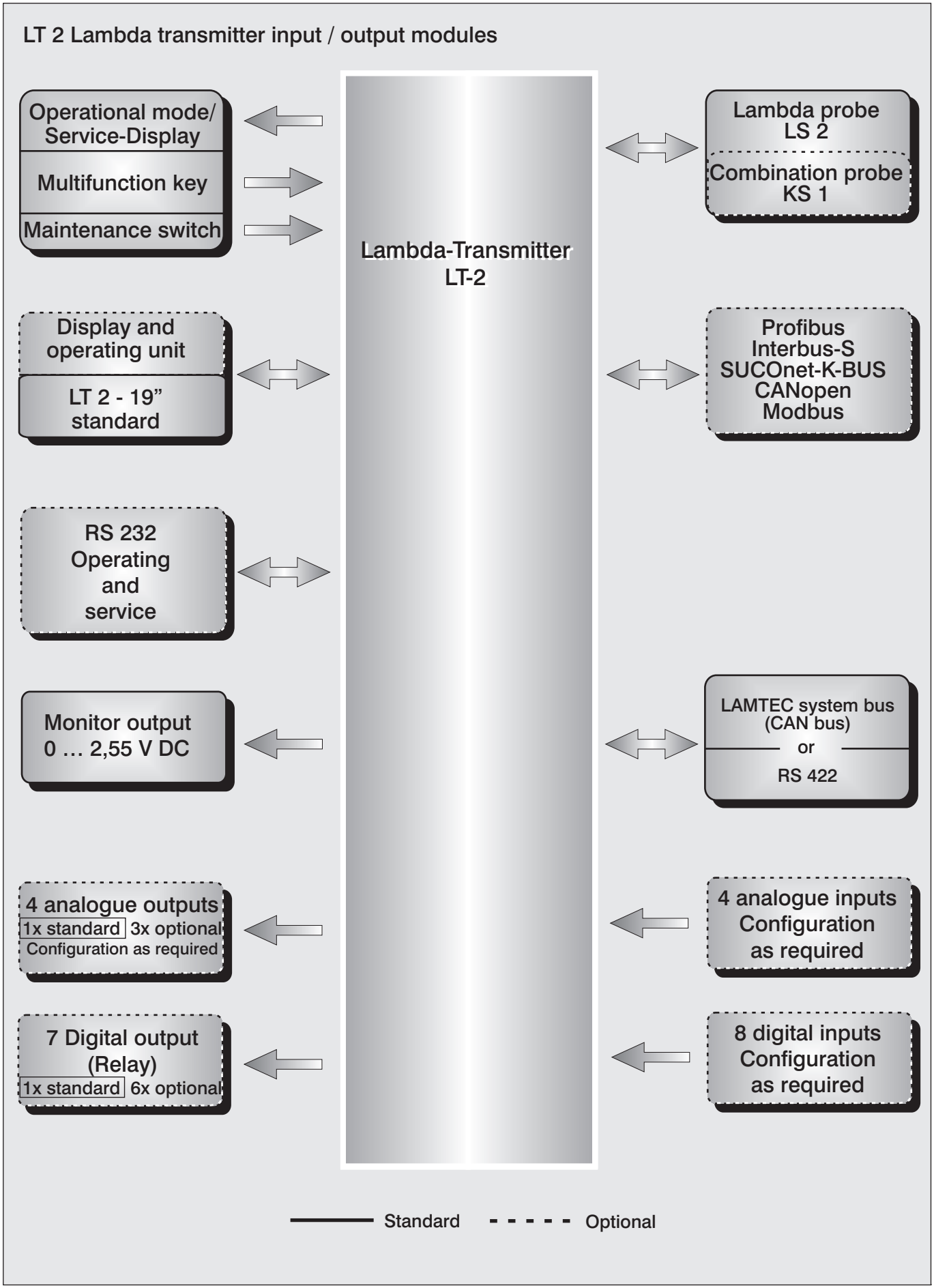
Contents

Contents

The Lambda Transmitter LT 1 is a universal, microprocessor-based measuring device for directly measuring the O_2 concentration in the super-stoichiometric range ($\lambda > 1$) in combination with the proven Lambda probe LS 1.

The Combination Probe KS 1 can be connected for measuring combustible Gas constituents (CO/H_2).




LT 2 Lambda transmitter input / output modules
Operational mode/ Service-Display
Multifunction key
Maintenance switch
Display and operating unit
LT 2 - 19" standard
RS 232 Operating and service
Monitor output 0 … 2,55 V DC
4 analogue outputs
1x standard 3x optional
Configuration as required
7 Digital output (Relay)
1x standard 6x optional
Lambda-Transmitter LT-2
Lambda probe LS 2
Combination probe KS 1
Profibus
Interbus-S
SUCOnet-K-BUS
CANopen
Modbus
LAMTEC system bus (CAN bus)
or
RS 422
4 analogue inputs Configuration as required
8 digital inputs Configuration as required
Standard
Optional

Universal O_2 measuring instrument, based on the LS 2 Lambda probe (zirconium dioxide voltage probe), for the direct continuous measurement and monitoring of oil (EL) and gas combustion systems in the super-stoichiometric domain ($\lambda > 1$) without special gas purification.

LS 2 Lambda probe,
650 R 1000 with gas
extraction device (MEV)
type 655 R 1001 - R 1003
and probe installation fitting
(SEA) type 655 R 1010

LT 2 Lambda transmitter in
IP54 wall-mounted housing,
steel panels
400 x 300 x 155 mm
(h x w x d)
type 657 R 1025

LT 2-19” Lambda transmitter
in 19” rack for control panel
installation 3 HE, 50 TE
173 x 310 x 270
(h x w x d)
type 657 R 1040

These operating instructions were written to provide you, the user, wit clear and unambiguous instructions for installation, commissioning, maintenance, service and operation.

The operating instructions are subdivided into 11 blocks, each of which is self-contained and deals with one set of tasks:

0. Introduction
This chapter

1. Safety notes for users

2. Theoretical background, measurement principle
In this chapter you will find the fundamental physical context explained.

3. Technical description
All system components are described in detail, and the functional processes explained.

4. Installation
This section provides you, the user, with important directions for the installation of all system components.

5. Commissioning
If you carry out commissioning yourself, all necessary steps can be found in this chapter.

6. Operation
This section explains the day-by-day use of the O_2 measuring system.

7. Service and maintenance
The fundamental idea behind service and maintenance works is that regular inspection and preventive replacements and repairs maintain the device continuously functional and help to avoid damage and failures. Service means the replacement of worn or damaged parts. Maintenance means the replacement of consumables such as filters etc, and the cleaning of units.

8. Fault analysis and rectification
Any faults that occur should be rectified as soon as possible. This section shows you how to go about identifying solutions, in order to deal with problems

9. Spare parts
A list of the relevant spare parts, plus a suggested list of spares that should always be kept in stock.

10. Appendix
- Technical data
- Wiring diagrams
- LT 2 factory settings
- Fuses
- Dimensional diagrams
- Wet/dry deviations

11. EC Conformity Declaration
Certification of compliance with the European Directives relevant to this device.

What these operating instruction describe

These operating instructions describe the LT 2 Lambda transmitter with all the components necessary for O_2 measurements such as the LS 2 Lambda probe, probe installation fitting etc.

Accessories and special applications

The accompanying documentation applies to accessories and special applications. If necessary, please contact the Walldorf works for any information required.

These operating instructions serve to understand the LT 2 Lambda transmitter's functions, assembly, installation and maintenance works and its operation. Other documentation, such as e.g. product data sheets, may contain further information but should never be used as a substitute for these instructions.

ATTENTION!

Always read the operating instructions before starting work! Carefully observe all warning notes!

Certain works, such as electric installation, presuppose special expertise. These works may only be carried out by personnel with the appropriate qualifications. See the chapter Authorised users.

Validity

Our products undergo constant development. Equally, we make every effort to ensure that the operating instructions are accurate and customised for the individual application.

Previous editions become void as soon as a supplemented and amended new edition is issued.

On the last page you will find the current version number of these operating instructions and the associated ordering number.

Standards:

The instruments conform to the following Standards and regulations:

Low-voltage Directive
EMC Directive.

See also the Conformity Declaration on pages 82-83.

Do you have suggestions for improvements ?

If you have suggestions for improvements, please write to us immediately, quoting the current version number and the associated ordering number. Please write to:

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Explanation of the symbols in the safety notes

The following symbols are used in these operating instructions as important safety notes for the user. They are placed within each chapter where the information is required. The safety notes, and in particular the warnings, must always be observed and followed.

WARNING

highlights possible hazards to personnel, particularly through electrical equipment.

WARNING
indicates possible hazards to personnel arising from improper handling of system parts.

ATTENTION!
identifies hazards to system parts or possible malfunctioning.

NOTE:
contains additional information important to the user about the system or system parts, and offers further suggestions.

Occurs in texts containing instructions for carrying out an action.

The operator is urged to observe the statutory accident prevention regulations when carrying out any works, and to do everything appropriate to the circumstances in order to avoid personal injury and damage to property.

Applications

The LT 2 Lambda transmitter is an O_2 measuring instrument for the continuous measurement of O_2 concentration in non-combustible gases in the super-stoichiometric domain, in conjunction with the LS 2 Lambda probe.

If the system is to be used in some other way, and if the instrument's functionality in this application cannot be unambiguously assessed, the manufacturer should be contacted in advance.

Prerequisites

It is assumed that facility planning, assembly, installation, commissioning, maintenance and service works are carried out by sufficiently trained personnel, and these works are supervised by qualified specialists.

unterwiesenem Personal vorgenommen werden und diese Arbeiten durch verantwortliche Fachkräfte geprüft werden.

Correct handling

Special attention must be paid to the following:

- The application must conform to the technical data and the specifications regarding authorised use, assembly, connection, environmental and operational conditions (derived from the job documentation, the instrument's user information, rating plates etc), and to the documentation supplied.

- The local regulations and facility-specific and technical hazards must be noted and followed.

- All steps necessary to protect the equipment, e.g. during transport, storage, maintenance and inspection, should be carried out.

Qualified personnel

Those responsible for safety must always ensure that

- only qualified personnel carry out work on system parts. Qualified personnel have been authorised by those responsible for maintaining the safety of employees and that of the facility, to perform such activities as a result of their training, experience or familiarity with the relevant Standards, regulations, accident prevention measures and local conditions. The important factor is that such personnel are able to identify and prevent possible hazards in good time.

  Specialist personnel are those meeting DIN VDE 0105 or IEC 364, or directly comparable Standards such as DIN 0832.

- these personnel have the supplied operating instructions and the associated, job-related documentation available to them during all works, and observe these documents in order to avoid hazards and damage.

User groups

Two user groups are assumed to handle the LT 2 Lambda transmitter:

A Service technicians of LAMTEC or their OEM customers, or the customer's trained personnel:
qualified technicians/engineers -
have very good knowledge of the instrument.

B Operators, the customer's installers,
measurement/control/electric/electronic technicians -
have elementary knowledge of the instrument.

Hazards from electric equipment

The LT 2's system parts are items of equipment designed to be used in industrial high-current facilities. When working on parts connected to the supply or carrying supply voltage, disconnect from the supply and ensure zero voltage. Re-install all machine guards before reconnecting to the supply.

Damage to health or to property may result from improper use or incorrect handling. To prevent damage, observe the appropriate safety notes.

Preventive measures for improving operating safety

Where the LT 2 is used as a sensor in conjunction with regulating or control systems, it is the operator's responsibility to ensure that LT 2 failure or faults cannot lead to dangerous situations or those that cause unacceptable damage.

In order to prevent faults, which in turn could cause direct or indirect damage to personnel or to property, the operator must ensure that

– the appointed maintenance personnel can be notified at any time and as soon as possible

– the maintenance personnel are trained to respond correctly to LT 2 faults and associated operational faults

– in the event of doubt, the affected equipment is immediately switched off

– switching off does not lead to direct consequential faults

Prevention of consequential damage

To prevent consequential damage in the event of instrument faults, which in turn could cause direct or indirect damage to personnel or property, ensure that qualified personnel assess the faults and initiate appropriate steps.

The LT 2 Lambda transmitter is directly attached to the gas-carrying channel, via the probe installation fitting (SEA). If the LS 2 Lambda probe or the SEA installation fitting are dismantled; then depending on the facility and particularly in the event of excess pressure, aggressive and/or hot gas may be emitted from the channel and cause severe health damage to unprotected operatives, unless suitable protective measures have previously been put into place.

WARNING

In the event of excess pressure and temperatures above 200°C in the gas channel, dismantling the LS 2 Lambda probe or the installation fitting lead to the emission of gases.

– Switch off the facility before opening. If this is not possible, wear protective clothing and a protective mask.

– Put up appropriate warning signs near the installation site.

– Close the aperture at once.

The LT 2 Lambda transmitter and the LS 2 Lambda probe form a high-quality electronic measurement system. Treat them with care at all times, including during shutdown, transport and storage.

Shutdown

ATTENTION!

Do not switch the LT 2 Lambda transmitter off as long as the LS 2 Lambda probe is mounted; incl. when the relevant facility has been shut down. Residual gases cause corrosion and may damage system parts.

Do not store the instruments outdoors without protection!
Always store in a dry place, if possible in the original packaging.

When dismantling, protect cable ends and plugs against corrosion and dirt. Corroded plugs may cause malfunction.

If possible, transport in the original packaging.

Environmental protection, waste disposal

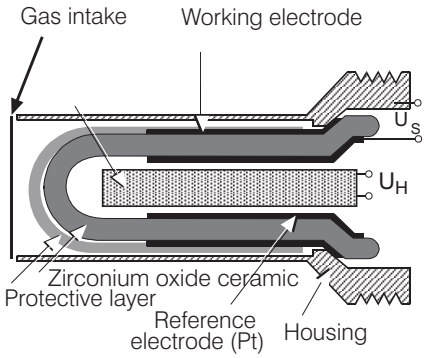
The LT 2 Lambda transmitter's construction is also based on environmental considerations.
The modules can easily be separated and sorted into distinct types, and recycled accordingly.

2. Theoretical background
Measurement principle

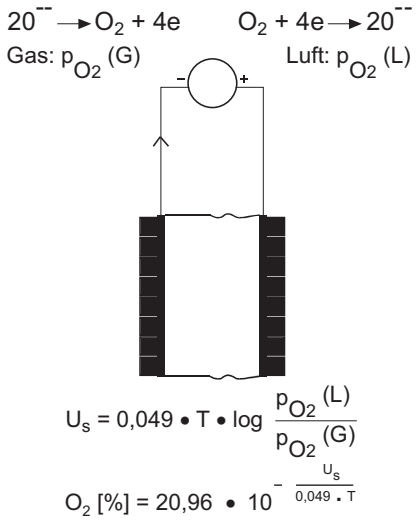
In essence, the LS 2 Lambda probe consists of a zirconium dioxide-ceramic electrochemical cell. The cells operates as an electrochemical concentration chain, and generated direct voltage that depends on the absolute temperature T and the logarithm of the O_2 concentration or the O_2 partial pressure ratio at the inner and outer electrodes.
If the outer electrode is supplied with the test gas and the inner one with a reference gas with a known O_2 concentration, such as e.g. air (20.96%), then assuming the temperature is held constant, we obtain the logarithmic relationship between probe voltage E and the oxygen concentration of the test gas shown below. The characteristic curves for two different temperatures T_1 and T_2 show clearly that when using the voltage probe, the temperature affects the measured value in the cell's active part. In addition, the curves show that the probe is preferentially suitable for measuring low oxygen concentrations, since sensitivity and accuracy increase with decreasing O_2 concentration because of the logarithmic relationship.
Since the measurement of high O_2 concentrations is subject to high error due to the low voltage dependence, it is not possible to use, for example, air (20.96% O_2) to calibrate or tune the probe.
Each LS 2 Lambda probe is tested at the factory under real-life conditions, in a gas-combustion system with an exhaust temperature of ca. 150°C. The test protocol is enclosed with each probe. The sensor temperature recorded in the protocol should be input into the LT 2 during commissioning. Calibration with test gases is not required.

During operation it is possible to check and compensate for the measured values through counter-measurement; see 7.1.2, page 56.

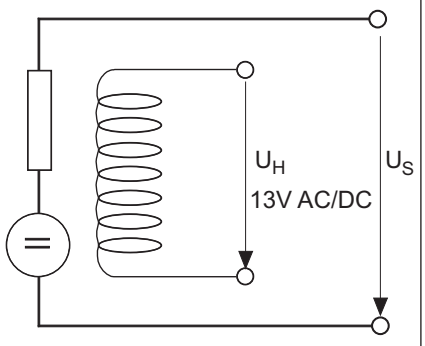
Schematic construction of the ABB oxygen probe



The voltage probe's working principle



The voltage probe's equivalent electric circuit diagram and working principle



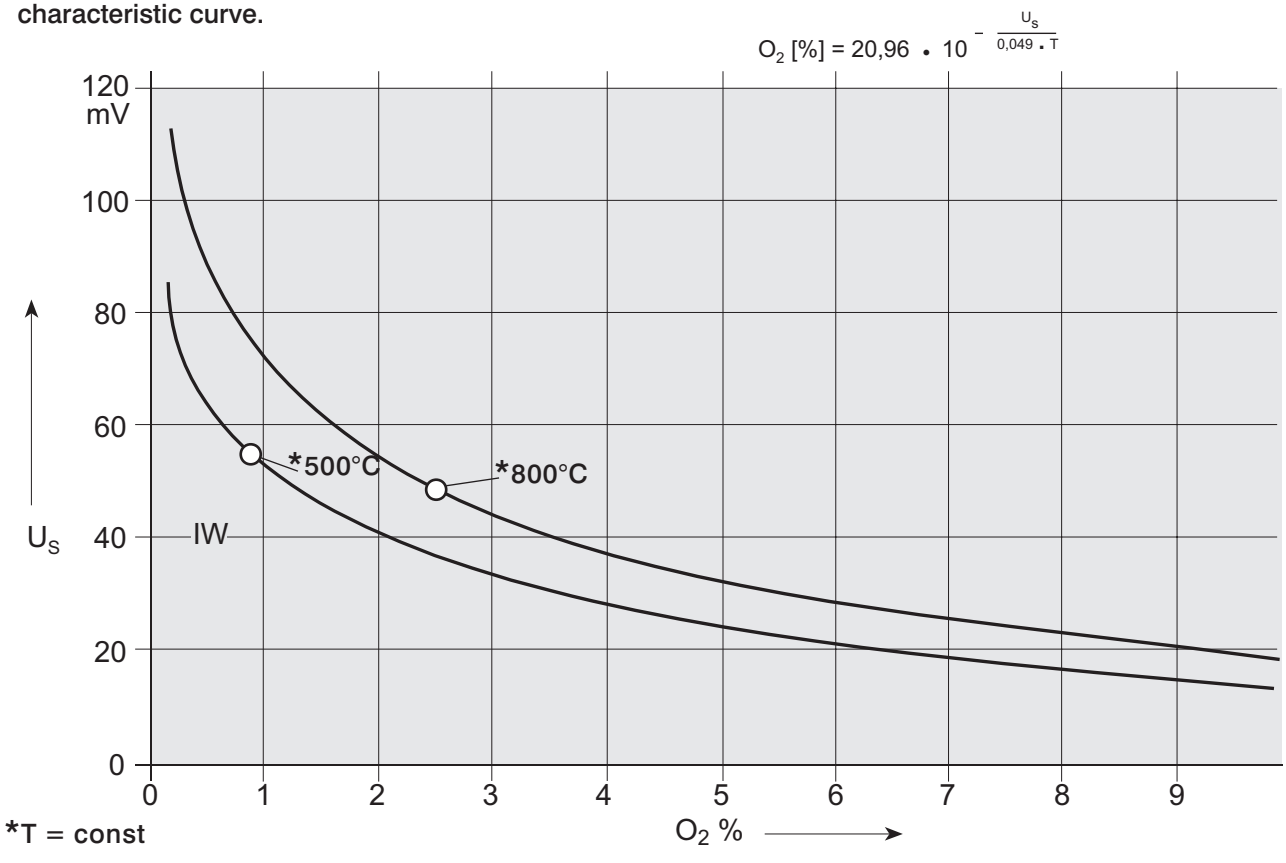
LS 2 Lambda probe with MEV and SEA, standard version

2. Theoretical background
Measurement principle

The curve shown below demonstrates that oxygen measurements require knowledge of the proportionality factor and of the probe's temperature. In practice this means that the probe's tuning is possible simply through air voltage compensation (offset compensation), and entering the cell temperature obtained during final testing in accordance with the test protocol enclosed with the probe (usually ca. 1000 K) during commissioning with the LT 2.
The probe's logarithmic characteristic depends on cell temperature and on each probe's individual curve. The temperature of the solid electrolyte and of the electrodes affects the probe's signal, however the probe is heated with constant current to ca. 730°C. The temperature of the measured gas and the installation site affect the cell's temperature only slightly. Hence, probe temperature needs to be neither measured nor regulated. Individual deviations are compensated for during commissioning by adjusting the air voltage (offset compensation) and entering the sensor temperature obtained during final testing and recorded in the test protocol.
The probe can only be used up to a gas temperature of 300°C. Probe ageing in long-term operation leads to a stretching of the characteristic curve. However, this can be recognised from the fact that the internal resistance increases.
The probe should be replaced every 2 heating periods, however no later than after 10.,000 hours in operation.

Note: *Calibration of the LS 2 Lambda probe with test gases has been avoided for the sake of simple handling and low maintenance. The probes are measured at the factory under operational conditions (gas combustion, exhaust gas temperature 150°C). Individual deviation is taken into account by adjusting the air voltage (offset compensation) and entering the obtained sensor temperature obtained during commissioning.*
Measurement accuracy is ±10%, at best ±0.5% vol. O_2.

Measurement and calibration diagram of the LS 2 oxygen probe. The effect of temperature on the probe's characteristic curve.

