E M I S S I O N MONITORING SYSTEMS

Operating Instructions

Exhaust Gas Analyzer
DELTA 1600-L

For Otto-cycle and diesel engines

Always read operating instructions before work !

MRU-Nr. 58330

G:\TECH-DOC\D1600-L\ENG\D1600L_ENG.DOC

MRU AIR fair
EMISSION MONITORING SYSTEMS

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.

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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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Table of contents Page

1 Introduction

1.1 Exhaust Gas Measuring Device DELTA 1600-L

In our today's society, the automobile has a fix place. The protection of our lives and our natural surrounding is our first priority. Therefore reduction of pollutant emission is demanded. For this, the legal conditions are existent and the best of the necessary and suitable monitoring and controlling devices are
MRU exhaust gas tester **DELTA 1600-L** and the
OPAZIMETER **MRU-OPTRANS 1600**.

All vehicles disposing of a diesel engine or an Otto-cycle-engine, with or without catalytic converter are to be checked regarding their exhaust gas. In the long run, neither three-way catalytic converters nor diesel injection systems can warranty a perfect function and thus the observation of the legal limiting values of exhaust gas emission.

The technology of automobiles keeps on developing. High tech and micro processor technology is more and more used in the vehicles. The controlling process and the demands regarding monitoring and controlling devices correspondingly are very complex and costly. The work shops, garages, the German Boiler Code and the police therefore are in need of exhaust gas testers that do not only exactly and quickly determine the emission values, but control also all motor components. Clear diagnosis – high tech and environmental protection -
the DELTA 1600-L and the OPTRANS 1600.

The DELTA 1600-L determines the emissions of CO (carbon monoxides), CO2 (carbon dioxides), HC (hydrocarbons) with means of infrared measurement and O2 (oxygen) and NO (nitrogen oxides) with means of electrochemical sensors. The 5-gas analysis is processed by the integrated micro processor and described in the display. Simultaneously, the Excess Air value is calculated. Also the oil temperature of the engine and the engine revolutions are determined at the same time.

The logical operation menu leads the user step by step through the program. At the end of a measurement, the measured values, the date and the time can be documented b a integrated printer.

1.2 Scope Range of Use for DELTA 1600L and OPTRANS 1600

The scope range of use for the MRU emission and soot testers are test units, work shops, garages, automobiles as well as text benches of the automobile industry (research and laboratory).

- Mobile use in test drives, control drives as well as function control text of the catalytic converters
- Use at the police, in schools, formations, guilds
- Use as a diagnosis tester in work shops,
  as precaution respectively text examinations before an official examination respectively exhaust gas emission examination (ASU)
- Use in official exhaust gas emission examinations (ASU)
- Use as a test bench device in the development of engines, engine production, continuous tests – in test benches and test drives – emission tests and fuel tests.

1.3 Essential Features

- stationary and portable use
- continuous emission analysis and smoke density measurement
- simple, easy and fast commissioning
- large, illuminated, graphical LCD display in order to show the measured values with operation menu
- extremely short warm-up stage
- due to the little weight of the device, the measurement “free acceleration” can be effected easily and without any problems
- short measuring gas sampling probe, for this reason the loss of volume between sampling and indication on the display is very little
- high accuracy and performance through 16-bit micro processor
- automatic self check program with diagnosis indication in the display
- extremely high and fast computing output and for this also a very fast indication e. g. of the Excess Air values
- different AUX input connections in order to scan engine revolutions, oil temperature and/or flue gas clouding
- serial interface, RS 232
- internal electronic data storage with 100 data blocks (optional 300)
- external input of the vehicle data by a PC keyboard, e. g. license plate
- integrated protocol printer in order to document the analysis data together with date and time
- device heating for use with temperatures below +5°C
- heated gas sampling line with gas cooler as well as automatic condensate pump for use with temperatures below +5°C
- easy to service construction of the IR bulbs and the measuring device as well as automatic indication when ready for measurement

2 Security Advices

The following security advices have to be strictly observed.

2.1 General Security Instructions

Before commissioning the exhaust gas tester DELTA 1600-L and OPTRANS 1600, please read carefully the security advices and make sure, that you have understood all correctly. Only this way, you can avoid any damage to the exhaust gas tester DELTA 1600-L and OPTRANS 1600, the vehicle measuring instrument and the vehicle itself.
The motor vehicle and particularly the engine compartment itself are a potential source of danger for the user of test devices. Therefore, any test, adjustment or repair work is only to be done by trained staff or under direction. This is also valid for the connection and operation of test devices. Before connecting, operating and starting the test device, it is absolutely necessary to read carefully its instructions, in order to avoid any uncertainty which can mean security risk. Not observing the security advices can mean loss of your right to claim under guarantee.

All operation and works, as well as the connection of testing devices in the engine compartment are only to be done, then the engine and the ignition are off.

Never use pins or paper clips or other metal parts as electric conductors for the metal tube of the sensor, as the risk of accidents increases and electronic parts can be destroyed.

To be observed :

- When connecting power supplied tester, the testing device by all means has to be connected with the protective conductor (power supply) and turned on before being connected to the vehicle.
- Never turn on vehicle engine or ignition, before the testing device is connected to the ground conductor respectively B- of the engine.

Exhaust Gas Components :

- Exhaust gas of vehicles contains toxic components (e. g. CO, which does not smell) ! In closed rooms, please turn on and connect the suction installation in order to avoid intoxication! Some components are heavier than air. Therefore, please be attentive with works in mines. Always assure sufficient venting respectively suction.

Fuel and Fuel Fumes :

- Fuel and fuel fumes are inflammable and can lead – under certain conditions – to explosions. Therefore, when working with fuels, the ignition has to be turned off and smoking should be stopped. In closed rooms, sufficient venting or suction should be guaranteed. Also see to it, which no fire or spark source is near.

Noise :

- When effecting a measurement, especially with high engine revolutions, noise of more than 70 dB(A) can develop. In case of necessity, the operator should use personal sound-absorbing protection. The operator should also – if necessary – protect the working places near the test space against noise.

Etching Components :

- **Caution :** Moisture, being pumped out of the condensate trap could be slightly **acidic**.
  - In case of contact **IMMEDIATELY :** clean affected parts of the body !
  - Avoid contact of eyes with liquid.
  - **Please clean carefully** all parts that were in contact with the condensate

- **Viton Tubes :**
  This exhaust measuring device contains flexible tubes of fluoride Elastomers (Viton). They are needed for the measuring of hydrocarbons. Other flexibles would absorb and later give up hydrocarbons and therefore change the measured result. Under normal

conditions, Viton is not dangerous. Then overheated (more than 250 ° C) or burned, Viton discharges hydrogen fluoride, an etching gas, which builds together with humidity (water) hydrofluoric acid. On unprotected skin, this acid causes etchings, the gas attacks the lungs. **Immediately clean etched parts of the skin with water, after that, please consult a medical doctor.**

To assure a secure removal of combustion products, we recommend the following:

- Wear gloves made of neopren or PVC
- Neutralise combustion products with calcium hydrate solution. Un-toxic calcium fluoride develops, which can easily be washed away.
- **O_2 and NO Primary Elements :**
  The O_2 and NO primary elements contain alkaline solution. Caution : etching !
  The O_2 and NO primary elements are hazardous waste and have to be removed correspondingly.

Turning Parts :

- An energised engine is dangerous due to turning parts. Possibly also when using an electrically powered fan, although he engine and the ignition have been turned off.
  Watch – especially with energised engine – the positioning of the measuring cables.

Hot Parts :

- In the engine compartment – especially the exhaust gas parts – some components can reach temperatures of some hundred degrees Centigrade. Persons can be in danger of being hurt.
- **After measurement**, please **vent** the device with **fresh air** and watch that the **probe is getting cold**. **As long as it is hot**, the tube of the probe could **burn persons** or cause **fire damages on inflammable underground**.

Vehicle :

- Please see to it, that during the test the vehicle cannot roll, e. g. by pulling the hand brake, setting the automatic gearbox into parking position or by locking the wheels with stop blocks.

Operation Software and Nominal Data :

- In spite of careful programming, assembly and test, we cannot guarantee the correctness of the operation software.
  We refuse any liability regarding consequential damages !

Power Supply :

- The testing device is to be connected only by the enclosed original MRU power supply cable or a 12V vehicle adapter. Please observe the polarity :
  red = + terminal, black = - terminal

Ignition Installation :

- Electronic ignition systems can reach a power output, which can provoke dangerous voltages in the whole ignition installation, i. e. not only in single boiler units as ignition coil or ignition distributor, but also in the cable space, on plug-in connections, connections for testing devices etc. They occur not only as secondary, but also as primary current.
  If too high voltage – especially in the ignition installation (secondary and primary current) – or damaged or porous isolations regarding the ignition cable can be noticed, please take corrective action before connecting a testing device..
  Therefore, please do always turn off the ignition before operating at the ignition installation.

  Operating at the ignition installation is for example

  - connecting a testing device
  - exchanging ignition parts etc.
  - connecting extracted boiler units, in order to test them in test benches.

When the ignition is energised, live wires in the whole ignition installation should not be touched !.
When effecting testing or adjustment works, this is also valid for all vehicle connections of testing devices and connections of the boiler units in testing benches.
The connection lines have to be positioned in a matter that the individual lines do not touch the hot parts of the engine, do not get near the exhaust machine or touch the exhaust pipe.
Furthermore, it should be observed that the connection lines are not positioned near rotating parts.
Testing plug-in connections have to be plugged in correctly. If no vehicle-specific plug-in connections or adapter lines are available and the test connection is effected by commercially approved plug-in connections, please observe under all circumstances that they are plugged in correctly, for they cannot be shook off by vibrations.

