

CE

## Operating Manual

## System F-350

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We hereby confirm the conformity of the equipment listed below with the directives of the Council of the European Community. The safety and installation instructions of the product documentation must be observed.

Model: **EEx px Purge System F-35... and F-361.A/.B/.C/.F**, consist of:  
-EEx px Controller F-351  
-EEx m digital / proportional valves F-220.2/.2B/.3/.4  
-EEx d box (es)  
-EEx m main switch  
-EEx d cable glands  
-EEx e cable glands

Directive: EMC Directive 98/336/EEC)\*

European standard: EN 50081-1, 3/93\*)  
EN 50081-2, 3/93\*)  
EN 50082-1, 2/96\*)  
EN 50082-2, 2/96\*)

Directive: Low Voltage Directive 73/23/EEC\*)

European standard: EN 61010-1 :3/94\*  
EN 50014 :2000  
EN 60079-2 :2004  
EN 60954-1 :1996  
EN 50018 :2000  
EN 60079-7 :2004  
EN 50020 :1994\*  
EN 60079-18:2004

\*) including amendments

A quality management system according to ISO 9001 and ATEX 94/9 is established since 1998 and will be periodically supervised from a notified body (TÜV CE 0032).

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**Wheel-Shuttle®** - Patented and registered trademark of the University of Dresden and the E.L.B. company. Operating and parametrization for the EEx-p controller F-351 with simple, intuitive operator guidance.

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# 1 Introduction

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## 1.1 Revision Status

This operator manual describes the following revision status of the equipment:

Rev. 2.9 of the EEx-p controller F-351

Rev. 1.0 of the parametrizing software

## 1.2 General Information on the Types of Protection

In hazardous areas of Zones 1 and 2, only certified electrical equipment with the types of protection EEx-d (flameproof), EEx-e (increased safety), EEx-i (intrinsically safe) and EEx-p (pressurized apparatus) shall be used. For some types of electrical equipment, the type of protection EEx-p is the simplest and most economical, and in certain cases it is only possibility.

## 1.3 Pressurized Apparatus

In the case of pressurized apparatus, a distinction is made between two modes, namely (a) operation with compensation for leakage losses, and (b) operation purge (a continuous flow of protective gas). In both cases, the enclosure should have at least IP 65 protection.

### 1.3.1 Operation with Compensation for Leakage Losses

In this mode, after an initial purging (which removes the potentially explosive gas mixture of the surrounding atmosphere from the enclosure) has been performed, a sufficient flow of compressed air or inert gas is introduced to compensate for the leakage of the enclosure and to maintain a minimum overpressure in relation to the surrounding atmosphere.

During the purging, a pressure difference of the least 4mbar is built up, whilst during normal operation the difference is at least 1 to 2 mbar (can be adjusted to other values).

### 1.3.2 Operation with Constant Purge

In this mode, the enclosure is purged continuously with compressed air or inert gas, e.g. in order to dissipate the heat generated in the enclosure. The air outlet of the control unit can end in the hazardous location; it is certified for this purpose.

During the purge process and also normal operation, a pressure difference of at least 4 mbar is maintained.

## 1.4 EEx-p Controller F-351

The EEx-p controller F-351 is a high-performance EEx-p system that opens up completely new applications in the Ex-Zones 1 and 2 of Group IIC T4. It serves to generate and monitor an overpressure in an EEx-p enclosure, in order to prevent the ingress of the surrounding atmosphere, which may consist of a potentially explosive gas mixture.

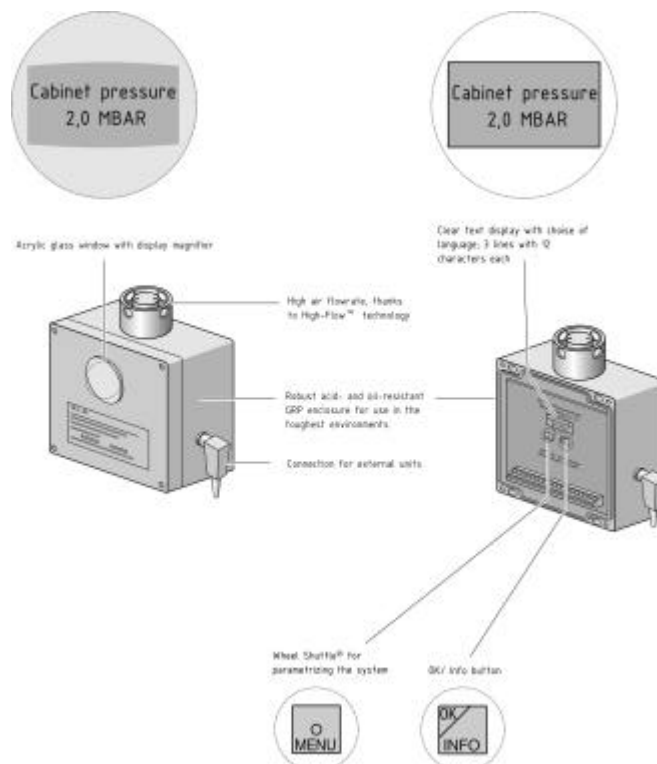
The controller is part of a product family of EEx-p controllers and is optimally designed to meet a variety of requirements. The world smallest system complies with the state of the art in EEx-p system technology.

Multiprocessor technology as well as consistently redundant signal acquisition and processing ensure that the safety level AK4 is met.

- smallest system worldwide for new possibilities realizing Ex p protection in ex areas
- Robust and wear-proof sensor engineering
- Robust, acid-and oil-resistant GRP enclosure, also suitable for applications in the offshore sector
- Clear text display with choice of language, in 3 lines with 12 characters each
- Innovative and intuitive Wheel Shuttle® user guidance for rapid parametrization in the field without the need for operating instructions
- High-Flow™ technology for short purge times, even for very large EEx-p enclosures
- EEx i connection for external operating, switching and monitoring units
- Acrylic glass window with magnification effect over the clear text display

The function of the pressurized apparatus has been approved by:

TÜV 02 ATEX 1801      EEx e m ia [p] [ia] IIC T4 for use in Ex areas classified as Zone 1 and 2



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## 2. Safety information and Notes

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### 2.1 Storage of this User Manual

Keep this user manual safe in the vicinity of the controller. Inform all persons who have to work on or with the controller where the manual is kept.

### 2.2 Types of Notes

The notes provided in this chapter provide information on possible dangers to the lives and health of persons (Danger, Warning), damage to property (Caution), malfunctions at the machine or in the vicinity (Important) and optimum use of the units (Information).

The notes listed in their entirety here are repeated at the corresponding points

### 2.3 List of Notes Used in this Documentation



For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the applicable ordinances and provisions concerned with explosion protection (VDE 0160, VDE 0165 or EN 60079-14, EN 50014 – 50039) as well as the Accident Prevention (UVV).



Before setting the units to work, read the technical documentation carefully.



The latest version of the technical documentation or the corresponding technical supplements is valid in each case.



Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.



Before switching on the electrical units in the enclosure, purge it out with a quantity of protective gas corresponding to at least five times the enclosure volume.



Work on electrically live parts, except for intrinsically safe circuits, is prohibited on principle if there is any danger of explosion.



If it can be assumed that safe operation is no longer possible, switch off the unit and secure it against renewed switching-on.



Before making any other electrical connection, link up the protective earth terminal and a protective earth conductor.



Before switching on, ensure that the operating voltages of the control unit and the digital/proportional controller correspond to mains voltage.



Ensure that only fuses of the specified type and the appropriate current rating are used as replacements. Jumpering or bypassing of fuses or back-up fuses is inadmissible on principle.



Whenever you open covers or remove parts- except if this is easily possible by hand - it is possible that electrically live parts may be exposed. Even terminal components may be electrically live.



The units comply with the state of the art and must only be connected to systems which have been approved for this purpose by E.L.B. Ex-Geräte Bachmann GmbH.



It is prohibited for the operator or his staff to open the units. This may only be done by specifically authorized personnel of E.L.B. Ex-Geräte Bachmann GmbH.

E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.



Modifications and conversions to the units are not permissible and will cause the Ex protection and the guarantee to become void.

E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.



The operating voltage of the units shall only lie within the limits specified in the technical documentation under Technical Data.

E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.



The technical data specified for the hazardous area comply with the values certified in the European EEx approval. The user bears the sole responsibility of examining the equipment with regard to its suitability for the intended application and environmental conditions.

E.L.B. Ex-Geräte Bachmann GmbH accepts no liability for any lack of suitability.



## 2.4 Note as per Ordinance on Hazardous Materials

According to the Waste Disposal Law of 27.8.1986 (AbfG. §11 Hazardous Wastes), the owner of hazardous wastes is responsible of their proper disposal. At the same time, according to the Ordinance on Hazardous Materials of 1.10.1986 (GefStoffV §17 General Responsibility for Protection), the employer has the duty of protecting his staff from danger. We must therefore point out that:

- (a) All units and/or systems sent to E.L.B. for repair must be free of any hazardous materials (acids, alkalis, solutions, potentially explosive gas mixtures etc.).
- (b) All units and/or systems sent to E.L.B. must be treated so that they do not contain any dangerous fluids or other hazardous materials. For this reason, in the case of units or systems which have come into contact with hazardous working materials (see the Ordinance on Hazardous Materials – GefStoffV), these materials must be neutralized appropriately.
- (c) In the event that service and repair is required, the measures described under (a) and (b) must be confirmed in writing.
- (d) Costs incurred through disposal of hazardous materials during a repair will be invoiced to the owner of the equipment.

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## 3 Structure and Function

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In conjunction with an enclosure with type of protection IP54 or higher, the EEx-p controller F-350 provides a pressurized apparatus that is in compliance with EN 50016.

For this purpose, it has all the facilities and sensors needed to monitor the necessary purge phase and then to monitor and maintain an overpressure within the EEx-p enclosure.

### 3.1 Structure

The controller consists mainly of two components which must be installed separately:

- controller F-351
- digital/ proportional controller F-220, with pressure regulator/ manometer

The controller itself monitors and regulates the overpressure in the enclosure, while the digital/ proportional controller doses the air quantity needed to achieve the pressurized apparatus.

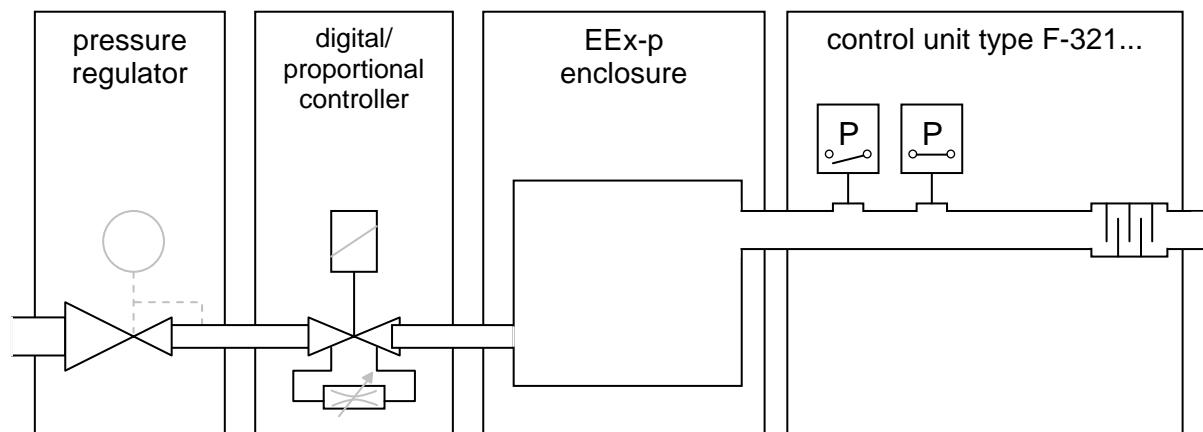


Fig. 1: Schematic diagram

As options, you can also expand the F-350 system with the following components:

- an external lockable switch (F-480)
- an external operating unit (F-411),
- a switching amplifier (F-420) for contact loads up to 10 A (25 A for starting currents),
- an external pressure sensor (RS-485 interface),
- an external temperature sensor (RS-485 interface).



