Operating Manual

Lambda Transmitter LT 1
Wall-Mounting Cabinet
19"-Rack

Sensors and Systems
for Combustion Engineering

LAMTEC

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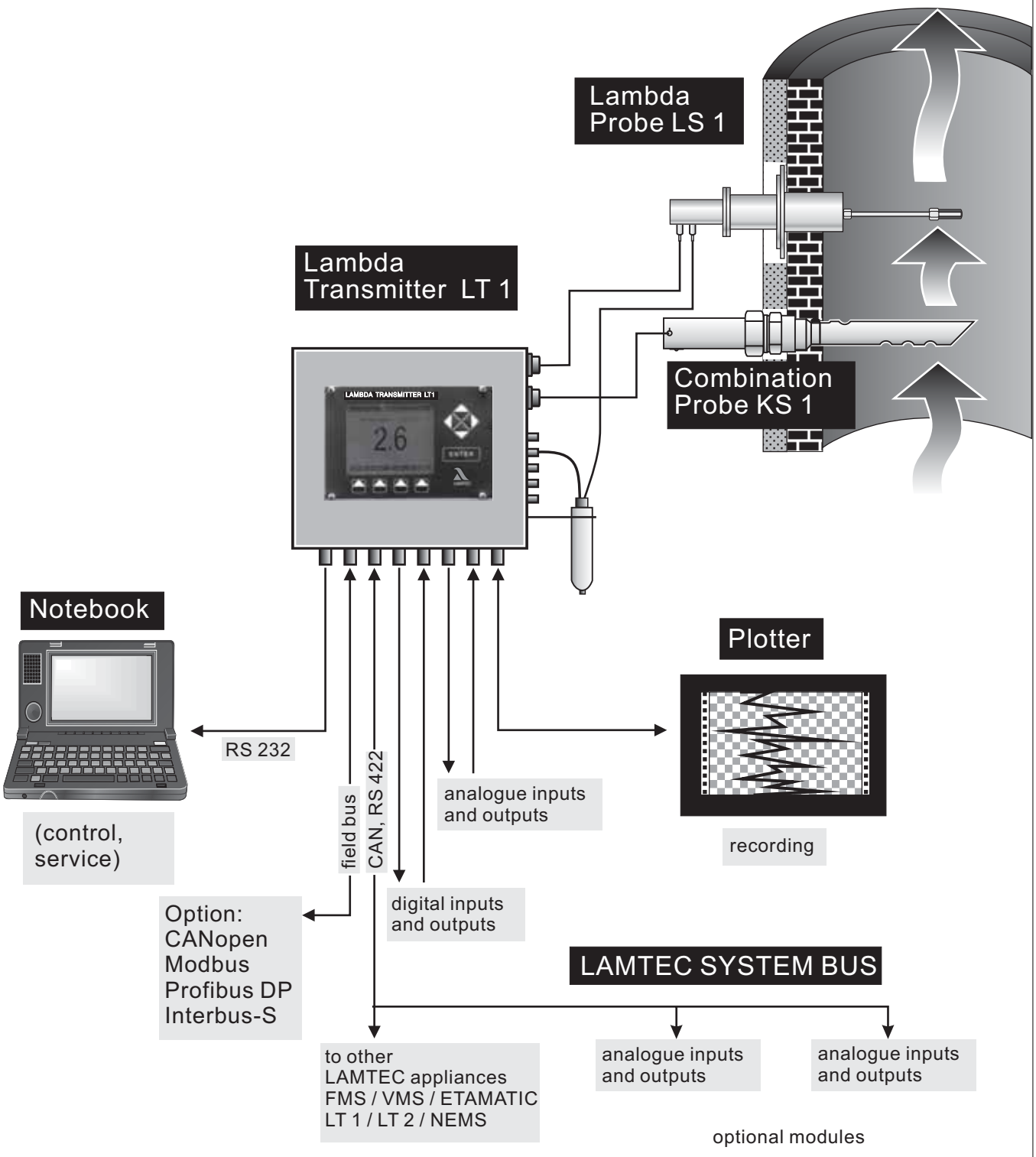
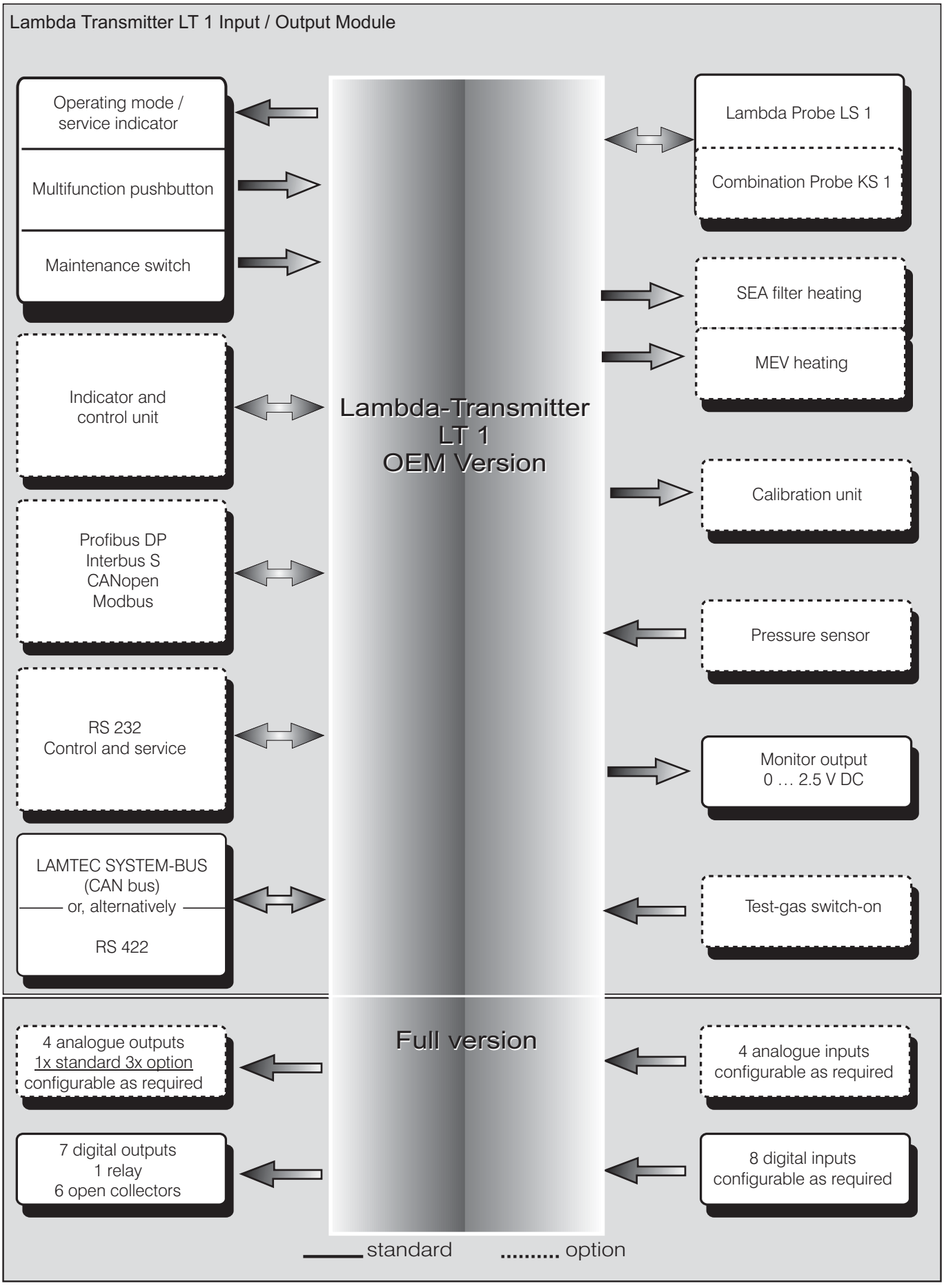
The Lambda Transmitter LT 1 is a universal, microprocessor-based measuring device for directly measuring the O_2 concentration in the super-stoichiometric range ($\lambda > 1$) in combination with the proven Lambda probe LS 1.

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

Wall-mounting cabinet for under-roof installation




Lambda Transmitter LT 1 Input / Output Module
Operating mode / service indicator
Multifunction pushbutton
Maintenance switch
Indicator and control unit
Profibus DP
Interbus S
CANopen
Modbus
RS 232
Control and service
LAMTEC SYSTEM-BUS
(CAN bus)
or, alternatively
RS 422
Lambda-Transmitter
LT 1
OEM Version
Lambda Probe LS 1
Combination Probe KS 1
SEA filter heating
MEV heating
Calibration unit
Pressure sensor
Monitor output
0 … 2.5 V DC
Test-gas switch-on
Full version
4 analogue outputs
1x standard 3x option
configurable as required
7 digital outputs
1 relay
6 open collectors
4 analogue inputs
configurable as required
8 digital inputs
configurable as required
standard
option

0.2 Short Description of the

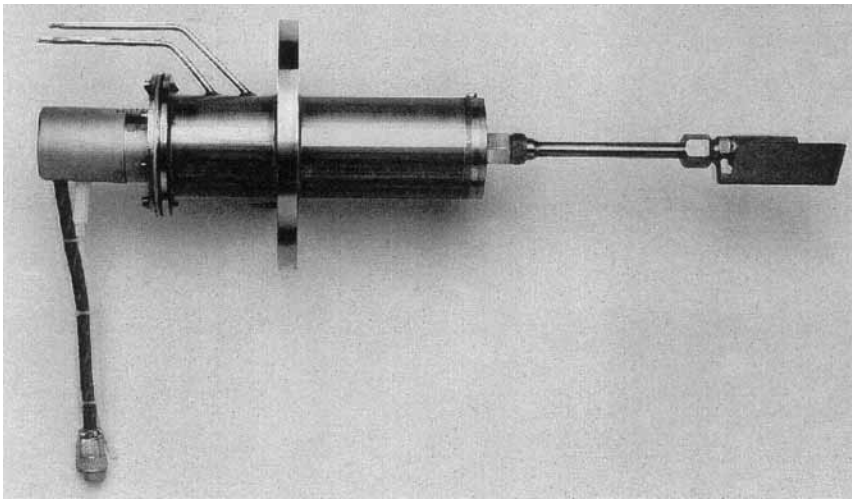
Intelligent probe interface with microprocessor, based on the proven Lambda Probe LS 1 (zircon dioxide current probe, “System ABB”), for direct, continuous measurement of the O_2 concentration

in combustion waste gases
in industrial plants

as a reference value for emission measurement, aptitude-approved by German Technical Inspectorate (TÜV) in accordance with Federal Immission Control Directives (BImSchV) 13 and 14, Test No. 502 / 118 / 96 / 689724, for the super-stoichiometric range (lambda > 1) without special gas preparation.

Lambda Probe LS 1
No. 6 50 R 0030...R 0039

Lambda Probe LS 1 No. 6 50 R 0030...R 0039 in probe installation fitting (SEA) Typ 6 55 R 0083 / R 1183



Lambda Transmitter LT1 No. 6 57 R 0020...R 0029 with indicator and control unit No. 6 57 R 0830 (option)

This Operating Manual has been produced to provide you, the user, with clear and unambiguous instructions for installation, system start-up, maintenance, servicing and operation.

The Operating Manual is divided into self-contained 10 sections, each dealing with on subject-area:

0. Introduction
This section

1. Safety instructions for users / 2. Theoretical principles, basis of operators

measurement
This section explains the basic physical relationships involved.

3. Technical description
All the system components are described in detail, with explanations of the operational sequences.

4. Installation
This section gives you, the user, important instructions for the installation of all system components.

5. System start-up / shut-down
If you are putting the system into operation yourself, you will find all the necessary procedures in this section.

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

7. Servicing and maintenance
The basic principle behind servicing and maintenance is that regular checks and preventive replacement and repairs should keep the appliance permanently serviceable and help to prevent damage and breakdowns. Servicing involves the replacement of worn or damaged components. Maintenance involves the replacement of consumables such as filters, etc. and cleaning of the appliance components.

8. Fault analysis and rectification
If faults occur, they must be rectified as quickly as possible. This section suggests possible solutions for an effective approach to problems.

9. Replacement parts
List of relevant spare parts and suggested list for stocks of spares.

10. EC Declaration of Conformity
Certificate of conformity with the European Directives applicable to this appliance.

Content of this Operating Manual

This Operating Manual describes the Lambda Transmitter LT 1 with all components necessary for O_2 measurement, such as the Lambda Probe LS 1, the probe installation fitting, etc.

Accessories and special applications

Information on accessories and special applications is provided in the booklets supplied with the particular systems. This information can be obtained from the manufacturers, at the Walldorf address.

This Operating Manual explains the functioning, mounting, installation, maintenance and operation of the Lambda Transmitter LT 1. Other booklets, such as Product Information for example, provide further information but must never be used as a substitute for this Operating Manual.

IMPORTANT!

Always read the Operating Manual before starting work!
Please adhere strictly to all warnings / safety instructions!

For particular tasks, for example electrical installation, specialised knowledge is required. These tasks may only be carried out by suitably qualified personnel. See section Authorised Usersand Operators.

Validity

Our products undergo constant redevelopment. However, we make every effort to ensure that the Operating Manual is accurate and relevant to individual applications.

All previous editions are rendered obsolete on publication of an updated and corrected new edition.

On the last page you will find the current version number of this Operating Manual and the corresponding order number.

Do you have any suggestions for improvement?

If you have any suggestions for improvement, please write to us, quoting both of these numbers, at the following address:

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Schlesierstraße 55
D-04299 Leipzig
Tel.: (+49) 03 41 / 86 32 94-00
Fax:(+49) 03 41 / 86 32 94-10

Association of German Electrical Engineers (VDE)	The Lambda Transmitter LT 1 conforms to the currently applicable regulations of the Association of German Electrical Engineers (VDE)
Apitude Approval of German Technical Inspectorate (TÜV)	The Lambda Transmitter LT 1 fulfils the conditions of the German Federal Immission Control Directives 13 and 17 (BImSch V) and the Federal Clean Air Regulations (TA-Luft). Test No. 502 / 118 / 96 / 689724.
Legal basis for development	The Lambda Transmitter LT 1 also complies with the “Minimum Requirements for Emission Measuring Equipment” of the Federal Environment Office, corresponding to the directives on suitability, installation, calibration and maintenance of measuring equipment for continuous measurement of emissions.

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

WARNING

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

WARNING

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

IMPORTANT!

Indicates danger to system components or possible impairment of functionality.

NOTE:

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

Contained in texts which provide information on how to perform tasks.

In performing all tasks, the operator is requested to observe all statutory safety regulations and to do everything possible, according to the circumstances, to prevent injury to persons or damage to equipment.

Using the system

The Lambda Transmitter LT 1 is an O_2 measuring system for continuous measurement of the O_2 concentrations in gases in the super-stoichiometric range in conjunction with the Lambda Probe LS 1.

If the measuring system is to be used for a different purpose and if it is not possible to determine whether the appliance performs correctly in that application, please consult the manufacturer first.

Requirements

It is assumed that the system planning, erection, installation, start-up, maintenance and repair work has been carried out by adequately trained personnel and that this work has been inspected by accountable experts.

Correct handling

In particular, it must be ensured that

- the system is used in accordance with the technical data and specifications regarding the permissible use, installation, connection, ambient and operating conditions (contained in the order documentation, user information, rating plates, etc.) and the documentation supplied with the system
- all operations are carried out taking account of the local, system-specific conditions and with due attention paid to the operating hazards and specifications
- all precautionary measures, e.g. during transportation and storage, as well as maintenance and inspection, must be undertaken to maintain the equipment in a serviceable condition

Qualified personnel

The persons responsible for safety must ensure that

– All work on the system components is performed by qualified personnel. Qualified personnel are persons who, by virtue of their education, training, experience or instruction, and their knowledge of the relevant standards, specifications, accident prevention regulations and properties of the systems, have been authorised by the person(s) responsible for operator and system safety to undertake these activities. It is imperative that these persons are able to detect and avoid possible hazards in good time.

  Specialist personnel are those who fulfil the requirements set out in DIN VDE 0105 or IEC 364 or directly equivalent standards such as DIN 0832.

– The Instruction Manual supplied with the system and the relevant order documentation are available to these persons for all work carried out and these persons comply with this documentation in order to prevent any danger or damage.

User groups

It is assumed that the Lambda Transmitter LT 1 is handled by two groups of users:

A Service technicians from LAMTEC or their OEM customers, or qualified customer personnel:
qualified technicians / engineers with very good knowledge of the system.

B Operators, customer installation personnel, technicians for measuring and control systems, electrical and electronic systems, familiarised with the system.

Electrical equipment hazard

The LT 1 system components are designed for use in industrial, high-voltage power installations. When performing work on connections to the electric power supply or on live parts, always disconnect the power leads. If any contact protection devices are removed, they must be replaced before the power supply is reconnected.

Incorrect use or handling may result in injury or damage. To prevent such injury or damage, always follow the safety instructions.

Preventive measures for improving operating safety

If the LT 1 is used as a sensor in conjunction with an automatic regulation and control system, the operator must ensure that a failure of malfunction of the LT 1 appliance cannot lead to operating conditions which could cause unacceptable damage or danger.

In order to avoid malfunctions which in turn could directly or indirectly cause injury or damage, the operator must ensure that

information can be conveyed to the relevant maintenance personnel as quickly as possible, and at any time

the maintenance personnel is trained to respond correctly to malfunctions of the LT 1 and to associated operational malfunctions

in case of doubt, the defective equipment is switched off immediately

switching off the equipment does not lead to further malfunctions

IMPORTANT!

If there is a danger of the temperature in the gas duct falling below the dew point, the gas extraction device (MEV) and, if necessary, the sintered metal prefilter must be electrically heated.
See 3.4.2, page 35 and 3.4.3, page 36.

Avoiding further damage

In order to avoid further damage as a result of malfunctions of the appliance which, in turn, can cause injury or damage either directly or indirectly, it must be ensured that malfunctions can be assessed and appropriate measures initiated by qualified personnel.

The Lambda Transmitter LT 1 is attached directly to the gas-carrying duct by the probe installation fitting (SEA) and the mating flange. If the Lambda Probe LS 1 or the probe installation fitting (SEA) is removed, the operating system, especially if pressurised, can cause corrosive and/or hot gas to escape from the duct through the flange, causing severe injury to the operator if the operator is unprotected and if appropriate safety precautions have not first been taken.

WARNING!

With pressurised gas, corrosive gases and/or temperatures greater than 200 °C in the gas-carrying duct, gases can escape if the Lambda Probe LS 1 or the probe installation fitting (SEA) is removed.

– Before opening, switch off the installation. If this is not possible, put on protective clothing and masks.

– Place appropriate warning signs in the vicinity of the unit.

– Reseal the opening immediately. Appropriate sealing flanges (blind flanges) are available as accessories.

The Lambda Transmitter LT 1 and the Lambda Probe LS 1 together constitute a sophisticated electronic measuring system. Extreme care must therefore be exercised when shutting down, transporting or storing the appliances.

Shut-down

IMPORTANT!

Do not switch off the Lambda Transmitter LT 1 while the Lambda Probe LS1 is mounted, even if the associated installation has been shut down. Residual gases cause corrosion and can damage system components.

Never store the appliances in the open without suitable protection. Always store in a dry place, preferably using the original packaging.

When removing the unit, protect the cable ends and plugs from dirt and corrosion. Corroded plugs can cause malfunctions.

Wherever possible, the original packaging should be used for transportation.

Restarting

As described in Section 5.2.1, pages 95 - 99 and 5.2.2, pages 100 - 101.

The Lambda Transmitter LT 1 has also been designed with ecological principles in mind. The modules can be easily disassembled, sorted and sent for recycling.

2. Theoretical Principles, Basis of Measurement

The Lambda Probe LS 1 consists, essentially, of a zirconium dioxide solid-electrolyte tube closed at one end, its internal and external surfaces carrying noble-metal coatings as electrodes. In its crystal lattice, the zirconium dioxide solid electrolyte, doped with yttrium oxide or other rare earth-oxides, contains oxygen voids, which permit oxygen-ion conductivity which increases exponentially with temperature. The solid-electrolyte cell, which can be heated by an internal electric heater, is surrounded by a quartz jacket through which a test gas flow is conducted, being kept constant by a diaphragm pump and critical nozzle. To determine the oxygen in the test gas, a d.c. voltage of 0.4 to 1.0 V is applied to the electrodes of the cell at the operating temperature (T $\geq$ 650°C), and the oxygen-ion current flowing through the solid electrolyte is measured with a milliammeter. Under the influence of the applied d.c. voltage, the entire oxygen of the test gas is ionized at the negative outer electrode.

Lambda Probe LS 1
No. 6 50 R 0030...R 0039

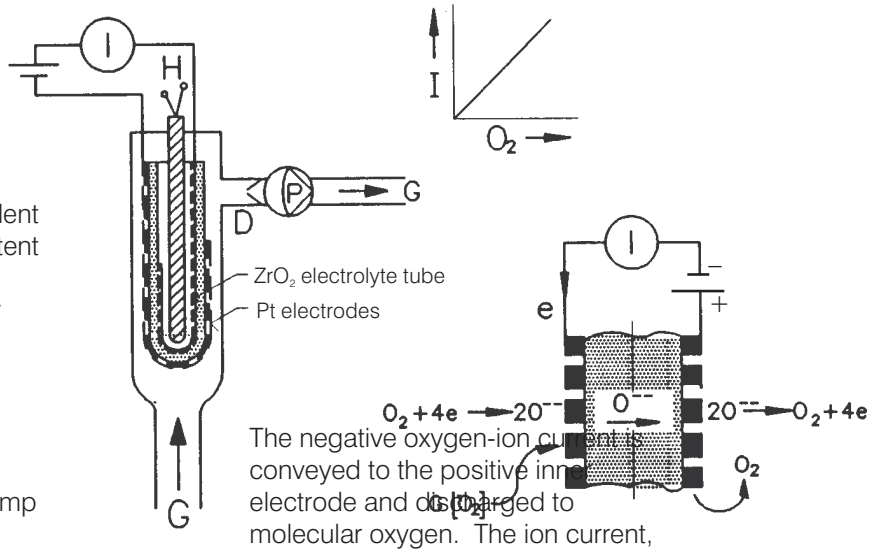
No. 6 50 R 0030...R 0039 M 91-7-0006

which is measured as the probe current signal, is a linear function of the oxygen concentration and of the quantity of test gas conducted through the cell per unit of time.

With the critical nozzle, the diaphragm pump keeps the test gas throughput constant. Consequently, the oxygen concentration is directly proportional to the current signal of the probe.

The proportionality factor and the test gas throughput of the critical nozzle can be determined by calibration with a gas of known oxygen concentration (preferably air with 21% vol.O_2).

Basic construction and functioning of the LAMTEC oxygen probe using the ABB system



I = current dependent on oxygen content

H = electric heater

G = test gas

D = nozzle

P = diaphragm pump

The negative oxygen-ion current is conveyed to the positive inner electrode and discharged to molecular oxygen. The ion current,

2. Theoretical Principles, Basis of Measurement

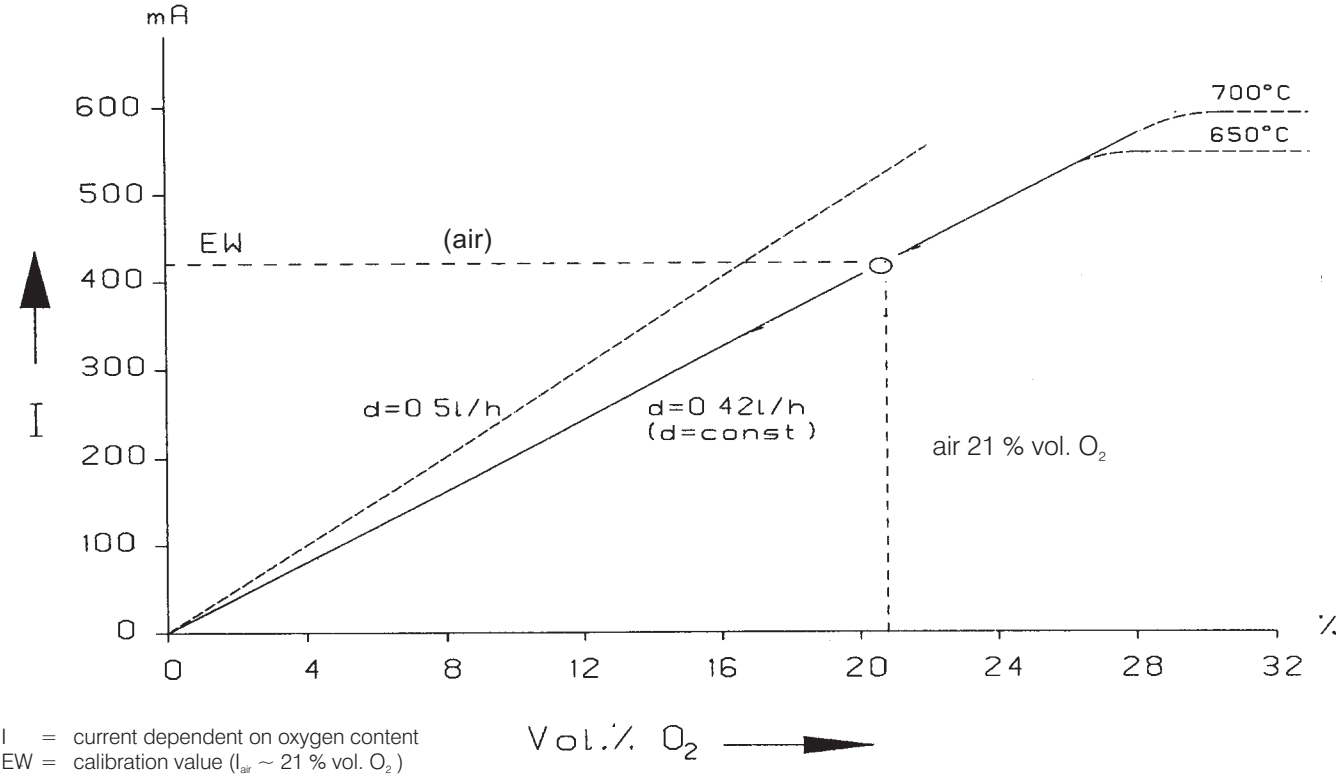
The calibration curve presented below shows that oxygen measurement does not require knowledge of the proportionality factor or test gas flow rate. It is sufficient to assign the oxygen concentration (O_2) = 21 % to the probe current I (air) measured with air, and to draw a straight line through the calibration point thus obtained to the origin (I = 0; (O_2) = 0). In practice, this means that it is easy to adjust or check the calibration of the probe, by assigning to the measured air value 21 ~ 21 % vol. O_2 .

With a suitable cell construction and an appropriate voltage, the linear characteristic of the probe is dependent only on the quantity of test gas determining the slope of the calibration lines (see Fig.).

The temperature of the solid electrolyte and of the electrodes does not affect the probe signal, but it does govern the internal resistance of the probe and its limiting current, and thereby the oxygen concentration range capable of being measured.
The probe temperature does not have to be measured or regulated: it must merely not fall below a critical value, which is dependent on the desired measuring range. For measurement of oxygen concentrations up to 21 % vol. (atmospheric oxygen), for example, the minimum temperature of the probe is 650 °C. The static probe characteristic
I = f (O_2) presented in the diagram shows that the measuring accuracy stays the same, largely independently of the probe temperature and oxygen concentration.

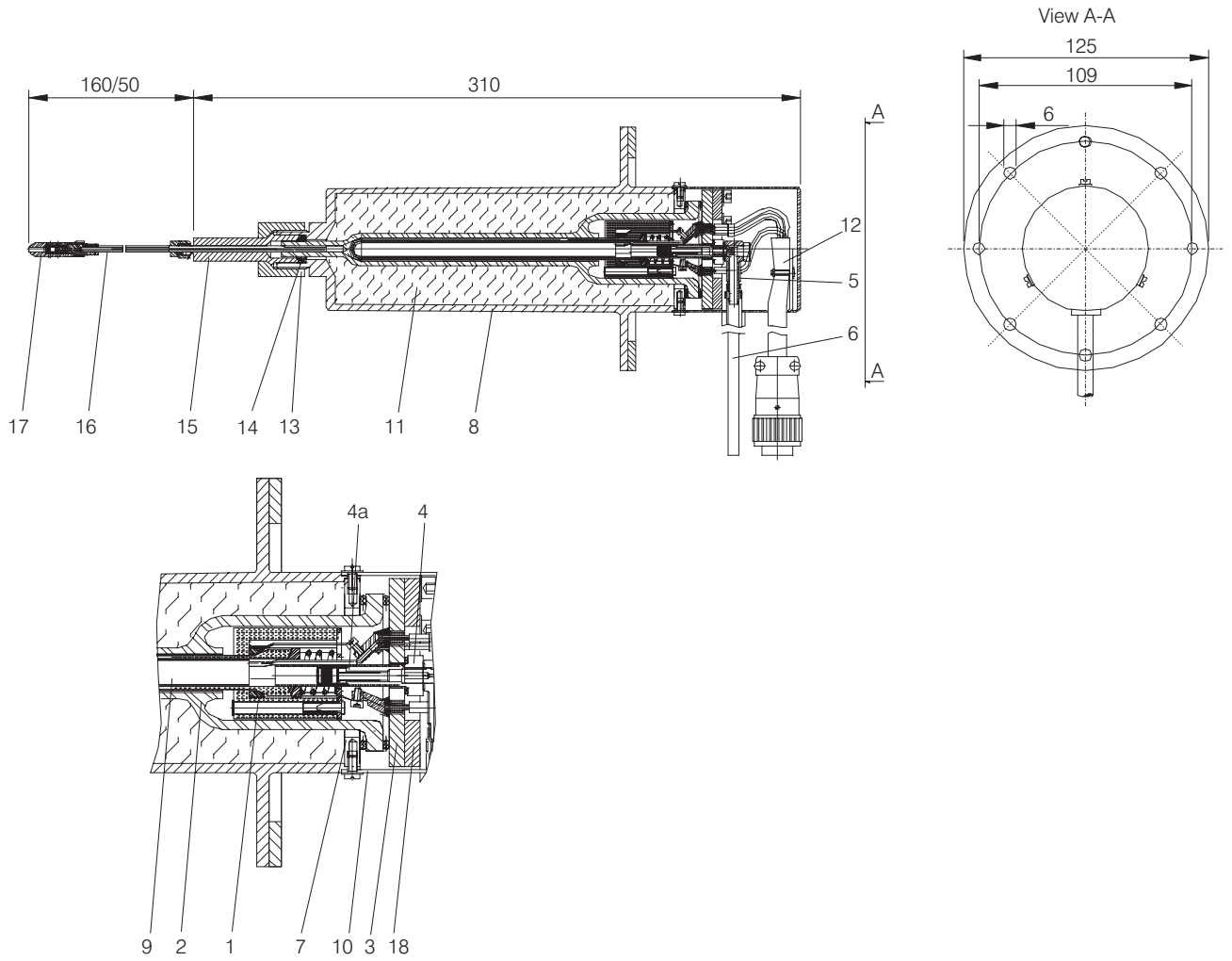
By using a probe voltage proportional to the current and preventing large temperature variations at the critical nozzle, it is possible to achieve a measuring accuracy of better than ±0.2 % vol. of oxygen in waste gases from all common fuels, even without activation of measurement value compensation. Ageing of the probe in protracted service does not affect the measuring accuracy, but merely limits the measuring range. It should, however, be at least 21 % vol. oxygen for checking calibration with air.
The ageing of the probe (measuring cell) can be compensated by adjusting (increasing) the temperature of the measuring cell within a wide range.

Measuring and calibration diagram of oxygen probe. Effect of temperature, ageing and test-gas flow rate on the probe characteristic

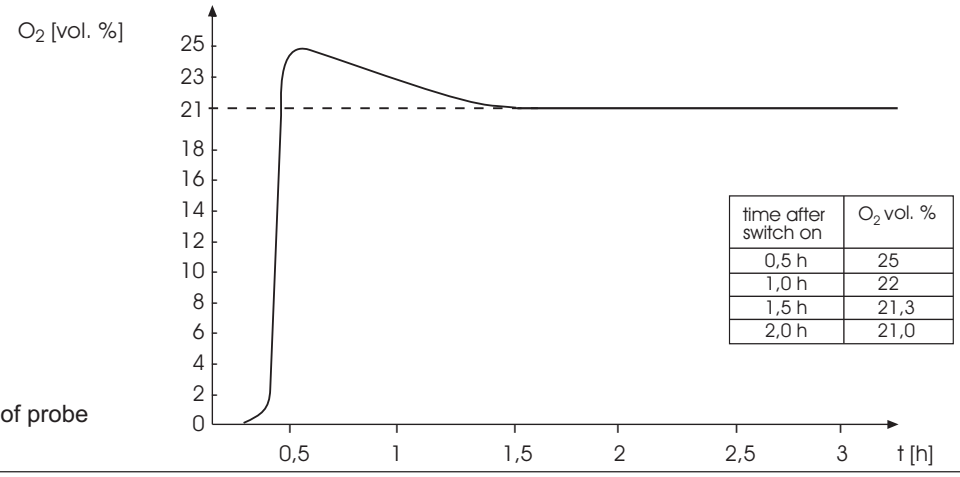


I = current dependent on oxygen content
EW = calibration value (I_{air} ~ 21 % vol. O_2)
d = test gas flow rate

Construction of Lambda Probe LS 1, No. 6 50 R 0030...R 0039



1	Sensor with contact No. 6 50 R 0100	10	Cover No. 6 50 P 0011
2	Quartz glass measuring chamber No. 6 50 P 0001	11	Insulation No. 6 50 P 0014
3	Flange with electrical bushing No. 6 50 R 0201	12	Connecting cable with plug No. 6 50 R 0225
4	Critical nozzle assembly No. 6 50 R 0800	13	Cap nut No. 6 50 P 2004
4a	Critical nozzle No. 6 50 R 0803	14	Graphite seal No. 6 50 P 0008
5	Hose connection No. 6 50 P 7011	15	Probe gas adapter No. 6 50 P 2001
6	Negative-pressure hose No. 6 50 P 0707	16	Gas extraction device (MEV) No. 6 50 R 0022 / 450 mm
7	Flange ring No. 6 50 P 0006	17	Sampling attachment with sintered metal filter No. 6 50 R 0028
8	Housing No. 6 50 R 0300	18	Disc spring No. 6 50 P 0016
9	Heater element No. 6 50 R 0500		



time after switch on	O_2 vol. %
0,5 h	25
1,0 h	22
1,5 h	21,3
2,0 h	21,0

Time-related behaviour of probe after connection to air

Many years of experience of difficult operating conditions, such as burning of industrial waste, incineration of refuse, biogas and sewage gas, has shown that the measuring principle is highly immune to “contamination”, provided that the Lambda Probe LS 1 is set properly.

There is no cross-sensitivity to non-combustible gas components, such as H_2O, N_2, CO_2, NO_X, SO_2, etc. With the simultaneous presence of oxygen, combustible gas components are catalytically burned at the platinum-coated surface of the sensor, which is at approx. 800 °C.

Example: $2CO + O_2 = 2CO_2$
This means that, with 1 % vol. CO in the measured gas, the oxygen indication will be deficient by 0.5 % vol..
For this reason, this measuring principle is unsuitable for measuring oxygen in combustible gases.

NOTE:
The amperometric measuring principle of the Lambda Probe LS 1 produces a virtually linear sensor characteristic. This characteristic passes through the zero point and is defined in its slope by a calibration point. This point is normally obtained by determination of the probe current I_{cal} [mA] in measurement with ambient air with an oxygen concentration $*_{cal} = 20.96$ % vol.. The ideal oxygen concentration $*_{02}$ of any given measured gas is obtained from the measured probe current I according to the formula:

$$*_{02,\ ideal} = *_{cal} \times I / I_{cal} \qquad \text{Eq. (1)}$$

In terms of physical and design factors, the LS 1 probe current depends not only on the oxygen content of the measured gas, but also on the gas temperature T and the gas pressure p before the nozzle, as well as on the mean mol mass M_m and a function of the mean isentropic index F(5) of the measured gas in relation to that in calibration conditions (index “cal”):

$$*_{02} = *_{02,\ ideal} \times p_{cal}/p \times (T/T_{cal})^{1/2} \times (M_m / M_{m,cal})^{1/2} \times F(5)_{cal}/F(5) \qquad \text{Eq. (2)}$$

To compensate these error influences, the Lambda Transmitter LT 1 has the following measured-value corrections:

– temperature compensation, optional
– pressure compensation, optional
– flow compensation

See also 3.5.5, Measured-value compensation, page 43.

The O_2 measurement system, based on the Lambda Transmitter LT 1, consists of the following components. see also drawing on page 25.

- Lambda Probe LS 1
- Gas extraction device (MEV)
- Probe installation fitting (SEA)
- Thermal insulation for LS 1 / SEA
- Lambda Transmitter LT 1 in IP 54 wall-mounting cabinet
- Mating flange for SEA

Optional components

- Indicator and control unit
- Automatic calibration unit for fully automatic checking and calibration of the installed Lambda Probe LS1 for operation of the system with ambient air; alternative using integral pump or compressed air
- Portable calibration device for connection to LT 1
- Test-gas connection (1 ... 4 test gases) for checking the calibration (EPA Standard)
- Pressure compensation of the measured value; pressure range 800...1200 mbar
- [1]Temperature compensation of the measured value
- Electric heating of the gas extraction device (MEV) and of the sintered metal prefilter
- [1]Fine-draught measurement
- [1]Measurement of the temperature of the flue gas and intake air and calculation of the combustion efficiency
- [1]Calculation of the CO_2 concentration, calculated, in relation to the fuel, from the measured O_2 value and the CO_2 max. value
- [1]Load-dependent and fuel-specific limiting values / limit curves
- [1]Combination probe KS 1 for detection of combustible constituents (CO / H_2)

[1] Not possible in OEM version

- [(1)] 1...3 additional analogue outputs, max. 2 potential-free
  (Outputs 1 and 2) max. potential difference ± 20 V
  Range and physical size configurable

- direct current	0/4...20 mA
load impedance	0...600 Ω
- d.c. voltage	0...10V
load impedance	≥ 10 kΩ

- [(1)] Electrically isolated analogue outputs

- [(1)] Up to 2 relay modules for digital outputs with 3 relays (2 changeover contacts) for output of operating, status and limiting-value messages, switching capacity 230 V AC, 4 A

- [(1)] 1 - 4 Analogue inputs for measurement cards, configurable as required, e.g. for connection of temperature sensors, further pressure sensors of the combination probe KS 1, standard signals, etc.; max. 2 of these potential-free, potential difference ±20 V max.

- Serial interface
  RS 232
  RS 422 / 485

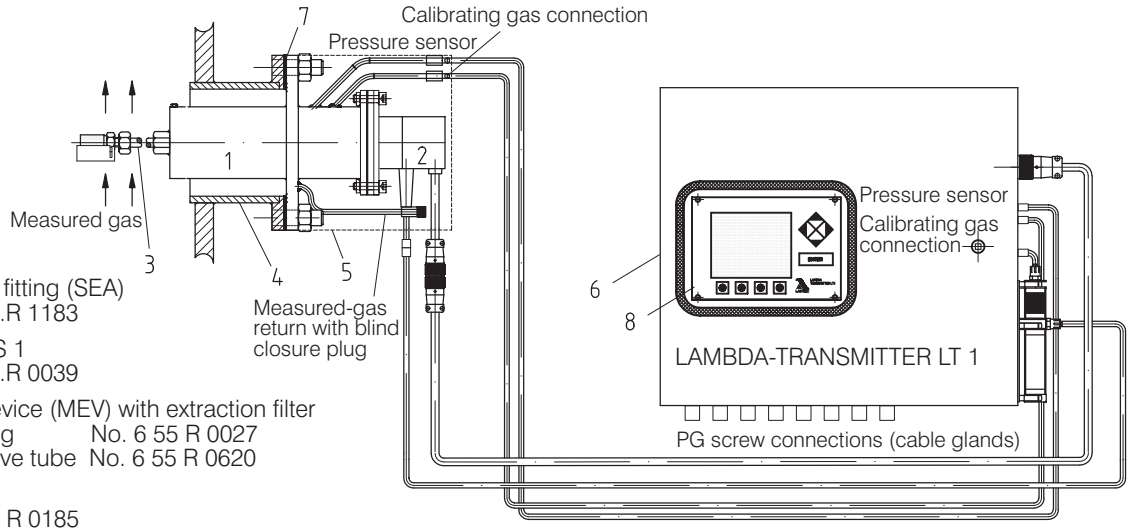
- Bus interface for
  - Profibus DP
  - Interbus S
  - Modbus
  - CANopen

- Remote display software for PC, on Windows platform

- Measured gas pump, 12 V DC, for corrosive measured gases

[(1)] Not possible in OEM version

Basic construction with integral pump and calibration device for under-roof installation



1 Probe installation fitting (SEA)
No. 6 55 R 0083...R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...R 0039

3 Gas extraction device (MEV) with extraction filter
e.g. 1000 mm long No. 6 55 R 0027
matching protective tube No. 6 55 R 0620

4 Mating flange
No. 6 55 R 0183 / R 0185

5 Insulation for LS 1
No. 6 57 P 0100

6 Lambda Transmitter LT 1 with integral measured gas pump and automatic calibration device (option)
No. 6 57 R 0020...R 0025 and 6 57 R 0800

7 Flange seal, BAS green
No. 6 50 P 4209

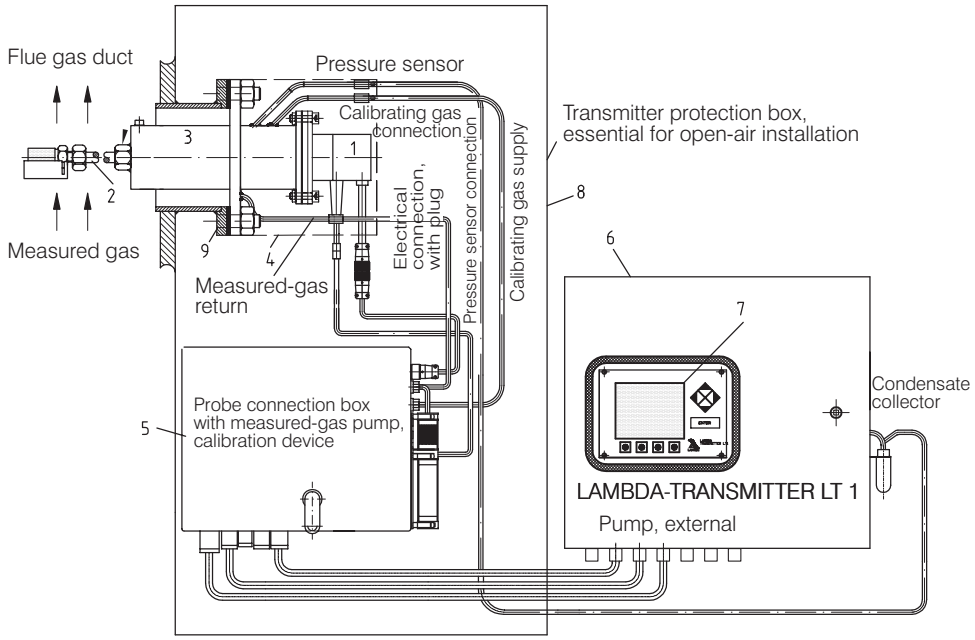
8 Indictor and control unit (option)
No. 6 57 R 0800

If the distance between the Lambda Probe LS 1 and the Lambda Transmitter LT 1 > 10 m, it is recommended to provide a probe connection box (SAK) with the measured-gas pump and, if necessary, with the automatic calibration device (option), close to the probe.

For open-air installation, a transmitter protection box is also necessary for weather protection.
The compact IP 65 version of the LT 1 has been specially developed for open-air installation. See Technical Data - Lambda Transmitter LT 1, Booklet No. D LT 6062.99 a D.

Basic construction of LT 1 / LS 1 with external pump and calibration device

Max. 400 °C
If the temperature of the measured gas is higher, the SEA must be set back further.



1 Lambda Probe LS 1
No. 6 50 R 0031...R 0039

2 Gas extraction device (MEV) with extraction filter e.g. 1000 mm long
No. 6 55 R 0027
matching protective tube
No. 6 55 R 0620

3 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

4 Insulation for LS 1 and SEA
No. 6 57 P 0100

5 Probe connection box (SAK)
No. 6 57 R 0013

6 Lambda Transmitter LT 1, external measured-gas pump
No. 6 57 R 0021 / R 0026

7 Indicator and control unit (option)
No. 6 57 R 0830

8 Transmitter protection box (option)
No. 6 55 R 0087

9 Mating flange
No. 6 55 R 0180 / R 0187

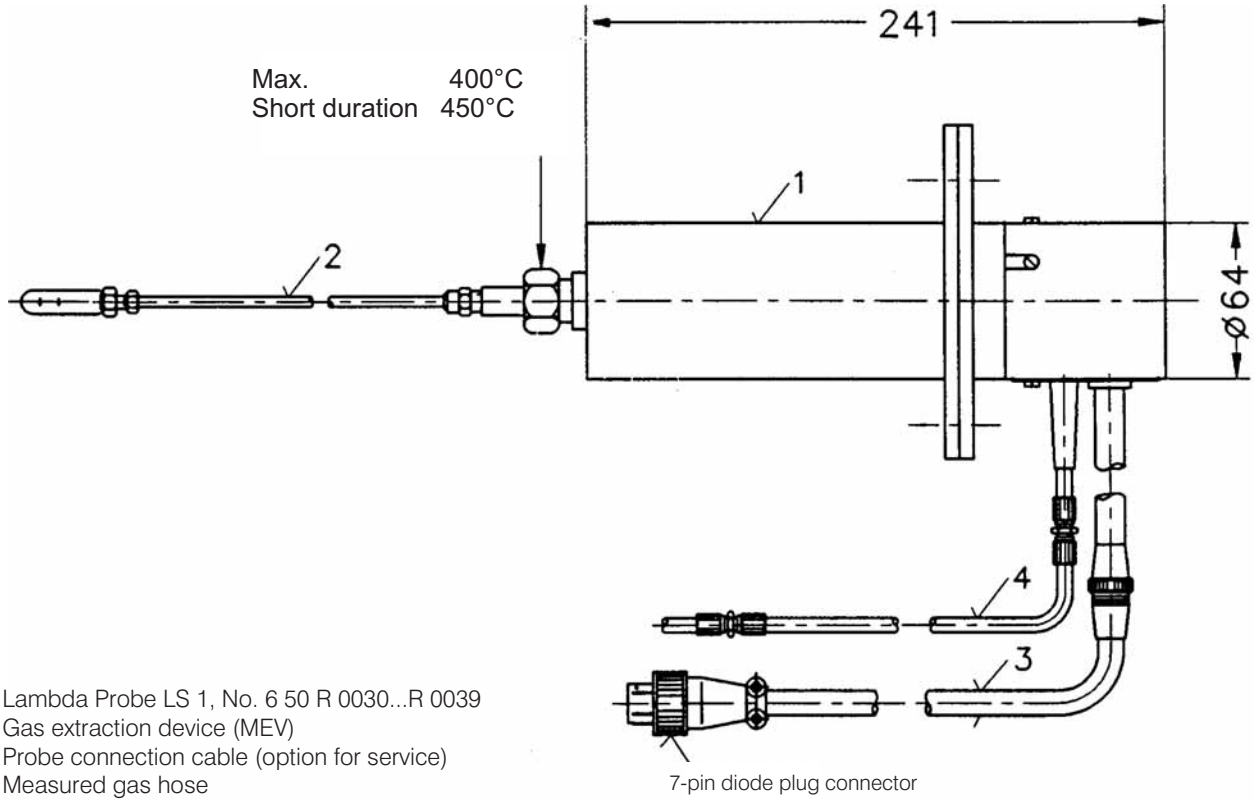
Temperature of measured gas:
> water or acid dew point, up to 800 °C. See 3.3.1, page 28.

Advantages of the ABB measurement principle

- No gas preparation necessary. Measurement effected directly in the moist flue gas
- Linear measurement signal with fixed zero point
- Calibration with ambient air, no special test gases required
- High measured gas accuracy, better than 0.2 % vol. O_2 in the range from 0...21% vol. O_2
- The temperature of the measured gas has no effect on the measurement accuracy, due to the low flow rate of the sample gas (approx. 0.5 l/h) and the location of the actual sensor system outside the waste gas system
- Short response time of the complete system (T_{90}) < 15 seconds with standard extractor 450 mm long
- No reference gas required
- No measuring cell temperature control required
- Low heat output, 70...150 watt, depending on state of ageing of the zircon dioxide measuring cell
- Automatic checking and calibration of the probe with ambient air (option)
- Sensor element outside the flue gas system (chimney), no ignition source in the flue gas duct. German Technical Inspectorate (TÜV) endorsement.
- Temperature of measured gas up to a max. of 800 °C with metal extractor and up to 1700 °C with the ceramic gas extraction device
- Easy to operate
- Plug-in probe connector
- Universal application
- Low-maintenance

The Lambda Probe LS 1 is the measuring sensor. By means of the gas extraction device (MEV), it extracts a small quantity (approx. 0.5 l/h) from the gas which is to be measured. Measurement is effected directly in the probe. The Lambda Probe LS 1 is connected to the electronic unit via a 7-core cable, fitted with a plug connector, and a Teflon hose.

Lambda Probe LS 1, No. 6 50 R 0030...R 0039



1 Lambda Probe LS 1, No. 6 50 R 0030...R 0039
2 Gas extraction device (MEV)
3 Probe connection cable (option for service)
4 Measured gas hose

3.3.1 Temperature of measured gas

The gas extraction device (MEV) is selected primarily on the basis of the temperature of the gas being measured.

Measured gas temperature up to 800°C

Standard MEV

Capillary tube:	Material:	2.4851 (alloy 601)
Sampling attachment:	Material:	1.4762
Sintered metal filter:	Material:	Hastalloy X
Protective tube:	Material:	1.4571 up to 600 °C
	* Material:	2.4610 up to 800 °C (Ni Mo 16 Cr 16 Ti DIN 17744)

* Available on request as optional extra

Measured gas temperature from 800°C to 1700°C:

Ceramic gas extraction device

Capillary tube:	Material $Al_2 O_3$
Protective tube:	Material $Al_2 O_3$
Prefilter:	Material $Al_2 O_3$ Filter gauge 50 μm

Measured gas temperature below 180°C:

The entire length of the MEV (capillary) must be above the dew point (water or acid dew point). This means over 180°C in the case of fuels with a high sulphur content, such as heavy oils and coal, over 80°C for gas and over 120°C for light fuel oils. If this cannot be guaranteed, the MEV must be heated, and if necessary, also the sintered metal prefilter. See 3.4.2 and 3.4.3, pages 35 - 36.

NOTE

High-grade steel is a poor thermal conductor. The use of a MEV protective tube with a core made from a material with good thermal conductivity (aluminium / copper) has proved effective for transmitting heat from the measured gas to colder regions of the gas extraction device, e.g. in the lining. The special MEV protective tube (Order No. 6 55 R 0606...R 0611) should be tried before the MEV is heated electrically. In cases of doubt, it is recommended to consult the manufacturer.

3.3.2 Length

Only make the MEV as long as is absolutely necessary.
Maximum possible MEV length is 2 m.

Important information:

"Core flow measurement", which in some cases is an imposed requirement, is generally superfluous. "Skeins" are extremely rare in practice. According to past experience, they occur:

a) When gases of different temperatures meet; generally entrained air meeting waste gas.
b) With gas speeds of less than 1 m/s (separation). However, if genuine "skeins" do occur, it is extremely difficult, with the insertion depth of the gas extraction device, to find an extraction position that is suitable for all operating conditions. Even the core flow of a genuine skein is not inviolate and it tens to "scatter".

NOTE - Reminder:

Only make the MEV as long as absolutely necessary. Lengths over 1.40 m should be avoided, if necessary surround the SEA with insulation.

