User's manual

Pressurized enclosure system

F 840

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Contents

1 Operation instruction explosion proofed devices

Application and Standards

This instruction manual applies to explosion protected control panels of type of protection types below. This apparatus is only to be used as defined and meets requirements of EN 60 079 particularly

EN 60079-14	"electrical apparatus for potentiality explosive atmospheres"

It can be used in hazardous locations which are hazardous due to gases and vapours according to the explosion group and temperature class as stipulated on the type label. When installing and operating the explosion protected distribution and control panels the respective nationally valid regulations and requirements are to be observed.

General Instructions

Please take care for adept transportation, storage and mounting, as well as accurate service and maintenance. Operation of this device should only be implemented by authorised persons and in strict accordance with local safety standards. The electrical data on the type label and if applicable, the "special conditions" of the test certificate **TÜV 03 ATEX 2095X** is to be observed.

For outdoor installation it is recommended to protect the explosion protected distribution and control panel against direct climatic influence, e.g. with a protective roof. The maximum ambient temperature is 40°C, if not stipulated otherwise.

Terminal compartment in Increased Safety

When closing, it is to be ensured that the gaskets of the terminal compartment remain effective, thus maintaining degree of protection IP 54 to DIN 40 050. Unused entries are to be closed off by impact-proof stopping plugs, which are secured against self-loosening and turning.

Maintenance Work

The gaskets of Ex e enclosures are to be checked for damages and replaced, if required. Terminals, especially in the Ex-e chamber are to be tightened. Possible changes in colour point to increased temperature. Cable glands, stopping plugs and flanges are to be tested for tightness and secure fitting.

Safety Measures: to read and to comply

Work on electrical installations and apparatus in operation is generally forbidden in hazardous locations, with the exception of intrinsically safe circuits. In special cases work can be done on non-intrinsically safe circuits, on the condition that during the duration of such work no explosive atmosphere exists. Only explosion protected certified measuring instruments may be used to ensure that the apparatus is voltage-free. Grounding and short circuiting may only be carried out, if there is no explosion hazard at the grounding or short circuit connection.

Warning! Extreme caution is advised when handling this device. High electrical discharge is possible and can be fatal.

2 Particular requirements to pressurized enclosure system F840

The FS840 can be combined with every EEx nP- housing that full fills the following requirements.

2.1 General requirements

1 The EEx nP system must be inspected by a skilled person of accordance to IEC 60079 –2, EN 60079 –14 and this manual.

2 Mount the solenoid valve (purging medium input) and control unit FS840 to an maximum of distance (optimal arrangement is diagonal)

3 The operator must not do any technical changes to the control unit FS840. Any change will invalidate the conformity statement TÜV 03 ATEX 2095 X.

4 Any maintenance activities has to be done by Gönnheimer Elektronic GmbH

5 Corrupt EEx p- pipe connections have to be repaired immediately

2.2 Determination of pre- purging period

If its not sure, at power up, that the atmosphere inside of the enclosure and the appropriate pipes is below 25% of the lower explosive limit (LEL) (EN 60079 – 14 chapter 13.4), a pre- purging of the pressurized enclosure is necessary.

2.3 Mechanical requirements to the EEx nP- housing

6 Regard particularly IEC 60079-2, section 7

7 The EEx nP- housing must hold the 1,5 – fold of the maximum pressure, which can be reached inside of the cabinet, 2 mbar at least. The operator has to define the maximum pressure of the housing and has to program this pressure value as monitored max. pressure into the FS840.

8 The EEx nP- housing must pass a impact test according DIN EN 50021 Table 13

9 The protection class of the EEx nP- housing must be greater than IP40.

10 Cable glands must have a protection class greater than IP54.

11 If the EEx nP- housing has surface made of synthetics (e.g. windows) with an area greater than 100 cm², than a warning sign against electro static discharge is necessary.

Caution ! Danger of static discharge. Clean only with humid cloth!