**The latest version of the technical documentation or the corresponding technical supplements is valid in each case.**



The units comply with the state of the art and must only be connected to systems which have been approved for this purpose by E.L.B. Ex-Geräte Bachmann GmbH.

## 3.2 General Functional Description

For details and technical functions, see 9.5 „Technical Functional Description“.

After a functional test and start-up, the controller F-351 monitors the flow rate of the compressed air or inert gas during the initial purging process, and then monitors and regulates the internal pressure of the EEx-p enclosure with regard to the surrounding atmosphere during normal operation.

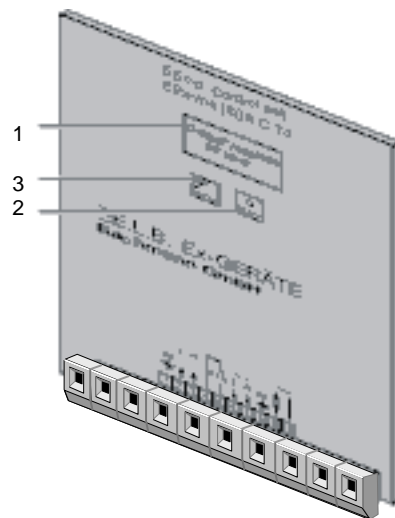


Fig. 2: Front cover panel of the controller

- (1) In three lines of 12 characters each, the digital display shows the enclosure's internal pressure during normal operation, and the remaining purge time in minutes and seconds (in combination with the flow rate) during the initial purge process. During normal operation, you can call up further information by pressing the button „OK/Info“ (see Chapter 5 “Parametrizing the Controller“). Faults which are detected during the self-check are shown here with a number (see 3.5 "Faults and Troubleshooting"). If a remote unit type F-411 is connected, then “Remote ctrl. active“ is displayed.

- (2) The right field (Menu) permits access to the Wheel Shuttle<sup>®</sup> with a tool (e.g. a screwdriver) for parametrizing the controller. With this Wheel Shuttle, you can start the parametrization and set the individual values.
- (3) The left button (OK/Info) is used in normal operation to call up the stored parameters “Enclosure Pressure“, “Purge Time“, “Function of Relay 3“, “Function of Relay 4“, “Switchpoint of Purge Start“, “Switchpoint of Minimum Pressure“, “Switchpoint of Overpressure“ and “Regulation“. During the parametrization, this button is used to select and confirm the various parameters.

In the lower part of the cover, the terminal assignment of the Controller is shown. Terminals 1 to 3 are inputs; they provide electrical power to the Controller. Terminals 4 to 19 are outputs, over which the monitoring unit drives its peripherals, e.g. the digital/ proportional controller.



**Before switching on, ensure that the operating voltage of Control unit and purge valve are equal to the voltage you want to connect**



**The operating voltage of the units shall only lie within the limits specified in the technical documentation under Technical Data.**

**E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.**

Immediately after the compressed air supply is opened and the main voltage is applied, the internal self-check of the controller begins automatically. Any fault occurring during the self-check sequence is indicated by

FAULT  
XX

An explanation of the fault numbers (XX) is given in Section 3.5 “Faults and Troubleshooting“, Table 1: Faults detected during the self-check. If the self check is carried out successfully, the initial purge of the enclosure commences, ending when at least five times the enclosure volume has been circulated. The purge process is indicated by the message

REMAINING  
PURGE TIME

in the display. All the time, the remaining purge time is counted down to 00 mins and 00 seconds.



**Before switching on the electrical units in the enclosure, purge it out with a quantity of protective gas corresponding to at least five times the enclosure volume.**

After the end of the purge phase, the non-Ex units in the enclosure are switched on. The overpressure in the enclosure then constantly monitored for adherence to the setpoint value (factory setting: 2.0 mbar) and also for transgressing of the MIN value (factory setting: 0.8 mbar) and exceeding of the MAX value (factory setting: 15.0 mbar). Normal operation is indicated by the message.

Cabinet pressure  
is  
xx.x mbar

in the display.

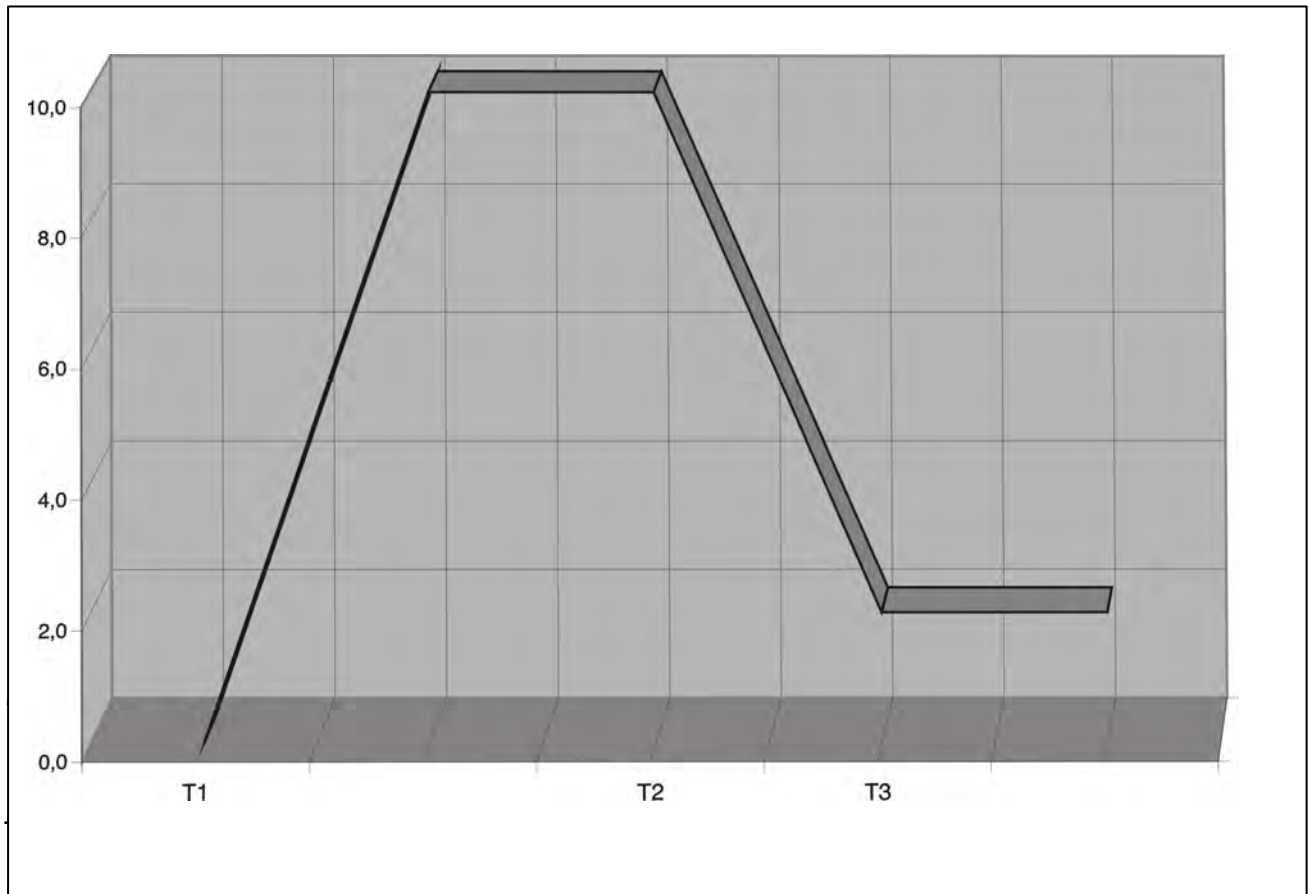


Fig.3: General function

- T1: When the mains voltage and the compressed air supply are applied, the functional test (self-check) begins, followed by the purge process of the EEx-p enclosure with a quantity of air corresponding to at least five times the enclosure volume.
- T2: The purge process has ended. The specified internal enclosure pressure (see Chapter 5 "Parametrizing the Controller"; here 2 mbar) is attained. The units inside the EEx-p enclosure are activated.
- T3: Normal operation begins. The internal enclosure pressure (see Chapter 5 "Parametrizing the Controller"; here 2 mbar) is regulated at the setpoint value.

### 3.3 Behaviour of the Controller during Normal Operation

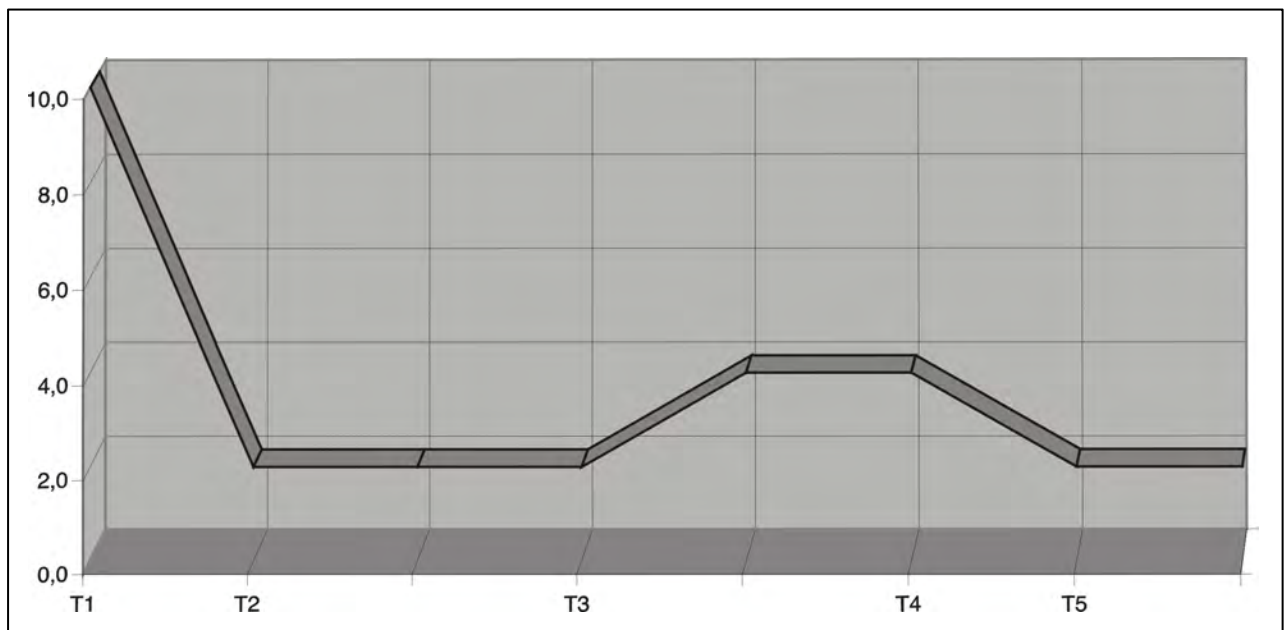
In normal operation, the controller F-351 monitors and regulates the internal pressure of the EEx-p enclosure to the setpoint value in relation to the surrounding atmosphere.

The limit values set in the factory are:

MIN: 0,8 mbar,

MAX: 15,0 mbar.

At an increased level of internal enclosure pressure (factory setting: 4.0 mbar) with regard to the surrounding atmosphere, a mechanical valve opens automatically in the controller. This allows the excessive internal pressure to drop. The valve closes again when the internal enclosure pressure has again attained normal values (factory setting: 3.5 mbar).



*Fig. 4: Normal operation*

T1: The purge process has ended. The specified internal enclosure pressure (see Chapter 5 “Parametrizing the Controller”; here 2 mbar) is attained. The units inside the EEx-p enclosure are activated.

T2: Normal operation begins. The internal enclosure pressure (see Chapter 5 “Parametrizing the Controller”; here 2 mbar) is regulated at the setpoint value.

T3: The internal enclosure pressure rises.

T4: The excessively high internal enclosure pressure is released through a mechanical valve.

T5: Normal operation begins.

