Advance Optima
Module Uras 14

Service Manual

43/24-1005-0 EN

ABB Automation

Table of Contents

Chapter 1: Description of functions

Overview

This chapter **...** describes the underlying physical principles and provides information on the determination of influence values.

Chapter contents You will find the following information in this chapter:

Physical principles

Measurement principle

- NDIR Technique
  (**N**on-**D**ispersive **I**nfra**R**ed Analysis)
- The measurement effect is based on resonance absorption of gas-specific vibration-rotation bands of gas molecules with differing atoms in the median infrared spectrum at wavelengths between 2.8 and 8 µm.

- The individual gases to be measured are identified by their specific absorption bands. Each gas has such an absorption spectrum (fingerprint).
  Exceptions:
  - Monoatomic gases, such as inert gases
  - Symmetrical gases, such as N_2, O_2 and H_2
  - These types of gases cannot be measured with this method.

The relationship between measured infrared emission absorption and the sample component is based on the LAMBERT-BEER law:

$$A = (I0 - I1) / I0 = 1 - e^{-\varepsilon(\lambda) \cdot \rho \cdot l}$$

where

A	= Absorption
I0	= Emission entering the cell
I1	= Emission leaving the cell
$\varepsilon(\lambda)$	= Sample component extinction coefficient
ρ	= Sample component density
l	= Sample cell length

The relationship between test component density ρ and its volumetric concentration c is

$$\rho = \rho_0 \cdot c \cdot p/p_0 \cdot T_0/T$$

where

ρ_0	= Pure gas density
p_0	= Pressure
T_0	= Temperature

under standard conditions (1013 hPa, 0°C).

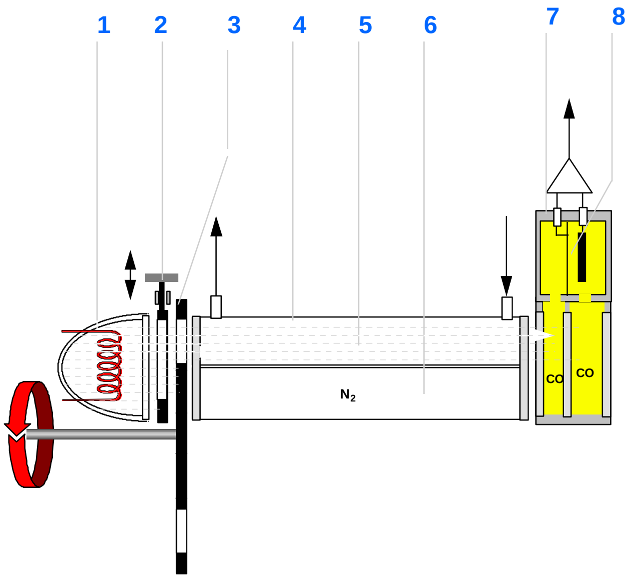
The second equation shows that the sample component's volumetric concentration depends on the sample cell pressure and temperature.
The first equation finds a non-linear relationship between absorption and volumetric concentration.

Continued on next page

Basic design

- The Uras 14 analyzer module is a twin-beam NDIR process photometer with no dispersive elements.
  The module consists of a completely self-contained optical unit with the following elements:
- Infrared source (emitter)
- Chopper wheel
- Emitter aperture
- Sample cell with sample and reference chambers
- Infrared detector with diaphragm capacitor

Figure 1-1 Measurement principle



1 Emitter
2 Emitter aperture
3 Chopper wheel
4 Sample cell
5 Sample chamber
6 Reference chamber
7 Infrared detector
8 Diaphragm capacitor

Physical principles, *continued*

IR emission

- Generated by broad-band emitter
- Emitted as a beam package alternately in the form of a sample and reference beam through the sample and reference chambers of the sample cell and is partially absorbed by the sample component molecules
- Counterphase modulation by means of a motorized chopper wheel
- Both modulated beam packages appear alternately at the infrared detector

---

Choppers

- Created by applicable regulation of the sample and reference beam balance

---

Sample cell

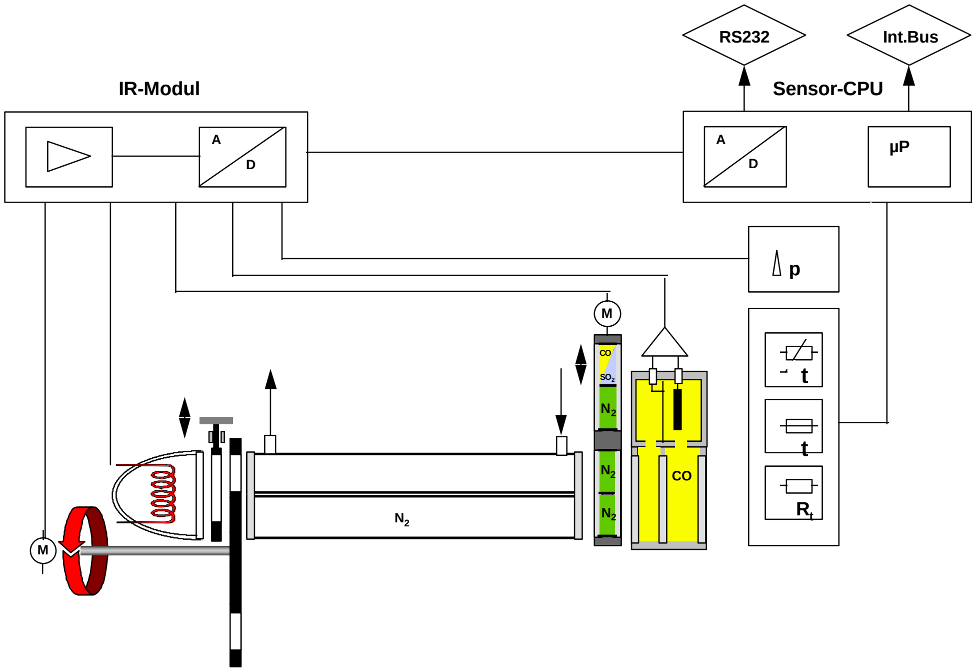
- Depending on the application, the sample chamber receives a sample, zero-point or end-point gas flow so that a part of the infrared radiation is absorbed in a concentration-dependent manner.
- The emission passes unhindered if the reference chamber is filled with a gas that does not absorb infrared (N_2).

Infrared detector

- A two-part transmission detector with front and rear chambers filled with the gas components to be measured; selectivity is determined by the infrared detector. The two chambers are separated by an infrared-transparent window. Additionally, the two chambers are separated by a stressed metal membrane with counterelectrodes. This unit is known as the diaphragm capacitor.
- It reacts in the following manner in the presence of the sample component:
  - IR radiation is weakened in the sample cell's sample chamber and enters the receiver's front chamber.
  - The equilibrium between the sample and reference beams initially established by calibration and the aperture is now disturbed.
  - There is an energy difference (temperature change) in the form of reduced pressure in the front chamber.
  - This pressure reduction is transformed into a capacitance change in the membrane capacitor by deflecting the metal diaphragm.
  - Since the diaphragm capacitor is connected to a high-impedance DC voltage, a corresponding periodic AC signal is generated.

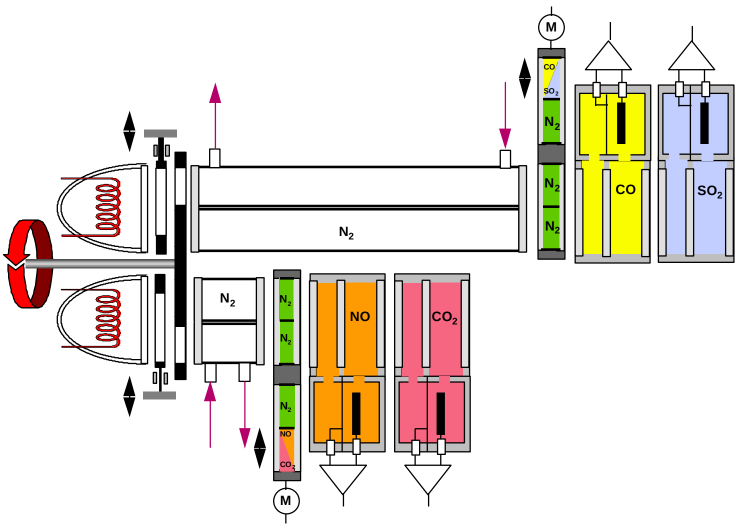
Continued on next page

Figure 1-2
Signal flow schematic



IR-Modul = IR module

Figure 1-3
Outline diagram of fully equipped unit



Determination of influence values

Associated gas effects

The sample gas is a mixture of the sample component and associated gas components. If the infrared absorption bands of one or more associated gas components overlap the sample component's bands, the test results will be affected.
The influence of interfering gas components is termed cross sensitivity or carrier gas dependence.
Cross sensitivity is determined by connecting an inert gas (e.g. N_2) which is mixed with the interfering gas components (corresponding to the test gas).
The influence acts on the zero-point measurement value indication.
Carrier gas dependence, which is rarely observed, occurs when the physical properties of the sample gas differ markedly from those of the test gas. This interference changes the slope of the device's characteristic curve. This curve is corrected at the end-point.
The Uras 14 has the following methods available for interference correction:

- Interference filter
- Filter cells
- Internal electronic cross-sensitivity correction
- Internal electronic carrier gas correction

Pressure

According to the gas laws, the sample cell's volumetric concentration depends on the pressure in the sample cell and is thus dependent on the process gas and air pressure. This effect acts on the end-point and amounts to approx. 1% of the measurement value per 1% of pressure change (therefore, per 10 hPa).
An internal pressure sensor reduces this effect to 0.2%.

Flow rate

The flow rate affects pressure in the sample cell and the module's T_{90} times.
The flow rate should be between 20 and 100 liters/hour.

Temperature

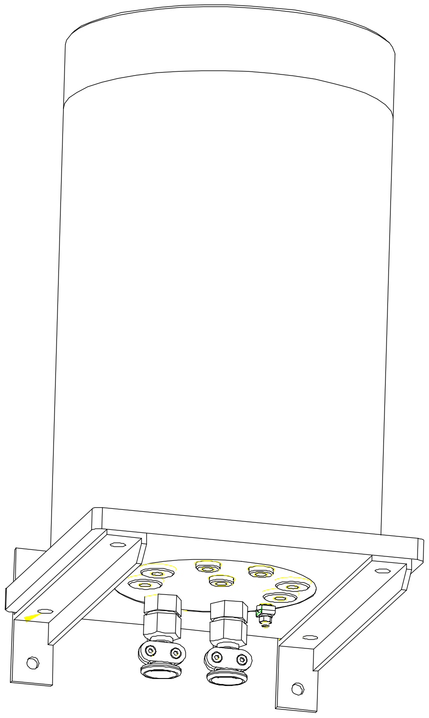
Temperature has a markedly different effect on all optical components in the beam path. This effect is reduced by:

- Temperature compensation
  A temperature sensor in the first infrared detector's preamplifier measures the temperature in the module.
  This signal is used for electronic correction.
  Zero-point effect: ≤ 1% of the measurement range per 10°C
  End-point effect: ≤ 3% of the measured value per 10°C
- Thermostat (optional)
  Zero-point effect: ≤ 1% of the measurement range per 10°C
  End-point effect: ≤ 1% of the measured value per 10°C

Ex Concept

Being prepared

Figure 1-4
Ex Module



Chapter 2: Analyzer module variants

Overview

Introduction

This chapter describes the individual module variants.

Chapter contents

You will find the following information in this chapter

Summary

General

Depending on the measurement application, the Uras 14 Analyzer can be equipped with the following main components:

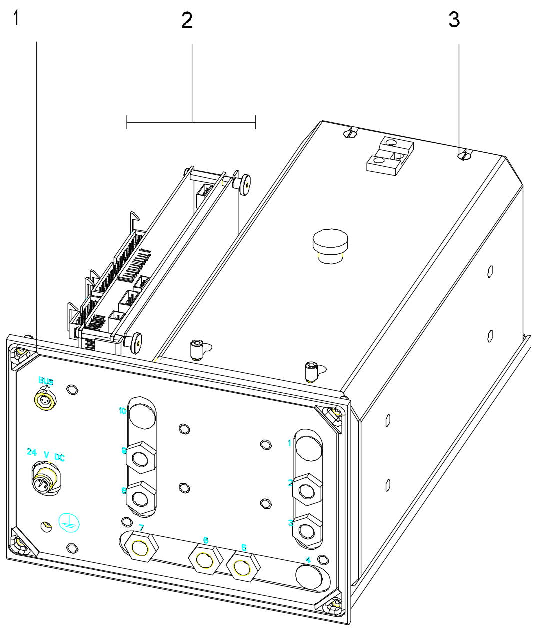
- 1 to 4 infrared detectors
- 1 to 2 beam paths
- Up to 2 infrared detectors per beam path
- The following elements are permanently installed
  - Both emitter inserts are filled
  - There is hardware support for installation of a thermostat
  - IR module circuit board
  - Sensor-CPU circuit board
  - Pressure sensor circuit board
- Other components are fitted according to the measurement application or configuration ordered.
- Any version of the module can be installed in a 19" rack or wall housing without special conversion.
- The pneumatics module and oxygen analyzer module can be incorporated together in the gas path.

Special components

The following components can be fitted according to the option ordered or measurement task to be carried out:

- 1 to 2 calibration units
- 1 to 2 filter cells
- Optics filter
- Gas paths
  - FPM hose
  - PTFE hose
  - Stainless steel pipe

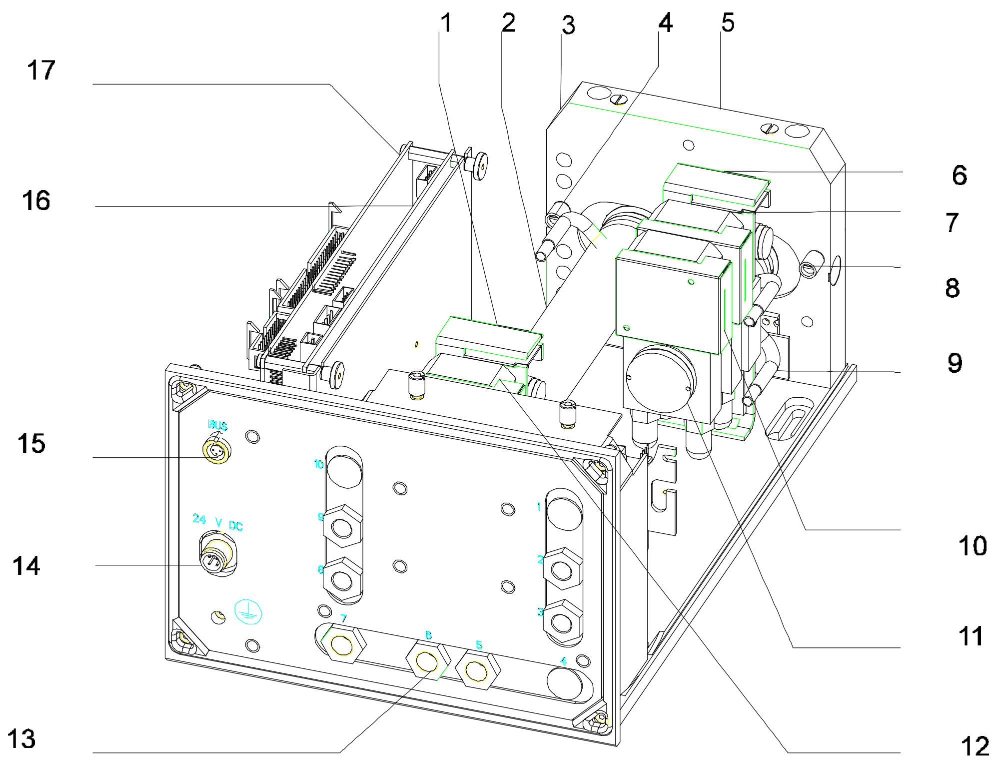
Figure 2-1
Uras 14
Analyzer Module



1 Connection plate with electrical and gas connections
2 Sensor electronics
3 Optical analyzer components with heat hood

Continued on next page

Figure 2-2
Uras 14
Analyzer Module
(open)

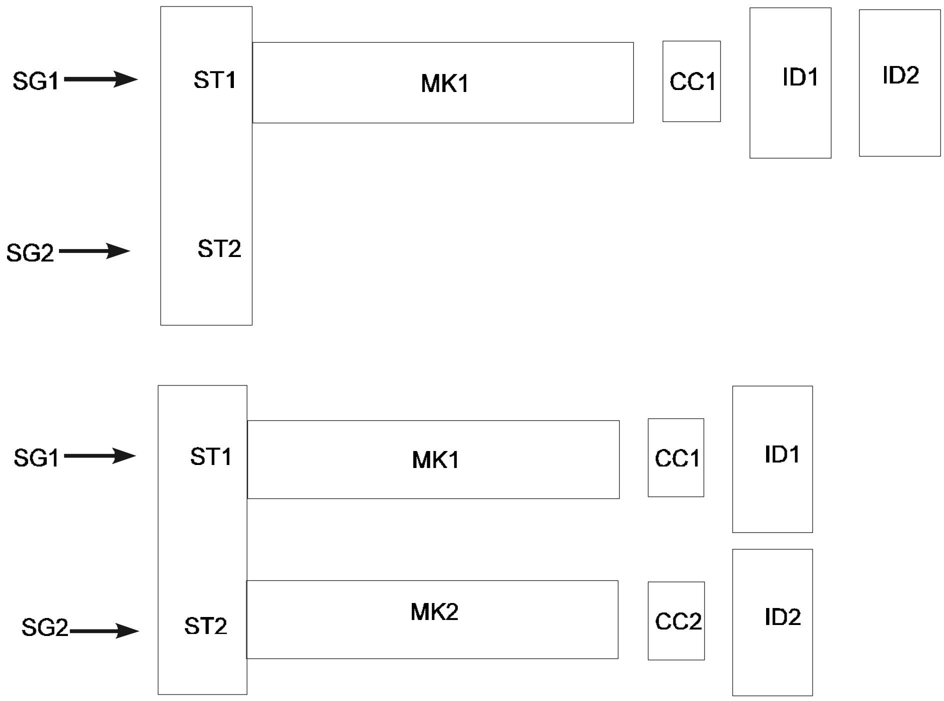


1 Calibration unit 2
2 Sample cell 2
3 Base support with choppers
4 Chopper adjustment screw for beam path 2
5 Modulator with emitters (not visible)
6 Calibration unit 1
7 Infrared detector 1
8 Chopper adjustment screw for beam path 1
9 Sample cell 1
10 Infrared detector 2
11 End disk (bright or dark)
12 Infrared detector 3
13 Gas connections
14 24-V external power supply
15 Internal bus, external connection

