E M I S S I O N MONITORING SYSTEMS

Instruction manual

DELTA 1600S-IV

Before use please read the following instructions carefully!

G:\TECH-DOC\D1600S-IV\ENG\D1600S-IV_ENG.DOC
MRU No 58322
ENGLISCH

MRU AIRfair EMISSIONSMESSTECHNIK

Attention!

Inspect shipments in the presence of deliverer. If necessary remove packaging material and have damages to packaging and goods confirmed on the packing slip. Any such notice must be received by MRU within 3 days upon receipt of package.

Otherwise they could not admit!

Important notice!

This is a high-grade electronic analyzer. To ensure proper and continuous function several batteries, lithium-cells and rechargeable batteries are built in, which have a self-discharging effect. Therefore it is absolutely necessary to recharge this analyzer at least every four to six weeks for at least 12 hours with the MRU line power ***– also if the analyzer is not used. – Thereafter switch on unit and let it calibrate completely.***

Not keeping to this rule will void your warranty.

Save the original box and the packing material to protect the device in case you have to ship or transport it.

EMISSION MONITORING SYSTEMS

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1 Notice

The products described in this manual are subject to continuous development and improvement and it is therefore acknowledged that this manual may contain errors or omissions. MRU encourage customer feedback and welcome any comments or suggestions relating to the product or documentation. These should be forwarded to the Customer Feedback Department at the address given below.

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This manual is intended as a guide to use the product.

MRU shall not be liable for any loss or damage whatsoever arising from the wrong comment / interpretation of information's from this manual or any mis-use come out of this manual.

2 MRU – Art. –Number

2.1 Options

MRU-Art.-Number	Description/technical data	Qty
55996	NO-measurement 0 – 5000 ppm, resolution 1 ppm	
55998	O2-measurement 0 – 25 %, resolution 0,01 %	
56001	IR-printer-interface	
55425	Infrared-Thermalprinter	
55715	ABS – Case	
55665	Genuine leather case	
56620	Battery pack, rechargeable, 12 V, capacity 3 to 4 hrs.	
56623	Quick-Charger, Microcontroller	
58039	Battery pack and Quick Charger	

2.2 Spare parts list

MRU-Art.-Number	Description/technical data	Qty. In the unit
Filter:		
11165	Star filter	1
Hoses:		
11250	Silicone hose 3x1 mm transparent	0,15 m
56306	Viton hose 2x1 mm	0,2 m
55641	Viton hose 3x1,5 mm	0.3 m
11250	Silicone hose 3x2 mm transparent	3,0 m
Sensors:		
55546	O2-sensor	1
56047	NO-sensor	1

2.3 Consumption parts

MRU-Art.-Number	Description/technical data
55633	Service + cleaning set
55116	Printer paper roll, 58 mm x 25 m, thermal paper, single layer

3 Content

4 In General

4.1 Introduction

The **DELTA 1600 S-IV** is a small, 5-gas exhaust gas analyser, designed for industrial applications.

System Cost Reduction

Due to the small size of the **DELTA 1600 S-IV**, the flow rate is reduced to ca. 1.2 l/min.

Because of the small size of the DELTA1600S, the reduced size of the pump module and the simplification of the power supply, the complete analyzer is constructed as a real hand held unit.

Life Time Cost Reduction

To offer overall lifetime cost reduction, MRU removed all moving parts from the infrared sensor module by means of modulating the infrared source. All infrared receivers (for CO, CO_2 and HC) are integrated in the same package . This new technology and the use of standard parts is increasing the reliability of the **DELTA 1600 S-IV**.

4.2 Area of Use

The **DELTA 1600 S-IV** is used to measure exhaust gases. It measures carbon monoxide (CO), carbon dioxide (CO_2) and hydrocarbons (HC).

By using an electrochemical cell, oxygen (O_2) and Nitric Oxide (NO) can also be determined optionally.

The measurement of the above mentioned gases allow emission control for any mandatory inspection and maintenance program as well as vehicle diagnosis based on exhaust gas measurement under static and dynamic conditions by sampling at the tailpipe.

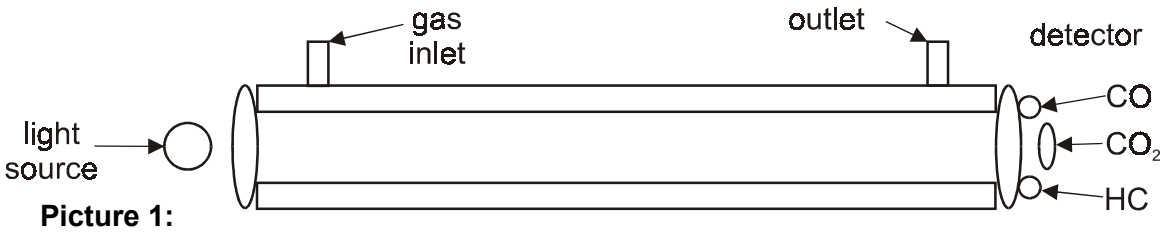
4.3 Principle of NDIR Measurement

The **DELTA 1600 S-IV** is based on a Non-Dispersive Infrared echnology.

NDIR devices are generally dedicated for measurement of concentrations of a limited, specific set of gases in mixtures with a limited, known set of background gases.

The **DELTA 1600 S-IV** Non-Dispersive Infrared gas analyzer is capable of measuring CO (carbon monoxide), CO_2 (carbon dioxide), and HC (hydrocarbons). It also performs both zeroing and calibration routines, which are completely microprocessor, controlled.

The measured gas data can be transmitted to a PC by means of a standard 5- wire RS-232 line (option).



Picture 1: **Principle of the IR-bench of DELTA 1600S-IV**

An example of such a limited framework might be the measurement of CO_2 concentration within an industrial exhaust gas background. Gases that might have an absorption spectrum overlapping that of CO_2 are known - a priori - to be absent.

