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Labcontrol Automation and System Technology TCU-II

PI/7.4/1/EN/1

Fume cupboard control with Labcontrol TCU-II



1. Application

The main application area of the TCU-II digital controller is in laboratories and hospitals. Here, it finds application as both a fume cupboard controller with a monitoring function as well as a room air balance controller. In hospitals, pressure controls are often required for controlling septic/aseptic areas. This task can be performed problem free by the TCU-II controller. The Labcontrol system with TCU-II controllers, modified to carry out customer-specific tasks, thus offers the perfect single-source system solution. The TCU-II generation of controllers also allows the handling of complex requests of ventilation systems including sensors and actuators, such as motion sensors, temperature sensors etc., from other manufacturers. This offers the greatest possible degree of flexibility and safety. Since technical control processes inside laboratories and hospitals are many-sided and very complex, it should be paid attention to the best possible association of all components. The TCU II generation of controllers fulfils optimally this function and controls a selfsufficient room pressure and temperature as well as, if necessary, fume cupboards according to the DIN EN 14175 requirements.

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Application area of TCU II Labair control



2. Functionality

The TCU-II digital controller has been designed for demanding technical control tasks. The software functions are stored in the controller. By means of this software, modified to fit the application, the TCU-II digital controller can perform a variety of control tasks.

The TCU-II contains a diaphragm pressure transducer to measure the actual volume flow in the form of a pressure difference. The pressure difference, from which the volume flow can be calculated, is measured as a static differential pressure. The differential pressure sensor in the volume flow control unit detects the pressure difference. This causes a deflection on the measurement diaphragm, which is recorded inductively and converted into a pressure linear voltage signal. Linearization of the volume flow is performed by the TCU-II. The measurement range depends on the volume flow controller. Since the controller is also used in areas with aggressive extraction, the transducer is additionally protected by inducting room air into the measurement tubing. For long-term stability of the measured signal, an automatic zero-point compensation is provided as standard. This allows exact measurement over long periods even if the pressure difference is low.

In order to manage all request into a variable and the various controls, the TCU II is equipped with numerous I/Os.

As well as the analogue inputs and outputs, three digital inputs and 5 relay outputs are available, so that, for example, alarm messages or switching of special functions may be achieved.

Note:

The TCU-II controllers are supplied with the projectspecific basic parameters. In order to adapt to the local room environment, an expert commissioning should be performed, including the documentation.

We recommend that start-up be undertaken by Trox service personnel.

Transmission of actual volume flow through the analogue signal TVLK with TCU-II FCC-E-Transducer Ready-made connecting cable with plug-in connector Operator terminal

Fume cupboard control

Fume cupboard control with motion sensor and additional switching functions



* Altogether three options can be used simultaneously

Control diagram intake velocity/volume flow



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2.1 Fume cupboard control

The TCU-II control unit is mainly used for controlling fume cupboards with variable volume flow rates. This is done by intake velocity/volume flow cascade control. All requirements of DIN 12924, EN 14175, the British Standard (BS) and the ASHRAE standard are complied with. This controller offers the highest possible level of safety while remaining economical. For use as a fume cupboard controller, the TCU-II is combined with a Trox volume flow control device (e.g. TVLK). The unit consists of the TCU-II controller with an integrated function control and the volume flow control device with actuator and control damper. In addition, the FCC-E intake velocity transducer is delivered separately and mounted on the fume cupboard by the customer. This needs a supplementary opening of 21 mm diameter. Also included in the delivery is an operator terminal for user operation of the controller. The TCU-II controller unit controls the intake velocity and the volume flow for a single fume cupboard. The FCC-E transducer measures intake velocity without contact, moving parts or wear. The sash window can be adjusted in its vertical plane and slid in its horizontal plane. The measurement system records the intake velocity independently of the location of the opening. Thermal loads inside of the cupboard do not affect measurement, but automatically lead to an increase in the volume flow rate and thus safe extract of the heat loads. The actual volume flow value is available as an analogue signal. As a result, the fume cupboard can be included in room air balance. Switches or relays can be used for override control. There is an integral intake velocity monitoring with both acoustic and visual alarms. For night operation, the acoustic alarm can be suppressed. The following safety requirements for fume cupboards are conformed to:

- Control of intake velocity independent of the position of the control damper (by means of contact-free, wear-free recording of actual values), so horizontally sliding windows are also included in the control operation
- · Quick recording of actual values
- Quick and stable control (response time <= 3 seconds)
- Maintenance of a minimum volume flow with closed sash windows
- Limiting of the maximum volume flow with fully opened sash windows
- Automatic increase of the extract air volume flow with high thermal loads
- · Possibility of full air tight shut off
- Special operating modes
- Can be integrated into the supply and extract volume flow control of the laboratory taking diversity factors into account
- Automatic zero-point compensation and room air induction by the integrated diaphragm pressure transducer