Module variants

Figure 2-3
Version with one infrared detector

Figure 2-4
Version with two infrared detectors



Legend for Figures 2-3 and 6

SG1	Beam path 1
SG2	Beam path 2
ST1	Emitter 1
ST2	Emitter 2
MK1	Sample cell 1
MK2	Sample cell 2
CC1	Calibration cell for infrared detectors in beam path 1
CC2	Calibration cell for infrared detectors in beam path 2
ID1...4	Infrared detectors 1-4

Continued on next page

Module variants, *continued*

Figure 2-5
Version with three infrared detectors

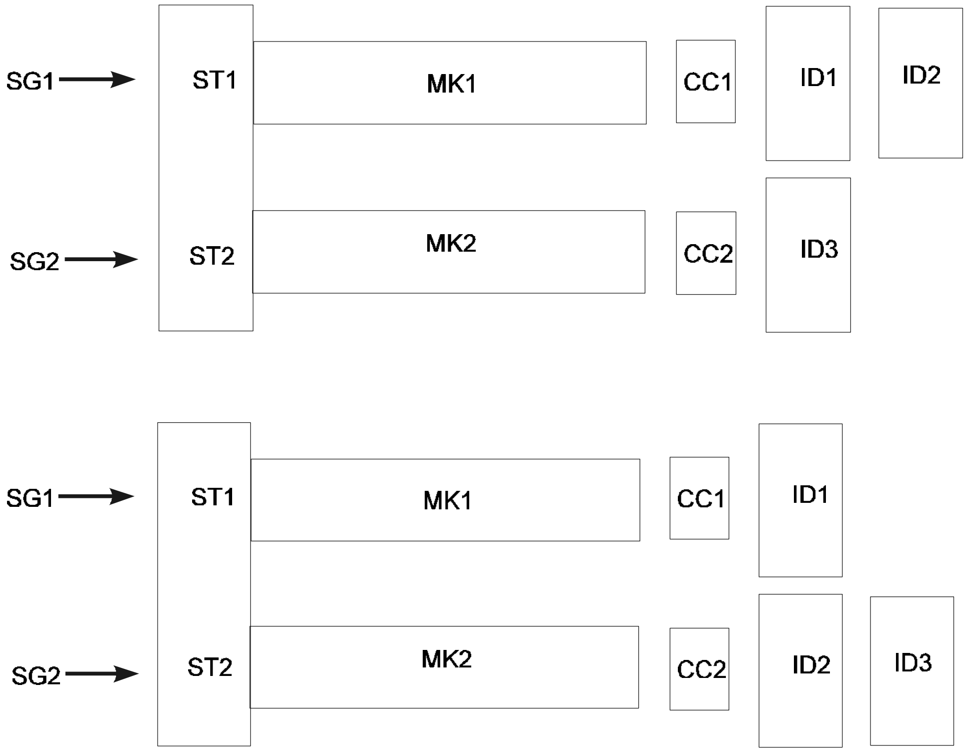
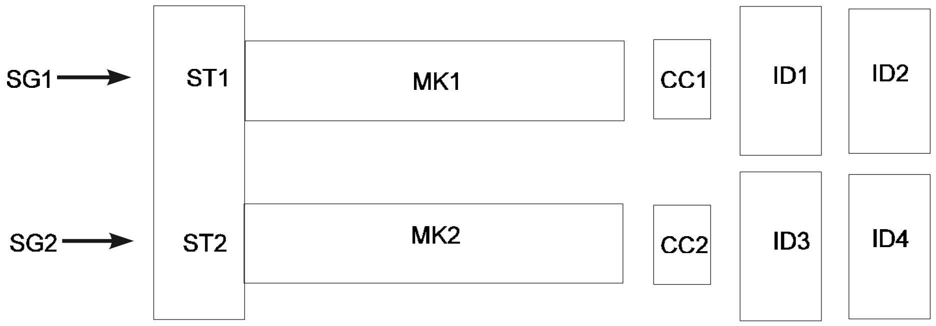


Figure 2-6
Version with four infrared detectors

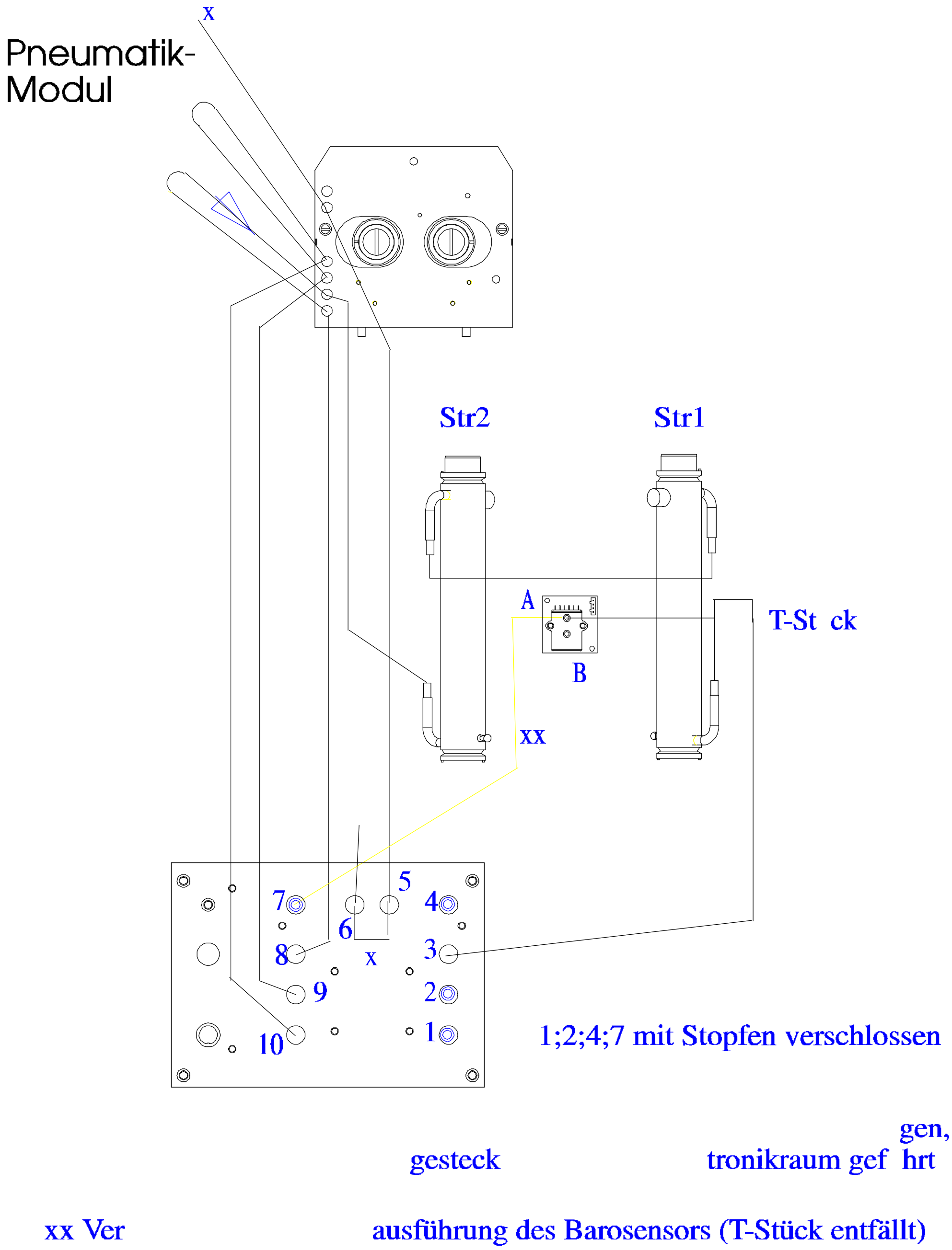


☞ Familiarity with the arrangement of the individual elements is needed for the following tasks:

- Troubleshooting
- Configuration
- Optical alignment
- Phase alignment

Hose and piping connections (still being supplemented)

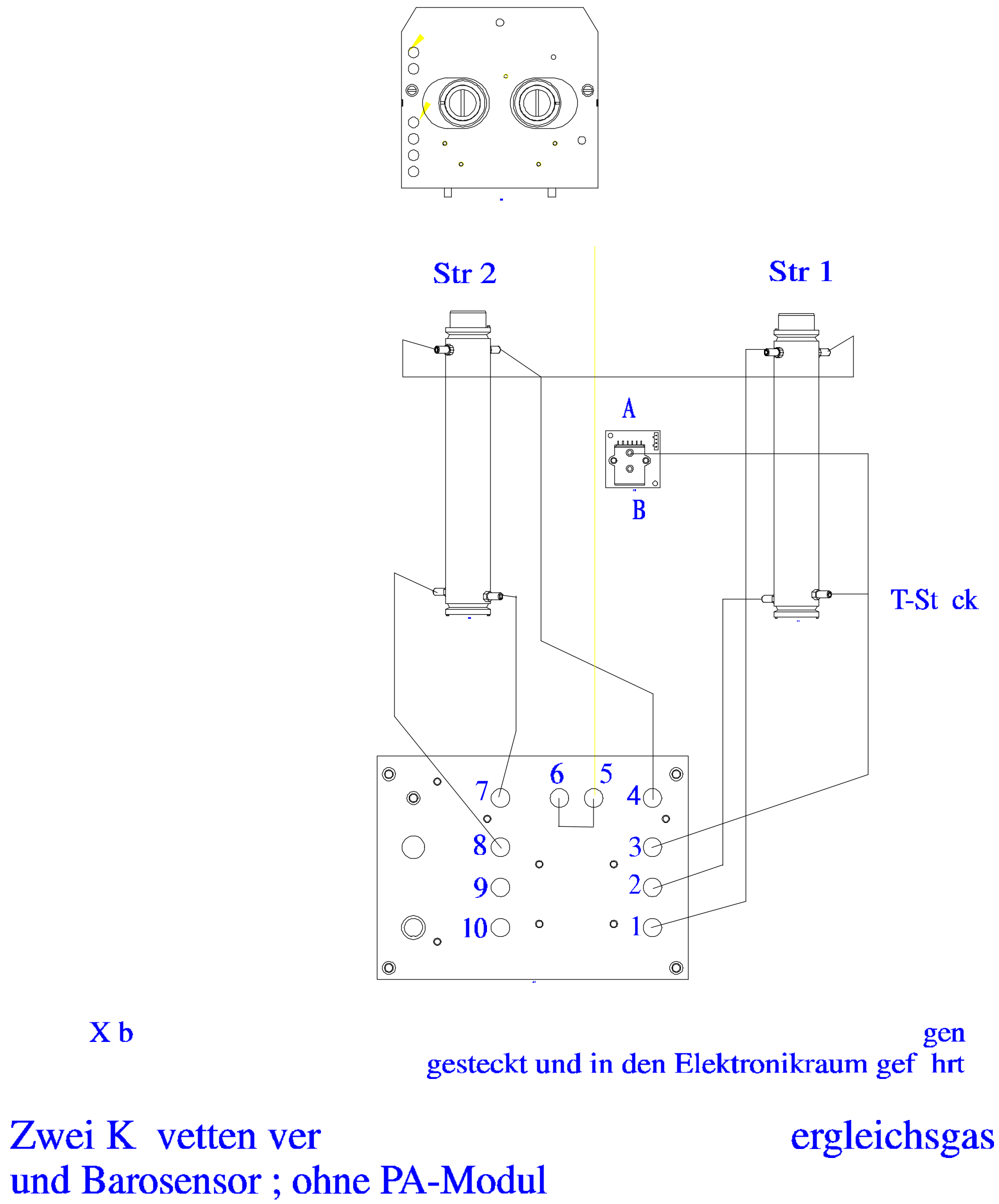
Figure 2-7
Two sample cells connected in series



Pneumatik-Modul = Pneumatics module
Str = Emitter
T-St ck = Tee
1;2;4;7 closed with plugs
xx Ver version with pressure sensor (Tee not present)

Continued on next page

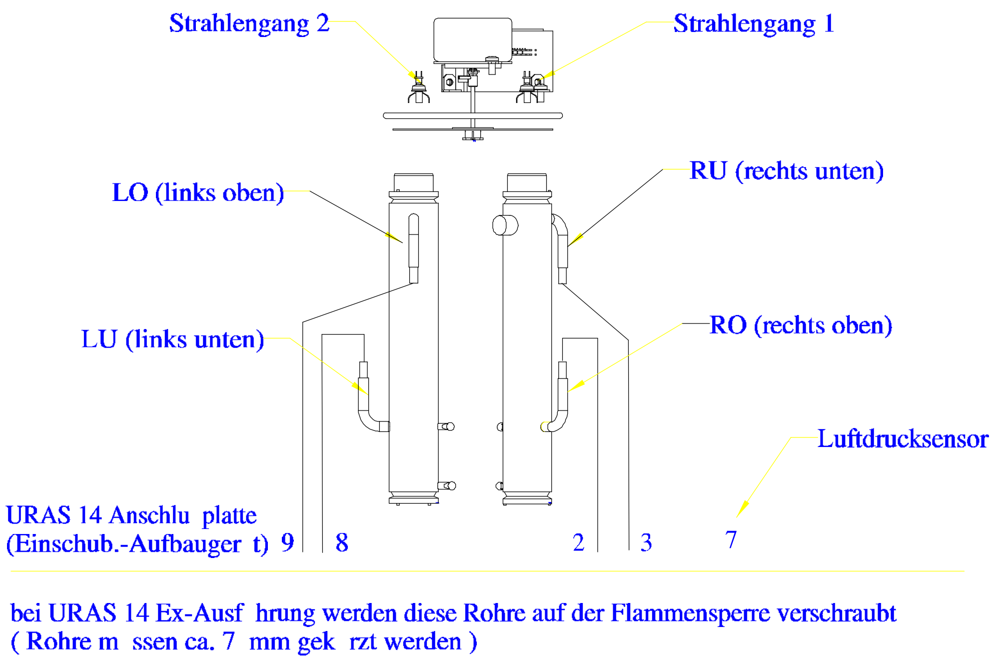
Figure 2-8
Two sample cells with flowing reference gas



Str = Emitter
T-St ck = Tee
X b … inserted and placed in electronics compartment
Two cells, reference gas and pressure sensor; No PA module

Continued on next page

Figure 2-9
Stainless steel pipe gas paths



Strahlengang = Beam path
LO = Left top
LU = Left bottom
RU = Right bottom
RO = Right top
Luftdruck… = Air pressure sensor
URAS 14 = URAS 14 connection plate (plug-in accessory)

In the URAS 14 Ex version, these pipes are screwed onto the flame barrier (pipes should be notched about 7 mm)

Chapter 3: Module components

Overview

Introduction

This chapter describes the individual assemblies and components.

Chapter contents

You will find the following information in this chapter:

Emitter

Location in module

Two emitters (emitter inserts) are installed at all times. The emitter inserts are attached to the modulator receiver plate (aluminum block).

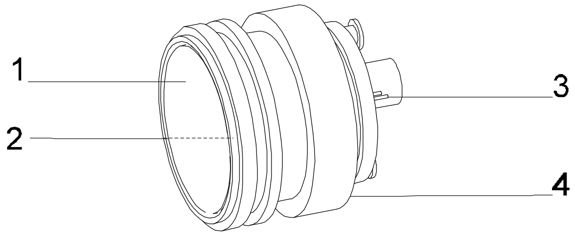
Design

The emitter insert consists of a reflective body, which houses a wire filament in a ceramic shell. The assembly is sealed behind a gas-tight, infrared-transparent window.
For increased service life the emitter insert filled with a special gas.

Function

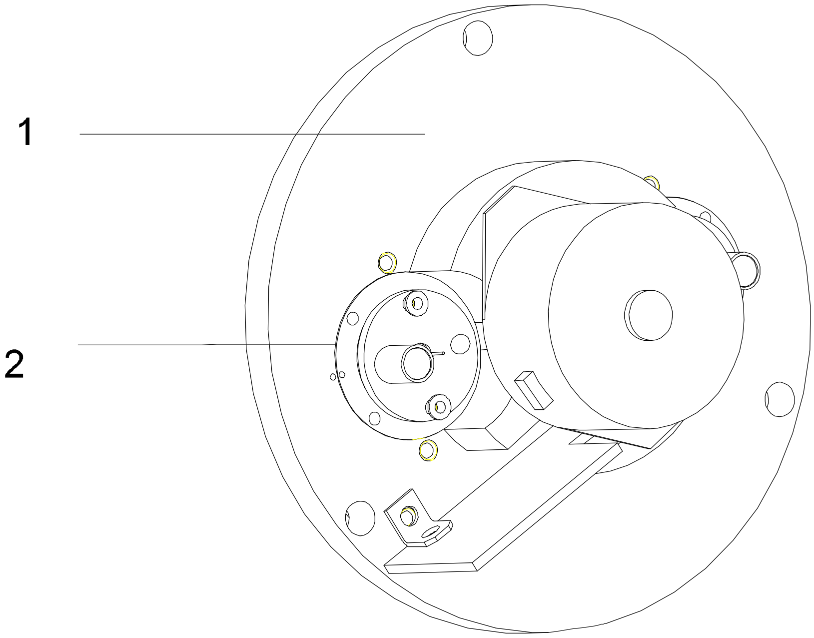
Depending on module equipment, test components and measurement ranges, the emitter inserts are supplied with approx. 5-10 VDC.
The filament then emits a broad-band, constant infrared light beam of the appropriate intensity.