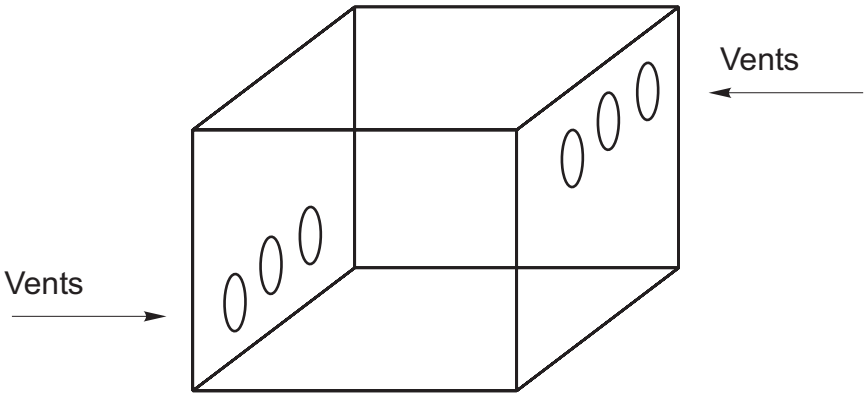
12 There is no danger of static discharge, if the synthetic surface has a thickness of $\leq$ 0,2 mm (Group IIC) respectively 2 mm (Group IIB) or less and it is mounted on a metallic ground.

13 If the EEx nP- housing posses internal compartments the installer has to obey the following rules:

a) Components with a free internal volume less than 20 cm³ are not considered to be internal compartments requiring purging as long as the total volume of all such components is not more than 1% of the free internal volume of the pressurized apparatus. (*IEC 60079 – 2; Abs. 5.5.4*)

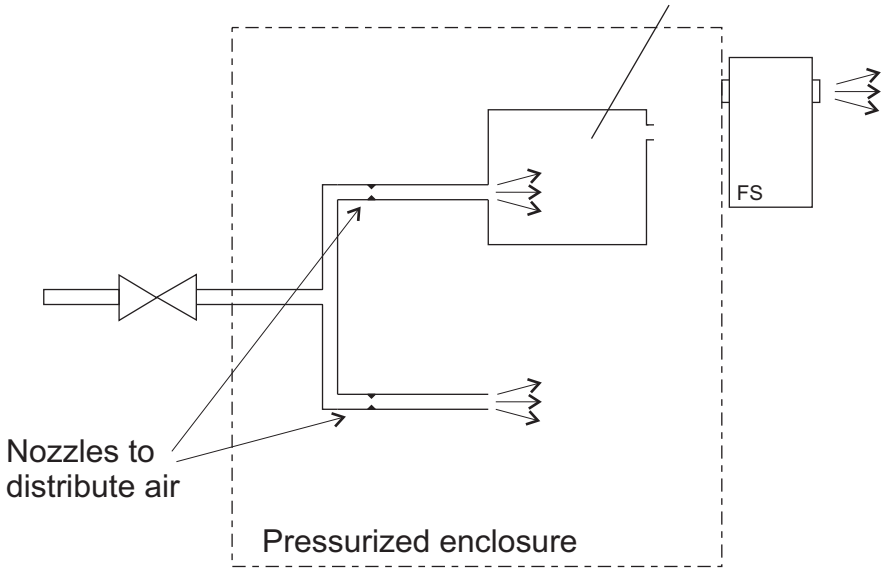
b) Provide not less than 1 cm² of vent area for each 1000 cm³, with a minimum vent size of 6,3 mm diameter should be allow for adequate purging. (*IEC 60079 – 2; Abs. 5.5.2*)

c) Place the vents in a diagonal order, as shown on the picture below, with a minimum vent size of 6,3 mm diameter



d) Installer can also remove covers or doors of internal housings if they provide adequate vent diameters alternatively.

e) If the topics above are not applicable, a separate piping must be added to the internal compartment. The purge medium flow through the compartment must be high enough to make sure that the air in the compartment is exchanged at least 10 times higher. For instance:



2.4 Purge medium requirements

14 The purging medium must not be derived from hazardous area, it must be contamination free (dry, free of oil and dust)

15 The temperature of the purge medium should not exceed 40°C.

16 If another purge medium than air is used, it is important to regard the minimum oxygen content of the ambient. Maybe it is necessary to install a exhaust pipe from the FS840 to out-of-door.

