DURAG

D-FL 200
Ultrasonic Flow Monitor

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Illustrations

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1. Application

Acoustic methods of flow measurement use sound waves to determine velocity and flow. The pulse differential method is among the best known and reliable of such methods. High resolution is achieved using frequencies in the ultrasonic range.

This monitoring system is applicable in acquiring flue gas volumetric flow in combustion or waste incineration systems. The system also allows measurements to be made that are otherwise poorly performed using traditional systems. Measurements in lower velocity ranges are also possible, in contrast to differential pressure methods. This system is especially advantageous due to its ease of installation, even on stacks that are wide in diameter.

Acquisition of volumetric flow occurs along the entire profile of the flow. The essential advantage of an ultrasonic monitoring system is that neither temperature, pressure nor density changes will influence the measured result. If you want receive the standard volumetric flow you have to consider these three parameters.

The system is designed for velocities of 0-40 m/s (0-131 ft/sec.) and stack diameters till 5 m (197 in.) with it measurements up to 0-5,000,000 m³/h (0-approx. $17{,}7*10^7$ ft³/h) are possible.

2. Function

The measurement of volumetric flow using ultrasonic probes offers great advantages compared to conventional methods using differential pressure, since this type of system operates with no moving parts. Conventional screens heavily choke the overall flow and cause pressure losses. This causes high energy costs. The employment of dynamic pressure probes requires the use of expensive special materials if the stack gas is heavily corrosive. In contrast, purge air is used to separate ultrasonic sensors from the stack gas.

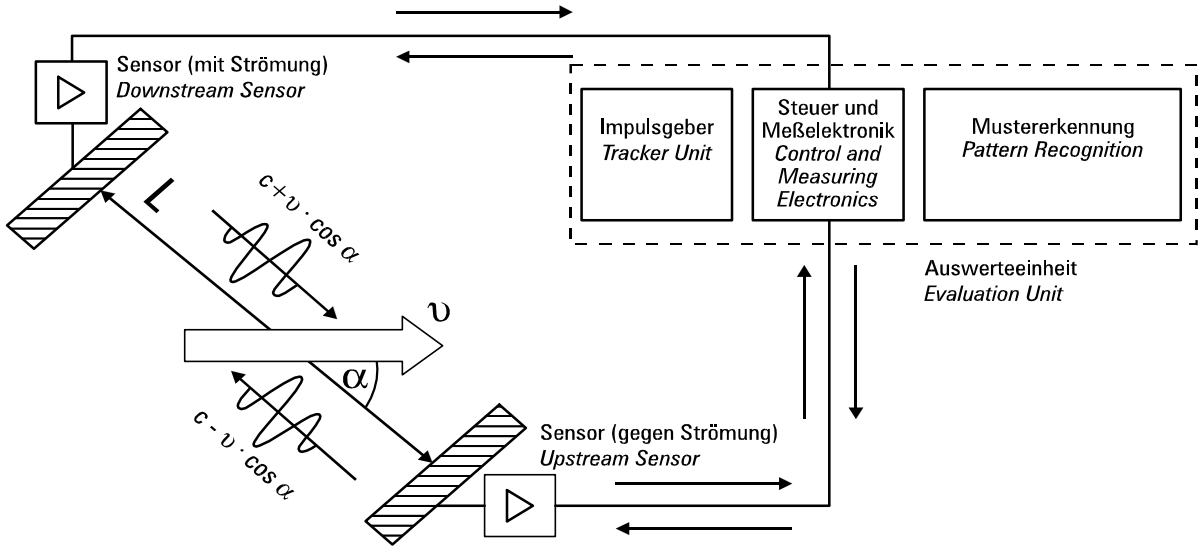
The monitoring system operates using two ultrasonic transducers, which can both transmit and receive acoustic signals. These transducers are installed in a stack such that the velocity of the acoustic signal is influenced by the gas flow. That is to say, the gas flow must show properties of a vectorial portion in the direction of the acoustic signal (see *(Fig. 1) Measuring principle*). The ultrasonic sensors are installed at an angle of about 45° (range 30° - 60°) to the axis of the stack. The transit times of the acoustic impulses form the basis of the volumetric flow and velocity calculations. *(Fig. 1) Measuring principle* offers a schematic of the monitoring system. The transmitting oscillator receives a keyed sinusoidal signal and transforms it into an acoustic wave pack whose transit time through the gas medium is measured. The transit times result as follows:

$$t_+ = \frac{L}{(c + v \cdot \cos\alpha)}$$ Equation 1

$$t_- = \frac{L}{(c - v \cdot \cos\alpha)}$$ Equation 2

with:
- t_+ Impulse transit time with the flow
- t_- Impulse transit time against the flow
- c Sonic velocity

v	Gas velocity
L	Measuring path in the medium
α	Angle of installation



(Fig. 1) Measuring principle

The two equations shown before for impulse transit times may be reduced down for sonic velocity ‘c’ and gas velocity ‘v’:

Equation 3

$$c = \frac{L}{2} \cdot \frac{t_- + t_+}{t_- \cdot t_+}$$

Equation 4

$$v = \frac{L}{2 \cdot \cos\alpha} \cdot \frac{t_- + t_+}{t_- \cdot t_+}$$

The speed of the sound changes with the temperature of the gas according to the next formula. whereby T is in Kelvin. With this equation the gas temperature can be obtained from the measurement.

Gl.5

$$c = 331{,}6\frac{m}{s} \cdot \sqrt{\frac{T}{273K}}$$

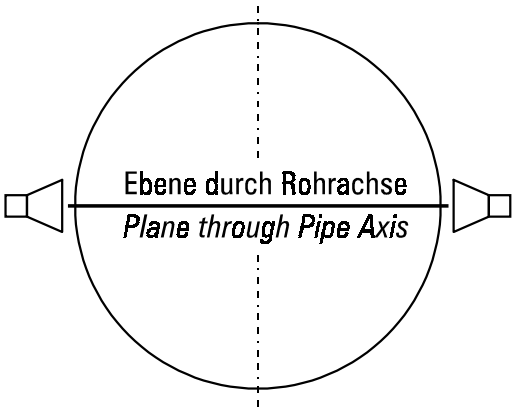
Volumetric flow may be obtained using the following formula:

$$Q = k \cdot A \cdot v$$ Equation 6

with: K Correction factor

A Stack diameter

Since each stack develops its own particular velocity distribution, the mean velocity is determined for calculation of the volumetric flow. If the flow were completely laminar, a single spot measurement would suffice. The acoustic impulse method enables a cross-sectional measurement to be made over the entire diameter of the stack. If the ultrasonic sensors are arranged in a plane through a pipe axis, as shown in *(Fig. 2) Plane through the pipe axis (standard)*, the measured velocity must be weighted according to the geometry of the pipe.

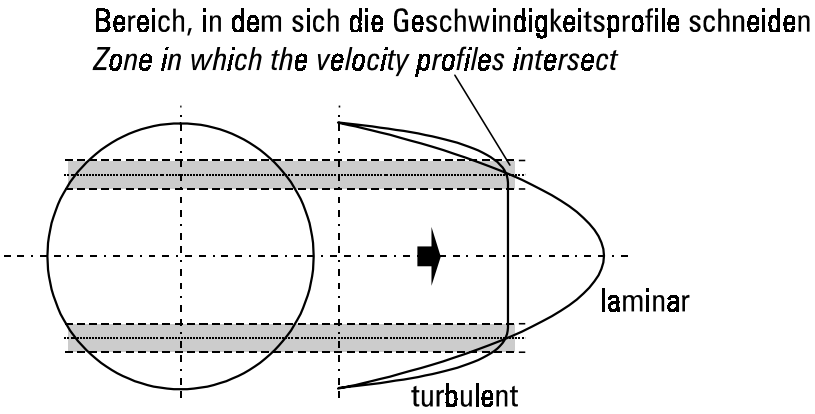


(Fig. 2) Plane through the pipe axis (standard)

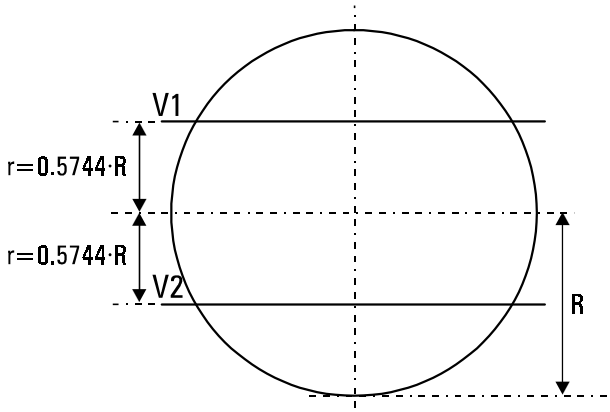
If flow velocity lies in the lower range, the correction factor is 0.75 for cylindrical stacks and 0.66 for square stacks. If it is technically feasible to do so, a calibration should be performed in such an installation.

Optional:

An alternative installation is one in which the ultrasonic transducers are installed in one or two planes which do not run through the pipe axis. This arrangement is shown in *(Fig. 4) Measurement independent of the flow profile (optional).* This setup is advantageous since the influence of the flow profile on the measured result is minimized. This is shown schematically in *(Fig. 3) Consideration of the flow profiles*. The measuring planes must lie in zones which intersect the variable velocity curves.



(Fig. 3) Consideration of the flow profiles



(Fig. 4) Measurement independent of the flow profile (optional)

As shown in *(Fig. 4) Measurement independent of the flow profile (optional)* the measuring planes must be arranged at a distance of r = 0.5774*R from the pipe axis. The correction factor is k=1.

The volumetric flow is determined using four ultrasonic transducers in two planes:

$$Q = k \cdot A \cdot \frac{(v1 + v2)}{2}$$

Equation 7

If only two ultrasonic transducers are used in a plane offset from the pipe axis, the volumetric flow is determined as follows:

$$Q = k \cdot A \cdot v1$$

Equation 8

In general, the measurement should result in the standard volumetric flow. This requires the following conversion:

Equation 9

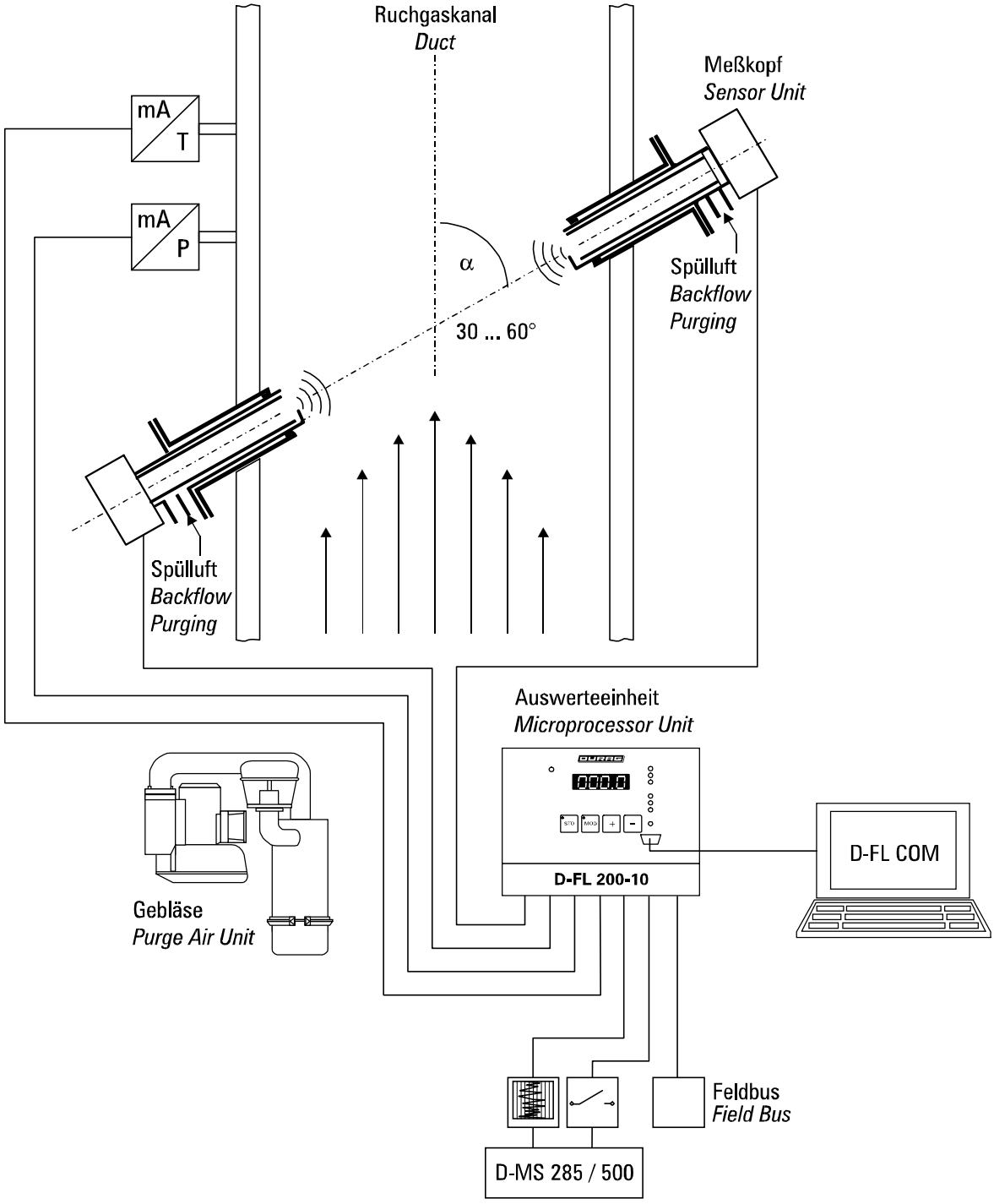
$$Q_n = Q \cdot \frac{P}{P_n} \cdot \frac{T_n}{T}$$

with:	P	Absolute pressure [hPa]
	P_n	Standard pressure = 1013 hPa
	T	Temperature [K]
	T_n	Standard temperature [K]