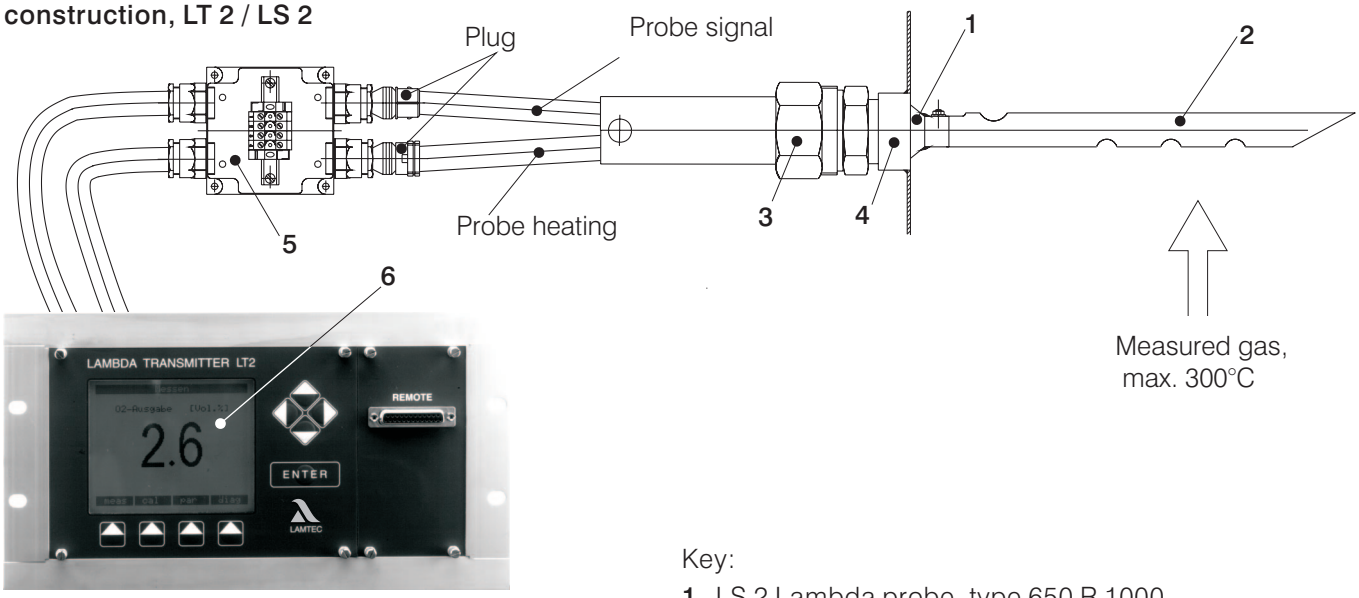


3.1 System overview
Required components

The O_2 measurement system is available in various versions.
It consists of the following components:

- LS 2 Lambda probe
- Gas extraction device (MEV)
- Probe installation fitting (SEA)
- Probe junction box (SAK)
- LT 2 Lambda transmitter
  either
  in 19" rack for control panel installation, incl. display and operating unit
  or in IP 54 wall-mounted housing

3.1.1 Schematic construction, LT 2 / LS 2



LT 2 Lambda transmitter
19" rack for control panel installation
Type 657 R 1040

Key:

1 LS 2 Lambda probe, type 650 R 1000
2 Gas extraction device (MEV),
type 655 R 1001-R 1003
3 Probe installation fitting (SEA), type 655 R 1010
4 Half-collar R 1.25", type 655 R 1012
5 Probe junction box (SAK), type 655 R 1025
6 Display and operating unit, type 657 R 0831

LT 2 Lambda transmitter in IP 54 wall-mounted housing
Type 657 R 1025, sheetsteel , 400 x 300 x 200mm (h x w x d)

3.1.2 Supplementary components (optional)

- Display and operating unit
  (already included in the 19" version)

- Measurement of flue gas and intake air temperature and calculation of combustion efficiency

- Calculation of fuel-specific CO_2 concentration,
  computed from the measured O_2 value and the CO_2 max. value.

- Load dependent and fuel-specific boundary values / boundary curves

- KS 1 combined probe for the detection of combustible components (CO/H_2)

(1) - Fine draught measurement

- 1…3 supplementary analogue outputs, max. 2, floating (output 1 and 2), max. potential difference ±20 V
  Range and physical size can be configured

  - Direct current 0/4…20 mA
  - Load 0…600 Ω
  - Direct voltage 0…10 V
  - Load $\geq$ 10 kΩ

- Relay module for digital outputs with 6 relays (1 switcher) for outputting operational, boundary value and status messages, switching capability 230 V AC, 4 A
  or
  Relay module 660 R 0012 with 3 relays
  (2 switchers), switching capability 230 V AC, 4 A

- 1…4 analogue inputs via 4 cards, arbitrary configuration, e.g. for switching on temperature sensors, additional pressure sensors of the KS 1 combined probe, standard signals etc; max. 2 of those floating, potential difference ±20 V max.

(1) - Test safety circuit for semi- or fully-automatic control of shutdown functions

- BUS interface for
  - Profibus DP
  - Interbus-S
  - SUCOnet-K-bus
  - Modbus

(1) - CANopen

(1) - Service and diagnostic software for PC, Windows-based.

(1) *In preparation*

3.1.3 Advantages of the zirconium dioxide (ZrO_2) measurement principle

- No gas purification necessary, measurement directly in humid flue gas
- Gas temperature up to 300°C
- No calibration gases required
- No reference gas pump required
- No temperature regulation of the measuring cell required
- Adjustment time to 90% value (T_{90}) < 15 seconds with standard extraction
- Low heating power 15…25 watt depending on the zirconium dioxide cell's ageing
- Universally applicable
- Simple handling Probe connected via plug
- Low maintenance

3.2 LS 2 Lambda probe

The LS 2 Lambda probe is the transducer. It is located directly in the exhaust gas stream. The gas to be measured is fed to the probe via the gas extraction device (MEV). Measurement takes place directly in the probe. The LS 2 Lambda probe is connected to the junction box via a 4 strand cable with two plugs.

Wiring between SAK and LT 2 Lambda transmitter via conventional cable and terminals, see wiring diagram on page 27 and in the Appendix, pp 70-72.

Alternatively, direct connection LS 2 → LT 2 without SAK is possible via a customised cable (2, 5, 10 and 20 m), see wiring diagram in the Appendix, pp. 70-72.

3.2.1 Gas extraction device (MEV)

The gas extraction device is available in four different lengths (150 mm, 300 mm, 450 mm, 1000 mm).

During installation please observe the flow direction!

The MEV's length should not exceed the minimum required. Maximum possible length 1 m. Only recommended in low-vibration installation sites.

Important to know:

Core flow measurement", which sometimes is stated as a strict requirement, is mostly superfluous. "Strands" are extremely rare in practice. According to current experience, they occur:

a) At the collision of gases of different temperatures; mostly air leaks to the exhaust gas.

b) At gas velocities below 1 m/s (separation). However, when genuine "strands" occur it is extremely difficult to find an extraction position suitable for all operating conditions within the gas extraction device's length. Even the core flow is not immune to genuine strands, and they tend to "wander".

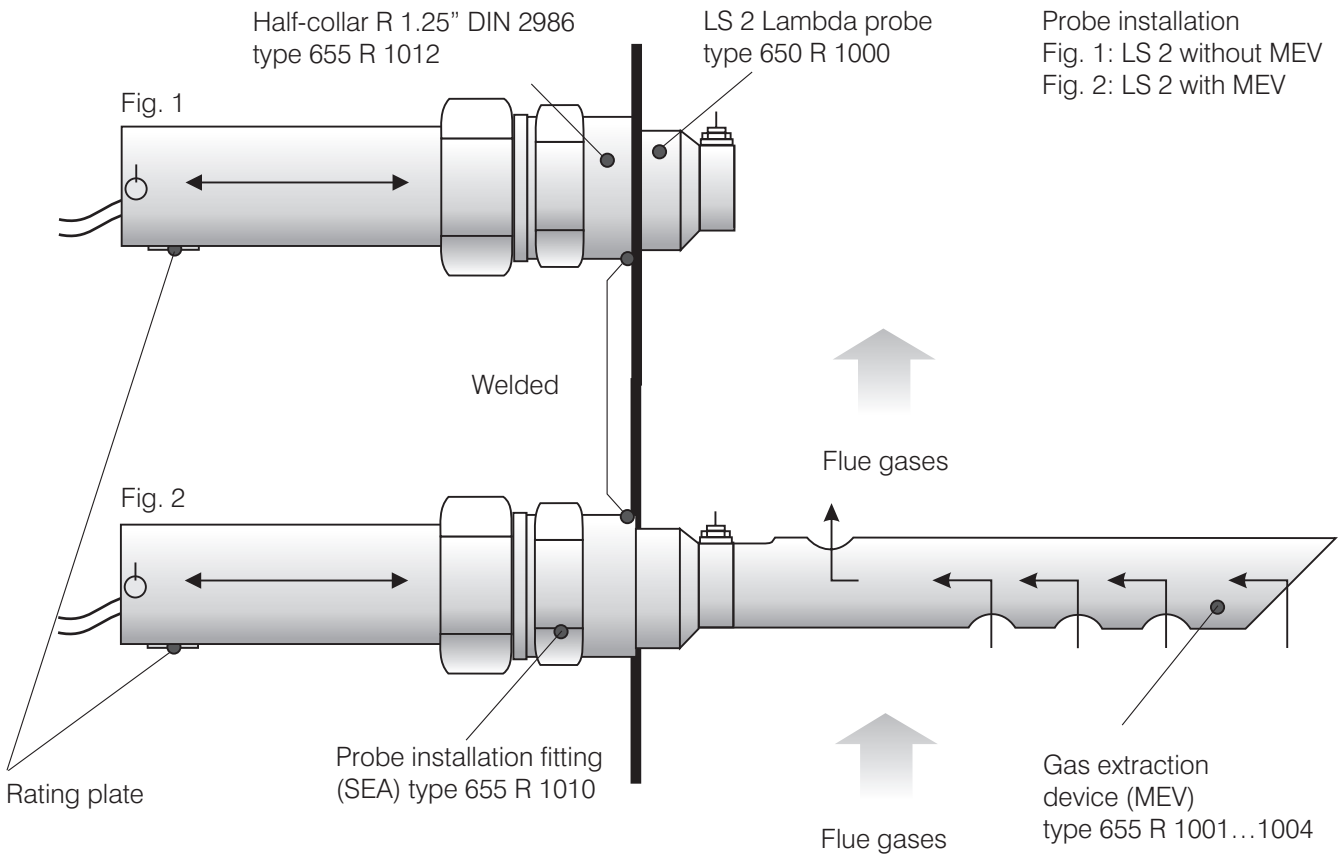
NOTE We repeat:

Only make the MEV as long as is absolutely necessary. Lengths exceeding 450 mm should be avoided if possible.

3.2.2 Probe installation fitting (SEA)

The probe installation fitting is attached at the measurement site, and serves to take up the LS 2 Lambda probe (see illustration).

LS 2 Lambda probe, type 650 R 1000 with MEV 655 R 1001 (150 mm)



3.3 LT 2 Lambda transmitter

The LT 2 Lambda transmitter is the LS 2 Lambda probe's analyser. It contains all the components necessary to operate the probe and analyse the measured signals. It also contains additional analogue inputs ands outputs, digital inputs and outputs for operational, status and boundary value messages, as well as serial interfaces and a universal BUS interface (optional) for coupling to the customer's control systems.

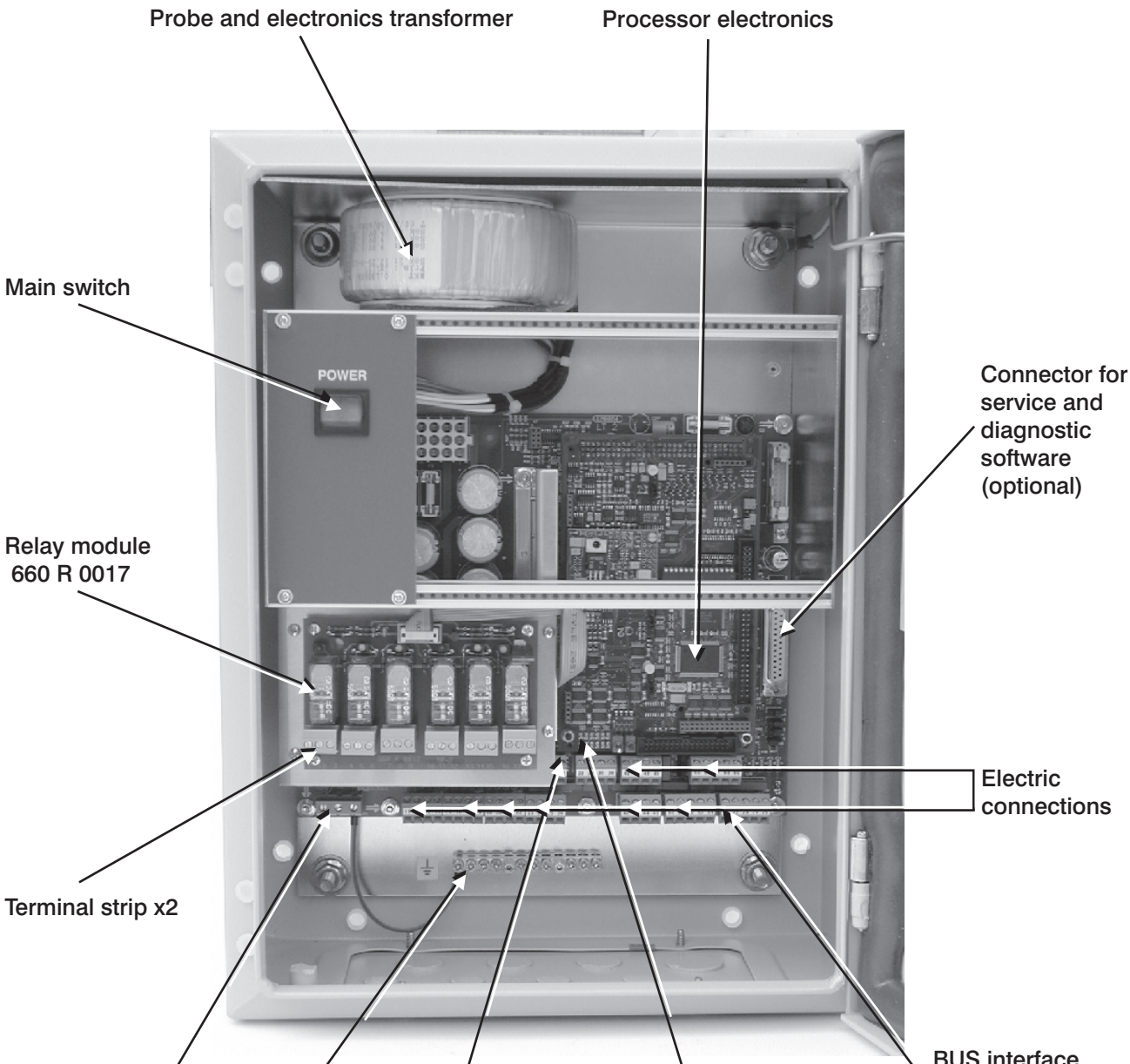
Two basic versions can be supplied:

– Mounted housing in sheet steel, lockable front door with impact resistant inspection window, IP 54
– Control panel housing, 19” system 3 HE 50TE for mounting in the control cabinet door

LT 2 Lambda transmitter
type 6 57 R 1020…R 1029
with display and operating unit
type 6 57 R 0831 (optional)

LT 2 Lambda
transmitter, 19”
type 6 57 R 1040

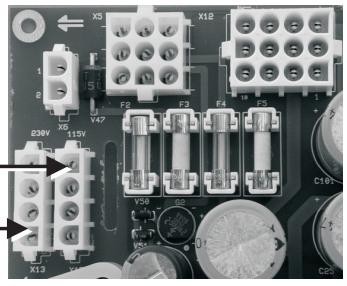
3.3.1 LT 2 Lambda transmitter type 6 57 R 1025



Selection power supply

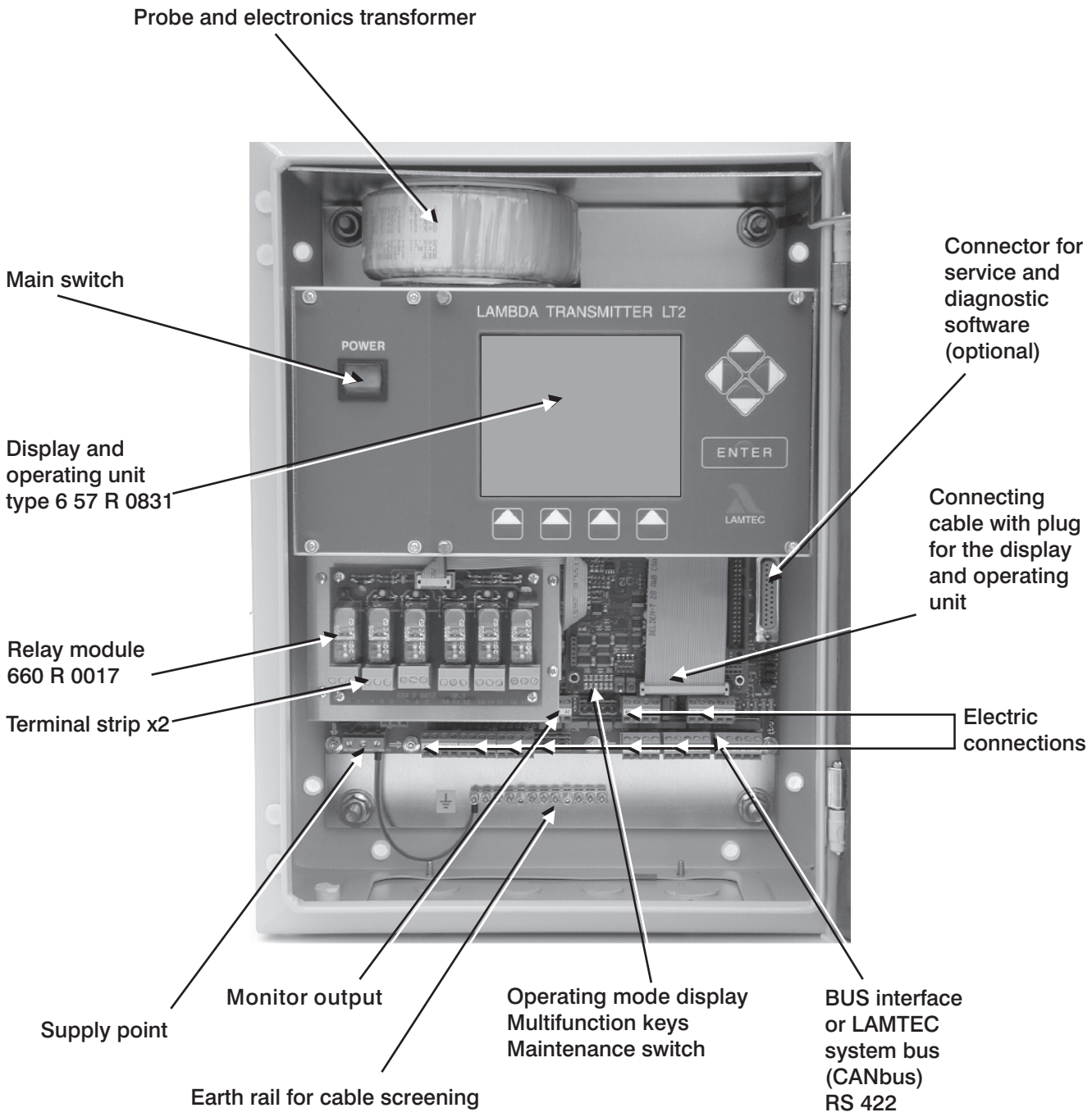
115 V

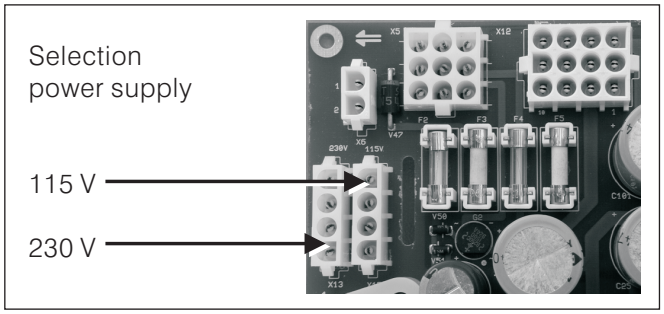
230 V



Accessible after removing the front plate with the main switch ("POWER")

3.3.2 LT 2 Lambda transmitter type 6 57 R 1025 with optional display and operating unit type 6 57 R 0831



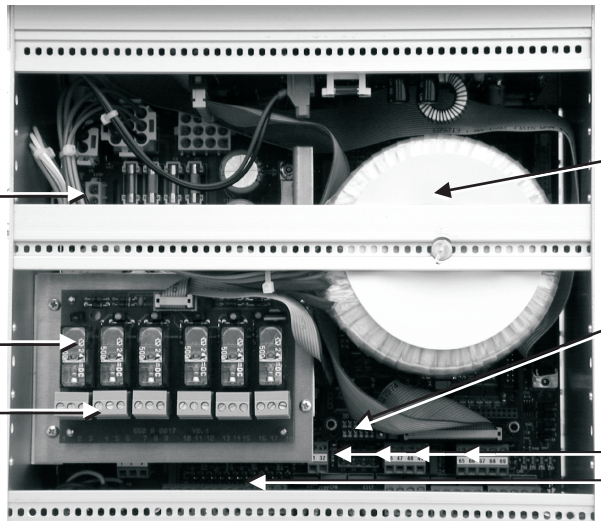


Accessible after removing the front plate with the main switch ("POWER")

3.3.3 LT 2 Lambda transmitter 19” type 6 57 R 1040

Display and operating unit (standard in LT 2-19”)

Connector for service and diagnostic software (optional)



Umschaltung Versorgungsspannung 230 / 115 V AC see fig., page 25

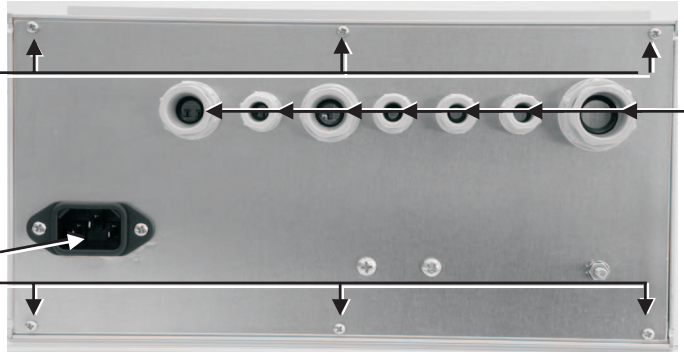
Relay module 660 R 0017

Terminal strip x2

Probe and electronics transformer

Operating mode display Multifunction keys Maintenance switch

Electric connections



Connecting terminals accessible after backplate's removal

Supply poin via cold instrument plug

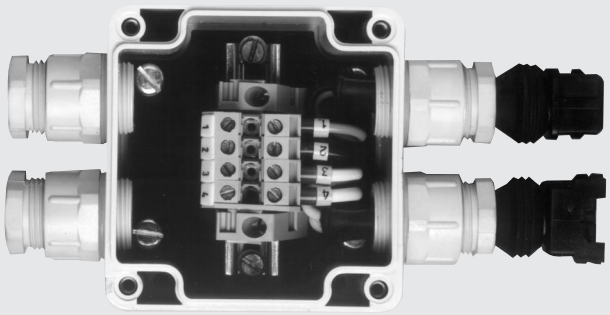
Cable routing holes

3.4 Probe junction box (SAK) for LS 2

For use at large distances between probe and analyser, where no customised cable is employed.
Input: Probe plug
Output: Terminal strip

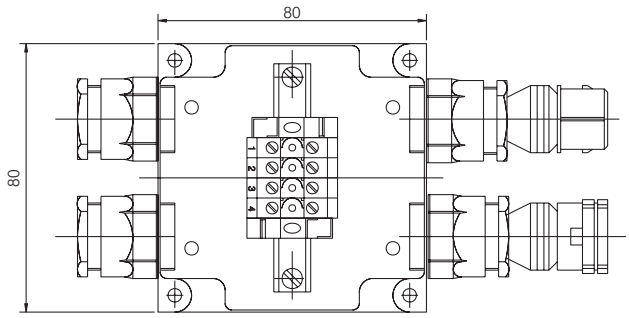
The SAK contains a terminal strip and conversion to the probe and heating plugs.