17 The pressure lost an the solenoid valve (P_{Valve}) must not be higher than 500 mbar, while pre- purging.

18 The introduction of flammable gas into the EEx nP- housing, e.g. for gas analyser application, is **prohibited**.

2.5 Temperature class of the EEx nP- housing

The installer has to define the maximum ambient temperature and the resulting maximum temperature class of the EEx nP- housing.

To determine the temperature class, measure, on worst conditions, the hottest point on the surface of the EEx nP housing and recalculate it to the maximum ambient temperature. The minimum temperature class is the one of the FS840 and its surface temperature.

If some parts inside of the housing get hotter than the temperature class, the installer has to determine the time in which the temperature of those parts falls below the temperature class. He has to place a sign on the EEx nP- housing with the following sentence:

Power off the apparatus and wait for x minutes for cool down !

X is the determinate time multiplied with a safety factor 1,5.

3 Introduction: pressurized enclosure system F 840

The use of simplified pressurized enclosures allows the operation of ‘non explosion protected’ devices in hazardous areas inside zone 2. The protection type ‘pressurisation’ is based on the principle of maintaining a constant pressure using air or a protective gas to prevent an explosive mixture forming near the apparatus inside the pressurized enclosure.

Generally before start-up, the pressurized enclosure must be purged with air or protective gas to remove any explosive mixture that may be inside the enclosure. This automatic procedure is called purging process.

An simplified pressurized enclosure system consists of two components and the enclosure.

1. control unit FS840 for process control and monitoring
2. Sinter metal throttle SD840 to control air input fed by pressured air network

See manual F840 for requirements of pressurized enclosure and integrated ignition capable apparatus.

If the operator is not sure, that the atmosphere inside of the enclosure and the appropriate pipe infrastructure is below 25% of the lower explosive limit (LEL) (EN 60079 – 14 chapter 13.4), the enclosure must be purged to achieve a safe atmosphere inside of the enclosure.

The F840 system can purge the enclosure automatically using the solenoid valve SVD.L. In this case the SVD.L replaces the sinter metal throttle.

3.1 Pressurized enclosure system for zone 2

The control device FS840 provides all necessary functions to install a pressurized enclosure system according EN 60079-14 section 13 : 1998, resp.. IEC 60079-2 : 2001 „pz“ . The FS840 measures the internal pressure and alarms or powers off, if the pre- defined minimum pressure is reached. The FS840 can also pre purge the housing before automatic powering on the housing. In this case connect a digital working 2/2 way solenoid valve to the appropriate terminals. The solenoid must have a separate certification for zone 2.