3. System Components

The D-FL 200 Ultrasonic Flow Monitor consists of the following components:

- D-FL 200-10 evaluation unit
- two or (optional) four D-FL200-MK ultrasonic transducers
- purge air unit
- temperature measurement (optional)
- absolute pressure measurement (optional)



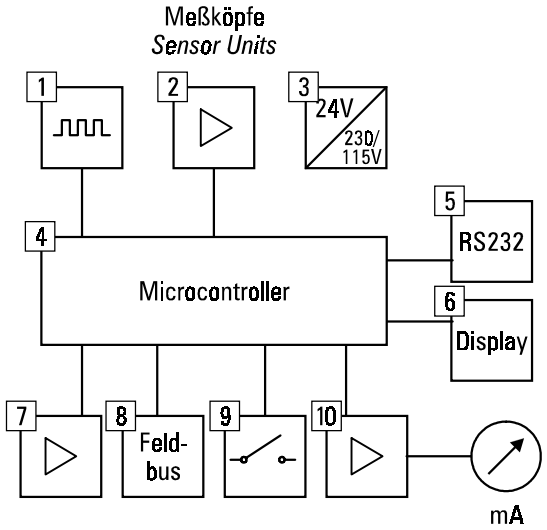
(Fi g. 5) System components

Temperature and absolute pressure measurements are required for converting the volumetric flow to standard volumetric flow. Alternatively these quantities can be programmed into the evaluation unit as constants. Two 4-20 mA inputs for absolute pressure and temperature measurements are provided in the evaluation unit. Existing equipment can simply be looped in.

The ultrasonic sensors do not come into contact with the stack gas. In particular, the build-up of condensate is prevented. The purge air system is specially designed for this and has a negligible effect on the ultrasonic signal.
The transducers are exclusively supplied with auxiliary power from the evaluation unit. The piezoelectric ultrasonic sensors are ruggedly built and are designed to withstand environmental conditions.

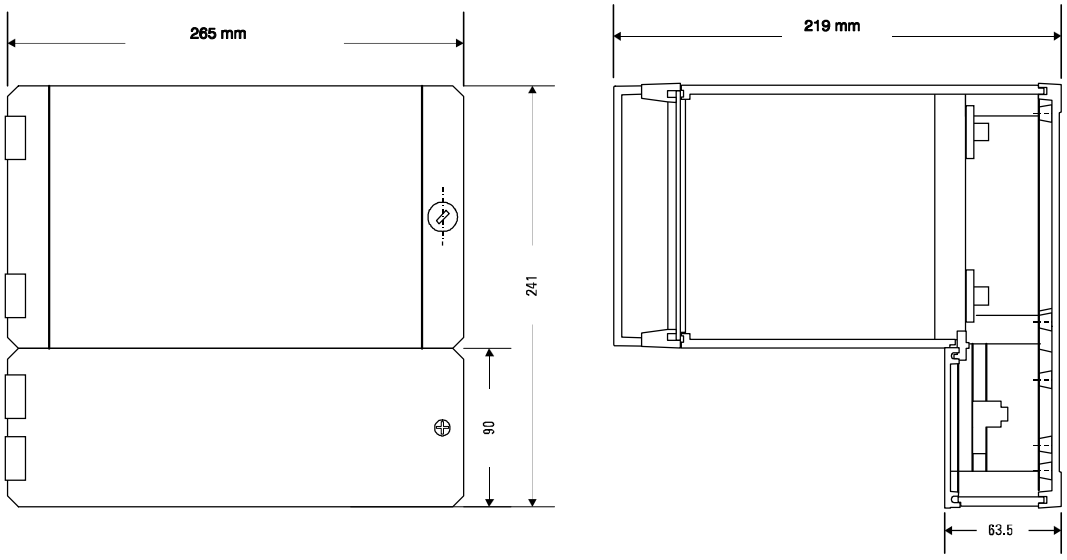
3.1. Evaluation Unit D-FL 200-10

Two or (optional) four transducers may be connected to the evaluation unit. The block diagram below depicts the operations of the unit.



(Fig. 6) Basic diagram of the microprocessor unit

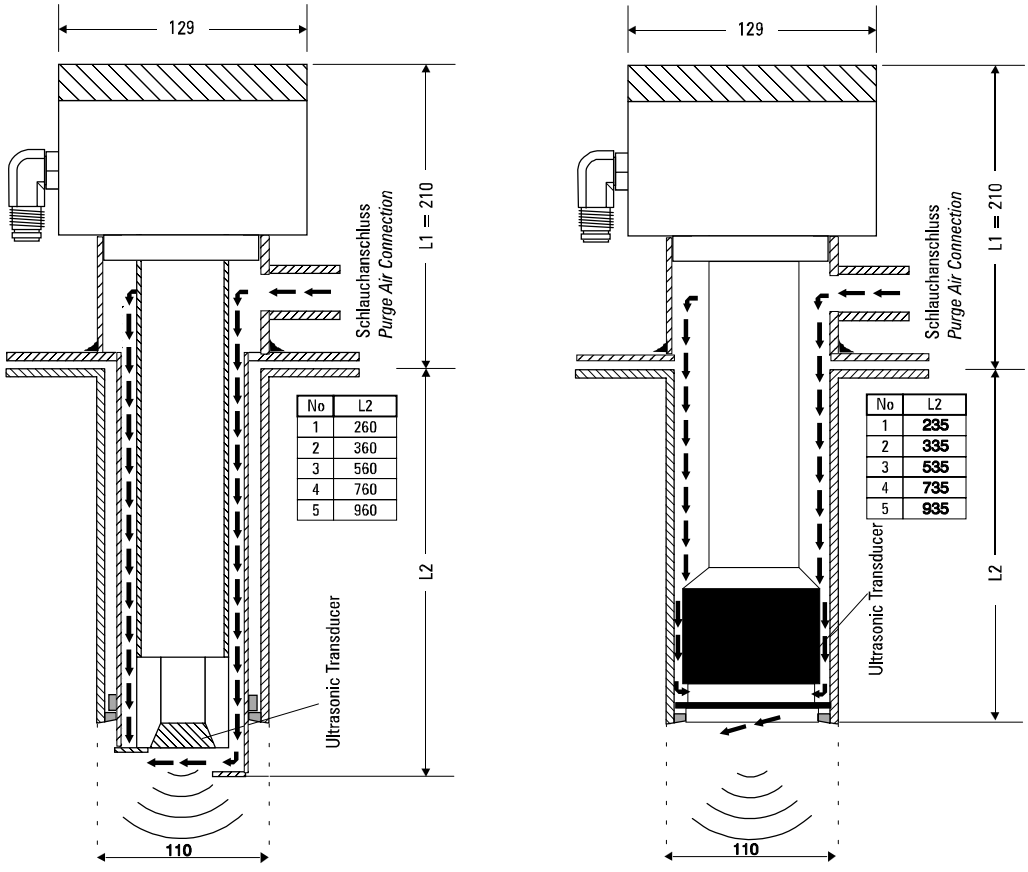
1. Drive sensors
2. Sensor signal amplification
3. Auxiliary power for the transducers
4. Algorithms for assessment of measured values
5. RS232 interface
6. Display output function
7. mA inputs
8. Field bus communications interface (optional)
9. Limit value and state contacts
10. mA outputs



(Fig. 7) Dimensions of the D-FL 200-10 evaluation unit

3.2. Transducer

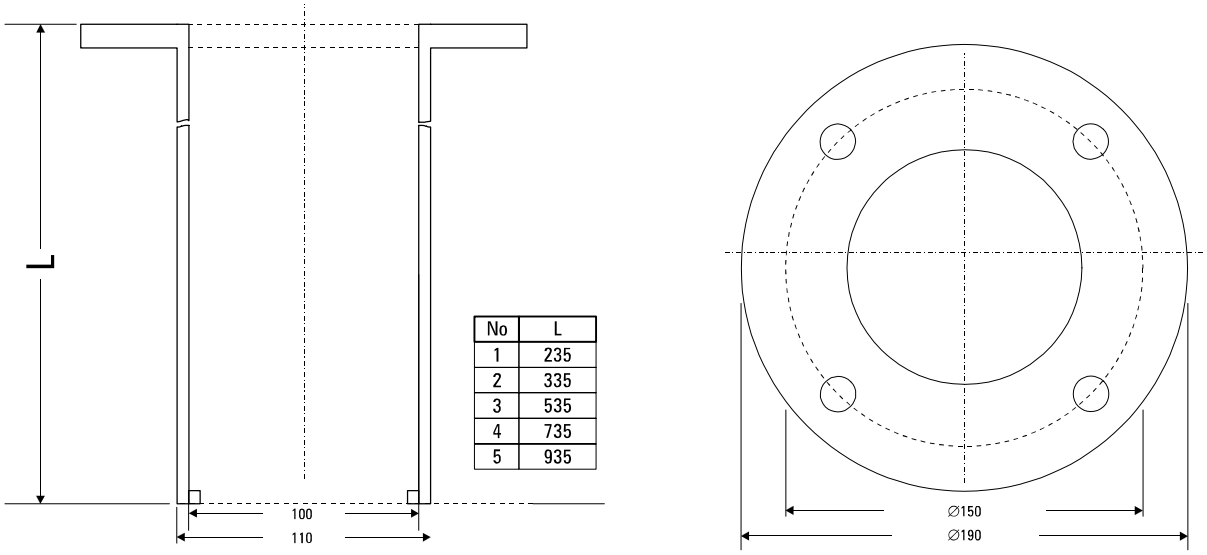
The transducer consists of the ultrasonic sensor, sensor electronics and welding flange.



D-FL 200 Standardausführung MK1 und MK2
D-FL 200 standard system MK1 and MK2

D-FL 200 Standardausführung MK3
D-FL 200 standard system MK3

(Fig. 8) Dimensional drawing of the transducer



No	L
1	235
2	335
3	535
4	735
5	935

(Fig. 9) D-FL 200 flange

The required minimum length of the welding flanges can be obtained from the next equation:

$$L = \frac{(20 + D_W + 150 \cdot \cos\alpha)}{\sin\alpha}$$

Equation 9

with: L Length of the flanges [mm]

D_W Wall thickness of the duct [mm]

3.3. Purge Air System

The use of a purge air system helps to prevent the surfaces from getting dirty prematurely and also protect the system against the heat of the flue gas. If a purge air system is not used, the monitoring system may suffer from excessive dirt accumulation in applications where negative pressure is prevalent. This is especially true if the boiler is shut down, absence of an upward draft and during start-up phase.

The following points should be considered when selecting a location to mount the purge air system:

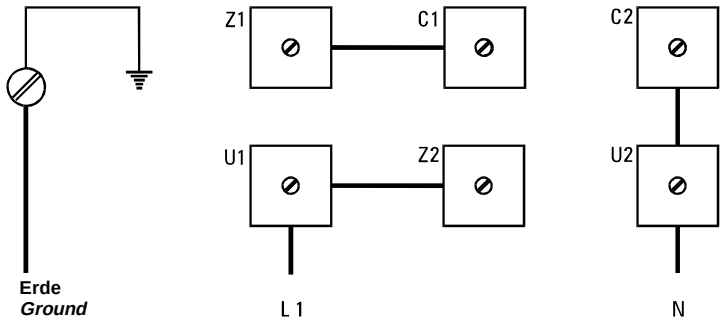
- The intake air must be as dry and dust-free as possible.
- The temperature of the intake air may be a maximum of 313 K (104°F/40°C).
- When mounting the system, the filter has to be vertical. The dust valve must situated at the bottom.
- Adequate space must be left for exchanging the filter (see page 11).

If the purge air system is being mounted outdoors, the weather hood D-WSH 290 GN is available.

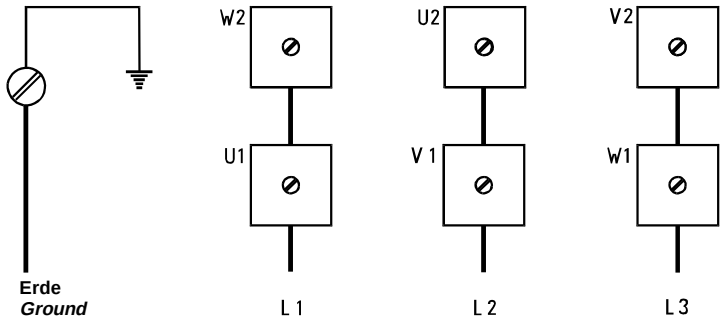
Caution! The following must be observed during the electrical installation of the D-FL 200:

- The installation may be done only by a skilled worker.
- Before performing any work on the system, it must be disconnected from the power supply.
- The power supply and frequency has to correspond with the information shown on the nameplate.
- Connections must be made as shown on the wiring diagram on the cover of the terminal strip.
- The grounded lead must be connected to the ground terminal.
- The motor safety switch (not included) must be set to the rated current of the motor.
- The direction of rotation of the motor must be checked (Arrow on the cover).
- Ensure a separate power supply for the purge air system, because the purge air has to blow all the time.

