Product description

Microprocessor based system for control and monitoring of fume hood exhaust air volume flow or face velocity in relation to the front sash and slide window opening. Depending on the configuration the following operating modes for fume hood control are possible:

Standard model

- face velocity control **iCM-F**

with optional add on system -E2

- face velocity control with limitation to V_{MIN} and V_{MAX} **iCM-FP**
- position sensor control **iCM-W**
- fully variable control **iCM-V**
- constant control (1, 2 or 3 point) **iCM-K**

The integrated functional monitoring in accordance with **EN 14175** offers maximum safety for laboratory staff. When the exhaust air setpoint that is to be regulated is underrun, an acoustic and optical alarm is activated.

Suitable for all fume hood constructions and extraction units. Standard model with air flow sensor.

Functional description

In order to calculate the exhaust air volume flow that is to be regulated, the vertical (sash position sensor) and horizontal (air flow sensor) adjustment of the sash opening is determined. The calculated sash opening serves as a command variable and setpoint value for the air volume flow that is to be regulated. A high-speed control algorithm constantly compares the setpoint with the actual value measured by a air flow sensor and regulates the constant face velocity (air input speed) quickly, precisely and steadily, independent of pressure fluctuations in the duct system. The precalculated exhaust air requirement developed by SCHNEIDER is calculated immediately and is available as a setpoint. This considerably improves the control time of the room air controller (e.g. SCHNEIDER VAV supply air volume flow controller).

Advantages of the sash dependent variable fume hood controller

The containment-safety of the fume hood is guaranteed in all sash opening positions while at the same time ensuring minimal air consumption. Ventilatory robustness of fume hood operation is achieved by appropriate programming of the constant face velocity and can be individually adapted to any type of fume hood construction. The air flow sensor is used in the standard model. The optional add-on system -E2 allows the connection of three independent sensors (sash position sensor, static differential pressure transmitter and air flow sensor). The controller iCM checks these three sensors for mutual plausibility. The logical context of the actual values of the differential pressure and air flow sensors in relation to the actual value of the sash is constantly checked and validated. This represents a considerable increase in the safety potential for the entire control system and for the user. Measurement errors and discrepancies are recognized and signalled immediately.

Performance features

Standard model

- Microprocessor based variable control system with full graphic LC display
- Numerical and bar graph display of the air input velocity in m/s or ft/min
- Compact low cost built in system
- External plug in adaptor 230V AC/15V DC
- All system data are saved mains voltage failure-safe in the EEPROM
- Programming and read out of all system values via the service module SVM100 or software PC2500
- Air flow sensor for measuring the face velocity
- Air volume flow range 10:1
- Integrated functional monitoring of fume hood operation in accordance with EN 14175 with acoustic and optical alarm
- Optical and optionally acoustic alarm for the operating status "Sash position > 50cm"
- Emergency operation (override) = $V_{OVERRIDE}$
- Night-time operation (reduced operation) = V_{NIGHT}
- Monitoring of supply air and exhaust air systems
- High-speed, predictive control algorithm
- Rapid, stable, precise control through direct activation of the servo motor with feedback potentiometer
- Reaction time and upward regulation of the exhaust air volume flow ≤ 2 sec ($V_{MIN} \rightarrow V_{MAX}$)
- Programming of the downward regulation control time for the exhaust air volume flow ≤ 2...24 sec ($V_{MAX} \rightarrow V_{MIN}$)
- Closed loop control

with optional add on system -E2

- Integrated power supply 230V AC
- Separate terminal board for for simple cable connection and fast commissioning
- Static differential pressure transmitter 3...300 pa (optionally 8...800 pa) with high long-term stability for measuring the exhaust air actual value (volume flow)
- Maintenance-free measuring tube with two ring chambers and self-cleaning effect
- Linear sash position sensor for stable, error-free measurement of the vertical front sash opening
- Internal functional monitoring of all sensors for plausibility
- Suitable for all fume hood constructions

Functional description

Building management system

The building management system (BMS) balances the ventilation requirements of the entire building and can also check all room controllers for plausibility. Daytime/night-time operation, visualization of malfunction notifications and actual values as well as remote maintenance and error diagnostics can easily be integrated. Determination of room-related air consumption and individual billing is also possible.

Function display and control panel with fully graphic and numerical LC-Display

The function and control panel is available as a build in version with fully graphic LC-Display.

Functions:

- Acoustic and optical alarm (red LED) for insufficient exhaust/supply air
- Optical display (green LED) for sufficient exhaust/ supply air
- Numerical and bargraph display of the air input speed (face velocity) in m/s or ft/min.
- Yellow blinking LED as an optical warning signal for the operating status “Sash position > 50cm”
- RESET button for acknowledgement of the acoustic alarm
- Button Control ON/OFF
- Button Light ON/OFF (fume hood interior lighting)
- Button V_{MAX} with LED status display for emergency operation (override)
- Button Set with LED status display for night-time reduction (reduced operation)
- Integrated user operating interface for programming
- Plug for programming via the service module SVM100 or laptop (program PC2500)

Fume hood controller operating modes

Depending on the configuration and the area of application, various modes of operation are possible. The following control types are implemented:

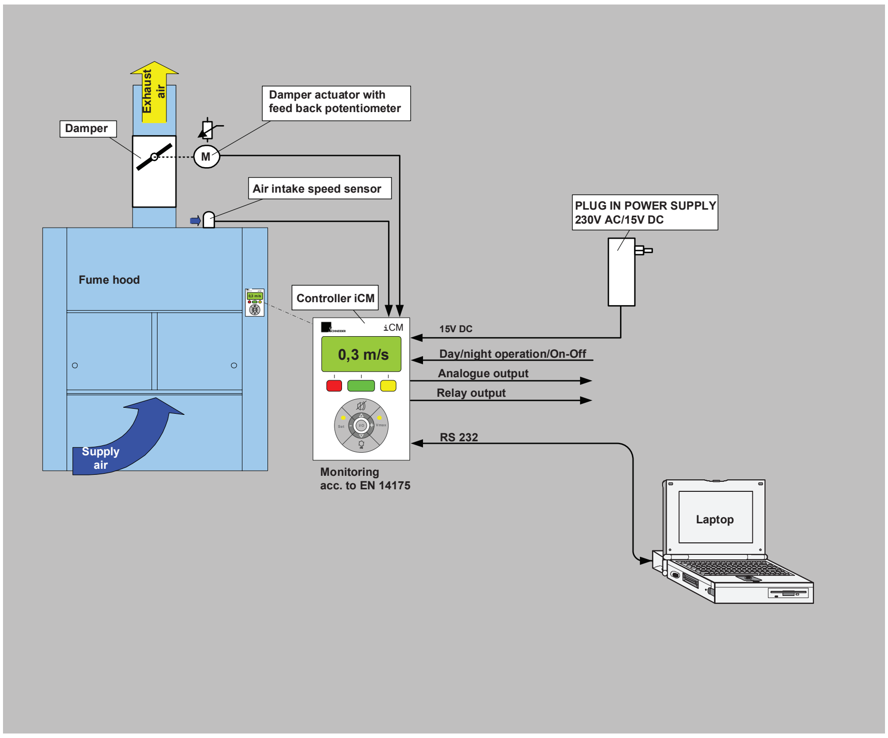
Standard model

- **face velocity control** — **iCM-F**

with optional add on system -E2

- **face velocity control** — **iCM-FP**
  with limitation to V_{MIN} and V_{MAX}
- **sash position control** — **iCM-W**
- **fully variable control** — **iCM-V**
- **constant control** (1 point) — **iCM-K**

Schematic diagram:
Fume hood controller iCM



Standard operating mode iCM-F
Constant face velocity

The operating mode **iCM-F (standard mode) or iCM-FP 8only with add on system -E2)** regulates at a constant face velocity (e.g. v = 0,3...0,5 m/s), independent of the sash position. The exhaust air volume flow is changed in relation to the fume hood sash position so that the face velocity remains constant. The fume hood exhaust air volume flow is regulated either by a motor-driven damper (in hoods connected to a central exhaust air system) or by an integrated exhaust air motor with a frequency inverter.

Pressure fluctuations in the duct system are regulated quickly, precisely and steadily. The face velocity v and additional with FC500-FP the exhaust air volume flows V_{MIN} und V_{MAX} are freely programmable.

Air volume limitation V_{MIN} und V_{MAX}
(operating mode iCM-FP only with optional add on system -E2)

When the sash is closed, the face velocity is increased v > 0,3 m/sec. To ensure the security of the laboratory staff, a minimum exhaust air volume flow $\mathbf{V_{MIN}}$ is guaranteed. Regulation now takes plac e to a constant minimum exhaust air volume flow.

When the sash is opened, the face velocity is reduced v < 0,3 m/sec. When the safe exhaust air volume flow $\mathbf{V_{MAX}}$ for the specific fume hood is reached, this value is constantly regulated. Thus the fume hood is within the safe range and definitely containment-safe. The restriction of the exhaust air volume flow to $\mathbf{V_{MAX}}$ ensures an energy saving effect and guarantees maximum safety for the laboratory staff. The load on the ventilation system is only as high as is absolutely necessary for the operating status of the particular fume hood.