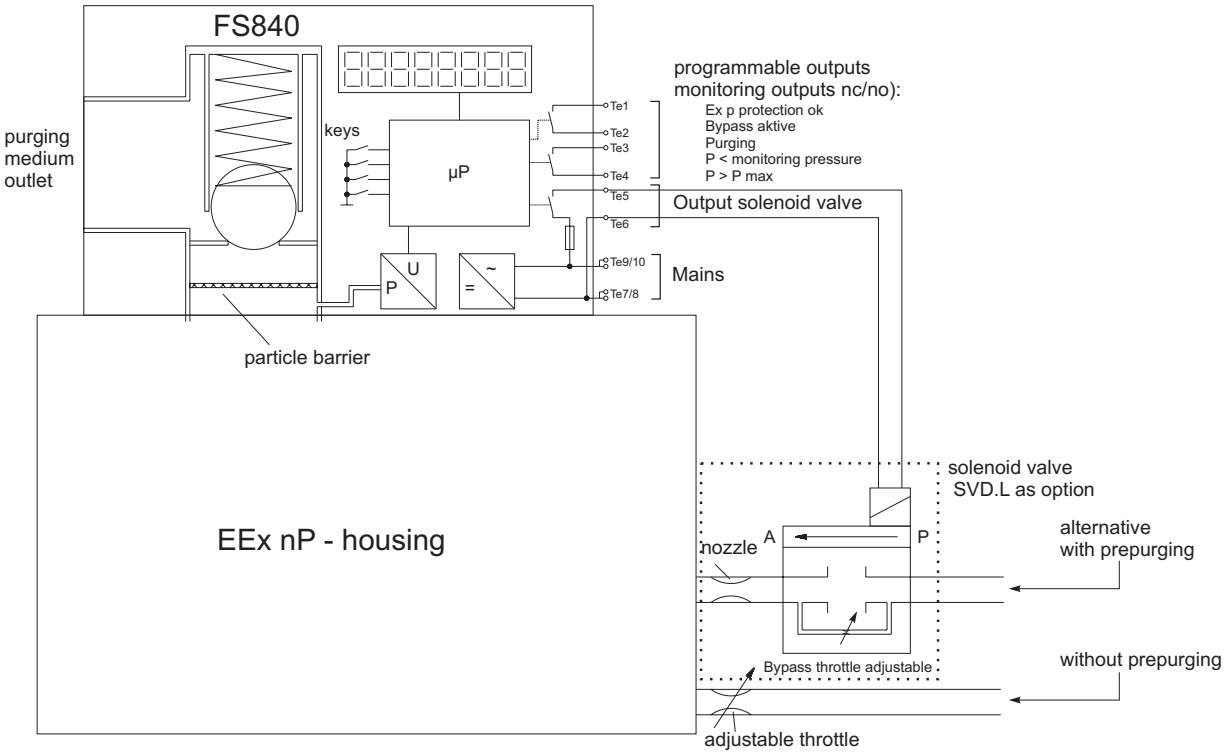


Figure 1 Block diagram

3.1.1 Pressurized enclosure system without pre- purging

If the operator is sure, that the atmosphere inside of the enclosure and the appropriate pipe infrastructure is below 25% of the lower explosive limit (LEL) (EN 60079 – 14 chapter 13.4) at power up, he can abandon the pre purging of the enclosure in zone 2. In that case the FS840 monitors only the pressure inside of the enclosure on 0.8 mbar at minimum and maximal 18.0 at maximum. If any limit is exceed, the FS840 changes the state on relay(s) output(s).

The purge medium flows through an adjustable sinter metal throttle into the housing while reducing its pressure (see block diagram). The FS840 has an mechanical output valve which opens at approximately 5 mbar to let the purge medium out. Before this valve is a spark lattice located thus the purge medium can be exhausted directly to the hazardous area.

3.1.2 Pressurized enclosure system with pre- purging

To pre- purge the housing connect a digital working 2/2 way solenoid valve (SVD.L) to the terminal 5 and 6 of the FS840. Also configure the pre- purging period into the structure menu of the control device. After pre- purging the valve closes automatically and the adjustable throttle of the SVD.L lets a small amount of purging medium into the housing to hold pressure.

The installer can determine the pre- purging time once by doing the attenuation test according EN 50016 section 14.3.

As an alternative he can calculate the purging time without the elaborate attenuation test see below:

The purging time depends on minimum flow (Q_{min}), free internal volume (V) and the free volume of the connected pipes (Va). Final the calculated time must be multiplied by 10. The purging time t_{purge} is:

$$t_{purge} = \frac{10 \times (V + Va)}{Q_{\min}}$$

The minimum flow (Q_{min}) depends on the minimum pre pressure (P_{premin}), the pressure lost at the valve (P_{Valve}), internal pressure of the EEx nP- housing (P_{Int}) and the nozzle diameter (d). The pressure lost at the valve (P_{Valve}) should not exceed 500 mbar. The maximum internal pressure of the housing is defined to be less than 20 mbar. The minimum flow Q_{min} can be calculated by:

$$Q_{\min} = \sqrt{\frac{2 \times (P_{pre\min} - P_{Valve} - P_{Int})}{\rho}} \times \frac{d^2 \times \pi}{4}$$

ρ is the density of the purging medium. The density of air is ρ =1,2393 kg/m^3, the density of nitrogen is 1,25 kg/m^3. WE calculate the ρ of air for all gases, because the difference is only 3%.