Probe junction box for LS 2



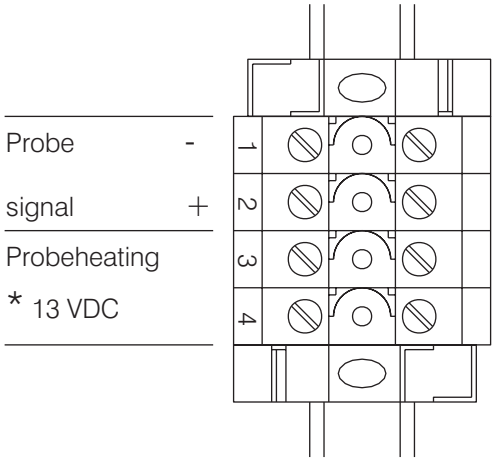
GZAH 018 655 R 1025

SAK dimensional diagram



Height: 40 mm
Safety class: IP55

SAK wiring diagram



*

Note:
The heating voltage is cyclically reversed (+/-). Measurement with a voltmeter is therefor only possible to a limited degree.

3.5 Options

– Display and operating unit
6 57 R 0831

– Measurement of flue gas and intake air temperature and calculation of combustion efficiency 657 R 0895

– Calculation of CO_2 concentration, fuel-referenced, computed from the measured O_2value and the CO_2 max. Value 657 R 0910

– Load-dependent and fuel-specific boundary values/boundary curves 657 R 0920

– KS 1 combined probe for detecting combustible components (CO/H_2) (on request)

– ① Fine draught measurement
(on request) 657 R 0110

– 1…4 analogue outputs (0/4…20 mA, 0…10 V), max. 2 floating (outputs 1 and 2), max. potential difference ±20 V
Arbitrary configuration

Direct current 0/4…20 mA	Load 0…600 Ω
Direct voltage 0…10 V	Load ≥ 10 kΩ

Analogue output card 0/4…20 mA, 0…10 V
6 57 R 0050
Analogue output card 0/4…20 mA, 0…10 V floating, max. potential difference ±20 V
6 57 R 0051

– Relay module for digital outputs with 6 relays (1 switcher) for outputting operational and status messages
Switching capability 230 VAC, 4A
6 60 R 0017
or
Relay module 6 60 R 0012
3 relays (2 switchers)
Switching capability 230 VAC, 4 A

– 1…4 analogue inputs via measurement cards, arbitrary configuration e.g. for temperature sensor, further pressure sensors, KS 1 combined probe,standard signals etc;
max. 2 of these floating
max. potential difference ±20 V

– BUS connection for Profibus DP, Modbus, Interbus-S, SUCOnet-K, CANopen etc.
Consists of:
BUS card 6 63 P 0400
BUS interface for BUS card 6 63 P 0400
6 63 R 0301

– Interface module RS 422 / 485
6 63 P 0500

– Interface module RS 232
(on request)
6 63 P 0600

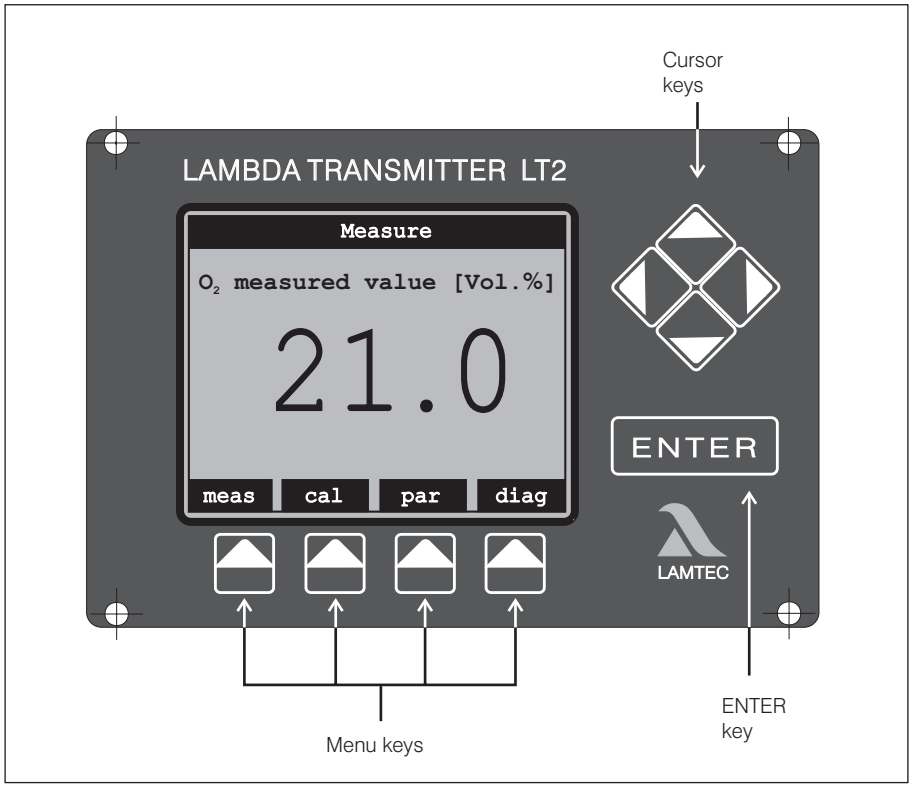
– Interface module RS 232 for PC, incl. licence for service and diagnostic software
6 57 R 1101

– Additional licences for service and diagnostic software
6 57 R 1102

① *in preparation*

3.6 Display and operating unit type 6 57 R 0831

Optional with LT 2 in wal lmounted housing
type 657 R 1020…R 1029.
Included as standard in LT 2 - 19”
for panel installation
see separate publication.



3.7 Cold-start delay

Serves to suppress false measurements while the probe warms up to operating temperature.
Cold-start delay is always activated after "Power off” and probe replacement.

The cold-start delay can be aborted at any time

- via the multifunction key
- via the optional display and operating unit, see separate publication
- optional operating unit via interface, see separate publication
- via service and diagnostic software, see separate publication

During the cold-start delay, either

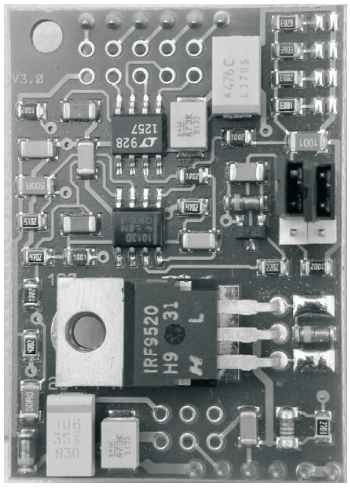
→ a substitute value (factory setting O_2 → 0 vol.%)
→ the "current measured value”is output.

The zirconium dioxide cell's internal resistance is monitored during the cold-start delay. Measurement is authorised only once the resistance is below the threshold value of 200 Ω, after expiry of the specified delay.

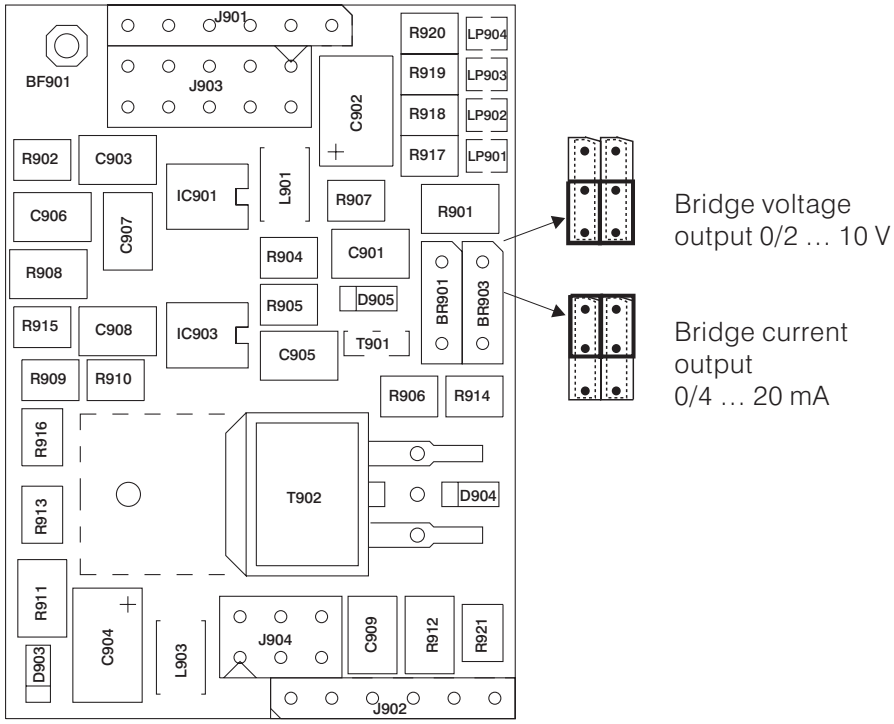
3.8 Analogue outputs 0/4…20 mA, 0…10 V

Via mini plug-in cards to LT 2 processor card (max. 4) - can be added on at any time

Parameter group 530 to 569

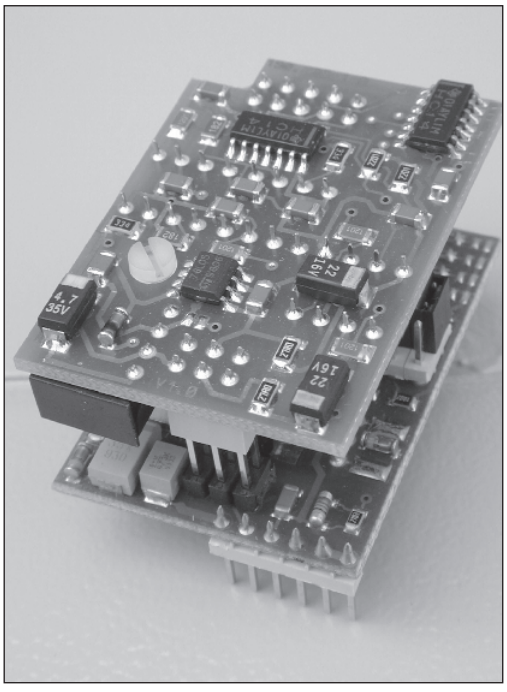


– Type 6 57 R 0050 potential-biased (1 channel)



Toggling between voltage and current outputs is exclusively hardware-based, via jumpers.
The choice between 0 or 4…20 mA is via software, using the appropriate parameters.

– Type 6 57 R 0051 floating (1 channel), max. possible potential difference ±20 V (only possible at outputs 1 and 2).



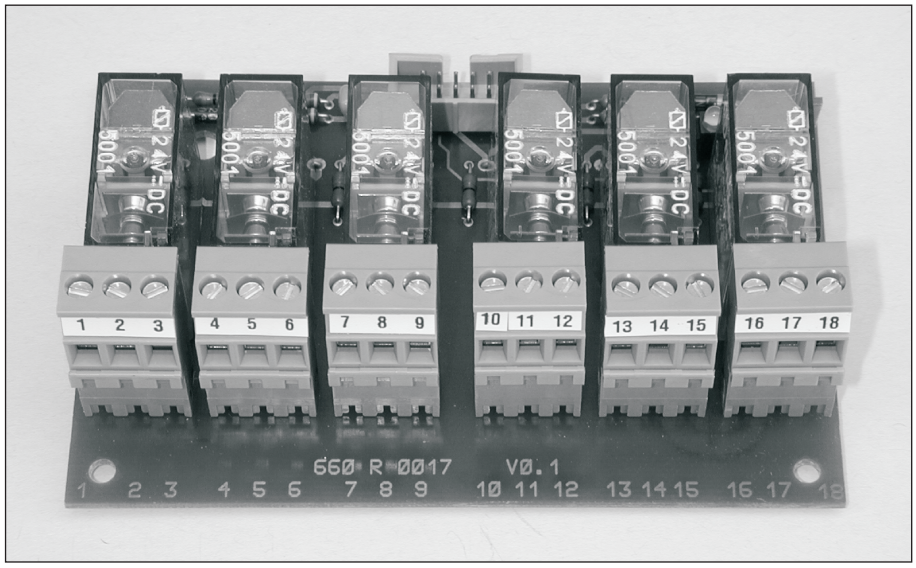
3.9 Digital outputs

Parameter group 1030 to 1069

Digital output 1:	Via internal relay (1 switcher) to LT 2 supply section electronics 1…48 V DC / AC; 3 A as standard 12…230 V AC / 4A
Digital outputs 2 to 7: 660 R 0017 (optional)	Via internal relay module 6 relays (1 switcher), switching capability max. 230 VAC,4A or (on request): Relay module 660 R 0012 3 relays (2 switchers), switching capability max. 230 VAC, 4 A, only for digital outputs 2-4

The outputs can be configured arbitrarily via the (optional) display and operating unit and the service and diagnostic software.

Relay module 660 R 0017



3.10 Analogue inputs (optional)
Parameter group
570 bis 609

Via mini plug-in cards to LT 2 supply section electronics (max. 4)

– Universal module for one analogue input
Potentiometer, 0/4…20 mA
Type 6 63 P 6000

– Temperature input for PT 100
Range either 0…320°C
or 0…850°C (please specify when ordering)
Type 657 R 0890

Electric connections: see 3.14, page 33

– Further modules in preparation

3.11 Digital inputs
Parameter group
1170 to 1249

8 digital inputs to LT 2 supply section electronics, 24 V DC, 6 mA either referenced to instrument potential or floating (see Electric connection in the Appendix, page 70), arbitrarily configured via (optional) display and operating unit and service and diagnostic software.

3.12 BUS links (optional)

Consists of:
BUS card type 663 P 0400
can be added on to LT 2 processor card (see page 66)
BUS interface type 663 R 0301
for the systems

Interbus-S	(Phoenix)	
Profibus DP	(Siemens)	
Modbus		
SUCOnet	(Klöckner, Möller)	
CANopen	(in preparation)	For details see separate publication

3.13 Service and diagnostic software (optional)

Type 657 R 1101
For PC, Windows-based. Coupling to LT 2 via RS 232 interface.

3.14 Measurement of flue gas and intake air temperature and calculation of combustion efficiency (optional) Type 6 57 R 0895 / R 0896

:

The calculation follows the formula:

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

q_{Af} = Exhaust gas loss through free heat
q_{Ag} = Exhaust gas loss through bound heat

$$q_{Af} = (t_A - t_L) \cdot \left[\frac{A_2}{21 - O_2} + B \right]$$

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

Oil	$A_2 = 0.68$;	$B = 0.007$
Gas	$A_2 = 0.66$;	$B = 0.009$

It is assumed that the combustion is CO- and soot-free.
Exhaust gas losses through bound heat are not taken into account.

Display:

Efficiency	0 … 100%
Exhaust gas losses	0 … 100%
Exhaust gas temperature	0 … 320°C
Intake air temperature	0 … 320°C

Other ranges on request.

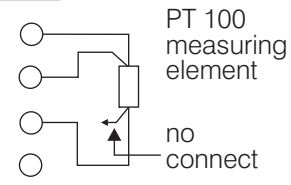
Measurement accuracy:
Temperature - better than 2K
Efficiency / exhaust gas losses - better than 0.2%

Electric connections:

depending on configuration / equipment

Measurement card

1	2	3	4
14	18	22	26
13	17	21	25
12	16	20	24
11	15	19	23



In the 657 R 0896 version, the intake air is specified as a constant. The intake air temperature is not measured. Only recommended where the intake temperature remains nearly constant over the whole year.

3.15 Calculation and display of CO_2 concentration (optional) Type 657 R 0910

The calculation follows the formula:

$$CO_2 = CO_{2\,max} - \frac{21\% - O_2}{21\%}$$

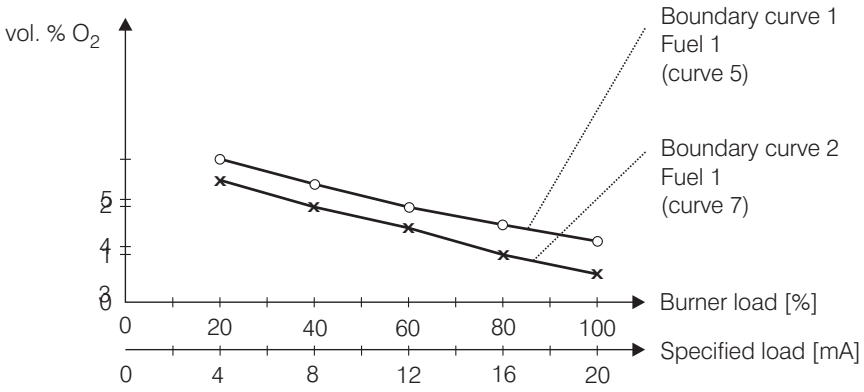
The calculation is based on
the following max. CO_2 contents at $\lambda = 1 \mathrel{\hat{=}} O_2 = 0$ vol.%,
referenced **to dry** exhaust gas:

Heating oil	EL	15.4 vol.%
Natural gas	H	12.0 vol.%
Natural gas	L	11.7 vol.%

Individual specification of CO_2max is possible via the parameters 846, 862, 878 and 894.

3.16 Load-dependent and fuel-specific boundary values/ boundary curves (optional) Type 657 R 0920

The load value (burner load) or some other measured quantity is supplied via analogue input 4. Instead of fixed boundary values, fuel-specific curves with 2 up to a maximum of 8 checkpoints can be entered.



Boundary curves (factory settings), parameters adjusted to values below threshold.

Possible combinations:

either

- 2 fuels with 4 boundary curves / boundary values per fuel
- 4 fuels with 2 boundary curves / boundary values per fuel

For details see supplement to the operating instructions for the optional "Display and operating unit".

3.17 Fine draught measurement (optional) Type 657 R 0110

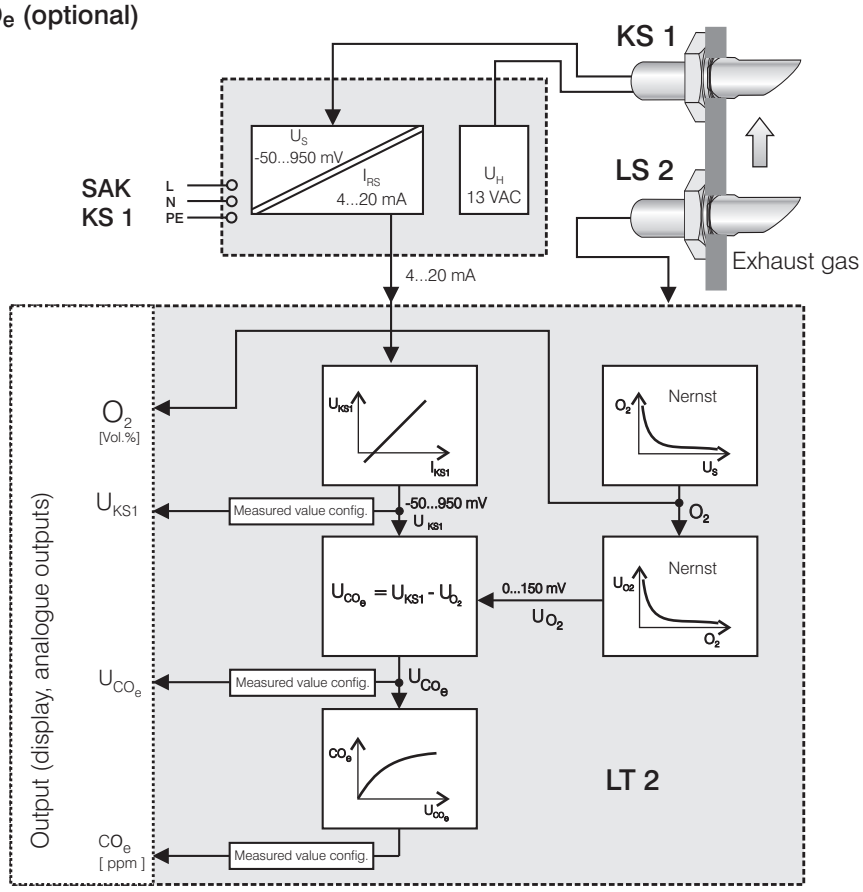
Differential pressure sensor for measuring

Flue draught
Combustion chamber pressure
etc.