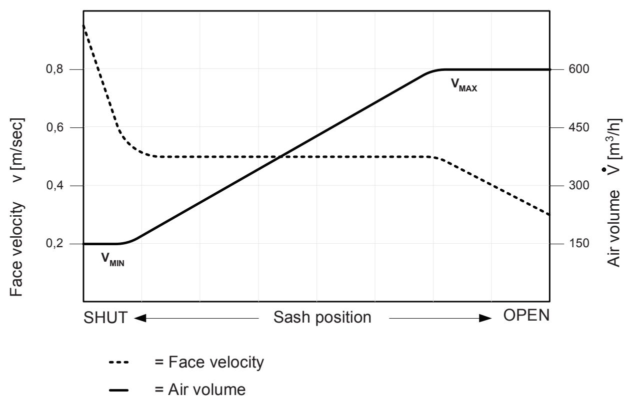


Figure 1: face velocity control

Air flow sensor

With the air flow sensor developed by SCHNEIDER a change in position of the sash and/or slide window is automatically detected and integrated in the control algorithm.

Sash position dependent control
(operating mode iCM-W only with optional add on system -E2)

In fume hoods without a slide window, only one sash position sensor is needed to for exact measurement of the vertical sash position.

The specification of setpoints by the sash position sensor enables stable, fast and accurate control. If turbulent and indefinable air flows are present in the laboratory that may affect the measuring accuracy and stability of the air flow sensor, a sash position sensor **SPS-100** is always a better choice than a flow sensor **AFS-100**.

The sash position measured by the sash position sensor is the setpoint for the **iCM-W** controller, which calculates the required exhaust air volume flow and and regulates it as needed. Volume flow is always linear in relation to the position sensor.

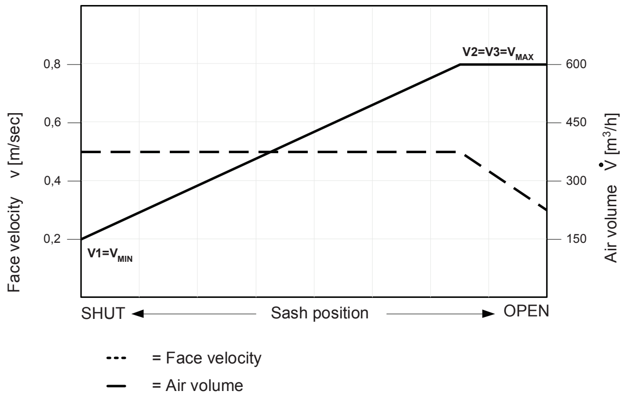


Figure 2: Linear sash position control

Operating modes

Fully variable volume flow control
(operating mode iCM-V only with optional add on system -E2)

In terms of energy efficiency, this mode of operation is the most expedient and the best method of fume hood control. A very fast and yet stable control algorithm is the most notable technical feature of this control mode.

The operating mode **iCM-V (only with optional add on system -E2)** seamlessly regulates the exhaust air volume flow in relation to the fume hood sash position. The fume hood exhaust air flow is regulated either by a motor-driven damper (in hoods that are connected to a manifold air system) or by an integrated exhaust air motor with a frequency inverter.

Pressure fluctuations in the duct system are regulated quickly, precisely and steadily. The exhaust air volume flows V1, V2 and V3 are freely programmable and define the vertices of the control curve.

$V1 = V_{MIN}$

When the sash is closed (SHUT) regulation takes place according to a programmable V1 exhaust air flow (minimum exhaust air flow). The containment-safety of the fume hood is guaranteed at all times while air consumption remains at a minimum.

$V2 = V_{50cm}$

The second vertex of the volume air flow is V2, which represents the exhaust air volume flow when the sash is partly open (e.g. sash = 50 cm). Seamless regulation of the required exhaust air volume flow takes place independent of the sash opening between V1 and V2 (SHUT ≤ sash ≤ 50 cm). The vertices V1, V2 and V3 are freely programmable and can be assigned to any sash opening, e.g. V2 at sash = 50 cm.

$V3 = V_{MAX}$

The third vertex of the exhaust air volume flow is V3, which represents the exhaust air volume flow when the sash is fully open (e.g. sash = 90 cm). Seamless regulation of the required exhaust air volume flow takes place between V2 and V3 (50 cm ≤ sash ≤ 90 cm) and is dependent on the sash opening.

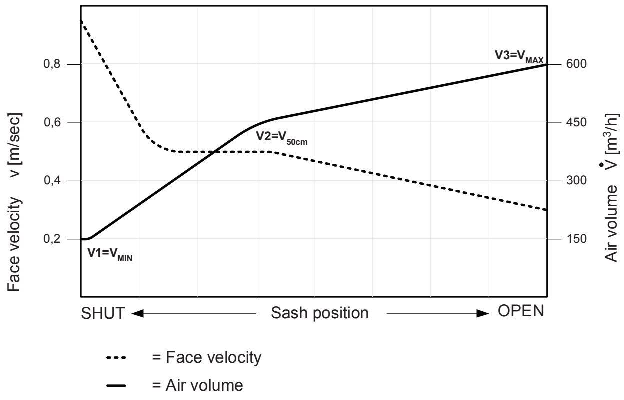


Figure 3: Fully variable control

Constant 1 setpoint controllers
(operating mode iCM-K only with optional add on system -E2)

The operating mode **iCM-K (only with optional add on system -E2)** regulates the exhaust air volume flow in relation to the sash position of the fume hood. The fume hood exhaust air is regulated either by a motor-driven damper (for hoods that are connected to a central exhaust air system) or by an integrated exhaust air motor with a frequency inverter.

Pressure fluctuations in the duct system are regulated quickly, precisely and steadily. The exhaust air volume flows V1 is freely programmable.

1 point constant controllers

In 1 point constant controllers the exhaust air volume flow is constantly regulated at V1, independent of the sash position.

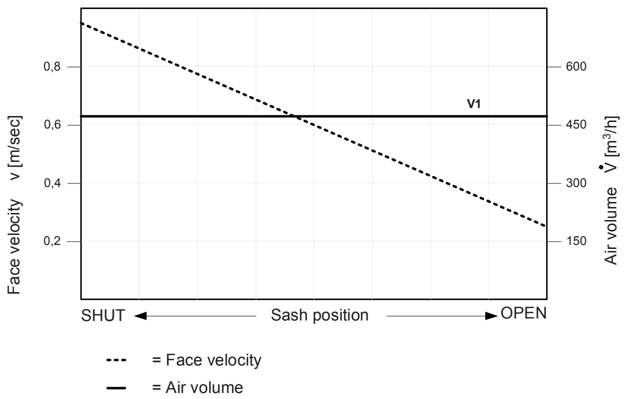


Figure 4: 3 point constant control

Dynamic air flow sensor (standard mode)

Using a air flow sensor developed by SCHNEIDER a change in position of both the slide window (horizontal) and the front sash (vertical) is registered on the fume hood and provided as a standardized output signal 0...5 V DC.

A measuring principle devised by SCHNEIDER recognizes the direction of the air flow and enables very precise, fast measurements in the range 0...1 m/s. This measuring range is particularly suitable for determining the face velocity speed in fume hoods (e.g. 0,3..0,5 m/s).

The air flow sensor **AFS100** is mounted on the fume hood in a suitable position and measures the flow of air in the bypass into the fume hood.

The air flow measured in the bypass corresponds exactly to the face velocity in the sash area, both in the open and shut positions. If the sash is opened, the face velocity drops and is thus directly dependent on the sash opening. The face velocity (e.g. 0,3...0,5 m/s) is regulated stable within < 2 s.

AFS100

Figure 5: Air flow sensor

Nominal diameter DN [mm]	Overall length L [mm]	Volume flow V_{MAX} [m³/h]
160	150	434
200	170	679
250	175	1060
315	175	1683
400	180	2714

Table 1: Dimensions damper and air volumes related to a recommended air velocity v = 6 m/s

Damper with fast servo motor with feedback potentiometer (standard mode)

The required exhaust air volume flow is adjusted via the damper. The very fast servo motor (3 s running time for 90 °) specially developed for SCHNEIDER is mounted directly on the damper shaft and has a torque of 3 Nm. The servo motor is operated directly by the control electronics (Fast Direct Drive), which guarantees fast, stable control behaviour. This operating mode has considerable advantages over analogue motor operation (0...10V DC), because the internal control electronics of the analogue (continuously) controlled servo motor have a hysterisis which can lead to control fluctuations if the volume flow differences that are to be regulated are small.

A feedback potentiometer reports the actual value of the current damper position to the control electronics. A special control algorithm quickly and directly "starts up" the required exhaust air volume flow without undefined overshoot.

When the servo motor is activated, a damper control concurrently checks whether the damper position is actually changed. This control concept with integrated servo motor monitoring functionality exceeds the stringent safety criteria for fume hood controllers.

In standard mode iCM-F (constant face velocity) the damper comes without integrated venturi measuring tube. The limit positions of the damper (damper SHUT=0% and damper OPEN=100%) can be freely programmed. The servo motor stops automatically at the programmed limit damper position and controls only within the programmed bandwidth (e.g. between 10...80%).

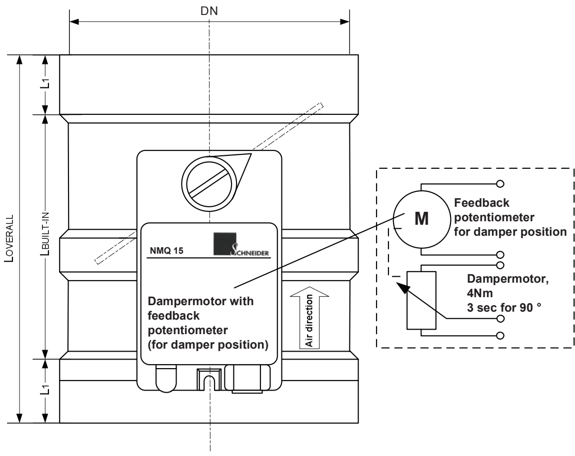


Figure 6: Damper with fast servo motor with feedback potentiometer

Extended operating modes with optional add on system -E2

Optional add on system -E2

The optional add-on system -E2 is simply connected to the iCM controller and placed on the roof of the fume hood. It allows the connection of three independent sensors (sash position sensor, static differential pressure transmitter and air flow sensor). In addition to the standard **face velocity controller iCM-F**, the following operating modes can be implemented:

with optional add on system -E2

■ **face velocity control** with limitation to V_{MIN} and V_{MAX}	**iCM-FP**
■ **sash position control**	**iCM-W**
■ **fully variable control**	**iCM-V**
■ **constant control** (1 point)	**iCM-K**

The optional add-on system -E2 includes a static differential pressure transmitter and, together with the damper with integrated venturi measuring tube, the sash dependent exhaust air volume flow (with position sensor) can be regulated as well as the constant face velocity. These extended operating modes ensure more stable and precise control and also enable plausibility checks of the connected sensors.