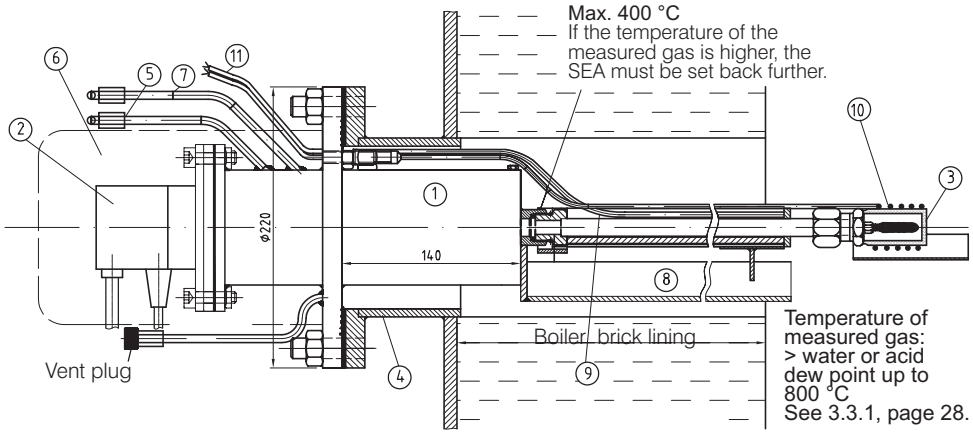
IMPORTANT!

In the case of horizontal installation, it is recommended that the MEV protective tube should be supported for extractor lengths in excess of the following:

Standard:	> 1400 mm
Protective tube with aluminium core:	> 1000 mm
Protective tube with copper core:	> 600 mm

Even where shorter lengths are used, the MEV protective tube should also be supported if there is vibration at the measuring point.

Probe installation fitting No. 6 55 R 0083 / R 1183 with MEV and filter heating and support



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...6 55 R 0039

3 Gas extraction device (MEV) with extraction filter,
e.g. 1000 mm long No. 6 55 R 0027
matching protective tube No. 6 55 R 0620

4 Mating flange
No. 6 55 R 0183 / R 0185

5 Calibrating gas connection

6 Insulation for LS 1 and SEA
No. 6 57 P 0100

7 Pressure sensor connection

8 Protective tube support
No. 6 55 R 0614

9 Protective tube with MEV heater, e.g.
No. 6 55 R 0602 (1000 mm)

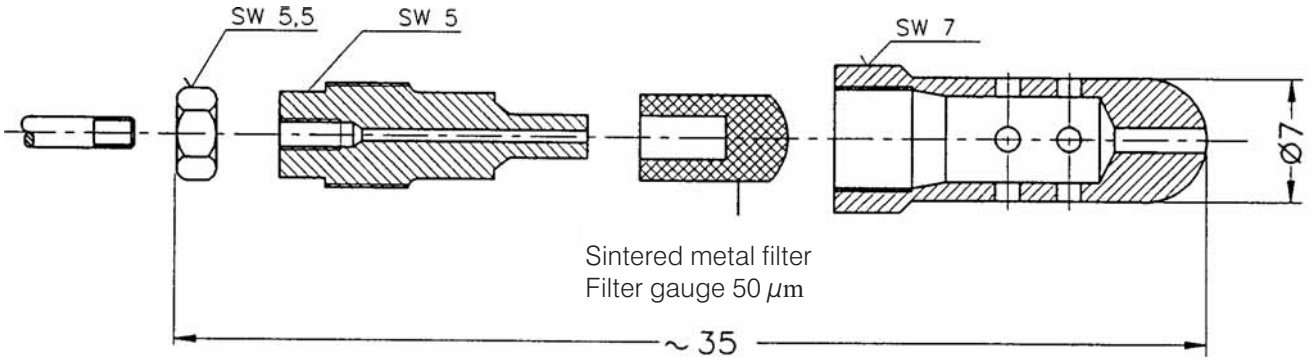
10 Filter heater, e.g.
No. 6 55 R 1092 (1000 mm)

11 Electrical connections for MEV and filter heaters

3.3.3 Sampling attachment

The sampling attachment is located at the “tip” of the gas extraction device (MEV).The function of the sampling attachment is to protect the MEV from coarser particles which could cause a blockage.

Sampling attachment with sintered metal filter No. 6 55 R 0028

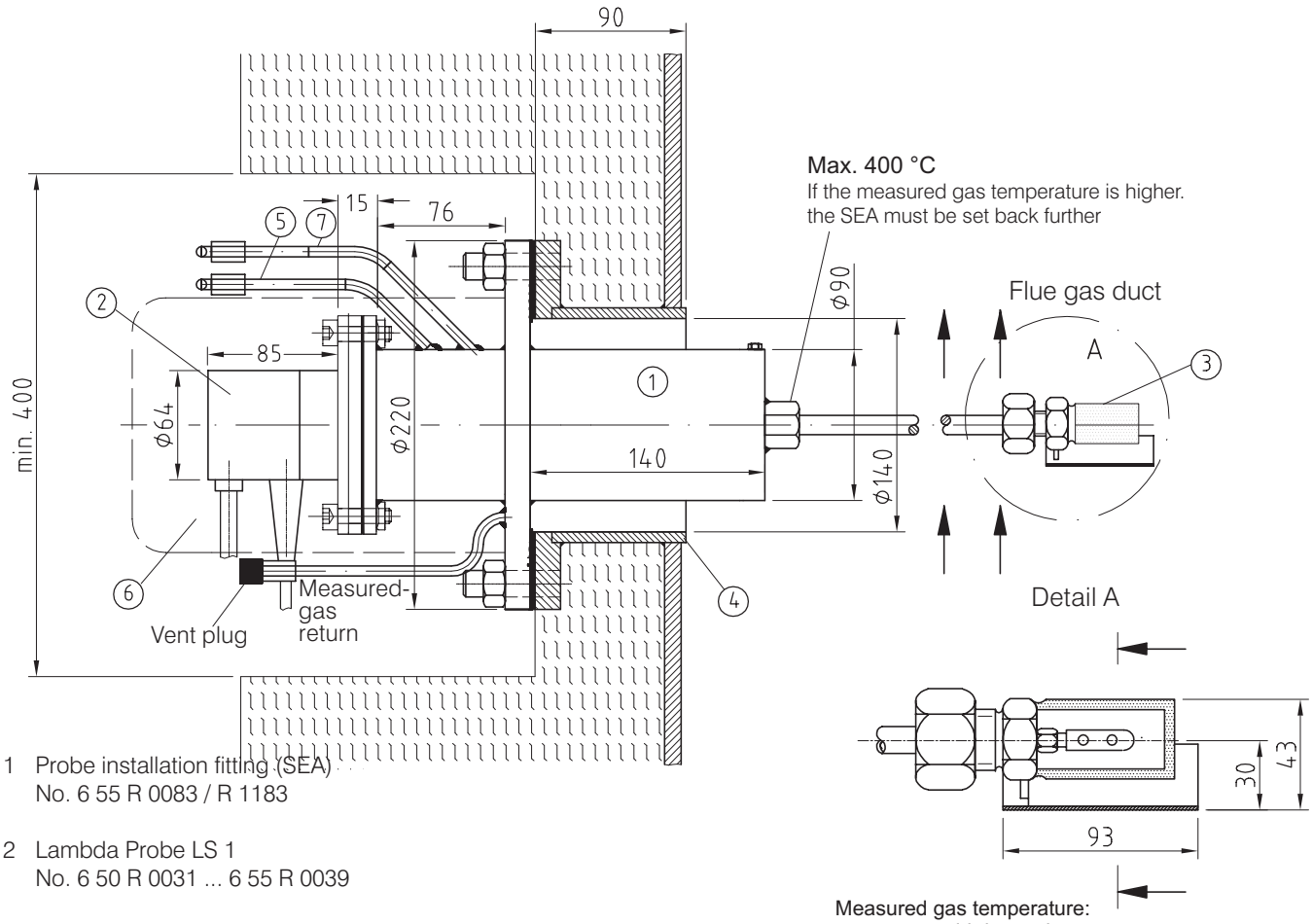


Standard:	Sampling attachment with sintered metal filter No. 6 55 R 0028	
Material:	Casing:	1.4762
	filter:	Hastalloy X

The probe installation fitting performs the following functions:

- Holder for the Lambda Probe LS 1
- Delivery of calibrating gas or ambient air to the extraction point for calibration or checking of the mounted probe
- Heating of the gas extraction device (MEV) when the temperatures of the gases to be measured are below the water or acid dew point, or when the dew point is not attained in the case of walled channels with thick walls (option).

Probe installation fitting (SEA) No. 6 55 R 0083 / R 1183, mounted on flue gas duct



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031 ... 6 55 R 0039

3 Gas extraction device (MEV)
with extractor filter, No. 6 55 R 0027
e.g. 1000 mm long No. 6 55 R 0028

4 Mating flange
No. 6 57 R 0190, galvanized steel
No. 6 57 R 0187, high-grade steel - material 1.4571 (V4A)

5 Calibrating gas connection

6 Insulation for LS 1 and probe installation fitting
No. 6 57 P 0100

7 Pressure sensor connection

In the case of the No. 6 55 R 0083 / R 1183 probe installation fitting, the SEA and the probe are inserted in the flue gas pipe.

This offers the following advantages:

– Shorter gas extraction device
– No temperature drop on the gas extraction device and therefore no deviation below the dew point

Material: Probe installation fitting No. 6 55 R 0083, high-grade steel-material 1.4571 (V4A)
Probe installation fitting No. 6 55 R 1183, galvanized steel

Outside insulation: No. 6 57 P 0100 or, alternatively, 6 55 R 0053 (essential)

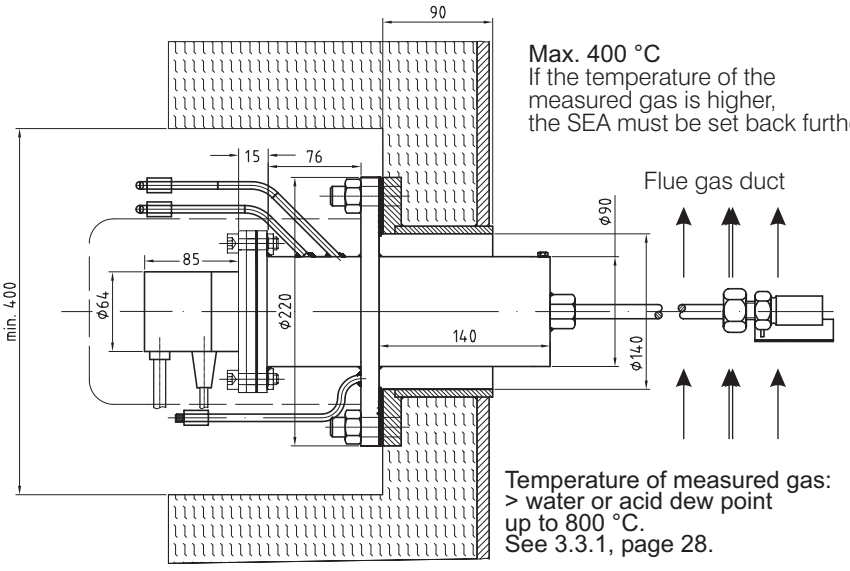
Flue gas temperature: > Dew point up to 800°C (see 3.3.1, page 28)

IMPORTANT:

In the case of flue gas temperatures below the water or acid dew point, the MEV and, if necessary, the sintered metal filter must be must be heated (option). See 3.4.2 page 35 and 3.4.3 page 36.

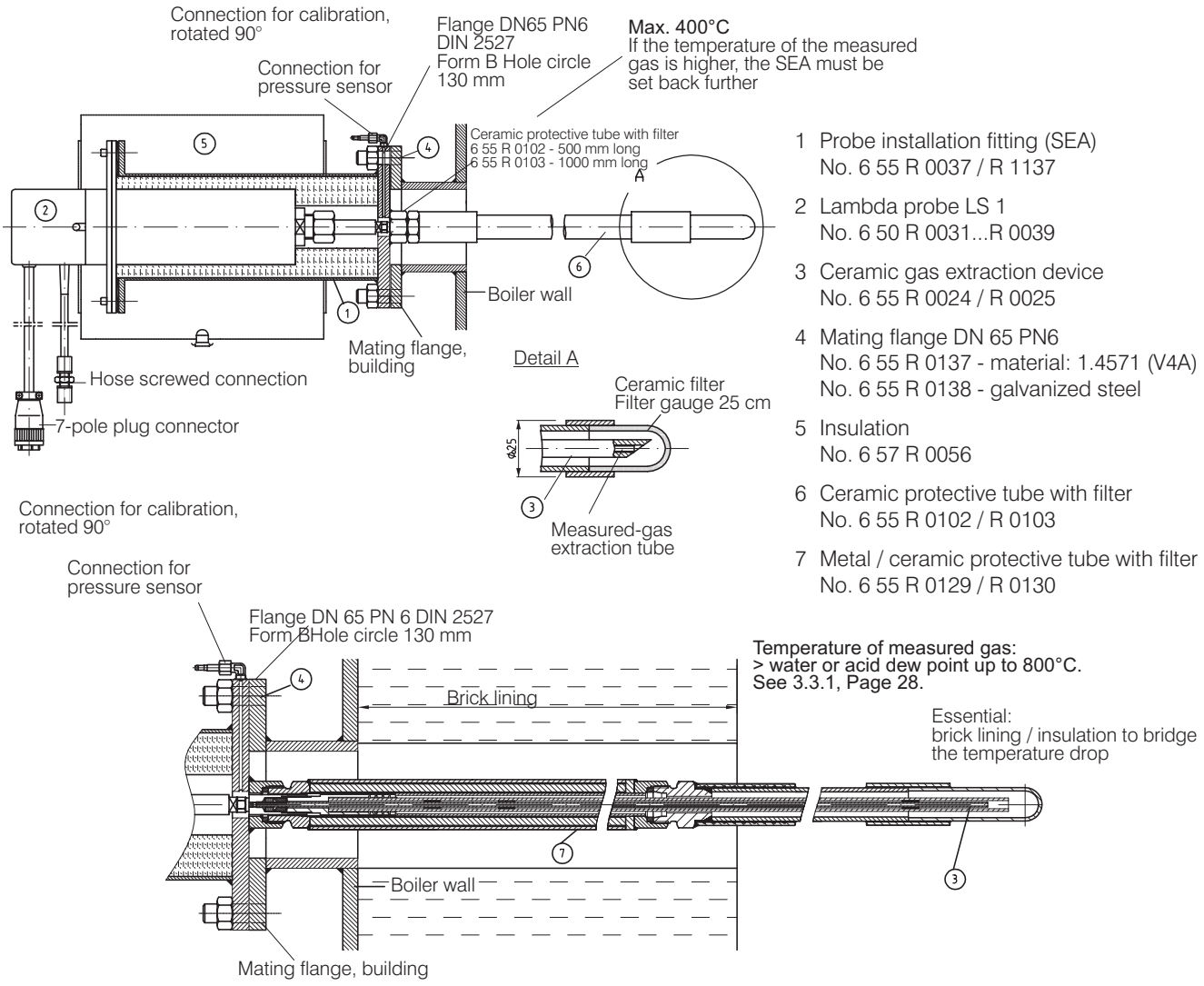
If the gases to be measured have temperatures above 500°C, the SEA must be located so that the temperature of the probe retaining tube does not exceed 400°C.

The compact IP 65 version of the LT 1 must be used for ambient temperatures below + 5°C (see Technical Data - Lambda Transmitter LT 1, Booklet No. D LT 6062.99 aD); alternatively, it is essential to use an electrically heated transmitter protection box. See 3.5.5, page 43.



For measured-gas temperatures of up to 1700°C it is necessary to use the SEA No. 6 55 R 0037 / R 1137 with ceramic protective tube in combination with a ceramic gas extraction device (MEV).

SEA No. 6 55 R 0037 with ceramic protective tube mounted on the flue gas duct



1 Probe installation fitting (SEA)
No. 6 55 R 0037 / R 1137

2 Lambda probe LS 1
No. 6 50 R 0031...R 0039

3 Ceramic gas extraction device
No. 6 55 R 0024 / R 0025

4 Mating flange DN 65 PN6
No. 6 55 R 0137 - material: 1.4571 (V4A)
No. 6 55 R 0138 - galvanized steel

5 Insulation
No. 6 57 R 0056

6 Ceramic protective tube with filter
No. 6 55 R 0102 / R 0103

7 Metal / ceramic protective tube with filter
No. 6 55 R 0129 / R 0130

Material:	Mounting special steel 1.4541; alternatively, electro-galvanized steel Protective tube Al_2O_3
LS 1 Model No.:	No. 6 50 R 0030... R 0039 (gas-tight model)
External insulation:	No. 6 55 R 0056 / R 0057 (essential)
Ambient temperature:	+ 5°C ... + 100°C
Flue gas temperature:	Up to 1700°C
Flange:	DIN 2527, DN 65 PN 6 standard DN 80 and DN 100 upon request
Mounting position:	up to 1400°C, vertical to horizontal; see Fig. under 4.2.1 on page 77 over 1400°C, vertical

3.4.1 Calibrating gas supply

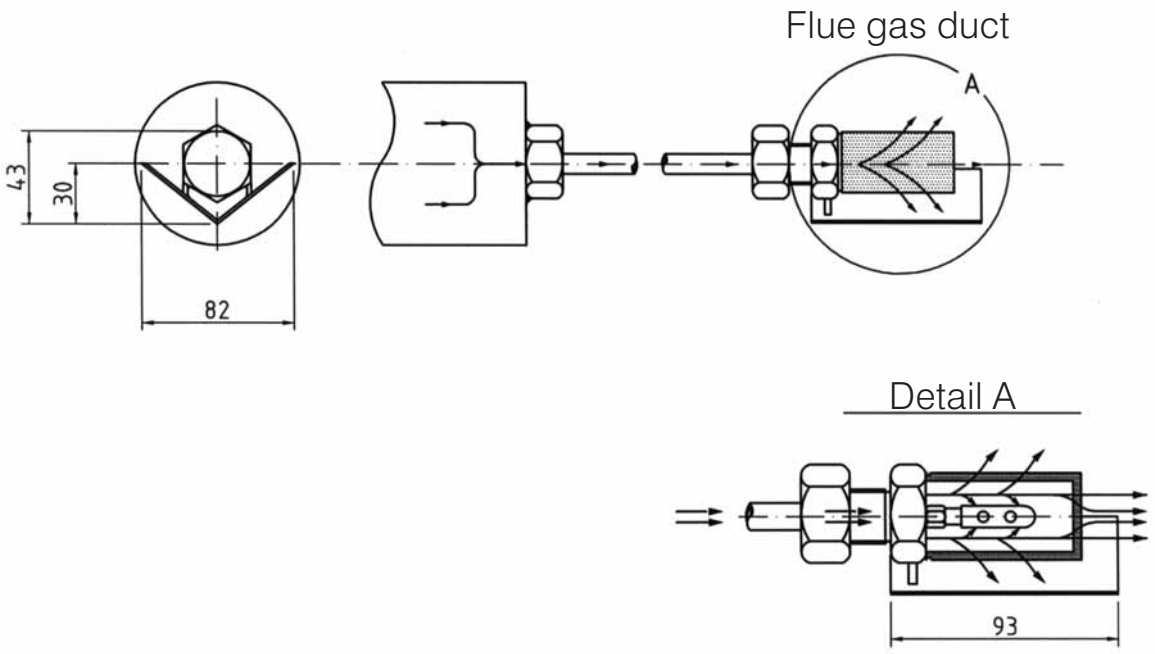
NOTE:

Except where the automatic or portable calibration device (optional) has been purchased with the probe installation fitting, the supply of calibrating gas to the SEA is closed off with a blind plug. The installation must be switched off to calibrate the device. It is also necessary to ensure that there is ambient air present at the measuring point.

For calibration purposes, a calibrating gas, normally air, is blown through the protective tube via the filter into the waste gas. An overpressure of a few (1 - 2) mbar must be developed in the filter for the gas flow to be reversed over the entire area of the filter. If the filter is dirty, the pressure rises sharply for the same flow.

An absolute pressure sensor in the LT 1 senses the pressure in the filter before and during the calibration process and the measured value is corrected accordingly (pressure compensation of the measured value). If the pressure in the filter rises by more than 50 mbar (parameter 276) during calibration, the warning “sintered metal prefilter dirty” is signalled. The pressure increase at the last check / calibration can be read on parameter 50.

Calibrating gas supply



Sintered metal prefilter, No. 6 55 R 0212

By virtue of its size, the filter is relatively immune to dirt. Even if only a small portion of its area stays clean, this will still be sufficient for the gas flow rate (~ 0.5 l/h) required for measurement.

NOTE:

If the waste gas is highly contaminated, it is advisable to use compressed air for the calibrating gas supply instead of the pump. Due to its higher pressure, the compressed air offers the possibility of blasting the filter clean. A special calibrating device with a “blast-cleaning” option is available on request.

The compressed air supply with maintenance unit and pressure reducer are to be provided by the customer.

Required calibrating gas flow rate (compressed air):	1 Nm^3/h for short duration
Max. admission pressure:	2 bar
	1 bar for ceramic version
	7 bar for “blast-cleaning” option

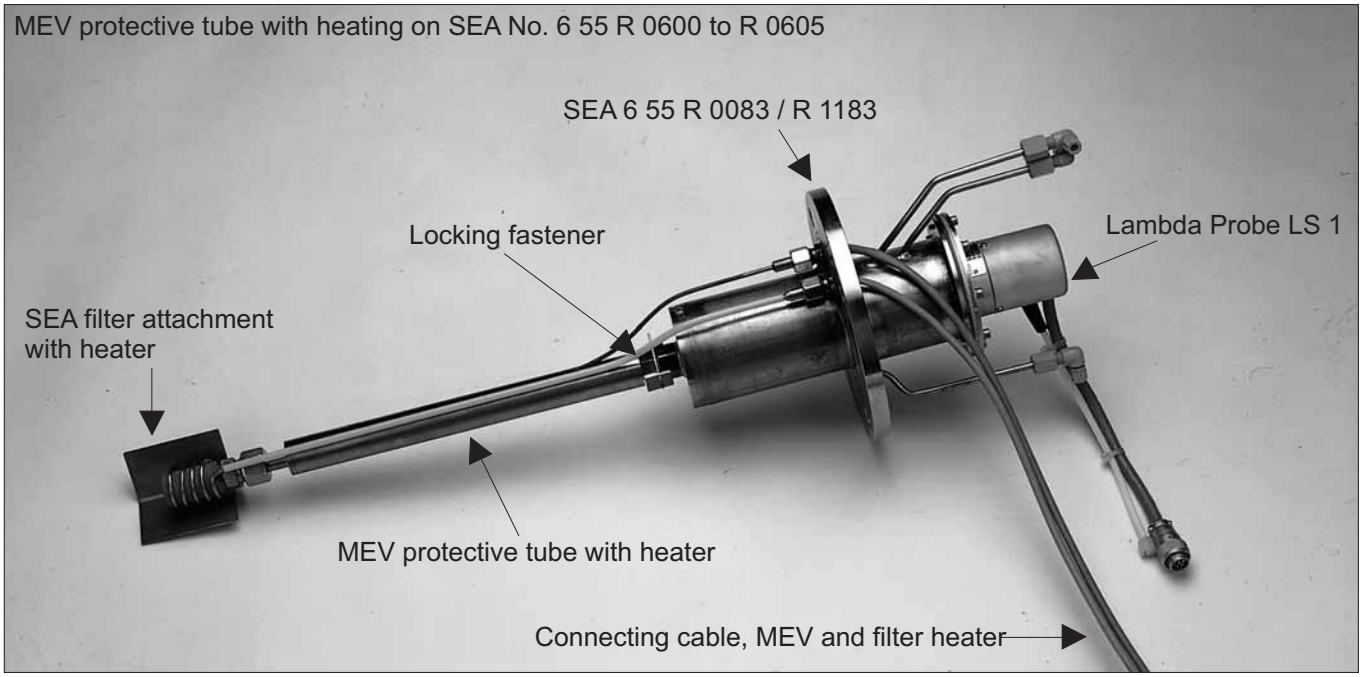
For safety reasons, two solenoid valves are connected back-to-back to shut off the compressed air supply. The valve on the probe side is thus always pressureless on the intake side.
An automatic calibration device using compressed air is in the course of development.

3.4.2 Gas extraction device (MEV) heating

This is absolutely essential where the gases which are to be measured have temperatures below the water or acid dew point or if the probe is passed through thick-walled chimneys where there is a risk of deviation below the dew point in the capillary.

MEV protective tube with heating	450 mm long	No. 6 55 R 0600
	1000 mm long	No. 6 55 R 0602
	1400 mm long	No. 6 55 R 0604

MEV protective tube with heating on SEA No. 6 55 R 0600 to R 0605

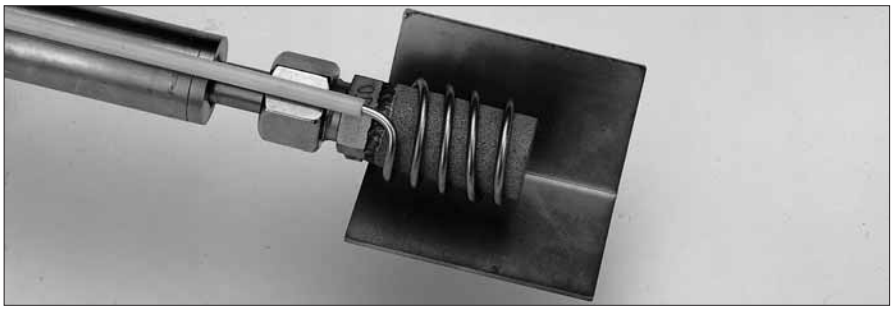


Additionally required: Power supply unit for MEV and SEA filter heater, adjustable heat output, mounted in LT 1 No. 6 57 R 0820, see 3.6.8, page 63 - 64.

3.4.3 Heating of the sintered metal filter attachment

This is absolutely essential where gases to be measured have Temperatures below the dew point.

Heating for SEA filter attachment	450 mm long	No. 6 55 R 1091
	1000 mm long	No. 6 55 R 1092
	1400 mm long	No. 6 55 R 1093



Additionally required:

Power supply unit for MEV and SEA filter heater, adjustable heat output, mounted in LT 1 No. 6 57 R 0820, see 3.6.8, page 63 - 64.

3.4.4 MEV protective tube with Cu / Al core

In many cases, electrical heating is not necessary to prevent temperatures falling below the dew point when the probe is passed through wall linings, insulations, etc.
The protective tube with the copper or aluminium core distributes the heat of the measured gas evenly over the full length of the gas extraction device.

MEV with copper core, without heating	No. 6 55 R 0606...R 0611
MEV with aluminium core, without heating	No. 6 55 R 1606...R 1611

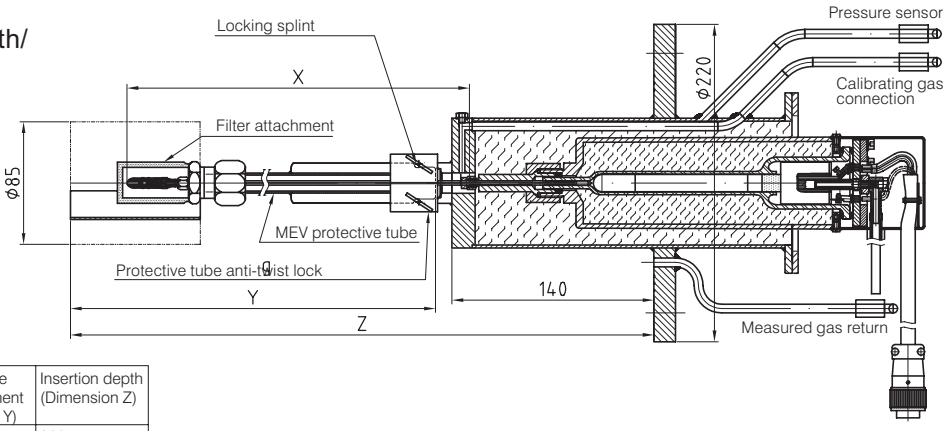
IMPORTANT!

In the case of horizontal installation, it is recommended that the MEV protective tube with the copper or aluminium core should be supported for lengths in excess of the following:

Protective tube with copper core:	>	600 mm
Protective tube with aluminium core:	>	1000 mm

Even where shorter lengths are used, the MEV protective tube should also be supported if there is vibration at the measuring point.

3.4.5 MEV protective tube length/ Insertion depth SEA



Filter attachment Filter gauge	Article No.
40 µm	655 R 0210
20 µm	655 R 0209
10 µm	655 R 0211
2 µm	655 R 0208

MEV Length (Dimension X)	Article No MEV	MEV protective tube without filter attchment Length (Dimension Y)	Insertion depth (Dimension Z)
50	655 R 0090	105	260
250	655 R 0120	267	420
350	655 R 0026	367	520
450	655 R 0022	467	620
800	655 R 0030	817	970
1000	655 R 0027	1017	1170
1200	655 R 0122	1217	1370
1400	655 R 0123	1417	1570
1800	655 R 0124	1817	1970
Special Length	655 R 0023		

3.4.5.1 Mating flange

3.4.5.2 For SEA
No. 6 55 R 0083 / R 1183

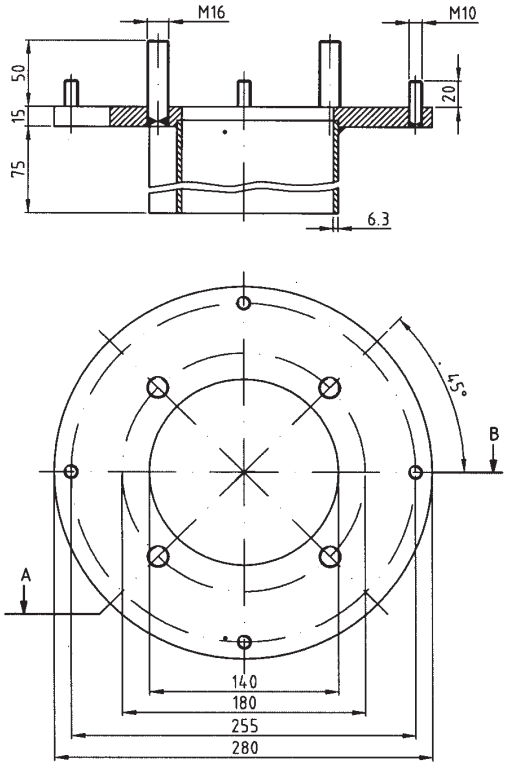
3.4.5.2.1 With retainer for
the transmitter protection box
No. 6 55 R 0187 / R 0190

Material:
6 55 R 0187 special steel 1.4571 (V4A)

6 55 R 0190 steel, electro-galvanized
or painted black

Dimensional diagram: mating flange 6 55 R 0187 / R 0190

Section A-B



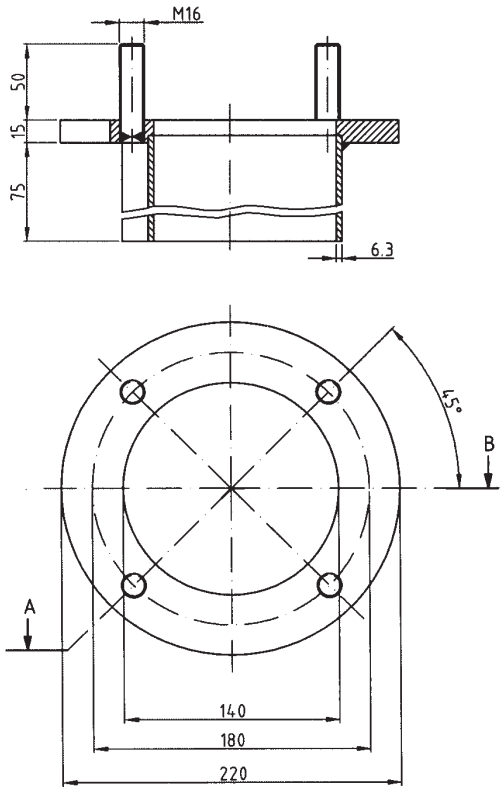
3.4.5.2.2 Without retainer for
the transmitter protection box
No. 6 55 R 0183 / R 0185

Material:
6 55 R 0183 special steel 1.4571 (V4A)
(on request)

6 55 R 0185 steel, electro-galvanized
or painted black

Dimensional diagram: mating flange 6 55 R 0183 / R 0185

Section A-B

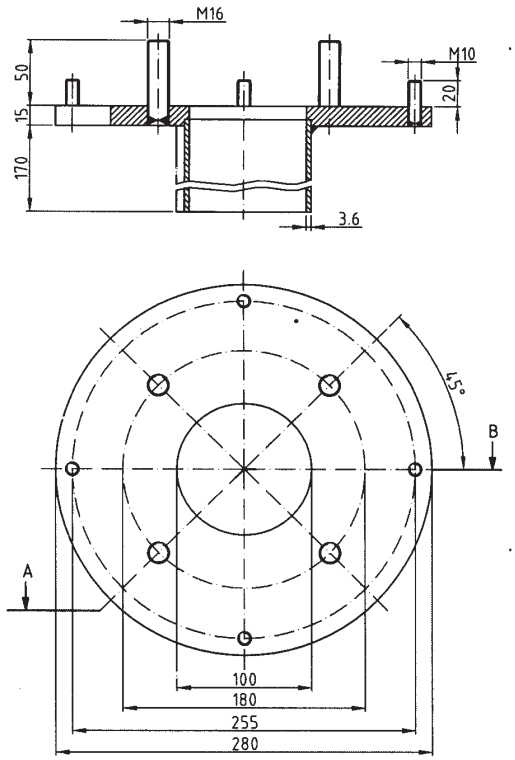


3.4.5.2.3 For small tube diameter (on request)

Do not use for SEA with MEV heating

Dimensional diagram: mating flange 6 55 R 0195

Section A-B



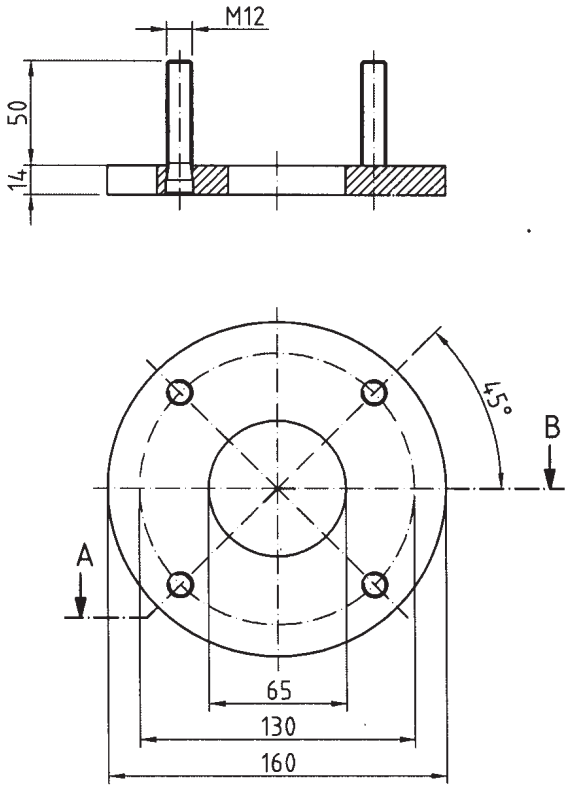
3.4.5.3 For SEA No. 6 55 R 0037 / R 1137

3.4.5.3.1 Without retainer for the transmitter protection box No. 6 55 R 0137 / R 0138

Material:
6 55 R 0137 special steel 1.4571 (V4A)
6 55 R 0138 steel, electro-galvanized or painted black

Dimensional diagram: mating flange 6 55 R 0137 / R 0138

Section A-B



3.4.5.3.2 With retainer for the transmitter protection box
No. 6 55 R 0196 / R 0197

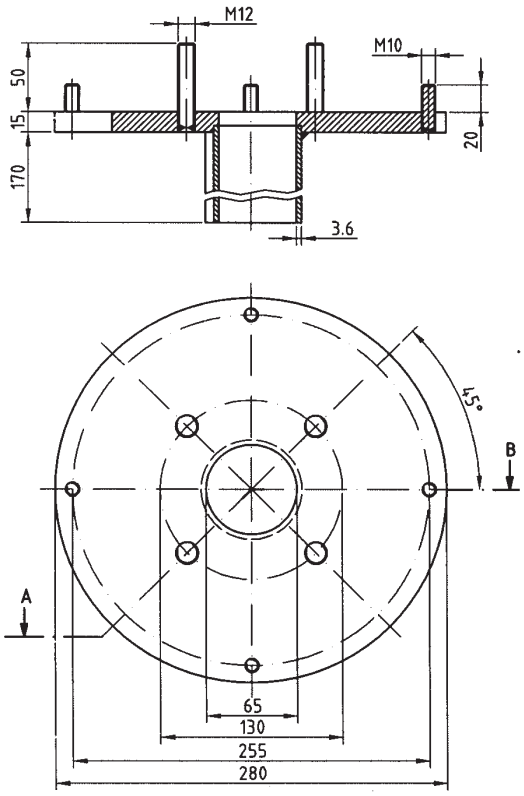
For SEA
No. 6 55 R 0037 / R 1137

Material:
6 55 R 0196 steel, electro-galvanized or painted black

6 55 R 0197 special steel 1.4571 (V4A)

Dimensional diagram: mating flange 6 55 R 0196 / R 0197

Section A-B



3.5.1 SAK with measured-gas pump and calibration device No. 6 57 R 0013 / 0015

(Only in combination with LT 1 - external measured-gas pump No. 6 57 R 0021 and R 0026)

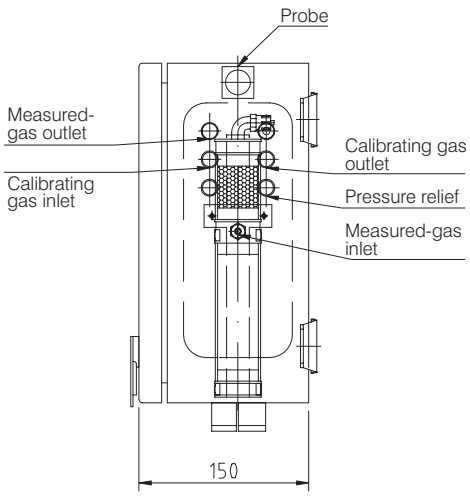
To be used for greater distances (>10 m cable length) between Lambda Probe LS 1 and Lambda Transmitter LT 1.

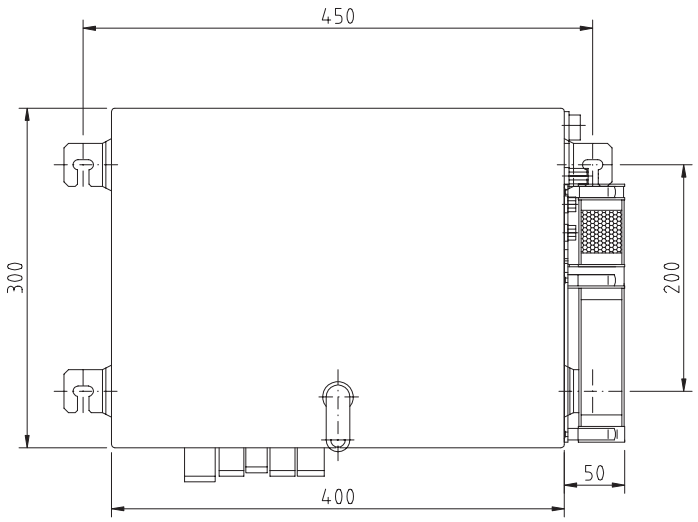
Intake: probe connector plug
Outlet: terminal strip

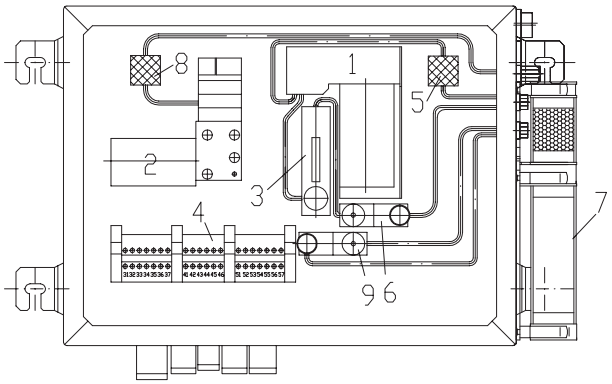
The SAK comprises the measured-gas pump and a calibration unit consisting of a calibration pump, flow meter and solenoid valve.

A probe connection box (SAK) with additional pressure relief during calibration is available as a variant, No. 6 57 R 0015. This is essential for use in combination with a ceramic gas extraction device (MEV).
The "pressure relief" solenoid valve opens 30 seconds after the start of calibration and ensures than an excessively high measured-gas pressure during calibration does not adversely affect the accuracy of the calibration.

Probe connection box with measured-gas pump, calibration device and pressure relief, protection class IP54
No. 6 57 R 0015

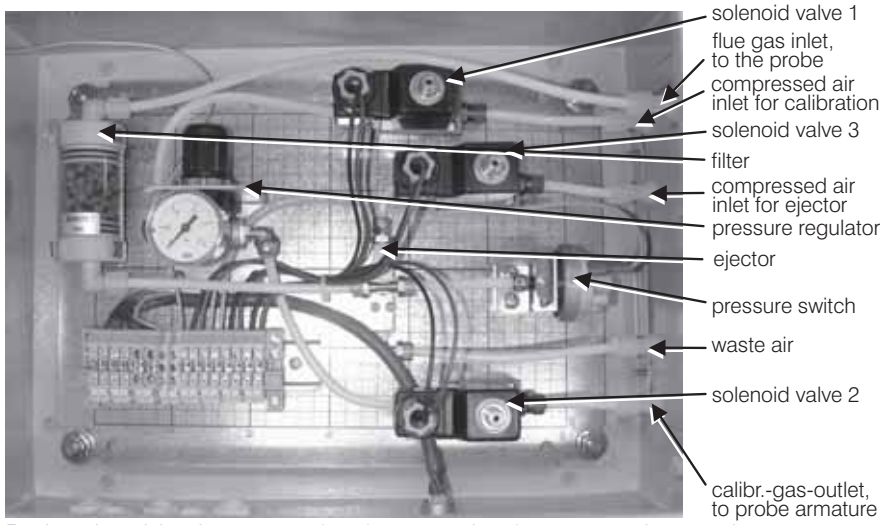






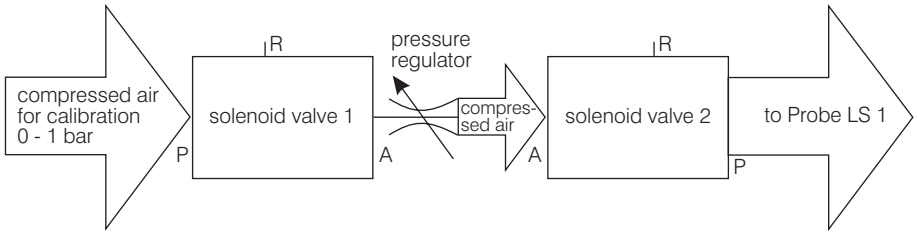
1 Calibrating gas pump
2 Measured-gas pump
3 Flow meter (setting 400 Nl/h)
4 Terminal strip
5 Pump protection filter
6 Solenoid valve, calibrating gas supply
7 Condensate collector
8 Pump or acid protection filter for measured-gas pump corrosive measured gases
9 Solenoid valve, pressure relief (only for No. 6 57 R 0015)

5.2 Probe-Connection-Box
with Ejector-Flue-Gas-Pump and
Calibration-Unit operating by
compressed air,
Type 657 R 0010



Calibration function principle:

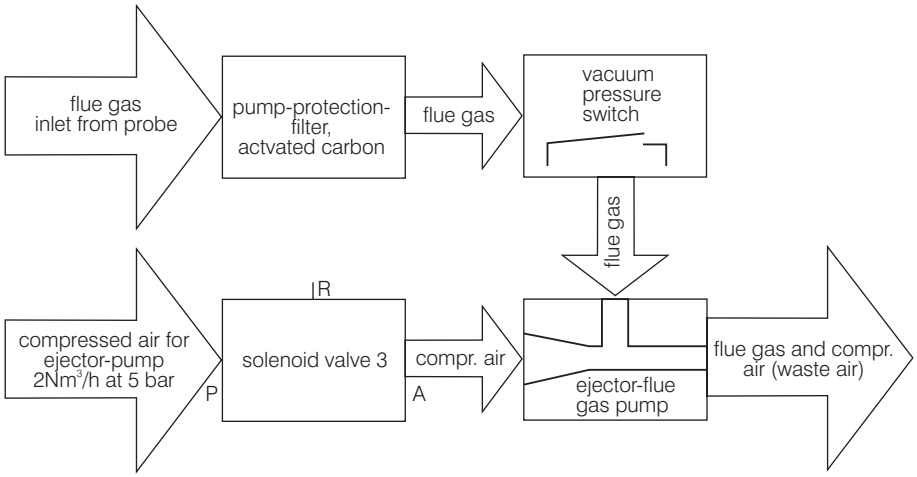
Both solenoid valves no. 1 & 2 (3-way valves) are turned on and opens during calibration. The air volume (ca. 500 l/h) can be set by the internal pressure regulator (0-1bar), the air flow is to adjust for a > 1 mbar higher pressure than the atmospheric-/stack-pressure is indicated on the display of the LT 1 oxigen transmitter. The pressure inside the LS 1 mounting armature corresponding to the atmospheric- or stack-pressure is measured by a pressure sensor for a pressure-compensating-calculation.
These 3-way solenoid valves are installed against each other, that under measuring mode operation for safety reasons between these valves always atmospheric pressure exists, see the pneumatic diagram.



Flue gas intake principle:

The solenoid valve no. 3 is turned on, compressed air flows through the ejector. The air flow generates an absolute pressure of 0,5 bar, which is required for LAMTEC's measurement principle. The vacuum-pressure-switch supervise, that the absolute pressure ≧ 0,5 bar exists (contact is closed). Compressed air and flue gas together are flowing through the waste air outlet into the outsite.

Compressed air >5 bar at inlet
Air consumption ca. 2 Nm^3/h at 5 bar pressure
Compressed air connection with pressure regulator 0 -10 bar, water separation and filter, provided onsite plant



3.5.3 SAK without calibration device

All probe connection boxes (SAKs) mentioned in 3.5.1 to 3.5.2, page 40/41, are available without a calibration device.

Details:

SAK with measured-gas pump	No. 6 57 R 0014
SAK with ejector measured-gas pump	No. 6 57 R 0017 / R 0018

In wall-mounting cabinet IP 54 300 x 300 x 150 (H x W x D) mm.

Electrical connection is identical, except that there are no connections for the calibration device.

3.5.4 Test-gas connection option No. 6 57 R 0810 / R 0811

The test-gas connection option is available for all SAKs with a calibration device. See 3.6.4.1, page 55.

3.5.5 Open-air measurement point

3.5.5.1 Transmitter protection box

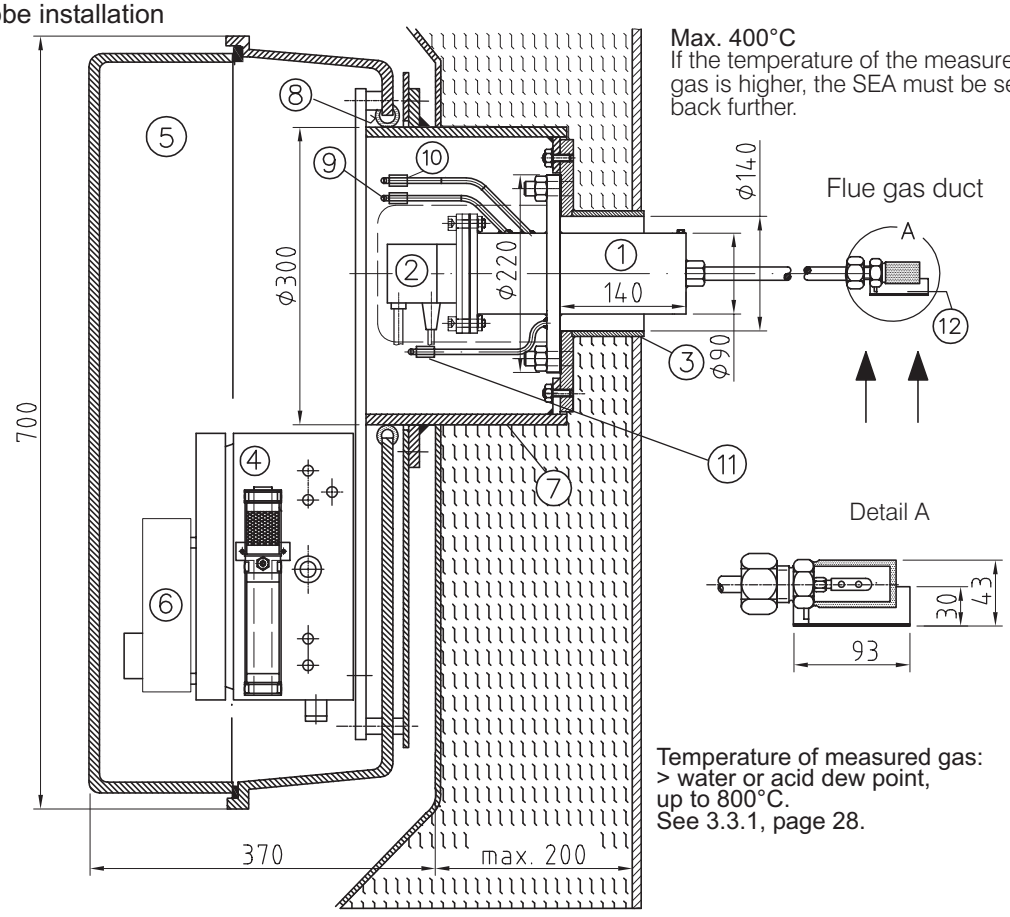
The box protects the probe, measured-gas line and probe connection box from weather exposure (rain, frost) when fitted in the open air. Comprises 250 watt electrical heating with a factory-fitted adjustable thermostat on the cover of the SAK.

NOTE:

The compact IP 65 version of the LT 1, No. 6 57 R 0000...R 0009, has been specially developed for open-air probe installation. See Technical Data - Lambda Transmitter LT 1, Booklet No. D LT 6062.99 aD.

The transmitter protection box is used only if the Lambda Transmitter LT 1, together with the indicator and control unit, is to be installed away from the measurement point or if the ambient flue gas temperature does not allow installation of the compact version of the LT 1.