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2.1.1 Overview of most important functions

Can be freely configured for:

- Reduced operation mode (constant volume flow 1)
- . Volume flow increase in emergency
- (constant volume flow 2)
- Shut off •
- Fully open
- Closed
- Connection of a window contact (opened 500 mm) according to EN 14175

Alarm messages through:

Alarm control lamp, (red LED): Lit: unacceptable control deviation Flashes: hardware error

Piezo:

The acoustic alarm time can be configured

Monitoring modes:

Volume flow rate or intake velocity

Alarm transmission: relay / changeover contact

V_{max}-Mode / Emergency Mode

- Increased volume flow adjustable with the V_{max}-button, irrespective of the window position
- Can be set for limited times (1 to 999 min)
- · Priority over all other operation modes

Upon request:

When the fume cupboard is open, no movement in front of the fume cupboard: Acoustic signal and flashing yellow LED (meaning: please close fume cupboard)

Operator terminal







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Operator terminal



General information

The Trox TCU-II operator terminal indicates whether the safety of the fume cupboard is guaranteed. The volume flow and/or the intake velocity is monitored. This function monitoring is required under DIN 12924, Part 1 / DIN EN 14175 and is used for the safety of the fume cupboard user. The Trox Labcontrol operator terminal has three control lamps (LEDs) that display the actual operation mode of the fume cupboard. There are two buttons for acoustic alarm suppression and for overriding the \dot{V}_{max} -switching. If the specified conditions are not fulfilled, the alarm control lamp 1 lights up and an acoustic alarm sounds. Eventually, the loss of power is displayed by the red, capacitor-buffered LED.



Description, Operation

1. Alarm control lamp, (red LED)

- If this control lamp is permanently lit, the actual volume flow and/or the air intake velocity is no longer in the safe range or the reduced operation mode is activated. The acoustic alarm (standard duration 10 seconds), can be eliminated with the "suppress" button. The red control lamp lights only if the alarm cause has been eliminated and/or normal operations have been resumed. Reasons for the alarm can be:
 - Fully open sash window (with pure face velocity monitoring)
- Failure of the fan or pressure drop in the ductwork
- Note: If after closing the protection window the alarm is not eliminated, inform the service staff immediately! A permanent flashing alarm LED points out to a hardware error.

2. Alarm button (Quit)

The acoustic alarm can be switched off with this button.

3. Function control lamp (green LED)

Permanently lit LED: Controller in normal operation mode LED: Special operation mode (e.g., reduced operation Full shut-off, in this case the red LED is permanently lit)

4. V_{max}-control lamp, yellow

The \dot{V}_{max} lights up when the controller is working in \dot{V}_{max} operation mode. If in \dot{V}_{max} operation the required volume flow is not sufficient, there is a visual and an acoustic alarm.

Flashing LED in conjunction with motion sensor means: "Please close fume cupboard"

5. V_{max} button

This button can be used to manually increase the volume flow to the maximum \dot{V}_{max} value (keep the button pressed until yellow control lamp 4 lights up). Press the button again to return to normal operation mode. If a time limit has been set, the yellow LED lights up after the set time and the normal mode is resumed.

6. Network control lamp (red LED)

This control lamp flashes if the power supply fails for approx. 12 hours (maintenance-free capacitor buffering). In this case, no further alarm message is generated.

- (A) Construction with casing, for installation inside fume cupboard housing
- (B) Construction without casing, for installation inside fume cupboard housing, Opening in fume cupboard housing 21 x 148 mm with 2 mm corner radiuses.

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Example



Control diagram



2.2 Room volume flow control

The TCU-II controller can be combined with the VAV controller types TVZ, TVA, TVJ, TVT, TVRK, TVR, TVS to control variable supply and extract volume flows in the room. The settling time corresponds to the control at the fume cupboards so that stable room pressure can be maintained. Since the air tightness requirements of rooms are continually increasing due, for example, to fire protection measures, this is of critical importance. For balancing the room, up to 7 actual volume flow rates from fume cupboards, room controllers or other extract sources can be connected to a corresponding room controller. In addition, temperature, room pressure and other control components can be connected via an analogue input.

The volume flow controller works independently of the duct pressure, i.e. pressure fluctuations do not bring about any permanent changes to the volume flow.

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2.2.1 Room pressure control

Instead of having only a room balance control, it is possible to make a combination between a room balance

recorded and communicated to the room controller. The room controllers themselves balance the necessary room supply and extract air. Additionally, the recorded room pressure is connected to the room supply controller in cascade.