A specific set of gases (i. e. CO, HC as propane C_6H_{14}, or methane propane CH_4 , and CO_2 for the DELTA1600S-IV) is measured as follows:

A regulated infrared source (IR) provides a photon stream in the range of 2 to 5 microns (µm). The infrared light is directed through the sample cell to the optical block. The source is modulated with ca. 2Hz.

Infrared transparent sapphire windows are provided at each end of the sample cell. The sample cell is temperature regulated so that a measurement compensation for the sample gas temperature and pressure variances is provided.

Infrared light not absorbed by the sample gas is transmitted to the optical block. It passes four optical bandpass filter that are each characteristic for the target gases (one filter is the reference filter; it is used for ageing and soiling compensation).

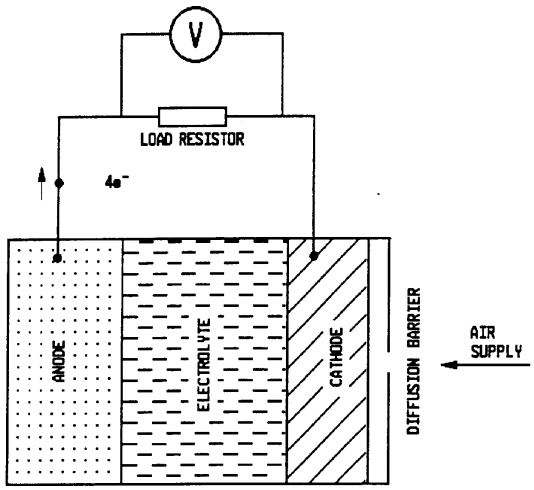
Four pyroelectric detectors that share the same housing collect light passed through the filter. They produce a voltage that is proportional to light intensity. The detector block temperature measurement and regulation facilitates compensation for IR filter and IR detector temperature variances. The detector output is preamplifier and sent via a multiplexed to an analogue or to a digital converter (ADC).

The microprocessor samples the ADC and provides all compensation routines, calculation, displaying and data management.

4.4 O_2 and NOx MEASUREMENT

O_2 and NO_x gas concentrations are measured by using electrochemical (fuel cell) sensors.

A fuel cell sensor provides an electrical response that is proportional to the concentration of the sample gas.



Picture 2: Principle of the electrochemical sensors of the DELTA 1600 S-IV

5 ANALYZER SPECIFICATION

5.1 Storage Temperature

-20 °C to 50 °C

5.2 Rated Operatio propane C_6H_{14}n Conditions

Temperature	+5 °C to 40 °C
Relative humidity	up to 90% non-condensing
Atmospheric pressure	860 mbar to 1100 mbar

5.3 Measured Gases

HC Hydrocarbons as propane (C_6H_{14}) or methane (CH_4)

CO Carbon Monoxide

CO_2 Carbon Dioxide

O_2 Oxygen (optional through electrochemical sensor)

NO_x Nitric Oxide (optional through electrochemical sensor)

5.4 Measuring Range

HC	= 0 to 5.000 ppm	as C_3H_8 (propane) or
HC	= 0 to 2,5 %	as CH_4 (methane)
CO	= 0 to 10%	
CO_2	= 0 to 20%	
O_2	= 0 to 21%	
NO_x	= 0 to 5000 ppm	(as Nitric Oxide)

5.5 Accuracy/Performance

The performance of the analyser is

HC : +/- 20 ppm HC or +/- 5% of reading

CO : +/- 0.03% CO or +/- 5% of reading

CO_2 : +/- 0,6% CO_2 or +/- 5% of reading

O_2 : +/- 0.2% O_2 absolute

NO_x : +/- 10ppm NO or +/-5% of reading

5.6 Resolution

HC: 1 ppm

CO 0.01% vol.

CO_2 0.1% vol.

O_2 0.01% vol.

NO_x 1 ppm

5.7 Warm Up Time

< 5 minutes (self controlled) at 20 °C ambient temperature

5.8 Response Time

T_{90} < 15s

Flow Rate approx. 1.2 l / min.

5.9 Power Supply

12Vdc +/- 1,5V from attached NiCd battery pack
max. 2A

5.10 Proposed Calibration Gases

The HC sensor reacted different to the various HC-gases – it should be adjusted with the same gas-air mixture, which will be measured later.
The device is adjusted with propane.

	Cal Gas 1	Cal Gas 2
CO	0.50 % vol.	3.50 % vol.
CO_2	6.0 % vol.	14.0 % vol.
HC	200 ppm vol.	2000 ppm vol.
N_2	rest	rest

Table 1:Calibration Gases

5.11 O_2 Specification

The **DELTA 1600 S-IV** meets the O_2-requirements with its O_2-sensor.

The **DELTA 1600 S-IV** software determines whether the sensor is still ready or not.

MRU's O_2-sensor:

New sensor in ambient air: 9...14 mV
Old sensor in ambient air: 5. ..7 mV

If the sensor is outside of the specifications, a message will indicate that there is a problem with the sensor. Please check the service values.

(1000 di ⟺ 1 mV)

5.12 NO_x Specification

The **DELTA 1600 S-IV** meets the NO-requirements with its NO-sensor.

The **DELTA 1600 S-IV** software determines whether the sensor is still ready or not.

MRU's NO-sensor:

New sensor in ambient air: ca. +-50 di

If the sensor is outside of the specifications, a message will indicate that there is a problem with the sensor.

For detailed information consult with MRU's' application engineers.

6 DELTA 1600 S-IV Module Applications

6.1 Operational requirements / Sample System

The design of the sample system assures that, when the gas reaches the **DELTA1600S-IV**, the gas temperature is similar to the ambient temperature.
Condensation in the analyser has to be avoided;
To reach this target, the condensate is collected in a condensate trap. The bench itself is temperate to + 50° C to avoid a condensation inside the sensor bench and protect the IR bench and the analyser.
The sample gas stream should not contain particles > 5 µm (filter included in the condensate trap)
The gas flow through the bench should be the same for all conditions (i.e. measuring mode, zeroing and calibration).