This is a significant safety improvement for the entire control system and for the user. Measuring errors and differences are recognised and signalled immediately.

Depending on the desired operating mode, the corresponding sensor is connected to the optional add-on device -E2.

The add-on device -E2 also has relays for light (contact load 250V AC/16A), malfunction alarm and On/Off (contact load 250V AC/3A), its own 230V AC/15V DC power pack and galvanically separated BMS inputs via optocoupler for On/Off and Daytime/Nighttime operation.

Sash position sensor
(only with optional add on system -E2)

A sash position sensor (cable potentiometer) determines the vertical sash position with an absolute accuracy of more than 2 mm (0,2%). The reproducible and seamless linear determination of the sash position enables very fast, precise, stable control. With this technique overshoot or undershoot are largely avoided.

The sash position sensor is easy to mount and ensures an absolutely safe and stable actual value signal for the vertical sash position.

The sash position sensor cable has an ejection length of 1m and can easily be hooked into the front sash counterweight.

The **SPS100** position sensor developed by SCHNEIDER is specially designed for precise, reproducible determination of the vertical sash opening height.

Static differential pressure transmitter
(only with optional add on system -E2)

Static differential pressure measurement is suitable for contaminated or abrasive air, because the air does not flow through the static differential pressure transmitter.

Measuring volume flow with a static differential pressure transmitter

The basis for determining the volume flow is the differential pressure on the damming body, which may take the form of a venturi tube, a measuring orifice or a measuring cross. SCHNEIDER always uses the venturi measuring principle due to its very high measuring accuracy and especially due to the fact that it is not dependent on a inlet and outlet route.

Air flow that occurs on a damming body generates resistance pressure proportional to flow velocity, which results in differential pressure. Measurement over the entire measuring range 3...300 pa (optional 8...800 pa) is very precise and stable, which means that a volume flow range of 10:1 can be regulated.

The volume flow is calculated using the following formula:

$$\dot{V} = c \cdot \sqrt{\frac{\Delta p}{\rho}}$$

$\dot{V}$ = Air volume
c = geometric constant of the measuring system
Δp = Differential pressure
ρ = Density of the air

SPS100

Figure 7: Linear position sensor for determining the sash position

Measuring and control components

Accurate design of the measuring and control components is crucial for the speed, stability and accuracy of the entire control process. SCHNEIDER products are developed with the best available technology and fulfill these requirements.

Maitenance-free measuring tube with integrated damper (only with optional add on system -E2)

SCHNEIDER offers two measuring systems MD (maintenance-free measuring tube) and VD (venturi tube), which has the following advantages:

- Maintenance-free operation due to self-cleaning measuring system
- Very high measuring accuracy (better than 3%)
- Integrated annulus measuring process
- Very good sound levels due to favourable inflow
- Compact design (e.g. DN250, overall length=400mm)
- Independent of the inlet and outlet route

Due to the compact design and the insensitiveness from a inlet route the system can be mounted directly on the fume hood exhaust air outlet.

Figure 8: Damper with integrated venturi tube MD and fast servo motor, running time 3 s for 90°
Model: flange/flange

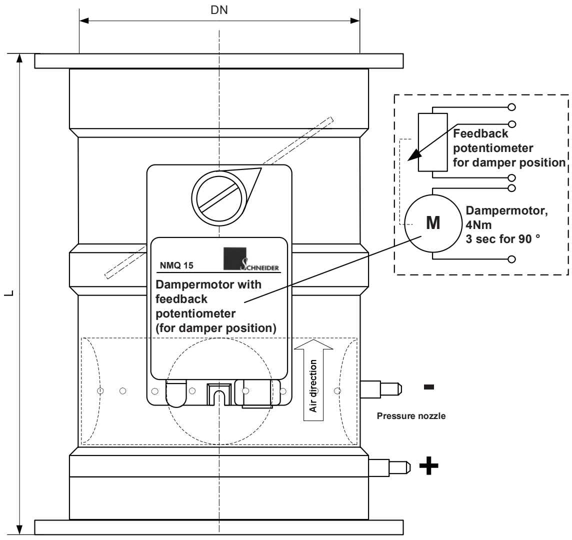


Figure 9: Schematic diagram connection of servo motor with feedback potentiometer

Compact design

In consideration of structural conditions in laboratories, we have developed a compact venturi tube that can be mounted directly on the fume hood exhaust air outlet. A special inlet route is not necessary. For a pipe diameter of DN200 the compact venturi tube with integrated damper requires a length of just 310 mm (optionally 235 mm).

Table 2 shows the relationships between the nominal diameter (DN), overall length (L) and the maximum volume flow V_{MAX} at a flow velocity of 6 m/s.

Nominal diameter DN [mm]	Overall length L [mm]	Minimum Volume flow V_{MIN} [m^3/h]	Maximum Volume flow V_{MAX} [m^3/h] (v = 6m/s)
160	340	59	434
200	350 optionally 235	100	679
250	400	163	1060
315	490	267	1683

Table 2: Nominal diameters of the maintenance-free measuring tube MD with integrated damper

Fast upward regulation and slow downward regulation

In all operating modes regulation is always upwards and at maximum velocity, i.e. when the front sash or slide window is opened, the calculated required volume flow follows and is increased without delay.

When the front sash or slide window is closed, downwards regulation can be done at adjustable speed of 2...24 s. Slow downwards regulation has the advantage that there is sufficient time for the required room supply air and the laboratory always remains in a state of negative presssure in all operating conditions.

Slow downwards regulation of the volume flow increases work safety for the laboaratory staff and eliminates the tendency towards oscillation of the entire control system.

Plausibility check with three different sensors (only with optional add on system -E2)

The **iCM-V** controller uses **three different sensors** (sash position sensor, static differential pressure transmitter and air flow sensor) to constantly check the mutual plausibility of the sensors, i.e. it is checked whether the actual values of the sensors (differential pressure transmitter and air flow sensor) are logically in line with the sash position sensor setpoint. This offers additional security for the entire control system and for the user.

Control parameters

All project-specific control parameters, such as the upper and lower limits for maximum and minimum volume flow, can easily be retrieved, changed and monitored on site via the internal system level or a laptop. Cyclic, sequential retrieval and verification of the control actual and setpoint values guarantees fast, stable, demand-related volume flow control.

Teach-in mode

A software controlled, automatic self-learning mode (teach in) facilitates and optimizes setup. The **iCM-V** controller determines and programs all necessary system data and control parameters fully automatically in teach in mode.

Test and diagnostic functions

A comprehensive, accurate overview of the measured actual values is essential for setup, diagnostics and troubleshooting.

With a special test and diagnostics program, SCHNEIDER provides service and setup staff with the following actual values in the service module SVM100 or PC software PC2500.

In addition, an integrated user interface for programming is implemented that can be accessed with the function keys and is password protected.

Actual value	Unit
Exhaust air	m³/h
Supply air	m³/h
Face velocity	m/s
Sash position (with position sensor)	%
Exhaust air pressure (measured by venturi tube)	pa
Damper position	%
Temperature (with PT-1000 measuring element)	°C

The following tests can be carried out:

- **Show digital inputs**
  Shows the current status of all digital inputs
- **Analogue inputs**
  Shows all analogue inputs with the current signal voltages
- **Analogue outputs**
  Shows all analogue outputs with the current signal voltages
- **Motor/damper test**
  With this test function the motor/damper can be set to OPEN and SHUT

These test and diagnostic functions greatly facilitate and simplify system setup and troubleshooting.

Notes on control dimensioning (dimensions and volume flow)

During constant face velocity control, the exhaust air volume flow V is calculated from the inflow area A [m²] (open sash or slide window) and the face velocity v using the following formula:

$$V = A \cdot 3600 \cdot v$$

Calculation example:

Given that: Fume hood width = 1.2 m
Sash opening = 10 cm
Face velocity v = 0.3 m/s

V = 1,2 • 0,1 • 3600 • 0,3
V = 129,6 [m³/h]

At a sash opening of 10 cm, a sash width of 1.2 m and a face velocity of 0.3 m/s the volume flow is 129.6 [m³/h].

The following table shows the resulting volume flow V [m³/h] for various inflow areas and a constant face velocity of 0.5 m/s.

At a sash opening width of 1.5 m and an sash opening height of 50 cm the volume flow is V = 1350 [m³/h].

Sash opening width [m]	Sash opening hight [cm]	V [m³/h]	Sash opening hight [cm]	V [m³/h]
1,2	5	108	50	1080
1,5	5	135	50	1350
1,8	5	162	50	1620

At a constant face velocity v = 0.3 m/s the volume flows decrease by 40%.

Due to the control accuracy, care must be taken to ensure that at minimum volume flow V_{MIN} the flow velocity in the fume hood controller does not fall below 1,05 m/s.