Figure 3-1
Emitter insert



1 Infrared-transparent window
2 Emitter filaments (not visible here)
3 Electrical connections
4 Reflective housing

Figure 3-2
Modulator with emitter insert



1 Modulator (receiver plate)
2 Emitter insert

Modulator

Location in module

The modulator is fastened to the base support with the chopper adjustment.

Design

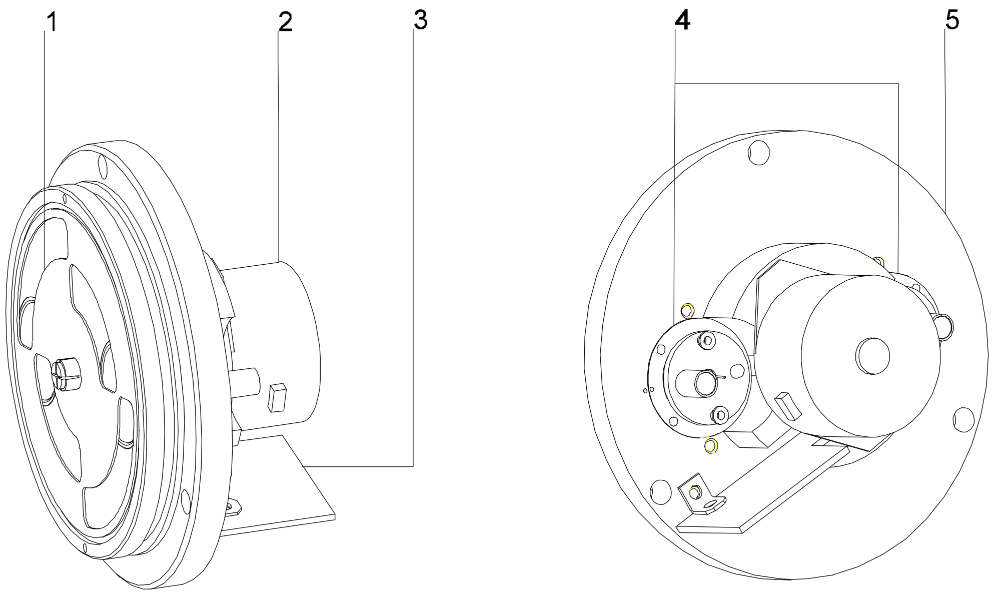
The modulator consists of:

- Receiver plate, on which all components are mounted
- 2 emitter inserts
- Chopper wheel
- Synchronous motor to drive the chopper wheel
- Coupling between synchronous motor and chopper wheel
- Circuit board with
  - Emitter power supply connectors
  - Synchronous motor connector
  - Split light barrier
  - O rings to seal the emitter inserts and the entire modulator assembly

Function

The computer-controlled synchronous motor drives the chopper wheel.
Modulation rate: 7.3 Hz (standard setting).
The motorized chopper wheel is designed to alternately cover the test and reference chambers in the sample cell so that infrared light from the emitters passes alternately through each chamber twice per revolution.
This alternating arrangement is assured by the split light barrier fastened to the motor shaft by means of a lug.
This design solution creates modulated light which results in a highly stable measurement signal.

Figure 3-3 Modulator

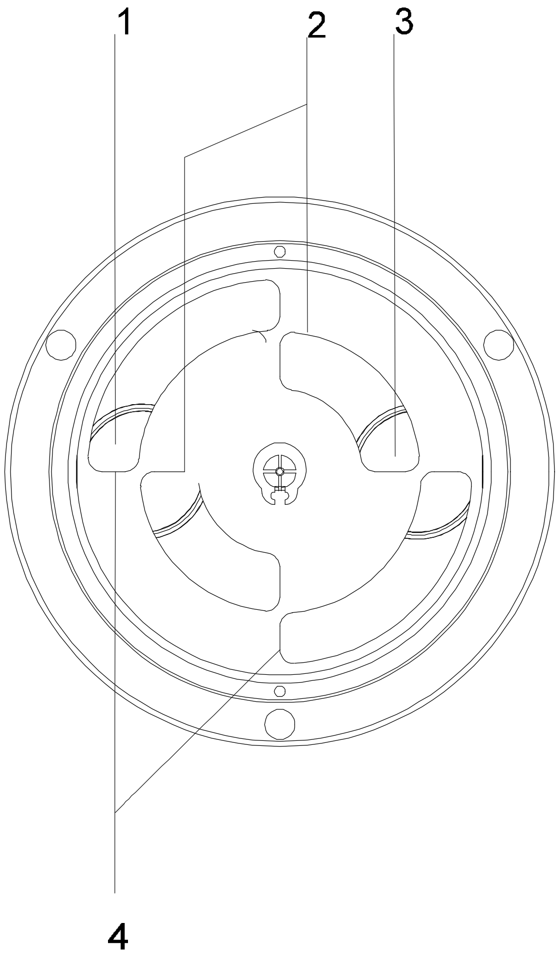


1 Chopper wheel
2 Synchronous motor
3 Emitter circuit board
4 Emitter inserts
5 Receiver plate

Continued on next page

Modulator, *continued*

Figure 3-4 Modulator Chopper wheel

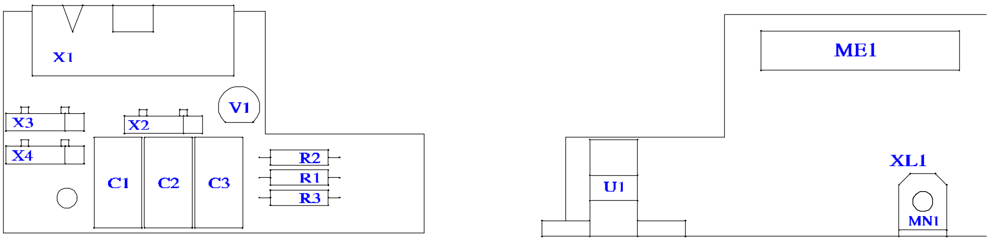


1 Emitter 2
2 Chopper wheel aperture to reference chamber
3 Emitter 1
4 Chopper wheel aperture to test chamber

Continued on next page

Modulator, *continued*

Figure 3-5
Emitter circuit board



U1 Split light barrier

Inputs/Outputs

X1 Connection to IR module circuit boardX2 Synchronous motor
X3 Emitter 1
X4 Emitter 2

Figure 3-6
Pin layout

Choppers

Location in module

The choppers and their adjusting screws are found on the base support, between the modulator and sample cells.

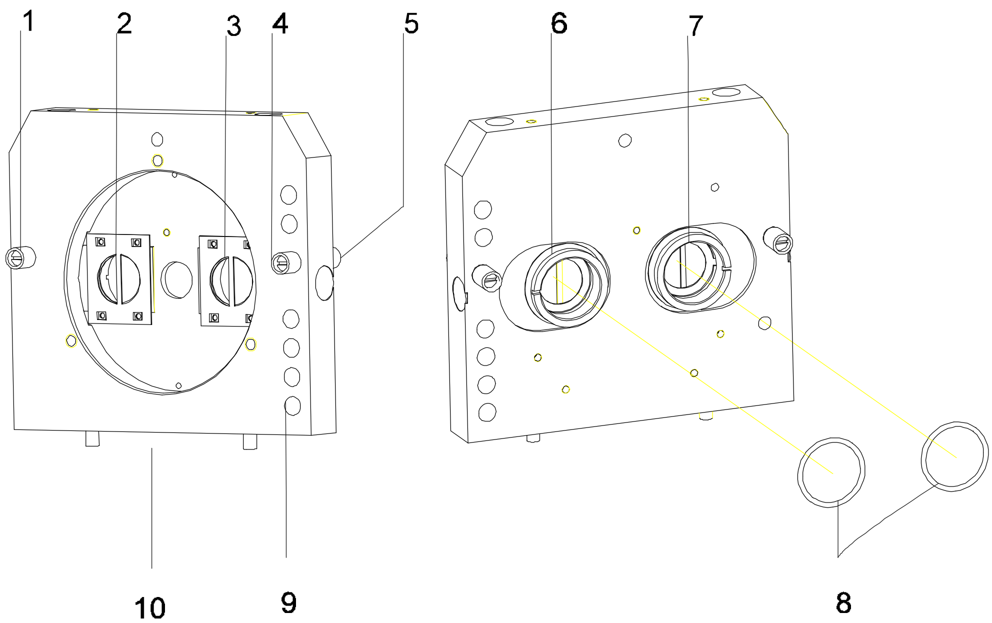
Design

In the base support there are always two choppers installed in slides which can be moved in and out horizontally by means of a screw.
Their arrangement reflects the division of the test cell into test and reference chambers.

Function

The chopper cuts the emitter's infrared output into the test and reference beams according to the adjustment in effect.
Goal: Equal intensity for both beams in the infrared detector during the initial adjustment.
Asymmetry is induced by design or sample gas considerations.
The "Optical alignment" function is used to achieve balance.

Figure 3-7
Choppers



1	Chopper adjustment screw for beam path 1
2	Chopper adjustment screw for beam path 1
3	Chopper for beam path 2
4 and 5	Chopper adjustment screw for beam path 2
6	Opening for sample cell in beam path 2
7	Opening for sample cell in beam path 1
8	O rings to seal the sample cell(s)
9	Openings for hoses to pneumatics module
10	Base support

Sample cell

Location in module

The sample cell is installed between the base support with modulator and the infrared detector or calibration unit.

Design

The cell consists of a gold-plated, special-section tube. A land divides it into a sample and a reference chamber. The chambers are closed off at both ends with infrared-transparent windows. As standard equipment, the reference chamber is filled with N_2. Two gas inlets allows the sample gas to flow through the sample chamber. The gas inlets are designed for the connection of piping or hoses. Positioning dowels hold the sample cells firmly in the beam path. For design reasons, shorter sample cells have additional N_2 -filled chambers in the sample and reference beams.

Function

Cell length depends on the measurement range involved.
Since infrared detectors for the components being measured have an assigned signal output, absorption adjustment according to the Lambert-Beer Law has to take place in the sample cell. Infrared light absorption depends on the concentration to be measured (measurement range) and the optical path length. The optical path length is the distance between the two windows in the sample and reference chambers.
The gold plating on the chamber surfaces serves the following purpose:

- Optimal light reflection
- Corrosion protection for the cell

Reflective properties are taken into consideration during optical alignment and calibration.
There are special sample cells for specific applications:

- Sample cells with flowing reference gas
  In this application the reference chamber can receive a sample gas flow (without the sample component). Result: Absorption of the portion of light in the interference gas absorption line region. This occurs equally in both chamber portions. There is no cross sensitivity.
  Δ measurements are another application.
- Sample cell with integrated filter cell
  Here, both filter chambers (sample and reference side) are filled with the interference gas component.
  Here, the light portion in the interfering gas line range is absorbed to suppress the interfering gas effect (cross sensitivity).

Variants

The nominal length is the optical path between the insides of the two windows.

NL (Nominal length) mm	Hose connection	Pipe connection	Flowing reference gas
0.3	X	X	-
0.6	X	X	-
2	X	X	-
6	X	X	X
20	X	X	X
60	X	X	X
200	X	X	X

Continued on next page

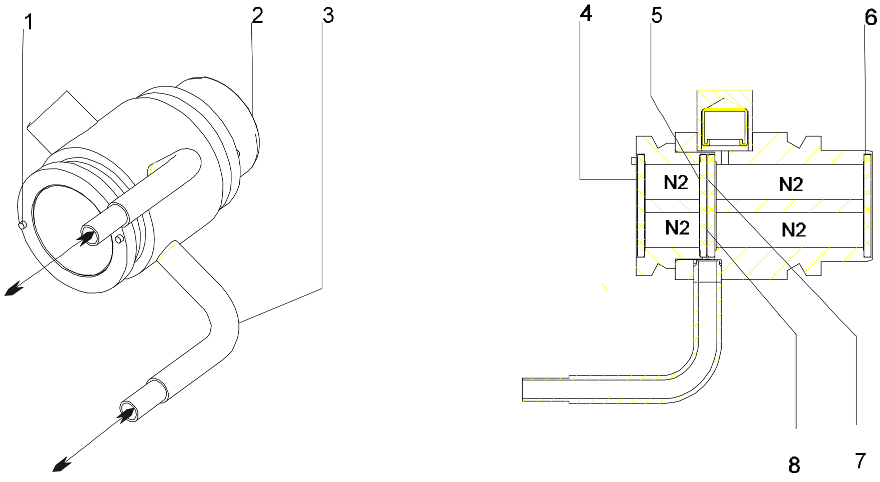


Figure 3-8
Sample cells
NL 0.3, 0.6, 2, 6 mm

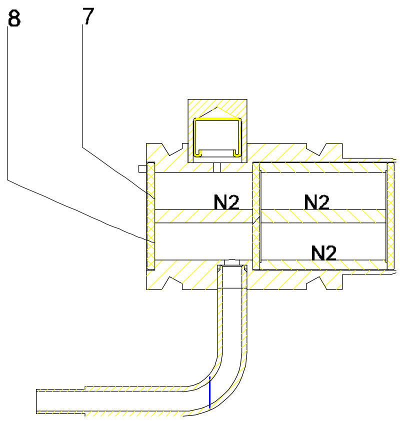


Figure 3-9
Sample cell
NL 20 mm

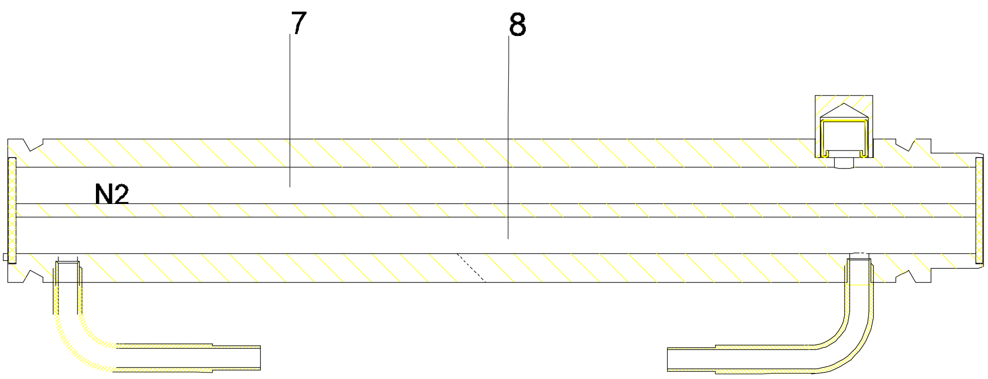


Figure 3-10
Sample cells
NL 60, 200 mm

Legend for
Figures 3-8 and 11

1 Positioning dowel to correctly locate the cell in the beam path
2 Shaft on chopper side
3 Gas input, output
4 Infrared-transparent window
5 Infrared-transparent window (in front of and behind the sample and reference chambers)
6 Infrared-transparent window
7 Reference chamber
8 Sample chamber

Continued on next page

Sample cell, *continued*

Figure 3-11
Sample cell with flowing reference gas

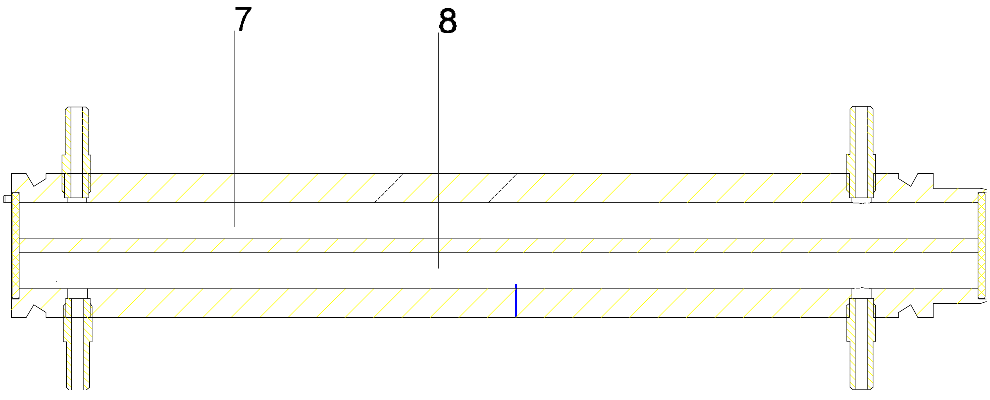
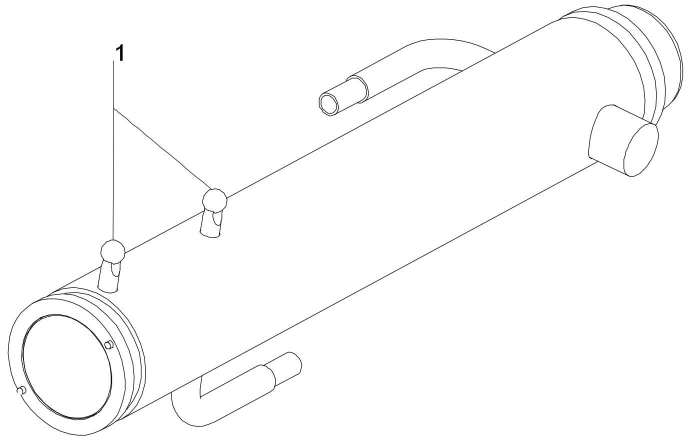
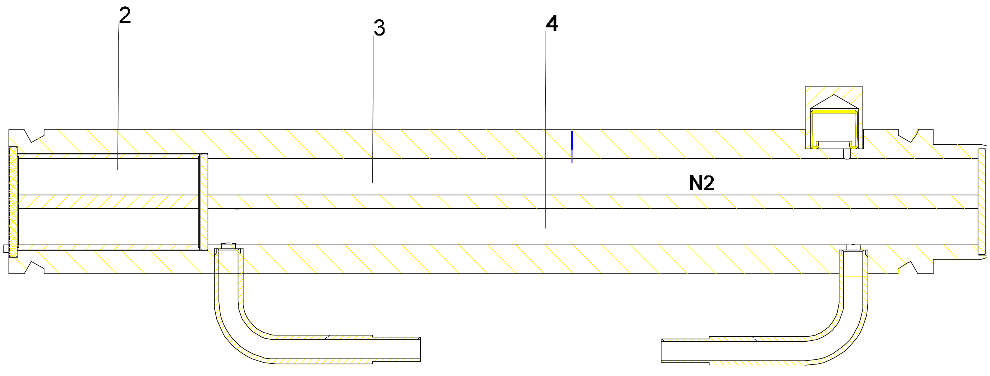


Figure 3-12
Sample cell with filter cell





1 Filter cell fill port (mechanically sealed and soldered)
2 Filter cell, NL 40 mm (filling both chambers per indication)
3 Reference chamber, NL 160 mm
4 Sample chamber, NL 160 mm

Filter cell

Location in module

The filter cell is mounted between the sample cell and the infrared detector or between the sample cell and the calibration cell.

