

## 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 different operating modes for fume hood control (e.g. fully variable, face velocity, sash sensor) are possible.

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 differential pressure transmitter.

The integrated dual-port switch allows a simple and effective Ethernet-networking of fume hood controls and supply-/exhaust air volume flow controller. The parameterisation and the access to the data is carried out by a standard web browser. Native BACnet® with Trendlog and Intrinsic Reporting is implemented. LON® and Modbus® are supported as further field bus systems.

## 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 differential pressure transmitter and regulates the exhaust air volume flow 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).

The random selection of the hysteresis-free actuator guarantees a stable controlled operation.

The graphic OLED-display (64 x 64 pixel) as well as the ECO-indication simplify significantly the operation of the fume hood, indicate the operation status and make recommendations regarding the economical controlled operation.

The circuit-entering of a temperature sensor allows the temperature measurement in the fume hood according to DIN EN 14175, part 7.

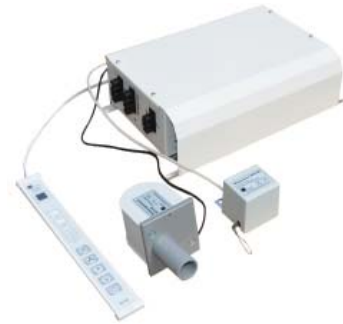
The support jet technology of the fume hood is supported by an integrated self-sufficient controlling, monitoring and activation of the optional support jet.



## Performance features

- Modular variable control system for fume hoods
- Integrated power supply 230 V AC
- All system data are saved mains voltage failure-safe
- Integrated web server
- Easy Ethernet-networking with dual port switch
- ECO-display for supporting the sustainable fume hood operating
- Graphic OLED-display (64x64 pixel) for alphanumeric display and icons
- Modular extension due to pluggable boards
- Parameterizing and read-out of all system values via standard web browser
- Up to three position-independent static differential pressure sensors from -100 to 300 Pa, freely configurable for exhaust air, supply air, room pressure, support air
- Linear sash position sensor for stable, error-free measurement of the vertical front sash opening
- Air flow sensor for measuring the face velocity
- Air volume flow range 1:15
- Compact design (DN 250, overall length only 400 mm)
- Integrated functional monitoring of fume hood operation in accordance with EN 14175 with acoustic and optical alarm
- Integrated air volume control, monitoring and control of the optional support air at the fume hood
- Patented maintenance-free measuring tube with two ring chambers and self-cleaning effect
- High-speed, predictive control algorithm
- Rapid, stable, precise control through direct activation of the servomotor with feedback potentiometer
- Control time of the air volume  $\leq 2$  sec ( $V_{MIN} \rightarrow V_{MAX}$ )
- Closed loop control
- Internal functional test of all sensors for plausibility
- Emergency =  $V_{OVERRIDE}$  and night operation =  $V_{NIGHT}$
- Optical and optionally acoustic alarm for the operating status "sash position > 50 cm"
- Different add-on extension modules for room controller, sash closer, field bus and backup accumulator
- Integrated native BACnet® (IP or MS/TP) with trendlog and intrinsic reporting
- Suitable for all fume hood constructions
- Temperature measuring in the fume hood according to DIN EN 14175-7

**Order code: Fume hood controller with integrated web server**



FC700 - V - A - BIP - 2 - 0700 - 3 - 0 - T

<b>Type</b>		FC700 - V - A - BIP - 2 - 0700 - 3 - 0 - T	
<b>Control type</b>			
Fully variable air volume	V		
Face velocity with V <sub>MIN</sub> and V <sub>MAX</sub> limitation	FP		
Constant face velocity	F		
Position sensor dependent air volume control	W		
Constant air volume control (1/2/3-step)	K		
<b>Housing</b>			
Standard	A		
Client-specific designs	G...Z		
<b>Interface to BMS/field bus module</b>			
Internal networking TCP/IP, Ethernet	IP		
Analogue/digital (extension module EM10)	AD		
Native BACnet®, TCP/IP, Ethernet	BIP		
Native BACnet®, MS/TP, RS485	BM		
LON, FTT-10A (Extension module EMLON)	L		
Modbus, IP	MIP		
Modbus, RS485	M		
		<b>Supply voltage</b>	
		0	24 V AC external, 30 VA
		T	Internal power supply 230 VAC/24 VAC/30 VA
		<b>Emergency power pack 12 V/1,2 Ah</b>	
		0	without
		N	with
		<b>Function display cable length</b>	
		3	3 m
		5	5 m
		<b>Function display type</b>	
		0700	various SCHNEIDER standard models (see data sheet: functional displays and control panels, standard versions)
		...	
		0999	
		...	client-specific designs (see data sheet: functional displays and control panels, standard versions)
		1000	
		...	
		9999	
		<b>Static differential pressure sensors -100...300 Pa</b>	
		1	1 sensor, free configurable: exhaust, supply, support, room pressure
		2	2 sensors, free configurable: exhaust, supply, support, room pressure
		3	3 sensors, free configurable: exhaust, supply, support, room pressure

Control type	Sensors included with delivery and customer supplied limit switches
V = fully variable	position sensor, air flow sensor, differential pressure sensor
FP = face velocity with V <sub>MIN</sub> and V <sub>MAX</sub> limitation	air flow sensor, differential pressure sensor
F = face velocity	air flow sensor
W = position sensor	sash position sensor, differential pressure sensor
K = constant (1 step up to 3 steps)	differential pressure sensor and 1 limit switch (2 step control) or 2 limit switches (3 step control). Limit switches customer supplied

**Important:**  
Order MD-measuring system with damper and actuator as well. Order optional extension modules as well.

**Ordering example: fume hood controller FC700**

fully variable air volume control, housing = standard, with BACnet®/IP, 2 relays, with 2 static differential pressure sensors, function display and control panel type = 0700 with 3 m cable, without emergency power pack, with internal transformer (power supply, 230 V AC).

**Make: SCHNEIDER**                      **Type: FC700-V-A-BIP-2-0700-3-0-T**

**Order code: Measuring system with damper and high-speed actuator, round design**

**MD - 250 - P - 0 - 0 - 0 - MM - 1**
**Measuring system**

Maintenance-free measuring tube	<b>MD</b>
Venturi nozzle	<b>VD</b>
Measuring nozzle	<b>DD</b>
Measuring cross with add. baffle	<b>KD</b>

**Nominal diameter DN [mm]**

110, 125, 160, 200, 250, 315	<b>110</b> ... <b>315</b>
------------------------------	---------------------------------

**Material**

Housing	Versions	
Polypropylene (PPs), fire retardant	MD, VD	<b>P</b>
PPs-el (electrically conductive)	MD, VD	<b>PeI</b>
Polyvinyl chloride (PVC)	MD, VD	<b>PV</b>
Galvanised steel	MD, DD, KD	<b>S</b>
Stainless steel 1.4301 (V2A)	MD, DD, KD	<b>V2</b>
Stainless steel 1.4571 (V4A)	MD, DD, KD	<b>V4</b>

**Actuator type**

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

**Pipe connections**

	Air inflow	Air outflow	Remarks
<b>MM</b>	socket	socket	only PPs, PPs-el
<b>FF</b>	flange	flange	PPs, PPs-el, steel, stainless steel
<b>MF</b>	socket	flange	only PPs, PPs-el
<b>FM</b>	flange	socket	only PPs, PPs-el
<b>RR</b>	pipe	pipe	PPs, PPs-el, steel, stainless steel

**Insulating shell**

<b>0</b>	without
<b>D</b>	with insulating shell

**Rubber lip seal**

<b>0</b>	without
<b>G</b>	with rubber lip seal (only steel and stainless steel)

**Damper blade seal**

<b>0</b>	without (standard version in PPs)
<b>K</b>	with (standard version in steel and stainless steel)

**Important:**

 Air volumes and dimensions at page 25.  
 Order fume hood controller FC700 as well.

**Note:**

For measuring systems VD, DD or KD ensure adequate inflow and outflow distances (&gt; 1xD) (see data sheet VAV500/VAV700).

**Ordering example: Round damper with maintenance-free measuring system and actuator**

Maintenance-free measuring system with damper, DN 250, PPs, without damper blade seal, without insulation shell, socket/socket, fast actuator 3 s for 90 ° (fast direct drive SCHNEIDER).

**Make: SCHNEIDER**
**Type: MD-250-P-0-0-0-MM-1**



Order code: \_\_\_\_\_ Extension modules

		Extension modules	Bemerkung/Lieferumfang
<b>EM10</b>	<b>EM10</b>	2 analogue inputs, 2 analogue outputs, 2 digital inputs, 2 relay outputs	Suitable for conventional connection to the building management system (BMS)
--	<b>EM20</b>	4 analogue inputs, 4 analogue outputs	General applications, actuator and valve activation
--	<b>EM30</b>	6 relay outputs	General applications, actuator and valve activation
--	<b>EM40</b>	4 Triac outputs	For valve activation, heating/cooling
--	<b>EM50</b>	Charging circuit with discharge circuit for battery backup 12 V DC	With battery backup 12 V DC/1,2 Ah in its own housing
<b>EMSC</b>	<b>EMSC</b>	Automatic sash closing module	wit PIR, light barrier and drive unit
--	<b>EMLON</b>	LON, FTT10-A	Field bus module

**Important:**  
Maximal 4 extension modules are pluggable (4 free slots in the FC700).

**Order example: Extension module**

1 x EM10 for conventional connection to the building management system with 2 analogue inputs, 2 analogue outputs, 2 digital inputs, 2 relay outputs, 1 x EMSC automatic sash closing module with equipment.

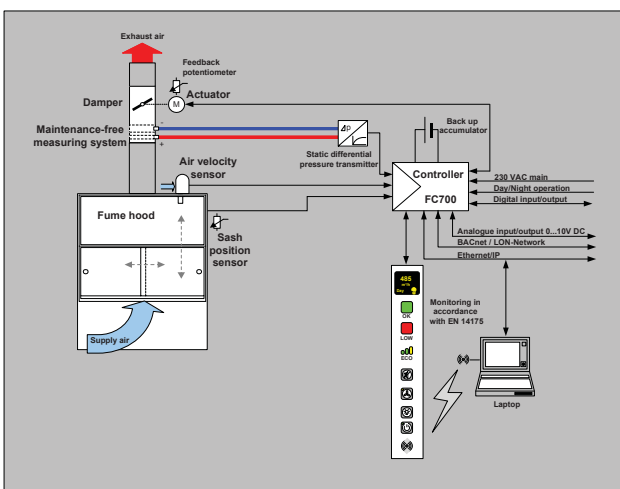
**Make: SCHNEIDER**                      **Type: EM10, EMSC**

## Block diagram

Picture 1 shows the block diagram and the piping of the static differential pressure sensor with a maintenance-free measuring system.

All plugs of the sensors and actuators are pre-assembled and directly pluggable on the outside of the FC700-housing. That means an immense reduction of the assembly time and a simplification of the commissioning. The high speed hysteresis-free actuator is operated in the proven direct drive mode and guarantees high control accuracy, highest durability and lifetime.

The pre-assembled CAT6/CAT7-cable for the Ethernet-networking will be plugged in the dual port switch and the system is ready for commissioning.



**Picture 1:** Block diagram fume hood controller FC700

## Networking

The networking offers maximum flexibility and safety. The connection to the building management system offers the complete ventilation control and monitoring of all laboratories.

A flexible network-adjustment is simply realised by modular extension cards. Besides the already integrated native BACnet® (IP or MS/TP) and Modbus® (IP or MS/TP) LON® is also available. The field bus boards can be retrofitted simply and at any time for all SCHNEIDER LabSystem products.

## Internet technology with integrated web server

The FC700 possesses an integrated web server for a simple data exchange and to improve the system security and it communicates via the Internet protocol TCP/IP. The operation and parameterisation is carried out by a laptop with a standard web browser. For this reason a simple circuit-entering into multivendor capable building management systems is guaranteed and the system is therefore prepared for all future applications.

## Web browser operation

The internal web sites of the integrated web server can be visualised via a standard web browser. Adjustments and parameter can be simply changed. By using a standard web browser project-dependent files are no longer necessary to access the central building control system worldwide and at any time. The internal visualisation software VIS7000 reduces significantly the system costs (data points) on the building management system level and can assume the building management functions if necessary.

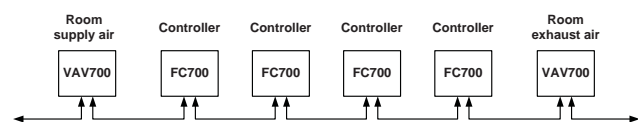
## Native BACnet®-IP

The building management system is provided with a multitude of data and therefore allows an optimised requirement planning and process control. Native BACnet® (IP or MS/TP) guarantees a fast, simple and direct connection to the building management system without additional gateways. Our own BACnet® stack developed by SCHNEIDER guarantees maximum flexibility. We support the read-out and storage of trendlog data as well as intrinsic reporting.

## Simple wiring and fast commissioning

A simple and fast wiring and commissioning are the main parameters to reduce significantly the installation and assembly costs. The dual port switch integrated on the CPU-board allows an easy daisy chain wiring with pre-assembled cables.

**Picture2:** Daisy chain wiring



The wiring can be executed radially as well.

The commissioning, configuration, diagnosis and visualisation of all system data (e. g. control time, damper position and setpoint settings) occur centrally through the network by a control unit via PC with standard web browser or decentrally via infrared interface of the graphic indication and operation panel.

## Function description

Therefore the connection of the bus cable is omitted. All standard cables, e. g. sensor cable, actuator cable, etc. are pre-assembled and externally pluggable.