Due to noise radiation, in laboratory applications care must be taken to ensure that at maximum volume flow V_{MAX} the flow velocity in the volume flow controller does not exceed 7,5 m/s.

VAV dimensions for room application

The volume flows V_{MIN}, V_{MED} and V_{MAX} are freely programmable within the range 50...25.000 m³/h, but care must be taken that the dimensions of the VAV for room supply and room exhaust air are appropriate in relation to the volume flow range while at the same time taking the flow velocity into account.

Determining volume flow for laboratory applications with regard to the flow velocity v

Volume flow	Flow velocity v
V_{MIN}	v ≥ 1,05 m/s
V_{MAX}	v ≤ 6 m/s

Planning values for sound and exhaust air volume flow

The tables on pages 14 to 15 should be consulted when planning a system, in order to project an optimal ratio between exhaust air volume flow, control behaviour and minimum sound values.

Planning values for duct pressure

The duct pressure on the fume hood controller is calculated to the given air volume flow and is the addition of the controller pressure loss (Δpv•factor 3) plus the pressure loss of the connected fume hood (controller pressure loss Δpv see table 5 on page 15).

Example:

Given: MD measuring tube DN250
max. air volume flow = 720 m³/h
fume hood pressure loss acc. to manufacturer e.g. 40 Pa

Calculated: air velocity = 4,08 m/s

Table 3 : Δpv = 14 Pa
Δpv•3 = 14•3 = 42 Pa

The multipilcation with factor 3 guarantees a save and stable air volume control over the whole range and a sufficient damperposition

Calculated minimum duct pressure: 42 + 40 = 82 Pa

Choosen minimum duct pressure with controller DN250 and maximum air volume flow = 720 m³/h:	**ca. 100 Pa**

Ordering code: Fume hood controller

Order code: **Fume hood controller**

Important:
Order the DK damper or the MD measuring tube with damper and actuator additionally.

iCM - F - 0

Type

Control type	
Face velocity	**F**
Extended operating mode only with optional add on system -E2	
Face velocity with V_{MIN} and V_{MAX} limitation	**FP**
Sash position sensor	**W**
Fully variable	**V**
Constant (1-Punkt)	**K**

	Optional add on system with own case
0	no add on system (standard mode) **Please order Round damper DK with actuator additionally**
E1	Add on system with 3 relays and 2 digital inputs for BMS **Please order Round damper DK with actuator additionally**
E2	Add on system with 3 relays and 2 digital inputs for BMS and static differential pressure transmitter for extended operating/control mode **Please order Round damper with measuring tube and actuator MD or VD additionally**

Ordering example: Fume hood controller iCM-F-0

Control mode = face velocity, 3 relays, integrated function display with graphic LCD and control panel, with plug-in power supply.

Make: SCHNEIDER **Typ: iCM-F-0** **Please order round damper with actuator DK additionally.**

Power supply:
The standard model iCM-F (face velocity) is delivered with a plug-in power supply.

Extended operating mode with optional add on system -E2

Control type	Sensors included with delivery	Order code for optional add on system	Damper without/with measuring tube
F = Face velocity	air flow sensor	-0 oder -E1	DK (without measuring tube)
Extended operating mode only with optional add on system -E2			
FP = Face velocity with V_{MIN} and V_{MAX} limitation	air flow sensor, differential pressure transmitter	-E2	MD or VD (with measuring tube)
W = Sash position sensor	sash position sensor, differential pressure transmitter	-E2	MD or VD (with measuring tube)
V = Fully variable	position sensor, air flow sensor, differential pressure transmitter	-E2	MD or VD (with measuring tube)
K = Constant (1-Punkt)	differential pressure transmitter	-E2	MD or VD (with measuring tube)

Ordering example: Fume hood controller iCM-F-W-E2

Control mode = sash position sensor, integrated function display with graphic LCD and control panel, with optional add on system -E2, 3 relays, static differential pressure sensor and integrated power supply 230V AC.

Make: SCHNEIDER **Typ: iCM-F-0** **Please order round damper with measuring tube MD or VD and actuator additionally.**

Power supply:
The add-on devices -E1 and -E2 include their own 230V AC power supply. The plug-in power supply is not required for these models and is not included in the scope of delivery.

Ordering code: Round damper with optional measuring tube

Important:
Air volumes and dimensions on page 14. Order the fume hood controller iCM as well.

Order code: **Round damper with actuator**

DK - 250 - P - MM - 1

Type

Damper niminal diameter [mm]

DN160, DN200, DN250 DN315, DN400	**160** **...** **400**

Material

Polypropylene (PPs)	**P**
Electrically conductive PPs (Ex-Version)	**Pel**
Polyvinyl chloride (PVC)	**PV**
Galvanized steel	**S**
Stainless steel 1.4301	**V**

Actuator

1	SCHNEIDER standard 12V, 3 s for 90°
2	Analogue linear drive 24V, 5 s for 90°

Pipe connections

	Air inflow	Air outflow
MM	Socket	Socket
FF	Flange	Flange
MF	Socket	Flange
FM	Flange	Socket

Ordering example: Round damper with actuator

DN250, PPs, socket/socket, fast actuator 3 s for 90° (Fast Direct Drive SCHNEIDER).

Make: SCHNEIDER **Type: DK-250-P-MM-1**

Order code: **Round damper with maitenance-free tube and actuator**

Important:
Air volumes and dimensions on page 15. Order the fume hood controller iCM as well.

MD - 250 - P - MM - 1

Measuring system

Maitenance-free measuring tube	**MD**
Venturi tube	**VD**

Damper niminal diameter [mm]

DN160, DN200, DN250, DN315	**160** **...** **315**

Material

Polypropylene (PPs)	**P**
Electrically conductive PPs (Ex-Version)	**Pel**
Polyvinyl chloride (PVC)	**PV**
Galvanized steel	**S**
Stainless steel 1.4301	**V**

Actuator

1	SCHNEIDER standard 12V, 3 s for 90°
2	Analogue linear drive 24V, 5 s for 90°

Pipe connections

	Air inflow	Air outflow
MM	Socket	Socket
FF	Flange	Flange
MF	Socket	Flange
FM	Flange	Socket

Ordering example: Round damper with maitenance-free measuring tube and actuator

DN250, PPs, socket/socket, fast actuator 3 s for 90° (Fast Direct Drive SCHNEIDER).

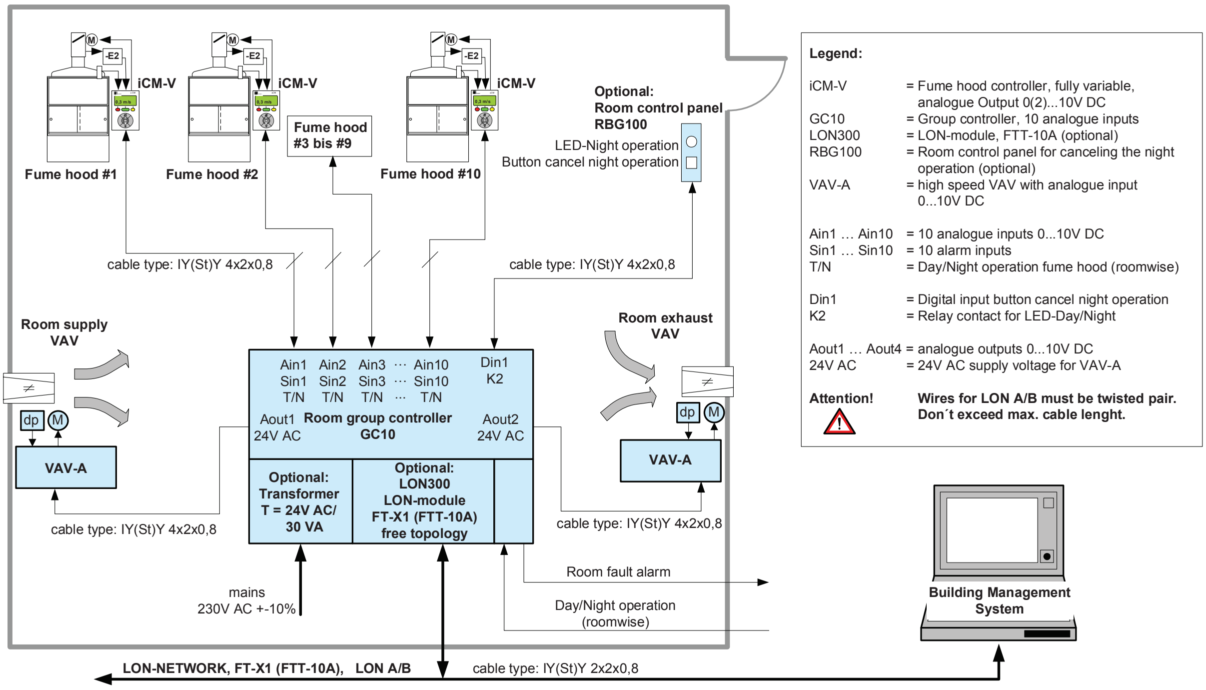
Make: SCHNEIDER **Type: MD-250-P-MM-1**

Room plan 1 • Fume hood controller iCM with analogue output and room group controller GC10

Room plan 1 shows the interconnection of up to 10 fume hood controllers iCM-V (fully variable) and add on system -E2 (Ain1 to Ain10) with the group controller GC10. The group controller can operate up to four freely configurable VAV variable air volume controllers for room supply/exhaust air (Aout1 to Aout4). The internal transformer (optional) provides the supply voltage for the VAV controllers 24V AC, which simplifies planning and reduces construction costs.

The analogue inputs Ain1 to Ain10 are summated and can be combined in any number of groups on the analogue outputs Aout1 to Aout4. Optionally, a room by room LON connection to the building services management system is also possible.