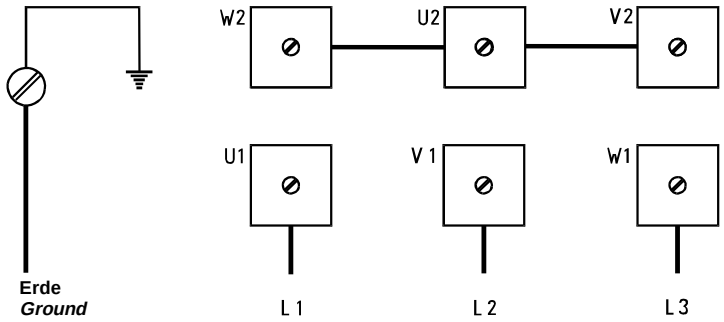
Use the wiring diagram as shown in *(Fig. 10) Electrical connection of the purge air system* if your power supply is single phase. In the case of using three-phase power supply you must connect your motor according to *(Fig. 11) Electrical connection 3-phase power supply 230V* and *(Fig. 12) Electrical connection 3-phase power supply 400V.* Use *Fig. 11* if you supply with 200V - 240V. If you supply with 345V - 415V than connect the motor according to *Fig. 12.*



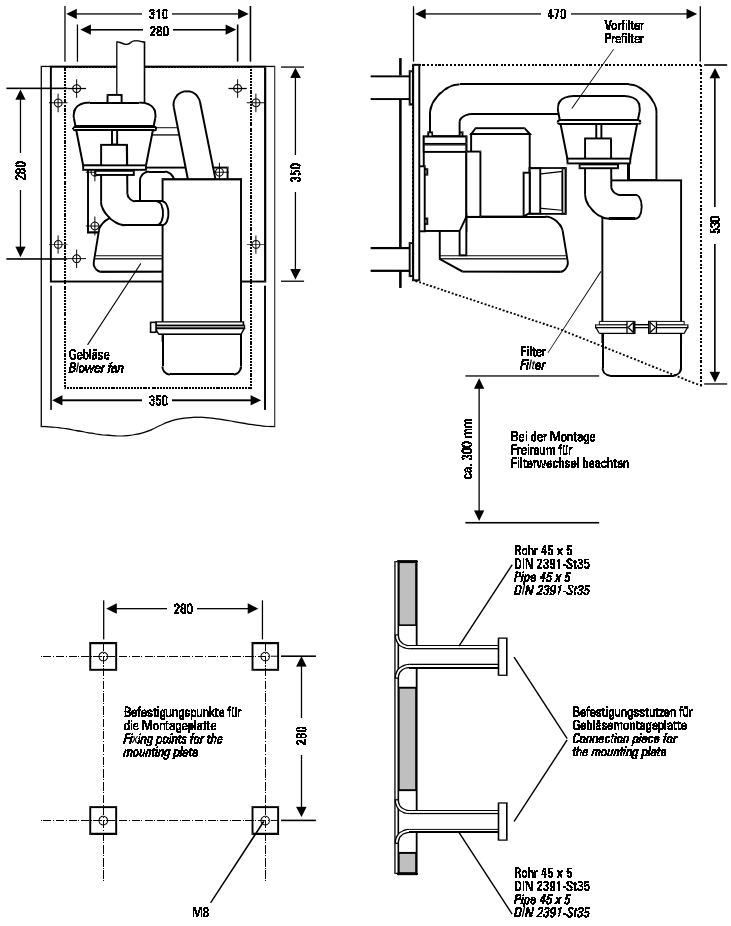
(Fig. 10) Electrical connection of the purge air system



(Fig. 11) Electrical connection 3-phase power supply 230V



(Fig. 12) Electrical connection 3-phase power supply 400V



(Fig. 13) Dimensional drawing of the purge air system

4. Choosing the Measuring Point

The technical conditions found in different stacks, boilers or filtering systems vary greatly. In principle, it is advisable to have a qualified independent agency (e.g., TÜV) make the determination. One must observe, however, that the most symmetrical flow profile possible is present at the measuring point.

There must also be enough space available to install the purge air system and evaluation unit.

The flow paths (length of stack) ahead of and after the measuring point should be at least 3D (D = interior diameter of the stack). If using four transducers, the flow paths may, if necessary, be less than 3D. This should only be done, however, in consultation with the independent agency mentioned above.

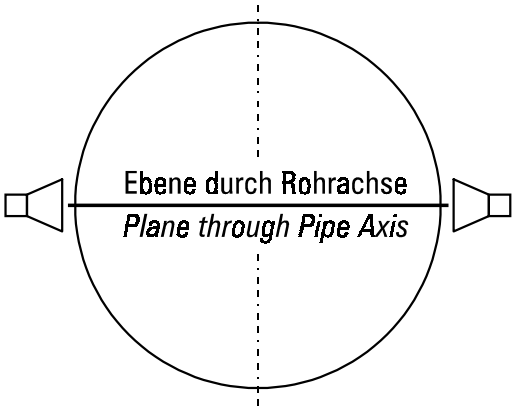
The measuring point should not only be safely accessible for start-up and calibration procedures, but also for any necessary future maintenance.

The measuring path should, if possible, be set up at an angle of 45°. If the interior diameter of the stack is very great, the equipment may be installed at a flatter angle. According to the flow direction the angle should be at the very most 60°. Also, the maximum measuring path length for the acoustic signals may not be exceeded:

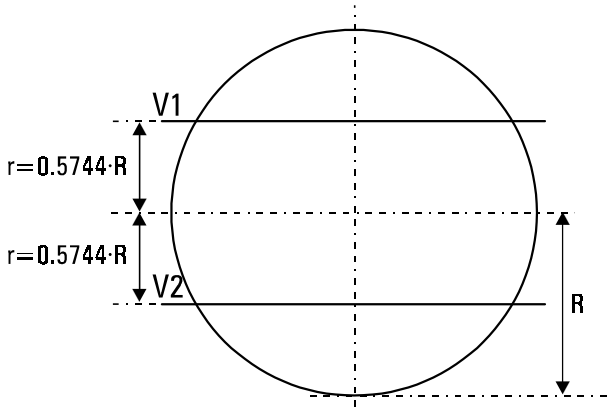
	Maximum measuring path length, standard flue gas		
Temperature	Measuring head 1 (50 kHz)	Measuring head 2 (41 kHz)	Measuring head 3 (30 kHz)
up to 80°C / 176°F	5m / 197 in	8m / 315 in	11m / 433 in
up to 120°C / 248°F	4m / 157 in	6,5m / 256 in	8,0m / 315 in
up to 160°C / 320°F	3m / 118 in	5m / 197 in	6m / 236 in
more than 160°C / 320°F	2m / 79 in	3,5m / 138 in	4,5m / 177 in

For stacks with a small interior diameter, it is recommended that the measuring heads be installed at a smaller angle (min. 30°) concerning to the gas flow, since this increases the resolution. The minimum measuring path length is 2 m/ 6.6ft. The angle is flexible enough that one can consider a working platform, etc.

As already discussed in the section *2. Function, page 1* several installations are possible:



(Fig. 14) Measurement in a plane through the pipe axis, standard



(Fig. 15) Measurement in two planes offset from the pipe axis, optional

Ultrasonic transducers are frequently installed as shown in *(Fig. 14) Measurement in a plane through the pipe axis* because it is less expensive. However, an installation of transducers in two planes can certainly be carried out, as shown in *(Fig. 15) Measurement in two planes offset from the pipe axis*. The correction factors, which you can find in section *2. Function, page 1,* have to be programmed into the evaluation unit.

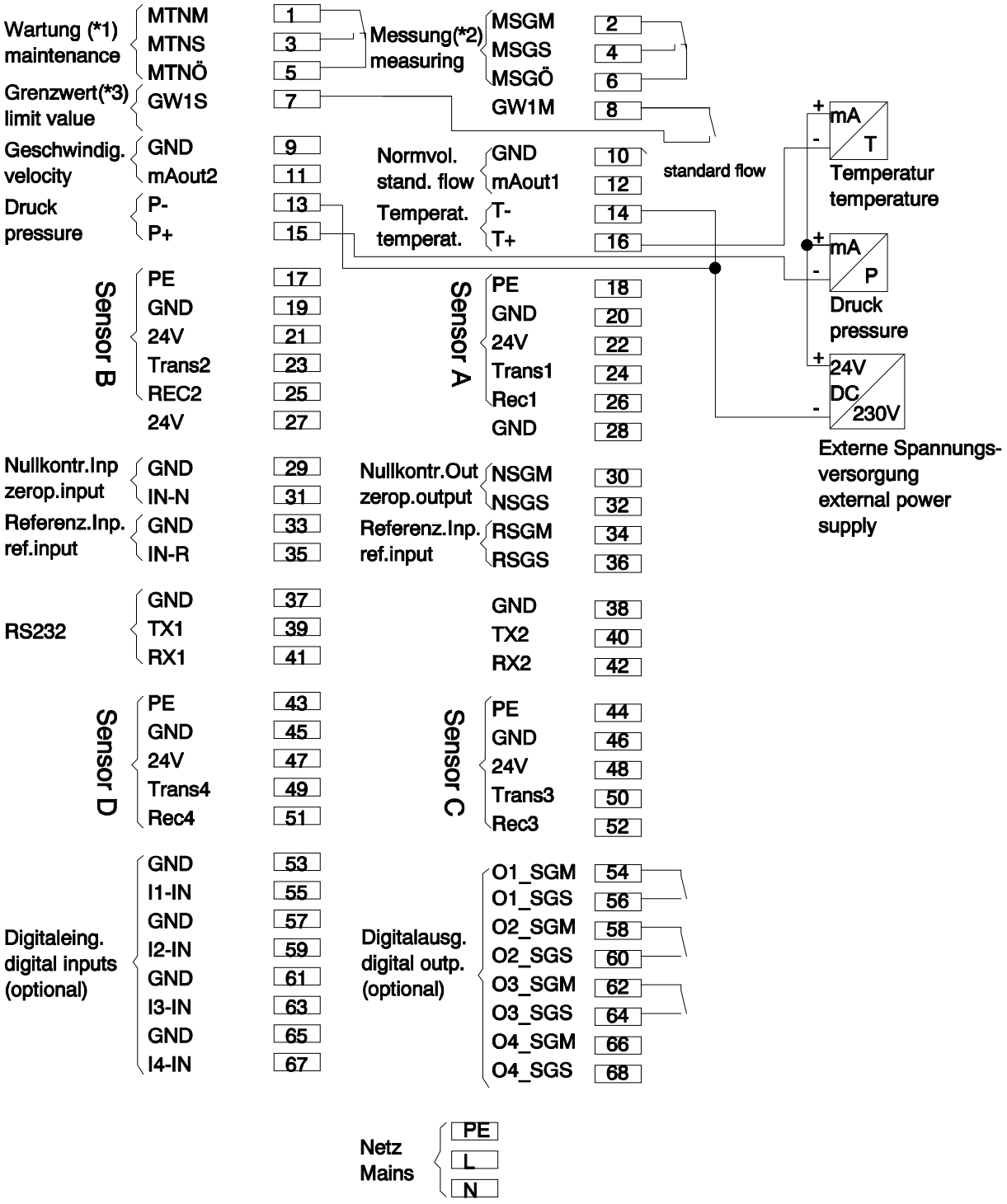
The handling of this evaluation unit is explained in section *8. Operating the D-FL 200-10 Evaluation Unit*. The correction factors can be improved by parallel measurements of an independent agency if necessary.

If the duct runs horizontally, the transducers may be installed in a horizontal plane. If the transducers are installed in a vertical plane, the lower sensor will more easily accumulate condensate and dust.

5. Electrical Connection D-FL 200

5.1. Electrical Connection of the D-FL200-10 Evaluation Unit

The D-FL200-10 evaluation unit is manufactured as a 19” module. Since the evaluation unit is to be mounted as close to the transducers as possible, an IP 65 / NEMA 4X housing is supplied. The layout of the terminal strip on the housing is depicted in *(Fig. 16) Terminal strip on the* housing. The transducers are connected to the evaluation unit with specially shielded cable. The maximum permissible cable length from the transducers to the evaluation unit is 50 m / approx. 164 ft.