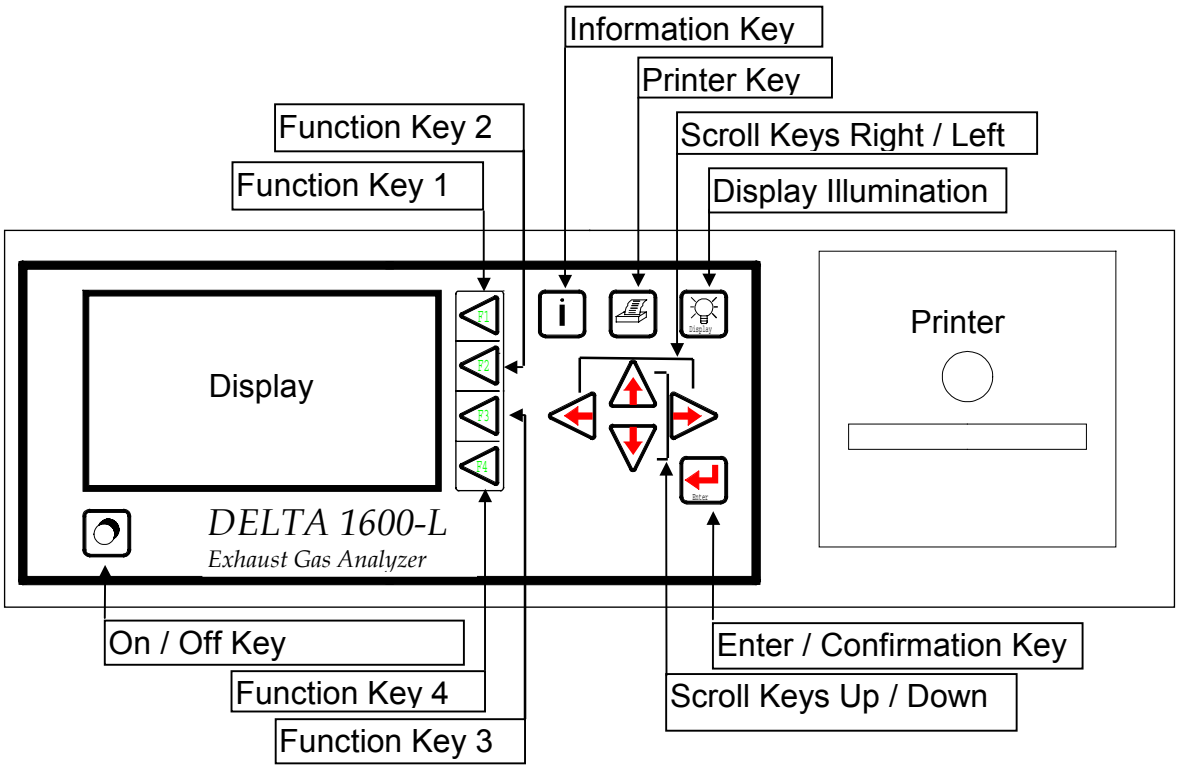
2.2 Security Instructions

1. The devices DELTA 1600-L and MRU-OPTRANS 1600 are exclusively to be used by specialists.
2. The devices DELTA 1600-L and MRU-OPTRANS 1600 are exclusively to be used for their original purposes, the measurement of exhaust gases of combustion engines.
3. The devices DELTA 1600-L and MRU-OPTRANS 1600 and the corresponding adapter lines are not to be put into service, if they are damaged or if they seem to be.
4. Liquids as oil, fuel or water should not enter the devices DELTA 1600-L and MRU-OPTRANS 1600 and the corresponding adapter lines. Therefore, the devices DELTA 1600-L and MRU-OPTRANS 1600 should not be placed on the floor of the work shop.
5. The devices DELTA 1600-L and MRU-OPTRANS 1600 tap the machine's mains of the vehicle to be measured. A non-observation of the above mentioned security advices can provoke worse damages regarding the vehicle electric's, e. g. short circuit.
6. The devices are delivered by MRU GmbH according to **DIN 0100** as well as **DIN 0701**.
7. The general basic principles for safety-relevant design of technical products of the Association of Fine-mechanics and Electro-technics according to **DIN 31000/ VDE 1000** and the respective **UVV = VBG 4** are observed.
8. The MRU GmbH assures, that the device corresponds to the essential requirements of the legal regulations of the member states of the electro-magnetic compatibility (89/336/EWG)
9. Please avoid charging the battery inside the device for more than **14 hours**.
   Should the battery catch fire due to an operating error or a technical defect, the fire shall only be extinguished with corresponding fire-extinguishing gears.
10. The device is not to be used in and under water.
11. The device is not to be placed near or directly at open fire or heat.
12. Please avoid plunges of the device.
13. Please observe the security advices of the connected vehicle measuring device.

Your Quality Control Department MRU GmbH

3 Functional Description

3.1 Front Panel and Operating Elements



Keyboard

By pressing the on / off key the device is switched on / off.

Via scroll keys the cursor is placed.

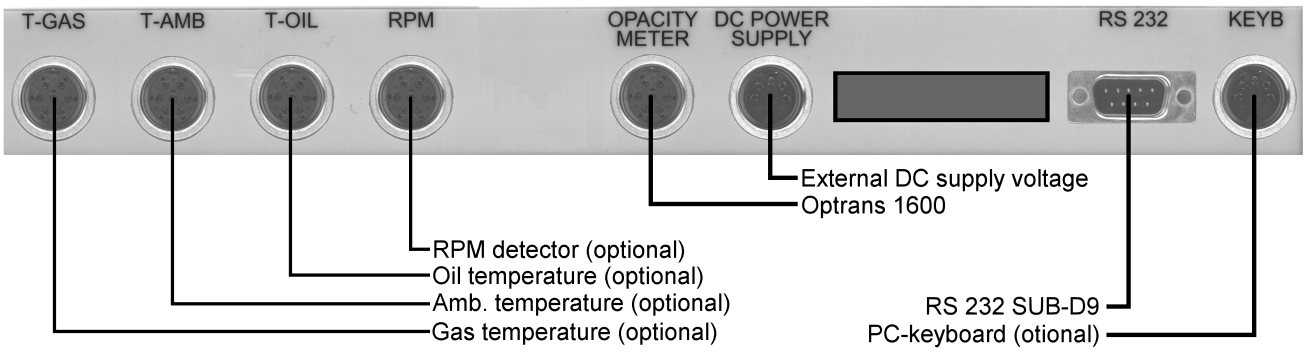
Via enter / confirmation key the selected menu item is activated.

The function keys F1, F2, F3, F4 allow a direct access to the program modules (measuring, deletion, etc.)

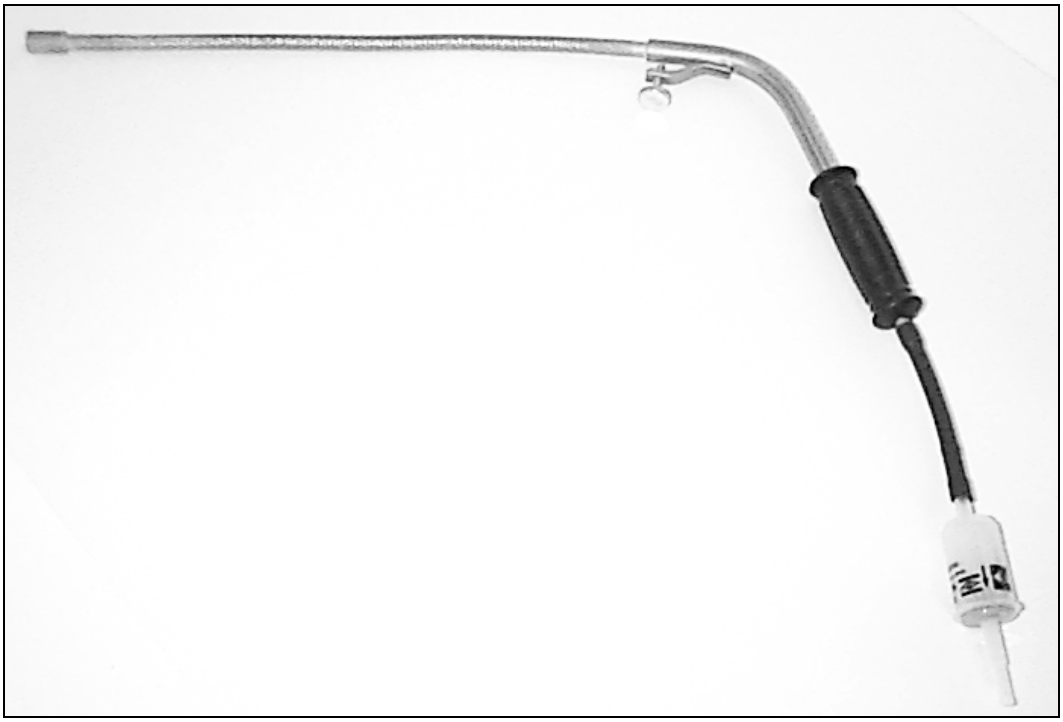
Via illumination key the display illumination is switched on / off. In case of insufficient or lack of power supply, the display illumination is switched off automatically.

By pressing printer key the printing procedure can be started in menus *Exhaust Gas Measurement, Opacity Measurement, Measuring Data Storage, IR Status, Service* or *PIN Administration.*

3.2 Connectors at the front of DELTA1600-L



3.3 Probe DELTA 1600-L with Exhaust Gas Filter



3.4 Prerequisite Conditions for Measurement

A perfect exhaust gas measurement can only be effected under the following conditions :

- The engine has to be warmed up, e. g. oil temperature > 60 ° C. Carburetor primes (automatic and manual) are not to be activated.
- The exhaust gas line has to be hermetic (for your own security, please observe chapter 2 *Security Advices*).
- The engine must have the ignition adjustment stipulated by the manufacturer.

3.5 Preparation for Measurement

Operation with External Power Supply
In order to effect measurement with the DELTA 1600, it has to be connected to an external power supply.
This can be either a **85..230VAC / 100VA**-source or **12VDC** (e. g. car battery).
Optionally, when using a DC converter 24VDC/12VDC, a 24VDC / 5A-source can also be used.
For the supply with **85..230VAC /100VA** the delivered helix cable is used, for supply with **12VDC** please use the cable of the cigarette-ignitor plug.
The power supply needed for DELTA 1600-L is relatively high. A fully charged car battery with 36 Ah can supply the DELTA 1600-L with the needed power **for max. 4 hours**.
As soon as the battery power decreased, the **battery symbol** appears in the upper right corner of the display.
In order to avoid a **total discharge**, DELTA 1600 switches off automatically in time.
As soon as the DELTA 1600 is connected to another power supply source, the **warm-up time of 5 minutes** has to be respected for further measurements.

Operation Temperature of DELTA 1600-L
Below +5°C and above +40°C , measurements are not possible with this device.

Exhaust Gas Filter
DELTA 1600-L is equipped with an exhaust gas filter in front of the probe handle. For replacing this filter, remove the tube connection carefully. The filter pollution can be controlled optically
. ***white = ready for operationdark = replacement necessary***

Condensate Trap
Please position the side condensate container with the filter vertically. Please check, whether the condensate trap is **empty** and the filter is still **white**.
. ***white = ready for operationdark = replacement necessary***

Built-in Filter (with Option Gas Cooler)
There is a built-in filter at the front plate of the device body (optionally). For replacing the filter insert, please unscrew the bell from the basic body. The filter pollution can be controlled optically. Please check, whether the filter is still **white.**
. ***white = ready for operationdark = replacement necessary***

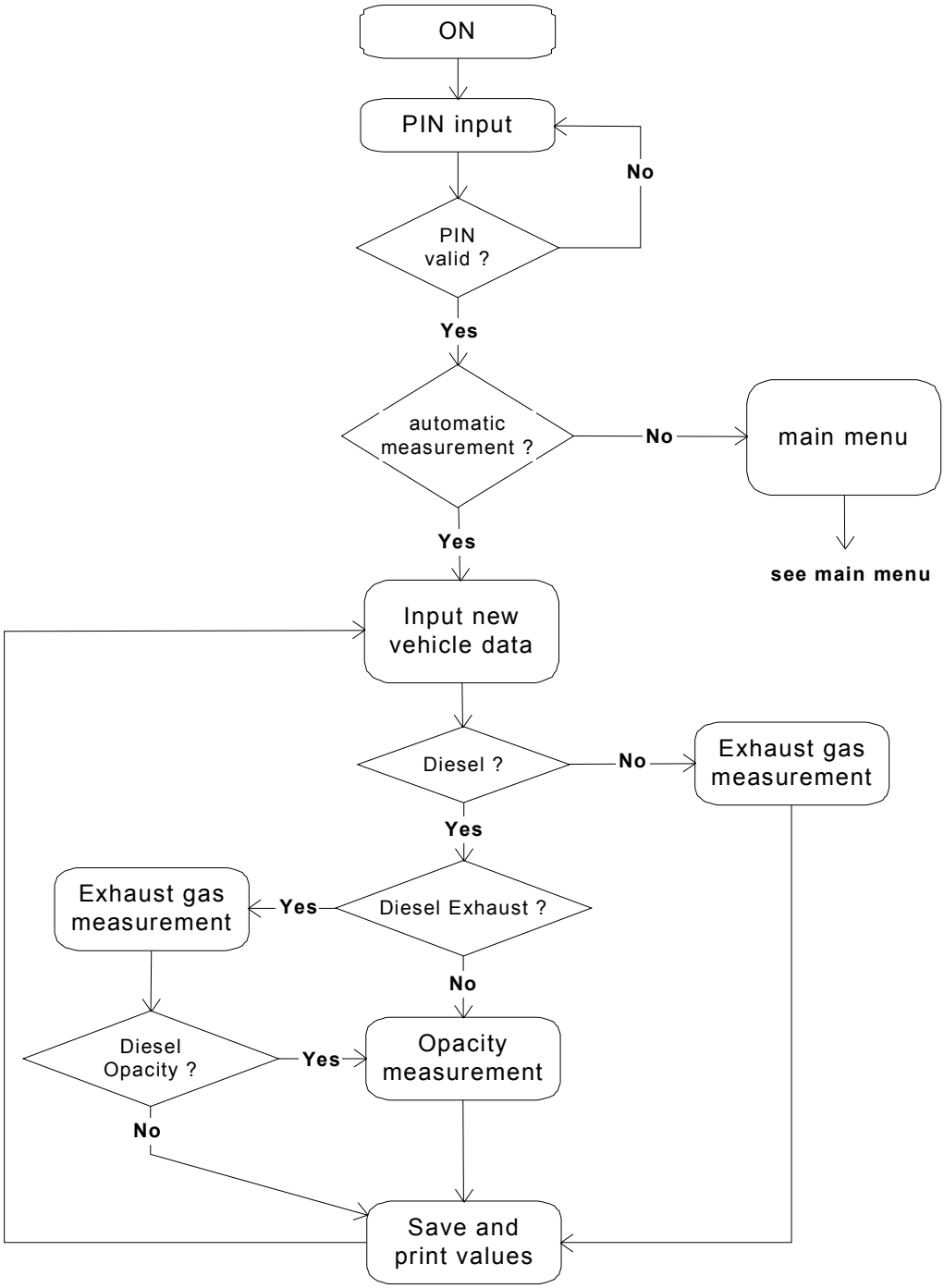
Probe Heating Tube (Option)