6.1.1 Summary

- Relative humidity: non condensing
- Gas temperature: T_{gas} approx. $T_{ambient}$ when the gas reach the analyser
- Particle size: < 5µm
- Ambient Temperature: $T_{ambient}$ > + 5°C

6.2 User Interface Requirements Summary

6.2.1 Software & Communications

- 9600 Baud rate.
- Communicates over RS-232.

6.2.2 Electrical & Electronic

- + 12 VDC input
- Typical 6 watts, max. 24 watts

6.2.3 Mechanical & Pneumatic

- 1.2 l/min sample flow
- Weight: 800g
- Size:100 mm x 210 mm x 50 mm

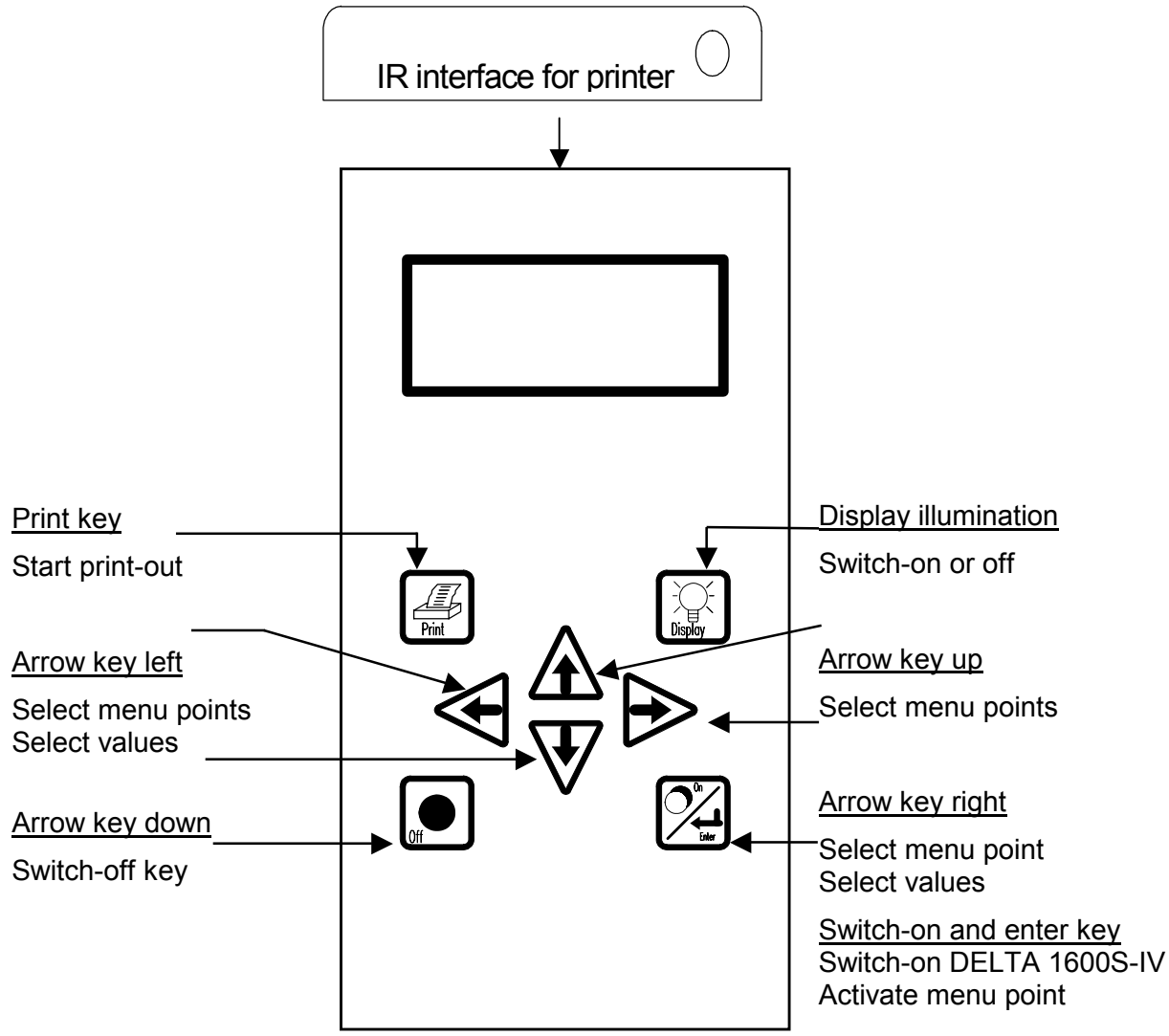
6.3 RS-232 Configuration

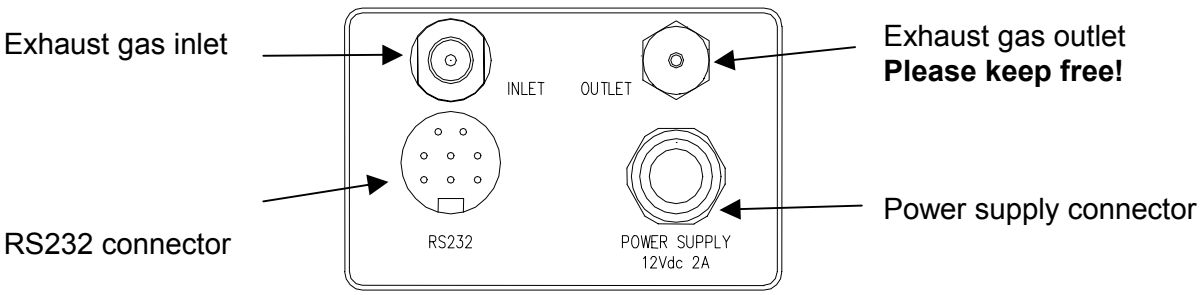
Baud : 9600 Stop Bits : 1

Data Bits : 8 Parity : none

7 FUNCTIONAL DESCRIPTION

7.1 DEVICE ILLUSTRATION





7.2 DEVICE OPERATION

7.2.1 THE KEYBOARD

- Device is switched-on or selected menu point is activated by means of key
  If the ON-key is being pressed for a while, device gives an acoustical signal.