Open-air probe installation



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...R 0039

3 Mating flange
No. 6 55 R 0187 special steel - material 1.4571 (V4A)
No. 6 55 R 0190 galvanized steel

4 Probe connection box (SAK)
No. 6 57 R 0013

5 Transmitter protection box
No. 6 55 R 0087

6 Electrical heating (frost protection) included in
No. 6 55 R 0087

7 Mounting for transmitter protection box included in
No. 6 55 R 0087.

8 Sealing profile
No. 6 55 P 8705

9 Calibrating gas connection

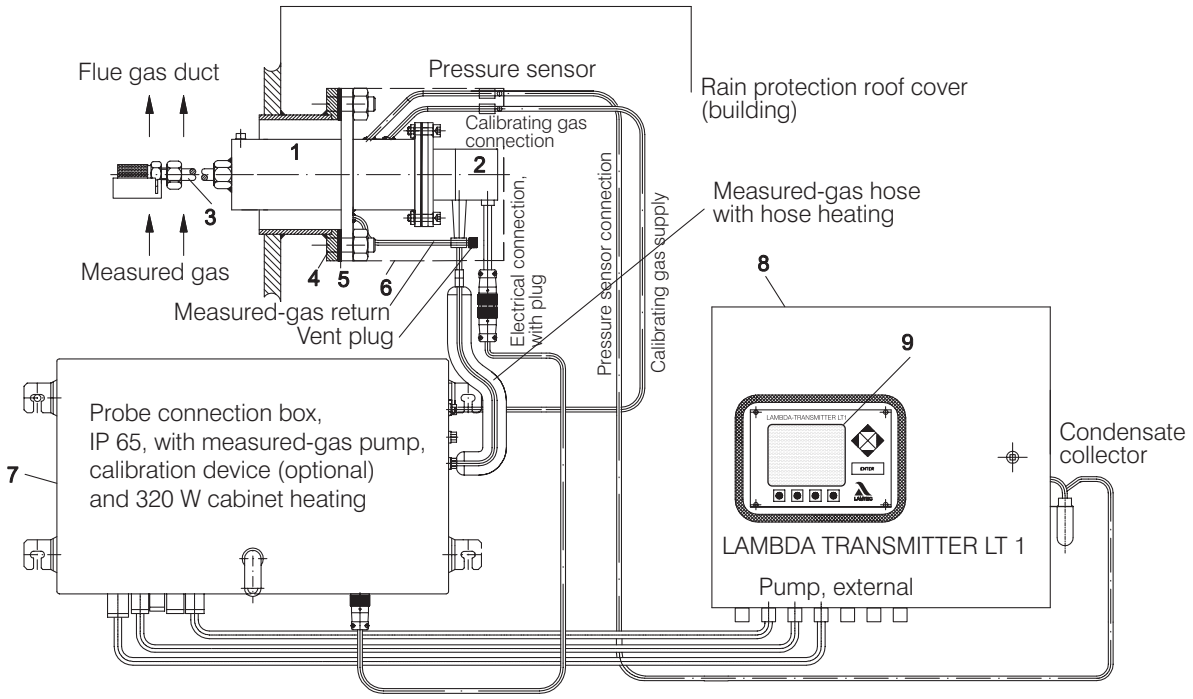
10 Connection for pressure sensor for filter monitoring

11 Flue gas pump outlet, feedback to stack

12 Baffle plate

3.5.5.2 Probe connection box (SAK) with power supply unit for measured-gas heater No. 6 57 R 0030

As an alternative to the transmitter protection box, it is possible to use a heated probe connection box with a power supply unit to heat the measured-gas hose.
See diagram.



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda probe LS 1
No. 6 55 R 0034 (essential)

3 Gas extraction device (MEV) with extraction filter
e.g. 1000 mm long No. 6 55 R 0027
matching protective tube No. 6 55 R 0620

4 Mating flange
No. 6 55 R 0183 / R 0185

5 Flange seal, BAS green
No. 6 55 P 4027

6 External insulation for SEA
No. 6 55 R 0053

7 Probe connection box (SAK)
No. 6 55 R 0030

8 LT 1, wall-mounting cabinet
No. 6 55 R 0021 / R 0026

9 Indicator and control unit (optional)

IMPORTANT!

The measurement point must be protected against direct contact with water by means of an appropriately dimensioned rain protection roof cover.

The Lambda Transmitter LT 1 has a protection class of IP 54 only. It cannot therefore be mounted outdoors.

3.6.1 Basic appliance

Intelligent microprocessor-based interface.
It contains all the components necessary for operation of the Lambda Probe LS 1 and for evaluation of the measurement signal.

Lambda Transmitter LT 1
No. 6 57 R 0020...R 0029

with indicator and control unit
No. 6 57 R 0830 (option)

Lambda Transmitter LT 1
No. 6 57 R 0025

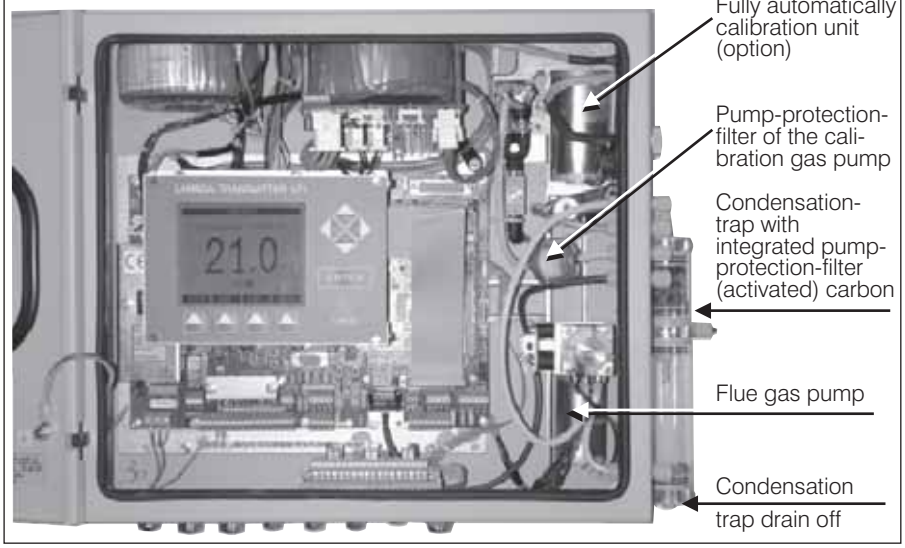
with optional indicator and control unit
No. 6 57 R 0830

and

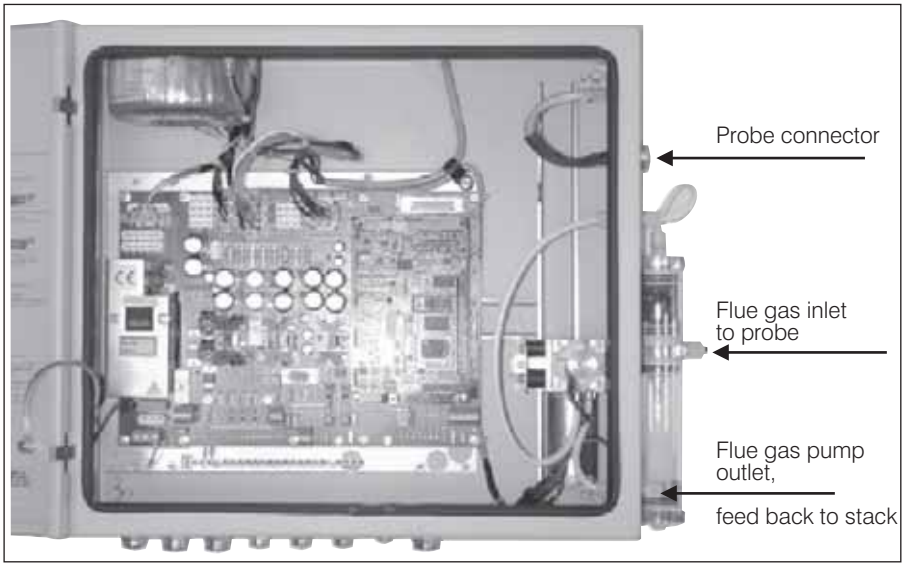
fully automatic calibration unit
No. 6 57 R 0800

and

power supply for flue gas intake (MEV) and pre-filter-heating
type 6 57 R 0820



Lambda Transmitter LT 1 - OEM model
No. 6 57 R 0020

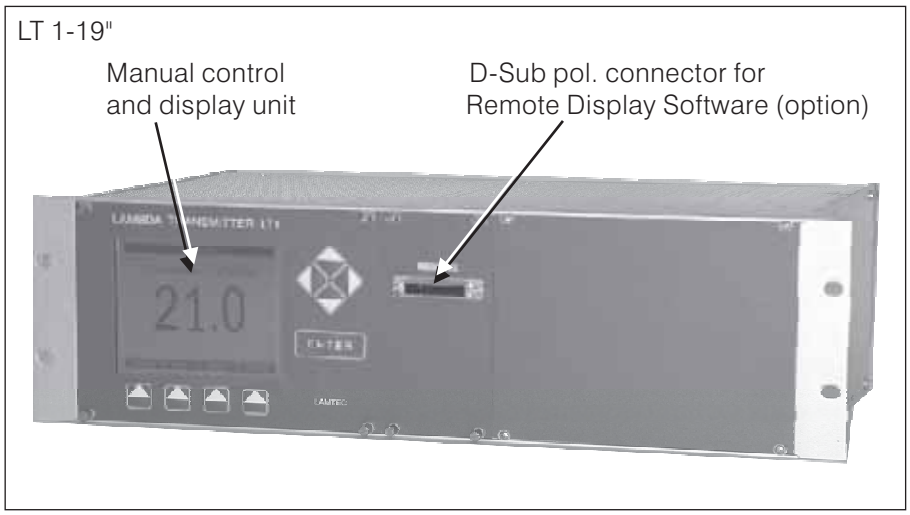


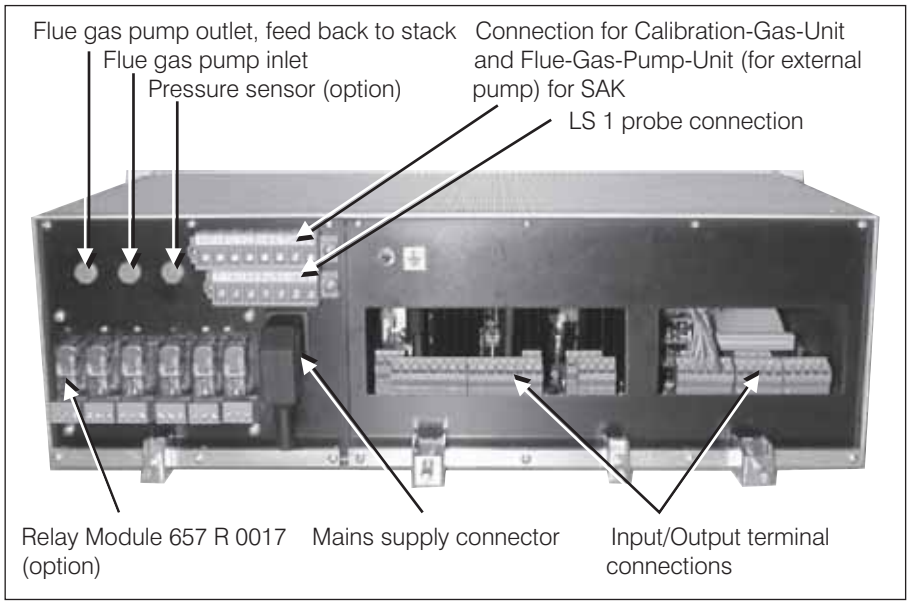
Lambda Transmitter LT 1-19"
Type 657 R 0045/0046

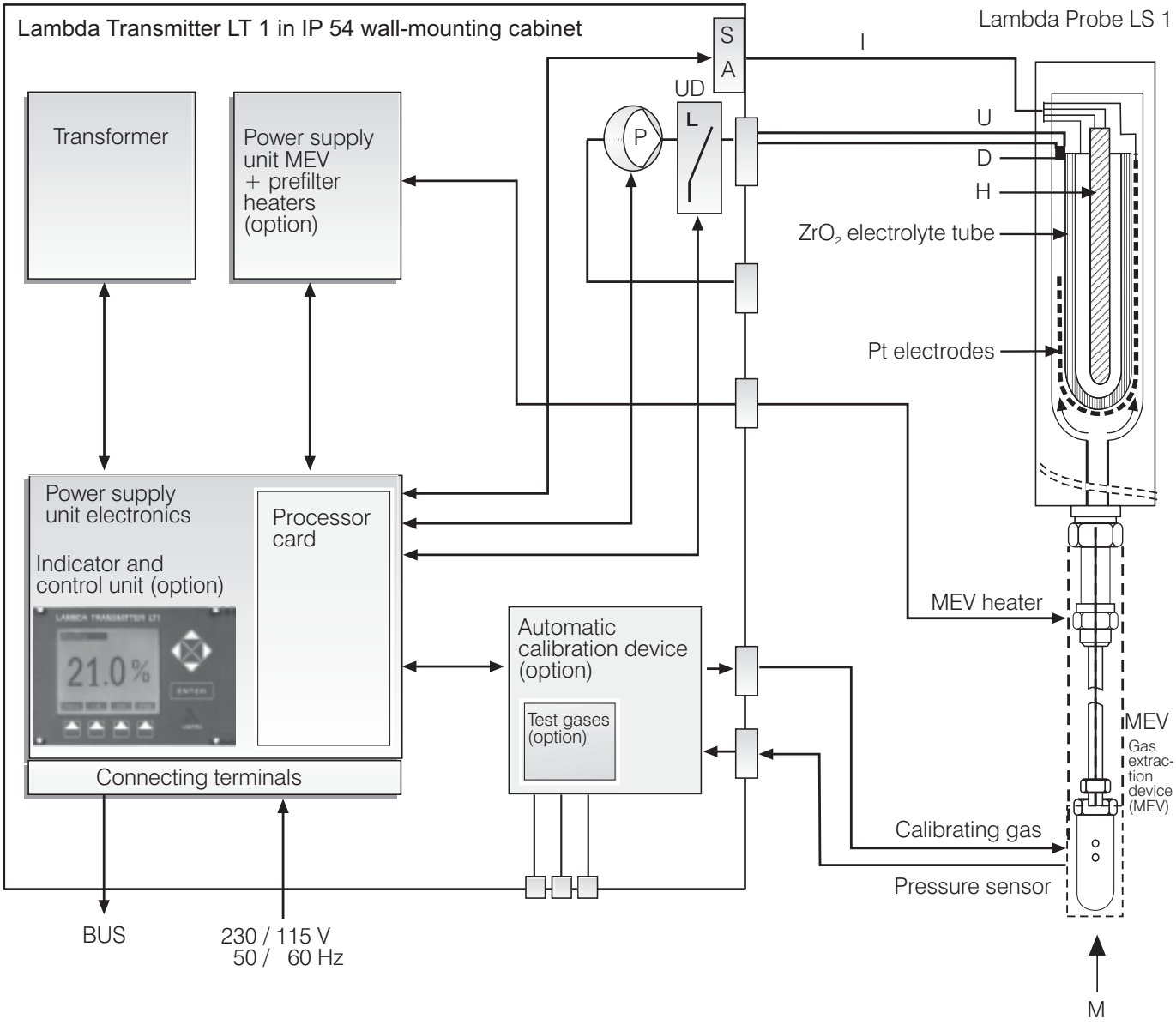
Type 657 R 0045
with integrated flue gas pump

Type 657 R 0046
without flue gas pump

The manual control and display unit includes the standard delivery. Delivery with an integrated automatically Calibration-Unit is not possible, due to the reduced size or space. In conjunction with Probe-Connection-Box (SAK, type 657 R 0013) only is it possible to operate automatic calibration.



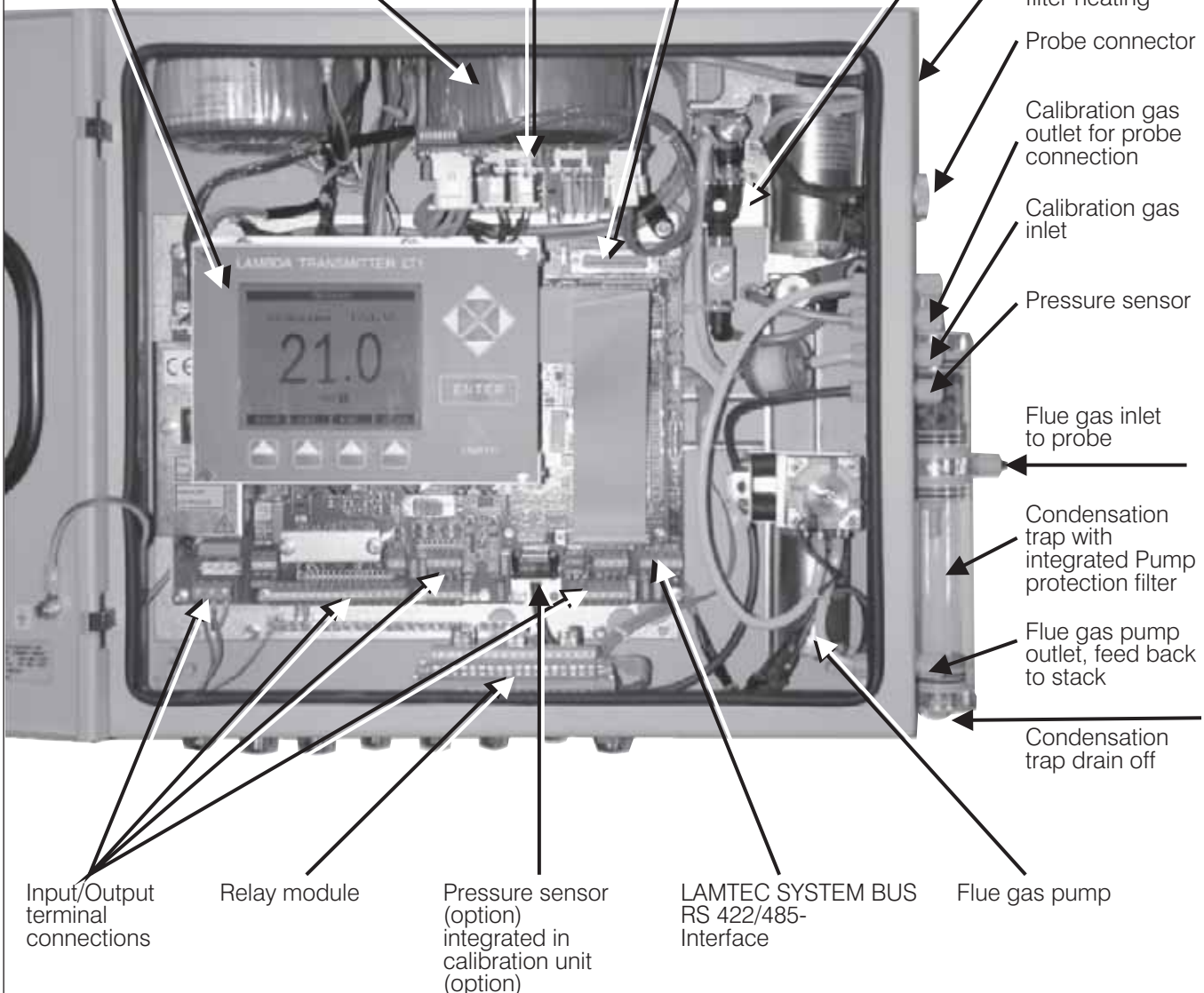




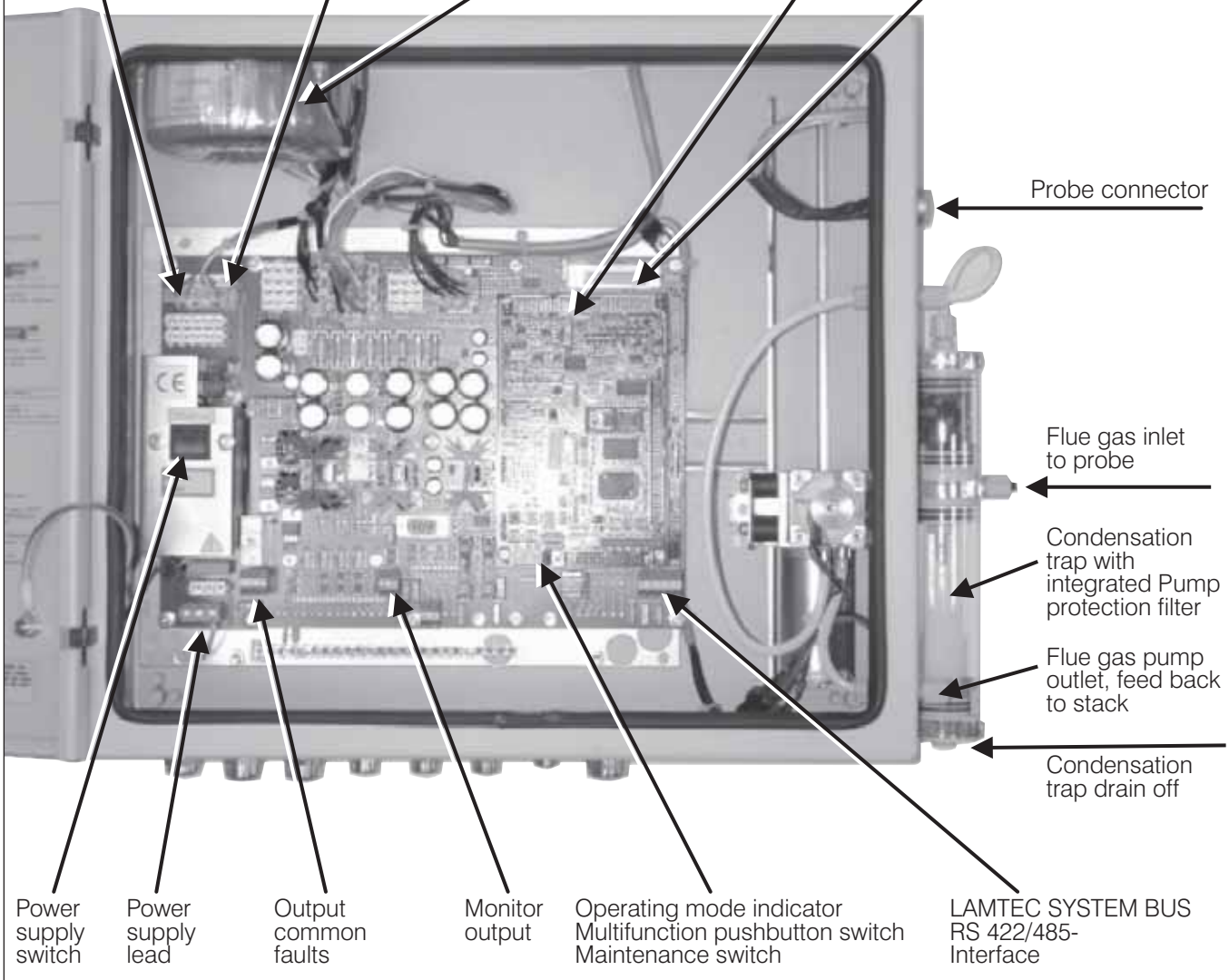
Key:

I	=	oxygen-dependent current
H	=	electrical heating
M	=	gas to be measured
D	=	nozzle
U	=	negative pressure hose
UD	=	negative pressure switch
P	=	pump
SA	=	probe electrical connection
MEV	=	gas extraction device

Lambda Transmitter LT 1 type 6 57 R 0025
with optional indicator and control unit type 6 57 R 0830
and fully automatic calibration unit type 6 57 R 0800
Power supply for flue gas intake - (MEV) and pre-filter-heating, type 6 57 R 0820
Relay Module 660 R 0012



Lambda Transmitter LT 1, OEM version, type 6 57 R 0020



3.6.2 Options

– Indicator and control unit
6 57 R 0830

– Automatic calibration device via integral pump
6 57 R 0800

– Automatic calibration device via customer's compressed-air supply
6 57 R 0801

– Test-gas connection
1 test gas
6 57 R 0810

– Test-gas connection
2 test gases (EPA Standard)
6 57 R 0811

– Portable calibration device
To be operated only in conjunction with adapter No. 6 57 R 0061.
One adapter is required per LT 1.
(In course of preparation)
6 57 R 0060

– Measured-value pressure compensation
6 57 R 0860

– Measured-value temperature compensation
6 57 R 0864

– Measured gas pump, 12 V DC, for corrosive measured gases
6 57 R 0835

– Power supply unit for the electrical heating of the gas extraction device and sintered metal prefilter of the SEA (MEV protective tube)
6 57 R 0820

– 1...4 Analogue outputs (0/4...20 mA, 0...10 V) max. 2 potential-free (Outputs 1 and 2) max. potential difference ± 20 V
Configurable as required

  direct current 0/4...20 mA, load impedance 0...600Ω

  d.c. voltage 0...10 V, load impedance 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 potential-free, max. potential difference ±20 V
  6 57 R 0051

– Electrically isolated analogue outputs
6 57 R 0053

(1) Not possible in OEM version

(1) - 1...4 analogue inputs, configurable as required via measurement cards. e.g. for temperature sensor, further pressure sensors, combination probe KS 1, standard signals, etc.; max. 2 of these potential-free, max. potential difference $\pm$20 V

(1) - 1...2 Relay modules for digital outputs with 3 relays (2 changeover contacts), for output of operating and status messages, switching capacity 230 VAC, 4 A
6 60 R 0012

(1) - Fine-draught measurement (upon request)

(1) - Measurement of the flue gas and intake air temperature and calculation of the combustion efficiency

(1) - Calculation of the CO_2 concentration, in relation to fuel, calculated from the measured O_2 value and the CO_2 max. value

(1) - Load-dependent and fuel-specific limiting values / limit curves

(1) - Combination probe KS 1 for detection of combustible constituents (CO / H_2) (upon request)

- Bus connection for Profibus DP, Modbus, Interbus S, CANopen, etc.

  Consisting of:

Communication processor Profibus DP	663 R 0401 LT1
Communication processor CANopen	663 R 0402 LT1
Communication processor Modbus	663 R 0403 LT1
Communication processor Interbus	663 R 0405 LT1

- Interface module RS 422 / 485
  6 63 P 0500

- Interface module RS 232
  (upon request)
  6 63 P 0600

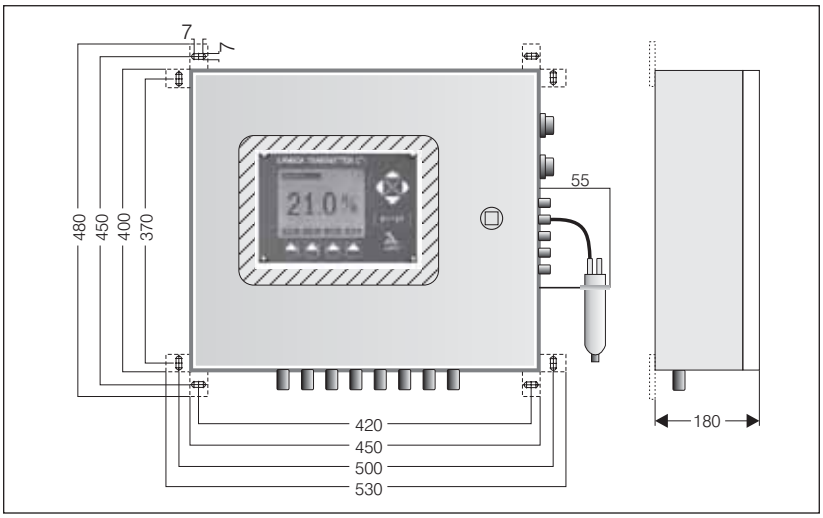
- Interface module RS 232 for PC including licence for remote display software
  6 57 R 1101

- Further licences for remote display software
  6 57 R 1102

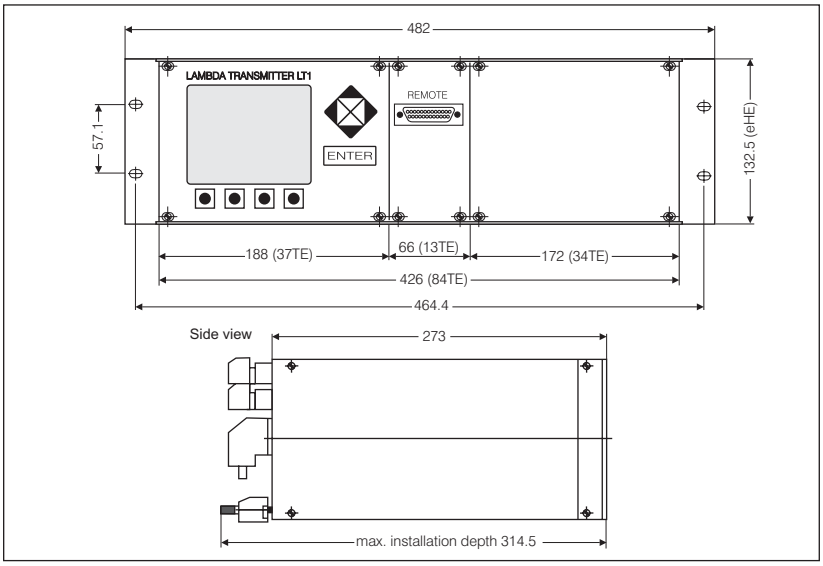
(1) Not possible in OEM version

3.6.3 Dimensional diagram
type 6 57 R 0020...R 0029
Wall-mounting cabinet IP 54
with optional indicator
and control unit

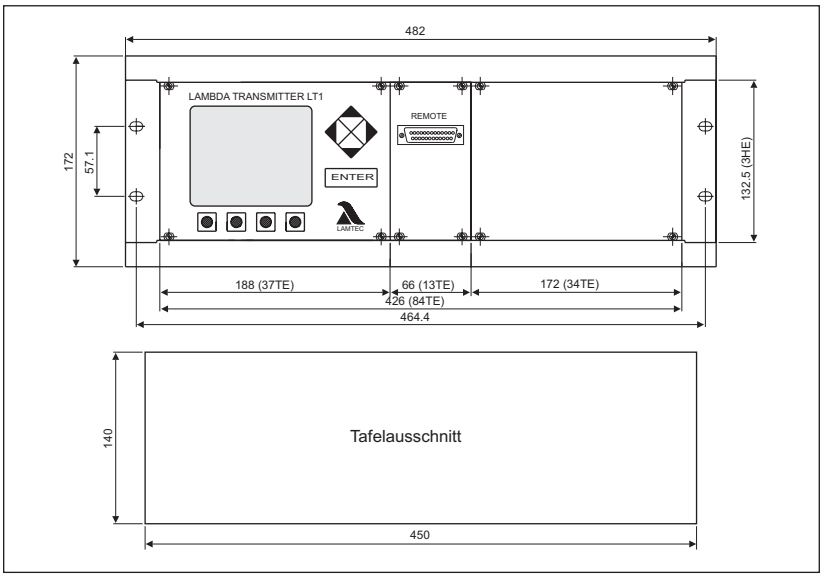
Under-roof installation
Ambient temperature
0°C to +60°C



Type 657 R 0045/0046
19"-rack with control-
and display unit



Type 657 R 0045/0046
with option 657 R 0049
19"-rack for control panel installation
with control- and display unit

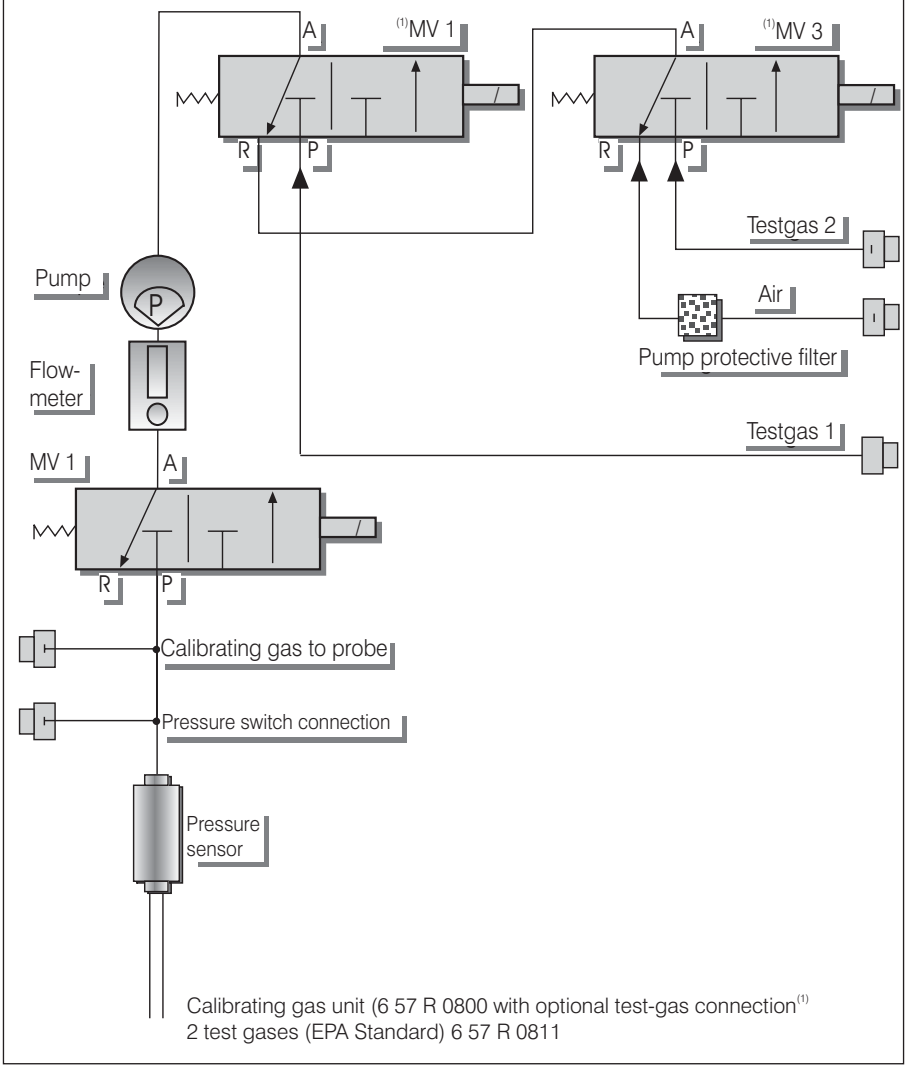


3.6.4 Automatic calibration device (option) No. 6 57 R 0800

Parameter group 250 to 288

Block diagram

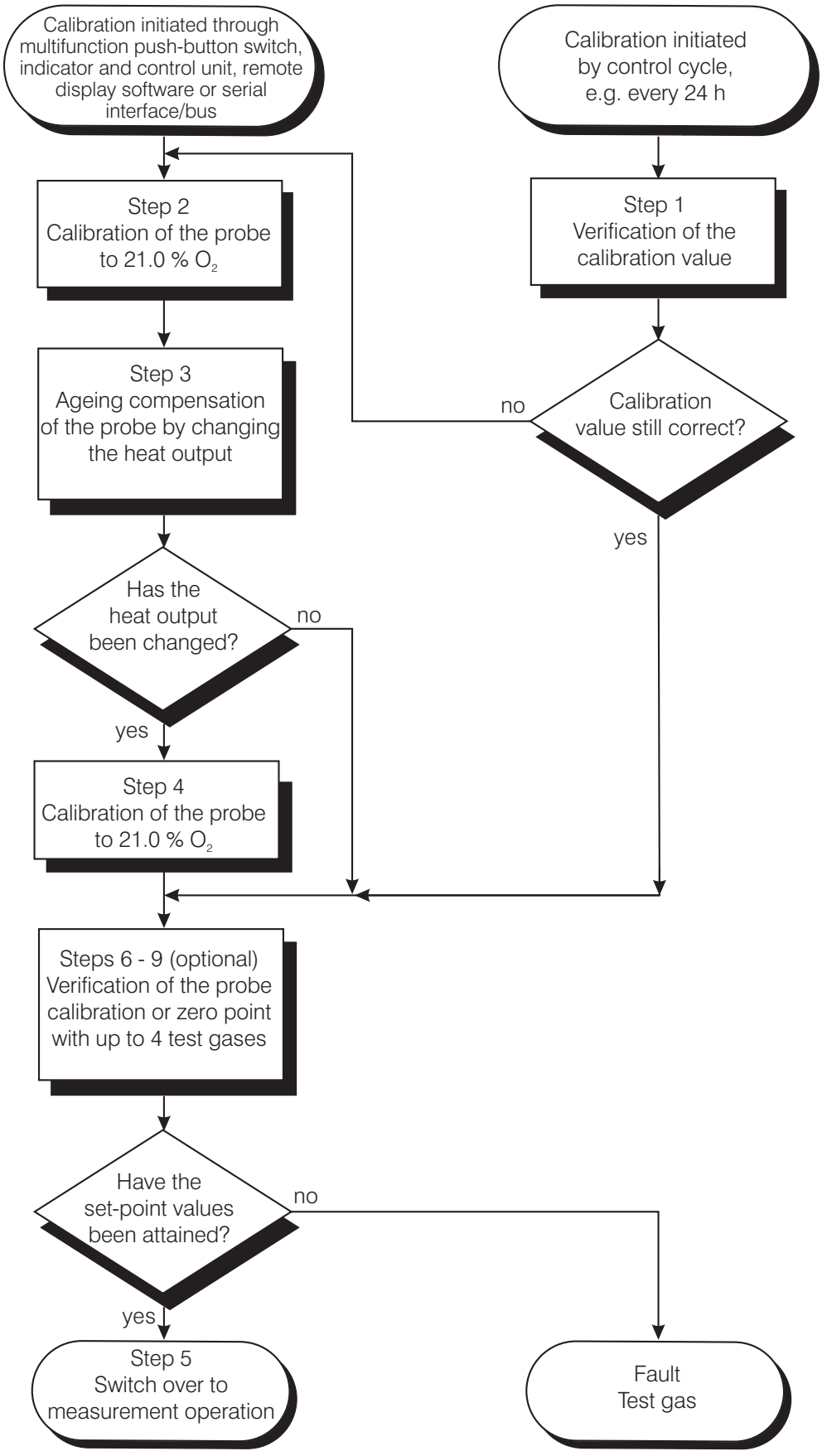
Calibration device for 3 gases, air, zero gas (N_2) and a test gas



A microprocessor controls the calibration process, in which a pump blows ambient air through the SEA to the tip of the gas extraction device. The flow rate of the calibrating gas can be set on the flow-meter using a needle valve (recommended setting 300 to 500 Nl/h).

In each calibration operation, the internal resistance of the zircon dioxide measuring cell is measured and the heat output is corrected (adapted) as necessary - automatic ageing compensation of the zircon dioxide measuring cell.

Automatic calibration of the Lambda Probe LS 1
Flow Chart



Initiation of a calibration operation

- Cyclical, based on a time value (0 - 10,000 hours)
  Can be set using the indicator and display unit or the Remote display software, parameter 270
  no calibration for "0" and "10000"

- By command → multifunction pushbutton switch
  → indicator and control unit (option)
  → control unit, via interface (option)
  → remote display software (option)
  → serial interface / bus

There is a facility to activate a counter, so that calibration is only performed on every twelfth calibration command (programmable). This is advantageous if the control unit is used to operate other measurement devices which require a more frequent calibration, parameter 272.

Daily, weekly or monthly calibration cycle, depending on application.

Calibration output:

Either: current measured value

substitute value

last measured value

These can be selected via the indicator and control unit or via the remote display software, parameters 282 and 283

Manufacturer's setting: last measured value

3.6.4.1 Test gas connection (option) No. 6 75 R 0810 / R 0811 Parameter group 330 to 341

Ambient air is adequate for verification and calibration of the Lambda Probe LS 1. Test gases are not necessary.

However, there are countries which test and approve these appliances in accordance with the EPA Standard. The EPA Standard mandatorily prescribes the use of test gas for verification of the zero point and the characteristic.

The “test gas connection” option offers the facility of determining the zero point using a zero gas (nitrogen), in addition to calibration with ambient air. It is also possible to test the linearity of the characteristic using a test gas. We recommend that a test gas with 5 % vol. oxygen (O_2) in nitrogen (N_2) is used for this purpose (manufacturer's setting).

The oxygen concentration of the test gases, the tolerance and the mode can be specified using the parameter group 330 to 341 via the indicator and control unit or the remote display software.

NOTE

The test gases used must be free from combustible gas constituents such as carbon monoxide (CO). Combustible gas constituents are oxidized (burned) on the platinum electrode of the zircon dioxide measuring cell, which has a temperature of approx. 800°C, and reduce the oxygen which is to be measured. The measured value is falsified to indicate less O_2 .

Example: $2\,CO + O_2 \rightarrow 2\,CO_2$
i.e., for 1 % CO in the measured gas, 0.5 % less O_2 is measured.

IMPORTANT!

The integral pressure sensor measures the pressure at the extraction point over the entire calibration cycle. If dirt on the prefilter causes the pressure to increase to values in excess of 0.6 bar (1.6 bar absolute), the pump is switched off to protect the pressure sensor and the fault “sintered metal prefilter dirty” is indicated.

3.6.4.2 Calibration pressure relief (option)
No. 6 75 R 0809
Parameter 287

This is necessary with a ceramic gas extraction device and sintered metal prefilter with a filter gauge of 2 μm.

The increased viscosity of the gas at higher temperatures sharply increases the flow resistance of the prefilter, with the result that the differential pressure across the prefilter can exceed 50 mbar.

The calibration process is as follows:

1. Blowing clear with relief valve closed - manufacturer's setting 30 seconds; this can be set via the indicator and control unit or the remote display software, using parameter 287.

2. Pressure relief and calibration.

3.6.4.3 Blast cleaning prior to calibration (on request)
Parameter 287

At the start of calibration / verification, a by-pass applies the full pressure to the SEA calibrating gas feed in order to blow away any deposits from the sintered metal prefilter.

This is only possible with the automatic calibration device, using the customer's compressed air supply - No. 6 57 R 0801.

The blast time is set using parameter 287 - manufacturer's setting 30 seconds; it is set via the indicator and control unit, or the remote display software.
Max. admission pressure 7 bar.

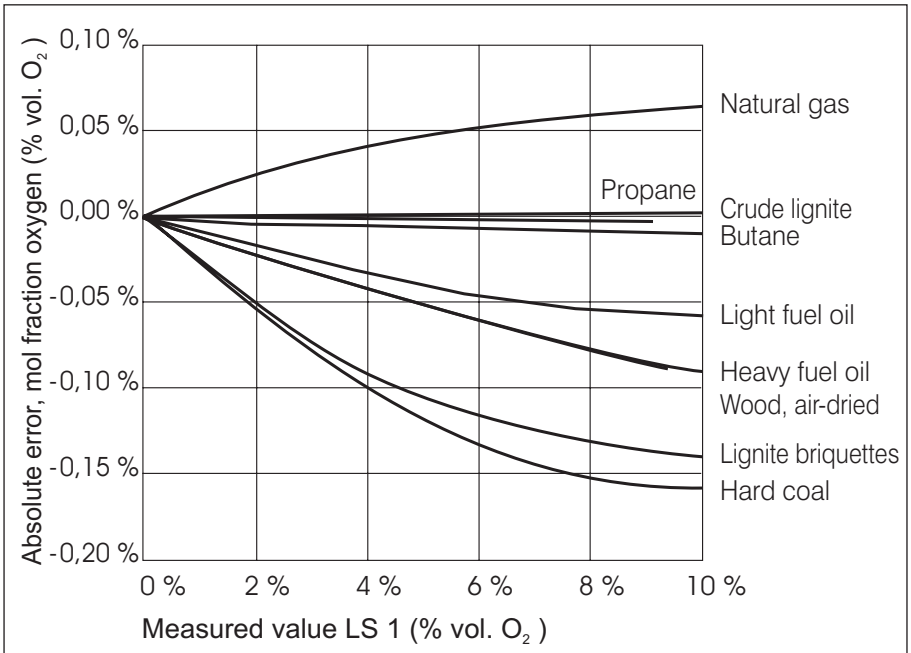
There is an integral discharge valve, set to 1 bar, to protect the Lambda Probe LS 1 and the pressure sensor.

3.6.5 Measured-value compensation

3.6.5.1 Flow compensation

The sound velocity and hence the flow through the “critical nozzle” of the Lambda Probe LS 1 depend on the mean mol mass / gas constant of the gas to be measured. In the case of “normal” waste gases from the combustion of oil, gas and coal, the effect on the measuring accuracy is insignificant.

The measuring error lies within the specified measuring accuracy of $\pm$0.2 % vol. O_2. See the graph below.



Error influence due to the dependence of the measured gas flow on the mean mol mass / gas constant of the flue gas for different fuels with typical ratio of CO_2 to H_2O in the flue gas in calibration of the LS 1 with dry air.

Fuel-specific compensation is included as standard
- parameter group 835 - 899.

NOTE:

Activation of the fuel-specific flow compensation using parameter 836.

Enable level “Service”

Manufacturer's setting → switched off.

Following activation, e.g. setting to digital inputs, the following fuels are specified by the manufacturer:

No. signal	light fuel oil	(fuel 1)
Signal on input 6	natural gas type H	(fuel 2)
Signal on input 7	heavy fuel oil	(fuel 3)
Signal on input 8	natural gas type L	(fuel 4)

In highly imbalanced waste gases, i.e., gases with a high moisture content (H_2O), a low CO_2 content - e.g. after wet-washers - and also gases with a high CO_2 content or low H_2O content, it is recommended to activate measured-value correction using the parameter group 1280 to 1283 via the indicator and control unit (option) or via the remote display software (option).

For details, see the Supplement to the Operating Manual for the indicator and control unit or remote display software options.

3.6.5.2 Pressure compensation (option) No. 6 57 R 0860

Error influence: 1.3 % of the measured value / 10 mbar pressure variation at the measuring point (measured gas pressure)

Via absolute pressure sensor on the power supply unit electronics of the LT1. Also possible, on request, via an external pressure sensor, via analogue input card. The fully automatic calibration unit (option), No. 6 57 R 0800 / R 0801, comprises a pressure sensor for equalising atmospheric pressure fluctuations.

3.6.5.3 Temperature compensation (option)

Error influence: 1 % of the measured value / 10 K temperature variation of the aluminium probe casing.
Only necessary in the case of large temperature fluctuations at the measuring point, e.g. as a result of strong sunlight or process factors (radiation from the measuring point).

A PT 100 temperature sensor incorporated in the Lambda Probe LS 1 measures the temperature in the immediate vicinity of the “critical nozzle” which determines the flow and the measured O_2 value is corrected accordingly.

3.6.6 Cold-start delay

This serves to prevent waste gas being drawn through a cold probe.

IMPORTANT!

Never draw waste gas through a cold probe. This can result in blockage of the “critical nozzle”. Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour.

There are two different types of cold-start delay, depending on whether or not the LT 1 is equipped with an automatic calibration device:

- time-based cold-start delay (without calibration device)
- intelligent cold-start delay (with calibration device)

A cold-start delay is always activated if the pressure switched on the measured gas pump is also disengaged following “power supply off” or replacement of the probe.

The maximum wait time can be set using parameter 204 via the indicator and control unit or the remote display software.
Manufacturer's setting 120 minutes.
If the “intelligent cold-start” function is active, it can terminate the cold-start earlier if necessary. The “intelligent cold-start” is always active (manufacturer's setting) when an automatic calibration device is fitted.

The cold-start delay can be over-ridden at any time

– via the multifunction starter
– via the indicator and control unit (option)
– via the remote display software

During the cold-start delay, either

→ a substitute value
→ the current measured value
is output.

Manufacturer's setting: → substitute value 0.0 % vol. O_2

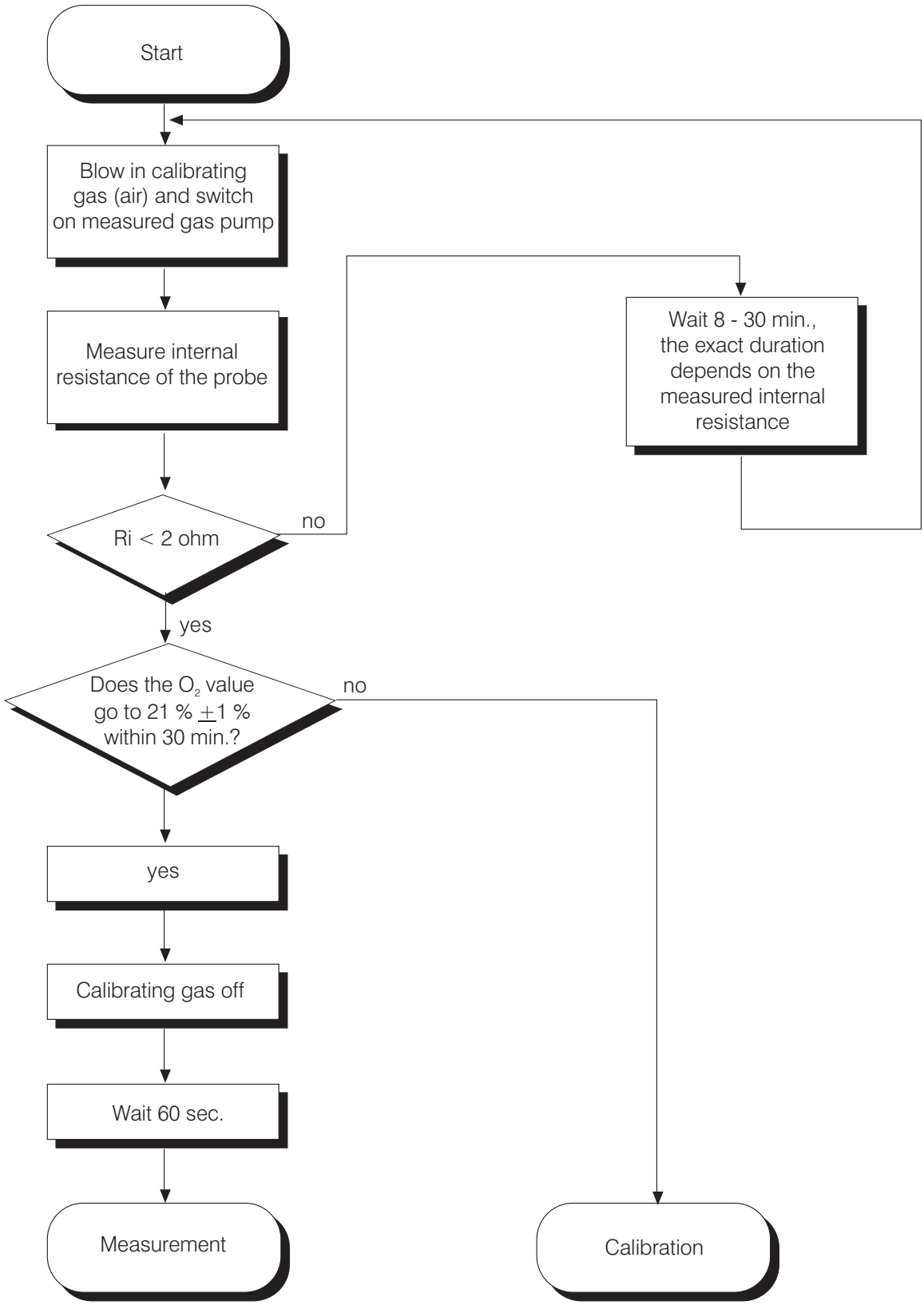
Selection and setting using parameters 361 and 362 via the indicator and control unit or the remote display software.

The intelligent cold-start delay determines the temperature of the zircon dioxide measuring cell by measuring the internal resistance of the cell during the heating-up phase and uses this to determine the optimum time for switching on the measured gas pump.

NOTE:

In the case of short interruptions, the measured gas pump is delayed (twice the pump off time) and then switched on again.

"Intelligent Cold-Start Delay" Function Sequence



3.6.7 Measured gas pump operating time control

The measured gas pump is operated intermittently. This is possible because the Lambda Probe LS 1 only requires approx. 0.5 l of measured gas per hour for measurements. A buffer container (condensate trap) is located between the measured gas pump and the Lambda Probe. This buffer causes the pump to operate approximately 2...10 times per minute, with each pump operation being less than 5 seconds. If the pump is to operate with a significantly greater frequency or for a significantly longer period, the tightness of the screwed hose connections must be checked.

The optimum pump operating time is determined by an intelligent pump operation system, which is activated as follows:

– via the indicator and control unit (option)

– via the remote display software (option)

– by over-riding the cold-start delay

NOTE: Function Pushbutton	 operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**

* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress.
** If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds.

