



Controller for potentially explosive areas

EASY - SAFE – SMART

- ATEX / IECEx certified for Gases and Dusts
- Measurement in Zone 0/21
- Direct power supply without Ex i zener barrier
- Easy plug-in mounting
- Quick and safe installation
- Junction box Ex e integrated
- No variants only one basic unit
- Temperature range -40 ... +58°C
- Protection class IP66
- Analog outputs switchable between mA and V
- Simple setpoint adjustment
- Integrated display
- Onsite parameterization
- LED status indication
- Low power consumption <3 W
- Cable length from the transducer to the sensor up to 100 m
- Highly resistant against corrosion by use of high-tech polymer and stainless steel



AC.Ex + IY.Ex Manual

BA.Ex-0005.04.EN

**Assembly and installation instructions for safe use of explosion-proof
Controller AC.Ex with mA/V in- and output and sensors (setpoint – actual value) and
Sensor IY.Ex for Differential pressure, Volume flow**



ATEX Documentation

D Alle Betriebsanleitungen für ATEX Ex bezogene Produkte stehen in den Sprachen Englisch, Deutsch und Französisch zur Verfügung. Sollten Sie die Betriebsanleitungen für Ex-Produkte in Ihrer Landessprache benötigen, setzen Sie sich bitte mit Ihrem örtlichen Vertreter in Verbindung.

GB All instruction manuals for ATEX Ex related products are available in English, German and French. Should you require Ex related instructions in your local language, you are to contact your nearest office or representative.

F Tous les manuels d'instruction des produits ATEX Ex sont disponibles en langue anglaise, allemande et française. Si vous nécessitez des instructions relatives aux produits Ex dans votre langue, veuillez bien contacter votre représentant le plus proche.

P Todos os manuais de instruções referentes aos produtos Ex da ATEX estão disponíveis em Inglês, Alemão e Francês. Se necessitar de instruções na sua língua relacionadas com produtos Ex, deverá entrar em contacto com a delegação mais próxima ou com um representante.

DK Alle brugervejledninger for produkter relateret til ATEX Ex er tilgængelige på engelsk, tysk og fransk. Skulle De ønske yderligere oplysninger om håndtering af Ex produkter på eget sprog, kan De rette henvendelse herom til den nærmeste afdeling eller forhandler.

SF Kaikkien ATEX Ex -tyyppisten tuotteiden käyttöohjeet ovat saatavilla englannin-, saksan- ja ranskankielisinä. Mikäli tarvitsette Ex -tyyppisten tuotteiden ohjeita omalla paikallisella kielellänne, ottakaa yhteyttä lähimpään toimistoon tai edustajaan.

I Tutti i manuali operativi di prodotti ATEX contrassegnati con Ex sono disponibili in inglese, tedesco e francese. Se si desidera ricevere i manuali operativi di prodotti Ex in lingua locale, mettersi in contatto con l'ufficio più vicino o con un rappresentante.

E Todos los manuales de instrucciones para los productos antiexplosivos de ATEX están disponibles en inglés, alemán y francés. Si desea solicitar las instrucciones de estos artículos antiexplosivos en su idioma local, deberá ponerse en contacto con la oficina o el representante de más cercano.

S Alla instruktionsböcker för ATEX Ex (explosionssäkra) produkter är tillgängliga på engelska, tyska och franska. Om Ni behöver instruktioner för dessa explosionssäkra produkter på annat språk, skall Ni kontakta närmaste eller representant.

NL Alle handleidingen voor producten die te maken hebben met ATEX explosiebeveiliging (Ex) zijn verkrijgbaar in het Engels, Duits en Frans. Neem, indien u aanwijzingen op het gebied van explosiebeveiliging nodig hebt in uw eigen taal, contact op met de dichtstbijzijnde vestiging van of met een vertegenwoordiger

GR Όλα τα εγχειρίδια λειτουργίας των προϊόντων με ATEX Ex διατίθενται στα Αγγλικά, Γερμανικά και Γαλλικά. Σε περίπτωση που χρειάζεστε οδηγίες σχετικά με Ex στην τοπική γλώσσα παρακαλούμε επικοινωνήστε με το πλησιέστερο γραφείο της ή αντιπροσωπώ της

PL Wszystkie instrukcje obsługi dla urządzeń w wykonaniu przeciwwybuchowym Ex, zgodnych z wymaganiami ATEX, dostępne są w języku angielskim, niemieckim i francuskim. Jeżeli wymagana jest instrukcja obsługi w Państwa lokalnym języku, prosimy o kontakt z lokalnym przedstawicielem.

SK Všetky návody na obsluhu pre prístroje s ATEX Ex sú k dispozícii v jazyku anglickom, nemeckom a francúzskom. V prípade potreby návodu pre Ex- prístroje vo Vašom národnom jazyku, skontaktujte prosím miestnu kanceláriu firmy.

SLO Vsi predpisi in navodila za ATEX Ex sorodni pridelki so pri roki v angleščini, nemščini ter francoščini. Če so Ex sorodna navodila potrebna v vašem tujejnem jeziku, kontaktirajte vaš najbližji office ili predstavnika.

CZ Všechny uživatelské příručky pro výrobky, na něž se vztahuje nevybušné schválení ATEX Ex, jsou dostupné v angličtině, němčině a francouzštině. Požadujete-li pokyny týkající se výrobků s nevybušným schválením ve vašem lokálním jazyku, kontaktujte prosím vaši nejbližší reprezentační kancelář

H Az ATEX Ex műszerek gépkönyveit angol, német és francia nyelven adjuk ki. Amennyiben helyi nyelven kéri az Ex eszközök leírását, kérjük keressék fel a legközelebbi irodát, vagy képviselőt.

BG Всички упътвания за продукти от серията ATEX Ex се предлагат на английски, немски и френски език. Ако се нуждаете от упътвания за продукти от серията Ex на родния ви език, се свържете с най-близкия офис или представителство на фирма

LT Visos gaminio ATEX Ex kategorijos Eksploatavimo instrukcijos teikiama anglų, vokiečių ir prancūzų kalbomis. Norėdami gauti prietaisų Ex dokumentaciją kitomis kalbomis susisieki su artimiausiu bendrovės biuru arba atstovu.