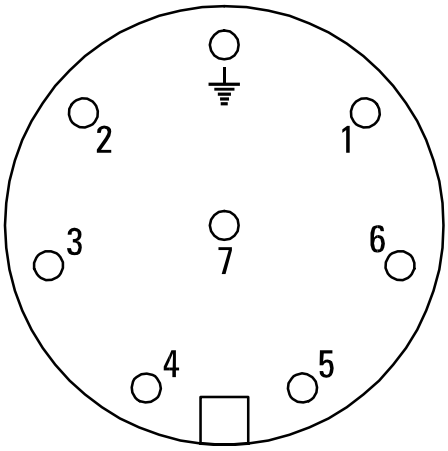
1: Relaiskontakt Wartung: geschlossen, wenn System in Wartung oder Kalibrierung ist
1: Relay contact maintenance: closed, if system is in maintenance or calibration mode
2: Relaiskontakt Messung: geschlossen, wenn System fehlerfrei arbeitet
2: Relay contact: closed, if system is working without error
3: Relaiskontakt Grenzwert: geschlossen, wenn Normvolumenstrom größer als Grenzwert ist
3: Relay contact limit value: closed, if standard flow is greater than limit value

(Fig. 16) Terminal strip on the housing

5.2. Electrical Connection of the D-FL200-20 Transducers

The transducers are delivered with a plug connection. The terminal layout is shown in *(Fig. 17) Layout of the transducer plug.*

Steckerbelegung Meßkopf
Terminal Layout of Measuring Head



1	braun/*br*	24VDC Spannungsversorgung	*Power Supply*
2	blau/*bl*	Gnd	
3	gelb/*ye*	Sendesignal	*Transmission Signal*
4	weiß/*wh*	Empfangssignal	*Receiver Signal*
5-6	nicht belegt / *not used*		
7	grün/gelb *gr/ye*	PE	
⏚	schwarz/rot *bk/re*	Schirm	*Shield*

(Fig. 17) Layout of the transducer plug

The sensor electronics are located in the transducer, along with a terminal strip. This terminal strip was wired to the plug at the factory. The pin-out of this connector is shown in *(Fig. 18) Layout of the terminal strip on the sensor board.*

D-FL 200 Klemmleiste Sensoren
Sensor Terminal Strip of D-FL 200

1	grün/gelb *gr/ye*	PE	
2	blau/*bl*	Gnd	
3	braun/*br*	24VDC Spannungsversorgung	*Power Supply*
4	gelb/*ye*	Sendesignal	*Transmission Signal*
5	weiß/*wh*	Empfangssignal	*Receiver Signal*

(Fig. 18) Layout of the terminal strip on the sensor board

6. Measuring Sequence

6.1. Self-Check

The evaluation unit performs a self-check upon power-up. The display will indicate “Self-Check” throughout the duration of the test and the relay contact "Maintenance“ is in operation.

6.2. Calibration Cycle

After the self-check a calibration cycle is performed for 4 minutes. The calibration cycle consists of a ‘zero test’ and ‘span test’. This cycle is performed according to the time interval programmed in program mode2 (standard every 24h). The state output contact “Maintenance” is contacted during this period.

Unaffected of this two calibration tests an automatic check cycle is performed. This automatic check cycle inspects the right operation of the electronic parts. It takes place beside the permanent measuring cycle.

6.2.1. Zero Test

After the sensor check, a zero test is performed for two minutes. Each sensor transmits two brief impulses, which are received by the opposite sensor. This sequence is repeated in both directions. The zero point is checked using the evaluation formulas noted above.

6.2.2. Span Test

During the span test, staggered signals are transmitted and received. Using the evaluation formulas, the reference point can be checked.

6.3. Monitoring

The system automatically begins monitoring after the calibration cycle. The state output contact “Maintenance” changes from the position “ON” to “OFF”.

7. Registration of Measured Values

The D-FL 200-10 is equipped with two mA outputs. The standard volumetric flow is given to output 1, and the gas velocity is given to output 2.

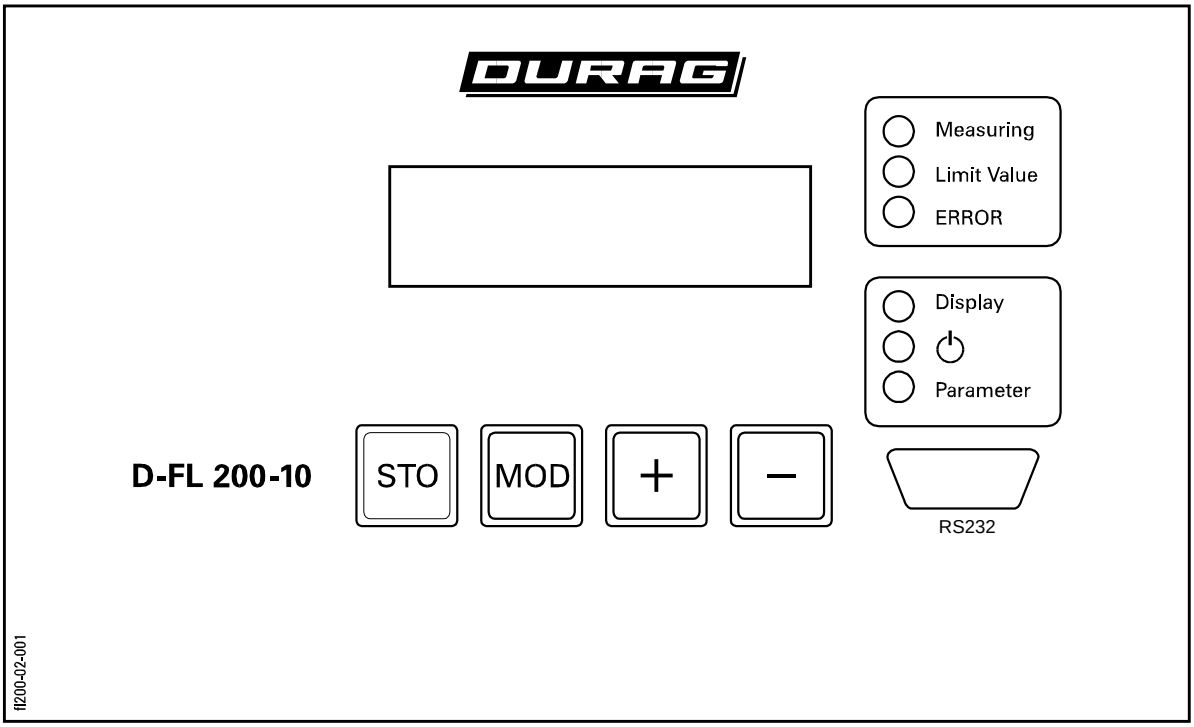
For continuous registration of measured values, strip chart recorders (0-20 mA) with a printing width of at least 100 mm (4 inch) can be used (quality class 1.0, according to VDE 0410. The zero point (live zero) lies at 20% (4 mA) of scale.

A computerized emissions evaluator may also process the measured values issued.

The integration time (continuous mean value generation) of the measured value can be set in the D-FL 200-10 in one-second steps between 1 and 180 seconds.

8. Operating the D-FL 200-10 Evaluation Unit

The parameters can be entered both by pressing the four keys on the front panel as well as via the RS232 interface.



(Fig. 19) Front panel of the D-FL 200-10 evaluation unit

The three upper LED's indicate the following:

LED Display	Display Functions
Measuring	The system is in measuring-mode
Check Cycle	The system is doing a check cycle
Limit Value	The limit value is reached

The three lower LED's indicate the following:

LED Display	Display Functions
Display	<u>Select Display.</u> The operator may choose to display the gas velocity, operating volumetric flow, standard volumetric flow and temperature. Measurement continues when switching from one display to the next. The "Measurement" state contact is closed and the "Maintenance" state contact remains open.
Maintenance	The "Maintenance" state contact is closed
Parameterisation	<u>Parameterisation</u> - the "Maintenance" state contact remains closed - the parameters may be entered using menus on the display

LED (lower)	Parameter	Meaning
Display		**Select display output**
		Standard volumetric flow Velocity Operating volumetric flow Temperature Absolute pressure
Maintenance		**Maintenance mode**
		Sensor A (for 10 s index position) **400-3000** (for 8 s amplification) **0,0-0,512** (for 8 s transmit power) **0.0000-0.0100** (cyclic rotation of these 3 values) (signal amplitude) **0-204** (noise value max.) **450**
	If 'STO-Key' is active then amplification is variable, else **0,320**	
		Sensor B (for 10 s index position) **400-3000** (for 8 s amplification) **0,0-0,512** (for 8 s transmit power) **0.0000-0.0100** (cyclic rotation of these 3 values) (signal amplitude) **0-204** (noise value max.) **450**
	If 'STO-Key' is active then amplification is variable, else **0,320**	
		Sensor C (for 10 s index position) **400-3000** (for 8 s amplification) **0,0-0,512** (for 8 s transmit power) **0.0000-0.0100** (cyclic rotation of these 3 values) (signal amplitude) **0-204** (noise value max.) **450**
	If 'STO-Key' is active then amplification is variable, else **0,320**	
		Sensor D (for 10 s index position) **400-3000** (for 8 s amplification) **0,0-0,512** (for 8 s transmit power) **0.0000-0.0100** (cyclic rotation of these 3 values) (signal amplitude) **0-204** (noise value max.) **450**
	If 'STO-Key' is active then amplification is variable, else **0,320**	

Parameter	**Code 1**	Store release code for parameterisation with ‘STO-Key’ **code = 100**	
R01	integration time	Integration time (1-180s)	
R02	limit value	Limit value 1,in relation to the standard volumetric flow (1-9999x10^3Nm^3/h) (1Nm^3/h =35,3Nft^3/h)	
R03	measuring path	Measuring path length (0-30m) (1m=3,28ft)	
R04	angle	Angle of installation (0°-80°)	
R05	cross-section	Stack cross section (0-99,99m²) (1m²=10,76ft²)	
R06	corct-factor	Correction factor (0-5) **default 1**	
R07	offset	Zero point offset (-2m/s…+2m/s) **default 0**	
R08	span mA .out1	Measuring range end value of the mA output for the standard volumetric flow measurement (1-99,99x10^3Nm³/h)	
R09	span mA .out2	Measuring range end value of the mA output for the gas velocity measurement (0-99,99 m/s)	
R10	measuring plane	1 Measuring plane **0001**	corresponds with two transducers (standard)
		2 Measuring planes **0002**	corresponds with four transducers
R11	calculation mode	Calculation mode	Calculation
		0000	constant temperature, constant absolute pressure
		0001	extern temperature input, constant absolute pressure
		0002	constant temperature, extern absolute pressure input
		0003	extern temperature input and extern absolute pressure input
		0004	ultrasonic temperature calculation and constant absolute pressure
		0005	ultrasonic temperature calculation and extern absolute pressure input
		0006	ultrasonic temperature calculation and constant absolute pressure, output of the ultrasonic temperature on standard flow output, measuring range 0-400°C (corr. 32-752°F)

R12	zero_tmperature_in	Beginning of measuring range for temperature sensor (4 mA) (0-800°C) (corr. to 32-1472°F)
R13	span_tmperature_in	End of measuring range for temperature sensor (20 mA) (0-800°C) (corr. to 32-1472°F)
R14	zero_pressure_in	Beginning of measuring range for absolute pressure sensor (4 mA) (0-1500hPa)
R15	span_pressure_in	End of measuring range for absolute pressure sensor (20 mA) (0-1500hPa)
R16	const_tmp	constant temperature (0-800°C) (corr. to 32-1472°F)
R17	const_p	constant absolute pressure (0-1500hPa), **default 1013**
Parameter	**code_2**	Release code for internal parameterisation, *only for internal use at Durag factory*, **code = 200**
R22	frequency	Drive frequency for ultrasonic sensor / evaluation algorithm (10-100kHz), MK1=**50**kHz, MK2=**41**kHz, MK3=**30**kHz
R23	amplitude min.	Minimum signal amplitude, values below this limit are not evaluated. If this appears 30 seconds in a row, the error detection is launched (E16-E19), (0-2000), **default 350**
R24	amplifier target	Set point for the automatic gain control, **constant 1900**
R25	amplification f..	Amplification factor/ manual/ automatic; values between 1 and 512 will set the variable amplifier to a fixed amplification, values greater than 512 enable the automatic gain control (0-1000), **default 600**
R26	assessment level	Assessment level, used for searching of the trigger point, **constant 10**
	input temperature	mA input for temperature
	input pressure	mA input for absolute pressure
R27	error detection	Error detection system, enabled=1, disabled=0; single error evaluations can be disabled by setting the value or the sum of values: 2→E12-E15; 4→E16-E19; 8→E20-E23; 16→E24-E27; 32→E28-E31; 64→E32-E33
R28	zero suppress	Zero suppress of gas flow velocity (0-3m/s) (10ft)
R29	sensor offset	Sensor offset , (0-600mm) (corr. to 23,6in), **default 0**
R30	noise limit	noise limit, signals with a higher noise component are not evaluated. If this appears longer than 30 seconds in a row, the error detection is launched (E24-E27) (0-2000), **default 450**
R31	ultras. speed NT	Ultrasonic speed at 0°C (100-500m/s),

		default 332 m/s (corr. to 1089 ft/s)
R32	calibration time	calibration interval (0-720h), disabled=0, **default 24h**
R33	normal/reverse	inverse mode for the velocity measurement (0=normal direction, 1= inverse), **default 0**

8.1. Key Functions

The keys have the following functions:

Key 

For switching to the "*Input*" (storing) mode.
The LED on the "STO"-key is illuminated when in this mode.

Key 

For switching to the "*Display*" mode.
The LED on the "MOD"-key is illuminated.

Key 

For counting up when in the "*Input*" mode, and for switching the display when in the "*Display*" mode. The LED in the "MOD" key is illuminated.

Key 
For counting down when in the "*Input*" mode, and for switching back the display when in the "*Display*" mode. The LED in the "MOD"-key is illuminated.