## Building management system

The building management system balances the air requirement of the complete building and can check the plausibility of all room controllers. Day/night switching, visualisation of status and fault reports as well as actual values can be easily integrated. Remote maintenance and remote fault diagnostics as well as an air consumption measuring related to the laboratory or fume hood with individual accounting is also possible.

## Graphic functional display and operation panel

Due to the graphic OLED display (64 x 64 pixel) of the function indication all significant operation and status information are directly readable. Volume flow, inflow velocity, fault and operation reports are shown immediately in clear words and status reports are illustrated by graphic icons.

**Picture 3:** Graphic OLED display



Different variants of the function and operation panel are available as a wall mounted housing or as an integrated version (please refer to the data sheet „function displays standard versions“).

Custom made constructions can be realised quickly and cost-effectively on demand.

## Functions:

- Graphic OLED display (64 x 64 Pixel) for numeric indication of the volume flow or the inflow velocity as well as alphanumeric indication of operation and status reports
- Energy efficiency indication (ECO) as a tricoloured bargraph

- Audible and visual alarm (red LED) for too low exhaust air/supply air
- Visual indication (green LED) for sufficient exhaust air/supply air
- RESET-key to confirm the audible alarm
- Yellow flashing LED as a visual alarm for the operating condition „sash position > 50 cm“
- Infrared interface for decentral parameterisation via laptop (software PC2500) with IR adapter

## Options:

- Button controller ON/OFF with LED status indication
- Button light ON/OFF (fume hood interior light)
- Button  $V_{MAX}$  with LED status indication for emergency power supply (override)
- Button  $V_{MIN}$  with LED status indication for night setback (reduced operation)
- Button UP/DOWN for automatic sash locking system (with extension module EMSC)

## Energy efficiency indication (ECO)

The energy efficiency indication (ECO) of the controlled fume hood is a global innovation. The energy consumption of the individual operating mode is established by the average determination compared to other linked fume hoods in the laboratory building and shown on the ECO indication. Parameter like busy time, sash and cross slide opening period as well as fast and complete closing of the sash are included in this evaluation. The ECO indication provides information to the user how energy-consciously the fume hood is operated and promotes a rethinking towards a conscious and economical handling of the energy.

**Picture 4:** Energy efficiency indication (ECO)



### Integrated support jet controlling and regulation

The support jet technology improves the blowout behaviour in case of lower exhaust air flows if the construction of the fume hood is applicable. That means a fume hood with support jet is more energy-efficient. The integrated support jet activation controls, regulates and monitors the support jet fan of the fume hood. You can choose a simple on/off-controller or a controller (0-10 V DC) depending on the sash.

An own static differential pressure sensor is used to monitor the faultlessly functioning support jet fan by constant monitoring the support jet volume flow. In case of alarm (volume flow is too low) it will be indicated clearly on the graphic display and the sash will be closed automatically (with extension module EMSC). As an option the exhaust air flow can be automatically raised to a safe range.

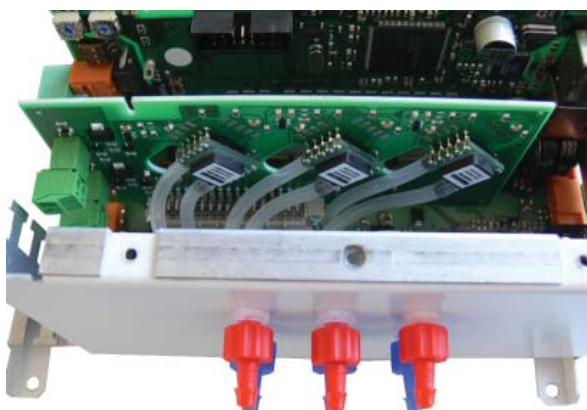
A flow monitoring (maximum and minimum) of the connected support jet fans is possible as well.

### Up to three position independent sensors

For FC700 up to three position independent static sensors (-100-300 Pa) are available as an option and can be freely configured. Because of the high sensibility and resolution a volume flow range of 1:15 can be adjusted smoothly.

The function classifications exhaust air, supply air, support jet and room pressure to the static differential pressure sensors are freely configurable. Therefore the controller can be simply and flexibly adjusted to all kind of applications. All data and measuring values are available at any time by the connected network.

**Picture 5:** Sensor board with three static differential pressure sensors

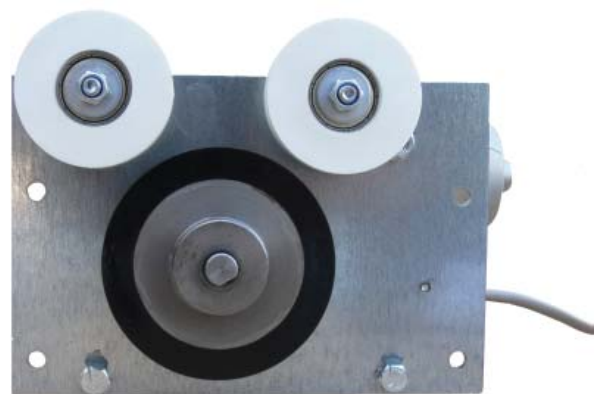


### Integrated sash closing system

The FC700 controller can simultaneously be used as an automatic sash closing system via the extension card EMSC and a drive unit to be mounted at the fume hood. This includes a passive infrared sensor for presence detection of the user and a light barrier for obstacle detection during the automatic closing.

This combination of control and closing system offers a cost-effective compact function unit with all advantages of the networked technology. The sash position is visualisable at any time via the building management system and e. g. in case of fire and smoke scenarios the sash can be closed immediately and automatically.

**Picture 6:** Drive unit closing system



Function description

Extension modules

The motherboard of the FC700 controller possesses up to four free extension slots. The controller can be arbitrarily extended to further functions besides the sash closing function (extension module EMSC).

Custom made extension modules for special measuring, controlling and regulation functions can be easily and cost-effectively developed.

The following extension modules are available:

Extension module	Function
EM10	2 analogue inputs, 2 analogue outputs, 2 digital inputs, 2 relay outputs
EM20	4 analogue inputs, 4 analogue outputs
EM30	6 relay outputs
EM40	4 Triac outputs for fan regulation, heating/cooling
EMNA	Charging circuit with discharge circuit for battery backup 12 V DC
EMSC	Automatic sash closing module
EMLON	Field bus module, LON®, FTT10-A

Picture7: Four free slots



Slot 6 (on the right side) is always equipped with the sensor board and slot 5 with the CPU board. The slots 1 to 4 (left to right) can be freely equipped with the above listed extension modules.

Temperature monitoring according to DIN 14175-7 in the fume hood's interior

Thermal loads are measured conforming to standards according to DIN EN 14175-7, alarmed via the graphic OLED-display and safely conducted by increasing the exhaust air volume flow.

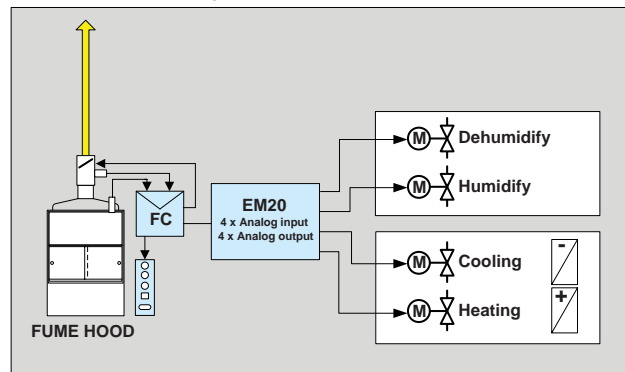
The temperature sensor PT1000 with stainless steel measuring sleeve specifically mounted inside the fume hood is therefore directly connected with the input terminal of FC700.

Heating and cooling of the laboratory

The heating and cooling of laboratories via appropriate heating and cooling registers can also be executed by FC700. The appropriate analogue and Triac outputs to regulate the heating and cooling valves will be made available by the extension modules EM10 to EM40. The power supply of the valves is provided by FC700 as well and the independent closed loop which is already implemented by default.

All measured room temperatures are available as actual value via network.

Picture 8: Valve regulation



Project planning

The project planning and parameterisation software PRO7000 is compatible to Windows and is used for a simple and fast commissioning. Parameterisation of devices can be executed from a central point for the entire room respectively the entire building. All data of the connected devices with integrated web server by SCHNEIDER can be indicated via standard web browser and entries can be done password protected.



## Visualisation

All relevant data is available for the building management system (BMS) via the network and can be used for facility management functions. A better planning and utilisation of the resources as well as a reduction of energy and operational costs are the significant characteristics.

Laboratory occupation plans, night setback and individual accounting of the air consumption data, energy-efficient operation as well as the safety improvement via remote maintenance and remote diagnosis of the fume hood controller and the volume flow controller for room supply air and room exhaust air are the outstanding advantages of the network technology with an integrated building management system (BMS).

The visualisation software module VIS7000 is the reasonable extension of PRO7000 and allows the simple creation of room graphics and a free alignment of single devices (e. g. fume hood, volume flow controller, etc.) in the room. This is a cost-efficient integral system solution with functions of the building management system.

The touchscreen controller PAD7000 developed by SCHNEIDER is especially adjusted to the requirements of the laboratory ventilation system and adopts the functionalities of the building management system. Special templates are a freely disposable. Trendlog and intrinsic reporting are implemented as well. Networking via BACnet® (IP or MS/TP) and LON® is supported.

**Picture 9:** Touchscreen controller PAD7000



Controller operating modes

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:

Controller type	Controller operating mode
FC700-V	Fully variable air volume flow control
FC700-FP	Constant face velocity control with limitation to $V_{MIN}$ and $V_{MAX}$
FC700-F	Constant face velocity control
FC700-W	Sash sensor air volume control
FC700-K	Constant air volume flow control (1-/2-/3-steps)

The listing of the controller operating modes describes from top to down the distribution in the market, e.g. the fully variable air volume flow control FC700-V has the highest market share.

Fully variable air volume flow control

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 **FC500-V** controller 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  $V_1$ ,  $V_2$  and  $V_3$  are freely programmable and define the vertices of the control curve.

$V_1 = V_{MIN}$

When the sash is closed (SHUT) regulation takes place according to a programmable  $V_1$  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.

$V_2 = V_{50cm}$

The second point of the volume air flow is  $V_2$ , 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  $V_1$  and  $V_2$  (SHUT  $\leq$  sash  $\leq$  50 cm). The vertices  $V_1$ ,  $V_2$  and  $V_3$  are freely programmable and can be assigned to any sash opening, e.g.  $V_2$  at sash = 50 cm.

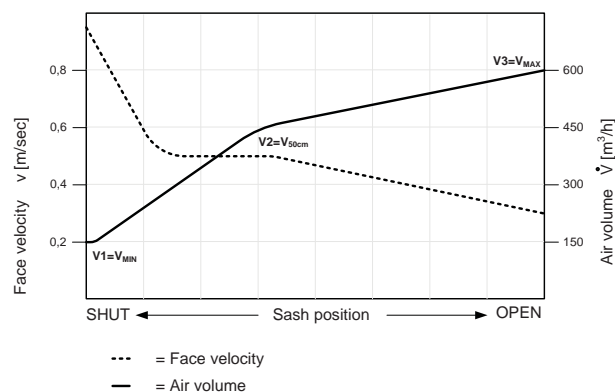


Figure 10: Fully variable air volume flow control

$V_3 = V_{MAX}$

The third point of the exhaust air volume flow is  $V_3$ , 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  $V_2$  and  $V_3$  (50 cm  $\leq$  sash  $\leq$  90 cm) and is dependent on the sash opening.

Constant face velocity control

The **FC700-FP/FC700-F** regulates at a constant face velocity (e.g.  $v = 0,3...0,5$  m/s), independent of the sash position. Here the air flow sensor AFS100 is used. A flow measurement (**FC700-FP**) is mandatory.

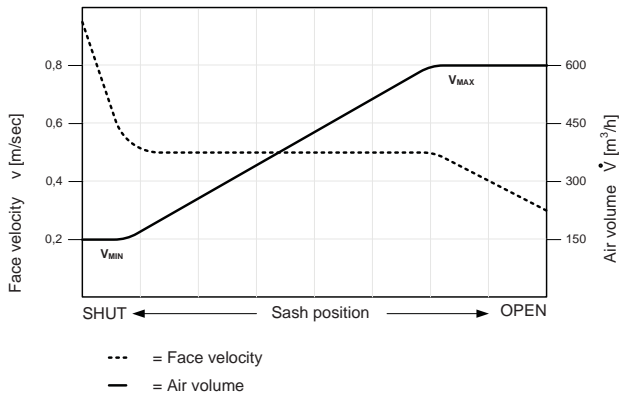
The exhaust air volume flow is changed in relation to the fume hood sash position so that the face velocity remains constant. The fume hood exhaust air volume flow is regulated either by a motor-driven damper (in hoods connected to a central exhaust air system) or by an integrated exhaust air motor with a frequency inverter.

Pressure fluctuations in the duct system are regulated quickly, precisely and steadily. The face velocity  $v$  and additional with **FC700-FP** the exhaust air volume flows  $V_{MIN}$  and  $V_{MAX}$  are freely programmable.

Air volume flow limitation  $V_{MIN}$  and  $V_{MAX}$

For operator safety, a minimum exhaust airflow  $V_{MIN}$  is not undercut.