The heating tube shall only be used, if the outside temperature is very low (starting with temperatures below zero). Otherwise, please use a Viton tube (MRU-N° 55640) of the corresponding length.

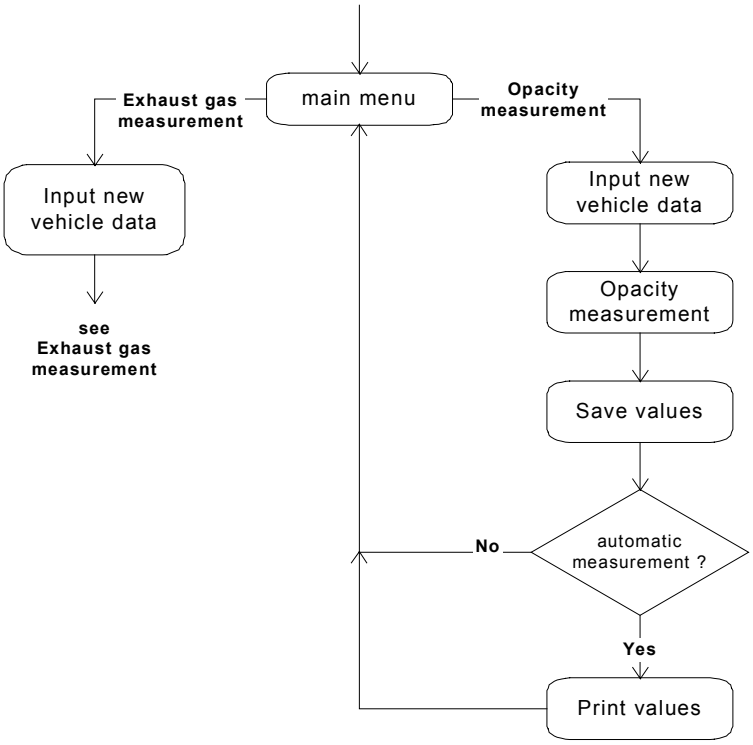
Connections and Tightness
Please check all plugged and screwed connections regarding their tight fit. Check all tubes, tube connections and condensate traps (from probe tube to gas connection at the device) regarding their tightness.

3.6 Functional flow charts (schematic description)

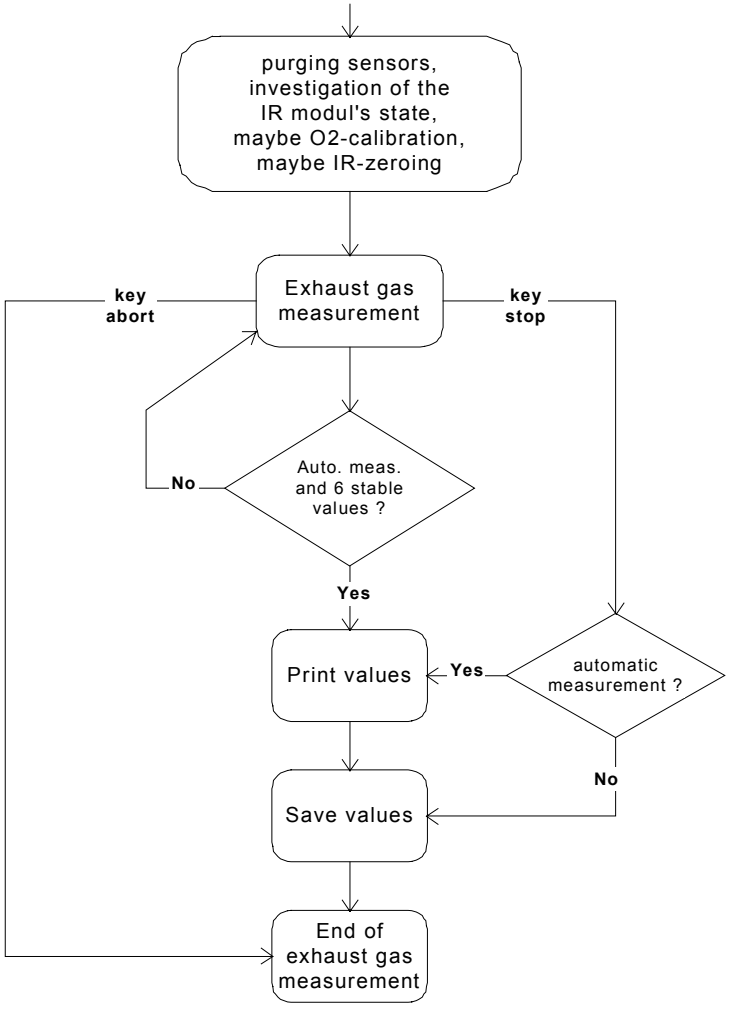
Automatic measurement



Main menu



Exhaust gas measurement



3.7 Functional Course of Exhaust Gas Measurement

1. **Switch on the measuring device DELTA 1600-L** : Press key **ON**.
2. **Warm-up stage** of the infrared measuring unit : the time needed depends on the ambient temperature and is about 5.....15 minutes (indication in seconds in the upper right corner of the display).
3. **Calibration :** calibration has to be effected at ambient air. Fresh air is conducted to the device by a 2/3-way valve during calibration (**zero point adjustment**).
4. Insert the probe into the exhaust pipe and suck exhaust gases.
5. Through a heated gas tube, the exhaust gas is conducted to the sensor modules (only with cold temperatures. Otherwise a special Viton tube should be used !)
6. Evaluation of the sensor data is effected by the micro processor.
7. The values are shown in the display.

3.8 Functional Course of Opacity Measurement

1. The connection between **Optrans 1600** (terminal RS 232) and **DELTA 1600-L** (terminal OPACITY METER) has to be effected via the MRU transmitter cable.
2. **Switch on the DELTA 1600-L** : press **ON** key.
   Connect Opazimeter **Optrans 1600** to the power supply.
3. **Warm-up stage** of **Optrans 1600** : time needed depends on the ambient temperature.
4. **Calibration :** the calibration has to be effected at ambient air (time needed : about 2 min.)
5. After finishing the warm-up stage and the calibration, the probe of the **Optrans 1600** is inserted into the exhaust pipe.
6. Give three gas ejection's up to the dam-in revolutions (at least 10 sec. break between them).
7. The exhaust gas is conducted to measuring bulb via a gas sampling tube.
8. The micro processor calculates three maximum values of clouding and their average.
9. The measured values are transferred from the **Optrans 1600** to the **DELTA 1600-L** via the MRU transmitter cable
10. The values are shown in the display .

3.9 Sensory

The measuring device is equipped with a high-quality infrared measurement unit.
O_2 and **NO** are measured via electrochemical sensors.
Avoiding transverse strain sensitivity : through software and integrated filters.

3.10 Analysis and Calculation

The emission analyzer DELTA 1600-L is a multi-component analyzer, **which measures continuously:**

CO (carbon monoxide)	[%]	O_2 (oxygen)	[%]
CO_2 (carbon dioxide)	[%]	NO (nitrogen monoxide)	[ppm]
HC (hydrocarbons)	[ppm]		

Simplified Excess Air calculation according to Brettschneider :

$$Lambda = \frac{[CO_2]+[CO]/2+[O_2]+\left(\frac{1{,}7261}{4}\cdot\frac{3{,}5}{3{,}5+[CO]/[CO_2]}-0{,}0088\right)\cdot([CO_2]+[CO])}{\left(1+\frac{1{,}7261}{4}-0{,}0088\right)\cdot([CO_2]+[CO]+K1\cdot[HC])}$$

4 Technical Data

Technical specification DELTA 1600

Measuring ranges:	oxygen	(O_2)	0 - 25,00 % vol
	carbon monoxide	(CO)	0 – 15,00 %
	carbon dioxide	(CO_2)	0 – 20,0 %
	carbon hydride	(HC)	0 - 20000 ppm n-hexane
	nitrogen monoxide	(NO)	0 - 2000 ppm
	Excess Air		calculated according to Brettschneider
	temperature		-40 ... +650°C
	rounds per minute		400 ... 10000 U/min
Precision:	oxygen (O_2)		+/- 0,1 % or +/- 3%
	carbon monoxide (CO)		+/- 0,06 % or +/- 5% of measured value
	carbon dioxide (CO_2)		0,5 % or +/- 5% of measured value
	carbon hydride (HC)		+/- 12 ppm or +/- 5% of measured value
	nitrogen monoxide (NO)		+/-5 ppm or +/- 5 % of measured value
	temperature		+/- 1%(T<150°C) +/ 2%(T<250°C) +/-3%(T>250°C)
	rounds per minute		+/- 1%
Resolution:	oxygen (O_2)		0,01 %
	carbon monoxide (CO)		0,01 %
	carbon dioxide (CO_2)		0,1 %
	carbon hydride (HC)		1 ppm
	nitrogen monoxide (NO)		1 ppm
	temperature		0,1°C
	rounds per minute		1U/min (<6000) or 10U/min (>6000)

Response time T_{95} : 15s

Mains supply: 110 - 230 V 50 / 60 Hz or 12 V dc (car battery or ciga jack)

Power consumption: max 100 VA

Warm-up time of Infrared measurement unit: at least 5 minutes, depending on operating conditions

Operating conditions: temperature : +5°C....+40°C
humidity : 0 - 90 % v H (not condensing)

Display: 8-line big-display, illuminated

Standard accessories: flexible probe, length 400 mm; (temp. approx. 50°C), case

Tubes: black Viton tube, optionally for heating tube

Case: robust aluminium case with swing-out front
Dimensions case: 560 x 330 x 215 mm
Dimensions device: 540 x 280 x 135 mm
Weight : 14,5 kg
System of protection: IP 21

Options: Gas cooler, heated gas sampling tube 1,5m, motor speed transmitter with revolution impulse converter, PC keyboard for text input, device heating (for operation below +5° C), NO measurement, oil temperature measurement, gas temperature measurement, air temperature measurement.