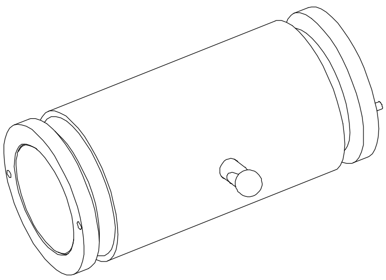
Design

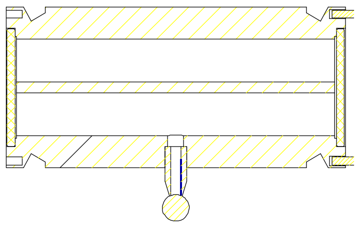
The filter cell consists of a gold-plated, special section tube.
A land divides it into sample and reference chambers with a gas connection between them.
The filter cell is closed off at both ends with infrared-transparent windows.
Two positioning dowels hold the filter cell properly in the beam path.

Function

The sample and reference sides are individually filled with the corresponding interference gas.
This causes absorption of the beam portion within the range of the interfering gas absorption lines.
Result: A marked reduction in cross sensitivity.

Figure 3-13
Filter cell
NL 60 mm





Optics filter

Location in module

Depending on the module arrangement and measurement task involved, the optical filters are placed in the following locations:

between Sample cell and infrared detector
Two infrared detectors
Calibration unit and infrared detector

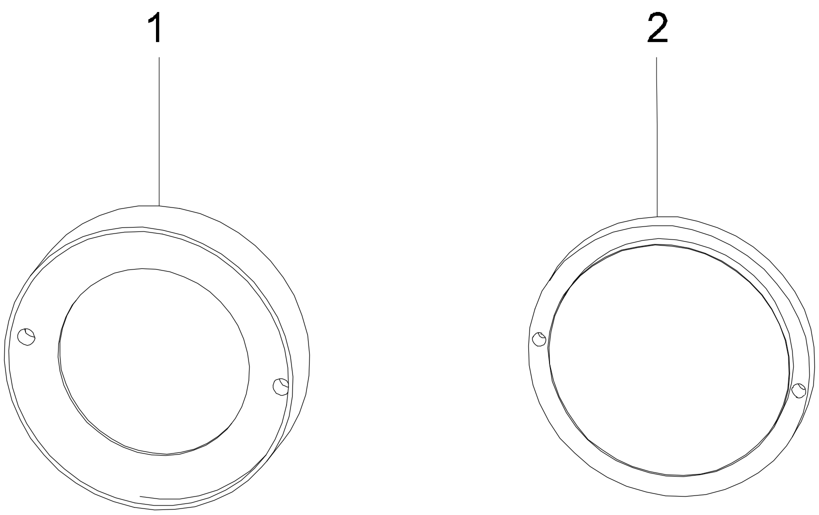
Design

The optical filter (interference filter) consists of a silicon disk with varying degrees of metallic dampening depending on the desired properties.
The filter is clamped in a metal socket.
The design of the sockets varies according to the sites listed above.

Function

Emission ranges in the sample and interference band overlap regions are diminished by installing interference filters. This means that certain filter types only allow specific wavelengths to pass.
For reasons of symmetry, the filter acts on the sample and reference sides of the beam path.
Use of filters is dependent on the following marginal conditions:
Combination of gas components in the sample gas
Component concentrations
Measurement ranges
Filters are primarily used for the SO_2, NO, N_2O, and C_nH_m components.

Figure 3-14
Optics filter



1 Optical filter, Type A (between sample cell / detector and detector
2 Optical filter, Type B (between calibration cell and detector)

Calibration unit

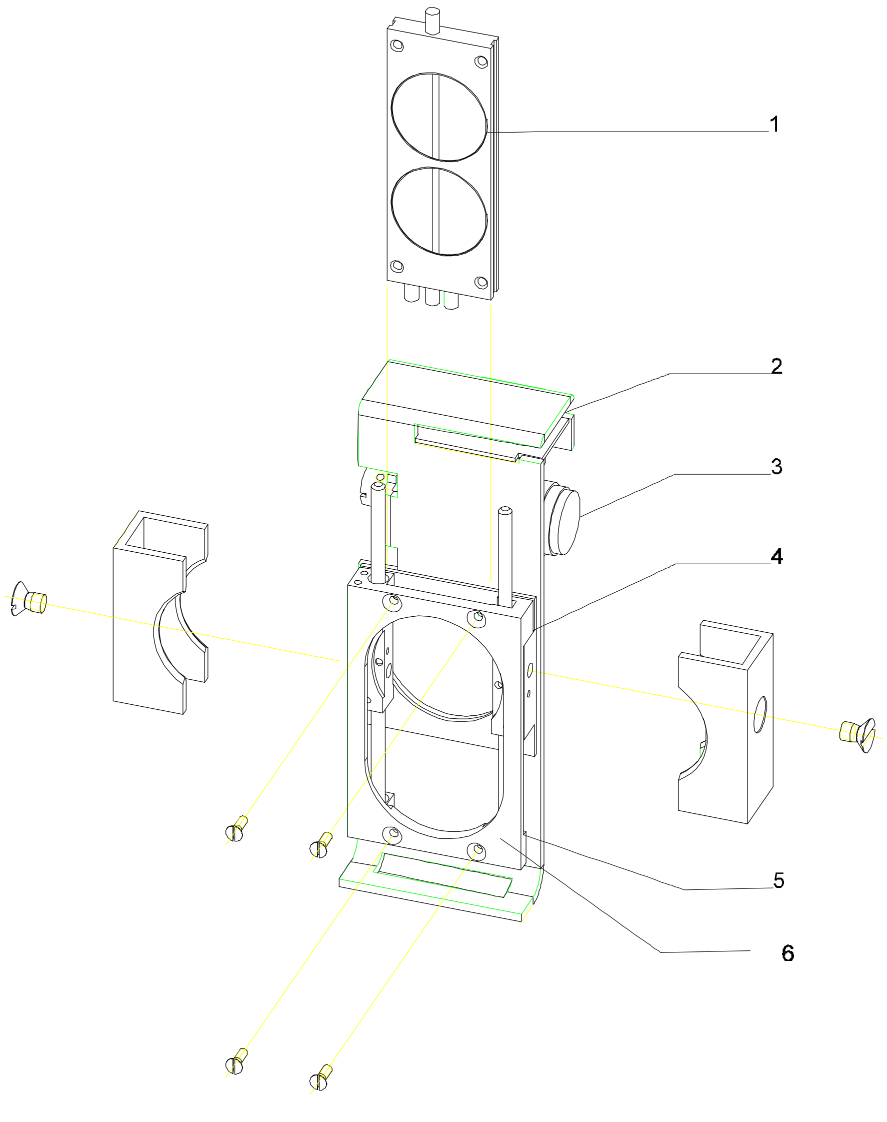
Location in module

The calibration unit is an option.
It is installed between the sample cell and infrared detector.

Design

The calibration device is a motor-driven slide system for the calibration cell.
A small geared motor with a drive pin moves a slide block.
Small permanent magnets are used to improve calibration cell positioning and fastening.
Two U-clamps are used to attach the cell. Different versions are provided for use with and without an optical filter.

Figure 3-15
Calibration unit

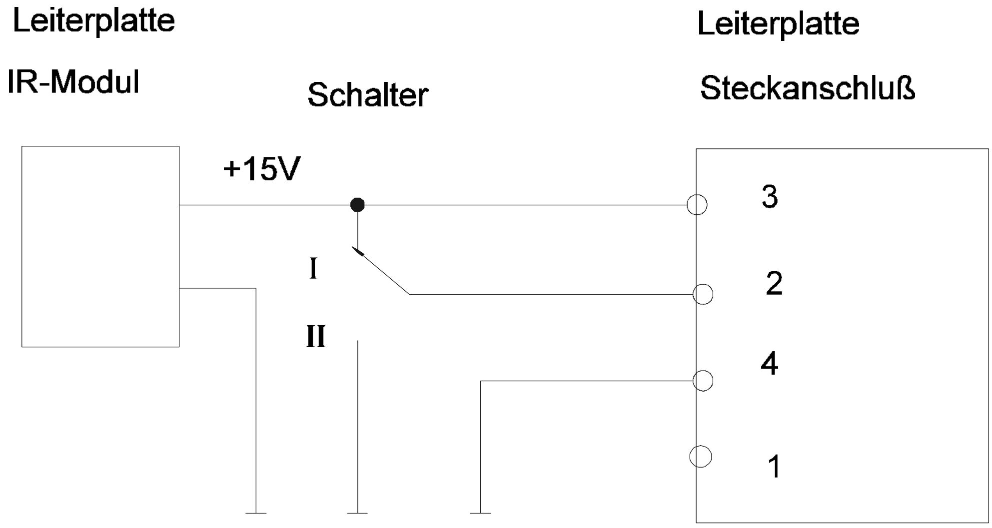


1	Calibration cell
2	Connector circuit board
3	Geared motor
4 & 5	Permanent magnet
6	Slide block

Continued on next page

Calibration unit, *continued*

Figure 3-16
Connections



IR module PCB Switch PCB plug

Calibration cell

Location in module

The optional calibration cell can be installed in the calibration unit.
A calibration cell can be installed in each beam path.

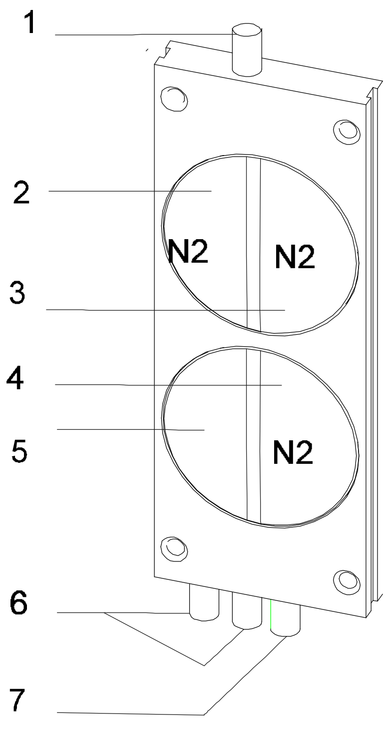
Design

The calibration cell housing consists of a gold-plated metal frame with four chambers which are sealed in a gas-tight manner by infrared-transparent window.
Three chambers are filled with nitrogen.
One chamber is filled with the required test gas mixture.

Function

The calibration cell is used for end-point calibration.
Each beam path can have a calibration cell. When there are two infrared detectors in the beam path, the calibration cell contains a mixed filler.
The calibration gas fill is comparable to that of a test gas vessel.
The concentration marked on the calibration cell is the fill concentration. This is not the calibration concentration for the Uras 14. It should be determined with the test gas.

Figure 3-17
Calibration cell



1 N_2 fill port (sealed gas-tight and soldered)
2 & 3 Chambers filled with N_2 , for measurement and zero-point alignment in the beam path
4 N_2-filled chamber, for end-point calibration in reference gas beam path
5 Test gas-filled chamber, for end-point calibration in the sample beam path
6 Test gas fill ports (sealed gas-tight and soldered)
7 N_2 fill port (sealed gas-tight and soldered)

Infrared detector

Location in module

The infrared detector is placed at the end of the sample cell.
Depending on the application, there can be 1-4 detectors. Up to 2 detectors can be installed per beam path.

Design

The infrared detector consists of the following parts:

- Optopneumatic part, consisting of 2 consecutively connected chambers; these are separated by infrared-transparent windows.
  The chambers are filled with the gas appropriate for the sample component involved.
  The emission-free area contains the diaphragm capacitor made up of a gas-tight, metal diaphragm installed between the two chamber portions and a fixed counterelectrode. Both parts are connected to the preamplifier via gas-tight passages.
- The preamplifier is an integral part of the detector.
  The preamplifier incorporates a temperature sensor for temperature compensation.

Function

The beam reaching the detector is absorbed in the region of the fill gas absorption line and by means of molecular collision is momentarily changed into a pressure reflecting the heat energy. This pressure change is detected by the diaphragm capacitor.
Via a high-impedance circuit, the 150-volt power supplied now generates a corresponding mV-range DC voltage.
Primary absorption of the emission occurs in the front chamber (positive displacement). The flank-emphasized light emission portion of the rotation line, which leads to cross sensitivity in case of interfering gas component overlap, acts on the rear chamber. Due to the greater depth of the rear chamber this interfering emission is extensively absorbed so that here there is a pressure increase which counters the pressure in the front chamber. This results in some suppression of cross-sensitivity effects.
The temperature sensor determines the ambient temperature of the optical components and thus is part of the measurement signal temperature compensation mechanism. Only the sensor of the first infrared detector is involved.

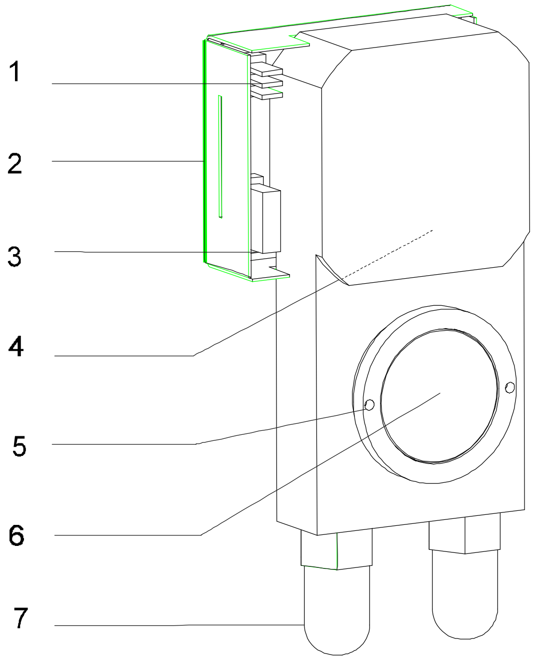
Types

All infrared detectors are mechanically identical. The application determines the fill.
The detectors are suitable for all measurement ranges permitted according to the data sheet.
Measurement components:
CO, NO, SO_2, N_2O, Frigen/R12, H_2O, SF_6, CS_2, NH_3
CH_4, C_2H_2, C_2H_4, C_2H_6, C_3H_6, C_3H_8, C_4H_{10}, C_6H_6, C_6H_{14}
CO_2 with 10% fill for small measurement ranges
CO_2 with 100% fill for large measurement ranges

Continued on next page

Infrared detector, *continued*

Figure 3-18
Infrared detector



1 Jumpers for amplifier matching
2 Preamplifier
3 Plug for IR module circuit board4 Diaphragm capacitor
5 Front and rear chambers
6 Positioning dowels and bores
7 Fill ports (mechanically sealed and soldered)

Figure 3-19
Preamplifier

BR 1	Amplification x 1
BR 2	Amplification x 3
BR 3	Amplification x10
ST1	Connection to IR module circuit board
A / B	Solder points for diaphragm capacitor

Continued on next page

Infrared detector, *continued*

Figure 3-20
Preamplifier
Pin layout

_

Plug 1 Connection to IR electronics	
SIGN. GND	1
+ 150V	2
	3
AGND	4
TEMP	5
+ 15V	6
GNDA	7
SIGN. INP.	8
TEST	9
- 15V	10

Note

Pin 3 of plug ST1 is not available.
It is used for keying (positioning the plug).

IR module circuit board

Location in module

The circuit board sits beside the analyzer module and is connected to the Sensor-CPU circuit board.

Design

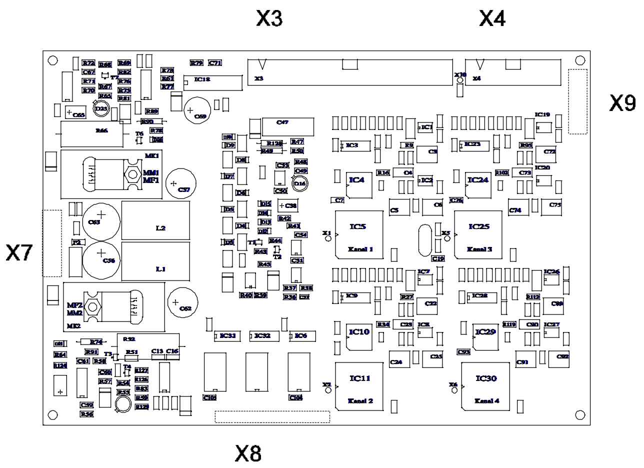
There are three socket terminal strips on the back of the circuit board for power supply and signal communication purposes.
There are two side-mounted pin-type terminal strips for flat cable connections to the optical components.

