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DURAG

D-FW 231

Filter Monitor

CE

TÜV CERT DIN ISO 9001 Zertifikat QA 07 100 052

DURAG GmbH

Kollaustraße 105 · D-22453 Hamburg · Tel. +49 40 / 55 42 18-0 · Fax +49 40 / 58 41 54

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1 Application

The DURAG D-FW 231 Filter Monitor is employed for continuous monitoring of filtering systems in flue gas ducts or in duct work for dust extraction, etc. The filter monitor is placed behind a filter on the clean-gas side, and will report any defect. By using filter monitors at the most important emissions sources or filters, appropriate action may be taken in the event of a malfunction to prevent or limit damage, e.g., by shutting down the defective filter chamber

This system offers several advantages over comparable optical devices, including low purchase, installation and maintenance costs, and extremely high performance.

The filter monitor has been suitability tested by TÜV Nord, test report 98CU026 from 12.01.1999. Itemized in the list of suitable instruments for continuous monitoring of emissions GMBI 1999 Nr. 22.

The measuring system is designed, made and tested for application in not explosive zones.

2 Description of the Measuring Principle

The DURAG D-FW 231 Filter Monitor operates according to the principle of triboelectric measurement.

When dust particles collide with one another, they acquire an electrical charge. If these electrically charged particles strike the probe lance, the charge is transferred through the probe to ground. The current flowing through the probe is proportional to the number of particles colliding with it.

Due to the measuring principle used, the results do not depend upon dust concentration only. Flow velocity also plays a role. The measured result will thus accurately correspond to the dust emission. Dust concentration may be determined by calculating the particle flow velocity.

In addition to dust concentration and particle flow velocity, the ability of the particles to acquire and give off an electrostatic discharge also influences the measured result. Humidity and particle type are decisive factors in determining this.

3 Basic Characteristics

- In-situ measurement, directly behind or in the filter
- Continuous measurement
- Integration which can be activated or deactivated according to choice
- Compact design
- Complete functionality in one component
- Protection from dust or moisture penetration (IP65)
- Rugged construction, no moving parts
- Easy mounting, installation and operation
- Monitor can be easily checked for proper performance
- Low maintenance costs

4 Functional Description

The sensor records the electrical charge of the dust using a probe lance which is inserted directly into the flue gas duct. It then processes the signal into a 4-20 mA signal. In addition to the amplification of the input signal, other necessary tasks are performed during signal processing, including rectification and damping of the signal.

These operations are carried out entirely in the sensor probe. Possible interference is minimised since signal processing takes place directly in the sensor probe and measured values are transmitted as interference-resistant current signals.

The probe lance can be disconnected electrically from the amplifier chain in order to perform a zero test. The unit cannot then display the dust content (measured value 0 = 4 mA).

An integration period may be added to smooth the measurement signal.

5 Description of System Components

The filter monitor consists of one assembly and contains the following:

- Probe lance, insulator
- Amplifier
- 20mA output driver for measurement signal
- Sensitivity setting
- Switching of the integration period
- Button for checking the zero point
- Power supply
- Test points for checking measured values when performing service
- Connection via plug or fixed wiring

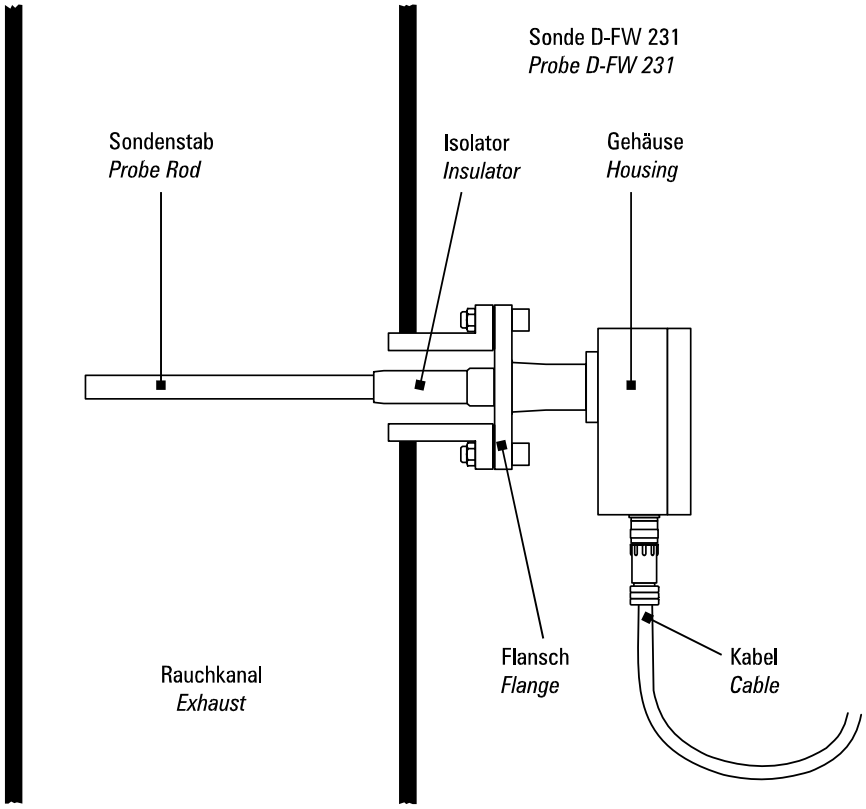


Fig. 1 System components

The sensor probe consists of the probe lance in the flue gas duct, the flange and the housing with the electronics.

Operations are carried out essentially by the probe lance and amplifier chain, which amplifies the current from the sensor probe and converts it into a 4-20 mA signal.

Amplification is set digitally using a six-way DIL switch.

The signal from the pre-amplifier is rectified and integrated during signal processing. The two possible integration periods are selected by means of the "OFF Int. ON" signal input

A voltage-current conversion to 4-20 mA takes place before transmission.

