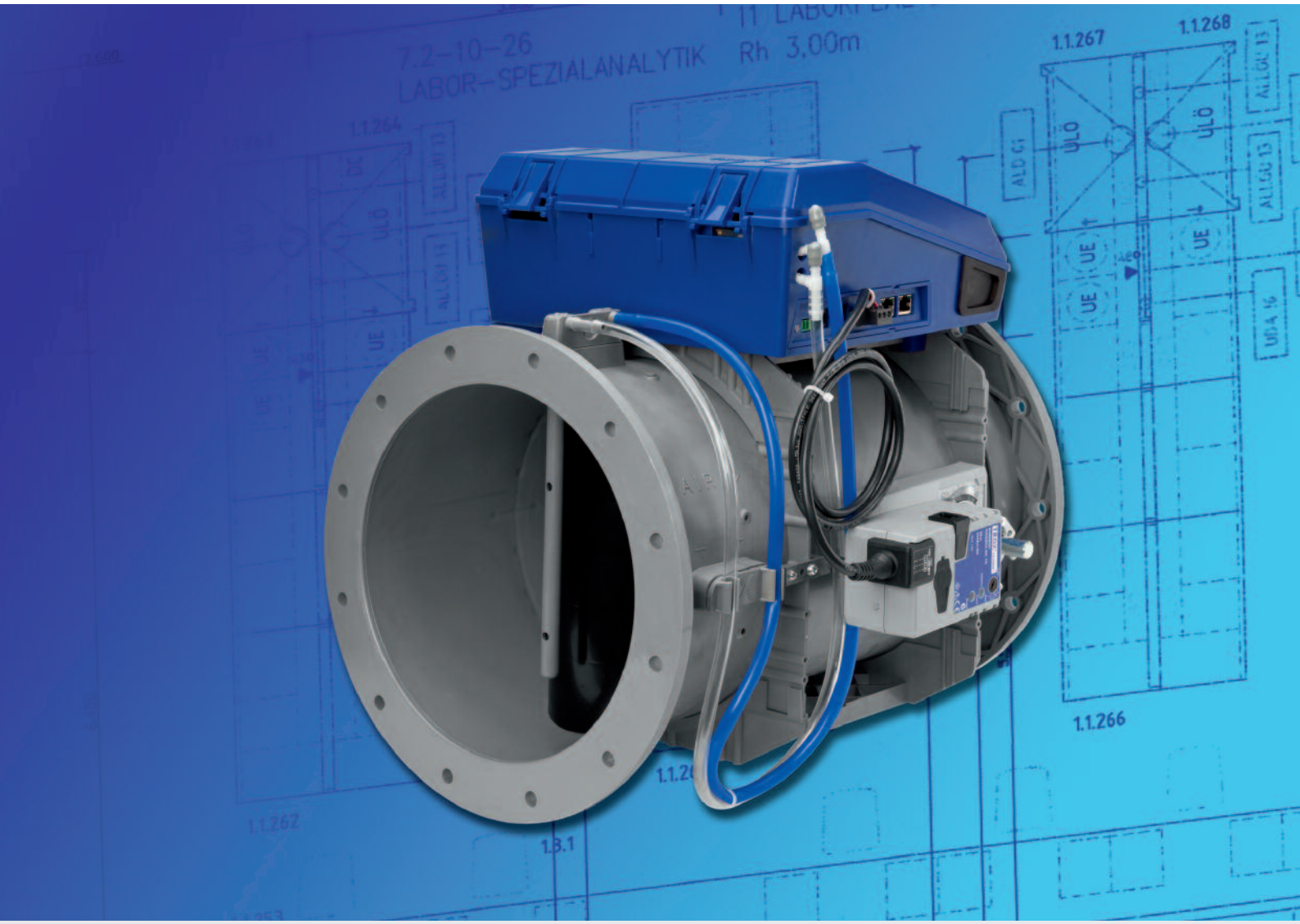
LABCONTROL

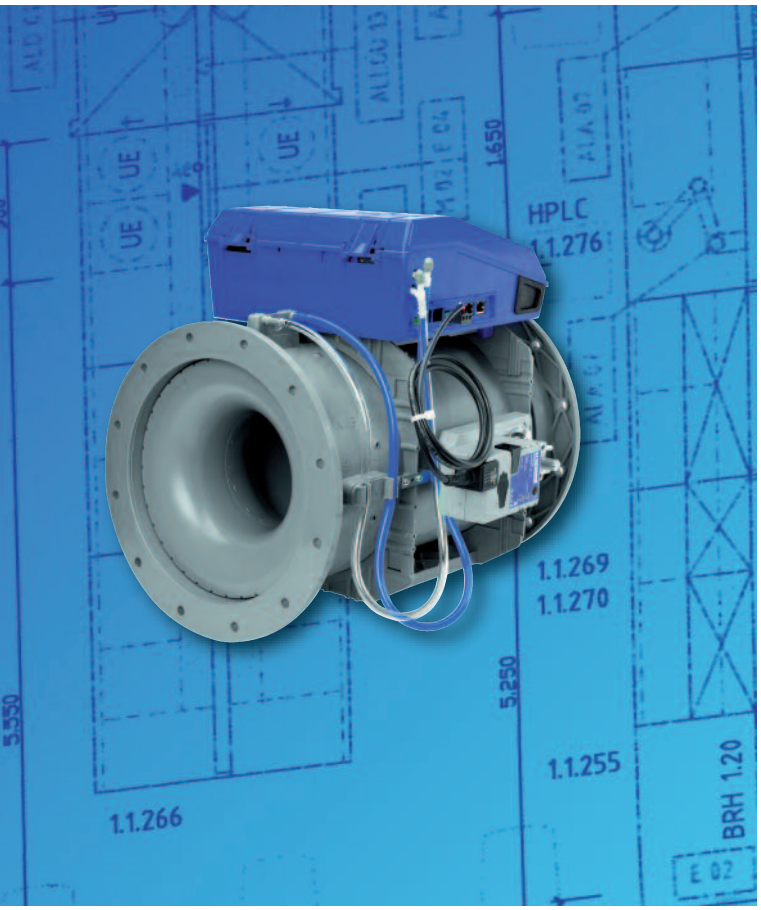
Air management systems

Design manual



TROX® TECHNIK

The art of handling air



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The art of handling air

TROX understands the art of competently handling air like no other company.
Working in close partnership with sophisticated customers all over the world, TROX is the leader in the development, manufacturing, and sale of components and systems for the air conditioning and ventilation of internal spaces.

The systematic research and development associated with individual products continues to expand based on project specific requirements.
With its customer-specific solutions, TROX sets a trail-blazing standard and continues to enter new markets and maintain sustainable business opportunities. As a result, TROX, since the introduction of the first ceiling chilled beams in the 1980s, has been the leading supplier of these multifaceted products in Europe.

Products for ventilation and air conditioning technology

Components

- Air terminal devices
- Air terminal units
- Fire and smoke protection components
- Sound attenuators
- Dampers and external louvres
- Filter units and filter elements

Systems

- Air-water systems
- Air management systems for laboratory ventilation, pressure control and clean room areas
- Communication systems for fire and smoke protection
- High capacity cooling systems for the IT sector (AITCS)

International Center Fire Protection, Neukirchen-Vluyn, Germany

TROX-headquarters, Neukirchen-Vluyn, Germany

TROX CUSTOMER SUPPORT
TROX places great value on customer care and provides support in the design and supply of components and systems, as well as service and maintenance, during the entire project design, development, and operation phase of a ventilation and air conditioning system.

TROX in Figures

- 3,200 employees worldwide
- 350 million euros turnover in 2010
- 25 subsidiaries in 22 countries
- 13 production plants in 11 countries
- 12 research and development centres worldwide
- More than 25 TROX sales offices and more than 50 representatives and importers across the globe

TROX has created this design manual to enable you to easily select individual types of LABCONTROL systems. Here, you will find general explanations regarding functionality, the design criteria for the system components, and the advantages of our system solutions.

Share the experience: **The art of handling air!**

TROX® TECHNIK
The art of handling air

Air handling technology is of decisive importance in sensitive areas such as hospitals, research institutes, and animal cages or in clean room technology. Without a functioning and reliable ventilation system, these areas would not be able to function correctly.

For many years, TROX GmbH has dealt with these special requirements: it is a member of the standardisation committees for these areas and provides the appropriate components for achieving these objectives. A market success for almost 15 years, the LABCONTROL system, which is constantly adapted to the demands of the market and successfully used in laboratories, is a prime example. The experience gained from the project meetings and development of these projects help us transform the new requirements into new innovations.

The EASYLAB system is the logical extension of our experience and your requirements. With a wide range of possibilities for individual configurations, the project requirements can be achieved in detail without unnecessarily complicating handling. With standardised data cables, wiring is thus easier than ever. All kinds of operational scenarios that take individual customer wishes into consideration can be set up intuitively. In the process, we investigate the possibilities for system delivery from a single source.

We also continue where others stop. From volume flow rate control, fire protection, and acoustics to filter technology and air supply, you can count on more than 50 years of experience in all areas of air handling at TROX.

Städtische Krankenanstalten Düsseldorf (Municipal Hospital), Düsseldorf, Germany

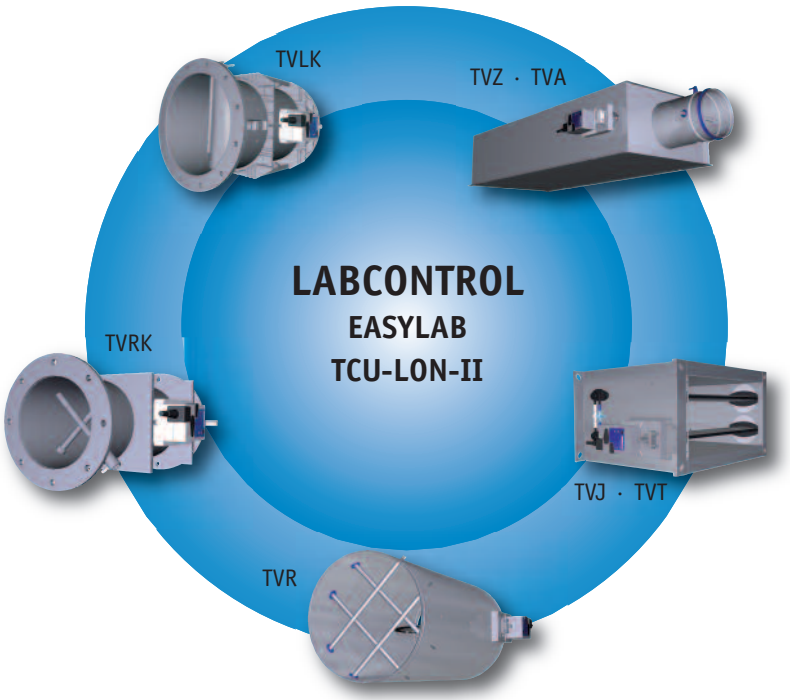
The most important product advantages of the LABCONTROL controllers

- Two functional tests of all controllers:
  1. Check of the electronic modules
  2. Check the air on all terminal units on the TROX test rigs
- Presetting of all flow rate ranges and functions defined in the order for all controllers
- Certification of the fume cupboard controllers according to EN 14175, Part 6, by an independent testing authority
- Experience gained from more than 40,000 installed LABCONTROL volume flow controllers worldwide

Bayer Health Care AG, Wuppertal, Germany

Areas of application and advantages

The LABCONTROL systems consist of an electronic controller, an actuator, and a control panel and can be combined with the basic units of the VARYCONTROL volume flow controllers (TVR · TVRK · TVLK · TVT· TVJ · TVZ · TVA).



Combination of the LABCONTROL controllers with air terminal units

Differences of the LABCONTROL system in comparison with the VARYCONTROL types

The greatest difference to our VARYCONTROL type is the control speed. VARYCONTROL generally needs about 120 seconds. EASYLAB and TCU-LON-II only needs about 3 seconds.

Rapid response

The response time of the VARYCONTROL standard controllers is usually about 120 seconds, this time is reduced to about 3 seconds in the case of the EASYLAB/TCU-LON-II types.

These rapid response times guarantee that, for example, in the case of fume cupboards with variable, demand-based extract air, no outflow of hazardous material can occur through the open sash. For sequence control loops, these rapid response times enable stable room conditions that guarantee room pressure conditions according to the regulations of DIN 1946, Part 7. Actuators that have been specially matched to the controllers convert the setpoint value changes rapidly and precisely.

High-quality actuators

For rapid response control systems, TROX relies on fast acting, continuous actuators since affordable three-point actuators (PWM technology) cannot always implement the required minimum damper movements for system-related reasons. Actuators with a three-point design need minimum pulse durations in order to achieve the required torque and thus prevent very small positioning movements.

For this reason, TROX only uses high-quality actuators with internal position recording.
The precision of these actuators permits a precise positioning of the control damper blade to 0.5°.

In particular this is very important advantage in the room pressure control technology. A torque of 8 or 15 Nm and, alternatively, a brushless actuator concept guarantee a precise positioning of the control damper blade at any time and thus a long service life.

Static measurement systems for the determination of the volume flow rates

For the measurement of the volume flow rates, only transducers with a static pressure measurement method are used in the EASYLAB and TCU-LON-II systems; these transducers provide the following advantages:

- Contamination resistance, additionally optimised by very small induction levels of room air
- Rapid measurement response
- As an option can be equipped with a cyclic zero balance for the optimisation of the long-term stability

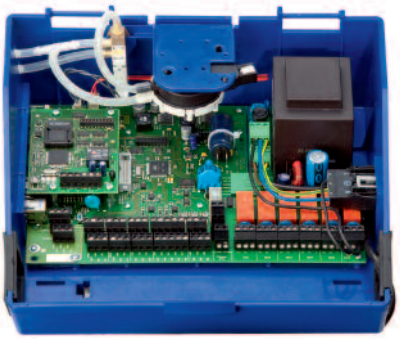
System demonstration in TROX's demo laboratory, Neukirchen-Vluyn, Germany

	Control						Monitoring	
								
	EASYLAB system Page 8			**TCU-LON-II system** Page 48			**TFM / TPM** Page 58	
								
Area of application	Fume cupboard control Page 27	Room balance control Page 38	Room pressure control Page 44	Fume cupboard control Page 54	Room balance control Page 56	Room pressure control Page 57	**TFM-1, TFM-2** Volume flow monitoring Page 61	**TPM** Room pressure monitoring Page 63
Hardware components								
TROX adapter module (TAM)		•						
Expansion for 230 V AC mains supply	Optional	Optional	Optional				Optional	
Expansion module for UPS mains supply	Optional	Optional	Optional					
LonWorks® interface	Optional	Optional	Optional	•	•	•		
Solenoid valve expansion	Optional	Optional	Optional	•	•	•		
Fume cupboard lighting expansion	Optional						•	
Control panel with segment display	•							
Control panel with LCD	•	•	•					
TCU-LON-II standard control panel				•			•	•
Expanded type AF-1 control panel							•	
Functions								
Volume flow rate monitoring	•	•	•	•	•	•	•	
Incoming air flow velocity monitoring	•			•			Only TFM-2	
Sash position monitoring acc. to EN 14175	•			•			•	
Room pressure monitoring			•			•		•
Volume flow rate control – fixed value	•	•		•	•			
Volume flow rate control – variable	•	•		•	•			
Constant volume flow rate difference		•	•		•	•		
Room pressure control			•			•		
Room management function		•	•					
Additional functions								
Interface to centralised BMS	•	•	•	•	•	•	•	•
Damper blade position signal	•	•	•					
Diversity control		•	•		•	•		
Volume flow rate change		•	•		•	•		
Smoke extract function	•							
Motion detector	•			•				
Control of sash moving mechanism	•						•[1]	
Commissioning								
Configuration via TROX computer software	•	•	•				•	•
Configuration via system integration tool				•	•	•		
Configuration – wired	•	•	•				•	•
Configuration – wireless via Bluetooth	•	•	•					
Configuration – via LonWorks® network				•	•	•		

[1] Only with expanded type AF-1 control panel

System selection aid

EASYLAB system



EASYLAB controller with expansion modules

Area of application

- Control of fume cupboards, supply air, extract air, and pressure
- TROX adapter module (TAM) as group controller

Hardware

- Modular hardware structure with expansion possibility
  - For 230 V AC power supply, also with UPS function
  - LonWorks® interface (FT10) for single controller or room
  - Automatic zero balance
- Casing design with external connections and signalling systems
- Pluggable communication cable
- Adaptive control panels with service connection for fume cupboards and room control

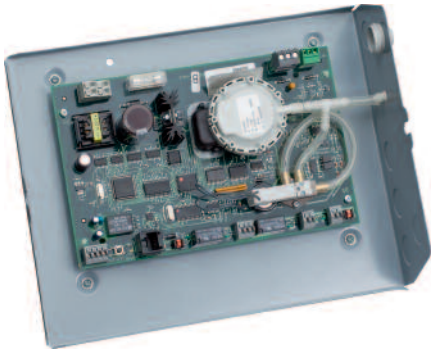
Special functions

- Flexible room control strategies
- Automatic or individual division of room supply and extract air volume flow rates with use of several controllers of the same type
- Damper blade position signalling
- Fault display and signalling can be configured individually (common alarm)

Commissioning

- Easy commissioning and expansion possibility
  - Due to plug-and-play of the various controller types
  - Due to commissioning without network management tool
  - No component addressing required
- Room management function for centralised configuration and signalling of room settings
- Configuration of the controllers using computer software with user-guided commissioning sequence

TCU-LON-II system



TCU-LON-II controller

Area of application

- Control of fume cupboards, supply air, extract air, and pressure

Hardware

- Controller electronics with
  - integrated LonWorks® interface (FT10) and automatic zero balance
- Possibility for direct integration of peripheral devices with LonWorks® interface such as control and display units or sensors
- Cross-manufacturer standardisation with standard network variables (SNVT)
- Control panel with service connection for fume cupboards

Special functions

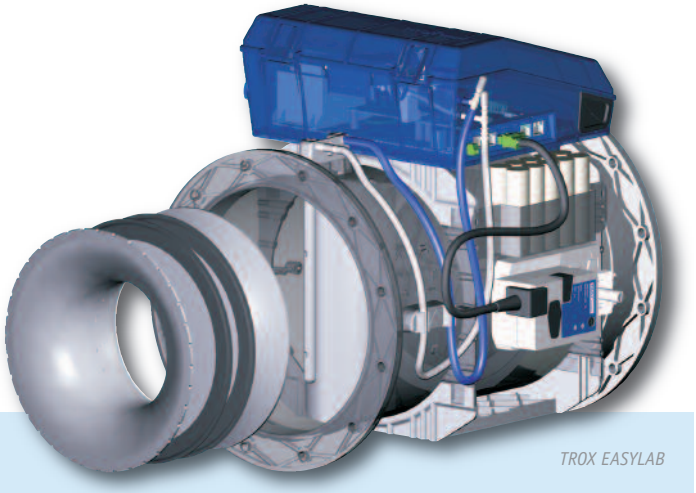
- Flexible linking possibilities using the LonWorks® technology
- Due to remote access, worldwide access to configuration, maintenance, and diagnostics available

Commissioning

- Configuration and diagnostics of the controller using the network management tool and free TROX plug-ins
- Centralised access to the actual values, setpoint values, and operating settings for the configuration and maintenance of all controllers in the network from a single service point

Innovations at a glance

During project meetings and discussions with specialist consultants, system designers, and users of our systems, the desire for the simplification of the assembly, wiring, commissioning, and expansion capability was of particular importance.
This was the basis for the EASYLAB system, which considers these requirements and includes them in the following programs:



TROX EASYLAB

EASYLAB

Hardware

- **Modular controller concept**
  Regardless of whether you need a LON connection, a 230V AC supply with or without an uninterruptible power supply (UPS), a volume flow rate transducer with or without automatic zero balance, or a lighting connection for your fume cupboard or regardless of whether you rely on the flow grid or venturi concept for volume flow rate measurement, EASYLAB offers an individual configuration to meet your needs.

- **Pluggable communication cable (KL)**
  The controllers can be connected to each other through a data cable that can be plugged into the outside of the casing.

- **New casing concept**
  – Installation options for all expansions
  – External plug sockets for the most important functions

- **Adaptive control panels for fume cupboards and room control**
  The displays for room or fume cupboard control can be individually set up to the project requirements. In addition, they automatically adapt to the particular operating situation, whereby easy operation is guaranteed, even in the most complex case.

- **TROX adapter module (TAM)**
  Provision of a hardware interface for room solutions with fume cupboards in combination with conventional room controllers using analogue technology.
  The TAM enables the following functions:
  – Room balancing
  – Connection of the EASYLAB room control panel
  – Integration into the centralised BMS

Functions

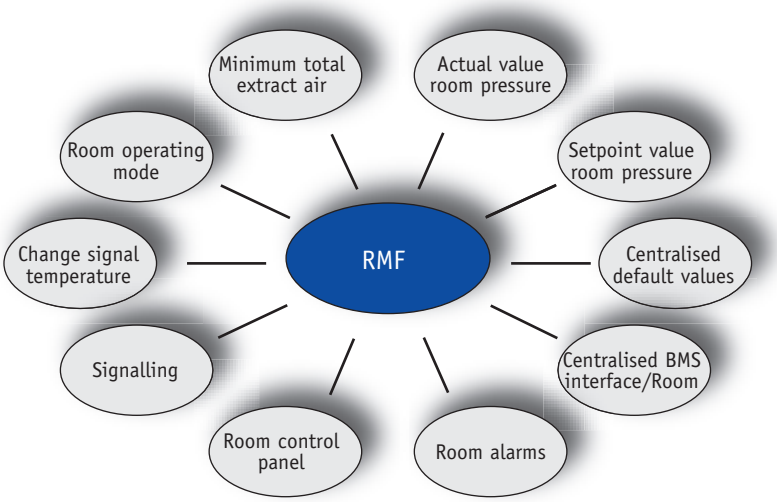
- **Automatic split of volume flow rates**
  In case of more than one room controller, the volume flow rates are automatically distributed evenly across controllers in the room.

- **Room control is fixed component of the system strategy**
  Operating modes and room information can be displayed comfortably by EASYLAB and set using the control panels. This is conveniently coordinated with the extensive capabilities of the system.

- **Signalling of the damper blade positions to increase energy efficiency**
  For the optimisation of the fan speed, the damper blade positions can be signaled to the parent centralised BMS individually or with system scan results (selective point measurement).

- **Selective diversity control**
  Refined control strategy for maintaining work safety at as many workstations as possible when the total extract air determined during design is exceeded.

- **Cutback in unnecessary extract air volume flow rates**
  Optimised safety strategy for extract air distribution



Commissioning

- **Simple commissioning method**
  The systems needs only one communication cable (KL) between the individual controllers. No functional assignment between the individual controller types of a room is required. The addressing otherwise needed in the case of a communication network is completely unnecessary for the EASYLAB system. After the communication cable is plugged in, all connected controllers and their proper function are detected and immediately exchange all required operating data.

- **User-guided configuration and maintenance of the controllers**
  The user is guided through the configuration software step-by-step in clear individual stages. Commissioning to finished controller configuration, as well as a typical maintenance run, are supported here.

- **Wireless commissioning**
  In addition to the intuitive commissioning concept, optional wireless access simplifies configuration and maintenance work on the controller.

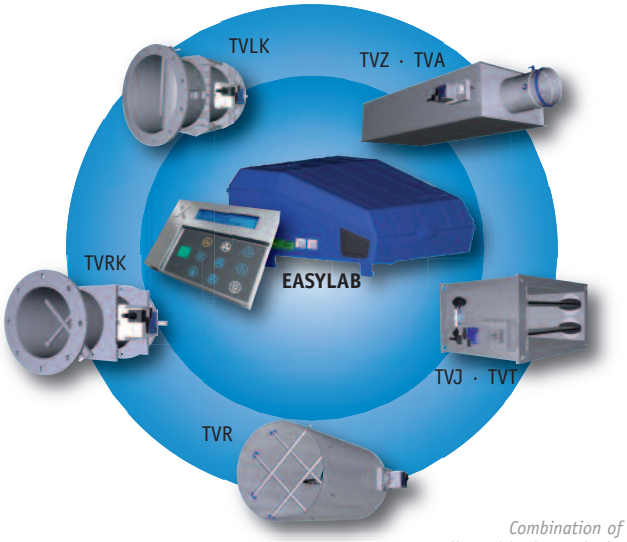
- **Centralised default settings using the room management function (RMF)**
  Default settings affecting the room can be entered centrally on a controller, which assumes the room management function. This offers excellent advantages in installation, commissioning, and maintenance.

The EASYLAB system is expanded in steps.
The following functions will be available:

- *Wireless commissioning with Bluetooth adapter module (12/2010)*
- *Extract air balance optimisation (12/2010)*
- *Control of air terminal devices (12/2010)*
- *Supply air master system for clean room technology (7/2011)*

Area of application and function of the EASYLAB controller

The electronic EASYLAB TCU3 controller is designed for special regulating tasks in the area of volume flow rate control and can be used with the following air terminal units:
Types TVLK · TVRK (plastic PP) or types TVR · TVA · TVZ · TVT · TVJ (galvanised sheet steel, optional powder-coated or stainless steel design)



Combination of the EASYLAB controllers with air terminal units

The EASYLAB controllers can be set up individually or as a combined system. The following functions can thus be realised:

Volume flow rate control
The essential features of the EASYLAB system include the correction of volume flow rate balances in all types of room scenarios and the volume flow rate control of fume cupboards. In addition to the precise recording of the actual volume flow rates, a prerequisite for stable control is the exact and rapid correction to the determined setpoint values.

Fume cupboard control
In laboratories, the fume cupboard has a special task with respect to personal safety. In this case, the retention capability and flushing are the focus of the air handling. To meet all individual demands, all common control options come into use with the EASYLAB system.

Scope of functions:
- Fixed set point control (one-point)
- Two-point or three-point control
- Variable control using the distance sensor, linear function or optimised safety function
- Variable control using incoming air flow sensor
- Monitoring and display of functions according to EN 14175
- Signalling of motion detector
- Control of sash moving mechanism
- Fume cupboard with supportive flow technology
- Operation of extract air scrubber
- Smoke extract function
- Fume cupboard lighting

Pressure control
The typical areas of application for our systems increasingly include areas with room or duct pressure control. Both control strategies can be fulfilled with EASYLAB and have been taken into consideration in comprehensive, specially adapted control strategies. The consistent use of cascade control systems in comparison with regulating the pressure with a control damper results in considerably more stable room conditions, even in case of rapid response control loops.

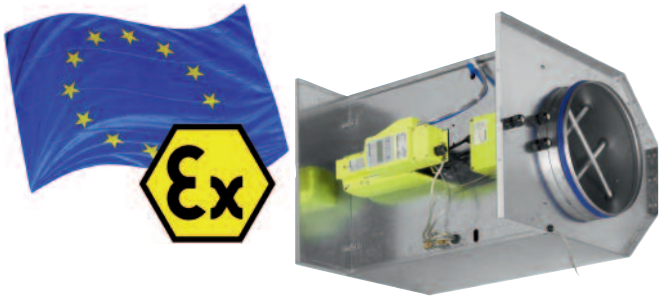
Through constant research and development, situations that could previously only be controlled with alternative systems can now be electronically controlled, as well.

In application areas in which certified room pressure transducers are required (GMP), corresponding signal transducers can be ordered.

The optional uninterrupted power supply (UPS) of the EASYLAB controllers allows maintenance of the control functions and thus the room pressure, even in case of a primary power failure of up to four hours.

External pressure control
In addition to independent pressure control, the EASYLAB-system allows room pressure control through an external volume flow rate change. The change signal required for this task can be sent through an analogue input or a LonWorks® network.

Regulation for potentially explosive atmospheres according to ATEX
Especially in areas with laboratory technology, certain areas must be equipped with ATEX-certified components. For this purpose, TROX offers components that fulfil the requirements of more rapid response volume flow controllers, room pressure controllers, and fume cupboard controllers, including monitoring. The EASYLAB system is designed for controlling the volume flow controllers of type TVR-Ex.



Adaption of the air change rate or temperature control
Temperature control or a demand-based change in the air change rate takes place through the sending of a change signal on the main controller using the room management function (RMF). A 0–10V analogue input or a LonWorks® network variable is available for the volume flow rate change.

The change signal automatically alters the extract air volume flow rate in laboratories with controlled extract air and, accordingly, the supply air volume flow rate and thus the air change rate in clean rooms with controlled supply air.

Diversity control
The EASYLAB system makes it easier than ever before to implement a solution for maintaining diversity factors effectively. If all controllers are connected to each other, a maximum permissible total extract air volume flow rate can be set using the room management function (RMF). This function reliably ensures that an exceedance of the set value leads to a reduction of the total extract air to the allowed value.

The new, selective intervention strategy initially reduces the extract air only on the largest consumers. This lets technicians continue to work at most workstations.

A local alarm in the control panel of the affected fume cupboard and, if necessary, a room alarm through the room control panel indicate an exceedance of the total extract air visually and acoustically.

Extract air balance optimisation
Energy efficiency regulations require special focus on the optimum utilisation of the extract air. In case of a sufficient flushing of the room by the extract air of fume cupboards and hoods, the system independently adapts the extract air in the room down to shut-off.