The installer can calculate the purging time of ist own or he can use the automatic calculation in the menu of the FS840 (see also section 5.5.1)

Example:

$$Q_{Beispiel} = \sqrt{\frac{2 \times (2 - 0{,}5 - 0{,}025) \times 10^5 \frac{kg\frac{m}{s^2}}{m^2}}{1{,}293\frac{kg}{m^3}}} \times \frac{0{,}002^2 \times m^2 \times \pi}{4}, \qquad mit\ 1\ bar = 10^5 \frac{kg\frac{m}{s^2}}{m^2}$$

$$Q_{Beispiel} \approx 0{,}0015\ \frac{m^3}{s} \approx 1{,}5\frac{l}{s}$$

4 Mounting and Connecting

4.1 Mounting, Dimensions

4.1.1 Control device FS840

The control device FS840 is suitable for mounting in hazardous area zone 2. The installer can place it in or outside of the EEx nP housing.

The installer can mount the control device using the 4 mounting holes in the housing rear, but the fixing on the air in- or outlet is sufficient.

Warning **Observe local safety guidelines and the regulative: EN 60079-14**

Warning **Additional see conditions to EEx nP System in section 2 in this manual.**

4.1.2 Optional solenoid valve for purging

The installer can mount the solenoid valve in or outside of the EEx nP housing, see details from manufacturer documentation.

4.2 Connecting and starting

Note the following item while connecting:

Warning!

- **LINE VOLTAGE Extreme caution is advised when handling this device. High electrical discharge is possible and can be fatal.**
- **See Installation regulative EN 60079-14 as well as Conformity statement TÜV 03 ATEX 2095X**
- **Do not exceed terminal safety limits of each terminal**
  See limits in technical details or declarations of conformity.
- **The internal solenoid valve fuse must be adapted to the solenoid valve**

4.2.1 Terminals of the FS840

Terminal		*Comment*
1,2		Relay contact 1
3,4		Relay contact 2
5,6		Terminal for solenoid valve
7,8	-	Mains, according to model conductor N or minus by DC
9,10	+	Mains, according to model conductor L1 or plus by DC

5 Configuration and operation

Configure the F840 with the 4 keys and the display.

5.1 Display

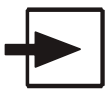
The built-in 8- figures display indicates operation modes, present pressure or flow rate data, as well as malfunctions.

5.2 Monitor Lamp

The FS840 has a monitor lamp below the display. This red lamp (LED) blinks if the pressure inside of the EEx p- housing is below the defined minimum pressure. In bypass mode the LED is permanently on and in normal operation the lamp is off.

5.3 Keyboard

The four multi-functional keys have different meanings and functions depend on the present operation mode.

Key	*Operation mode*	*Function*
 *„Shift right“-button*	normal operation running menu	none Shift cursor one position right.
BYPASS  *„Up“-button*	normal operation running menu	Activates Bypass; i.e. enable toggle ignition-capable device on or off independently of the purging status **(Be sure, that no explosive atmosphere is in environment)** Get next menu item
INFO  *„Down“-button*	normal operation running menu	Changes indication of the display: present pressure, flow rate, remaining purge time and present state of the purging system Get previous menu item
MENÜ  *„Enter“- button*	normal operation running menu	Enters main menu Initiates and confirms parameter input

5.4 Indication modes during normal operation

The actual status of the EEx nP- System is generally shown on the info display. Using the “Down- button the user can toggle to the pressure and remaining purge time indication.

5.5 Configuration

You must configure and enter the parameters of the control unit FS840 to achieve a desired mode of operation. All parameters of the control unit are structured in form of a menu.

5.5.1 The menu format

In the following table below shows explanations of the menu items. The table works as a reference guide for programming the desired system structure and to set the appropriate parameters correctly. The menu items are roughly sorted by class.

Please note that the viewable conditions of parameters are not included.