The offset alignment of all amplifiers in the signal path may be checked thanks to a relay that electrically uncouples the sensor ("4mA" signal input).

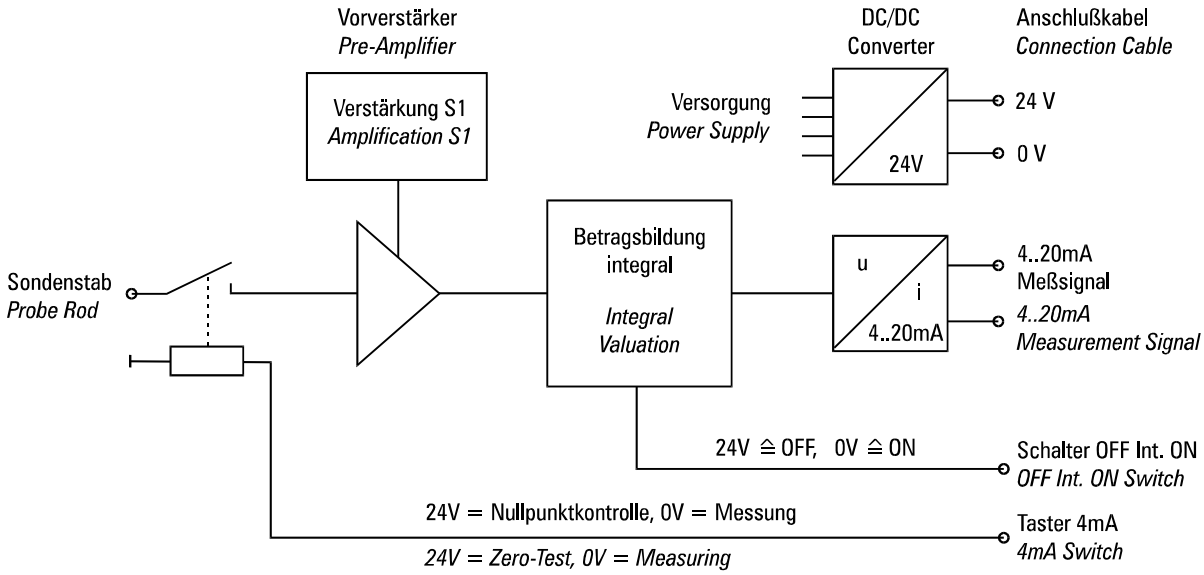


Fig. 2 Block diagram of the electronics

6 Technical Data

Gas temperature	-20 - 200°C (-4-392°F), with option for up to 500°C (932°F)
Ambient temperature	-20 - 50°C (-4-122°F)
Penetration depth of the probe	400mm (15.75 in.), with options for 80 mm (3.15 in.), 250 mm (9.84 in.) and 700 mm (27.56 in.); custom lengths available upon request
Measured value signal	4 - 20mA, load 500Ω; maximum of 28 mA in case of overload
Integration period	2 sec. or 20 sec., selectable
Power supply	24V DC (18V to 36V), 0.2A
Enclosure rating	IP65
Functional test	zero test (manual or via signal input)
Cable length	max. cable length: several hundred meters
Weight	1.9 - 4.5 kg., depending on flange used and length of probe lance
Flow velocity of monitored gas	> 7 m./sec.; if velocity is low, dust concentration must be correspondingly high

7 Choosing the Measuring Point

The measuring point must be located on the clean-gas side of the flue gas duct, at least 2 m. beyond the filter. The length of the flow path prior to reaching the filter monitor must total at least 5x the diameter of the channel.

If dust concentration is low, the selection of the measuring point is especially important in order to take full advantage of the triboelectric measuring principle. The chosen measuring point must be located at a site where both the flow velocity is high and the longest possible measuring probe may used.

The following illustration shows three potential measuring points behind a filter installation. Measuring points 1 and 3 are unfavourable. Mounting the filter monitor at measuring point 2 is the best choice.

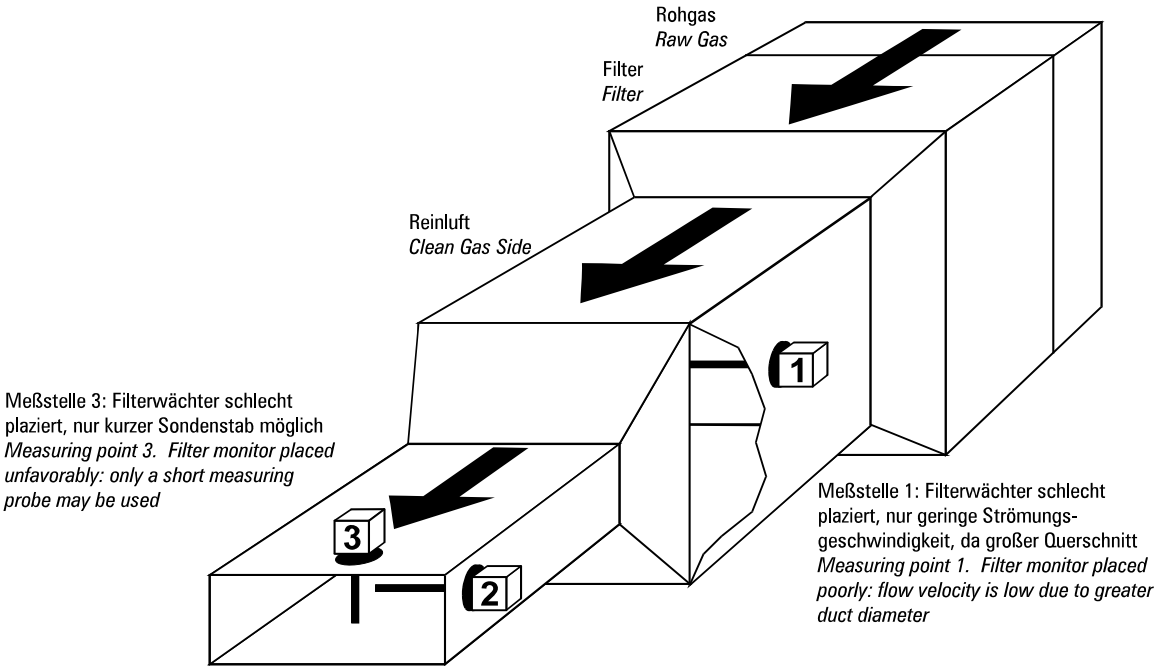


Fig. 3 Choosing the measuring point

In order to keep moisture away from the sensor insulator, the sensor should be mounted horizontally or with a downward slope.