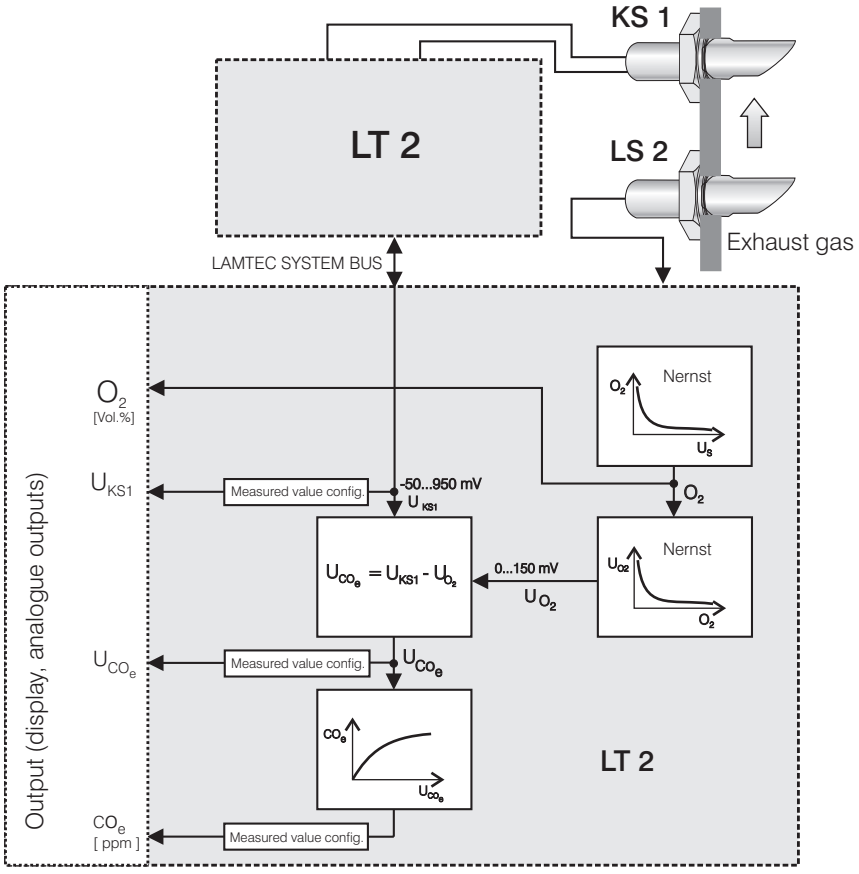
On request → please specify the required pressure range.

3.18 Switching on the KS 1 combined probe for the detection of combustible exhaust components CO/H_2 Shown as CO_e (optional)

till 2001



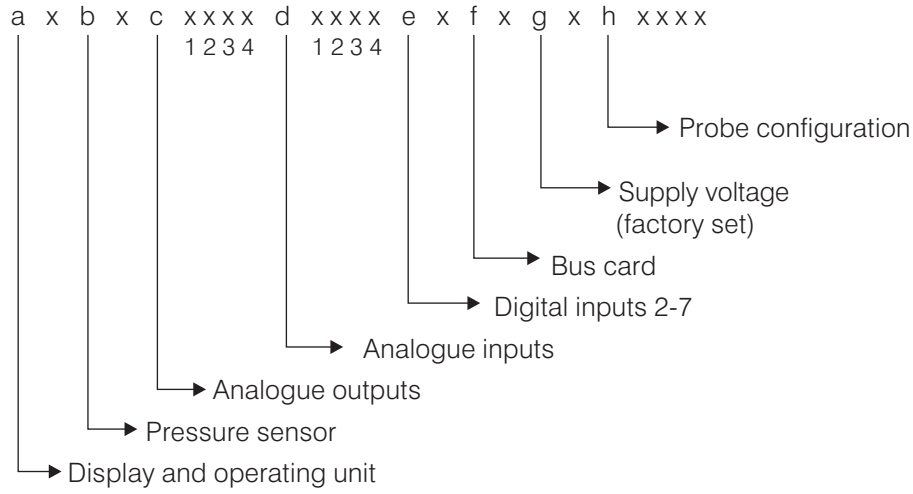
until 2001



3.20 Instrument configuration and factory settings

The instrument's configuration and the factory settings can be derived from the configuration number. The configuration number is found on the inside of the housing door, or on the rear in the case of LT 2-19".
The configuration number consists of 17 digits, and is constructed according to the following key:

Configuration number for LT 2



a: Display and operating unit

0 → without
1 → with

b: Pressure sensor

(via analogue input; see d)

0 → without
1 → absolute pressure
2 → differential pressure
3 → fine draught measurement

c: Analogue outputs

Output
1 2 3 4
0 → not used
1 → 4...20 mA
2 → 0...20 mA
3 → 0...10 V
4 → 4...20 mA floating
5 → 0...20 mA floating
6 → 0...10 V floating

d: Analogue inputs

Input

1 2 3 4

0 → not used

1 → potentiometer 1 kΩ…5 kΩ

2 → current 0/4…20 mA

3 → DPS input

4 → Impulse input (Namur)

5 → PT 100 input

6 → Flame detector

7 → current 0/4…20 mA, galvanic isolation

8 → current 0/4…20 mA with +24 V DC feed

9 → Pressure sensor type see b

e: Digital outputs

0 → open collector

1 → 2 to 4 relays

2 → 2 to 7 relays

f: Bus card

0 → not used

1 → Interbus-S

2 → SUCOnet-K, CANopen, Profibus DP, Modbus

g: Supply voltage
(factory-set)

1 → 230 V AC

2 → 115 V AC

3 → 24 V AC

4 → 24 V DC

5 → special voltage

h: Special configuration

4.1 General notes

Measured gas temperature

< 300 °C

Fuels

Suitability:

– Light hydrocarbons such as natural gas, propane, butane
– Light heating oil
– Other fuels such as e.g. heating oil S, coal, pyrolysis gases etc, under restricted conditions, with distinctly reduced useful life.

Measuring site

The measurement site should be so chosen that representative exhaust gas (complete mixing) is present. Exhaust gas temperature at the measurement site: max. 300°C.

Gas extraction device (MEV)

The gas extraction device is simply fitted onto the probe and fastened with a screw.

NOTE: *It is not necessary for the MEV to reach all the way to the centre of the flue gas channel. It suffices to have representative measured gas at the MEV's flow apertures.*

Guideline: The length of the probe with MEV should be ca. 1/3 of the flue diameter.

Available lengths: 150 mm, 300 mm, 450 mm and 1000 mm.

Distance probe - LT 2 Lambda transmitter (cable length!)

– up to 20 m:
  Connection via pre-made extension of 2 m, 5 m, 10 m and 20 m recommended;
  or through locally-made wiring via probe junction box. (1)

– beyond 20 m::
  via probe junction box. (1)

(1) see diagram in 3.1.1 "Schematic construction", page 18, and under 3.4, page 27 and wiring diagrams in the Appendix.

Connection via a probe junction box has the advantage, compared with a probe extension, that conventional cable can be used for wiring from the probe's junction box onward. Thus, the cable's length can be adapted on site to local conditions.

Recommended cable cross-sections for probe heating (from LT 2 Lambda transmitter terminals 35 and 36, to probe junction box terminals 3 and 4)

Cable length SAK-LT 2	Cross-section
unter 20 m	= 1,5 mm^2
bis 20 m	= 2,5 mm^2
All other connecting cables (screening necessary)	
bis 10 m	$\geq$ 0,5 mm^2
über 10 m	$\geq$ 0,75 mm^2

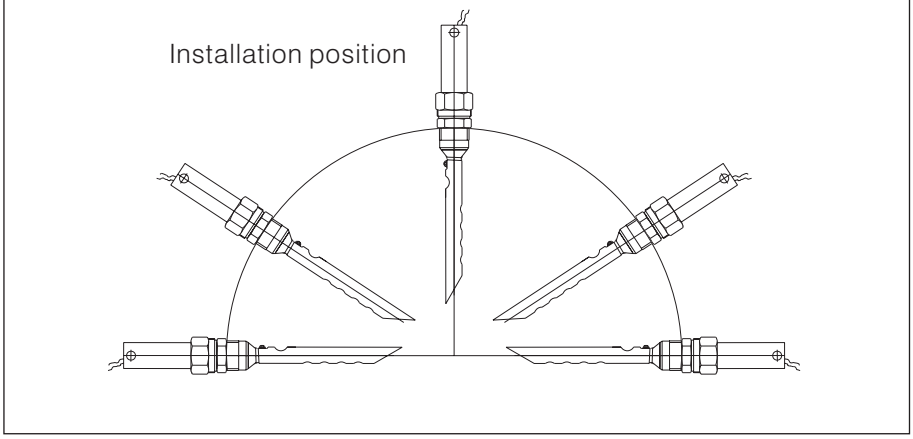
4.2 Mounting the LS 2 Lambda probe

Outdoor mounting

The measurement site should be protected on site against direct contact with rainwater, through a sufficiently large roof.

Installation position:

The installation position can be chosen arbitrarily, from the horizontal to the vertical (see diagram):



Mounting procedure

– Drill or burn out a hole in the flue channel, with diameter R 1.25”.

– Firmly weld a half-collar, interior thread R 1.25”, "tight” at the measurement site.
– Screw in the SEA without probe, and tighten.
– Seal the SEA aperture if necessary with a blank cap.

ATTENTION: ***When making the apertures, any parts falling into the channel may cause damage. Secure parts to be separated with wires!***

Suitable protective measures should be taken against emerging hot, explosive or health-damaging exhaust gases.

NOTE: Only install the probe immediately before commissioning. In its installed state, the LS 2 Lambda probe should always be heated. This avoids the precipitation of moisture on the measuring cell, which in certain cases could lead to erroneous measurements and to the probe's destruction.

4.3 Mounting the LT 2 Lambda transmitter

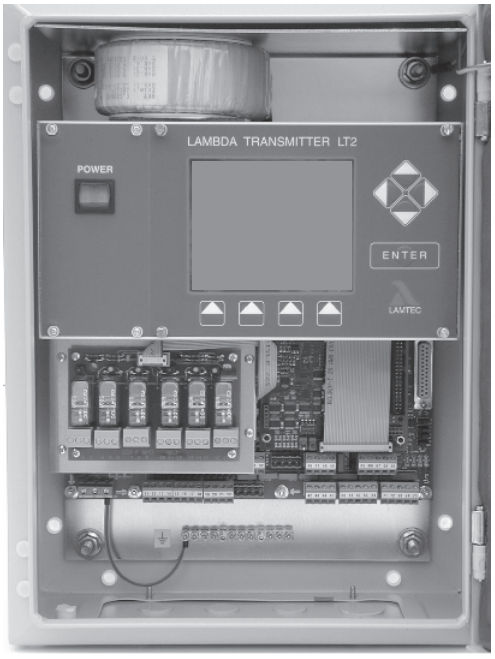
Ambient temperature

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

Note: This motto should always be observed when determining the LT 2 Lambda transmitter's installation site.

4.3.1 LT 2 wall-mounted housing

– Mount the LT 2 Lambda transmitter at a suitable location
Electric connections and probe connector underneath
See also LT 2 dimensional diagram in the Appendix, page 78



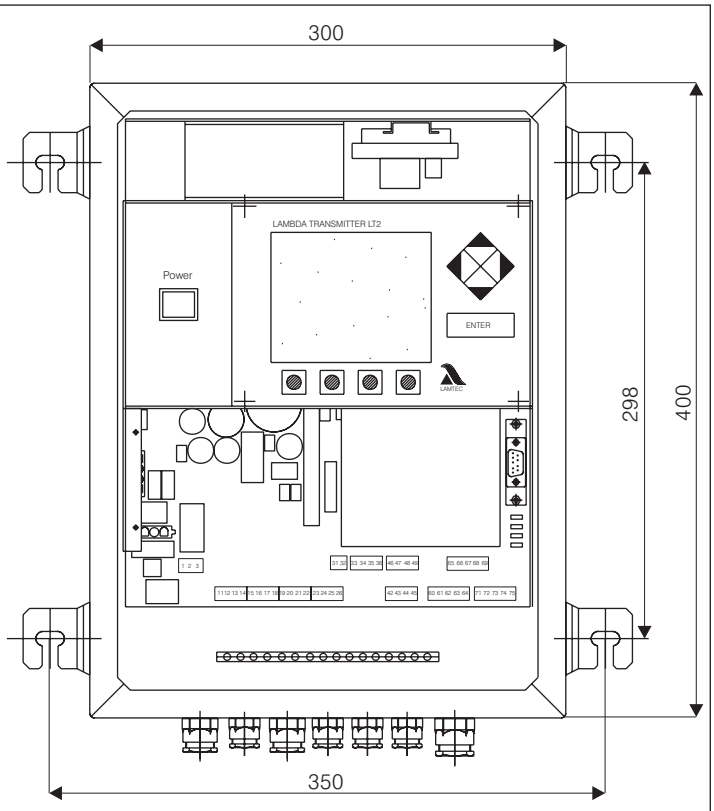
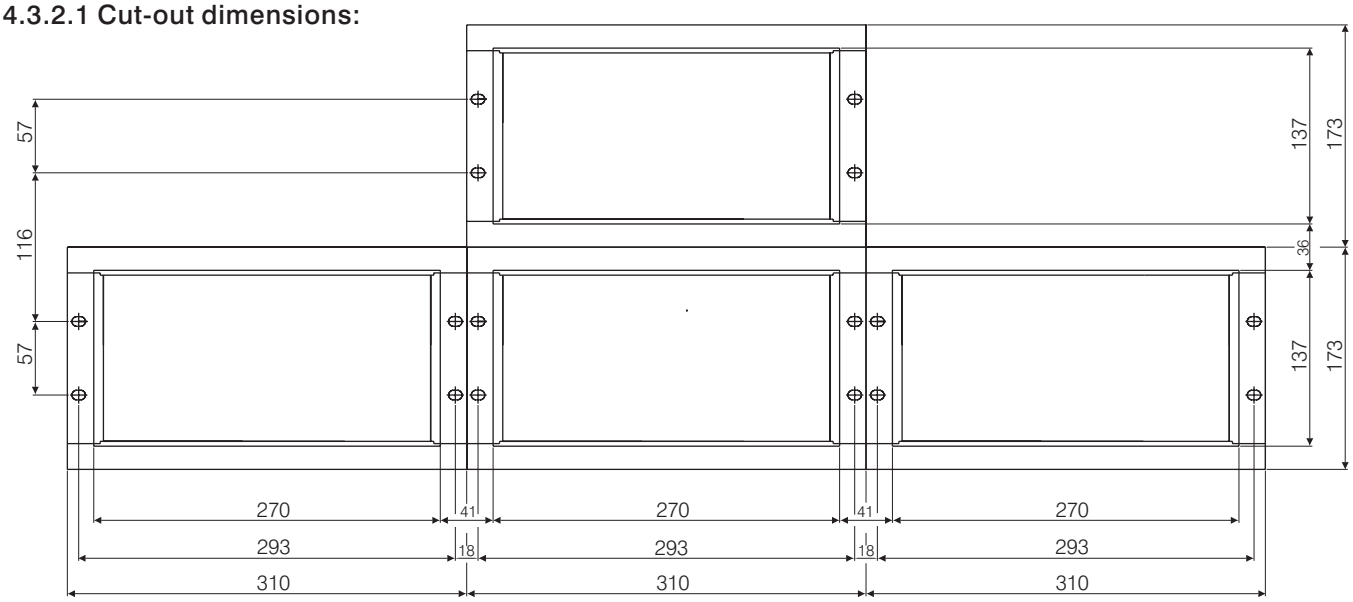


Diagram: LT 2 wall housing without door
with (optional) display and operating unit

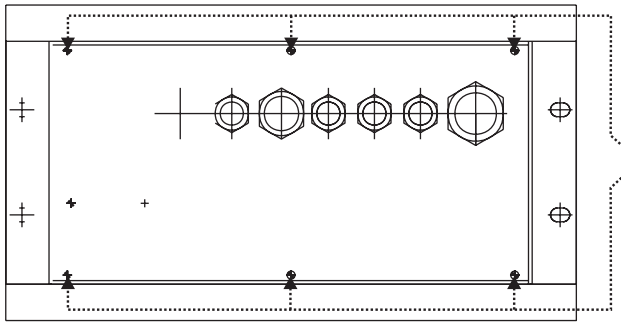
4.3.2 LT 2 - 19” rack

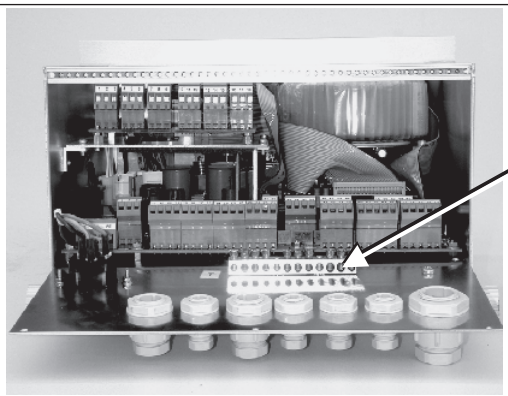
Control panel installation, safety class IP20; front side IP40
Ensure sufficient ventilation, if necessary provide forced ventilation.
Interior control cabinet temperature max. 60°C.
Electric connections at rear accessible after removing the back panel, see the following diagrams.

4.3.2.1 Cut-out dimensions:



4.3.2.2 Connecting terminals





Note: The LT 2 contains jump terminals. In the LT 2 -19”, these are also easily accessible after installation, with the back panel removed.

4.3.3 LT 2 Lambda transmitter electric connections

WARNING

When working on any electric facilities, disconnect them from the supply and check for zero voltage. The relevant safety regulations must be observed at all times.

Note: Observe recommended cable cross-section for probe heating:
Cable length SAK-LT 2
under 20 m = 1.5 sq. mm.
up to 40 m = 2.5 sq. mm.
All other connecting cables
up to 10 m $\geq$ 0.5 sq. mm.
above 10 m $\geq$ 0.75 sq. mm.

Wiring diagrams in the Appendix, pages 70-72

Attention:

AObserve proper cable routing and screening.

Probe connections:
the signal line, LT 2 terminals 33 and 34, must not be laid together with supply cables, particularly revolution speed control cables from frequency converters. Any coupling to the power circuit should be avoided.

Warning:

Incorrect probe connections can destroy the probe. Check probe connections at terminals 33 to 36 before commissioning.

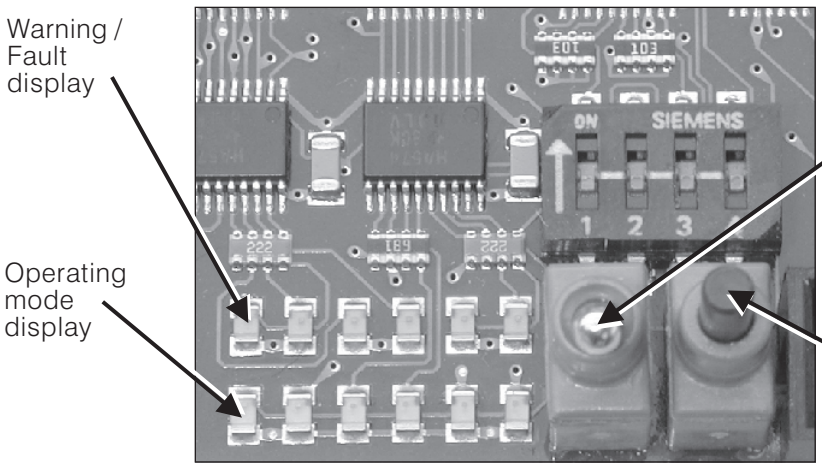
33 (-)	Probe signal
34 (+)	Probe signal
35	Probe heating
36	Probe heating

5.1 Preliminary works

5.1.1 The LT 2 Lambda-transmitter´s display and operating elements

The LT 2's operation and the display of measured valued, operational and error messages take place via the (optional) display and operating unit, see separate publication no. D LT 2002.99D, or via a PC in conjunction with the (optional) service and diagnostic software, or via an external operating unit using an RS 422 interface (in preparation). The LT 2 itself has only limited operating capabilities, which however allow it to initiate or to display on the LT 2 all the functions necessary for operation, maintenance and servicing, including directly.

Note: The display and operating elements are not freely accessible on the LT 2 - 19". For this reason the LT 2 - 19" is generally supplied only with a 657 R 08 31 display and operating unit.



Display- and operating elements on processor card

5.1.2 Monitor output

The monitor output [terminals 31 (-), 32 (+)] make it possible to connect (e.g.) a multimeter. The following values can be interrogated on site via the LT 2's monitor output:

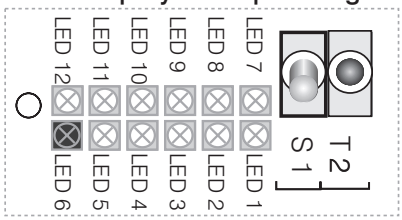
- O_2 measured value
- Probe voltage [U_s]
- The measuring cell's AC internal resistance [R_i]

DIP switch processor card

SW 1	SW 2	Monitor output function		
open	open	O_2 measured value	0…2,5 V ≙ 0…25 Vol.% O_2	
connected	open	Probe voltage	0…2,5 V ≙ 0…250 mV	
open	connected	Cell internal resistance	0…2,5 V ≙ 0…250 Ω	1

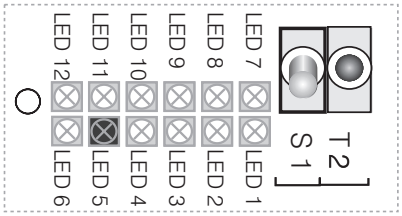
Input resistance of the connected meter greater than 10 kΩ

5.1.3 Display and operating elements



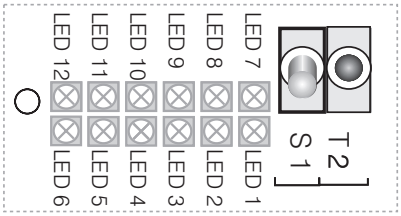
Operational display (green) LED 6

● - Operation (lights up)

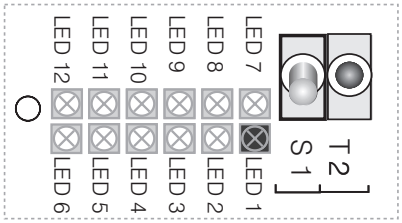


Operational status display (green) LED 5

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

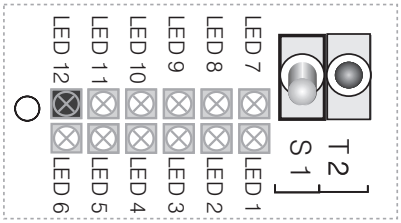


Maintenance switch S 1



Maintenance (orange) LED 1

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

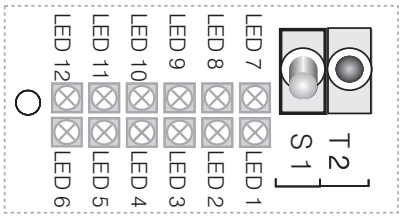


Warning/
fault display (red) LED 12

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

- Maintenance mode off

- Maintenance mode on

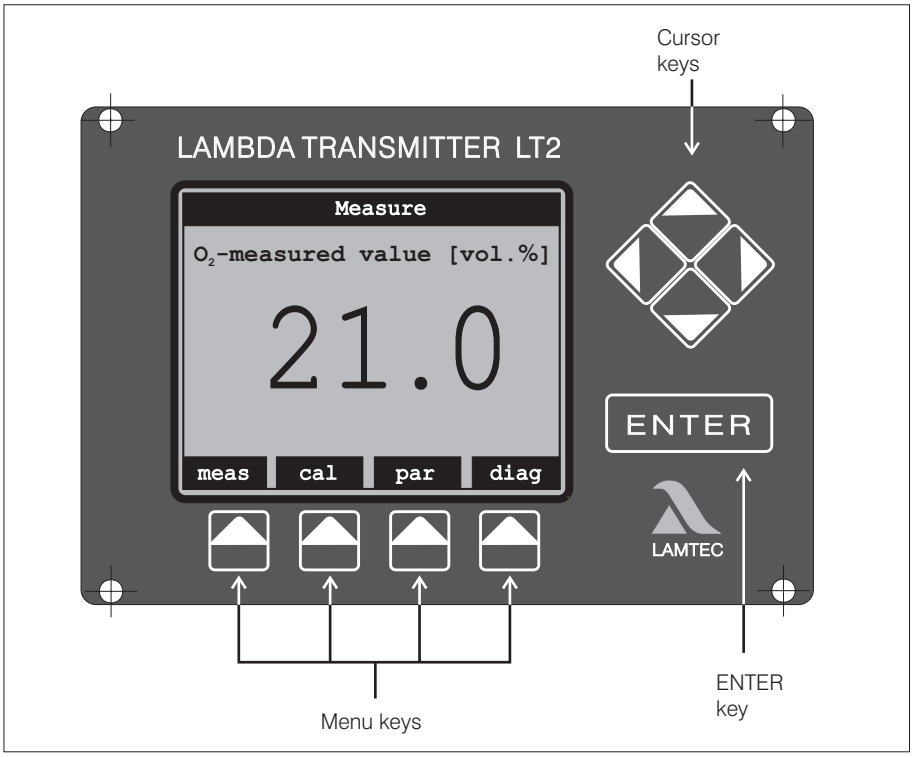


Multifunction key T 2

NOTE: **Function**	**Key operation**
Toggle the displayed warning/ fault	Press briefly
Reset the displayed warning/fault	Press for longer than 3 sec *
Rapid start-up of the measured gas pump, abort cold-start	Press for longer than 3 sec **
Trigger an offset calibration or test gas calibration	Press key for longer than 3 sec during measurement **

* Some warnings and faults cannot be reset if the error is still present or the routine is still running.
** If at least one warning or fault is still present, the key must be pressed for longer than 6 seconds.