8.2. Storing / Entering Parameters by using the Keys

- Pressing the "MOD"-key switches from the 'Measuring'-mode to the 'Display'-mode. The "MOD" LED is illuminated.
- The "+"-key causes that the parameters will be displayed one after the other, according to the second table below *Fig.19*. The corresponding parameter appears in the display.
- Pressing the "STO"-key switches the system into the "Input" mode. The "STO" LED is illuminated.
- The "+" and "-" can be used to change the value in the display. The longer these keys are pressed, the more quickly the value is changed.
- If the "STO"-key is pressed again, the new value is stored and the system switches back to the "Display" mode. The "STO" LED is extinguished.
- By pressing the "MOD"-key the system switches back from the "Display" mode to the "Measuring" mode. The "MOD" LED is extinguished, and the current measured value is shown on the display.

  If the system is switched back from the "Input" mode to the "Measuring" mode using the "MOD"-key before the new values are stored, they will not be saved.

8.3. Storing / Entering Parameters via the RS232 Interface

Parameters may also be entered using the serial interface of a PC or Notebook. The D_FL_COM parameter program can run on Windows 3.1x and Windows 95/98. The detailed description how to use it you find in section *10. PC-Parameterisation of the D-FL 200COM* page *25*.

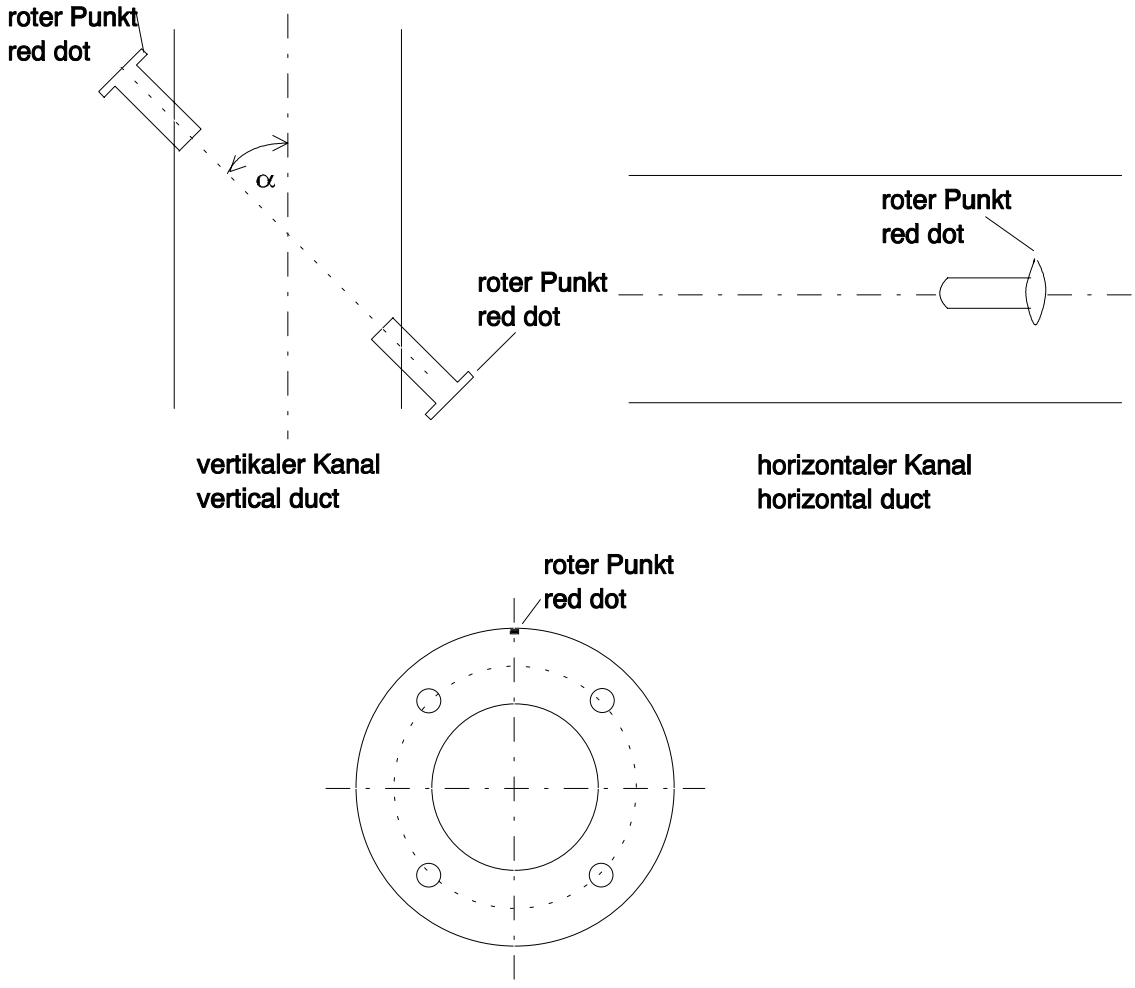
9. Installation

The following installation advice should be followed step by step, to prevent damage to the system. In the *''Customer Specific Calculations for the D-FL 200"* (extra sheet enclosed with your system) you can find the specific parameters for your application to install your system. There are also the dimensions of your welding flanges. Please use it for your installation.

9.1. Mounting the Welding Flanges

The welding flanges should be mounted on the stack as shown in the drawing below. The flange tubes should project slightly into the interior of the stack. This helps to prevent condensate from accumulating. The standard angle is 45°. You have to ensure that there is enough space to build in the measuring heads. The length of the measuring head depends on the respective wall thickness. The standard lengths are listed in section *3.2. Transducer* page 8 in the picture *(Fig. 9) D-FL 200 flange* page 9. Ensure a safe access to the flanges for later maintenance.

Attention! The measuring heads may not be installed before the purge air system is connected and running. Because missing of purge air they may become overheated and destroyed.



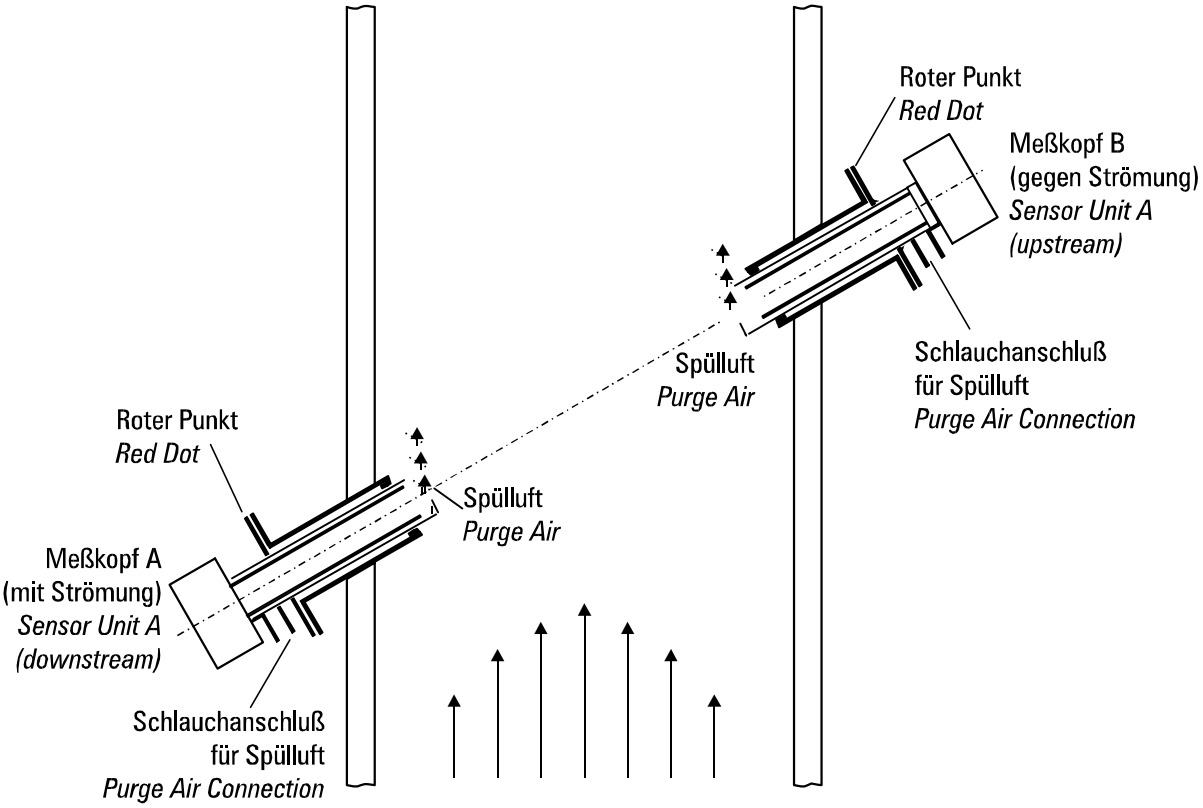
(Fig. 20) Recommended installation of the D-FL 200 welding flanges

9.2. Installation of the purge air system

The installation of the purge air system is done according section *3.3. Purge Air System, page 9*. The best place for the purge air fan is either in the centre of the two sensors or near the lower sensor. Finally the hoses should be attached. Consider that you should use special acid-resistant hoses if there is aggressive gas or gas below the dew point. Before installing the measuring heads you must finish the electrical connection of the purge air system.

9.3. Installation of the sensor units D-FL 200-MK

The measuring heads are mounted according to the next figure. The red indication dots have to be directed upwards on a vertical stack, on a horizontal duct they should be in direction of the flow. The sensor A is transmitting downstream, the sensor B upstream (when four sensors are used the sensor A is equivalent to C and sensor B is equivalent to D). The sensors are all the same, the indication with A to D is only necessary to connect the sensors in the right order to the evaluation unit. If the temperature of the gas is higher than 120°C (248°F) or there is aggressive gas, permanent purging is necessary to protect the sensor. This is also necessary if the sensor is not in operation.



(Fig. 21) Recommended installation of the D-FL 200 welding flanges

9.4. Installation of the evaluation unit D-FL 200-10

The evaluation unit should be installed at an open place. The required mains voltage is stated on the device-plate. The standard cable length between evaluation unit and sensor is 15 m (49 ft), the maximum length is limited to 50 m (164 ft). You should always use the shielded cable enclosed with the sensor. The sensor unit A has to be connected to the terminal strip *(Fig. 16) Terminal strip on the* housing, page *14* connector 22-26, the sensor B to connector 27-31 (sensor C and D according connection C and D to the figure). The shield of the cable should have a good electrical connection to the metal cable holder.

As an option temperature and pressure transmitters can be used. This is shown in *5.1. Electrical Connection of the D-FL200-10 Evaluation Unit, (Fig. 16) Terminal strip on the* housing page *14.* The measuring resistors of these inputs are 100Ω. The maximum load of the transmitter should be taken into account.

On the output side there are a mA-output for standard flow, a mA-output for velocity and three state relays "ERROR", "Maintenance" and "Limit value" available. On that outputs a strip chart recorders or an "Emissions Evaluator" (for example DMS 285 or DMS 500) can be connected.

If there is **no** 'ERROR' the relay is **in operation**. If a fault occurs this relay contact is switched to 'OFF'. That includes, if there is a power fail this state relay will indicate an error too.

9.5. Start up of the evaluation unit D-FL 200-10

The system is programmed according to the data of the stack (see section 16. Measuring Point Questionnaire*, page 40*).

Before appropriation you should check weather the data in the 'evaluation Unit' and the data in the parameterisation sheet of the 'Customer Specific Calculations' are equal. Make sure that the temperature and pressure measuring is set in the right way (internal/external).

If the data has changed the new parameters can be introduced as described in section *8. Operating the D-FL 200-10 Evaluation Unit, page 17*. For the set up of the system the programmed measuring path length is the most important parameter. If the programmed length is extremely different from the real length, the system looks at the wrong time period for the transmitted signal (tolerance is about 2m).

If the installation and the parameterisation are finished, the verification of the ultrasonic signals can be performed. This can either be done with the program D-FL200COM and a Notebook or PC where the signal is directly shown.

The second possibility is to use the display output of the D-FL 200-10. Press at first the "MOD"-key and afterwards the "+"-key until the display shows "Sensor A". In that position the amplitude of the received signal is shown.

Indication of the Sensor→	Sensor A	1734	← Index position in Array
Signal amplitude→	87	5.	← Noise number

-> 10 seconds later the display shows another output:

Indication of the Sensor→	Sensor A	0.320	← Amplification number
Signal amplitude→	87	5.	← Noise number

-> 8 seconds later a new output appears.

Indication of the Sensor→	Sensor A	0.00830	← Transmit power number
Signal amplitude→	87	5.	← Noise number

-> 8 seconds later the original display output appears again, a. s. o.

If now the "STO"-key is pressed and the red LED changes to "ON", the automatic amplification control is launched. The change of the amplification appears automatically in the display.

Indication of the Sensor→	Sensor A	0.165	← Amplification number
Signal amplitude→	195	11.	← Noise number

The following values should be obtained:

- Using the fixed amplification factor 0,320 the signal amplitude should be set on about 100. Increasing or decreasing the amplification switch on the sensor boards can achieve this. At least the signal amplitude should be 10.
- The index position should be about 1500 in the middle of the array (for index positions ≤400 or ≥3000 an error will occur). The index position changes when the length of the measuring path is changed (program mode 1, code 1).
- The noise number should be as little as possible (error limit is 450).
- The transmit power number should be at least 0,00600 (typical 0.00800).
- When the amplification is variable, the signal amplitude normally will increase (about 180-200). The highest value of the signal amplitude is 204. The amplification number can decrease down to 0,001. The noise value should be small (error level is 450). The index position has to be again about 1500.

If those conditions are not fulfilled, the signal should be evaluated with a Notebook and the program "D-FL200COM".