Function

The circuit board contains the following functions:

- 4x channel electronics for the four possible infrared detectors with computer-controlled 0.3/ 1.0/3.5/12-fold amplification matching.
- 150-V power supply for the diaphragm capacitors
- Power supply for Emitter 1 with computer-controlled emitter power adjustment
- Power supply for Emitter 2 with computer-controlled emitter power adjustment
- Power supply for chopper wheel motor
- Light barrier signal
- Power supply for calibration unit motors

Figure 3-21
IR module circuit board



Inputs/Outputs

X3	Infrared detector 1 preamplifier
	Infrared detector 2 preamplifier
	Modulator (Emitter 1 and 2, synchronous motor, split light barrier
	Calibration unit 1
	Calibration unit 2
	Pressure sensor
X4	Infrared detector 3 preamplifier
	Infrared detector 4 preamplifier
X7	Connection to sensor-CPU circuit board
X8	Connection to sensor-CPU circuit board
X9	Connection to sensor-CPU circuit board

Continued on next page

Figure 3-22.1
Pin layout
IR module circuit board

Plug X 3		Plug X3	
S1 +	1	CCVORH 1	39
S1 +	2	CC 1	40
F1 +	3	+ 15V	41
S1 -	4		42
F1 -	5		43
S2 -	6		44
S2 +	7	CCVORH 2	45
F2 -	8	CC 2	46
MOTOR 1	9	+ 15V	47
F2 +	10		48
MOTOR 2	11		49
	12		50
+ 5V	13		
L_SCHR	14		
+ 15V	15		
- 15V	16		
	17		
BARO 1	18		
	19		
+ 150V	20		
	21		
	22		
LN335 - 1	23		
+ 15V	24		
	25		
VV 1	26		
VV-Test	27		
- 15V	28		
	29		
+ 150V	30		
	31		
	32		
LM 335-2(nc)	33		
+ 15V	34		
	35		
VV 2	36		
VV-TEST	37		
- 15V	38		

Continued on next page

IR module circuit board, *continued*

Figure 3-22.2
Pin layout
IR module circuit board

Plug 4		Plug 7	
	1	+ 5V	1
+ 150V	2		2
	3	+ 24V	3
	4		4
LM 335 (no)	5		5
+ 15V	6		6
	7	24_COM	7
VV 3	8		8
VV-TEST	9		9
- 15V	10		10
	11	BARO 1	11
+ 150V	12		12
	13	CCVORH1	13
	14	CCVORH2	14
LM 335-4 (no)	15	S_DOWN1	15
+ 15V	16		16
	17		17
VV 4	18		18
VV-TEST	19		19
- 15V	20		20

Plug 8		Plug 8	
+ 5V	1	A8	17
	2	A9	18
	3	A10	19
	4	CS-I/O-1	20
D0	5	CS-I/O-2	21
D1	6	RD	22
D2	7	WR	23
D3	8	ADH-CLK	24
D4	9	ADH-CLK2	25
D5	10	RUN/HOLD	26
D6	11	AD1_PW	27
D7	12		28
A0	13	INT_1	29
A1	14	INT:2	30
A2	15	INT_3	31
A3	16	INT_4	32

Continued on next page

IR module circuit board, *continued*

Figure 3-22.3
Pin layout
IR module circuit board

Plug 9		
+ 15V	1	
- 15V	2	
	3	
NTC 1	4	
LM335-1	5	
(NTC)	6	
RESET	7	
ICLK	8	
IDAT	9	
	10	
TFS_77	11	
RFS_77	12	
DIN_77	13	
DOUT_77	14	
SCLK_77	15	
DRDY_77	16	
SYNC_77	17	
A=/CS_77	18	
	19	
	20	

Sensor-CPU circuit board

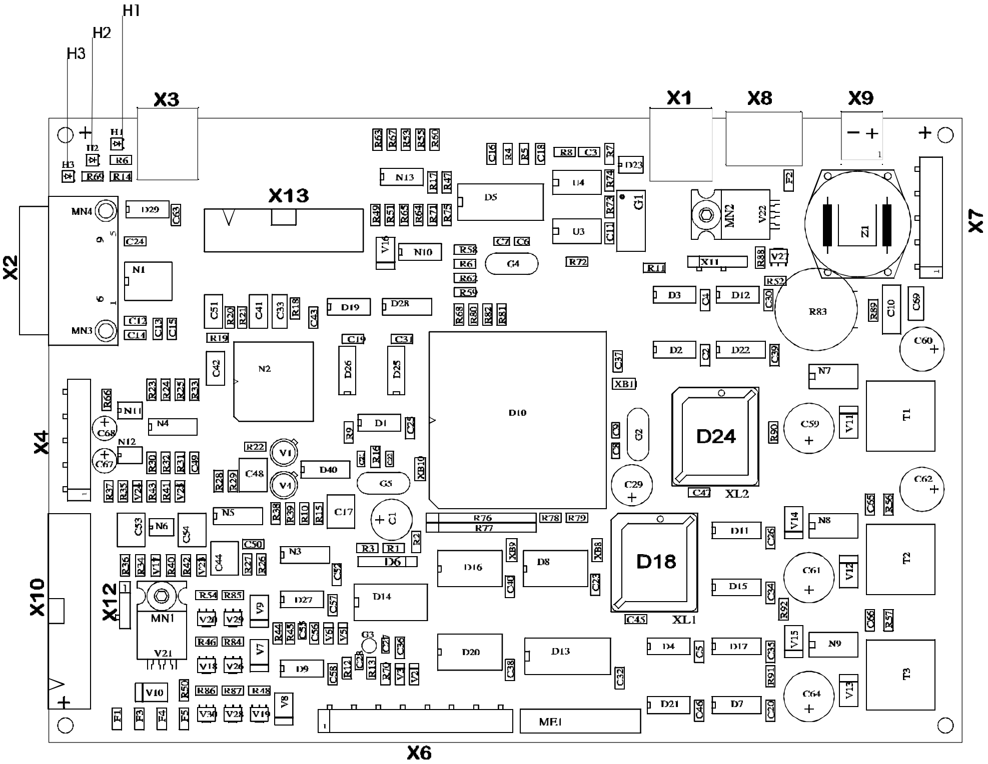
Location in module The Sensor-CPU circuit board sits beside the analyzer modules and is connected to the IR module circuit board.

Design The Sensor-CPU circuit board transfers signals to the Sensor-CPU circuit board *[Translator's note: sic]* via 3 pin-type terminal strips.
Also there are 5 plug connections for central and peripheral functions.

Function The circuit board contains the following functions:

- Module signal processing and control processor
- A/D converter for variables
- Multiplexer for variables
- Selection of internal sample preparation
- 15-V, 24-V power supplies
- Reset generation
- Internal bus controller

Figure 3-23 Sensor-CPU circuit board



Continued on next page

Sensor-CPU circuit board, *continued*

Inputs/Outputs

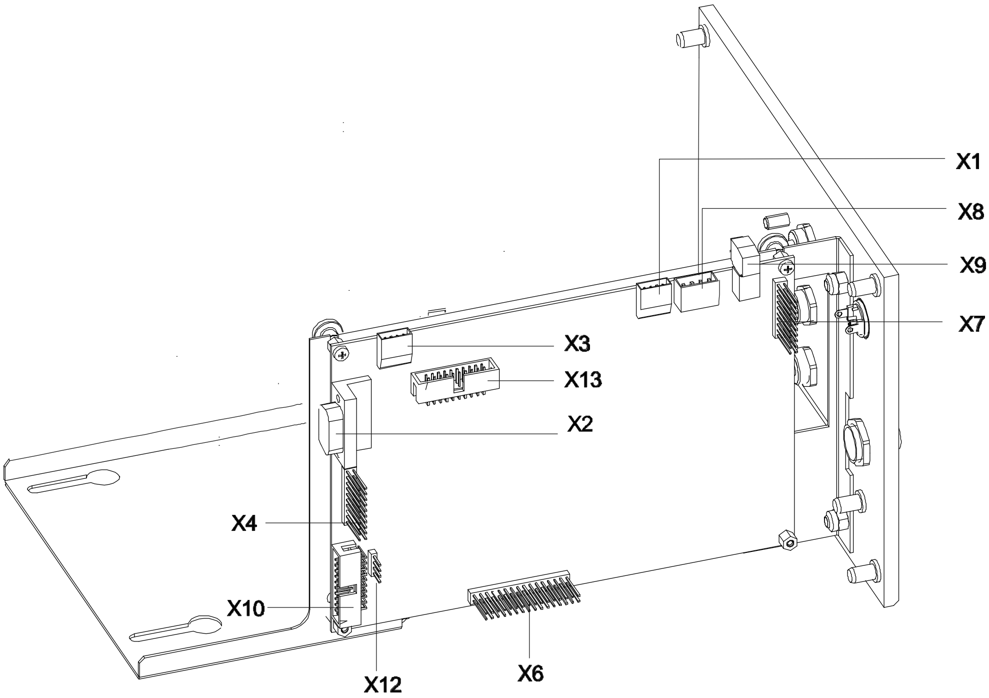
X1	Internal bus
X2	RS232/Service
X3	RS232
X4	Connection to IR module circuit board
X6	Connection to IR module circuit board
X7	Connection to IR module circuit board
X8	Heater
X9	24-V power supply
X10	Connection to pneumatics module
X12	Pressure sensor input (not for Uras 14 module)
X13	Dongle

Equipment

D24	Flash EPROM with Firmware
D18	EEPROM with analyzer data
H1	Green LED, power supply
H2	Yellow LED, analyzer module needs service
H3	Red LED, Sensor-CPU failure

EEPROM D18 contains all analyzer and electronics data.

Figure 3-24 Pin layout on Sensor-CPU circuit board

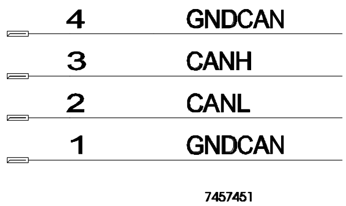


Continued on next page

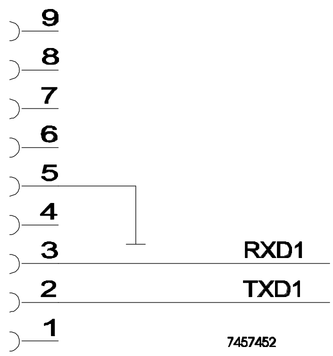
Sensor-CPU circuit board, *continued*

Figure 3-25.1
Pin layout
Sensor-CPU

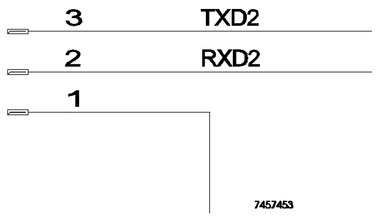
Plug X1
Internal bus



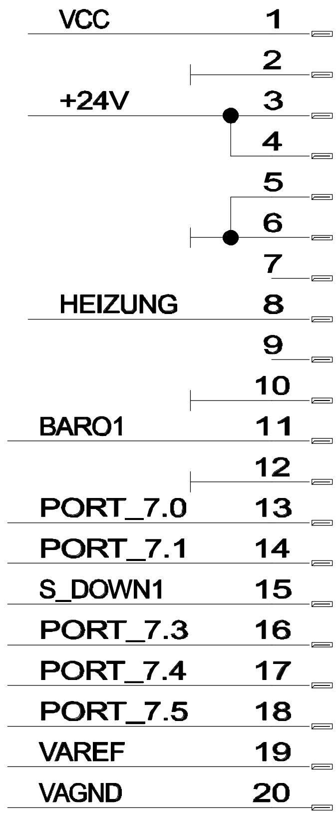
Socket X2
RS232 Service



Plug X3
RS232



Plug X4
Connection to IR electronics

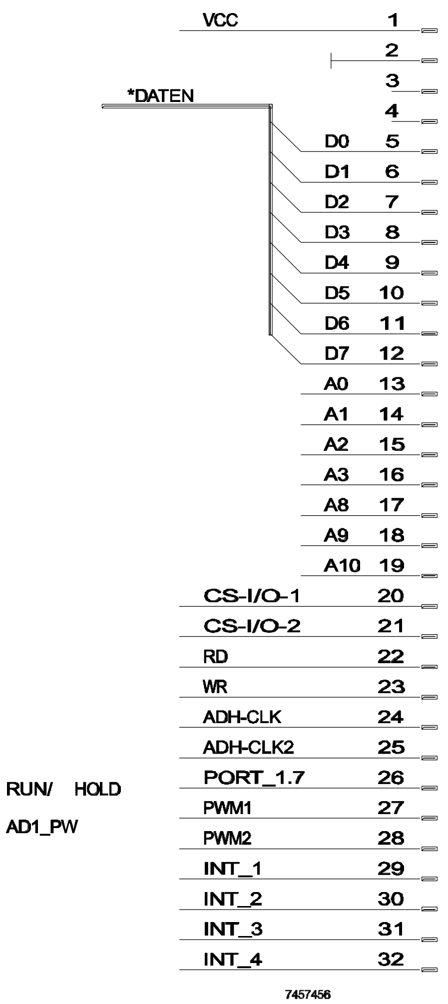


Continued on next page

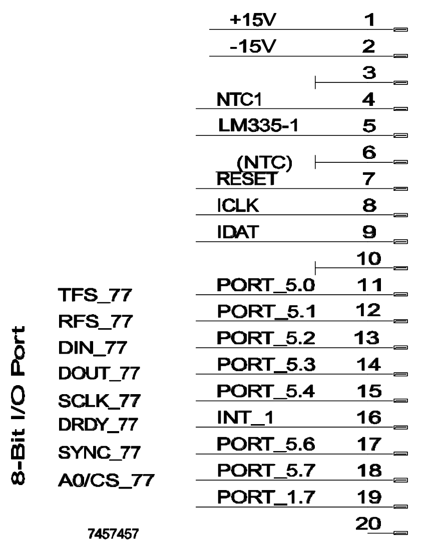
Sensor-CPU circuit board, *continued*

Figure 3-25.2
Pin layout
Sensor-CPU

Plug X6
Connection to IR electronics

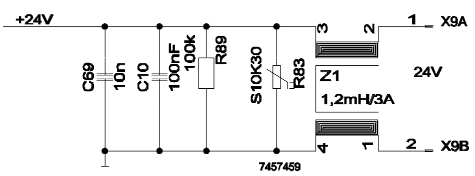


Plug X7
Connection to IR electronics



Plug X8
Heater

Plug X9
24V



DATEN = DATA
HEIZ = HEATING
HEIZUNG = HEATING

Continued on next page

Sensor-CPU circuit board, *continued*

Figure 3-25.3
Pin layout
Sensor-CPU

Plug X10
Pneumatics module

PUMPE24V	1
PUMPE24V	2
PUMPE_M	3
PUMPE_M	4
MV1_24V	5
MV1_M	6
MV2_24V	7
MV2_M	8
MV3_24V	9
MV3_M	10
NTC2	11
	12
O2-A	13
	14
O2-B	15
	16
+15V	17
-15V	18
FLOW1	19
	20
FLOW2	21
	22
	23
	24
	25
	26

74574510

Plug X12
Flow rate sensor
not applicable to Uras 14

+15V	1
-15V	2
FLOW1	3
	4

74574512

Pressure sensor circuit board

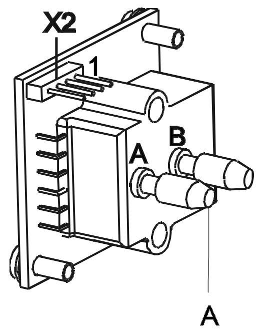
Location in module The pressure sensor is mounted on the analyzer module base plate.

Design The pressure sensor is fastened to a circuit board with the appropriate circuitry. The circuit board is plug-connected to the IR module circuit board.

Function The pressure sensor measures the pressure in the sample cell.
This signal is used for pressure correction of the measurement signal.
Optionally the pressure sensor can be connected to measure external pressure via a separate hose line.
Specifications:

- Absolute pressure sensor
- Working range 700-1300 mbar
- Offset calibration required

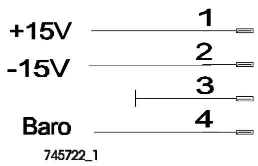
Figure 3-26 Pressure sensor circuit board



Inputs/Outputs

X2	Connection to IR module circuit board
A	Gas input (pressure in the sample cell)

Figure 3-27 Pin layout



Thermostat circuit board

Location in module

The circuit board is connected to the base support.

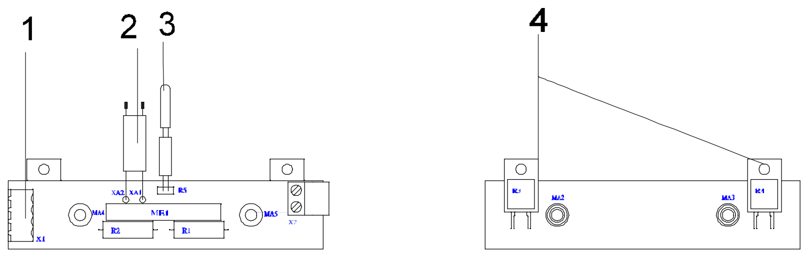
Design

The circuit board contains 2 heating resistors.
The temperature sensor (NTC) is soldered via a cable.
A connecting cable for supplemental heating is also soldered.
A single plug is used for power supply and regulation.
The thermal link is clamped in.

Function

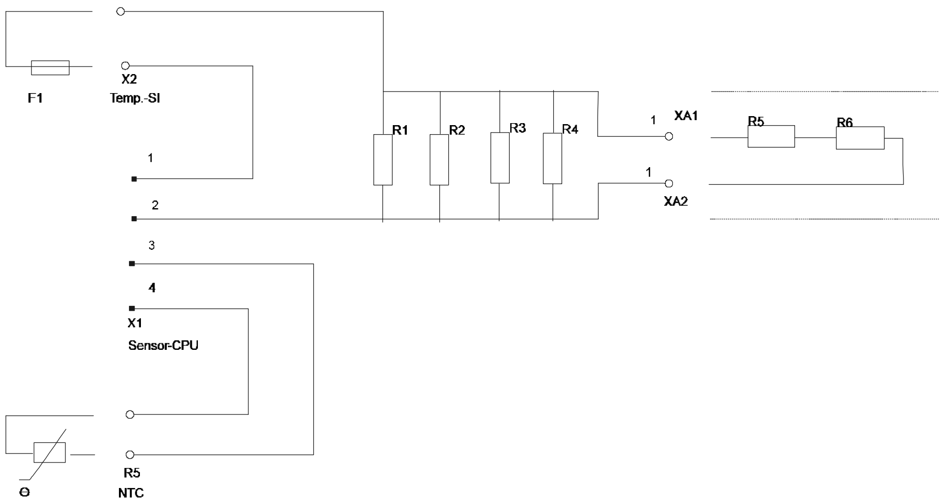
The thermostat circuit board is responsible for control of the optical element temperature.
The temperature setting is 55°C.
The thermal link fails at 85°C.