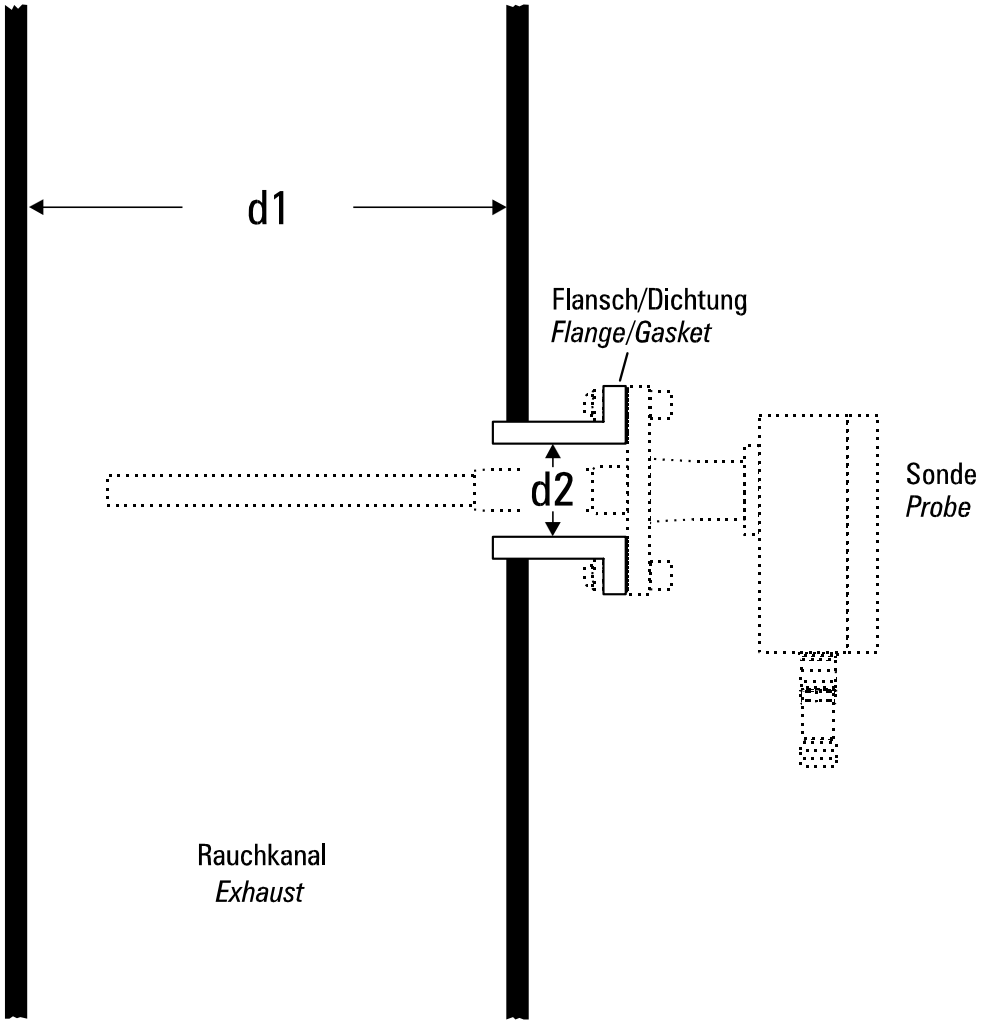
Be cautious at precipitators

A precipitator charges, due to its mode of operation, the dust particulates and covers thus the electrical charge, caused by the triboelectric effect and thus falsifies the measurement. This influence can be diminished by a long duct distance or by additional units e.g. bag filter, heat exchangers or scrubbers between the ESP and the triboelectric measurement point.

An assembly directly behind a precipitator can lead to device failures.

8 Mounting

A flange with a welded pipe socket, or a corresponding pipe socket, is to be provided for mounting the probe. For dimensional drawings see figures 7 through 9.



Flange/Pipe Socket	Standard:	Pipe socket with 1“ (G1) female thread connection DIN ISO 228
	Alternative:	DIN 2633 nominal size 32, line 1
	Alternative:	quick release flange
	The flange/pipe socket must be welded on such that the insulator projects 10 to 15 mm. into the flue gas duct.	
d1	Diameter of the flue gas duct. This determines the length of the probe lance; penetration depth approx. 50 to 70% of d1, with a maximum of 1000 mm.	
d2	Interior diameter of the pipe socket. At least 36 mm. overall internal width	

Fig. 4 Mounting

In stacks with flue gas temperatures over 150°C or weak insulation, thermal shields and/or insulating gaskets should be employed. It must be ensured that the electronics housing is never heated above 50°C (122°F).

9 Installation

The electrical connection for the D-FW 231 is made according to the wiring diagram.