Classification			
1.Level	2.Level	3.Level	Description, Explanation
Language			Define the language shown on the display of the FS840 in this menu item. Available languages are: German, English, French, Dutch, Spanish
Structur	Purging	Purg. Y.	„Purg. Y.“ means that the EEx nP-housing will be pre purged before “Ex Ok” Message is set
		Purg. N.	„Purg.N.“ means that the housing will not be pre- purged. The “Ex Ok” Message is set and the min. Pressure is monitored
	Auto	Auto. Y.	***Automatic purging time Yes:*** The FS840 calculates the purging time out of pre- pressure, nozzle diameter
		Auto.N.	***Automatic purging time No*** (= Enter the purging time directly):
	O1 Func.	none	Define the function of output ***O1 (te. 1/2)***.
		O-Ex ok	***Explosion protection is ok:*** The output is set, if the pressure is higher than minimum.
		O-Bypas	***Bypass- output***: The output is high, if the bypass is active
		O-Purg.	***Purging- output***: The output is high as long the pre- purging procedure is running
		O-.Signal	***Signal pressure- output:*** the output is high, if the actual pressure inside of the EEx nP- housing is below the signal pressure level
		O-Pmax	***Maximum pressure- output:*** the output is high, if the actual pressure inside of the EEx nP- housing is higher the maximum pressure level
	O2 Funkt.	none	Define the function of output ***O2 (te. 3/4)***. See functions O1 above
	O2 no/nc.	no	define the circuit-opening connection of output O1 (terminal (1/2) no (= normal open) nc (=normal closed)
	O2 no/nc.	no	define the circuit-opening connection of output O2 (terminal (3/4) no (= normal open) nc (=normal closed)

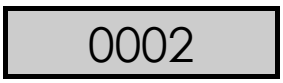
Param.	Pur. Time	***Purge time [h/min/sec]:*** Enter the purge time directly. The parameter only appears, if "automatic = no " is chosen. If „automatic = Yes" the following parameters will be asked:
	Pur. Vol.	• ***Purge volume [dm³]***
	Pre.-Pres	• ***Pre- pressure [bar]:*** pressure of the purge medium pipe or pre pressure controller
	Nozzle	• ***Internal nozzle diameter [mm]:***
	Min.Pres.P	• ***Minimum pressure while pre-purging [mbar]:*** During pre- purging procedure the FS840 monitors a increased pressure inside of the EEx nP housing to achieve the defined flow on the output valve. This increased pressure is monitored with this parameter (range = 7.0 mbar ... max. pressure)
	Min.Pres.R	***Minimum pressure at normal operation [mbar]:*** Monitored minimum pressure
	Max. Pres	***Maximum pressure at normal operation [mbar]:*** Monitored maximum pressure
	Sig. Pr.	***Signal pressure at normal operation [mbar]***
Codes	M-Code	***Menu code:*** Code word to start the main menu It is not possible to deactivate this code with „0000".
	By-Code	***Bypass code:*** Code word to start bypass mode. The code can be disabled with „0000" . The sequence „9999" disables the bypass in general

5.6 How to enter and leave the bypass mode

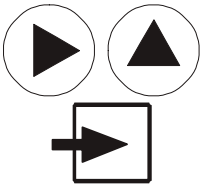
Warning **The use of the bypass is only allowed, if its sure that no explosive atmosphere is inside and around the EEx nP- housing**

(1) 1. Press the “up”- button

(2) The bypass code is needed



(3) The ex works Bypass code is ‘0002’.



Enter is right code using the arrow keys and confirm with the ENTER- key.

The bypass mode is now active.

NB Leave the bypass mode in the same way to enter.

6 Annex

6.1 Terminals and Terminals Ex- limits

Terminal	Voltage	Current	Power	Comment
1, 2	U_m = 250VAC U_m = 250VAC U_m = 30V DC	I_m = 5A bei AC1 I_m = 1,2A bei AC15 I_m = 5A bei DC1	P_m = 1500VA P_m = 300VA P_m = 150W	Relay contact 1
3, 4	U_m = 250VAC U_m = 250VAC U_m = 30V DC	I_m = 5A bei AC1 I_m = 1,2A bei AC15 I_m = 4A bei DC1	P_m = 1500VA P_m = 300VA P_m = 150W	Relay contact 2
5, 6				Terminal for solenoid valve
7/8, 9/10	U_m = 250VAC			mains