When the sash is opened, the face velocity is reduced  $v < 0,3$  m/sec. When the safe exhaust air volume flow  $V_{MAX}$  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  $V_{MAX}$  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 11:** Constant face velocity control with air volume flow limitation  $V_{MIN}$  and  $V_{MAX}$

### Air flow sensor

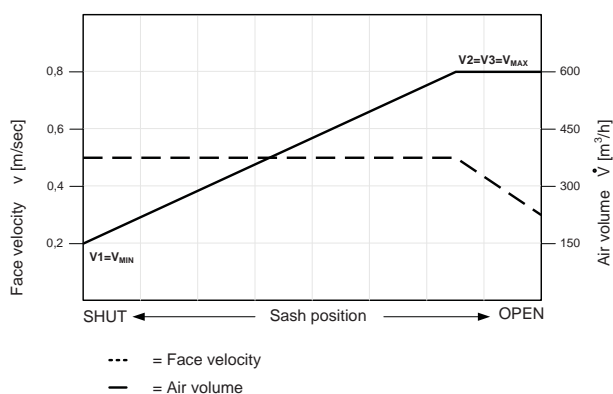
With the air flow sensor developed by SCHNEIDER a change in position of the sash and/or slide window is automatically detected and integrated in the control algorithm.

### Sash position dependent air volume flow control

In fume hoods without a slide window, only one sash position sensor SPS100 is needed for an 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 is always a better choice than a flow sensor.

The sash position measured by the sash position sensor is the setpoint for the **FC700-W** controller, which calculates the required exhaust air volume flow and regulates it as needed. Volume flow is always linear in relation to the position sensor.



**Figure 12:** Linear sash position air volume flow control

### Constant air volume flow control 1/2/3-steps

The **FC700-K** controller 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. This regulation mode is next to the **FC700-F** the energetically worst solution.

Pressure fluctuations in the duct system are regulated quickly, precisely and steadily. The exhaust air volume flows  $V_1$ ,  $V_2$  and  $V_3$  are freely programmable.

#### 1 step constant air volume flow control

In 1 step constant controllers the exhaust air volume flow is constantly regulated at  $V_1$ , independent of the sash position.

#### 2 step constant air volume flow control

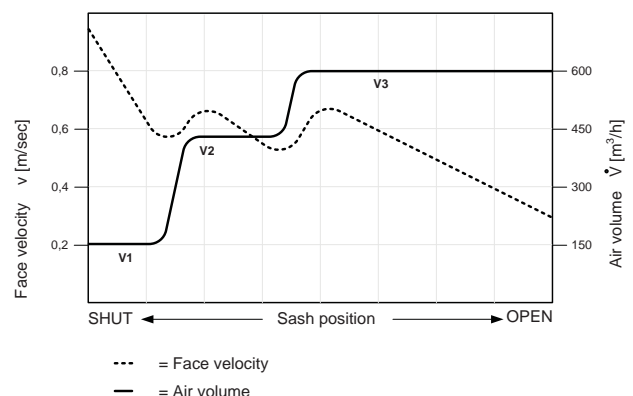
A 2 step constant controller regulates the exhaust air volume flow at  $V_1$  (sash = SHUT) or  $V_2$  (sash = NOT SHUT), depending on the sash position.

The sash position (SHUT) is recognised by a limit switch. It is also possible to switch to reduced operating mode (night-time operation and work-free time) manually or via a remote control input.

#### 3 step constant air volume flow control

A 3 step constant controller regulates the exhaust air volume flow at  $V_1$  (sash = SHUT),  $V_2$  (sash < 50 cm OPEN) and  $V_3$  (sash > 50 cm OPEN), depending on the sash position. The sash positions (SHUT and > 50 cm) are both signalled by a limit switch. Switching to night-time operation is also possible.

If the fume hood has a slide window, the slide window position (SHUT) must also be determined and in the 2 step or 3 step operating mode allowance must be made for the slide window position so that the exhaust air volume flow is increased accordingly when the slide window is opened.



**Figure 13:** 3-step constant air volume flow control

## Controller operating modes

### 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 pressure in all operating conditions.

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

### Plausibility check with three different sensors

The **FC700** controller uses three different sensors (sash position sensor SPS100, static differential pressure transmitter and air flow sensor AFS100) 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 service module 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 the setup. The **FC500** 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 on the laptop with the installed software PC2500.

Actual values	Value range	Unit
Exhaust air volume flow	0 - 25000	m <sup>3</sup> /h
Supply air volume flow	0 - 25000	m <sup>3</sup> /h
Room pressure	-100 - 300	Pa
Support air: Pressure	-100 - 300	Pa
Air volume flow	0 - 200	m <sup>3</sup> /h
Face velocity	0 - 1,0	m/s
Sash position (with position sensor SPS100)	0 - 100	%
Pressure exhaust air (measured via measuring system)	-100 - 300	Pa
Damper position	0 - 100	%
Temperature (with PT-1000 measuring element)	0 - 100	°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.

In networked systems, these diagnostic functions can also via the BMS or through the Internet performed as remote diagnostics.

### 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.

### Maintenance-free measuring tube with two ring chambers and integrated damper

The patented SCHNEIDER maintenance-free measuring system guarantees the user a high level of availability and always safe and accurate measurement. Almost any measurement task is possible with this new system and it is suitable for both round-PPs tubes and for rectangle ducts.

The benefits of maintenance-free measuring system:

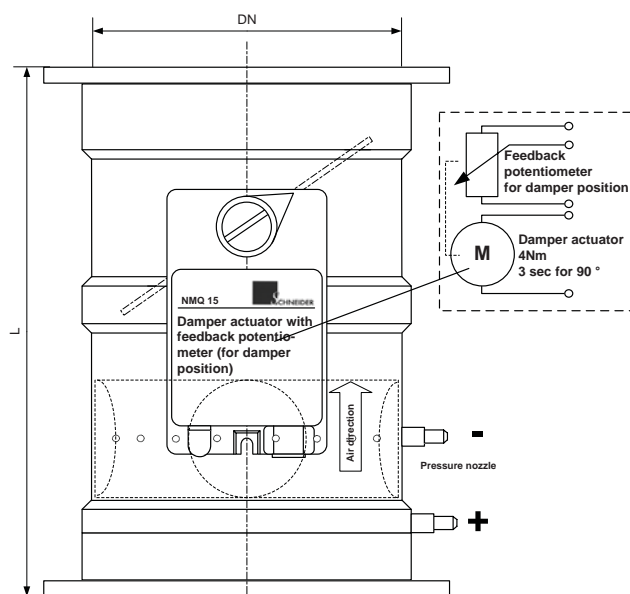
- Very high measuring accuracy (better than 3%)
- Integrated annulus measuring process
- Very good sound levels due to favourable inflow
- Maintenance-free operation due to self-cleaning measuring system
- Compact design (e.g. DN 250, overall length = 400 mm)
- Independent of the inlet and outlet route

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.



**MD-250-P-0-0-0-FF-1**

**Figure 14:** Damper with integrated maintenance-free tube and fast servomotor, running time 3 s for 90 °  
Model: flange/flange



**Figure 15:** Schematic diagram connection of servomotor 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 DN 200 the compact maintenance-free tube with integrated damper requires a length of just 350 mm (smaller lengths on request).

Table 1 shows the relationships between the nominal diameter (DN), overall length (L), minimum air volume flow  $V_{MIN}$  and the maximum air volume flow  $V_{MAX}$  at a flow velocity of 6 m/s.

Please consider in laboratory applications due to the noise and pressure drop that at maximum air volume flow  $V_{MAX}$  the flow rate in air volume controller/duct of 6 m/s is not exceeded.

Nominal diameter DN [mm]	Overall length L [mm]	Shield factor B	Minimum air volume flow $V_{MIN}$ [m <sup>3</sup> /h]	Maximum air volume flow $V_{MAX}$ [m <sup>3</sup> /h] with $v = 6$ m/s
160	340	34	61	434
200	350	58	104	679
250	400	94	169	1060
315	490	146	262	1683

**Table 1:** Nominal diameters, shield factor and air volume flow range of the maintenance-free measuring tube with integrated damper

High-speed actuator • Sensors

### Hysteresis-free high speed actuator with feedback potentiometer

The required exhaust air volume flow is adjusted via the damper. The high speed actuator (3 s running time for 90 °) specially developed for SCHNEIDER is mounted directly on the damper shaft and has a torque of 3 - 4 Nm. The servomotor is operated directly by the control electronics (fast direct drive), which guarantees fast, stable control behaviour.

The fast direct drive control mode has considerable advantages over analogue motor operation (0 - 10 V DC), because the internal control electronics of the analogue (continuously) controlled servomotor have a hysteresis which can lead to control fluctuations which affected both the general performance, as well as the actuator life time considerably. For this reason, we have consistently used the fast direct drive technology.

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

### Static differential pressure transmitter

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

The fume hood controller FC700 can be optionally equipped with up to three configurable static differential pressure sensors with a measuring range from -100 - 300 Pa.

### Measuring volume flow with a static differential pressure transmitter

The basis to determine 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 recommends the patented maintenance-free measuring tube due to its very high measuring accuracy and especially due to the fact that it is not dependent on an 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 -100 - 300 Pa is very precise and stable, which means that a volume flow range of 1:15 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  
 $\Delta p$  = Differential pressure  
 $\rho$  = Density of the air

### Dynamic air flow sensor AFS100

Using an 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 standardised 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.



Figure 16: Air flow sensor

### Sash position sensors SPS100/SPS200

The sash position sensors SPS100 and SPS200 developed by SCHNEIDER determine the vertical sash position with an absolute accuracy of better than 2 mm (0,2 %). The reproducible and seamless linear determination of the sash position enables very fast, precise, stable control. With this technology overshoot or undershoot are largely avoided with a suitable control algorithm.

The sash position sensor cable of the SPS100 has an ejection length of 1 m and can easily be hooked into the front sash counterweight. The sash position sensor cable of the SPS200 has an ejection length of 2 m and is mainly suitable for walk-in fume hoods.

The sash position sensor is easy to mount, does not need to be adjusted and provides a completely secure, stable and trouble-free feedback signal of the vertical sash position over the entire front sash opening area. There is no need to adjust limit switches (e. g. sash position = 50 cm) and the sash position can be configured easily using the sash position sensor and the teach-in menu.

The sash position sensors SPS100/SPS200 guarantee reliable operation in rugged environment and without adjustment or readjustment. Easy Mounting and connecting. Done.



**Figure 17:** Linear sash position sensor SPS100, 1 m ejection length to determine the sash position

### Detection of thermal loads

Thermal loads must be detected quickly and safely and alert in accordance with DIN EN 14175, Part 7 and dissipated by increased exhaust air volume flow. The face velocity sensor is not suited to the additional task of detecting thermal loads. It must be temperature compensated in order to generate a safe air velocity value that is independent of the room temperature as a command variable for the fume hood controller.

For this purpose, SCHNEIDER offers a **PT-1000** thermal element in V4A casing for precise, safe measurement of the interior temperature of the fume hood. As soon as the interior temperature increases and a freely programmable value is exceeded, the exhaust air volume flow is increased instantly and safely and on the graphic OLED displayed and alarmed.



**Figure 18:** Temperature sensor PT1000

VAV dimension • Planning values for duct pressure

VAV dimensions for room application

The air volume flows  $V_{MIN}$ ,  $V_{MED}$  and  $V_{MAX}$  are freely programmable within the range 50 - 25.000 m<sup>3</sup>/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 air volume flow for laboratory applications with regard to the flow velocity v

Air volume flow	Flow velocity v
$V_{MIN}$	$v \geq \text{app. } 1 \text{ m/s}$
$V_{MAX}$	$v \leq 6 \text{ m/s}$

Notes on control dimensioning (dimensions and volume flow)

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 1,5 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 6 m/s, otherwise costly noise caution (e. g. insulation shells, silencer) must be taken in order to comply with the DIN 1946, Part 7 required sound pressure level < 52 dB (A).

Planning values for noise and exhaust air volume flow

The tables on pages 25 to 27 should be consulted when planning a system, in order to design an optimal ratio between exhaust air volume flow, control behaviour and minimum noise level.

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 ( $\Delta p_v \cdot \text{factor } 3$ ) plus the pressure loss of the connected fume hood (controller pressure loss  $\Delta p_v$  see table 3 on page 27).

Example:

- Given:
- Maintenance-free measuring tube DN250
  - max. air volume flow = 720 m<sup>3</sup>/h (sash open)
  - fume hood pressure loss acc. to manufacturer e.g. 40 Pa

Calculated: air velocity at a maximum air volume flow of 720 m<sup>3</sup>/h = 4,08 m/s

Table 3 :  $\Delta p_v = 14 \text{ Pa}$   
 $\Delta p_v \cdot 3 = 14 \cdot 3 = 42 \text{ Pa}$

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

Calculated minimum duct pressure:  $42 + 40 = 82 \text{ Pa}$

<b>Chosen minimum duct pressure with controller DN250 and maximum air volume flow = 720 m<sup>3</sup>/h:</b>	<b>ca. 100 Pa</b>
--	-------------------



The room plan 1 shows the networking by default with the Internet protocol TCP/IP via Ethernet. Due to the high data transfer rate it is possible to network any number of subscribers. The response time of the linked subscribers (e. g. room supply volume flow controller) is sufficiently secured even during heavy data traffic.

### Wiring

The integrated dual port switches of FC700 and VAV700 allow a simple and fast daisy chain wiring with pre-assembled CAT6/CAT7 patch cables and therefore reduce the assembly and installation costs significantly. Therefore the connecting of the bus cable is omitted and all standard cables like sensor cable, actuator cable, etc. are pre-assembled and pluggable on the outside.