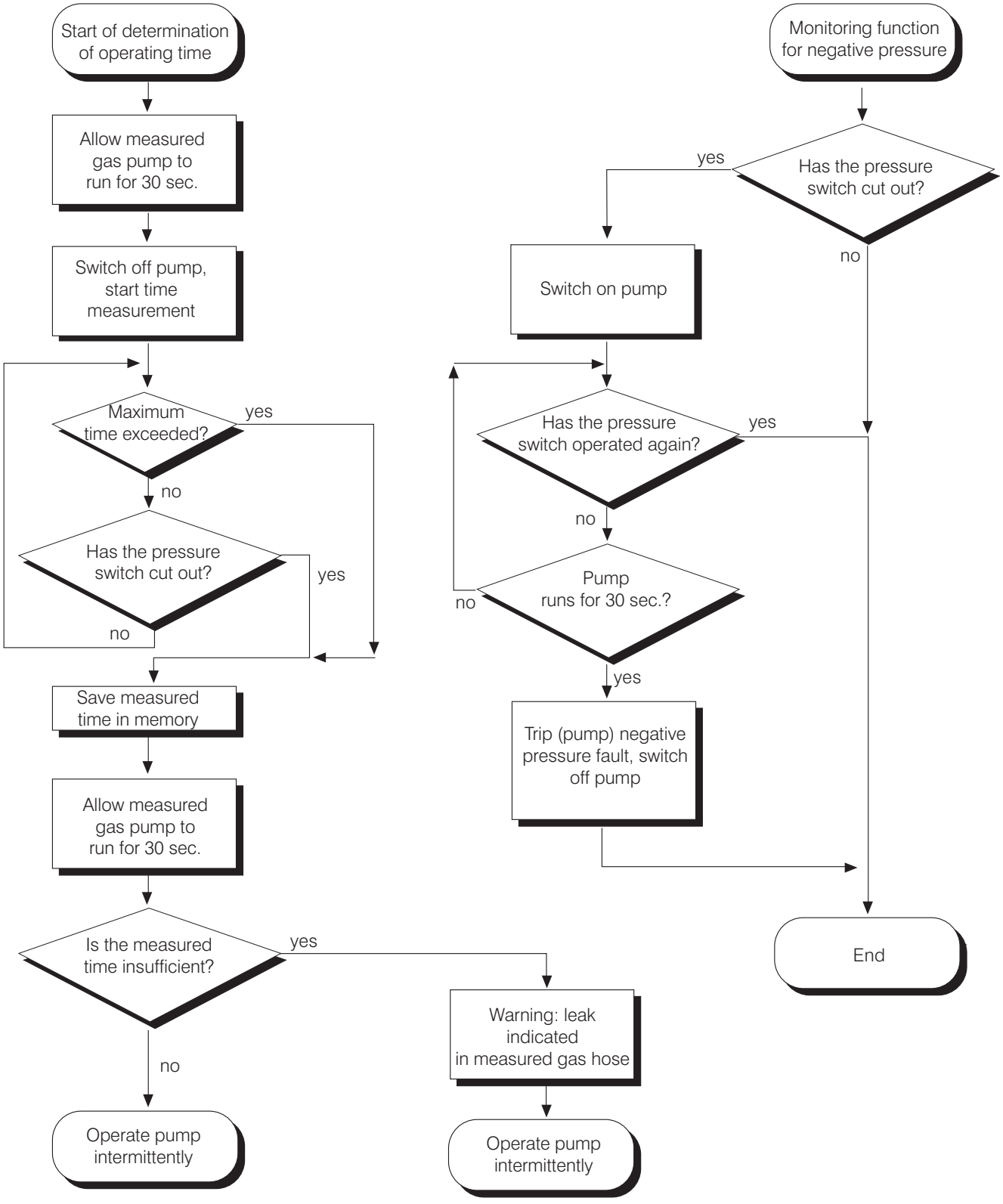
To prevent moisture from collecting in the pump head, the pump is temporarily switched from intermittent operating mode to continuous operation. The operating time and the repetition time can be adapted to the specific installation conditions using parameters 190 and 189 respectively - enable level “Service”, via the indicator and control unit or via the remote display software.

Manufacturer's setting: 10 min. continuous operation, every 2 operating hours

parameter 189 → 120

parameter 190 → 10

Function Sequence “Determination of Operating Time of Measured gas Pump”



3.6.8 Power supply unit for electrical heating of Gas extraction device (MEV) and sintered metal prefilter (option)

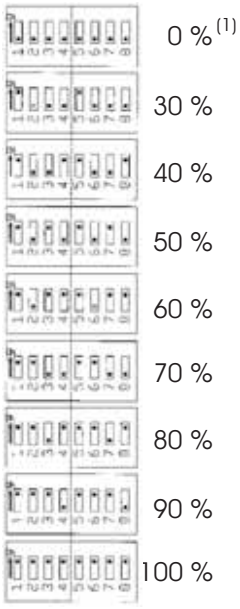
The MEV and sintered metal prefilter heating must also be activated at programming (Service) level. Parameter 121 is used for this purpose. The options comprise:

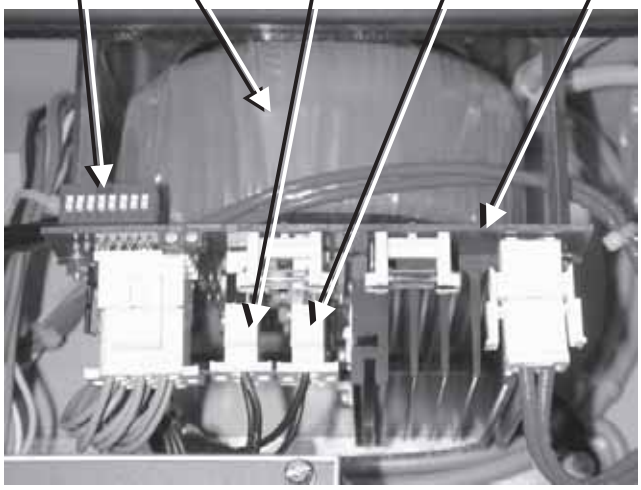
- MEV and sintered metal prefilter heating switched off
- only MEV heating activated
- only sintered metal prefilter heating activated
- MEV and sintered metal prefilter heating activated

IMPORTANT!

If a heating system is activated but not connected, a warning is indicated: MEV or sintered metal prefilter heating defective.

A temperature control option is in the course of preparation. In appliances without temperature control, parameter 122 must be set to “OFF”.





1) OFF, and alternative heater setting with display- and operating unit or remote display software respectively.

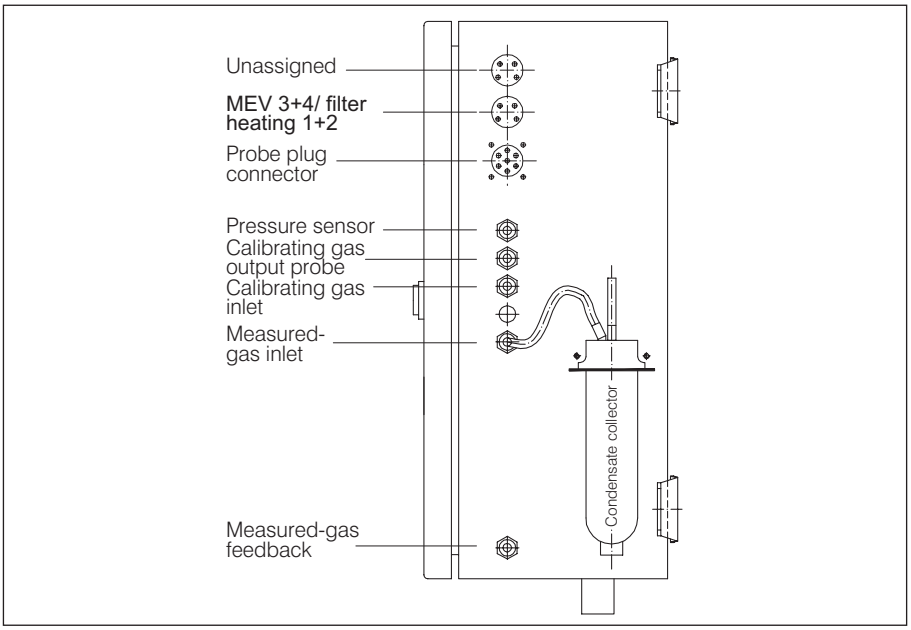
If the MEV- and filter-heater are connected correctly, both LEDs (LED1 and LED2) are flushing.

IMPORTANT!

If an indicator and control unit is available, it is recommended that the heating should always be set via the unit.
Parameters 400 and 401.
The manufacturer's setting is then 0 %.

The DIP switches have priority and over-write the setting pre-selected via the indicator and control unit or via the remote display software.

Electrical connection:

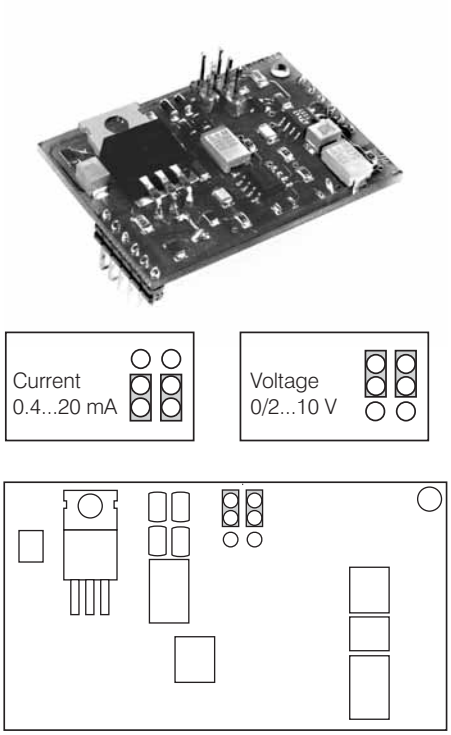


3.6.9 Analogue outputs

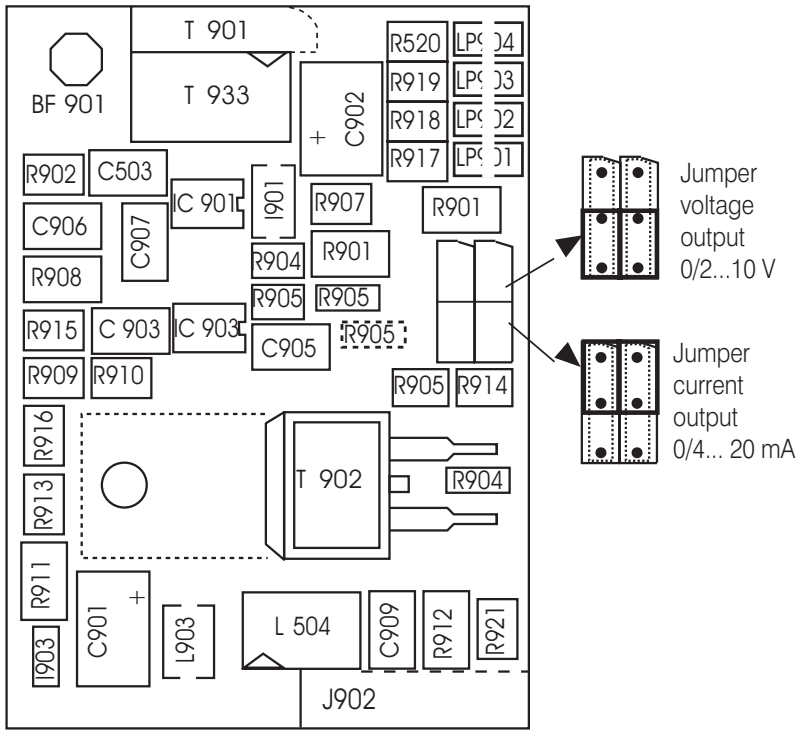
(Not possible with OEM version)
0/4...20 mA, 0/2...10 V (option)
Parameter group 530 to 569

Can be retrofitted at any time via plug-in cards on LT 1 - processor card (max. 4)

- No. 6 57 R 0050, potential-carrying (1 channel)



Up to delivery date of September 1997



From delivery date of October 1997

The plug-in jumpers provide only for hardware switch-over between current and voltage output.

The indicator and control unit, or the remote display software is used for selection between 0 or 4...20 mA, parameters 531/541/551/561.

- No. 6 57 R 0051 potential-free (1 channel), maximum possible potential difference 20 v (only possible for outputs 1 and 2).

3.6.10 Digital outputs

Parameter group 1030 to 1099

(Not available on OEM version)

Digital output 1: Relay output, relay location is on base electronic board, one SPDT contact for 0...48 V DC - 3 A, 0...230 VAC - 2A. The relay is standard equipment for the complete version.

Digital outputs 2 to 7: Open collector relay driver outputs, switching current max. 25 mA at 24 Volts, to connect directly to the Relay modules type 6 60 R 0012 or R 0017 The open collector drivers are standard equipment for the complete version.

WARNING

Digital outputs no. 2 to 7 are not protected against a short circuit !

The digital outputs can be set up for any configuration through the LCD-Display and manual Keypad, as well by Remote Control Software on parameters 1030 to 1099.

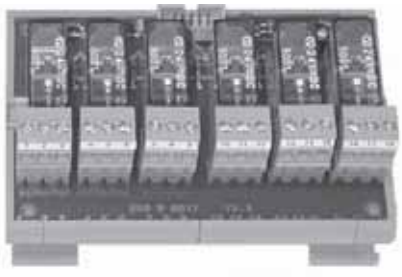
Factory set up:
- Digital output no.1 → collected faults
- Digital output no.2 → collected warnings
- Digital output no.3 → calibration
- Digital output no.4 → maintenance
- Digital output no.5 - 7 → no configuration

Option:
– Internal Relay module or external supplementary installation in control panel on site plant, Relay module type 660 R 0012 or 660 R 0017

Relay modul type 660 R 0012 on rail-clip on socket (option)

3 relays, each with 2 changeover contacts (230 V/AC, 4 A)

Relay modul type 660 R 0017 on rail-clip on socket (option)



6 relays, each with 1 changeover contact (230 V/AC, 4 A)

3.6.11 Analogue inputs (option)
Parameter group 570 to 609

(Not possible with OEM version)
Via plug-in cards on LT 1 power supply unit electronics (max. 4)

– Universal module for analogue input, No. 6 63 P 600...
  Potentiometer, 0/4...20 mA, 0/2 - 10 V

– Temperature input for PT 100, No. 6 57 R 0890

  Measuring range either

0...320 °C			or	0...850 °C		
Resolution:	1 °C			Resolution:	2 °C	
Meas. error:	typically	1 °C		Meas. error:	typically	±2 °C
	max.	2 °C			max.	±4 °C

  Please specify measuring range when ordering.

  For electrical connection, see 3.6.15, page 67.

– Further modules in course of preparation

3.6.12 Digital inputs
Parameter group 1170 to 1249

(Not possible with OEM version)
8 Digital inputs on LT 1 power supply unit electronics, 24 V DC, 6 mA, either related to appliance potential or potential-free (see connection plan in 4.3.2.1, page 84 - 91), can be configured as required via indicator and control unit (option) and remote display software
Manufacturer's assignment:

Input 1 → Pump on
Input 2 → Initiate calibration
Input 3 → Initiate check
Input 4 → Cyclic calibration
Input 5 → Fault cancellation
Inputs 6 to 8 → Not assigned

3.6.13 Fine-draught measurement (option) No. 6 57 R 0110

(Not possible with OEM version)
Differential pressure sensor for measurement of
– Chimney draught
– Combustion chamber pressure
– etc.
  On request → please state there required pressure range.

3.6.14 Fuel configuration
Parameter group 835 to 899

As the manufacturer's setting, the fuel configuration is activated only with the following options:
– Combustion efficiency
– CO_2 calculation

The fuel is selected via the digital inputs 6 to 8.

Manufacturer's setting:
– No input assigned → Fuel 1 (light fuel oil)
– Signal on input 6 → Fuel 2 (natural gas type H)
– Signal on input 7 → Fuel 3 (heavy fuel oil)
– Signal on input 8 → Fuel 4 (natural gas type L)

If the appliances are supplied without these options the fuel configuration is deactivated. Parameter 836 → 0.

Individual fuel configuration via the indicator and control unit (option) and the remote display software (option), parameter group 835 to 899.
Enable level Service.
If the fuel is selected via the digital inputs, parameter 836 must be set to 1.

3.6.15 Measurement of the temperature of the flue gas and intake air and calculation of the combustion efficiency (option) No. 6 57 R 0895 / R 0896

The calculation is made according to the formula:

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

q_{Af} = waste-gas loss through uncombined heat

q_{Ag} = waste-gas loss through combined heat

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

The calculation of the waste gas losses is based on the following mean fuel values;

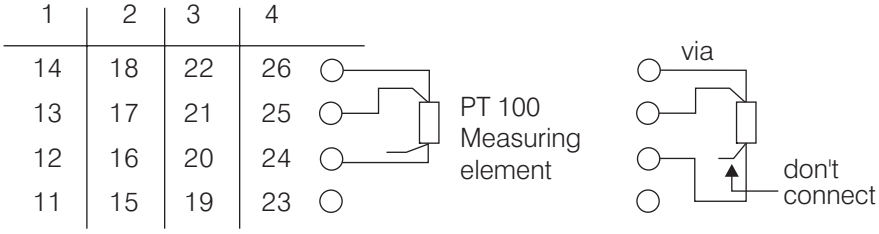
Oil $A_2 = 0.68$; $B = 0.0007$
Gas $A_2 = 0.66$; $B = 0.0009$

It is assumed that combustion does not include CO or soot. The waste gas losses due to combined heat Ag are disregarded.

Indicated values:	Efficiency	0...100 %
	Waste gas losses	0...100 %
	Waste gas temperature	0...320°C
	Intake air temperature	0...320°C
	Other ranges on request.	
Measuring accuracy:	Temperature better than 2 K	
	Efficiency / waste gas losses better than 0.2 %	

Electrical connection:
Depending on configuration / equipment

Measuring card



In the case of the variant 6 57 0896, the intake air is predefined. The intake air temperature is not measured in that case.
This is to be recommended only if the intake air temperature remains virtually constant over the entire year.
The mean intake air temperature can be defined in parameter 1450.

3.6.16 Calculation and display of the CO_2 concentration (option) No. 6 57 R 0910

This is calculated using the following formula:

$$CO_2 = CO_{2max.} - \frac{O_2 \cdot CO_{2max}}{21}$$

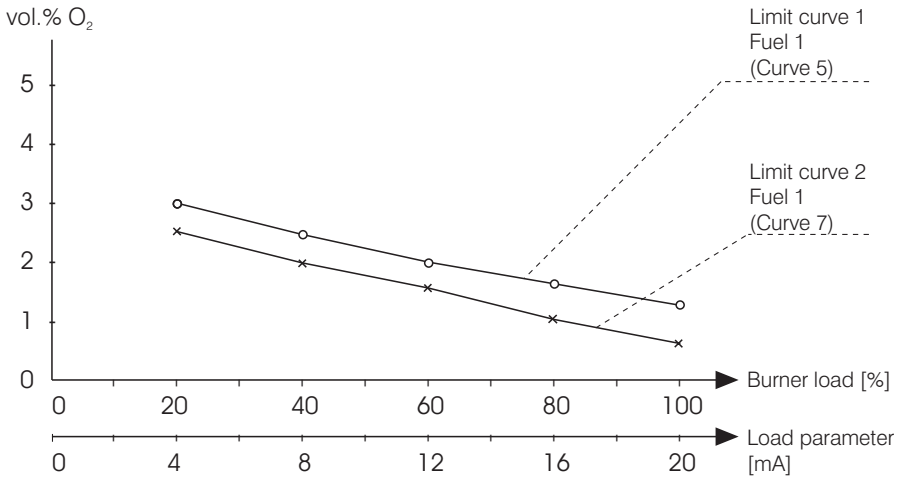
The calculation is based on the following maximum CO_2 contents for $\lambda = 1 \triangleq O_2 = 0$ % vol. based **on dry** waste gas:

light fuel oil	15.4 % vol.
heavy fuel oil	15.9 % vol.
natural gas type L	11.7 % vol.
natural gas type H	12.0 % vol.

Individual fuel-specific specification of $CO_{2\,max.}$ possible using the parameters 846 / 862 / 878 and 894.

3.6.17 Load-dependent and fuel-specific limiting values / limit curves (option) No. 6 57 R 0920

Analogue input 4 is used for connection of the load value (burner load) or another measurement value. Instead of fixed limiting values, fuel-specific curves of 2 to a maximum of 8 interpolation points can be entered.



Limit curves (manufacturer's setting), differentiation parameters

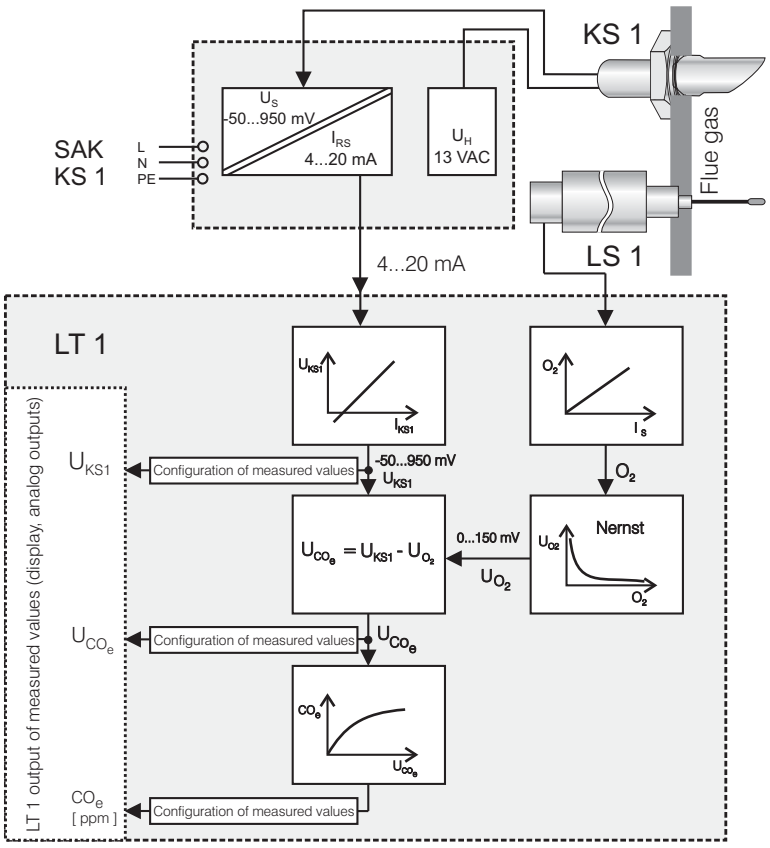
Combination possibilities:

either:- 2 fuels with 4 limit curves / limiting values per fuel
or- 4 fuels with 2 limit curves / limiting values per fuel

For details, see Supplement to the Operating Manual for the “Indicator and Control Unit” option.

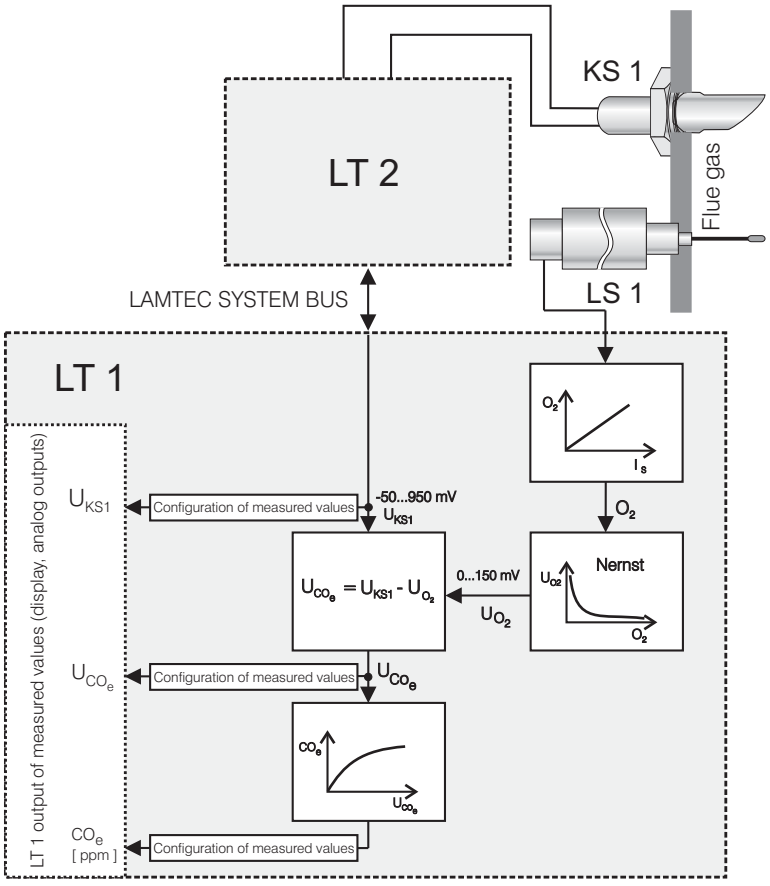
3.6.18 Connection of the combination probe KS 1 for the detection of combustible waste constituents CO / H_2 indicated as $CO_{equivalent}$ [CO_e] (option on request)

till 2001



either

until 2001



3.6.19 Bus connection (option)

Consisting of:

Bus card	No. 6 63 P 0400, can be retrofitted on LT 1 processor card, see 4.3.2.2, page 89
Bus interface	No. 6 63 R 0301

for the systems:

Interbus S	(Phoenix)
Profibus DP	(Siemens)
Modbus	
CANopen	(in course of preparation)

For details, see separate booklet.

3.6.20 Diaphragm pump for corrosive measured gases (option) No. 6 57 R 0835

Gas-carrying parts	Ryton
Diaphragm	Teflon on buna N base
Valves,seals	Viton

- Essential for all types of refuse combustion
- Recommended for measured gases with a high SO_2 and HCL content

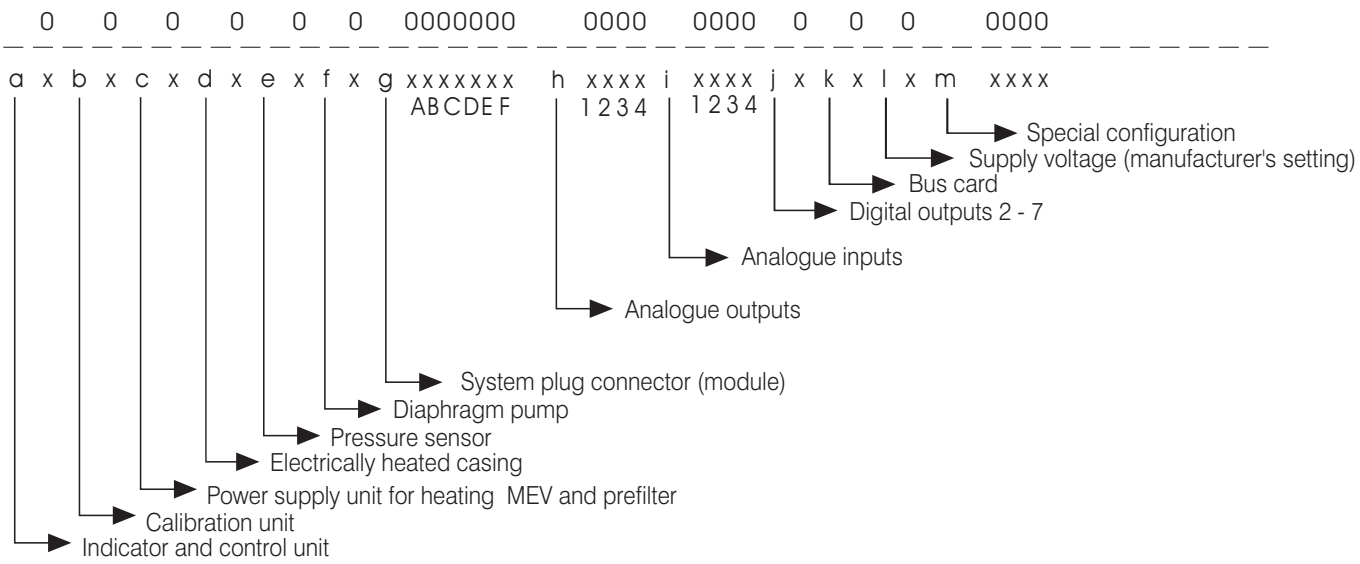
3.6.21 Remote display software (option) No. 6 57 R 1101

For PCs, on Windows platform (from Windows 95). Connection to LT 1 via RS 232 interface.

3.6.22 Appliance configuration and manufacturer's settings

The configuration of the particular appliance and the manufacturer's settings are indicated by the configuration number. The configuration number is located on the inside of the casing door to the electronics section.
The configuration number is a 28-digit number and is constructed on the basis of the following key:

Configuration number for LT 1



a: Indicator and control unit (option)

0 → Without

1 → With

b: Calibration unit (option)

0 → Without

1 → Fully automatic calibration unit

2 → Fully automatic calibration unit with optional test-gas connection (1 test gas)

3 → Fully automatic calibration unit with optional test-gas connection (2 test gases)

4 → Fully automatic calibration unit, using compressed air

5 → Fully automatic calibration unit, using compressed air, with optional test-gas connection (1 test gas)

6 → Fully automatic calibration unit, using compressed air, with optional test-gas connection (2 test gases)

7 → free

8 → Fully automatic calibration unit with optional "pressure relief"

9 → Fully automatic calibration unit, using compressed air, with optional "blast cleaning"

c: Power supply unit for electrical heating of MEV and prefilter	0 →	Without	
	1 →	With	
d: Electrically heated casing with thermostat	0 →	Without suitable for ambient temperatures	>-10°C
	1 →	With (standard)	>-25°C
	2 →	With (enhanced)	>-40°C
e: Pressure sensor	0 →	Without	
	1 →	Standard (contained in fully automatic calibration unit)	
	2 →	Differential pressure desired pressure range .....mbar	
	3 →	Fine-draught measurement desired pressure range .....mmWS	
f: Diaphragm pump	0 →	Without Probe connection box (SAK) with flue gas pump alternative type 657 R 0010 to 657 R 0015 and 0017 / 0018 is necessary	
	1 →	Standard	
	2 →	Corrosive measured gases (option)	
	3 →	Ejector (pressure air operation)	
g: System plug connector	1 000 00 0 →	Plug connector module A (standard) Combined fault indication / analogue outputs	
	0 100 00 0 →	Plug connector module B Measurement cards 1 and 2 (option)	
	0 010 00 0 →	Plug connector module C Measurement cards 3 and 4 (option)	
	0 001 00 0 →	Plug connector module D (standard) Digital inputs	
	0 000 10 0 →	Plug connector module E (option) Relay module 1	
	0 000 01 0 →	Plug connector module F (option) Relay module 2	
	0 000 00 0 →	Relay module, internal	
	0 000 00 1 →	Relay module, external	
	0 000 00 2 →	Plug connector, special configuration	

h: Analogue outputs (4 positions)	1 2 3 4		
	0	→	Not assigned
	1	→	4...20 mA
	2	→	0...20 mA
	3	→	0...10 V
	4	→	4...20 mA, potential-free
	5	→	0...20 mA, potential-free
	6	→	0...10 V, potential-free
	7	→	4...20 mA, electrically isolated
	8	→	0...20 mA, electrically isolated
	9	→	0...10 V, electrically isolated
I: Analogue inputs (4 positions)	1 2 3 4		
	0	→	Not assigned
	1	→	Potentiometer, 1 kΩ ...5 kΩ
	2	→	Current 0/4...20 mA or 4...20mA
	3	→	DPS outputs
	4	→	Pulse input (Namur)
	5	→	PT 100 input range 0...320°C
	6	→	PT 100 input range 0...850°C
	7	→	Current 0/4...20 mA, with supply
	8	→	Differance pressure sensor range.....
	9	→	Absolute pressure sensor range.....
j: Digital outputs 2 to 7	0	→	Open collector
	1	→	2 to 4 relays, 1 relay module (2 changeover contacts) 660 R 0012 (option)
	2	→	2 to 7 relays, 2 relay modules (2 changeover contacts) 660 R 0012 (option)
	3	→	2 to 7 relays, 1 relay module (1 changeover contact) 660 R 0017 (option)
k: Bus card	0	→	Not assigned
	1	→	Interbus S
	2	→	Profibus DP
	3	→	Modbus

l: Supply voltage (manufacturer's setting)	1	→ 230 V AC
	2	→ 115 V AC
	3	→ 24 V AC
	4	→ 24 V DC
	5	→ Special voltage
m: Special configurations	- - - -	

Temperature of measured gas

Criterion 1

No condensation water in the Gas extraction device (MEV).
This means that the temperature of the entire MEV must be above the relevant dew point.

Guide values:

- Light hydrocarbons, such as natural gas, propane, butane, hydrogen, etc. → greater than 80 °C
- Light fuel oil → greater than 120 °C
- Fuels such as heavy fuel oil, coal, pyrolysis gases, etc., with which increased formation of SO_2 , HCL or corrosive substances is to be anticipated → greater than 180 °C

Criterion II

Limits of use of the MEV material

Metal MEV (alloy 601): 600°C; or 800°C with protective tube made from material 2.4851
Ceramic MEV (Al_2O_3): 1400°C; or 1700°C without MEV protective tube in vertical installation position

For details, see 3.3.1, page 28.

NOTE:

- The MEV should always be kept as short as possible
- The probe installation fitting (SEA) should be fitted as near to the measuring point as possible.

IMPORTANT!
Should it prove impossible to ensure that the temperature of the capillaries (MEV) is above the dew point over the entire length using the methods described above, the MEV must be heated or fitted with a MEV protective tube with a core made from a highly conductive material (copper or aluminium). Heated measured-gas extraction devices (MEV) are available as an option.
See also 3.4.2, page 35.

Mounting in open air

The following points should be noted:
At temperatures below 0°C, the condensate freezes in the measured-gas hose and in the condensate trap between the probe (LS 1) and the measured-gas pump. Furthermore, there are problems with starting the measured-gas pump at temperatures below 5°C.

The Lambda Transmitter LT 1, Compact version IP 65, No. 6 57 R 0000...R0009 has been specially developed for open-air mounting. See Technical Data - Lambda Transmitter LT 1, Booklet No. D LT 6062.99 aD.

The transmitter protection box is used only if the Lambda Transmitter LT 1, together with the indicator and control unit, is to be installed away from the measurement point or if the ambient flue gas temperature does not allow installation of the compact version of the LT 1.

Distance between probe and Lambda Transmitter (cable length!)

– Less than 10 metres:
Direct connection recommended, or connection using 2 m, 5 m or 10 m extension; see Figure in 3.1, page 25.

– Over 10 metres:
Via probe connection box; see connection diagram in 4.3, page 83.

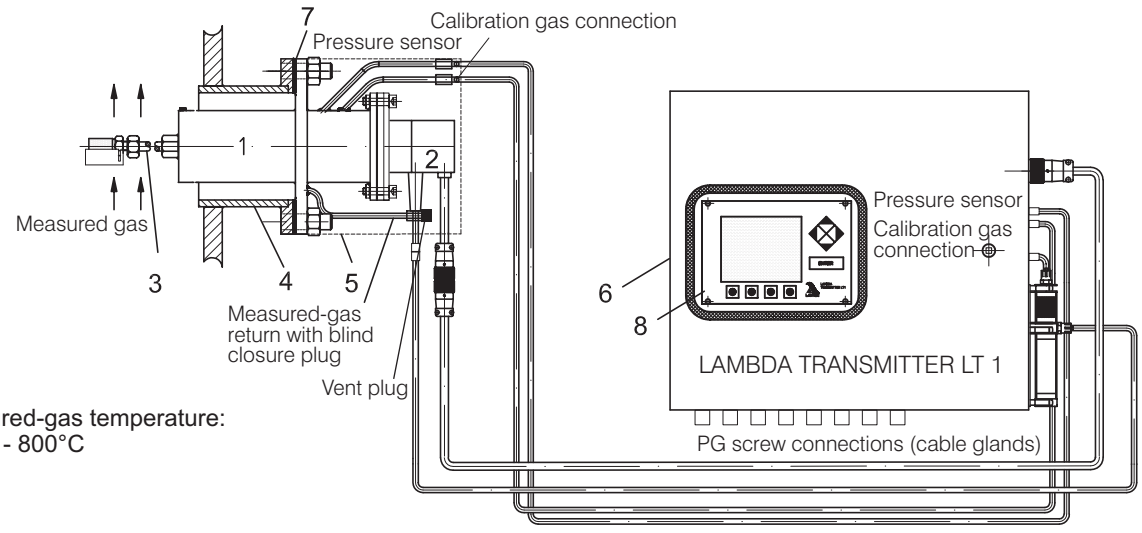
Compared with the use of a probe extension, connection by means of a probe connection box offers the advantage that conventional cable can be used for wiring from the probe connection box. The cable length can be adapted in situ to the local conditions.
The hoses for the measured gas and the calibrating gas to be installed only as far as the probe connection box (SAK).

IMPORTANT:

Note cable cross sections of probe heating
LT 1 Terminal 92 and 93
SAK Terminal 35 and 36

Length	Cross-section
10 m	> 2 mm²
20 m	> 4 mm²
30 m	> 6 mm²
40 m	> 8 mm²
> 50 m	> on request

Basic construction with integral pump and calibration device for under-roof installation



Measured-gas temperature:
300°C - 800°C

1 Probe installation fitting (SEA)
No. 6 55 R 0083...R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...R 0039

3 Gas extraction device (MEV) with extraction filter
e.g. 1000 mm long No. 6 55 R 0027
matching protective tube No. 6 55 R 0620

4 Mating flange
No. 6 55 R 0183 / R 0185

5 Insulation for LS 1
No. 6 57 P 0100

6 Lambda Transmitter LT 1 with integral measured-gas pump and automatic calibration device (option)
No. 6 57 R 0020...R 0025 and 6 57 R 0800

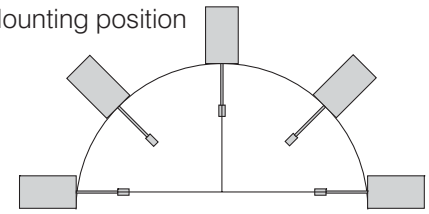
7 Flange seal, BAS green
No. 6 50 P 4209

8 Indicator and control unit (option)
No. 6 57 R 0800

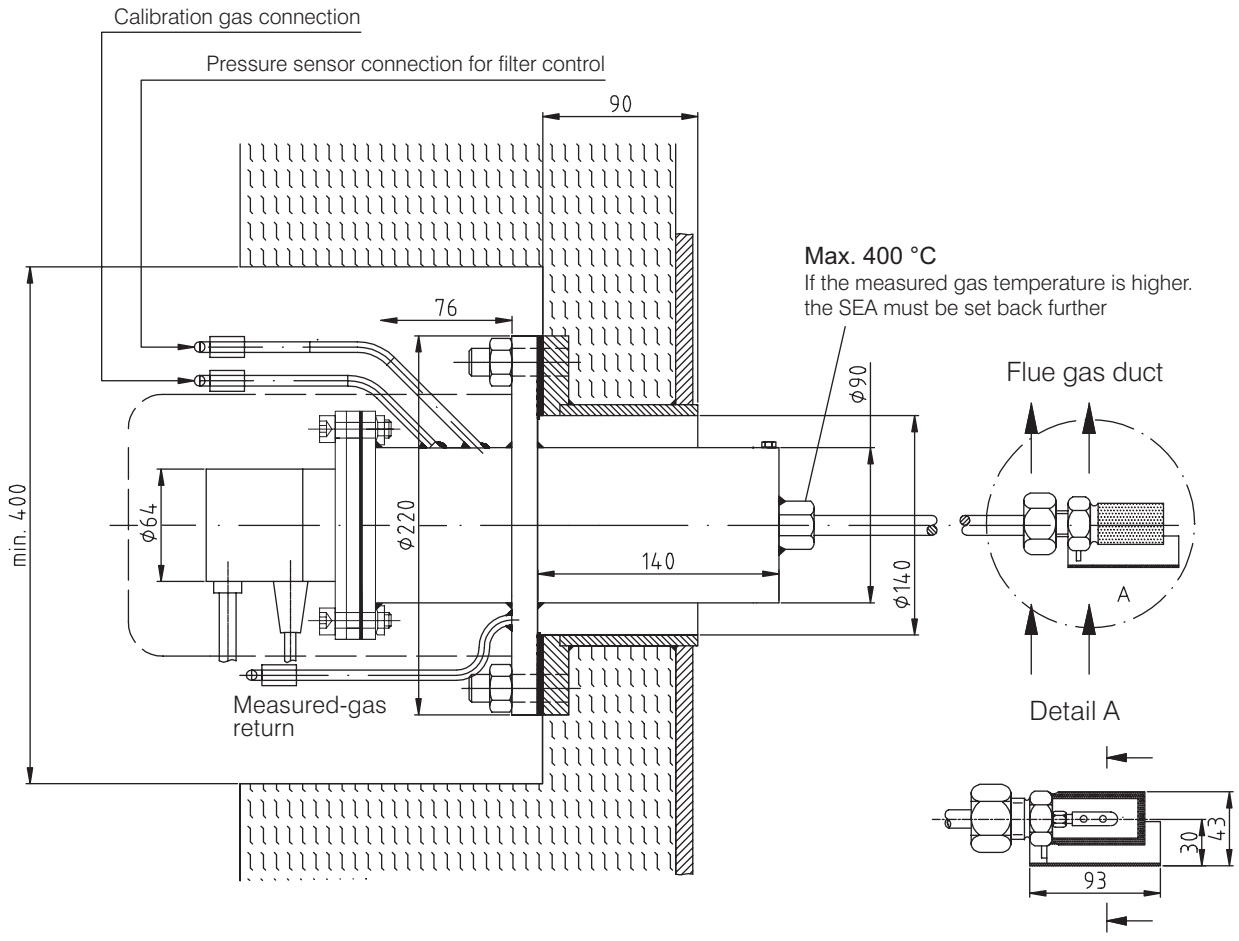
4.2.1 Fitting of mating flange and probe installation fitting

Any mounting position, from horizontal to vertical. Measured-gas hose electrical connection cable pointing downwards. Measured-gas hose to be installed in falling alignment.

Mounting position



Probe installation fitting (SEA) No. 6 55 R 0083 / R 1183 with Lambda Probe LS 1 No. 6 50 R 0030...R 0039 and external insulation No. 6 57 P 0100 or, alternatively, No. 6 55 R 0053



Measured gas temperature:
> water or acid dew-point
up to 800 °C, see 3.3.1, page 28

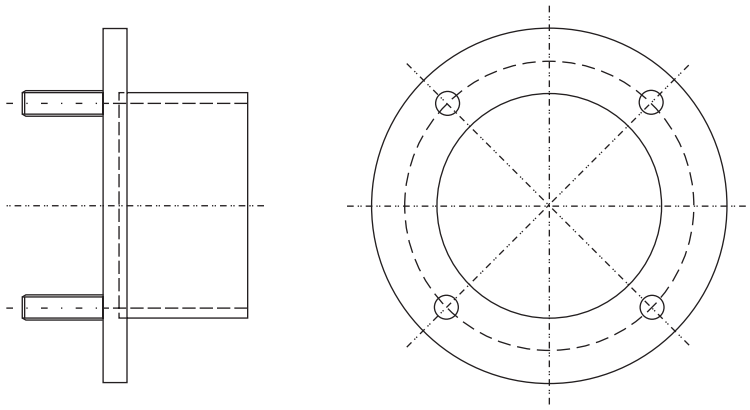
– Burn a hole with a diameter of 110 mm or 155 + 5 mm out of the flue gas duct.

WARNING

Damage can be caused by parts falling into the gas duct when openings are made. Parts which are to be removed should be secured with wire stapling. Appropriate protective measures should be taken against emerging hot, explosive or harmful waste gases.

– Align the mating flange (pipe) (see Fig..) and weld to the measuring point with a “tight” weld joint.

Align mating flange at measuring point and weld in place



– Fit transmitter protection box, if used
– Mount protective tube with sintered metal filter on the SEA (see Fig.) and align baffle plate. Apply anti-burn-in paste, No. 6 50 R 1090, to all screwed connections and threads.

IMPORTANT! The sintered metal filter breaks easily. Without the filter, calibration is not possible when the device is installed.

– Fit the MEV protective tube anti-twist lock, see Fig. on page 79.
– Fit the SEA without the probe. Do not forget the seal.
– Firmly tighten the screws.
– Close the opening in the SEA.
A blind flange, No. 6 57 P 0445, is available for this purpose.
– Fit LT 1 or SAK close to SEA (max. distance 10 m).

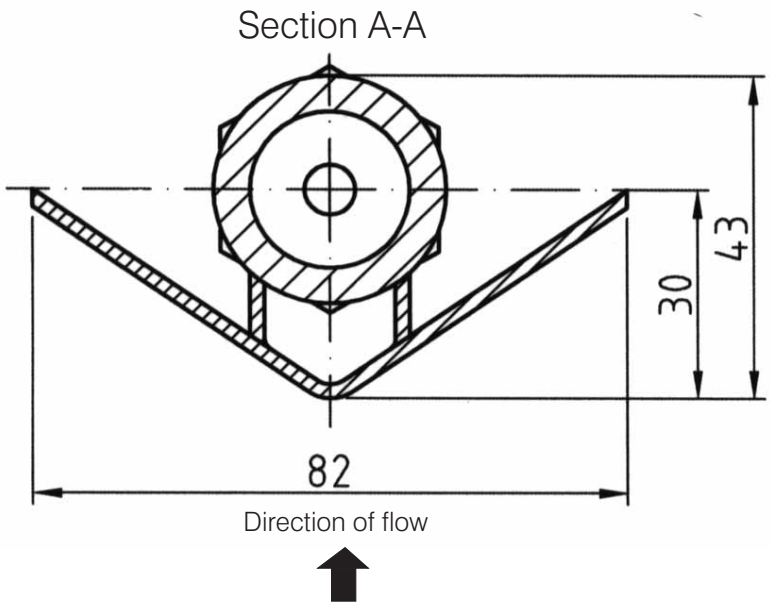
IMPORTANT!

The Lambda Probe should not be pre-fitted under any circumstances.

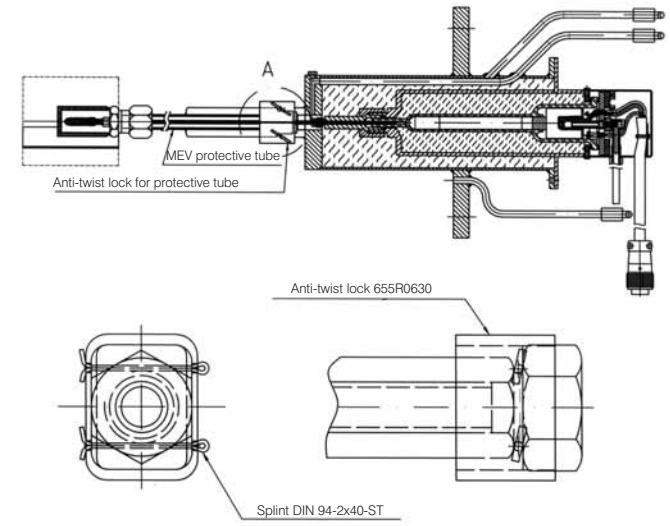
The over-pressure or under-pressure at the measuring point causes the gas which is to be measured to flow through the probe and this can result in blocking of the “critical nozzle”.

The Lambda Probe should therefore only be fitted when the appliance is put into operation.

Align sintered metal filter attachment with baffle plate



Detail A



Fit MEV protective tube anti-twist lock

IMPORTANT!

In the case of horizontal installation, it is recommended that the MEV protective tube should be supported for MEV lengths in excess of the following:

Standard:	> 1400 mm
Protective tube with aluminium core:	> 1000 mm
Protective tube with copper core:	> 600 mm

Even where shorter lengths are used, the MEV should also be supported if there is vibration at the measuring point.
See also Fig. in 3.3.2, page 29.

4.2.2 Fitting the transmitter protection box

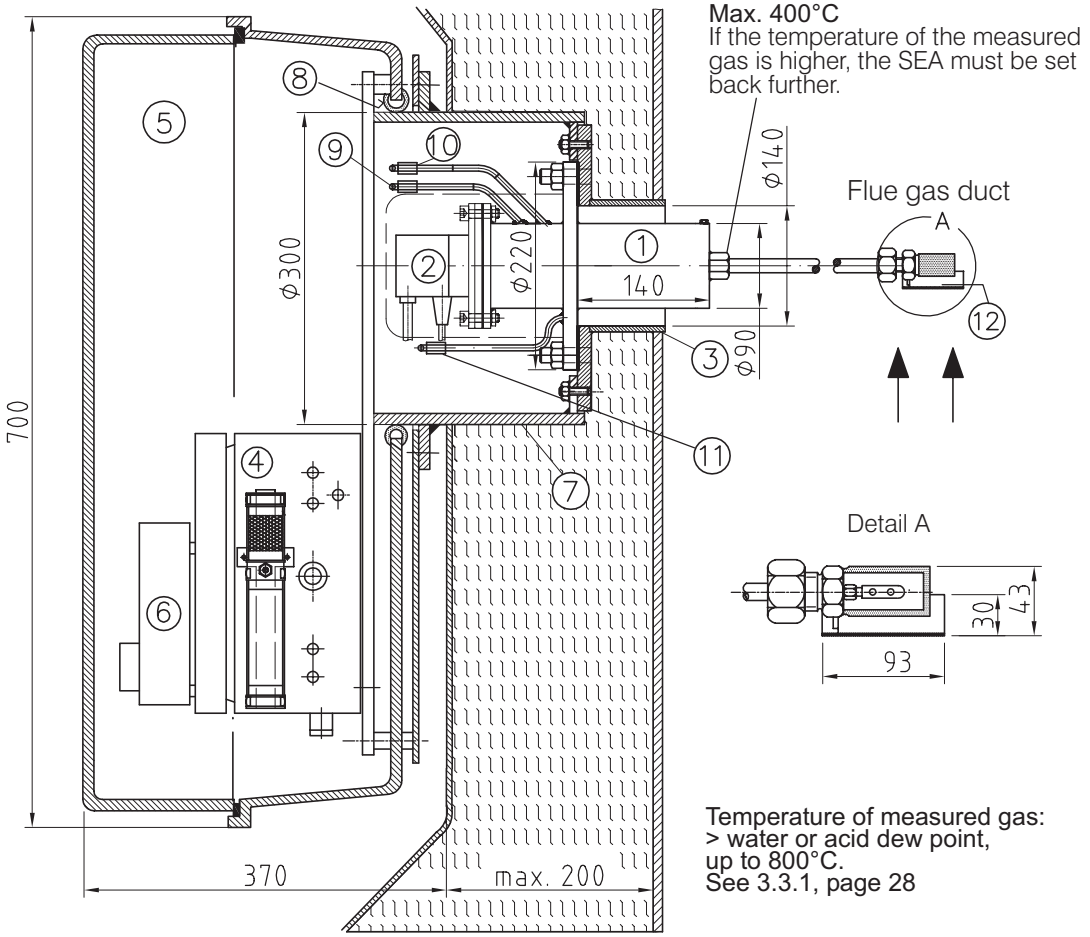
The transmitter protection box is necessary only in special cases, for open-air installation and for ambient temperatures below +5°C.

NOTE:

The Lambda Transmitter LT 1, Compact version IP 65, No. 6 57 R 0000...R0009 has been specially developed for open-air mounting. See Technical Data - Lambda Transmitter LT 1, Booklet No. D LT 6062.99 aD.

The transmitter protection box is used only if the Lambda Transmitter LT 1, together with the indicator and control unit, is to be installed away from the measurement point or if the ambient flue gas temperature does not allow installation of the compact version of the LT 1.