A supply-extract volume flow difference shift will compensate it. In contrast to room pressure control only, this process takes the room volume flow balance into account, so that this system works stable in operation with changing openings as doors and no extreme damper blade positions occur. The desired room under-pressure or over-pressure is thus maintained at all times.

In contrast to constant volume flow difference, the excess flow can be increased when doors are opened without loss

A change-over between under and over pressure can be

and a room pressure control. In this case, all individual extract air volume rates are

of convenience. configured as well.

2.2.2 Room temperature control

Volume Flow Shift

A temperature control can be realised in a number of ways. The volume flow rate is varied dependant of the temperature signal, without room pressure changing.

Following variants are practicably:

- 1. Volume flow rate influence with temperature control by TCU II, direct connection of temperature signal (see example). (Switch-over for summer/winter integrated and can be controlled.)
- 2. Changing of volume flow by an external temperature controller with 0 to 10 VDC signal.

Reheater Control

The TCU-II can be operated with a VAV controller with an integral reheater. Here, the TCU-II controls the reheater actuator.

Room pressure/room balance cascade control







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Example of inclusion of diversity factor in room control



Example

- Room with 5 fume cupboards, $\dot{V}_{max fume cupboard} = 500 \text{ m}^3/\text{h},$ $\dot{V}_{max fume cupboards total} = 2500 \text{ m}^3/\text{h}$
- At most 3 fully open fume cupboards allowed simultaneously, equals
 V_{max fume cupboards total} = 1700 m³/h
- As in the example shown, also the fourth fume cupboard is opened, the TCU-LON II-Controller will reduce the total volume flow
 V_{tot} 1700 m³/h to 400 m³/h per fume cupboard.

The four fully opened fume cupboards give an alarm signal. For safety operation, one cupboard must be closed.

2.2.3 Diversity factor

Large laboratory buildings are often operated in volume flow balance taking diversity factors into account for reasons of economics. As a result, the advantages of variable volume flow control can be fully utilised. This method is based on only a few of the fume cupboards being open at the same time. Most of the fume cupboards are assumed to be closed. The advantage of this procedure lies in the fact that both the duct system and the fans can have smaller dimensions. Until recently, however, this could lead to problematical situations which, thanks to the new Labcontrol system, are now a thing of the past. It was previously necessary to carry out hydraulic balancing to ensure that the calculated air conditions were maintained in all areas. This is now checked by the room controller itself and corrected if necessary. This prevents a diversity factor = 1 occurring in areas which, for example, are near the fans, which results in a diversity factor of under the calculated value in other areas. It is difficult, of course, for laboratory users to find out which part of the laboratory is responsible for this imbalance. Unacceptably exceeding

of the air balance is recognized by Labcontrol and can be corrected by lowering the volume flow at the open fume cupboards. Laboratory areas in the vicinity are not negatively affected by this. The fume cupboard controller generate an alarm at the operator terminal, alerting the user that the diversity factor has been exceeded. Moreover, an alarm message can be transmitted via LON and/or relay output to the BMS, if the diversity factor is exceeded.

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3. Technical data

Wiring

The unit control components are factory-wired. When a 24 VAC supply is required, safety transformers (EN 60742) are to be used. If several controllers are connected to a 24 VAC supply, it is important that a common zero wire is defined and not altered. Project-related standard wiring schematics for the Labcontrol components will be provided by Trox.

Intake Velocity Control

The FCC-E transducer is mounted on the fume cupboard and connected up according to the installation instructions.

Overriding control

Room control of variable volume flow or air intake velocity can be overridden by potential-free contacts on the customer side.

Technical data

Distribution voltage Power consumption Temperature range Protection 24 VAC, ± 5 %, 50 Hz 20 VA 10 to 40 °C IP 20

FCC-E-Transducer



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2

- 1 Connection terminals
- 2 Sensor tube

Technical data

- Distribution voltage 24 VAC ±5%, 50 Hz
- Measurement range 0.1 to 1 m/s
- Output signal 2 to 10 VDC
- Protection IP 20

Display with integrated background illumination

15

50

3.1 External display

Optional display for the visualization of the controller modes

The information about set and actual volume flow rates, as well as the operating modes and error messages can be shown comfortably on the display.

When using the TCU II as a fume cupboard controller, the display can be mounted on the fume cupboard and allows to see comprehensive information about the personnel use.

The unit can serve building services as a quick service tool in order to check the correct status of the controller or to supply a first fault analysis in the event of an fault.



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4. Wiring diagrams



FCC-E TRM Actuator Alarm output relay

24 VAC

Terminal connection / Label in the unit cover