For a detailed description see the data sheet GC10.

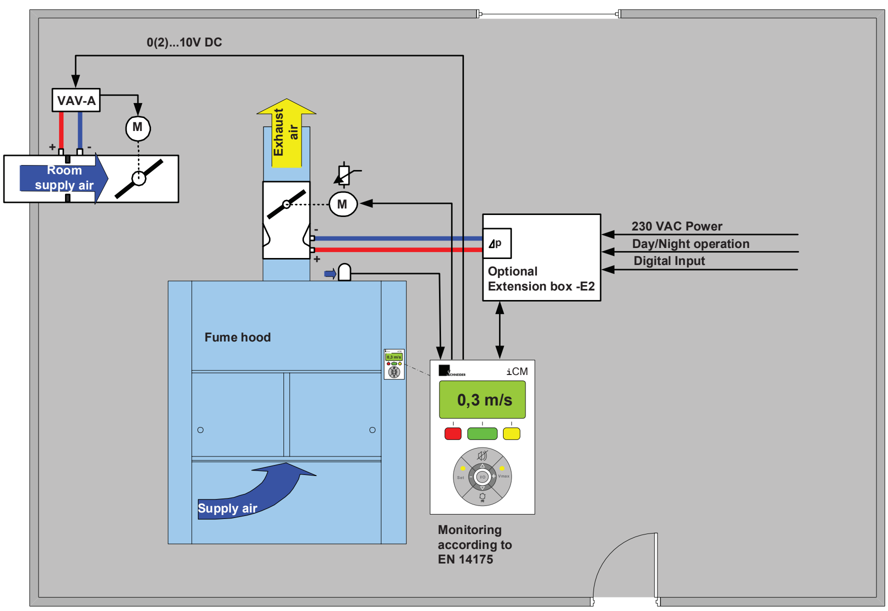


Room plan 2 • Fume hood controller iCM with analogue output and direct actuation of the room VAV

Direct actuation of the room supply air controller (VAV)

In laboratory applications with a fume hood in the room, the iCM-FP fume hood controller can actuate the room supply air controller directly with 0(2)...10V DC, i.e. room pressure management (e.g. negative pressure in the laboratory) is taken into account for all operating modes of the fume hood.

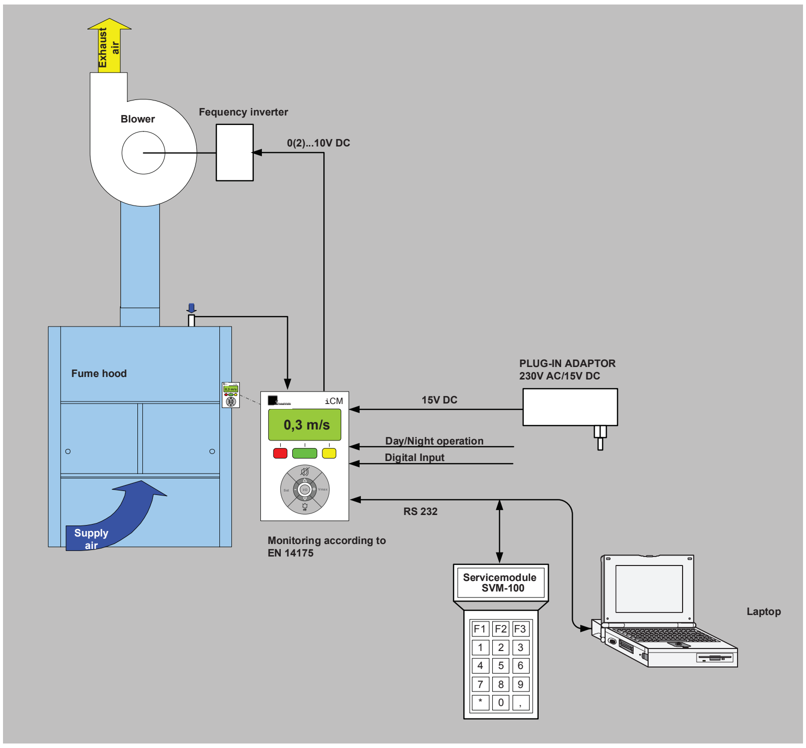
The optional add on system -E2 provides the 24V AC supply voltage for the room supply air controller. The direct actuation of the room supply air controller means that room pressure management can be achieved cost-effectively.



Direct actuation of the frequency inverter

The analogue output of the iCM-F controller serves as a direct setpoint for the frequency inverter and actuates the exhaust air fan in accordance with the constant face velocity that is to be regulated.

This application is used when the exhaust air fan extracts the air from the fume hood directly.



Pipe-in-pipe controller

If higher volume flows are required, such as in walk-in hoods, and an even air distribution is desired, this can be achieved by the use of a pipe-in-pipe system.

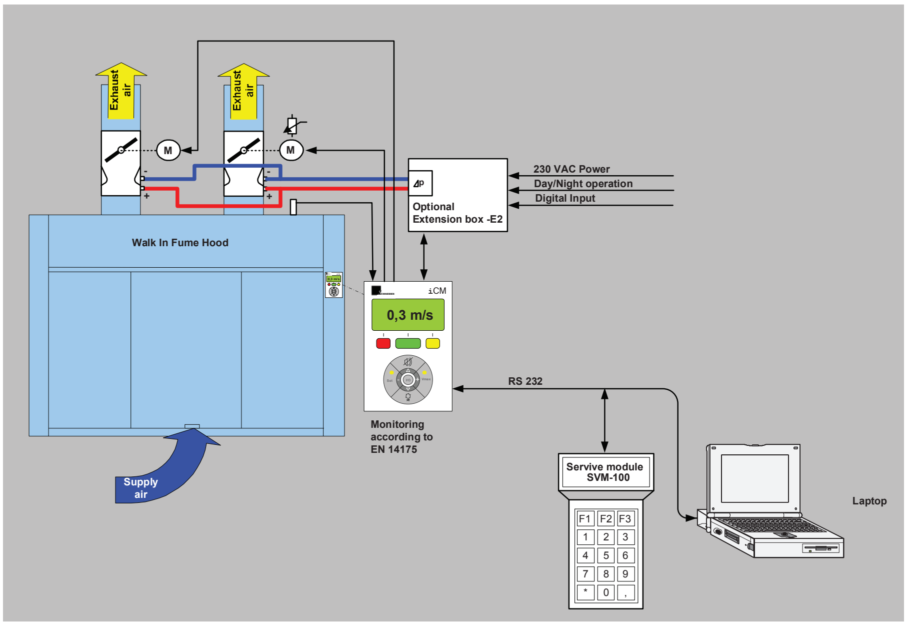
The iCM fume hood controller can actuate up to two venturi measuring tubes with damper. The servo motors are actuated in parallel, ensuring an even distribution of air over both volume flow controllers.

The volume flow actual value is determined via both venturi measuring tubes. The shield factor to be programmed is multiplied by 2.

Calculation example:

Given: Shield factor B at DN250 = 94

Shield factor in pipe-in-pipe applications:
B•2 = 94•2 = 188



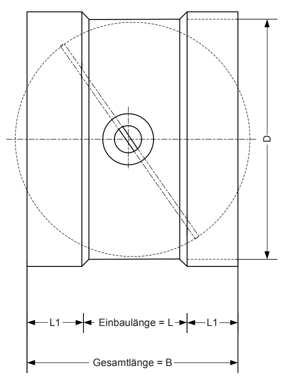
Dimensions ● Volume flow ranges

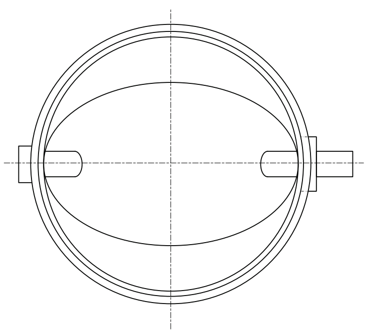
Damper without measuring tube, PPs (polypropylene, flame resistent), round model, with servo motor

- Control unit: -F (face velocity)
- Fast, stable volume flow control (< 2 s)
- High control accuracy and response sensitivity
- Option: tightly closing damper in accordance with DIN

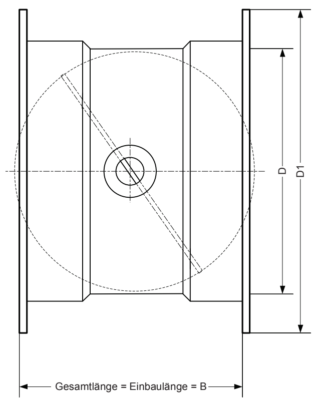
Nominal diameter	Inner-Ø	Volume flow V_{MIN}, V_{MAX}, V_{NENN} at airflow velociy v		
		v=ca. 0,5 m/s	v=6 m/s	v=ca. 10m/s
NW [mm]	D [mm]	V_{MIN} [m³/h]	V_{MAX} [m³/h]	V_{NENN} [m³/h]
160	161	**30**	**434**	589
200	201	**50**	**679**	1005
250	251	**80**	**1060**	1628
315	316	**130**	**1683**	2667
400	401	**217**	**2714**	4347

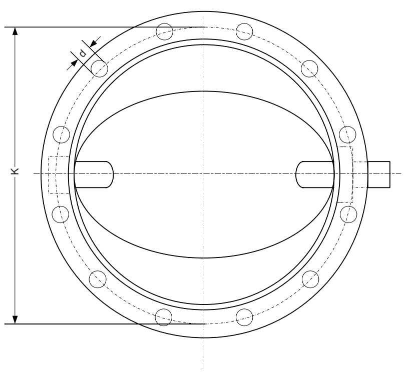
Model: DK-XXX-P-MM-1 (Muffe/Muffe)