5 Storage

If the below mentioned points should not be respected, **DELTA 1600-L** can be damaged by **complete discharge of battery** and **oxidation inside the device**.

5.1 Operational and Storage Temperature

Operational Temperature : +5° to +40°C

Device cannot be switched on with inside temperatures below 0°C !! (e. g. through storing in boot over night)

Storage Temperature : -20°C to +60°C.

5.2 Maintenance of the Battery

For Non-operation and Storing:

1. recharge battery on mains power supply **once a week** for at least **12 hours** or via automatic switch 0,5 hours daily.
2. store in dry place.

6 Operation

6.1 Start of Device

Press key **ON** , and the display will show the MRU logo for a few seconds :

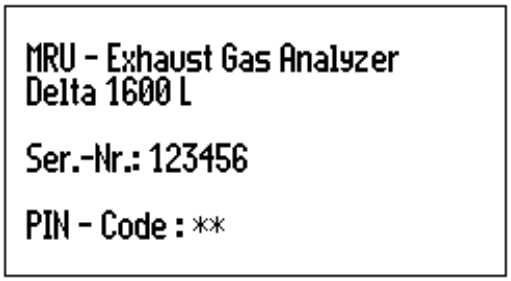
6.2 Switch off the device

Press key (ON/OFF) and the device is saving the configuration. After this, the power down mode is counting downwards from 120 seconds up to zero. From 30 seconds the device is alarming up to 0 seconds.
By pressing the keys F1 an F4 the device is switching off immediately without saving any configurations. *(emergency shutdown)*

6.3 Input of PIN code

If the demand of PIN codes as been deactivated (see chapter 6.12 **PIN Administration**), this point is dropped and the device directly enters to the main menu.

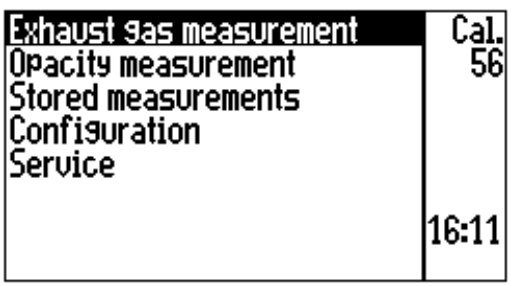
The following window is displayed:



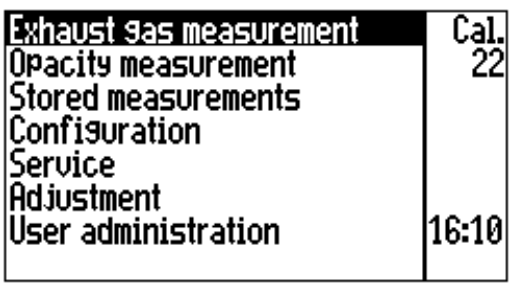
Please enter your 6-digit PIN code to log in. If a wrong PIN code is entered, the device needs 20 seconds until the next attempt can be started. The waiting time doubles after each unsuccessful attempt (so 20, 40, 80 sec. etc.). For further information on **PIN codes** (see chapter 6.11 **PIN Administration**).

6.4 Main Menu

After successful log-in, the main menu appears. If the setting *Automatic Measurement* is activated (see chapter **6.8 Device Configurations**), the device directly enters the window *Input Vehicle*.
If the user is the administrator (see chapter **6.11 PIN Administration**), the main menu contains two more lines than for the standard user.



Standard User



Administrator

Operation :

- *Scroll Keys* : selecting menu items
- *Enter* : confirmation of selected item
- *Print* : print a blank line (e. g. a printer test or for paper feed)
- *Info* : show information regarding the device

6.5 Calibration and Warm-Up Stage

As long as the infrared measurement unit is in the warm-up stage, in the main menu and in the window *New Vehicle* first the indication **Cal.** and later the indication **Cal. 240** appears (i. e. the remaining warm-up time is about 240 seconds). This time indication is updated app. Every 8 seconds.

During the calibration and warm-up stage, no adjustment and no exhaust gas measurement can be effected. However, you can use the calibration time for preparation of the measurement by inserting the vehicle data. If during the calibration and warm-up stage you would like to change from the vehicle input to the exhaust gas measurement, the following is displayed :

Infrared Measurement Unit not ready yet ! (warm-up stage)

Calibration not finished yet !

The time needed for the calibration and warm-up stage can differ. Among other, it depends on the ambient and inner temperature of the device. I. e. generally spoken it is shorter, if the device has not been switched off for a long time, as the inner temperature still is relatively high.

Reaching the end of the calibration and warm-up stage, the following messages are displayed :

O2 Sensor Adjustment Please wait...

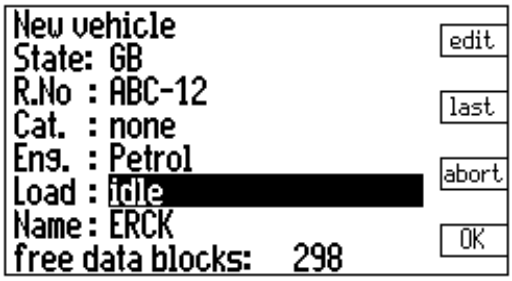
Measuring Unit Zero Point Adjustment Please wait ...

Calibration finished All sensors ready Device ready for measurement

Now you can start with the measurements.

6.6 Exhaust Gas Measurement

Select in the main menu the item ***Exhaust Gas Measurement*** via Scroll Keys and confirm with Enter Key, the following window appears :



Before getting to the gas measurement itself, you have now the possibility to enter the following data regarding the vehicle :

- State : selection from a list of international vehicle country abbreviations (pre-setting GB = Great Britain)
- R.No : the license plate number can be inserted
- Cat. : catalytic converter, selection from none / open-loop / comp. controlled (pre-setting: none)
- Eng. : engine, selection from petrol, diesel, two-stroke (pre-setting : petrol)
- Load : selection from idle, under load, double-speed-test-method (see chapter **6.6.1**)

In the last two lines, you can see the name of the presently logged-in user as well as the number of free data blocks, i. e. the number of measurements that still can be archived in the data storage.

I you select *Diesel* and the setting *Exhaust Diesel* is not activated, you will not reach the exhaust measurement but the opacity measurement by pressing *OK* (see chapter 6.8 Device Configurations).

Operation :

- *Scroll Keys Up / Down* : move cursors to country, N°, cat., eng., or pow.
- *Scroll Keys Left / Right* : modification of country, cat., eng., or pow.
- F1 *Text* : insertion of the license plate number (see chapter 6.12 Insertion of Text)
- F2 *Last* : take over of data of the last entered vehicle
- F3 *Cancel* : back to the main menu
- F4 Key *OK / Enter :* end input, save and start measurement

During the calibration and warm-up stage, the indication **Cal. 240** for example is shown in the display. You cannot enter the measuring (see chapter 6.4 Calibration and Warm-Up Stage).

When starting the exhaust gas measuring process, first the following message appears :

Determination
Status of
Measuring Unit

Please wait ...

The device checks, if a new zero point adjustment is necessary and if yes, it will be effected. Afterwards, the following messages are displayed :

Rinsing Measuring Unit
Please wait...

Time needed max. 5 min.
Cancel with key

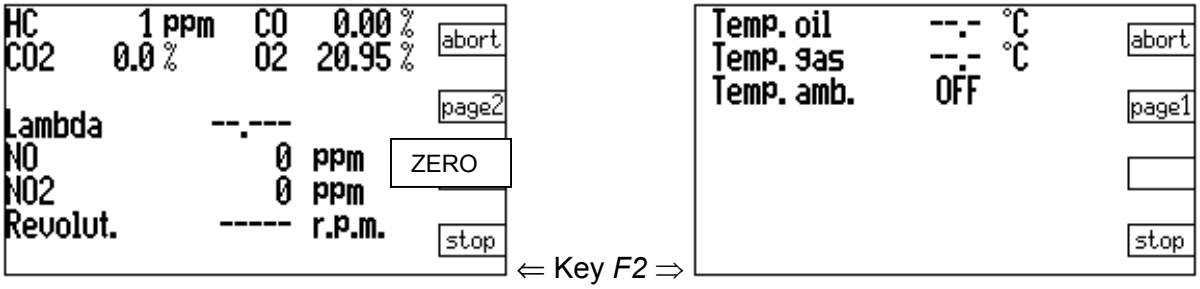
Measuring Unit
Zero Point Adjustment

Please wait ...

O2 Sensor Adjustment

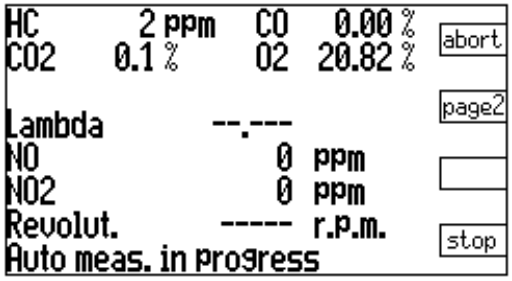
Please wait...

Now you are entering the Exhaust Measuring window :



page 1 ⇐ Key *F2* ⇒ page 2

If the setting Automatic Measurement is activated (=ON), this will be shown to you in the last line of page 1 :



If on the first page „ZERO“ is flashing, the IR-mdule has requested a new zero point calibration.

By ressing the F3 key following window appears:

purging sensor
pease wait....
duration
about 1 minute

Operation :

- F1 *Cancel* : quit measurement, values are not saved, back to the main menu
- F2 *p.1 / p.2* : change between page 1 and page 2
- F4 ↵ *Stop / Enter* : end measurement, details see below
- *Print* : present values are printed

What happens after ending the measurement with *Stop / Enter* ?

- you will be back to the main menu, except for an automatic measurement
- if you did effect an automatic measurement, the measured values will be printed and you will be sent directly to the input of the next vehicle
- if you did effect a measurement with a diesel engine vehicle and the setting Diesel-Opaz is activated (=AN), you will be sent directly to the opacity measurement

How does an Automatic Measurement work ?

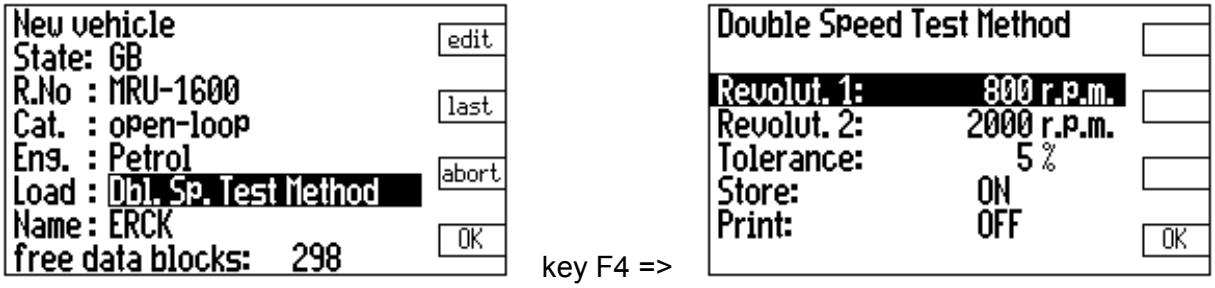
If the setting Automatic Measurement is activated (=ON) see chapter 6.8 Device Configurations), the device DELTA 1600-L watches the measured values during measurement and ends the measurement automatically, as soon as the measured values are stable (as you would, too). Also, when ending the measurement process automatically, the measured values are saved and printed.

6.6.1 Double-Speed-Test-Method (DSTM, resp. 2-point-measurement)

The Delta 1600L offers the possibility to make a combined, automatic double-measurement at 2 different rpm's. The analyzer determines an average for each rpm-value over a period of 30 seconds.