Plug Contact	Cable Colour	Description
1 / A	red	24V DC power supply, positive potential
3 / C	white	24V DC power supply, negative potential
4 / D	pink	Zero test “4mA“
5 / E	grey	Connection of the integration “Integral“
6 / F	green	Reference potential for “4mA” and “Integral”
8 / H	yellow	Measured value output (+)
9 / J	brown	Measured value output (-)

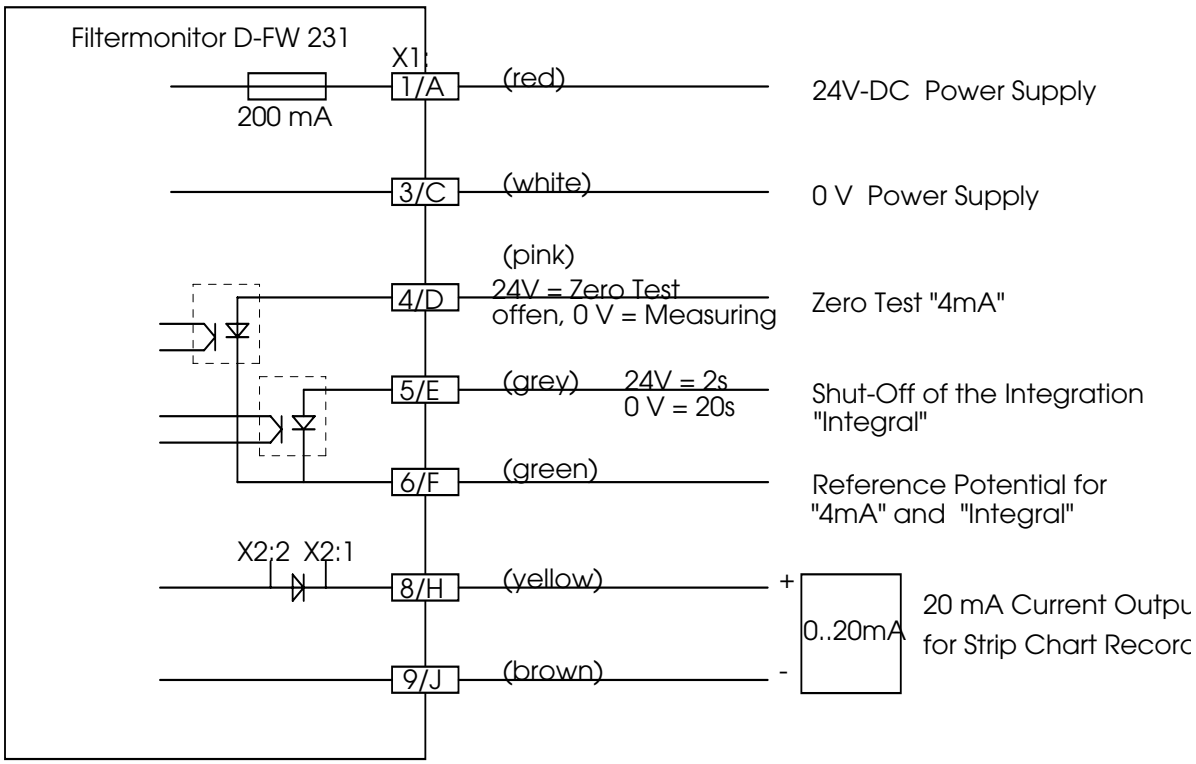
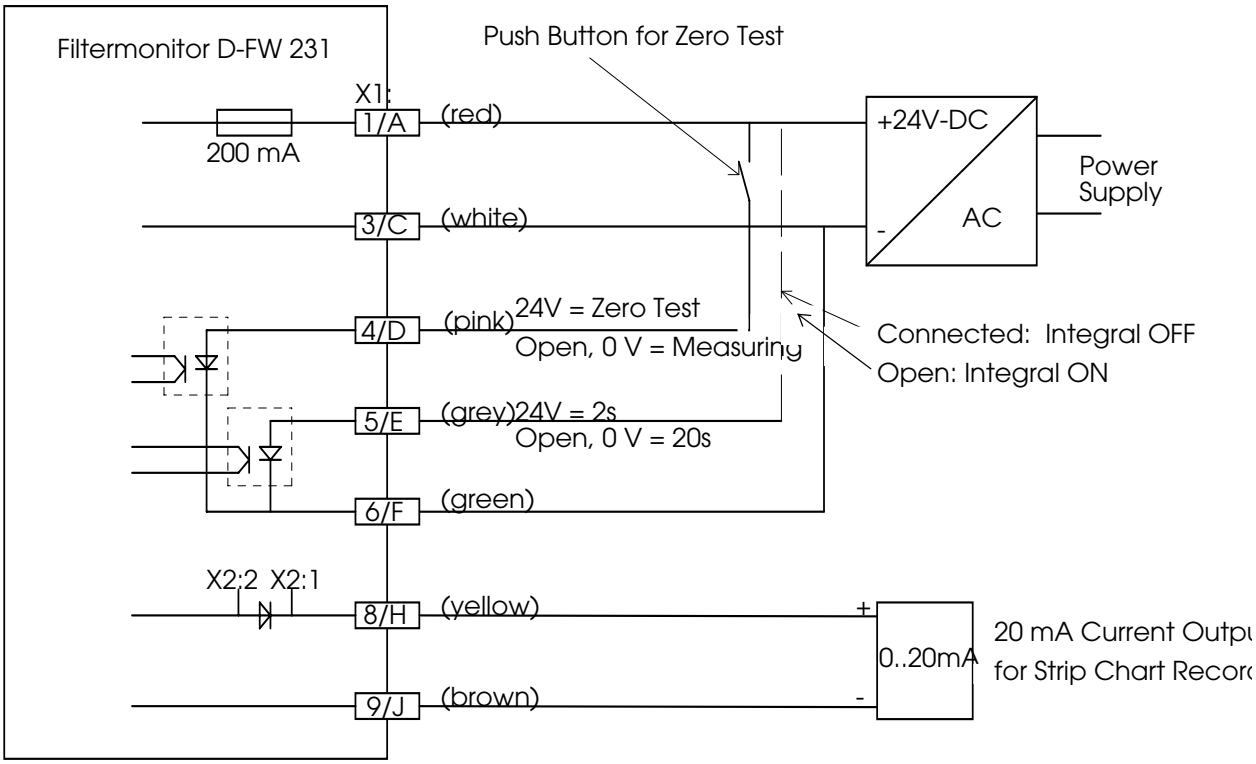