ALTANA BYK-Chemie, Wesel, Germany

Fan control by signalling of the damper blade positions
The majority of the central systems are equipped with variable speed control of the fans. This makes sense in case of variable volume flow rate control since the duct pressure rises and falls depending on the volume flow rate at constant speed. After-effects are high levels of air-generated noise and increased operating costs.

In the case of comprehensive ducting schemes, the duct pressure control, which should ideally track the fan using a frequency converter, often has the disadvantage that the areas with too little duct pressure start to occur in different parts of the ducting. For this reason, a static pressure measurement should be performed not directly at the air handling unit, but rather at different points in the duct network.

Alternatively, the damper blade positions of the individual volume flow controllers are increasingly being used as selective point signals so that a statement can be made regarding the necessary speed of the fan or duct pressure.

The EASYLAB system naturally offers the opportunity to use this control system and provides you with information on the individual damper blade positions or a scanned signal of up to 24 system subscribers per room.
This scan can considerably reduce the data points needed and thus help save costs.

Operating modes and room control strategy
The following operating modes are possible with the EASYLAB controller:

- Standard operation, e.g. as daily operation with 8 air changes per hour
- Reduced operation, e.g. as night economy or as office operation with reduced air change rate
- Increased operation, e.g. as emergency operation mode with increased air change rate
- Shut-off; the control damper blade is closed, e.g. for system shutdown
- Open position of the controllers
- Pressure reversal, e.g. switchover between underpressure and overpressure in hospital areas (septic/aseptic)

During design, room control is often neglected. Later tenant requirements are then only inadequately implemented by many systems.

In times when everyone is talking about "green buildings," the local tenant should have the possibility to actively influence the energy use .

For this purpose, the EASYLAB system can be equipped with room control panels that provide important information regarding air distribution and at the same time allow the influencing this distribution. During the development of the operating mode strategy, a special focus was thus placed on simple operation and versatile adaption possibilities to various project requirements.

Bayer Pharma-Forschungszentrum (Pharmaceutical Research Centre), Wuppertal, Germany

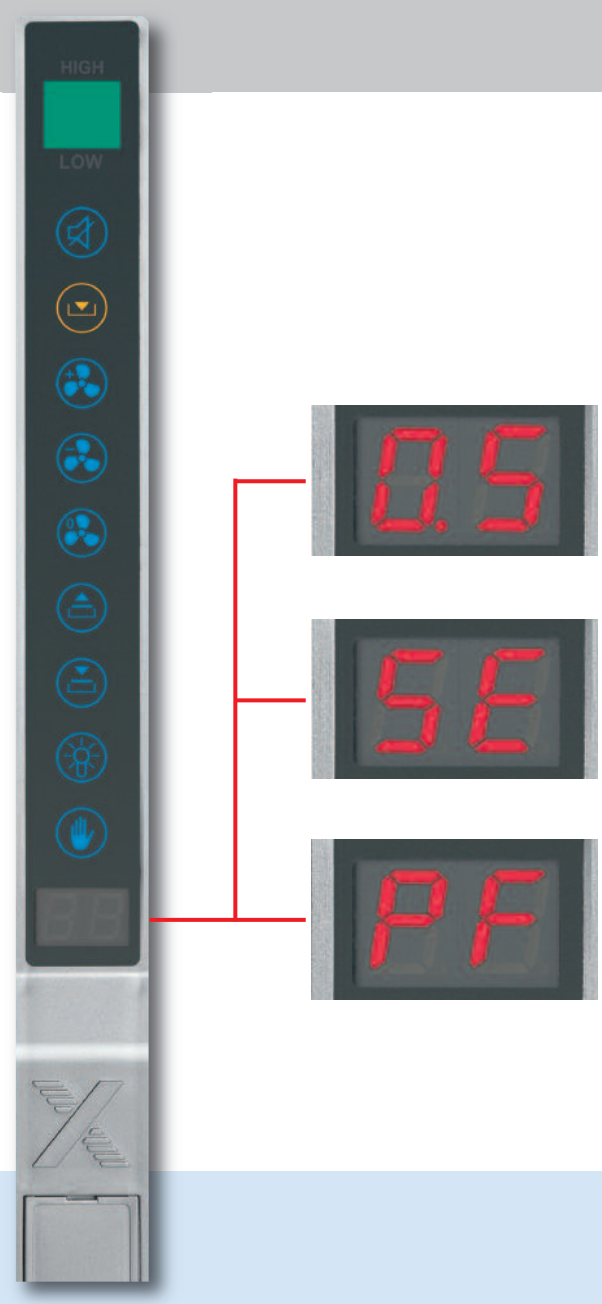
Fault identification and signalling

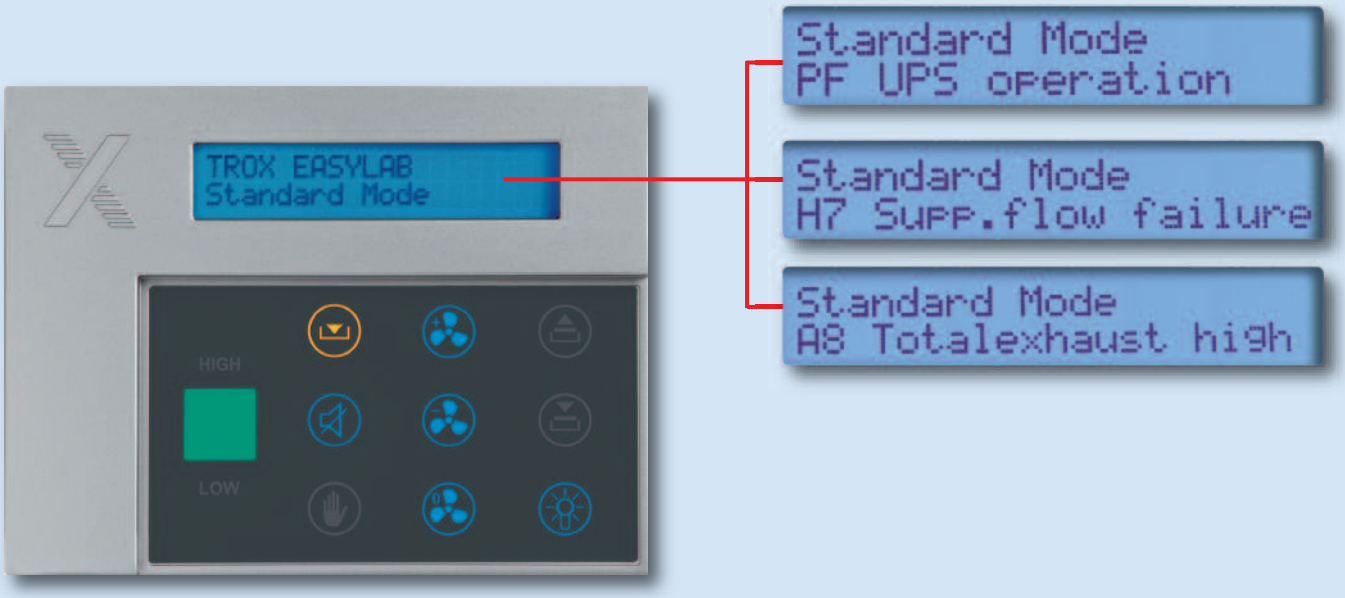
All systems are dependent on the upstream components in the ventilation system.
Faults in this area inevitably lead to alarms on the downstream systems.
The EASYLAB system allows collection of alarms from individual controllers in the room and forwards them to the centralised BMS as a consolidated alarm. The consolidated alarm composition can be set up to include various alarm categories for a certain room. It enables a reduction in data points and thus saves costs.

The local control panels differentiate the various alarm categories and display them as plain text or clear fault messages. Fault analysis is thus considerably simplified despite the centralised local consolidated alarm.

Faults that can be combined in a consolidated alarm:

- Exceeding of the designed total extract air
- Room pressure alarm
- Undershooting of the minimum total extract air according to DIN 1946, Part 7, or the desired room flushing
- Volume flow rate deviation of individual controllers
- Hardware faults of individual controllers
- Power failures of individual controllers





Combination example
EASYLAB controller on TVLK

Basic components

- **EASYLAB controller (TCU3)**
  The core of the system is the TCU3 electronic controller. For the various areas of application (fume cupboard controller, supply air controller, extract air controller, pressure controller), the hardware is equipped with different software and can be combined with the following air terminal units:
  Types TVLK · TVR · TVRK · TVT · TVJ · TVA · TVZ

External plug sockets and status displays for the most important functions

- Display of alarm state on both sides
- Display of normal controller function (heartbeat display)
- Display of controller communication (KL)
- Connection for input and output of the communication cable (KL)
- Connection for the actuator
- Connection for two control panels
- Connection for sash contact according to EN 14175
- Connection for incoming air flow sensor in the case of fume cupboard control
- Connection for actuated fume cupboard lighting (optional)

1 Luminous diode for alarm display
2 Connection of switching contact for monitoring the maximum sash opening (500 mm contact for fume cupboard)
3 Connection for control panel 1
4 Connection for control panel 2
5 Connection for actuator
6 Connection for incoming air flow sensor (only for fume cupboard)
7 Connection for the communication cable – input
8 Connection for the communication cable – output

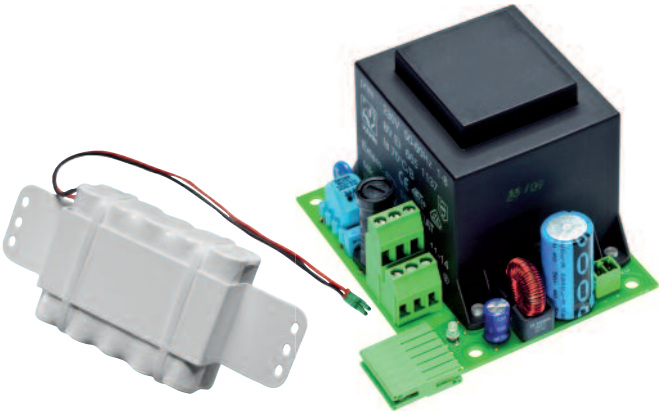
- **TROX adapter module (TAM)**
  Hardware interface for room balancing, connection of a room control panel, and interface to the centralised BMS.

Modular hardware structure

The basic EASYLAB components (TCU3 controller and TAM) can be optionally supplemented by expansion modules:

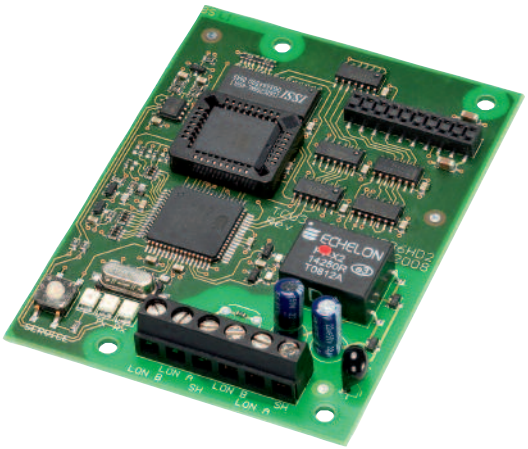
- **Expansion module for mains supply (EM-TRF)**
  Possibility of a 230 V AC mains supply for the EASYLAB TCU3 controller or the TAM.

The expansion module is mounted in the casing of the basic components and plugged into the motherboard.



- **Expansion module for mains supply with UPS (EM-TRF-USV)**
  Possibility of a 230 V AC mains supply for the EASYLAB TCU3 controller or the TAM with a guarantee of the power supply even in case of a mains failure using the emergency power storage battery.
  In addition to the signalling of status and alarm messages, this expansion permits the following alternatives in case of a power failure:
  - The continuation of normal operation
  - The opening of the control damper blade
  - The closing of the control damper blade
  - The maintaining of the last position of the control damper blade

The expansion module is also integrated into the casing of the basic components and emergency power storage battery is mounted to the volume flow controller using an angle bracket.



- **Expansion module for LON (EM-LON)**
  Provision of an interface to the centralised BMS via LonWorks® technology for the exhange of data using standard network variables (SNVT).

In the casing of the basic components, the expansion module is plugged directly into the motherboard.

- **Expansion module for the solenoid valve (EM-AUTOZERO)**
  For optimising the long-term stability of the volume flow measurement, the solenoid valve is integrated into the measuring tubes of the differential pressure transducer in the controller casing.

- **Expansion for the control of the fume cupboard lighting (EM-LIGHT)**
  Control of the interior lighting of a fume cupboard or the room lighting using the control panel of the fume cupboard controller through the provision of a connecting socket wired to the TCU3 casing.

- **Control panels for fume cupboards (BE-SEG-01)**
  Adaptive control panel with function display and operating mode setting for fume cupboards according to EN 14175.

- **Control panels for fume cupboards or room control (BE-LCD-01)**
  - Adaptive control panel with function display and operating mode setting for fume cupboards according to EN 14175.
  - Convenient function display and operating mode setting for EASYLAB room control systems
  - In the case of these control panels, operating states and faults are displayed in plain text.

- **Incoming air flow sensor (VS-TRD)**
  The VS-TRD is used in fume cupboard control for a variable volume flow rate control on the basis of the incoming air flow velocity. For this purpose, the sensor is mounted on the fume cupboard.

- **Sash distance sensor (DS-TRD-01)**
  The DS-TRD-01 is used in fume cupboard control for a variable volume flow rate control on the basis of the sash opening.
  For this purpose, the sensor is installed into the fume cupboard in such a way that it can detect the movements of the sash.

- **Bluetooth adapter module (BlueCON)**
  This module offers wireless controller configuration. For this purpose, it is plugged into the service socket in the control panel or controller.

- **Room pressure transducers**
  For room pressure control, room pressure transducers are available in various pressure ranges upon request, even in a certified construction.

General note:
Further details regarding the individual components can be found in the respective technical leaflets.

Room control panel

The multifunctional room control panel is appropriate for convenient operating mode control and monitoring of a complete laboratory, e.g. through the display of consolidated alarms, or for the status display of a pressure control system.

Highlights of the room control panel:

- *Setting option for the room operating mode*
- *Plain text display of operating mode, operating values, and faults*
- *Up to two room control panels can be connected at the controller using the activated room management function*
- *Convenient access to the configuration of the room management function*

Display options for the room control panel

- Plain text display of current volume flow rates/setpoint and actual values (total extract air/total supply air)
- Plain text display of current room pressure
- Room pressure alarm
- Faults consolidated into a single alarm
- Exceeding of the total defined total extract air set at the design stage
- Undershooting of the minimum extract air defined at the design stage, e.g. according to DIN 1946, Part 7

Design information:
Since the control panel plays a central role in room control and monitoring, it is connected to the controller responsible for the room management function (RMF).

ALTANA BYK-Chemie, Wesel, Germany

Operating modes and room control strategy

The operating modes can be switched over using the centralised BMS just as conveniently as on site. In the process, not a single controller, but rather all the controllers of the entire room are primarily switched over using a room operating mode in the case of the EASYLAB system. The operating mode is preset using the following:

- The room control panel
- Switch contacts
- LonWorks® standard network variables (only with the EM-LON expansion module)

Local intervention possibilities for the fume cupboards

To meet the special conditions for use of fume cupboards, such as 24-hour operation, the following possibilities are available for alternative room control strategies:

- **Adaption of the configuration**
  A fume cupboard can be permanently removed from the default setting of the other fume cupboards within a room. In this case, the operating mode default settings for this particular controller can be set up using the control panel, external switches, or, if appropriate, the LonWorks® interface.

- **Manual mode**
  The EASYLAB control panels have a manual mode button. After the activation of the manual mode, the operating mode default setting is determined solely by the tenant by means of the local control panel. A room operating mode default setting is not taken into consideration while the manual mode is activated on this controller. After the deactivation of the manual mode, the current room operating mode default setting is again taken up by the fume cupboard controller.

The manual mode is deactivated in the following ways:

- Renewed actuation of the manual mode button
- Expiry of a set time interval (max. 72 hours possible)

The flexibility of the system allows many options. A consultation would certainly help you implement project bespoke requirements.

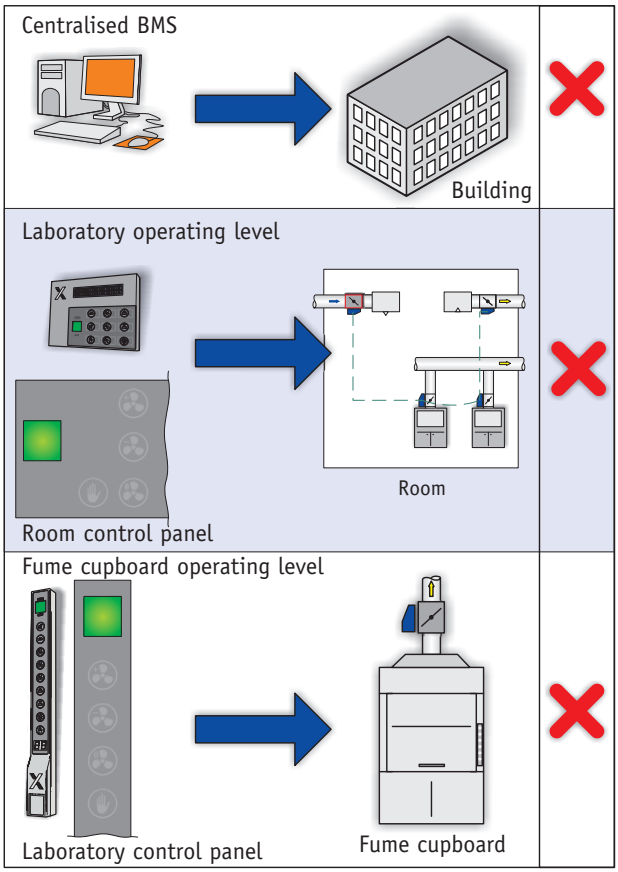
Bayer Health Care AG, Wuppertal, Germany

Examples of possible room control strategies

Example 1:
24-hour operation without any possibility of intervention

Particularly suited for special laboratories subject to hazardous conditions.

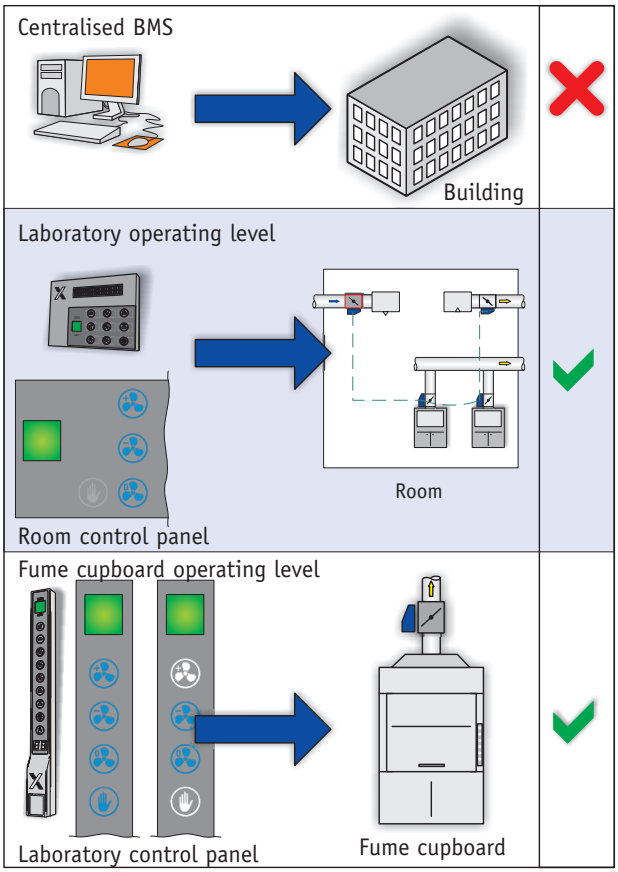
- Without centralised BMS
- Standard operation is permanently maintained
- The system accepts no changes from the outside, no switch contacts, no buttons on the control panels, and no intervention through the centralised BMS.



Example 2:
Operating mode default setting for all controllers in the room

Particularly suited for laboratories without a centralised BMS.

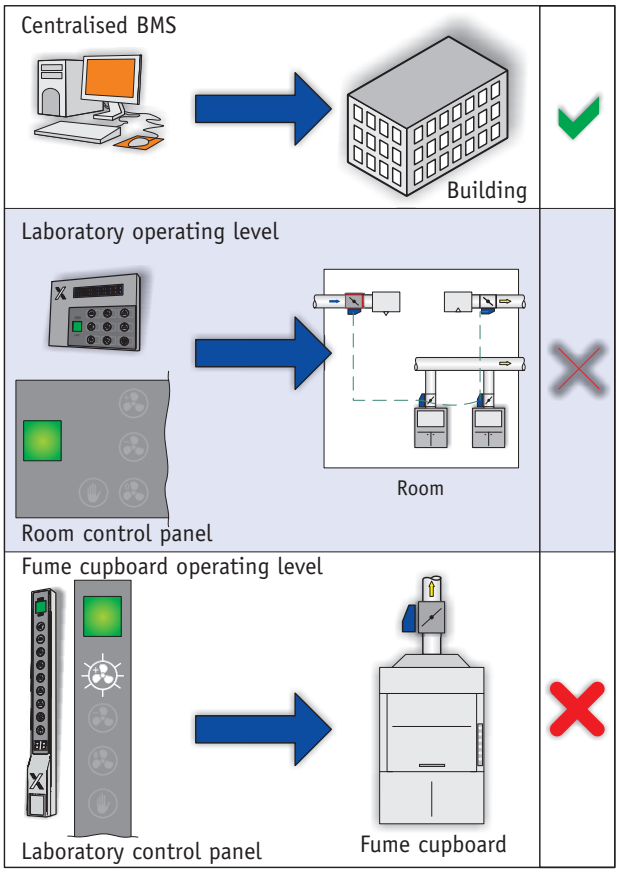
- The operating mode can be preset using a room control panel or switch contacts
- Some fume cupboard controllers can ignore the room default settings (configuration or activation of manual mode)



Example 3:
Room operating mode default setting made only through centralised BMS

Especially suited for weekend operation or holidays.

- The centralised BMS determines the operating mode for all controllers in the room.
- There is no possibility of local intervention through switch contacts or control panels.
- When configured accordingly, some fume cupboard controllers can ignore the default settings of the centralised BMS.
- The default settings of the centralised BMS can also only be used temporarily without a possibility of intervention.



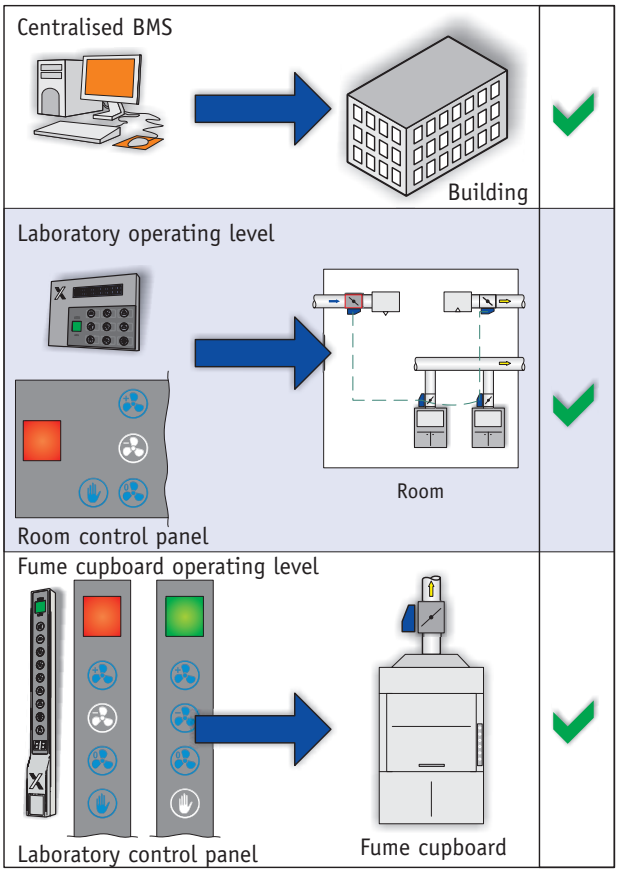
Example 4:
Room operating mode default setting made through centralised BMS with option of local intervention

Particularly suited for individual work, even in case of centralised night economy.

- The centralised BMS sets a default operating mode for the room.
- The room can accept this operating mode or it can be overridden using the room control panel.
- There are two override possibilities:

Automatic mode
The default setting of the centralised BMS for the room operating mode can be overridden. The last operating mode default setting for the room is used.

Manual mode
In contrast, the manual mode permits no further default settings of the centralised BMS after activation. The manual mode can be temporally limited in the configuration. Advantage: the default settings of the centralised BMS are assumed again when the set time has expired (e.g. night economy).



Room management function (RMF)

For the first time, the EASYLAB system allows the room management functions comprising room related data and configuration to be incorporated into a single controller.

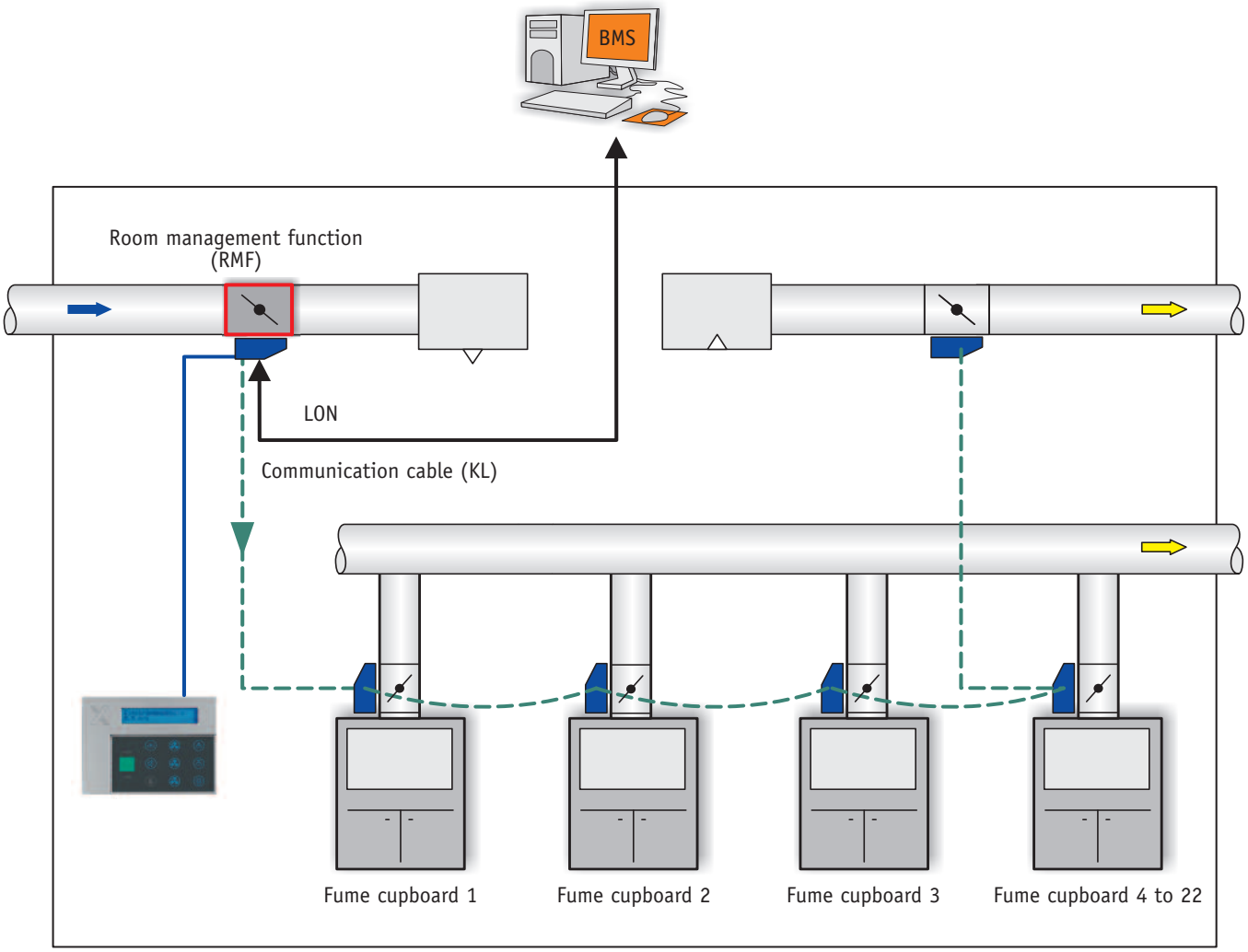
Advantages
- *Easy commissioning*
- *Easy maintenance*
- *Easy room diagnostics*
- *Easy room configuration*

The room management function is not bound to hardware. It can be activated in supply or extract air function on any room controller or TROX adapter module (TAM).