Probe installation fitting (SEA) with Lambda probe LS 1 and transmitter protection box



Temperature of measured gas:
> water or acid dew point,
up to 800°C.
See 3.3.1, page 28

1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...R 0039

3 Mating flange
No. 6 55 R 0187 special steel - material 1.4571 (V4A)
No. 6 55 R 0190 galvanized steel

4 Probe connection box (SAK)
No. 6 57 R 0013

5 Transmitter protection box
No. 6 55 R 0087

6 Electrical heating (frost protection) included in
No. 6 55 R 0087

7 Mounting for transmitter protection box included in
No. 6 55 R 0087.

8 Sealing profile
No. 6 55 P 8705

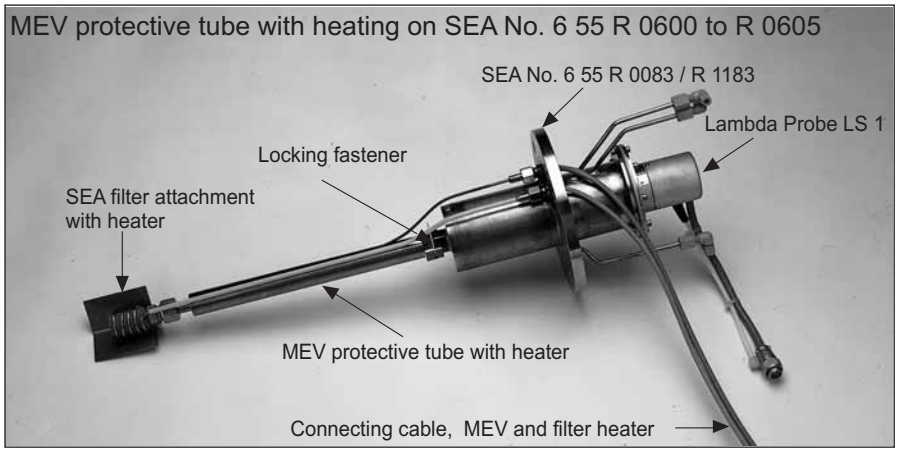
9 Calibration gas connection

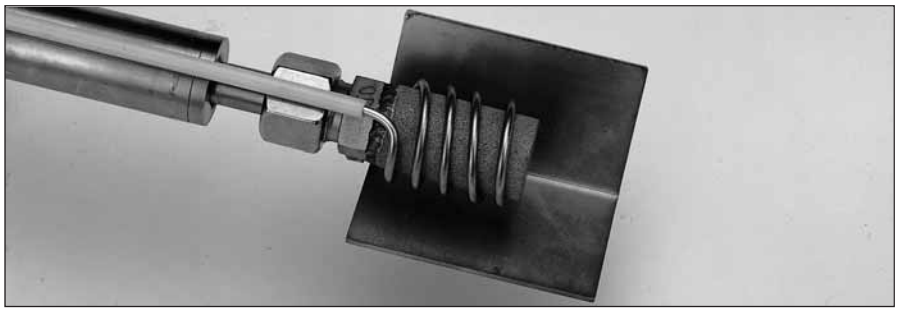
10 Connection for pressure sensor for filter monitoring

11 Measured-gas return

12 Baffle plate

4.2.3 Fitting of heating for MEV and prefilter (option)





– The MEV protective tube and heater are generally factory-prefitted

– Mount protective tube locking device
For details, see drawing in 4.2.1, page 77 - 79

– Provisionally fit MEV protective tube and align heater in the connection area

– Fit the MEV protective tube and tighten

– Align connector plug towards socket

IMPORTANT!

The connector must fit in the socket with minimum correction, without the contact pins being damaged. Otherwise, realign.

– Firmly tighten the screwed olive connection

– Measure the resistance on the heater connecting cable. The resistance is correct if less than 30 Ω

– Tighten the MEV protective tube

– Fit the protective tube locking device

– Fit the SEA

– Connect the heater to the electric power supply
See connection diagram in 3.6.8, page 63 - 64

4.2.4 Supporting the gas extraction device (MEV)

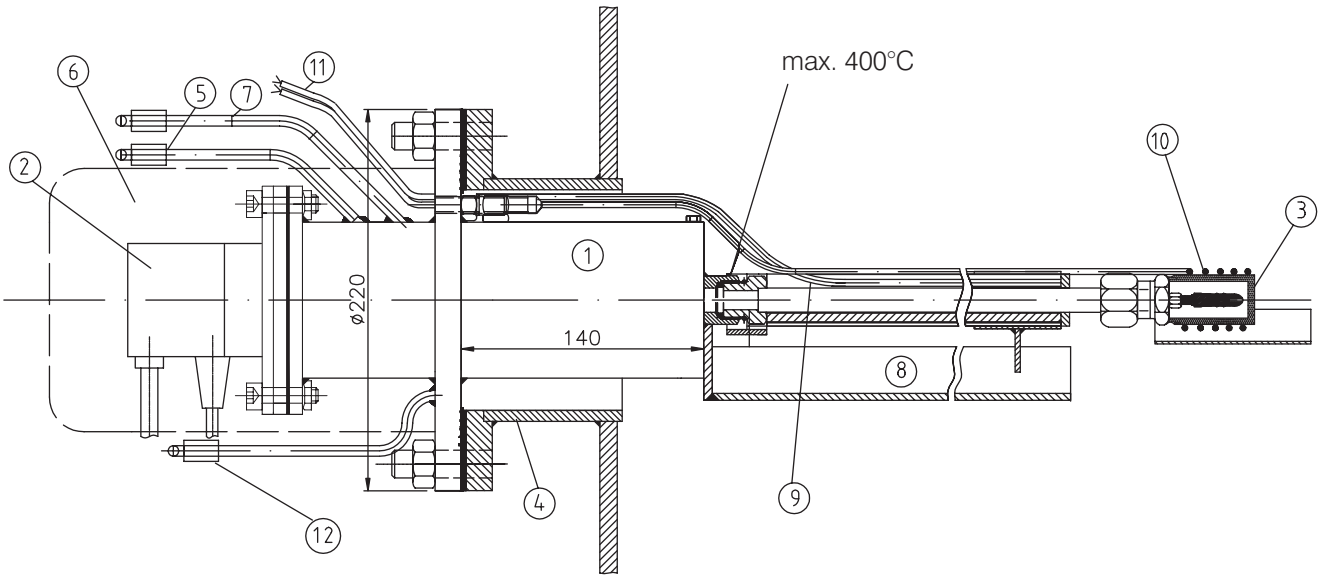
IMPORTANT!

In the case of horizontal installation, it is recommended that the copper or aluminium cored MEV protective tube should be supported for MEV lengths in excess of the following:

Standard:	> 1400 mm
Protective tube with copper core	> 600 mm
Protective tube with aluminium core:	> 1000 mm
Ceramic protective tube	> 1000 mm

Even where shorter lengths are used, the MEV should also be supported if there is vibration at the measuring point.
See also drawing in 3.3.2, page 29.

SEA No. 6 55 R 0083 / 1183 with MEV heating
MEV support



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031...6 55 R 0039

3 Gas extraction device (MEV) with extraction filter,
e.g. 1000 mm long No. 6 55 R 0028
matching protective tube No. 6 55 R 0620

4 Mating flange
No. 6 55 R 0183 / R 0185

5 Calibrating gas connection

6 Insulation for LS 1 and SEA
No. 6 57 P 0100

7 Pressure sensor connection

8 Protective tube support
No. 6 55 R 0614

9 Protective tube with MEV heater, e.g.
No. 6 55 R 0602 (1000 mm)

10 Filter heater, e.g.
No. 6 55 R 1092 (1000 mm)

11 Electrical connections for MEV and filter heaters

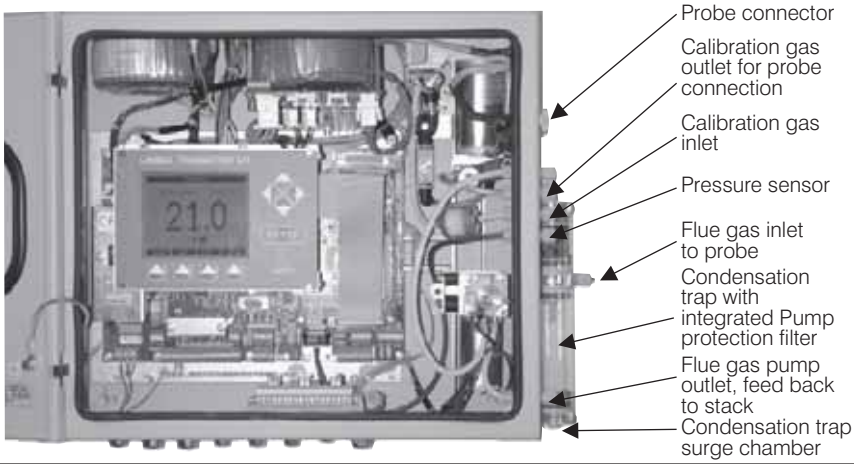
12 Measured-gas return

4.3.1 Mounting the Lambda Transmitter LT 1

– Mount the Lambda Transmitter LT 1 in an appropriate location.
Electrical connections facing downwards.
Probe connection to the side (right)
See also LT 1 dimensional diagram on page 52 and figures on page 48-49.

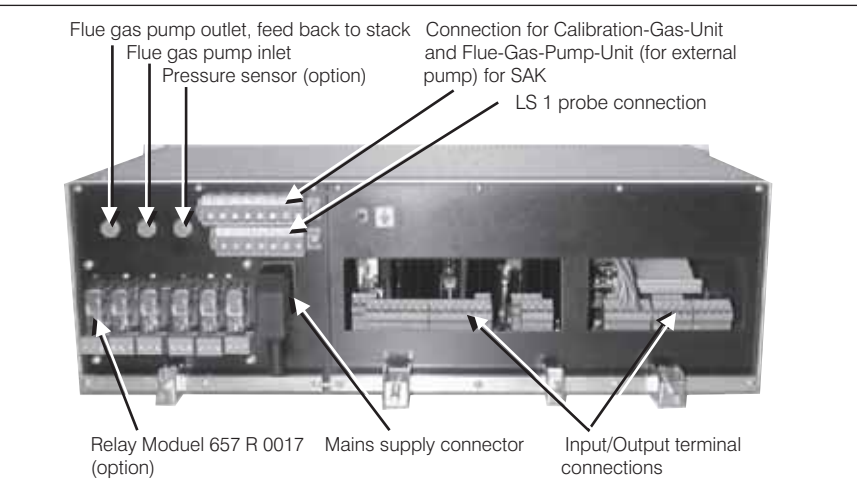
Note!

Ambient temperature
LT 1 with measured-gas pump +5 °C...+60 °C
LT 1 without measured-gas pump and calibration pump -20 °C...+ 60 °C



– The measured-gas return may only be connected in combination with a transmitter protection box.
For under-roof installation, it is recommended that the measured-gas return should not be connected, particularly in the case of large distances between the SEA and the LT 1.
Close the measured-gas return connection on the SEA using a blind plug.

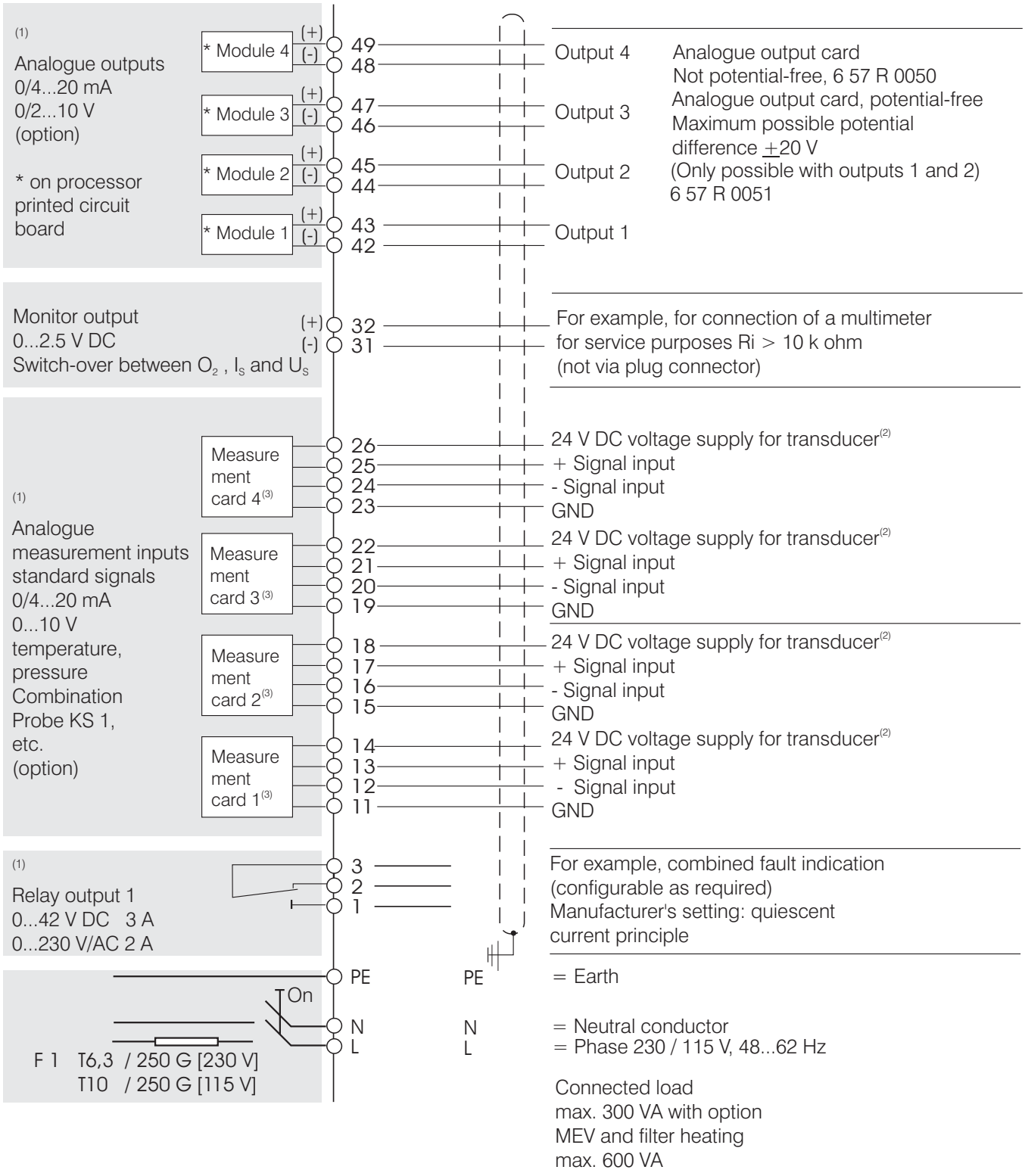
– Connect the calibrating gas supply to the SEA
(if the appliance is equipped with the optional “automatic calibration device”).



WARNING
Before working on electrical appliances, disconnect the power supply and check the disconnection. It is essential to follow the relevant safety instructions.

NOTE:
In the case of the OEM version, all data (measurement values, operating and fault messages, etc.) is transmitted via the BUS. An analogue or digital output of the data.

Lambda Transmitter LT 1/LT 1-19"

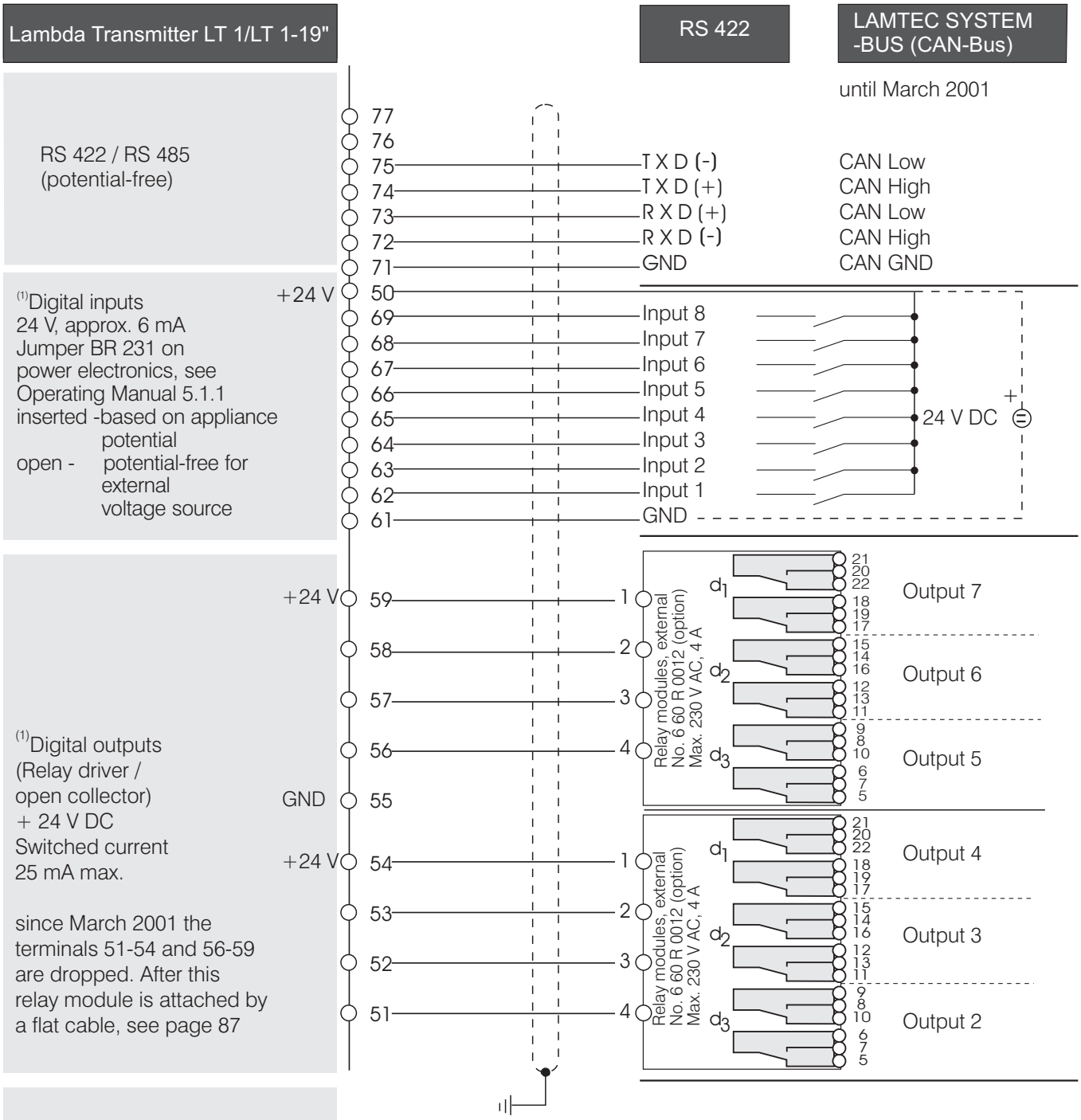


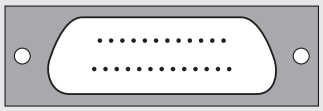
(1) Not possible with OEM version

(2) Maximum total current load for all 4 measurement cards, together 80 mA

(3) Other levels / signal inputs also possible, depending on measurement card
Of these, a maximum of 2 potential-free; maximum possible potential difference ± 20 V

4.3.2.1.1 Relay modules for digital outputs, external





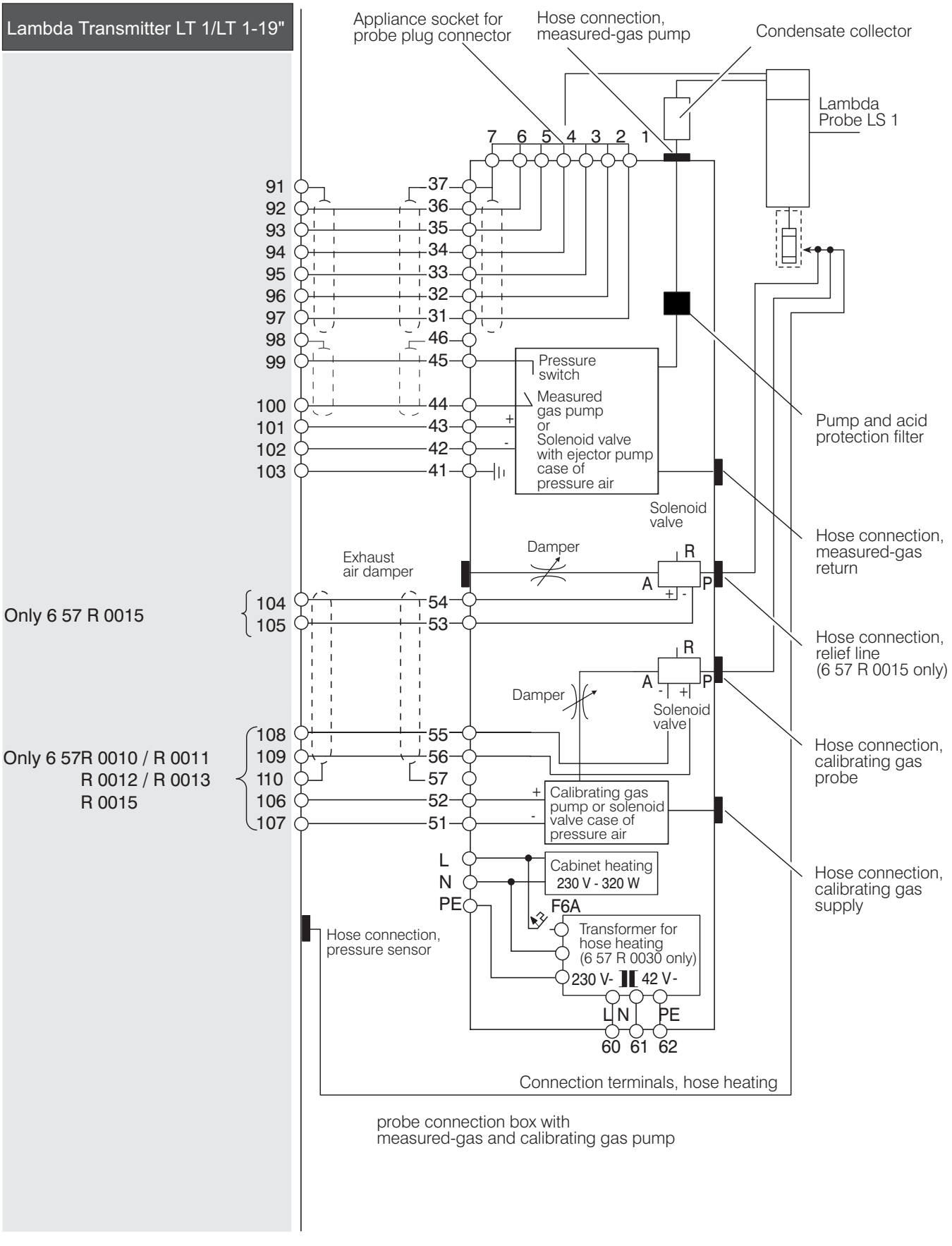
Plug connector for interface module, 25-pin

Interface module:

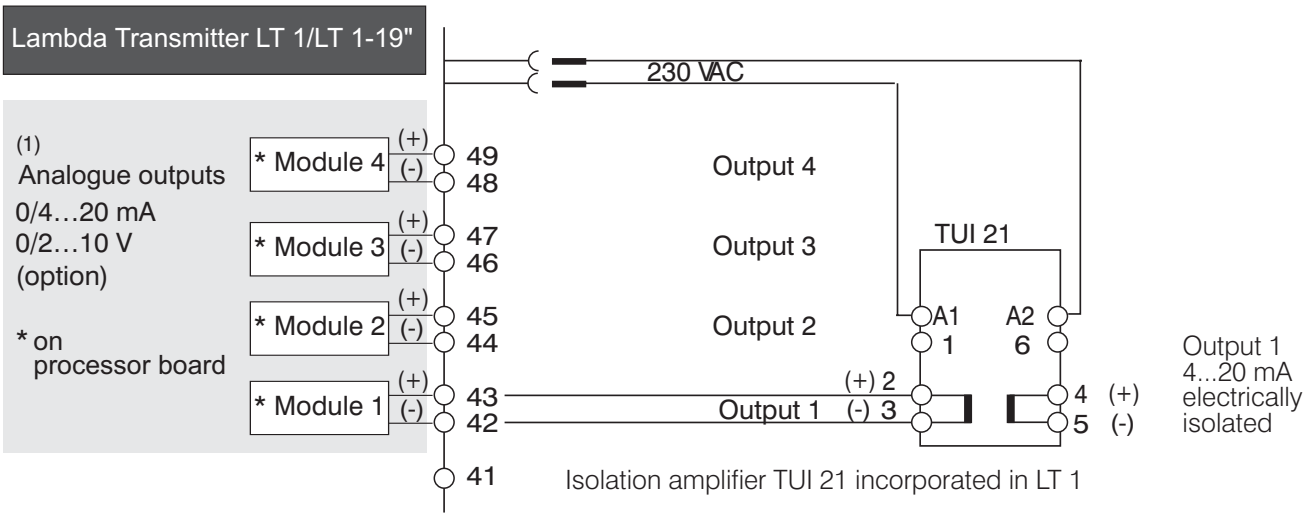
RS 232	in conjunction with Remote- and display software 657 R 1101	- 6 63 P 0600
RS 422 / 485		- 6 63 P 0500

(1)Not possible with OEM version

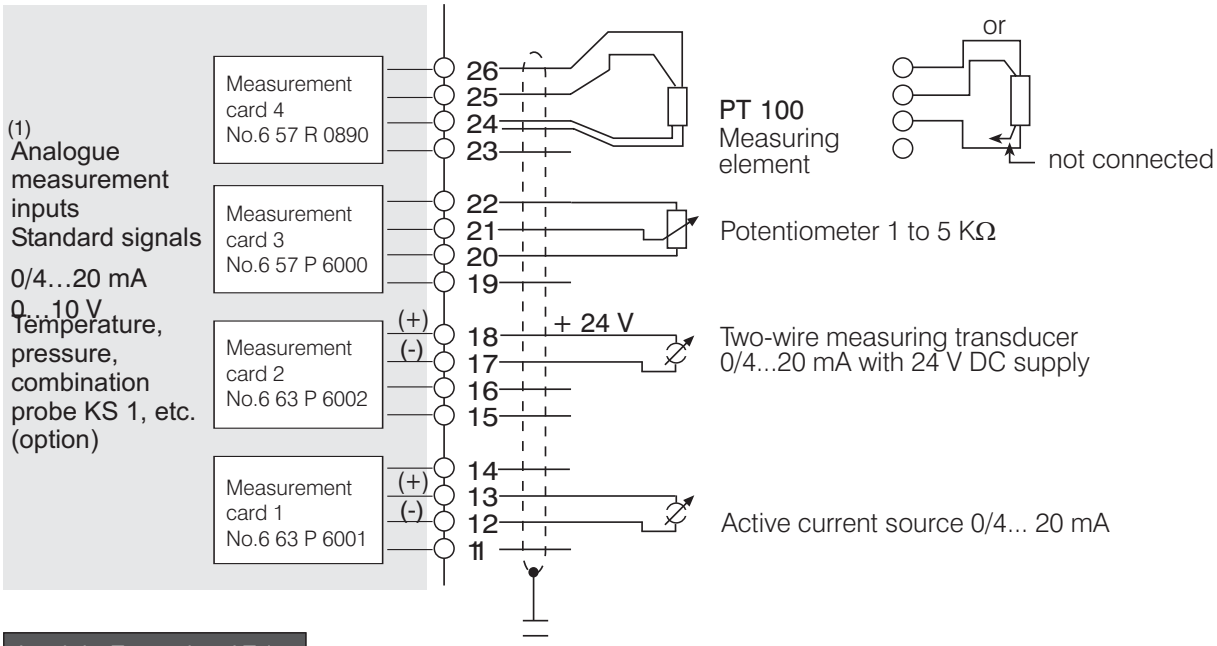
Connecting the probe connection box (SAK) to the Lambda Transmitter LT 1

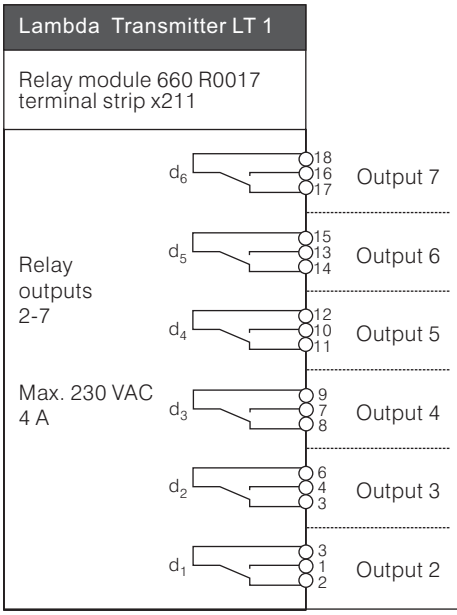


Electrically isolated analogue outputs - No. 6 57 R 0053 (option)



Analogue inputs, Terminals 11 to 26 - connection variants





Cable cross section:
Probe heater

LT 1 Terminal 92, 93
SAK Terminal 35, 36

Cable length SAK - LT 1	Cross section	Suggested
up to 10 m	$\geq$ 2.0 mm^2	2.5 mm^2
up to 20 m	$\geq$ 4.0 mm^2	4.0 mm^2
up to 30 m	$\geq$ 6.0 mm^2	2 x 4.0 mm^2
over 30 m	on request	

Measured-gas pump

LT 1 Terminal 101, 102
SAK Terminal 42, 43

Calibrating gas pump

LT 1 Terminal 106, 107
SAK Terminal 51, 52

Cable length SAK - LT 1	Cross section	Suggested
up to 10 m	$\geq$ 1.0 mm^2	1.5 mm^2
up to 20 m	$\geq$ 2.0 mm^2	2.5 mm^2
up to 30 m	$\geq$ 3.0 mm^2	4,0 mm^2
over 30 m	on request	

All other cable cross sections:

up to 10 m cable length 0.50 mm^2
over 10 m cable length 0.75 mm^2

Hose connections:
Measured-gas lines

Teflon tube (PTFE) 6 x 4 mm No. 6 50 P 0707

Calibrating gas supply and pressure sensor connection

Polyamide tube (PA 6) 6 x 4 mm No. 6 50 P 1001
For ambient temperatures over 60 °C Teflon tube (PTFE) 6 x 4 mm No. 6 50 P 0707

Hose connection via

Hose screwed connection (PVDF) No. 6 55 R 0213
A condensate separator must be inserted in the measured-gas line.
Condensate collector, standard No. 6 52 R 0212
Condensate collector, PVDF No. 6 52 R 0240 and R 0241
The probe connection box No. 6 57 R 0010...R 0018 is supplied with a factory-fitted condensate collector with an integral pump protection filter.

WARNING:

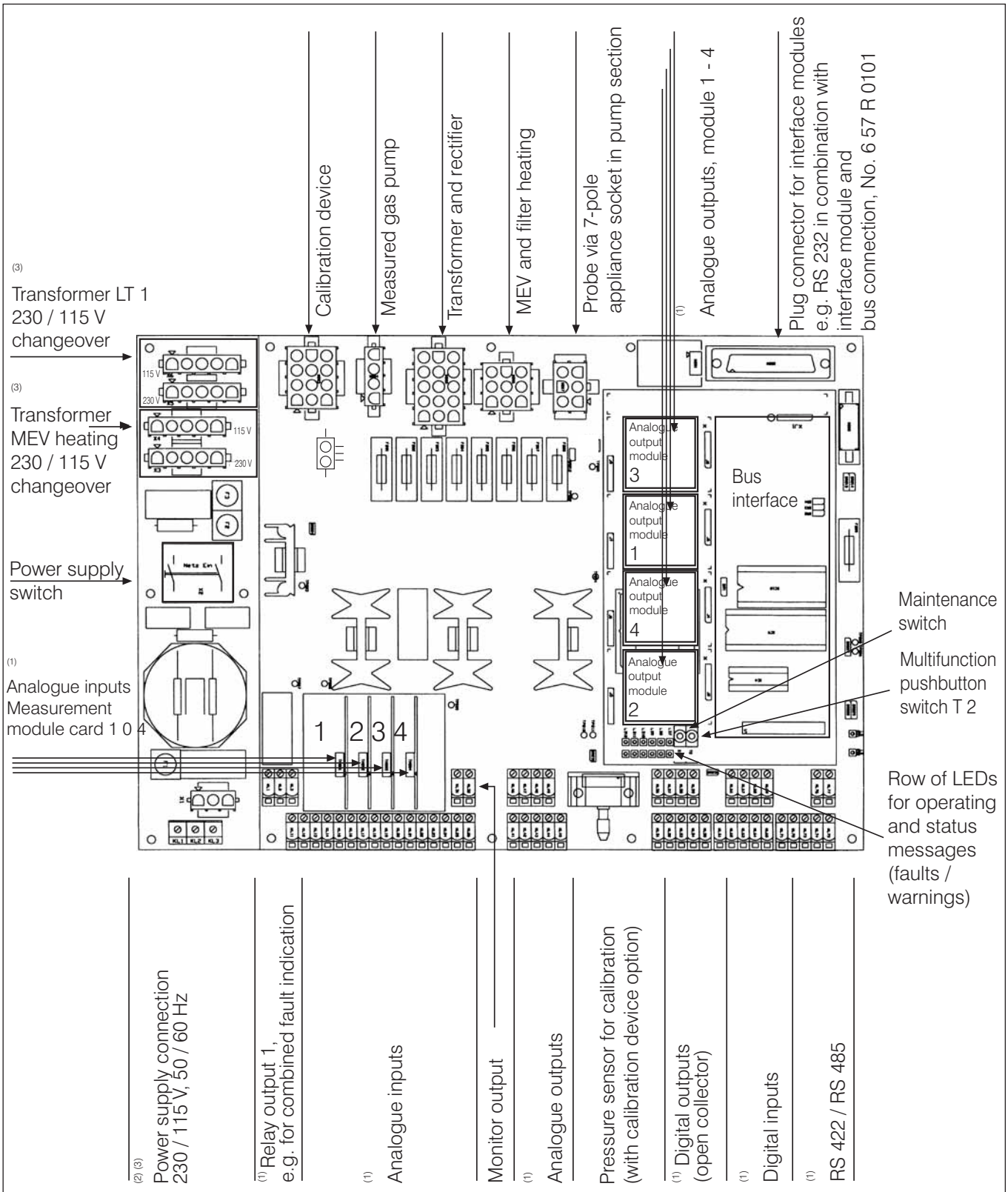
The probe can be damaged if incorrectly connected. Check probe connection terminals 31 to 34 before start of operation.

31 (-) probe current
32 (-) sensor line for sensor voltage
33 (+) sensor line for sensor voltage
34 (+) probe current

NOTE:

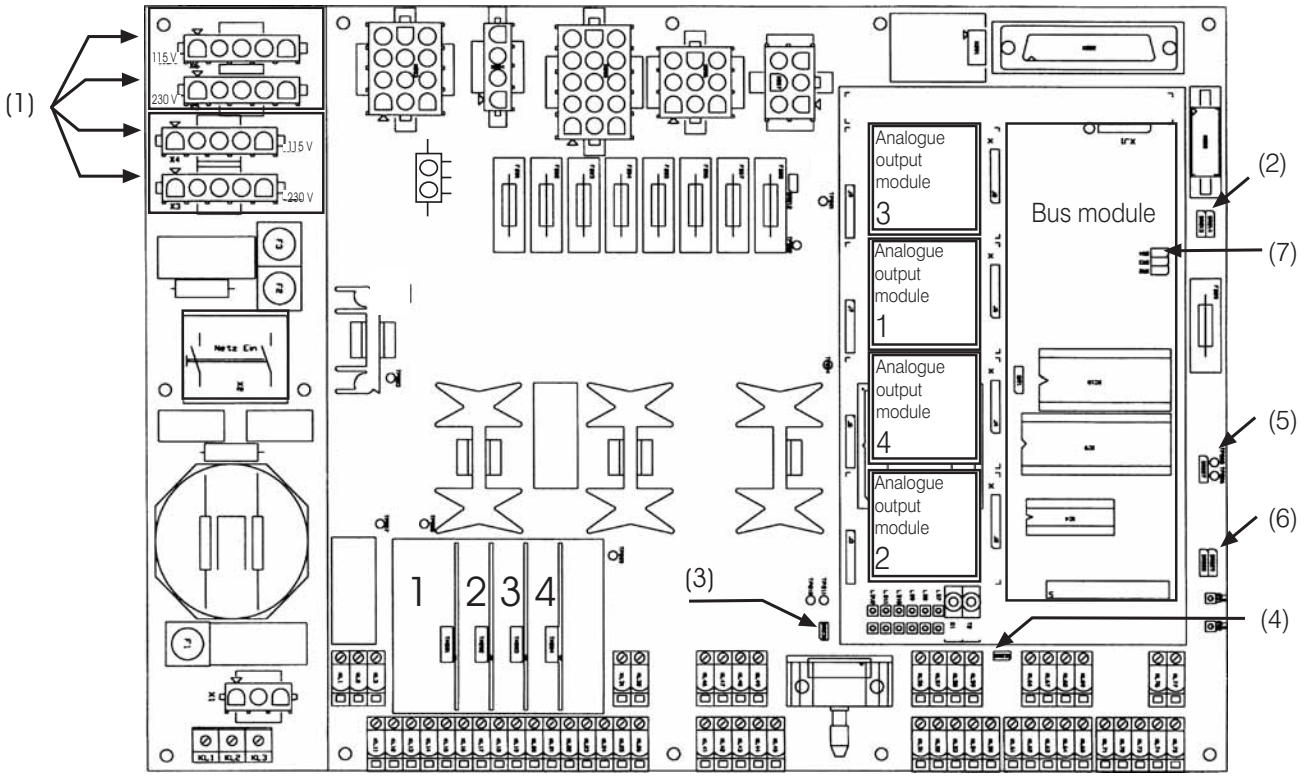
If the measured gas contains high concentrations of SO_2, NO and HCL, it is recommended that the active carbon filter preceding the measured-gas pump, or the filling in the combined filter / condensate collector, should be cyclically replaced. Order No. 6 52 R 0248 and 6 57 R 0780 respectively.
The LT 1 has 2 service warnings. These can be set individually, according to the requirements of the measurement location, via the
– indicator and control unit (option), see separate document
– remote display software (option), see separate document
A warning is then emitted on expiry of the pre-set number of operating hours, e.g. to empty the condensate collector, replace the filter insert. Factory setting OFF.

4.3.2.2 Base electronic PCB up to March 2001 or device serial no. 599
Processor board PCB up to May 2000, see also page 157



(1) Not equipped in OEM version
(2) In Compact Version IP 65, connection in pump section
(3) IMPORTANT! Different fuse ratings for 230 V and 115 V supply voltages (230 V below).
Correct fuse ratings must be ensured before changing over power supply voltage. For fuse ratings, see 8.6, page 156 - 157.

5.1.1 Checking manufacturer's settings



Mainboard till March 2001, processor unit till May 2000

(1) Power supply voltage changeover 230 / 115 V

IMPORTANT!

Different fuse ratings for 230 V and 115 V supply voltage. Correct fuse ratings must be ensured before changing over the power supply voltage. For fuse ratings, see 8.6, page 154.

(2)	BR 213	left		Quiescent level from internal relay (not fitted in OEM version)	
			top	Working-current principle	X
			bottom	Quiescent-current principle	
	BR 214	right	top	RS 422 / RS 485 deactivated	
			bottom	RS 422 / RS 485 activated	X
(3)	BR230	right	open	Absolute pressure sensor (standard)	X
	BR 232	left	closed	Relative pressure sensor (option)	

X = Manufacturer's setting

(4) BR 231	open	24 V inputs, potential-free (not fitted in OEM version)		
	connected	24 V inputs, related to appliance potential		X

RS 422 / RS 485 interface

(2) BR 214	right	Position 1 - 2 top	RS 422 / RS 485 deactivated (second interface on X 202[1])	
		Position 2 - 3 bottom	RS 422 / RS 485 activated	X
(5) BR 227		Position 1 - 2 top	Full duplex operation	X
		Position 2 - 3 bottom	Half duplex operation	

In full duplex operation

			duplex operation	X
		Position 1 - 2 top	No 120 ohm receiver termination	

In half duplex operation

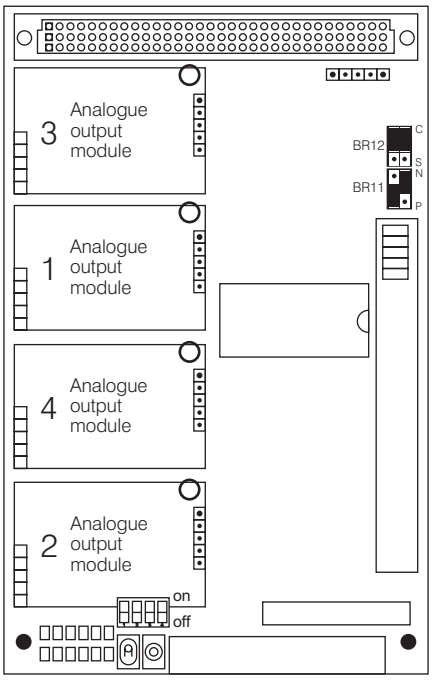
(6) BR 229	right	Position 2 - 3 bottom	120 ohm receiver termination in half duplex operation	
		Position 1 - 2 top	No. 120 ohm receiver termination	X

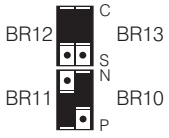
(7) Plug-in jumper assignment, processor card
(till delivery date May 2000))

BR 2 (bottom)	BR 3 (centre)	Function of monitor output)
open	open	O_2 content 0...2.5 V ≙ 0...25 % vol. O_2
inserted	open	Probe voltage 0...1.4 V ≙ 0...1400 mV
open	inserted	Probe current 0...1.0 V ≙ 0...1000 mA

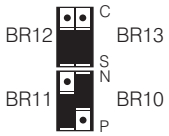
BR 4 (top) inserted Test gas connection deactivated (manufacturer's setting “open”)

Until delivery date June 2000





Configuration for LAMTEC SYSTEM BUS. Required for LAMTEC SYSTEM BUS screw terminals no. 71 to no. 75
BR12 and BR13 in position "C" (CAN-Bus)
Check jumper 301 to 306 on base electronic PCB,
see page 157

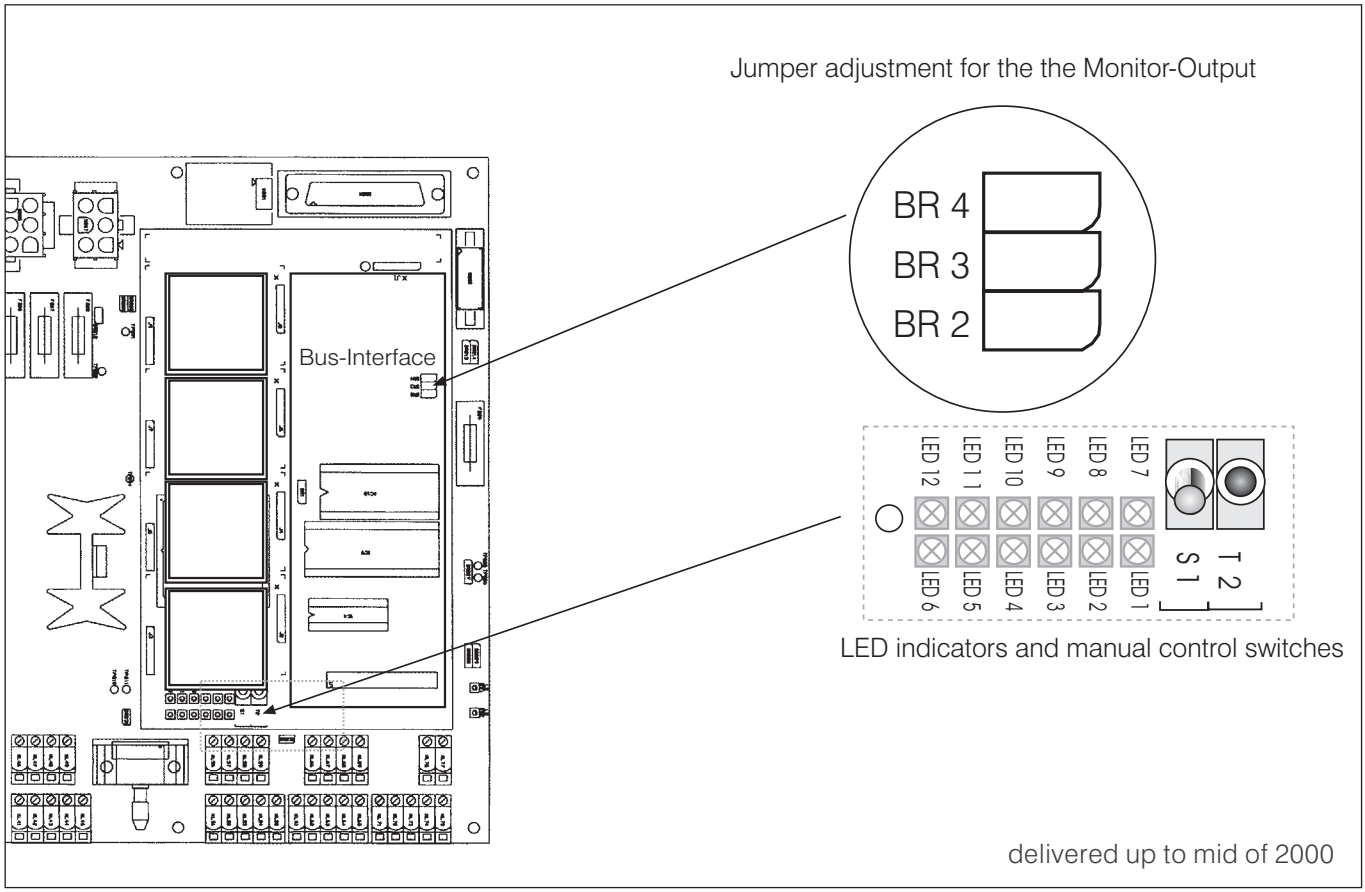


Configuration for 2nd serial interface (SICK). Required for 2nd serial interface, screw terminals no. 71 to no. 75
BR12 and BR13 in position "S" (serial)
Check jumper 301 to 306 on base electronic PCB,
see page 157

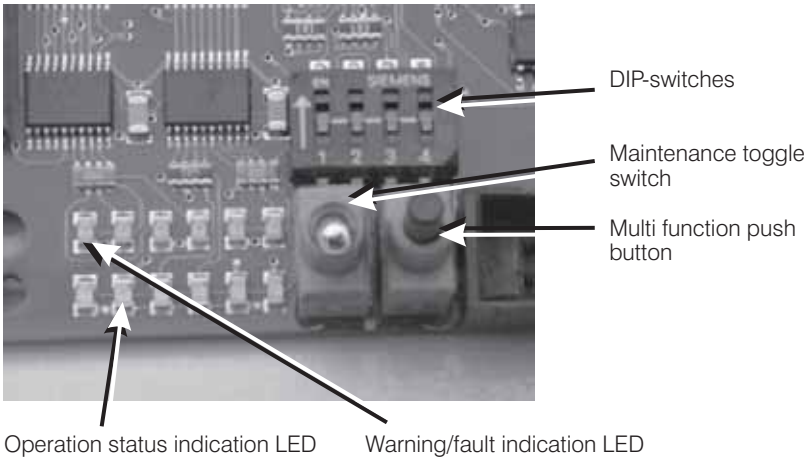
[1] = 25-pole plug connector on power supply electronics, usable via special interface module
X = Manufacturer's setting

5.1.2 Display- and manual control elements of the Lambda Transmitter LT1 delivered up to May 2000

The manual control of the LT 1 as well to display measured values, operation status and fault messages are done by the LCD Display- and Keypad-unit (optional), type 657 R 0830 or via an external manual control unit with RS422 interface, see special application notes.
The LT 1 itself offers only a limited manual control possibility, which ia able to control direct from the LT 1 the required functions for operation, maintenance and service, as well to display the operating- and/or fault-status by LSDs.



Since June 2000 a new designed Processor Board was build in series. The jumpers BR2 and BR3 are replaced by DIP-switches.



5.1.2.1 Monitor Output

The Monitor Output on LT 1 (screw terminals (–) / (+) 32) can be used to connect a digital Voltmeter. In a range of up to 2.5 Volts dc the LT 1 directly provides on the Monitor Output the following measured values:

– O_2-actual measured value
– Probe voltage
– Probe current

Up to May 2000 it was done by jumpers to switch between the different measured output, from June 2000 then a DIP-switch was used on the Processor Board. The maintenance toggle switch, multi function push button and the LEDs-indication all have the same function and meaning as they have had on the old type of Processor Board and have their description in the LT 1 Instruction Manual.

BR 2 (below)	BR 3 (mid)	Function of Monitor Output
open	open	O_2-value 0...2.5 V ≙ 0...25 % vol. O_2
closed	open	Probe voltage 0...1.4 V ≙ 0...1400 mV
open	closed	Probe current 0...1.0 V ≙ 0...1000 mA

Input burden of the Multimeter should be > 10 kΩ /Volt.

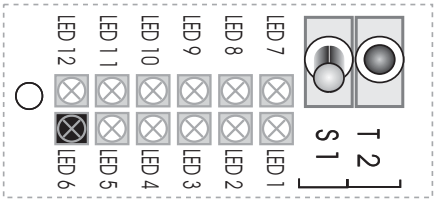
BR 4	Test gas application
open	enabled
closed	disabled

SW1	SW2	Function of Monitor Output	
off	off	O_2-value 0...2.5 V ≙ 0...25 % vol. O_2	
on	off	Probe voltage 0...1.4 V ≙ 0...1400 mV	
off	on	Probe current 0...1.0 V ≙ 0...1000 mA	

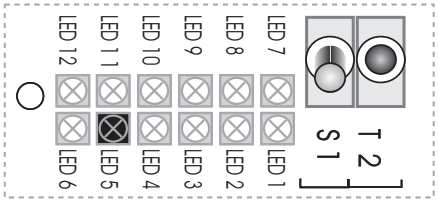
SW3	Test gas application
on	disabled
off	enabled

Input burden of the Multimeter should be > 10 kΩ /Volt.

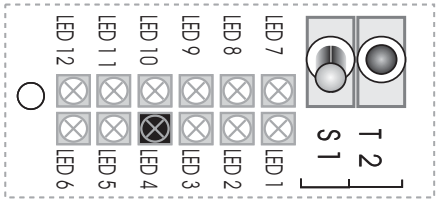
5.1.2.2 Indicator and control elements



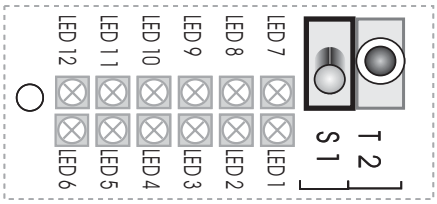
Operation indicator (green) LED 6
● - Operation



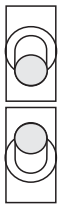
Operating mode indicator (green) LED 5
● - Measurement
⊖ - Calibration



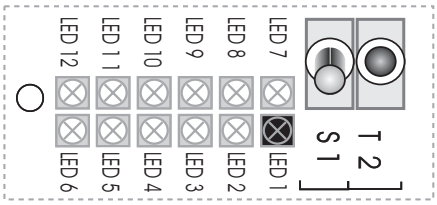
Heating monitoring LED 4 (orange)
⊖ - Heating control
● - heating with fixed voltage



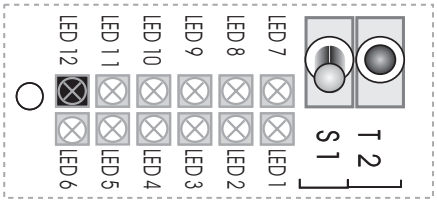
Maintenance switch S 1



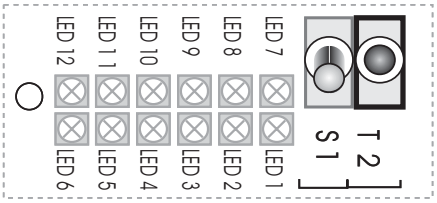
- Maintenance mode off
- Maintenance mode on



Maintenance (orange) LED 1
● - Maintenance mode active
⊗ - Normal operation



Maintenance / fault indication (red) LED 12
⊗ - No warning / fault
● - At least one warning active
⊖ - At least one fault active



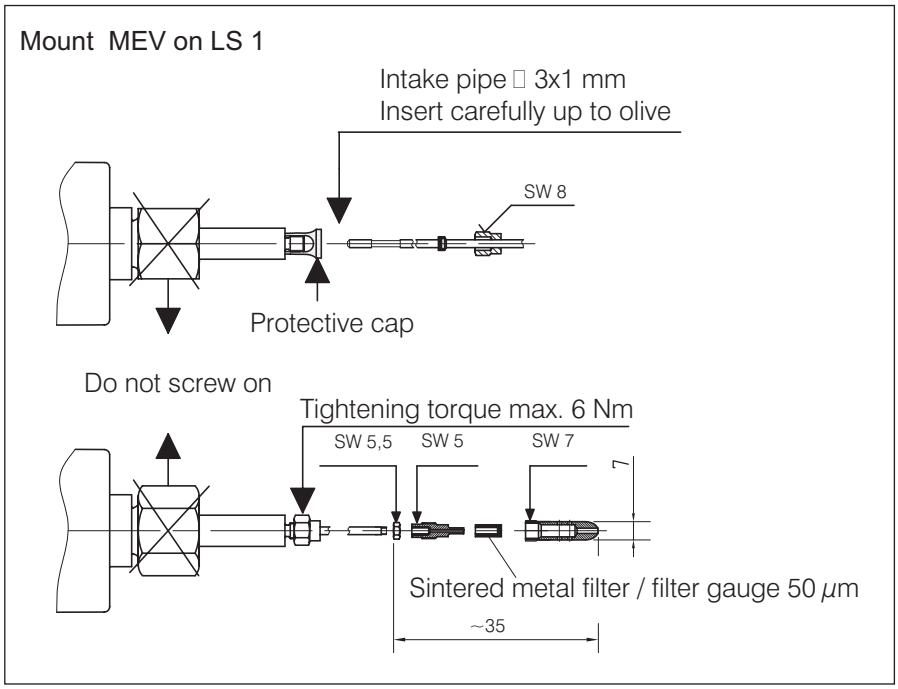
Multifunction pushbutton switch T 2

Note: Function	Pushbutton operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**

* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress.
**If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds.