## 3.4 Behaviour of Controller during Malfunctions



If it can be assumed that safe operation is no longer possible, switch off of unit and secure it against renewed switching-on.

The fault conditions described here for the system can be remedied by appropriately qualified service personnel of the plant operator or by an external service company. If work is intended on the controller itself or on the digital/proportional controller, the manufacturer must always be consulted beforehand. Contact possibilities:

By phone: + 49 6251 637 36  
By fax : + 49 6251 637 29  
By email : service@elb.de respectively kundendienst@elb.de

### 3.4.1 Faults during the Purge Process

The purge process is aborted if:

- the mains voltage fails for longer than 2 s
- the internal enclosure pressure falls below the set MIN value (factory setting: 0.8 mbar)
- the internal enclosure pressure rises above the set MAX value (factory setting: 15.0 mbar)
- the volume flowrate (of compressed air or inert gas) falls below the set minimum flowrate value (pressure difference between “switchpoint of purge start“ and the factory setting of 2.0 mbar).

Once the malfunction has been remedied, purge operation is resumed automatically.

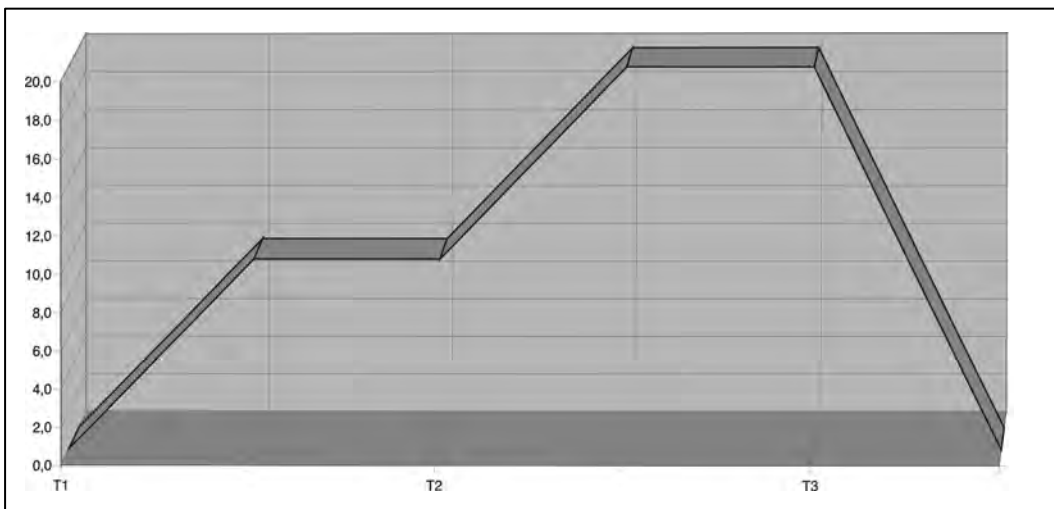


Fig. 5: Fault during the purge process

T1: When the mains voltage and the compressed air supply are applied, the purge of the EEx-p enclosure commences, with a quantity of air corresponding to at least five times the enclosure volume.

T2: During the purge process, the internal enclosure pressure increases to an excessively high value. The purge operation is aborted.

### 3.4.2 Faults during Normal Operation

The controller switches off automatically, if:

- the mains voltage fails for longer than 2 s
- the internal enclosure pressure falls below the set MIN value (factory setting: 0.8 mbar)
- the internal enclosure pressure rises above the set MAX value (factory setting: 15.0 mbar)

Once the malfunction has been remedied, operation resumes automatically; if the pressure drops below the MIN value, the purge process is repeated.

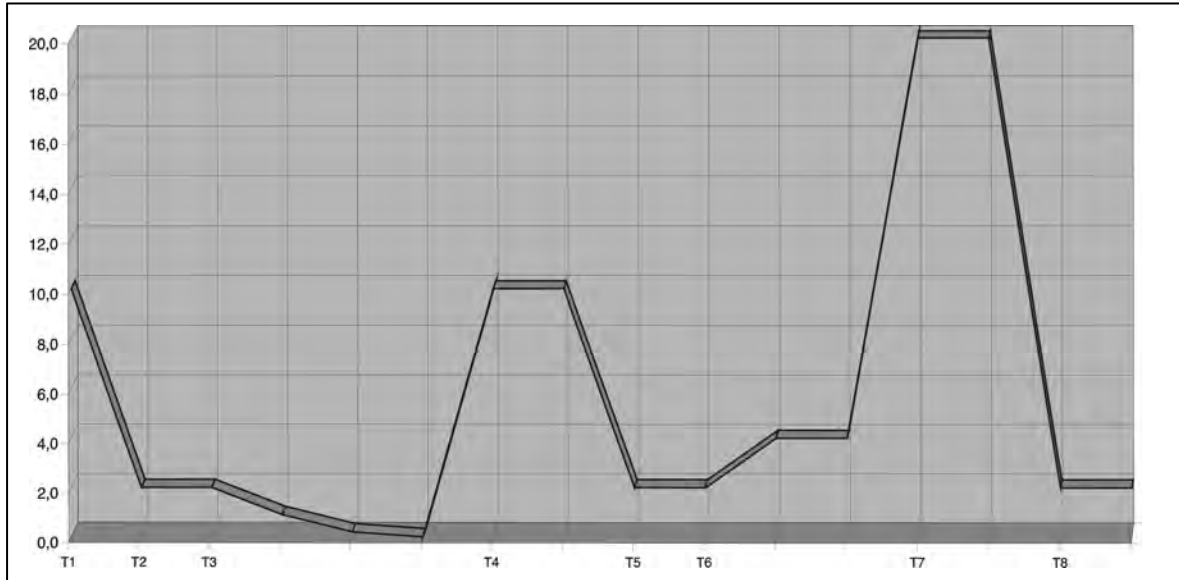


Fig. 6: Fault during normal operation

- T1: The purge process has ended. The specified internal enclosure pressure (see Chapter 5 “Parametrizing the Controller”; here 2 mbar) is attained, and the units inside the EEx-p enclosure are activated.
- T2: Normal operation begins. The internal enclosure pressure (see Chapter 5 “Parametrizing the Controller”; factory setting: 2 mbar) is regulated to the setpoint value.
- T3: The internal enclosure pressure drops. If the pressure value falls below the “Switchpoint of Minimum Pressure”(see: 5 “Parametrizing the Controller”; factory setting: 0.9 mbar) in relation to the external pressure, the units located inside the enclosure are switched off.
- T4: Renewed purge
- T5: Normal operation begins
- T6: The internal enclosure pressure rises. The increased internal enclosure pressure cannot escape through the mechanical valve.
- T7: If the internal pressure value exceeds the “Switchpoint of Overpressure” (see Chapter 5 “Parametrizing the Controller”; factory setting: 15 mbar), the units located inside the enclosure are switched off.
- T8: After the pressure has been relieved, normal operation resumes without purge.



### 3.5 Faults and Troubleshooting

Faults can occur during the self-check, setting-to-work, purge as well as during normal operation.



**For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the applicable ordinances and provisions concerned with explosion protection (VDE 0160, VDE 0165 or EN 60079-14, EN 50014-50039) as well as the Accident Prevention Regulations (UVV).**



**Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.**



**If it can be assumed that safe operation is no longer possible, switch off the unit and secure it against renewed switching-on.**

The faults described in Table 1 are detected by the system during the self-check. These faults stop the system from starting the purge process.

*Table 1: Faults detected during the self-check*

<b>Fault number</b>	<b>Explanation</b>	<b>Remedy</b>
01	Checksum error – EPROM defective	Report the fault to the manufacturer's service department
02	Remote control is defective	Exchange the remote control
03	EEprom fault-EEprom is defective. Values of the same variable differ in all three Eeproms	Report the fault to the manufacturer's service department
04	A/D converter DSS1 is defective. Conversion not in the value range 0 to 25.0 mbar	Report the fault to the manufacturer's service department
05	A/D converter DSS2 is defective. Conversion not in the value range 0 to 25.0 mbar	Report the fault to the manufacturer's service department
06	A/D converter DSS3 is defective. Conversion not in the value range 0 to 25.0 mbar	Report the fault to the manufacturer's service department
07	Fault in the output relay. Output relay does not switch at all, or incorrectly	Report the fault to the manufacturer's service department
08	Malfunction in multiprocessor communication	Report the fault to the manufacturer's service department
09	A processor is defective	Report the fault to the manufacturer's service department

Table 2: Faults, effects, causes and remedy

<b>Fault</b>	<b>Effect</b>	<b>Possible cause</b>	<b>Remedy</b>
Purge process does not begin	No display of remaining purge time after the supply voltage has been applied	Fuse blown in the controller	Service by manufacturer
	No display of remaining purge time after the supply voltage and the compressed air have been applied	Minimum overpressure for purge start has not been achieved	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
		Air quantity is not sufficient for successful purge	Dynamic inlet pressure too low (<"Switchpoint for Purge Start"). Set inlet pressure to at least 2 bar dynamic
		Pressure is below MIN value. Internal enclosure pressure not sufficient after purge. Pressure drops off.	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
		Air quantity is not sufficient for successful purge. Cross-section of inlet for compressed air/ inert gas is too small	Increase the diameter of the air supply hose
		Pressure regulator incorrectly set (e.g. 2.0 bar static)	Adjust the pressure regulator to e.g. 2.0 bar dynamic (i.e. for flow of compressed air/ inert gas)
		Fuse of the purge valve is defective (valve is closed when de-energized)	Exchange the fuse at the digital/proportional valve
Purge process is aborted	After 5 s, the remaining purge time is reset to the initial value	Air quantity is not sufficient for successful purge	Dynamic inlet pressure too low. Set the inlet pressure to at least 2 bar dynamic

<b>Fault</b>	<b>Effect</b>	<b>Possible cause</b>	<b>Remedy</b>
		Pressure is below MIN value. Internal enclosure pressure is insufficient after purge. Pressure drops off	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
		Air quantity is not successful purge. Cross-section of inlet for compressed air/ inert gas is too small	Increase the diameter of the air supply hose
		Pressure regulator incorrectly set (e.g. 2.0 bar static)	Adjust the pressure regulator to e.g. 2.0 bar dynamic (i.e. for flow of compressed air/ inert gas)
	After more than 10 s, the remaining purge time is reset to the initial value	Air quantity is not sufficient for successful purge. Cross-section of inlet for compressed air/ inert gas is too small	Increase the diameter of the air supply hose
			Recalibrate to 1 bar inlet pressure. Double the purge time
Normal operation does not begin after successful purge process	Display for enclosure pressure is shown for approx. 4 s and then switches off	Pressure is below MIN value. Internal enclosure pressure is insufficient after purge. Pressure drops off	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
	Display for enclosure pressure is shown for a while (longer than 4 s) and then switches off	Pressure is below MIN value. Internal enclosure pressure is insufficient after purge. Pressure drops off	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
		Pressure is below MIN value. Pressure regulator incorrectly set (e.g. 2.0 bar static)	Adjust the pressure regulator to e.g. 2.0 bar dynamic (i.e. for flow of compressed air/ inert gas)

<b>Fault</b>	<b>Effect</b>	<b>Possible cause</b>	<b>Remedy</b>
		MAX pressure has been exceeded. Internal enclosure pressure too high. Pressure increases e.g. through heat	Readjust leakage air nozzle
			Check the limit value for "Switchpoint of Overpressure" and enter new value
		MAX pressure has been exceeded. Air outlet opening (mechanical valve of the control unit) closed or clogged	Open or clean the air outlet opening of the control unit
	Display for enclosure pressure is shown, but no enabling for non-Ex units in the enclosure takes place	Electrical circuit incorrectly wired	Check electrical connections
Unit switches off automatically during normal operation	Unit switches off sporadically, followed by a new purge start	Internal enclosure pressure too near the limit	Readjust leakage air nozzle
		Inlet pressure of the system fails briefly, possibly through activation of a large consumer	Increase the inlet pressure at the pressure regulator up to 3.5 bar maximum
	Automatic switching-off of the non-Ex units within the enclosure	Mains failure for longer than 2 s	Automatic restart
		Pressure is below MIN value. Enclosure has a leak	Seal off enclosure and internal installations; possibly readjust leakage air nozzle
		Pressure is below MIN value. Cross-section of inlet for compressed air/ inert gas is too small	Exchange hoses for ones with a larger diameter

Fault	Effect	Possible cause	Remedy
		MAX pressure has been exceeded. Air outlet opening (mechanical valve of the control unit) closed or clogged	Open or clean the air outlet opening of the control unit
	Display of enclosure pressure does not disappear 4 s after pressure drop (e.g. through opening of enclosure door)	“Switchpoint of Minimum Pressure“ is incorrectly set	Readjust the limit value
		Lockable switch for EEx bypass has been activated	Turn lockable switch to “off“ position

---

## 4 Use for the Intended Purpose

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**Important**

**Before setting the units to work, read the technical documentation carefully.**



**Important**

**The latest version of the technical documentation or the corresponding technical supplements is valid in each case.**

The EEx-p Controller F-350 is built according to the state of the art and is reliable in operation. It must only be used for the intended purpose. Use for the intended purpose also includes compliance with the instructions issued by the manufacturer for installation, setting-to-work and service.