- Switch-off device by pressing key.

- Select by pressing the or keys.

- Activate printer by pressing the key.

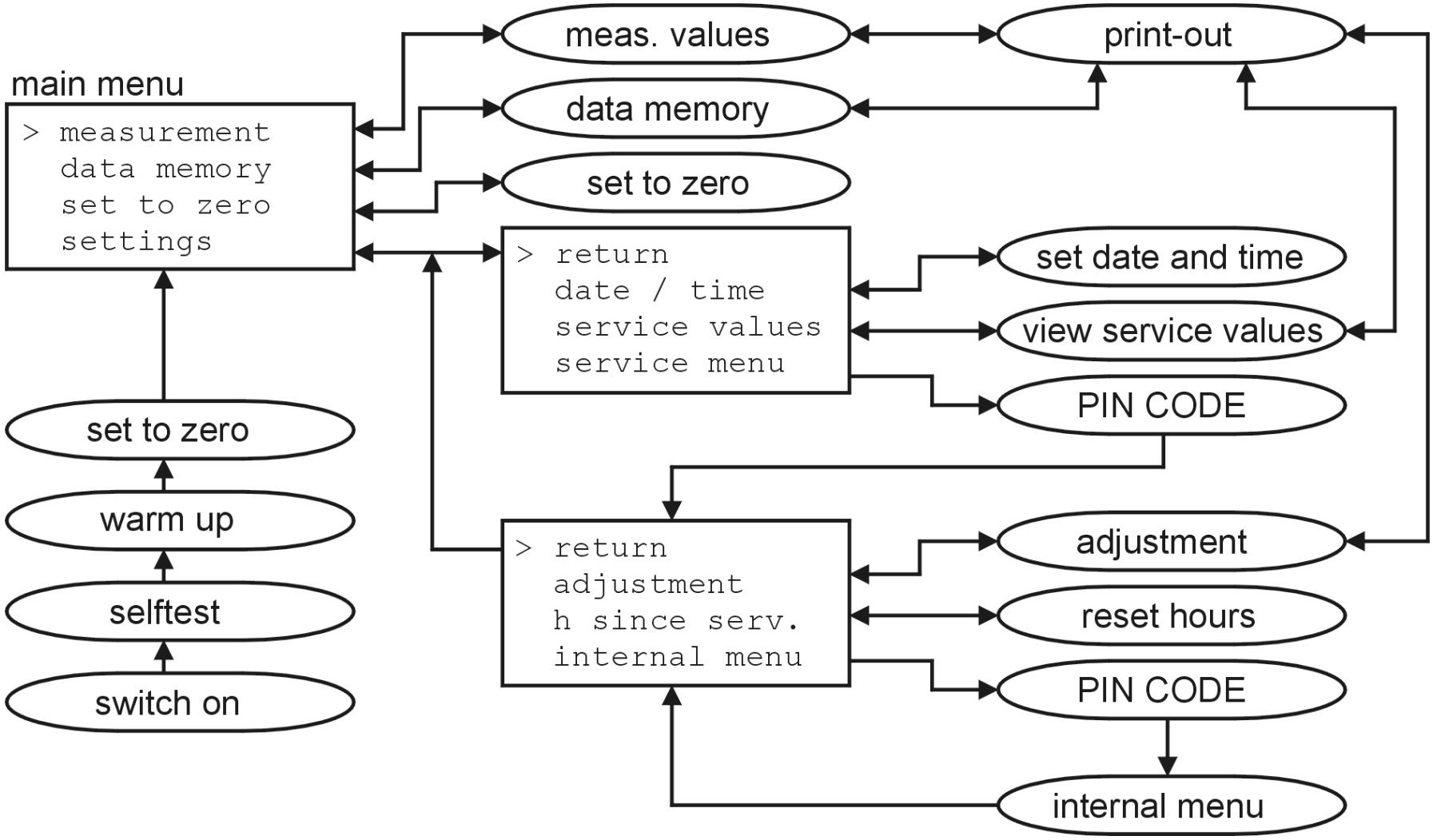
- Display illumination can be switched on and off by pressing the key.

7.2.2 POWER SUPPLY

The DELTA 1600-S-IV can be operated either

1. by means of MRU battery pack
2. by means of MRU mains power supply 85…240Vac, 30 W (option)

7.3 MENU FLOWCHART



8 OPERATION

8.1 PREPARE FOR MEASUREMENT

MAINS OPERATION DELTA 1600-S-IV (option)

- The MRU mains power supply has to be connected at the rear side of the device.

  Rotate knurled ring of the plug clockwise to screw the connector.
  Rotate knurled ring of the plug anticlockwise to unscrew the connector.
  Suitable for mains operation **85…230 V, 50 Hz**.

MAINS OPERATION OF INFRARED PRINTER

- The MRU power supply or the HP power supply has to be connected to the upper side of the printer. For **mains operation**, use **230 V, 50 Hz**.
  Notice: Never use power supply without inserted batteries!

Condensate trap

- Fix condensate trap vertically (filter must be topside).
- Check whether condensate trap is **empty** and filter cartridge is **white !**
  White filter = OK
  Dark filter = replace

Connections and tightness

- Check all plugged and screwed connections on tight fit.
- Check tightness of all tubes, tube connections, condensate trap (from probe tip to gas connection on device.