Model: DK-XXX-P-FF-1 (Flansch/Flansch)





Nominal dia-meter	Inner-Ø	Dimensions socket/socket		
NW [mm]	D [mm]	B [mm]	L_1 [mm]	L [mm]
160	161	**150**	40	**70**
200	201	**170**	50	**70**
250	251	**175**	50	**75**
315	316	**175**	50	**75**
400	401	**180**	50	**80**

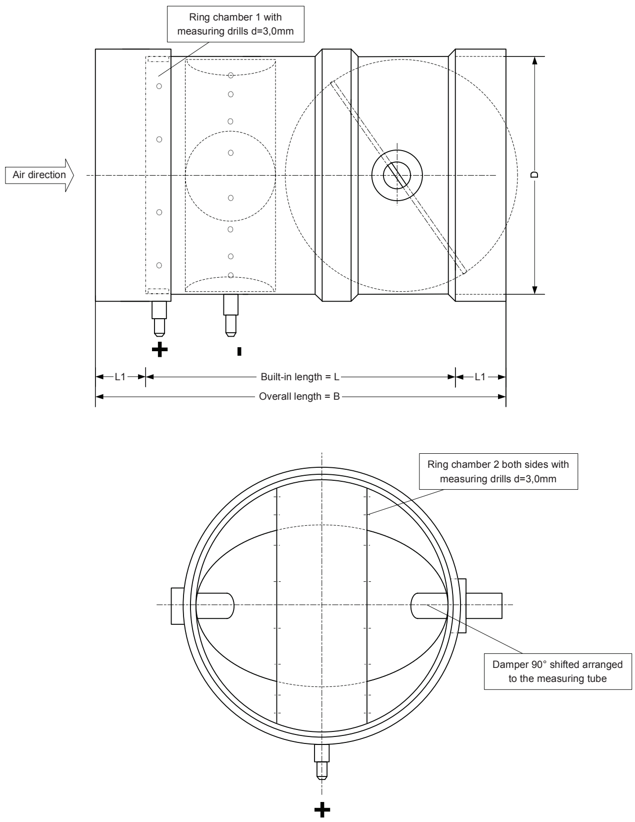
Nominal dia-meter	Inner-Ø	Dimensions flange/flange				
NW [mm]	D [mm]	B [mm]	Outer-Ø D1 [mm]	K [mm]	d [mm]	No
160	161	**210**	230	200	7	8
200	201	**230**	270	240	7	8
250	251	**235**	320	290	7	12
315	316	**240**	395	350	9	12
400	401	**240**	480	445	9	16

Maintenance-free measuring tube with damper and servo motor, PPs (polypropylene, flame resistent), round model

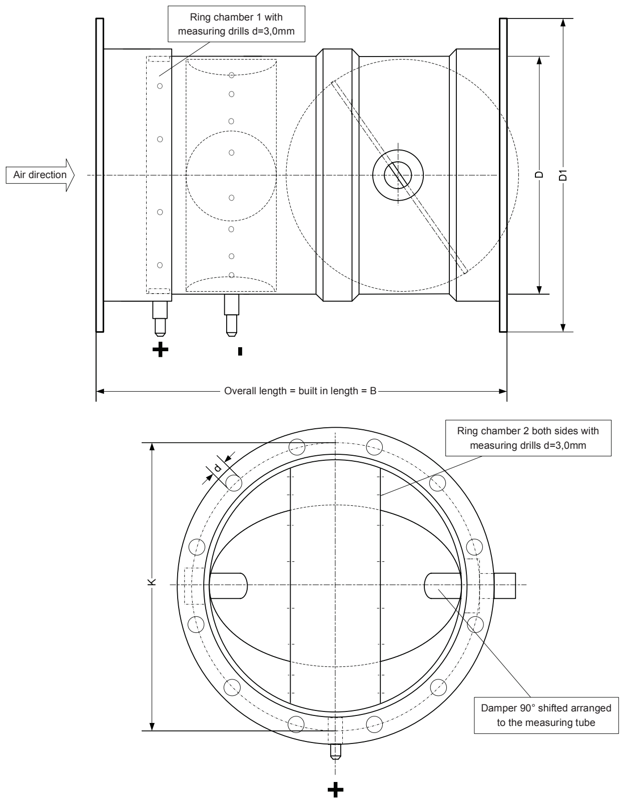
- Control unit: analogue, LON, LON balancing
- Fast, stable volume flow control (< 2 s)
- High control accuracy and response sensitivity
- Static differential pressure transmitter 3...300 pa
- Measuring system with integrated ring chamber
- Option: tightly closing damper in accordance with DIN

Nominal dia-meter	Inner-Ø	Volume flow V_{MIN}, V_{MAX}, V_{NOM} at airflow velocity v			Length			Dimension flange			
		v ≈ 1 m/s	v = 6 m/s	v ≈ 10m/s							
NW [mm]	D [mm]	V_{MIN} [m³/h]	V_{MAX} [m³/h]	V_{NOM} [m³/h]	L [mm]	L1 [mm]	B [mm]	Outer-Ø D1 [mm]	K [mm]	d [mm]	No.
160	161	**59**	**434**	589	**340**	40	**260**	230	200	7	8
200	201	**100**	**679**	1005	**350**	50	**250**	270	240	7	8
250	251	**163**	**1060**	1628	**400**	50	**300**	320	290	7	12
315	316	**267**	**1683**	2667	**490**	50	**390**	395	350	9	12

Model: MD-XXX-P-MM-1 (socket/socket)



Model: MD-XXX-P-FF-1 (flange/flange)



Planning notes for determining volume flow:

Bear in mind the volume flow in relation to airflow velocity v

V_{MIN} = volume flow at airflow velocity v ≈ 1 m/s
V_{MAX} = volume flow at airflow velocity v = 6 m/s (recommended)
V_{NOM} = volume flow at airflow velocity v ≈ 10 m/s

For laboratory applications (exhaust and supply air) the airflow velocity v = 6 m/s at V_{MAX} should not be exceeded due to the sound levels. If this value is exceeded the sound pressure level of < 52 dB(A) stipulated by DIN1946, Part 7 can only be achieved with very extensive sound absorption. The maximum volume flow V_{MAX} that is to be regulated should therefore always be less than app. 40% below V_{NOM}.

Sound values ● Damper with venturi measuring, PPs, round model

Table 3: Flow noise

Nominal diameter in mm	v in m/s	V in m3/h	Δp_g = 100 pa										Δp_g = 250 pa										Δp_g = 500 pa									
			L_W in dB/octave										L_W in dB/octave										L_W in dB/octave									
			f_m in Hz										f_m in Hz										f_m in Hz									
			63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**
	2	148	50	47	44	46	45	46	33	22	50	**42**	53	54	53	53	51	50	56	42	60	**52**	56	58	55	60	59	57	58	54	65	**57**
	4	290	55	51	48	51	47	42	35	27	52	**44**	64	61	58	57	55	53	49	43	60	**52**	67	67	64	63	60	58	60	58	67	**59**
160	6	434	62	58	53	56	50	46	41	35	56	**48**	67	65	61	61	58	54	50	45	63	**55**	72	72	69	67	63	60	59	57	69	**61**
	8	579	62	60	57	59	55	51	49	45	61	**53**	71	67	64	64	60	56	53	48	66	**58**	75	73	71	69	65	62	59	56	71	**63**
	10	724	67	66	62	58	59	55	54	51	64	**56**	73	70	66	68	62	59	55	51	69	**61**	76	76	72	72	67	64	61	58	73	**65**
	2	226	47	50	47	47	47	46	49	39	54	**46**	50	53	52	56	57	58	57	59	65	**57**	55	57	54	59	63	67	67	66	73	**65**
	4	452	56	57	53	51	53	60	56	42	63	**55**	59	62	60	60	59	59	60	62	67	**59**	61	64	64	66	66	67	66	66	73	**65**
200	6	679	59	61	56	55	58	58	52	45	63	**55**	65	66	64	63	63	63	63	64	70	**62**	68	70	70	70	69	69	67	70	76	**68**
	8	905	61	64	60	57	59	58	52	46	64	**56**	69	72	67	66	67	68	66	61	73	**65**	70	74	72	73	72	71	69	69	78	**70**
	10	1131	63	65	62	59	62	60	55	50	66	**58**	74	72	70	68	69	69	65	61	75	**67**	75	77	74	74	74	73	71	70	80	**72**
	2	353	50	47	44	46	45	46	33	22	50	**42**	53	54	53	53	51	50	56	42	60	**52**	56	58	55	60	59	57	58	54	65	**57**
	4	707	55	51	48	51	47	42	35	27	52	**44**	64	61	58	57	55	53	49	43	60	**52**	67	67	64	63	60	58	60	58	67	**59**
250	6	1060	62	58	53	56	50	46	41	35	56	**48**	67	65	61	61	58	54	50	45	63	**55**	72	72	69	67	63	60	59	57	69	**61**
	8	1414	62	60	57	59	55	51	49	45	61	**53**	71	67	64	64	60	56	53	48	66	**58**	75	73	71	69	65	62	59	56	71	**63**
	10	1767	67	66	62	58	59	55	54	51	64	**56**	73	70	66	68	62	59	55	51	69	**61**	76	76	72	72	67	64	61	58	73	**65**
	2	561	42	47	45	43	38	35	33	32	45	**37**	47	47	49	51	54	52	50	50	57	**49**	52	52	54	56	59	57	55	55	62	**54**
	4	1122	52	55	50	49	43	38	31	29	50	**42**	60	61	57	55	55	51	47	48	59	**51**	65	66	62	60	60	56	52	53	64	**56**
315	6	1683	54	57	52	51	45	40	33	31	52	**44**	62	63	59	57	57	53	49	50	61	**53**	67	68	64	62	62	58	54	55	66	**58**
	8	2244	59	57	56	55	47	43	38	33	55	**47**	67	68	64	61	58	55	51	50	64	**58**	72	73	69	66	63	60	56	55	69	**61**
	10	2806	61	59	58	57	49	45	40	35	57	**49**	69	70	66	63	60	57	53	52	66	**58**	74	75	71	68	65	62	58	57	71	**63**
	2	905	41	48	47	44	38	36	34	32	46	**38**	48	49	49	50	53	50	48	48	57	**49**	53	54	54	55	58	55	53	53	62	**54**
	4	1810	53	54	53	52	46	40	34	30	52	**44**	62	62	59	57	54	52	48	47	60	**52**	67	67	64	62	59	57	53	52	65	**57**
400	6	2714	55	56	55	54	48	42	36	32	54	**46**	64	64	61	59	56	54	50	49	62	**54**	69	69	66	64	61	59	55	54	67	**59**
	8	3619	60	58	61	62	53	46	42	35	61	**53**	66	68	67	64	59	56	51	50	66	**58**	73	73	72	69	64	61	56	55	71	**63**
	10	4524	62	60	63	64	55	48	44	37	63	**55**	70	70	69	66	61	58	53	52	68	**60**	75	75	74	71	66	63	58	57	73	**65**