5.1.4 Display and operating unit 657 R0831 (optional) (in LT 2 - 19" type 657 R 1040 - R 1049, included in the standard version supplied)



For details see separate publication DLT 2002.99

5.1.5 Service and diagnostic software (optional)

Suitable for all PCs with RS 232 or RS 422 interface from Windows 95, Windows NT (32-bit version) onward
In preparation

5.1.6 Wiring inspection

Warning: ***When working on any electric facilities, disconnect them from the supply and check for zero voltage. The relevant safety regulations must be observed at all times.***

As per wiring diagrams in the Appendix, pages 70-72.

5.2 Factory settings

5.2.1 Plug configuration

→ see Appendix, pages 74-75

5.2.2 Instrument configuration

(unless otherwise specified in the order)

Measuring range:	0…30 vol.% O_2
Resolution:	0,1 vol.% O_2 im Bereich von 0…18 vol.% O_2
	1 vol.% O_2 im Bereich über 18 vol.% O_2
Probe temperature: (Parameter 141)	1000 K
Analogue output 1:	4…20 mA ≙ 0…10 vol.% O_2
über Parameter 531	0…20 mA einstellbar
Load:	0…600 Ω

– Measurement span can be freely configured via the parameters 532 and 533

  0…20 mA / 4…20 mA toggled via the parameter 531

– Relay outputs Idle current principle

Relay output 1:	Collecting fault message
Relay output 2:	Warning and maintenance
Relay output 3:	Measurement
Relay output 4:	Boundary value 1
Relay output 5:	Boundary value 2
Relay output 6:	Boundary value 3
Relay output 7:	Boundary value 4

– Boundary values

Boundary value 1:	Switched off
Boundary value 2:	Switched off
Boundary value 3:	Not used
Boundary value 4:	< -5 mV, value smaller than threshold Reset mode "automatic" (for monitoring the probe; air value)

– Digital inputs

Input 1:	Reset fault/warning
Input 2:	Reset boundary value messages
Input 3:	Fuel 2 (gas) Parameter 836 - service level must be present at digital inputs. Without signal specification heating oil EL
Input 4…8:	Not configured

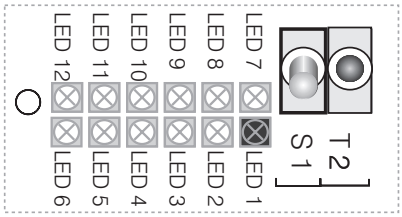
– RS 232 interface	Instrument address 1 9600 baud Parity none

5.3 Measurement start-up

– Mount the gas extraction device on the probe and tighten.

ATTENTION: ***When installing the probe and during later operation, ensure that the probe does not into contact with oils, grease or boiler cleaning materials. This applies not just to the cell, but also the connector region!***
The thread and the clamping ring should be treated with mounting paste type 655 R 1090 against seizing. Poisoned or contaminated probes can be identified by an air voltage of -20…-30 mV. In addition, the probe must always be in operation when installed. This avoids the precipitation of moisture on the measuring cell, which in certain cases could lead to erroneous measurements and to the probe's destruction!

– Connect the probe but do not install it
Switch to Maintenance
either via the display and operating unit under "diag" or via the maintenance switch S1



Note:
The maintenance switch always has priority.

Maintenance (orange) LED 1

● - Maintenance mode active

⊗ - Normal operation

– Switch on voltage

– "Maintenance" is shown

– Probe warms up
– Cold-start is shown
LED 6 "Operation" lights up
LED 5 "Measurement is off
The measurement function is operational after 10 minutes.

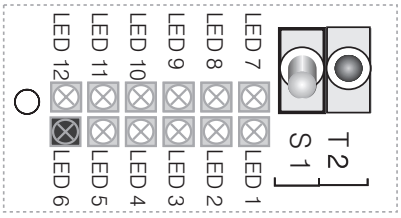
Maintenance switch S 1

-Maintenance mode off

- Maintenance-mode on

NOTE:

The cold-start delay can be activated from the display and operating unit → "cal" key. Proceed as prompted by the menu, or it can be interrupted by pressing the multifunction key T2 (for longer than 3 seconds, or if a warning or a fault is still present, for longer than 6 seconds).



Function	Key operation
Toggle the displayed warning/fault	Press briefly
Reset the displayed Warnung / Störung	Press for longer than 3 sec *
Abort the cold-start	Press for longer than 3 sec **
Trigger an offset calibration	Press key for longer than 3 sec during measurement **

* Some warnings and faults cannot be reset if the error is still present or the routine is still running.

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

Operational display (green) LED 6

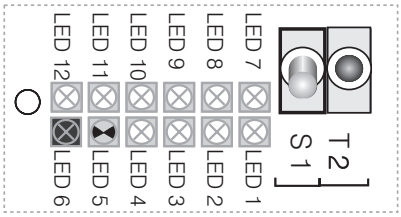
● - Operation

– Reading off probe voltage:

  either via display and operating unit
  (if available) → press "meas", or the monitor output.

  After a heating-up phase of 3-5 minutes, probe voltage stabilises at a value between -5 and -15 mV and the AC internal resistance at a value below 100 Ω (in a new probe below 50 Ω). If positive values are displayed in air, the probe has been connected in reverse. Swap the probe connecting terminals 33 / 34.

– Carry out offset compensation
  either via display and operating unit under "cal" or the multifunction key.



Multifunction key T 2

NOTE: **Function**	**Key operation**
Toggle the displayed warning/fault	Press briefly
Reset the displayed warning/fault	Press for longer than 3 sec *
Abort the cold-start	Press for longer than 3 sec **
Trigger an offset calibration	Press key for longer than 3 sec during measurement **

* Some warnings and faults cannot be reset if the error is still present or the routine is still running.
** If at least one warning or fault is still present, the key must be pressed for longer than 6 seconds.

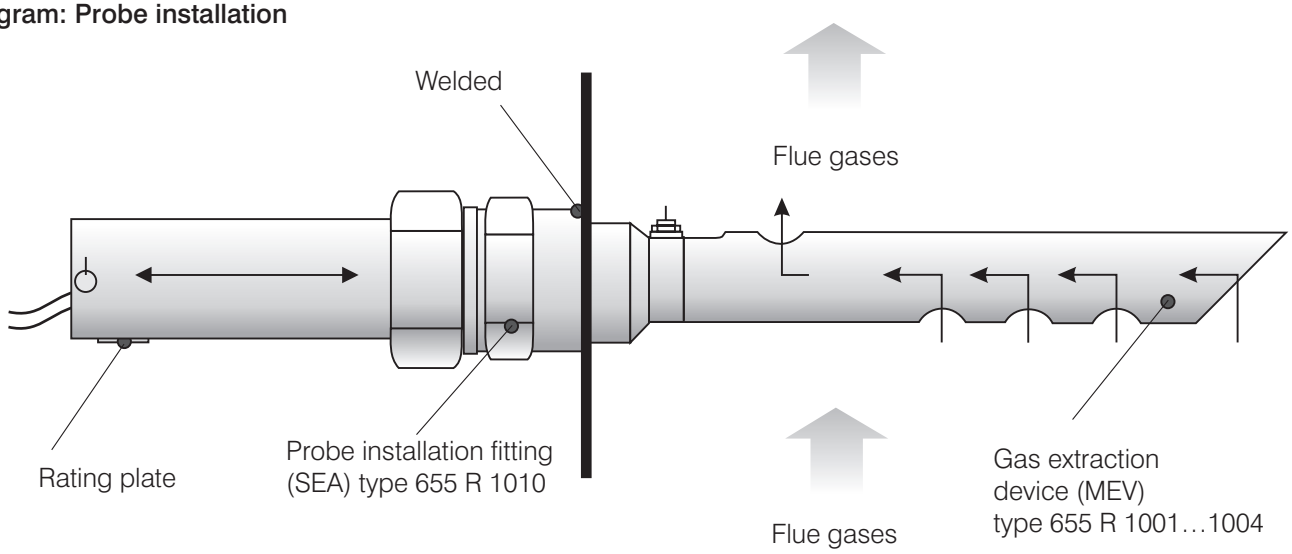
– Wait until the offset compensation is completed (flashing stops).

– Enter the probe temperature from the test protocol (see page 50), parameter 141
  "Customer release level"; see separate operating instructions
  either via
  - display and operating unit
  - service and diagnostic software (optional)

HINWEIS: *"Probe temperature T"*
The LT 2 Lambda transmitter and the LS 2 Lambda probe are not adjusted to each other. The LS 2 Lambda probe is subject to certain manufacturing deviations, which can be compensated for via the offset compensation and the probe's temperature. Probe calibration with a test gas is not required. The probe temperature obtained during final testing can be derived from the test protocol enclosed with each probe, see page 50.

– Install the robe in the SEA and align the MEV, see illustration:

Diagram: Probe installation



– Start up combustion
– Measured value plausible?
  Check if necessary via comparative measurement

ATTENTION:
Almost all extractive O_2 meters measure "dry", in contrast to the in-situ ZrO_2 meters; i.e. moisture is extracted from the flue gas through a purification process (cooler) or a chemical absorber (silica gel). This reduces the volume of the measured gas, and thus the proportion of O_2 increases. This fact must be taken into account during comparative measurement. A diagram for converting wet into dry measurements can be found in the Appendix, page 81.

– If large deviations are present, it is possible to compensate for the values obtained via
  - the display and operating unit, under "cal"
  - the service and diagnostic software
  - as follows, using the multifunction key:

  Measure the O_2 value at the monitor output or analogue output.
  Start calibration with the multifunction key.
  LED 5 should flash rapidly (see page 44).
  Briefly pressing the multifunction key increases the output O_2 value by 0.1% (pressing for a longer period reduces the O_2 value; 0.1% in 2 seconds). If no operation follows within 15 seconds, the test gas calibration is terminated.

ATTENTION: **Which instrument measures correctly?**

Compensation should only be carried out if it was previously ascertained, e.g. by using test gases, that the comparison instrument is measuring correctly.

In any event, offset compensation should previously have been carried out under operational (warm) conditions.
It is necessary to ensure that ambient air is present at the measurement site. If this is not ensured, the probe must be dismantled again for the offset

Each probe is accompanied by a test protocol.

LS 2 Lambda probe

---TEST PROTOCOL---

probe no.: 860

Production batch: 566201
Apr 96

Measured on: 23.04.96
Test site; 6
File name: c:\Data\23049606.06H

Offset in mV

At start = -12,35
At end = -12,21

Measurement 1: Heater characteristics

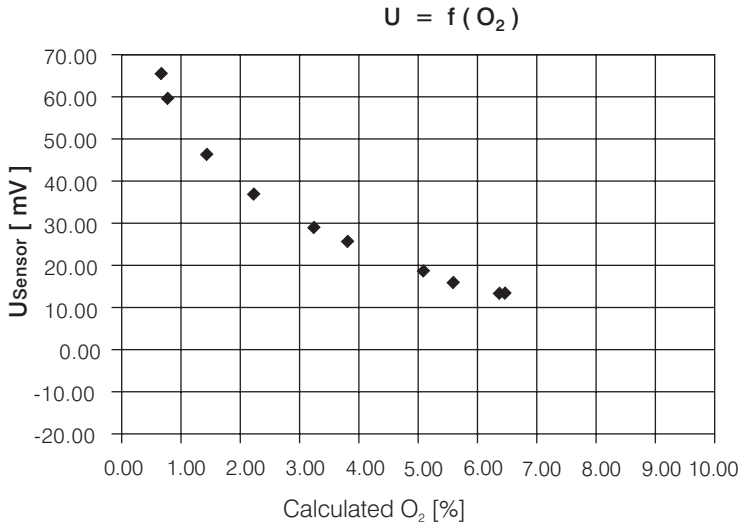
U heater [Volt]	I heater [Amps]	R heater [Ohm]	P heater [Watt]
13.72	1.35	10.16	18.54

Measurement 2: AC internal resistance
Sensor stationary at 100 kHz

Ri-Sensor = 19.74 [Ohm]

Calculated characteristic curve U = f (O_2)

Step	O_2 sensor [%]	U sensor [mV]
1	6.46	13.40
2	6.38	13.68
3	5.67	16.23
4	5.11	18.50
5	5.10	18.56
6	3.78	25.10
7	3.25	28.41
8	2.23	36.65
9	1.45	45.99
10	0.79	59.36
11	0.62	64.45
12	0.17	92.87
13	2.21	36.86
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00
18	0.00	0.00
19	0.00	0.00
20	0.00	0.00



Derived factors:

Correction factor K2	= 0,35 mV
Sensor temperature T calculated	= 1026,43 Kelvin
Relative error at 5% O_2	= 0,75 %

5.3 Setting up service warnings

Service warnings 1 and 2 are designed to draw attention to regular servicing. The service warnings can be freely defined by the operator, e.g.

Service warning 1 → Check probe
Service warning 2 → Dismantle and clean probe

The appropriate cycle times can be specified via the parameters 1260 and 1261 in the range 1 to 65535 hours.

5.4 Shutdown

In order to be sure to avoid damaging the LS 2 Lambda probe's ZrO_2 measuring element, the probe must be dismantled before the system is shut down or immediately after the supply voltage is switched off.

ATTENTION:

Dismantle the Lambda probe before shutting down the measurement system.

Caution: hot!

NOTE:

Once dismantled, the LS 2 Lambda probe can be stored indefinitely. The irconium element is only consumed during operation (measuring cell at operating temperature). This also applies where a probe has already been used previously.

6.1 Controls/ measurement output

– Display and operating unit (optional) is included as standard in LT 2 - 19” for panel installation.
– Service and diagnostic software (optional).
– In part via multifunction key and monitor output
– External operating unit via LAMTEC system bus (in preparation).

6.1.1 Measurements

– O_2 actual value	0…30 vol.% O_2 Resolution: 0.1 vol.% O_2 up to 18 vol.% O_2 1 vol.% O_2 above 18 vol.% O_2
– Probe voltage	-100…+1250 mV Resolution: 0.1 mV
– AC internal resistance of the ZrO_2 cell:	0…750 Ω Resolution: better than 0.2 Ω Displayed up to 999.9 Ω
– Exhaust gas temperature (optional)	0…320°C Resolution: 1°C Alternatively: 0…850°C Resolution: better than 2°C
– Combustion efficiency (optional)	0…100% Resolution: 0.1%
– Calculated CO_2 concentration (optional)	0…20 vol.% Resolution: 0.1 vol.%
– CO/H_2 concentration, shown as CO_e [CO equivalent]	0…10.000 ppm Resolution: variable 1…100 ppm depending on measured value Alternatively: 1% of measured value not better than 1 ppm
– Customised values	Can be freely configured, e.g. exhaust gas temperature, efficiency, CO_2 concentration etc.

6.1.2 Commands

– Cold-start delay” Abort "	→	Directly during measurement
– Offset compensation	→	Compensate probe to ambient air, 21 vol.% O_2
– "Calibration”	→	Perform measured value compensation via comparative measurement Test calibration not provided
– "Fault/warning”	→	Reset
– "Boundary values”	→	Reset

6.1.3 Status messages

- Measurement
- Calibration offset ["Cal - offs"]
- Calibration ["Cal - gas"]
- Maintenance
- Cold-start
- Probe heating active
- Measurement / no measurement
- At least one warning active
- At least one fault active

Status message during calibration

- Offset
- Cal Gas

6.1.3.1 Warnings

Warning no.:	
1	LS 2 internal resistance too high
2	LS 2 offset voltage to air invalid
9	LS 2 probe pressure too high / low
10	LS 2 probe temperature too high / low
12	LS 2 temperature def.
19	Analogue input 1: input value too large / small
20	Analogue input 2: input value too large / small
21	Analogue input 3: input value too large / small
22	Analogue input 4: input value too large / small
23	Configuration error, analogue outputs
24	Service warning 1
25	Service warning 2
26	No LS 2 probe dynamics
27	Dynamic test triggered

6.1.3.2 Faults

Fault no.	
1	Probe voltage < -20mV
2	LS 2 probe heating faulty
5	Probe wire break / probe faulty
9	No LS 2 probe dynamics
11	Fault analogue outputs

6.1.4 Operational parameters – Downward counter, cold-start delay

- Clock time, date
- Operating hours counter

6.2 Practical operating notes

6.2.1 Measurements during pronounced pressure surges at the measuring site

If the display jumps badly, damping can be increased via the (optional) display and operating unit and the service and diagnostic software (i.e. by increasing the integration's time-constant); this steadies the display: parameter 360 - Operational release level. However, this slows down the display in terms of reaching an end state.

NOTE:

Large damping simultaneously leads to an artificial slowing down of the measurement signal.

6.2.2 Interruptions, switching on and off

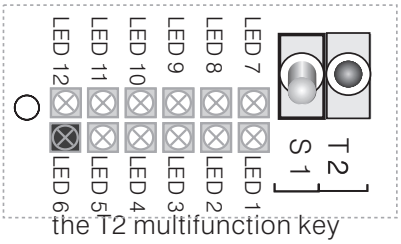
In the event of long interruptions during operation, lasting for longer than ca. 3 months, it is recommended to switch off the measuring system. The probe should be dismantled to avoid damage.

Es wird empfohlen, bei kurzen Betriebsunterbrechungen die Messung auf jeden Fall weiterlaufen zu lassen.

7 Checking the probe

7.1 Checking the LS 2 Lambda probe

7.1.1 Checking the air voltage



the T2 multifunction key

– Switch off the facility
– Pre-ventilate, until no more flue gas is present at the measurement site (ca. 1 minute).
– Turn off the pre-ventilation.
– Carry out offset calibration
either via
-the (optional) display and operating unit
via "cal" - menu-driven
-the (optional) service and diagnostic software
- T2 multifunction key

NOTE: Function	Key operation
Toggle the displayed warning/fault	Press briefly
Reset the displayed warning/fault	Press for longer than 3 sec *
Abort the cold-start	Press for longer than 3 sec **
Trigger an offset compensation	Press key for longer than 3 sec during measurement **

* Some warnings and faults cannot be reset if the error is still present or the routine is still running.
**If at least one warning or fault is still present, the key must be pressed for longer than 6 seconds.

If probe voltage is outside the permissible range, the warning "Offset calibration to air invalid" is output.

– Read out probe voltage at LT 2
either via
- the (optional) display and operating unit
- the (optional) service and diagnostic software
- measure probe voltage with a multimeter; see page 57

– Permissible range: 0 mV … -20 mV
– If the probe is outside this range → replace probe.

ATTENTION: Do not forget!

After replacing the probe, carry out new offset compensation to air and enter the new probe temperature value.

The boundary values 3 and 4 are so set at the factory that automatic checking of the probe is possible during standstill and during the facility's pre-ventilation.
No boundary value addressed!

Boundary value 3 → - 5 mV exceeded - automatic reset
Boundary value 4 → -20 mV below threshold -
manual reset "Acknowledge"

Boundary value 4 must never be addressed in an intact probe.
If boundary value 4 is addressed, it must be reset manually.

NOTE: After supply voltage failure (and thus also that of the probe's heating), probe voltage may fall below -20 mV for a brief period during reheating.

It is recommended to retain the factory-set boundary value 4 for safety reasons.

If the facility cannot be switched off, the probe must be dismantled for examination.

7.1.2 Checking by counter-measurement

Precise checking of the measurements is only possible through counter-measurement with a 2nd probe, or by comparing the values measured after probe replacement.

NOTE: During counter-measurement, check whether the instrument being used measures wet or dry. Those with an advance gas cooler are always used for dry measurement. This also applies to instruments that extract moisture via a chemical compound.
The LS 2 Lambda probe measures wet. The difference between wet and dry measurements can be obtained from the diagram in the Appendix (see page 81).

– If large deviations are present, it is possible to compensate for the values obtained via
- the display and operating unit, under "cal"
- the service and diagnostic software
- as follows, using the multifunction key:
  Measure the O_2 value at the monitor output or analogue output.
  Start calibration with the multifunction key.
  LED 5 should flash rapidly (see page 44).
  Briefly pressing the multifunction key increases the output O_2 value by 0.1% (pressing for a longer period reduces the O_2 value; 0.1% in 2 seconds). If no operation follows within 15 seconds, the test gas calibration is terminated.

ATTENTION: Which instrument measures correctly?