RO Toate manualele de instructiuni pentru produsele ATEX Ex sunt in limba engleza, germana si franceza. In cazul in care doriti instructiunile in limba locala, trebuie sa contactati cel mai apropiat birou sau reprezentant

LV Visas ATEX Ex kategorijas izstrādājumu Lietošanas instrukcijas tiek piegādātas angļu, vācu un franču valodās. Ja vēlaties saņemt Ex ierīču dokumentāciju citā valodā, Jums ir jāsazinās ar firmas Jokogava tuvāko ofisu vai pārstāvi

M Il-manwali kollha ta' l-istruzzjonijiet għal prodotti marbuta ma' ATEX Ex huma disponibbli bl-Ingliż, bil-Ġermaniż u bil-Franċiż. Jekk tkun teħtieġ istruzzjonijiet marbuta ma' Ex fil-lingwa lokali tiegħek, għandek tikkuntattja lill-eqreb rappreżentant jew ufficiju ta'

ESTKõik ATEX Ex toodete kasutamishuhtid on esitatud inglise, saksa ja prantsuse keeles. Ex seadmete muukeelse dokumentatsiooni saamiseks pöörduge lähima lokagava kontori või esindaja poole

EN

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SICHERHEITSHINWEISE **SAFETY NOTES** **CONSIGNES DE SÉCURITÉ**

Ex-Bereich Hazardous area Zone dangereuse Zone 0,1,2,21,22	Zone 1,2,21,22			Sicherer Bereich Safe area Zone de sécurité
---	----------------	---	---	---

Ta (T6) -40...55°C
Ta (T5) -40...70°C
Ta (T4) -40...100°C
Ta (T3-1) -40...125°C

IY.Ex-...

Leitung /cable

AC.Ex

Ta (T4) -40 ... +58°C

Nachweis der Eigensicherheit

Proof of intrinsic safety

Preuve de sécurité intrinsèque

Ui = 5,0 V DC

Ii = 1055 mA

Pi = 492 mW

Ci = 440 nF

Li = 0 mH

Cc' ≤ 200 nF/km

Lc' ≤ 1 mH/km

siehe Hersteller

see mfr. values

Io ≤ 1055 mA

Po ≤ 492 mW

Co = 3,7 µF

Lo = 0,091 mH

Die Anwendung der 50% Regelung

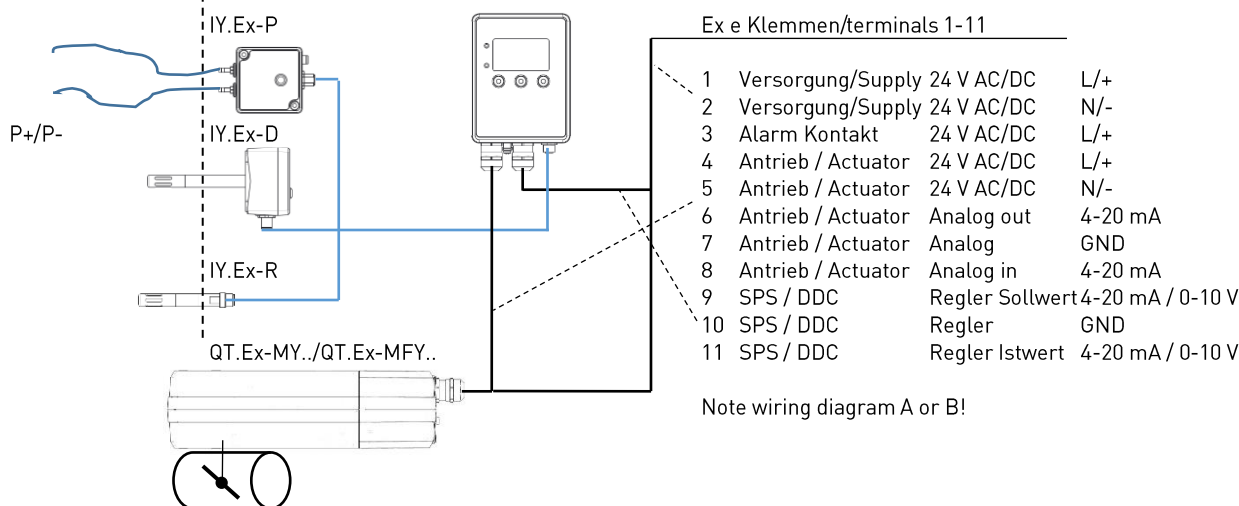
ist nicht notwendig Li = 0!

It is not necessary to use the 50%

regulation Li = 0!

Il n'est pas nécessaire d'utiliser la

régulation 50% Li = 0!



- Installieren Sie gemäß Herstellerangaben und für Sie gültigen Normen und Regeln.
- Das Entriegeln des Gerätes oder öffnen des Klemmkastens ist nur im spannungslosen Zustand gestattet.
- Beim Einbau des Gerätes ist darauf zu achten, dass die Gehäuseschutzart IP66 nach EN 60529 eingehalten wird.
- Dieses Betriebsmittel kann nach Herstellerangaben in der Zone 1, 21 (II 2GD) bzw. Zone 22 (II 3GD) eingesetzt werden.
- Der Sensorstromkreis darf in die Zone 0 (II 1G) eingeführt werden. Entspricht der Bezeichnung II 2(1)G.
- Die Geräte dürfen nur in Messstoffen eingesetzt werden, gegen welche die prozessberührenden Materialien beständig sind.
- Das Gerät ist an den Potenzialausgleich (PA) anzuschließen, dazu steht ein innerer und äußerer Anschluss zu Verfügung.
- Das Gerät ist vor mechanische Belastung und UV Licht zu schützen.

- Install in accordance with manufacturer's instructions and valid standards and rules.
- Unlocking the device or open the junction box is only permitted with the power off.
- When installing the unit, make sure that the housing IP66 degree of protection is maintained in accordance with EN 60529.
- This equipment can be used according to manufacturers' instructions in Zone 1, 21 (II 2GD) and 22. (II 3GD).
- The sensor circuit can be introduced into the zone 0 (II 1G). Corresponds to the designation II 2(1)G.
- The device may only be used in such conditions, against which the process-contacting materials are resistant.
- The unit must be connected to the potential equalization (PA), an internal and external terminal is available.
- The unit must be protected against mechanical impact and UV light.

- Installer conformément aux instructions et aux normes et règles en vigueur du fabricant.
- Libérer l'appareil ou ouvrir la boîte à bornes ne est autorisée qu'avec l'appareil hors tension.
- Lors de l'installation, assurez-vous que le degré de protection IP66 boîtier est maintenu conformément à la norme EN 60529.
- Cet équipement peut être utilisé selon les instructions du fabricant dans la zone 1, 21 (II 2 GD) et 22 (II 3GD).
- Le circuit de capteur peut être introduit dans la zone 0 (II 1G). Correspond à la désignation II 2(1)G.
- Le dispositif ne peut être utilisé dans de tels liquides, contre lequel les matériaux de traitement contact sont résistants.
- L'appareil est connecté à la liaison équipotentielle (PA) pour rejoindre, ceci est une borne interne et externe à votre disposition.
- L'appareil doit être protégé contre les chocs mécaniques et la lumière UV.

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1. General

The operating instructions are included in the scope of delivery and are intended to ensure proper handling and optimal function of the device. The manufacturer provides no warranty for this publication and assumes no liability for improper handling of the products described. For this reason, the operating instructions must be read before use. Furthermore, the operating instructions must be made known to all persons involved in the transport, installation, operation, maintenance, and repair of the device. This operating manual may not be used for competitive purposes without the written consent of the manufacturer, nor may it be passed on to third parties. Copies for personal use are permitted. This documentation may contain technical inaccuracies or typographical errors. The information contained herein is regularly revised; please check the contact address for possible updates. The manufacturer reserves the right to modify or change the products described at any time.