10. PC-Parameterisation of the D-FL 200COM

The following section describes the parameterisation of the D-FL 200 system. The tables code1 and code2 appear again to improve the handling of this manual.

10.1. Installation of the program

The program is working on PCs with Windows 3.1x as well as Windows 95/98. For the installation insert the disk into the floppy drive and go to your floppy directory and call "install". The installation batch file will create a new directory on the hard disk: "C:\FLCOM". Afterwards it copies the file "flcom.exe" into this directory. This is a self- extracting zipped file. The program files will be installed. After this has been finished the installation batch file deletes the zipped file "flcom.exe". The configuration program can be started with "C:\FL200COM\fl200com.exe".

10.2. Connecting the D-FL 200 system and the PC

For the connection the signals "GND", "RxD" and "TxD" are required. A D-Sub 9 cable is delivered with the system (1:1 connection). One connector of this cable has to plug in the COM-Port of your PC. The other connector should link with the D-FL 200-10. There is a suitable socket in the front panel.

10.3. Parameterisation Program D-FL 200COM

10.3.1. First Page / Main

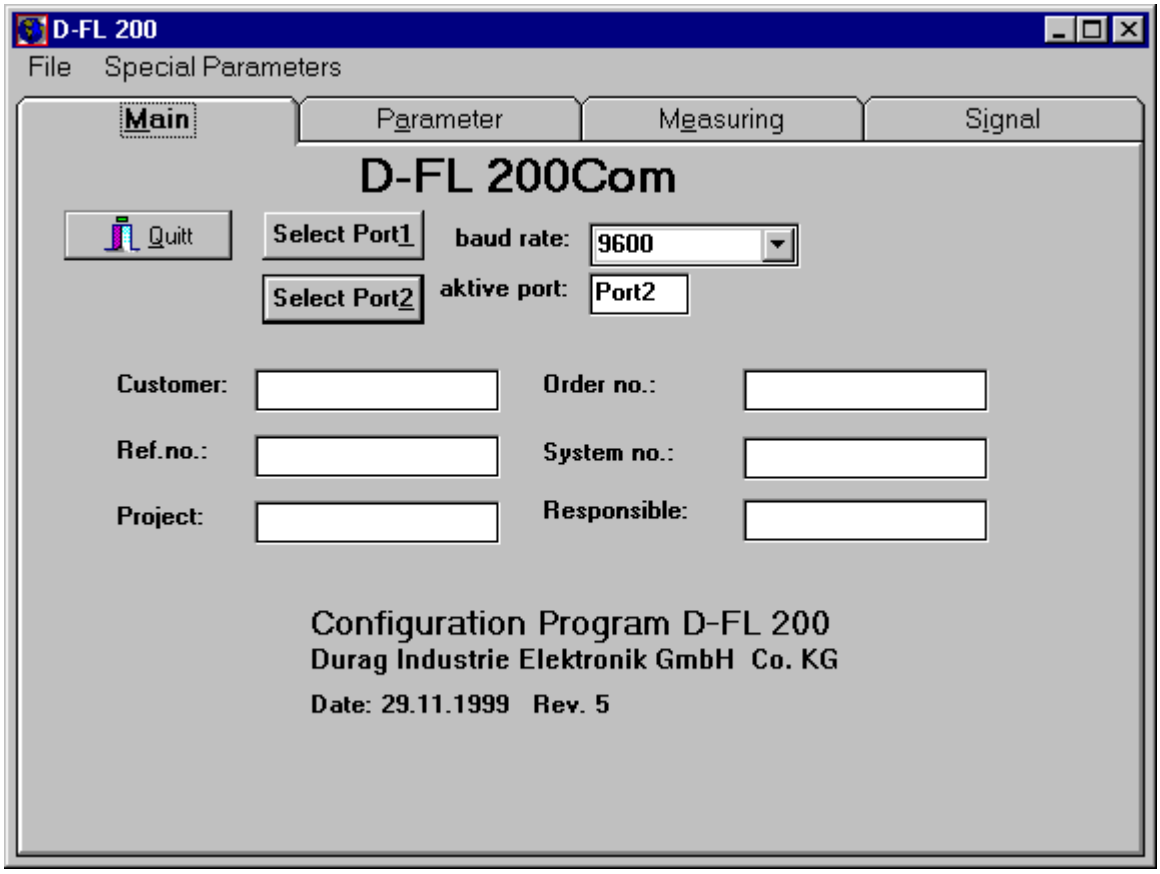
The start page is shown in *(Fig. 22) First page / Main.* With the buttons "Select Port1" and "Select Port2" the serial COM-Port can be selected. As a standard the program starts always with Port2. If this Port is used for example for your serial mouse, press only the "1" on your keyboard. Afterwards the active port is changed to Port1. By pressing the "2" on the keyboard Port2 will be selected. The standard baudrate that is required from the D-FL 200 system is 9600 (Baud).

In the subsequent entry field

- the Customer,
- the reference number,

- the project name,
- the order no.,
- the system number and
- the responsible person/company

can be entered.



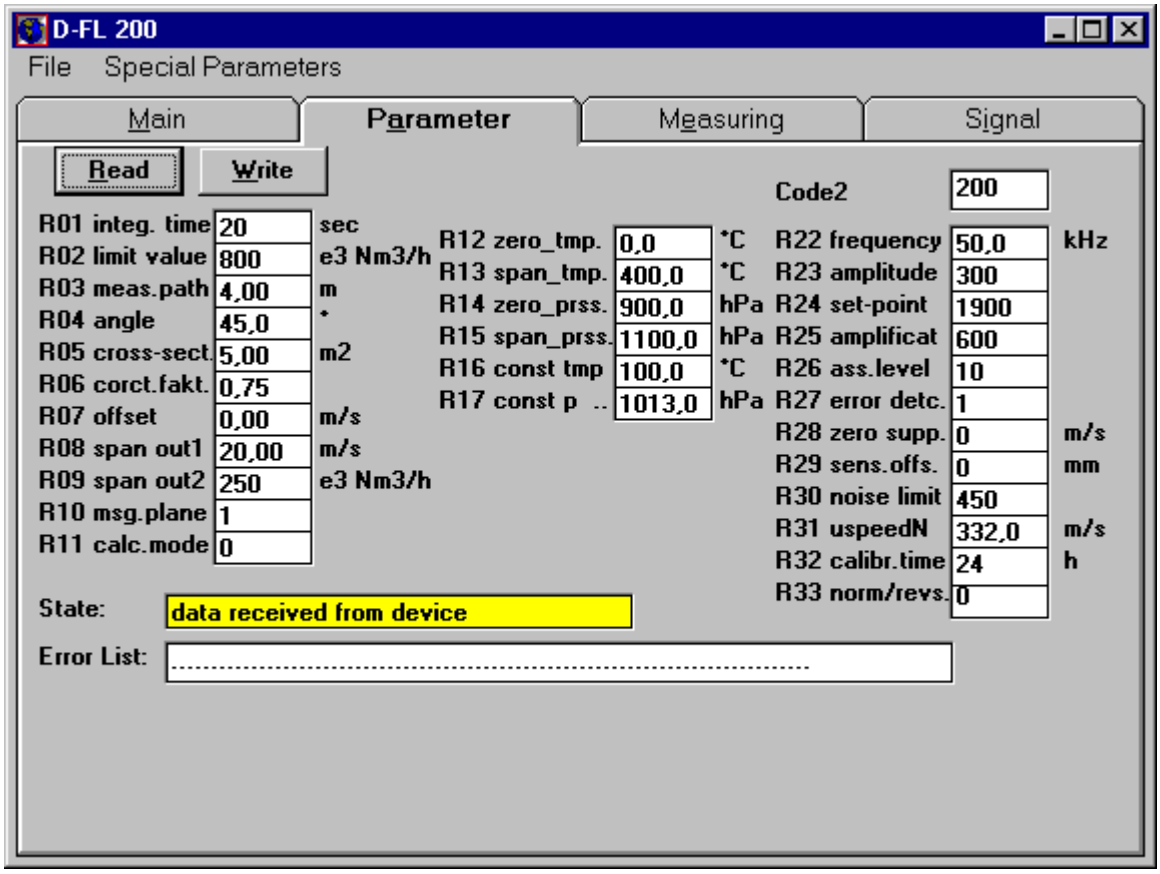
(Fig. 22) First page / Main

10.3.2. Second Page / Parameter

With the "Read"-Button the actual parameters are requested from the system. If any of the parameters in the system is different from the contents of the entry field before, then this entry field is marked red. In that case the parameter of the system is displayed. If the contents of the entry field and the system parameters are equal the entry field remains white.

With the "Write"-Button the parameters from the PC are sent to the D-FL 200-10. The state-bar in the lower part of this page tells the actual state of the communication.

The special parameters R22 - R33 are normally not visible. This is because the normal user doesn't need to change these values. They were pre-programmed by the manufacturer. Nevertheless these parameters become visible after opening "Special Parameters" and the "Visible"-bar in the menu have been selected. The parameters can only rewritten into the system if the correct code2 is entered into the entry box.



(Fig. 23) Second page / Parameter

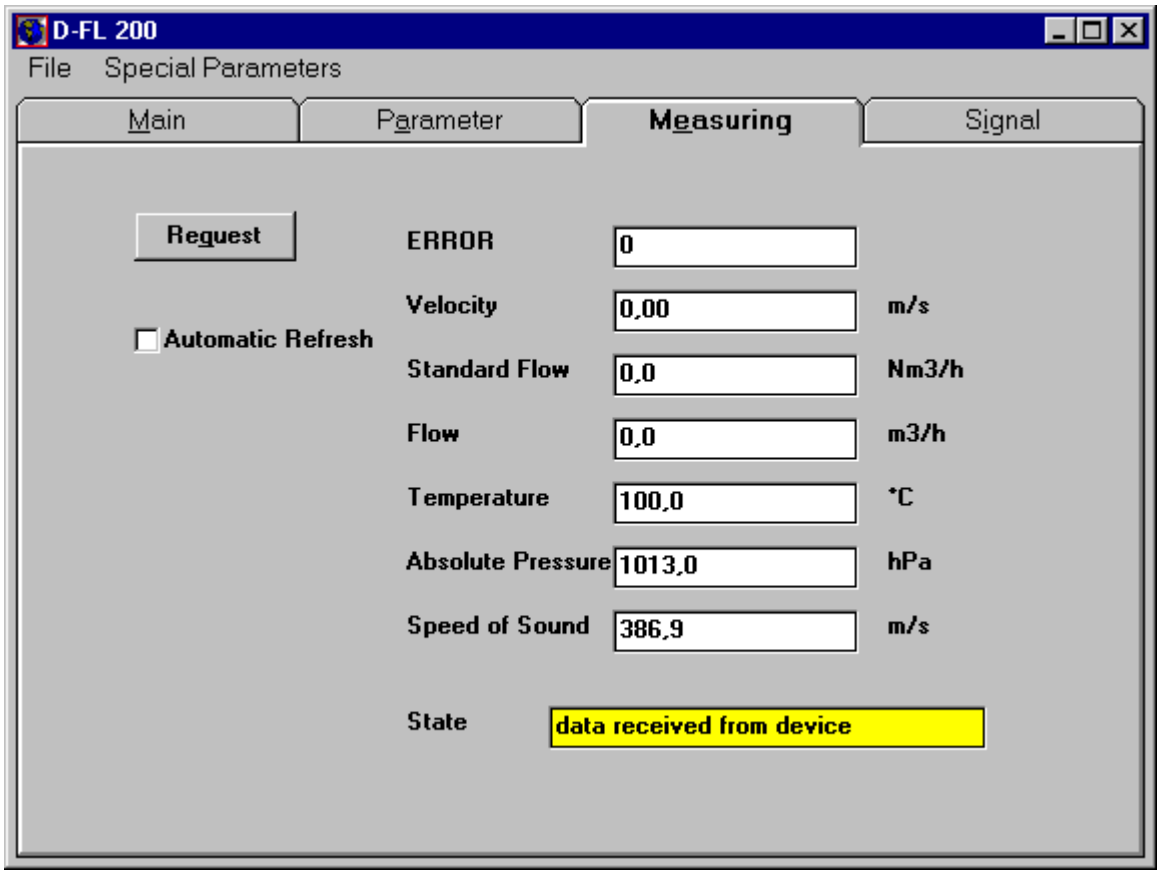
Parameter	Parameter name	Meaning
	Code 1	Store release code for parameterisation with ‘STO-Key’ **code = 100**
R01	integration time	Integration time (1-180s)
R02	limit value	Limit value 1,in relation to the standard volumetric flow (1-9999x10^{3}Nm^3/h) (1Nm^3/h =35,3Nft^3/h)
R03	measuring path	Measuring path length (0-30m) (1m=3,28ft)
R04	Angle	Angle of installation (0°-80°)
R05	Cross-section	Stack cross section (0-99,99m²) (1m²=10,76ft²)
R06	Corct-factor	Correction factor (0-5) **default 1**
R07	Offset	Zero point offset (-2m/s…+2m/s) **default 0**
R08	Span mA .out1	Measuring range end value of the mA output for the standard volumetric flow measurement (1-99,99x10^{3}Nm³/h) (1Nm^3/h =35,3Nft^3/h)
R09	Span mA .out2	Measuring range end value of the mA output for the gas velocity measurement (0-99,99 m/s)