Definitions:

f_m	in Hz:	Centre frequency of the octavos
L_W	in dB/octave:	Sound power level measured in the echo chamber
L_{WA}	in dB(A):	Total sound power level , A-weighted
L	in dB(A):	Sound pressure level, A-weighted, room insulation of 8dB/octave taken into account
Δp_g	in Pa:	Total pressure difference (measured in front of and behind the volume flow controller)
V	in m3/h:	Volume flow
v	in m/s:	Flow velocity

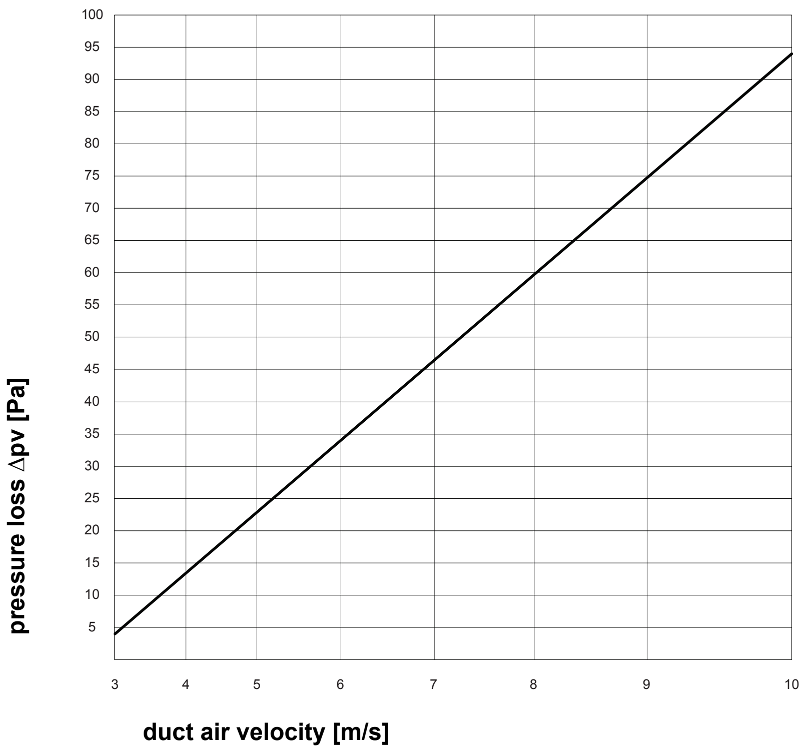
Sound values ● Damper with venturi measuring, PPs, round model

Table 4: Sound emission

Nominal diameter in mm	v in m/s	V in m³/h	Δp_g = 100 pa										Δp_g = 250 pa										Δp_g = 500 pa									
			L_W in dB/octave, f_m in Hz										L_W in dB/octave, f_m in Hz										L_W in dB/octave, f_m in Hz									
			63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L_{WA} in dB(A)	**L in dB(A)**
160	2	148	30	28	21	20	26	28	15	9	31	**23**	33	26	24	25	36	38	31	20	42	**34**	33	25	26	31	42	47	41	33	50	**42**
	4	290	38	32	27	23	27	27	20	7	32	**24**	43	36	32	29	36	38	30	22	41	**33**	42	37	36	34	42	45	39	32	49	**41**
	6	434	41	34	32	29	30	29	22	9	35	**27**	47	41	38	33	37	38	33	23	43	**35**	48	44	42	38	44	46	40	33	49	**41**
	8	579	46	41	40	39	35	31	22	10	41	**33**	49	43	42	38	40	40	35	26	45	**37**	54	48	47	41	46	47	41	34	51	**43**
	10	724	51	45	46	46	41	37	28	18	47	**39**	52	46	45	42	43	42	36	26	48	**40**	54	50	49	44	47	48	43	35	53	**45**
200	2	226	24	22	20	19	20	20	20	6	26	**18**	28	30	27	27	26	28	27	22	34	**26**	37	31	28	32	34	37	32	33	41	**33**
	4	452	31	33	27	23	23	27	20	6	31	**23**	38	37	33	30	30	30	29	29	37	**29**	53	39	37	42	39	38	34	34	45	**37**
	6	679	38	37	32	28	28	28	20	12	33	**25**	44	43	38	34	33	35	31	29	40	**32**	47	46	42	44	41	40	35	34	47	**39**
	8	905	39	39	35	33	33	30	22	14	37	**29**	45	44	41	39	38	38	32	26	43	**35**	47	47	46	45	44	43	41	37	50	**42**
	10	1131	43	43	39	37	38	33	26	19	41	**33**	52	49	45	41	40	40	34	30	46	**38**	54	52	49	47	44	44	41	38	51	**43**
250	2	353	30	28	21	20	26	28	15	9	31	**23**	33	26	24	25	36	38	31	20	42	**34**	33	25	26	31	42	47	41	33	50	**42**
	4	707	38	32	27	23	27	27	20	7	32	**24**	43	36	32	29	36	38	30	22	41	**33**	42	37	36	34	42	45	39	32	49	**41**
	6	1060	41	34	32	29	30	29	22	9	35	**27**	47	41	38	33	37	38	33	23	43	**35**	48	44	42	38	44	46	40	33	49	**41**
	8	1414	46	41	40	39	35	31	22	10	41	**33**	49	43	42	38	40	40	35	26	45	**37**	54	48	47	41	46	47	41	34	51	**43**
	10	1767	51	45	46	46	41	37	28	18	47	**39**	52	46	45	42	43	42	36	26	48	**40**	54	50	49	44	47	48	43	35	53	**45**
315	2	561	34	34	31	29	25	24	24	24	33	**25**	39	34	35	37	41	41	41	42	45	**37**	44	39	40	42	46	46	46	47	50	**42**
	4	1122	44	42	36	35	30	27	22	21	38	**30**	52	48	43	41	42	40	38	40	47	**39**	57	53	48	46	47	45	43	45	52	**44**
	6	1683	46	44	38	37	32	29	24	23	40	**32**	54	50	45	43	44	42	40	42	49	**41**	59	55	50	48	49	47	45	47	54	**46**
	8	2244	51	44	42	41	34	32	29	25	43	**35**	59	55	50	47	45	44	42	42	52	**44**	64	60	55	52	50	49	47	47	57	**49**
	10	2806	53	46	44	43	36	34	31	27	45	**37**	61	57	52	49	47	46	44	44	54	**46**	66	62	57	54	52	51	49	49	59	**51**
400	2	905	33	36	33	33	25	26	26	24	34	**26**	40	37	35	35	40	40	40	40	45	**37**	45	42	40	40	45	45	45	45	50	**42**
	4	1810	45	42	39	39	33	30	26	22	40	**32**	54	50	45	45	41	42	40	39	48	**40**	59	55	50	50	46	47	45	44	53	**45**
	6	2714	47	44	41	41	35	32	28	24	42	**34**	56	52	47	47	43	44	42	41	50	**42**	61	57	52	52	48	49	47	46	55	**47**
	8	3619	52	46	47	47	40	36	34	27	49	**41**	60	56	53	53	46	46	43	42	54	**46**	65	61	58	58	51	51	48	47	59	**51**
	10	4524	54	48	49	49	42	38	36	29	51	**43**	62	58	55	55	48	48	45	44	56	**48**	67	63	60	60	53	53	50	49	61	**53**