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SYMBOLS



This sign shows Safety notes.

Safety notes must be followed. Failure to observe may result in personal injury or property damage. The manufacturer assumes no liability.

SAFETY NOTES



Installation, electrical connection, maintenance and commissioning may only be carried out by trained personnel.



Excessive mechanical and improper stress must be avoided.



The power supply must be disconnected during assembly and disassembly.



The display loses contrast and brightness in cold temperatures. It recovers to its original state as the temperature rises.



The IP66 housing protection applies to the installed and properly sealed device. With the electronics unit removed, the housing meets IP20 protection requirements.



Due to the limited space in the AC.Ex junction box, we recommend a cable cross-section of $\leq 1 \text{ mm}^2$. For a maximum current consumption of 2 A, a 0.5 mm^2 cross-section is sufficient. If necessary, an additional Ex e terminal box must be used.

2. Product description

A basic device AC.Ex and various sensors of the IY.Ex series solve a wide variety of measuring tasks. The sensors stand for multifunctionality, maximum accuracy and easy installation.

The following sensors are available

- Differential pressure, volume flow
- Special sensors available upon request

Furthermore, the buttons enable on-site commissioning and the LCD display serves as an on-site measured value display.

The integrated junction box with Ex e protection type ensures direct electrical connection in the Ex zone.

The modular concept of separating the electronics and mounting console ensures simple, safe installation and commissioning.

Options such as different sensor cables for difficult installation conditions complement the product portfolio. The device's design makes calibration of the measuring chain extremely simple.

MEASURING PRINCIPLE

The physical quantity is recorded in the IY.Ex series sensors. The measured value is processed digitally. The data is transmitted to the AC.Ex controller via an "intelligent" protocol, which allows for easy sensor replacement and is open to future sensor integration.

The robust, interference-free signal from the sensor to the controller enables transmission of up to 100 m in harsh industrial environments.

In the AC.Ex controller, this signal is converted into a volume flow using duct-specific parameters and compared with the setpoint. The control deviation is converted into scalable analog outputs and is typically used to control an actuator to further open or close a damper or valve. Voltage and current outputs are available, which can be configured via the software menu. A non-floating contact is available as an alarm contact.

AREAS OF APPLICATION

VAV Variable Volume Control

The differential pressure sensor measures the pressure drop in the ventilation duct, e.g., via a measuring orifice or a cross-shaped measuring device, as a measure of the volume flow. In variable volume flow controllers (VAV), the measured pressure is used to control the damper position within a closed control loop, enabling demand-based ventilation.

CAV Constant Volume Control

CAV systems are often used with frequency converters to maintain the air flow rate regardless of changes in pressure drop. These changes occur, for example, when filters become dirty. A constant flow rate is set as the setpoint.

INTENDED USE

The device is intended for use in the industrial HVAC sector for technical ventilation. In addition to the legal requirements, please observe engineering and professional practice. The device is approved according to the explosion protection equipment group and category and in compliance with all manufacturer's instructions necessary for the safe operation of the equipment, protective systems, and devices. Failure to comply with these instructions will void the operating license.

FORESEEABLE MISAPPLICATION

The manufacturer has incorporated maximum safety to prevent damage to property and personal injury. Limitations and hazards are specified. Use outside the technical specifications stated in the user manual is not permitted.

3. Technical Data

AC.Ex REGLER / CONTROLLER

SUPPLY		TERMINAL 1-2 resp 4-5 ACTUATOR	
Voltage		20 – 28,8	V AC/DC
Frequency		50 – 60	Hz
Power consumption without actuator		3 / 5	W / VA
Protection class / Overvoltage category / Pollution degree		II / II / 2	insulated
ALARM CONTACT		TERMINAL 1 (GND) 3 (V+)	
Voltage		20 – 28,8	V AC/DC
Current		5 – 100	mA
Power		< 3	W
INPUT SETPOINT		TERMINAL 9 (V/mA) 10 (GND)	
Voltage/Current selectable by menu		0(2)– 10 / 0(4) – 20	V DC / mA
Bürdeneinfluß		0,1/100	% / Ohm
OUTPUT CONTROLLER, ACTUAL VALUE		TERMINAL 11 (V/mA) 10 (GND)	
Voltage/Current selectable by menu		0(2)– 10 / 0(4) – 20	V DC / mA
Accuracy		0,1	% FS
Effect of temperature		< 0,01	% / K
Effect of load		0,1/100	% / Ohm
DISPLAY / LED			
LCD, backlight		128 x 64	pixel
LED red / green		Status indication	
HOUSING			
High Tech Polymer		halogen-	free
Corrosion resistant		On- and Offshore	
Increased protection (locked, plugged in)		IP66	
GENERAL			
Terminal cross-section		without end sleeve 0,08 – 2,5	mm
ATEX/IECEX Ex e		with end sleeve 0,25 – 1,5	mm
Cable glands 2 x M20x1,5 ATEX/IECEX Ex e		6 - 13	Ø mm
Dimensions H x W x D		175 x 110 x 56	mm
Weight		800	g
MATERIALS			
Housing		PC	Electrostat. conductive
Front plate		PE	
Screws		Stainless steel	
Encapsulation		PUR	
Seals		EPDM	
Cable glands, Sensor connection M12		Brass plated	
AREA OF APPLICATION			
Ambient temperature		-40 ... +58	°C
Storage temperature		-40 ... +70	°C
Humidity, without condensing		0 ... 90	%r.F.
Installation position, altitude		any, recommendation vertical, < 2000 m	

IY.Ex-P-... PRESSURE / DIFFERENTIAL PRESSURE / AIR VOLUME

TYPE	MEASURING RANGE	MIN. ADJUSTMENT	MAX. PRESSURE	ACCURACY MAX / TYPICAL	
IY.Ex-P-0060	-60 ... +60	18	7000 [1 psi]	<2,75 % / <0,5 %	Pa
IY.Ex-P-0100	-100 ... +100	30	7000 [1 psi]	<2,75 % / <0,5 %	Pa
IY.Ex-P-0250	-250 ... +250	75	7000 [1 psi]	<1,5 % / <0,3 %	Pa
IY.Ex-P-0600	-600 ... +600	180	7000 [1 psi]	<1% / <0,2 %	Pa

4. Certificate

AC.Ex	ATEX IECEX	EPS 22 ATEX 1 338 X IECEX EPS 22.0074X	II2(1)G II2D	Ex eb mb ib [ia Ga] IIC T4 Ex tb [ia Da] IIIC T130°C	Gb Db
IY.Ex	ATEX IECEX	EPS 22 ATEX 1 338 X IECEX EPS 22.0074X	II1/2G II2D	Ex ia IIC T6...T1 Ex ia IIIC T75...T145°C	Ga/Gb Db