This results in free choice for the following:
– Connection possibility of the room control panel
– The use of a LonWorks® interface for the room
– The transmission of change signals
– The integration of other controllers

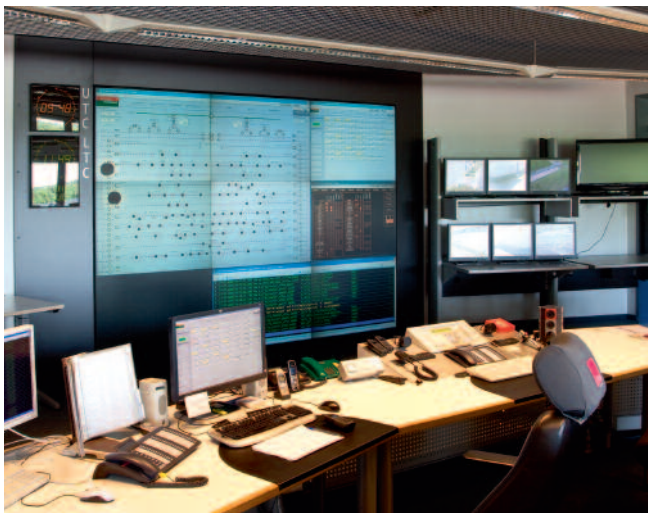
The room management function expands any room controller or TAM in the room as:
- A central transmission point for the centralised BMS
- A central transfer point for the room operating mode
- A consolidated central output of alarms
- Connection option for an EASYLAB room control panel
- Point of collection for all room-relevant data such as total volume flow rates, damper blade positions, room pressure, and all room settings

Design information for the room management function (RMF):
- *For each room, the RMF can be activated for one specific controller.*
- *The RMF can be activated for any room controller or TROX adapter module (TAM).*
- *Each of these controller types is prepared for the activation of the function at the factory.*
- *A room control panel can be connected only on a controller with an activated RMF.*



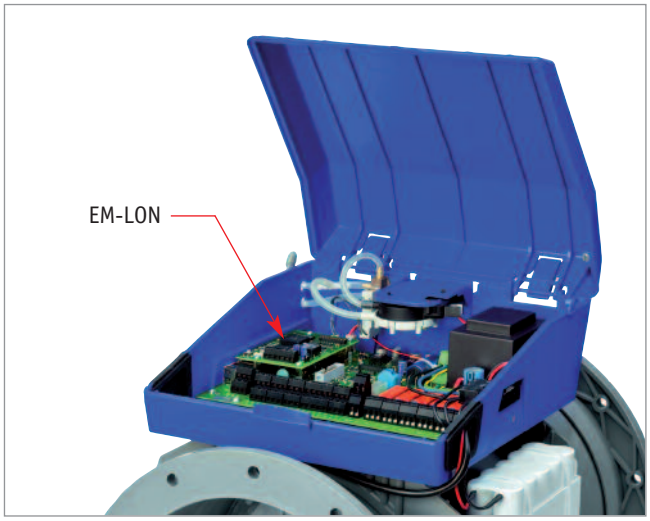
Interface to centralised BMS

Complex systems, especially ones that are part of the safety system, must offer the facility to be simply connected to a higher management level. For this purpose, the system must have interfaces that let it provide flexible connections.
In addition to analogue inputs and outputs for setpoint value, default settings and actual value output procedures via 0–10 V DC signals, EASYLAB also provides switch contacts as a means of altering the system and transmitting information.
More frequently, however, digital network communication is preferred nowadays to combine data transparency with low wiring costs.



In the process, the LonWorks® protocol represents a comprehensive option for exchanging information. Here, the EASYLAB system consistently supports the standard network variables (SNVT) and thus offers the greatest compatibility.

The EM-LON expansion module is available for expanding the EASYLAB system by a LonWorks® interface. This module can be used either centrally on the controller with the RMF or in a decentralised manner on every single controller. A centralised arrangement provides an access interface for room data, whilst a decentralised arrangement permits access to individual controllers.



The centralised BMS can poll the following information:

- Setpoint and actual values for volume flow rates and room pressure
- Local faults
- Consolidated fault messages with configurable content
- Damper blade positions of the control damper (optimised central system management)
- Feedback of operating modes
- Sash position (for fume cupboard control)
- Incoming air flow velocity (for fume cupboard control)
- Set fume cupboard steps (for fume cupboard control)

The centralised BMS can set these parameters for the room or a fume cupboard controller:

- Operating mode
- Switchover of the priority for operating mode default settings between the local control panel or the centralised BMS
- Switchover between room pressure setpoint values
- Volume flow rate change signals (external temperature and pressure control)

Detailed information on the LonWorks® interface and the list of supported network variables can be found in the technical leafless of the EM-LON expansion module.

Design information:
In addition to the wide-spread LonWorks® interface, other interfaces such as BACnet can be supported. We gladly consider a customised strategy for the connection of the EASYLAB system to a centralised BMS.

LONMARK® PARTNER

BACnet™

One of the main development objectives for the EASYLAB system is the simple commissioning.
Due to the new communication system, the installation and commissioning expense costs can be considerably reduced in comparison with the previous systems.

Commissioning without the network management tool

The necessary data exchange between the individual controllers of a room takes place automatically after the components are connected in via the pluggable communication cable and after the connection of the power supply. A definition of communication paths or data points for the controllers of a room is not necessary. The use of a network management tool like the Echelon LonMaker is required only if a LonWorks® interface to the centralised BMS is required.

User-guided commissioning software

In addition to these changes, the software for adapting the control configuration for commissioning, maintenance, and diagnostics has been redeveloped from the ground up.
The typical working sequences for commissioning and maintenance work have been divided into individual clear steps and the user is now intuitively guided through the individual commissioning steps.

Main screen of the commissioning software

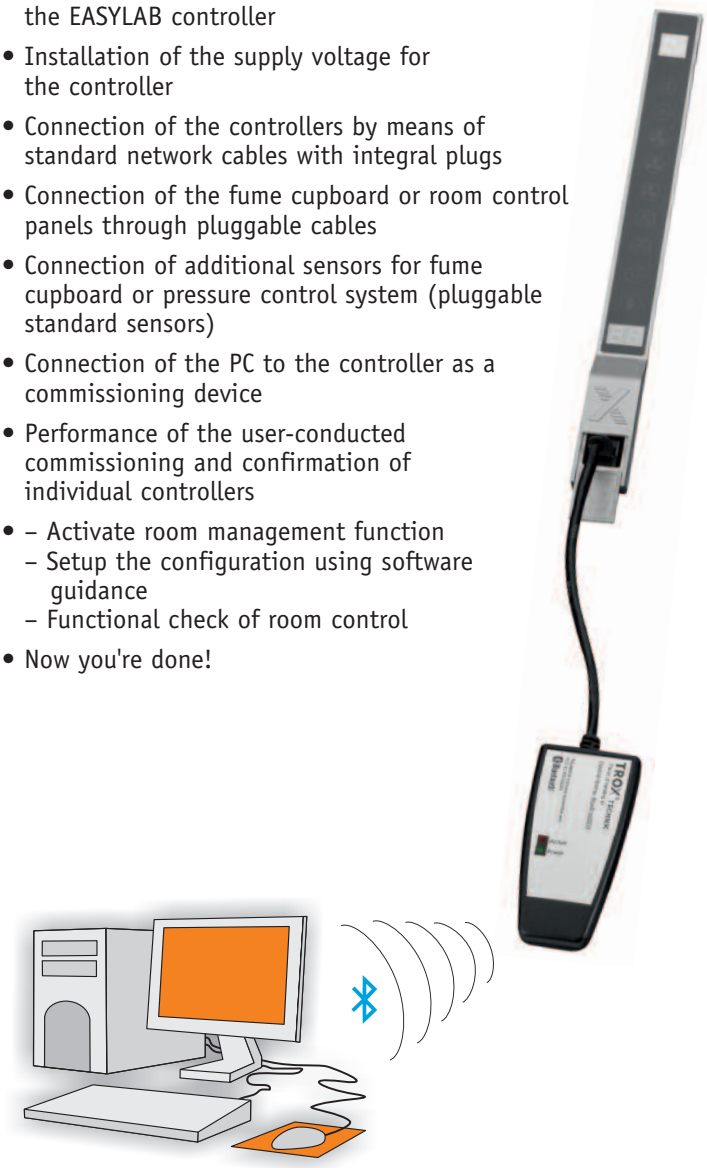
Setting dialog for the fume cupboard control system with incoming air flow sensor

Commissioning highlights

- *Reduced installation costs due to pluggable communication cable*
- *Automatic definition of the data exchange between the controllers without special software*
- *Access to the room settings from a central point (room management function)*
- *User-guided commissioning software with clear individual steps*
- *Optional wireless integration of the EASYLAB controllers into the configuration software*

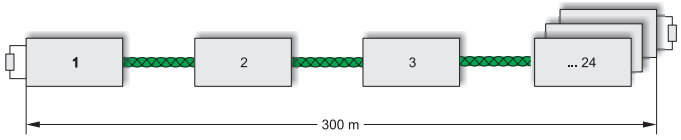
The typical commissioning steps for an EASYLAB system are as follows:

- Installation of air terminal units with the EASYLAB controller
- Installation of the supply voltage for the controller
- Connection of the controllers by means of standard network cables with integral plugs
- Connection of the fume cupboard or room control panels through pluggable cables
- Connection of additional sensors for fume cupboard or pressure control system (pluggable standard sensors)
- Connection of the PC to the controller as a commissioning device
- Performance of the user-conducted commissioning and confirmation of individual controllers
- – Activate room management function
  – Setup the configuration using software guidance
  – Functional check of room control
- Now you're done!



Electrical system setup

- Power supply with 24 V AC;
  Optional with 230 V AC through EM-TRF or EM-TRF-USV expansion module
- Connection of up to 24 air terminal units with the EASYLAB TCU3 controller or the communication cable (KL)
- Any combination of EASYLAB-TCU3 controllers possible in a single system:
  fume cupboard controller, supply air control, extract air controller, and TROX adapter module (TAM)
- Connection setup via communication cable (KL)
  - Pluggable standard network cable (patch cable), type S-FTP (external connecting socket)
  - Alternative: network cable type S-FTP on a reel cut to fit, use screw terminals
- Connection of the controllers in a sequential line structure
- Termination of the communication cable at the beginning and end of the sequential line structure using the individually activatable terminal resistors integrated into the controller
- Total length of the communication cable for an EASYLAB room: up to 300 m



Centralised system setup

To guarantee a clear overview of the room settings, a controller that assumes the room management function (RMF) is required in the system:

- Activation of the room management function (RMF) on a selected one controller (supply air, extract air, TAM)
- Central room interface for room pre set values or room set values on the controller with activated RMF (easy to connect through the service socket on the room control panel)
- Settings such as the minimum extract air, air transfer, constant volume flow rates, etc. are stored here centrally and automatically taken into consideration by the entire system
- Centralised installation of the room interface via switch contacts, analogue signals, and LonWorks®
- Connection of the room control panel on the controller with activated RMF

Control panels

- For fume cupboards, the BE-SEG-01 and BE-LCD-01 control panels are alternative options.
- As room control panel, only the BE-LCD-01 on the controller with the RMF can be used.
- Up to two control panels can be connected.
- The connecting cables provided for the control panel are pluggable and 5m long.
- Alternatively, standard network cable type S-FTP with a length of up to 40 m can be used.

Integration of external volume flow rate values

Also integrated	Existing inputs on controller for			
	Fume cupboard	Supply air Extract air	TAM	Supply air /Extract air / TAM with room management function
Variable extract or supply air using 0–10 V DC signals	Up to 4[1]	4	5	2–4[2]
Constant extract or supply air using switches	Up to 5[2]	6	6	Up to 6[2]

[1] According to control strategy.
[2] Depending on the number of special functions using switches, the balance of switches can be used for flow rate control.

Interface to centralised BMS

Possibilities	Fume cupboard	Supply air / Extract air / TAM	Supply air /Extract air / TAM with room management function
Alarms sent by potential free switch outputs	1	1	2
Room operating mode default settings by switching inputs	–	–	•
Actual controller volume flow rate by 0–10 V analogue outputs	Actual controller volume flow rate Total room volume flow rate Damper blade position	Actual controller volume flow rate Total room volume flow rate Damper blade position	Actual controller volume flow rate Total room volume flow rate Damper blade position
Controller interface Actual values and alarms via LonWorks® network	•[1]	•[1]	•[1]
Room interface Cumulative values and alarms via LonWorks® network	–	–	•[1]

[1] Only with EM-LON expansion module.

Sanofi-Aventis, Frankfurt, Germany

In laboratories, the fume cupboard has a special task with respect to personal safety.
Here, three safety objectives are particularly important:

1. Retention capability
Fume cupboards must prevent gases, fumes, or dust from escaping from the inside of the fume cupboard in dangerous concentrations.

2. Flushing
Fume cupboards must prevent an ignitable (explosive) atmosphere from developing with the cupboard.

3. Spray and flying fragment protection
Fume cupboards must prevent employees from being injured by spray or flying fragments.

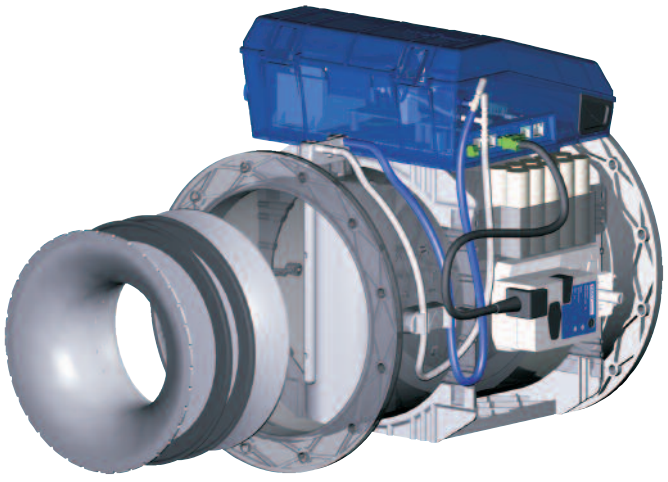
Whilst the last point is guaranteed purely through the design of the fume cupboard, the ventilation control is of critical importance for the first two points. To meet all individual requirements, all the usual control options are available with the EASYLAB system.

All LABCONTROL controllers and thus also the EASYLAB TCU3 controller are tested by an independent, certified testing institute according to EN 14175, Part 6.

TVLK volume flow controller for fume cupboards
For the volume flow rate control of polluted extract air on fume cupboards, the air terminal unit type TVLK is generally used in connection with the EASYLAB TCU3 controller.

The advantages of type TVLK:

- Highly accurate manufacture using state-of-the-art injection moulding technology
- Diameter of 250 mm for direct attachment onto top of fume cupboard
- Compact installation length of 400 mm
- Very insensitive to unfavourable flow conditions
- Volume flow rate ranges can be changed using different types of flow grid or venturi nozzles
- Use of flow grids:
  for cleaning the sensor tubes can be removed
- Use of venturi nozzles:
  for cleaning the sensor nozzles can be removed
- Very low leakage when the damper blade is closed (also seals on the damper blade shaft)
- All parts in the air stream made of chemically resistant and flame retardant plastic (PP)
- Together with the EASYLAB controller, TVLK forms an optimised functional assembly.



Design information:
If other nominal sizes or volume flow rate ranges are required, the type TVRK, also manufactured from PP plastic, is available in nominal sizes 125 – 400 mm for fume cupboard control.
Alternatively, the controller type TVR in stainless steel or powder coated galvanised construction can also be used with the EASYLAB system.

Strategies for fume cupboard control

Control strategies can vary between standard operation – often called laboratory operation – and the special operating modes.

Standard mode

In the standard operation of the fume cupboard control system, various control strategies can be supported using different recording systems.

- Fixed value control
- Two-point or three-point control via switch contacts
- Variable volume flow rate based on sash distance sensor
- Variable volume flow rate based on incoming air flow sensor

Special operating modes

For certain operating situations, special operating modes are available that can be activated through default settings by the centralised BMS or directly using the control panel on the fume cupboard.

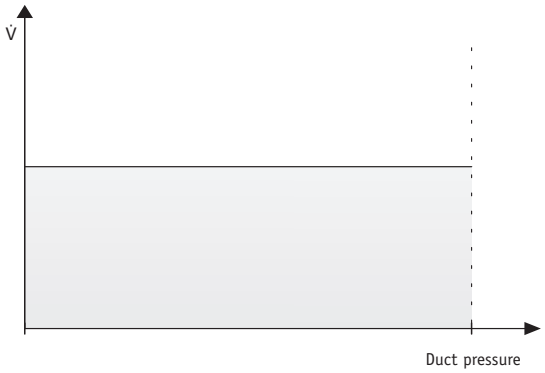
The following special operating modes can be activated as an alternative to standard operation:

- Increased operation, for example, for emergency situations
- Reduced operation, for example, for night economy
- Shut-off for system shutdown
- Open position (cannot be activated using the control panel / only using external default settings)

Standard operation – adaption of the volume flow rates to up to three staggered values

Fixed value control

In the case of fixed set point control, the simplest variant, the volume flow rate is constantly adjusted to maintain the constant set point. In the process, the control system reacts to duct pressure fluctuations and corrects these effects quickly and precisely.

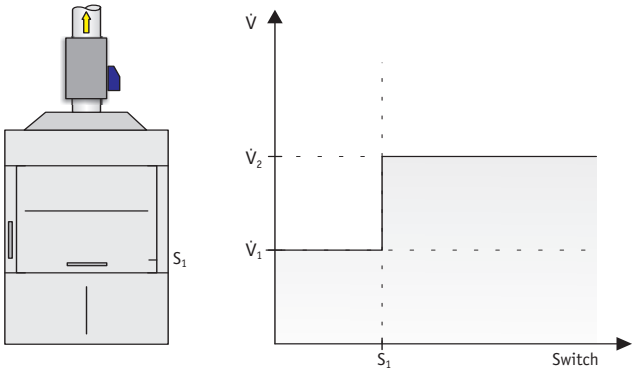


Design information:
Fixed value control results in the highest energy costs.

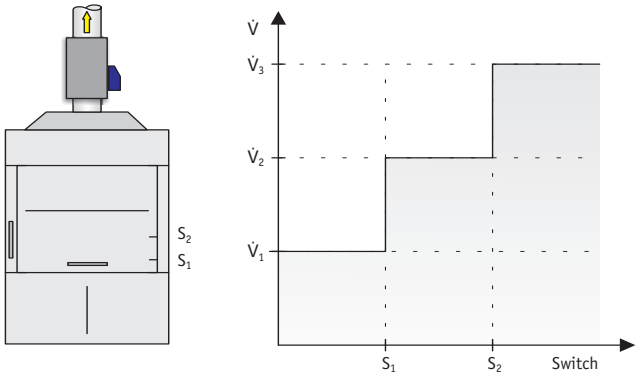
Two-point or three-point control

Fume cupboards that should vary the volume flow rate depending on the sash positions can be assigned adjustable extract air volume flow rates in several steps using this control variant. The steps are achieved using switch contact signals that are transmitted to the controller and provide information regarding the degree of opening of the sash.

The lower volume flow rate value ($\dot{V}_1$) is generally present when the fume cupboard is closed in the case of the two-point control system, a higher volume flow rate ($\dot{V}_2$) is corrected using the status change on the switching contact when the sash is open.



The three-point control system enables the control of three different volume flow rates using two switch contacts:
closed ($\dot{V}_1$), partially open ($\dot{V}_2$) or completely open ($\dot{V}_3$) position of the sash of the fume cupboard.



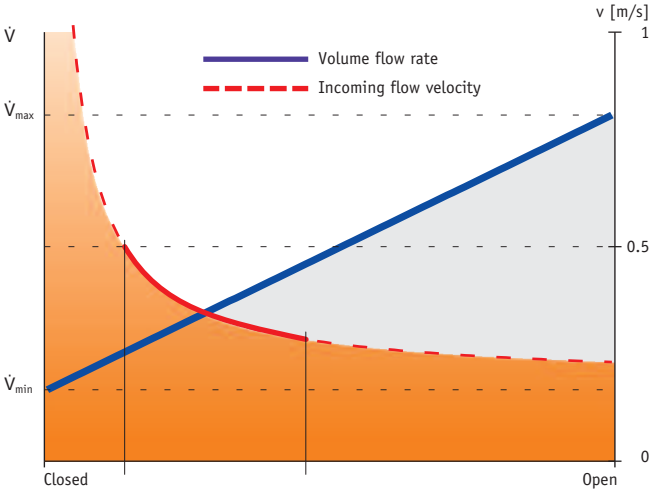
Design information:
The switch contacts for the two-point or three-point control system are not part of the scope of supply. On the EASYLAB fume cupboard controller, all switches and switch contacts can be connected on site with flip flop switching behaviour. Flip flop switch contacts are closed by a brief pulse and not reopened till the next pulse (e.g. flip flop reed contact).

Standard operation – variable adjustment of the volume flow rates to the respective operating situation

From the point of view of energy savings and safety, a variable control system is the most convenient way to control a fume cupboard aerodynamically.

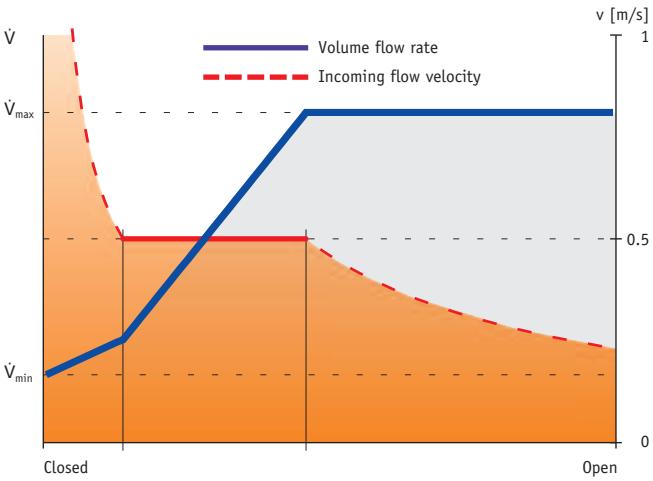
Sash distance sensor – linear control strategy

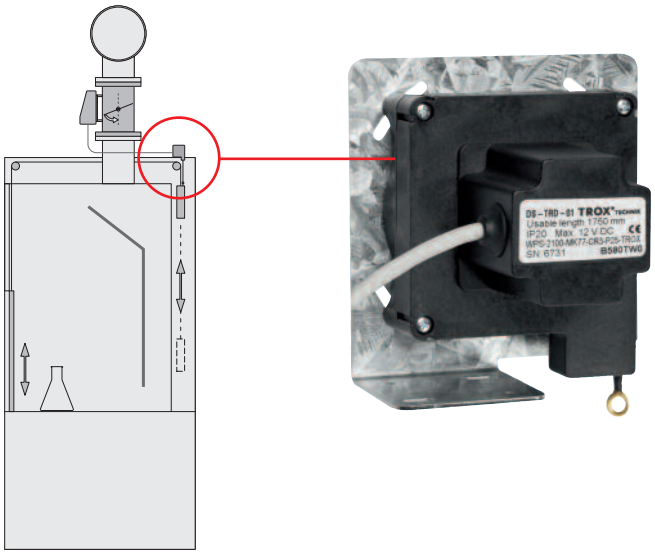
The first possibility for variable control lies in the linear change of the volume flow rate between two adjustable values through the recording of the opening slot of the sash using a distance sensor.



Sash distance sensor – control strategy with optimised safety

As a variant of the distance sensor-controlled volume flow rate, this strategy determines the theoretical incoming air flow velocity in the fume cupboard and makes sure that this velocity maintains a set value, usually 0.5 m/s, the set value can however be adjusted. This variant increases safety as by design the entry velocity is kept higher than the air velocity within the room.



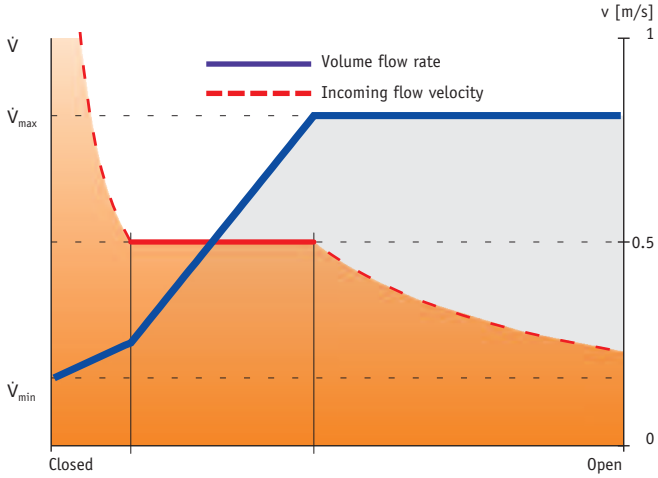


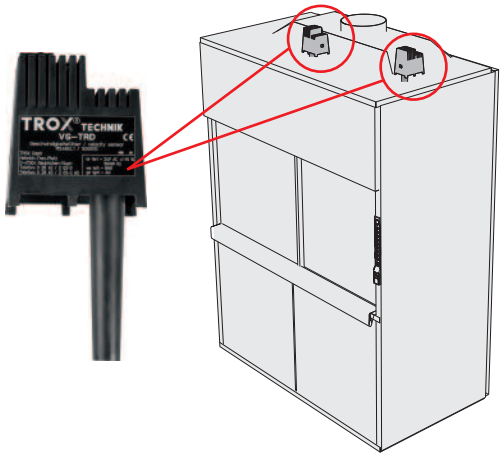
Design information:
This strategy is particularly suited for fume cupboards in environments with increased air flow inside the fume cupboard (turbulence). Due to an extension length of DS-TRD-01 up to 1,750 mm, the sash distance sensor can also be used on fume cupboards with particularly large sash openings.

University of Cologne, Germany

Incoming air flow sensor – control strategy for guaranteeing a specified incoming air flow velocity

As a third possibility for variable control, this method is based on the measurement of the incoming air flow velocity using a small bypass. It is particularly suited for fume cupboards that have both vertical and horizontal sashes. All openings on the fume cupboard are recorded and the incoming air flow velocity (usually 0.5 m/s) set during commissioning is kept constant in a working range between the minimum and maximum volume flow rates. In Europe, these volume flow rate limit values generally arise from the results of the EN 14175 test of the fume cupboard.





Detection of thermal loads without influencing the temperature compensation

As a special feature of this variant, the incoming air flow sensor detects increased thermal loads inside the fume cupboard so that the control system can increase the volume flow rate to safety dissipate the thermal loads. The temperature compensation of this sensor is naturally unaffected by this function.

Design information:
This control strategy is particularly suited for fume cupboards that have vertical and horizontal sliding sashes. This variant results in the lowest assembly and installation costs.

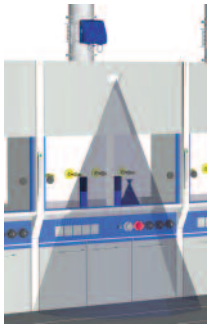
Corning, Fontainebleau, France

Support of additional functions

Execution of diversity control

To maintain the designed total extract air, the diversity function can be activated within the EASYLAB system. This function reliably limits the maximum value of the extract air volume flow rate through targeted reduction at individual fume cupboards and thus guarantees safe working at as many fume cupboards of the laboratory as possible. If a fume cupboard is affected by the reduction, a clear signal of the situation is displayed on its control panel.

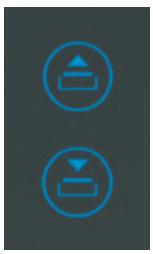
Design information:
The diversity control can be used only in combination with EASYLAB-room controllers or the TROX adapter module.



Signalling of motion detector

Motion detectors can be integrated into the system to save energy. Via optical and acoustic signals, the fume cupboard user is reminded to close the sash in case of when a sash is unnecessarily left open and this exceeds a set time.

Design information:
An appropriate motion detector is included in the TROX portfolio: TROX motion detector type TBS.



Control of sash moving mechanism

A sash moving mechanism can be activated directly using the “Open” and “Closed” buttons on the EASYLAB control panel. For the control of such a mechanisms, the controller provides the necessary switch contacts.

Fume cupboards with supportive flow technology

The necessary functions for the control of fume cupboards with this technology are completely supported by the EASYLAB system.

Release of extract air scrubber

The system monitors the fume cupboard control system and makes sure that an extract air scrubber is switched on only when the required flow rate is achieved.

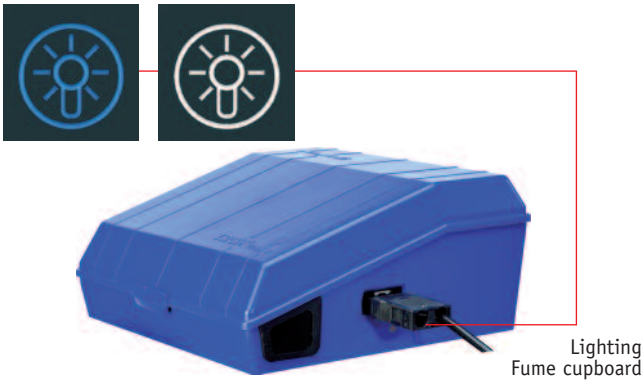
Smoke extract function after fire and smoke detection

With a temperature switch or smoke detector, an additional smoke extract function can be achieved on the fume cupboard. If the temperature in the fume cupboard rises above a critical point then depending on the configuration the flow rate control damper will take up a fully closed or open position. The corresponding alarm will be displayed on the control panel.
The signalling of the alarm to a centralised BMS can also easily be achieved.
Alternatively, a smoke detector can be connected to activate this function.

Design information:
The necessary sensors can be determined in a design meeting.

Fume cupboard lighting

With the EM-LIGHT expansion module, the EASYLAB fume cupboard controller offers the opportunity to control the lighting of the inside of a fume cupboard using the control panel. For this purpose, the lamp cables can be inserted in a socket directly on the controller, through which they then obtain a switched supply voltage.