R10	Measuring plane	1 Measuring plane **0001** 2 Measuring planes **0002**	corresponds with two transducers (standard) corresponds with four transducers
R11	calculation mode	Calculation mode	Calculation
		0000	constant temperature, constant absolute pressure
		0001	extern temperature input, constant absolute pressure
		0002	constant temperature, extern absolute pressure input
		0003	extern temperature input and extern absolute pressure input
		0004	ultrasonic temperature calculation and constant absolute pressure
		0005	ultrasonic temperature calculation and extern absolute pressure input
		0006	ultrasonic temperature calculation and constant absolute pressure, output of the ultrasonic temperature on standard flow output, measuring range 0-400°C (corr. 32-752°F)
R12	zero_tmperature_in	Beginning of measuring range for temperature sensor (4 mA) (0-800°C) (corr. to 32-1472°F)	
R13	Span_tmperature_in	End of measuring range for temperature sensor (20 mA) (0-800°C) (corr. to 32-1472°F)	
R14	Zero_pressure_in	Beginning of measuring range for absolute pressure sensor (4 mA) (0-1500hPa)	
R15	Span_pressure_in	End of measuring range for absolute pressure sensor (20 mA) (0-1500hPa)	
R16	const_tmp	constant temperature (0-800°C) (corr. to 32-1472°F)	
R17	const_p	constant absolute pressure (0-1500hPa), **default 1013**	
Parameter	**Code_2**	Release code for internal parameterisation, *only for internal use at Durag factory*, **code = 200**	
R22	Frequency	Drive frequency for ultrasonic sensor / evaluation algorithm (10-100kHz), MK1=**50**kHz, MK2=**41**kHz, MK3=**30**kHz	

R23	Amplitude min.	Minimum signal amplitude, values below this limit are not evaluated. If this appears 30 seconds in a row, the error detection is launched (E16-E19), (0-2000), **default 350**
R24	amplifier target	Set point for the automatic gain control, **constant 1900**
R25	amplification f..	Amplification factor/ manual/ automatic; values between 1 and 512 will set the variable amplifier to a fixed amplification, values greater than 512 enable the automatic gain control (0-1000), **default 600**
R26	assessment level	Assessment level, used for searching of the trigger point, **constant 10**
	input temperature	mA input for temperature
	input pressure	mA input for absolute pressure
R27	error detection	Error detection system, enabled=1, disabled=0; single error evaluations can be disabled by setting the value or the sum of values: 2→E12-E15; 4→E16-E19; 8→E20-E23; 16→E24-E27; 32→E28-E31; 64→E32-E33
R28	zero suppress	Zero suppress of gas flow velocity (0-3m/s) (10ft)
R29	sensor offset	Sensor offset , (0-600mm), (corr. to 23,6in), **default 0**
R30	noise limit	noise limit, signals with a higher noise component are not evaluated. If this appears longer than 30 seconds in a row, the error detection is launched (E24-E27) (0-2000), **default 450**
R31	ultras. speed NT	Ultrasonic speed at 0°C (100-500m/s), **default 332 m/s** (corr. to 1089 ft/s)
R32	calibration time	calibration interval (0-720h), disabled=0, **default 24h**
R33	normal/reverse	inverse mode for the velocity measurement (0=normal direction, 1= inverse), **default 0**

10.3.3. Third Page / Measuring

On this page the actual reading of the D-FL 200 system can be requested. This is done once if the "Request"-Button is clicked. If a permanent display is necessary the automatic refresh box has to be activated. In this case the actual readings of the system are renewed every 5 seconds.



(Fig. 24) Third page / Measuring

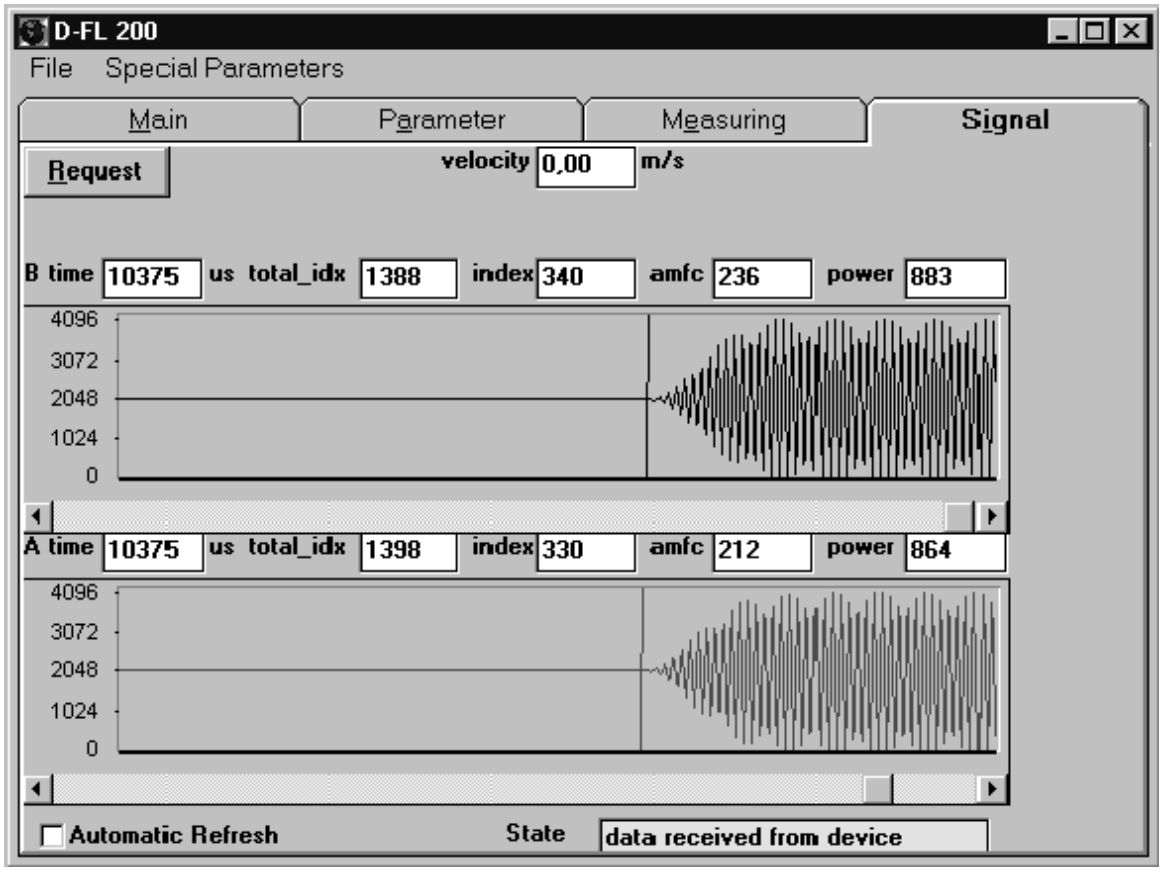
Meaning of the items:

Request	:	single request of measuring values
automatic refresh	:	automatic refresh every 5 seconds
ERROR	:	automatically display of the error-code
Velocity	:	gas velocity [m/s] (1m/s=3,28ft/s)
Standard Flow	:	standard gas flow [m³/h] (1m³/h=35,3ft³/h)
Flow	:	absolute gas flow [m³/h] (1m³/h=35,3ft³/h)
Temperature	:	gas temperature [°C] (y[°F]=1,8x[°C]+32)
Absolute Pressure	:	absolute pressure [hPa]
Speed of Sound	:	stored speed of sound [m/s] (1m/s=3,28ft/s)
State	:	state of communication

- data received from device
- communication error
- data saved in device

10.3.4. Fourth Page / Signal

On this page the ultrasonic signal can directly be displayed. This is done with the "request"-Button. The two charts display the received signals from sensor A and from sensor B.



(Fig. 25) Fourth page / Signal

velocity	Average velocity of the gas flow in [m/s] (1m/s=3,28ft/s)
time	Transit time of the ultrasonic signal in [µs]
total idx	Position of the maximum value inside the array of 3000 values. This represents the time window in which the system looks for the ultrasonic signal. This time window is set by the programmed length of the measuring path and the programmed speed of sound. This value should be somewhere in the middle of the array (about 1500)
index	Position of the trigger point inside the displayed part of the array of 512 values
amfc	The amplification of the variable amplifier. The maximum amplification is reached with the value 1, the minimum amplification is 512. Normally this value is between 60 and 200.
power	The transmit power of every sensor. Normally the values are about 800 (without dimension). The minimum value for error detection is 600.

- The vertical strike displays the trigger point for the measurement.
- The no-signal-noise is measured in the first 100 values of the selected time frame of 512 values. If the no-signal-noise is big enough you can recognise it in the picture (Fig. 25) Fourth page / Signal, page 31. So, the evaluation takes place in the first fifth of the displayed chart.

11. Error Messages

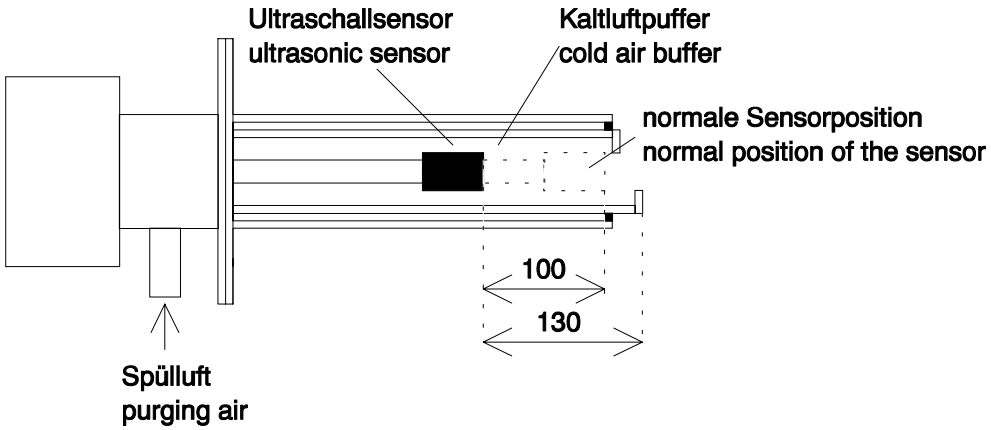
Essential functions are monitored by the system itself. Errors are indicated in the display by the messages “E.01” to “E.33”. If an error is detected, the relay “Error“ is not in operation position. The relay “Error” is only in operation if no “Error” is occurred.

Error Message	Type of Error	Remedy
E.01	EEPROM-Error Error in the input storage	Power up the system again; contact DURAG customer service if necessary
E.02	RAM-Error Error in the working memory	Power up the system again; contact DURAG customer service if necessary
E.03	PROM-Error Error in the program memory	Power up the system again; contact DURAG customer service if necessary
E.04	Temperature transmitter lower than 3,6 mA	
E.05	Pressure transmitter lower than 3,6 mA	
E.06	Temperature transmitter higher than20 mA	
E.07	Pressure transmitter higher than 20 mA	
E.08	Sensor A is not transmitting	Check sensor and connections
E.09	Sensor B is not transmitting	look at E.08
E.10	Sensor C is not transmitting	look at E.08
E.11	Sensor D is not transmitting	look at E.08
E.12	Sensor A signal distorted	Check transducer, increase amplification if necessary
E.13	Sensor B signal distorted	look at E.12
E.14	Sensor C signal distorted	look at E.12
E.15	Sensor D signal distorted	look at E.12
E16	Transducer A is not receiving a sufficient signal	Check transducer, increase amplification if necessary
E.17	Transducer B is not receiving a sufficient signal	look at E.16
E.18	Transducer C is not receiving a sufficient signal	look at E.16

E.19	Transducer D is not receiving a sufficient signal	look at E.16
E.20	Automatic amplification channel A exceeded	Increase pre-amplification in sensor unit.
E.21	Automatic amplification channel B exceeded	look at E.20
E.22	Automatic amplification channel C exceeded	look at E.20
E.23	Automatic amplification channel D exceeded	look at E.20
E.24	Signal A noisy	Decrease pre-amplification in sensor unit.
E.25	Signal B noisy	look at E.24
E.26	Signal C noisy	look at E.24
E.27	Signal D noisy	look at E.24
E.28	Signal A not available	The device does not receive a signal. Either there is no sensor connected or the measuring path length is not correctly programmed.
E.29	Signal B not available	look at E.28
E.30	Signal C not available	look at E.28
E.31	Signal D not available	look at E.28
E.32	wrong path length stored	The device does not receive a signal in expected time. Either there is no sensor connected or the measuring path length is not correctly programmed.
E.33	calculation overflow	The calculation exceeds the normal value range. The parameters should be checked.

12. High temperature applications

If the temperature of the gas is higher than 250°C it is recommended to set the sensor back. Thus a cold air buffer decouples the sensor better from the gas. If the sensors are installed like this it is necessary to reprogram the evaluation unit. At first the measuring path length (R03) has to be increased for the additional length. The second parameter that has to be changed is the sensor offset (R29). In the example stated in the next figure the measuring path length (R03) has to be increased for 200mm (2 sensors) and the sensor offset R29 is 100mm.



(Fig. 26) Measuring in high temperature applications

13. Maintenance

The D-FL 200 is designed to require little maintenance. Maintenance intervals are long, typical several months. The exact length of an interval will vary from site to site. In addition to this, however, the monitoring system should be routinely inspected every three months.