Compensation should only be carried out if it was previously ascertained, e.g. by using test gases, that the comparison instrument is measuring correctly.

7.2 Checking the LT 2

7.2.1 Checking the LT 2's measuring input

Connect a digital voltmeter between terminals 33 (-) and 34 (+), in parallel to the probe. Compare the measured voltage with the probe voltage displayed (Us).
Range: -20 mV … +300 mV.

If the difference is less than 1 mV, the LT 2 is operating correctly.

If the difference exceeds 1 mV, repeat the above step with another digital voltmeter.

ATTENTION! *Check the accuracy of the digital voltmeter used.*

If the difference persists → exchange the instrument.

7.2.2 Checking the probe's internal resistance measurement

Only possible with an LS 2 probe simulator, item no. 655 R 1030.
Connect the probe simulator between terminals 33 (-) and 34 (+).

With a potentiometer, set an internal resistance $< 200\ \Omega$ at R_i probe.

Use a voltmeter as follows to check the internal resistance:

Measure AC voltage between terminals 33 (-) and 34 (+).
The displayed value in mV ≙ corresponds to about one half of the probe's internal resistance.
If $R_i > 200\ \Omega$, the following warning is output after 10 seconds:
"LS 2 internal resistance too high".
If $R_i > 300\ \Omega$, the following fault message is output:
"Probe wire break / probe faulty".
Example: 150 W ≙ 75 mV.

NOTE: The probe's internal resistance monitor is deactivated during a cold-start.

7.3 Maintenance

Check the measurement system on a monthly, quarterly or semi-annual basis, depending on the application.

7.3.1 Consumables

LS 2 Lambda probe
Mean lifetime 2-3 years (depending on fuel).

8. Faults/warnings

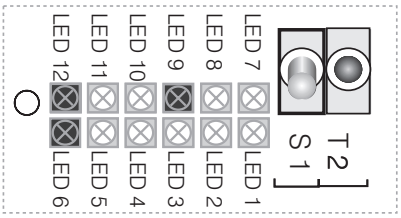
Messages in plain text. See also 6.1.3, page 53.
Via (optional) display and operating unit, under **"diag"**
via service and diagnostic software, under **"status"**
via LAMTEC system bus at an external operating unit.
Message via LED row, LED 7 to 12, on LT 2's processor board (see 8.1; 8.2).

If several faults/warnings are present, they can be called up in sequence by activating the T2 multifunction key.

8.1 Faults

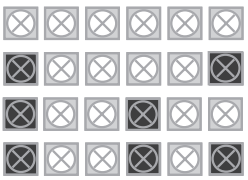
Message via LED row, LED 7 to 12, LED 12 flashes.

Faults (flashing)



Display of active faults (red), flashing.

12 11 10 9 8 7



No warnings/faults active

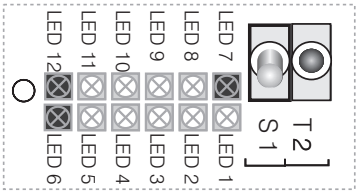
Probe faulty

Probe heating faulty

Probe wire break

8.2 Warnings

Message via LED row, LED 7 to 12, LED 12 lights up.



Display of active warnings (red), LED(s) permanently on.

	Faults (LEDs on) LED 12 11 10 9 8 7	
	⊗ ⊗ ⊗ ⊗ ⊗ ⊗	No warnings/faults active
	● ⊗ ⊗ ⊗ ⊗ ●	LS 2 internal resistance too high
	● ⊗ ⊗ ⊗ ● ⊗	Offset voltage to air invalid
	● ● ⊗ ⊗ ● ●	Analogue input 1: input value too large / small
	● ● ⊗ ● ⊗ ⊗	Analogue input 2: input value too large / small
	● ● ⊗ ● ⊗ ●	Analogue input 3: input value too large / small
	● ● ⊗ ● ● ⊗	Analogue input 4: input value too large / small
	● ● ● ⊗ ⊗ ⊗	Service warning 1
	● ● ● ⊗ ⊗ ●	Service warning 2
①	● ● ● ⊗ ● ⊗	No LS 2 probe dynamics
①	● ● ● ⊗ ● ●	Dynamic test triggered

8.3 Resetting faults/warnings

Via (optional) display and operating unit, via "diag", menu-driven

Via service and diagnostic software, via "status", menu-driven

Via external operating unit, via LAMTEC system bus

Via digital inputs - input 1

By pressing the T2 multifunction key
(for longer than 3 seconds per fault).

If several faults are present simultaneously,
the multifunction key must be pressed several times.

(1)
Only relevant in conjunction with an integrated O_2 control system.
Without an integrated O_2 control system the dynamics test should remain switched off parameter 1330 "0"

8.3 Faults
Causes and solutions

8.3.1 "Probe wire-break" / defective probe

This message is output if the AC internal resistance (R_i) or the ZrO_2 cell exceed the permissible limit of 300 Ω during operation. Generally, this message is accompanied or preceded by the warning "LS 2 internal resistance too high".

Possible causes:

– The plug carrying the probe's signal has been pulled out.
– Wobbly contact check the terminals, tighten
– Check the wiring

8.3.2 "Defective LS 2 probe heating"

NOTE:
In 99% of cases, the LS 2 Lambda probe was not connected properly during operation (the probe heating plug had been pulled out).
Reset the fault, either via the multifunction key or via the display and operating unit etc. A fault is only present if the fault cannot be reset.

Possible causes:
- Check fuse F 5, see page 76

Check the probe's heater. In an intact heater, ca. 10 Ω / 9…11 Ω should be measured between the probe plug's two pins (identified by the two white wires). If not, (R) heater faulty - replace probe.
If intact, check the supply voltage: the probe's heater must be supplied with ca. 13 V DC, cyclically reversed; if not, check the wiring and the terminals and tighten if necessary.

NOTE:
The probe is heated with direct current at ca. 13 V, cyclically reversed. Hence the use of a multimeter to measure it is somewhat difficult.

NOTE:
The current heating data can be read out from operating parameters 41/42/43.

8.3.3 Probe voltage too low

- Probe +/- reversed → swap probe terminals 33-34 around
- Probe poisoned → replace

NOTE:
Probe voltage to air 0 to -20 mV.

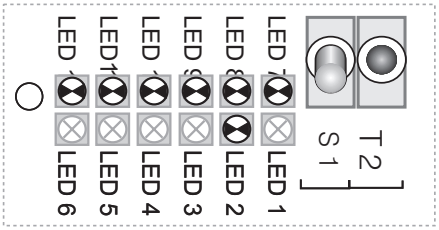
8.3.4 O_2 value incorrect

If a control measurement results in a different O_2 value than the one displayed:
- Has the relationship between wet/dry measurement been taken into account?
  See diagram in the Appendix, page 81.
- Check LT 2, see 7.2, page 57.
- Replace LS 2 Lambda probe.
- Commission the new probe as described in 5.3.

NOTE:
During counter-measurement, check whether the instrument being used measures wet or dry. Those with an advance gas cooler are always used for dry measurement. This also applies to instruments that extract moisture via a chemical compound. The LS 2 Lambda probe measures wet. The difference between wet and dry measurements can be obtained from the diagram in the Appendix (see page 81).

8.3.5 Internal electronics faults

In the event of an internal fault, the top row of LEDs (LED 7 … LED 12) flashes rapidly.
The bottom row shows the number of the relevant fault.



LED 6 5 4 3 2 1	Internal fault code	
⊗ ⊗ ⊗ ⊗ ⊗ ⊗	0:	Run-time monitoring
⊗ ⊗ ⊗ ⊗ ⊗ ☢	1:	EEPROM parameter destroyed
⊗ ⊗ ⊗ ⊗ ☢ ⊗	2:	EEPROM cannot be corrected
⊗ ⊗ ⊗ ⊗ ☢ ☢	3:	Internal program error
⊗ ⊗ ⊗ ☢ ⊗ ⊗	4:	EEPROM parameter destroyed
⊗ ⊗ ⊗ ☢ ⊗ ☢	5:	EEPROM cannot be corrected
⊗ ⊗ ⊗ ☢ ☢ ⊗	6:	Too many EEPROM errors
⊗ ⊗ ⊗ ☢ ☢ ☢	7:	EPROM CRC16 error
⊗ ⊗ ☢ ⊗ ⊗ ⊗	8:	Division by zero error
⊗ ⊗ ☢ ⊗ ⊗ ☢	9:	Interrupt error
⊗ ⊗ ☢ ⊗ ☢ ⊗	10:	Internal program error
⊗ ⊗ ☢ ⊗ ☢ ☢	11:	Not used

☢ = LED flashes

⊗ = LED off

The number of the internal fault can be calculated from the following formula:

Internal fault =

LED 1 +2 • LED 2 +4 • LED 3 +8 • LED 4 +16 • LED 5 +32 • LED 6

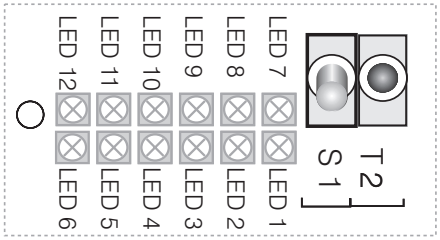
where LED 1 … 6 should be replaced by 1 if the LED flashes, otherwise by 0.

NOTE:

If you are unable to rectify the fault yourself, please work out the internal fault number using the above formula and contact the manufacturer.

The following table lists the steps which should be taken if an internal fault occurs:

Internal fault code	Steps to take
0: Run-time monitoring	Notify the manufacturer, if possible with exact details of the circumstances.
1: EEPROM parameter destroyed	Program default parameters, check that the EEPROM is properly located in its socket, replace EEPROM, replace processor card.
2: EEPROM cannot be corrected	Check that the EEPROM is properly located in its socket, replace EEPROM and program default parameters, replace processor card.
3: Internal program error	As 0
4: EEPROM parameter destroyed	As 1
5: EEPROM cannot be corrected	As 2
6: Too many EEPROM errors	As 2, possibly also software error
7: Flash CRC16 error	Reprogram the Flash Replace processor card
8: Division by zero error	Meaningless parameters may have been set, otherwise as 0
9: Interrupt error	As 0
10: Internal program error	As 0
11: Not used	



Maintenance switch S1
Multifunction switch T2

Programming the default parameters:

- Switch the instrument off
- Switch on bridge SW 1, SW 2, SW 3 on the processor card; see illustration.

- Switch maintenance switch S1 to the maintenance position
- Keep multifunction switch T2 pressed and switch the instrument on
- LED 1 (Maintenance) flashes during the write procedure; all others
- All the LEDs flash once the write procedure is completed
- Switch the instrument off, restore BR 2, BR 3 and BR 4 to their original position and switch the instrument back on.

ATTENTION!
Only program the default parameters if absolutely necessary and after consulting the manufacturer.
After programming the default parameters (factory parameters), all the customised settings are lost and must be restored via the (optional) display and operating unit or the (optional) service and diagnostic software. Some parameters may be at factory level and can only be set by the manufacturer. In case of doubt, inform the manufacturer.

8.4 Warnings Causes and solutions

Generally speaking, warnings do not affect the measurement functions.

8.4.1 LS 2 internal resistance too high

This message is output if the AC internal resistance (R_i) of the ZrO_2 cell exceeds the permissible limit of 200 Ω during operation.

Possible cause:

Probe aged (worn out) → Obtain a spare probe and replace.

Measurement can continue, using caution. Check accuracy by counter-measurement, see 7.1.2, page 56.

- Check fuses F2, see Appendix, page 76
- Fault in supply section electronics → replace

Check LT 2 electronics:
Measure the AC voltage across LT 2 terminals 33-34, using a multimeter. The result in mV corresponds appx. to half the AC internal resistance.

8.4.2 Offset voltage to air invalid

The voltage determined during offset compensation is not permissible.
Check whether probe is in air.
If yes - check probe voltage to air.
Permissible voltage range 0 … -20 mV.

8.4.3 Analogue inputs 1/2/3/4 Input value too large/too small

The input value at the relevant analogue input is outside the permissible range.
Limits: Check parameters 574/584/594/604 (min. value) and 575/585/595/605 (max. value).
The current input value can be output via parameter 570/580/590/600.

Steps to take:
- Check wiring → poles reversed?
- Check source (connected instrument)

8.4.4 Configuration error at analogue outputs

Parameters have been set for analogue outputs not physically found. Check parameters 539, 549, 559, 569 and 530, 540, 550, 560 and compare with the fitted cards.
If necessary, replace the analogue output cards and/or processor card.

8.4.5 Service warning 1/ service warning 2

The service warnings are designed to draw attention to regular servicing. The service warnings can be freely defined by the operator, e.g.

Service warning 1 → Check probe
Service warning 2 → Dismantle and clean probe

The appropriate cycle times can be freely configured via the parameters 1260 and 1261.

9. Spare parts

The following is a list of relevant spare parts.

It is recommended to maintain a stock of the spares marked *.

Spares marked with the footnote (1) should be kept if considered appropriate.

Spares marked with the footnote (2) should be kept only if the system is equipped with the relevant option.

Consumables:

* 1 LS 2 Lambda probe
Mean lifetime ca. 10,000 - 20,000 operating hours (depending on fuel)
without Gas extraction Device (MEV)
Type 6 50 R 1000

Spares:

* 1 Gas extraction Device (MEV),
e.g. 300 mm long,
Type 6 55 R 1002
For standard lengths see price lists

* 1 Clamping ring for SEA 655 R 1010
(5-pack)
Type 6 50 R 1013

* 1 1 mounting paste for LS 2
(5-pack)
Type 6 50 R 1090

* 1 Probe installation fitting
for LS 2
Type 6 50 R 1010

* 1 Spare plug set for LS 2
Type 6 50 R1002

(1) 1 Spare power electronics (full version)
Type 6 57 R 1882

(1) 1 Spare computer electronics
Type 6 57 R 0874

(1) 1 LT 2 supply section (transformer)
Type 6 57 R 0342

(2) 1 Analogue output card 0/4 … 20 mA; 0 … 10 V (1 channel)
Type 6 57 R 0050

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

(2) 1 Analogue input card Potentiometer 1…5 kΩ
Type 6 57 R 6000

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

(2) 1 Analogue input card 0/4 … 20 mA
with 24 VDC supply to transducer
Type 6 63 R 6002

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

(2) 1 Temperature sensor PT 100, 250 mm long
Type 6 57 R 0891

[2] 1 Relay card for digital outputs, 6 relays, 1 switcher each
Type 6 60 R 0017

[2] 1 Relay card for digital outputs, 3 relays, 2 switchers each
Type 660 R 0012

[2] 1 Probe junction box (SAK)
Type 6 55 R 1025

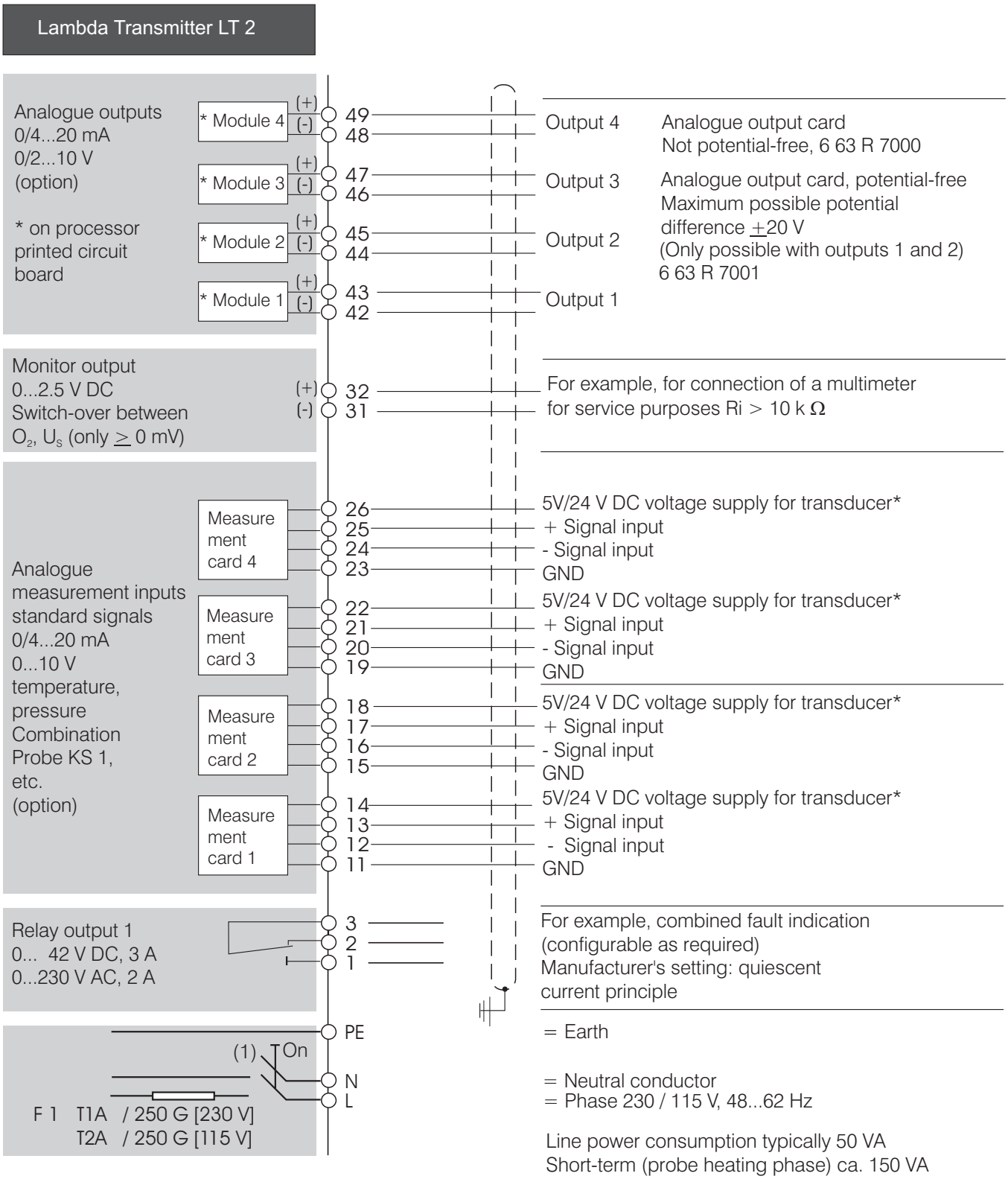
Version:	Wall-mounted housing	Panel installation housing
Housing:	Housing in sheet steel, powder-coated	3 HE / 50 TE, control panel housing in 19” technology
Safety class, DIN 40050	IP54	IP 20 Front panel IP 40
Dimensions (h x w x d), mm	400 x 300 x 200	173 x 310 x 270
Colour	Grey RAL 7032	Metallic silver (alum. anodised), control elements grey
Weight plus display and operating unit	ca. 10 kg ca. 0.5 kg	ca. 5 kg

Ambient temperature: Operation	-20°C … +60°C
Transport and storage	-40°C … +85°C
Auxiliary voltage:	230 V AC and 115 V AC +10% / -15%, 48 Hz … 62 Hz
Power consumption:	Typically 50 VA, short-term 150 VA (probe heating-up phase)
Display:	LCD graphic display 100 x 80 mm (w x h) in LT 2 wall-mounted housing type 6 57 R 1020_R 1029 optional Display and operating unit 6 57 R 0831
Resolution:	0.1 vol.% O_2 in the range 0…18 vol.%O_2 1 vol.% O_2 in the range 18…30 vol.%O_2
Measuring accuracy: (with LS 2 Lambda probe)	+/- 10% of measured value not better than +/- 0.5 vol.% O_2
Settling time (90% time):	T 90 < 15 s
Time for operational status to be achieved with LS 2:	Ca. 10 minutes after "SUPPLY ON”

Analogue outputs:		
Monitor output	0…2.55 V DC, load > 10 kΩ, $\leq$ 100 nF	
Accuracy	2% of measured value, not better than 0.2 vol.% O_2	
Factory settings	0…2.55 V DC ≙ 0…25.5 vol.% O_2 Can be switched via jumpers to	
	Probe voltage U_s	U_s 0…255 mV DC ≙ 0…2.55 V
	Probe (cell) internal resistance R_I	0…255 Ω ≙ 0…2.55 V
1…4 current/voltage outputs 1 standard 2…4 optional	- DC current	0/4…20 mA Load 0…600 Ω
	- DC voltage Load	0…10 V $\geq$ 10 kΩ
	not floating (potential isolation optional)	
Accuracy:	0.5% of measured value, not better than 0.1 vol.% O_2	
Resolution:	0.1 vol.% O_2 Measurement range and physical quantity can be configured	
Factory settings:	0…10 vol.% O_2 ≙ 0…20 mA	
Analogue inputs:	Optional 1…4 via mini plug-in card to LT 2 supply section electronics	
	- Analogue input card LT1/LT2 Potentiometer 1…5 kΩ Type 6 57 R 6000	
	- Analogue input card 0/4 … 20 mA Type 6 63 R 6001	
	- Analogue input card 0/4 … 20 mA with 24 VDC supply to transducer Type 6 57 R 6002	
	- Temperature input for PT 100 sensor 657 R 0890	
Control elements:	<u>Wall-mounted housing</u>	<u>19" panel installation</u>
	Multifunction key, maintenance key and 2 LED rows of 6 LEDs each. Display and operating unit with LCD graphic display available as option.	Display and operating unit with LCD graphic display
Interfaces:	LAMTEC system bus, either RS 422 with floating potential, or RS 232 only in conjun. with interface module 6 63 P 0500	
BUS links:	Optional for the systems Profibus DP (Siemens) Interbus-S (Phoenix) SUCOnet-K (Klöckner - Möller) Modbus CANopen consisting of:	
	BUS card	6 63 P 0400
	BUS interface	6 63 R 0301