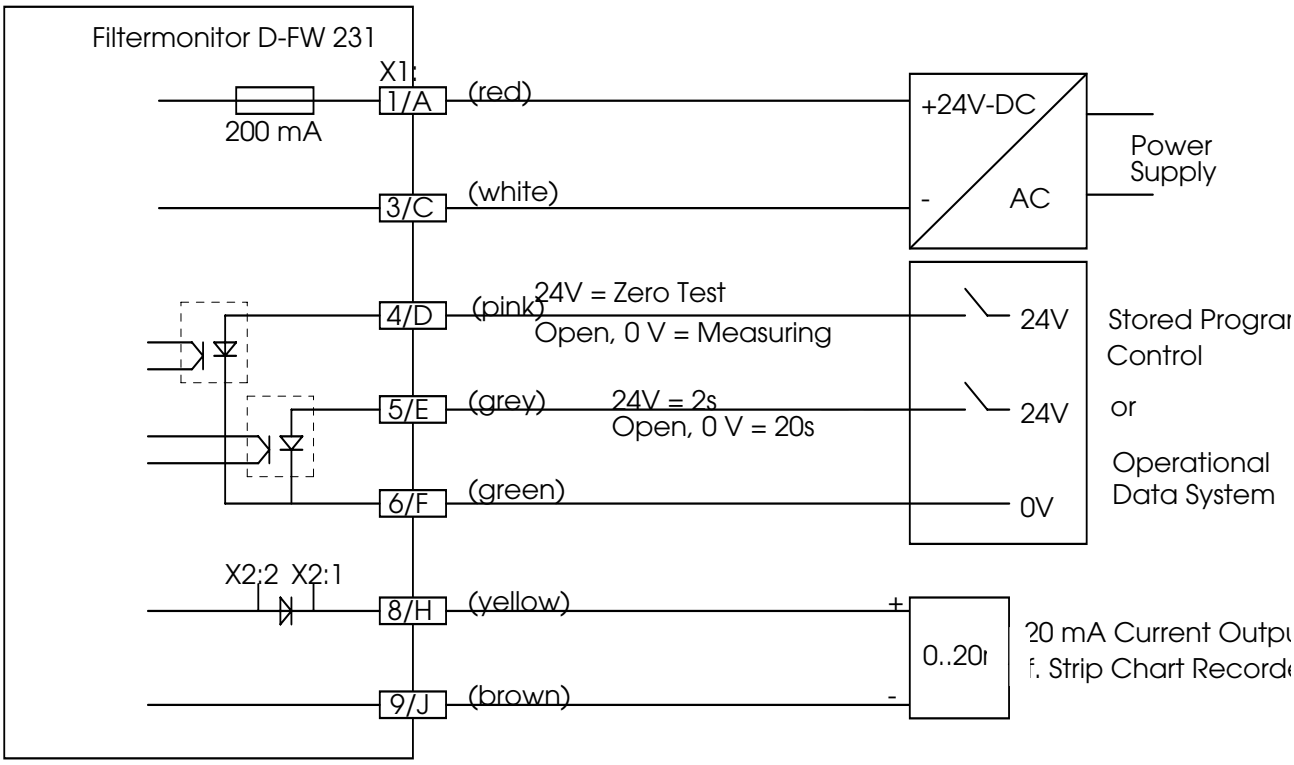
Fig. 5 General installation diagram for D-FW 231 Filter Monitor

Caution!
All relevant local electrical regulations must be observed when making the installation.

Examples



Simple application in which the switching of operational modes (zero test, integral ON/OFF) occurs using a 24V power supply.



Application in which operational status is switched via a logic (stored program control, operational data system, etc.).

Fig. 6 Possible installations for the D-FW 231 Filter Monitor

Installation of the Control Unit D-FW230-B

The Filter Monitor D-FW 231 can also be connected to the Control Unit D-FW230-B. When the Control Unit D-FW230-B is used with the Filter Monitor D-FW231 instead of the D-FW230-S, it is possible to have distances between the Control Unit and the measuring point of several 100m. Please find the wiring diagram below. For distances more than 20m it's recommended to use shielded cable, the shield has to be connected only on the Control Unit side. The connector is specified for cable diameters AWG22 to AWG20 (0,32-0,52mm2).