The operator sets the rpm for both measuring segments, as well as tolerance (acceptable ± - deviation from the nominal rpm-value). Further more he decides whether the calculated averaged values are to be saved and/or printed.

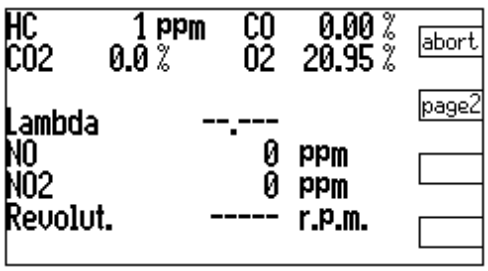
If while entering the vehicle data (see chapter 6.6) the load-method „*Dbl. Sp. Test Method*" is chosen, then the following window (on the right side) will appear after pressing F4 "*OK*":



Operation:

- *Scroll Keys Up / Down*: Move Cursor to Revolut. 1/2, tolerance, Store, Print
- *Scroll Keys Left / Right*: changing of Revolut. 1/2, tolerance, Store, Print
- F4 *OK / Enter*: end input, save and start measurement

After entering the options F4 „OK" will lead you to the measuring window where you can see the status of the 2-point-measurement (DSTM) below the measurement values:

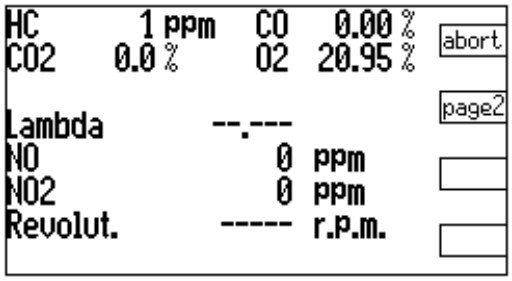


In the last line you can see the remaining time until the 30-second-average values are calculated, as well as the preset rpm-range (nominal-value ± tolerance). The seconds-countdown will begin under the following conditions:

- the measurement has been active for at least 15 seconds
- the O_2-value is smaller than 20% (otherwise it couldn't be exhaust gas))
- the measured rpm-value is within the preset tolerance

Should the measured rpm-value be outside of the preset tolerance, you will hear a beep every second.

As soon as the 30-second-average values of the lower rpm-range are calculated, the analyzer prints and/or saves – depending on the settings – the average values. Immediately thereafter the rpm tolerance-range will be changed to the preset, higher values and the measurement will continue:



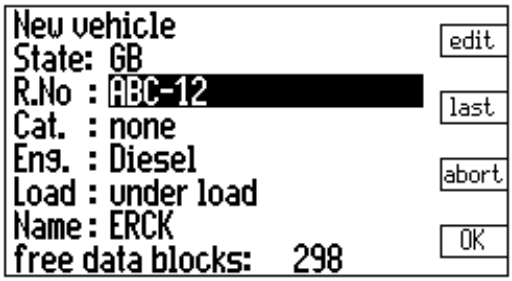
As soon as the 30-second-average values of the upper rpm-range are calculated, the analyzer prints and/or saves – depending on the settings – the average values and stops the measurement.

Note:

By selecting the load method „*Dbl. Sp. Test Method*" the settings „*Automatic measurement*" and „*Continuous measurement*" (see chapter 6.9) will be switched off.

6.7 Opacity Measurement

Please select ***Opacity Measurement*** in the Main Menu with Scroll Keys ▽ △ and confirm with Enter ↵. Afterwards, the following window appears :



Before reaching the opacity measurement itself, you have now the possibility to enter the following data regarding the vehicle :

- State : selection from a list of international vehicle country abbreviations (pre-setting GB)
- R.No : the license plate number can be inserted
- Cat. : catalytic converter, selection from none / open-loop / comp. controlled (pre-setting : none)
- Eng. : engine, selection from fuel, diesel, fuel 2-stroke (pre-setting : fuel)
- Load : selection from idle, under load, double-speed-test-method (see chapter **6.6.1**)

In the last two lines you can see the name of the presently logged-in user as well as the number of free data blocks, i. e. the number of measurements that still can be archived in the data storage.

Operation :

- *Scroll Keys Up / Down* : move cursors to State, R.No, Cat., Eng. or Load
- *Scroll Keys Left / Right* : modification of State, Cat., Eng. or Load
- F1 *edit* : insertion of the license plate number (see chapter 6.13)
- F2 *Last* : take over of data of the last entered vehicle
- F3 *abort* : back to the main menu
- F4 *OK / Enter :* end input, save and start measurement

During the calibration and warm-up stage, you can see in the right upper corner e. g. **Cal. 240**. However, you can start the opacity measurement now.

When starting the opacity measurement, the following is displayed :

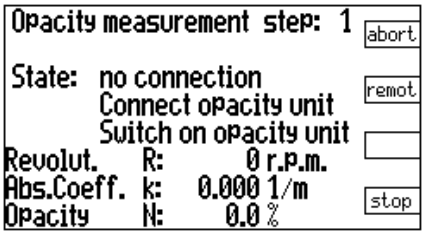


illustration 6.7/1

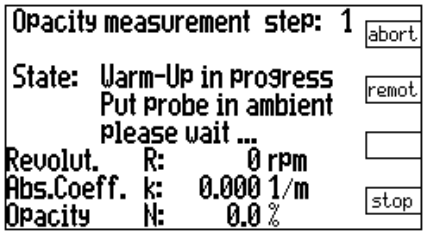


illustration 6.7/2

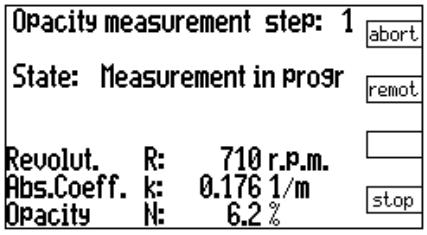


illustration 6.7/3

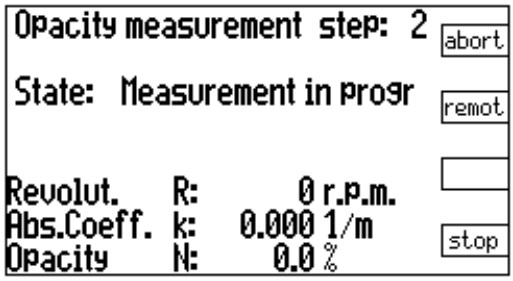
The time needed for the warm-up stage (see illustration 6.6/2) depends on the ambient and inner temperature of the OPTRANS 1600. I. e. generally spoken it is shorter, when the device has not been switched off for a long time, as the inner temperature still is relatively high.

After the warm-up stage the Zero Point Adjustment follows, you will see the following message :

- Zero Point Adjustment -
Probe to fresh air

The Opacity Measurement demands three gas ejections up to the dam-in revolutions. The DELTA 1600-L independently calculates the three maximum values of clouding. Between the gas ejections should be a break of a least 10 seconds.

As soon as the device calculates the clouding value of a gas ejection, the pace indicator in the right upper corner of the display increases (pace 1, 2 or 3) and the measured values are set to zero.



Only as soon as the measured values are updated again (a diesel engine does produce a percentage of clouding even with low idle), you can give the next gas ejection, as the 10 seconds are over now.

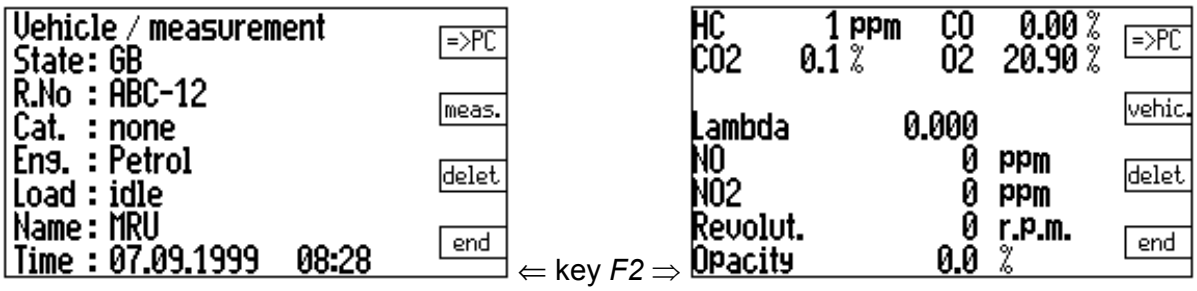
After the third gas ejection, the opacity measuring process is quit automatically and the calculated values are saved. If the setting *Automatic Measurement* is activated (=AN) (see chapter 6.8 Device Configurations), the measured values will also be printed.

Operation :

- F1 *abort* : quit measurement, values will not be saved, back to the Main Menu
- F2 *remote* : take over of the measured values of a OPTRANS 1600 hand-control unit
- F4 + ↵ *Stop / Enter*: end measurement, save values up to now, back to the Main Menu
- *Print* : print values up to now

6.8 Stored measurements

Select with Scroll Keys ⇩ ⇧ the line ***Stored measurements*** and confirm with Enter ↵, then the following windows are displayed :



vehicle data measuring data

First, you will always see the data block saved last. The data blocks are arranged chronologically in the Measuring Data Storage.

Operation :

- ⇧ ⇩ *Scroll Keys Up / Down* : change to next newer / older data block
- F1 *=>PC* : transfer measurement data to PC (see chapter **6.8.1**)
- F2 *Mes. / veh.* : change between vehicle data and measuring data

-  *Delete* : only Administrator : delete measuring data blocks (see chapter **6.8.2**)
-  *End / Enter*: quit window, back to the Main Menu
-  *Print* : start print (see chapter **6.8.3**)

In the Measuring Data Storage you will find saved measuring data blocks, which are consisting of vehicle data and measuring data. The user who has effected the measurement, the date and the time of the measurement are also saved.

The data blocks can be printed and / or be transferred to a PC. The Administrator can also delete data blocks.

The device is equipped with a limited data storage with a standard configuration of **100 vehicle / measuring data blocks** (optional 300). When entering a new vehicle, the number of free storage locations is always indicated.

If now more remaining free data blocks are left (free data blocks : 0), it is nevertheless possible to effect and save further measurements, however, the new data block will overwrite the oldest one.

If all space is about to be occupied, we recommend the following procedure :

- Save all data blocks (either all or the oldest ones up to a certain date) by printing or transferring them to a PC.
- Delete the data blocks after saving them as above mentioned, as they are no longer needed in the Measuring Data Storage of your DELTA 1600-L..

6.8.1 Transfer of stored measurements to PC

Press key *F1 =>PC* in the window *Stored measurements*. Now the device asks you, if you would like to transfer all data blocks or only the presently visible one :

Transmission of Vehicle and and Measuring Data to PC F1: present data block F2: all data blocks

After selecting F1 or F2, the data is outputted via the serial interface. In normal writing, the data is outputted the same way as it would appear by printing it.

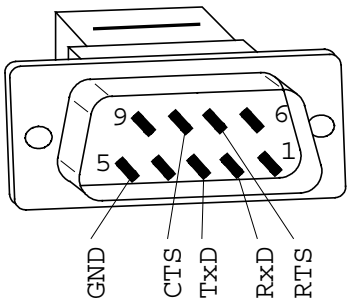
Three reasonable receivers are :

- A standard terminal program (terminal adjustment ANSI) which runs on a PC or notebook and which can save the received data. Afterwards, the data could be outputted e. g. on the PC printer or be filtered with a macro of a chart calculation.
- A serial printer.
- A purpose-made PC program for this data format, which processes the data at will.