Any other use is regarded as conflicting with the intended purpose. The manufacturer is not liable for any subsequent damage resulting from such inadmissible use. The user bears the sole risk in such cases.

### 4.1 Transportation and Storage

All units (controller, digital/ proportional controller, accessories) must be so transported and stored that they are not subjected to any mechanical stresses over 1.5 g, are not dropped from heights exceeding 0.3 m and are not exposed to mechanical impact exceeding 3 J. For the transportation and storage, the “Ambient temperature during storage/ transport“ specified in the Technical Data shall apply.

### 4.2 Authorized Persons

Only persons specially trained for the purpose are authorized to handle the EEx-p controller F-350; they must be familiar with the unit and must be aware of the applicable ordinances and provisions for explosion protection as well as the relevant accident prevention regulations. The user can familiarize himself with the unit through training at the manufacturer, through a special familiarization session or through an “on the job“ training course.

### 4.3 Cleaning and Maintenance

System F-350 and all its components require no maintenance and are self-monitoring. All work on the monitoring unit F-351 or the digital/proportional controller by personnel who are not expressly qualified for such activities will cause the Ex approval and the guarantee to become void.

All that is needed is to regularly clean the sight glass of monitoring units mounted externally on the enclosure. The same applies for the display of the operation unit F-411 which may be connected as an option.

Before commencing any work on units located inside the enclosure, please take care to observe the applicable regulations, ordinances and provisions.



**Important**

**Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.**

### 4.3.1 Safety Precautions

Before opening the enclosure, it is absolutely necessary to switch off the units located inside this enclosure and to secure them against powering-up.



**For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the applicable ordinances and provisions concerned with explosion protection (VDE 0160, VDE 0165 or EN 60079-14, EN 50014 – 50039) as well as the Accident Prevention Regulations (UVV).**

### 4.3.2 Cleaning and Maintenance Work



**For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the applicable ordinances and provisions concerned with explosion protection (VDE 0160, VDE 0165 or EN 60079-14, EN 50014-50039) as well as the Accident Prevention Regulations (UVV).**



**Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.**

All that might be necessary is to clean the sight glass of the monitoring unit F-351 mounted externally on the enclosure or the operating unit F-411 which may be connected, if the sight glass is very dirty. Use only mild soap solutions or similar mild detergents. Maintenance work on the system and on all components belonging to the system must only be performed by personnel who are adequately qualified for this task.

### 4.3.3 Cleaning and Maintenance Intervals

The cleaning intervals depend on how dirty the system is. Please take care to ensure that the display of the monitoring unit or the operating unit F-411 are always easy to read.

### 4.3.4 Testing of the Relay Contacts

The facility to open of both relay contacts must be verified by the user in time intervals, which depend on the danger of the application.

#### **Example:**

1. Remove the front cover and switch the supply voltage on.
2. Measure the voltage between the contacts 2 ("L IN") and 6 ("N OUT"). There must be no tension.
3. Measure the voltage between the contacts 3 ("N IN") and 7 ("L OUT"). There must be no tension.
4. Close the front cover again.

---

## 5 Parametrizing the Controller

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The Controller is programmed with the aid of the patented Wheel Shuttle® in the field “Menu“, in conjunction with the button “OK/INFO“ on the front cover. Changes to the parametrization can only be made with the aid of a suitable tool, e.g. a screwdriver.

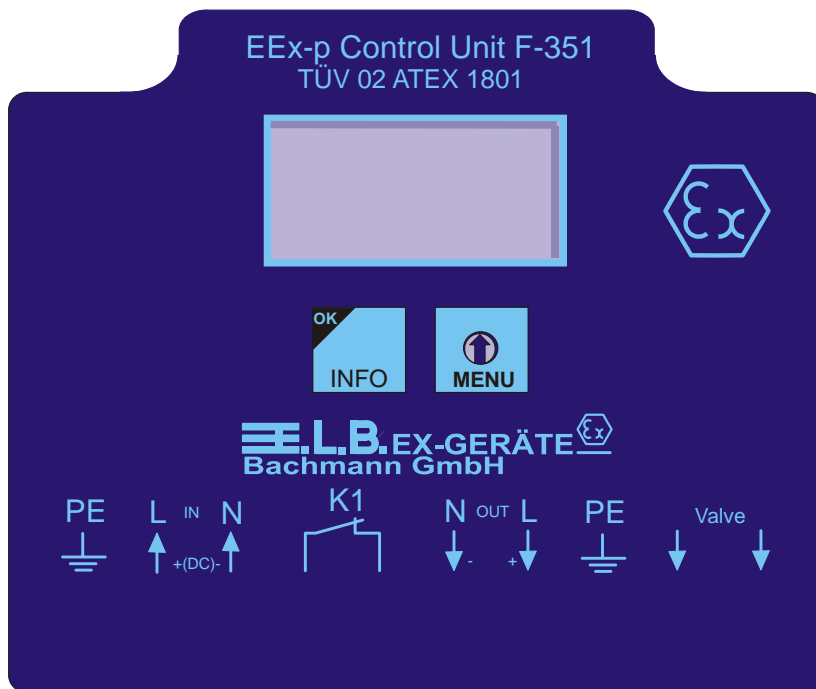


Fig. 7: Front cover panel of the controller

### 5.0 Menus

#### 5.0.1 Factory Settings

If you want to reset all values to the factory settings, please follow this procedure:

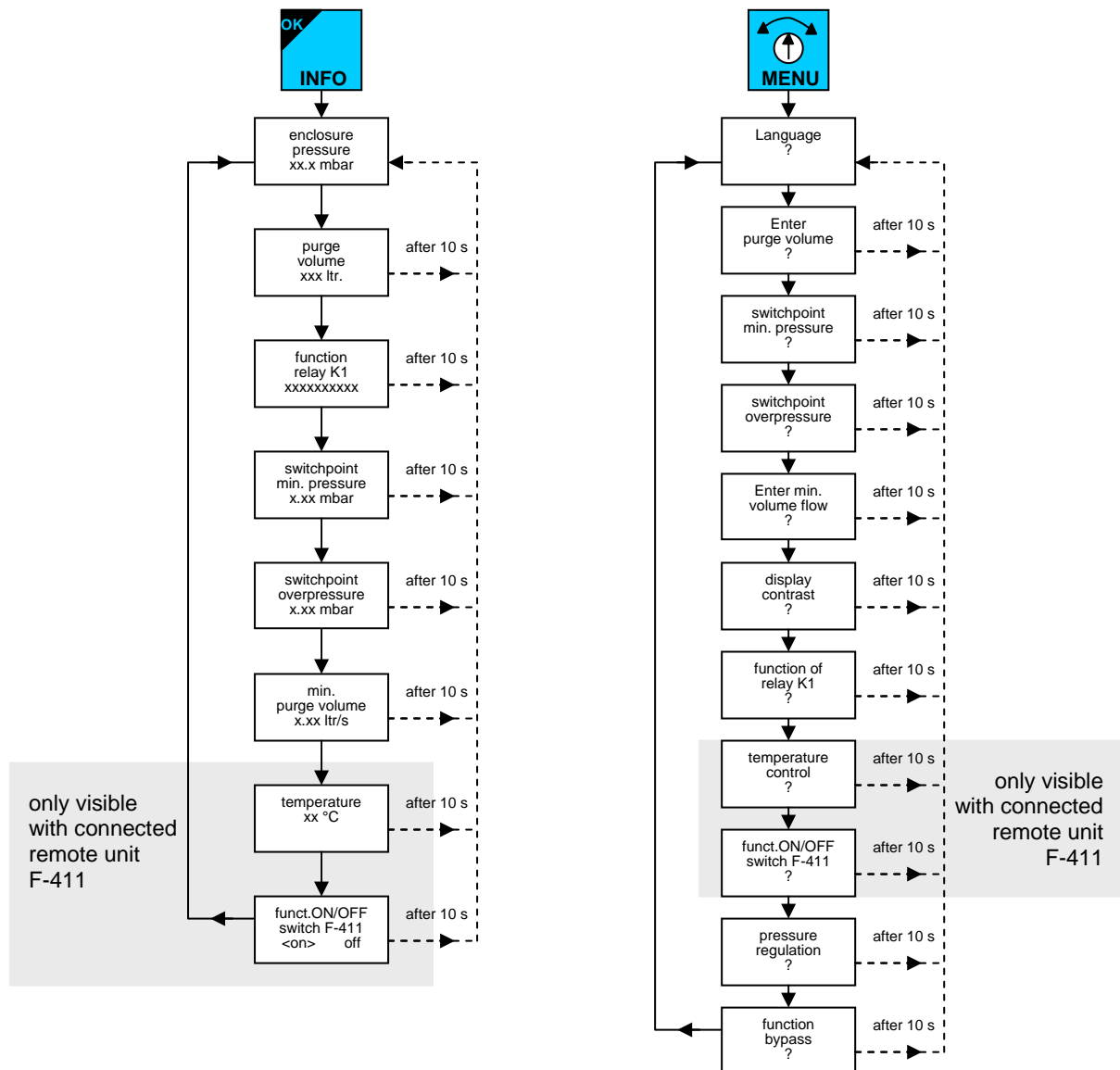
1. Separate the controller from the mains.
2. Switch the Wheel Shuttle to the „one o'clock“ position (one step clockwise from the position shown in figure 7).
3. Keep the INFO button pressed, then connect the controller with the mains again.
4. Release the INFO button, as soon as „Load factory setting“ appears in the display.



## 5.0.2 Menu Functions

The values which are currently set can be reviewed at any time by means of the „OK/INFO“ button. Press the button repeatedly, and the following information is shown in sequence:

You can modify any parameter by means of the Wheel Shuttle. Turn the switch and the following requests appear on the display. You can enter the respective parameter's setting by pressing the OK/INFO button.