Pressure loss table ● Damper with venturi measuring, PPs, round model

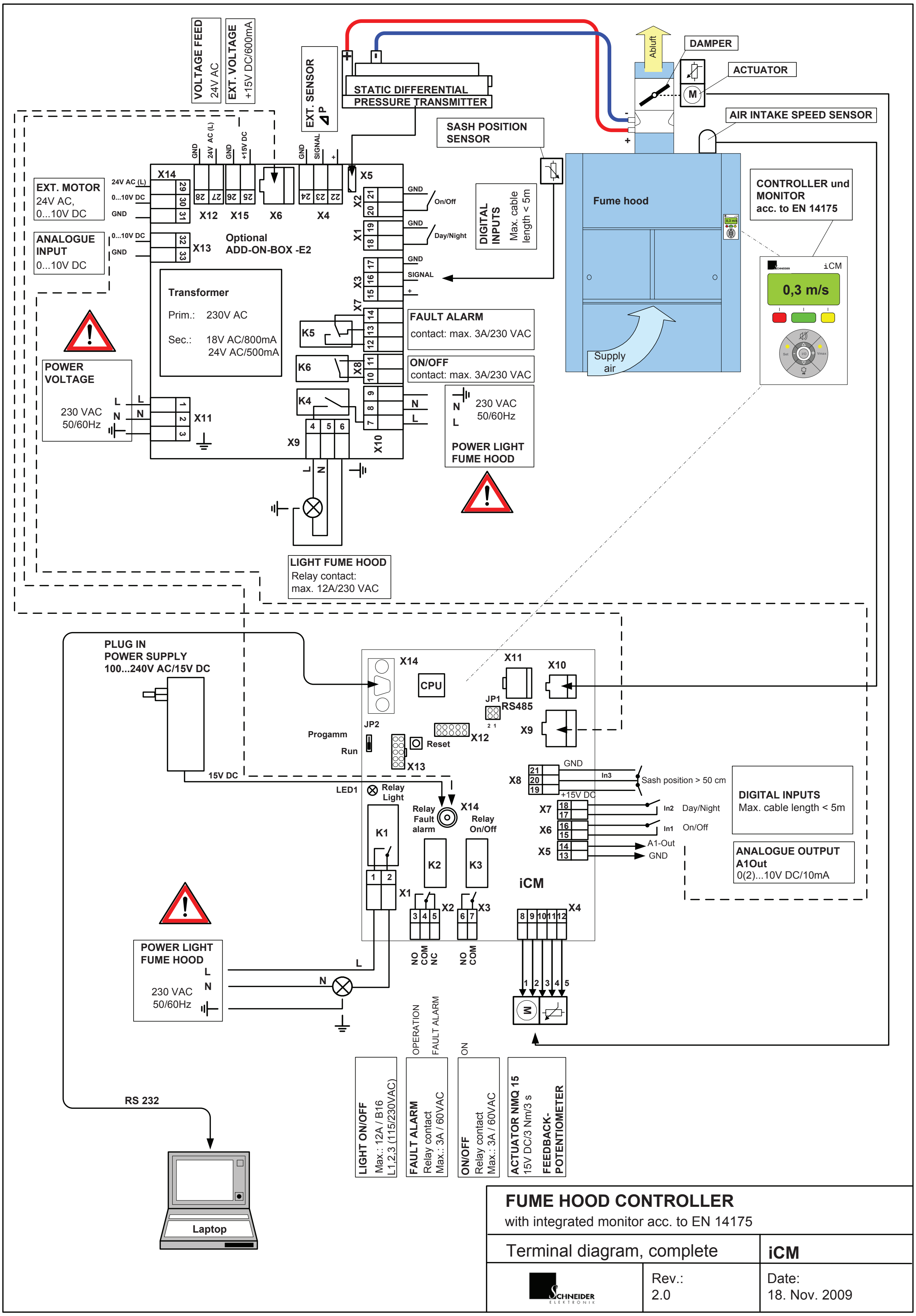
Table 5: Pressure loss



Definitions:

Δpv	in Pa:	Total pressure loss with fully open damper (measured in front of and behind the volume flow controller)

Terminal diagram: Fume hood controller iCM



Standard model iCM-F (face velocity)

■ General	
Plug in power supply	230/110V AC/50/60Hz/ +-15%
Max. current	100 mA
Max. power input	20 VA
Reactivation time	600ms
Operating temperature	0 °C to +55 °C
Humidity	max. 80 % relative, non-condensing

■ Case (iCM controller)	
Protection type	IP 20
Material	plastic
Colour	grey
Dimensions (LxWxH)	(134 x 80 x 40) mm
Weight	approx. 1,0 kg
Terminals	screw terminal 0,75 mm²

■ Relay outputs	
Number	1 relay (K1)
Contact type	front contact
Max. switching voltage	250V AC
Max. continuous current	3A
Number	2 relays (K2, K3)
Contact type	changeover/ front contact
Max. switching voltage	250V AC
Max. continuous current	2A

■ Digital inputs	
2 inputs	5V DC, 5mA

■ Analogue output	
1 output	0(2)...10VDC, 10mA

■ Air flow sensor AFS100	
Measuring principle	dynamic, heat wire anemometric principle
Flow range	0...1 m/s
Response time	< 100 ms

■ Damper without venturi measuring tube	
Number	4 optocouplers
Max. input voltage	24V DC +-15%
Max. continuous current	10mA (per input)

■ Servo motor	
Torque	3 Nm
Running time	3 sec. for 90 degrees
Activation	directly drive with integrated current monitor
Resolution	< 0,5°
Angle feedback	< 0,5° via potentiometer

Extended operating mode wit add on system -E2

■ General	
Internal power supply	230/110V AC/50/60Hz/ +-15%
Max. current	100 mA
Max. power input	20 VA
Reactivation time	600ms
Operating temperature	0 °C to +55 °C
Humidity	max. 80 % relative, non-condensing

■ Case (add on system)	
Protection type	IP 20
Material	sheet steel
Colour	white, RAL 9002
Dimensions (LxWxH)	(185 x 167 x 92) mm
Weight	approx. 1,5 kg
Terminals	screw terminal 1.5 mm²

■ Sash position sensor SPS100	
Measuring principle	static, cable pull potentiometer
Measuring range	0...1000 mm
Accuracy	± 2 mm
Response time	< 1 ms

■ Differential pressure transmitter	
Measuring principle	static
Pressure range	3...300 pascal 8...800 pascal optional
Accuracy	< 0,1 %
Response time	< 10 ms
Overpressure	500 mbar

■ Relay outputs	
Number	1 relay (K1)
Contact type	front contact
Max. switching voltage	250V AC
Max. continuous current	16A
Number	2 relays (K2, K3)
Contact type	changeover contact
Max. switching voltage	250V AC
Max. continuous current	12A

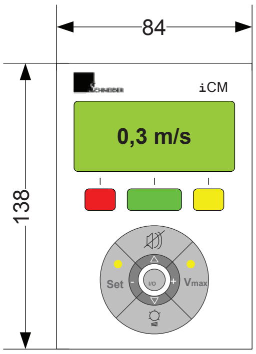
■ Analogue input	
1 input	0(2)...10VDC, 1mA

■ Digital inputs (galvanically separated)	
Number	2 optocouplers
Max. input voltage	24V DC +-15%
Max. continuous current	10mA (per input)

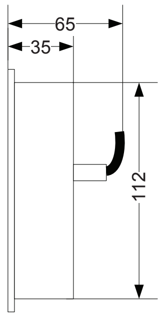
■ Maintenance-free measuring tube with damper	
Material	polypropylene (PPs)
Measuring system	maintenance-free measu-ring tube with two ring chambers, optionally venturi tube

Dimensions ● Dimensional diagrams ● Tender specification

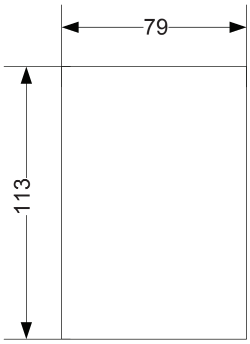
Case iCM: Top view



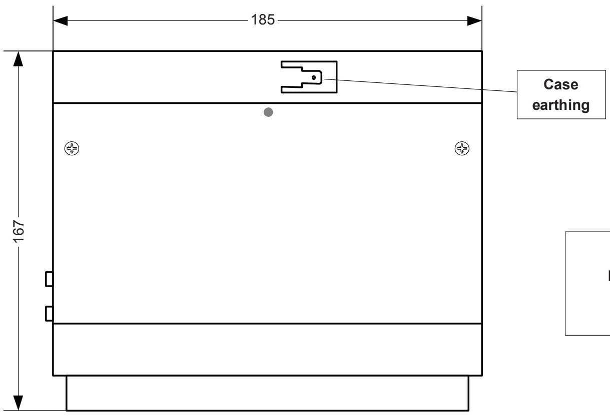
Case iCM: Side view



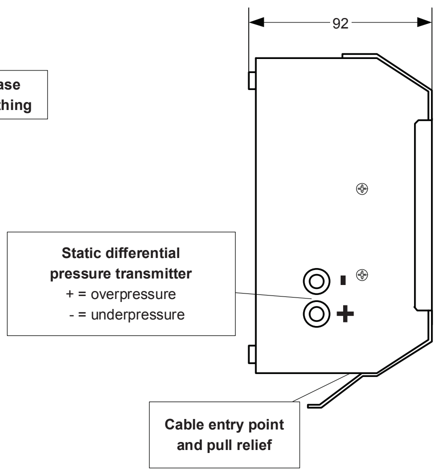
Case iCM: section



Case add on system: top view



Case add on system: Side view



Sash position sensor

SPS100

Air flow sensor

AFS100

Tender specification iCM-F

Fume hood controller with integrated microprocessor, independent watchdog circuit and air flow sensor. Variable fume hood control depending on the sash position (constant face velocity freely programmable) with integrated safe operation monitoring function in accordance with EN 14175 with acoustic and optical alarm. Optical and optionally acoustic alarm for the operating status “Sash position > 50cm”. Full graphic LC display with numerical display of the face velocity in m/s or ft/min. System data storage in mains voltage failure-safe EEPROM. Controller in compact built in case with separate air flow sensor. Direct digitalisation of the high speed actuator (< 3 s for 90°) for precise and stable control without any fluctuations. Damper model in PPs. All cables are ready to plug in. With optional add-on system upgradeable for extended operating modes. Suitable for all fume hood constructions.

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