Procedure :

- The data transmission cable is **not** to be connected while measuring device and PC are switched on!
- Connect the data transmission cable to the R 232 interface.
- The necessary connections on the MRU measuring device as will as on the PC have to be fixed **before** transmission.

Transmission modalities and assignment of the 9-pin SUB-D standard plug for RS232 :

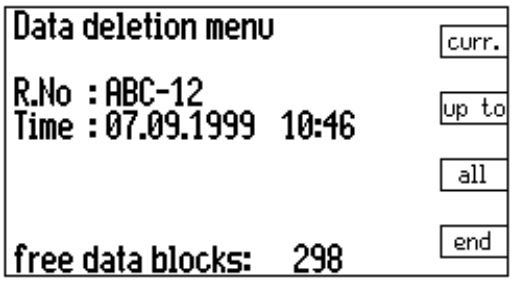


2 = RxD input	baud rate : 9600
3 = TxD output	parity : none
5 = GND ground	data bits : 8
7 = RTS ready for transmission	stop bits : 1
8 = CTS ready for receipt	Handshake: none

6.8.2 Delete Stored measurements

Only the Administrator can delete data blocks.

Press key *F3 Delete* in the window *Stored measurements*, the following window appears :



Operation :

- *Scroll Key Up* : change to the next newer data block
- *Scroll Key Down* : change to the next older data block
- F1 *curr.* : delete data block presently visible (return question)
- F2 *up to* : delete all data blocks from the oldest one up to the visible one (return question)
- F3 *all* : delete all data blocks (return question)
- F4 *end / Enter* : quit window, back to the Main Menu

Return question :

When deleting, the device will ask you to make sure that you are willing to delete :

You are about to delete the present data block ! F1: cancel F2: continue	You are about to delete data blocks up to the present one ! F1: cancel F2: continue	Caution ! You are about to delete all data blocks ! F1: continue F2: cancel

The keys F1 and F2 are chosen in a way, that a double click by mistake does not provoke data loss.

If you confirmed the continuation of data deletion, the device informs you, how many data blocks have been deleted, e. g. :

13 data blocks deleted !

After this information, you will be back to the Main Menu.

6.8.3 Print Measuring Data Storage

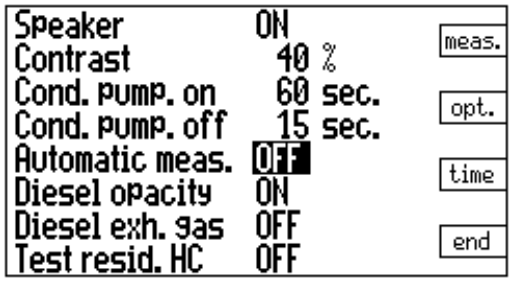
Press Printer Key in the window *Measuring Data Storage*. The device now asks you, if all data blocks or only the presently visible one should be printed

Print-out of vehicle and measurement data F1: current data block F2: all data blocks	And if you chose all data blocks with F2 ⇒	Print-out of all data blocks may take some minutes ! F1: continue F2: cancel

After selection F1 or F2, the data will be printed.

6.9 Configuration

Select menu item ***Configuration*** via Scroll Keys and confirm with Enter, then the following window appears :



Operation :

- *Scroll Key Up / Down* : move cursor
- *Scroll Key Left / Right* : change selected item
- F1 *meas.* : change average valence during measurement (see chapter **6.9.1**)
- F2 *opt.* : show device options (see chapter **6.9.2**)
- F3 *time* : set clock (only Administrator, see chapter **6.9.3**)
- F4 *End / Enter* : quit window, back to the Main Menu

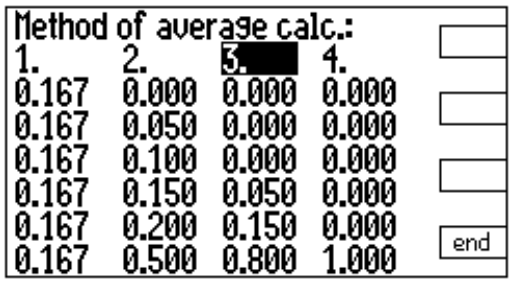
Configuration	Possible Values	Definition
Speaker	ON / OFF	beep with key press on / off
Contrast	0, 5, 10 ... 100 (%)	adjustment of the display contrast
condens. pump on	15 ... 60 (sec.)	period of condensate pump activity
condens. pump off	15…300(sec.)	break between condensate pump activities
autom. Measurem.	ON / OFF	automatic measurement on / off
diesel opac.	ON / OFF	opacity measurement of diesel vehicles on / off
diesel exhaust	ON / OFF	exhaust gas measurement of diesel vehicles on / off

Diesel Opacity and Diesel Exhaust :

These two items select, which measurement should be effected. The not reasonable adjustment of both items off is not admitted by the device. If diesel exhaust is ON, after the input of the data of a diesel vehicle, first an exhaust gas measurement is effected. If diesel opacity is ON, afterwards also an opacity measurement will be effected. If diesel exhaust is OFF, only the opacity measurement will be started.

6.9.1 Average Value Valence

By pressing *F1 meas.* in the window *Configuration*, the following window appears :



The adjustment of the average value valence influences the exhaust gas measuring process. You have the choice between calm indication, short T90 or compromises in-between.

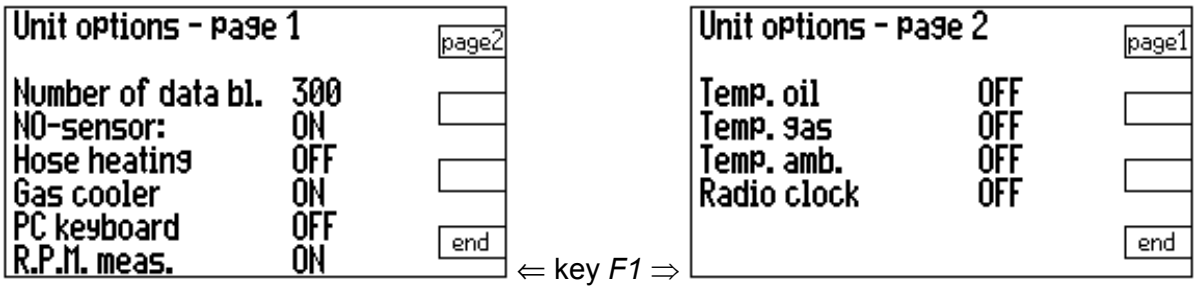
1	arithmetic average of the last 6 values	very calm indication	very long T90
2	valence average of the last 5 values	relatively calm indication	long T90
3	valence average of the last 3 values	calm indication	short T90
4	only last value, no valence	normal indication	very short T90

Operation :

- *Scroll Keys Left / Right* : move cursor and change adjustment
- F4 *end / Enter* : quit window, save selection, back to *Adjustments*

6.9.2 Options

By pressing *F2 opt.* in the window *Configuration*, the following windows appear :



A list of all possible device options and which are available in your device will be shown. However, you cannot switch them on or off.

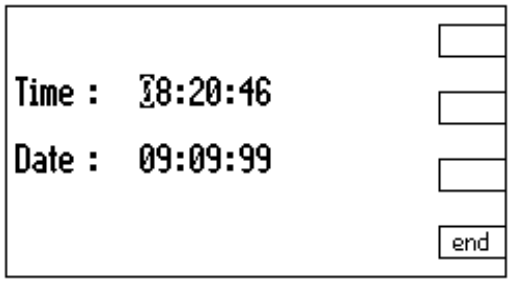
Operation :

- F1 *page 1 / page 2* : change between page 1 and page 2
- F4 *end / Enter* : quit window, back to *Adjustments*

6.9.3 Set Clock

Only the Administrator can set time and date of the clock, other users can only view time and date.

By pressing the key *F3 time* in the window *Configuration*, the following window appears:



Operation :

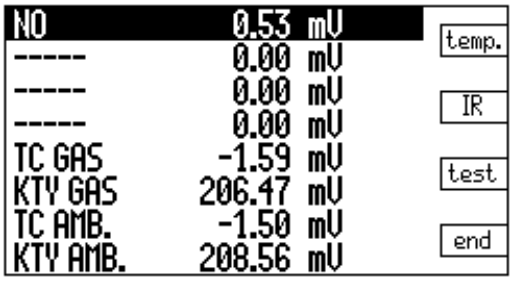
- *Scroll Key Up / Down* : change figure selected by cursor
- *Scroll Key Left / Right* : move cursor
- F4 *end / Enter* : quit window, save time and date setting, back to *Configuration*

You can never set a time or date (not even during the adjustment process) which does not exist, example :

the month is 05 and should be changed to 10. It is not possible to increase 0 to 1, as long as the next figure is a 5, as a month 15 does not exist. First, 5 should be decreased to 0, then 0 increased to 1.

6.10 Service

Select in the Main Menu via Scroll Keys menu item ***Service*** and confirm with Enter, then the following window appears :



In the Service window, the momentary analogue values of the DELTA 1600-L in mV are shown. Normally, the user of the analyzer does not need this information. However, it means a lot to a trained service technician. It may be possible, that you will be asked regarding these values on the phone in case of a problem.

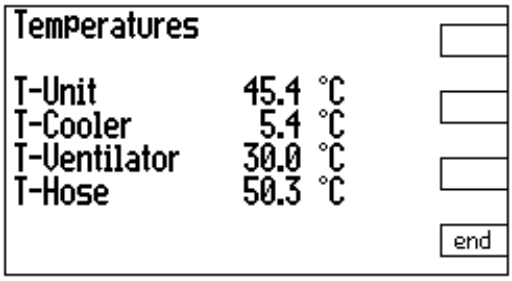
There are more analogue values than can be displayed in one window. Therefore, the values move up or down, when moving the cursor beyond the top or bottom line (*scrolling*, the same procedure as in word processing on a PC).

Operation :

- *Scroll Key Up/ Down* : move cursor up or down (*scroll*)
- F1 *temp.* : to the window *Service Temperatures* (see chapter **6.10.1**)
- F2 *IR* : to the window *State of the infrared modul* (see chapter **6.10.2**)
- F3 *test* : to the window *Test functions* (see chapter **6.10.3**)
- F4 *end / Enter*: quit Service window, back to the Main Menu
- *Print* : start print of Service

6.10.1 Service Temperatures

By pressing the key *F1 temp.* in the *Service* window, the following window appears :

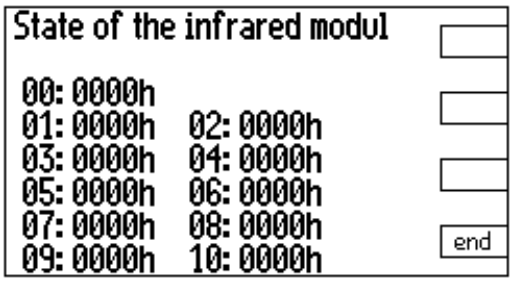


Operation :

- F4 *end / Enter*: quit window, back to the Service window

6.10.2 State of the infrared modul

By pressing the key *F2 IR* in the *Service* window, the following window is displayed :



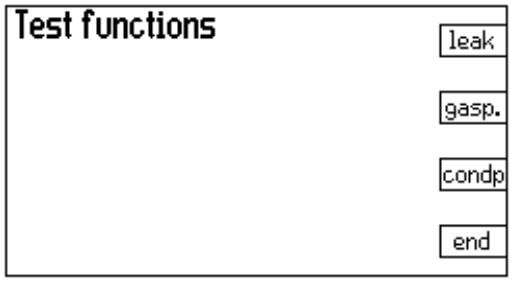
In the window *State of the infrared modul* the momentary state of the IR modul is shown in hexadecimal order. If all 11 values are 0000h, the modul is all right, calibrated and the warm-up stage is over. Normally, the user of the analyzer does not need this information. However, it means a lot to a trained service technician. It may be possible, that you will be asked for these values on the phone in case of a problem.