8.2 START OF DEVICE

- **Press**  **key.** The following window is displayed:

```
Zero setting
has to be
determined in
ambient air!
```

Gas sampling probe in ambient air. After a few seconds, the following window appears:

```
Delta 1600S      MRU

     -Self test-
```

- In this programme sector, microprocessor checks all signals on plausibility.
- After self-check, warming-up phase is started automatically.

```
Delta 1600S MRU
- Warm up -
T-Blk.:  28.09°C
T-Det.:  49.73°C
```

Temperature of infrared bench

Temperature of infrared detector

- Warming-up time depends on ambient temperature.
  Low ambient temperature: long warming-up phase.
  High ambient temperature: short warming-up phase.
- Temperature of the IR bench (T-Blk) and temperature of the IR detector (T-Det) are displayed.
  Set point of the detector temperature: +50°C.
- When this temperature is reached: automatic zero point setting is started.

```
For zeroing
please remove
inlet hose
```

```
Set to zero
please wait

60
```

```
Please
connect
inlet hose
```

- Zero point setting takes approx. 60 seconds.
- Afterwards, **MAIN MENU** is displayed.
  Device is ready for user's selection:

```
> Measure
  Stored data
  Tests / zero
  Settings
```

Cursor is placed at **> Measure**. Start measurement by pressing the enter key ⏎, or select other menu points by pressing the ▲ ▼ keys.

8.3 MENU "MEASURE"

- The following window is displayed (e.g.):

```
* HC          2ppmvol
  CO           0.00 %
  CO2           0.0  %
  O2           20.93 %
```

Cursor (*) blinks at the first line.
Cursor can be moved by means of the ▲ ▼ keys.
Values can be changed by means of the ◀ ▶ keys.
Settings can be stored permanently, if device is switched off by pressing the "Off" key.
Enter key ⏎ ends measurement, last values are being stored.

8.4 Stored data with 50 memory places

In the main-menu there is the number of the next free memory place displayed in the right edge.

```
  Measure          2
> Stored data
  Tests / zero
  Settings
```

With the keys ◀▶.it is possible to change this number.

The second menu point „Stored data“
If this option is activated following window is displayed:

```
Place   1
Date    28.06.00
Time    12:22
```

With any key you can reach to the values with the “m” (memory)

```
m HC          10ppmvol
  CO           0.02 %
  CO2          0.0  %
  O2          20.9  %
```

It can be changed between the memory places with the keys ◀▶..

With the key ⏎ the following window is displayed:

```
> Return
  Print actuel
  Send data > PC
  Del all data
```

8.5 PRINTING PROCEDURE (OPTION)

- Switch-on infrared (IR) printer (option). Optical connection between infrared (IR) printer and DELTA 1600-S-IV has to be provided and ***must not be interrupted during printing procedure***.
  Protect infrared (IR) printer against direct sunshine (detailed description about max. distance and transmission angle please see manual of Hewlett Packard printer).

- Printing procedure is started in window **"*Measure"***, ***"stored data"*** or **"*Service"***.

- Press printing key  .

Print out values (e.g.):

Customer: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

****

MEASURE Delta 1600S-IV

****

18.01. 01 10:10

HC	*2260 ppm*
CO	*8.7 %*
CO2	*12,0 %*
O2	*2.55 %*
NOx	*132 ppm*

M R U G m b H
Fuchshalde 8
74172 Obereisesheim
Tel. 07132/9962-0
Fax. 07132/9962-20

Your company address can be saved upon request.

1 – OFF - ON

2 – Print contrast

3 – Paper advance

4 - Door

5 – Paper slot

6 – IR-receiver

Insert printer paper roll:

Cut end of paper properly (see drawing).
Do not use paper with wrinkles or bad paper edges.
Avoid any obstruction of the printer mechanism !

Open paper protection flap.

Position paper like illustrated (see printer manual of Hewlett Packard).

Pull paper through lid of printer.

Pull paper through lid of printer.
Press (3) until paper is coming out.

In case of paper jam, pull paper back very carefully !

Insert printer paper roll and close protection flap.

Never operate printer without paper !

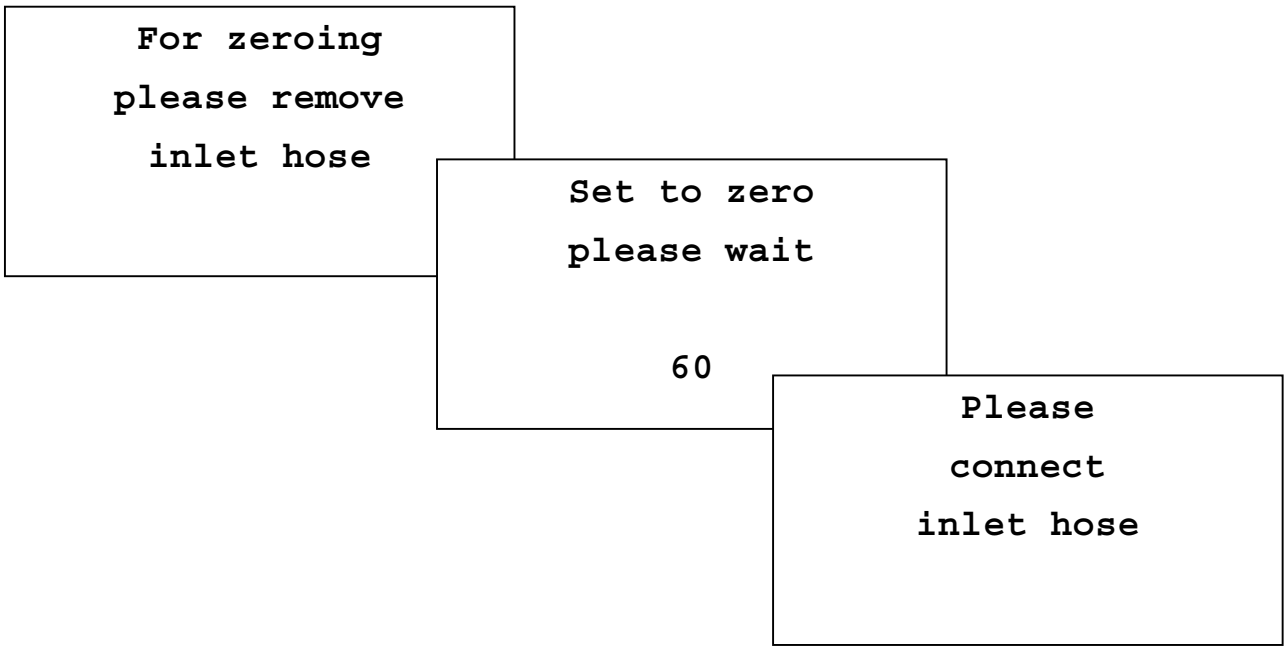
Do not pull paper from the front press (3)

Do not pull paper from the back press (3)

End of printer paper roll: Do not use printer paper until paper end, in case that the paper end is pasted to the inner body (HP paper is not pasted).