Figure 3-28



1 Plug X1: Power supply, regulation
2 Connection for supplemental heating in hood
3 Temperature sensor (NTC)
4 Heating resistors

Figure 3-29
Pin layout Thermostat circuit board



Inputs/Outputs

X1	Plug connection to Sensor-CPU
X2	Thermal link clamp connection
R5	Solder points for NTC temperature sensor
XA1/XA2	Plug connection for supplemental heating in hood

Hood with supplemental heater

Location in module

This hood covers the optical components.

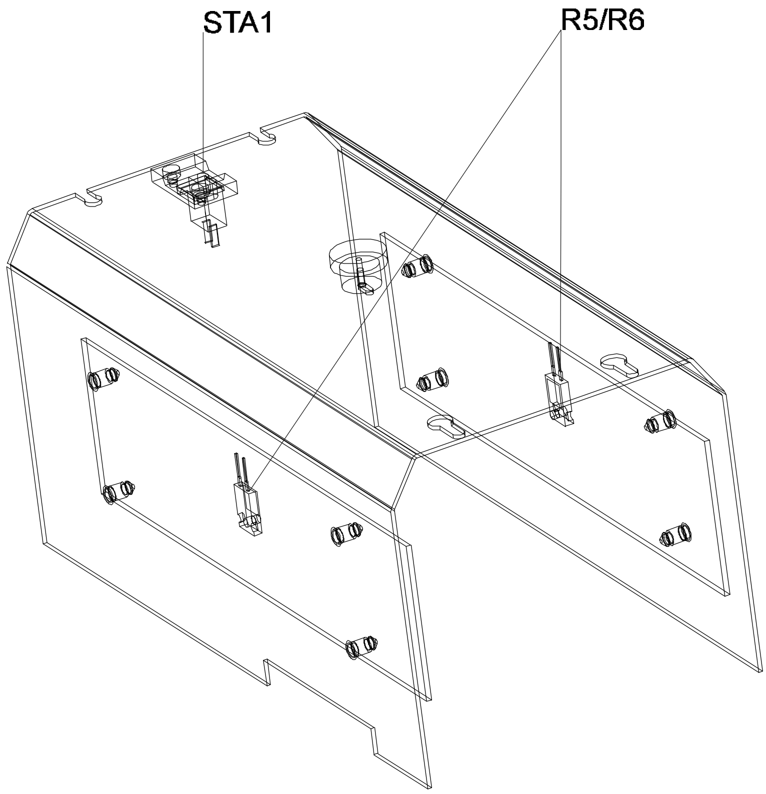
Design

The hood consists of a U-shaped piece of sheet metal with a heating element fitted on each of the side walls.

Function

The heated hood works with the base support heating system to control the temperature of all optical elements. It is plug-connected in parallel with the thermostat circuit board.

Figure 3-30
Hood with heater



Connecting cable

Location in module Connection between IR module circuit board and optical components.

Figure 3-31 Connection 1

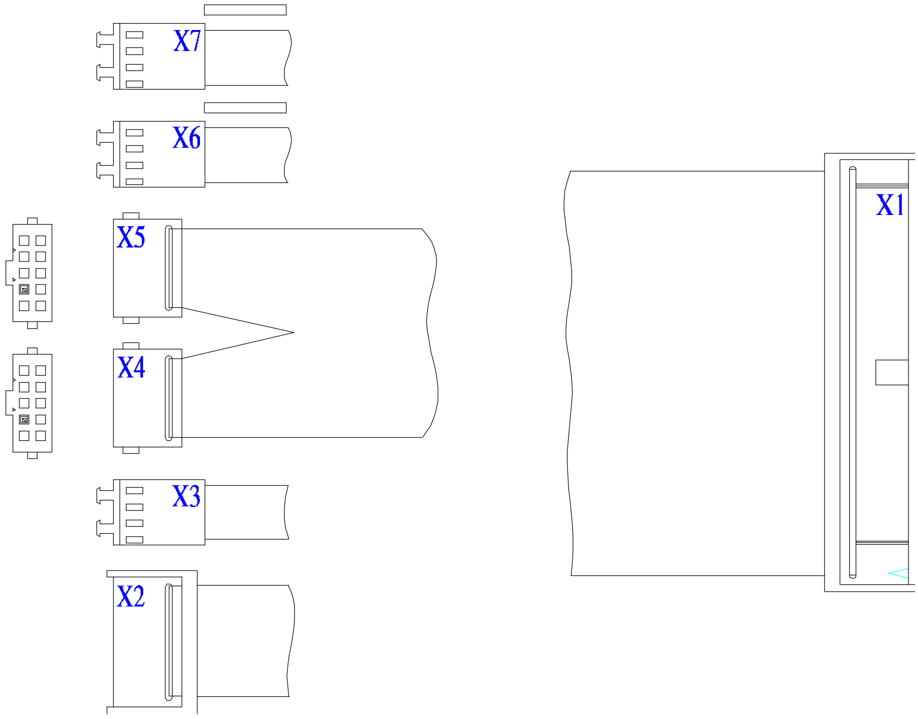
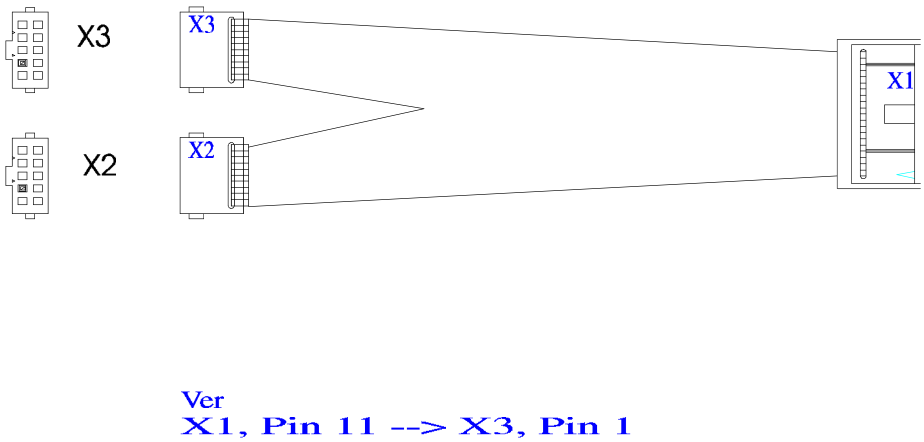


Figure 3-32 Connection 2



Continued on next page

Connecting cable, *continued*

Figure 3-33
Pin layout
Connecting cable 1

Strahler=Emitter; VV = Preamplifier; Kanal = Channel; Kalibrierküvette=Calibration cell;
IR-Elektronik = IR electronics

Continued on next page

Connecting cable, *continued*

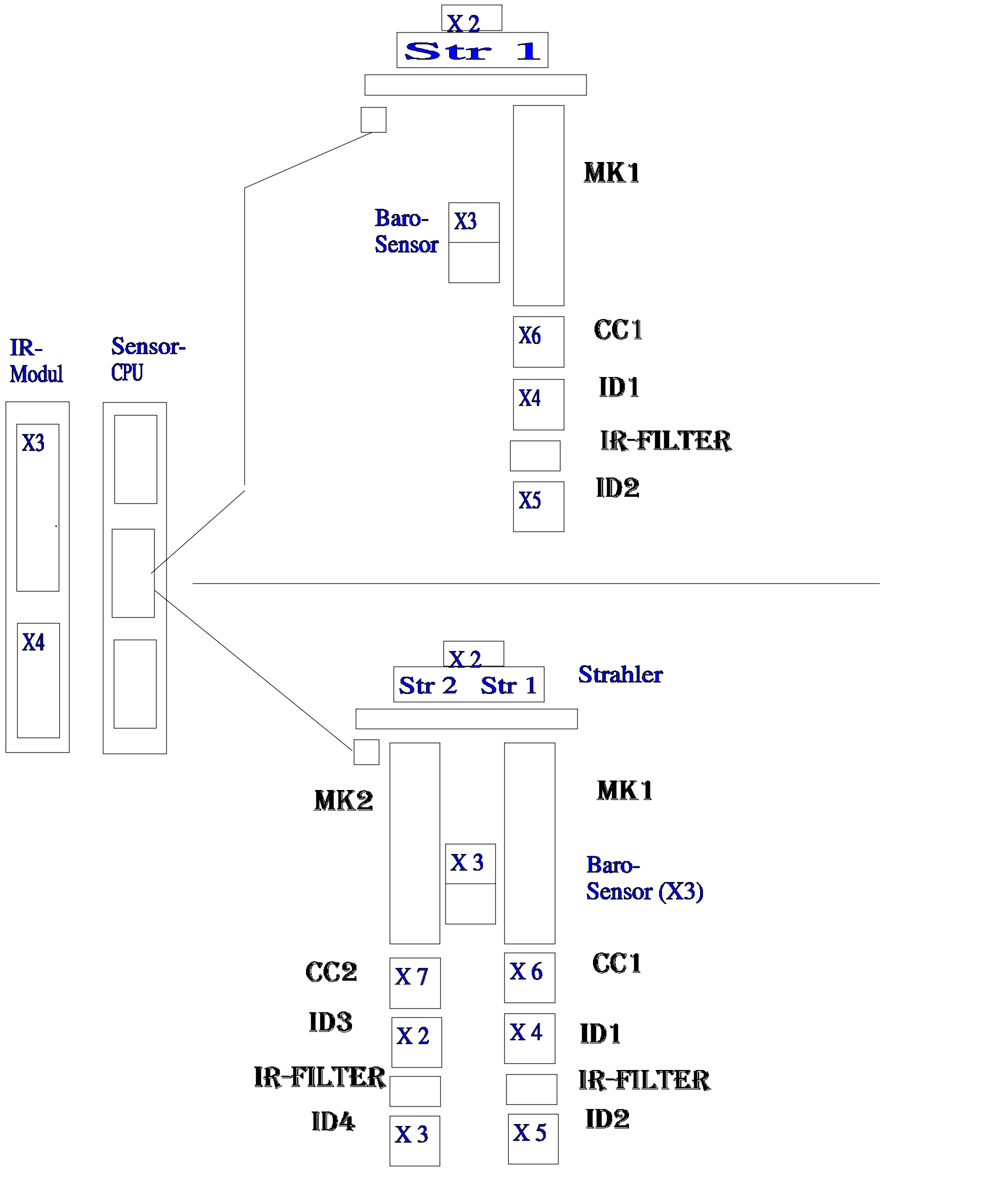
Figure 3-34
Pin layout
Connecting cable 2

Kanal = Channel
IR-Elektronik = IR electronics

Continued on next page

Connecting cable, *continued*

Figure 3-35
Connector position



IR-Modul = IR module
Str = Emitter
Strahler = Emitter
Baro-Sensor = Pressure sensor

Chapter 4: Troubleshooting

Overview

Introduction

This chapter contains information on troubleshooting and repairing the analyzer module.

Chapter contents

In this chapter you will find the following information:

Being prepared

Chapter 5: Testing

Overview

Introduction

This chapter describes procedures for testing the primary measurement and influence values on the analyzer module as well as testing of components. Special accessories will be described where necessary.

Chapter contents

In this chapter you will find the following information:

Some portions are still being prepared

Checking Gas Path Seal Integrity

Accessories

Pressure leak tester

Test method

Pressure drop method:

- Test pressure p = 50 mbar
- Test time t = 180 sec
- Pressure drop< 5 mbar

Procedure

Step	Action
1	Verify hose routing per hose connection diagram.
2	Close sample gas outlet.
3	Connect the pressure leak tester to the sample gas inlet.

Flow Rate

Being prepared

Measurement signal

Being prepared

IR module circuit board

Being prepared

Sensor-CPU circuit board

Being prepared

Emitter

Accessories Multimeter

Test method Voltage/resistance measurements

- Cold resistance: 13 ± 0.5 Ω
- Impressed voltage:

5.6 ± 0.5 V	2.2 W emitter output
7.45 ± 0.5 V	3.8 W emitter output
9.5 ± 0.5 V	6.8 W emitter output

Procedure

Step	Action
1	Voltage test: • Emitter voltage can be measured at the emitter insert electrical leads. Note: The filament will light visibly at voltages between 7.45 and 9.5 V.
2	Resistance test: • Loosen the emitter circuit board connections. • Measure cold resistance at the emitter leads.

Modulator

Being prepared

Sample cell

Accessories Cleaners as necessary

Test method Visual check

Procedure

Step	Action
1	Remove the sample cell.
2	Visual check; • The windows should be unobstructed and free of coatings. • The gold-plated interior surfaces should have the typical gleam and be free of any shading.
3	Cleaning: • Rinse (agitate) with distilled water; if necessary, loosen contaminants with a small amount of detergent. • Rinse with distilled water. • Dry with nitrogen (if possible, warmed to approx. 60°C).

Calibration unit

Being prepared

Calibration cell

Being prepared

Infrared detector

Being prepared

Pressure sensor

Being prepared

Temperature regulation

Accessories Multimeter

Test method Voltage/resistance measurements

• Power supply voltage		24 V
• Heat resistors	Base support:	approx. 12.5 Ω
	Hood:	approx. 50 Ω
• Temperature sensor (NTC)		approx. 8 kΩ
• Thermal link		Check continuity

Procedure

Step	Action
1	Remove the connecting cable from the board (plug X8 on Sensor-CPU PCB).
2	Remove the electrical connection from the hood.
3	Measure resistance at the appropriate connectors.

Chapter 6: Component Interchange

Overview

Introduction

This chapter contains the steps and procedures to be followed when interchanging components.

☞ In order to remove and install components safely and correctly, read and follow all the instructions and warnings in this chapter.

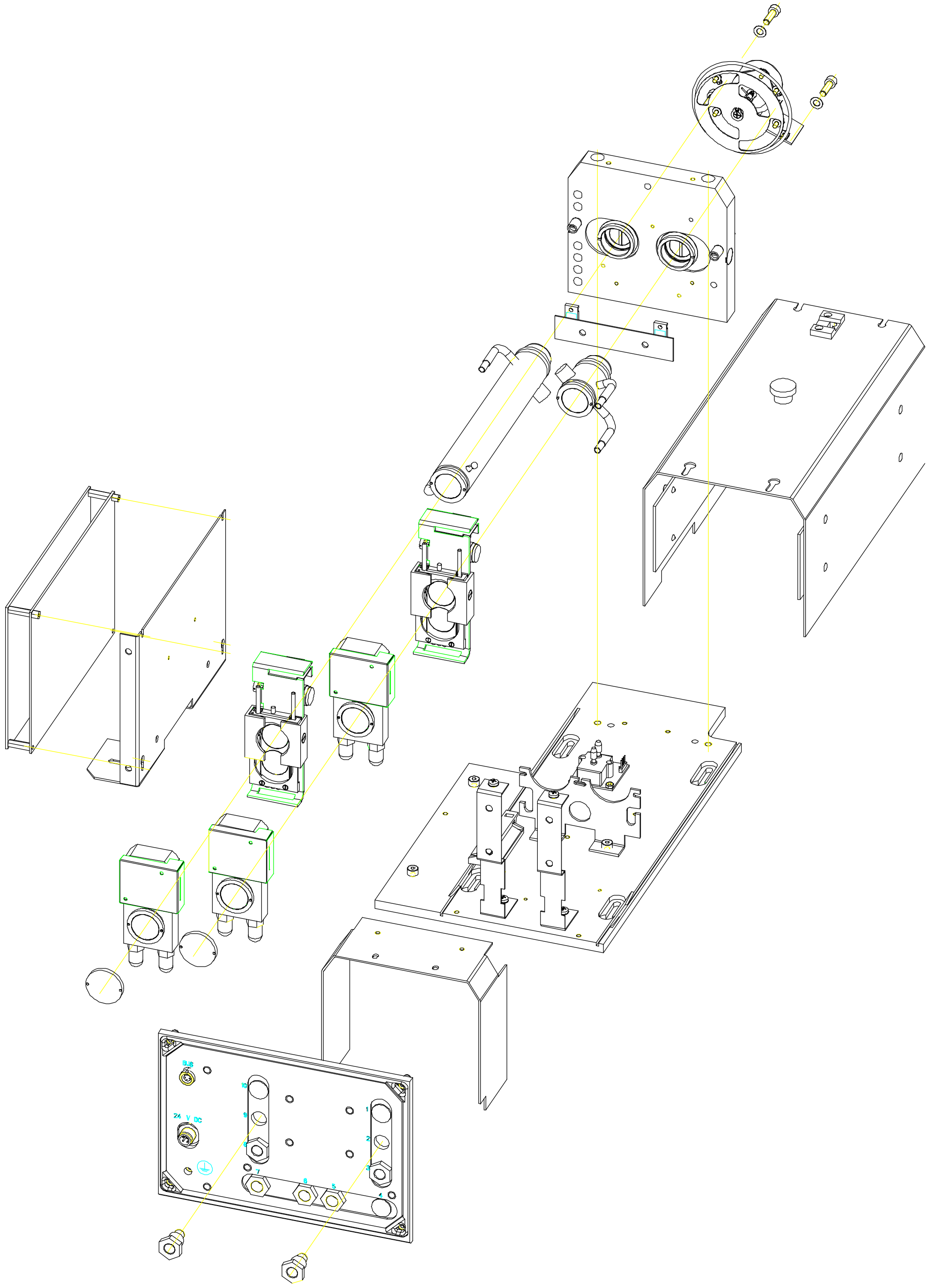
Caution!
The tasks described in this chapter require special training and under certain conditions involve working on the analyzer while it is open and powered up. For this reason, these tasks should only be carried out by specially trained and qualified persons.