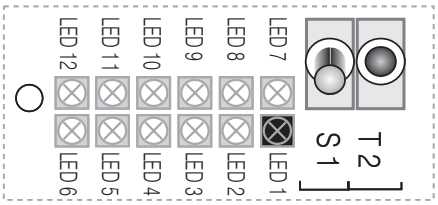
5.2 Lambda Probe fitting and putting into operation

- Remove probe from the packaging and remove plug from the measured gas intake
- Fig gas extraction device on probe and tighten



5.2.1 Without automatic calibration device

Connect, but do not fit, probe with 2 m or 5 m extension for the probe connection cable, No. 6 55 R 0010



Maintenance (orange) LED 1

● - Maintenance mode active

⊗ - Normal operation

-Set maintenance switch (S1) to “Maintenance”

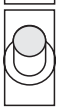
-Switch on LT 1

-“Maintenance” LED is illuminated

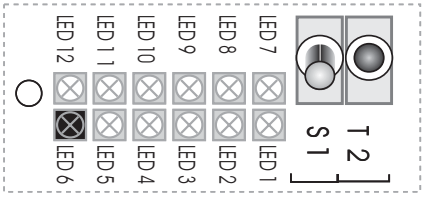
-Probe heats up

Maintenance switch S 1

- Maintenance mode off

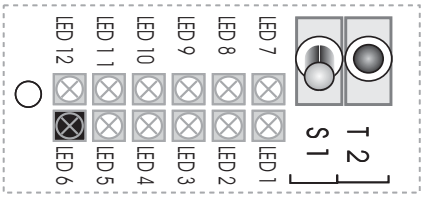


- Maintenance mode on



Operation indicator (green) LED 6
● - Operation

- Cold-start delay active
  LED 6 “Operation” is illuminated
  LED 5 “Measurement” off
  Measured gas pump off



Operating mode indicator (green) LED 5
● - Measurement
⊖ - Calibration

- The measured gas pump starts after expiry of a pre-set wait time (manufacturer's setting 120 min.)
  LED 5 “Measurement” is illuminated
- Wait at least one hour, or preferably 2 hours, and then fit and connect the probe in the probe installation fitting (SEA). Do not forget the graphite seal. Tighten the eight screws evenly.
- Fit the moulded insulating part.

NOTE:

The cold-start delay can be over-ridden by pressing the multifunction pushbutton switch T 2 (for more than 3 seconds, or for more than 6 seconds if there is a warning or fault present).

Function	Pushbutton Operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**

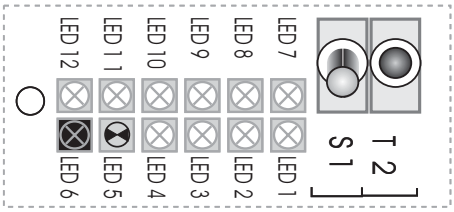
* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress.
** If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds.

IMPORTANT!

Never draw waste gas through a cold probe. This can result in blockage of the “critical nozzle”. Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour. See also 3.6.6, page 58.



Multifunction pushbutton switch T 2

- Having performed the above tasks, operate the “multifunction pushbutton switch T 2” and initiate calibration. LED 5 “Measurement” flashes
  → “Calibration” active.

It must be ensured that ambient air is present at the measuring point. If this is not ensured, the probe must be removed again for calibration.

Alternatively, it is possible to use a probe mounting with a calibrating gas supply, Nos. 6 55 R 0037 / R 1137 and 6 55 R 0083 / R 1183, to blow compressed air on to the measuring point via the calibrating gas supply on the SEA.

The procedure is described in detail in 7.1.1, page 117.

NOTE: Function	 Pushbutton operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**

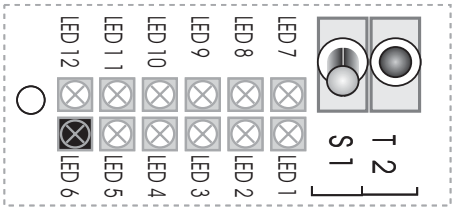
* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress.

** If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds .

- Wait until calibration is completed. Flashing will have stopped.
- If the probe has been removed for calibration, re-mount the probe.
- Mount the probe in the SEA and connect. Do not forget the graphite seal. Tighten the 8 screws evenly.

IMPORTANT!

If possible, the graphite seal should only be used once. A negative pressure at the measuring point will cause the measurement result to be falsified by entrained air.
Check the hose connection of the calibrating gas supply and of the pressure switch.



Multifunction pushbutton switch T 2

- Fit the moulded insulating part
- Switch LT 1 on again
- Operate the multifunction pushbutton switch T 2 and override cold-start delay, see Note on page 96.
- The pump operating time is now determined. See 3.6.7, page 61.

NOTE:

The operation for determining the pump running time is now performed once, following the “cold-start override”, via the multifunction pushbutton switch T 2. This operation cannot be interrupted.

WARNING

“Do not draw waste gas through cold probe “ (LED 8, 10 and 11) and “measured gas pump operating time control” (LED 7 and 11) are illuminated. If the pump operating time control is inadvertently interrupted, it can be reactivated as follows via the indicator and control unit (option), the service interface or, if neither is available, with a new cold-start.

- Switch off LT 1
- Switch LT 1 on again immediately
- Interrupt cold-start-delay using multifunction pushbutton switch T 2
- Wait for 60 minutes
- [1] Re-start calibration via multifunction pushbutton switch T 2 or via the remote display software or the control unit
- [1] Start calibration again after 24 hours

NOTE:

Function	Pushbutton operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**

* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress.

** If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds.

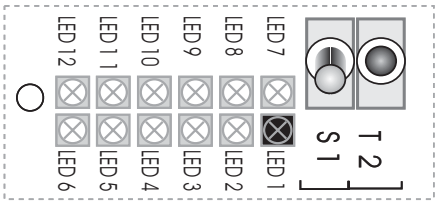
[1] For calibration purposes, if it cannot be ensured that ambient air is present at the measuring point the probe must be removed in each case. Alternatively, a SEA with a calibrating gas supply, Nos. 6 55 R 0037 / R 1137 and 6 55 R 0083 / R 1183, can be used to apply compressed air to the calibrating gas supply.
Recommended calibrating gas flow rate 400...500 Nl/h ≙ for a pressure rise of approx. 2 mbar in the filter.
The procedure is described in detail in 7.1.1, page 117.

5.2.2 With automatic calibration device, or with connected portable calibration device

- Mount the probe in the SEA and connect
  Do not forget the graphite seal.
  Tighten the eight screws evenly.

- Fit the moulded insulating part

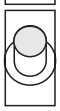
- Set the maintenance switch S 1 to “Maintenance”



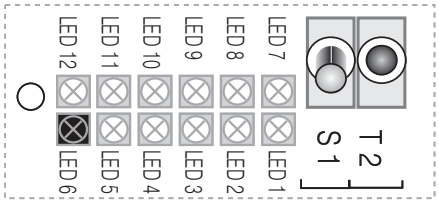
Maintenance (orange) LED 1
- ● - Maintenance mode active
- ⊗ - Normal operation

Maintenance switch S 1

- Maintenance mode off



- Maintenance mode on



Operation indicator (green) LED 6
- ● - Operation

- Switch on LT 1

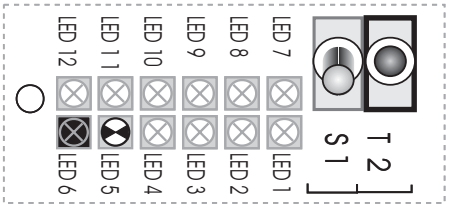
- The probe heats up
  Intelligent cold-start delay active, see 3.6.6, page 58
  LED 6 “Operation” illuminated
  LED 5 “Measurement” off
  Measured gas pump off
  Calibrating gas pump operates, thus preventing the probe from coming into contact with waste gas during the heating-up phase

- Set the calibrating gas flow rate to 400 Nl/h on the flow-meter

IMPORTANT!

It is essential to check that the calibrating gas is flowing, e.g. using the indicator and control unit (option) or the remote display software.
During calibration, monitor the pressure increase in the sintered metal prefilter. It is possible to influence this pressure increase by changing the calibrating gas flow rate on the flow-meter.

If the probe should come into contact with waste gas during the heating-up phase, there is a danger of blockage of the “critical nozzle” in the probe.



Multifunction pushbutton switch T 2
Calibration, LED 5, flashes

– The measured gas pump starts as soon as the probe is warm.

– The cold-start delay can be overridden at any time using the multifunction pushbutton switch T 2, but wait at least 1 hour before overriding in this way.

– Wait at least 2 hours before starting calibration via the multifunction pushbutton switch T 2.

LED 5 “Measurement” flashes → “Calibration active”.

If calibration is started before this period, it should be repeated after 2 hours of operation.

NOTE: Function	 Pushbutton operation
Switch between the indicated warning / fault	Press briefly
Cancel the indicated warning / fault	Press for more than 3 secs.*
Quick-start of measured gas pump, over-ride cold-start	Press for more than 3 secs.*
Initiate calibration	Press pushbutton for more than 3 secs. in measurement mode**
* Some warnings or faults cannot be cancelled if the fault is still present or if the cycle is in progress. **If one or more warnings or faults are present, the pushbutton must be pressed for 6 seconds.	

– Wait until the calibration process is completed (flashing will have stopped).

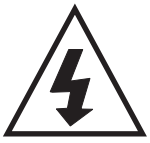
– The pump operating time is now determined.

Proceed as follows:

- Switch LT 1 off again
- Switch LT 1 on again immediately
- Interrupt the cold-start delay via the indicator and control unit CAL and pump on, via the remote display software or the multifunction pushbutton switch T 2, see Note on this page.
- The pump operating time is now determined, see 3.6.7, page 61.
- Wait for 60 minutes.
- Re-start calibration via the multifunction pushbutton switch T 2, or remote control or control unit.
- Start calibration again after 24 hours.

NOTE:

The operation for determining the pump running time is now performed once, following the “cold-start override”, via the multifunction pushbutton switch T 2. This operation cannot be interrupted.



WARNING

“Do not draw waste gas through cold probe “ (LED 8, 10 and 11) and “measured gas pump operating time control” (LED 7 and 11) are illuminated. If the pump operating time control is inadvertently interrupted, it can be reactivated as follows via the indicator and control unit (option), the service interface or, if neither is available, with a new cold-start.

– Switch off LT 1

– Switch LT 1 on again immediately

– Interrupt cold-start-delay using multifunction pushbutton switch T 2

5.2.3 Activation of flow test (dynamic test)

Parameter group 1330 to 1334

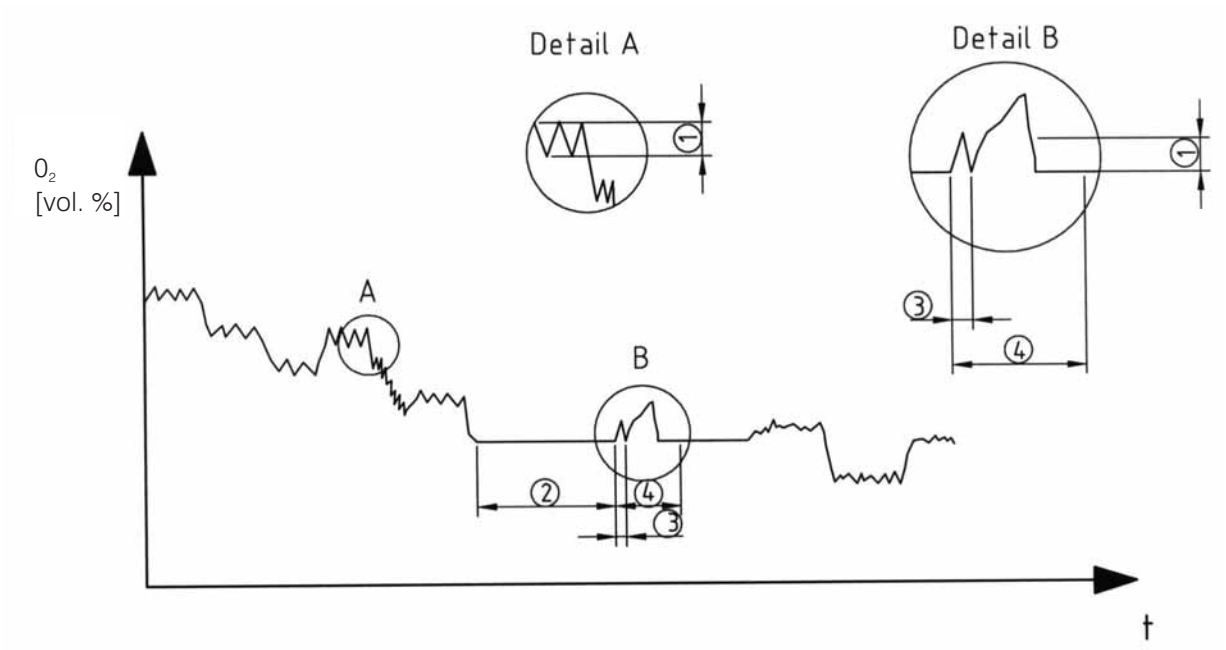
The purpose of the flow check (dynamic test) is to determine whether the gas to be measured is still flowing through the Lambda Probe LS 1 or whether the Gas extraction device (MEV) or the “critical nozzle” or any other gas-carrying part is blocked.

NOTE:

In the event of a blockage, the Lambda Probe LS 1 does not indicate 0 % vol. O_2 , but a value between 2 and 4 % vol. O_2. This is because the external and internal electrodes of the ZrO_2 measuring cell are not isolated from one another by a gas-tight separation. The measuring cell “pumps” the oxygen in the circuit.

Software versions from 1V28 onwards include a so-called dynamic test, which continuously checks the measured signal for variations (dynamic) within the programmable monitoring period. If a dynamic ceases to be registered, a warning or fault message can be signalled. If the LT 1 is equipped with a fully automatic calibration device 6 57 R 0800 / 6 57 R 0801 (option), a forced dynamic is generated by switching on the calibration function, provided that no measurement signal dynamic is detected. If no reaction can be detected within a second programmable monitoring period a calibration cycle is initiated. A fault[1] or warning[2] can be signalled instead of initiation of a calibration cycle.
A warning “Dynamic test active” is indicated while the dynamic test is in progress - from the point of brief activation of the calibration function through to the end of the second monitoring period.

[1] Fault
“No LS 1 probe dynamic”
[2] Warning
“No. LS 1 probe dynamic”



	Parameter	Designation	Manufacturer's setting
①	1330	Dynamic setpoint value WO_2	0.0 % vol. O_2
②	1331	Monitoring period 1	10 minutes
③	1332	Calibrating gas on-time	0.6 seconds
④	1333	Monitoring period 2	30 seconds
	1334	Type of response either Calibration Fault Warning	Calibration

IMPORTANT!

The appliance is supplied from the manufacturer with the flow test deactivated. It must be activated by the customer, via the indicator and control unit (option, No. 6 57 R 0830) or the remote display software (option, No. 6 57 R 0101), using parameter 1330, raising the dynamic threshold.
Recommended setting: 0.6 % vol. O_2 .

Parameter 1332, “Calibration on-time”, must be determined for the particular installation. For this purpose, the parameters 1330 / 1337 must be set so as to ensure a reliable test response.

5.2.4 Set service warnings

The function of the service warnings 1 and 2 is to provide reminders of regular service tasks. The service warnings can be defined as required by the operator, e.g.:

Service warning 1 → check probe
Service warning 2 → remove and clean probe

The appropriate cycle intervals can be predefined by the customer, using parameters 1260 and 1261 within the range of 1 to 655535 hours.

Each probe is supplied with a “probe record card”. It is useful to complete this card, as in the example given, when the probe is put into operation and to place the card in the Lambda Transmitter LT 1.
If the LT 1 does not have an indicator and control unit, the probe current (mA) can be read from the monitor output, see 5.1.2.1, page 92-93, or by means of the remote display software, via the service interface. Values between 300 mA and 600 mA for ambient air are normal.

Depending on the insulation of the probe, the probe current of a probe mounted in a SEA is actually 10 to 20 % below the manufacturer's test value stated on the probe record card.

Explanation:
The probe current in air depends on the temperature of the probe (probe casing). For each 10 K temperature difference, the probe current varies by approx. 1 % from any given measured value.
For the manufacturer's bench test, the measurement is taken on a “bare” probe (without SEA and without insulation). After fitting in the SEA and after the addition of external insulation, the probe temperature increases significantly. This results in a drop in the probe current.

A record should always be made on the probe record card if

– the probe current has changed significantly

– the “critical nozzle”, MEV, etc. has been replaced

– the LT 1 has signalled probe-related faults

It is essential that the probe record card be submitted in the case of any claims.

IMPORTANT!

Accommodation claims cannot be made without the probe record card.

Probe Record Card, front

LAMTEC

Probe Record Card

Lambda Probe LS 1 *GZAH 018650 R* 35

Probe No.: 6509

Probe current in ambient air 470 mA

This current is bench test value! It may vary by up to 20 % due to variations of supply voltage and ambient temperature. Enter your reading after running in for at least 3 hours.

To be completed by combustion system manufacturer:

Customer: SICK

Office /Branch: Reute

Plant: KW Feldberg

Start of operation on:

Fuel: Gas/Feststoff

Installation location: Betriebsmessung vor Filter

Flue gas temperature at installation location: 220 °C

Probe installation fitting (SEA) 55 R 1183

Distance of probe to power supply or analyser: 10 m

Probe heating conductor area:
(Probe connection terminal 5 and 6,
lambda power supply unit 35 and 36 O_2 analyser) 2 mm^2

Initial probe current value, in air: 425 mA

Returned probe must be accompanied by Probe Record Card. No accommodation claims without Probe Record Card.

IMPORTANT!
Never draw waste gas through cold probe. Wait at least ½ hour- 1 hour after start of operation before switching on pump. In the case of fuels with a high sulphur content (coal / heavy fuel oil), wait at least 1 - 2 hours.
Probe current:
Lambda controller: readout x 100 = probe current (mA)
O_2 analyzer:
The same readout after pressing the probe current button

Probe Record Card, back

Checks

Date	O_2 value in ambient air	Probe current	LS 1 heat output	Recalibrated yes	Recalibrated no	Remarks
14.1.98	20/5	407	75 W	X		20.9.

Electrical connection,
see pages 62 - 63

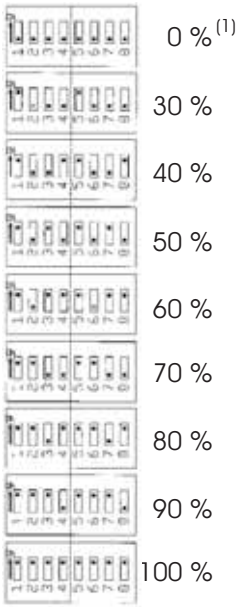
The MEV and sintered metal prefilter heating must also be activated at programming (Service) level. Parameter 121 is used for this purpose. The options comprise:

- MEV and sintered metal prefilter heating switched off
- only MEV heating activated
- only sintered metal prefilter heating activated
- MEV and sintered metal prefilter heating activated

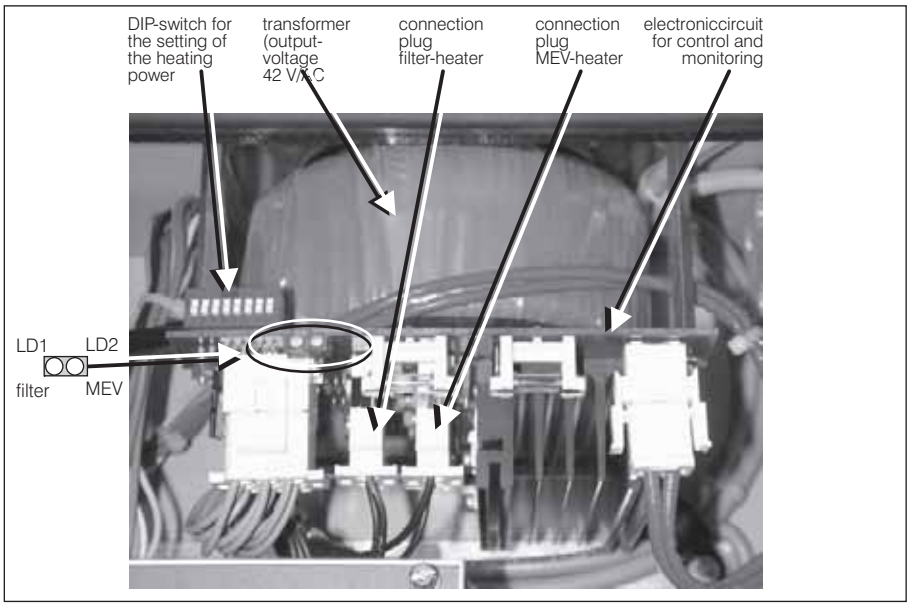
IMPORTANT!

If a heating system is activated but not connected, a warning is indicated: MEV or sintered metal prefilter heating defective.

A temperature control option is in the course of preparation. In appliances without temperature control, parameter 122 must be on “OFF”.



(1) OFF, or alternative heater settings via display- and operating unit or remote-display-software



If the control of the MEV or the filter hater works correctly, LED1 and LED2 are flashing.

IMPORTANT!

If an indicator and control unit is available, it is recommended that the heating should always be set via the unit, using parameters 400 and 401.
The manufacturer's setting is then 0 %.
Manufacturer's setting 50 %
The DIP-switches have priority. They overwrite the settings, which are made via display and operating unit or remote-display-software.

The heat output must be set so as to ensure that the temperature does not drop below the acid dew point, over the entire length of the Gas extraction device (MEV) and in all operating conditions.

Corrosion on the MEV is an indicator of temperature below the dew point. Clogging of the MEV is a sure sign of temperature having dropped below the dew point.

NOTE:

The heat output should be set only as high as is necessary. The higher the heat output, the shorter the service life of the heater.

Measurement and control of the MEV temperature are in the course of preparation

To ensure that the “critical nozzle” does not become blocked, the Lambda Probe LS 1 must be removed when measuring operations are discontinued, either before or immediately after the power supply voltage is switched off.

IMPORTANT!

Remove the Lambda Probe before measuring operations are discontinued.

CAUTION - HOT COMPONENTS!

NOTE:

The Lambda Probe LS 1 can be stored indefinitely in its dismounted stated. The zircon dioxide measuring element only becomes exhausted when in operation (measuring cell at operating temperature). This also applies where a Lambda Probe has already been used once in operation.

6.1 Operator Control / Output of Measured Value

Via either:

- Customer's external control unit, via RS 422 / RS 485 interface
- Indicator and control unit
- External indicator and control unit, via LAMTEC system-bus (option in course of preparation)
- Remote display software (option)
- To a limited extent, via multifunction pushbutton switch, digital inputs and outputs and monitor output

6.1.1 Measured values

- O_2 actual value
  0...25 vol. O_2
  Resolution: 0.1 % vol. O_2
- Probe current
  0...1400 mA
  Resolution: 1 mA
- Absolute pressure
  800...1200 mbar
  Resolution: 1 mbar
  Only in conjunction with automatic calibration device (option) and pressure compensation of the measured value (option)
- Waste-gas temperature (option) either:
  0...320 °C

Resolution:	1 °C	
Measuring error:	typically	± 1 °C
	max.	± 2 °C

  or:
  0...850 °C

Resolution:	2 °C	
Measuring error:	typically	± 2 °C
	max.	± 4 °C

- Combustion efficiency (option)
  0...100 %
  Resolution: 0.1 %
- CO_2 concentration, calculated (option)
  0...20 % vol.
  Resolution: 0.1 % vol.
- CO / H_2 concentration, *indicated as* Co_e *(*$CO_{equivalent}$*)*
  0...10000 ppm
  Resolution: 1 % of measured value, not better than 1 ppm
- Customer-specific measured values
  Configurable as required

6.1.2 Commands

- "Measurement"	Measurement operation	
- "Calibration"	Start calibration Customer-specific, in combination with fault / warning cancellation	S
- "Pump on"	Switch on pump when cold-start delay operated	

IMPORTANT!

Never draw waste gas through a cold probe. This can result in blockage of the "critical nozzle". Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour. See also 3.6.7, page 61.

- "No calibration"	Automatic and manual calibration blocked
- "Cyclic calibration"	At intervals of 0...10000 hours
- "Check"	Start measurement (calibration) check
- "Fault / Warning"	Cancellation
- "Limiting value"	Cancellation

NOTE:

A calibration is not the same as a measurement check.

In the case of a manually initiated calibration, a complete cycle is always executed, including determination of the internal resistance of the O_2 measuring cell and, if necessary, adjustment of the heating voltage. In addition, a re-calibration is carried out in each case. In the case of cyclical calibration, calibration is preceded by a check. No calibration is carried out if the measured O_2 value attains the calibration value of 21 % vol. O_2 with a tolerance of $\pm$ 0.5 % vol. O_2 . The tolerance can be adjusted via the indicator and control unit or via the remote display software. If the tolerance is "0", a complete test cycle is performed in each case.
If only a check is initiated, e.g. via the remote display software, the calibration cycle is interrupted following the check. No fault message is signalled. The check serves only to monitor the behaviour of the (probe) measurement by blowing in air.

S = Only these customer-specific faults are indicated via the connected customer's control units

6.1.3 Status messages

- Measurement S
- Calibration S
- Maintenance S
- Probe heating active S
- Cold-start delay pump active
- At least one warning active
- At least one fault active

Calibration status messages

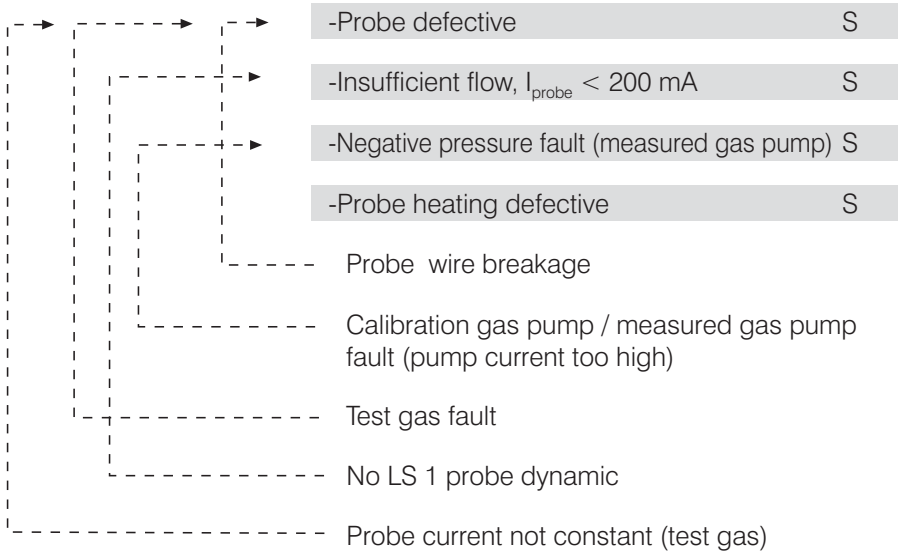
- Check
- First calibration
- Ageing compensation
- Second calibration
- Wait time for measurement
- Test gas 1 (option)
- Test gas 2 (option)

6.1.3.1 Warnings

- Probe heating control failure S
- Sintered metal prefilter dirty S
- Insufficient flow $I_{probe} < 260$ mA
- O_2 sensor exhausted D replace S
- Leakage in measured gas hose S
- MEV heating defective (option) S
- SEA prefilter heating defective (option) S
- Nozzle or measured gas hose blocked S
- Pressure outside the range (option)
- Temperature outside the range (option)
- Do not draw waste gas though cold probe
- LS 1 temperature measurement defective (option)
- MEV heating temperature measurement defective (option)
- SEA prefilter heating temperature measurement defective (option)
- Probe current limitation active
- Power supply voltage too high / too low
- Measured gas pump operating time control active
- Calibration inaccurate (probe current not constant in calibration)
- Analogue input 1: input value too large / too small
- Analogue input 2: input value too large / too small
- Analogue input 3: input value too large / too small
- Analogue input 4: input value too large / too small
- Configuration error, analogue outputs
- Service warning 1
- Service warning 2
- No LS 1 probe dynamic
- Dynamic test started

S = Only these customer-specific faults are indicated via the connected customer's control units

6.1.3.2 Faults



S =	Only these customer-specific faults are indicated via the connected customer's control units

6.1.4 Operating parameters

- Backward counter, cold-start delay
- Time, date
- Operating time meter

6.1.5 Digital outputs
(not with OEM Version)
Parameter group 1030 to 1099

The Lambda Transmitter LT 1 has 7 digital outputs which can be configured as required via the indicator and control unit (option) or via the remote display software (option).

The manufacturer's assignment of the digital outputs is as follows:

Output 1	→	Combined fault indication
Output 2	→	Combined warning indication
Output 3	→	Calibration
Output 4	→	Maintenance
Output 5	→	Not configured
Output 6	→	Not configured
Output 7	→	Not configured

6.1.6 Digital inputs (not with OEM Version)

Parameter group 1170 to 1249

The Lambda Transmitter LT 1 has 8 digital inputs which can be configured as required via the indicator and control unit (option) or via the remote display software (option).

Manufacturer's configuration:

Input 1	→	Pump on
Input 2	→	Start calibration
Input 3	→	Start check
Input 4	→	Start cyclic calibration
Input 5	→	Fault cancellation
Input 6	→	Not assigned
Input 7	→	Not assigned
Input 8	→	Not assigned

6.2.1 Dependence of measuring accuracy on pressure of measured gas

The constancy of the flow rate of the sample gas (measured gas flow rate) through a “critical nozzle” is to a small extent dependent on the density of the sample gas, i.e., on the ambient pressure or pressure of the gas being measured.
The error influence is 1,3 % of the measured value per 10 mbar of pressure change. A higher pressure means a higher measured value.

Automatic pressure compensation of the measured value is available as an option, No. 6 57 R 0860.

6.2.2 Measurement in highly contaminated waste gas

Allow sufficient heating time (at least 1 hour, preferably 2 hours, and 3 hours for refuse combustion), i.e., NEVER PUMP WHEN COLD!
See also 3.6.6, page 58.
Keep the measured gas sample extraction tube (capillary tube) at a temperature of over 180 °C over its entire length. The hotter, the better!
If the temperature of the gas to be measured is lower, the Gas extraction device (MEV) must be electrically heated, see 3.4.2, page 35.

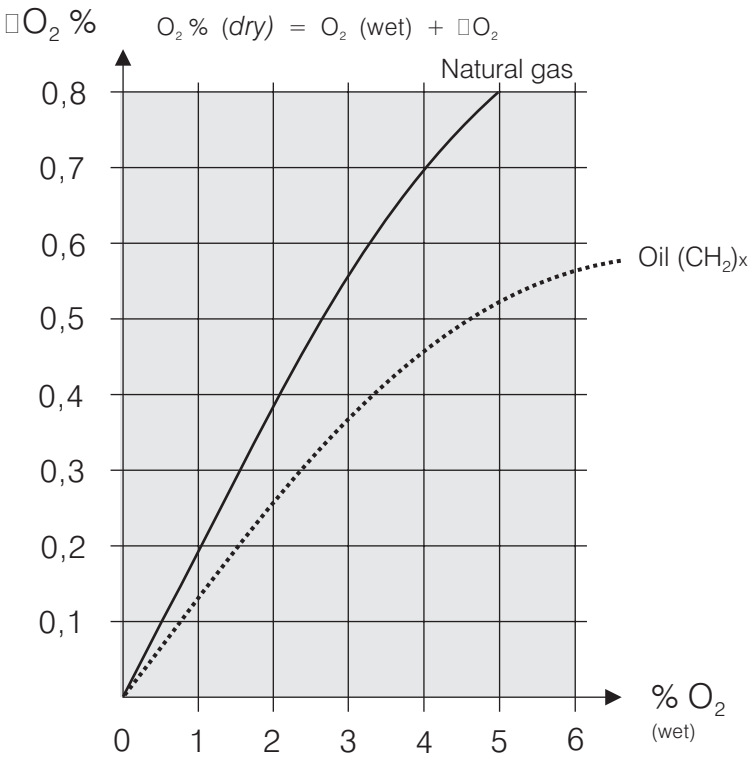
If it is only a question of bridging the thermal drop, e.g. in the case of a walled flue, it is also possible to transfer the heat from the measured gas to the MEV by means of a MEV protective tube with a core made from a material which has good thermal conductivity (e.g. aluminium / copper), see 3.4.4, page 36.

6.2.3 Measurement with marked pressure surges at the measuring point

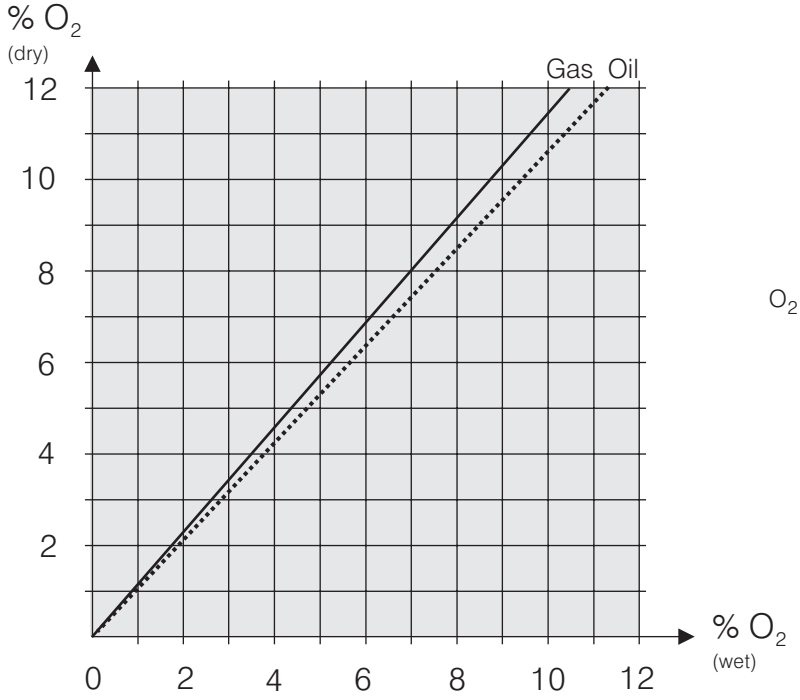
If marked surges are indicated, the indicator and control unit (option) and the remote displaysoftware can be used to increase the damping (i.e., by increasing the time constant of the measured-value integration) and thereby even out the indicated pressure.
Parameter 360 for measured O_2 value enable level - operation
Parameter 441 for pressure measurement enable level - customer
This, however, slows down the display in terms of the attainment of an end value.

NOTE:

A large degree of damping also results in a simultaneous artificial slowing of the measurement signal.



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 ($O_{2(tr)}$).

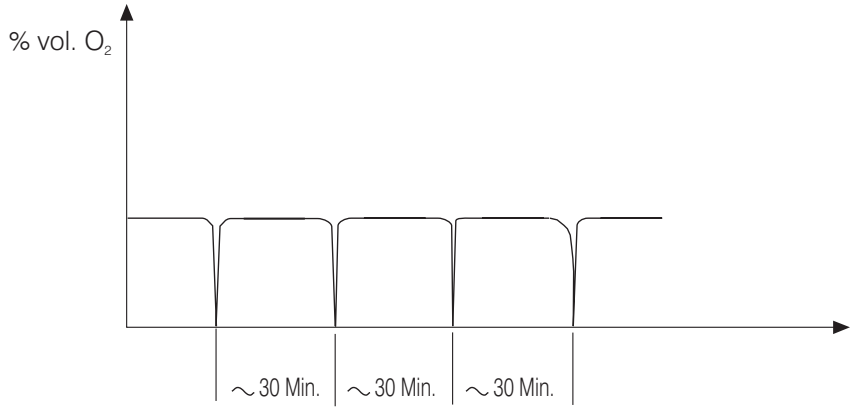
6.2.5 Measurement in moist waste

It must be ensured that the temperature of the MEV (capillary tube) is kept above the particular water or acid dew point. If the temperature of the gas to be measured is lower than the water or acid dew point the MEV and, if necessary, the sintered metal prefilter must be electrically heated. See 3.4.2 and 3.4.3, pages 35 and 36.

If it is only a question of bridging the thermal drop across the MEV, it is also possible to transfer the heat from the measured gas to the MEV by means of a MEV protective tube with a core made from a material which has good thermal conductivity (e.g. aluminium / copper), see 3.4.4, page 36.

Note:

Fluctuation of the measured value due to condensation in the MEV



Indication of condensation in the capillary:

The displayed value drops cyclically toward 0 % vol. O_2 . This occurs when the water droplet which has formed in the capillary tube has been sucked into the hot probe and evaporated. The cycle time is largely constant under constant conditions (temperature of measured gas).

6.2.6 Measurement in waste gases containing a large amount of water (following wet-washer)

In highly imbalanced waste gases with a high moisture content and a low CO_2 content, it is recommended to activate flow compensation.
See 3.6.5.1 on page 57.
Parameter group 1280 to 1283 - enable level Customer or service.
See also:

Supplement to the Operating Manual for the indicator and control unit or remote display software options.

6.2.7 Replacing the probe

The new probe must always be fitted so that the measured gas hose is aligned downwards. This is to prevent the condensate from running back into the probe, causing a blockage.

IMPORTANT!

Following replacement of the probe, the probe heating output control must always be reset to the base value. See 6.2.7.1

6.2.7.1 Resetting the probe heating control to the base value

With indicator and control unit (option)
Set parameter 104, “Replace probe”, to “Clear” in customer level and confirm with “Enter”.
Parameter 104 then resets to “0” D command executed.

Without an indicator and control unit:
1 Switch off the power supply voltage (power supply switch off)
2. Set maintenance switch to “off”

IMPORTANT!
First check:
Is the maintenance switch actually off?
Check jumpers BR 2, BR 3 and BR 4 on the processor card!
See Fig. on page 143.

All three jumpers must not be inserted at the same time, since otherwise there is a danger that, if the maintenance switch is set incorrectly, the default parameters will be transferred and the customer-specific setting will be lost.

3. Press and hold down multifunction pushbutton switch
4. Switch power supply voltage (switch) on again
5. The lower row of LEDs (LED 1 - LED 6) flashes, indicating that the command has been executed
6. Release the multifunction pushbutton switch
7. Flashing of LED row ceases

IMPORTANT!

Never draw waste gas through a cold probe. This can result in blockage of the “critical nozzle”. Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour. See also 3.6.6. page 58.

6.2.8 Interruption of operation, switching on and off

Where operation is interrupted for fairly long periods, i.e. in excess of approx. 4 weeks, it is recommended to switch off the measurement function.
The probe must be removed to prevent flue gases from being forced through the cold probe.

For shorter interruptions of operation, it is recommended to leave the measurement function running. When the measured gas pump is switched on, an acoustic velocity is produced in the hole of the nozzle which acts to prevent blockage.

IMPORTANT!

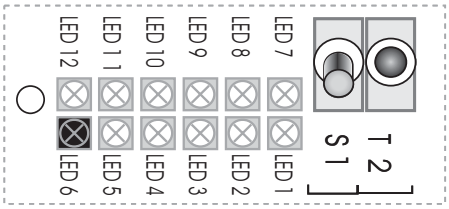
To be noted when re-starting operation!

Never draw waste gas through a cold probe. This can result in blockage of the “critical nozzle”. Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour. See also 3.6.6. page 58.

7.1 Checking and calibrating the Lambda Probe



Multifunction pushbutton switch T 2

Checking and calibration are performed automatically, controlled by the microprocessor.

The calibration process can be initiated:

- Via the customer's control unit, via an interface
- By operating the multifunction pushbutton switch T 2 on the processor circuit board for 3 or 6 seconds
- Via the indicator and control unit (option), via “cal” menu
- Via the remote display software (option)
- Via digital inputs (input 2)
- Cyclically, with a predefined time interval of 1 to 10000 hours.
  Parameter 270 - enable level “Customer”
  The time interval is predefined via the indicator and control unit (option) or via the remote display software,
  no calibration for "0" and "10000".
- Automatically, by an external command in combination with the calibration of other analysis devices. The remote display software can be used to determine whether the calibration is performed each time or only each nth time.
  Parameter 272 - enable level “Service”.

NOTE:
Cyclic and automatic calibration is preceded by a “check routine”. No calibration is carried out if the actual O_2 value varies only slightly from the anticipated setpoint value, generally 21 % vol. O_2 , the manufacturer's tolerance setting being $\pm$0.5 % vol. O_2 . The tolerance can be set as required via the indicator and control unit (option) or via the remote display software.
Parameter 250 - enable level “Customer”.

Calibration is always performed when initiated manually.

7.1.1 Without integral automatic calibration device

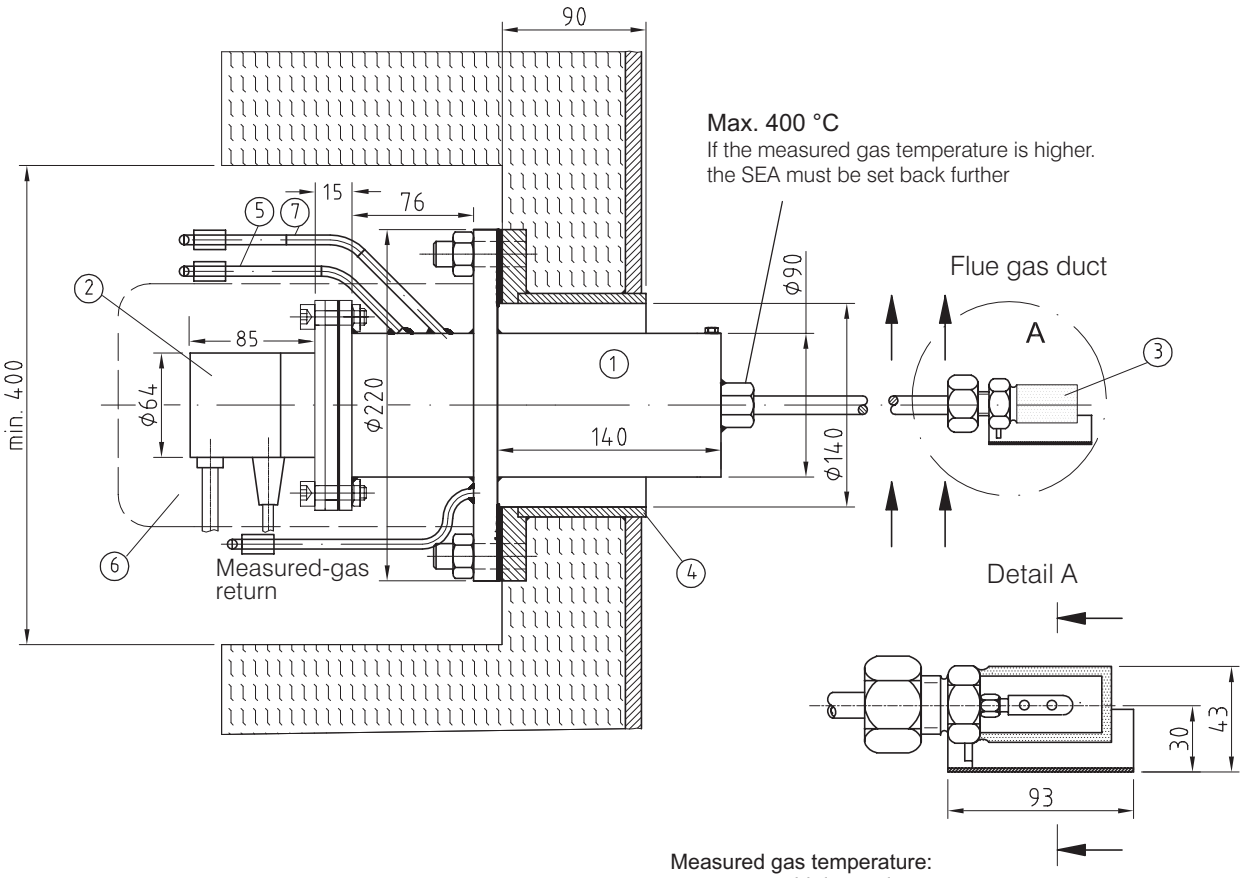
Checking and calibration are performed semi-automatically, controlled by the microprocessor. This requires air to be supplied to the Lambda Probe LS 1.

There are two possibilities:

- Switch off the installation and ensure that only air is present at the measuring point.
- Blow compressed air on to the measuring point via the calibrating gas supply on the probe installation fitting (SEA).

The air flow rate must be set at 400 to 500 Nl/h, using a flow-meter. It must be ensured that a slight overpressure of $\sim$ 1 to 5 mbar is built up in the filter. The overpressure can be measured on the pressure sensor connection. See drawing page 118.

Probe installation fitting (SEA) No. 6 55 R 0083 / R 1183 mounted on flue gas duct



1 Probe installation fitting (SEA)
No. 6 55 R 0083 / R 1183

2 Lambda Probe LS 1
No. 6 50 R 0031 ... 6 55 R 0039

3 Gas extraction device (MEV) with extractor filter, e.g.
1000 mm long No. 6 55 R 0027
matching protective tube No. 6 55 R 0620

4 Mating flange similar to DN 100, PN 16
with retainer for Lambda Transmitter LT 1
No. 6 57 R 0183, high-grade steel - material 1.4571 (V4A)
No. 6 57 R 0185, galvanized steel

5 Calibrating gas connection

6 Insulation for LS 1 and probe installation fitting
No. 6 57 P 0100

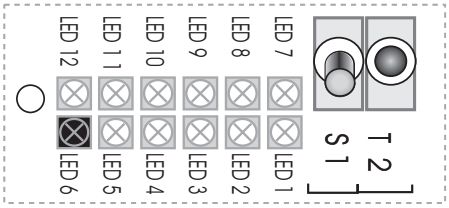
7 Pressure sensor connection

NOTE:
The measured value and, consequently, the calibration value, is pressure-dependent. The error effect is:

1.3 % of the measured value per 10 mbar pressure rise, i.e., for air (21 % vol. O_2) and 10 mbar pressure rise, approx. 0.3 % vol. O_2.

Pressure compensation of the measured value is useful, and available as an option - No. 6 57 R 0860. The automatic calibration device includes pressure compensation as standard.

7.1.1.1 Starting the calibration process without the indicator and control unit



Operating mode indicator (green) LED 5

- Measurement
- Calibration or testing of probe

Press the multifunction pushbutton switch T 2 and hold for more than 3 seconds. If one or more warnings or faults presents, hold pressed down for more than 6 seconds, until LED 5 flashes.

Calibration is then performed in a fully automatic procedure, as shown in the flow chart in 3.6.4 on page 54. When calibration is completed, the flashing of the LED ceases and LED 6 is continuously illuminated.

If there are no warnings / faults present the appliance is then ready for operation again. The calibration process lasts for between 1 and 5 minutes.

Calibration can be interrupted by re-pressing the multifunction pushbutton switch T 2. This again requires the multifunction switch to be operated for 2 x 3 or 2 x 6 seconds.

Following the first actuation of the switch, LED 6 flashes more slowly, i.e., the LT 1 is in the "Check" mode - see also 7.1.3 on page 120. Further actuation of the multifunction pushbutton switch then results in interruption of the calibration process.

7.1.1.2 Starting the calibration process with the indicator and control unit

Menu-controlled, via "cal".
See booklet - Supplement to Operating Manual for the "Indictor and Control Unit" option

7.1.1.3 Starting the calibration process via a connected PC using the remote display software

See booklet - Supplement to Operating Manual for the "LT 1 remote display software" option

7.1.1.4 Starting the calibration process via customer's external control unit

See customer's Operating Manual

7.1.2 With automatic calibration device, or with connected portable calibration device

Following initiation of the calibration process, the solenoid valve opens and a pump blows calibration gas, normally air, to the extraction point via the SEA, through the protective tube. The flow rate of the calibrating gas can be set using a flow-meter.
The prefilter at the tip of the SEA protective tube produces an overpressure of a few mbar in the protective tube (an overpressure of 1 mbar is sufficient). This ensures that no flue gas can penetrate to the extraction point in the protective tube and that the measured gas sample extraction point is surrounded exclusively by calibrating gas.

An absolute pressure sensor measures the pressure in the filter and the measured value is compensated within limits ($\pm$50 mbar).

If the filter becomes dirty, the pressure rises sharply for the same rate of flow. If the pressure increase is $>$ 50 mbar, a "sintered metal prefilter dirty" warning is signalled.
The filter must then be cleaned by the operator. The SEA must be removed for this purpose.

By virtue of its size, the filter is relative immune to dirt accumulation. Even if only a small portion of its area remains clean, this is still sufficient for the measured gas flow rate of approx. 0.5 l/h.

The advantage of "in situ" calibration is that calibration is performed at the pressure prevailing in the flue, thereby precluding errors due to different pressures during calibration and measurement.

Setting the calibrating gas flow rate (flow-meter):

- Start the calibration process.
- Set a calibrating gas flow rate of 400 Nl/h at the flow-meter valve.
- Wait for 3 minutes.
- Reduce the calibrating gas flow rate by 100 Nl/h. The O_2 value should not change. If it does, reset the calibrating gas flow rate to 400 Nl/h.

The variation of the absolute pressure in the SEA filter can be observed via the display window of the indicator and control unit (option) or via the remote display software (option), under parameter 4. Pressure increase in calibration at least 1 mbar.

IMPORTANT!

There is a long time-lag before the value is displayed. Please wait until the pressure has levelled out.

If the measured value drops by more than 0.3 % vol. O_2 , increase the calibrating gas rate again until the value is stable. Changing the calibrating gas rate by 100 Nl/h should not affect the measured value.

If, after the calibrating gas rate has been increased to values in excess of 500 Nl/h, the measured value is still not stable, the prefilter should be checked. The prefilter may be torn. The requires removal of the SEA.

7.1.3 Checking with test gas

NOTE:

The test gases used must be free from combustible gas constituents such as e.g. carbon monoxide (CO). Combustible gas constituents are oxidized (burned) on the platinum electrode of the zircon dioxide measuring cell, which has a temperature of approx. 800 °C, and reduce the oxygen which is to be measured.

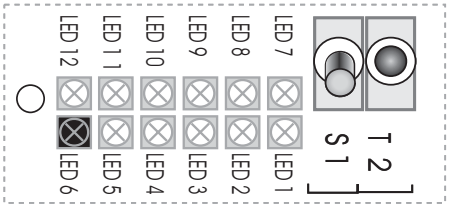
The calibrating gas is applied to the intake of the calibrating gas pump (screwed hose connection), see Fig. in 4.3.1, page 83.

Checking can be initiated by one of the following methods:

- Customer's control unit, via interface
- By pressing the multifunction pushbutton switch T 2 on the processor circuit board twice (3 or 6 seconds)
- Indicator and control unit (option), menu-controlled via "cal"
- Remote display software (option)
- Digital inputs (input 3)

7.1.3.1 Manually

Initiation of checking via the multifunction pushbutton switch T 2



Multifunction pushbutton switch T 2

- LT 1 in "measurement" operating mode, LED 5 on
- Initiate calibration via multifunction pushbutton switch T 2 (press for more than 3 seconds), LED 5 flashes

NOTE:

If one or more warnings or faults are present, the pushbutton switch must be pressed for more than 6 seconds.