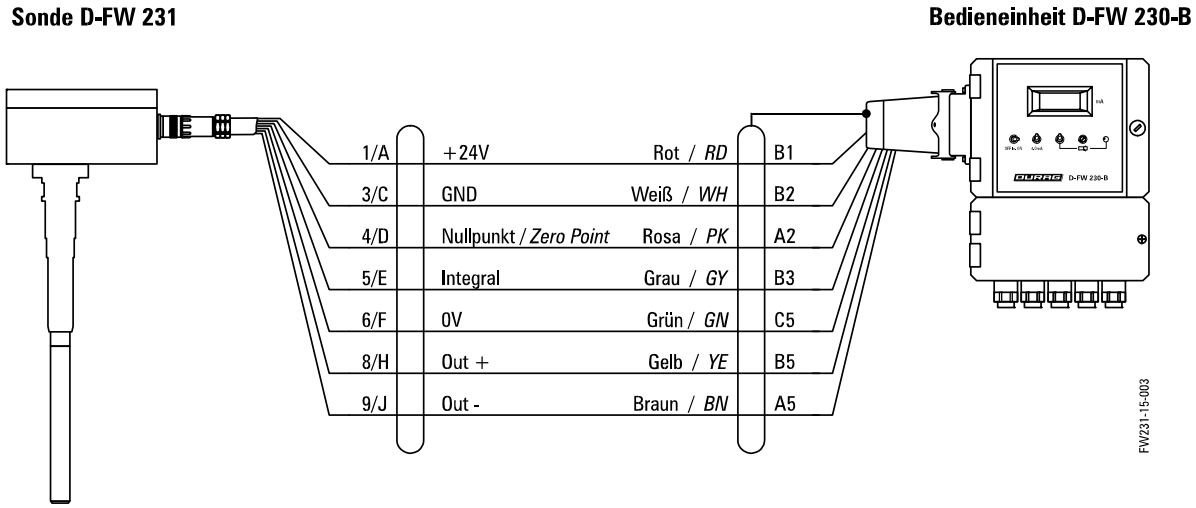


Fig. 7 Wiring diagram to use the Control Unit D-FW230-B

10 Start-Up

Caution: Operating voltage is 24V DC

Start-up may begin once the monitor is mounted and the electrical installation is concluded. The filter monitor is aligned at the factory so that only the amplification needs to be set.

Setting the Amplification:

The amplification is set using a six-way DIL switch in the sensor probe. The switch is accessible once the sensor cover is opened. The amplification is to be set such that signal changes are already recognisable during normal operation.

S1:1	S1:2	S1:3	S1:4	S1:5	S1:6	Amplification
ON	ON	*	*	*	*	67
ON	*	*	*	*	*	45
*	ON	ON	*	*	*	31
*	ON	*	*	*	*	21
*	*	ON	ON	*	*	14.5
*	*	ON	*	*	*	10
*	*	*	ON	ON	*	6.7
*	*	*	ON	*	*	4.5
*	*	*	*	ON	ON	3.1
*	*	*	*	ON	*	2.1
*	*	*	*	*	ON	1
*	*	*	*	*	*	0.4

* OFF

11 Maintenance

If the probe lance ever suffers damage, it must be replaced.

Cleaning the Probe:

Under normal operating conditions, the sensor probe is maintenance-free. In the case of a filter defect, the sensor probe should be taken down and the probe lance/insulator cleaned with a cloth. If caking occurs due to high relative humidity in the gas or as a result of adherent dust, cleaning should be done at regular intervals.

Zero-Testing:

The zero-point should be checked monthly. 24 V DC potential is to be applied to the “Zero-Test 4 mA” input. Alternatively, the S3 switch in the probe may be activated. The measured value should then fall to 4 mA, +/- 0.2 mA. If deviations occur, the zero may be adjusted as follows:

Setting the Zero-Point and Sensitivity of the System:

The potentiometers are located in the sensor electronics.

The setting **must** be made in the sequence **P1, P3 , P2**. Potentiometers P2 and P3 only needs to be adjusted after a repair has been made.

P1	Zero-Point	The zero-point of the evaluation electronics is aligned. Settings: the probe lance is electrically uncoupled by activating the S3 switch in the probe. The displayed measured value is set to a minimum with potentiometer P1.
P3	4mA	The zero-point of the evaluation electronics is aligned to 4mA. Settings: the probe rod is electrically uncoupled by activating the S3 switch in the probe. The displayed measured value is set to 4 mA with potentiometer P3.
P2	System Sensitivity	The sensitivity of the amplifier is aligned. Settings: DIL switch S1:6 set to ON, the rest OFF. The tests points MP3 and MP4 must be connected. A defined current will be fed through these points. The measured value is set to 20 mA with potentiometer P2. **Potentiometer P2 must be set only if a repair has been made to the sensor probe, and may only be performed by the manufacturer or authorised repair service.**

12 System Components and Accessories

Qty.	Part Number	Description
1	D-FW231-System	D-FW 231 Filter Monitor With complete electronics in the sensor probe Rated voltage: 24V DC Length of probe lance: 400 mm (15.75 in.) 1“(G1) threading used for mounting
1	D-FW230 MP-FD	Option: mounting: DIN-flange
1	D-FW230 MP-FK	Option: mounting: Quick release flange
1	D-FW230-TE	Option: gas temperature up to 500°C (ceramic insulator)
1	D-FW230-ST08	Option: Length of probe lance 80 mm (3.15 in.)
1	D-FW230-ST25	Option: Length of probe lance 250 mm (9.84 in.)
1	D-FW230-ST70	Option: Length of probe lance 700 mm (27.56 in.)
1	Upon Request	Option: Custom length for probe lance
		Accessories:
1	D-FW230-FL	Mounting equipment: Flange with pipe socket for welding to the flue gas duct
1	D-FW230-DI	Mounting and incidental items: Gasket between sensor probe and flange on the flue gas duct
1	D-FW230-KFL	Quick release flange with pipe socket for welding to the flue gas duct
1	D-FW230-KDI	Quick release sealing
1	D-FW230-KDS	Quick release clamp
1	D-FW231-ST-SET	Contra connector for the D-FW231