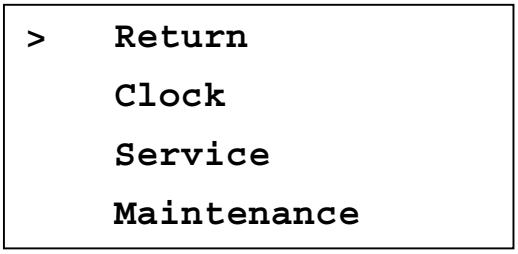
8.5.1 Menu “Set to zero”

In this menu you can perform the “Set to zero” if it is required.



8.6 **MENU “SETTINGS”**

Select menu point “SETTINGS” in the MAIN MENU by means of the arrow keys ⍋ ⍒ and confirm by pressing the Enter key ⏎ . The following window is displayed:



Window ***„SETTINGS“***

- Cursor can be moved between the 4 menu points by means of the arrow keys ⍋ ⍒ .
- Confirm selected menu point by pressing the Enter key ⏎ .

8.6.1 MENU ”POINT “RETURN

- Press Enter key in the menu point **“RETURN”** ➢ return to **MAIN MENU**.

8.6.2 MENU POINT “CLOCK”

Select menu point **“CLOCK”** in the menu**„SETTINGS“** by means of the arrow keys and confirm by pressing the Enter key . The following window appears:

```
Time     13:08

Date     28:01:99
```

Window: ***“CLOCK”***

- Cursor can be moved by pressing the arrow keys .
- Value can be increased or decreased by pressing the arrow keys .
- Date is displayed according to European standard (day/month/year).

Confirm by pressing the Enter key ➢ return to menu point **“SETTINGS”**.

8.6.3 MENU POINT “SERVICE”

Menu point **„SERVICE“** can be selected by 2 different ways:

- Menu **„SETTINGS“** ➢ select menu point **“SERVICE”** by pressing the arrow keys ➢ confirm by pressing the Enter key .
- Press On/Enter key as long as device gives a long buzzer tone (after switching-on the unit).

The following analogue value window (1) appears:

```
HC          18000di
CO          18000di
CO2         -----di
IR-Ref      18000di
```

Window ***„ANALOG VALUES 1“***

- Analog values are indicated as digits for the determination of the analog/digital converter.
- Service values can be scrolled by pressing the arrow keys ⚠ ⚠ and ◀ ▶ .

```
T-Detec      5000 di
T-Block      4950 di
T-Unit       3521 di
U-Ext.        125 di
```

Window ***„ANALOG VALUES 2“***

```
O2           -----di
NO           -----di
hPa          -----di
mbar         -----di
```

Window ***„ANALOG VALUES 3“***

- Window ***“ANALOG VALUES 3 “*** appears only in connection with the corresponding options.
  Leave menu point ***“ANALOG VALUES”*** by pressing the Enter key ↵ .
  The following window appears:

```
   Ser.Nr. 272 082
      V 3.01 IV
```

Window: ***“DEVICE NUMBER / SOFTWARE VERSION”***

Software version of the device is indicated below the serial number.

Window closes approx. seconds without user’s action ➢ return to menu point **“SETTINGS”**.

You can also print-out values in the the menu point **”SERVICE”**

This print-out is very important for correct diagnosis in case of an error !, ,

8.7 Menu adjustment

The adjustment is possible in the menu “Adjustment →Maintenance”:

```
   Return
   Clock
   Service
>  Maintenance
```

Please select with the arrow keys “Maintenance” and confirm with the “Enter” key.

Now you have to enter the PIN-code.

```
Maintenance
PIN-Code
------
```

```
Return
Adjustment
h since serv.
Internal menu
```

This **Code** is for **authorised Service people only!** It is forbidden to pass this information to any third people!

PIN-Key combination:	Arrow key↑ / Printer key / Arrow key↓ / Enter key / Arrow key← / Enter key

Now you enter the following menu.

```
   Return
>  Adjustment
   h since serv.
   Internal menu
```

8.7.1 Adjustment

Please select “Adjustment” and confirm with the “Enter” key.

The following window appears:

```
>  Return
   HC   CO   CO2
   O2   NO
   Set calib.Date
```

The HC sensor reacted different to the various HC-gases – it should be adjusted with the same gas-air mixture, which will be measured later.
The device is adjusted with propane.

Select with the arrow keys “HC CO CO”” and push “Enter”.

8.7.1.1 Adjustment IR-bench

The following window appears:

Gas	set	actual
HC	2025	8
CO	3,45%	0,0
CO2	14,0%	0,0

Window „IR-bench adjustment”

Propane, CO and CO_2 only will be displayed with the set and actual values.

Now you can test the analyser with gas. We propose a gas mixture with following set values: Approx. 14% CO2, 3,5 % CO and 2000 ppm C3H8 (Propane), rest N_2. The readings are stable after approx. 90 sec.

With ↑↓ you select the line. The twinkle colon behind the name shows the actual position.

With ←→ you can adjust the set values to the actual test gas values.

With the “Print” key you come to following menu :

```
Return
Print
Adjust
Set to zero
```

With ↓ select “Adjust” and press “Enter”. Now a window with the coefficient of correlation between Propane and Hexane and the parameters of the setting appears.

```
HC        0,924
CO        1,034
CO2       1,003
```

With the Enter-key the window IR bench adjustment appears once more. The new – after the adjustment calculated actual values – will be displayed.

If necessary you have to repeat the procedure.

By means of pushing the „Enter“ key three times, you can return to the „Adjustment“ menu.