- Interrupt the calibration process by pressing the multifunction pushbutton switch T 2 again ($\geq$3 seconds, or $\geq$ 6 seconds if there is a warning or fault present)

  The "calibration" operating mode indicator LED 5 changes frequency

  → flashes more slowly

  The calibrating gas pump continues to run for 15 minutes.
  Connect a test-gas flask to the calibrating gas connection on the LT 1

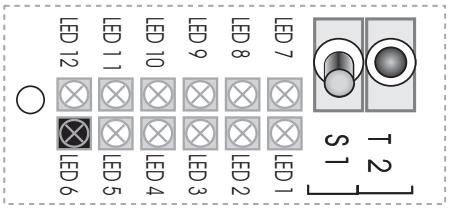
  Set the admission pressure on the pressure-reducing valve of the test-gas flask so as to give a flow rate which is approx. 100 Nl/h higher than for calibration with ambient air

  This setting ensures that no secondary air is drawn in by the pump

  On the flow-meter valve, set the same calibrating gas flow rate as for calibration with ambient air

  Compare the measured value with the test-gas value

- Press the multifunction pushbutton switch T 2 again for more than 3 seconds to "return" to the measurement operation



Operating mode indicator (green) LED 5

- Measurement
- Calibration or testing of probe

- "Measurement" operating mode indicator LED 5 on, continuously illuminated

Alternatively, the test gas can also be applied directly to the calibrating gas supply of the probe installation fitting (SEA). In this case, however, it is recommended to view the absolute pressure at the measuring point via display window of the indicator and control unit (option) or via the remote display software (option), under parameter 4, and to set the flow rate of the calibrating gas so that the absolute pressure rises by 1 to 6 mbar.
This ensures that the measured gas sample extraction point is surrounded by test gas.

NOTE:

Requires the option "fully automatic calibration device",
No. 6 57 R 0800 / R 0801 or measured-valued pressure compensation,
No. 6 57 R 0866.
Without one of these options it is not possible to read off the absolute pressure.

It is then not necessary to initiate calibration or testing on the LT 1. However, it is recommended to set the maintenance switch S 1 to "Maintenance".

7.1.3.2 Automatically

The zero point and the characteristic can be checked automatically using test gas with the option "Test gas connection", No. 6 57 R 0810 (1 test gas) and R 0811 (2 test gases) in combination with a calibrating cycle.
See 3.6.4.1, page 55.

7.2 Maintenance

Depending on the application, measurement should be checked weekly, monthly or every three months.

In the case of emission measurement, the measurement should be checked every 4 weeks, in accordance with the specification in the Test Report, by checking the air value as described in 7.1, pages 117 - 121.

7.2.1 Consumables

	Average service life
Lambda Probe LS 1	2 - 4 years (depending on fuel)
Diaphragm pump	2 - 3 years
Diaphragm (pump)	1 - 2 years
Protective pump filter (measured gas side)	3 - 6 months (depending on fuel)

7.2.2 Maintenance tasks and maintenance schedule

7.2.2.1 Maintenance tasks

Maintenance is governed by the particular application and by the degree of contamination of the waste gases being measured.

The following preventive maintenance is recommended for emission measurement on a coal-fired furnace (clean gas side):

Maintenance I (monthly)

Empty condensate trap.

IMPORTANT!

The condensate must be collected and disposed of.

Inspect filter on the measured gas side, replace if necessary.

Check the probe (calibration) as described in 7.1, pages 117 - 121

Maintenance II (six-monthly)

Maintenance I

In addition, check pump:

Negative pressure:	$\geq$ 0.6 bar
	$\leq$ 0.4 bar absolute
Pressure switch operating point:	0.45...0.58 bar negative pressure

Maintenance III (annually)

Maintenance I and II

In addition
Clean pump head; inspect diaphragms, valves and seals and replace if necessary.

As required

- Replace gas extraction device (MEV) if blocked
- Clean extraction attachment at the tip of the MEV.
  Replace or renew the filter.
- Clean or replace the filter attachment if the warning “sintered metal prefilter dirty” is indicated, or on the basis of empirical values
- Replace moulded insulation part in the SEA (inside) if broken
- Replace the “critical nozzle” if there is an “insufficient flow” warning, $I_{probe} < 260$ mA

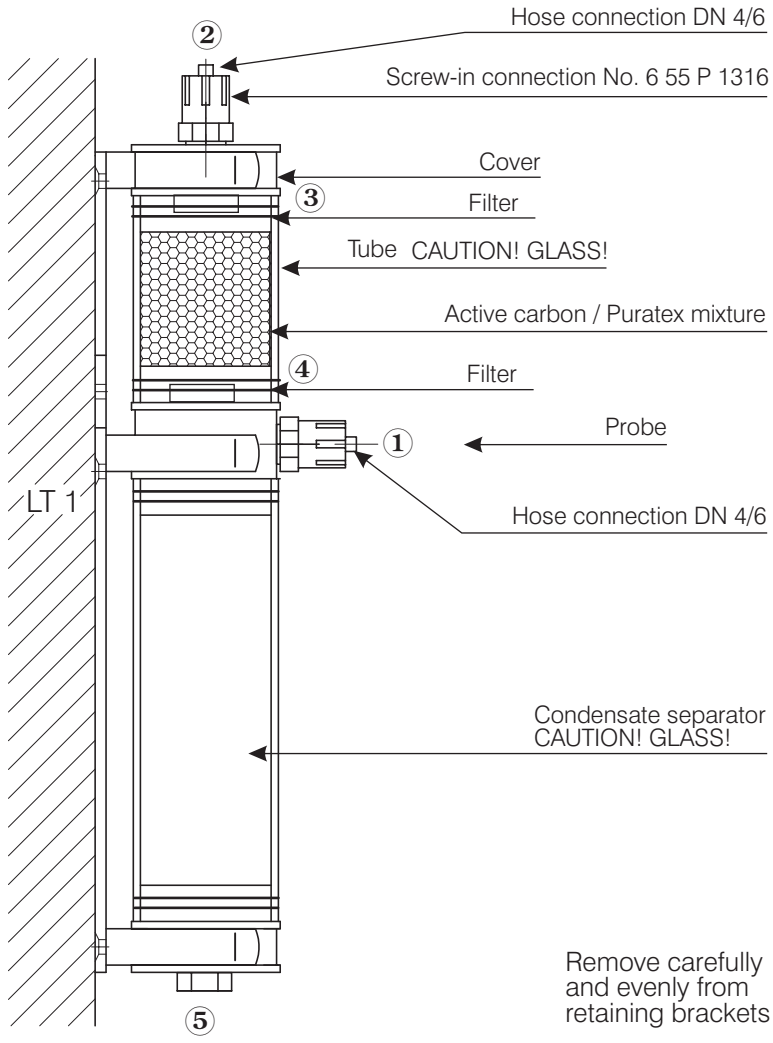
NOTE:

It is recommended to carry out the above maintenance tasks during scheduled installation lay-up periods as part of the maintenance schedule.

7.2.2.1.1 Emptying the condensate and replacing the pump protection filter

The IP 54 version of the LT 1 and the probe connection boxes with integral measured-gas pump are equipped with a condensate collector with an integral pump protection filter; see drawing.

Condensate collector with integral pump protection filter



WARNING

CAUTION! GLASS!

Emptying the condensate collector

- Switch off the measuring gas pump via
  - Indicator and control unit and remote display software.
    Set Parameter 100 to “Off (1)”.
  - Simultaneously press the multifunction pushbutton switch and
    Set maintenance switch to Maintenance (since software version 1.V40)
    "Maint." (maintenance) and "Pump OFF"
    The measuring gas pump is switched off.
- To pretend the pump from condensate residues you have to plug off the hose connection ① first.
- plug off hose connection ②
- Remove the glass tube

CAUTION!
Hold the glass tube with both hands at the upper and the lower end.
Remove the glass tube with circular motion.
The glass tube is very sensitive and easily to damage.
There is a risk of injury!

- Replace the active carbon / Puratex mixture if necessary. the mixture has to be replaced if its colour has changed to black.
  The function of the pump protection filter is to prevent failure of the pump as a result of solid or liquid deposits in the pump head. The filling consists of an active carbon / Puratex mixture to bind acid and alkali gas constituents and silica gel to bind moisture. The filling can be matched to the particular application. The standard filling is active carbon / Puratex.
  Replace the filling when visibly dirty or completely black.
  Replacement fillings (pack of 10) consisting of:
  Active carbon / Puratex mixture, 2 felt discs and 3 separating discs
  Order No. 6 57 R 0791

CAUTION!
Remove the glass tube with circular motion.
The glass tube is very sensitive and easily to damage.
There is a risk of injury!

- Remove the glass tube.
- Clean the glass tube with alcohol or methylated spirits
- Replace filter ③ and ④. The rough side of the filter has to face in direction mixture, the flat side of the filter has to face direction housing. Adhere the filter with a small drop of glue.
  Fitting Replacement Filter
  Pump protection filter
  Order No. 6 57 R 0790 - R 0795

IMPORTANT!
When changing the filter, note the mounting direction (or direction of flow of the measured gas). See drawing on this page.

- Lubricate the "O" ring seals with special Vaseline (Order no. 655 P0155)
- Fill in the new active carbon / Puratex mixture into the glass tube
- mount the glass tube with circular motion.

CAUTION!

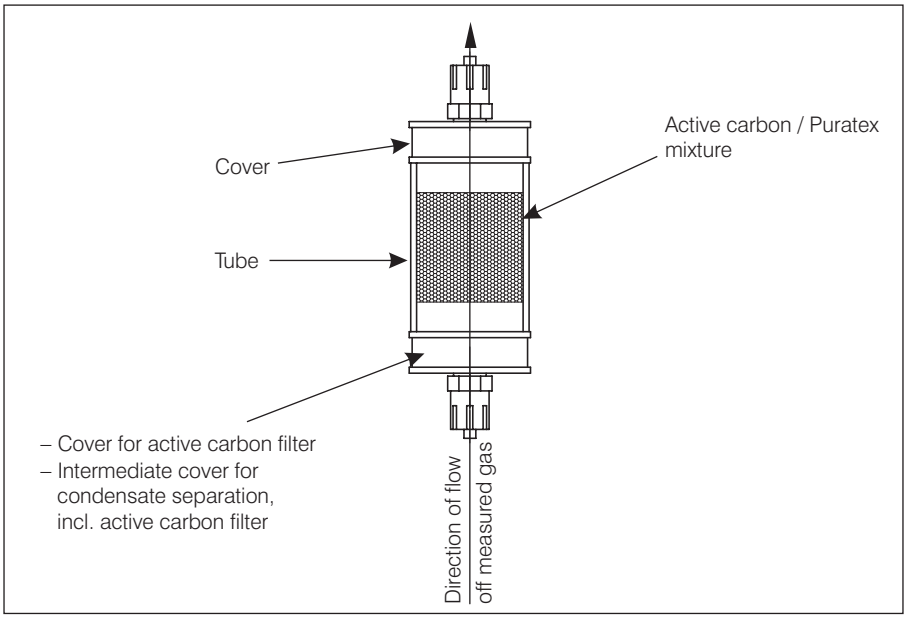
Remove the glass tube with circular motion.
The glass tube is very sensitive and easily to damage.
There is a risk of injury!

- Set the condensate seperator carefully into the brackets.
- Fix the hose connection ① and ②.
- Switch maintenance switch to "Maintenance OFF" (upper position)
- The measuring gas pump will start.

NOTE:

If the idle time is considerably longer than the running time of the measuring gas pump, the pump protection filter is mounted prperly.

If you only want to discharge the condensate:
- Simultaneously press the multifunction key and set the maintenance switch to "Maintenance" (upper position).
- plug off hose connection ① and remove hose
- open drain screw⑤
- condensate drains
- fix drainscrew
- fix hose and hose connection①
  set maintenance switch back to "Maintenance OFF" (lower position)

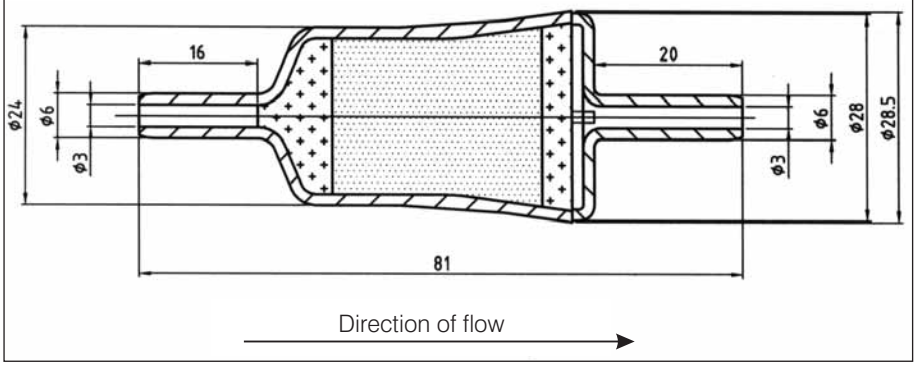


For very fine-grained dust, e.g. in applications in the steel industry or in cement furnaces, it is recommended to insert a particle filter, No. 6 52 R 0250, between the protective pump filter and the measured gas pump.

IMPORTANT!

Note direction of flow!

Particle Filter No. 6 52 R 0250

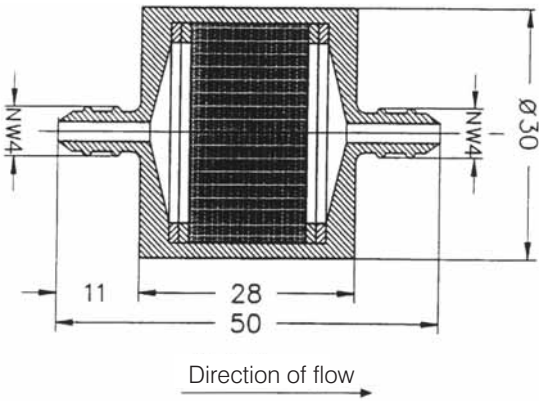


A protective pump filter (Standard - No. 6 52 R 0210) is mounted before the calibrating gas pump, on the intake side, to prevent the pump from becoming dirty.

IMPORTANT!

Note direction of flow!

Protective Pump Filter (Standard) - No. 6 52 R 0210

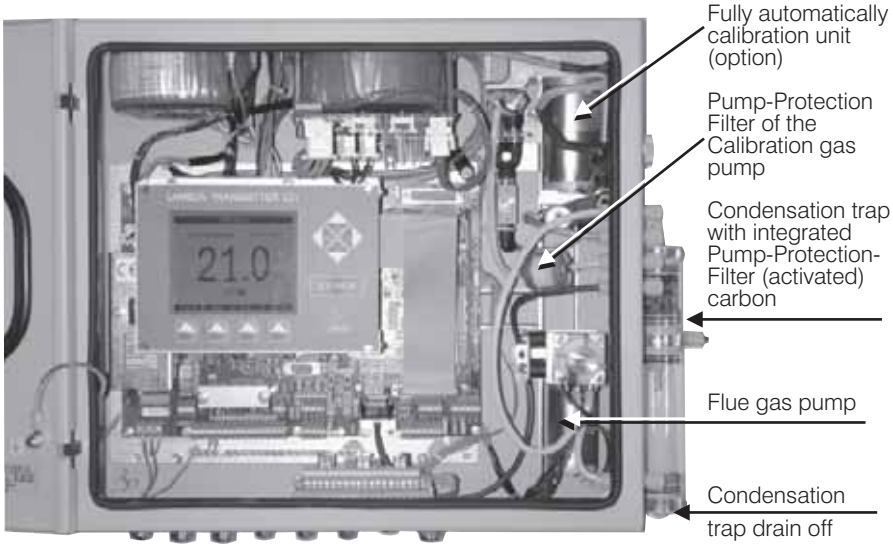


Lambda Transmitter LT 1
type 6 57 R 0025

with optional
indicator and control unit
type 6 57 R 0830

and
fully automatic calibration unit
type 6 57 R 0800

Lambda Transmitter LT 1



7.2.2.1.2 Checking the negative pressure and the switching point of the pressure switch

Fit a negative pressure gauge in the suction line. Close the suction line after the negative pressure gauge.

Negative pressure:
$\geq$ 0.6 bar
$\leq$ 0.4 bar absolute

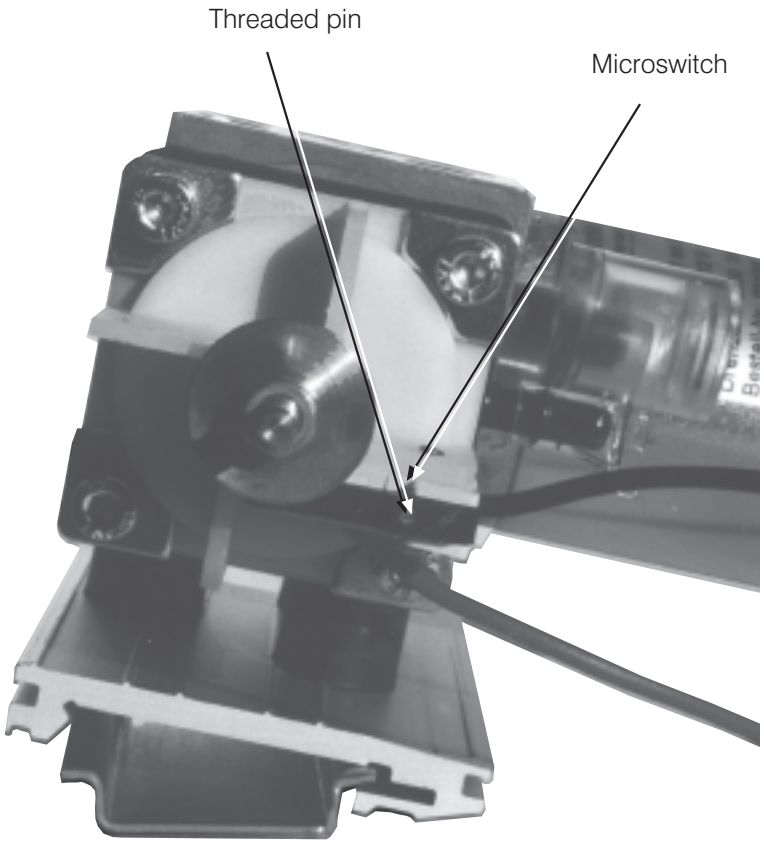
Pressure switch switching point:
On - 470 mbar to -500 mbar negative pressure
Off - 400 mbar to -490 mbar negative pressure

Check the switching point for rising and falling pressure.

The switching point can be adjusted on the threaded pin on the lever of the microswitch, see Fig.

Negative pressure gauge Order No. 6 52 R 0230

Diaphragm Suction Pump
type 6 57 R 0872



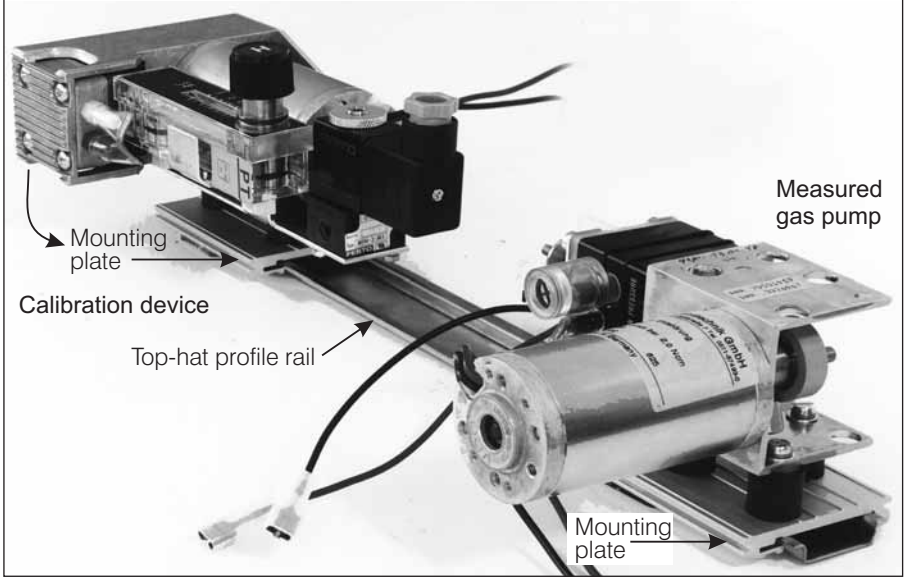
7.2.2.1.3 Cleaning the pump head, replacing worn parts

These operations require the removal of the measured gas pump.
To facilitate servicing, the measured gas pump is mounted on a top-hat profile rail (snap-on mounting).

Remove as follows:

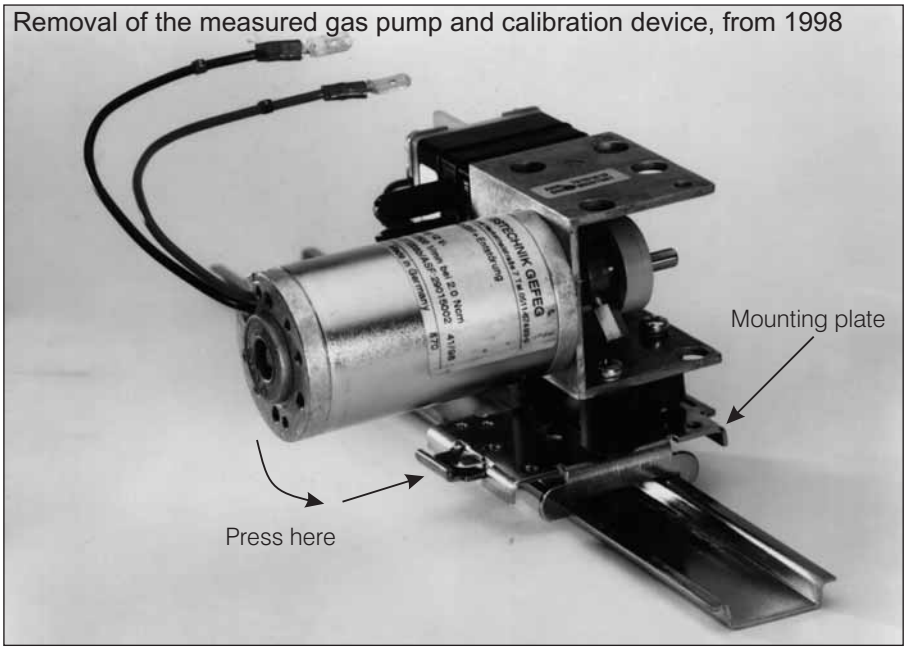
- Open the hose screwed connection
- Press the measured gas pump to the right, towards the wall of the casing. At the same time, press downwards on the motor. The retainer is released.
- Release the measured gas pump, but continue to hold the motor side pressed downwards
- The measured gas pump should now be free and can be completely removed with the plate
- Disconnect the electrical connections
- Reinstall in reverse sequence

Removing the measured gas pump and calibration device



The mounting of the measured gas and calibrating gas pump was redesigned in mid-198 to facilitate removal.
1. Release the protective pump filter on the pump side
2 Release the pump from the top-hat profile rail as shown in the figure below.

Removal of the measured gas pump and calibration device, from 1998



Removing the pump head

Unscrew the four M4 hexagon socket screws. The pump head and chamber can then be lifted off the support, if necessary with the aid of a plastic hammer. See the exploded-parts drawing on page 129.
Remove the valve reeds.

IMPORTANT!

In the case of the pump for corrosive measured gases, it is not possible to replace the valve reeds. In this case, the complete pump chamber must be replaced. The pump chamber is included in the sealing set for the measured gas pump for corrosive gases, No. 6 52 R 0217. Pump chamber only, Order No. 6 52 P 0218.

Carefully lever out the spring washers using a screwdriver.

NOTE:

To assist assembly, it is advisable to mark all the plates (with a line or notch) before removing the pump head. This helps considerably in correctly assembling the individual plates of the pump head.

Cleaning the pump head

Seals and pump parts can be cleaned with a soft clean cloth. Detergents, such as domestic washing-up liquid, may be used for accumulated dirt.
Do not use solvents!

All parts can be advantageously cleaned in an ultrasonic cleaning tank, if available.

IMPORTANT!

On no account should hard objects be used to clean the valve seats.

Replace rubber parts that have become hardened.
The sealing sets for the diaphragm pump for corrosive measured gases, No. 6 52 R 0215 and No. 6 52 R 0217, include, respectively, the diaphragm and valves, and the pump chamber with valves and seals.

Refitting the valve reeds

IMPORTANT!

Ensure correct location!
The two reeds should be fitted with their rough faces towards the diaphragm, i.e., the reed on the diaphragm with its smooth face towards the valve seat and the reed on the pump head side with its rough face towards the valve seat.

Cleaning and replacing the diaphragm

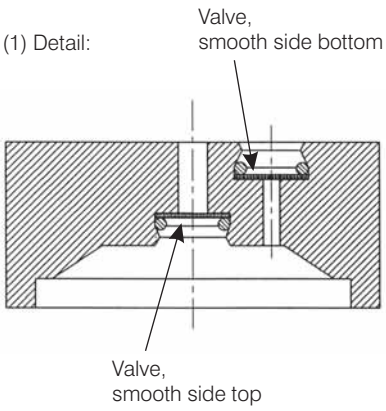
Unscrew the diaphragm retaining screw and lift out the diaphragm together with the lock-washer. The diaphragm can then be released from the lower diaphragm plate.
Insert the new diaphragm and rearrange all parts on the screw.

IMPORTANT!

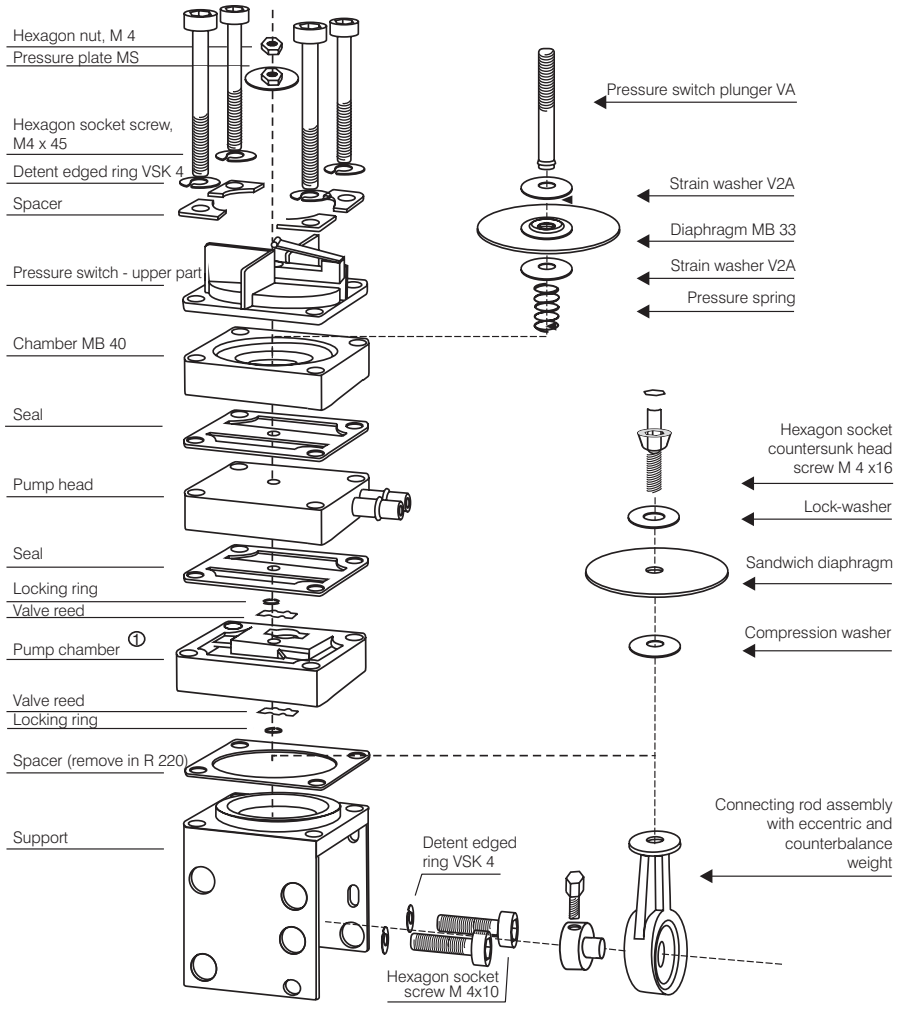
With compound diaphragms (Teflon / Perbunan), the Teflon side (light side) should face upwards towards the pump chamber.

IMPORTANT!

(1) Detail:



Diaphragm Pump type 6 52 R 0220 - Pump Section



7.2.2.1.4 Replacing the measured gas pump

The measured gas pump is removed and mounted as described in 7.2.2.1.3 on page 127.

IMPORTANT!

Following replacement of the measured gas pump it is necessary to re-determine the pump operating time. See 7.2.2.1.5, page 130.

NOTE:

The data (operating time, cycles, etc.) is stored in the appliance and can be called up at any time via the indicator and control unit (option) or the remote display software (option), under the Time and Operating Hours counter, parameters 78, 80 ("view").

Following replacement of the measured gas pump, therefore, it is advisable to reset the "pump history". This requires parameter 105 to be set to "start" (display). The remote display software has a separate window, "replace measured gas pump" for this purpose. In this case, the pump operating time is re-determined immediately.

7.2.2.1.5 Determining the pump operating time

This is always necessary following:

- Replacement of the measured gas pump
- Servicing work on the measured gas pump (cleaning, replacement of diaphragm / valves, etc.)
- Replacement of the protective pump filter
- Elimination of leakages in the measured gas hose

Briefly switch the power supply voltage OFF, then switch ON again. Over-ride cold-start delay by pressing the multifunction pushbutton switch → 3 seconds, or → 6 seconds if fault / warning present.

The pump operating time is always determined following each over-ride of the cold-start delay.

Alternatively: switch on the measured gas pump via the indicator and control unit (option), using "CAL", or via the remote display software (option), "pump on".

7.2.2.1.6 Checking the transmissivity of the gas extraction device (MEV)

Remove the MEV. If the O_2 value rises significantly, the capillary tube or the sampling attachment with the sintered metal filter is blocked.

Unscrew the sampling attachment and refit the MEV.

No improvement → capillary tube blocked → replace.

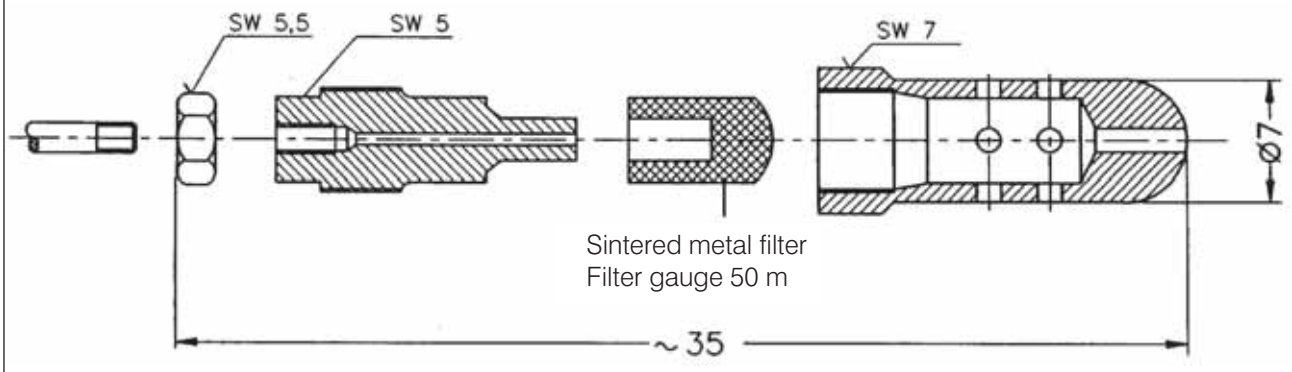
Otherwise, clean the sampling attachment.

If the capillary tube is blocked near to the probe, the cause will be that the temperature is below the dew point at that location.
For remedy, see 3.3.1, page 28; 3.4.2, page 35 and 3.4.3, page 36.

7.2.2.1.7 Cleaning the sampling attachment with the sintered metal filter

Remove the sampling attachment - see the exploded-parts drawing. If the sintered metal filter cannot be removed, it must be drilled out and renewed. Replacement filters are available in packs of 10.
Order No. 6 55 R 2803

Sampling attachment with sintered metal filter, type 6 55 R 0028



7.2.2.1.8 Replacing the "critical nozzle"

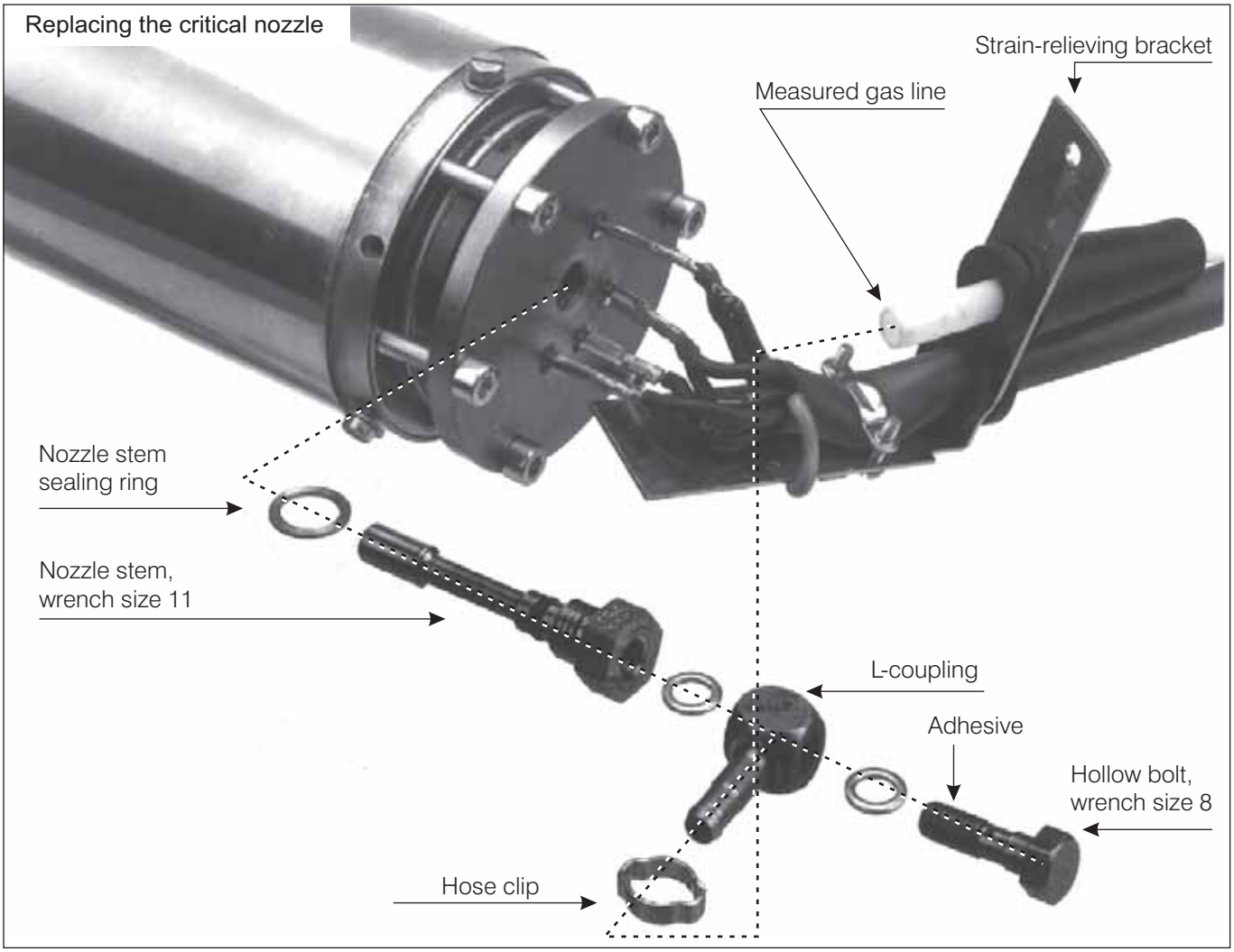
The repair kit No. 6 50 R 0900 (see Section **9. Replacement Parts**) is required for this operation. It is not possible to clean the nozzle or drill out the nozzle hole (hole diameter 42 μm!). All parts have to be replaced.

- Remove the probe cap
- Measured gas line (Teflon): undo hose connection (cut clip) and pull hose off
- Unscrew strain-relieving bracket and fold cable back to make screw connection easily accessible.
- Remove hose connection (L-coupling)
- Undo using size 8 socket wrench (hollow bolt); use size 11 fork wrench to prevent L-coupling turning
- Loosen the nozzle stem with size 11 socket wrench and carefully remove

IMPORTANT!

Ensure that the ceramic tube remains in the probe. It must not be drawn out on any account. In various probe models, it is not possible to re-fit the tube because of the granulate filling. The probe must then be returned to the manufacturer for repair.

Replacing the critical nozzle



Assemble the new parts from the repair kit in reverse order.

Pay particular attention to the following points:

- Apply adhesive carefully at the points indicated.
- Tightening torques: Nozzlestem: 10 Nm
  L-coupling: 8 Nm

When tightening the nozzle stem, ensure that the aluminium sealing ring is correctly seated on the stem (turning).

When tightening the L-coupling, it should be aligned towards the tapped hole for mounting the strain-relief bracket and secured against loosening using the adhesive provided.

Cut off approx. 10 mm of Teflon hose and fit. Press on the hose-clip using pliers, ensuring a tight joint.

Enter the nozzle replacement and the new probe current in air on the Probe Record Card.

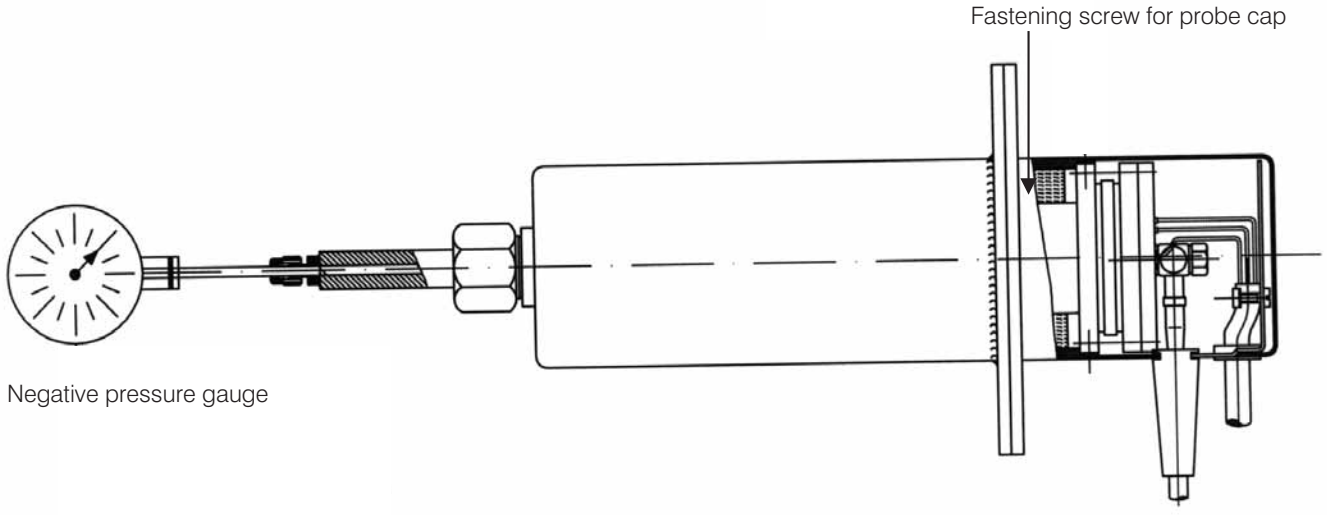
7.2.2.1.9 Checking the tightness of seal of the Lambda Probe LS 1

- Remove the Lambda Probe
- Remove the MEV
- Connect a negative pressure gauge (Order No. 6 52 R 0230) to the measured gas intake in place of the MEV. Operate the measured gas pump. A slow build-up of negative pressure indicates that the probe seal is tight.

NOTE:

Depending on the tightness of the seal, a negative pressure of between 0.2 and 0.6 bar will build up. If the negative pressure built up is less than 0.3 bar probe seal not tight. Remove the probe cap: undo the 3 screws and draw off the cap. **Carefully** tighten the 6 flange screws (see Fig. on page 131) - **glass!**

Connect negative pressure gauge in place of MEV

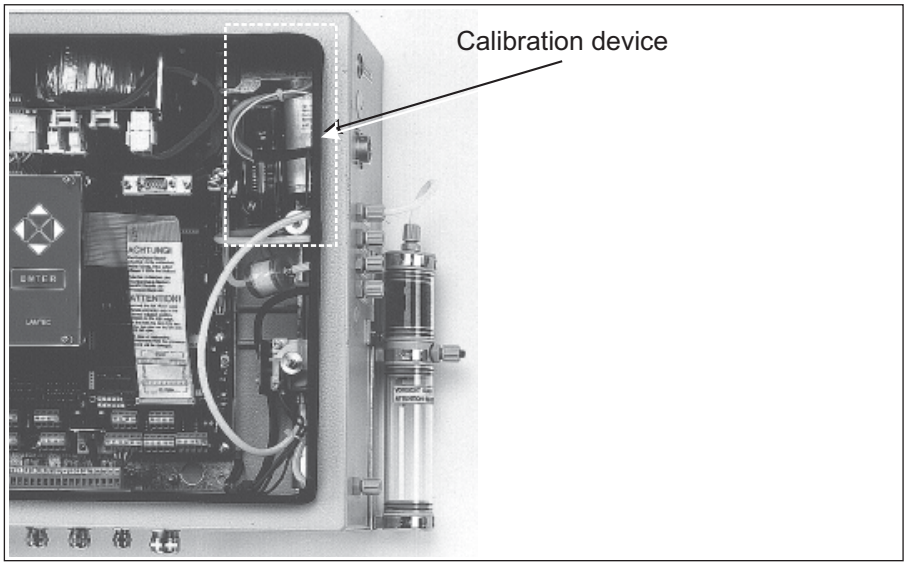


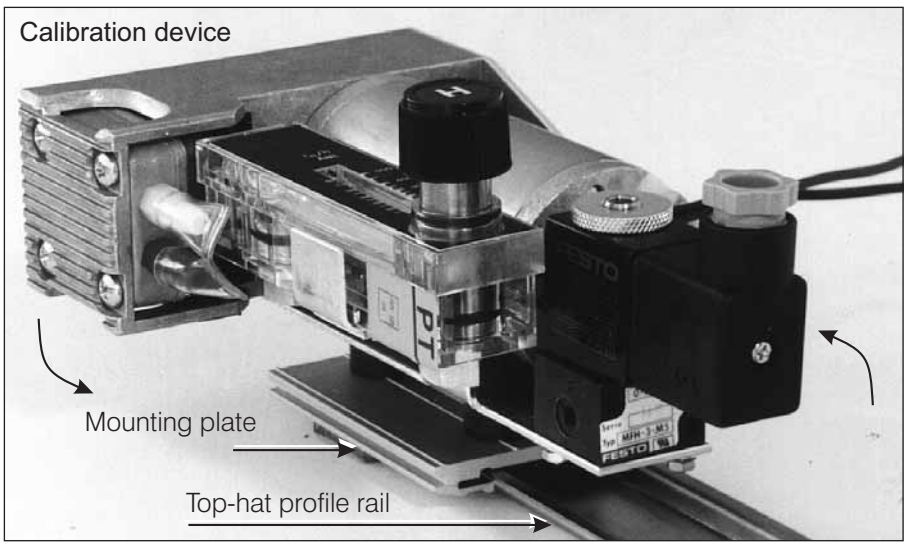
7.2.2.1.10 Fitting / removing the calibration device

To facilitate servicing, the calibration device is mounted on a top-hat profile rail (snap-on mounting). Remove as follows:

- Open the hose screwed connection
- Press the calibration unit to the right, towards the wall of the casing. At the same time, press downwards on the flow-meter. The retainer is released.
- Release the calibration unit, but continue to hold the flow-meter pressed downwards. The calibration unit should now be free and can be removed completely.
- Disconnect the electrical connections (pump / solenoid valve)

Reinstall in reverse sequence





NOTE:

The mounting of the measured gas and calibrating gas pump was redesigned in mid-1998 to facilitate removal.
The mounting bar can now be opened with a screwdriver.
See Fig. in 7.2.2.1.3 on page 127.

7.2.2.1.11 Replacing the computer electronics

NOTE:

These components should only be replaced by trained personnel.

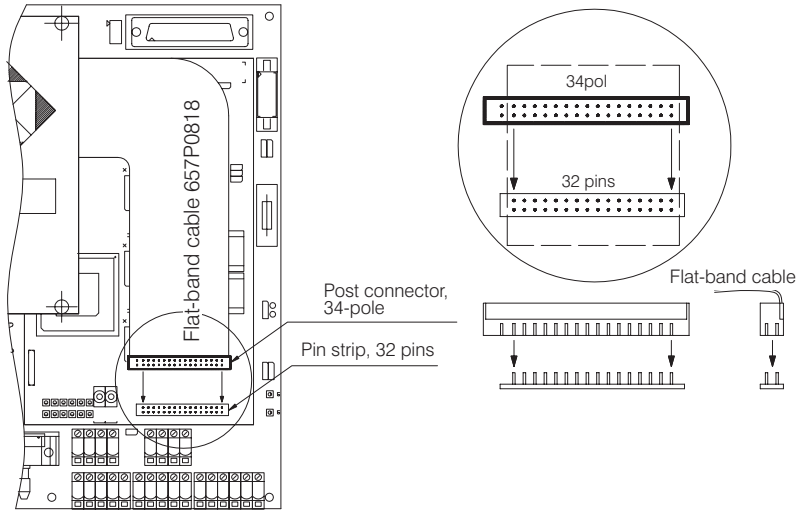
- Switch off the electric power supply to the appliance
- If the LT 1 is equipped with the indicator and control unit option, first remove the plug connector of the indicator and control unit.

IMPORTANT!

Points to be noted when replacing the processor / power supply unit electronics!

The plug connector for the indicator and control unit is not coded. Incorrect plug connection can result in malfunction of the appliance

Identify clearly and connect as shown in the drawing.



- Undo fastening screws, see Fig. in 3.6.1, page 49.
- Carefully lift computer electronics upwards.

IMPORTANT!

Grasp plug connector to power supply unit electronics (rear or top) and lift computer electronics upwards.

- Refit in reverse sequence

7.2.2..1.12 Replacing the power supply unit electronics

NOTE:

These components should only be replaced by trained personnel.

- Switch off the electric power supply to the appliance
- Remove all plug connectors and the hose to the pressure sensor. Caution: locking
- Undo base plate fastening screws. The electronics can now be removed from the casing together with the base plate.
- Remove computer electronics as described in 7.2.2.1.11
- The power supply electronics are now easily accessible. Change all plug-in cards to the new circuit board, compare jumper positions. Undo fastening screws and replace electronics circuit board
- Refit in reverse sequence

7.2.2.1.13 Replacing the indicator and control unit

NOTE:

This component should only be replaced by trained personnel.

- Switch off the electric power supply to the appliance
- Release the indicator and control unit (4 knurled screws)
- Undo connection to LT 1 electronics (plug connector. Care: locking

IMPORTANT!

Do not remove the plug connector on the computer electronics, unless the plug connector has been removed inadvertently.
Note "IMPORTANT" in 7.2.2.1.11 on page 136.

- Refit in reverse sequence

7.2.2.2 Maintenance schedule

It is advisable to compile a maintenance schedule for each measuring point, on the basis of the following model:

Maintenance Schedule 1999 O_2 Measurement

Measuring point:

Calendar Week	Maintenance carried out			Remarks	Date	Sign.
	I	II	III			
1	X					
3						
5	X					
7						
9	X					
11						
13	X					
15						
17	X					
19						
21	X					
23						
25		X				
27						
29	X					
31						
33	X					
35						
37	X					
39						
41	X					
43						
45	X					
47						
49			X			
51						
53						
55						
57						
59						
61						
63						

Faults / Warnings

Clear text messages. See also 6.1.3, page 109.

- Via indicator and control unit (option), under "***diag***"
- Via external indicator and control unit (in course of preparation)
- Via remote display software (option)
- Via interface and customer-specific control unit

NOTE:

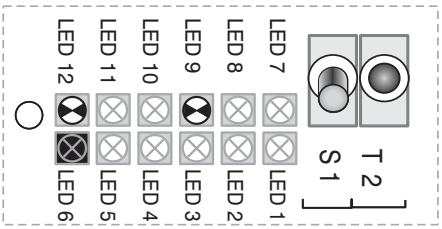
For technical reasons, customer-specific faults / warnings can be combined, but not displayed.

Faults / warnings are indicated via the row of LEDs, LED 7 to 12, on the processor board in the LT 1
(See 5.1.2.2, page 94)

If there are several faults / warnings present, these can be called up in succession by pressing the multifunction pushbutton switch T 2.

8.1 Faults

Active faults (red) indicated by flashing Indicated via the row of LEDs, LED 7 to 12, LED 12 flashes



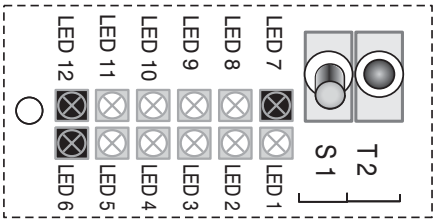
Faults (flashing)

12 11 10 9 8 7	
⊗ ⊗ ⊗ ⊗ ⊗ ⊗	No warning / fault active
⊕ ⊗ ⊗ ⊗ ⊗ ⊕	Probe defective
⊕ ⊗ ⊗ ⊗ ⊕ ⊗	[(1)] Insufficient flow I_{probe} < 200 mA
⊕ ⊗ ⊗ ⊗ ⊕ ⊕	Negative pressure (measured gas pump)
⊕ ⊗ ⊗ ⊕ ⊗ ⊗	Probe heating defective
⊕ ⊗ ⊗ ⊕ ⊗ ⊕	Probe wire breakage
⊕ ⊗ ⊗ ⊕ ⊕ ⊗	Calibrating gas / measured gas pump (power consumption too high)
⊕ ⊗ ⊗ ⊕ ⊕ ⊕	Probe current not constant (test gas)
⊕ ⊗ ⊕ ⊗ ⊗ ⊗	Test gas
⊕ ⊗ ⊕ ⊗ ⊗ ⊕	No LS 1 probe dynamic
⊕ ⊗ ⊕ ⊗ ⊕ ⊗	Sintered metal prefilter dirty
⊕ ⊗ ⊕ ⊗ ⊕ ⊕	Fault analogue outputs
⊕ ⊗ ⊕ ⊕ ⊗ ⊗	Not assigned
⊕ ⊗ ⊕ ⊕ ⊗ ⊕	Not assigned
⊕ ⊗ ⊕ ⊕ ⊕ ⊗	Not assigned
⊕ ⊗ ⊕ ⊕ ⊕ ⊕	Not assigned

Fault signals can be cancelled as described in 8.3, Page 139, or by pressing the multifunction pushbutton switch T 2 (for more than 3 seconds per warning).
If there are several warnings, or warnings and faults present simultaneously, the multifunction pushbutton switch must be pressed several times.