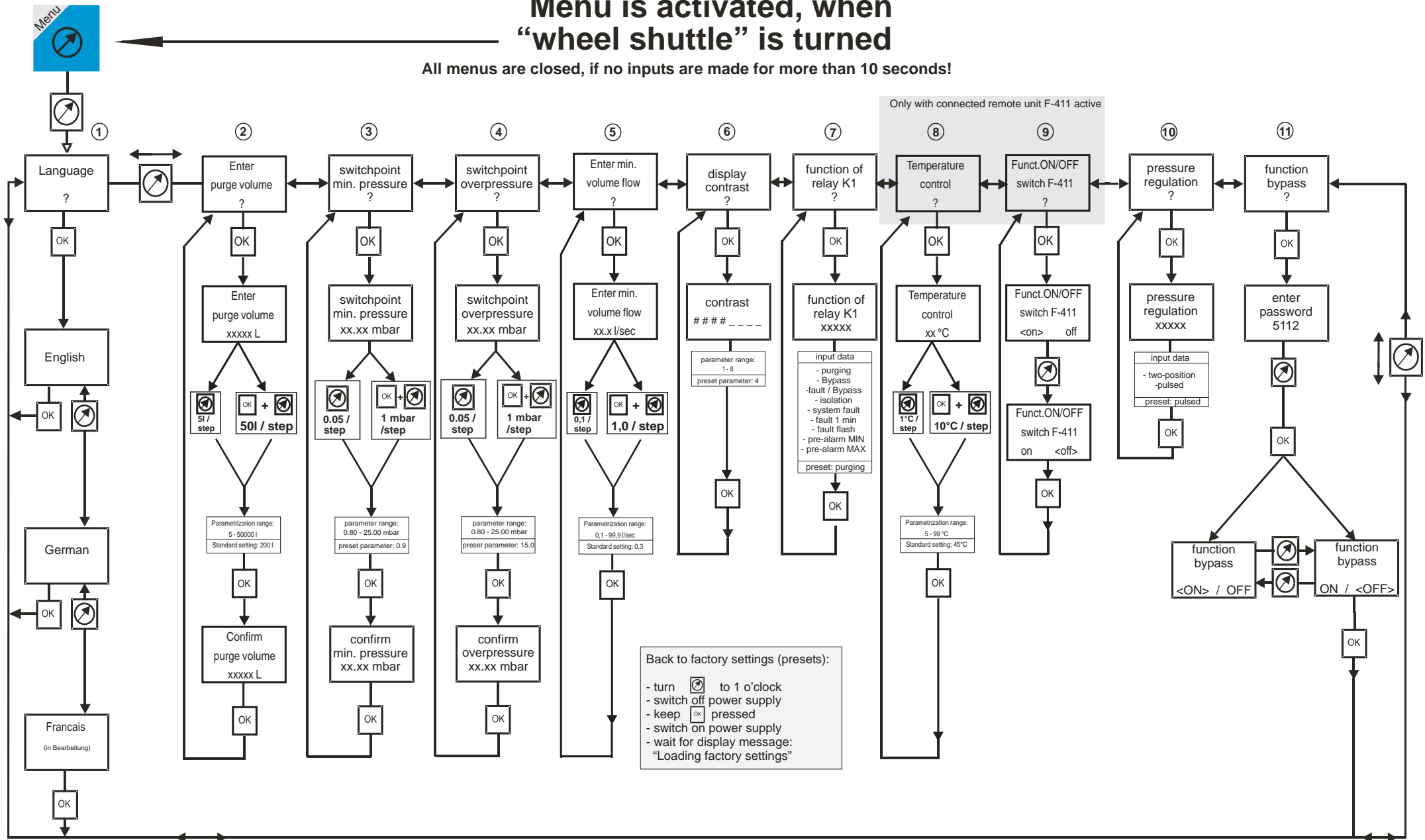


The Wheel Shuttle sequence is shown for clockwise turning. If you don't press the button or turn the Wheel Shuttle for more than 10 seconds you will get back to the actual display function during operation automatically.

The following figure shows the menu functions in detail.

# Menu is activated, when "wheel shuttle" is turned

All menus are closed, if no inputs are made for more than 10 seconds!



## 5.1 Language ①

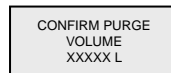
Select  in the display with „OK“ and choose from GERMAN, ENGLISH and FRENCH by turning the Wheel Shuttle. Confirm the chosen language by pressing „OK“. The display gets back to the language request, but this time in the selected language.

Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

## 5.2 Enter Purge Volume ②

Select  in the display using „OK“. Purge volume range is from 5 ltr. to 50.000 ltr. and can be adjusted in steps of 5 litres by turning the Wheel Shuttle. If you press „OK“ while turning the Wheel Shuttle the step size is 50 litres. Save the selected value by pressing „OK“. Factory presetting is 200 ltr.

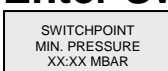
The display now shows the saved value:



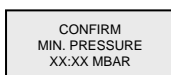
Confirm the displayed value by pressing „OK“ again.

Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

## 5.3 Enter Switchpoint min. Pressure ③

Select  in the display using „OK“. The min. pressure range is from 0.8 mbar to 25 mbar and can be adjusted in steps of 0.05 mbar by turning the Wheel Shuttle. If you press „OK“ while turning the Wheel Shuttle, the step size is 1 mbar. Save the selected value by pressing „OK“. Factory presetting is 0.9 mbar.

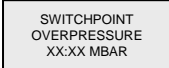
The display now shows the saved value:

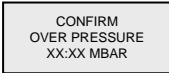


Confirm the displayed value by pressing „OK“ again.

Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

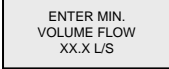
## 5.4 Enter Switchpoint Overpressure ④

Select  in the display using „OK“. The overpressure range is from 0.8 mbar to 25 mbar and can be adjusted in steps of 0.05 mbar by turning the Wheel Shuttle. If you press „OK“ while turning the Wheel Shuttle, the step size is 1 mbar. Save the selected value by pressing „OK“. Factory presetting is 15.0 mbar.

The display now shows the saved value:  Confirm the displayed value by pressing „OK“ again.


Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

## 5.5 Enter min. Volume Flow ⑤

Select  in the display using „OK“. The minimum volume flow range is from 0.1 to 99.9 litres/sec. and can be adjusted in steps of 0.1 litres/sec. by turning the Wheel Shuttle. If you press „OK“ while turning the Wheel Shuttle, the step size is 1 ltr/s. Save the selected value by pressing „OK“. Factory presetting is 0.3 ltr/s.

Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

## 5.6 Display Contrast ⑥

Select  in the display using „OK“. The factory setting of 4# can be changed by turning the Wheel Shuttle. Save the selected value by pressing „OK“.

Turn the Wheel Shuttle clockwise or counterclockwise to continue the parametrization.

## 5.7 Function of Relay K1 7

FUNCTION OF  
RELAY K1  
XXXXXXXXXXXX

Select XXXXXXXXXXXX in the display using „OK“. You can change the function by turning the Wheel Shuttle. The following settings are possible:

- purging PURGING (= factory presetting)
- bypass BYPASS
- fault / bypass fault/Bypass
- isolation ISOLATION (K1 opens and closes simultaneously with the switches of contact 6 and 7; see fig. 11)
- system fault SYSTEM FAULT
- malfunction 1 minute FAULT 1 MIN
- malfunction flashing FAULT FLASH
- pre-alarm min. pressure PRE-ALARM MIN
- pre-alarm overpressure PRE-ALARM MAX

Save the selected function by pressing „OK“.

Turn the Wheel Shuttle clockwise or counter-clockwise to continue the parametrization.

With relay K1, it is possible to carry out actions at certain events, which extends beyond the pure monitoring and regulating function of the controller. For example, circuits can be interrupted and alarms can be signalled externally. The functions which can be set for relay K1 have the following effects on the behaviour of the controller:

- Purge (setting: purging). The relay is closed during the purge process.
- Ex protection bypass (setting : bypass)  
The relay is closed for as long as the lockable switch in operating unit F-411 or the external lockable switch F-480 is activated for bypassing the Ex protection
- Fault / bypass. The relay is constantly closed during low pressure and alternates with a frequency of 2 Hz while the controller is bypassed.
- Electrical isolation (setting: Isolation)  
The relay is normally closed and opens in case of fault.
- System fault (setting: System fault) – quiescent current principle  
The relay is normally closed and opens in case of a system fault. In such a case, the following is shown in the display:

Fault  
xx

XX is the number of the system fault. For an explanation of fault numbers, see Section 3.5 “Faults and Troubleshooting“, Table 1.

- Malfunction 1 minute (setting: fault 1 min) – quiescent current principle  
The relay is normally closed and opens 1 minute after a fault according to Table 2 in 3.5 “Faults and Troubleshooting“ has occurred.
- Malfunction, flashing (setting: fault flash) - quiescent current principle  
The relay is normally closed and opens for the first time 1 minute after a fault according to Table 2 in 3.5 “Faults and Troubleshooting“ has occurred. Then the relay alternates with a 1 s duty cycle.
- Pre-alarm (setting: pre-alarm min) - quiescent current principle  
The relay is normally closed and opens when the internal enclosure pressure has dropped to 0.3 mbar (30 Pa) over the value set for “switch point of minimum pressure“.
- Overpressure alarm (setting: pre-alarm max) – quiescent current principle  
The relay is normally closed and opens if the internal enclosure pressure rises above the value set for “Switchpoint Overpressure“.

## 5.8 Temperature Control ⑧

TEMPERATURE  
CONTROL  
XX°C

Select in the display (only possible, when remote unit F-411 is connected) using „OK“. The enclosure temperature range is from 5°C to 99°C and can be adjusted in steps of 1°C by turning the Wheel Shuttle. If you press „OK“ while turning the Wheel Shuttle, the step size is 10°C. Save the selected value by pressing „OK“. Factory presetting is 45°C.

Turn the Wheel Shuttle clockwise or counter-clockwise to continue the parametrization.

## 5.9 Function of F-411 Switch ⑨

FUNCT. ON/OFF  
SWITCH F-411  
<ON> OFF

Select in the display (only possible, when remote unit F-411 is connected) using „OK“. The actual function of the F-411 switch is the one in brackets. You can switch over between <ON> and <OFF> by turning the Wheel Shuttle“. Confirm the selected function by pressing „OK“. If you choose <OFF> the function of this switch is disabled.

Turn the Wheel Shuttle clockwise or counter-clockwise to continue the parametrization.

## 5.10 Pressure Regulation ⑩

PRESSURE  
REGULATION  
XXXXXXXXXX

Select in the display using “OK“. You can change the factory setting of “pulsed” by turning the Wheel Shuttle. The values “two-point” for use with the digital controllers F-220.2 and F-220.2B and “pulsed” for use with the digital controller F-220.3 are available.

Confirm the selected type of pressure regulation with “OK“.

Turn the Wheel Shuttle clockwise or counter-clockwise to continue the parametrization.

## 5.11 Function Bypass ⑪

FUNCTION  
BYPASS  
<ON> OFF

ENTER  
PASSWORD  
XXXX

Select in the display using „OK“. Enter the password after by selecting each number with the Wheel Shuttle and confirming it with „OK“. Factory setting is 5112.

The display shows the actual function of the bypass in brackets as shown above. Turn the Wheel Shuttle to switch between <ON> and <OFF>. In the <ON> state the components connected with the controller switch on immediately. The display stays in "FUNCTION BYPASS <ON>" in order to avoid operation in the Ex area by mistake. In the <OFF> state the display switches back to the start of the bypass menu after pressing "OK".

Turn the Wheel Shuttle clockwise or counter-clockwise to continue the parametrization.

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## 6 Installation and Setting-to-Work

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For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the ordinances and provisions concerned with explosion protection (EN 60079-14, EN 50014-50039) as well as the Accident Prevention Regulations (UVV).



Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.



Modifications and conversions to the units are not permissible and will cause the Ex protection and the guarantee to become void.

E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.

### 6.1 Preparatory Work



Before connecting the mains supply, check the units installed in the enclosure. In particular, ensure that there is an adequate flow of air around the units and that any unit casings can be purged properly. Furthermore, ensure that the electrical units are de-energized if there is any loss of pressure. This includes the isolation of any data lines.

### 6.2 Installation

It is permissible to mount the EEx-p system F-350 on or in any casing which is suitable for applications with overpressure (but at least IP 54).



The wall thickness of the casing should not exceed 4 mm.