### Balancing

The volume flow controller VAV700-IP balances the required room supply air and room exhaust air independently according to the laboratory exhaust air and controls the calculated value self-sufficiently. If the added exhaust air of the fume hoods is not sufficient for the maintenance of a defined room air exchange rate (e. g. room air exchange rate = 4 or eightfold) the room exhaust air volume flow controller raises the volume flow as long as the requested room air exchange rate is reached.

The room supply air volume flow controller follows the total room exhaust air, reduced by a fixed value or a percentaged reduction. Therefore the required low pressure in the laboratory according to DIN 1946, part 7 is guaranteed for all operating conditions. The supply of the volume flow controller with 24 V AC has to be provided by the customer.

The optional room management controller RMC700 can be connected directly to the network via LON® or Modbus and regulates e. g. day/night operation per room. Status and operation information (temperature, humidity, pressure) can be indicated additionally on the graphic display.

### Commissioning via Internet protocol TCP/IP

For a simple data transfer and to improve the system security FC700-IP has an integrated web server and communicates via the Internet protocol TCP/IP by default. The operation, parameterisation and commissioning occur via laptop with standard web browser.

The commissioning can occur decentrally for all linked subscribers via a standard web browser or directly via infrared interface at the fume hood with a laptop and the installed software PC2500.

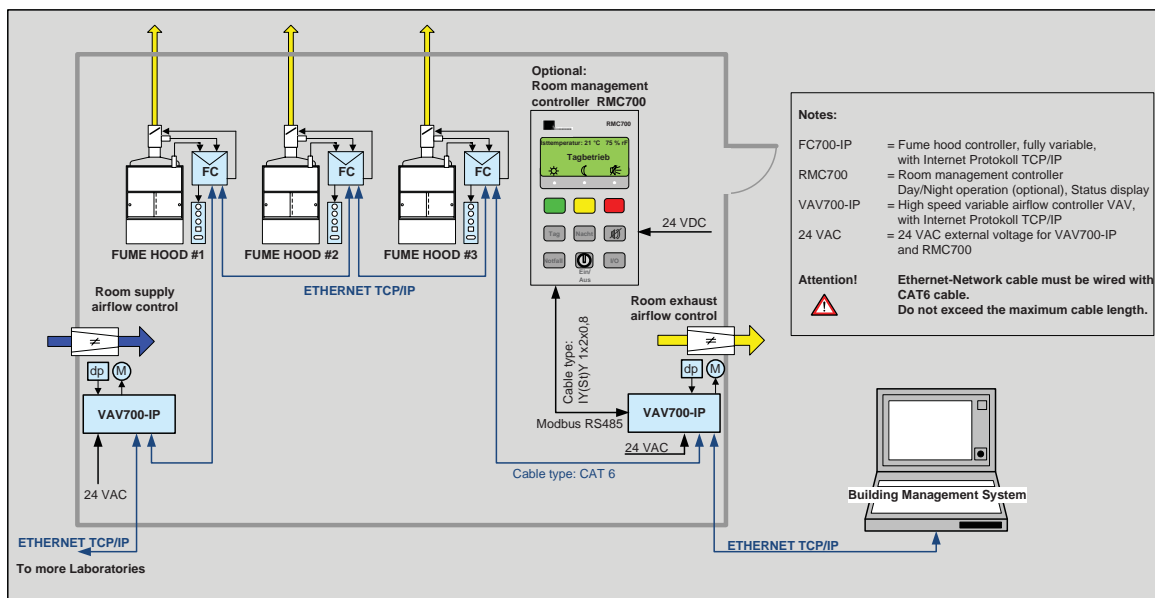
The internal websites of the integrated web server can be visualised worldwide with a standard web browser. Therefore a simple remote maintenance can be realised. The internal visualisation software VIS7000 reduces significantly the system costs (data points) on the building management system level and can assume the building management functions if necessary.



### Extension modules

Any function extensions can be simply and modularly realised by the subsequently pluggable extension modules. Besides the sash closing function (extension module EMSC) miscellaneous input and output modules (analogue and digital) for measuring value collection (temperature, humidity) respectively for controlling heating and cooling valves as well as field bus modules (LON®) are available. The controller can be arbitrarily extended to further functions besides the sash closing function (extension module EMSC).

All extension modules are embedded in the networking and provide the data and measuring values via the Internet protocol TCP/IP.



Room plan 2 • fume hood controller FC700 with analogue output and laboratory controller LCO500

The room plan 2 shows the connection of up to 9 fume hoods (Ain 1 to Ain 9) with the laboratory controller LCO500. The laboratory controller regulates up to eight freely configurable volume flow controller for room supply air/room exhaust air (Aout1 to Aout8). The internal switching power supply (optional) provides a maximum of 8 volume flow controller with supply voltage 24 V DC which simplifies the planning and the implementation is more cost-effective.

The analogue inputs Ain1 to Ain10 will be summed-up and can be combined to miscellaneous groups on the analogue outputs Aout1 to Aout8. Thereby any configurations are possible. Therefore it is possible to regulate independently e. g. several laboratories (max. 8) with one room supply air volume flow controller each and 10 fume hoods at most. Like it is shown in room plan 2 an additionally room exhaust air can be configured besides the room supply air. Each room exhaust air volume flow controller requires an analogue input (recirculation actual value room exhaust air).

**Networking with building management system**

A cost-effective and simple connection to the multivendor capable building management system (BMS) can be realised via the network by an optional field bus module (LON®, BACnet® or Modbus).

Via the BACnet® bus board a native BACnet® can be realised which means that no gateways are necessary to possibly implement protocols and data. Therefore a full compatibility as well as a simple and fast commissioning is guaranteed.

With the extension of the digital fault warning inputs (optional) all fault warnings of the connected fume hoods will be gathered and sent via network to the building management system (BMS).

The laboratory controller LCO500 fulfills the functionality of a DDC-substation respectively a router.

The following data are available as network variables in the business management system:

- readout of the exhaust air actual values of the fume hoods Ain1 to Ain10
- readout of the summed-up room balances (room supply air/room exhaust air)
- setpoints for 8 analogue outputs
- readout of the 8 digital outputs
- setting of the 8 relay outputs

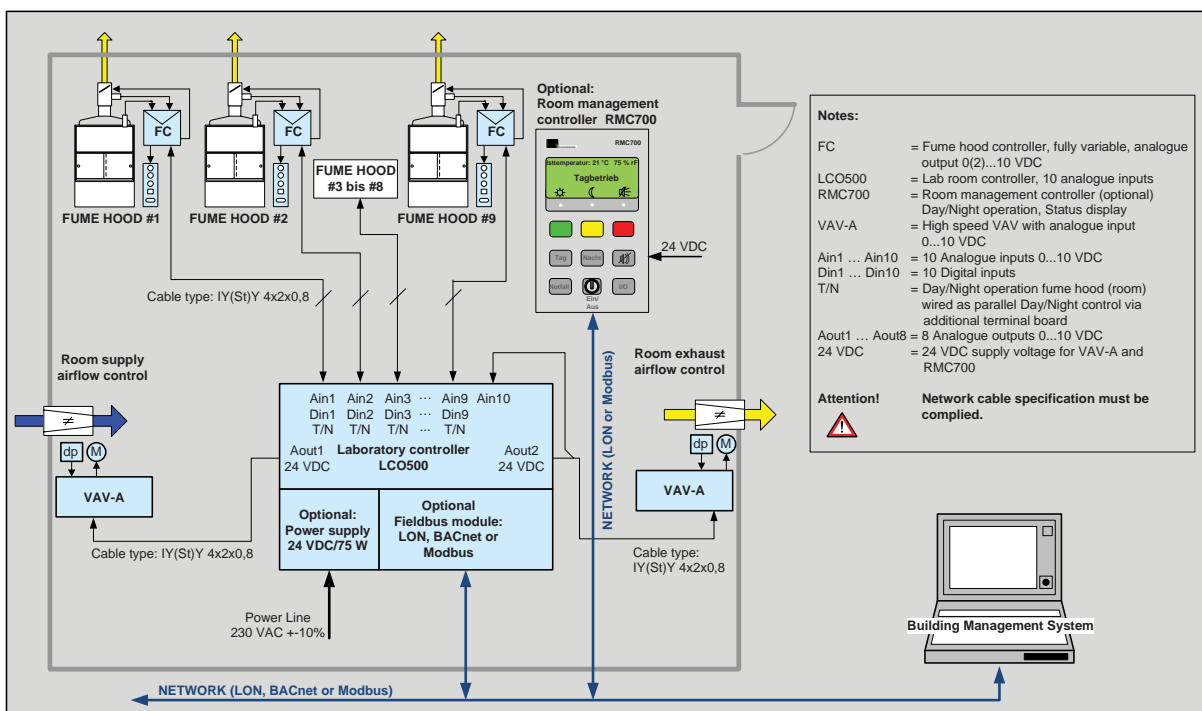
Therefore special functions like day/night switchover of the fume hood controller, regulation and monitoring of the room control unit, temperature regulation as well as controlling of the heating and cooling valves are simply realisable.

Extended functions like remote maintenance are realisable as well. By day/night switchover, retrieval and comparison of the individual exhaust air actual values each fume hood can be checked regarding this function.

The optional room management controller RMC700 can be connected directly via LON® or Modbus to the network and regulates e. g. day/night operation per room. Status and operation information (temperature, humidity, pressure) can be additionally indicated on the graphic display.

The laboratory controller LCO500 combines the analogue technology with the advantages of the bus technology and offers a cost-effective, flexible and secure regulation and visualisation per room via the building management system.

For detailed description please refer to data sheet LCO500.



**Room plan 3 • fume hood controller FC700 with BACnet®-IP networking and room visualisation**

The room plan 3 shows a networking with native BACnet®-IP protocol. The BACnet®-IP protocol is increasingly established as de facto standard for the building automation. Due to the high data transfer rate it is possible to network any number of subscribers. The response time of the linked subscribers (e. g. room supply volume flow controller) is sufficiently secured even during heavy data traffic.

**Wiring**

Refer to description of room plan 1.

**Balancing**

Refer to description of room plan 1.

**Native BACnet®-IP**

A BACnet® stack implemented in the 700 product series allows the direct communication with the business management system RMS700 by SCHNEIDER. Gateways are not required anymore and due to the direct implementation of the BACnet® stack to the CPU board the term "native BACnet®" has been created.

BACnet® is a multivendor capable interface for management systems and allows the simple implementation and visualisation of functions.

**Extension modules**

Refer to description of room plan 1.

**List of variables and object types**

The PICS list (Protocol Implementation Conformance Statements) for BACnet® applications as well as the SNVT list (Standard Network Variable Type) can be required or downloaded from our website:

[www.schneider-elektronik.com](http://www.schneider-elektronik.com).

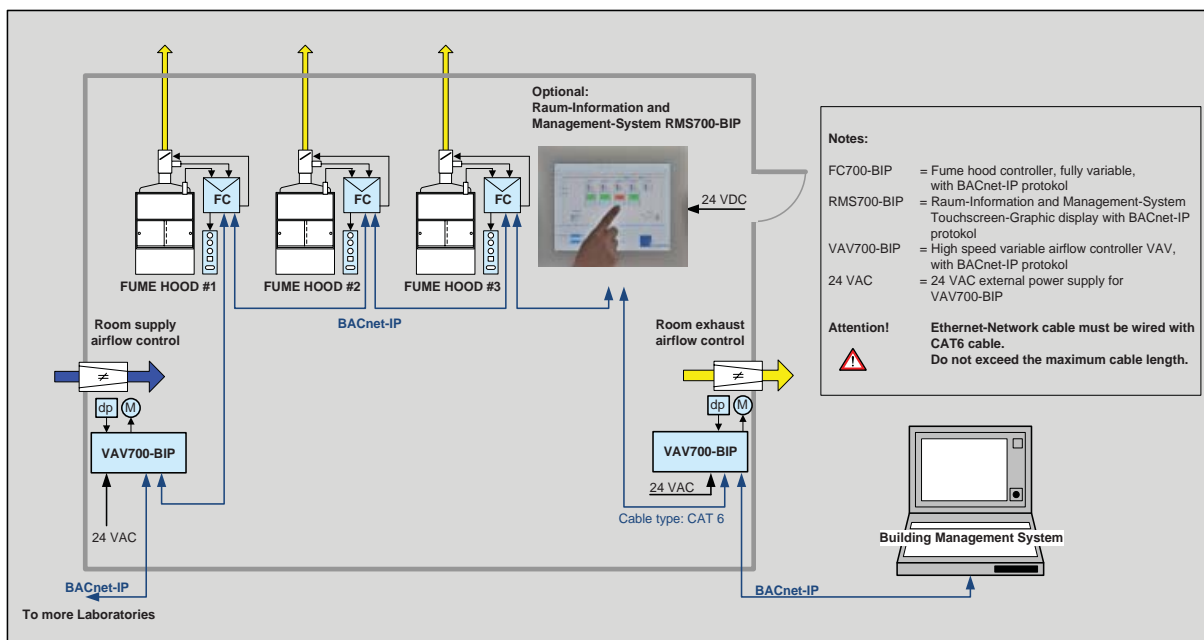
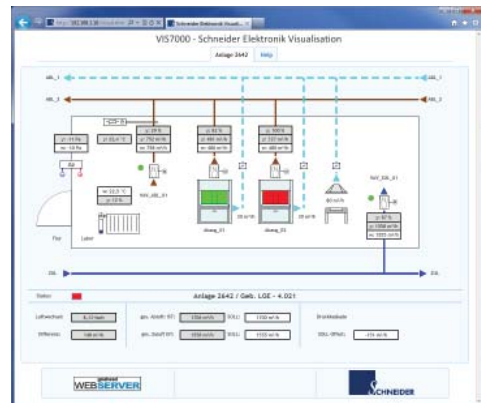
**Room visualisation**

The project planning and parameterisation software PRO7000 is compatible to Windows and is used for a simple and fast commissioning. Parameterisation of devices can be executed from a central point for the entire room respectively the entire building. All data of the connected devices with integrated web server by SCHNEIDER can be indicated via standard web browser and entries can be done password protected.