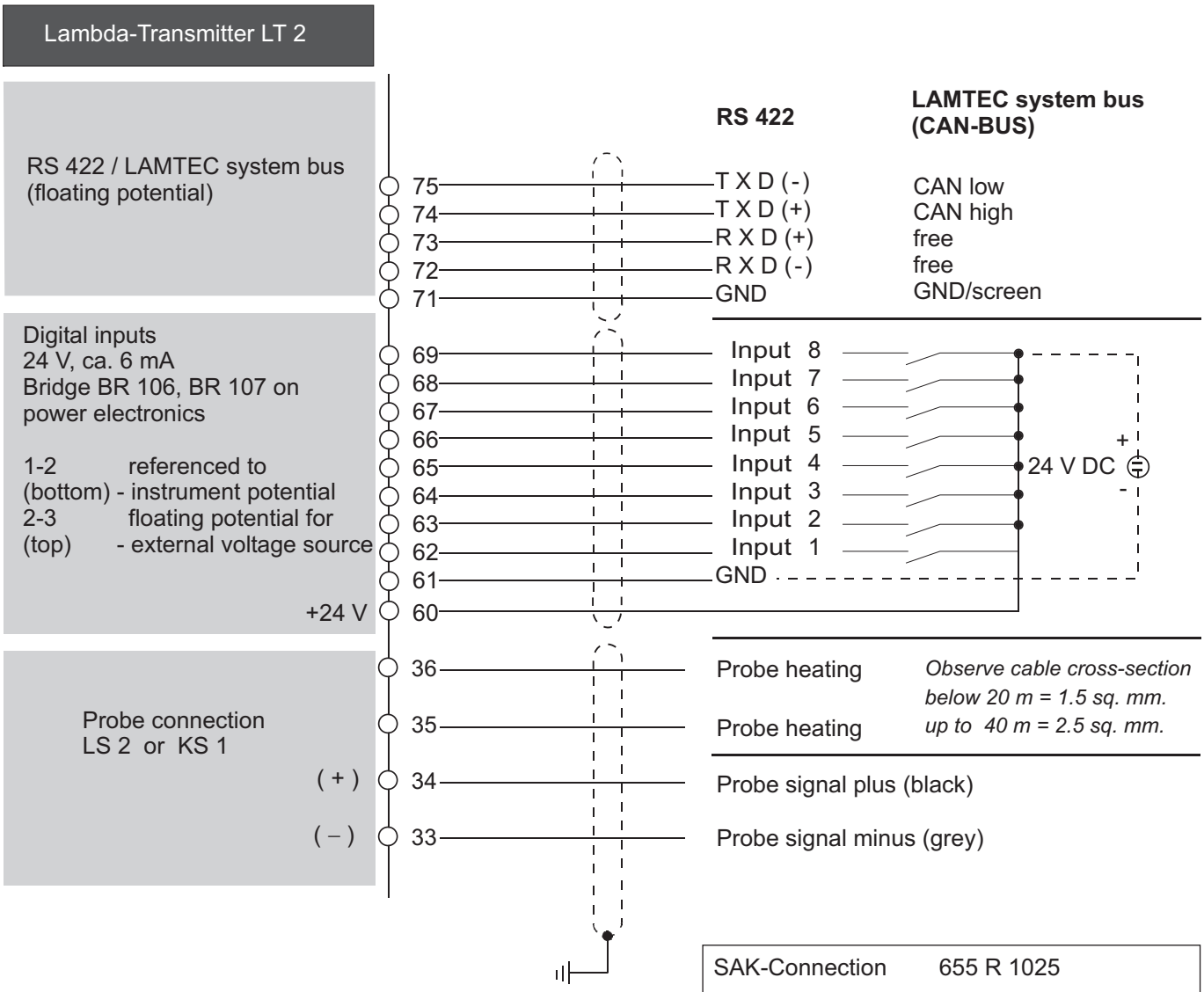
Digital outputs:	1 standard + 6 optional 1 relay output 0…230 V AC, 4A Collection error message 0 … 48 V DC, 3A Optional: Relay card with 6 relays (1 switcher) Switching capability 0…230 V AC, 4A 0 … 48 V DC, 3A 660 R 0017 or: Relay card with 3 relays (2 switchers) Switching capability 0…230 V AC, 4A 0 … 48 V DC, 3A 660 R 0012 Can be freely configured for operational, status and boundary value messages.
Digital inputs:	8 inputs - can be freely configured Factory settings: 24 V DC, referenced to instrument potential Can be switched via jumper to floating potential, for external voltage source.
Cold-start delay	Automatic cold-start delay 10 mins.
Conforms to the following European Directives:	89 / 336 / EEC Electromagnetic compliance 73 / 23 / EEC Electric equipment within certain voltage limits

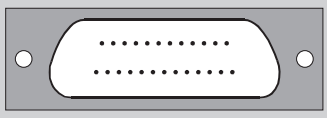
Measurement range	0…18 vol.% O_2 with restriction 0…21 vol.% O_2
Measurement accuracy	+/- 10% of measured value not better than +/- 0.5 vol.%
Effect of measured gas pressure	-1.6 mV / 100 mbar change
Permissible fuels	Residue-free gaseous hydrocarbons and light heating oil
Permissible constant exhaust gas temperature	$\leq$ 300°C
Useful life	$\geq$ 2 years with heating oil EL and natural gas
Probe output voltage 0.01 to 12 vol.% O_2	150…0 mV
Probe internal resistance R_i in air 20°C and 13 V heating voltage	$\leq$ 150 Ω
Probe voltage in air 20°C when new and 13 V heating voltage	-5…-15 mV
Supply voltage at plug	11…16 V DC; polarity cyclically reversed
Heat output at 13 V, steady state	ca. 18 W
Heating current at 13 V, steady state	ca. 1.4 A
Isolation resistance between heating and probe connections	> 30 MΩ



* Other levels/signal inputs possible, depending on meas. card.
Max. 2 of these floating (meas. card 1 and 2); max. possible potential difference ±20 V.

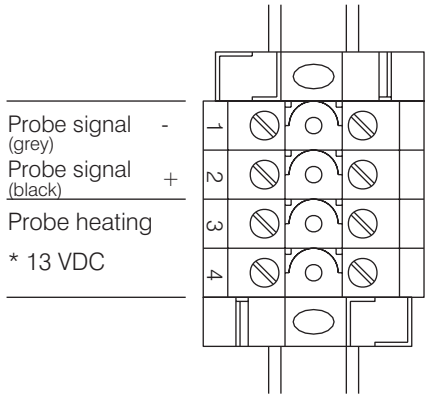
(1) Only in type 6 57 R 0020 - 6 57 R 0029
Wall-mounted housing IP 54





Socket for interface module, 25 pins

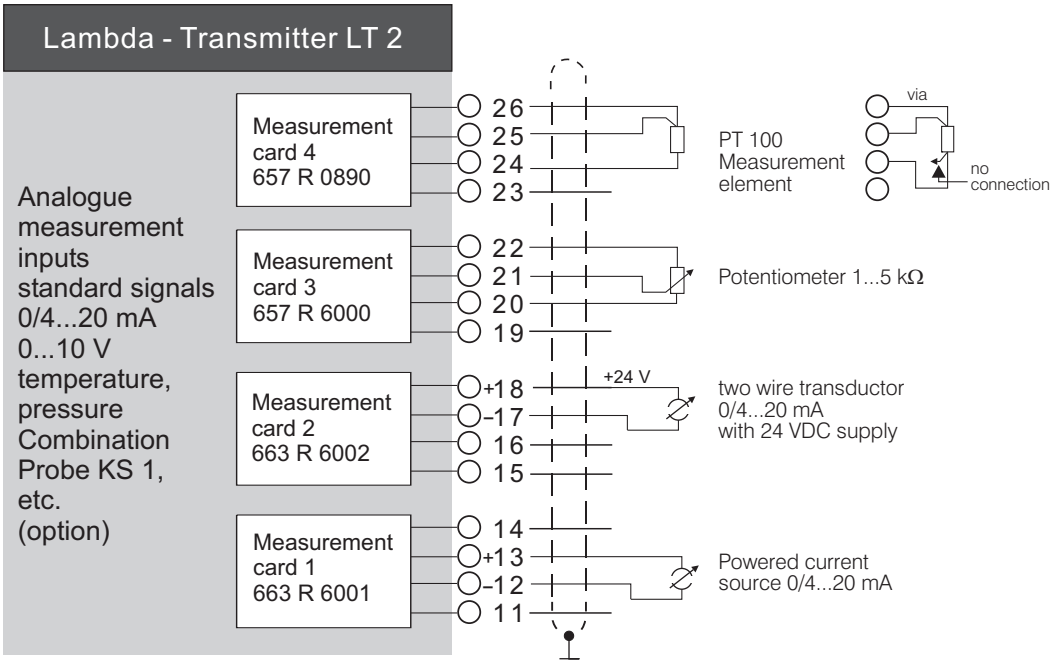
SAK-Connection 655 R 1025



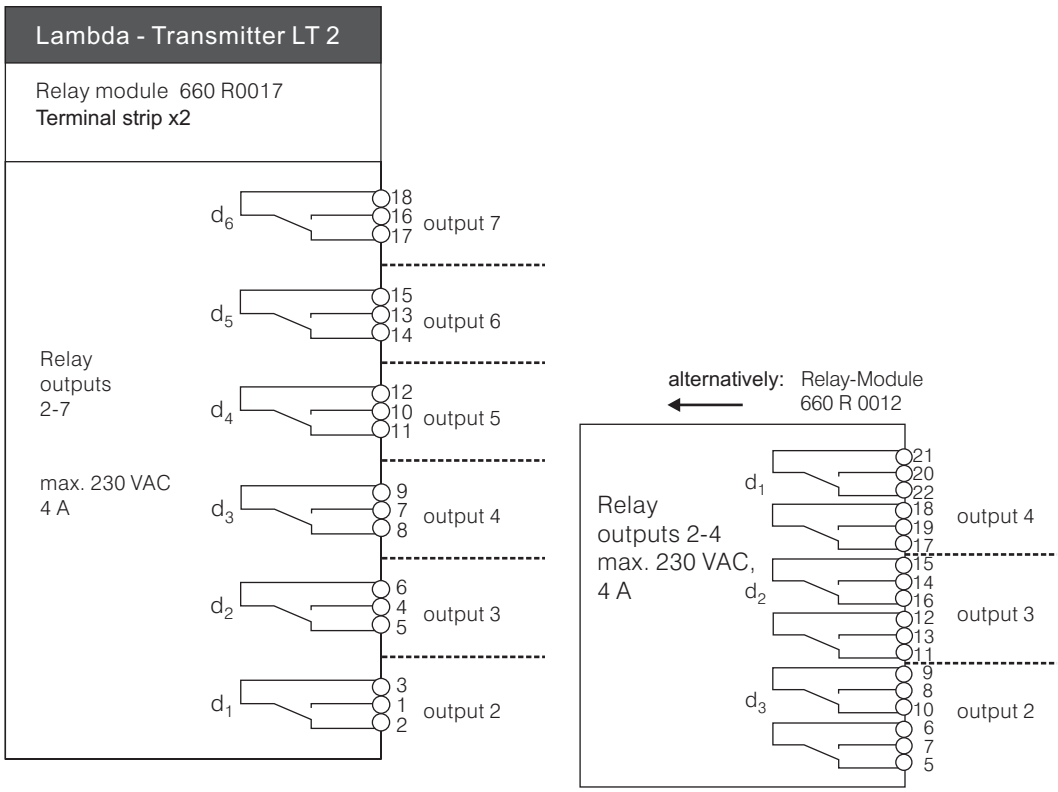
Interface module

RS 232	Only in conjunction with service and diagnostic software	- 6 57 R 0100
RS 422		- 6 63 P 0500

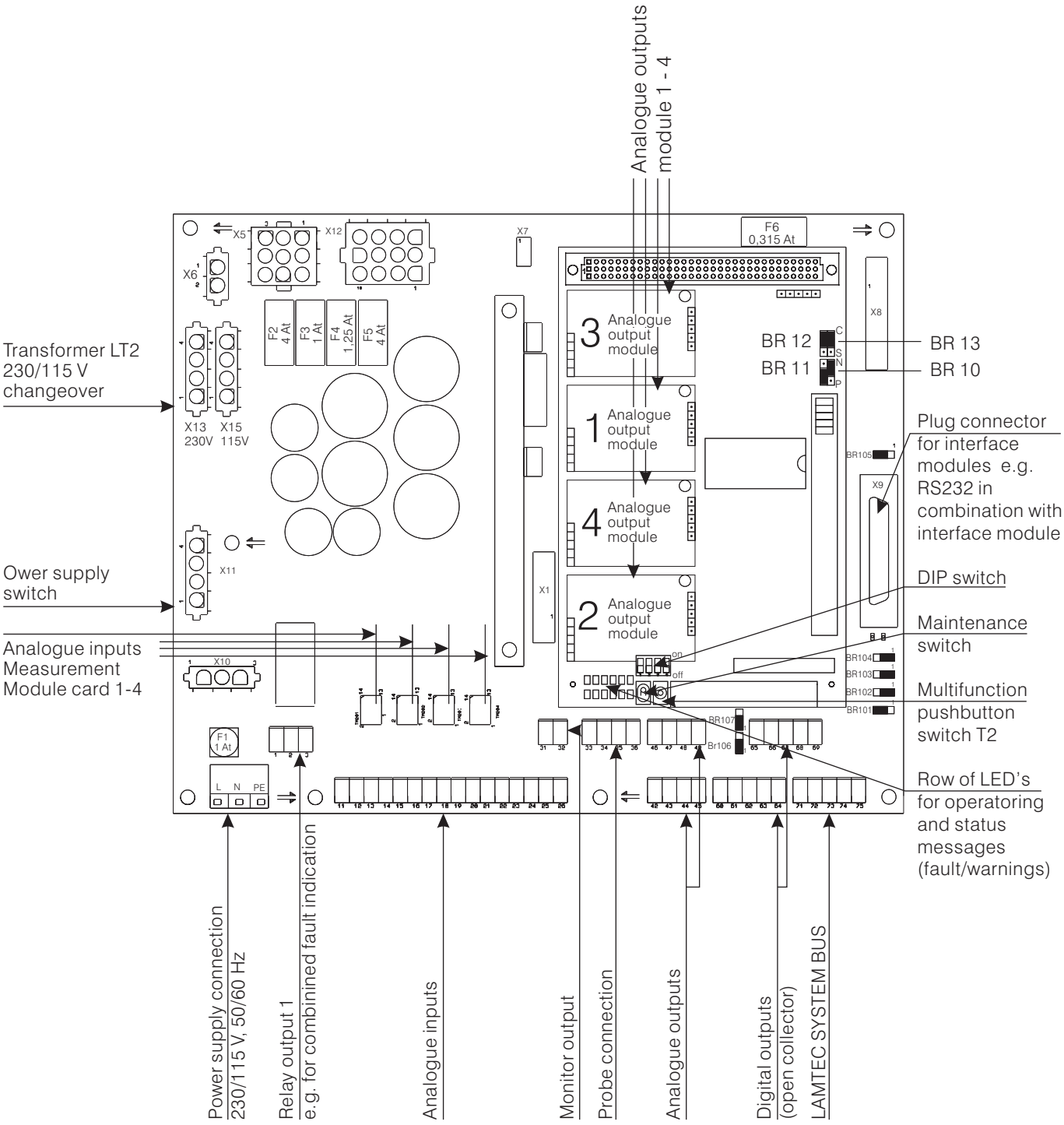
Analogue inputs terminal 11 to 26
Example



Relay-Module for digital outputs (option)



LT 2 Main board 657 R 1882



(3)
ATTENTION! Different fuse figures for 230 V and 115 V supply voltage.
Guard against supply voltage toggling! For fuses see page 76.

Plugs

X1: Connection for flat line cable from relay module
X5: Secondary plug, supply transformer
X6: 12 V connection for display illumination (as LT1)
X7: I^2C module (as LT1)
X8: Connection for flat line cable from the bus card (as LT1)
X9: Interface module (as LT1)
X10: Output for supply voltage (as LT1)
X11: Plug for mains switch
X12: Extension connector for 2nd probe electronics
X13: Transformer plug, 230 V
X15: Transformer plug, 115 V

TM201 to 204: analogue input module 1 to 4 (as LT1)

Plug layouts, if needed (only for internal use):

X1:

Pin 1, pin 2:	+24 V
Pin 3:	Control signal, relay 1
Pin 4:	Control signal, relay 2
Pin 5:	Control signal, relay 3
Pin 6:	Control signal, relay 4
Pin 7:	Control signal, relay 5
Pin 8:	Control signal, relay 6
Pin 9:	Do not use
Pin 10:	Do not use

X5:

Pin 1:	red	12.25 V, 4.8 A
Pin 2:	blue	0 V
Pin 3:	red	12.25 V, 4.8 A
Pin 4:	green	9 V, 1.5 A
Pin 5:	green	
Pin 6:	black	9 V, 0.25 A
Pin 7:	black	
Pin 8:	brown	9 V, 0.35 A
Pin 9:	brown	

X11: One contact of the supply switch between pin 1 and pin 4, the other between pin 2 and pin 3. In the ON state, pin 1 is connected to pin 4 and pin 2 to pin 3.
L is on pin 1, N on pin 2.

X13, X15:

One primary winding on pin 1 and pin 2:	Pin 1 white, pin 2 yellow
The other primary winding on pin 3 and pin 4:	Pin 3 white, pin 4 yellow.

LAMTEC system bus:

BR101: Selection of connection resistance: 1-2 off, 2-3 on.
BR102, 103, 104: Position 1-2
BR105: Position 2-3
The new processor card must also be set up for the LAMTEC system bus (2 jumpers).

RS 422 interface:

BR101: Position 2-3
BR102, 103, 104: Position 2-3
BR105: Position 2-3
The new processor card must be set up for serial 2nd interface (2 jumpers).

2nd interface on the 25-pole plug X9 (only for internal use)

BR105: Position 1-2
BR102 to 105: No assigned meaning

Digital inputs:

BR106, 107: Position 1-2:Digital inputs referenced to instrument potential.
Position 2-3:Digital inputs, galvanic isolation.

Terminals:

Attention: Terminals 1 and 2 are swapped around in the first PCB version.

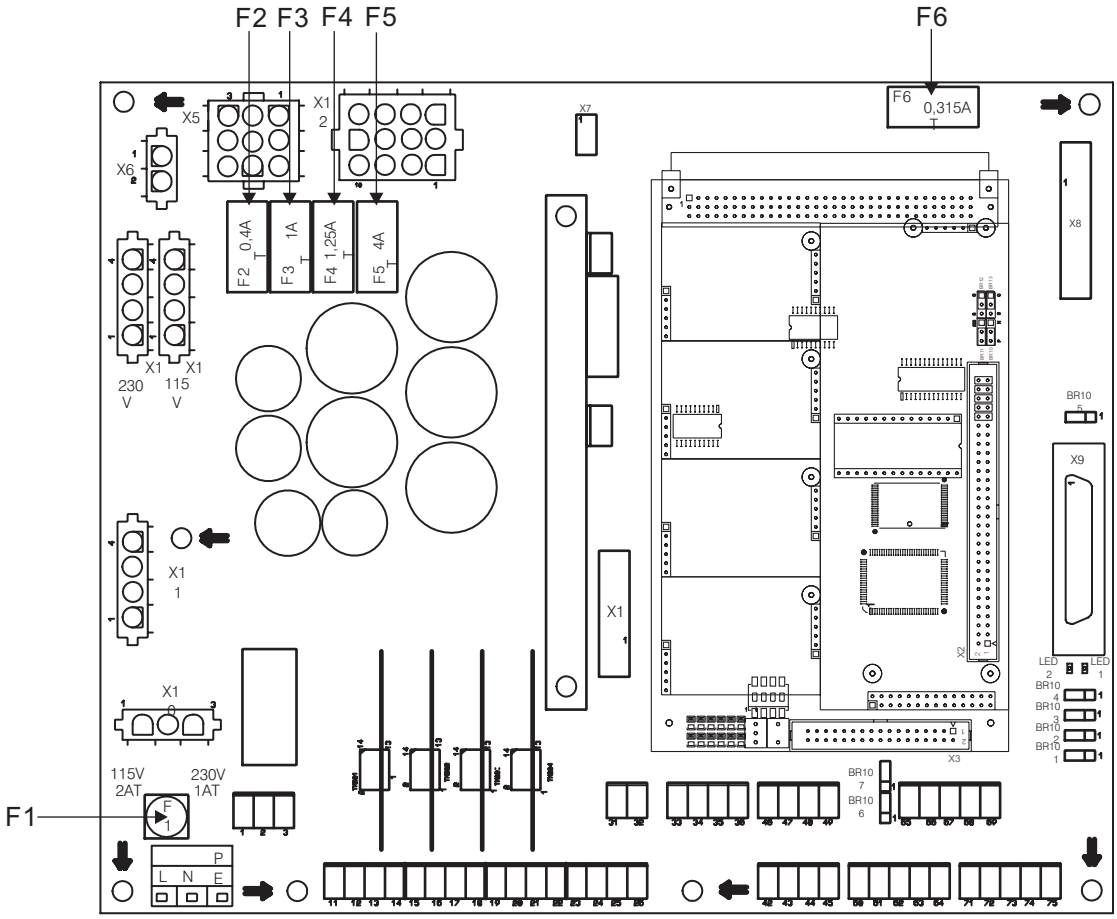
Terminals L, N, PE: Supply connection (as LT1)
Terminals 1, 2, 3: Relay 1 (as LT1)
Terminals 11-26: Analogue inputs, as LT1
Terminals 31, 32: Monitor output, as LT1
Terminals 33 to 36: Probe connection, LS2 or KS1
Terminal 33: Negative probe signal
Terminal 34: Positive probe signal
Terminal 35: Probe heating
Terminal 36: Probe heating
Terminals 42 to 49: Analogue outputs, as LT1
Terminal 60: +24 V for the digital inputs, only if BR106, 107 are positioned at 1-2.
Terminals 61 to 69: Digital inputs, as LT1
Terminals 71 to 75: LAMTEC system bus or RS 422 interface

For LAMTEC system bus
Terminal 71: Screen, earth
Terminal 74: CAN - high
Terminal 75: CAN - low

For RS 422: Connection layout, terminals 71 to 75, as LT1.