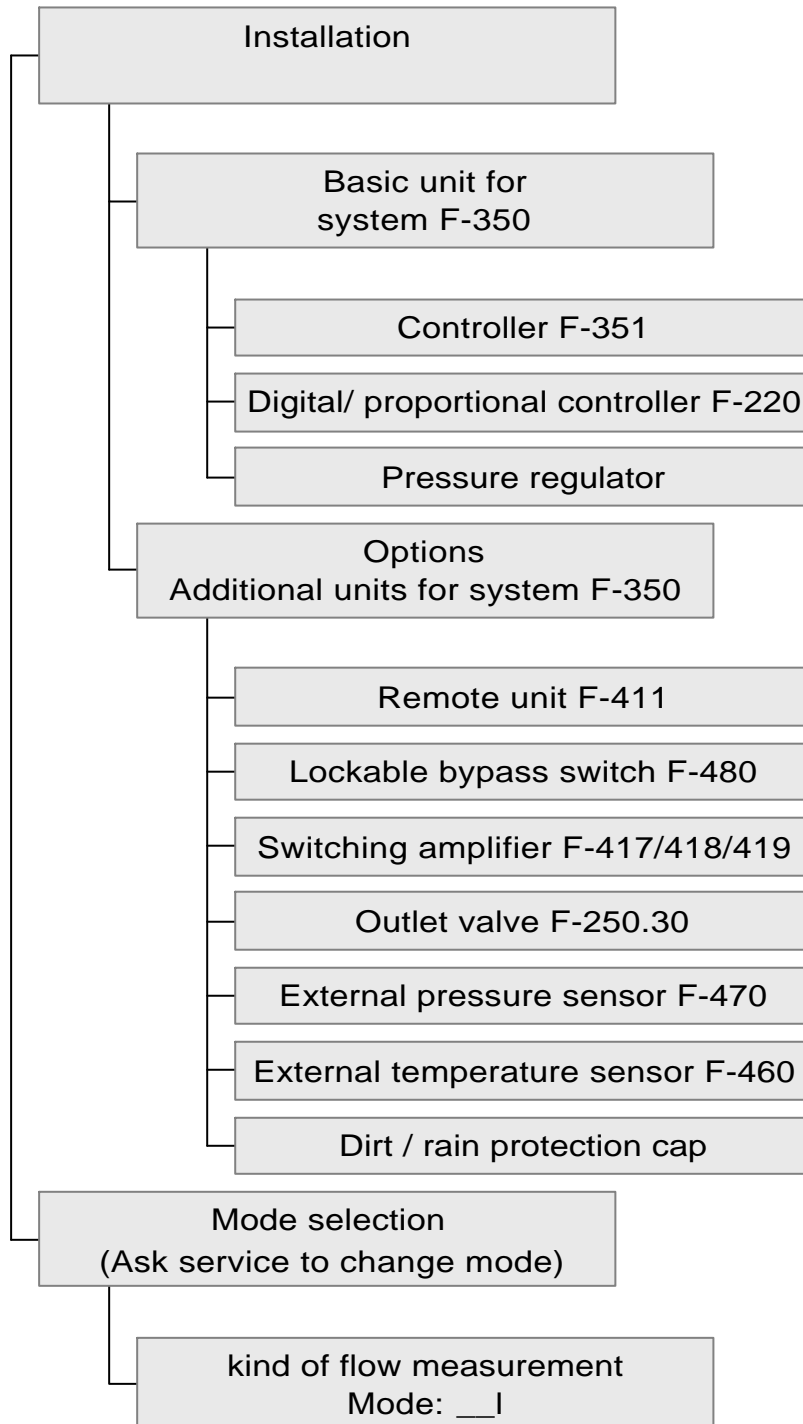
#### 6.2.1 EEx-p System F-350

The EEx-p system F-350 consists of the monitoring unit F-351, the digital/ proportional controllers of the series F-220 and a pressure regulator. The areas of application for the various digital/proportional controllers are given in Section 9.2.2 Digital/ Proportional Controller.

In addition, the following options are available:

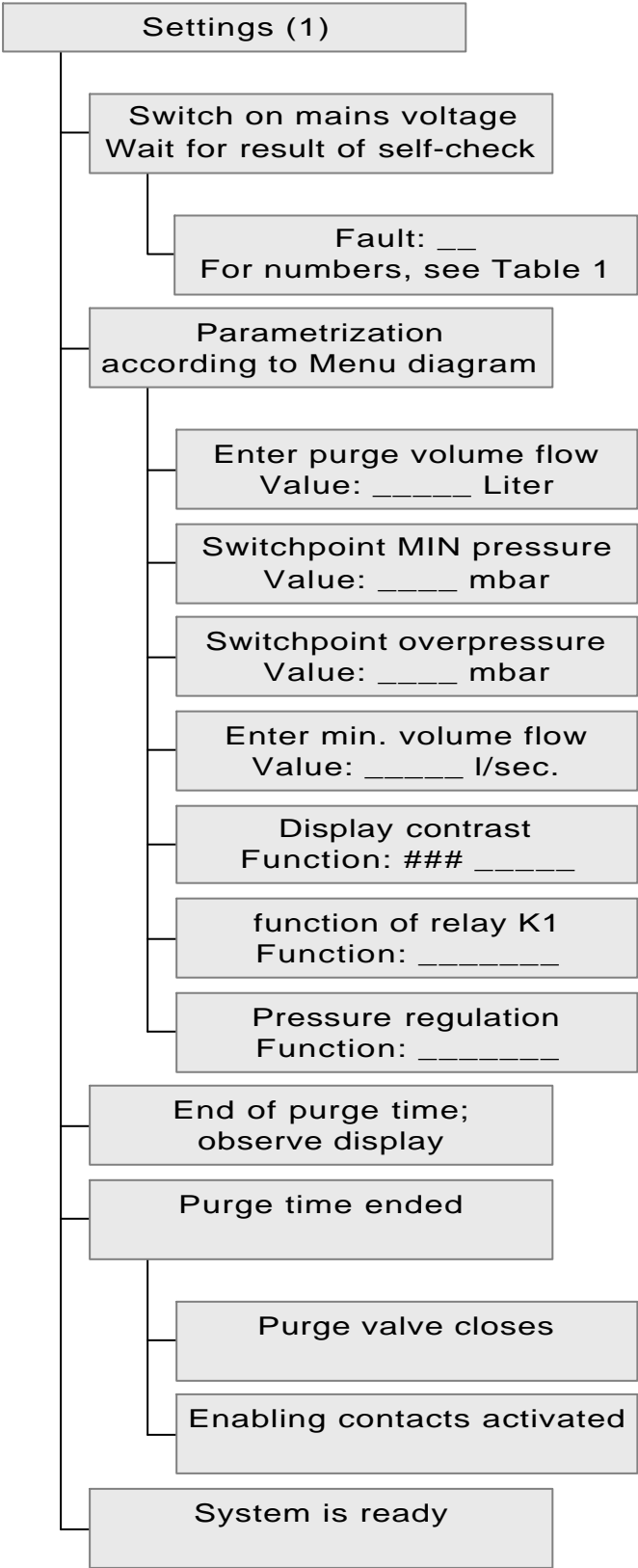
- remote unit F-411,
- external pressure sensor F-470 or temperature sensor F-460
- external bypass lockable switch F-480
- switching amplifier F-417/F-418/F-419
- relay boxes type F-420/F-421/F-422 to cut off datalines
- outlet valve F-250.30
- rain protection cap (for outside mounting)

## Sequence Diagram for Installation / Setting-to-Work

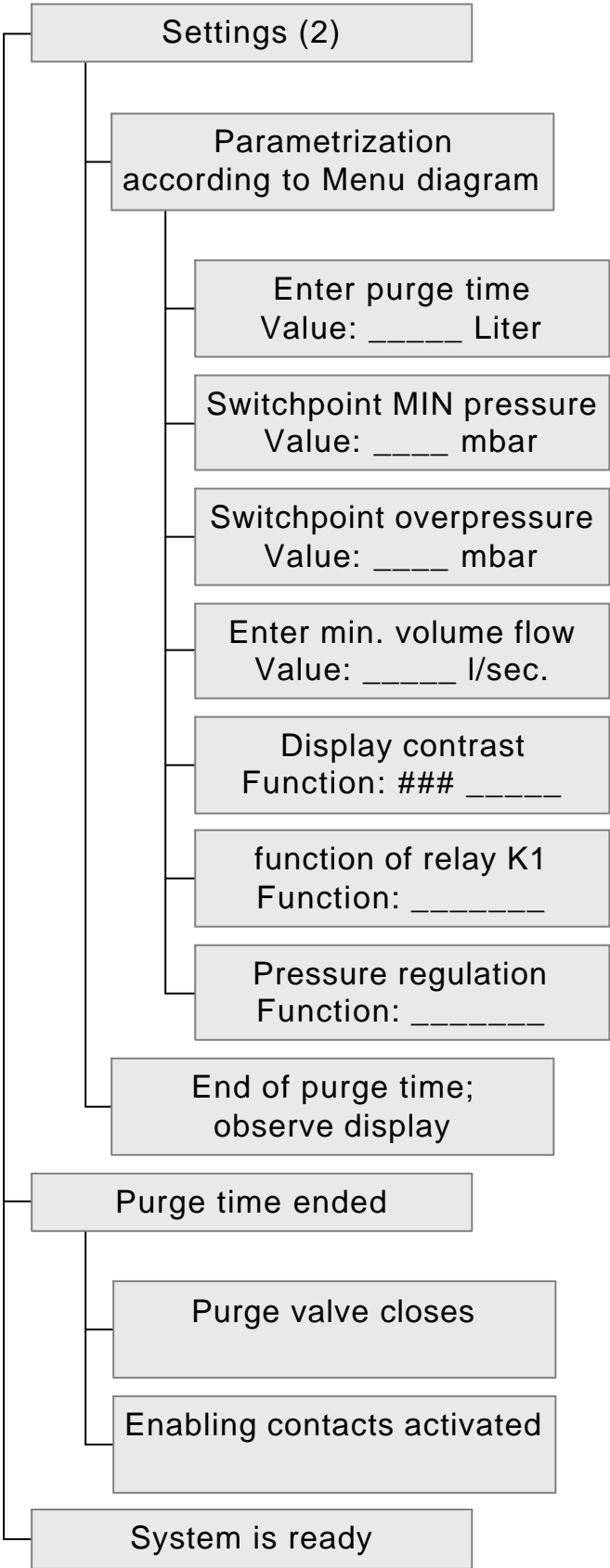




**Sequence Diagram for Installation/Setting-to-Work (for volume controlled purge Mode1)**



**Sequence Diagram for Installation/Setting-to-Work (for time controlled purge Mode 3)**



### 6.2.1.1 Mounting the Monitoring Unit

For external mounting on an enclosure, holes must be drilled for the digital/proportional valve/air inlet, the air outlet and the mounting holes for the monitoring unit.

Any mounting position is possible, but ensure that the display is easy to read.

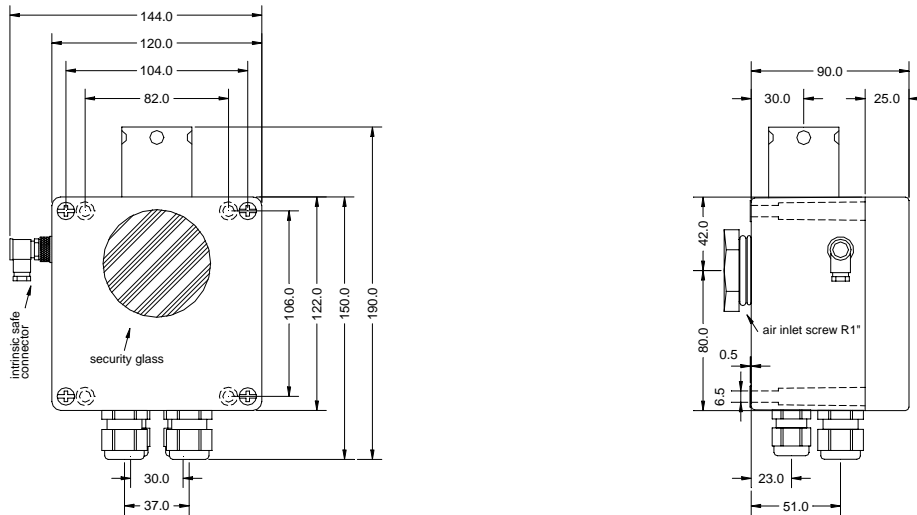


Fig. 9: Dimensions of the controller F-351

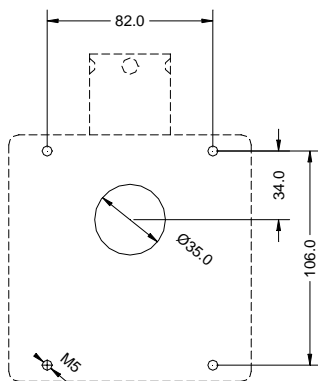
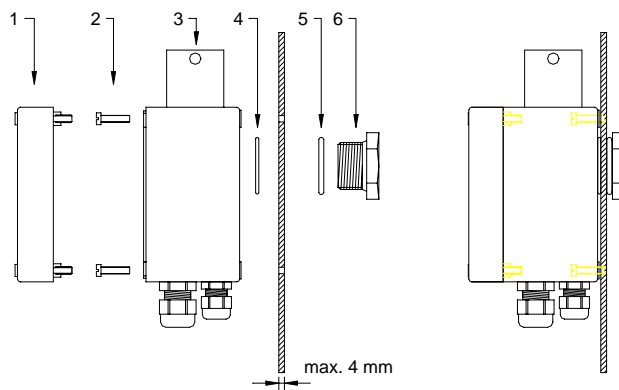


Fig. 9a: Drilling plan to mount controller on cabinet



- 1 Cover F-351
- 2 Mounting screws 4x M5x20
- 3 F-351 housing
- 4 Sealing 33,7 x 2,2 mm
- 5 Sealing 33,7 x 3,5 mm
- 6 Inlet screw with hole 1"

Fig. 10: Mounting of F-351

### 6.2.1.2 Technical Data for Controller F-351



The units comply with the state of the art and must only be connected to systems which have been approved for this purpose by E.L.B. Ex-Geräte Bachmann GmbH.