The visualisation software module VIS7000 is the reasonable extension of PRO7000 and allows the simple creation of room graphics and a free alignment of single devices (e. g. fume hood, volume flow controller, etc.) in the room. This is a cost-efficient integral system solution with functions of the building management system.

The touchscreen controller PAD7000 developed by SCHNEIDER is especially adjusted to the requirements of the laboratory ventilation system and adopts the functionalities of the building management system. Special templates are a freely disposable. Trendlog and intrinsic reporting are implemented as well..

**Figure 19:** Touchscreen controller PAD7000



Extension modules

**Extension modules**

The motherboard of the FC700 controller possesses up to four free extension slots for special functions. The controller can be arbitrarily extended to further functions besides the sash closing function (extension module EMSC).

Custom made extension modules for special measuring,

controlling and regulation functions can be easily and cost-effectively developed.

The following extension modules are available:

Extension modules	Functionality	Description
EM10	In- and outputs	Suitable for general applications:
	2 analogue inputs	Measuring of temperature, humidity, pressure
	2 analogue outputs	Building management system connection, volume flow controller regulation, valve regulation
	2 digital inputs	Building management system connection, regulation
	2 relay outputs	Building management system connection, valve regulation (2-point), status report
EM20	In- and outputs	Suitable for general applications:
	4 analogue inputs	Measuring of temperature, humidity, pressure Analogue room balancing
	4 analogue outputs	Building management system connection, volume flow controller regulation, valve regulation
EM30	Outputs	Suitable for general applications:
	6 relay outputs	Building management system connection, valve regulation (2-point), status report
EM40	Outputs	Suitable for valve regulation:
	4 Triac outputs	Direct regulation of heating and cooling valves (2-point)
EMNA	Special module	Suitable for external battery backup:
	Charging circuit with discharge circuit for battery backup 12 V DC	This module is required for an optional external battery backup 12 V DC.
EMSC	Special module	Suitable for integrated sash closing system:
	Automatic sash closing module	This module is required for the integrated automatic sash closing system and substitutes the separate product SC500. The scope of delivery includes: 1 pc. module EMSC 1 pc. motor operated drive unit (cable, tooth belt or direct drive) 1 pc. passive infrared sensor (PIR) 1 pc. sash position sensor SPS100/SPS200 (if not delivered with the regulation) 1 pc. light barrier IRL100 for obstacle detection
EMLON	Special module	Suitable for network connection:
	Field bus module, LON®, FTT10-A	This module is required for a LON network connection

### Fume hood controller with integrated sash closing function

With the extension module EMSC the fume hood controller FC700 adopts additionally a cost-effective automatic sash closing function. This extension is useful because good energy-efficiency values can be reached in combination with the controller. As the sash is only open when needed the operational costs are immensely reduced due to a minimal air consumption.

This extension board substitutes the separate automatic sash controller SC500 by SCHNEIDER.

Miscellaneous sash drive units can be adapted. The following additional inputs and outputs for standard fume hood controllers are available for the automatic sash closing function:

- Sash drive unit with magnetic coupling for manual operation
- Light barrier for obstacle detection during closing process
- Passive infrared sensor for user detection at the fume hood
- Up/down inputs for direct sash controlling (extinguish function, smoke extraction, fire)

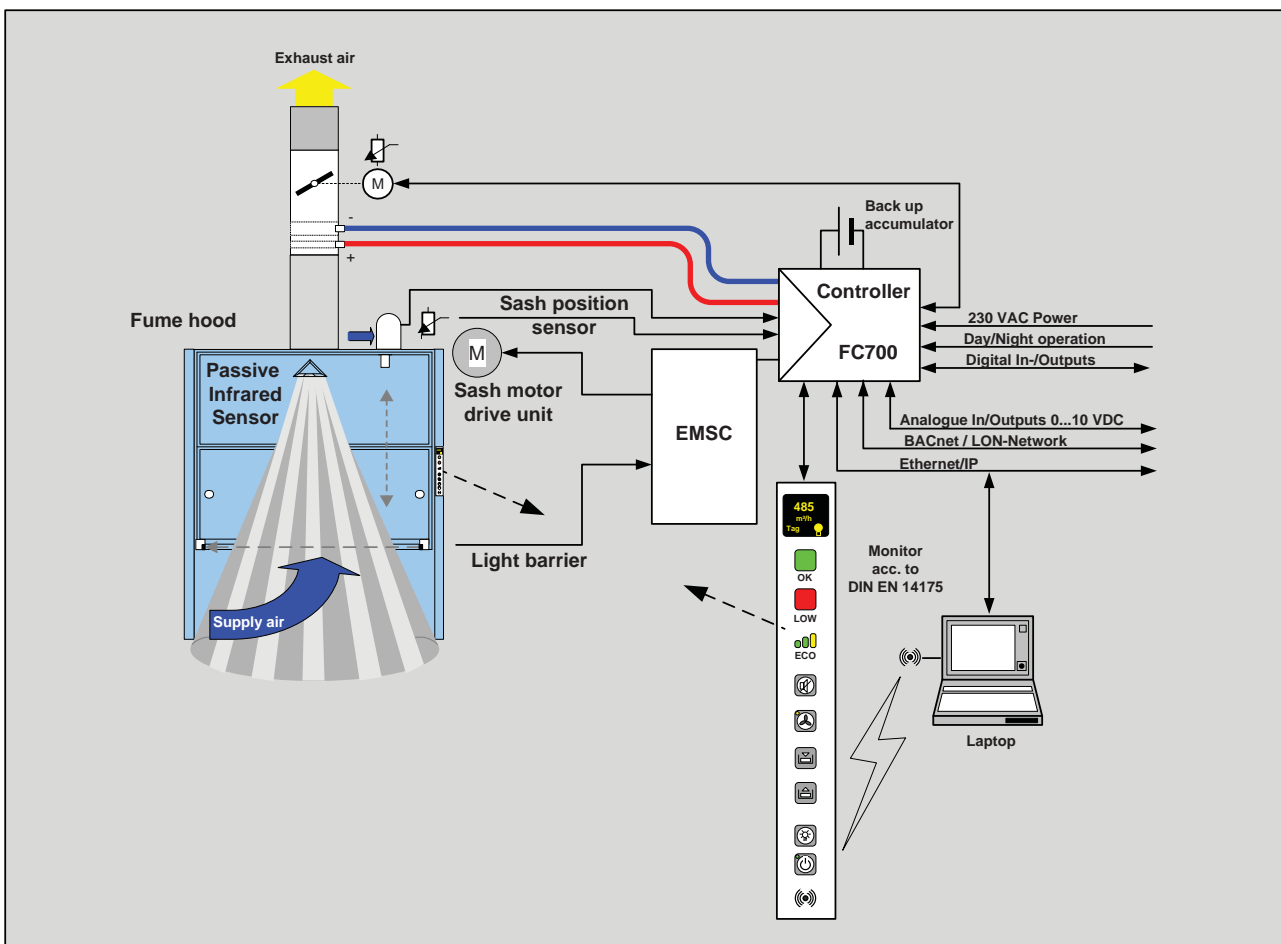
The reliable and rugged sash position sensor is used by the controller as well as by the integrated sash controller (extension module EMSC).

Due to the predominantly closed sash the simultaneity factor for the complete laboratory building is significantly improved which means that air ducts and fans (supply and exhaust air) can be smaller dimensioned. Therefore the investment costs can be significantly reduced.

The functional display with the integrated up/down keys allows a direct controlling of the sash (open/close). The parameterisable inching mode (up/down) guarantees an automatic opening/closing of the sash via manual tapping of the sash towards the requested moving direction. After recognition of the direction the control electronics adopts the automatic mode.

The functionality corresponds basically to the separate sash controller SC500 by SCHNEIDER (please refer to the technical data sheet SC500).

FC700 with the extension module EMSC substitutes two systems and provides the overall functionality in one cost-effective and compact device.



**Room controller functions**

Each fume hood controller FC700 can be upgraded with 4 boards at most with the universal extension modules EM, so that complete room controller functions can be realised. A permanently enhanced variety of modular boards is available for the individual process application. With the extension modules EM10 to EM50 the following functions can be realised:

- Room temperature controlling with setpoint setting
- Room humidity controlling with setpoint setting
- Activation of heating and cooling valves for static radiators respectively cooling ceiling or
- Activation of the demand-based room illumination
- Activation of the curtains (automatic shading)
- Alarm detection (e. g. gas alarm, water alarm)
- Extinguish functions

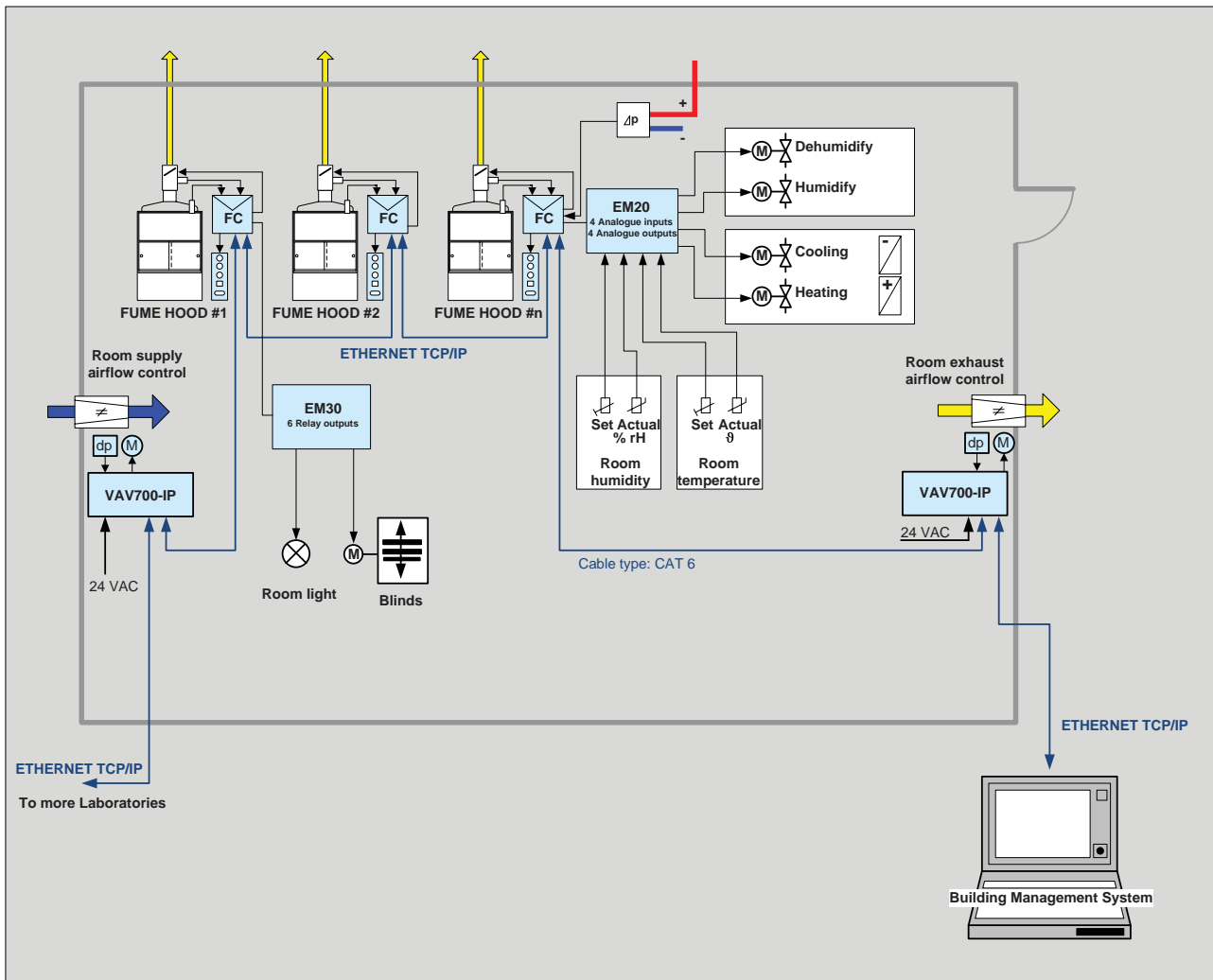
With this technology sustainable and energy-efficient office and functional buildings can be realised which can be certified according to LEED or DGNB.

All relevant data are available via TCP/IP, BACnet®/IP over Internet or for a central building management system. Decentral closed loops adopt the independent room controlling functions without intervention of the building management system which mainly dynamically visualises the processes and rooms.

The room pressure maintenance of laboratory and clean rooms as well as the energetic capacity accounting is easily realised.

The visualisation software module VIS7000 allows the simple creation of dynamic room graphics and a clear exposition on the PC. This is a cost-efficient integral system solution with functions of the building management system.

PAD7000 adopts the functionalities of a building management system.