Chapter contents

You will find the following information in this chapter:

Summary

Figure 6-1
Analyzer module



Remove/install Uras 14 analyzer module

Module removal

To remove the module, proceed as follows:

Step	Action
1	☝ Turn off the analyzer power supply.
2	Shut off the gas supply (sample gas and, if applicable, reference gas) to the analyzer.
3	Disconnect the gas lines from the analyzer module ports.
4	Flush the analyzer module.
5	Open the system housing.
6	Remove the cables connecting the analyzer module to the central unit.
7	Disconnect the hood cable.
8	Remove 4 screws (1)
9	Remove the hood.
10	Remove the analyzer module mounting screws. 4 bolts on the gas connection plate (2). 4 nuts on the base plate (3).
11	Remove the analyzer module from the housing

Module installation

To install the module, proceed as follows

Step	Action
1	Place the analyzer module in the system housing.
2	Secure the analyzer module with the four bolts and four nuts.
3	Install the hood.
4	Reconnect the cables.
5	Close the system housing.
6	Check the analyzer module seal integrity.
7	Connect the gas lines to the analyzer module.
8	Open the gas supply to the analyzer module.
9	Turn on the analyzer system power supply

Continued on the following page

Remove/install Uras 14 analyzer module, *continued*

Figure 6-2
Opening the analyzer module

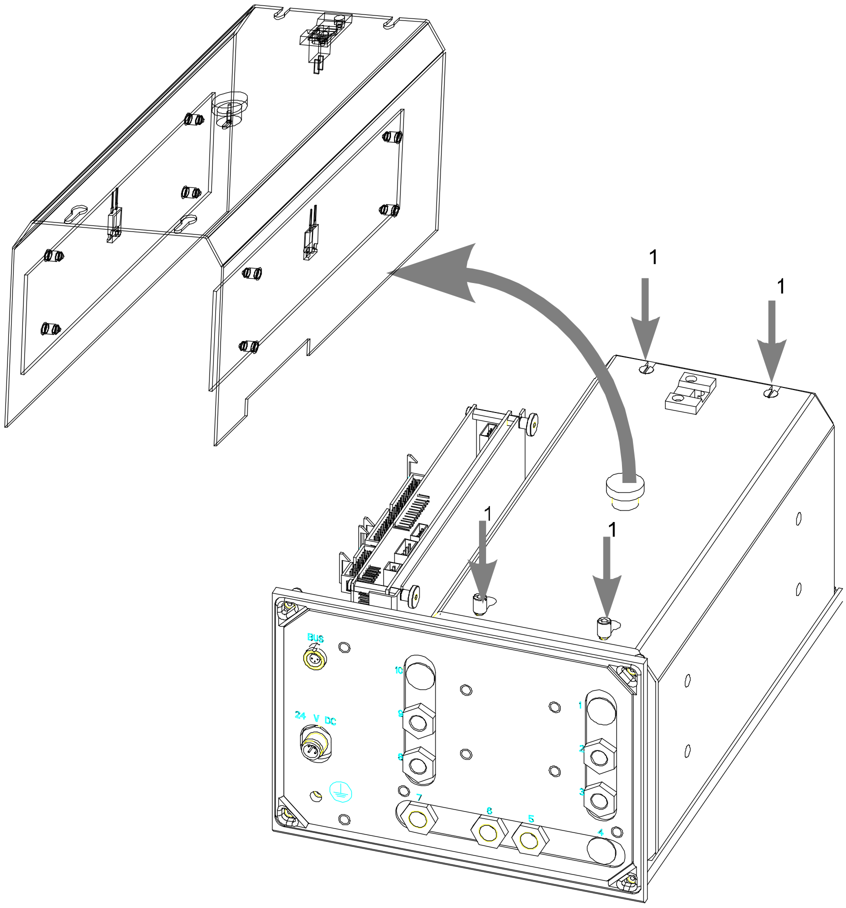
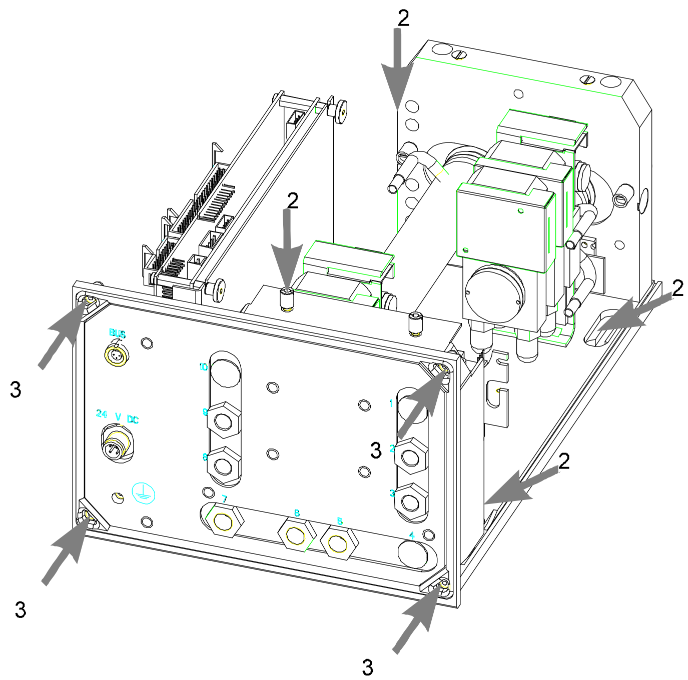


Figure 6-3
Removing the analyzer module

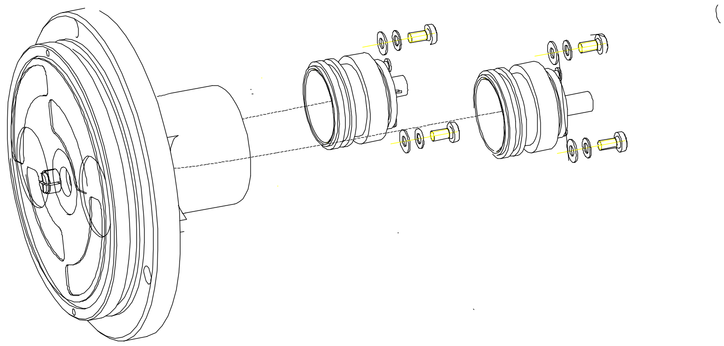


Change emitter insert

Note

The emitter inserts can be changed without removing the analyzer module.
Both plugs need to be removed from the modulator circuit board.
Two screws in each case need to be removed.

Figure 6-4 Changing emitter inserts



Change modulator

Note

The modulator can be changed without removing the analyzer module.
The connecting cable plug needs to be removed from the modulator circuit board.
Remove three screws (1).

Figure 6-5 Removing the modulator

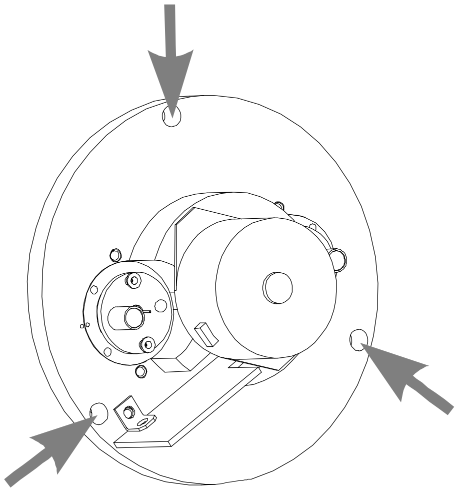
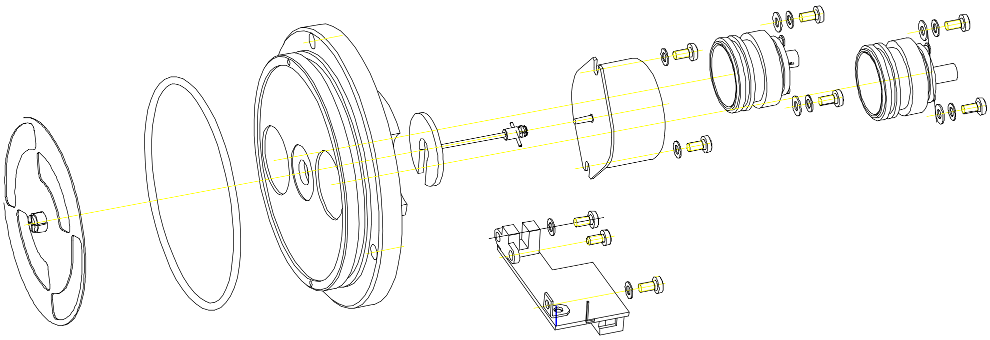


Figure 6-6 Disassembling the modulator



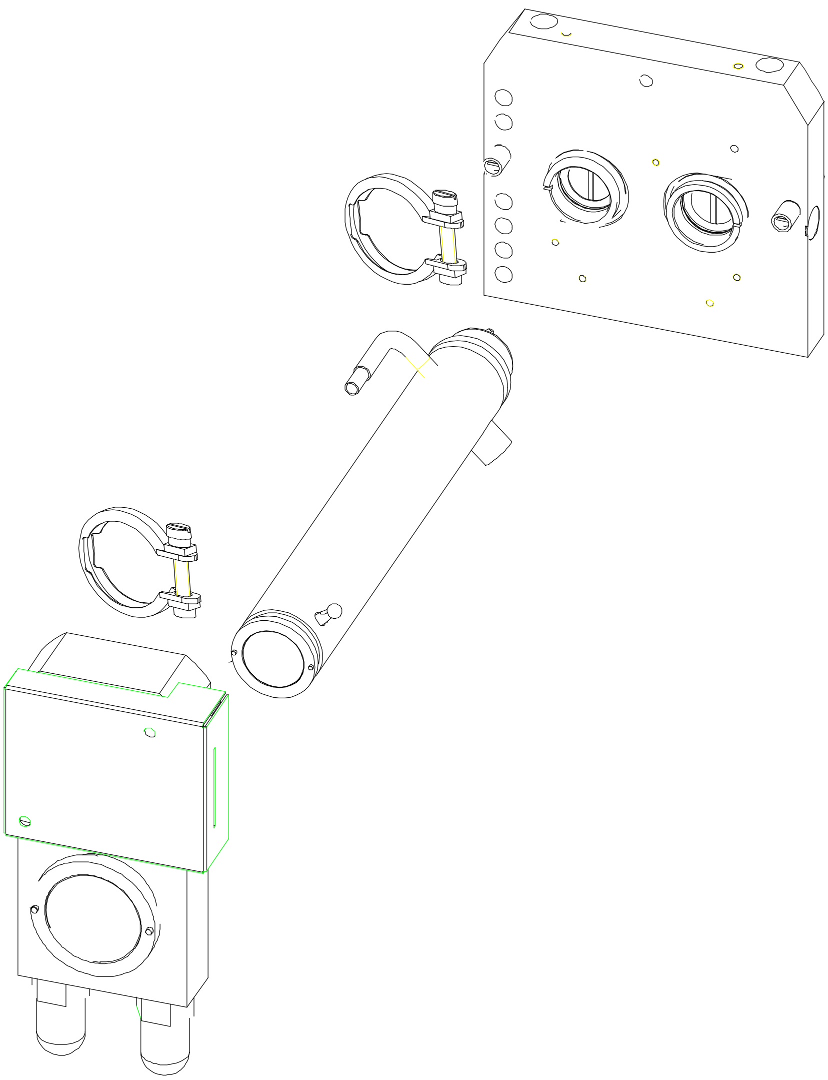
Change sample cell

Removing/installing the sample cell

To remove the sample cell, proceed as follows:

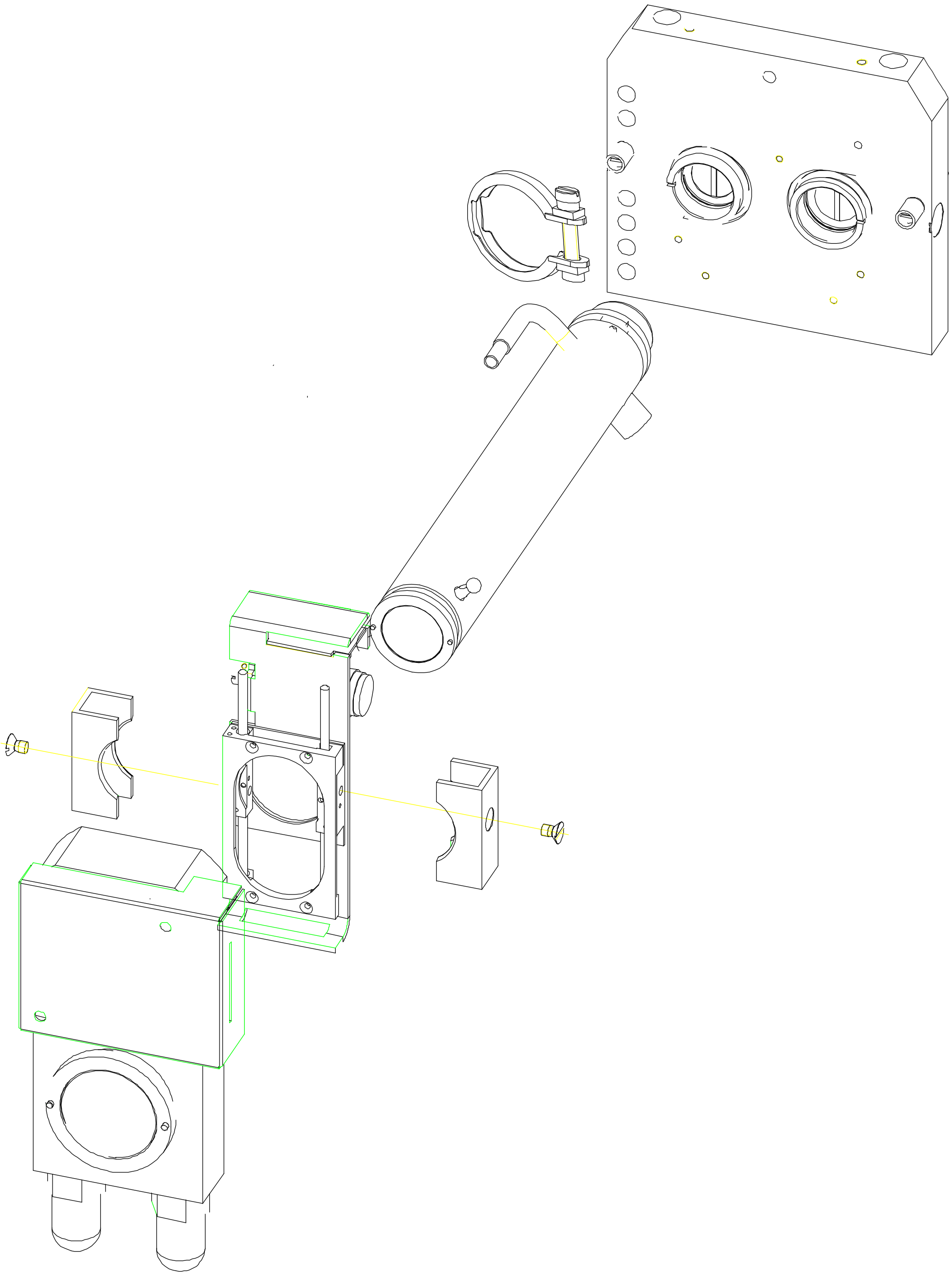
Step	Action
1	Carry out "Analyzer module removal" steps 1-7.
2	Remove the infrared detector wiring.
3	If applicable, remove the calibration unit wiring.
4	Loosen and bend back the clamp on the base support.
5	Remove the hoses from the sample cell.
6	If applicable, remove the 200-mm cell attachment O-ring
7	Slide the entire optical unit out of the base support.
8	Depending on the option involved, disassemble the optic unit according to the figure.
9	Reverse the above steps to install.

Figure 6-7
Removing without calibration cell



Continued on the following page

Figure 6-8
Removing sample cell
with calibration unit



Change calibration cell and calibration unit

Removing the calibration cell

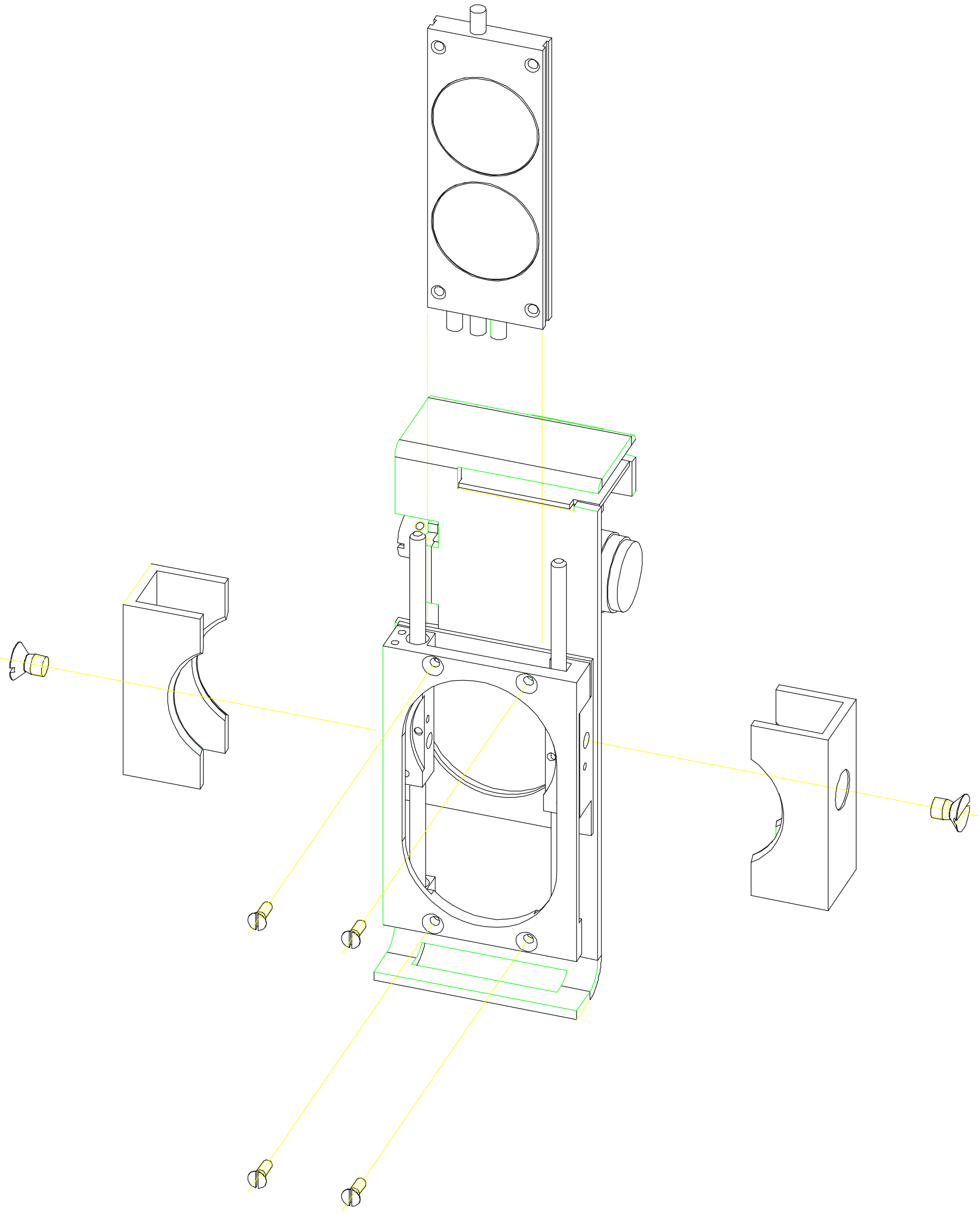
To remove the calibration cell, proceed as follows:

Step	Action
1	Carry out all steps listed under "Sample cell removal".