Operation :

- F4 *end / Enter*: quit window, back to the *Service* window
- *Print* : start print IR status

6.10.3 Test functions

By pressing the key *F3 test* in the window *Service*, the following window will be displayed:



Operation :

- F1 *leak* : start the leak proof test (see below)
- F2 *gasp.* : gas pump on / off
- F3 *condp* : condensate pump on for a short time (switches off automatically)
- F4 ↵ *end / Enter*: quit window, back to the *Service* window

Leak proof test

The leak proof test checks the gas line system of your DELTA 1600-L regarding leakages. The internal gas pump produces low pressure. The pressures decrease during 10 seconds will be measured and should not exceed 5 %. When pressure decrease exceeds 10 % and more, a serious leakage is present.

After starting the test with key *F1 leak*, the device will ask you to wait for a moment (zero point adjustment of the pressure sensor). Then the following message appears :

Please put
the leak proof cap
on the probe.

Then press Enter

Plug in the hermetic test cap on the probe top and press any key. The following messages will appear on the display one after the other :

Generating slight vacuum...

⇓

Please wait a moment...

⇓

pressure loss in 10 sec...

If the gas line system in your DELTA 1600-L is hermetic, the result could be as follows :

Leak proof test

Loss: 1.1 %

System tight!

Remove leak proof test cap!
115.9 mbar

With a loss between 5 and 10 %, the result is **system slightly leaky**, and with a loss of more than 10 % **system leaky.**

Please remove now the cap of the probe top. The device controls pressure and waits for its decrease (removal of cap).

6.11 Adjustment

Caution : The adjustment should only be done by especially trained staff !

Operation mistakes during adjustment may cause malfunction of the device !

Only the Administrator can enter the Adjustment Menu.

Select menu item ***Adjustment*** in the Main Menu with Scroll Keys and confirm with Enter.

A warning return question first appears, asking you, if you are willing to enter the Adjustment Menu. After confirmation with the key F1, you can enter the Adjustment Menu.

For further information, please consult the Adjustment and Service Instructions of the DELTA 1600-L.

6.12 User administration

In order to protect the device against unauthorised entry, but also in order to record, which authorised person effects measurements, the users have to log in with a 6-digit PIN-code. Up to 12 operators can be saved.

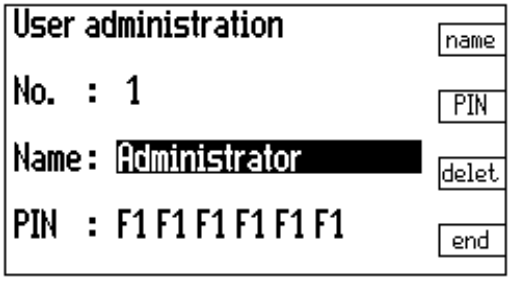
User N° 1, the so-called **Administrator**, has a special status with extended authorisations :

- start menu item Adjustment
- start menu item PIN Administration
- delete saved measurements
- set system time of device

If the PIN-code of the Administrator is F1-F1-F1-F1-F1-F1 (state of delivery), the PIN-code log-in is deactivated, i.e. the device does not ask for a PIN-code and every user has Administrator authorisations.

If the Administrator forgets the respective PIN-code, an **Emergency** respectively **Service PIN** can be entered, which furnishes the user with Administrator authorizations. *However, when entering with the Emergency PIN, all user names and PIN codes will be deleted*. In that way, a misuse of the Emergency PIN code will not stay unnoticed. You will receive the Emergency PIN-code together with the other documents with delivery of the device.

Select in the Main Menu the menu item **User administration** with the Scroll Keys and confirm with Enter, then the following window appears :



Operation :

- Scroll Keys : change of users 1-12
- *name* : input of name (see chapter **6.13**)
- *PIN* : input of PIN-code of the selected user
- *delete* : deletion of the user currently shown on the display.
- *Enter* / *end* : quit, save and back to the Main Menu
- *Print* : print user list including names and Pins (secret document!)

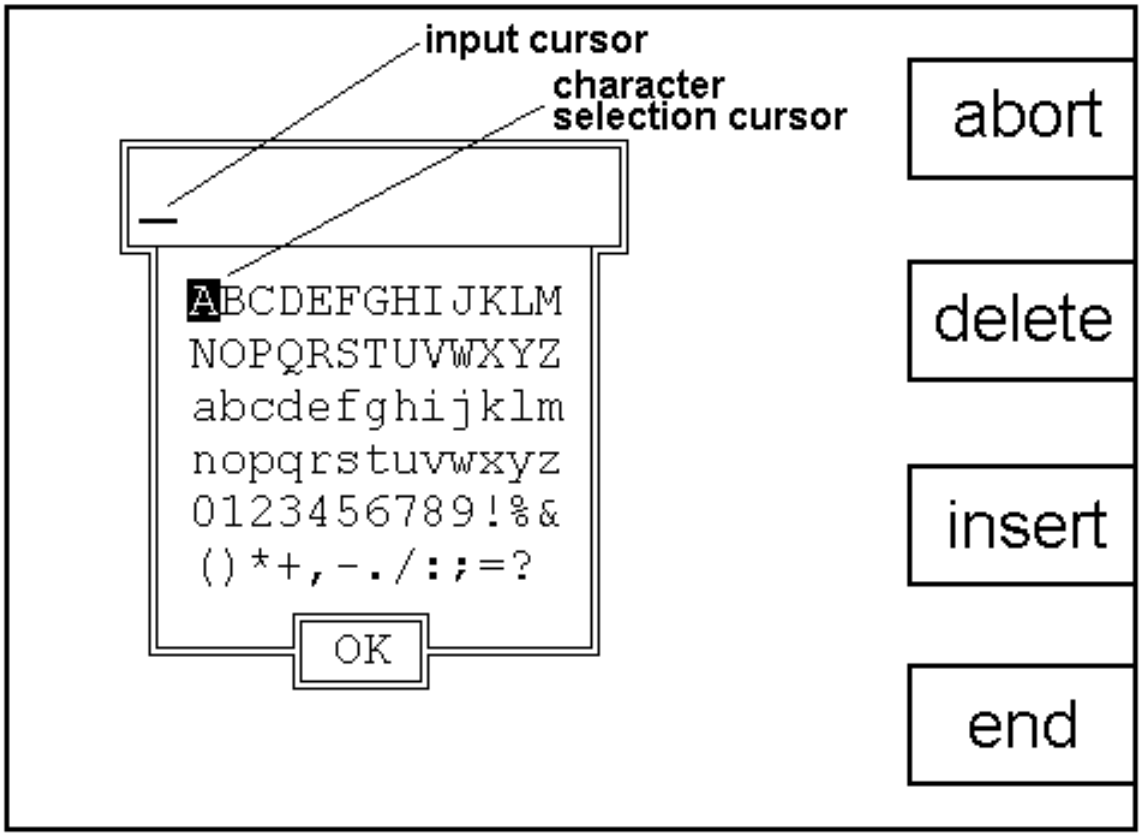
All keys except for ON can be used for PIN codes.

The following abbreviations are used for the indication of the PIN-codes on the display :

= PR	= EN	= LT	= HP
= F1	= F2	= F3	= F4
= LE	= UP	= RI	= DN

6.13 Insertion of Text

Various operations demand an insertion of text. Therefore, the window *Insertion of Text* is shown in the foreground of the actual screen :



A chain of letters with up to 15 items can be inserted. The insertion is effected in the mode *overwrite*.

Operation :

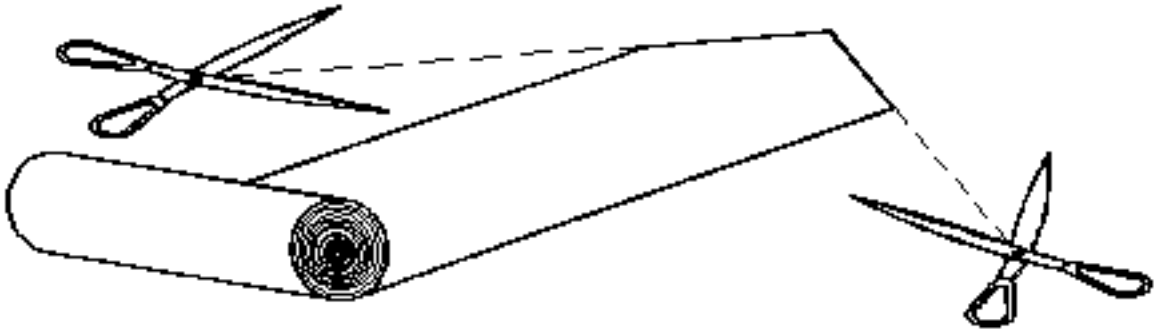
- Scroll Keys : move of the item cursor or of the insertion cursor (when no item cursor is visible)
- F1 Key *Cancel* : end input, cancel changes
- F2 Key *Delete* : delete item above insertion cursor
- F3 Key *Insert* : insertion of a blank
- F4 Key *End* : end input and save changes
- Key *Enter* : insert item of the item cursor

If the option PC keyboard is available, the input of text in the insertion window can be affected in the usual way – similar to PC.

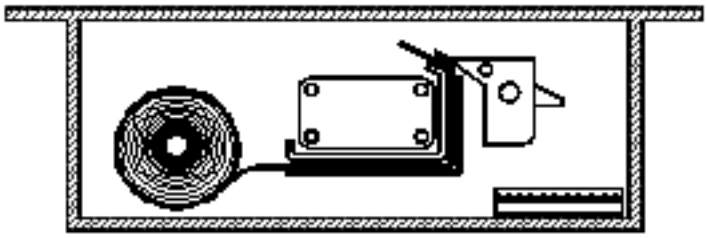
7 Printer

7.1 Insertion of Paper Feed

1. Cut beginning of the paper roll in a pointed way (see drawing)



2. Insert paper roll (see drawing)



3. Pull paper through printer cover.

7.2 End of Paper Roll

The end of the paper roll is indicated through a red or black stripe on the right / left paper side. Now, approx. 0,5 m of thermo paper are left.

7.3 Paper Jam

In case of paper jam, please **switch off device immediately** and remove superfluous paper.

8 Errors and Solutions

Error / Problem	Possible Causes	Possible Solutions
filter does not work failure of sensors failure of pump	dirty and / or wet filters outside or inside !	Check resp. replace filters white = O.K., dark = replace it New filters are cheaper than new sensors or pump.
During operation, the device does no longer react on input of the user, without visible cause. Device can even not be switched off	Software does not work. Maybe software error or micro processor could not work correctly due to EMV exceeding the CE limits	Press simultaneously keys F1 and F4 (= Reset)
After switching on, the device behaves without control, e. g. pumps are switched on and off, display shows strange things,, e. g. change between MRU logo and black screen, beeper is activated, printer is activated, etc. Device can even not be switched off.	Condensed humidity has entered the device, caused e. g. a very cold device (over night in the car in winter time) is switched on in a heated room or filters are too wet or have not been changed for a long time.	Store device possibly in a cold place, and before switching on wait until it has slowly adapted the ambient temperature. Check / change filters Press simultaneously keys F1 and F4 (= Reset)
Data transmission to PC does not work	Wrong cable (no so-called zero modem cable) or cable is not connected from both sides. PC works with Windows and the DOS box did not get a free interface	Correct cable (if possible original MRU cable), connected from both sides. Start Windows in MS-DOS-mode
After switching on, device always indicates : *no external power supply existent*, even though the mains power supply cable is connected.	Receptacle or power supply cable defective Defective fuse	Check resp. change receptacle / power supply cable Change fuse (if defective again right after change, after-sales service)
Printing of the results when ending the measurement is requested, but not achieved.	Automatic Measurement in the Device Configurations is deactivated (= OFF).	Activate Automatic Measurement (= ON).
Printing of the results when ending the measurement is present, but not requested.	Automatic Measurement in the Device Configurations is activated (= ON).	Deactivate Automatic Measurement (= OFF).
When trying to start the exhaust gas measurement of a diesel engine vehicle, the device enter the opacity measurement.	Diesel Exhaust in the Device Configurations is deactivated (= OFF).	Activate Diesel Exhaust (= ON).