Lighting
Fume cupboard

Design information:
The fume cupboard lighting with the EM-LIGHT expansion module is normally controlled in combination with the EASYLABEM-TRF or EM-TRF-USV mains supply expansion module.

Integration of variable volume flow rates

Volume flow controllers with an analogue actual value output (0–10 V DC) such as hoods and local point suction units can be signaled to the fume cupboard controller. According to the configuration, the signals are interpreted as extract or supply air and thus included in the determination of either the total extract air volume flow rate or the total supply air volume flow rate.

Design information:

- *Up to four analogue inputs are available on every fume cupboard*
- *Additional signalling is possible on a TROX adapter module (TAM) or the room controllers*

Integration of fixed volume flow rates

Fixed volume flow rate values can be signaled to the fume cupboard controller using the switch inputs. According to the configuration, these values are interpreted as extract or supply air and thus included in the determination of either the total extract air volume flow rate or the total supply air volume flow rate when the switch is activated.

Design information:

- *According to the number of special functions used, up to five switched inputs are available on every fume cupboard controller.*
- *Additional signalling is possible on a TROX adapter module (TAM) or the room controllers*

Available input and output signals on the fume cupboard controller

Input signals	Analogue input	Digital input	LonWorks® expansion EM-LON
Integration of variable extract or supply air	•		
Integration of constant extract or supply air (switchable)		•	
Special functions: prompt for extract air scrubber, feedback of supportive flow technology function, smoke extract, motion detector		•	
Operating mode default setting (only for individual operating mode presettings)		•	•

Output signals	Analogue output	Digital output	LonWorks® expansion EM-LON
Actual volume flow rate of the fume cupboard	•		•
Total extract or total supply air volume flow rate	•		•
Incoming air flow velocity / Sash position			•
Alarm signalling		•	•
Damper blade position	•		•
Currently executed operation mode			•
Special functions: release of extract air scrubber, control of supportive flow technology function, control of automatic sash moving mechanism, fume cupboard lighting		•	•

Fume cupboard control panels according to EN 14175
Besides the aerodynamic function, further important issues of overall control system design are, user operation, monitoring alarms (optical and acoustic) or the possible configuration of the different control strategies. For the function display according to EN 14175 and the operation of the fume cupboard control system, the EASYLAB system has two different control panels available that can adapt to the current situation.

Acoustic alarm off

Sash monitoring according to EN 14175

High mode

Low mode

Shut off mode

Open sash

Close sash

Fume cupboard lighting

Manual mode

The operating state display has three colours and is supplemented by the display texts “HIGH” and “LOW.” A monitoring display of the permissible maximum sash opening according to EN 14175 is also available.

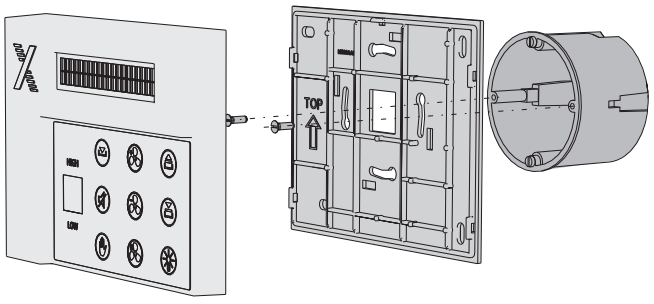
Clearly emphasised display field in green/yellow/red for the operating state display (2.5 cm²). Alarm display alternatively flashing.

For the laboratory furniture manufacturer, included are operation of the fume cupboard internal lighting, the actuation of the sash moving mechanism and a service interval display.
Functions that are not currently available, because they were temporarily limited , centrally blocked, or, for example, not required for the specific project, are not displayed. Through this adaptive concept, changes to the display system or replacement of the complete control panel in case of later changes in use are a thing of the past.

Time duration activation such as the temporary use of the increased operation on fume cupboards or manual mode (override of central operating mode default settings) simplify the saving of energy. Via the integrated service socket, the control panels enable a convenient access for the commissioning and maintenance of the EASYLAB controllers. Status messages can be displayed on the control panels. Depending on the model, a 40-character display with plain text in various languages or an easily legible 2-character display is used.

The advantages for the user:

- Display of the current operating mode
- Display of status messages
- Display of current incoming air flow velocity
- Plain text display of current volume flow rates (only BE-LCD-01)
- Either one or two control panels can be connected.



Further details for the precise scope of functions and technical data can be found in the technical leaflets on the control panels.

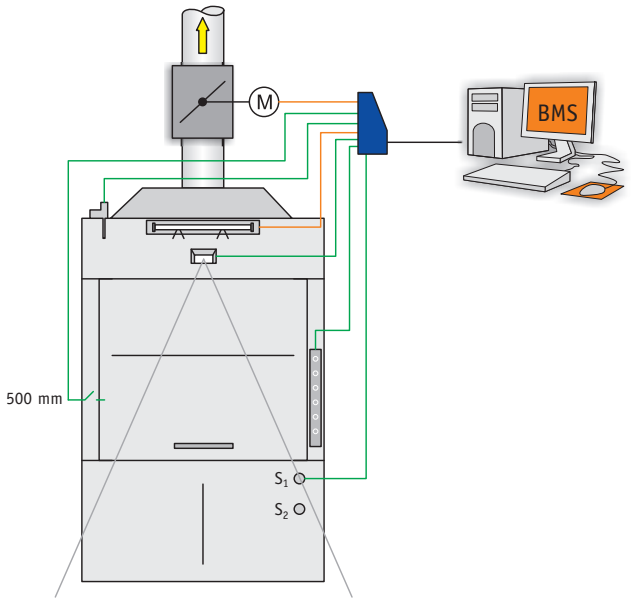
Application example 1:

Individual fume cupboard controller as stand-alone solution

Area of application:

- A fume cupboard controller can be used autonomously.
- All variants of fume cupboard control are possible.
- The operating modes and special functions of the fume cupboard control system can be influenced by the control panel or digital switching inputs.
- The integration of external volume flow rates of the suction units and hoods is possible by means of signals.

Supplementary to that, the EM-LON expansion module can be used with LonWorks® for the individual operating mode default setting or for polling actual values through a centralised BMS.



Order code examples:

Variant 1:
TVLK - FL / 250 -100 / GK / ELAB / FH-VS / TZS / $\dot{V}_{min}$ – $\dot{V}_{max}$
EASYLAB fume cupboard controller TVLK and incoming air flow sensor with the following equipment:
differential pressure measuring device, flange, matching flange, 230 V AC mains supply, solenoid valve, connection for fume cupboard lighting

Variant 2:
TVLK / 250-D10 / ELAB / FH-DS / L / $\dot{V}_{min}$ – $\dot{V}_{max}$
EASYLAB fume cupboard controller TVLK and sash distance sensor with the following equipment:
venturi nozzle, supply voltage 24 V AC, EM-LON expansion module

Note:
Explanation of the order codes see p. 68.

ALTANA BYK-Chemie, Wesel, Germany

Application example 2:

Several fume cupboard controllers with TROX adapter module (TAM) as the central transfer station

Area of application:

Provision of the fume cupboard controller by the laboratory furniture manufacturer

- Central transfer station, e.g. for the centralised BMS or for the integration of the supply air and/or extract air controller
- All variants of fume cupboard control are possible.
- The operating modes and special functions of the fume cupboard control system can be made using the control panel on the fume cupboard.
- Room operating modes can be signaled on the TROX adapter module (TAM).
- The integration of external volume flow rates of the suction units and hoods is possible by means of signals.

System setup:

All fume cupboard controllers are connected with each other via the pluggable communication cable. In addition, a TROX adapter modul (TAM) can be integrated at any point. This module administers the volume flow rate information of all connected controllers and can transmit the total volume flow rates, e.g. via analogue signals or LonWorks®, to the connected room controller or centralised BMS. Up to 23 fume cupboard controllers can be connected to a TAM. An additional signalling of volume flow rate values through 0–10 V signals or switch contacts is possible on the fume cupboards or supply air controller.

Advantages due to the room management function (RMF) on the TROX adapter module (TAM):

If the room management function is activated on the TROX adapter module, the centralised signalling of an operating mode default setting through a room control panel is possible. All controllers connected through the communication cable follow this central default setting unless it has been set in the controller that this room default setting should not be taken into consideration. This can be important if individual fume cupboards are used for 24-hour operation.

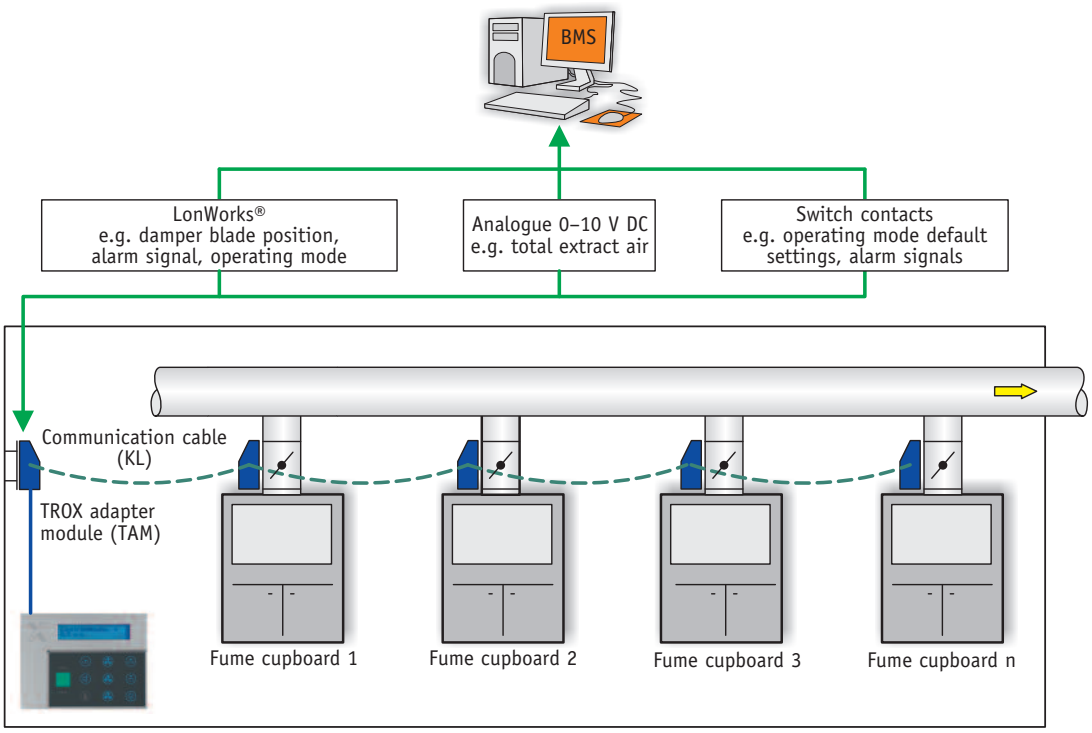
Additional possibilities through the RMF:

- Volume flow rate balancing
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Integration into the centralised BMS:

For integration through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On a fume cupboard controller
  → Local data interface for a fume cupboard
- On the TROX adapter module (TAM)
  → Central data interface for the room
  Operating mode default settings, current volume flow rate values, and consolidated alarm signals can be exchanged through the network. This reduces the required data points and thus the costs. The TAM thus becomes the main communication interface in the laboratory.



Fume cupboard control · application examples

Order code examples:

Fume cupboard controller:
TVLK / 250-100 / ELAB / FH-VS / Z / $\dot{V}_{min}$ – $\dot{V}_{max}$
TVLK fume cupboard controller and incoming air flow sensor with the following equipment:
differential pressure measuring device, solenoid valve,
supply voltage 24 V AC

TROX adapter module:
TAM / TL / LAB-RMF
TROX adapter module with the following equipment:
Expansions: supply voltage 230 V AC, EM-LON,
room management function for laboratories

Note:
Explanation of the order codes see p. 68.

Design information:
The total solution is only provided by EASYLAB controllers which offer the following options:

- *Easy integration of the room controllers using a standardised communication cable*
- *Automatic volume flow rate distribution across all supply air and extract air controllers*
- *Monitoring of the total extract air volume defined during design and correction option through selective diversity control*

Sanofi-Aventis, Frankfurt, Germany

For the control of the volume flow rates inside a room, the EASYLAB TCU3 controllers can be used with all TROX air terminal units types TVR · TVRK · TVZ · TVA · TVJ · TVT. In addition to the construction with galvanised sheet steel, powder-coated variants made of stainless steel or plastic (PP) are also available. All controllers required for a room (max. 24) are connected to each other via the communication cable (KL).

Advantages due to the use of the EASYLAB room controller

- Easy coupling of the room controllers using a standardised communication cable
- Room balance on air transfer
- Automatic volume flow rate distribution across all supply air and extract air controllers
- Diversity control
- Extract air balance optimisation
- Maintaining of the minimum air discharge velocity on air terminal units
- Critical control systems are safe using an uninterruptible power supply (UPS).

New:
If more than one supply or extract air controller is used in a room, the volume flow rate distribution takes place automatically.

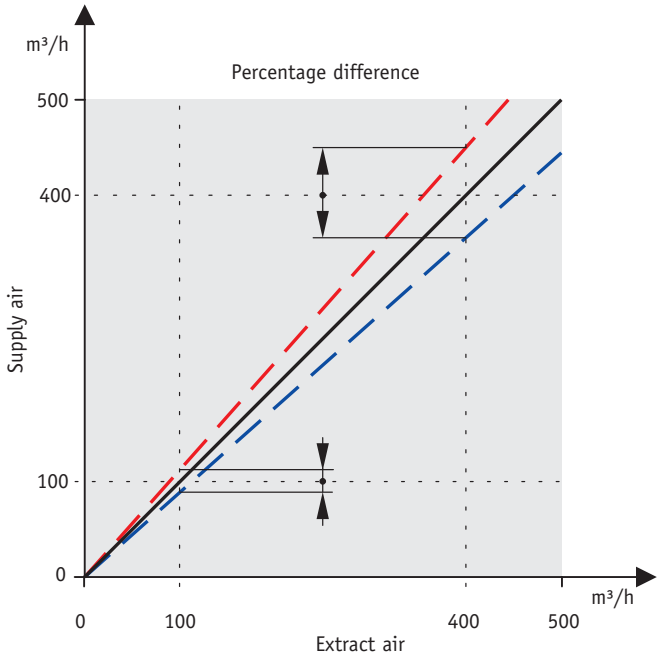
Room balance control

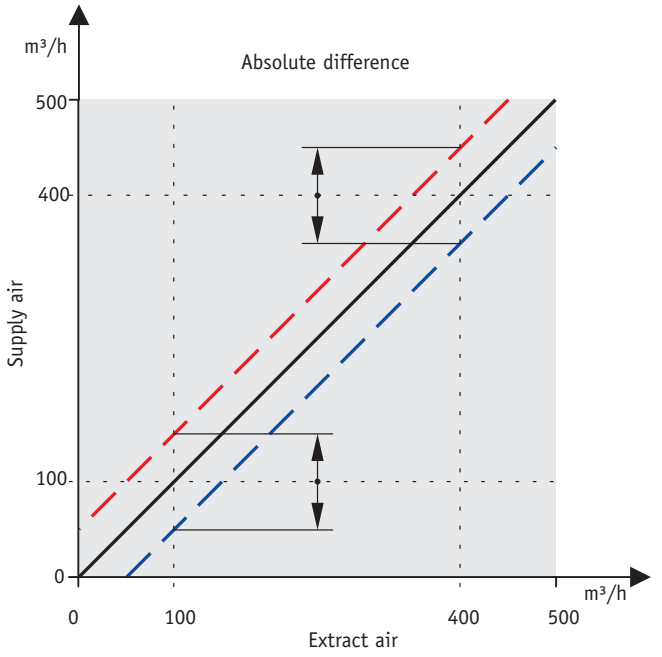
In the case of the room balance control, the correction of a master-slave relationship is important.
In the process, the extract air consumers (fume cupboards, room extract air, hoods, or point suction units) usually determine the required supply air. The supply air controllers summate the individual extract air consumers to obtain a total extract air and tracks this total extract air with an absolute difference. This strategy guarantees the underpressure required according to DIN 1946, Part 7.

In special cases such as clean rooms, this relationship can be exactly reversed, which means that, in these cases, the air change rate is determined by the supply air and the extract air tracks the supply air as a slave. Both basic principles are supported.

An absolute difference is preferable to a percentage difference since, in the case of a percentage difference, different underpressure conditions are bound to occur depending on the amount of total extract air.

On the basis of this fact, the percentage difference is not supported in the case of the TROX room control systems.





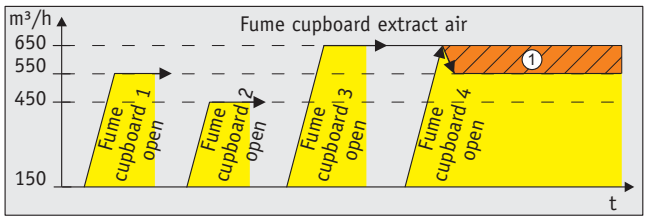
Only an absolute difference between the supply air and extract air guarantees stable underpressure conditions.

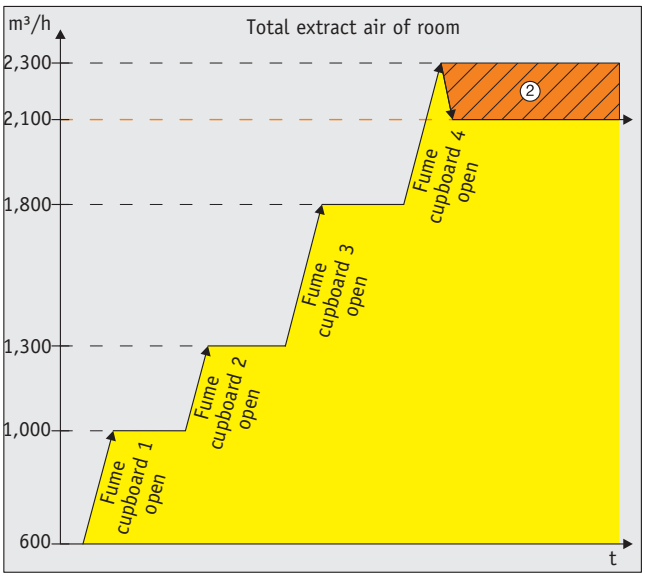
Additional functions of the room control system

Diversity control

In large laboratory buildings, room control systems pose an additional task:
For reasons of investment cost optimisation, central systems are often not designed for 100% capacity. This has the positive side effect that the energy costs and spatial requirement for these systems reduces.
Another result of this design is that the tenants of the laboratories may open only the fume cupboards that are currently in use. If all extract air consumers are loaded up to 100%, the areas that are more unfavourably connected to the duct system may suffer from a lack of air.
To counteract these effects, the EASYLAB system offers two functions:

1. The maximum extract air value defined for the individual room is monitored and signaled in a centralised manner. In the process, an optical and, if desired, acoustic alarm is emitted through the room control panel.
2. A more elegant possibility is the diversity control introduced by TROX. It actively intervenes in the room control process and thus guarantees the limitation of the extract air to the defined maximum value.





In the process, the improved variant of the selective diversity control guarantees that as many fume cupboards as possible can be used to capacity at the same time.
At the fume cupboards on which this control results in a limitation, a clear display and alarm are emitted. It is thus guaranteed that safety is maintained.

Extract air balance optimisation

For room balance, it is often required that the room extract air drops down to complete shut-off when extract air consumers are switched on. In the process, however, it is important that no unstable conditions occur in the room. The activation of extract air balance optimisation integrated into the EASYLAB system takes this problem into consideration and guarantees that all controllers remain within their control ranges.

Consideration of the minimum air discharge velocity on air terminal devices

As a supplier of all kinds of ventilation components, TROX knows that the minimum air discharge velocity on diffusers must be achieved to ensure comfort in all the operating conditions of a variable flow rate control system.
The EASYLAB system takes the type of diffuser into consideration and provides the necessary signals for guaranteeing the minimum air discharge velocity.

Monitoring functions of the room control system

The functions of the room control system are permanently monitored by the EASYLAB control system. In the process, the optional room control panel provides information on the current status.
The results of this functionality can also be forwarded to the centralised BMS as alarm signals.

The following values can be monitored:

- Undershooting of the minimum extract air volume flow rate
- Exceeding of the design total extract air volume flow rate
- Diversity control active
- Consolidated alarm signals of all system participants
- Hardware fault
- Configuration fault

① Flow rate reduction at fume cupboards 3 and 4 due to diversity control

② A flow rate reduction to the set maximum value of the total extract air is achieved

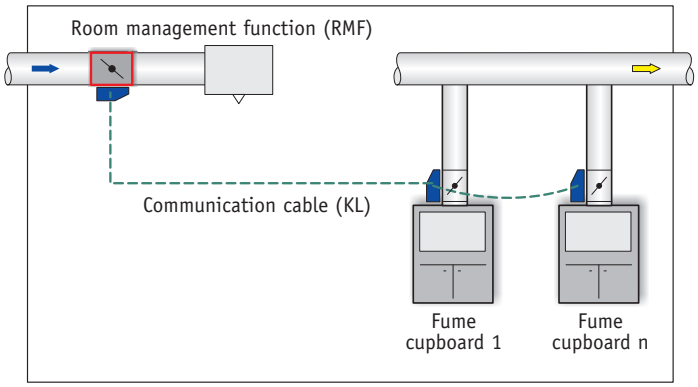
Example 1:
Fume cupboard controller with a supply air controller

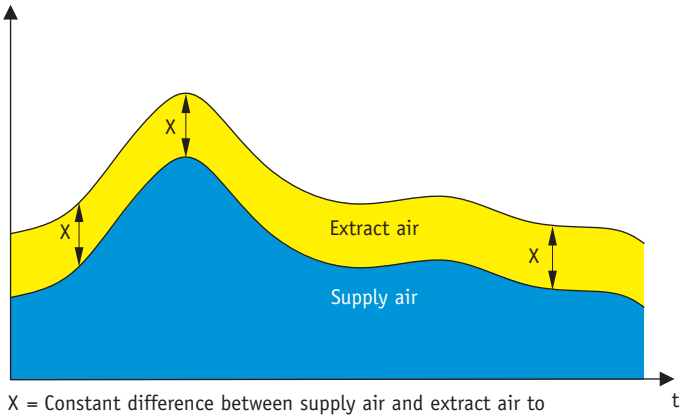
Area of application:

- Laboratory with several fume cupboards
- The design minimum total extract air is already guaranteed by the extract air volume flow rates of the fume cupboards in all operating conditions. For this reason, no additional extract air controller is necessary.
- A supply air controller supplements the supply air volume flow rate required for the operating situation.
- The integration of external volume flow rates of the suction units and hoods is possible by transmission of signals to the controller.

System setup:

All fume cupboard controllers are connected with each other via the pluggable communication cable.
The EASYLAB supply air controller is inserted into any point using the communication cable. The room management function (RMF) is activated on this controller. An additional signalling of volume flow rate values through 0–10 V signals or switch contacts is possible on the fume cupboards or supply air controller. A total of 24 controllers can be connected in series, that is, for example, up to 23 fume cupboard controllers can be combined with one supply air controller.





X = Constant difference between supply air and extract air to ensure that the required transfer flow is achieved

Room management function (RMF) on the supply air controller:

- Connection possibility for the room control panel
- Operating mode default setting for all controllers in the room (exclusion of individual controllers possible)
- Monitoring of room parameters (undershooting of the minimum total extract air/exceeding of total extract air)
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Integration into the centralised BMS:

For integration to the centralised BMS through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On a fume cupboard controller
  → Local data interface for a fume cupboard
- On the supply air controller
  → Central data interface for the room

Order code examples:

EASYLAB fume cupboard controller:
TVLK / 250 -100 / ELAB / FH-VS / Z / $\dot{V}_{min}$ – $\dot{V}_{max}$
TVLK fume cupboard controller and incoming air flow sensor with the following equipment:
differential pressure measuring device, supply voltage 24 V AC, solenoid valve for automatic zero balance

EASYLAB supply air controller type TVR:
TVR / 250 / ELAB / RS / Z / LAB-RMF /$\Delta\dot{V}$ – $\dot{V}_{constant}$
TVR supply air controller with the following equipment:
Supply voltage 24 V AC, solenoid valve for automatic zero balance, room management function for laboratories

Note:
The room management function may only be provided on a single room controller.
Explanation of the order codes see p. 68.

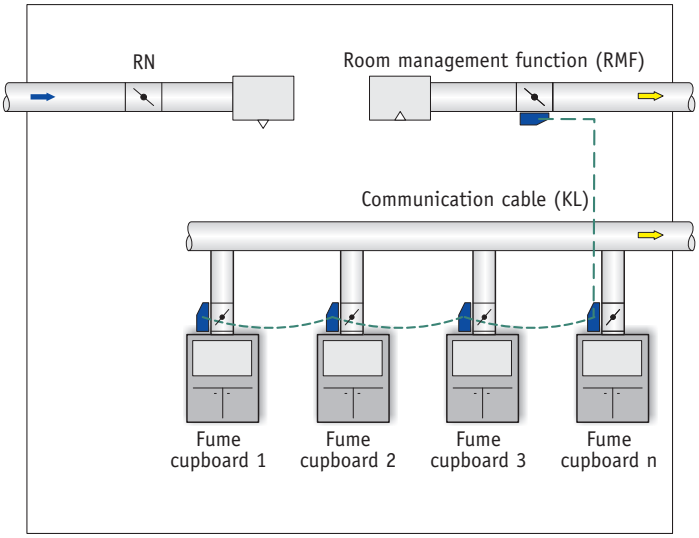
Example 2:
Fume cupboard controller with an extract air controller

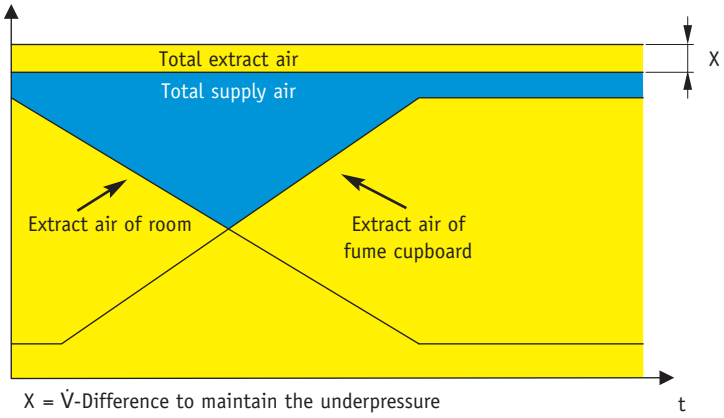
Area of application:

- Laboratory with several fume cupboards
- The design minimum total extract air cannot be completely guaranteed by the extract air volume flow rates of the fume cupboards. For this reason, an additional extract air controller is necessary. Depending on the operating situation on the fume cupboards, the extract air controller increases or reduces the extract air volume flow rate.
- The supply air is regulated by a constant flow rate controller (e.g. RN controller).
- The integration of external volume flow rates of the suction units and hoods is possible by transmission of signals to the controller.

System setup:

All fume cupboard controllers are connected with each other via the pluggable communication cable. The EASYLAB extract air controller is inserted into any point using the communication cable. The room management function (RMF) is activated on this controller, thus guaranteeing the minimum total extract air defined at the design stage.
An additional transmission of volume flow rate values through 0–10 V signals or switch contacts is possible on the fume cupboards or extract air controller. A total of 24 controllers can be connected in series, that is, for example, up to 23 fume cupboard controllers can be combined with one extract air controller.





X = V̇-Difference to maintain the underpressure

Room management function (RMF) on the extract air controller:

- Connection possibility for the room control panel
- Operating mode default setting for all controllers in the room (exclusion of individual controllers possible)
- Monitoring of room parameters (undershooting of the minimum total extract air/exceeding of total extract air)
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Integration into the centralised BMS:

For integration to the centralised BMS through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On a fume cupboard controller
  →Local data interface for a fume cupboard
- On the extract air controller
  →Central data interface for the room

Order code examples:

EASYLAB fume cupboard controller:
TVLK / 250–D10 / ELAB / FH-VS / Z / $\dot{V}_{min}$ – $\dot{V}_{max}$
TVLK fume cupboard controller and incoming air flow sensor with the following equipment:
venturi nozzle, supply voltage 24 V AC, solenoid valve for automatic zero balance

EASYLAB extract air controller type TVR:
TVR / 160 / ELAB / RE / Z / LAB-RMF / $\dot{V}_{day}$ – $\dot{V}_{night}$ – $\dot{V}_{constant}$
TVR extract air controller with the following equipment:
Supply voltage 24 V AC, solenoid valve for automatic zero balance, room management function for laboratories

Note:
The room management function may only be provided on a single room controller.
Explanation of the order codes see p. 68.