8.7.1.2 Adjustment of electrochemical sensors

```
Gas    factor   actual
O2 :    0       20,90
NO      0.978      0
```

window *„electrochemical sensors adjustment“*

The setting values of the test gaz bottle are adjusted in co-operation with the factors so that the setting values are equal with the actual values

With the keys , you can choose the sensor and with the keys left / right the appropriate factor will be adjusted.

Also theses factors will be stored in the EEPROM.

By means of pushing the „Enter“ key three times, you can return to the „Adjustment“ menu.

8.7.1.3 Interval of adjustment (Set.Calib.Date)

By selection of the menu point adjustment interval appears following inquiry:

```
Adjustment
correct ?
> yes
  no
```

window „set. Calib.Date

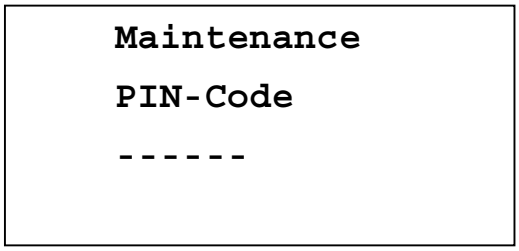
With the selection of „Yes“ the counter for the checking of the adjustment interval will be set to zero.

8.7.1.4 Menu hour since service

In this menu the state of the service-hours-counter will be displayed. This shows the add up of the operating hours between two successive adjustments.
After an adjustment the counter will be set to zero,.

8.7.2 MAINTENANCE

The menu „MAINTENANCE“ can be reached via PIN code. Only the manufacturer or the service stations are permitted to use this PIN code. In case that you should have selected this menu point by mistake, please press 6 x any key (the choice is open) ➢ return to the „SERVICE“ menu.



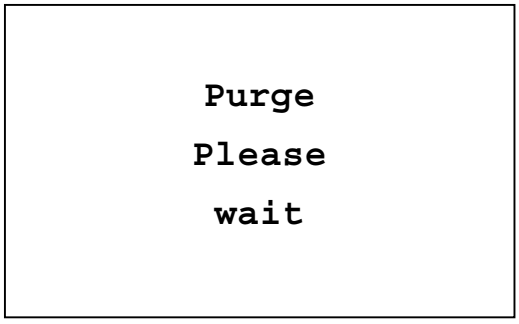
Window “*PIN-CODE“*

The subdivision of this menu is described in the service manual..

8.8 SWITCH OFF

When the device is being switched off, device configuration is saved in the EEPROM permanently.
In case that the IR bench is still in the stack, device can not be switched off by means of the OFF key 

The following window will be displayed:



After successful purging (HC < 20 ppm), device switches off automatically.

8.9 Quick-Charger

8.9.1 Features

- Microcontroller controlled charging
- Battery test phase at the start of each charging cycle to detect broken battery packs
- Broken battery pack detection and charging current off
- Short circuit detection
- Electronic protection against reversed battery
- Battery charging at the start of the charging cycle is of no importance
- Automatic switching over to trickle charge
- Button for discharging automatically followed by charging

8.9.2 Operation

The charger starts charging automatically as soon as a battery pack is installed and the charger is plugged in. The red LED (battery contact detection –test phase) flashes for about 10 seconds.

Note!!

If the red LED after the test phase still keeps flashing, check the polarity of the battery pack (+/- switched?). If polarity is right and the red LED keeps flashing after the test phase, the battery pack is broken and you have to throw it away in a special container for small chemical waste. The test phase is followed by charging procedure (red LED on). After the charging procedure the charger switches automatically over to trickle charge (green LED flashing, red LED off). To avoid memory effect (loss of capacity due to frequent partly discharging), you have to discharge the battery pack every now an then. After the test phase, press the “PRESS” button approximately 2 seconds (red LED flashing)! After discharging and after a power interruption the charger automatically switches over to charging.

8.9.3 LED’s3

Red LED flashing:	Battery contact detection (test phase)
	Battery pack reversed
	Battery pack broken, discharging after pressing the PRESS button
Red LED on:	Charging
Green LED on:	Battery fully charged, trickle charge

8.9.4 Technical Specifications

Charging time:	appr. 3 hrs.
Operation on mains:	230V/50Hz
Charging tension:	4,8 – 12 VDC
Charging current:	700 mA

9 ERRORS

9.1 ERROR DIAGNOSIS

1. Effect	2. Error message	3. Cause	4. Solution
Device cannot be switched off by pressing the OFF key.		Gas ways are filled with gas.	Purge device with ambient air.
Measured values are incorrect.		During set of zero point, gas is already impinged on the sensors.	Purge device with ambient air. Set new zero point.
No measurement possible.		Device cannot be switched on.	Check current supply on correct contact.
Warming-up phase does not stop.	Temperature display: T-Blk °C T-Detect °C noes not reach set point.	Temperature sensor defect or heating element defect	Please call our service station.
Measured values are incorrect.	Measuring range exceeding: O_2 value too high, CO and CO_2 value too low.	No proper connection between probe and device. Probe, hose condensate trap not tightly fit. Pump does not work properly.	„Tightness test". Check probe, hoses, condensate trap on tightness.
Measured values are incorrect.		Internal contamination of gas ways and IR bench. No routine 3-month-check.	Check and clean gas ways. New calibration with test gas.

9.2 ERROR DIAGNOSIS CONDENSATE TRAP

1. Effect	2. Cause	3. Solution
Dirt and / or humidity inside the device, filter does not work, sensors fail, pump fails.	Dirty and / or wet filter	Check filter more regularly resp. replace it. White = OK Dark = replace
Incorrect measured values.	Lid, middle piece, plexi glass tube and real rings are not sealed or screwed properly	Check tightness whenever changing the filter.