9 Maintenance and Servicing

9.1 Cleaning and Maintenance

1. Occasionally : cleaning of probe and probe tube.
2. After every measurement : remove gas sampling tube from device, so that the tube can get dry.
3. Grease connection nipple, so that the O-rings stay supple.
4. In case of non-operation, recharge battery **every week** for at least **12 hours** on mains power supply.
5. Clean and dry or replace dirty and humid filters.
   Filters can be cleaned (rinsed out) and dried up to 5 times.

Recommendation for maintenance : once a year at our works

9.2 Spare Parts List

MRU Order N°	Denomination / technical data	existing in device
power supply:		
10754	device slow to blow fuse 2A	2
18017	power supply cable 230V / 10A	1
11303	battery 12 V / 2,2 P	1
filter:		
11150	filter, fine	3
11165	filter	1
11180	filter spare roll (option gas cooler)	1
11152	activated carbon filter	1
55783	exhaust filter in probe	1
tubes :		
11250	silicone tube 3x2 mm transparent	1 m
51165	silicone tube 2x1 mm transparent	0,5 m
53048	spare parts kit for tube pump	
55640	Viton tube, black, for gas probe	2,5 m
sensors:		
55546	O_2 sensor	1
54904	NO sensor	1
printer:		
55441	paper roll, 80 mm thermo paper, simple	1
55552	paper roll, 80 mm thermo paper, document proof	1

10 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 EUR 250,00 net, cost estimate will be sent general.)

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

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D 74172 Neckarsulm - Obereisesheim

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Fax +49 (71 32) 99 62-20

Internet: http://www.mru.de
E-mail: info@mru.de

11 Packing and Removal

11.1 Return of Packing

- Packing Regulation dated 12.07.1991 -

It is possible to return MRU packing to our factory or our operational staff, if the local recycle does not accept it.

However, please understand, that transport of returned packing material cannot be at our cost.

11.2 Return of Hazardous Waste

- Removal and Return Warranty -

MRU warranties the return of al parts being hazardous waste, which cannot be removed “in the normal way”.

The return has to be effected free of transport charges. Hazardous waste is e. g. sensors.

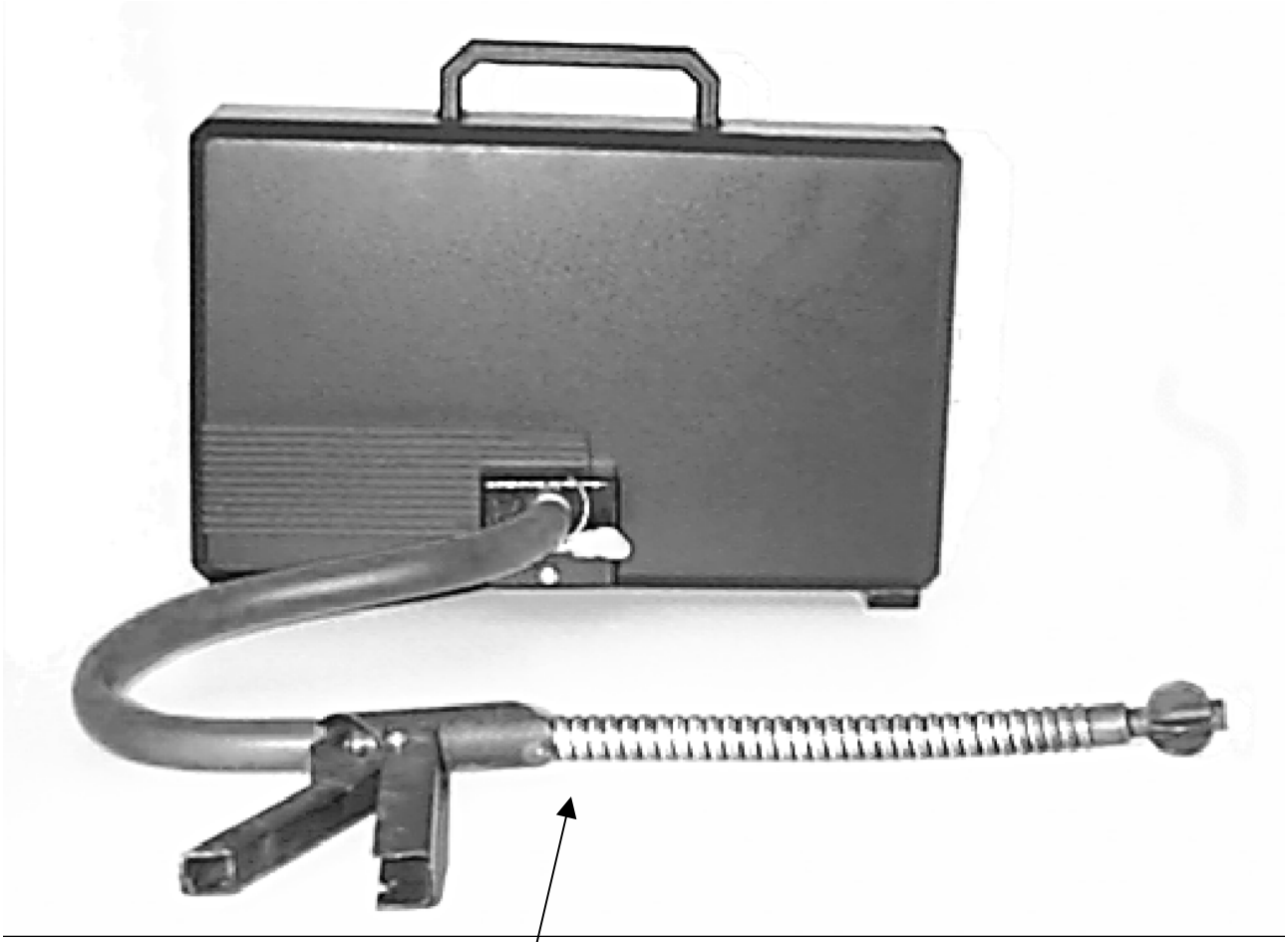
12 Appendix

12.1 Address “Your Contacts to MRU“

	manufacturer	
	M R U	
	Messgeräte für Rauchgase und Umweltschutz GmbH	
	Fuchshalde 8	Tel.: +49 7132/9962-0
	D-74172 Neckarsulm-Obereisesheim	Fax. +49 7132/9962-20
	Service-Hotline	+49 7132/996259
	E-Mail:	info@mru.de
	Homepage:	http://www.mru.de
	P. O. Box 2736	
	D-74017 Heilbronn	
express railway:	Heilbronn-Hbf self-collect	

12.2 Additional Device Opacimeter MRU-Optrans 1600

12.2.1 Front View



gas sampling probe MRU-Optrans 1600

12.2.2 Use

The exhaust gas measuring device is used for measurement of the smoke ejection of diesel vehicles. The clouding is indicated in %, the absorption coefficient in 1/m (K-factor) respectively the substance concentration in mg/m^3.

12.2.3 Diesel Fumes Measurement

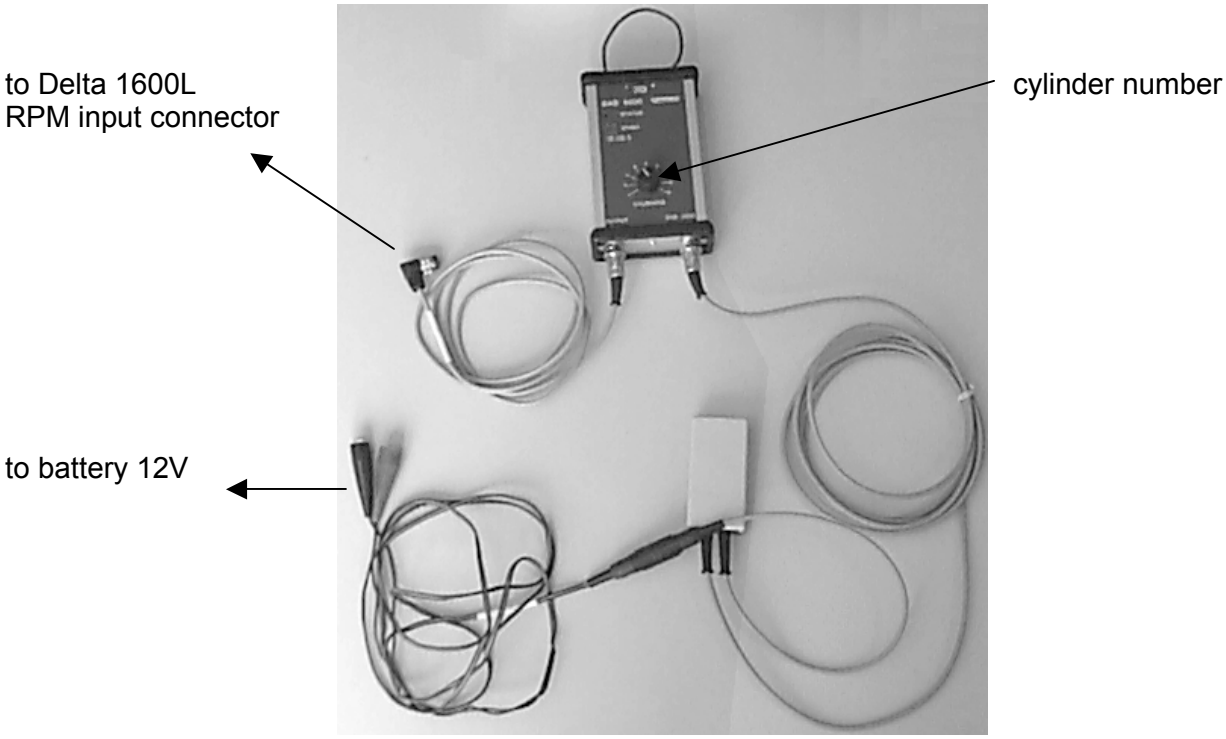
see chapter **3.4** Prerequisite Conditions for Measurement
3.8 Functional Course of Opacity Measurement
6.7 Opacity Measurement

For further information and data on the opacimeter MRU-OPTRANS 1600, please consult the **Operating Instructions MRU-OPTRANS 1600**.

12.3 Additional Device Tachometer DAB 5000

With the additional device Tachometer DAB 5000, the engine rotation speed of the vehicles can be measured.

The engine rotation speed is continuously measured, saved and printed during the exhaust gas measurement as well as during the opacity measurement.



In order to use the tachometer DAB 5000, the following steps have to be carry out:

- Connect DAB 5000 to the vehicle 12V battery (either with the battery terminals or with the mains plug in the cigarette lighter)
- Connect DAB 5000 to the Delta 1600-L and setup the cylinder number.
- Switch on a consumer in the vehicle (e. g. light or heating of the rear window)
- press the red button on the DAB 5000 once (>700 U/min) or twice (<700 U/min), the red LED display starts to twinkle for approx. 10 seconds
- Wait until the red LED stops twinkling and the green LED is on (learning phase)
- Now the DAB 5000 is ready for operation and the measurement can be started

For further information, please consult the Operating Instructions of the Tachometer DAB 5000.