Installing the calibration cell

Caution!
When installing, make sure to place the calibration cell window which is filled with test gas in the proper side.
The left and right beam paths are mirror images of each other.

Figure 6-9
Calibration unit with calibration cell



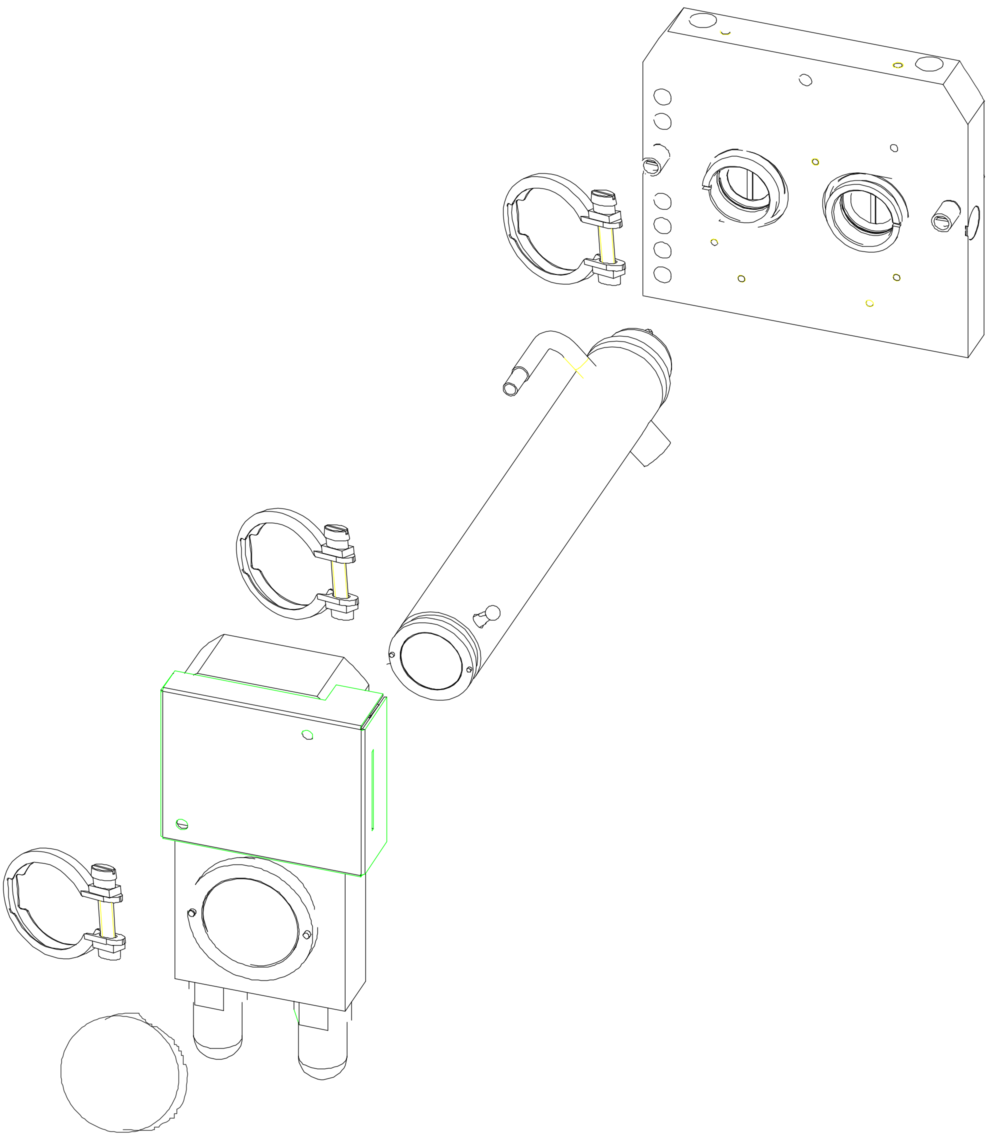
Change infrared detector

Removing/installing the infrared detector

To remove the infrared detector, proceed as follows:

Step	Action
1	Carry out "Analyzer module removal" steps 1-7.
2	Remove all wiring connected to the optical components.
3	Loosen and bend back the clamp on the base support.
4	Remove the hoses from the sample cell.
5	If applicable, remove the 200-mm cell attachment O-ring
6	Pull the entire optical unit out of the base support.
7	Remove the infrared detector per Figure 5-8 and 5-10.
8	Reverse the above steps to install Make sure the proper end disk (bright or dark) is installed behind the infrared detector.

Figure 6-10
Removing the infrared detector



Change IR module and Sensor-CPU circuit boards

Removing the circuit board

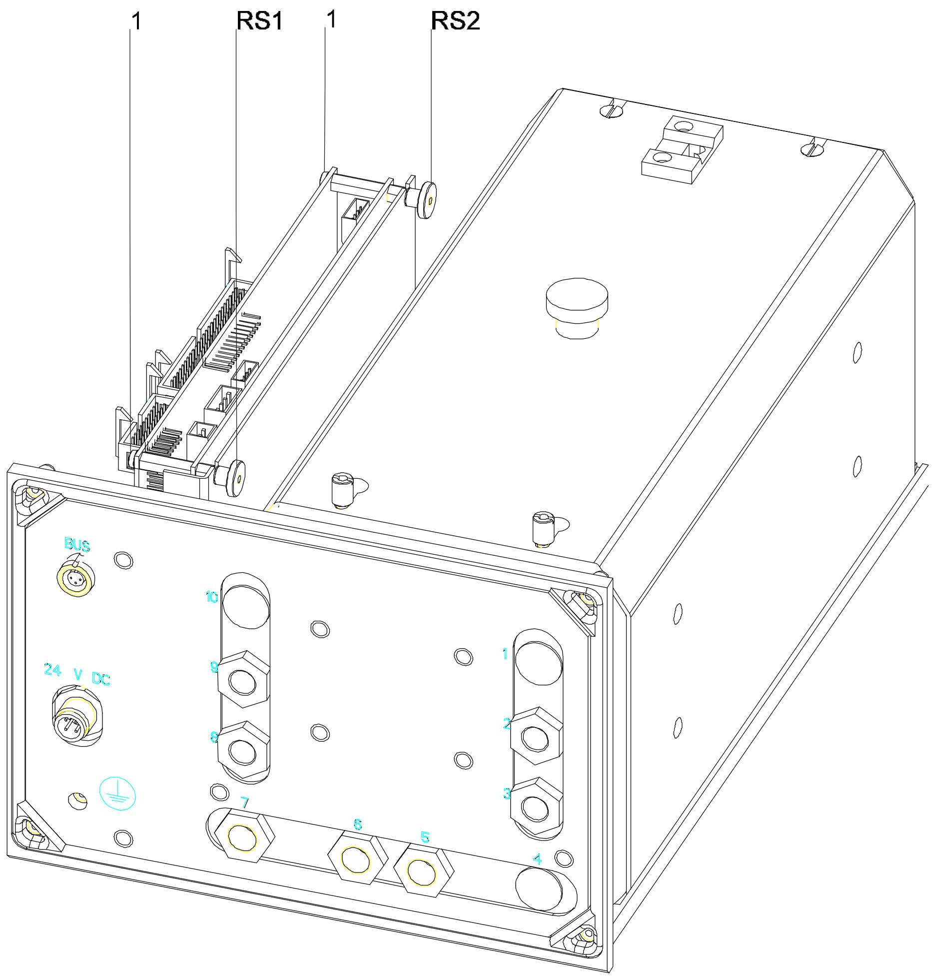
To remove the circuit boards, proceed as follows:

Step	Action
1	Turn off the analyzer power supply.
2	Open the large door on the system housing.
3	Remove all cable connections from the circuit boards.
4	Loosen the two knurled nuts (RS1 and RS2) and remove the IR module and Sensor-CPU board from the support.
5	Remove the four attaching screws (1) and carefully remove the IR module circuit board from the Sensor-CPU board connector.

Installing the circuit board

Essentially the installation process is the reverse of the removal process.

Figure 6-11 Analyzer module view



Caution!
The Sensor-CPU circuit board contains the flash EPROM with the module firmware and the EEPROM with module-specific data.

Change thermal link

Removing the thermal link

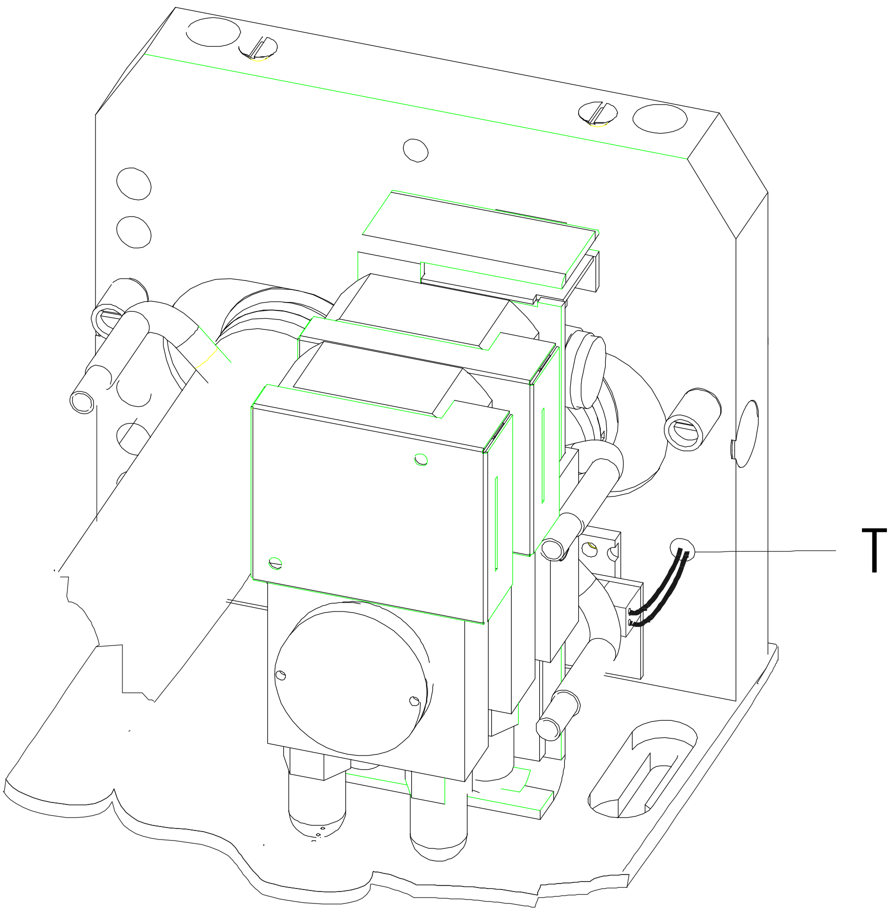
To remove the thermal link, proceed as follows:

Step	Action
1	Turn off the analyzer power supply.
2	Open the large door on the analyzer housing.
3	Remove the hood.
4	Remove the thermostat circuit board connector.
5	Pull the thermal link (T) out of the base support.

Installing the thermal link

Essentially the installation process is the reverse of the removal process.

Figure 6-12
Analyzer module
Partial view



Chapter 7: Calibration

Overview

Introduction

This chapter describes the basic calibration of the analyzer module and the ancillary detectors.

Chapter contents

In this chapter you will find the following information:

Being prepared

Chapter 8: Configuration

Overview

Being prepared

Chapter 9: Spare parts list

Overview

Introduction

This chapter contains the spare parts list for the Uras 14 analyzer module.
It identifies the spare parts with a part number, description and additional information.

Chapter contents

You will find the following information in this chapter:

Notes

being prepared

Spare parts list

Part number	Description	Additional information	VT	VE	JB	Note
0745 611	Modulator	with 2 emitter inserts				
0745 401	Emitter insert	complete	x		0.2	
0768 417	Base support	for modulator, with chopper				
0967 979	Wrench	for emitter insert				
0746 271	CO receiver	with preamplifier			0.2	
0768 458	SO_2 receiver	with preamplifier			0.2	
0768 459	NO receiver	with preamplifier			0.2	
0856 053	CO_2-10% receiver	with preamplifier			0.2	
0856 296	CO_2-100% receiver	with preamplifier			0.2	
0743 968	H_2O receiver	with preamplifier			0.2	
0856 320	Frig/R12 receiver	with preamplifier			0.2	
0856 629	N_2O receiver	with preamplifier			0.2	
0746 254	NH_3 receiver	with preamplifier			0.2	
0856 096	CH_4 receiver	with preamplifier			0.2	
0746 255	C_2H_2 receiver	with preamplifier			0.2	
0746 256	C_2H_4 receiver	with preamplifier			0.2	
0746 257	C_2H_6 receiver	with preamplifier			0.2	
0746 258	C_3H_6 receiver	with preamplifier			0.2	
0743 969	C_3H_8 receiver	with preamplifier			0.2	
0746 260	C_4H_{10} receiver	with preamplifier			0.2	
0746 261	C_6H_6 receiver	with preamplifier			0.2	
0856 319	C_6H_{14} receiver	with preamplifier			0.2	
0746 259	CS_2 receiver	with preamplifier			0.2	
0746 262	SF_6 receiver	with preamplifier			0.2	
0271 234	End disk	dark				
0271 324	End disk	bright				
0768 443	Sample cell	0.3 mm			0.3	
0768 444	Sample cell	0.6 mm			0.3	
0768 448	Sample cell	2 mm			0.3	
0768 449	Sample cell	6 mm			0.3	
0768 450	Sample cell	20 mm			0.3	
0768 453	Sample cell	60 mm			0.3	
0768 454	Sample cell	200 mm			0.3	
0768 433	Sample cell	6 mm, flowing reference gas			0.3	
0768 435	Sample cell	20 mm, flowing reference gas			0.3	
0768 437	Sample cell	60 mm, flowing reference gas			0.3	
0768 439	Sample cell	200 mm, flowing reference gas			0.3	
0768 472	Sample filter cell	200 mm, (160/40), specify filler			0.3	
0768 477	Filter cell	FK60, specify filler			0.2	

Continued on the following page

Spare parts list, *Continued*

Part number	Description	Additional information	VT	VE	JB	Note
0856 484	Calibration unit	for version without optional filter			0.2	
0856 485	Calibration unit	for version with optional filter			0.2	
5618 170	Calibration cell installation	Specify filler concentration			0.2	
0768 180	Optical filter	CO2				
0768 181	Optical filter	CO2, for calibration unit				
0856 303	Optical filter	NO				
0856 306	Optical filter	NO, for calibration unit				
0856 304	Optical filter	CnHm				
0856 307	Optical filter	CnHm, for calibration unit				
0856 631	Optical filter	N2O				
0856 632	Optical filter	N2O, for calibration unit				
0768 491	Optical filter	SO2				
0768 492	Optical filter	SO2, for calibration unit				
0768 515	Optical filter	SF6				
0768 516	Optical filter	SF6, for calibration unit				
0768 523	Optical filter	CO2, for reduced sensitivity				
0271 565	Hose ports					
0271 586	Piping connection					
0839 968	Piping threads	SO 5.1021-5-4, stainless steel				
0801 936	Connection set	for (internal) pipe threads	x	Set	1	
0801 937	Seal kit	Seals and fasteners	x	Set	1	
0768 534	Connecting hose	complete, PTFE				
0069 841	Hose	FPM-70-SW-4x1.5 (7/4x1.5)				
0801 935	Tension ring	optional component with optional filter		Set		
0856 099	Clamp					3 each
0745 722	Circuit board	Pressure sensor				
0745 744	Circuit board	Temperature equalization				
0745 836	Thermal link		x		1	
0745 823	Heating resistor	installed, for hood				
0745 648	Circuit board	IR module				
0745 745	Circuit board	Sensor-CPU				
0745 832	Connector	IR module - IR electronics, large				
0745 833	Connector	IR module - IR electronics, small				
0745 927	Connector	24V				
0801 938	Accessory plug	24V, with cable and multi-pin connector		Set		
0801 945	Connectors	Internal bus				

Continued on the following page

Spare parts list, *Continued*

Part number	Description	Additional information	VT	VE	JB	Note
0743 091	Connector	Module/PC				
0768 494	Flame barrier	Purge gas				
0768 493	Flame barrier	Sample gas				

ABB Automation
Analytical Division
Stierstaedter Strasse 5, D-60488 Frankfurt am Main
Phone +49-69-79 30-40, Fax +49-69-79 30-45 66
E-Mail analytical-mkt.deapr@de.abb.com, http://www.abb.com/analytical

Subject to technical changes
Printed in the Fed. Rep. of Germany
43/24-1005-0 EN 10.98