[(1)] Parameter 51 can be used to read-out the probe current at the last calibration

8.2 Warnings



Active warning indicator LED (red) permanently illuminated

Indicated via the row of LEDs, LED 7 to 12, LED 12 illuminated

Warnings (illuminated)

LED 12	LED 11	LED 10	LED 9	LED 8	LED 7	
○	○	○	○	○	○	No warning / fault active
●	○	○	○	○	●	Probe heating control failure
●	○	○	○	●	○	Sintered metal prefilter dirty
●	○	○	○	●	●	(1) Insufficient flow, $I_{probe} < 260$ mA
●	○	○	●	○	○	O_2 sensor exhausted: replace
●	○	○	●	○	●	Leakage in measured gas hose
●	○	○	●	●	○	MEV heating defective
●	○	○	●	●	●	Prefilter heating defective
●	○	●	○	○	○	Calib. gas flow rate too low, increase gas flow rate
●	○	●	○	○	●	Pressure outside the permissible range
●	○	●	○	●	○	Temperature outside the permissible range
●	○	●	○	●	●	Do not draw waste gas through cold probe
●	○	●	●	○	○	LS 1 temperature measurement defective
●	○	●	●	○	●	(2) MEV temperature measurement defective
●	○	●	●	●	○	(2) Prefilter temperature measurement defective
●	○	●	●	●	●	LS 1 probe current limitation active
●	●	○	○	○	○	Power supply voltage too high / too low
●	●	○	○	○	●	Measured gas pump operating time control active
●	●	○	○	●	○	Probe current not constant in calibration
●	●	○	○	●	●	Analogue input 1: input value too large / too small
●	●	○	●	○	○	Analogue input 2: input value too large / too small
●	●	○	●	○	●	Analogue input 3: input value too large / too small
●	●	○	●	●	○	Analogue input 4: input value too large / too small
●	●	○	●	●	●	Configuration fault, analogue outputs
●	●	●	○	○	○	Service warning 1
●	●	●	○	○	●	Service warning 2
●	●	●	○	●	○	No LS 1 probe dynamic
●	●	●	○	●	●	Dynamic test started
●	●	●	●	○	○	Not assigned
●	●	●	●	○	●	Not assigned
●	●	●	●	●	○	Not assigned
●	●	●	●	●	●	Not assigned

(1) ut the probe current at the last calibration

(2) Option in course of preparation

Fault signals can be cancelled as described in 8.3, page 136, or by pressing the multifunction pushbutton switch T 2 (for more than 3 seconds per warning).
If there are several warnings, or warnings and faults present simultaneously, the multifunction pushbutton switch must be pressed several times.

8.3 Cancelling faults / warnings

- Via indicator and control unit (option), menu-controlled via "diag"
- Via remote display software (option), menu-controlled via "status"
- Via customer-specific control unit, via interface
- Via digital inputs
  Manufacturer's setting Input 1)
- By pressing multifunction pushbutton switch T 2
  (for more than 3 seconds per fault / warning)

If several faults / warnings are present simultaneously, the multifunction pushbutton switch T 2 must be pressed several times.

8.4.1 "Probe defective"

Internal resistance of the zircon dioxide measuring cell too high

Possible causes:

Measuring cell exhausted or broken

Probe defective → replace. See 6.2.7, page 115

IMPORTANT!

Following replacement of the probe, the probe heating output control must always be reset to the base value, see 6.2.7.1, page 115

8.4.2 "Insufficient flow"

Probe current in air less than 200 mA

Possible causes:

- MEV blocked → replace, see 7.2.2.1.6, page 130
- Measured gas hose or measured gas return blocked or kinked
- Calibration device defective
  Fuses F 201 and F 202 defective check, see 8.6, page 156
  Solenoid valve fails to operate
  Calibrating gas pump defective
  Calibrating gas supply blocked
- Nozzle blocked→ replace, see 7.2.2.1.8, page 131

8.4.3 "Measured gas pump negative pressure"

Incorrect release of pump pressure switch

Possible causes:

- Fuse F 203 defective → check, see 8.6, Page 156
- Direct-current motor (12 V) defective
- Leakage in measured gas hose or screwed connection
- Measured gas return blocked
- Diaphragm torn[(1)]
- Pump head dirty[(1)]
- Protective pump filter not tight, see 7.2.2.1.1, Page 123
- Misadjustment of switching threshold of micro-switch on the pump head[(1)]
- Contact resistance on the pump pressure switch (micro-switch on pump head)

NOTE:

If, following cancellation of the fault, the measurement function operates correctly but the fault recurs sporadically, the fault is caused by the micro-switch (contact resistance in the contact area).
Replace the negative pressure switch with micro-switch. This requires the following parts:
Order No. 6 57 R 0838 - Replacement kit for pump pressure switch for diaphragm pump, standard

[(1)] See also
7.2.2.1.2, page 126 and
7.2.2.1.3, page 127

8.4.4 "Probe heating defective"

NOTE:

In 99 % of cases, the Lambda Probe LS 1 will have become disconnected during operation (probe plug connector withdrawn).
Cancel fault via either the multifunction pushbutton switch or the indicator and control unit. The probe heating is defective only if the fault cannot be cancelled.

Possible causes;

- Check fuses F 206 and F 207, see 8.6, Page 156
- Inspect probe heater. On an intact heater the resistance measured between pins 5 and 6 of the 7-pin probe plug connector must be approx. 9 ohm / 8...11 ohm. If this is not the case (R → ∞), the heater is defective → replace probe.
  If the probe is not defective, then there is an electronics fault → replace the power supply unit electronics.
  If there is no measuring instrument available remove the probe.
  Check whether the probe is "hot": 140 °C - 160 °C.
  If not → the heater is defective → replace the probe, see 6.2.7, Page 115

IMPORTANT!

Following replacement of the probe, the probe heating output control must always be reset to the base value, see 6.2.7.1, Page 115

8.4.5 "Probe wire breakage"

Possible causes:

- No probe connected
- Check fuses F 208, see 8.6, Page 156
- Wire breakage in probe supply line / probe connector □ check
- Probe defective → replace

IMPORTANT!

Following replacement of the probe, the probe heating output control must always be reset to the base value, see 6.2.7.1, Page 115

- Fault in power supply → unit electronics replace

IMPORTANT!

Points to be noted when replacing the computer / power supply unit electronics:

The plug connector for the indicator and control unit is not coded.
Incorrect plug connection can result in malfunction of the appliance.

Connect as shown in drawing in 7.2.2.1.11 on Page 134 !

8.4.6 "Calibrating gas pump / measured gas pump"

Possible causes:

- Current consumption too high, check smooth running of pump
- Bearing damage??
- Check fuses F 201 and F 203, see 8.6, Page 156
- Check calibrating gas supply
- Check flow-meter setting

Removal of the pump: see also 7.2.2.1.3, Page 127

8.4.7 "Probe current not constant"

Only with the "test gas connection" option

Probe current not constant in testing with test gas fluctuates

Possible causes:

- Test gas flow rate too low
  Check flow-meter setting, increase test gas flow rate
- Sintered metal prefilter broken, see 3.4.1, Page 34
- Leakage in probe installation fitting (SEA)
  Check probe, seals / screwed connections, etc.
- Quartz glass measuring chamber in Lambda Probe broken
  Check Lambda Probe for tightness of seal, see 7.2.2.1.9, Page 132
- Very large pressure fluctuations at the measuring point
  (in combination with warning "probe current not constant in calibration")

8.4.8 "Test gas fault"

Only with the "test gas connection" option

Checking with test gas reveals upward or downward variation from the permissible tolerance (manufacturer's setting $\pm$0.5 % vol. O_2)

Possible causes:

- Test gas flask empty

For further causes, see 8.4.7

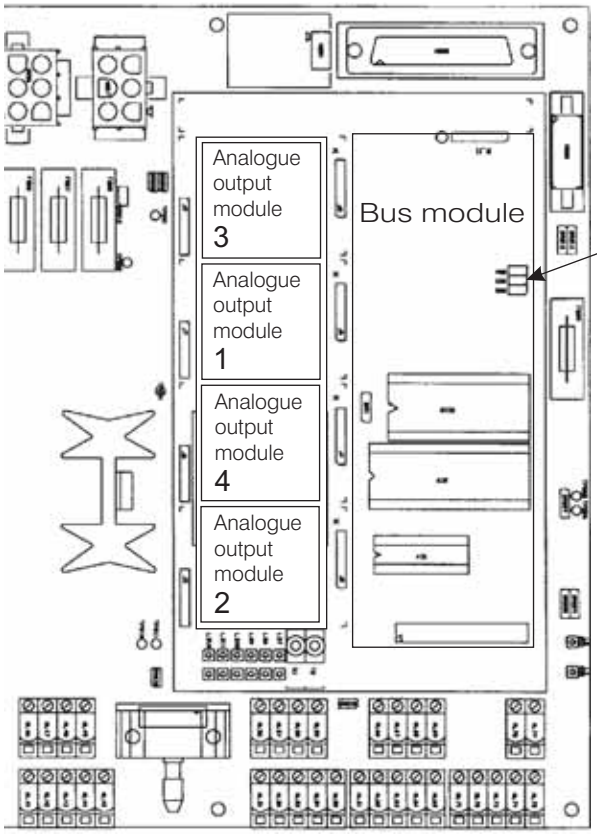
The test gas option can be switched off using jumper 4 on the processor board, see Fig. on Page 143.

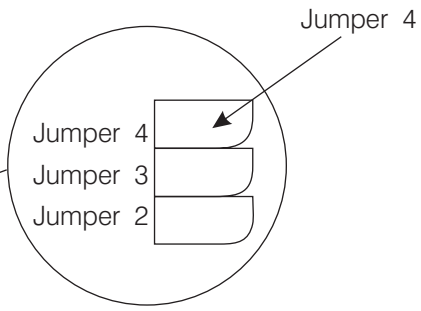
"Jumper 4 inserted → checking with test gases deactivated"

NOTE:
If the jumper is inserted during a calibration cycle, the complete cycle is still executed. In this case, the calibration process should be interrupted and then reactivated by pressing the multifunction pushbutton switch T2 again (3 seconds or, if a warning or fault is present, ≥6 seconds).
Operating mode indicator "Calibration", LED 5,
changes frequency → flashes more slowly

– Press the multifunction pushbutton switch T 2 again for more than 3 seconds to "return" to the measurement operation
– "Measurement" operating mode indicator LED 5 on, continuously illuminated

Deactivation of the test gas connection

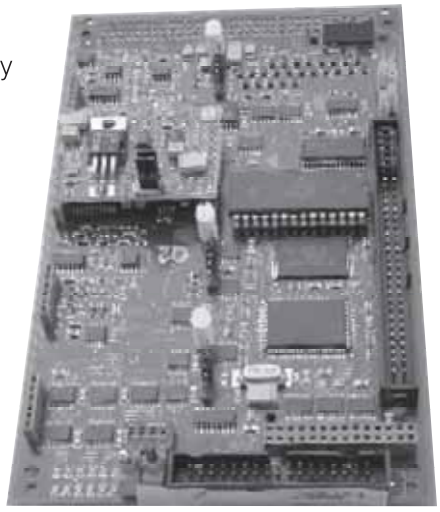


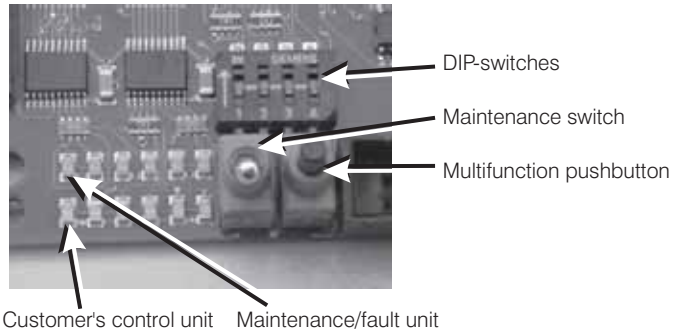


Jumper 4 inserted test gas connection deactivated

till delivery date May 2000

New processor unit until delivery date June 2000





SW3	Test gas application
on	disabled
off	enable

8.4.9 "No LS 1 probe dynamic”

No probe dynamic has been detected. See 5.2.3 on Page 101.
Possible causes:

- Gas duct blocked
- MEV
- "Critical nozzle”
- Hose connection
- Sintered metal prefilter
- Measured gas hose pinched
- Incorrect setting of dynamic test parameter

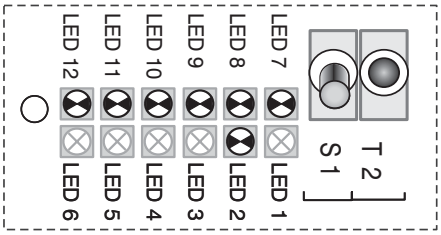
Remedies:
- Start check / calibration, see 7.1, from Page 117 onwards
  If in order → parameter incorrectly set check.

8.4.10 "Fault - sintered metal prefilter dirty”

It has been ascertained in the automatic calibration process that the pressure at the measuring point during calibration has risen over 0.6 bar (1.6 bar absolute). Calibration has been terminated to protect the pressure sensor.

8.4.11 “Internal electronics faults”

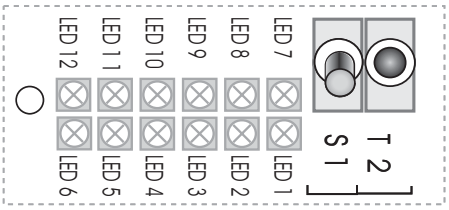
If a fault is present, the upper row of LEDs (LED 7...LED 12) flashes rapidly. Contact the manufactorer, service hotline (0049) 6227 6052 33



Programming the default parameters:

IMPORTANT!

All customer-specific settings will be lost following programming of the default parameters (manufacturer's parameters). They must then be reset via the indicator and control unit (option) or the remote display software (option). In case of doubt consult the manufacturer.



Maintenance switch S 1
Multifunction pushbutton switch T 2

- Switch off the appliance
- Insert jumpers BR 2, BR 3 and BR 4 on the processor card; see Fig. on page 143
- Set maintenance switch S 1 to Maintenance position
- Hold multifunction pushbutton switch T 2 pressed down and switch on appliance
- LED 1 (maintenance) flashes during the write process, all other LEDs remain off (not in case of software versions <V20, in which case the LED indication is undefined)
- When the write process is completed all LEDs flash
- Switch off appliance, return jumpers BR2, BR 3 and BR 4 to original position and switch appliance on again

NOTE:

If you are unable to rectify the fault yourself, please ascertain the internal fault number using the formula on page 145 and consult the manufacturer.

IMPORTANT!

Points to be noted when replacing the computer / power supply unit electronics:

The plug connector for the indicator and control unit is not coded. Incorrect plug connection can result in malfunction of the appliance.

Connect as shown in drawing in 7.2.2.1.11 on Page 134.

In general, warnings do not affect the functioning of measurement operations.

8.5.1 "Probe heating control failure”

The (AC) probe heating control is effected by zero-crossover-switched groups of pulses controlled by the microprocessor.

It comprises the following functions:

- Supply voltage compensation
- Adaptation of the heat output to the internal resistance of the zircon dioxide measuring cell, in steps of 5 watt.

The probe heating control is permanently monitored. If it fails, a relay switches to a fixed voltage (29 VAC). This generally safeguards the functioning of the measurement operation, unless the probe has already undergone significant ageing. The measuring accuracy is reduced, without power supply voltage compensation, to $\pm$ 5 % of the given measured value, depending on the power supply voltage fluctuation.

- Check fuse F 206, replace if necessary, see 8.6, Page 154
- Cancel fault. If in order, the fault will have been caused by (spurious) EMC pulses

It is advisable to replace the power supply unit electronics as soon as possible.

NOTE:

Following cancellation of the warning, the instantaneous heat output can be read under operating data, parameter 54.

8.5.2 "Sintered metal prefilter dirty”

Only with the "calibration device” and "pressure compensation” options.

In order to prevent calibration faults due to excess pressure, the transmissivity of the prefilter on the probe installation fitting (SEA) is monitored by means of a pressure sensor, with ambient air being blown towards the sampling point when calibration is activated. A warning is emitted as soon as the pressure rises over 50 mbar. See 3.4.1, Page 34.

NOTE:

The absolute pressure can be read both before and during calibration by means of the indicator and control unit (option) or the remote display software. The pressure increase at the last calibration can be read under operating data, parameter 50.

If the warning "sintered metal prefilter dirty” is given, check the calibrating gas flow rate (recommended setting 300 to 500 Nl/h). Progressively reduce the calibrating gas flow rate (in steps of 100 Nl/h). Cancel the warning and check whether the warning reappears. If it does, reduce further the flow rate of the calibrating gas.

The calibrating gas flow rate should not be less than 100 Nl/h. If it is below this value, the SEA must be removed and the SEA prefilter cleaned or replaced.

Required replacement part: Filter attachment for SEA
Order No. 6 55 R 0212

Manufacturer's limit value setting + 50 mbar

This can be changed via the indicator and control unit (option) or via the remote display software.
Following adjustment of the calibrating gas flow rate, restart calibration using the multifunction pushbutton switch.

8.5.3 "Insufficient flow"

Probe current in air less than 260 mA. It is advisable to ascertain the cause. For possible causes, see 8.4,2 Page 140.

8.5.4 "O_2 sensor exhausted"

Internal resistance of the zircon dioxide measuring cell can no longer be compensated by heating control
The Lambda Probe must be replaced, see 6.2.7.1, Page 115.

IMPORTANT!

Following replacement of the probe, the probe heating output control must always be reset to the base value, see 6.2.7.1, Page 115.

Measurement can be continued provisionally.

8.5.5 "Leakage in measured gas hose"

The measured gas pump operating time control has been actuated.
Pressure drops too rapidly.

Check the tightness of seal of the measured gas hose, including all screwed connections and the condensate or buffer trap. Also check the hose connection the Lambda Probe. This requires the removal of the probe cap. Check the screwed connection and tighten if necessary.

Following completion of the inspection, start a new pump operating time control using the indicator and control unit (option) or remote display software or, alternatively, by the following procedure:

- Switch off the LT 1
- Switch the LT 1 on again immediately (within 10 seconds)
- LT 1 in "cold-start delay" mode
- Interrupt the cold-start delay immediately (within 1 minute) using the multifunction pushbutton switch T 2
- The pump operating time is now redetermined automatically

NOTE:

The current pump operating time setting can be read under "times and operating time counter", parameter 78 and 80.

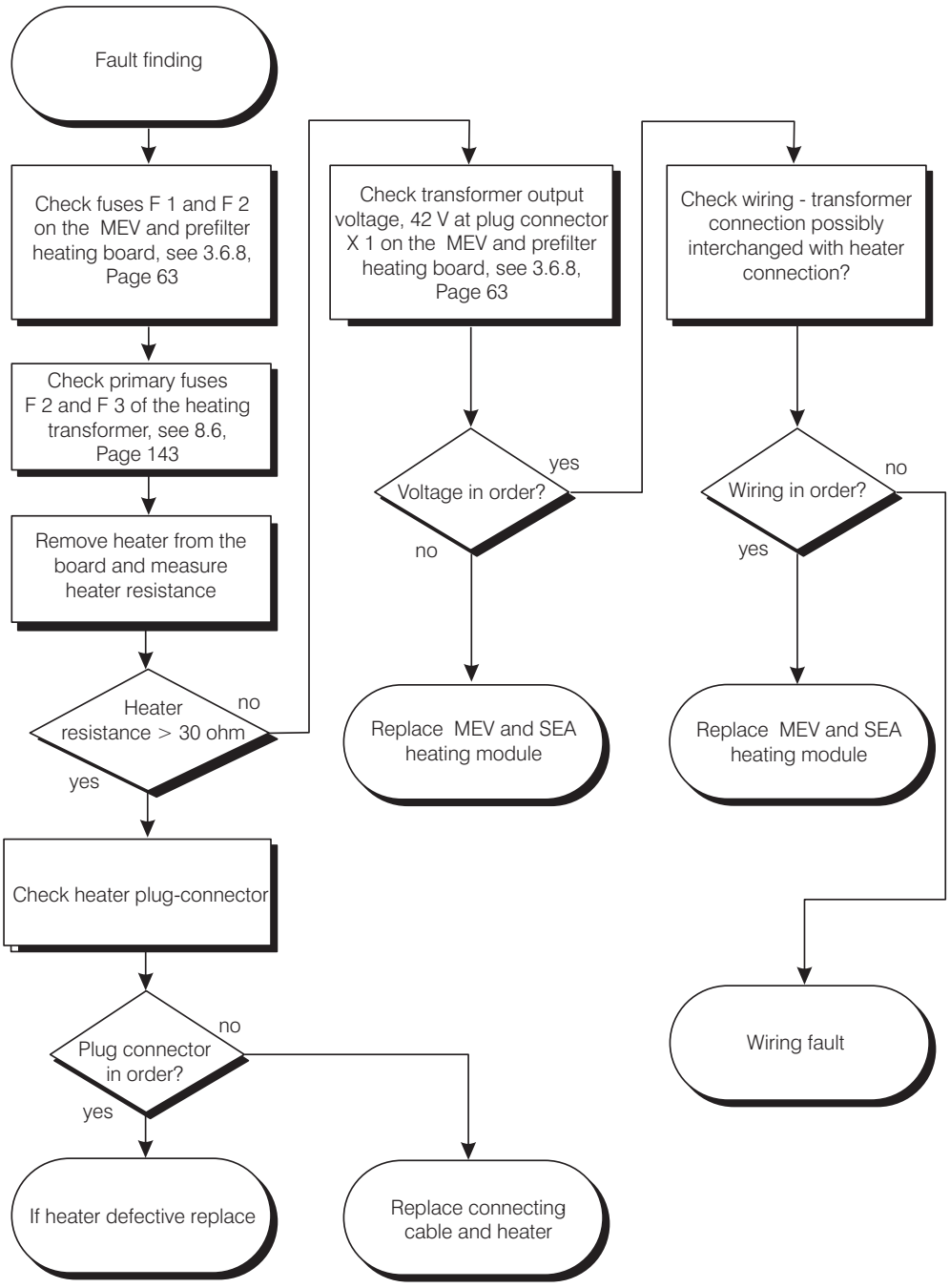
8.5.6 "MEV heating defective"
MEV = Gas Extraction Device

Only applicable to probe installation fitting (SEA) with MEV heating, otherwise fault in wiring or power supply electronics defective.
See also 3.4.2, Page 35 / 3.6.8, Page 63 / 5.4, Page 105

NOTE:

A software fault can result in a warning being signalled even if the LT 1 has not been equipped with either MEV or prefilter heating. This fault has now been rectified: ask for the software update, stating the model, appliance number and software version.

Use the following chart for fault finding



8.5.6.1 Replacing the MEV heater

- Disconnect the heater connecting cable from the LT 1.
- Measure the resistance. If it is greater than 30 ohm, the heater is defective or there is a contact problem in the heater - cable plug connection.

Replacing the heater

- Remove the SEA (probe installation fitting). The Lambda Probe does not need to be removed from the SEA
- Release the heating plug connector using a 19 mm spanner, brace with a 17 mm spanner
- Disconnect the plug connector and slide the heater upwards in the slot until the plug connector is free from the socket
- Measure the resistance directly on the heater
  If it is greater than 30 ohm, the heater is defective replace
  If it is less than 30 ohm, check whether there is a problem with the plug connection and replace if necessary
- Remove the protective tube locking device
- Release the protective tube using a 27 mm spanner, brace with a 24 mm spanner and unscrew
- Pull off protective tube over MEV
- Remove the defective heater
- Refit the protective tube and tighten
- Connect a new heater to the socket and tighten **securely**
- Shape the heater so that it is parallel to the mounting slot
- Release the heater and protective tube and remove them
- Insert the heater in the slot on the protective tube and slide upwards until the protective tube can be rotated without touching the heater plug connector
- Mount the protective tube and tighten
- Pull the heater downwards in the slot so that the plug connector can be inserted in the socket
- The plug connector must fit in the socket with minimum correction without the contact pins being damaged. Otherwise realign
- Securely tighten the screwed connection
- Refit the protective tube locking device
- Measure the resistance on the heater connecting cable.
  It is correct if less than 30 ohm
- Refit the SEA

8.5.7 "SEA prefilter heating defective”

Only applicable to the SEA filter heating option, otherwise there is an electronics fault.
Follow the procedure described in 8.4.6, Page 142, " MEV heating defective”.

IMPORTANT!
The heater must be correctly seated on the filter to ensure heat transfer.

8.5.8. “Calibration gas flow rate too low; increase gas flow rate”

Only relevant in combination with the option “automatic calibration unit”.
The absolut pressure sensor detects the measuring gas pressure in operation and calibration.
During calibration the software is checking the pressure inside the filter in relation to the operation. It must be risen more than 1 mbar. If the pressure is lower, a warning is announced. The flow of the calibration air has to be increased (adjustment flowmeter or throttle).

8.5.9 "Pressure outside the permissible range”

Only applicable to the "automatic calibration device” and "pressure compensation” options.

The absolute pressure sensor registers the pressure of the measured gas during operation and during calibration.
Manufacturer's setting: Max. permissible pressure 1100 mbar
Min. permissible pressure 900 mbar

The current absolute pressure can be read, and extended to a range of 800 to 1200 mbar, using the indicator and control unit (option) and the remote display software (option).

Check whether the displayed value is plausible. If not replace the pressure sensor.

8.5.10 "Probe temperature outside the Permissible range”

Only applicable to the "measured value temperature compensation” option.
A temperature sensor on the probe registers the casing temperature in the region of the "critical nozzle”.
Manufacturer's setting: Max. permissible probtemperature 390 °C
Min. permissible probe temperature 100 °C

This can be extended, via the indicator and control unit (option) and the remote display software (option) to a range of +50 °C to +400 °C.

Check whether the displayed value is plausible. If not, replace the temperature sensor or input card.

8.5.11 "Do not draw waste gas through cold probe”

The cold-start delay has been deliberately interrupted.

IMPORTANT!

Never draw waste gas through a cold probe. This can result in blockage of the "critical nozzle”. Allow the following wait times:

for gas and light fuel oil	1 hour
for coal and heavy fuel oil	2 hours
for refuse combustion	3 hours

In the absence of an automatic calibration device, mount the probe only after pre-heating for at least 1 hour. See also 3.6.6. Page 58.

If the cold-start delay was interrupted by mistake, it can be reactivated as follows.

- Switch off the LT 1
- Wait until the pressure has decreased, if necessary opening the hose screwed connection or alternatively, raise the tappet on the plate of the measure gas pump until the microswitch operates, and hold
- Switch the LT 1 on again
- LT 1 in "cold-start delay" mode

8.5.12 "LS 1 temperature measurement defective"

Only relevant to the "measured value temperature compensation" option

Check the temperature sensor, measuring transducer and input card and → replace if defective.

8.5.13 "Probe current limitation active"

Probe current greater than 1000 mA

In a perfectly operating probe, the probe current lies within the range of 0 to 600 mA. A probe current greater than 1000 mA indicates a defect, except where it occurs transiently during calibration as a result of polarisation compensation.

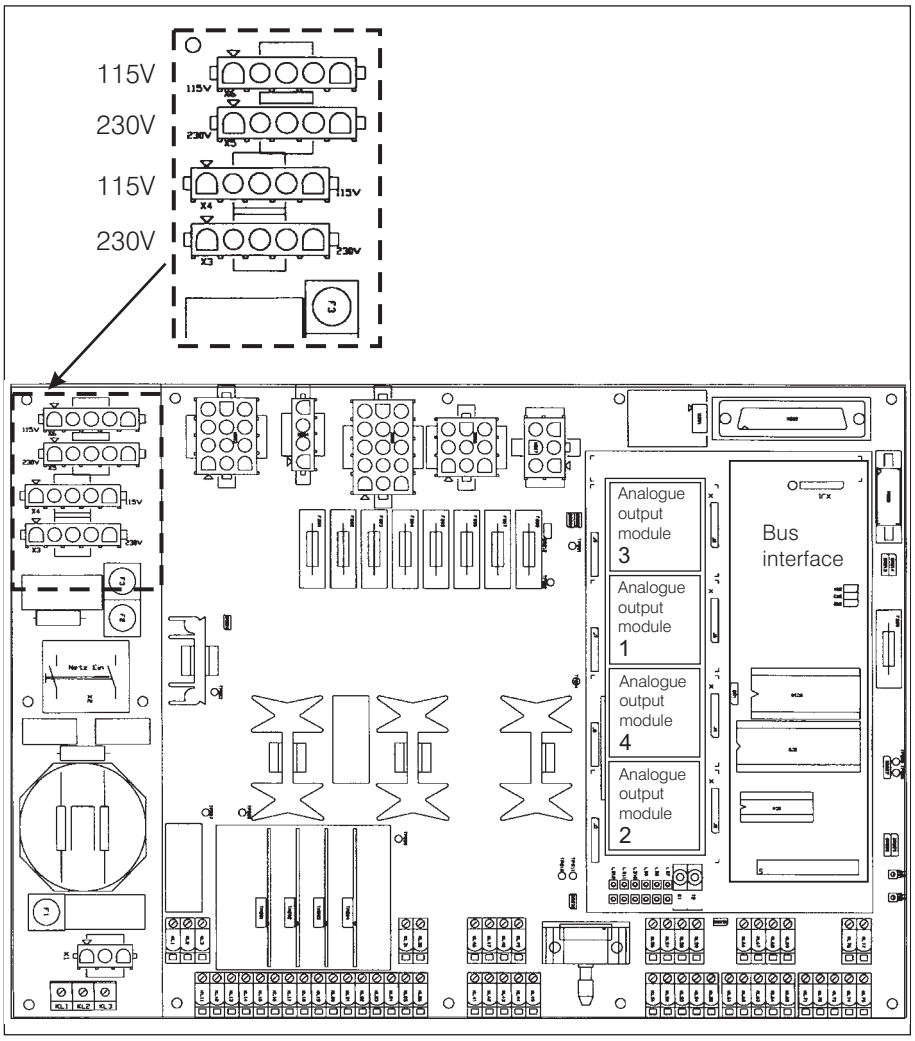
- Probe (quartz glass measurement chamber broken)
- Electronics (probe voltage control defective)
- Electrical connection → short-circuit between the current-carrying leads (probe plug connector between Pin 1 with Pin 3 and Pin 4
  Pin 4 with Pin 1 and Pin 2)

In this case, the probe should be replaced before any further checks are made.

8.5.14 "Power supply voltage too high / too low"

The probe heating control is no longer capable of correcting the power supply voltage fluctuations.

Check whether the plug connectors are correctly inserted in the power supply unit electronics. See Fig.



If they are correctly inserted, check the power supply voltage and the electrical connection.

The power supply voltage compensation has a ±15 % correction capacity.

If everything OK → power supply voltage compensation fault → replace the power supply unit electronics.

NOTE:

It is possible to use the indicator and control unit or remote display software options to compare the power supply voltage with the power supply voltage measured with a meter. This comparison is available under operating data, parameter 40.

8.5.15 "Measured gas pump operating time control active"

The switching point of the negative pressure switch located on the measured gas pump is actuated when the operating time of the measured gas pump is determined. This can result, briefly, in a somewhat greater measured value deviation (as much as -5 % from the given measured value).

The measured gas pump operating time control can only be activated manually via the indicator and control unit (option), under the "commands" parameter group, parameter 110, enable level "Service", via the remote display software and by interrupting the cold-start delay using the multifunction pushbutton switch T 2..

- Switch off the LT 1
- Switch the LT 1 on again immediately (within 10 seconds)
- LT 1 in "cold-start delay" mode
- Interrupt cold-start delay immediately (within 1 minute) using the multifunction pushbutton switch T 2
- The pump operating time is now redetermined automatically

8.5.16 "Probe current not constant in calibration"

Probe current fluctuates widely during calibration

Possible causes:

- Calibrating gas flow rate too low
  Check the setting on the flow-meter
  Recommended flow rate 300 to 500 Nl/h
  Increase the calibrating gas flow rate
- The absolute pressure can be checked via the indicator and control unit (option) and the remote display software (option).
  Pressure increase during calibration 1 - 6 mbar
  In the case of the ceramic MEV, as much as 50 mbar or above. There may be a need to increase the range, see 8.4.2, Page 140.
- Sintered metal prefilter broken, see 3.4.1, Page 34
- Leakage in the probe installation fitting (SEA), Lambda Probe, etc.
  Check seals and screwed connections.
- Quartz glass chamber in the Lambda Probe broken.
  Check the Lambda Probe for tightness of seal, see 7.2.2.1.9, Page 132
- Large pressure fluctuations during calibration

Increase the damping (measured value integration), only possible via indicator and control unit (option) and remote display software.
Parameter group "measured value processing": damping O_2 measured value
Parameter 360, enable level "Operation", damping absolute pressure measurement Parameter 441, enable level "Customer".
See separate Operating Manual.

8.5.17 Analogue input 1 / 2 / 3 / 4 Input value too large / too small

The input value at a particular analogue input is outside the permissible range. Check range limits, Parameter 574 / 584 / 594 / 604 / (min. value) and 575 / 585 / 595 / 605 (max. value).
The current input value can be read under Parameter 570 / 580 / 590 / 600.

Action:

- Check wiring - incorrect polarisation?
- Check source (connected appliance)
- Input card defective ? - replace

8.5.18 Configuration fault Analogue outputs

An analogue output has been activated which does not have a fitted component. Check the equipment of the analogue output module; see drawing in 4.3.2.2 on Page 89/Page 157 and compare with the set configuration, Parameter 530 / 540 / 550 and 560 for the analogue output modules 1 to 4.

IMPORTANT!

A configuration fault can result in incorrect analogue values.

8.5.19 Service warning 1 / Service warning 2

The function of the services warning is to provide reminders of regular service tasks. The service warnings can be defined as required by the operator, e.g.:

Service warning 1 → check protective pump filter and condensate trap

Service warning 2 → measured gas pump: replace diaphragm

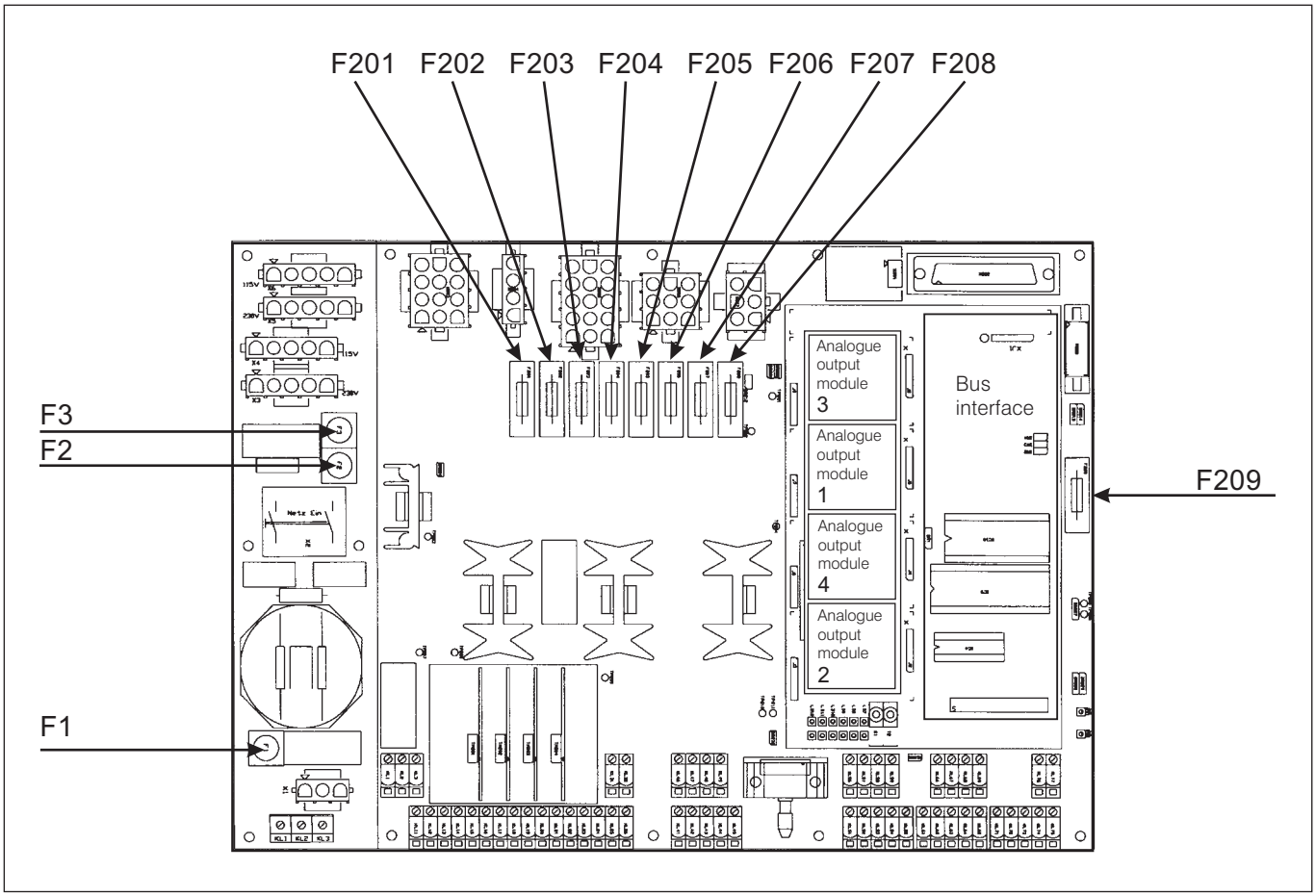
The appropriate cycle intervals can be configured as required using Parameters 1260 and 1261.

8.5.20 No LS 1 probe dynamic

See 8.4.9, Page 144

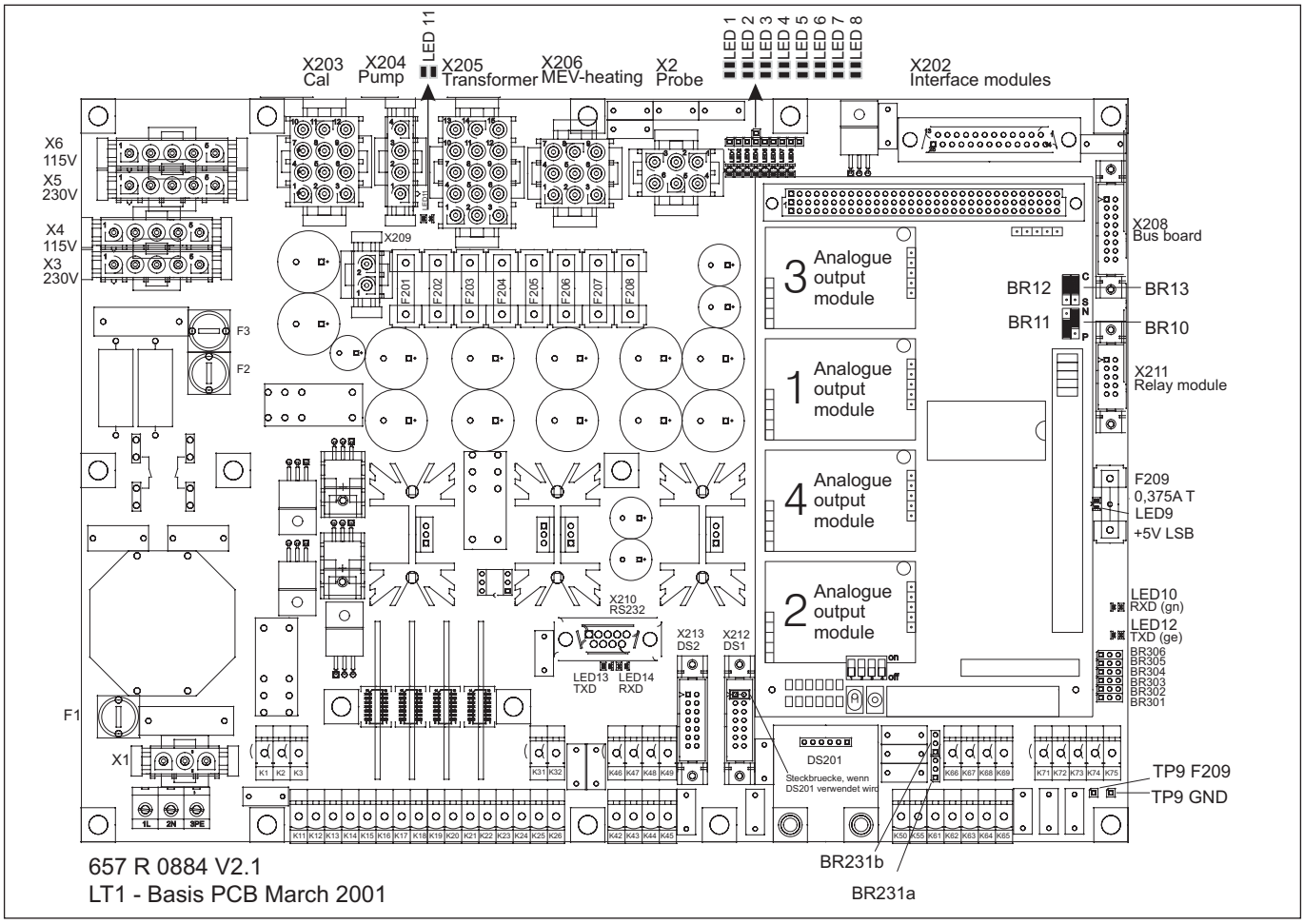
8.5.21 Dynamic test started

The active dynamic test has just been started.
For details, see 5.2.3 on Page 101.



Fuse ratings:

F 1			Main fuse, power supply input
	6.3 A	delayed-action	for 230 V power supply voltage
	10 A	delayed-action	for 115 V power supply voltage
F 2			Transformer, MEV and prefilter heating
	2.5 A	delayed-action	for 230 V power supply voltage
	5 A	delayed-action	for 115 V power supply voltage
F 3			Transformer, electronics
	2.5 A	delayed-action	for 230 V power supply voltage
	5 A	delayed-action	for 115 V power supply voltage
F 201	6.3 A	delayed-action	Calibrating gas pump
F 202	1 A	delayed-action	Solenoid valves
F 203	3.15 A	delayed-action	Measured gas pump
F 204	1 A	delayed-action	24 V
F 205	1 A	delayed-action	+ / - 5 V processor, analogue section
F 206	4 A	delayed-action	Probe heating (control)
F 207	4 A	delayed-action	Probe heating (fixed voltage)
F 208	1.5 A	delayed-action	Probe current supply (variable voltage)
F 209	375 mA	delayed-action	RS 422 / RS 485 (potential-free)



Description of the LEDs, Fuses, Jumpers, new Connectors and Terminals

LEDs

LED 1 green: monitoring supply voltage +12 V Calibration gas pump
LED 2 green: monitoring supply voltage +12 V Solenoid valves
LED 3 green: monitoring supply voltage +12 V Measured gas pump
LED 4 green: monitoring supply voltage +24 V
LED 5 green: monitoring supply voltage +5 V Digital circuit
LED 6 green: monitoring supply voltage -5 V Analog circuit
LED 7 green: monitoring supply voltage +5 V Analog circuit
LED 8 green: monitoring supply voltage +6 V Sensor gliding voltage
LED 9 green: monitoring supply voltage +5 V LSB or RS 422
LED11 yellow: Status of pump pressure switch (lit = switch ON = vacuum pressure existing)
LED10 green: LSB or RS 422 RXD-LED
LED12 yellow: LSB or RS 422 TXD-LED
LED13 yellow: integrated RS 232 TXD-LED
LED14 yellow: integrated RS 232 RXD-LED

F201 6,3 Atr
F202 1,5 Atr (1,6 Atr)
F203 3,15 Atr
F204 0,8 Atr
F205 1,5 Atr (1,6 Atr)
F205
F205
F208 1,5 Atr (1,6 Atr)
F209 0,375 Atr

Jumpers

BR231a and BR 231b: Both Jumpers in position 1-2 (down)
Digital inputs in reference to device GND
Both Jumpers in position 2-3 (above)
Digital inputs are floating, for external GND

BR302 bis BR306: Position 1-2 (left)
Configuration for Lamtec-System-Bus (CAN)
Position 2-3 (right)
Configuration for RS 422-Interface (SICK)

BR301: Position 1-2 (left)
Without termination, no end device
Position 2-3 (right)
With 120R termination, for end device

Setting for RS 422 Interface on 2-3, it means for RS 422 communication the whole Jumpers BR301 BR306 are in right position (2-3).

New Connectors

X210: Integrated RS 232 Interface
X211: Relay module with Watchdog-Signal
X212: Connector for pressure sensor module 1.
On to this connector can be fixed in future a pressure sensor module with the small pressure sensor. It replaces then the big DS 201 pressure sensor. In case of the use of the big pressure sensor, the pins 1 and 2 of this connector are to be jumpered.
X213: Connector for a 2nd pressure sensor module.

Screw terminals

The terminals KL51 - KL54 and KL56 - KL59 for the Relay Module are removed.
Terminals 71 - 75 configured for the LAMTEC-SYSTEM-BUS, have the following meaning:

KL71: CAN-GND (n.c.)
KL72: CAN-H (high)
KL73: CAN-L (low)
KL74: CAN-H (high)
KL75: CAN-L (low)

9. Replacement Parts

A list of relevant replacement parts is given below.

It is advisable to keep a stock of those parts marked with an asterisk (*).

Stocking of replacement parts marked [(1)] is a matter of discretion.

Stocking of replacement parts marked [(2)] is appropriate only if the measurement system is quipped with the relevant option.

Parts marked [(3)] - other lengths; see Price List, or upon request

Consumables:

* 1 Lambda Probe LS 1
Gas-tight version without gas extraction device (MEV)
No. 6 50 R 0031...R 0034, replacement probe on request

* 1 Set of seals for measured gas pump (diaphragm, valves, seals)
No. 6 52 R 0215

* 1 Set of seals for measured gas pump for corrosive measured gases
No. 6 52 R 0028, 6 57 R 0836
No. 6 52 R 0217

* 1 Replacement filling (pack of 10) for protective pump filter, measured gas pump
No. 6 57 R 0790

* 1 Protective pump filter (one-way filter) for calibrating gas pump
No. 6 52 R 0210

* 1 Active carbon filter (one-way filter)
No. 6 52 R 0248

1 Particle filter 0.1 μm, 98 % (one-way filter)
No. 6 52 R 0250

Replacement parts:

* 1 Gas extraction device (MEV), e.g. 1000 mm long,
No. 6 55 R 0023, length to be stated when ordering
For standard lengths, see Price List

* 1 Extraction filter for MEV
No. 6 55 R 0028

* 1 Sintered metal filter insert, 50 μm (pack of 10)
for extraction filter No. 6 55 R 0028

* 1 Filter attachment for probe installation fitting (SEA)
No. 6 55 R 0212 - filter gauge 20 μm (standard)
No. 6 55 R 0211 - filter gauge 10 μm
No. 6 55 R 1210 - filter gauge 40 μm
No. 6 55 R 0208 - filter gauge 2 μm

(3) + (2) 1 Replacement heater for MEV 1000 mm long
No. 6 55 R 0092

(3) + (2) 1 Replacement heater for SEA filter attachment for
MEV 1000 mm long
No. 6 55 R 1092

(2) 1 Connecting cable with plug connector for MEV and filter heating
No. 6 55 R 0094

(3) 1 MEV protective tube 1.4571 (V4A) 1000 mm long
No. 6 55 R 0620

(3) 1 MEV protective tube, material 2.4610 for measured gas
temperatures up to 800 °C, 1000 mm long
No. 6 55 R 1620

* 1 Moulded insulating part, internal, for probe installation fittings (SEA)
No. 6 55 R 0037 / R 0083 / R 1183, (set)
No. 6 55 P 3705

(2) 1 Temperature sensor PT 100 for LS 1
No. 6 57 P 0864

1 Blind flange SEA / LS 1, 8-hole
No. 6 57 P 0445

* 1 Flange seal for LS 1, probe installation fitting (SEA), graphite
No. 6 50 R 0910

* 1 Flange seal LT 1 - counter flange No. 6 57 R 0187 / R 0190 -
LT 1 No. 6 57 R 0000 to 6 57 R 0009, material: BAS - green
No. 6 57 P 0437

* 1 Repair kit, "critical nozzle”
No. 6 50 R 0900

* 1 Measured gas pump 12 V DC,
connection position D incl. vibration damper
No. 6 57 R 0872
or, alternatively:
Measured gas pump 12 V DC for corrosive measured gases,
connection position D incl. vibration damper
No. 6 57 R 0836

(2) 1 Pump head assembly, corrosive measured-gases model
No. 6 52 P 0214

(1) 1 Pump head assembly, for measured gas pump
No. 6 52 P 0215

* 1 Protective pump filter for measured gas pump - replaceable filling
No. 6 57 R 0790

1 Condensate collector with integral pump protection filter
(replaceable filling)
No. 6 57 R 0792

[1] 1 Calibrating gas pump 12 V DC, incl. vibration damper
No. 6 57 R 0837

[2] 1 Absolute pressure sensor, standard
No. 6 57 P 0416

* 1 Mounting paste (anti-burn-in paste), pack of 5
No. 6 50 R 1090

* 1 Box of assorted small parts for LT 1
No. 6 57 R 0305

[1] 1 Replacement indicator and control unit
No. 6 57 R 0829

[1] 1 Replacement power electronics (full version)
No. 6 57 R 0884
or, alternatively:
Replacement power electronics (OEM version)
No. 6 57 R 0885

[1] 1 Replacement computer electronics
No. 6 57 R 0874

[1] 1 LT 1 power supply unit (transformer)
No. 6 57 R 0871

[2] 1 Replacement electronics for MEV and filter heating
No. 6 57 P 0316

[2] 1 Power supply unit (transformer) for MEV and filter heating
No. 6 57 P 0319

[2] 1 Analogue output card 0/4...20 mA; 0...10 V (1 channel)
No. 6 57 R 0050

[2] 1 Analogue output card 0/4...20 mA; 0...10 V potential-free,
max. potential difference ± 20 V
No. 6 57 R 0051

[2] 1 Relay module for digital outputs with 3 relays each with 2 change-over contacts for output of operation and status messages
No. 6 60 R 0012

[2] 1 Universal module for analogue input potentiometer 1...5 kΩ
No. 6 57 P 6000

[2] 1 Universal module for analogue inputs 0/4...20 mA
No. 6 63 P 6001

[2] 1 Universal module for analogue input 0.4...20 mA
with 24 V DC feed for transducer
No. 6 63 P 6002

[1] 1 Temperature input for PT 100, specify measuring range,
see 3.6.15, Page 64,
No. 6 57 R 0890

(1) 1 Temperature sensor PT 100, 250 mm long
No. 6 57 R 0891

(1) 1 Temperature sensor PT 100, 150 mm long
No. 6 57 R 0897

(2) 1 Bus interface, Interbus S
No. 6 63 P 0300

(2) 1 Bus interface, Profibus, CANopen, Suconet-K-Bus, Modbus
No. 6 63 P 0400

(2) 1 Interface module RS 422
No. 6 63 P 0500

(2) 1 Interface module RS 232 (upon request)
No. 6 63 P 0600

(2) 1 Serial connecting lead, 9-pole Sub-D
Socket / socket 10 m long
No. 6 63 R 0100

(2) 1 Extension for serial connecting lead, 9-pole Sub-D
Socket / plug connector, 10 m long
No. 6 63 R 0101

10. EC Declaration of Conformity

Month / Year:	..... March ..... / ..... 1997 .....
Manufacturer:	LAMTEC Meß- und Regeltechnik für Feuerungen GmbH & Co KG
Address:	Impexstraße 5, 69190 Walldorf
Product designation:	Lambda Transmitter LT 1 incl. all options
	No. 6 57 R 0000...R 0009
	No. 6 57 R 0020...R 0029

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

Number	Text
89/336/EEC	Electromagnetic Compatibility
73/23/EEC	Electrical Equipment within Defined Voltage Limits

Further information concerning the procurement of these Directives is contained in the Appendix

CE mark:	Yes
Place and date:	Walldorf, 04 March 1997
Legally binding signature:	.....

The Appendices are a constituent part of this Declaration.
This Declaration certifies conformity with the stated Directives but does not contain any guarantee in respect of characteristics.
The safety instructions contained in the supplied product documentation must be observed.

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

Month / Year: ..... March ..... / ..... 1997 .....

Product designation: Lambda Transmitter LT 1
incl. all options

The conformity of the designated product with the provisions of the aforementioned Directives is attested by compliance with the following Standards and Regulations:

	Reference No.	Date of issue
Harmonised European Standards:	EN50081, Part 2 EN50082, Part 2 (ENV50140, ENV50141, EN61000-4-2, IEC801-4, EN55014)	
National Standards (in accordance with NSR or in accordance with MSR Art. 5, Parag. 1, Clause 2):	VDE0110 VDE0100	September 1989 ---
National Certifications	Federal Immission Control Directives (BImSchV) 13 and 17 502 / 118 / 96 / 689724	November 1997

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