Modifications and conversions to the units are not permissible and will cause the Ex protection and the guarantee to become void.

E.L.B. Ex-Geräte Bachmann GmbH is not liable for any subsequent damage.

The technical data specified for the hazardous are comply with the values certified in the European EEx approval. The user bears the sole responsibility of examining the equipment with regard to its suitability for the intended application and environmental conditions. E.L.B. Bachmann GmbH Ex-Geräte Bachmann GmbH accepts no liability for this.

Mains voltage:	230 V AC (+8,5% / -10%) / 48 – 62 Hz Optional: 24 / 115 VAC(10%), 250 (+5/-15%) VAC 12 / 24 V DC
Current consumption:	35 mA at 230/250 V AC 60 mA at 115 V AC 300 mA at 24 V AC 200 mA at 12 / 24 V DC
Contact circuit:	10 s to 99 mins on - delay
Contact load:	250 V AC maximum. Data of the Contact Circuits according to Table VDE 0435:

Contact voltage	Type of current	Max.current	Power factor (cos φ)	Utilization category	L/R
250 V	AC	12 A	1		
240 V	AC	3 A	0.3	AC-15	
24 V	DC	12 A			0 ms
24 V	DC	2:5 A		DC-13	50 ms

Reset for mains failure:	≥ 2 s
Pressure control module:	integrated into the control system
Flow sensor "Purge":	from 0.1 l/s to 20l/s (3 ranges)

Pressure switch "MIN":	static overpressure 0,8 to 25 mbar $\pm$ 0,3 mbar		
Pressure switch "MAX":	overpressure switch 10 to 25 mbar		
Ambient temperature during storage/ transport:	-35 °C bis +70 °C, without condensation		
Ambient temperature during operation:	-30 °C bis +60 °C, without condensation		
Enclosure material:	GRP, epoxy resin, black		
Dimensions (mm):	height of enclosure:	122	
	width of enclosure:	120	
	depth of enclosure, approx.:	94,5	
	protrusion of air outlet:	40	
	protrusion of cable glands, approx.:	35	
	protrusion of connection for external units, approx.:	1,5	
	protrusion of connection with plug:	22	
	diameter of air outlet:	40	
	cable glands:	2 x M20 for 7..13 mm cable $\varnothing$	
		2 x M16 for 4.5..10 mm cable $\varnothing$	
Weight:	2,5 kg		

### 9.2.1.2.1 System F-350 Circuitry



**Important**

Ensure that only fuses of the specified type and appropriate current rating are used as replacements. Jumpering or bypassing of fuses or back-up fuses are inadmissible on principle.

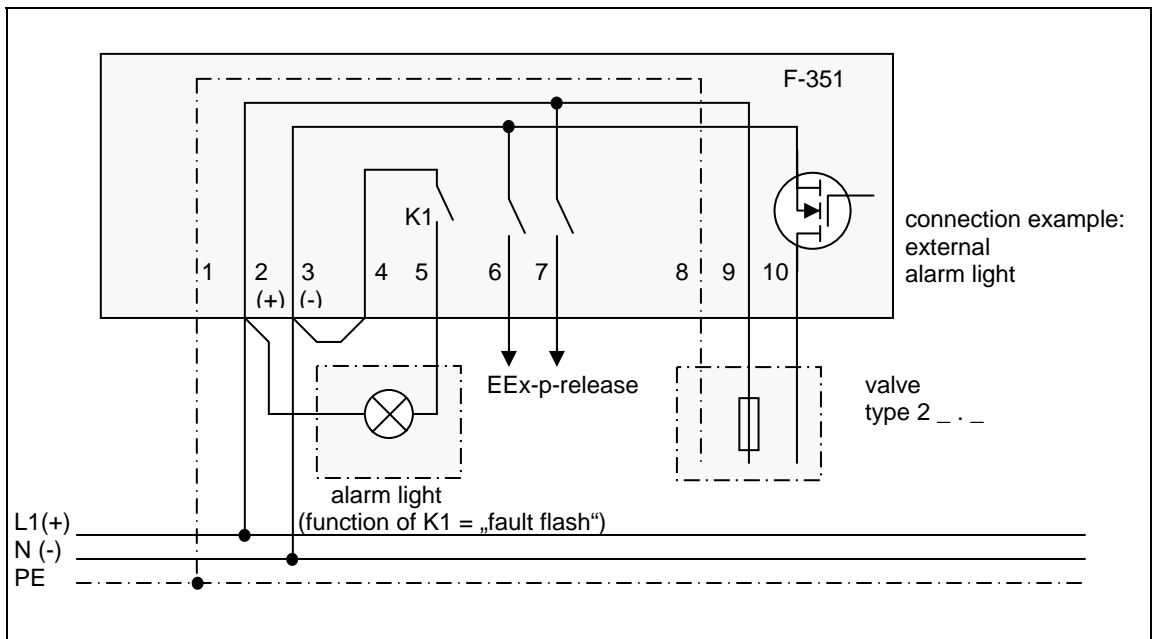
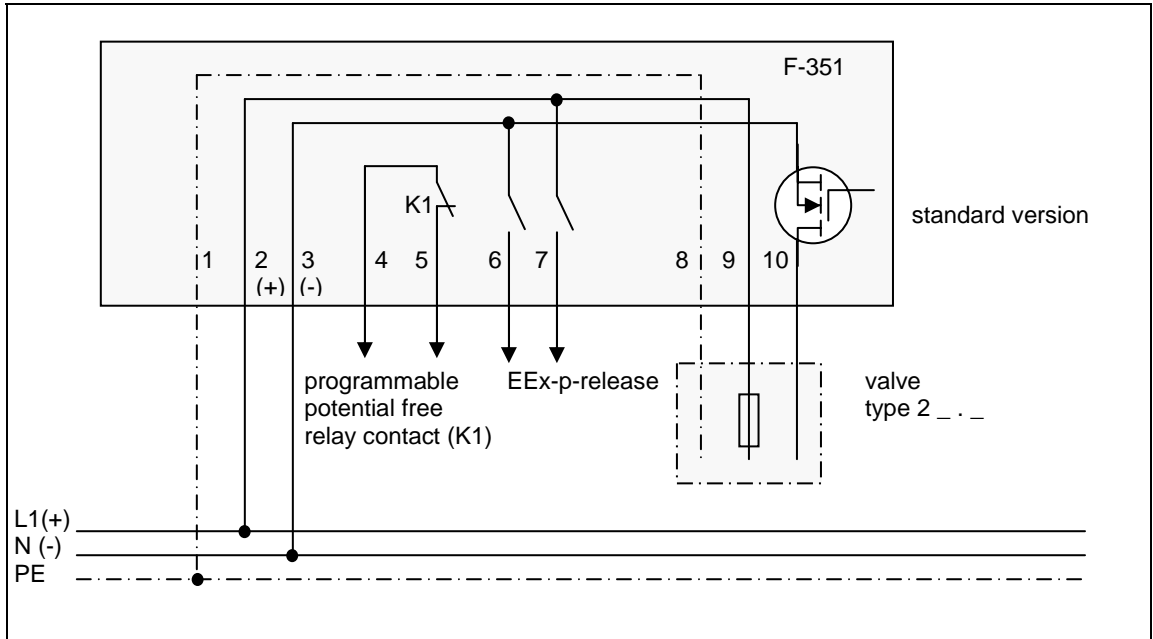


figure 11: F-351 wiring diagram

## 6.2.2 Pressure Regulator

The pressure regulator, with pressure gauge and automatic venting, is mounted externally on the enclosure and is bolted in an airtight manner to the digital/proportional controller (inside) through the G ¼" internal thread. The scope of delivery includes: pressure regulator (connection G ¼") and all necessary mounting material. Other pressure regulators are available on request.