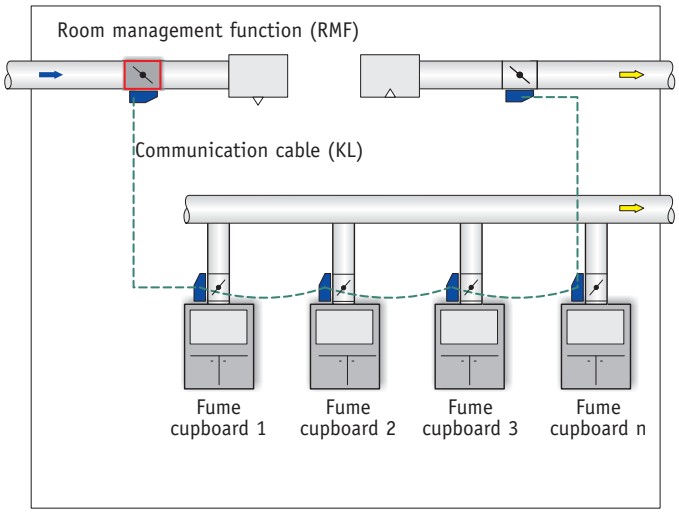
Example 3:
Fume cupboard controller with supply air and extract air controller

Area of application:

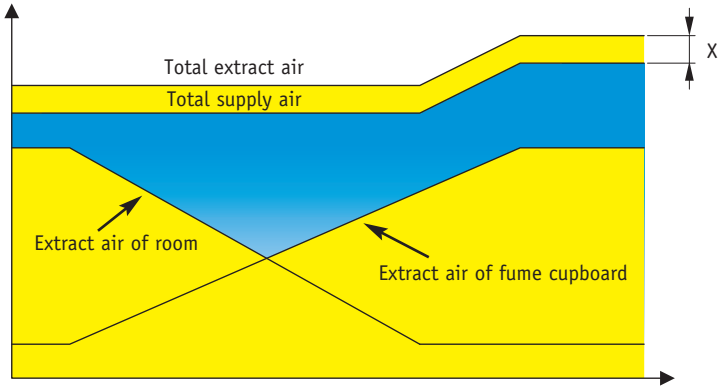
- Laboratory with several fume cupboards
- The design minimum total extract air cannot be completely guaranteed by the extract air volume flow rates of the fume cupboards. For this reason, an additional extract air controller is necessary. Depending on the operating situation on the fume cupboards, the extract air controller increases or reduces the extract air volume flow rate.
- The supply air is regulated by an EASYLAB volume flow controller.
- The integration of external volume flow rates of the suction units and hoods is possible by transmission of signals to the controller.

System setup:

All fume cupboard controllers are connected with each other via the pluggable communication cable. The EASYLAB supply air and extract air controllers are inserted into any point using the communication cable. The room management function must be activated on one of the two room controllers.
An additional transmission of volume flow rate values through 0–10 V signals or switch contacts is possible on all controllers. A total of 24 controllers can be connected in series, that is, for example, up to 22 fume cupboard controllers can be combined with one supply air controller and one extract air controller.



Order code examples:
EASYLAB fume cupboard controller:
TVLK / 250-100 / ELAB / FH-VS / Z / $\dot{V}_{min}$ – $\dot{V}_{max}$
TVLK fume cupboard controller and incoming air flow sensor with the following equipment:
differential pressure measuring device, 24 V AC supply, solenoid valve for automatic zero balance



X = $\dot{V}$-Difference controlled via supply air for maintaining the underpressure

Room management function (RMF) on the supply or extract air controller:

- Connection possibility for the room control panel
- Operating mode default setting for all controllers in the room (exclusion of individual controllers possible)
- Monitoring of room parameters (undershooting of the minimum total extract air/exceeding of total extract air)
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Integration into the centralised BMS:

For integration to the centralised BMS through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On a fume cupboard controller
  →Local data interface for a fume cupboard
- On the room controller with activated RMF
  →Central data interface for the room

EASYLAB extract air controller type TVR:
TVR / 160 / ELAB / RE / Z / LAB
TVR extract air controller with the following equipment:
24 V AC supply, solenoid valve for automatic zero balance, for laboratories

EASYLAB supply air controller type TVR:
TVR / 250 / ELAB / RS / Z / LAB-RMF / RMF operating values
TVR supply air controller with the following equipment:
24 V AC supply, solenoid valve for automatic zero balance, room management function for laboratories

Note:
The room management function may only be provided on a single room controller.
Explanation of the order codes see p. 68.

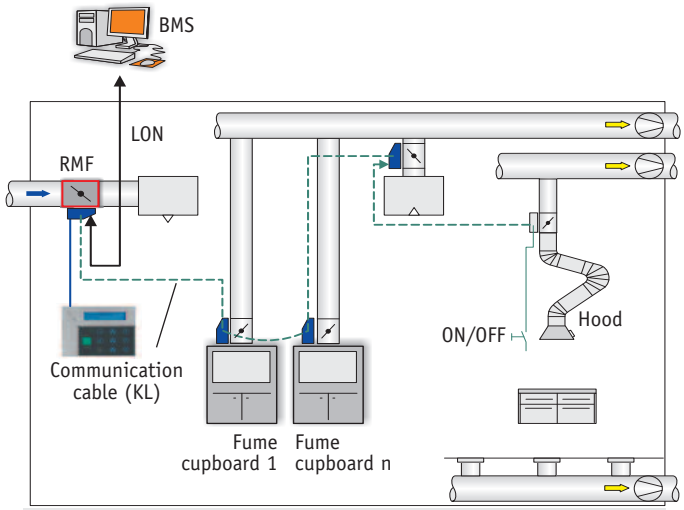
Example 4:
Fume cupboard controller with supply air and extract air controller including RN controllers and hoods

Area of application:

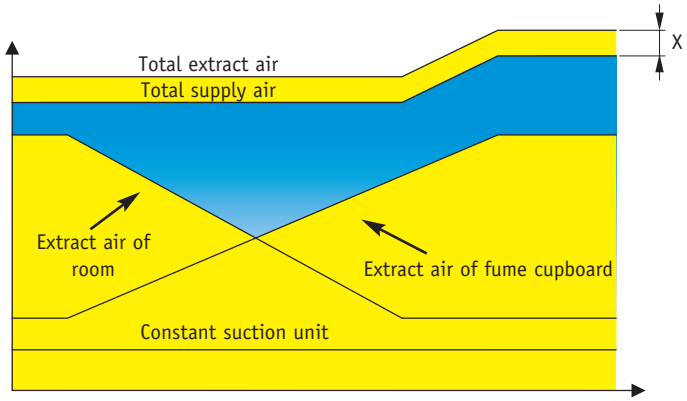
- Laboratory with several fume cupboards
- The design minimum total extract air cannot be completely guaranteed by the extract air volume flow rates of the fume cupboards. For this reason, an additional extract air controller is necessary. Depending on the operating situation on the fume cupboards, the extract air controller increases or reduces the extract air volume flow rate.
- A switchable hood must be included in the balance.
- The supply air is regulated by an EASYLAB volume flow controller.
- The integration of external volume flow rate: for example a constant suction unit

System setup:

All fume cupboard controllers are connected with each other via the pluggable communication cable.
The EASYLAB supply air and extract air controllers are inserted into any point using the communication cable.
The room management function must be activated on one of the two room controllers.
The additional transmission of a volume flow rate value through a 0–10 V signal takes place on any EASYLAB TCU3 controller. A total of 24 controllers can be connected in series, that is, for example, up to 22 fume cupboard controllers can be combined with one supply air controller and one extract air controller.



Order code examples:
Hood of the EASYLAB extract air controller type TVRK:
TVRK / 160 / BB3 / F2- $\dot{V}_{fixed\ value}$
TVRK extract air controller for aggressive media with the following equipment:
supply voltage 24 V AC, static volume flow rate measurement



X = $\dot{V}$-Difference controlled via supply air for maintaining the under-pressure

Room management function (RMF) on the supply or extract air controller:

- Connection possibility for the room control panel
- Operating mode default setting for all controllers in the room (exclusion of individual controllers possible)
- Monitoring of room parameters (undershooting of the minimum total extract air/exceeding of total extract air)
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Integration into the centralised BMS:

For integration to the centralised BMS through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On a fume cupboard controller
  →Local data interface for a fume cupboard
- On the room controller with activated RMF
  →Central data interface for the room

EASYLAB fume cupboard controller:
TVLK / 250 -100 / ELAB / FH-VS / Z / $\dot{V}_{min}$ **–** $\dot{V}_{max}$
TVLK fume cupboard controller and incoming air flow sensor with the following equipment:
differential pressure measuring device, supply voltage 24 V AC, solenoid valve for automatic zero balance

EASYLAB extract air controller type TVR:
TVR / 160 / ELAB / RE / Z / LAB
TVR extract air controller with the following equipment:
supply voltage 24 V AC, solenoid valve for automatic zero balance, for laboratories

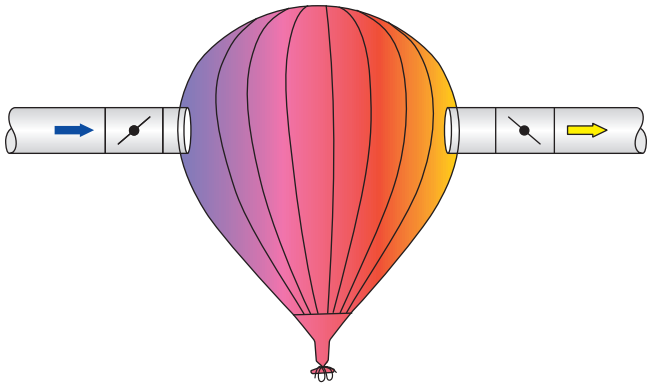
EASYLAB supply air controller type TVR:
TVR / 250 / ELAB / RS / Z / LAB-RMF / RMF operating values
TVR supply air controller with the following equipment:
Supply voltage 24 V AC, solenoid valve for automatic zero balance, room management function for laboratories
Note:
The room management function may only be provided on a single room controller.
Explanation of the order codes see p. 68.

Room pressure control as a cascade

The concept of simple room balance control can be supplemented by pressure control. This is necessary if, on the basis of the regulations, pressure control is required or that too low a room leakage occurs and it is no longer possible to alter the nominal flow rate within required tolerances.

In the process, the control strategy of the room balance control is also pursued further in the pressure control. It is supplemented by the pressure control circuit, which is transmitted as a cascade.

Here, the extensive experience of TROX in the area of electronic pressure control systems in combination with quick response control loops allows the progressive expansion of this basic principle.



The problem of the room pressure control systems is illustrated here:
The balloon corresponds to the room with the pressure control system; the balloon may neither shrink (pressure decreases) nor inflate (pressure increases).
The consequence may otherwise be that the balloon or room collapses or bursts.

Formula for calculating the expected room pressure depends on:

$$\Delta p = \frac{\rho}{2} \times \left(\frac{\dot{V}}{A \times \mu} \right)^2$$

- ρ Air density
- $\dot{V}$ Volume flow rate difference
- A Room leakage area
- μ Discharge coefficient

As you can see in Bernoulli's equation, the room leakage area A is the decisive variable for influencing the room pressure. As the room leakage tends toward zero, significant pressure fluctuations are the physical result, even in case of small volume flow rate differences.

Estimation of the necessary quality for room pressure control systems

For the pressure control, the estimation of the necessary supply air/extract air difference plays a key role.
The smaller this difference is, the more difficult it is to achieve stable control. In this context, it is understandable that, at the same room pressure, some projects work completely without a problem whilst other reach the limits of what is feasible.

To be able to make an estimation, the mathematically converted form of the formula may be helpful:

$$\dot{V}_{diff} = \sqrt{\frac{p_{set}}{\rho/2}} \times A \times \mu \times 3{,}600$$

Whereby:

- $\dot{V}_{diff}$ Volume flow rate difference (supply air – extract air) [m^3/h]
- p_{set} Room pressure setpoint value [Pa, $kg/m*s^2$]
- ρ Air density (20 °C) = 1.2 kg/m^3
- A Room leakage area [m^2]
- μ Discharge coefficient (dependent on geometry), for sharp-edged openings, the following applies: $\mu = 0.72$

As an example for a very airtight room –
Room leakage area A = 0.001 m²:
This corresponds to a gap of about 1 mm under the door or a circular hole with a diameter of about 3.5 cm.

$$\dot{V}_{diff} = \sqrt{\frac{25\ Pa}{0.6}} \times 0.001\ m^2 \times 0.72 \times 3{,}600 \approx 16.7\ m^3/h$$

As an example for an airtight room –
Room leakage area A = 0.015 m²:
This corresponds to a gap of about 15 mm under the door or a circular hole with a diameter of about 14 cm.

$$\dot{V}_{diff} = \sqrt{\frac{25\ Pa}{0.6}} \times 0.015\ m^2 \times 0.72 \times 3{,}600 \approx 251\ m^3/h$$

The abovementioned values are independent of the room size!
From this calculation, it quickly becomes clear that, in the case of the first example, all components of a ventilation system must harmonise perfectly so that this low flow rate difference can be even kept at a stable level at all. Every fluctuation of the central system results in just as many faults as an unfavourable installation location of the controller. In the case of complex rooms with an interaction of many volume flow controllers, the task becomes increasingly complex since each control procedure represents an additional disturbance variable.

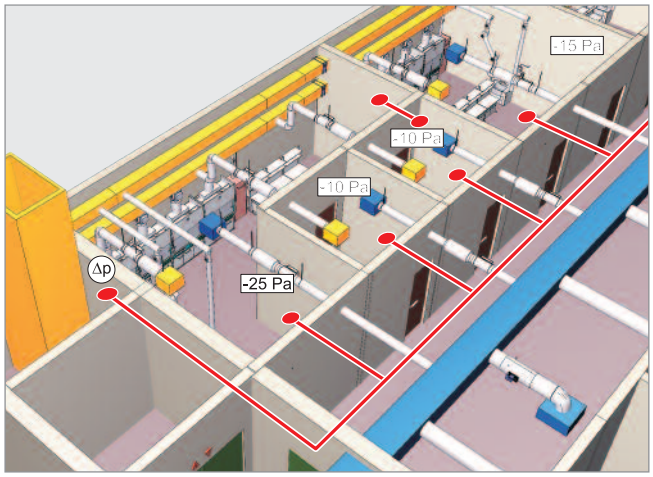
The EASYLAB control system also permits the configuration of the room pressure function in a centralised manner on the controller using the room management function (RMF). This also applies when the active pressure controller is not part of the room management.

Room pressure control with clear function display

Ideally, the room pressure control system is combined with the room control panel BE-LCD-01. In addition to the operating mode, this control panel displays the current room pressure and its pertinent setpoint value and provides an optical and acoustic alarm in case of an unacceptable deviation.

Design information:

- *In any case, the reference pressure should be observed closely. The connected room pressure control system can obtain a satisfactory result only with a stable reference.*
- *TROX recommends the activation of the RMF on the pressure controller.*
- *Especially in the case of room pressure control systems, the installation requirements of the controllers should be complied with.*



The EASYLAB system lets you subsequently realise a defined room pressure control from a volume flow rate control without exchanging the controllers. For this purpose, a room pressure transducer must be added and room pressure control must be enabled in the controller configuration.

Additional room pressure control functions

Switchover between overpressure and underpressure, for example, in hospital areas (septic, aseptic)

In the TCU3 controller, two completely different setpoint value default settings can be stored for the room pressure. The switchover between these values can take place using a switch on the digital input or through the LonWorks® interface.

Door contact

As a supplement to the pressure control, the EASYLAB system offers the opportunity for signalling a door contact.

This offers the following possibilities:

- Optimisation of the control function
- Suppression of the acoustic alarm in case of a pressure deviation for a programmable period of time
- Suppression of the alarm signalling to the centralised BMS for a settable period of time. Due to the use of the door contact, the alarm does not have to be immediately signaled when the door opens. The alarm can then be as an option be signaled when the door stays open too long.

Jägermeister, Wolfenbüttel, Germany

Example:

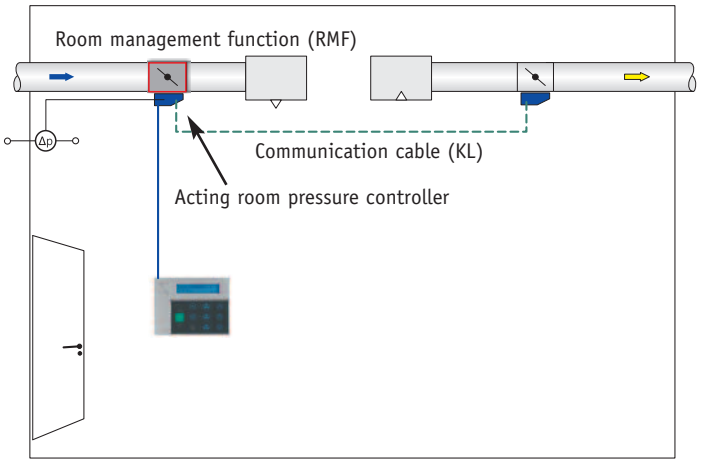
Pressure-controlled room with supply air and extract air controller

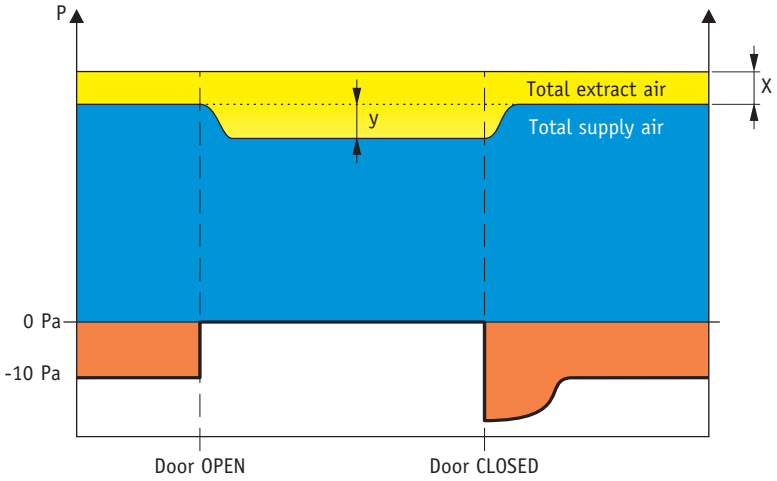
Area of application:

- Rooms that require pressure control for safety-related or structural reasons
- The room can contain fume cupboards and other suction units.
- The extract and supply air should each be controlled using an EASYLAB volume flow controller.
- The air change rate should be influenced by a temperature change.
- Pressure reversal or various pressure levels are possible.
- An integrated pressure monitor is possible in the room with an optical and, as an option, an acoustic alarm.

System setup:

The supply air controller and extract air controller are connected with each other via the pluggable communication cable. The room management function must be activated on one of the two room controllers. The signalling of the temperature change takes place on the controller with RMF.





X = V̇ Difference for maintaining room pressure
y = Limited volume flow rate shift from the pressure cascade

Room management function (RMF) on the supply or extract air controller:

- Connection possibility for the room control panel
- Operating mode default setting for all controllers in the room
- Monitoring of room parameters such as room pressure and volume flow rate
- Room function display via the room control panel
- Collection of the signals into a consolidated alarm

Design information:
In the case of pressure control systems, we recommend the activation of the room management function on the acting pressure controller (a supply air controller for laboratories).

Integration into the centralised BMS:

For integration to the centralised BMS through a LonWorks® network, the EM-LON expansion module can be used as follows:

- On the room controller without activated RMF
  →Local data interface for this controller
- On the room controller with activated RMF
  →Central data interface for the room

Order code examples:

EASYLAB extract air controller type TVR:
TVR / 200 / ELAB / RE / Z / LAB
TVR extract air controller with the following equipment:
24 V AC supply, solenoid valve for automatic zero balance, room management function for laboratories

EASYLAB supply air controller type TVR:
TVR / 200 / ELAB / PC / Z / LAB-RMF / RMF operating values
TVR supply air controller having pressure control function with the following equipment:
24 V AC supply, solenoid valve for automatic zero balance, room management function for laboratories

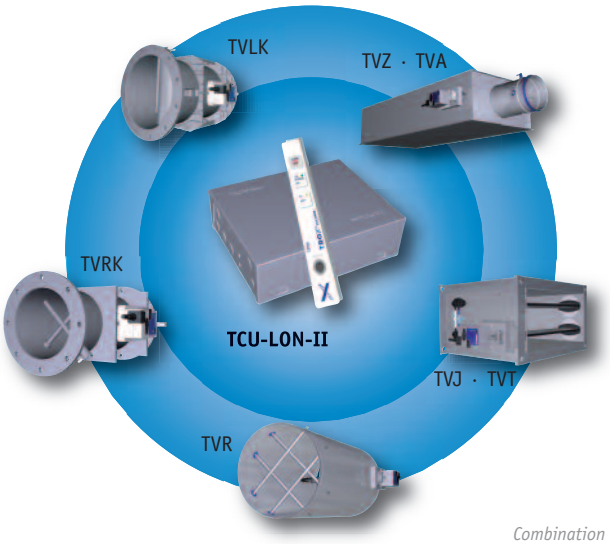
Note:
The room management function may only be provided on a single room controller.
Explanation of the order codes see p. 68.

Max-Planck-Institut, Münster, Germany

TCU-LON-II controller

Areas of application

The TCU-LON-II electronic controller was designed for sophisticated control-engineering tasks in buildings with a LonWorks® infrastructure. It can be combined with the air terminal units types TVLK · TVRK (plastic PP) or types TVR · TVA · TVZ · TVT · TVJ (galvanised sheet steel, and options of powder-coated or stainless steel design).



Combination of the TCU-LON-II controller with air terminal units

TCU-LON-II controllers can be set up individually or as a complete room solution. The following functions are thus available:

- Volume flow control and monitoring for fume cupboards
- Correction of room balances using the supply air/extract air controller
- Room pressure or duct pressure control as cascade control for stable room control
- Volume flow rate change for external pressure or temperature control

The controller is principally designed for use in clean room technology and in hospital and laboratory areas. However comfort-focused control systems used in conventional building services systems for offices or meeting rooms can also benefit from the use of this controller.

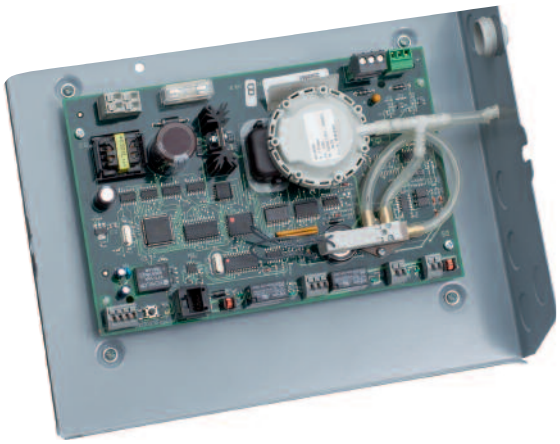
Technical details

For the monitoring of the actual volume flow rate, the differential pressure of the air terminal unit is measured by the TCU-LON-II controller using the diaphragm pressure transducer, this is then used to calculate the actual volume flow rate. For the long-term stability of the measurement, an automatic zero point compensation function via the integrated solenoid valve is included in the standard scope of supply.
Depending on the area of application of the controller, the current system deviation is determined using the actual volume flow rate in comparison with the setpoint volume flow rate and corrected within a maximum of three seconds.

The integrated LonWorks® interface permits a versatile exchange of information with the controller, which amongst other things includes the complete configuration via the network. This possibility is of great importance when being used in hard-to-access areas or for remote access via the Internet/modem.

In addition, two digital inputs and a relay output are available so that alarms or switchable special functions can also be provided in a conventional manner.
The integration of analogue volume flow rate signals (0–10 V DC or 2–10 V DC) from other controllers or extract air consumers can take place via the free analogue input (only on the supply air/extract air controller) or through the TROX LON-WA5/B expansion module.

The TCU-LON-II controllers are provided with project-specific basic parameters. The individual scope of functions makes an integration of the controllers into the on-site network necessary.
This can be performed quickly and easily with any LonWorks® system integrator using the free plug-ins.



Differences in comparison with the EASYLAB system

As the main differentiating feature in comparison with the EASYLAB TCU3 controller, the TCU-LON-II is designed as a consistent LON controller. This means that, in addition to the exchange of system data, the entire configuration of the controller takes place via LON and thus from everywhere on earth – even by telephone or through the Internet.

This control system is thus especially recommended when the controllers are hard to access or on projects where there is a requirement to monitor and configure systems remotely.
For this purpose, convenient software plug-ins, including diagnostic functions, are available. Accessible via their logical network addresses, this type of communication offers the greatest possible flexibility.

A local operating network (LON) is based on decentralised intelligent components that communicate with each other via a network to achieve a planned function together.

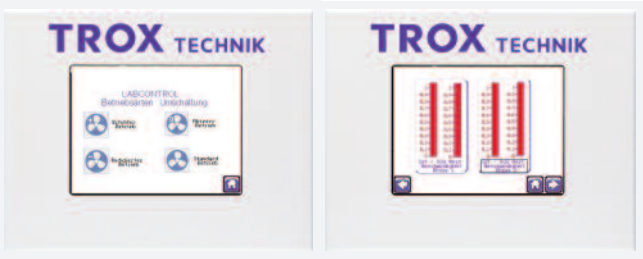
The information exchange between the components takes place through an internationally standardised interface using standard network variables. For this purpose, all components are connected with each other via a twisted pair cable. This reduces installation time and thus minimises costs.

The real exchange of measuring data, operating modes, and alarms between the components connected to the bus takes place in the form of messages. The transmission paths are defined by a system integrator during commissioning using a software tool through the so-called binding.

The control panels based on TCU-LON-II support this technology and, in a room solution, can communicate both with each other and with the components of other manufacturers.
The precise description of the LON interface can be found in the technical leaflets of the software plug-ins.

Advantages of the LonWorks® system

Through the support of the LonWorks® communication interface with standard network variables, this system is open for communication with external devices or with the centralised BMS. The room control panels (with a LonWorks® interface) of various suppliers, for example, can be used. In the process, a very convenient option is the use of touch screens on which not only operating modes can be switched, but also current values or alarms can be displayed. Since these devices are freely programmable, many customer requirements can be provided.

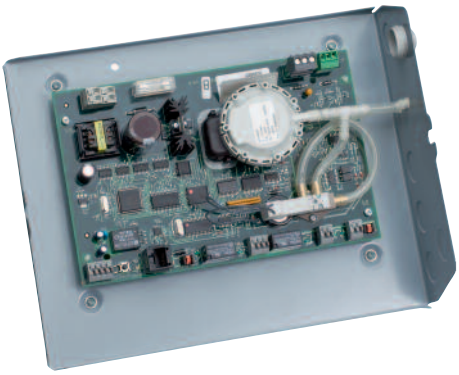


In addition to the system data, which is available in the network and predominantly used by the centralised BMS, the TCU-LON-II also enables complete configuration using LonWorks®.

Clear plug-ins, which are vital for the display of actual values and extensive diagnostic functions, guarantee the complete inspection of the system at all times.

The most important advantages of the LonWorks® technology

- From a central service point, all controllers can be addressed and access is possible to all actual values, setpoint values, and configuration parameters.
- Configuration and diagnostics of the TCU-LON-II controller using software (network management tool and free TROX plug-ins)
- Cross-manufacturer standardisation
- Only standard network variables (SNVT) are used.
- Direct and easy integration of peripheral devices into the system using the LonWorks® interface: centralised BMS, room control panels, motion detectors, I/O modules, etc.
- Based on the source of the fault, alarm signals can be passed on.
- Worldwide access for maintenance and configuration possible – flexible, affordable, and fast (additional devices required)
- Direct signalling of alarms via texting possible (additional devices required)



- **TCU-LON-II controller**

  The basis of the TCU-LON-II system is the TCU-LON-II controller with integrated LonWorks® interface. For the various areas of application (fume cupboard controller, supply air controller, extract air controller, pressure controller), the hardware is equipped with various grades of software and can be combined with the following air terminal units:
  Types TVLK · TVR · TVRK · TVT · TVJ · TVA · TVZ

  - Supply voltage 24 V AC
  - Integral diaphragm pressure transducer with automatic zero balance
  - LonWorks® FT10 interface
  - 2 digital switching inputs for the activation of operating modes and special functions
  - 1 digital switching output (change-over contact) for conventional alarm signalling
  - 1 analogue input 0–10 V with configurable characteristic curve for the summation of volume flow rate values (only for room controllers)

TCU-LON-II control panel

A suitable control panel is available for signalling the monitoring state according to EN 14175.

- Indicator LED for alarms and active operating mode $\dot{V}_{max}$
- Acoustic alarm emitter
- Power failure display
- Buttons for acknowledging the alarm and $\dot{V}_{max}$ activation
- Integrated LON bus service socket
- Integrated LON commissioning button

- **Incoming air flow sensor (VS-TRD)**

  The VS-TRD is used in fume cupboard control for a variable volume flow rate control based on the incoming air flow velocity.

- **LON-WA5/B**
  - Coupling of systems with LON and analogue communication
  - Standard volume flow controller types Gruner, Belimo, Siemens, Sauter, can be directly connected
  - Simple changing of the terminal assignment and operating state switchovers
  - Integration into higher level systems
  - Project-related special solutions

- **LON-WA5/B – TAG**
  - Summation and balancing of volume flow rates
  - Generation of consolidated alarms
  - Integration into higher level systems
  - Project-related special solutions with the existing inputs and outputs

- **Room pressure transducers**
  For room pressure control, room pressure transducers are available upon request for various pressure ranges, even in a certifiable construction.

Network design and commissioning

LonWorks® is based on decentralised intelligent components that communicate with each other via a network to achieve a planned function together.