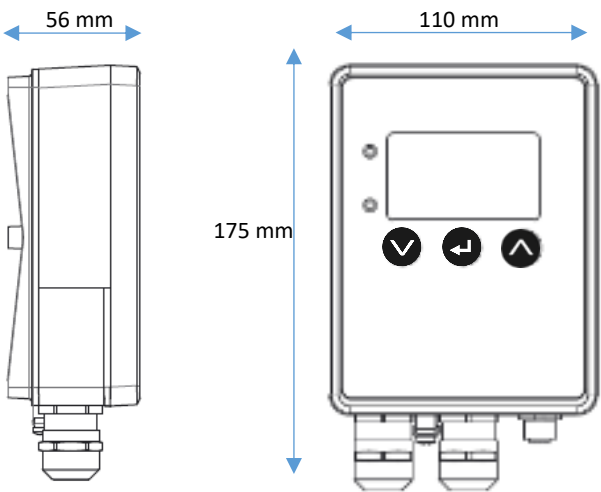


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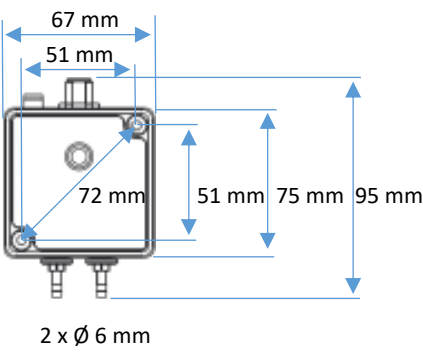
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5. Dimensions

AC.EX (REGLER / CONTROLLER)



IY.EX-P.... (PRESSURE / DRUCK)

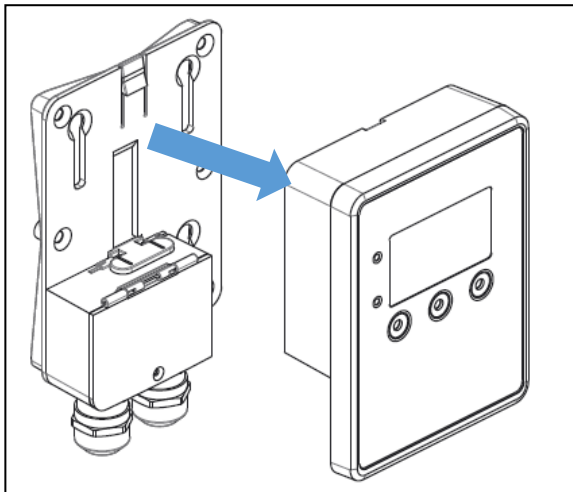
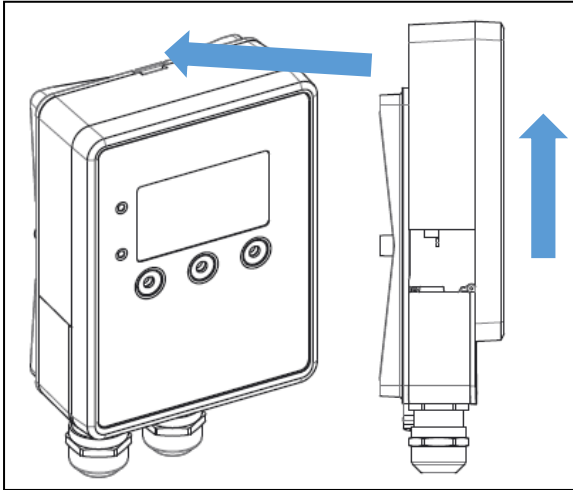


6. Assembly / Installation



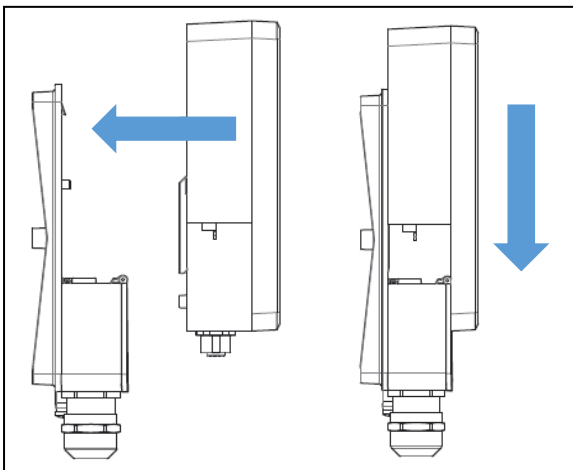
UNLOCK ELECTRONIC

- Switch off power and check
- Press down release tab carefully
- Slide the electronics module up and
- Remove it towards the front



LOCKING ELECTRONICS

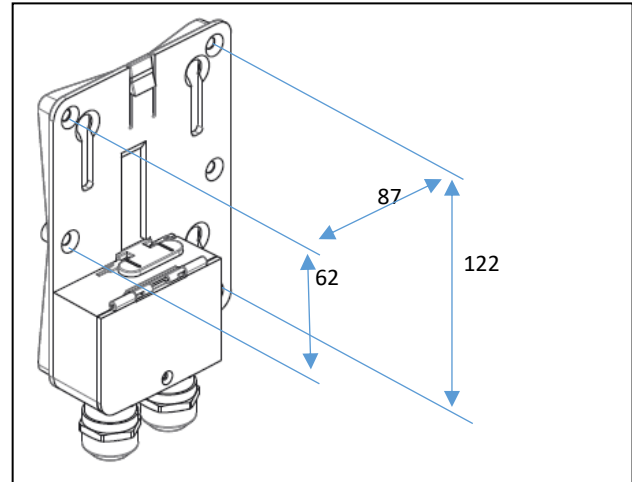
- Attach the electronics
- Lock by pushing together



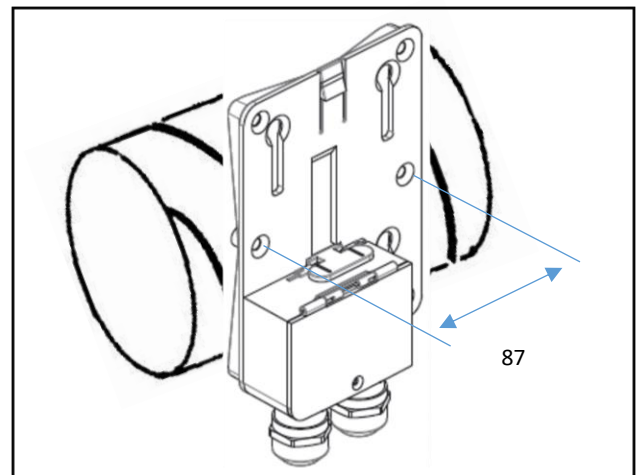
ATTACH MOUNTING FRAME

- Drill holes according to the drilling plan (see illustration)
- Mount base frame with delivered screws.
- Make sure when mounting that the mounting frame is not under strain or sags
- For outdoor mounting make sure that no water accumulates or frost can form