### 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 FC700 fume hood controller can actuate up to two maintenance-free measuring tubes with damper (e. g. MD-250-P-MM-1 and MD-250-P-MM-2). The servomotors are actuated in parallel, ensuring an even distribution of air over both air volume flow controllers.

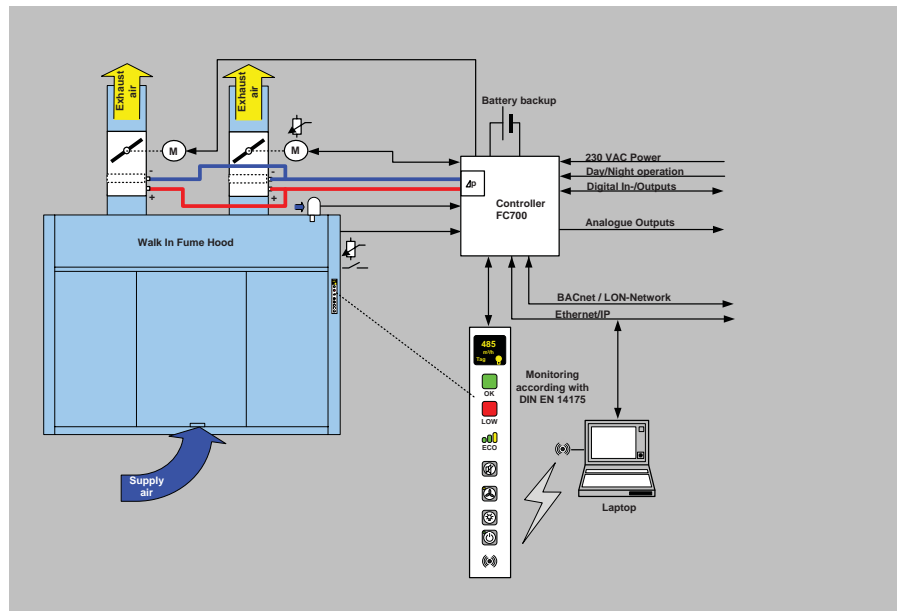
The air volume flow actual value is determined via both Venturi measuring tubes. The shield factor to be programmed is multiplied by 2.

### Calculation example:

Given: Shield factor B at DN250 = 92

Shield factor in pipe-in-pipe applications:

$$B \cdot 2 = 92 \cdot 2 = 184$$



### Control of a supply air fume hood

With a supply air fume hood, approximately 50 % of the exhaust air is fed into the fume hood as supply air and the remaining supply air is extracted from the laboratory. With this type of fume hood, the direct supply air does not require processing with energy (cooling or warming) and thus reduces running costs. In constant operating mode (1 step or 2 steps), the FC700 fume hood controller also actuates the measuring device (Venturi measuring tube, measuring tube or measuring cross) and the servomotor for the damper of the supply air controller.

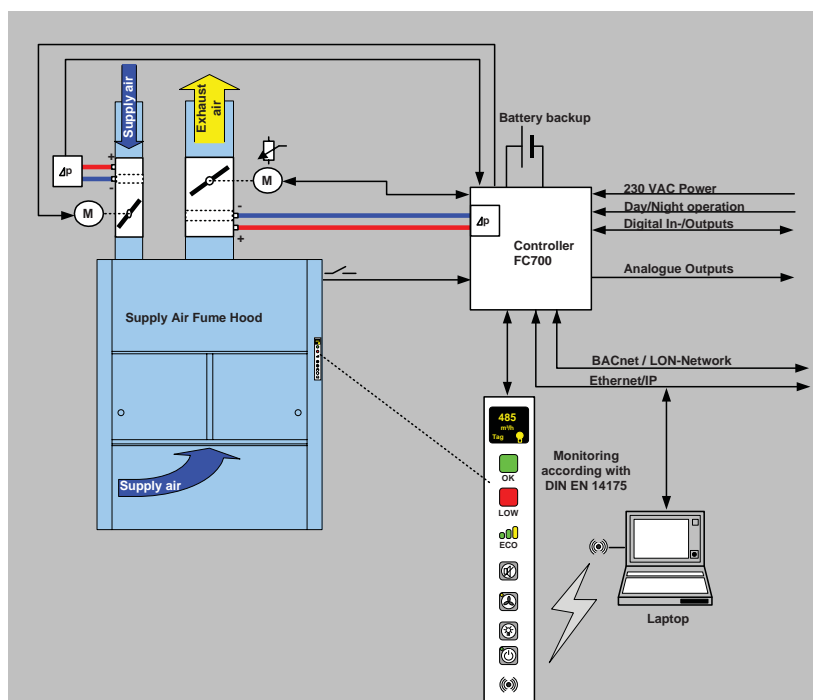
Ordering codes of the measuring devices with damper:

Exhaust air, e. g. MD-250-P-MM-1

Supply air, e. g. MD-160-S-MM-2

In order to maintain negative air pressure in the fume hood interior in all operating modes, a special regulation algorithm must be applied in supply air fume hoods. If the exhaust air is increased (e. g. by opening the sash), the supply air must follow the exhaust air. If the exhaust air is decreased (e. g. by closing the sash), the exhaust air must

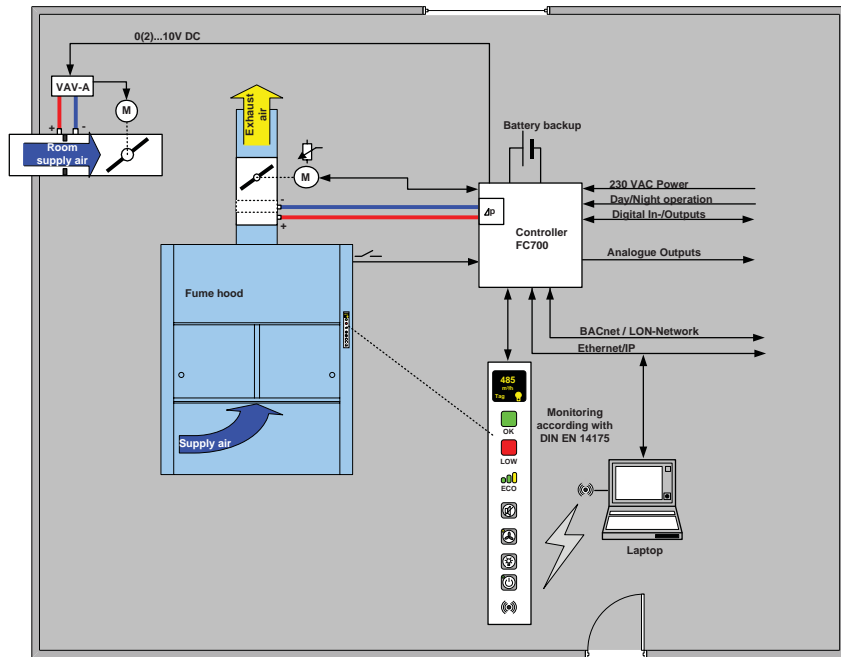
follow the supply air, i. e., the supply air is reduced first. When switching the fume hood controller on and off, this special on-off procedure is covered.



**Direct actuation of the room supply air controller**

In laboratory applications with a fume hood in the room, the FC700 fume hood controller can actuate the room supply air controller directly with 0(2) - 10 V 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 FC700 fume hood controller provides the 24 V AC supply voltage for the room supply air controller (model with internal transformer). The direct actuation of the room supply air controller means that room pressure management can be achieved cost-effectively.



**Room addition with extension module EM20**

The extension module EM20 can be plugged into each free slot of the fume hood controller FC700. Up to 4 analogue inputs (exhaust air actual values of 4 different fume hoods plus the master fume hood) as well as up to 4 digital inputs (e. g. switchable constant loads) can be connected.

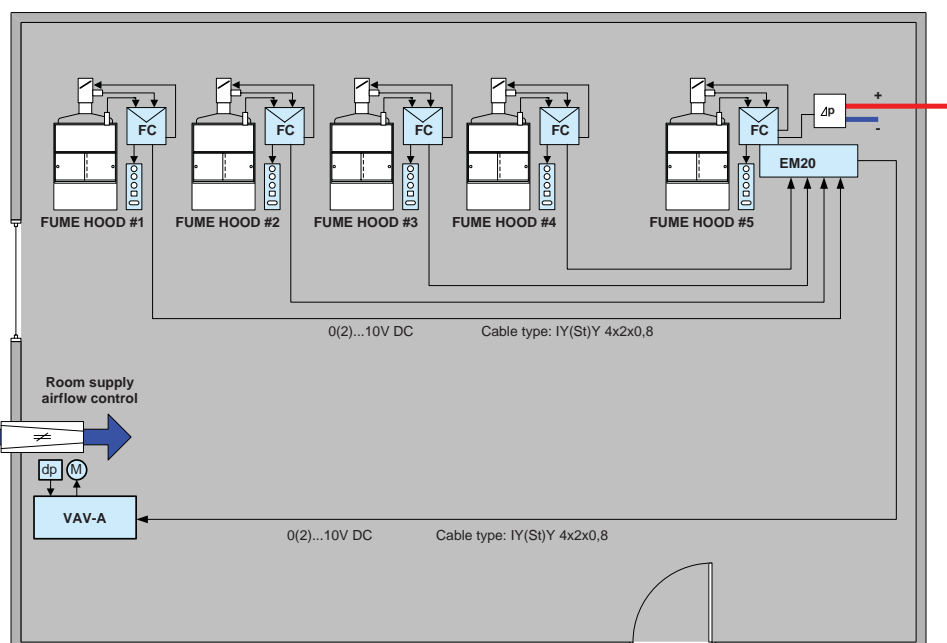
The fume hood controller FC700 additionally adopts the room pressure maintenance by making available the summed up exhaust air actual values as a percentaged weighted room supply setpoint with a range from 0(2) to 10 V DC.

The extension module EM20 substitutes the laboratory controller LCO500 in small and medium-sized laboratory applications and offers therefore a cost-effective alternative.

As each fume hood controller can be equipped with maximal 3 independent static differential pressure sensors a pressure cascade is easily realised. A second closed loop regulates a defined room pressure via the room supply air. Volume flow limits will not be under or overrun and a door contact is not required.

All special applications are still equipped with Ethernet/IP networking which means that all measuring values are available via Internet or BACnet®/IP.

The supply voltage 24 V AC for the room supply air controller is supplied by the fume hood controller FC700 (version with transformer).

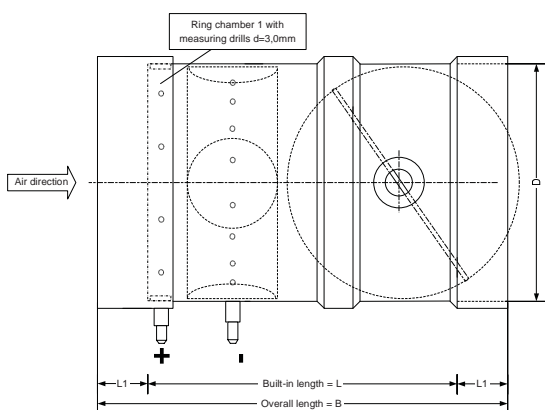
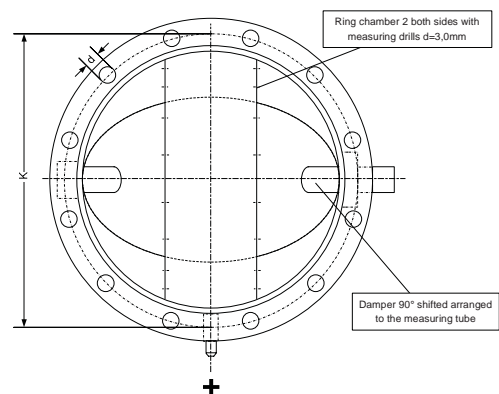
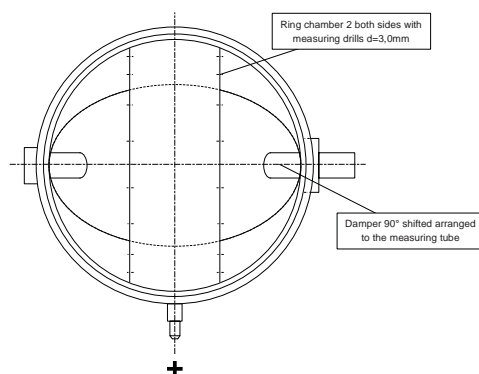
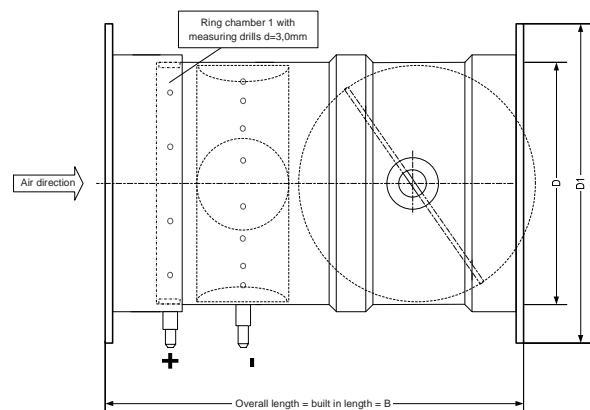




**Maintenance-free measuring system with damper and actuator, PPs (polypropylene, flame retardant), round version**

- static differential pressure transmitter -100 to 400 Pa
- measuring system with integrated ring measuring chamber
- high control accuracy and responsiveness
- option: air tight damper blade according to DIN

Nominal size	Inner- Ø	Volume flow $V_{MIN}$ , $V_{MAX}$ , $V_{NOM}$ with flow velocity $v$			Length			Flange dimension			
		$v=ca. 1\text{ m/s}$ $V_{MIN}$ [m <sup>3</sup> /h]	$v=6\text{ m/s}$ $V_{MAX}$ [m <sup>3</sup> /h]	$v=ca. 10\text{ m/s}$ $V_{NENN}$ [m <sup>3</sup> /h]	W [mm]	L <sub>1</sub> [mm]	L [mm]	Exter- nal- Ø D1 [mm]	D [mm]	d [mm]	An- zahl
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

**Version: MD-XXX-P-MM-1 (socket/socket)**

**Version: MD-XXX-P-FF-1 (flange/flange)**

**Planning instruction for volume flow determination:**

Consider the volume flow proportional to the flow velocity  $v$

$V_{MIN}$  = volume flow at a flow velocity  $v = ca. 1\text{ m/s}$

$V_{MAX}$  = volume flow at a flow velocity  $v = 6\text{ m/s}$  (recommended)

$V_{NOM}$  = volume flow at a flow velocity  $v = ca. 10\text{ m/s}$

Due to the flow noise of the volume flow  $V_{MAX}$  the flow velocity  $v$  should not overrun 6 m/s during the laboratory operation (exhaust and supply air). In case of exceeding this value the required noise level of < 52 dB(A) according to DIN1946, part 7 can only be reached with complex sound absorption. The maximal adjustable volume flow  $V_{MAX}$  should always be about 40 % below  $V_{NOM}$ .