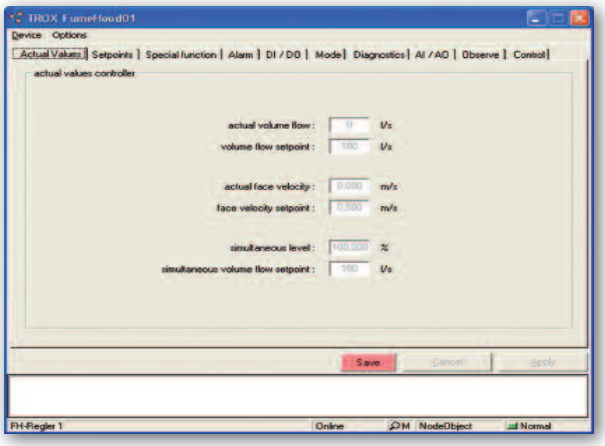
The TCU-LON-II control panels support this technology and, in a room solution, can communicate both with each other and with the components of other manufacturers.

The design and commissioning of a project with LonWorks® components is typically carried out or supported by a system integrator. His or her task is to plan the network and thus define the structure and the required network components (bridges, routers, repeaters).
The information exchange between the individual LonWorks® components takes place through an internationally standardised bus using standard network variables. From an electrical viewpoint, all components are connected with each other via a twisted pair cable. The exchange of measured data, operating modes, and alarms between the components connected to the bus takes place in the form of messages.

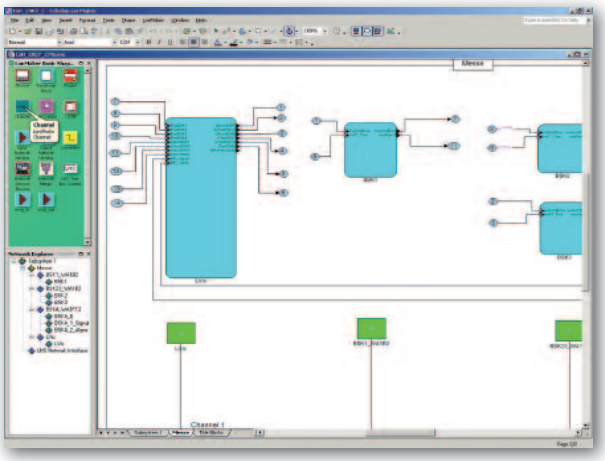
During commissioning, the necessary transmission paths are logically linked to each other by the system integrator using a network management tool (software), such as Echelon LonMaker. The links are called “bindings.” In the process, all components (nodes) in the network receive a clear assignment as to which transmission nodes should send information as measured data, operating data, and alarms to which receiving nodes.

During the commissioning of the LonWorks® network at the construction site, all components are first given their individual network address (domain-subnet-node) and the functional links (bindings) are transferred to the components.
It is thus guaranteed that the necessary exchange of information for fulfilling the overall function of all components through the established network is achieved.

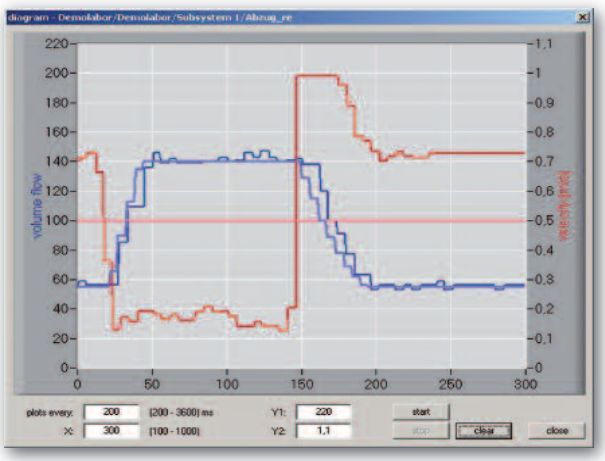
After that, the factory configuration is checked and changed if necessary during the commissioning of the volume flow controllers for fume cupboards or the room control system. The configuration change of the TCU-LON-II controllers is supported by so-called LNS plug-ins. These free TROX LNS plug-ins are integrated into the network management tool as add-ons and provide access to the controllers in this manner. The plug-ins are a dialog-oriented Windows user interface (in English), which allows the current operating values and operating states of the control system to be viewed and configuration changes made. Detailed operating instructions for the plug-ins are available in German and English.



Plug-in example page: fume cupboard control system – current values



The Echelon LonMaker network management tool

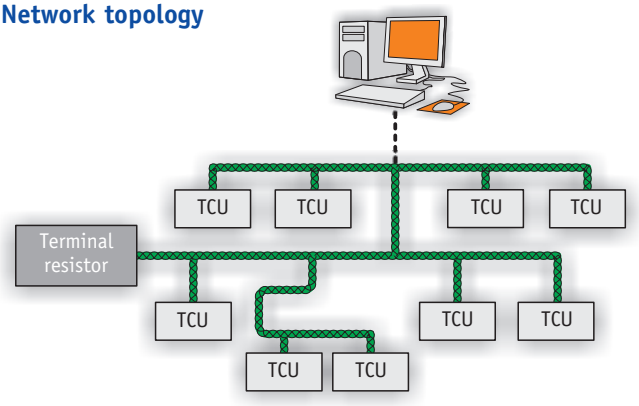


Plug-in example page: control function diagram in real time

Electrical system setup

- Supply voltage with 24 V AC; also with 230 V AC mains supply upon request
- Connection of the controllers in a free topology
- Collection of a maximum of 20 extract air controllers (fume cupboards and room extract air) and the respective supply air controllers in a single network segment (subnet)
- Additional network segments can be supplemented by the use of routers
- Connection of the controllers using network cable type UTB-flex 4PR AWG 26/7 Cat 5; alternatively, other cables types recommended by LonMark can be used, such as JY(St)Y 2x2x0.8
  (here, use only the twisted wire pairs)
- Maximum length for all cables in a network segment: 500 m; longer cable lengths are possible by the use of repeaters
- Line termination within a network segment in free topology is by using a terminal resistor at one end

Network topology



Control panels

- TCU-LON-II fume cupboard controllers can be combined with the TCU-LON-II standard control panel.
- The connecting cables provided for the control panel are pluggable and 4m long.
- 5 m long extension cables are available.

Interfaces

Integration of external volume flow rate values

Also integrated	Existing inputs on controller for	
	fume cupboard	Supply air / Extract air
Variable/constant extract or supply air via LonWorks® data points	–	16
Variable extract or supply air by 0–10 V DC signals	–	1[1]
Constant extract or supply air by switch contacts	–	Up to 2

[1] Not available for room temperature control or room pressure control.

Using the LON-WA5/B and LON-WA5/B – TAG expansion modules, additional variable volume flow rates or switch contacts can be integrated into the LonWorks® network.

Interface to centralised BMS

Possibilities	Fume cupboard	Supply air / Extract air
Alarms sent by potential free switch outputs	1	1
Variable/constant extract or supply air via LonWorks® data points	Up to 2[2]	Up to 2[2]
Variable extract or supply air by 0–10 V DC signals	•	•

[2] Depending on the special functions used, they may also require the existing switching inputs.

In laboratories, the fume cupboard has a special task in the area of personal safety. Here, three safety objectives are particularly important:

1. Retention capability
2. Flushing
3. Spray and flying fragment protection

Whilst the last point is guaranteed purely through the design of the fume cupboard, the ventilation control is of critical importance for the first two points.

Air terminal unit TVLK with TCU-LON-II for fume cupboard control

Strategies for fume cupboard control

There are two types of control strategies: standard operation, often called laboratory operation, and special operating modes.

Standard mode

In the standard operation of the fume cupboard control system, the following control strategies are supported by TCU-LON-II:

- Fixed value control
- Two-point control via switch contact
- Variable volume flow rate relationship via incoming air flow sensor

Special operating modes

For certain operating situations, the following special operating modes can be activated as an alternative to standard operation:

- Increased volume flow, for example, for emergency situations
- Reduced volume flow, for example, for night set back
- Shut-off for system shutdown
- Open position

The special operating modes are activated via switch contacts or the centralised BMS interface. In addition, increased volume flow can also be activated using the control panel on the fume cupboard controller.

Scope of functions of TCU-LON-II as a fume cupboard controller

- *Monitoring and display of functions according to EN 14175*
- *Monitoring of the volume flow rate and/or the incoming air flow velocity*
- *Monitoring of the maximum sash opening*
- *Support of various control strategies:*
  - *Fully variable control using an incoming air flow sensor*
  - *Two-point control via switch contact*
  - *Fixed value control (one-point)*
- *Support of the increased operation, reduced operation, shut-off, and open position special operating modes*
- *Operating mode default setting using the control panel, switch contacts, and LonWorks® network*
- *Prioritisation of centralised BMS and switching contact default settings*
- *Signalling of motion detector*
- *Support of fume cupboards with support flow technology*
- *Consideration of diversity factors*
- *Alarm signalling via LonWorks® network and floating switch contact*
- *Transparent display of all available data points (see the SNVT list)*

Scope of functions of the fume cupboard control panel

The control panel of a TCU-LON-II extract air controller indicates whether the safety of the fume cupboard is guaranteed. The controller monitors the volume flow rate and/or the sash gap air velocity and signals the current state through the control panel. For this purpose, it has indicator lights, an acoustic alarm emitter, and buttons for triggering various functions.

Displays

- Volume flow rate O.K.
- Volume flow rate too low (volume flow rate alarm)
- Maximum opening height of the sash (500 mm)
- Increased volume flow rate ($\dot{V}_{max}$) activated
- Reduced volume flow rate ($\dot{V}_{red}$) activated
- Power failure

Acoustic alarm

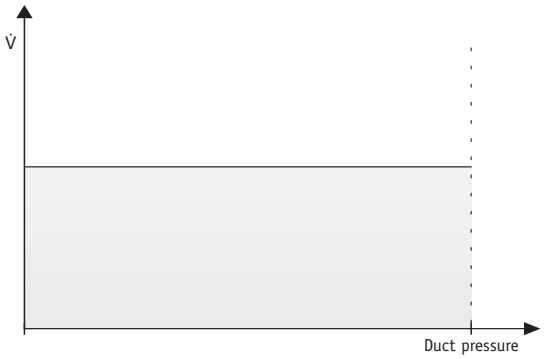
Operator functions

- Acknowledgement of the acoustic alarm
- Activation of the increased volume flow rate ($\dot{V}_{max}$)
- Commission of the LonWorks® network (Neuron ID)
- Access socket of the LonWorks® network

Overview of the control strategies

Standard operation with fixed value control

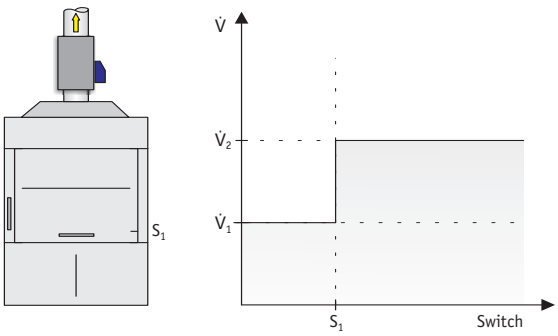
An adjustable volume flow rate is constantly corrected. In the process, the control system reacts to duct pressure fluctuations and corrects for these influences quickly and precisely.



Design information:
Fixed value control results in the highest energy costs.

Standard operation with two-point control

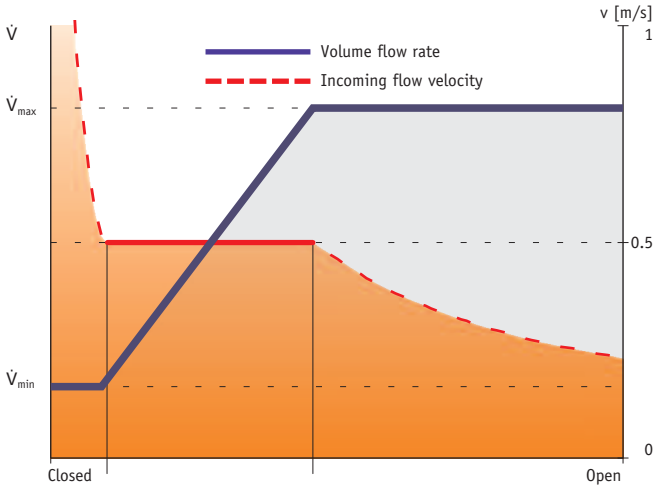
Fume cupboards that should vary the volume flow rate depending on the sash positions can control two different extract air volume flow rates using this control variant. For this purpose, the sash opening is recorded using a switch contact and the result is signaled to the controller for the determination of the volume flow rates. In the case of the two-point control, the lower volume flow rate value ($\dot{V}_1$) is generally used when the fume cupboard is closed, whilst a higher volume flow rate ($\dot{V}_2$) is corrected using the status change on the switch contact when the sash is open.



Design information:
The switch contact for the two-point control is not a part of the scope of supply. On the TCU-LON-II fume cupboard controller, all switches and switch contacts can be connected on site with flip flop switching behaviour. Flip flop switch contacts are closed by a brief pulse and not reopened till the next pulse (e.g. flip flop reed contact).

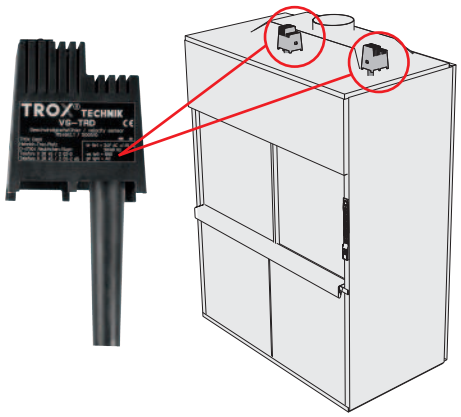
Variable volume flow rate change via incoming air flow sensor

This variable control system is based on the measurement of the incoming air flow velocity using a small bypass. It is particularly suited for fume cupboards that have both vertical and horizontal sash windows. All openings on the fume cupboard are recorded and the incoming air flow velocity (usually 0.5 m/s) set during commissioning is kept constant in a working range between the minimum and maximum volume flow rates. Due to the change of the volume flow rates according to the particular operating situation, this variant has the greatest possible savings potential from a power conservation perspective.

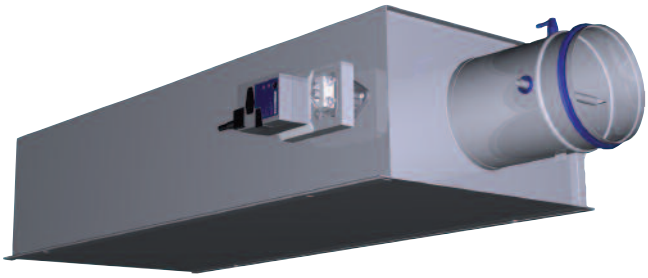


As a special feature of this variant, the incoming air flow sensor detects increased thermal loads inside the fume cupboard so that the control system can increase the volume flow rate to safely dissipate the thermal loads. The temperature compensation of this sensor is naturally unaffected by this function.

Design information:
This control strategy is the most effective from a power conservation perspective and particularly suited for fume cupboards that have vertical and horizontal sash windows.



The TCU-LON-II control panel can be used in connection with variable volume air terminal units types TVZ · TVA · TVJ · TVT · TVRK · TVR to control variable supply air and/or extract air volume flow rates in the room.



Air terminal unit TVZ

The volume flow rate control operates independently of the duct pressure; that is, the pressure fluctuations do not result in volume flow rate changes. In the process, the reaction time of the control system is all the same because the controller hardware and the rapid response actuators have the same reaction time, and the same software algorithms. A stable room balance is thus achieved. Since the air tightness of the rooms is increased more and more due to fire protection measures, this is of critical importance.

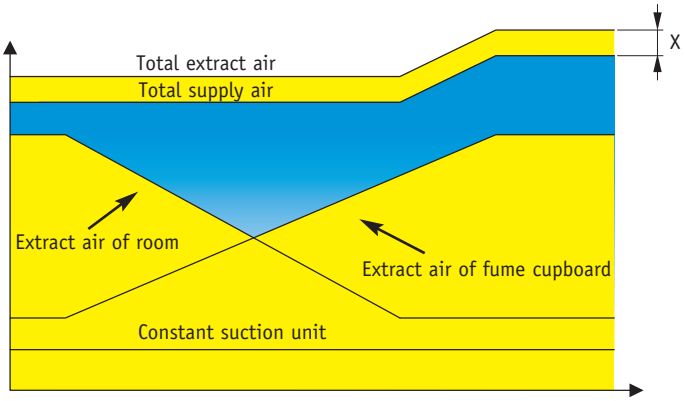
For balancing, the actual volume flow rate values of up to 16 fume cupboards, room controllers, or other extract air consumers are signaled directly to a corresponding room controller through the LonWorks® network. In addition, temperature, room pressure, and other control components, insofar as they are not LonWorks®-compatible, can also be integrated through an analogue input.

The integration of volume flow rate values in an analogue signal form or of additional switch contacts for project-specific special functions can be achieved using the TROX adapter module LON WA5/B.

LonWorks® adapter module LON-WA5/B

Scope of functions of TCU-LON-II as a room controller for supply or extract air

- *Room balance control*
  Maintaining of the minimum total extract air defined in the room balance accounting for the constant and variable extract air consumers in the room
- *Room pressure control*
  Maintaining of the desired room underpressure or overpressure through constant comparison of the actual pressure value measured using the room pressure transducer and the defined setpoint value, as well as the control of the required volume flow rate difference
- *Room temperature control through the volume flow rate change and/or reheating or recooling control*
- *Diversity control (monitoring and limitation of the total extract air)*
- *Operating mode default setting via the LonWorks® network or switch contacts with individual override possibility for individual controllers*
- *Prioritisation of the operating mode default values between the centralised BMS (LonWorks®) and switch contacts*
- *Alarm signalling via LonWorks® network and floating switch contact*
- *Integration of an analogue volume flow rate signal into the room balance (not available in case of room pressure or room temperature control)*



X = V̇-Difference controlled via supply air for maintaining the underpressure

Room balance control

In the case of the room balance control, the correction of a master-slave relationship is very important. In the process, the extract air consumers (fume cupboards, room extract air, hoods, or point suction units) usually determine the required supply air. The supply air controller summates the individual extract air consumers to obtain a total extract air and usually follows this total extract air with an absolute difference. This concept guarantees the pressure conditions required according to DIN 1946, Part 7.

Only an absolute difference between the supply air and extract air guarantees stable underpressure conditions.

An absolute difference is preferable to a percentage difference since, in the case of a percentage difference, different underpressure conditions are bound to occur depending on the amount of total extract air. On the basis of this fact, the percentage difference is not supported by the TROX room control systems.

Room pressure control

A variant of the room balance control is the linkage of the room balance control and room pressure control. In this case, the individual extract air volume flow rates are recorded and sent to the room controller. The necessary room extract or room supply air is then balanced on the room controller. After that, the information on the current room pressure is signaled as a cascade. A deviation from the setpoint pressure value is compensated by a supply air/extract air difference change.

In contrast with a pure room pressure control system, this process takes account of the volume flow rate balance of the room so that this system is stable even in case of opening or closing of the door and no extreme control damper blade positions occur. This philosophy permits a rapid volume flow rate change in case of critical room pressure stability. In contrast with the fixed difference, the air transfer flow when the doors are open can be eliminated without a resulting loss of comfort.

A switchover between overpressure and underpressure can also be achieved using a switch contact.

Additional theoretical background regarding the room pressure control can be found on page 44.

Diversity monitoring and control

For economic reasons, large laboratories are often operated allowing for diversity factors in the volume flow rate balance. In this way, the advantages of the variable volume flow rate control can be fully utilised.

In the case of this method, we assume that only a small number of the fume cupboards are open at the same time. Most of the fume cupboards are assumed to be closed. The advantage of this procedure is that the ductwork and fans can be designed to be smaller. In practice a larger number of fume cupboards can be operated during the renovation of laboratories with limited duct networks or with existing central systems due to diversity control.

Function:
An unacceptable exceedance of the summated extract air is detected by the TCU-LON-II controller and automatically corrected by a reduction of air volume flow rates on the open fume cupboards. Through the alarm on the control panel, these fume cupboards draw the attention of the operator to the exceeding of the diversity factor. In addition, an alarm can be sent through the LonWorks® network when the diversity factor is exceeded and/or a relay output can be forwarded to the centralised BMS.

Design information:
The diversity control can be used only if TROX is providing both the fume cupboard controller and the room controller for the room.
Only then can the fume cupboard controller be provided with the necessary control information for reducing the extract air volume flow rates when the diversity limit is reached.

Type TFM (TROX flow monitor)
Type TPM (TROX pressure monitor)

Area of application
In addition to the complete solutions for controlling and monitoring volume flow rates, there are areas of application that make a pure monitoring of volume flow rates, incoming air flow velocities, and/or room pressures desirable.
In the process, it might make sense to monitor ventilation functions in the case of fume cupboards, suction hoods, or other extract air consumers or sources of supply air.

Here, devices from the TFM/TPM monitoring systems product range can be used. These devices are suited for new build situations or for renovations. They work on the basis of a microprocessor that processes an undeletable program for monitoring the safety functions.
The system data is stored in EEPROM in a failsafe manner.

The type TFM device is used to monitor the volume flow rates of the supply or extract air or incoming air flow velocity and fulfils the requirements of EN 14175-2 for fume cupboards.
The type TMP product enables the monitoring of pressure-controlled areas.

Depending on the application, the control panel provides information on the correct volume flow rate or room pressure. In addition to the optical display, an acoustic signal sounds in case of an alarm. Using a floating change-over contact, an alarm can be sent to the centralised BMS.

The monitoring system can be set up for specific functions during commissioning.

Variants
Three different units are available:

TFM-1:
Volume flow rate monitoring for fume cupboards with integral differential pressure measurement.
Monitoring of the volume flow rate using a measuring probe (part of supply) or volume flow rate measuring device (to be ordered separately) and an internal transducer.
TFM-2:
Monitoring of volume flow rates or incoming air flow velocities for fume cupboards via the analogue input.
Measurement recording through the transmitting of an external signal for the actual volume flow rate value, for example, by using an on-site volume flow controller or an optional incoming air flow sensor.
TPM:
Monitoring of pressure-controlled room.
Measurement recording by the transmission of an external signal for room pressure, for example, by using an on-site room pressure transducer or ring balance.
A room pressure transducer is available as an option.

TFM-1 monitor

Control panels for displaying the monitoring status

The standard TFM-1 or TFM-2 control panel indicates whether the volume flow rate being monitored or incoming air flow velocity is being displayed. This function display is used for the safety of the fume cupboard user and required according to EN 14175. It has three indicator lights (LEDs) that indicate the current operating status. The signals include the following: normal operation (green), an excessive volume flow rate (yellow), a volume flow rate that is too high or the maximum set sash opening has been exceeded (red), and a power failure (red flashing). When the volume flow rate is too low, an additional acoustic alarm sounds.
The buttons are available for acknowledging the acoustic alarm and activating the fume cupboard lighting.

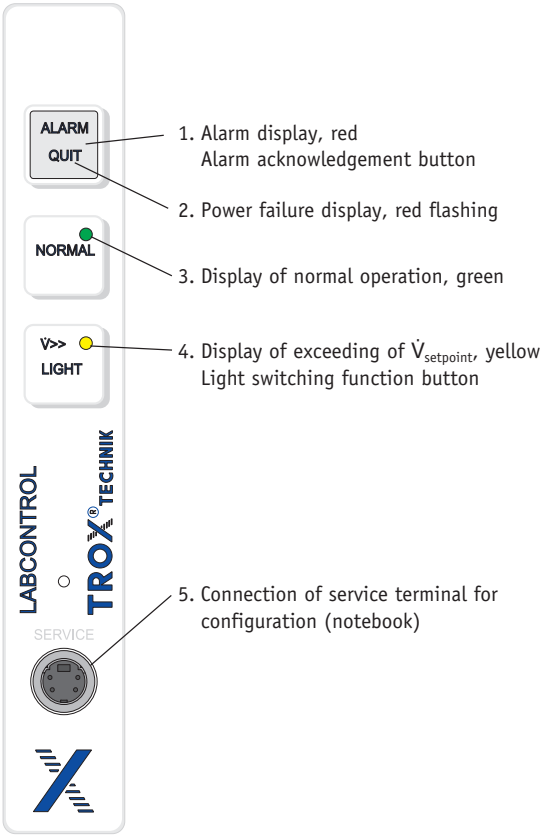
The standard TPM control panel indicates whether the room pressure being monitored is being achieved.
It has three indicator lights (LEDs) that indicate the current operating status. The signals include the following: room pressure within the tolerance range (green), room pressure deviation (yellow), critical room pressure deviation (red), and a power failure red flashing). According to the particular configuration, an additional acoustic alarm sounds. The alarm is shut off using the acknowledgement button.

Expanded control panel Type AF-1

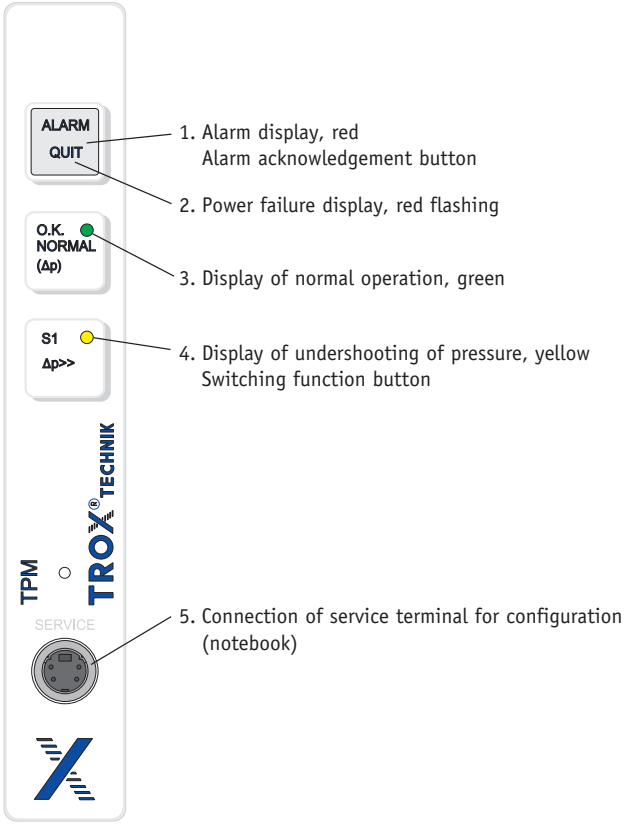
Alternatively, the expanded control panel type AF-1, which supports additional functions, can be connected to the TFM-1/TFM-2:

- Warning display for max. sash opening (500 mm)
- Display for the expiration of the service interval
- Display for the operating mode $\dot{V}_{max}$ and $\dot{V}_{reduced}$
- Control of a sash moving mechanism
- Activation of the operating modes $\dot{V}_{max}$ / $\dot{V}_{reduced}$

Standard control panel of the TFM-1 or TFM-2



Standard control panel of the TPM

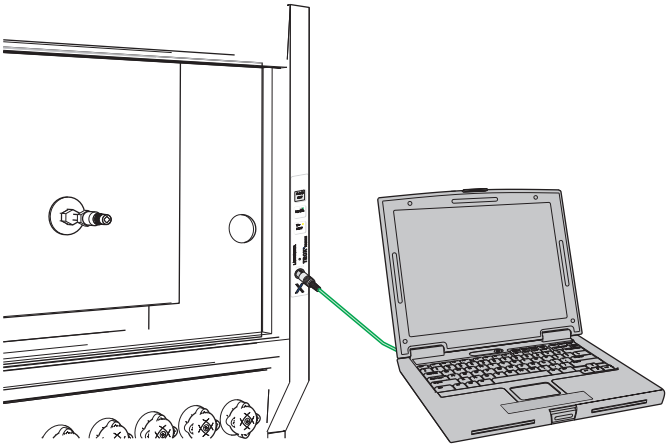


Configuration of the monitoring systems

Computer software TROX-MConnect for TFM/TPM

The TFM/TPM monitoring systems are set up on site to the particular application using the TROX-MConnect computer software.