WALL MOUNTING



TUBE MOUNTING



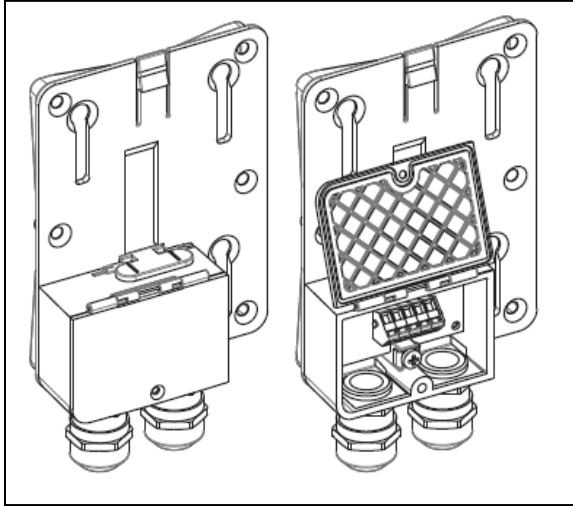
7. Electrical connection

The integrated electrical junction box protection type Ex e enables direct contact to the supply and the analog inputs and outputs. According to IEC 61010-1, the supply must be protected in the event of a fault against excessive high current draw from the mains by means of a slow-blow fuse rated $\geq 2 \text{ A}$ and $\leq 10 \text{ A}$, disconnecting all poles." Use copper wire only.

The IY sensors are supplied intrinsically safe Ex i either by screwing them in directly or via a cable from the M12 socket.

- Disconnect and check the power supply
- Unlock the electronics (see Chapter 5)
- Loosen the M3 screw on the cover and open the cover
- Remove the protection plug and insert the cable
- Strip the cable insulation (6 mm)
- Open the terminal by pressing with a screwdriver
- Insert the cable(s)
- Remove the screwdriver
- Close the cover
- Tighten the cable glands

- Close any unused opening with a blanking plug



TERMINAL ASSIGNMENT CONTROLLER

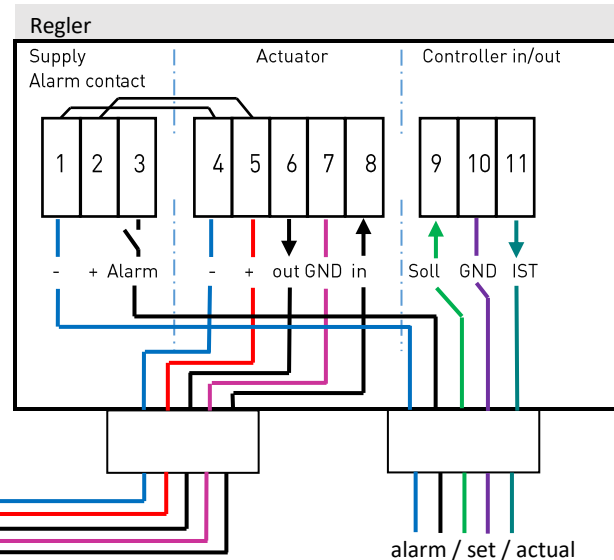
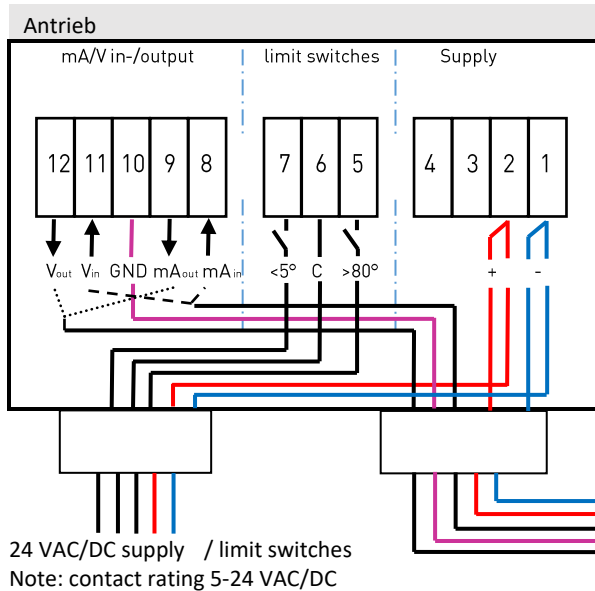
1	Supply	24 V AC/DC	L/+
2	Supply	24 V AC/DC	N/-
3	Alarm contact (potential affected)	24 V AC/DC	L/+
4	Actuator	24 V AC/DC	L/+
5	Actuator	24 V AC/DC	N/-
6	Actuator	Analog out	4-20 mA / 0-10 V
7	Actuator	Analog	GND
8	Actuator	Analog in	4-20 mA / 0-10 V
9	SPS/DDC	Controller set point	4-20 mA / 0-10 V
10	SPS / DDC	Controller	GND
11	SPS / DDC	Controller actual value	4-20 mA / 0-10 V



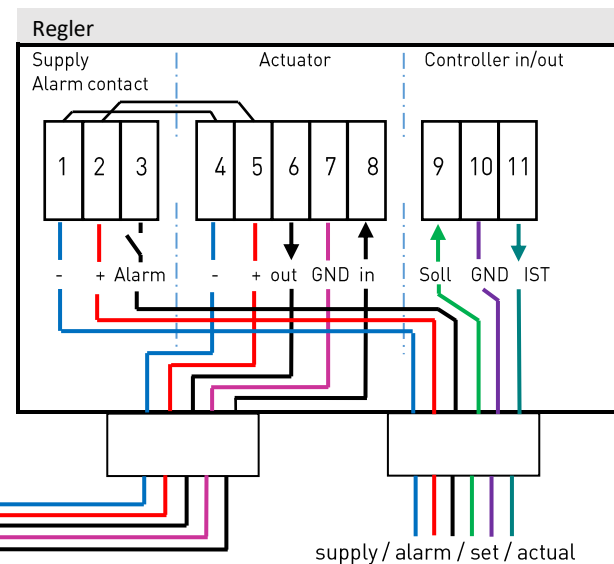
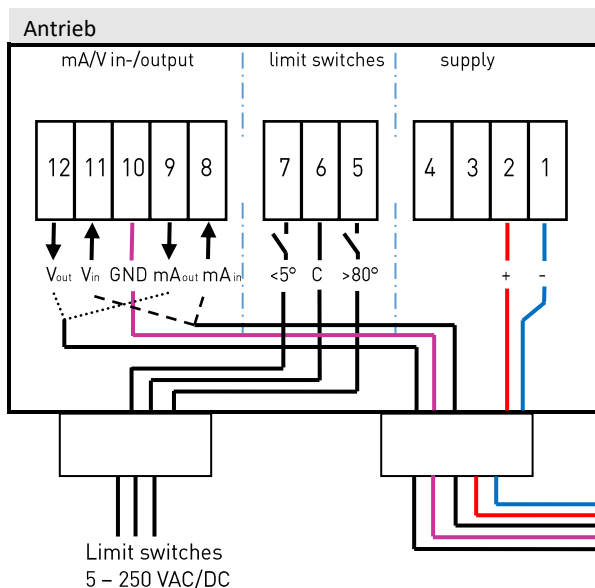
Due to the limited space in the AC.Ex terminal box, we recommend cable cross-sections of $\leq 1 \text{ mm}^2$.