Table 1: flow noise

Nom. size in mm	v in m/s	V in m <sup>3</sup> /h	$\Delta p_g = 100 \text{ Pa}$																$\Delta p_g = 250 \text{ Pa}$																$\Delta p_g = 500 \text{ Pa}$															
			L <sub>W</sub> in dB/octave																L <sub>W</sub> in dB/octave																L <sub>W</sub> in dB/octave															
			f <sub>m</sub> in Hz																f <sub>m</sub> in Hz																f <sub>m</sub> in Hz															
			63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L <sub>WA</sub> in dB(A)	L in dB(A)	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L <sub>WA</sub> in dB(A)	L in dB(A)	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	L <sub>WA</sub> in dB(A)	L in dB(A)																		
160	2	148	50	47	44	46	45	46	33	22	50	<b>42</b>	53	54	53	53	51	50	56	42	60	<b>52</b>	56	58	55	60	59	57	58	54	65	<b>57</b>																		
	4	290	55	51	48	51	47	42	35	27	52	<b>44</b>	64	61	58	57	55	53	49	43	60	<b>52</b>	67	67	64	63	60	58	60	58	67	<b>59</b>																		
	6	434	62	58	53	56	50	46	41	35	56	<b>48</b>	67	65	61	61	58	54	50	45	63	<b>55</b>	72	72	69	67	63	60	59	57	69	<b>61</b>																		
	8	579	62	60	57	59	55	51	49	45	61	<b>53</b>	71	67	64	64	60	56	53	48	66	<b>58</b>	75	73	71	69	65	62	59	56	71	<b>63</b>																		
10	724	67	66	62	58	59	55	54	51	64	<b>56</b>	73	70	66	68	62	59	55	51	69	<b>61</b>	76	76	72	72	67	64	61	58	73	<b>65</b>																			
200	2	226	47	50	47	47	47	46	49	39	54	<b>46</b>	50	53	52	56	57	58	57	59	65	<b>57</b>	55	57	54	59	63	67	67	66	73	<b>65</b>																		
	4	452	56	57	53	51	53	60	56	42	63	<b>55</b>	59	62	60	60	59	59	60	62	67	<b>59</b>	61	64	64	66	66	67	66	66	73	<b>65</b>																		
	6	679	59	61	56	55	58	58	52	45	63	<b>55</b>	65	66	64	63	63	63	63	64	70	<b>62</b>	68	70	70	70	69	69	67	70	76	<b>68</b>																		
	8	905	61	64	60	57	59	58	52	46	64	<b>56</b>	69	72	67	66	67	68	66	61	73	<b>65</b>	70	74	72	73	72	71	69	69	78	<b>70</b>																		
10	1131	63	65	62	59	62	60	55	50	66	<b>58</b>	74	72	70	68	69	69	65	61	75	<b>67</b>	75	77	74	74	74	73	71	70	80	<b>72</b>																			
250	2	353	50	47	44	46	45	46	33	22	50	<b>42</b>	53	54	53	53	51	50	56	42	60	<b>52</b>	56	58	55	60	59	57	58	54	65	<b>57</b>																		
	4	707	55	51	48	51	47	42	35	27	52	<b>44</b>	64	61	58	57	55	53	49	43	60	<b>52</b>	67	67	64	63	60	58	60	58	67	<b>59</b>																		
	6	1060	62	58	53	56	50	46	41	35	56	<b>48</b>	67	65	61	61	58	54	50	45	63	<b>55</b>	72	72	69	67	63	60	59	57	69	<b>61</b>																		
	8	1414	62	60	57	59	55	51	49	45	61	<b>53</b>	71	67	64	64	60	56	53	48	66	<b>58</b>	75	73	71	69	65	62	59	56	71	<b>63</b>																		
10	1767	67	66	62	58	59	55	54	51	64	<b>56</b>	73	70	66	68	62	59	55	51	69	<b>61</b>	76	76	72	72	67	64	61	58	73	<b>65</b>																			
315	2	561	42	47	45	43	38	35	33	32	45	<b>37</b>	47	47	49	51	54	52	50	50	57	<b>49</b>	52	52	54	56	59	57	55	55	62	<b>54</b>																		
	4	1122	52	55	50	49	43	38	31	29	50	<b>42</b>	60	61	57	55	55	51	47	48	59	<b>51</b>	65	66	62	60	60	56	52	53	64	<b>56</b>																		
	6	1683	54	57	52	51	45	40	33	31	52	<b>44</b>	62	63	59	57	57	53	49	50	61	<b>53</b>	67	68	64	62	62	58	54	55	66	<b>58</b>																		
	8	2244	59	57	56	55	47	43	38	33	55	<b>47</b>	67	68	64	61	58	55	51	50	64	<b>58</b>	72	73	69	66	63	60	56	55	69	<b>61</b>																		
10	2806	61	59	58	57	49	45	40	35	57	<b>49</b>	69	70	66	63	60	57	53	52	66	<b>58</b>	74	75	71	68	65	62	58	57	71	<b>63</b>																			

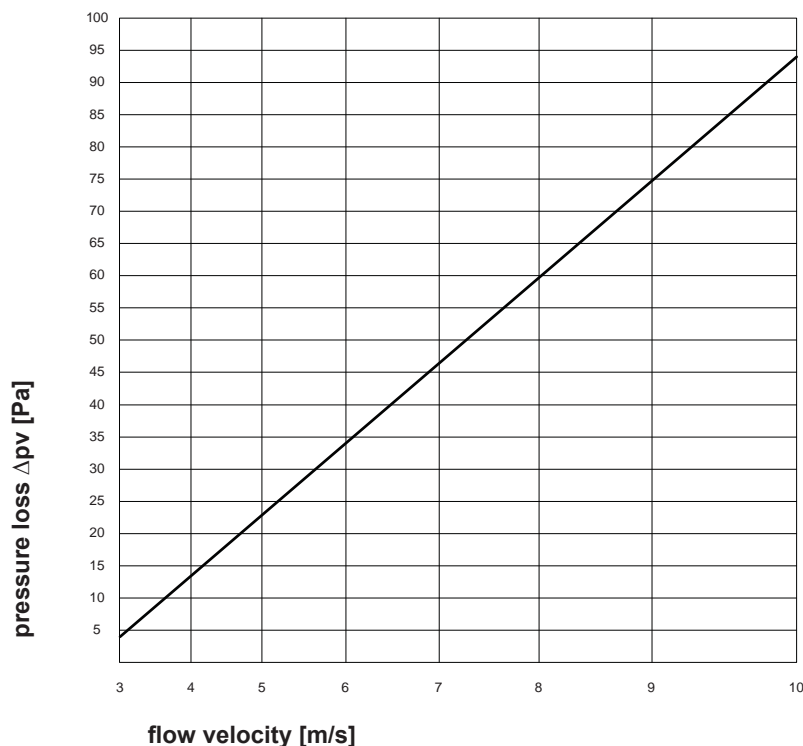
**Definitions:**

f <sub>m</sub>	in Hz:	mid-band frequency of the octave band
L <sub>W</sub>	in dB/Oktave:	sound power level determined in the echo chamber
L <sub>WA</sub>	in dB(A):	overall noise level, A-rated
L	in dB(A):	noise level, A-rated, room attenuation of 8 dB/octave considered
$\Delta p_g$	in Pa:	total pressure difference (measured in front of and behind the volume flow controller)
V	in m <sup>3</sup> /h:	volume flow
v	in m/s:	Strömungsgeschwindigkeit

**Table 2:** case-radiated noise

Nom. size in mm	v in m/s	V in m <sup>3</sup> /h	$\Delta p_g = 100 \text{ Pa}$										$\Delta p_g = 250 \text{ Pa}$										$\Delta p_g = 500 \text{ Pa}$									
			L <sub>W</sub> in dB/octave								L <sub>WA</sub> in dB(A)	L in dB(A)	L <sub>W</sub> in dB/octave								L <sub>WA</sub> in dB(A)	L in dB(A)	L <sub>W</sub> in dB/octave								L <sub>WA</sub> in dB(A)	L in dB(A)
			f <sub>m</sub> in Hz										f <sub>m</sub> in Hz										f <sub>m</sub> in Hz									
			63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz						
160	2	148	30	28	21	20	26	28	15	9	31	<b>23</b>	33	26	24	25	36	38	31	20	42	<b>34</b>	33	25	26	31	42	47	41	33	50	<b>42</b>
	4	290	38	32	27	23	27	27	20	7	32	<b>24</b>	43	36	32	29	36	38	30	22	41	<b>33</b>	42	37	36	34	42	45	39	32	49	<b>41</b>
	6	434	41	34	32	29	30	29	22	9	35	<b>27</b>	47	41	38	33	37	38	33	23	43	<b>35</b>	48	44	42	38	44	46	40	33	49	<b>41</b>
	8	579	46	41	40	39	35	31	22	10	41	<b>33</b>	49	43	42	38	40	40	35	26	45	<b>37</b>	54	48	47	41	46	47	41	34	51	<b>43</b>
	10	724	51	45	46	46	41	37	28	18	47	<b>39</b>	52	46	45	42	43	42	36	26	48	<b>40</b>	54	50	49	44	47	48	43	35	53	<b>45</b>
200	2	226	24	22	20	19	20	20	20	6	26	<b>18</b>	28	30	27	27	26	28	27	22	34	<b>26</b>	37	31	28	32	34	37	32	33	41	<b>33</b>
	4	452	31	33	27	23	23	27	20	6	31	<b>23</b>	38	37	33	30	30	30	29	29	37	<b>29</b>	53	39	37	42	39	38	34	34	45	<b>37</b>
	6	679	38	37	32	28	28	28	20	12	33	<b>25</b>	44	43	38	34	33	35	31	29	40	<b>32</b>	47	46	42	44	41	40	35	34	47	<b>39</b>
	8	905	39	39	35	33	33	30	22	14	37	<b>29</b>	45	44	41	39	38	38	32	26	43	<b>35</b>	47	47	46	45	44	43	41	37	50	<b>42</b>
	10	1131	43	43	39	37	38	33	26	19	41	<b>33</b>	52	49	45	41	40	40	34	30	46	<b>38</b>	54	52	49	47	44	44	41	38	51	<b>43</b>
250	2	353	30	28	21	20	26	28	15	9	31	<b>23</b>	33	26	24	25	36	38	31	20	42	<b>34</b>	33	25	26	31	42	47	41	33	50	<b>42</b>
	4	707	38	32	27	23	27	27	20	7	32	<b>24</b>	43	36	32	29	36	38	30	22	41	<b>33</b>	42	37	36	34	42	45	39	32	49	<b>41</b>
	6	1060	41	34	32	29	30	29	22	9	35	<b>27</b>	47	41	38	33	37	38	33	23	43	<b>35</b>	48	44	42	38	44	46	40	33	49	<b>41</b>
	8	1414	46	41	40	39	35	31	22	10	41	<b>33</b>	49	43	42	38	40	40	35	26	45	<b>37</b>	54	48	47	41	46	47	41	34	51	<b>43</b>
	10	1767	51	45	46	46	41	37	28	18	47	<b>39</b>	52	46	45	42	43	42	36	26	48	<b>40</b>	54	50	49	44	47	48	43	35	53	<b>45</b>
315	2	561	34	34	31	29	25	24	24	24	33	<b>25</b>	39	34	35	37	41	41	41	42	45	<b>37</b>	44	39	40	42	46	46	46	47	50	<b>42</b>
	4	1122	44	42	36	35	30	27	22	21	38	<b>30</b>	52	48	43	41	42	40	38	40	47	<b>39</b>	57	53	48	46	47	45	43	45	52	<b>44</b>
	6	1683	46	44	38	37	32	29	24	23	40	<b>32</b>	54	50	45	43	44	42	40	42	49	<b>41</b>	59	55	50	48	49	47	45	47	54	<b>46</b>
	8	2244	51	44	42	41	34	32	29	25	43	<b>35</b>	59	55	50	47	45	44	42	42	52	<b>44</b>	64	60	55	52	50	49	47	47	57	<b>49</b>
	10	2806	53	46	44	43	36	34	31	27	45	<b>37</b>	61	57	52	49	47	46	44	44	54	<b>46</b>	66	62	57	54	52	51	49	49	59	<b>51</b>