Table 1 Terminals Ex- limits

6.2 Technical details

		Control unit FS 840
General	Mounting	inside hazardous area
	Ex-protection class	II 3 G, EEx nAC [P] IIC T6 -20°C ≤ TA ≤ 40°C II 3 G, EEx nAC [P] IIC T5 -20°C ≤ TA ≤ 60°C Ex nAC [pz] IIC T6 -20°C ≤ TA ≤ 40°C Ex nAC [pz] IIC T5 -20°C ≤ TA ≤ 60°C
	EC- type certificate	TÜV 03 ATEX 2095 X
Housing	Environment protection	IP65 (Remark: without considering purge medium outlet)
	Dimensions	H x W x D: 120 mm x 122 mm x 90 mm
Electrical specifications	Material	Aluminium, lacquered / Ral 7035
	Main voltage	AC: 230V, 115V ; 48 ..62 Hz DC: 24V
	Power consumption	ca. 2 VA, without solenoid valve
	Working circuits Terminal 1-4	U_m = 250VAC, I_m = 5A bei AC1, P_m = 1500VA U_m = 250VAC, I_m = 1,2A bei AC15, P_m = 300VA U_m = 30V DC; I_m = 4A bei DC1, P_m = 150W
	Solenoid valve te. 5/6	Output voltage is equal to mains, protected by internal fuse
	Max. wire diameter	2,5 mm²
Pneumatic	Pressure range	0 ... 22 mbar
Mounting	Environment temperature	-20°C ...+40°C bei T6 -20°C ...+60°C bei T5
EEx p Configuration	Parameter input	LC-Display, menu guided Different languages : German, English, French, Dutch, Spanish