For a maximum current consumption of 2 A, a cable cross-section of 0.5 mm^2 is sufficient. If required, an additional Ex e junction box "JB.Ex.4M20" is available as an accessory.

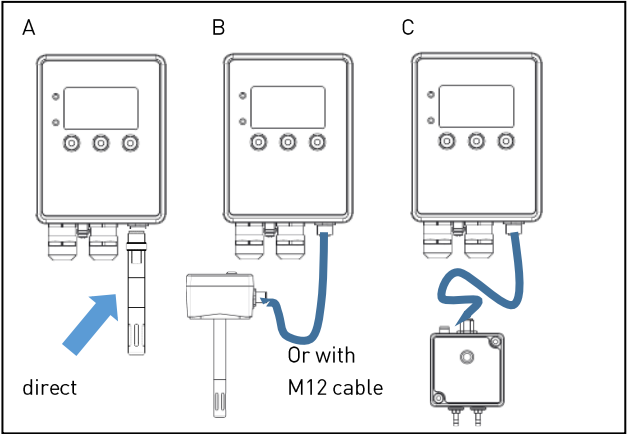
WIRING DIAGRAM A



WIRING DIAGRAM B



MOUNTING PROBE



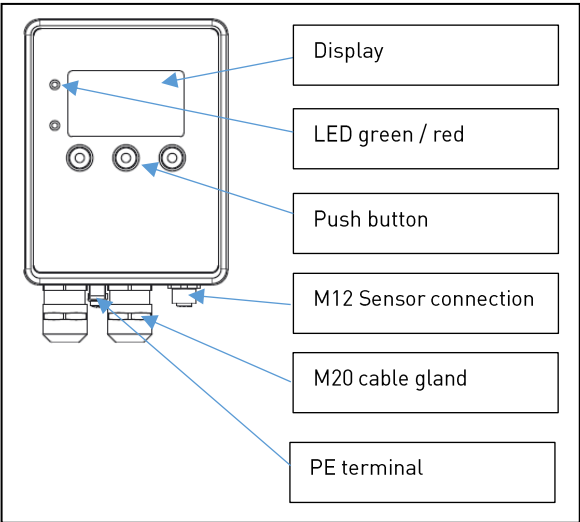
- A. Mounting a fixed sensor:
- The transmitter must be mounted so that the measuring sensor points downwards!
 - The room sensor can also be remotely connected via cable. Connecting cables or contacts for custom wiring are available as accessories.
- B. Mounting a remote temperature/humidity sensor
- The sensors can be extended up to 100 m using a plug-in connection cable.
 - The sensor must be mounted in such a way that no moisture can penetrate.
 - A drain elbow must be provided during installation.
 - The connection cable must be shielded.
- C. Mounting a remote pressure sensor.
- The sensor must be mounted in such a way that no moisture can penetrate.
 - Pressure hose connection with 6 mm inner diameter. Ensure a drain elbow is provided during installation. Moisture will permanently damage the sensor element.
 - The connecting cable must be shielded.

8. Commissioning

Make sure that the device has been correctly installed and connected according to the previous chapters and that the power supply corresponds to the information on the type plate.

- Turn on the power supply.
- The display turns on
 - The sensor data is loaded
 - The LED lights up green when the sensor is connected and within the set measuring range
 - A zero point adjustment is recommended for IY.Ex-P... pressure sensors. See the section Parameterization / Sensor Settings / Zero Point Adjustment

9. Operation



10. Parameterization

DISPLAY	ACTION	DISPLAY	ACTION	DISPLAY	ACTION	DESCRIPTION	ACTION
Parameterization mode					⬇	press for 3 seconds	
	⬇	Language setting	⬇	D Deutsch GB English F Francais E Espanol I Italiano		Use the arrow keys to select the desired language Confirm with Enter	
User Menu						Level 1 only for adjusting the setpoint	
	⬇	Enter Password	⬇	0 0 0 0 Save password? yes / no	⬆ ⬇	⚠ Enter password * or release the level if a password has been entered	⬇
	⬇	Setpoint	⬇	Setpoint 50 m3/h 0 600	⬆ ⬇	Setting the setpoint to which the device should regulate	⬇
	⬇	Display	⬇	Lighting off Lighting on	⬆ ⬇	Turn the backlight on or off.	⬇
	⬇	Save	⬇	Save entries? Discard Back to main menu	⬆ ⬇		⬇

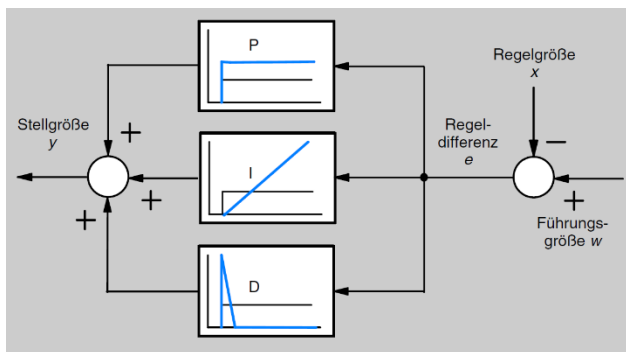
* Please note your password

OEM Settings						Level 2 for adjusting all values	
Basic settings	⬅	Enter Password	⬅	0 0 0 0 Save password? yes / no	⬆⬇⬆	⚠ Enter password * or release the level if a password has been entered	⬅
	⬇	IO's mA or Volt	⬅	mA 4 - 20 Volt 0 - 10 DDC mA 4 - 20 Volt 0 - 10 QT.Ex	⬆⬇⬆	Controller input/output values and setting the upper/lower limit Select mA or V actuator (pay attention to the actuator wiring must state exactly what you choose here on Controller, otherwise it will not function/will malfunction")	⬅
	⬇	Application	⬅	Pressure Airflow	⬆⬇⬆		⬅
	⬇	Setpoint	⬅	External (DDC) Internal Automatic	⬆⬇⬆		⬅
	⬇	Switch contact	⬅	Switch NO Switch NC	⬆⬇⬆	Alarm contact NO is normally open NC is normally closed	⬅
	⬇	Direction of Actuator	⬅	normal inverse	⬆⬇⬆	(CW) clockwise or (CCW) counterclockwise	⬅
	⬇	Back to main menu					⬅
Sensor settings	⬅	Zero point adjustment	⬅	Remove hose connections then press <ENTER>	⬆⬇⬆	The pressure sensor is set to zero	⬅
	⬇	Metering range	⬅	Pa 0 300 -600 600	⬆⬇⬆	Measuring range lower - upper Define limit min 15% FS This is used to calculate the volume flow Vmin / Vmax	⬅
	⬇	Attenuation	⬅	2 (1-50)	⬆⬇⬆	Averaging of the sensor adjustable from 01 to 50	⬅
	⬇	k-Factor	⬅	10 (0-500)	⬆⬇⬆	Aperture factor / k-factor specific coefficient of the fan, measuring orifice	⬅
	⬇	Back to main menu					⬅
Controller settings	⬇	Control range	⬅	m ³ /h 0 300 -60 60	⬆⬇⬆	Control range The setting range depends on the set measuring range	⬅
	⬇	Set point	⬅	123 0 600	⬆⬇⬆	Setting the setpoint The setting range depends on the set measuring range	⬅
	⬇	Controller parameters	⬅	Kp = 0,50 (0,00-1,00) ki = 0,05 (0,00-1,00) kd = 0,25 (0,00-1,00) ta = 100 mS (100-5000) rh = 2 % (2-10%) Rv = 0,50 (0,1-3,0)	⬆⬇⬆	Setting the PID controller parameters Information and assistance can be found in the following chapters of the operating manual.	⬅
	⬇	Input characteristic	⬅	Input <= 2.0 mA = Shut-off controller min value	⬆⬇⬆	Controller behavior when the input value falls below the set value.	⬅
	⬇	Dead time [s]	⬅	15 s (0-300)	⬆⬇⬆	Dead time setting Delayed actuation through running times or for alarm contact	⬅
	⬇	Max Deviation (E _{max})		5 % (2-20)		If max deviation (E _{max}) + dead time is exceeded = relay + LED red	
	⬇	Back to main menu					⬅
Manual control	⬇	Manual control	⬅	Sensor 1 3 Pa Sensor 2 20,3 m ³ /h Actuator 45,0° 12 mA	⬆⬇⬆	Scroll to the end and then press and hold the middle button to exit the menu	⬅
Record characteristic	⬇	Record characteristic	⬅		⬆⬇⬆	The actuator runs a 0°-90°-0° cycle in 1 mA/1 V steps and records the results in a graph.	⬅
Back							