Pressure loss table • PPs-Venturi-measuring system with damper, round version

**Table 3:** pressure loss

**Definitions:**

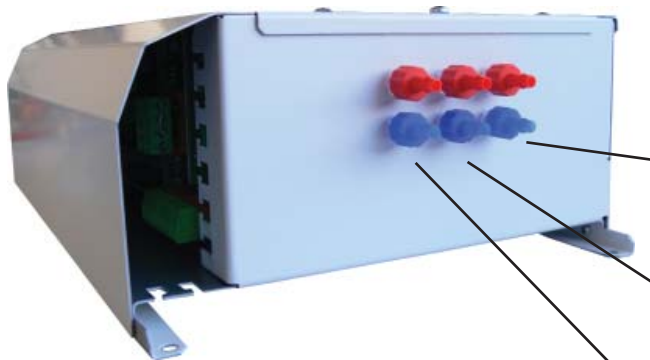
$\Delta p_v$  in Pa: Loss of pressure via the controller in case of a fully opened damper (measured in front of and behind the volume flow controller)

Connections

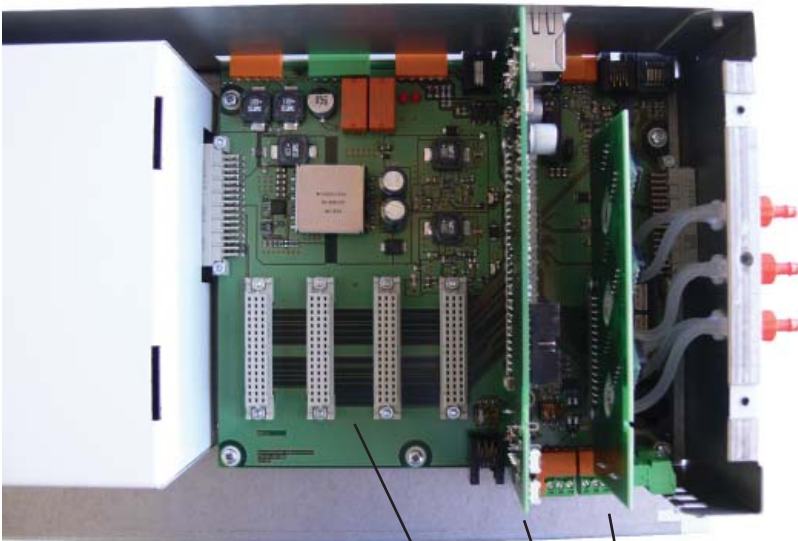
plug diagram: fume hood controller FC700



View: left side of the housing		
plug	function	description
light	on/off	fume hood interior lighting
stabilising jet	on/off	stabilising jet optionally OFF if sash is closed
net	network supply	Wiegand-plug 230 V AC



View: right side of the housing		
air supply	function	description
3	room pressure	static differential pressure sensor -100 bis 300 Pa (connect plus und minus)
2	stabilising jet	static differential pressure sensor -100 bis 300 Pa (connect plus und minus)
1	exhaust air	static differential pressure sensor -100 bis 300 Pa (connect plus und minus)

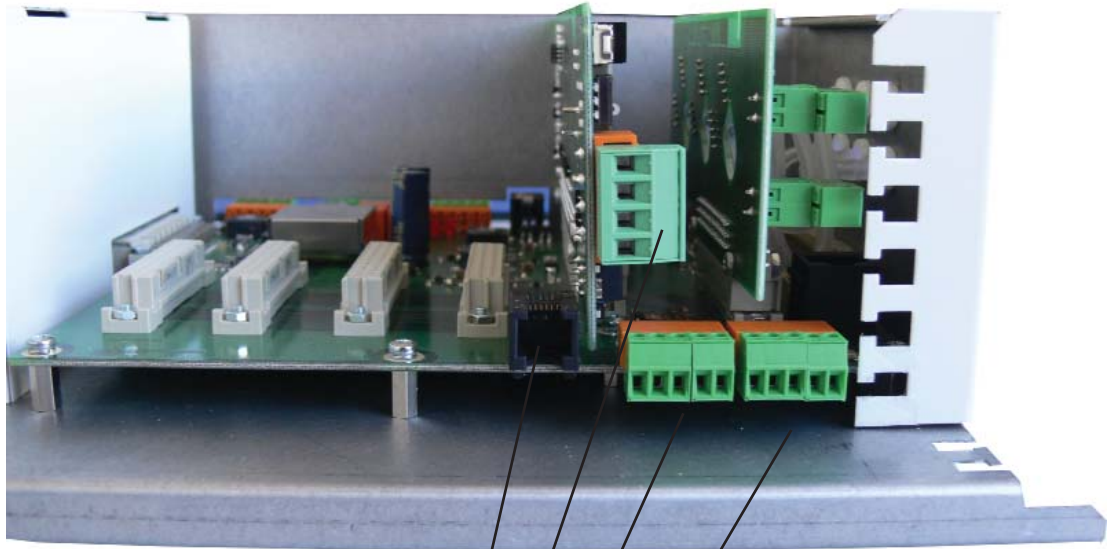

**Top view: cover plate opened**

slot	function	description
6	sensor board	maximal three independent static differential pressure sensors
5	CPU-board	Must always be plugged here! CPU with Ethernet-interface and dual port switch
4 bis 1	extension boards	four free slots for functionalities of the extension boards

Connections



View: backside housing		
plug	function	description
X1	actuator	damper actuator NMQ-12, direct drive mode
X2	relay output	two switch contacts 24 V AC/3 A
X3	digital input	two optocoupler
X4	AFS100	air flow sensor
X5	ETHERNET	channel 1 dual port switch
X6	ETHERNET	channel 2 dual port switch
X7	SPS100	sash position sensor
X8	FAnew1	functional display new generation, FA0700 with graphical display
X9	FAold	functional display, old generation



Front view: cover plate opened		
description	function	plug
functional display new generation, FA0700 with graphical display	FAnew1	X10
interface RS485	RS485	X11
CAN interface channel 1	CAN1	X12
CAN interface channel 2	CAN2	X13

## Technical data

■ General	
Nominal voltage	230 V AC/50/60 Hz/+ -15 %
max. charging rate	200 mA
max. power input	35 V A
Recovery time	600 ms
Operational temperature	0 °C to +55 °C
Humidity	max. 80 % relative, non-condensing
External supply	24 V AC/50/60 Hz/+ -10 %
Power input	20 V A

■ Housing	
Protection class	IP 20
Material	steel plate
Colour	white, RAL 9002
Dimensions (LxWxH)	(290 x 208 x 100) mm
Weight	ca. 2,8 kg
Appliances terminals	screw-type terminal 1,5 mm <sup>2</sup>

■ Relay outputs	
Amount	1 light relay
Operating principle	make contact
Max. switching voltage	230 V AC
Max. steady current	5 A
Amount	2 relays
Operating principle	reverse contact
Max. switching voltage	24 V AC
Max. steady current	3 A

■ Digital inputs (galvanically isolated)	
Amount	2 optocoupler
Max. input voltage	24 V DC + -15 %
Max. input circuit	10 mA (per input)

■ Analogue inputs	
Amount	1
Input voltage	0(2) - 10 VDC
Max. input circuit	1 mA (pro Eingang)

■ Sash position sensor (sash position) SPS100	
Measuring principle	static, Seilzugpotentiometer
Measuring range	0 - 1000 mm, optional 0 - 2000 mm
Response time	< 1 ms

■ Differential pressure sensor	
Amount	3
Measuring principle	static
Pressure range	-100 - 300 Pascal 8 - 800 Pascal optional
Response time	< 10 ms
Sensor burst pressure	500 mbar

■ Air flow sensor (face velocity) AFS100	
Measuring principle	dynamic, hot wire-anemometric principle
Measuring range	0 - 1 m/s
Response time	< 100 ms

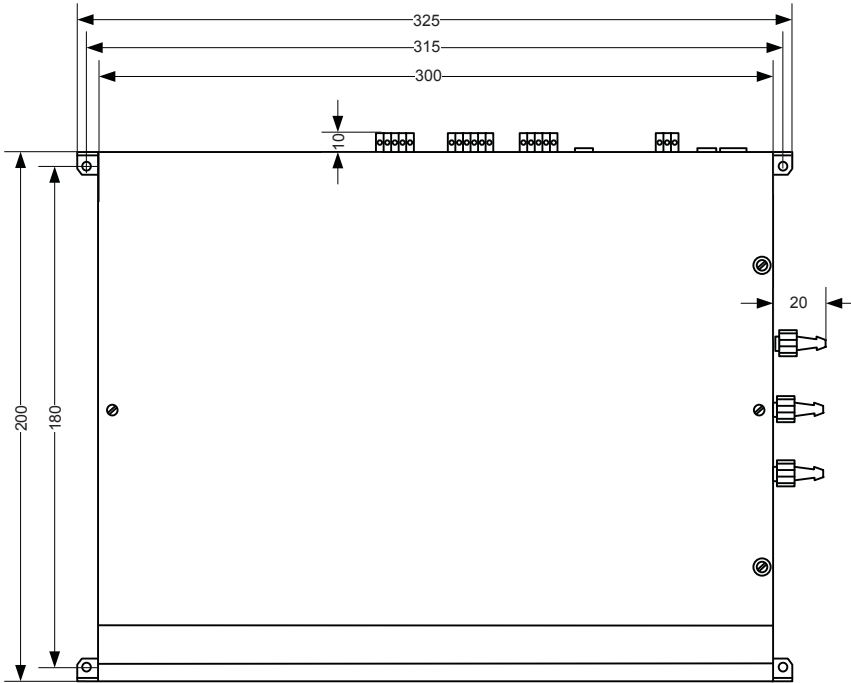
■ Maintenance-free measuring system MD with damper	
Material	polypropylene (PPs)
Measuring system	integrated measuring system with two ring chambers

■ Actuator	
Full load	3 Nm
Regulating time	3 s for 90 °
Activation	direct with integrated flow monitoring
Resolution	< 0,5 °
Feedback delay angle	< 0,5 ° via potentiometer

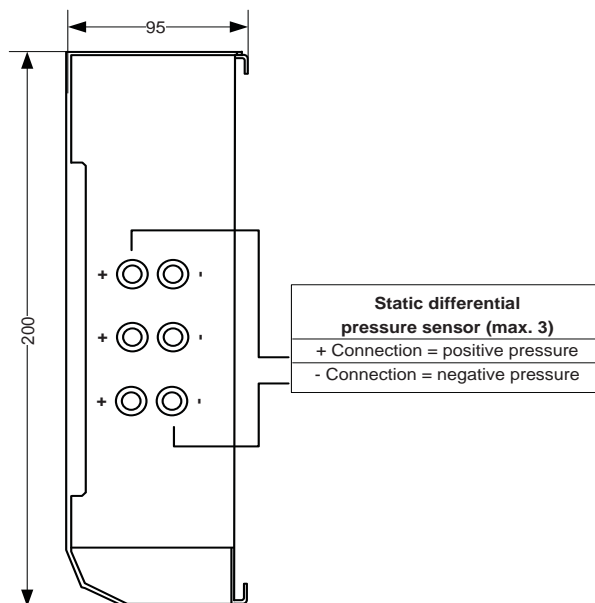
■ ETHERNET-specification	
No. of Channels	1 dual port switch
Speed	100 MBit
Cable	CAT 6



**Housing FC700: top view**

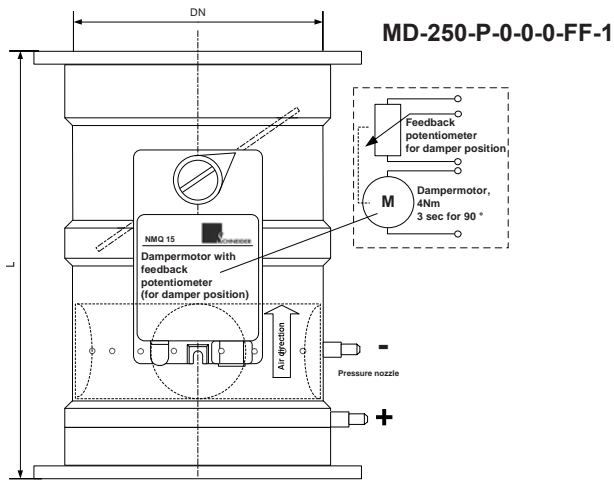


**Housing FC700: side view**



Dimensions

Measuring-free measuring system with integrated damper, version: flange/flange



SCHNEIDER standard functional display with graphical OLED-display

FA0700



Nom. diameter [mm]	length [mm]	Shield factor B	V <sub>MIN</sub> [m³/h]	V <sub>MAX</sub> [m³/h]
DN 160	340	34	68	434
DN 200	350	58	116	679
DN 250	400	94	188	1060
DN 315	495	146	292	1683

Shield factor B using an air density of 1,2 kg/m<sup>3</sup>

Sash position sensor



SPS100

Air flow sensor



AFS100

Changes reserved • All rights reserved © SCHNEIDER

Tender specification FC700

For the complete tender specification please visit our website [www.schneider-elektronik.com](http://www.schneider-elektronik.com)

**SCHNEIDER Elektronik GmbH**  
 Industriestraße 4  
 61449 Steinbach • Germany

phone: +49 (0) 6171 / 88 479 - 0  
 fax: +49 (0) 6171 / 88 479 - 99  
 e-mail: [info@schneider-elektronik.de](mailto:info@schneider-elektronik.de)