DIP switch processor card
(see illustration at 5.1.2, page 43)

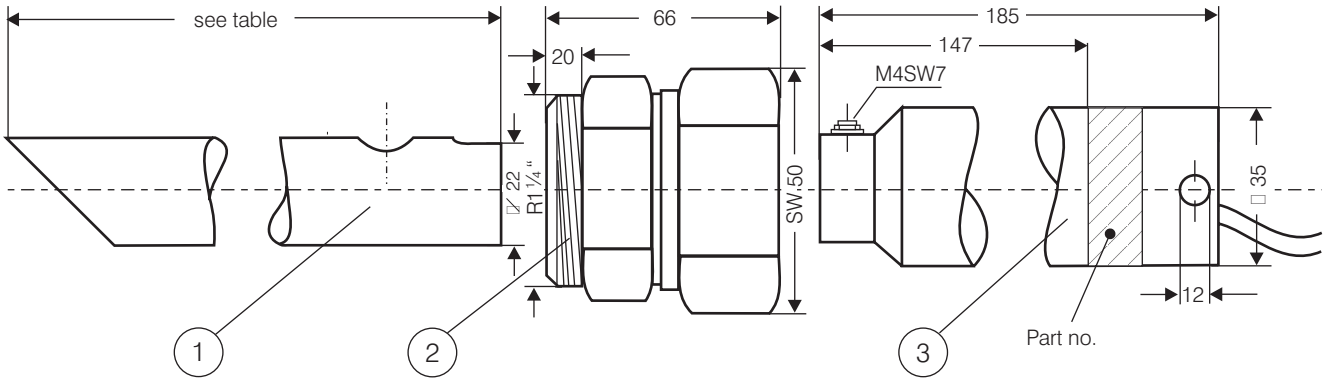
SW 1	SW 2	Monitor output function		
open	open	O_2 measured value	0…2,5 V ≙ 0…25 vol.% O_2	
connected	open	Probe voltage	0…2,5 V ≙ 0…250 mV	
open	connected	Cell internal resistance	0…2,5 V ≙ 0…250 Ω	1 



Fuses:

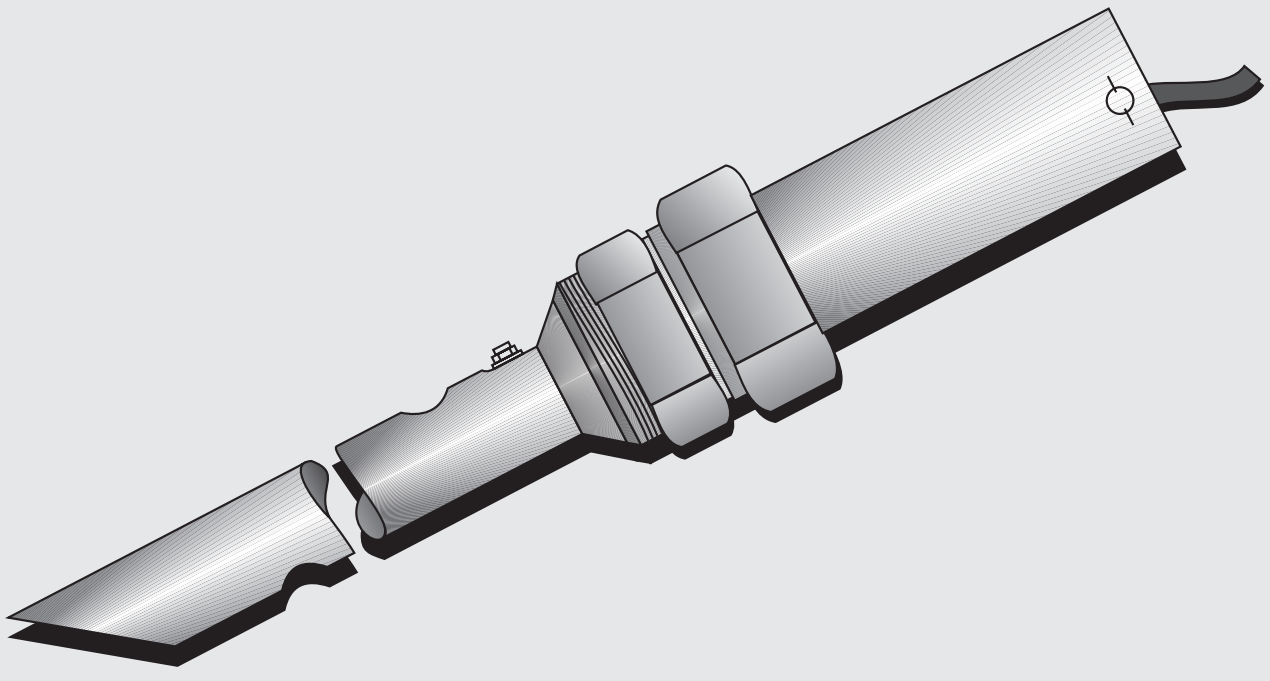
Designation	Value	Function
F1	1A inertial for 230V, 2A inertial for 115V	Primary fuse
F2	0,4A inertial	Probe measuring electronics
F3	1A inertial	12 V for display background illumination
F4	1,25A inertial	+/- 5 V supply for processor card
F5	4A inertial	Probe heating and 24 V supply
F6	0,315A inertial	LAMTEC system bus or RS 422

LS 2 dimensional diagram

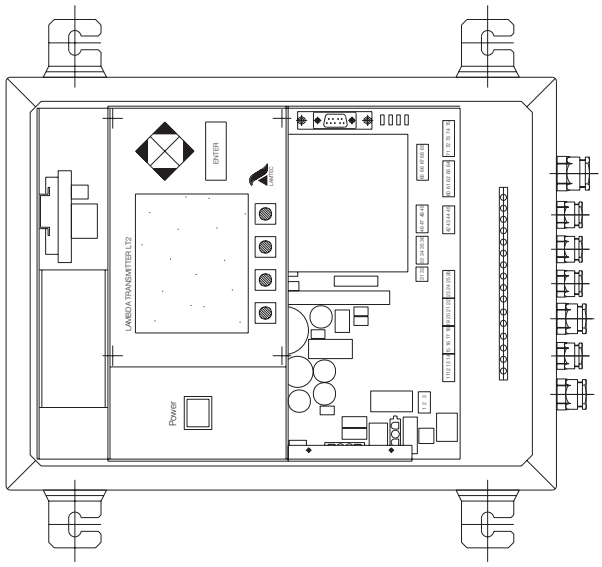


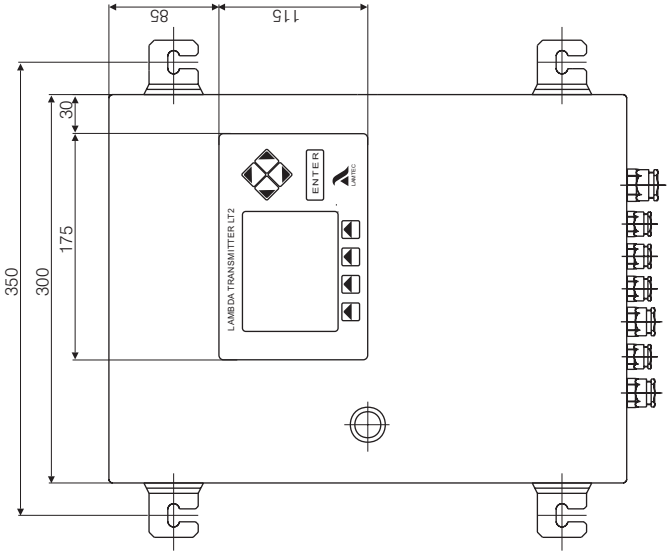
Part no.	Ordering information	
1	655 R 1001	Gas extraction device (MEV) for LS 2, 150 mm long
	655 R 1002	ditto, 300 mm long
	655 R 1003	ditto, 450 mm long
	655 R 1004	ditto, 1000 mm long
2	655 R 1010	Probe installation fitting (SEA) for LS 2, screw fitting, R 1¼"
3	650 R 1000	LS 2 Lambda probe

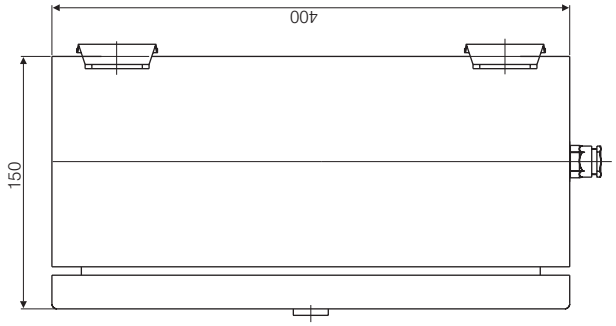
LS 2 Lambda probe with MEV and SEA

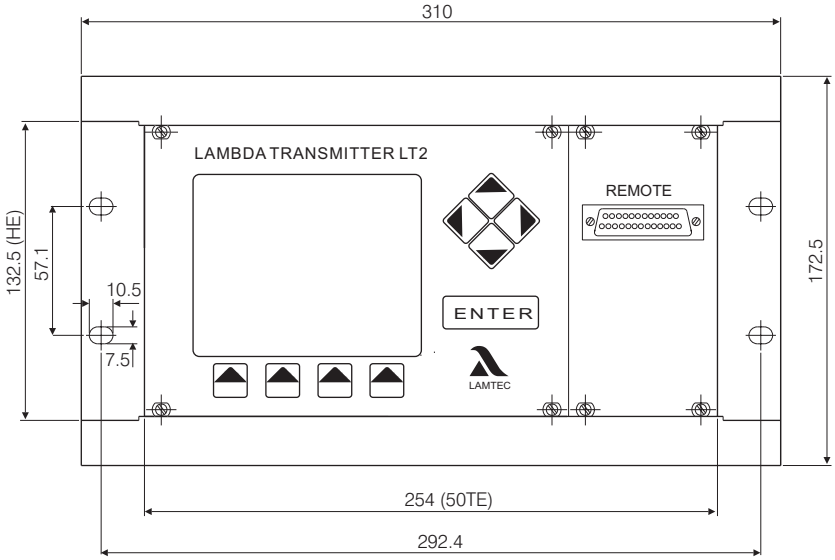


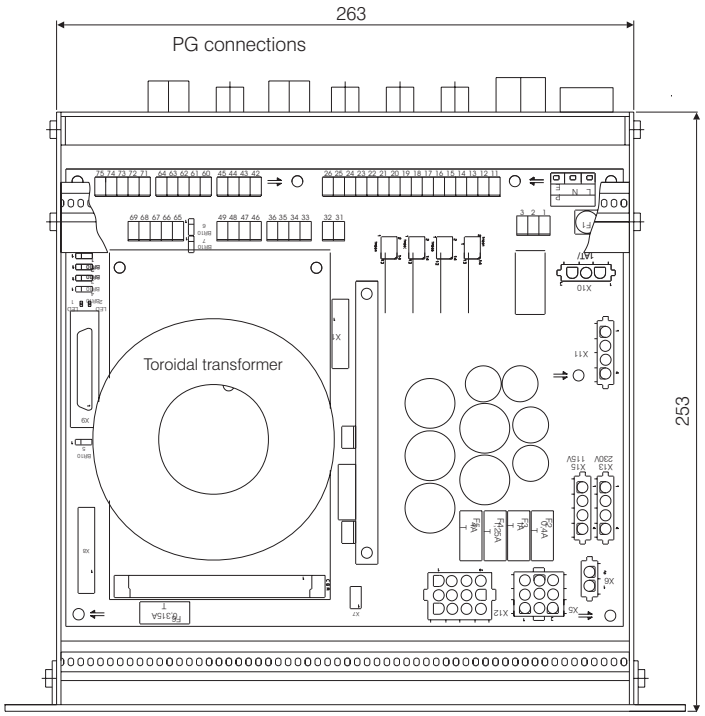
View with item open

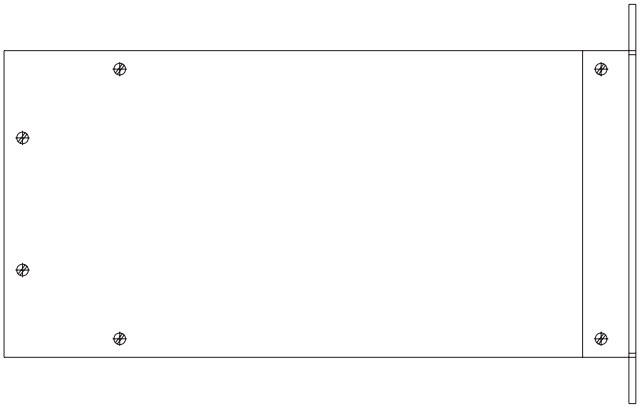




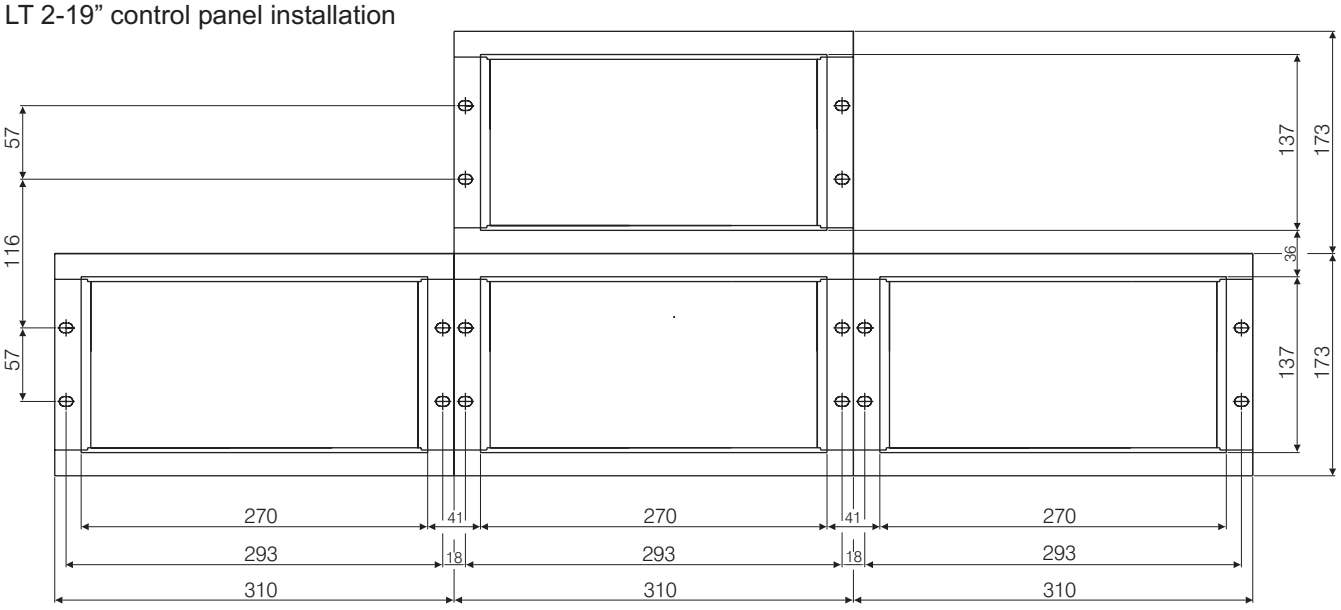



310
LAMBDA TRANSMITTER LT2
REMOTE
ENTER
LAMTEC
132.5 (HE)
57.1
10.5
7.5
172.5
254 (50TE)
292.4

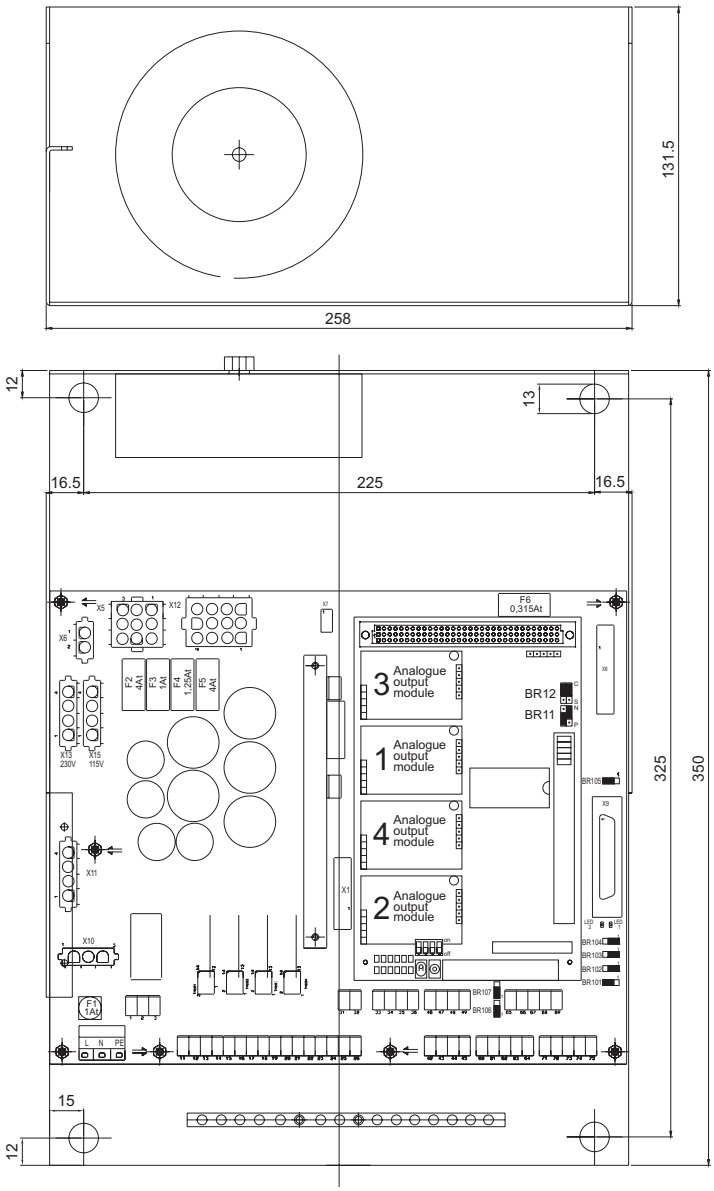

263
PG connections
Toroidal transformer
253

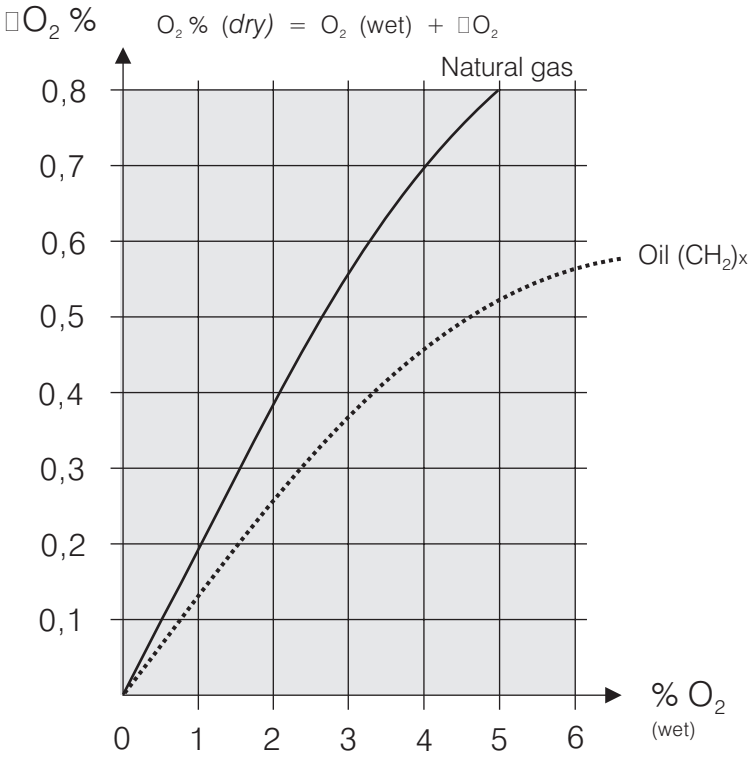


LT 2-19” control panel installation

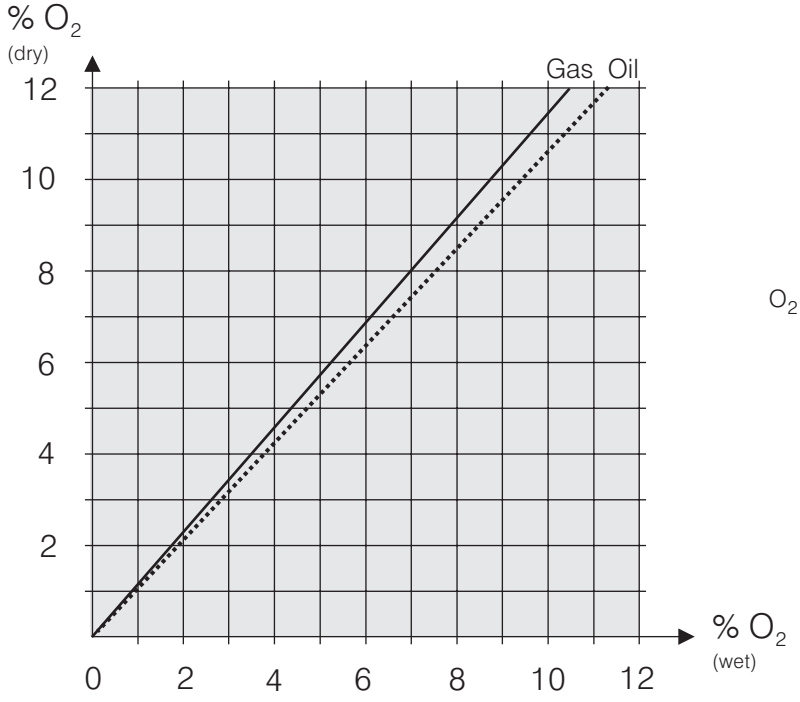


Dimensional diagram LT 2





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



O_2 (dry) = K • O_2 (wet)

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

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

11. EC conformity declaration

Month / year:	..... Jan ..... / ..... 1999 .....
Manufacturer:	LAMTEC Meß- und Regeltechnik für Feuerungen GmbH & Co. KG
Address:	Impexstrasse 5, 69190 Walldorf, Germany
Product designation:	LT 2 Lambda transmitter, *LT 2-19" incl. all options Type 6 57 R 1020…R 1029 ..... * Type 6 57 R 1040…R 1049 ....

The designated product conforms to the provisions of the following European Directives:

Number	Text
89/336/EEC	Electromagnetic compliance
73/23/EEC	Electric equipment within certain voltage limits

Further details about conformity to these Directives can be found in schedule

Carries CE labelling	Yes
Place, date	Walldorf, 4 January 1999
Legal signature:	.....

The schedules form an integral component of this declaration.
This declaration certifies conformity to the quoted Directives, however it does not warrant any properties.
The safety notes in the enclosed product documentation must be observed.

Schedule to EC Conformity Declaration or EC Manufacturer's Declaration

Month / year: ..... Jan ..... / ..... 1999 .....

Product designation: LT 2 Lambda transmitter, LT 2-19”
incl. all options

Type 657 R 1020...R 1029
Type 657 R 1040...R 1049

The designated product's conformity with the provisions of the quoted Directives is demonstrated through compliance with the following Standards and regulations:

Harmonised Europäische Normen:

Reference-no.	issue date
EN50081, part 2	
EN50082, part 2	
(ENV50140, ENV50141, EN61000-4-2, IEC801-4, EN55014)	

National Standards (as per NSR or MSR art. 5, para. 1, sent. 2):

Reference-no.	issue date
VDE 0110	September 1989
VDE 0100	–

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