* Please note your password

The color-coded fields correspond to the controller settings, which can be fine-tuned by the application!

11. Controller Structure



TERMS

Controller

Is the part of the control loop that calculates the manipulated variable y from the control deviation, taking into account the dynamic properties of the controlled system.

Controlled system

Is the part of the control loop that is to be controlled by the controller.

Reference variable (setpoint) w

The specified value at which the controlled variable is to be maintained by the controller. It is a variable not influenced by the controller and is supplied externally or preset.

Controlled variable (actual value) x

The output variable of the controlled system (e.g., volume flow) is recorded for control purposes and fed back for comparison. It is recorded by a sensor.

Control deviation e

The difference between the reference variable and the controlled variable $e = w - x$ forms the actual input variable of the controller.

Control variable y

The output variable of the control system and simultaneously the input variable of the process. It transfers the control effect of the controller to the process.

Disturbance z

An external variable that causes a change in the actual value of the controlled variable and triggers a control process.

CLASSIC CONTROL LOOP:

The controller compares the setpoint with the controlled variable. If there is a deviation, it calculates the corresponding manipulated variable to adjust the controlled variable back to the specified setpoint. The choice of controller type depends on the time behavior of the controlled system and the required control accuracy.

P-controller

The proportional controller multiplies the control deviation by its gain factor K_p and transmits the result without delay.

Software P controller: $y = K_p * e$

Disadvantage:

A small control deviation always remains.

I-controller

The integral-acting controller sums the control deviation over time and multiplies the sum (i.e., the integral) by the factor K_i . The longer a control deviation persists, the larger the manipulated variable of the I controller becomes. Deviations from the setpoint are completely compensated.

Software I-Regler: $esum = esum + e$
 $y = K_i * T_a * esum$

$esum$ is the sum of all previous deviations e . The parameter of the software I controller depends on the sampling time T_a .

Disadvantage:

Very slow, control time significantly longer than with other controller types.

PI-controller

The PI controller is the combination of P and I controller and combines the advantage of the P controller, the fast response, with the advantage of the I controller, the precise control.

Software PI-Regler: $esum = esum + e$
 $y = (K_p * e) + (K_i * T_a * esum)$

PD-controller

The PD controller combines the P controller with a D component. The D component differentiates the change in a control deviation and calculates the rate of change of the control deviation. This attempts to predict the behavior of the controlled variable and react to a change that has not yet fully occurred. The PD controller is very fast but introduces unrest into the control loop.

For example, if pressure fluctuations occur during volume flow control when measuring the differential pressure at the pressure gauge, the PD controller will never settle. As a result, the actuator on the control valve will continuously perform small control movements. This causes enormous wear and tear on the system!

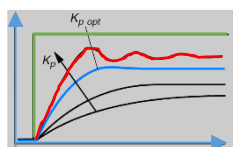
Software PD-Regler: $y = (K_p * e) + (K_d * (e - e_{alt})/T_a)$
 $e_{alt} = e$

PID-controller

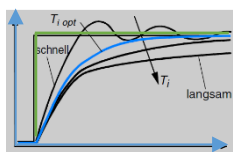
The PID controller tries to combine the positive properties of the other controllers and is therefore the most universal controller.

Software PID-Regler: $esum = esum + e$
 $y = (K_p * e) + (K_i * T_a * esum) + (K_d * (e - e_{alt})/T_a)$
 $e_{alt} = e$

EMPIRICAL SETTING OF THE CONTROLLER

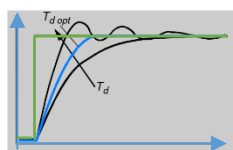


Start with a pure P-controller. Increase the control gain K_p until overshoot just stops. However, a permanent control deviation will occur.



Now, the integral action component is activated via K_i to reduce the residual control deviation to zero. Initially, a small K_i is selected so that the integrator is slow and the system remains stable. K_i is gradually

increased until the residual control deviation is quickly eliminated, but the system still remains stable. It may be possible to reduce the control gain K_p slightly.



Finally, you can try to further dampen the system with a D component and simultaneously increase the controller gain K_p to speed it up. To do this, gradually increase the D component K_d and observe the behavior. In a simple

system without dead time, an additional D component often cannot achieve any further improvement. In this case, a pure PI controller provides the best performance.

In summary:

- The P term increases the system speed and reduces the residual steady-state error of the step response, but cannot completely eliminate it: "residual control deviation."
- The integral term eliminates the residual error of the step response, but adds unwanted "oscillations" to the transient response (overshoot).
- The D term dampens and eliminates the unwanted oscillations. The control parameters E_{max} , R_v , and t_a further dampen the controller.
- A small E_{max} and R_v stabilize the controller.
- A small sampling time t_a , on the other hand, makes the controller faster but also unstable.