See certificate TÜV 03 ATEX 2095 X for more information

6.3 Flow chart

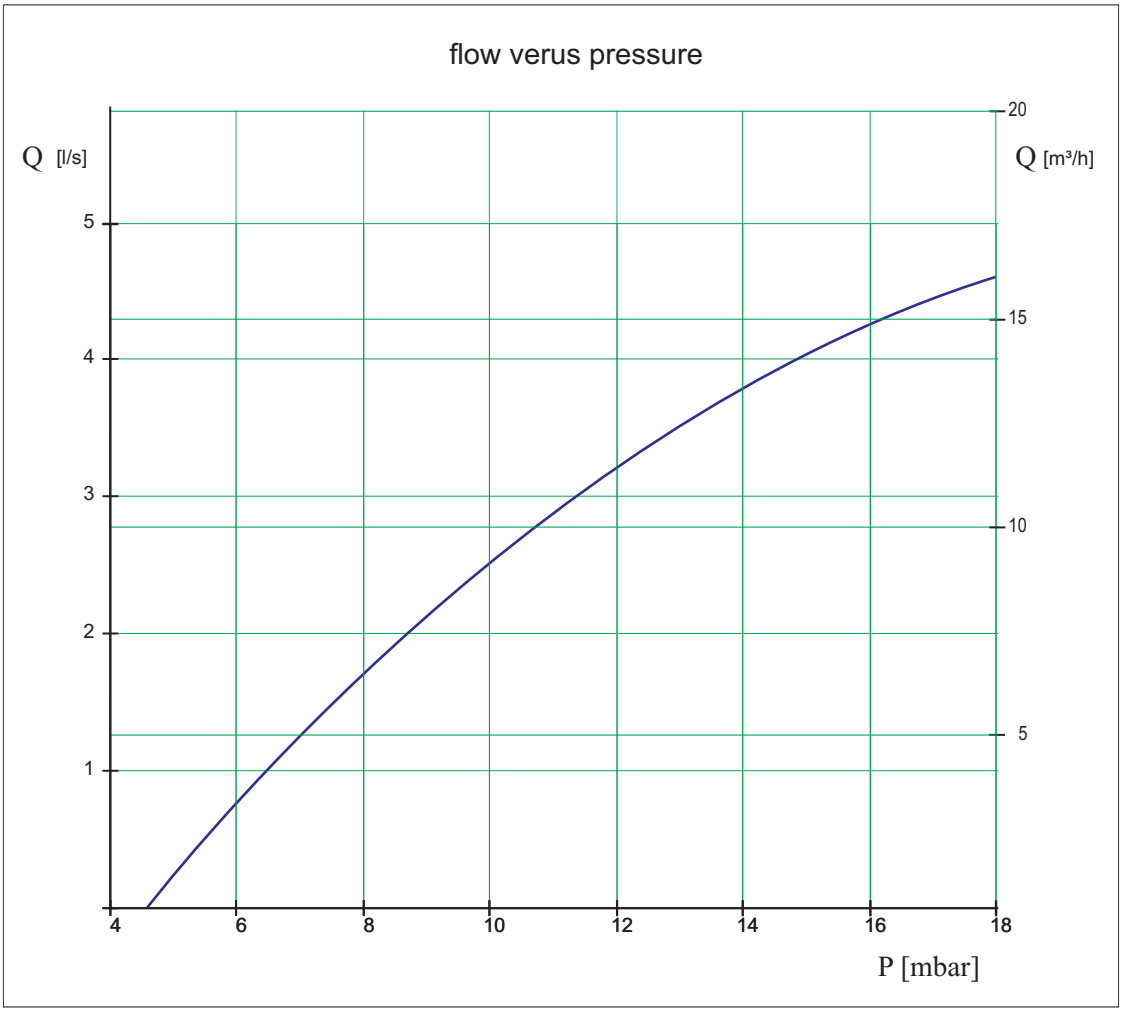


Figure 2: pressure versus flow inside Ex nP- housing

The diagram shows the relationship between pressure inside of enclosure and the output flow. The diagram is only valid, without reducing input or output diameters as well as flow reducing pipes.

6.4 Flow rate table

The table below shows the flow rate depending on pre- pressure and nozzle diameter

Pressure [bar]	Flow rate [l/s] ρ_{Air} = 1.293 kg/m^3 Nozzle diameter [mm]							
[10^5Pa]	*0,3*	*0,5*	*0,7*	*1*	*1,5*	*2*	*3*	*4*
1,5	0,0275	0,076	0,149	0,304	0,693	1,208	2,676	4,653
2	0,0338	0,094	0,184	0,374	0,838	1,48	3,27	5,651
2,5	0,0391	0,109	0,213	0,433	0,968	1,708	3,759	6,471
3	0,0438	,0121	0,238	0,484	1,063	1,908	4,186	7,177
3,5	0,048	0,133	0,261	0,53	1,195	2,087	4,569	7,804
4	0,0518	0,144	0,282	0,573	1,28	2,252	4,917	8,37
4,5	0,0554	0,154	0,301	0,612	1,367	2,404	5,239	8,883

6.5 Type sign

6.6 Problems and solutions

Code forgotten

- turn the device off (e.g. disconnect from power supply)
- press the very right (red) key, turn the device on
- hold the key, until "RESET" appears
- all data is set to ex work defaults

6.7 Type code

- Control unit FS840

	FS840 .x
mains:	
230V AC	.0
115V AC	.2
24V DC	.6

We can offer you the complete Solution: System F 840 with EEx p- housing and mounting of your apparatus inclusive system test and ATEX report

- Solenoid valve SVD.L.x

	SVD.L .x
nozzle:	
1 mm	.1
1,5 mm	.1.5
2 mm	.2
3 mm	.3
4 mm	.4
5 mm	.5

- adjustable Sinter metal throttle **SD840**

6.8 List of Parameters

System identification	Installation no.:	Date:	
FS 840. .	Production no.:	Solenoid valve	

Inputs	Description	Display	Value/ state	
Language	FS840 language	Language		
Structure				
Purging	Should the FS840 pre- purge the pressurized enclosure ?	Purging	Purg. Y. ❑	Purg. N. ❑
Purging method	Automatic or direct purging volume input	Auto	Auto. Y. ❑	Auto. N. ❑
Output function O1		O1 Func.	❑ none ❑ Exp. Protect. Ok ❑ Bypass	❑ Purging out ❑ Signal pressure ❑ Max.pressure
Output function O2		O2 Func.	❑ None ❑ Exp. Protect. Ok ❑ Bypass	❑ Purging out ❑ Signal pressure ❑ Max.pressure
O1 circuit opening connection		O1 no/nc	no ❑	nc ❑
O2 circuit opening connection		O2 no/nc	no ❑	nc ❑
Parameters	Purge time	Pur. Time		
	Purge volume	Pur. Vol.		
	Pre pressure	Pre.-Pres		
	Internal nozzle diameter	Nozzle		
	Minimum pressure while purg-ing	Min. Pres.P		
	Minimum pressure at normal operation	Min. Pres.R		
	Pressure monitor, maximum pressure	Max. Pres		
	Pressure monitor, signal pressure	Sig.. Pr.		
Codes	Code for main menu	M-Code		
	Code for bypass	By-Code		