13 Dimensional Drawing

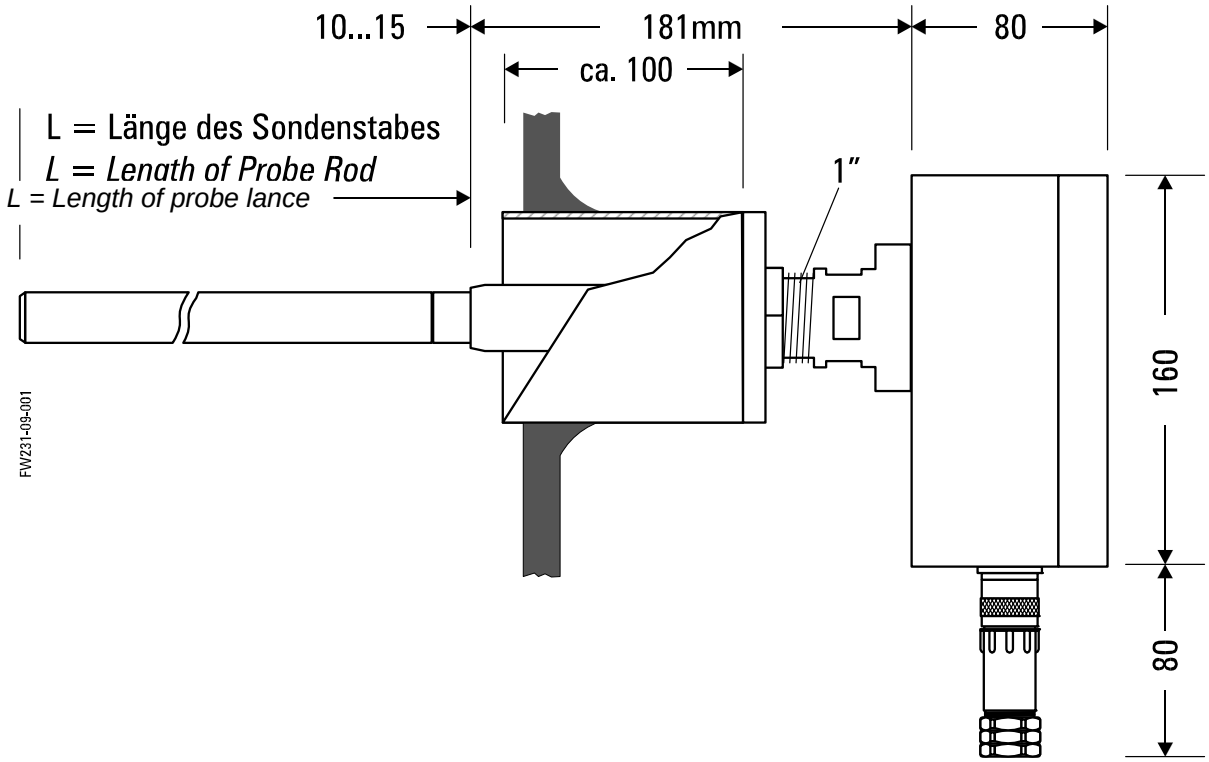


Fig. 8 Dimensional drawing of sensor probe with 1“ (G1) threading according to DIN ISO 228

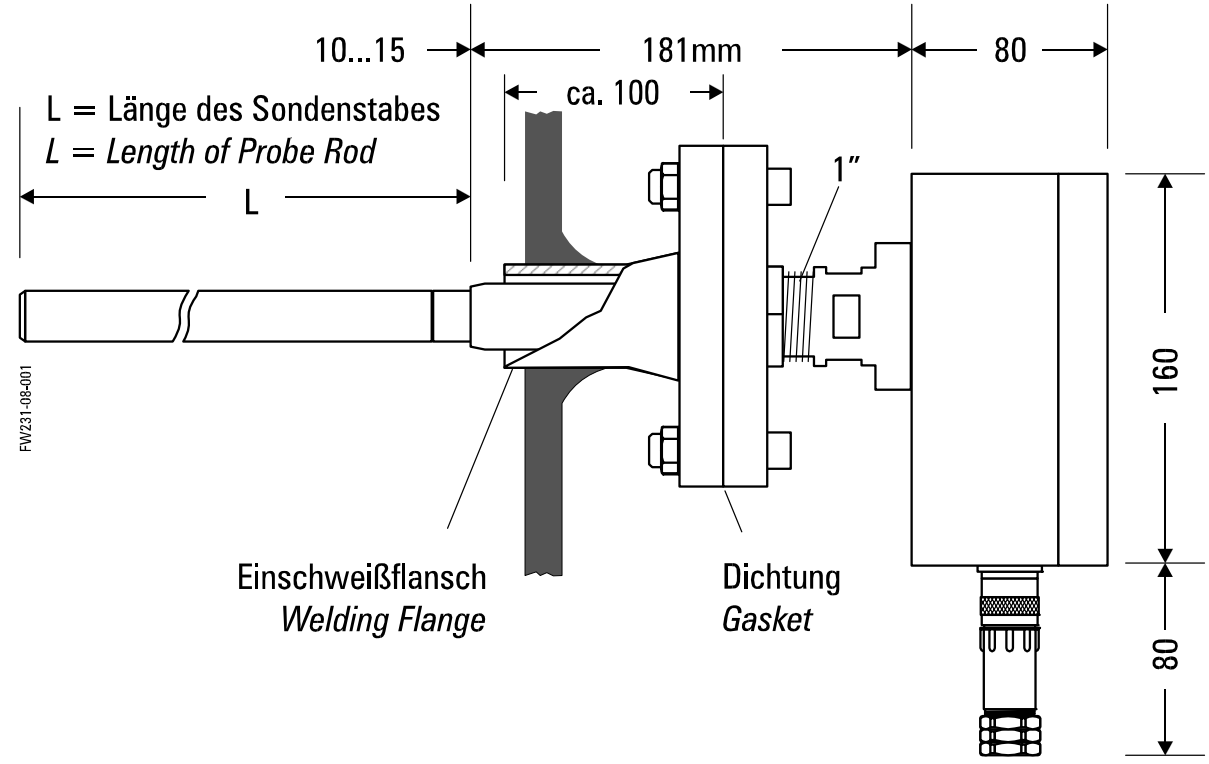


Fig. 9 Dimensional drawing of sensor probe with flange according to DIN 2633 DN 32