AC.EX

w	Set value (leading value)
t_a	Sampling time
K_p	P gain
K_i	I gain
K_d	D gain
R_v	Control gain
E_{max}	max value in % ($w - x$)
rh	Control hysteresis
e	Control deviation
$esum$	Deviation total
$ealt$	Last deviation
y	Manipulated variable
x	Actual value (controlled variable)

CONTROL ALGORITHM

$$\begin{aligned}
 e &= w - x \\
 esum &= e + ealt \\
 y [K_p] &= K_p \cdot e \\
 y [K_i] &= K_i \cdot (t_a \cdot esum) \\
 y [K_d] &= K_d \cdot \left(\frac{e - ealt}{t_a} \right) \\
 y [Ki] &= (K_p + K_i + K_d) \cdot R_v \\
 ealt &= e
 \end{aligned}$$

CONTROL SETTINGS ON THE AC.EX:

Adjustable control parameters:

k_p Factor	Adjustment 0,00 bis 1,00	default	0,50
k_i Factor	Adjustment 0,00 bis 1,00	default	0,05
k_d Factor	Adjustment 0,00 bis 1,00	default	0,25
t_a	Adjustment 100 bis 5000 ms	default	100
rh	Adjustment 2 bis 10 %	default	2
E_{max}	Adjustment 2 bis 20%	default	5
r_v	Adjustment 0,1 bis 3,00	default	0,50

k_p , k_i und k_d the classic control parameters are standardized to a range of 0.00 to 1.00

t_a is the sampling time of the controller.

rh is the control hysteresis.

E_{max} is the maximum permissible deviation from the setpoint in % at which no error is reported to the system. If this deviation is exceeded, the LED on the controller changes from green to red and the alarm relay is activated.

r_v is the control gain of the controller.

Selecting the controller type:

The controller type can be determined by entering 0 = k_p , k_i , or k_d . Example: PD controller is desired. $k_i = 0.00$, k_p and k_d are set to the desired value > 0.00.

VOLUME FLOW CONTROL

The volume flow is calculated according to the formula

$$Q \left[\frac{m^3}{h} \right] = k \cdot \sqrt{\Delta p [Pa]} \cdot 3.6$$

The size of the k factor depends on the measurement method used.

Example: A measuring cross generates a differential pressure of 50 Pa at a flow rate of 500 m³/h.

The k -factor is calculated as follows:

$$k = \frac{Q}{\sqrt{\Delta p}} \cdot 3.6 = \frac{500 \frac{m^3}{h}}{\sqrt{50 Pa}} \cdot 3.6 = 19,64$$

12. Error message

No display / LED

- Check the power supply
- Check that the mounting frame and electronics are locked

No output signal

- Check the power supply
- Check the wiring
- Check the parameter settings

Red LED

- Measured value outside the setting range
- Sensor cable break

13. Maintenance and repair

The device is maintenance-free; an annual functional test and regular cleaning of dust and dirt with a damp cloth is recommended.

14. Dismantling

- Disconnect and check the power supply
- Carefully press the release tab down
- Slide out the electronic module
- Open the terminal box
- Remove the cable

15. Repair

Returning a device for service. Installing and operating the device in accordance with this manual is generally extremely straightforward. Should a device need to be returned to our service department for repair or inspection, please note that a return form must be provided under the "Service Address" section on the last page.

16. Disposal

Every year, thousands of tons of environmentally harmful electronic components end up in landfills around the world. To ensure the best possible disposal and recycling of electronic components, the European Union created the WEEE (Waste of Electrical and Electronic Equipment) Directive. Please return these products directly to us at the end of their life so that we can dispose of them properly. WEEE is an important contribution to the environment, and we are happy to help reduce the burden on nature through this disposal concept.

17. Accessories Spare Parts

MA.Pa-06	connection tube and 2 m PVC hose
FM.Pa	filter to reduce humidity in pressure tubes
FK.Va-10	filter cap humidity pore size 10 µm
SC.Pu-01	1 m M12 cable for remote measurement
SC.Pu-05	5 m M12 cable for remote measurement
SC.Pu-10	10 m M12 cable for remote measurement
CS.Ms-M12FM	M12 shielded connector for cable confection
	Male and female connector
KL.Ms-20	Cable glands M20x1,5 Ms/Ni
KL.Va-20	Cable glands M20x1,5 A4, SS316
GW.Va-M5-G1/8	M5 thread enlargement to G1/8"
GW.Va-M5-G1/4	M5 thread enlargement to G1/4"
CR.Va-1/8-6	1/8" clamp fitting to 6 mm tube V4A
CR.Va-1/8-8	1/8" clamp fitting to 8 mm tube V4A
SR.Va-200	Pitot tube length 200 mm incl. adapter for pressure gauging for volume air flow measurement
JB.Ex-4M20	ATEX/IECEx Ex e junction box 110x75x75 plastic incl. 8 terminal clamps + PE and 4x20M cable glands

Revision Status

VERSION	DATE	SUPPLEMENT / CHANGE / NOTE
01	2023-05-15	First Edition
02	2024-05-21	Corrections, Circuit Diagrams
03	2024-11-13	Menu item control hysteresis rh
04	2025-05-28	Accessory expansion, circuit diagram corrections

EU Konformitätserklärung

EU Declaration of Conformity

Déclaration de Conformité UE

pi safety components GmbH & Co. KG ▪ Mühlenweg 2 ▪ 96358 Teuschnitz / Haßlach ▪ Germany

erklärt als Hersteller in alleiniger Verantwortung, dass das Produkt
declares as manufacturer under sole responsibility, that the product
déclare sous sa seule responsabilité en qualité de fabricant que le produit

AC.Ex
IY.Ex

den Vorschriften folgender Europäischer Richtlinien durch Anwendung harmonisierter Normen entspricht:
conforms with the provisions of the following European Directives by applying the harmonised standards:
est conforme aux prescriptions des Directives Européennes suivantes par l'application des normes harmonisées :

Richtlinien/Directives/Directives	Normen/Standards/Normes	Ex-Normen/Ex-Standards/Normes Ex
2014/35/EU (LVD)	EN 61010-1:2010+ A1:2019	EN 60079-0:2018
2014/30/EU (EMC)	EN 60529 (2012)	EN 60079-7:2015 + A1:2018
2014/34/EU (ATEX)	EN 61326-1 (2006)	EN 60079-11:2012
2012/19/EU (WEEE)	EN 61326-2-3 (2006)	EN 60079-18:2015 + A1:2017
2011/65/EU (RoHS)	EN 55011 Class A (2016)	EN 60079-26:2015
	EN 50581 (2012)	EN 60079-31:2014

EG-Baumusterprüfbescheinigung Nr:
EC-Type Examination Certificate No:
Numéro de l'attestation d'examen CE de type:

Regler
Controller
AC.Ex

EPS 22 ATEX 1 338 X
II 2(1)G Ex eb mb ib [ia Ga] IIC T4 (Gb)
II 2(1)D Ex tb [ia Da] IIIC T130°C (Db)

Sensor
IY.Ex-..

II 1/2G Ex ia IIC T6...T1 (Ga/Gb)
II 2D Ex ia IIIC T75...T145°C (Db)

Benannte Stelle Qualitätssicherung
Notified Body Quality assurance
Organisme Notifié Système d'assurance qualité

Bureau Veritas / 2004

Nürnberg, 15. Juni 2023



Rolf Petz
Geschäftsführer
Managing director
Le Directeur



Thomas Kellermann
Explosionsschutzbeauftragter
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Contrôleur de la protection Explosion

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