- Clear, menu-based user interface
- Setting of the monitoring values, types of alarms, and additional functions
- Software for notebooks or desktop computers with Windows operating system
- Connection of the monitoring system to be configured to the desktop computer/notebook using the TROX configuration cable for the MConnect software

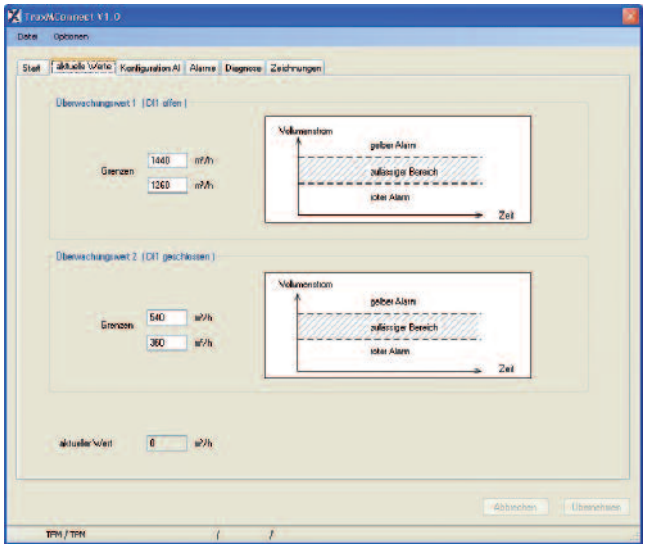


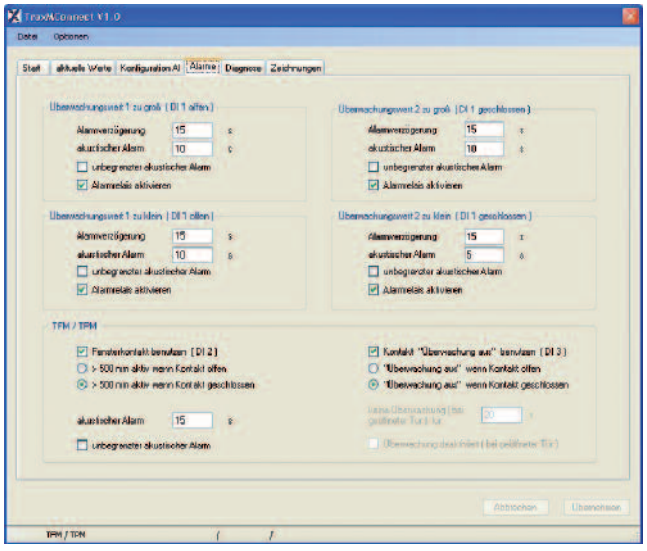
The software can be installed on a conventional desktop computer/notebook with a Microsoft Windows operating system equipped with a serial interface or even a USB/COM converter. The necessary connection between the computer and the control panel of the TFM/TPM monitoring system is established using a special configuration cable that can be obtained from TROX.

All adjustment data can be entered or read clearly and quickly. In the process, the displayed units (l/s or m³/h) can be simply selected and the dialogue language can be switched from German to English.
A setup program simplifies the installation.

In addition to the setting of the device type and the display of the current volume flow rate or room pressure values, the analogue input can be configured, the alarm situation can be determined, and the precise reason for the alarm can be queried quickly and easily using a diagnostics screen. After the selection of the basic type and configuration, a wiring example in which all the details are visible appears.

By means of the loading and saving data records function, databases can be created for documentation or rapid commissioning.





TROX-MConnect configuration software for monitors

TFM-1 device

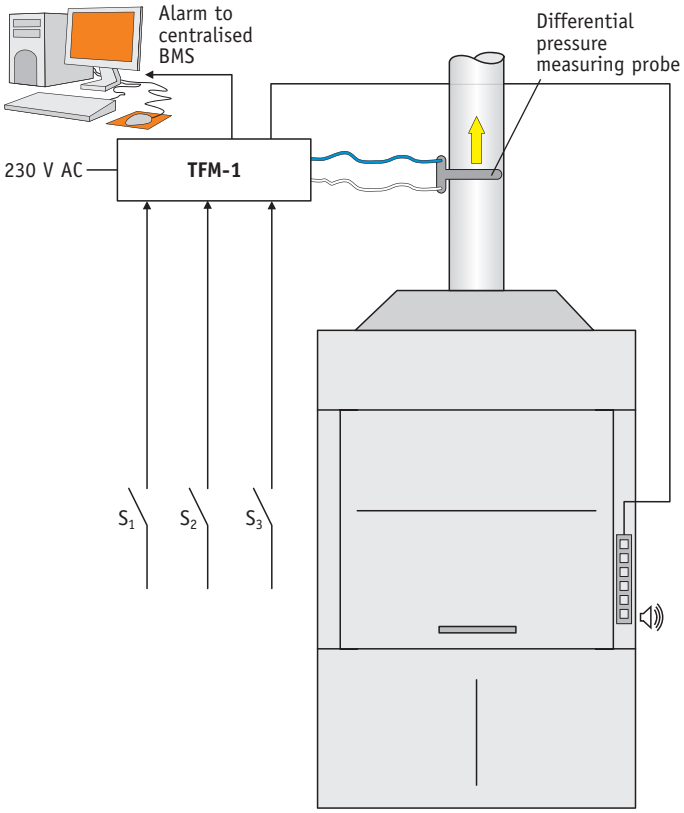
Volume flow monitoring with integral diaphragm pressure transducer

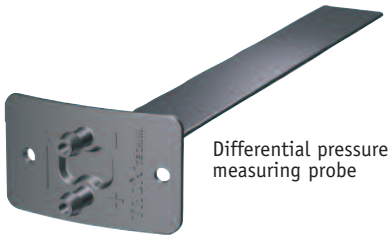
Scope of functions

- Recording of the pressure to be monitored using the measuring probe and the diaphragm pressure transducer (differential pressure monitoring) provided which is integrated into TFM-1
- Alternatively possible:
  Measured value recording using the volume flow rate measuring device, e.g. VMLK (not included in the scope of supply) and the diaphragm pressure transducer integrated into TFM. The volume flow rate to be monitored is calculated according to $\dot{V} = C \times \sqrt{\Delta p}$, with C = device constant and Δp = measured differential pressure
- 2 configurable monitoring values
- For both monitoring values the following parameters can be individually selected, both for the exceeding and the undershooting of the values:
  - Alarm delay
  - Duration of the acoustic alarm or suppression
  - Signalling via alarm relay: yes/no
- Deactivation of the monitoring function, e.g. during night operation, alternatively using the NC (normally closed) or NO (normally open) contact
- Display for the failure of the supply voltage through capacitor buffering (Goldcap), standard
- Monitoring of the front slide opening height > 500 mm
  - With optical and, optionally, acoustic alarm
  - Sash contact switching, alternatively via NC or NO contact
- Control of fume cupboard lighting using control panel
- Service interval display with adjustable time period (only with expanded type AF-1 control panel)
- Actuation of a sash moving mechanism (only with expanded type AF-1 control panel)
- Suitable for all types of fume cupboards

Technical data

- Supply voltage 230 V AC
- Integral diaphragm pressure transducer 0–300 Pa for the differential pressure measurement
- 3 switch inputs for the available special functions
- 3 switch outputs for alarm signalling, control of fume cupboard lighting, and special functions





Device configuration

The configuration of the monitor for the monitoring function required is set up on site using the TROX MConnect computer software.

Scope of supply

TFM-1 device
Differential pressure measuring probe
Standard control panel; optionally expanded type AF-1 control panel

Order code

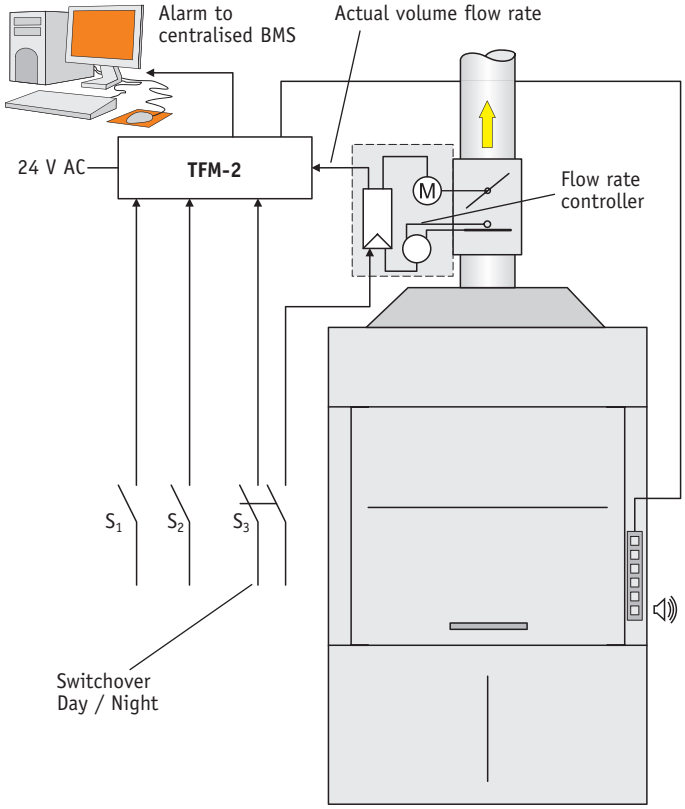
TROX TFM-1

TFM-2-/TPM device

Monitoring of the volume flow rate/incoming air flow velocity using the analogue input with transmission of the measurement signal from an external sensor

Scope of functions of TFM-2

- Monitoring of a volume flow rate value through the on-site volume flow rate measuring point with electrical signal output
  - The voltage signal corresponds to the differential pressure, calculation of the volume flow rate value to be monitored by means of $\dot{V} = C \times \sqrt{\Delta p}$ in TFM-2 with C = device constant and Δp=measured differential pressure
  - The voltage signal directly corresponds to the volume flow rate value to be monitored.
- Alternatively: monitoring of the incoming air flow velocity using an optional incoming air flow sensor with electrical signal output
- Connection possibility for the electrical signal via the analogue output (0–10 V DC) with configurable characteristics
- 2 configurable monitoring values
- For both monitoring values the following parameters can be individually selected, both for the exceeding and the undershooting of the values:
  - Alarm delay
  - Duration of the acoustic alarm or suppression
  - Signalling via alarm relay: yes/no
- Deactivation of the monitoring function, e.g. during night operation, alternatively using the NC (normally closed) or NO (normally open) contact
- Display for the failure of the supply voltage through capacitor buffering (Goldcap), standard
- Monitoring of the front slide opening height > 500mm
  - With optical and, optional, acoustic alarm
  - Sash contact switching, alternatively via NC or NO contact
- Control of fume cupboard lighting using the control panel
- Service interval display with adjustable time period (only with expanded type AF-1 control panel)
- Actuation of a sash moving mechanism (only with expanded type AF-1 control panel)
- Suitable for all types of fume cupboards
- TFM-2 optionally with standard control panel or expanded type AF-1 control panel



Technical data

- Supply voltage 24 V AC
- Analogue input for measuring signal 0–10 V DC with configurable characteristics for simple adaption to external sensors
- 3 switch inputs for the available special functions
- 3 switch outputs for alarm signalling, control of fume cupboard lighting (TMF-2), and special functions

Device configuration

The configuration of the monitor for the monitoring function required is set up on site using the TROX MConnect computer software.

Scope of supply

TFM-2/TPM device
Standard control panel with front faces for TFM-2 and TPM,
optionally expanded type AF-1 control panel (only for TFM-2)

Order code

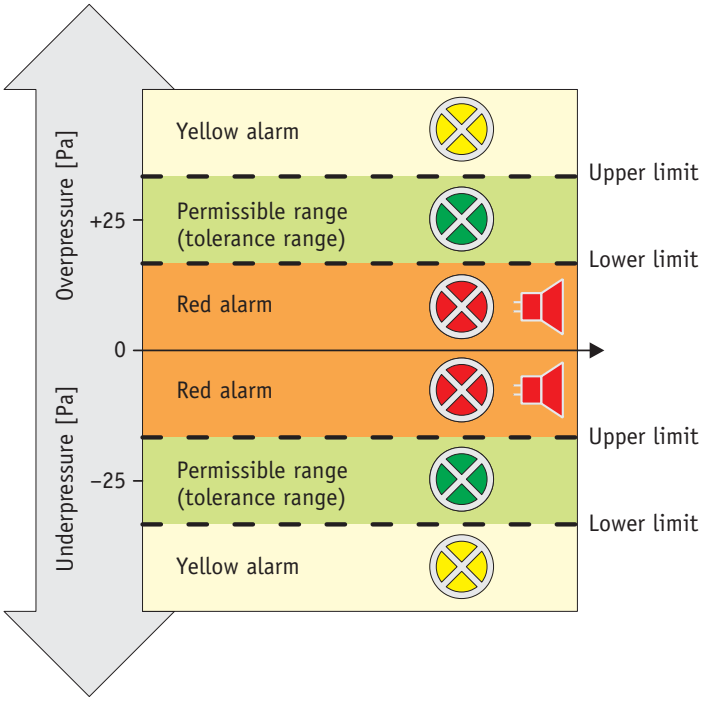
TROX TFM-2
TROX TPM

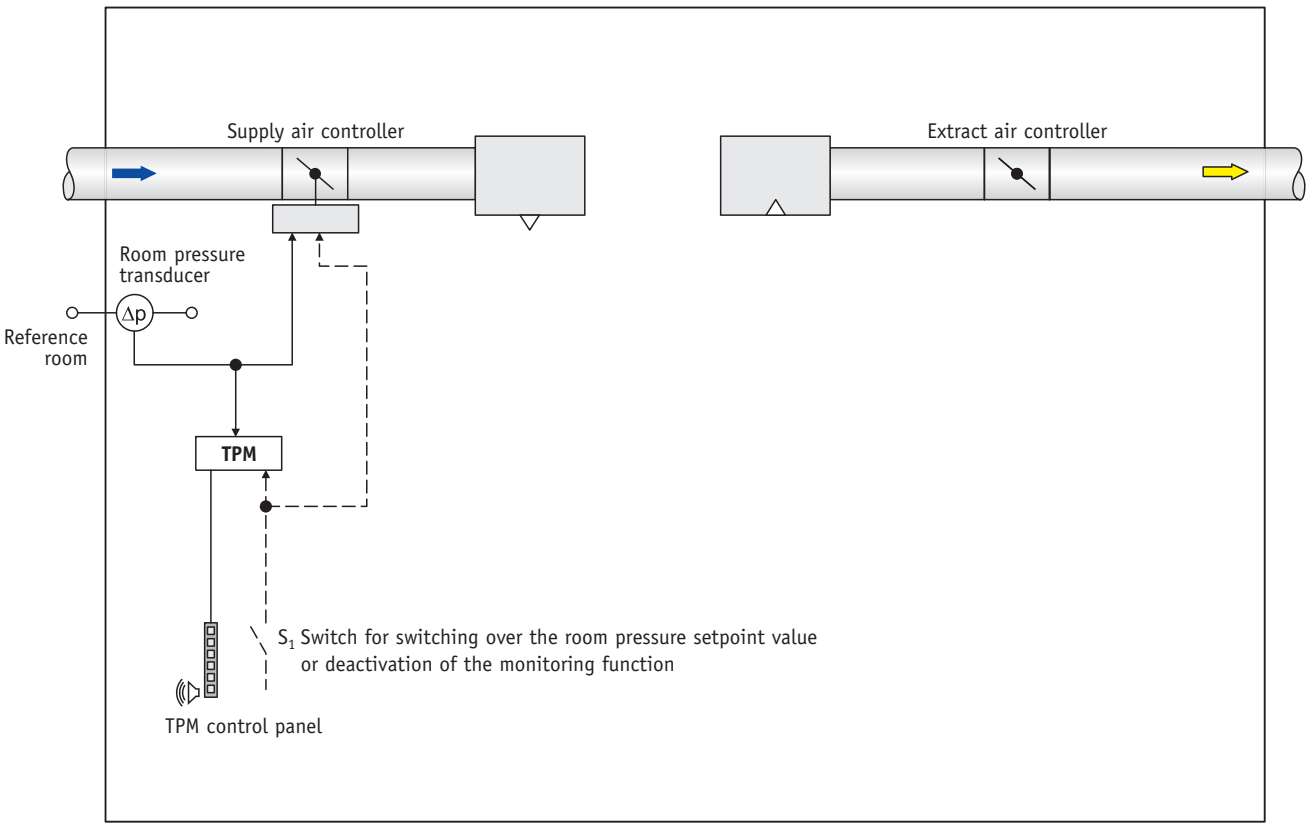
TFM-2/TPM device

Monitoring of the room pressure

Scope of functions of TPM

- Pressure measurement via an external measuring point
  - Integration of the room pressure as a voltage signal (0–10 V DC) via an analogue input
  - The characteristics of various pressure transducers can be configured.
- 2 configurable monitoring values
- For both monitoring values the following parameters can be individually selected, both for the exceeding and the undershooting of the values:
  - Alarm delay
  - Duration of the acoustic alarm or suppression
  - Signalling via alarm relay: yes/no
- Deactivation of the monitoring function, e.g. through the door switch, alternatively via the NC or NO contact
- Switchover between two pressure values to be monitored, alternatively via the NC or NO contact
- Definable alarm delay in case of "Door open"
- Display for the failure of the supply voltage through capacitor buffering (Goldcap), standard





What are the structural conditions of the room?

- Laboratory useful floor area in m²
- Air tightness and/or leakage of room/number of doors in the room?
- Suspended ceiling/pressure ceiling?

Which air change rate should be achieved?

For operating a laboratory, DIN 1946, Part 7 (June 1992), recommends a calculation of 25 m³/h total extract air for each m² of useable floor area. The standard also recommends that the 25 m³/h per m² is divided as follows – 10 m³/h of the 25 m³/h should be ceiling based extract air – 2.5 m³/h of the 25 m³/h should be as a floor suction unit. With this calculation method and a room height of 3 m there will be an air change rate of 8 times per hour.

Lower air change rates can be agreed upon with your local factory inspectorate; various air change rates can also be achieved by a switchover for use in laboratories or for use in offices. In this case, the specialist consultant has the responsibility to determine the required air change rate.

Should the room use extract or supply air for ventilation?

- For laboratories, the extract air volume flow rate to be achieved is usually defined (extract air master system)
- For clean rooms, the supply air volume flow rate to be achieved is usually defined (supply air master system)

Equipment extract air consumers in the the room

What extract air consumers are present?

- How are their volume flow rates recorded for the room balance?
- Are a sufficient number of the controller inputs required for the recording present?
- Possible variable or switchable extract air consumers are as follows:
  fume cupboards, suction hoods, electrically switchable point suction units, and suction arms for table workstations or ovens with hot gases
- How are constant consumers integrated into the room balance?
  - Take constant volume flow rate values into consideration using configuration settings in the room.
  - Take the volume flow rate values into consideration using analogue signals/LON variables.
    a) Direct signalling of the volume flow rate actual values
    b) Recording of the volume flow rates using measuring devices, such as type VMRK
- How are variable or switchable consumers integrated into the room balance?
  - Take constant volume flow rate values into consideration using switch contacts.
  - Take variable volume flow rate values into consideration via analogue signals/LON.
    a) Direct signalling of the volume flow rate actual values
    b) Recording of the volume flow rates using measuring devices, such as type VMRK
- Possible constant suction units in 24-hour operation are as follows:
  Suction units for cabinets, chemical or gas cylinder cabinets, and floor suction units for the use of heavy gases

How is the room extract air achieved?

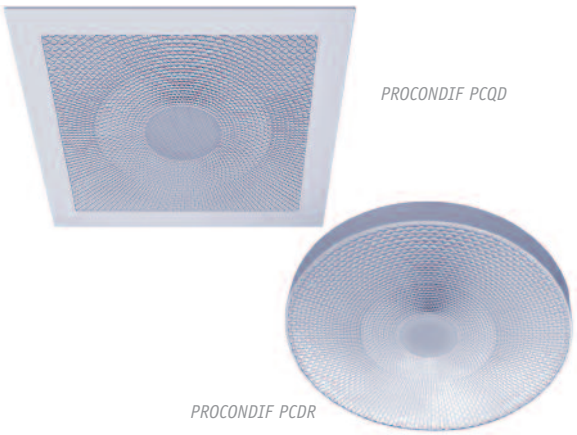
During the design of ventilation systems, the extract air equipment must meet the special requirements in regard to a possible release of hazardous materials, as well as activities which can not be performed in fume cupboards. In the process, a targeted suction unit at a known source (e.g. sampling line) and a preventive suction unit to prevent accumulation (e.g. ceiling extract air) should be provided.

- Is the total room extract air only achieved using fume cupboards or are additional room extract air controllers being used on the ceiling or floor?

How is the room supply air achieved?

In this case, DIN 1946, Part 7 (June 1992), makes the following requirement:
The supply air provided through the ventilation system must consist of 100% outdoor air. In supply air systems for laboratories, filters should be installed to keep the dust content of the compartment air low.
To prevent transfer flow from the laboratory to neighbouring rooms, the supply air volume flow rate should be kept lower than the extract air volume flow rate, even in case of varying extract air volume flow rates.

- Does a constant or variable supply air control result from the extract air design?
- How is the supply air brought into the room?
  The air flow through the laboratory is primarily determined by the arrangement and construction of the supply air outlets. If air pollutants are not removed at the location where they arise, the ventilation system can only effect a dilution of the pollution. For this reason, the supply air terminal devices have special significance since an accumulation of hazardous materials is prevented by a mixed air flow distribution. In order that turbulent air in front of the fume cupboard does not cause a release of hazardous materials suitable air terminal devices must be included in the design.
  Here, TROX offers the appropriate types:
  Type PROCONDIF, types PCDQ and PCDR, type NIDLAB, ceiling diffuser type DLQL.



PROCONDIF PCQD

PROCONDIF PCDR

Acoustic requirements for the room

According to DIN 1946, Part 7, the maximum weighted sound pressure level of 52 dB (A) generated by ventilation systems, including the fume cupboards, may not be exceeded.
What room noise level is to be targeted?
Remember that laboratories are also sometimes designed to be used as offices and that DIN has requirement for a maximum sound pressure level of 42 dB (A) for offices.

Volume flow rate control

- What transfer flow rate is required?
- If the room has large openings (leakage), allowance for a high transfer flow rate must be made;
  Rule of thumb: for rooms not explicitly sealed off, a difference of 5 m^3/h for each m^2 laboratory useful floor area; but include about 70 m^3/h for each door opening.
- If the room has very low leakage, a room pressure control system should be provided.

Room pressure control

- Pressure-controlled rooms must be sufficiently airtight to be able to build up the room pressure.
- Pressure-controlled rooms must permit a certain amount of transfer flow depending on the leakage openings (also see the “EASYLAB room pressure control” chapter); at a room pressure control of -20 Pa, about 10% of the total extract is should be included in the design as transfer flow; this corresponds to ≥ 0.005 m^2 leakage area, which in turn corresponds to a door gap of ≥ 0.5 cm.
- The pressure of the room to be controlled must be measured against a stable reference room; the reference room should have a constant atmospheric pressure at all times; when a ring line is used for the reference pressure, make sure its cross-section is large enough.
- Can two pressure values (septic/aseptic) be achieved?

What special functions can be achieved for the room?

- Do central default settings have to be signaled for the room?
  - Central operating mode default settings (e.g. day, night)
  - Volume flow rate change for temperature control or change of the air change rate
  - Which signals should be used for transmission (LON, analogue signals, switch contacts)?
- Diversity monitoring / diversity control?
  If a monitoring and/or maintaining of the maximum total extract air of the room is required, the room extract air controller and room supply air controller must also be equipped with the appropriate LABCONTROL controllers.

Construction of the air terminal units

- Fume cupboards for strongly chemically polluted extract air:
  use plastic controller type TVLK or TVRK for aggressive media.
- Fume cupboards for slightly polluted air:
  use type TVR in stainless steel with powder coating or in galvanised sheet steel.
- Room extract air controller on the extract air collecting duct with fume cupboards: plastic contruction type TVRK possible
- Room extract air controller with separate extract air ducting:
  construction possible in galvanised sheet steel, in powder-coated galvanised sheet steel, or in stainless steel
- Connecting method for the controllers?
  Use a flange or sleeve.
- Pay attention to the upstream ducting
  - Circular controller: at least 1.5*D, ideally 5*D
  - Rectangular controller: at least 1.5*B, ideally 5*B
  - Type TVLK: no minimum requirement

TVR TVLK

Volume flow rate range of the air terminal units

The design should ideally lie within a range of 30–70% of the nominal volume flow rate $\dot{V}_{Nom}$.

Monitoring system

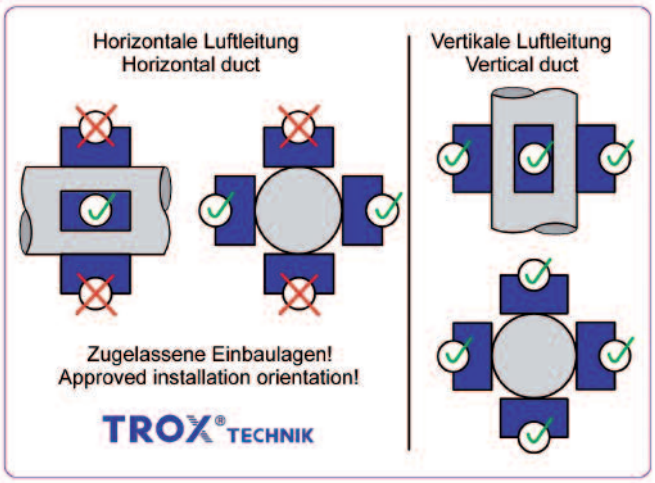
The monitoring and control of fume cupboards form a functional unit. For this reasons, the fume cupboards can be ordered without an additional monitoring system.

Power supply of the electronic control components

- Is the 24 V AC supply voltage for the controllers provided on site?
- On site, transformers and connecting cables must be dimensioned according to the power requirements of the controllers!
- Power supply cable should not be laid in parallel with signal or network cables!

Take the installation orientation of the electronic controllers into consideration when designing the duct routing.

The electronic controllers are provided with stickers on which the permissible installation orientations are listed.



Which special operating modes should the electronic controller support?

- Reduced operation (for night economy)/increased operation (for special operation, emergency operation)/shut-off?
- How should the special operating modes be signalled? LonWorks®, switching contacts, etc.
- Is there a prioritisation for local switching or the centralised BMS?

Which data interface should the electronic controller provide?

- Operating values, alarms – single or as collective alarm, etc.?
- Should the communication take place through LonWorks® or analogue signals and switching contacts?
- Should the operating data be visualised?
- Should the visualisation and operation take place roomwise or zonewise using a room control panel or a touch panel?

Control strategy for fume cupboard control

- Which control strategy is required?
  Incoming air flow sensor, sash distance sensor, 2 or 3 switching stages, or constant control.
- Which special functions must be able to be activated using the control panel?
- Is the support of special functions required?
  Support airflow technology, extract air scrubber, motion detector, sash moving mechanism, fume cupboard lighting, etc.

Who should perform the commissioning?

TROX, system integrator, someone else?

Commissioning of EASYLAB

What work is to be performed during commissioning

- Check of the variable volume flow controller for proper installation
- Check of the electric (and pneumatic, if pertinent) connections on the controllers.
- Function check of the variable volume flow controllers included in the scope of supply, including the actuators and transducers
- Setting and regulation according to the default setpoint values and control variables
- Set up of the parameters to the operating conditions
- Check of all control loops with regard to the volume flow rate and incoming air flow velocity, if appropriate
- Check of special functions ($\dot{V}$const switch functions, alarm suppression, day/night operation)
- Check of the follow-up control loops (room balances), as well as the optical/acoustic alarm systems on fume cupboards
- Creation of test reports

Have all commissioning prerequisites been met?

For clarification, there are special commissioning checklists, for which the most important points are:

- Has the room been finished, are openings in the laboratory closed, and are laboratory doors in place?
- Is the ventilation system functional, i.e. are the fans ready for operation and the fire dampers open?
- Are all controllers properly installed according to aerodynamic principles (have the requisite duct configuration)?
- Are all controllers electrically connected according to the wiring documents?
- Are all controllers accessible and available to local expert personnel?

Maintenance of the control components

- Who should perform the maintenance?
  - TROX
  - Laboratory furniture manufacturer
  - Someone else
- What should be checked?
- How often should maintenance be performed?
- What has to be documented?

Support in project development from TROX

- *System demonstration in TROX's demo laboratory*
- *Technical clarification and creation of the room balance*
- *Creation of wiring documents*
- *Delivery of electrically and aerodynamically tested components*
- *Commissioning and maintenance*

Manufacturing, inspection, and adjustment of volume flow rate controllers at the factory

General principles regarding the order code

A TROX volume flow controller consists of an air terminal unit for volume flow rate control and the electronic control components. To be ordered, both parts must be described completely with their characteristics. For this reason, the order code consists of two main parts:

Air terminal unit / **Electronic control components**

Part 1 of the order code describes the air terminal unit

- Type designation of the air terminal unit
- Construction of the air terminal unit (special material construction)
- Connection dimensions of the air terminal unit
- Possible accessory parts for the air terminal unit

Part 2 of the order code describes the electronic control components:

- Electronic control components (module)
- Possible additional equipment of the module
- Device function/operating mode of the module
- Operating values for the device function/operating mode

Examples for the coding of the air terminal unit:

TVLK - FL / 250-0 / GK /...
TVLK, plastic controller PP, Ø 250 mm, with flange and matching flange

TVRK / 160 /...
TVRK, plastic controller PP, Ø 160 mm

TVR / 200 /...
TVR, galvanised steel construction, Ø 200 mm

TVRD -FL / 160 /...
TVR, galvanised steel construction, Ø 160 mm, with with acoustic cladding and flange

TVR - A2 - FL / 315 / G2 /...
TVR, stainless steel construction, Ø 315 mm, with flange and matching flange

TVA / 250 / D1 /...
TVA, galvanised steel construction, Ø 250 mm, with lip seal

TVTD / 400 x 200 /...
TVT, galvanised steel construction, 400 x 200 mm, with acoustic cladding

Note:
These examples are not complete order codes since only the air terminal unit is described, but not electronic control components!

Order code part 1
Air terminal unit:

Air terminal unit type / construction / **Dimensions** / **Accessories**

Air terminal unit:
The various air terminal unit types have the following designations:
TVLK and TVRK for the types with a plastic construction and TVR · TVA · TVZ · TVT · TVJ for the types made of galvanised sheet steel.