Maintenance should be performed in the following sequence:

1. Cleaning of the external components of the transmitters and the evaluation unit.
2. Inspection of the purge air system and hose connections. Personnel should check for any leaks and verify that the hoses are firmly in place.
3. Visual inspection of the pre-filter. The pre-filter must be emptied out as soon as the dust reaches the level marked on the pre-filter. No tools are required to empty the pre-filter. The filter element of the main filter can be cleaned multiple times before being replaced.
4. The maintenance intervals of the filters are dependent on the quality of the incoming air.
5. Cleaning of the transducers: The sensors may be pulled out from the flanges after the quick-release hasps have been opened. A clean cloth should be used to clean the sensors.

14. Scope of delivery / standard system

D-FL 200 standard system MK1	Description	Order no.	Quantity
Consist of:	D-FL 200 standard, complete system	D-FL 200 SYS1	1
1	evaluation unit	D-FL 200-10	1
2	sensor unit 50kHz	D-FL 200-MK1**	2
3	welding flange	D-FL 200-MF1**	2
4	signal cable, 15m / 49 ft	BFL 200/Leitung	2
5	purge air unit "G" * incl. 10m / 33ft purge air hose	D-R 216 GN	1
6	PC-configuration program fl200com.exe	D-FL 200-COM	1
7	serial PC-cable 1,5m (5ft)	D-FL 200-PC	1
8	manual	D-FL 200-BHB	1
9	customer specific calculations	D-FL 200-AuB	1

* For ducts with gas temperature above dew point

** The length number of the flange and the measuring head must be added according to the figures in section *15. Technical Data*, page *38*.

D-FL 200 standard system MK2	Description	Order no.	Quantity
Consist of:	D-FL 200 standard, complete system	D-FL 200 SYS2	1
1	evaluation unit	D-FL 200-10	1
2	sensor unit 50kHz	D-FL 200-MK2**	2
3	welding flange	D-FL 200-MF2**	2
4	signal cable, 15m / 49 ft	BFL 200/Leitung	2
5	purge air unit "G" * incl. 10m / 33ft purge air hose	D-R 216 GN	1
6	PC-configuration program fl200com.exe	D-FL 200-COM	1
7	Serial PC-cable 1,5m (5ft)	D-FL 200-PC	1
8	manual	D-FL 200-BHB	1
9	customer specific calculations	D-FL 200-AuB	1

* For ducts with gas temperature above dew point

** The length number of the flange and the measuring head must be added according to the figures in section *15. Technical Data*, page *38*.

D-FL 200 standard system MK3	Description	Order no.	Quantity
Consist of:	D-FL200 standard, complete system	D-FL 200 SYS3	1
1	evaluation unit	D-FL 200-10	1
2	sensor unit 50kHz	D-FL 200-MK3**	2
3	welding flange	D-FL 200-MF3**	2
4	signal cable, 15m / 49 ft	BFL 200/Leitung	2
5	purge air unit "G" * incl. 10m / 33ft purge air hose	D-R 216 GN	1
6	PC-configuration program fl200com.exe	D-FL 200-COM	1
7	serial PC-cable 1,5m (5ft)	D-FL 200-PC	1
8	manual	D-FL 200-BHB	1
9	customer specific calculations	D-FL 200-AuB	1

* For ducts with gas temperature above dew point

** The length number of the flange and the measuring head must be added according to the figures in section *15. Technical Data*, page *38*.

Optional accessories	Description	Order no.	Quantity
1	temperature transmitter	D-FL100-TM/H	1
2	pressure transmitter	D-FL100-ADM/H	1
3	purge air unit "E" *** incl. 10m /33ft purge air hose	D-FL 200-GN	1
4	acid resistant purge air hose	wdisäureschlauch	10m
5	gas flow protection screen	D-FL 200-SB	1
6	purge air supervisor system	D-SK 300-10	
7	simple purge air watchdog with pressure switch at the fan	D-SK 200-DSCH	1
8	blind flange with sealing ring	D-FL 200-BF	1
9	weather protective hood for the sensor unit	D-WSH 200-MK	1
10	weather protective hood for the evaluation unit	D-WSH 200 A	1
11	weather protective hood for purge air unit "G"	D-WSH 290 GN	1
12	weather protective hood for purge air unit "E"	D-WSH 280 GN	1

*** For ducts with gas temperature below dew point

Spare parts recommendation	Description	Order no.	Quantity
1	ultrasonic transducer AT50 for system 1	D-FL200-AT50	2
2	ultrasonic transducer AR41 for system 2	D-FL200-AR41	2
3	ultrasonic transducer AR30 for system 3	D-FL200-AR30	2
4	signal cable, 15m / 49 ft	BFL 200/Leitung	1
5	fuses 0,5 A, 230V mains (for 230V supply)		10
6	fuses 1 A, 230V mains (for 115V supply)		10
7	fuses 1.6 A 230V (for 24V)		10
Purge air unit			
8	filter cartridge P77-5308 for purge air unit	wdilfilter5308	1
9	filter case FP G05-7505 for purge air unit	wdilfilter7505	1
10	air hose Ø 40 mm (1,5in)	wdiluftsch216	10 m
11	hose clamp for Ø 40 mm air hose	wdischelle216	1
12	hose clamp for Y-air splitter, Ø 50 mm	wdischelle280	1

15. Technical Data

Measuring principle:

Continuous in-situ measurement according to the principle of acoustic transit time differential

Measuring range:	0-40 m/sec.	(0-131 ft/sec.)
Corresponds to:	0-5*10^6 m^3/h	(approx. 0-17,7*10^7 ft^3/h)
Temperature:	0-250°C	(0-482°F)

Evaluation Unit:

Power supply:	115/230V (±10%), 50/60Hz
Permissible ambient temperature:	-20 to +50°C (-4 to +122°F)
Relay contacts:	"Error", "Maintenance", "Limit value'' All relay contacts are potential-free
Max. contact load given cosφ=1 :	230V/0.5A
Integration time of the measured value:	1 – 180 sec.
Output signal:	2 current outputs, 4-20mA
Maximum ohmic resistance:	500 Ω
Auxiliary power:	24V/1A for maximum of four sensors
Enclosure rating:	IP 65 / NEMA 4X

Transducers

Auxiliary power:	24V/DC
Permissible ambient temperature:	-20 to +60°C (-4°F to +140°F)
Flange:	special flange / tube 110x5
Material of the process parts:	1.4571 (standard)
Housing material of the evaluation unit :	Aluminium
Flue gas temperature:	up to 250°C (482°F), measurements below the dew point are possible
Angle of installation:	30° - 60°
Min. length of the measuring path:	1.4m (4,6ft)
Max. length of the measuring path:	see following table

	Maximum measuring path length, standard flue gas		
Temperature	Sensor MK1 (50kHz)	Sensor MK2 (41kHz)	Sensor MK3 (30kHz)
up to 80°C / 176°F	5m / 197 in	8 m / 315 in	11 m / 433 in
up to 120°C / 248°F	4m / 157 in	6,5m / 256 in	8,0m / 315 in
up to 160°C / 320°F	3m / 118 in	5 m / 197 in	6 m / 236 in
more than 160°C /320°F	2m / 79 in	3,5m / 138 in	4,5m / 177 in

Measuring head:

No.	length inside the flange	complete length
1	260 mm / 10,2 in	470 mm / 18,5 in
2	360 mm / 14,2 in	570 mm / 22,4 in
3	560 mm / 22,0 in	770 mm / 30,3 in
4	760 mm / 29,9 in	970 mm / 38,2 in
5	960 mm / 37,8 in	1170 mm / 46,1 in

Standard

⇨ ***To combine the measuring head and the flange pay attention that measuring head no. and flange no. are equal !!***

Flange:

Pipe 110x5 mm (4,3x0,2in)

Flange ∅ 190 mm (7,5in)

Material: 1.4571 (standard)
Flange length:

Flange-No.	length of the flanges
1	235 mm / 9,2 in
2	335 mm / 13,2 in
3	535 mm / 21,1 in
4	735 mm / 28,9 in
5	935 mm / 36,8 in

Standard

⇨ ***To combine the measuring head and the flange pay attention that measuring head no. and flange no. are equal !!***

Purge air unit “G” for gas above dew point

Mains:	230V,±10%, 50Hz	Others on request
Power consumption:	0,25kW at 230V	
Air volume at 0 mmWS:	app. 1,4 m³/min (49,4ft³/min)	
Weight:	app. 20kg	

Purge air unit “E“ for gas below dew point

Mains:	200...240V, Δ-Wiring 345...415V, Y-Wiring 50Hz … 60 Hz	Other voltage and frequencies on request
Nominal current:	2,1A Δ-Wiring, 1,2A Y-Wiring	
Power consumption:	0,43 kW at 230V, 50Hz	
Air volume at 0 mmWS:	app. 2,2 m³/min (77,7ft³/min)	
Weight:	app. 30 kg	

One purge air unit includes 10m (33ft) purge air hose.

16. Measuring Point Questionnaire

Technical requirements for selection of flow meters

Kunde / Customer	:	Datum / Date	:
Referenznummer Reference no.	:	Anlagentyp Plant type	:
Projekt Name Project Name	:	Bearbeiter Responsible	:
Auftragsnummer Order no.	:	Telefon Telefax	:

Anzahl der Messköpfe Number of sensors	:	2 Messköpfe / Standard 2 Sensors /standard	◯	4 Messköpfe 4 Sensors	◯
Anzahl der Geräte Number of devices	:	St. pc.			

Gas / Medium

Medium Gas type	:		Normdichte Standard density	:			kg/m³
CO_2 -Anteil CO_2 share	:	%Vol	aggressive Gasbestandteile aggressive gas components		◯		
Staubbeladung Dust load	:	mg/Nm³	—	Welche Which	:	Anteil Share	: %

Anlagenbedingungen / Plant Conditions

Gas-Temperaturbereich Gas temperature range	:	°C	Temperatur Umgebung Ambient temperature	:	°C
Taupunkt Gas Dew point	:	°C	Druck im Kanal Pressure in duct	:	hPa
Gasgeschwindigkeits-bereich Gas velocity range	:	m/s	Brennstoff Fuel	:	

Einbausituation Kanal / Installation Details Duct

Kaminquerschnitt Cross section duct	Rund Circular	◯		rechteckig rectangular	◯
Durchmesser (Innen) Diameter (Internal)	:	mm			
Durchmesser (Außen) Diameter (Outer)	:	mm	(ohne Isolation) (without insulation)		
Isolationsstärke Insulation thickness	:	mm			
Wandstärke Wall thickness	:	mm			
Einlaufstrecke Uninterrupted flow Distance before sensor	:	mm			
Auslaufstrecke Uninterrupted flow Distance after sensor	:	mm			

Kanalrichtung Duct direction	:	Horizontal Horizontal	◯	Vertikal Vertical	◯
		Innen Indoor	◯	Außen Outdoor	◯

Elektrischer Anschluss / Electrical Connection

Spannung Voltage	:	115V ◯		230V ◯	andere other	:	V
Frequenz Frequency	:	50Hz ◯		60Hz ◯	andere other	:	Hz
Netz Gebläseeinheit Mains purge air fan	:	Einphasig single phase ◯			dreiphasig three phases ◯		

Berechnung des Normvolumenstromes / Calculation of the standard flow

Temperaturmessung Temperature measurement	:	externer Sensor External sensor	◯	Messbereich Range	:	
		D-FL 200 Messung D-FL 200 reading	◯			°C
		konst. Temperatur const. temperature	◯			
Absolutdruckmessung Pressure measurement	:	externer Sensor external sensor	◯	Messbereich Range	:	
		konstanter Druck constant pressure	◯			hPa

Weitere Hinweise Further remarks	:	Zeichnungen anbei Drawings enclosed	◯

EG-Konformitätserklärung
EC Declaration of Conformity

Hersteller *Manufacturer*	**DURAG** Industrie-Elektronik GmbH & Co KG
Anschrift *Address*	Kollaustr. 105, D22453 Hamburg
Produktbezeichnung *Product description*	Name **Volumenstrom-Meßgerät D-FL 200 / D-FL 200T** *Name **Volume Flow Meter D-FL 200 / D-FL 200T***

Das bezeichnete Produkt stimmt mit den Vorschriften folgender Europäischer Richtlinie überein, vorausgesetzt, daß es installiert, gewartet und entsprechend seiner Bestimmung eingesetzt wird. Die einschlägigen Vorschriften und Hinweise aus der Bedienungsanleitung sind zu beachten.

The described product complies with the following provisions of Council Directive, provided that it is installed, maintained and used in applications for which it was made, in accordance with relevant installation standards and manufacturer's instructions.

Richtlinie des Rates 89/336/EWG (EMV), geändert durch 91/263/EWG, 92/31/EWG und 93/68/EWG

Council Directive 89/336/EEC (EMC), changed by 91/263/EEC, 92/31/EEC and 93/68/EEC

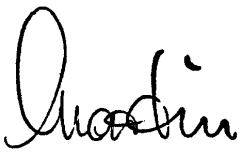
Wir bestätigen die Konformität des oben bezeichneten Produktes entsprechend den Normen:

We confirm the conformity of the above mentioned product according to the standards:

EN	50 081-1	(93)
EN	50 082-1	(93)

Aussteller *Issuer*	DURAG Industrie Elektronik GmbH & Co KG
Ort, Datum *Place, date*	Hamburg, 14.07.1999

Rechtsverbindliche
Unterschrift
Legally binding Signature



(Prof. Dr.-Ing. Martin)