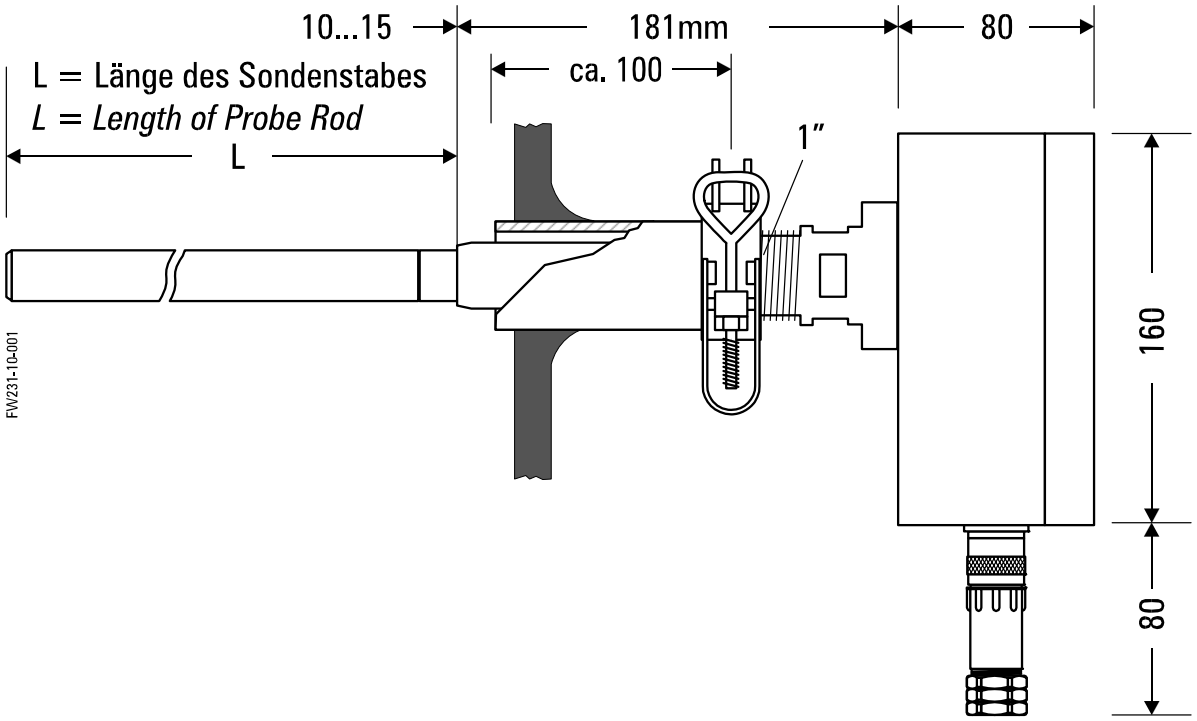


Fig. 10 Dimensional drawing of sensor probe with quick release flange

14 Appendices

DURAG

INDUSTRIE ELEKTRONIK GMBH & CO KG

EG-Konformitätserklärung
EC Declaration of Conformity

Hersteller *Manufacturer*	**DURAG** Industrie-Elektronik GmbH & Co KG
Anschrift *Address*	Kollaustr. 105, D22453 Hamburg
Produktbezeichnung *Product description*	Filterwächter **D - FW 230** *Filterwatch **D - FW 230***

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 50 082-2 (96)

Aussteller *Issuer*	DURAG Industrie Elektronik GmbH & Co KG
Ort, Datum *Place, date*	Hamburg, 16.09.96
Rechtsverbindliche Unterschrift *Legally binding Signature*	(Prof. Dr.-Ing. Martin)

KONFORM.DOT/KFW230.DOC

Postfach / P.O. Box: 61 02 20, 22422 Hamburg · Kollaustraße 105, 22453 Hamburg
Telefon: 040 / 55 42 18-0 · Fax: 040 / 58 41 54 · USt-IdNr.: DE 118034482
Banken: Hamburgische Landesbank 149 161, BLZ 200 500 00 · Commerzbank 19 511 10, BLZ 200 400 00
Postgiroamt Hamburg 50612-206, BLZ 200 100 20
Kommanditgesellschaft: Hamburg HRA 82808 · Persönlich haftende Gesellschafterin:
Durag Industrie Elektronik GmbH, Hamburg HRB 39787

Fig. 11 EC Declaration of Conformity

Nr. 22 GMBl 1999 Seite 445

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

Bundeseinheitliche Praxis bei der Überwachung der Emissionen und der Immissionen

– RdSchr. d. BMU v. 28. 4. 1999 – IG I 3 – 51134/2 –

I.

Eignung von Meßeinrichtungen zur kontinuierlichen Überwachung von Emissionen

Unter Bezugnahme auf Nummer 3 der Richtlinie über die Bundeseinheitliche Praxis bei der Überwachung der Emissionen – RdSchr. d. BMU vom 08. 06. 1998 – IG I 3 – 51 134/3 (GMBl 1998, S. 543) – wird die Eignung der folgenden Meßeinrichtungen bekanntgegeben:

1. Staubförmige Emissionen: qualitativ

1.1 Filterwächter D-FW 230 und D-FW 231

Hersteller:

DURAG Industrie Elektronik GmbH & Co. KG, 22453 Hamburg

Eignung:

Zur qualitativen Überwachung von Staubgehalten;

Kleinster Meßbereich bei der Eignungsprüfung:

0 – 35 mg/m³

Einschränkungen:

1. Die Meßeinrichtung soll nur an Anlagen mit konstanten Volumenströmen (± 10 %) und konstanten Abgasbedingungen eingesetzt werden.
2. Das Gerät besitzt keine Referenzpunktkontrolle.
3. Das Gerät kann nur eingesetzt werden, wenn eine Unterschreitung des Taupunkts ausgeschlossen werden kann.

Hinweise:

1. Die Kalibrierfähigkeit des Meßsystems wurde im Meßbereich 0 – 35 mg/m³ nachgewiesen.
2. Nach einer Filterstörung mit hohem Staubanfall ist die Sonde zu reinigen.

Prüfbericht:

Gesellschaft für Umweltschutz, TÜV Nord GmbH, Hamburg, Nr. 98 CN 026 vom 12.01.1999

Fig. 12 Extract of the list of suitable measuring instruments GMBl 1999 Nr. 22.