10 MAINTENANCE

10.1 CLEANING AND MAINTENANCE

1. Clean gas sampling probe and gas sampling hose occasionally.
2. Purge gas ways with ambient air after each measurement (until HC < 20 ppm)
3. Clean or replace dirty and humid star filters. Star filters are washable; they can be washed and re-used up to approx. 5 times. Dry star filters thoroughly after washing.
4. Grease connection nipples to keep seal rings soft.
5. Replace crude exhaust gas filter regularly.

Recommended maintenance interval: 1 x annually in the factory

10.2 SPARE PARTS LIST

10.2.1 Options

MRU-Art.-Number	Description/technical data	Qty
55996	NO-measurement 0 – 5000 ppm, resolution 1 ppm	
55998	O2-measurement 0 – 25 %, resolution 0,01 %	
56001	IR-printer-interface	
55425	Infrared-Thermoprinter	
55715	Standard Transport – Case	
55665	Genuine leather case	

10.2.2 Spare parts list

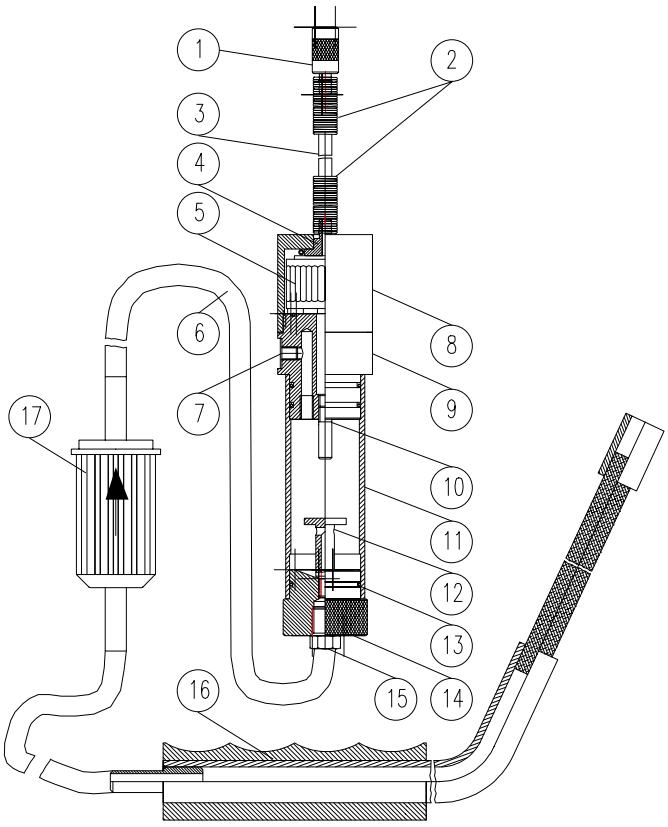
MRU Art.-Number	Description / technical data	Qty. in the unit
Filter:		
11165	Star filter	1
Hoses:		
11250	Silicone hose 3x1 mm transparent	0,15 m
56306	Viton hose 2*1,0 mm	0,2 m
55641	Viton hose 3*1,5 mm	0.3 m
11250	Silicone hose 3x2 mm transparent	3,0 m
Sensors:		
55546	O_2 sensor	1
56047	NO sensor	1

10.2.3 Consumption parts

MRU-Art.-Number	Description/technical data
55633	Service + cleaning set
56116	Printer paper roll, 58 mm x 25 m, thermal paper, single layer

10.3 CONDENSATE TRAP

- Empty condensate only when pump is switched off.
- Pull off condensate box (pos. 3).
- Dispose condensate.
- Wash and dry or replace dirty and humid filter tabs.



Pos. No.	Description	MRU-Art.-No.
1	Hose bushing	52552
2	Spring – inner diameter = 7 mm	56145
3	Viton hose 3 x 1,5 mm	55641
4	Adaptor nipple	54442
5	Star filter	11165
6	Viton hose 6x2 mm / 1,5 m	56141
7	Slotted set screw M 5 x 6	56150
8	Condensate lid	11365
9	Middle piece	51223
10	Stainless steel pipe	52867
11	Kondensate container	51317
12	Stainless steel pipe	55748
13	Seal ring 24x1,5 mm	51516
14	Plug	56123
15	Screwing nozzle R 1/8“ SO 40511-6-1/8 brass material	56142
16	Gas sampling probe	55582
17	Exhaust gas filter	55783

10.4 Repair Slip

Servicing stations .....
Address: .....
.....
.....

Repair Slip

Date: .....

Name of device: ..... MRU serial N°: .....

Customer's address .....
(stamp) .....
.....
.....
.....

Please mark: permanent malfunction ☒ malfunction temporarily ☐

☐ complete device check
☐ check and repair of the following items:

☐ O_2-sensor	☐ NO_x-sensor	☐ NO_2-sensor
☐ SO_2-sensor	☐ CO-sensor	☐ .....
☐ Chimney draft	☐ ambient air measurement	☐ gas temperature measurement
☐ Soot measurement	☐ pump capacity	☐ battery capacity
☐ printer	☐	☐ .....

☐ retrofit following options :

☐ printer	☐ memory	☐ solid-fuel
☐ NO_x	☐	☐ .....

☐ Other works to be effected: .....
.....
.....
.....
.....
.....
.....
.....
.....

Cost estimate desired no ☐ yes ☐
(Expenditure of repairs higher than DM 500,00 net, cost estimate will be sent general.)

Date..... Signature..... Stamp

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Fax +49 (71 32) 99 62-20
Internet: http://www.mru.de
E-mail: info@mru.de

11 Appendix

11.1 Addresses „Your Contacts to MRU“

	manufacturer
Address:	**M R U** Messgeräte für Rauchgase und Umweltschutz GmbH Fuchshalde 8 D-74172 Neckarsulm-Obereisesheim
Phone:	+49 71 32 – 99 62 - 0
Fax:	+49 71 32 – 99 62 - 20
Service-Hotline:	+49 71 32 – 99 62 -59
E-Mail:	info@mru.de
Web-Site:	www.mru.de
Mail Address:	Postfach 2736 D-74017 Heilbronn
Express Station:	Heilbronn-main station self collect