Construction:
Special constructions of the air terminal unit, for example, additional acoustic cladding (D), flanges on both ends (FL), or the powder-coated (P1) or stainless steel (A2) construction are defined here. Not all constructions can be provided with all air terminal units.

Dimensions:
Every air terminal unit type is available in various volume flow rate ranges and connection dimensions.

Accessories:
Description of possible accessory parts of the air terminal unit for example the matching flange (GK or G2) or the lip seal (D1 or D2). Not all accessory parts can be used with all air terminal units.

Precise descriptions regarding the constructions and accessories of the individual controller types can be found in the respective technical leaflets of the air terminal units or in the price list.

Order code part 2
Electronic control components of EASYLAB:

Module	/	Device function	/	Module expansion options	/	Additional functions	/	Operating values

Module:
The module differentiates the manufacturer and type of the electronic control components for the control of the damper blade.
In addition to the EASYLAB system (module order code ELAB), additional control components for other applications with different air terminal units can be supplied by TROX.

Device function:
An electronic controller of the EASYLAB module can perform various control functions.
This part of the order code determines whether the controller works as a supply air (RS), extract air (RE), pressure (PC), or fume cupboard controller (FH-xxx) with special sensor equipment.

Module expansion options:
The controllers of the EASYLAB module can be equipped with independent expansion modules, such as mains supply EM-TRF (T), uninterruptible power supply (U), automatic zero balance (Z), LonWorks® interface (L), or light connection socket (S). This part of the order code defines which of these expansion modules should be installed into the composite module.
Some of the expansions are only available for certain device functions.

Additional function:
Labelling of additional functions for the EASYLAB supply air and extract air controllers, such as the room management function and the distinction between laboratories and clean rooms.

Operating values:
Definition of the basic operating values of the controller ex works.
The number of necessary operating values depends on the device function and the additional functions.

Examples for the coding of the electronic control components

../ ELAB / FH-VS / TZS / 300 / 1200
EASYLAB fume cupboard control with rapid response actuator, incoming air flow sensor, Expansions: supply voltage 230 V AC, automatic zero balance, light connection socket
$\dot{V}_{min}$ = 300 m³/h and $\dot{V}_{max}$ = 1.200 m³/h

../ ELAB / RE / Z / LAB
EASYLAB room extract air control for laboratories with rapid response actuator, Expansion: automatic zero balance
Supply voltage 24 V AC

../ ELAB / RS / TL / LAB-RMF / 2000 / 1500 / 2500 / 100 / 100 / 200
EASYLAB room extract air control for laboratories with rapid response actuator, Expansion: supply voltage 230 V AC, LonWorks® interface,
and activated room management function

Note:
These examples are not complete order codes since only the electronic control components are described and not the complete air terminal unit!

Complete order code for EASYLAB fume cupboard controller

Air terminal unit / xxxx / xx / ELAB / FH-VS / UZS / operating values

Type and construction
TVLK · TVRK · TVR

Dimensions
According to type

Accessories
According to type

EASYLAB module:
Electronic controller with rapid response actuator

FH-VS
FH-DS
FH-DV
FH-3P
FH-2P
FH-F

Device function for fume cupboard control
With incoming air flow sensor
FH-VS: incoming air flow velocity control strategy

With sash distance sensor:
FH-DS: linear control strategy
FH-DV: safety-optimised control strategy

With switching stages via switch contacts:
On-site switch contacts
FH-2P: Two-point control
FH-3P: Three-point control

With fixed value:
FH-F: Control of a fixed volume flow rate

TLZS
U---

Module expansions

Option 1: Power supply
: with 24 V AC
T : with 230 V AC via EM-TRF expansion module
U : with 230 V AC and UPS via expansion module EM-TRF-USV

Option 2: LonWorks® interface
: none
L : with EM-LON expansion module

Option 3: Automatic zero balance
: not included
Z : with EM-AUTOZERO expansion module solenoid valve for automatic zero balance

Option 4: Lighting control expansion
: not included
S : EM-LIGHT expansion module
Wired socket for lighting control via control panel

Operating values of the fume cupboard control
According to the selected device function: $\dot{V}$ [m³/h]:
FH-VS: $\dot{V}_{min}$ / $\dot{V}_{max}$
FH-DS: $\dot{V}_{min}$ / $\dot{V}_{max}$
FH-DV: $\dot{V}_{min}$ / $\dot{V}_{max}$
FH-2P: $\dot{V}_1$ / $\dot{V}_2$
FH-3P: $\dot{V}_1$ / $\dot{V}_2$ / $\dot{V}_3$
FH-F: $\dot{V}_1$

Order examples of the EASYLAB fume cupboard controller

TVLK-FL / 250-0 / GK / ELAB / FH-VS / TZS / 300 / 1200
Air terminal unit type TVLK, plastic controller PP, Ø 250 mm, with flange and matching flange
EASYLAB module with rapid response actuator, fume cupboard control, and incoming air flow sensor,
Expansions: mains supply 230 V AC and automatic zero balance, and light connection socket
Operating values: $\dot{V}_{min}$ = 300 m³/h and $\dot{V}_{max}$ = 1,200 m³/h

TVRK / 160 / ELAB / FH-DS / UL / 200 / 600
Air terminal unit type TVR, plastic control PP, Ø 160 mm
EASYLAB module with rapid response actuator, fume cupboard control with sash distance sensor
Linear control strategy
Expansions: mains supply 230 V AC with UPS and LonWorks® interface
Operating values: $\dot{V}_{min}$ = 200 m³/h and $\dot{V}_{max}$ = 600 m³/h

TVR –A2 –FL / 315 / G2 / ELAB / FH-3P / 500 / 1200 / 1500
Air terminal unit type TVR, stainless steel construction, Ø 315 mm, with flange and matching flange
EASYLAB module with rapid response actuator, fume cupboard control with three-point control, 24 V AC supply
Operating values: $\dot{V}_1$ = 500 m³/h, $\dot{V}_2$ = 1,200 m³/h, $\dot{V}_3$ = 1,500 m³/h

Option:
Control panel for fume cupboard controller for displaying the functions of the control system according to EN 14175
BE-SEG-01 with segment display
BE-LCD-01 with LCD

Complete order code for EASYLAB room controller

Air terminal unit / xxxx / xx / ELAB / RS / UZ / LAB-RMF / operating values

Type and construction
TVR · TVRK
TVA · TVZ · TVT · TVJ

Dimensions
According to type

Accessories
According to type

EASYLAB module:
Electronic controller with rapid response actuator

Device function of room control
RS: Supply air control (Room Supply)
RE: Extract air control (Room Exhaust)
PC: Pressure control (Pressure Control)

RS / RE / PC

---- / TLZ / U---

LAB / LAB-RMF

Operating values of the room control system
According to the selected device function:
RS, RE, PC, LAB → no parameters

LAB-RMF → 7 parameters $\dot{V}$ [m³/h], pressure [Pa]
Total room extract air – standard operation
Total room extract air – reduced operation
Total room extract air – increased operation
Constant room supply air
Constant room extract air
supply air/extract air difference
Room pressure
(only for rooms with a pressure controller)

Additional functions
LAB: extract air led system (laboratories)
LAB-RMF: Extract air led system with activated room management function (laboratories)

Module expansions

Option 1: Power supply
: with 24 V AC
T : with 230 V AC via EM-TRF expansion module
U : with 230 V AC and UPS via expansion module EM-TRF-USV

Option 2: LonWorks® interface
: none
L : with EM-LON expansion module

Option 3: Automatic zero balance
: not included
Z : with EM-AUTOZERO expansion module
Solenoid valve for automatic zero balance

Order examples of the EASYLAB room controller

TVRD-FL / 160 / ELAB / RS / Z / LAB
Air terminal unit type TVRD, galvanised steel construction, Ø 160 mm, with acoustic cladding and flange, EASYLAB module with rapid response actuator, supply air control for laboratories (extract air led system), Expansion: automatic zero balance, Supply voltage 24 V AC

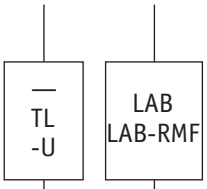
TVA / 250 / D1 / ELAB / RE / T / LAB
Air terminal unit type TVA, galvanised steel construction, Ø 250 mm, with lip seal
EASYLAB module with rapid response actuator, extract air control for laboratories (extract air led system)
Expansion: mains supply 230 V AC

TVR / 200 / ELAB / RS / LAB-RMF / 2000 / 1500 / 2500 / 100 / 100 / 200
Air terminal unit type TVR, galvanised steel construction, Ø 200 mm
EASYLAB module with rapid response actuator, supply air control for laboratories (extract air led system), 24 V AC supply, room management function with the following operating values:
Total room extract air: standard operation 2,000 m³/h, reduced operation 1,500 m³/h, increased operation 2,500 m³/h
constant supply air 100 m³/h, constant extract air 100 m³/h, supply air/extract air difference 200 m³/h

Option:
Room control panel for controllers with room management function
BE-LCD-01 with LCD

Complete order code for EASYLAB TROX adapter module

EASYLAB TAM / U / LAB-RMF / operating values



Operating values of the TROX adapter module
LAB → no paramters

LAB-RMF → 7 parameters $\dot{V}$ [m³/h], pressure [Pa]
Total room extract air – standard operation
Total room extract air – reduced operation
Total room extract air – increased operation
Constant room supply air
Constant room extract air
supply air/extract air difference
Room pressure
(only for rooms with a pressure controller)

TROX adapter module expansions

Option 1: Power supply
: with 24 V AC
T : with 230 V AC via EM-TRF expansion module
U : with 230 V AC via EM-TRF-USV expansion module

Option 2: LonWorks® interface
: none
L : with EM-LON expansion module

Additional functions
LAB: extract air led system (laboratories)
LAB-RMF: extract air led system with activated room management function (laboratories)

Order examples of the EASYLAB TROX adapter module (TAM)

TAM / T / LAB
TROX adapter module (TAM) for laboratories
Expansion: mains supply 230 V AC

TAM / UL / LAB-RMF / 2000 / 1500 / 2500 / 100 / 100 / 200
TROX adapter module (TAM) for laboratories
Expansions: main supply 230 V AC with UPS
LonWorks® interface
Operating values:
total room extract air: standard operation 2,000 m³/h,
reduced operation 1,500 m³/h, increased operation 2,500 m³/h
constant supply air 100 m³/h, constant extract air 100 m³/h,
supply air/extract air difference 200 m³/h

Option:
Room control panel for TROX adapter module (TAM)
With room management function
BE-LCD-01 with LCD

Order code part 2
TCU-LON-II electronic control components:

Module	/	Device function	/	Operating values

Module:
The module differentiates the manufacturer and type of the electronic control components and the type of actuator for the control of the damper blade.
In addition to the TCU-LON-II system (module designations TMA and TMB), additional control components for other applications with different air terminal units can be supplied by TROX.

Device function:
An electronic controller of the TCU-LON-II module can perform various operating modes/control functions.
This part of the order code determines whether the controller works as a supply air (RS), extract air (RE), pressure (PS, PE), or fume cupboard controller (FH).

Operating values:
Definition of the basic operating values of the controller ex works. The number of necessary operating values depends on the device function and the additional functions.

Examples for the coding of the electronic control components

.. / TMB / FH / 200 / 500
TCU-LON-II fume cupboard control
with brushless, rapid response actuator, incoming air flow sensor,
24 V AC supply, automatic zero balance, LonWorks® interface, and
$\dot{V}_{min}$ = 200 m³/h and $\dot{V}_{max}$ = 500 m³/h

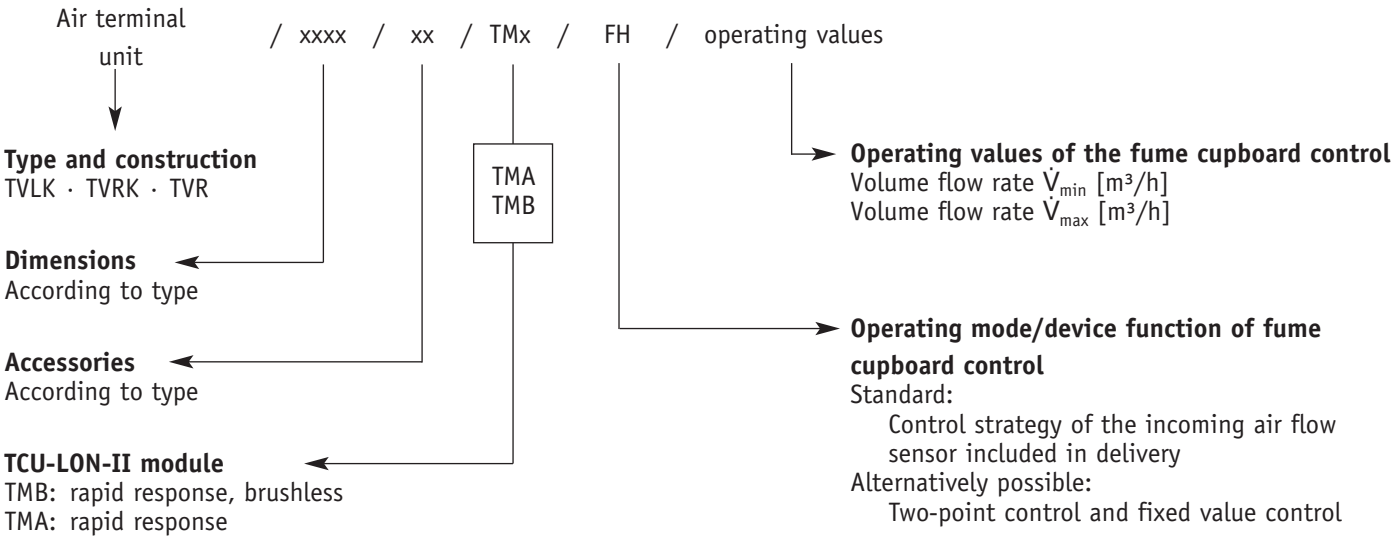
.. / TMA / RS / -50 / -100
TCU-LON-II supply air controller
with rapid response actuator,
24 V AC supply, automatic zero balance, LonWorks® interface,
and the operating values $\dot{V}_{constant}$ = - 100 m³/h

.. / TMB / RE / 1500 / 750 / -100
TCU-LON-II extract air controller
with brushless, rapid response actuator,
24 V AC supply, automatic zero balance, LonWorks® interface,
and the operating values $\dot{V}_{day}$ = 1,500 m³/h, $\dot{V}_{night}$ = 750 m³/h and
$\dot{V}_{constant}$ = - 100 m³/h

.. / TMB / PS / -50 / -100 / -20
TCU-LON-II supply air pressure controller
with brushless rapid response actuator, 24 V AC supply,
automatic zero balance, LonWorks® interface,
and the operating values $\Delta\dot{V}$ = -50 m³/h, $\dot{V}_{constant}$ = - 100 m³/h and
$P_{setpoint}$ = - 20 Pa

Note:
These examples are not complete order codes since only the electronic control components are described, and not the complete air terminal unit!

Complete order code for TCU-LON-II fume cupboard controller



Order examples of the EASYLAB fume cupboard controller

TVLK-FL / 250-0 / GK / TMB / FH / 300 / 1200
Air terminal unit type TVLK, plastic controller PP, Ø 250 mm,
with flange and matching flange
TCU-LON-II module
with brushless, rapid response actuator, fume cupboard control with incoming air flow sensor, 24 V AC supply, automatic zero balance, LonWorks® interface
Operating values: $\dot{V}_{min}$ = 300 m³/h and $\dot{V}_{max}$ = 1,200 m³/h

TVRK / 160 / TMA / FH / 200 / 600
Air terminal unit type TVR, plastic control PP, Ø 160 mm
TCU-LON-II module
with rapid response actuator,
fume cupboard control system with incoming air flow sensor,
24 V AC supply,
automatic zero balance, LonWorks® interface
Operating values: $\dot{V}_{min}$ = 200 m³/h and $\dot{V}_{max}$ = 600 m³/h

TVR-A2-FL / 315 / G2 / TMB / FH / 500 / 1200
Air terminal unit type TVR, stainless steel construction
Ø 315 mm, with flange and matching flange
TCU-LON-II module
with brushless rapid response actuator,
fume cupboard control system with incoming air flow sensor,
24 V AC supply, automatic zero balance, LonWorks® interface
Operating values: $\dot{V}_{min}$ = 500 m³/h and $\dot{V}_{max}$ = 1,200 m³/h

Option:
Standard control panel for the TCU-LON-II fume cupboard controller for displaying the functions of the control system according to EN 14175

Complete order code for TCU-LON-II room controller/room pressure controller

Air terminal unit / xxxx / xx / TMx / RS / operating values

Type and construction
TVR · TVRK
TVA · TVZ · TVJ · TVT

Dimensions
According to type

Accessories
According to type

TCU-LON-II module
TMB rapid response, brushless
TMA rapid response

Operating mode/device function for room control
RS: Supply air control (Room Supply)
RE: Extract air control (Room Exhaust)
PS: Supply air pressure controller (Pressure Supply)
PE: Extract air pressure controller (Pressure Exhaust)

Operating values of the fume cupboard control
according to operating mode/device function
Volume flow rates $\dot{V}$ [m³/h], pressure P [Pa]

RS: $\Delta\dot{V}$ / $\dot{V}_{constant}$
RE: $\Delta\dot{V}$ / $\dot{V}_{day}$/ $\dot{V}_{night}$/ $\dot{V}_{constant}$

PS: $\Delta\dot{V}$ / $\dot{V}_{constant}$/ $\Delta P_{setpoint}$
PE: $\Delta\dot{V}$ / $\dot{V}_{day}$ / $\dot{V}_{night}$ / $\dot{V}_{constant}$ / $\Delta P_{setpoint}$

Order examples of the TCU-LON-II fume cupboard controller

TVRD-FL / 160 / TMB / RS / -50 / -100
Air terminal unit type TVRD, galvanised steel construction,
Ø 160 mm, with acoustic cladding and flange,
TCU-LON-II module,
with brushless rapid response actuator,
supply air control, 24 V AC supply,
automatic zero balance, LonWorks® interface
Operating values:
$\Delta\dot{V}$ = -50 m³/h and $\dot{V}_{constant}$ = -100 m³/h

TVA / 250 / D1 / TMA / RE / -50 / 1500 / 750 / -100
Air terminal unit type TVA, galvanised steel construction,
Ø 250 mm, with lip seal,
TCU-LON-II module with rapid response actuator,
extract air control, 24 V AC supply,
automatic zero balance, LonWorks® interface
Operating values:
$\Delta\dot{V}$ = -50 m³/h, $\dot{V}_{day}$ = 1,500 m³/h, $\dot{V}_{night}$ = 750 m³/h,
$\dot{V}_{constant}$ = -100 m³/h

TVR / 200 / TMB / PS / -50 / -100 / -20
Air terminal unit type TVA, galvanised steel construction,
Ø 200 mm, TCU-LON-II module,
with brushless, rapid response actuator, supply air pressure controller,
24 V AC supply, automatic zero balance, LonWorks® interface,
Operating values:
$\Delta\dot{V}$ = -50 m³/h, $\dot{V}_{constant}$ = -100 m³/h, $P_{setpoint}$ = -20 Pa

As a basis for design, national and international guidelines and standards are usually consulted. It is important to know that these standards do not constitute the law, but rather represent the current state of the art and thus the basis for creating expert opinions in case of damage claims. It is naturally permissible to design systems that deviate from the data specified in a standard. The deviations should be well-founded, however, so that there are no doubts concerning negligence in the case of problems arising.

For the LABCONTROL system applications, the relevant standards can be divided into two areas:
1. Fume cupboards
2. Laboratories

Standards and guidelines for fume cupboards

The national fume cupboard standards were harmonised in to European standard **EN 14175, Part 1–7.**

This standard was recognised by the following countries and thus replaces the national standards:

- Austria
- Belgium
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Great Britain
- Greece
- Iceland
- Ireland
- Italy
- Luxembourg
- Malta
- Netherlands
- Norway
- Portugal
- Spain
- Sweden
- Switzerland

L'Oréal, Paris, France

The following content of EN 14175 is important from a ventilation system viewpoint:

Testing of the fume cupboard or pertinent ventilation components (VAV system)

Possibility 1:
On-site test of an individual fume cupboard with VAV system

The on-site test is performed at the location of an individual fume cupboard with attached VAV system. In contrast to a type test, the test result applies only to one fume cupboard and cannot be related to other fume cupboards of the same type.
→ "High costs, little benefit"

Possibility 2:
Type test of fume cupboards and type test of the VAV system

Possibility 3:
Separate type test of fume cupboards and VAV system, but combined approval

The type test of a fume cupboard according to EN 14175, is performed in a test chamber, leads to volume flow rate values that must be observed for this fume cupboard type. These volume flow rate values can be transferred to all fume cupboards of the same type and manufacturer.

For fume cupboards with a variable volume flow rate, additional testing requirements exist for the type test according EN 14175, Part 3. These requirements allow various possibilities for testing the ventilation control system (VAV system).

For more information, the following is an excerpt of standard EN 14175, Part 6 (2005-04):

"VAV systems and fume cupboards with variable volume flow rate can be tested either separately in accordance with 5.3 or as a combination in accordance with 5.4. As an alternative to the tests defined in 5.3, it is possible to test the VAV system together with a fume cupboard instead of the test box..."

In practice, this means that a test of the VAV system can be performed either with the test box or with a fume cupboard.

Test of the VAV system with test box (para. 5.3)	Test of the VAV system with a fume cupboard (para. 5.4)
Result: Type-tested VAV system	Result: Type-tested VAV system or prototype-tested VAV system for this fume cupboard

Here, the instigator of the test decides which test result is required!

Test of the (integrated) VAV system according to Paragraph 5.3

– A VAV system tested according to Paragraph 5.3 can be used if it fulfils the required control-engineering data.

Test of the VAV fume cupboard (prerequisite: type test according to EN14175, Part 3)

– Retention capacity at minimum and maximum volume flow rate
– Air exchange efficiency in case of minimum volume flow rate

Note:
Due to pressure exerted by laboratory tenants, type tests on fume cupboards without a specific VAV system are usual in the market since they provide the greatest possible flexibility for the tenant. If a control system is no longer available, a new test would be required for the change of the control system, which would in turn incur additional costs.

Certification

The TROX fume cupboard controllers of the EASYLAB and TCU-LON-II types are developed and certified according to the valid standards requirements.

In particular, they correspond to the following:

EN 14175	Type test methods for VAV systems
EN 60730-1	Electrical safety
EN 61000	Immunity to interference (EMC)
EN 55022	Radiated emissions (EMV)

Thus, nothing stands in the way of a use of the *type-tested* VAV control systems of TROX with all common laboratory furniture from the *viewpoint of the regulations*.

Standards and guidelines for laboratories

According to the type of laboratory, various regulations may apply. The most important rules and standards are as follows:

- **DIN 1946, Part 7, Raumlufttechnische Anlagen in Laboratorien (Ventilation Systems in Laboratories)**
  - Minimum extract air 25 m³/h for each m² main useful floor area
  - For fume rooms or solvent storerooms additional more demanding requirements apply
  - Variable volume flow rates for various operating situations must be able to be achieved
  - A direct supply air flow is provided from the outside into the laboratory
  - A full fresh air supply system must be provided; recirculated air operation is not permitted.
- **BGR 120, Regeln für Sicherheit und Gesundheitsschutz / Laboratorien (Rules for Safety and Health Protection/Laboratories)**
  - Minimum extract air 25 m³/h for each m² main useful floor area, accordingly an air change rate of 8 in case of 3 m room height
  - Extract air may pass entirely or partially through the fume cupboards
    Comment: large extract air volume flow rates may result in undesirably high levels of turbulence inside the fume cupboard in the case of when the sash is closed.
  - The ventilation function of a fume cupboard must be monitored by an independent unit.
  - Optical and acoustic signalling are required.
- **BGR 121, Arbeitsplatzlüftung – Lufttechnische Maßnahmen (Workstation Ventilation – Ventilation Measures)**
  - Requirements of the air quality at the workstation
  - Requirements in case of mechanical room ventilation
  - Prevention of transfer flow of air contamination
  - Requirements for ductwork and air discharge
  - Requirements for measuring devices for suction emissions; polluted air must be removed using the shortest possible route.
  - Ventilation system must be tested by a qualified person before commissioning, after essential changes, and at regular intervals (at least once a year).
    The system owner/operator is responsible for making sure these tasks are performed.

In terms of air handling, the dissipation and removal of hazardous materials are of primary importance. In addition, areas adjacent to the laboratories should be protected from potentially hazardous materials.

- **EN 12128, Biotechnology**
  Safety levels of microbiological laboratories.
  For laboratories from safety level 3, the following applies:
  - Mechanical ventilation is required
  - Safe maintenance of underpressure by the linking of supply air and extract air
  - Monitoring of underpressure with signalling and alarms
  - Use of HEPA high-performance particulate filters for the total extract air

- **DIN 25425, Part 1, Radionuklidlaboratorien (Radionuclide Laboratories)**
  - 8 air changes rate per hour
  - The supply air must be fresh outdoor air; recirculated air operation is not allowed.
  - A graduated underpressure maintenance from 10 to 30 Pa is recommended.
  - An independent extract air system is recommended for SK2 and required for SK3.

For this purpose, a minimum extract air of 25 m³/h per square metre main useful floor area is generally defined. In case of a room height of three metres, this approximates to an air change rate of 8, which can be found in some guidelines.

The air change rate may be reduced, if necessary. In this regard, BGR 120 requires that hazardous materials such as flammable liquids or volatile matter, dusty, or aerosol-forming substances should only be used to the smallest degree possible. In addition, these limitations for use must be made public. DIN 1946 also demands clear labelling at the entrances of laboratories.

DIN 1946, Part 7, requires the possibility that variable volume flow rates must be available from a central plant. This mainly affects the number and characteristics of fans!

All listed standards require that laboratories have to be operated in all conceivable operating states. According to EN 12128 (Biotechnology), underpressure must additionally be monitored and displayed. This monitoring is also required in Radionuclide Laboratories SK2 and SK3. In clean room laboratories or pharmaceutical production facilities, as well as other areas of clean room technology, these requirements can obviously be reversed to provide accurate overpressure control.

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University of Odense
France
University of Marseille
Germany
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Great Britain
Birmingham University
Oxford University
Italy
University of Catania
Norway
High School Oslo
Switzerland
University of Zurich
Turkey
Sabanci University, Istanbul

Universities of applied science

Germany
Ansbach, Jena, Koblenz, Magdeburg, Merseburg, Neubrandenburg, Nuremberg, Rosenheim

Research institutes

Algeria
AFSI Forensic Science Institute, Algiers
Finland
Nano Building, Helsinki
Germany
ISAS, Dortmund
Leibnitz Institute for Polymer Research, Dresden
Paul-Ehrlich Institute, Frankfurt
UTZ (Centre for Environmental Technology), Berlin-Adlershof
Max Planck Instituts
Dresden, Frankfurt amMain, Jena, Magdeburg, Mainz, Rostock
Switzerland
Institut de Chimie, Neuchâtel

Hospitals

Germany
Charité, Berlin
Clinic 2000, Jena
MHH Hannover
OMZ, Heidelberg
University Clinic, Aachen
University Clinic, Essen
Great Britain
Moorefield Eye-Hospital, London

Industry and technology

Austria
Sandoz, Langkampfen
Belgium
Coca-Cola, Bruxelles
Janssen Pharma, Beerse
PIDAPA, Antwerpen
China
3M, Shanghai
Henkel, Shanghai
Croatia
PLIVA, Zagreb
UMG KRC, Zagreb
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HTX, Randers
LEO Pharma, Ballerup
Odense Marcipan, Odense
Finland
ARK Therapeutics, Kuopio
France
Astra Zeneca, Dunkerque
Aventis, Lyons
Corning, Fontainebleau
Galderma, Biot
IECB-Pessac, Bordeaux
Innothera Arcneil
L'Oréal, Paris
NTE, Giberville
Rhône-Poulenc, Lyon
Sanofi, Azure, Montpellier, Sisteron
SNCF Vitry sur Seine, Paris
SOGIT, Grenoble
Germany
Abbott, Ludwigshafen
Aldrich Chemie, Steinheim
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Asta Medica, Mainz
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BAT, Bayreuth
Bayer AG, Dormagen, Leverkusen, Monheim, Wuppertal
Bayer Schering Pharma, Berlin
Biopark Regensburg
Bioscientia, Ingelheim
BMW, Dingolfing, München
Boehringer, Ingelheim
BP, Gelsenkirchen
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Dräger Medica, Lübeck
Goldschmidt AG, Essen
Grünenthal, Aachen
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Hilti, Kaufering
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Nestlé, Konolfingen
Novartis Pharma, Basel
Sandoz, Basel
Siegfried AG, Zofingen
Techcenter Reinach, Basel

Government facilities

Australia
Australian Nuclear Power Science and Technology Organisation (ANSTO), Sydney
Finland
Dynamicum,
Finnish Meteorological Institute and Finnish Institute of Marine Research, Helsinki
Evira, Finnish Food Safety Authority, Helsinki
Germany
Chemical-Veterinary Inspectorate, Münster
State Inspectorate for Saxony, Dresden
State Inspectorate, Erlangen
Office for Water Resources, Arnsbach, Bamberg
National Food Authority, Dresden
Police Department, Delmenhorst, Frankfurt
Italy
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