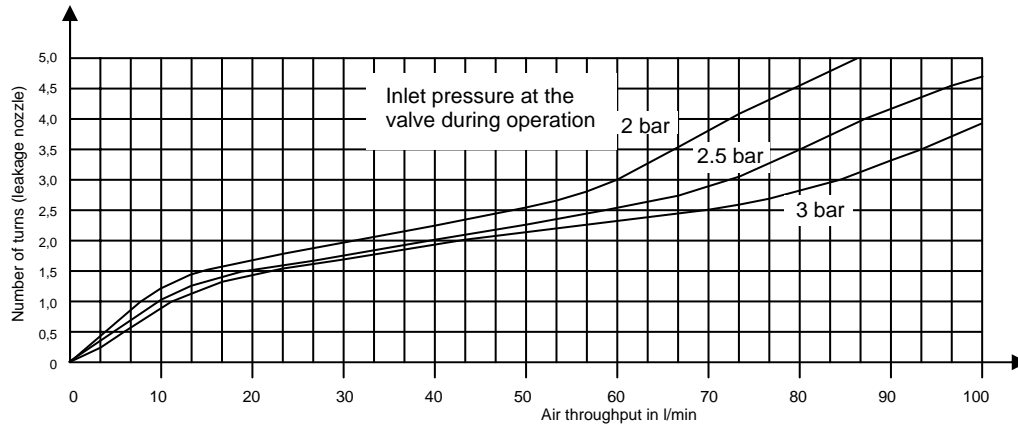


Fig. 12: Leakage air diagram

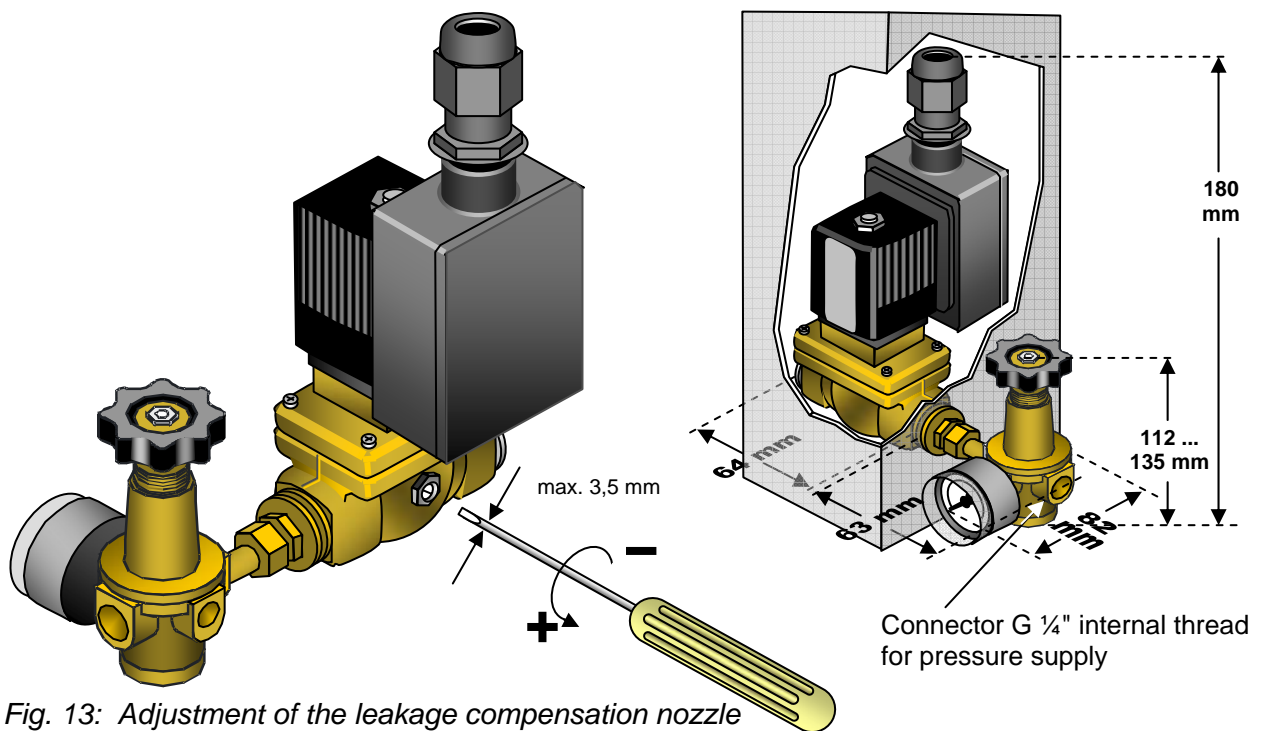


Fig. 13: Adjustment of the leakage compensation nozzle

### 6.2.21 Technical Data of the Pressure Regulator

Dimensions (mm):	length:	82
	width:	63
	height:	112 - 135
	hole drilled in enclosure	17

Connector pressure supply:	internal thread G ¼"
Connectable pressure:	0.5 - 25.0 bar
Extraction pressure:	0.0 - 6.0 bar
Flowrate (1 bar):	490 l/min
Weight:	0.5 kg

## 7 Digital Controller F-220.2B

### 7.1 Technical Data of the Digital Controller F-220.2B

This digital controller is used for enclosure sizes up to 2.000 L and for distances of over 5 m between the control system and the digital controller, and also whenever a separate EEx-e terminal box is required. It functions in the 2-position control mode (open / closed).

Type F-220.2B

PTB 00 ATEX 2129 X

Types of Ex protection:

II 2 G EEx m II T4, T5, T6 resp.  
II 2 G EEx em II T4, T5, T6

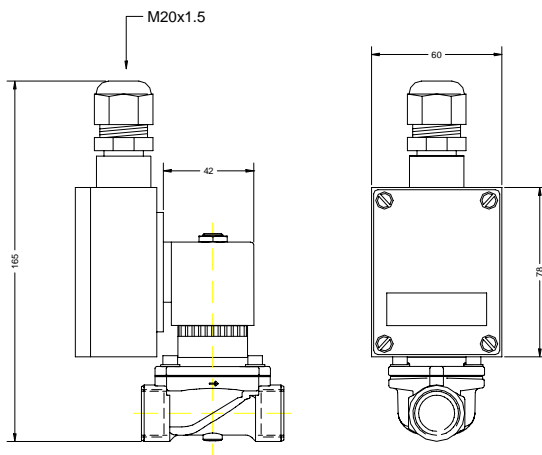


Fig. 29: Dimensioned drawing of the digital controller F-220.2B

Mains voltage:	230 V AC (+/-10%) / universal current Optional: 12 / 24 / 115 V universal current
Current consumption:	30 mA at 230 V; back-up fuse 0,08 A 60 mA at 115 V; back-up fuse 0,125 A 300 mA at 24 V; back-up fuse 0,63 A 600 mA at 12 V; back-up fuse 1,0 A
Ambient temperature during storage/transport:	-40 °C bis +60 °C, without condensation
Ambient temperature during operation:	-40 °C bis +60 °C, without condensation
Enclosure material:	GRP, epoxy resin, black and brass
Dimensions of F-220.2B (mm):	length of enclosure: 109 width of enclosure : 56 height of enclosure, approx.: 139 diameter of air inlet: 1/4" diameter of air outlet: 3/8" cable glands: M20
Weight:	1,0 kg



## 7.2 Connection of the Digital Controller F-220.2B



Ensure that only fuses of the specified type and the appropriate current rating are used as replacements. Jumpering or bypassing of fuses or back-up fuses is inadmissible on principle.

Electrical connection K  
with built-in fuse

### Universal magnet

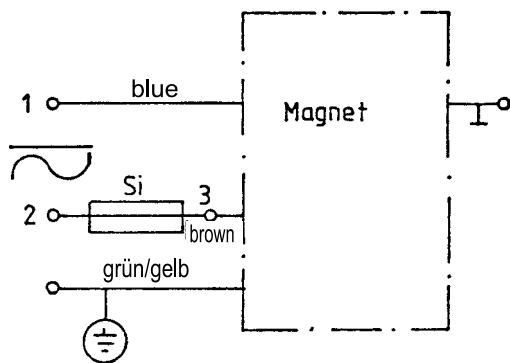


Fig. 30: Circuit diagram of the digital controller F-220.2B

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## 8 Decommissioning

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For the installation, maintenance and cleaning of the units, it is absolutely necessary to observe the applicable ordinances and provisions concerned with explosion protection (VDE 0160, VDE 0165 or EN60079-14, EN50014-50039) as well as the Accident Prevention Reg.



Installation, maintenance and cleaning of the units must only be performed by persons trained and authorized for this purpose, insofar as they are familiar with the units.



Work on electrically live parts, except for intrinsically safe circuits, is prohibited on principle if there is any danger of explosion.



Whenever you open covers or remove parts – except if this is easily possible by hand – it is possible that electrically live parts may be exposed. Even terminal components may be electrically live.

### 8.1 Dismantling the Components

Before commencing any work on the system or in the enclosure, switch off the supplies to the system and all units located in the enclosure and secure them against renewed powering-up. Remove the units mounted on and in the EEx-p enclosure only with the voltage switched off, and if possible outside the hazardous area. First remove the electrical cables leading to the outside and between the components, and then dismantle the digital/proportional controller, the pressure regulator and the monitoring unit.

### 8.2 Disposal and Recycling

The EEx-p system F-350 as well as all optional devices belonging to the system – insofar as they were delivered by E.L.B. Ex – Geräte GmbH, Bensheim – will taken back by the manufacturer for a small fee. Proper disposal by the user is then no longer necessary.

## 9 Glossary

### 9.1 User Classes (AK)

The classification of units into user classes denotes the safety levels of the unit. The user classes 3 to 5 of the units which are relevant in this connection are defined as follows:

- AK3 – the functional check of the unit is carried out when a button is pressed for 2 s. It is not necessary to remove the unit for the functional check.
- AK4 – the functional check of the unit is carried out through constant self-monitoring and automatic annunciation of faults. A fault does not lead to loss of the safety function. It is not necessary to remove the unit for the functional check.
- AK5 – the functional check of the unit is carried out through constant self-monitoring and automatic annunciation of faults, also externally. Two faults do not lead to loss of the safety function. It is not necessary to remove the unit for the functional check.

### 9.2 ATEX

Because of the EEC Treaty and the system, as specified in the so-called Single European Act, of separation into manufacture guidelines as per article 118 a, the rules of explosion protection are currently undergoing major changes. The guidelines as per article 100a are directed at the manufacturers of units. The guidelines of article 118a affect the operators of plants and the operation of units and protection systems. These are aimed at protecting the employees.

ATEX 100a – also known as the EC Ex-Protection Directive – regulates, for the whole of Europe, the manufacture of equipment and protective systems intended for use in potentially explosive atmospheres. Safety devices, controlling devices and regulating devices intended for use outside potentially explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems with respect to the risks of explosion are also covered by the scope of this Directive.

ATEX 100a was implemented in German law by the new Ordinance on Explosion Protection (ExVO/12.96).

### 9.3 ElexV/ 12.96

In addition to the new ExVO, the amended statutory provisions listed in the 2<sup>nd</sup> Ordinance on the GSG (Equipment Safety Law) also came into force in December 1996, including the new “Ordinance on Electrical Equipment in Potentially Explosive Atmospheres“ (ElexV/ 12.96).

In contrast to the old ElexV/ 2.80, which regulates the installation and operation of electrical equipment in potentially explosive spaces, the new ElexV is a pure operative regulation applying only for the mounting, installation and operation of electrical equipment in potentially explosive areas. In § 3 section 1 of the new ElexV, however, the plant operator is obliged to take into operation only such equipment and protective systems that comply with the new ExVO/ 12.96. In this way, the new ElexV is harmonized with the new manufacture requirements.

## **9.4 Explosion Protection**

In the Federal Republic of Germany, explosion protection is above all subject to the statutory provisions for plants requiring supervision, which have been regulated since 1992 in the Technical Plant and Equipment Act (Equipment Safety Law-GSG).

Besides the GSG, there are laws which can possibly also include explosion protection measures under certain circumstances, e.g. the Chemicals Law (ChemG) with the Ordinance on Hazardous Materials (GefStoffV) and the Federal Immission Protection Law (BImSchG) with the Ordinance on Incidents (StörfallV) and the Federal Mining Law (BBergG) and the Labour Protection Law (ArbSchG).

## **9.5 ExVO/12.96 (New Ordinance on Explosion Protection)**

On 20th December 1996, the “Second Ordinance on the Equipment Safety Law and for the Amendment of the Ordinances on the Equipment Safety Law“ dated 12<sup>th</sup> December 1996 came into force.

In this so-called article ordinance, article 1 contains the “Ordinance on the Bringing onto the Market of Equipment and Protective Systems for Potentially Explosive Areas“ – Ordinance on Explosion Protection – ExVo.

With this ordinance, the “Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheric atmospheres“ – ATEX 100 a – was implemented in German law.

According to this, equipment and protective systems may only be brought onto market if they meet the essential safety and health requirements (set out in Annex II of 94/9/EC) and the prescribed conformity assessment procedure (article 8 of Directive 94/9/EC).

## **9.6 Equipment Groups for Hazardous Areas**

For equipment in hazardous areas, at least K3 (see User Classes) is required.

Equipment group I covers equipment for use in underground mines (explosion proofing).

Equipment group 11 applies for general explosion protection and for dust explosion protection.

## 9.7 Equipment Categories for Hazardous Areas

For equipment in hazardous areas, at least AK2 (see User Classes) is required.

Category	Criteria	Applications
Category 1 (very high degree of safety)	Equipment for use in areas (zones), in which an explosive gas atmosphere is present continuously or for long periods.  Even for malfunctions occurring rarely, explosion safety must be ensured.	Zone 0  Zone 20 (formerly Zone 10)
Category 2 (high degree of safety)	Equipment for use in areas (zones), in which an explosive gas atmosphere is present occasionally. Ex protection must also be ensured for frequent malfunctions of the equipment.	Zone 1  Zone 21 (formerly Zone 11)
Category 3 (normal degree of safety)	Equipment for use in areas (zones), in which an explosive gas atmosphere can be expected not to occur at all. Sofern eine explosionsfähige  If an explosive gas atmosphere does occur, then only with low probability and for a short period only. For normal operation, equipment of category 3 provides an adequate degree of safety.	Zone 2  Zone 22

## 9.8 Equipment Marking

According to the new EC Explosion Protection Directive (ATEX 100a), all equipment and protective systems must be marked legibly and indelibly with the following minimum particulars:

- name und address of the manufacturer,
- CE marking, and the identification number of the notified body (e.g. the identification number for the PTB is 0102, for the TUV is 0032)
- designation of series or type,

- the specific marking of explosion protection, followed by the symbol referring to the category (see equipment categories for hazardous areas),
- for equipment group I (see equipment groups for hazardous areas) the letter “M”,
- for equipment group II (see equipment groups for hazardous areas) the letter “G” for areas containing explosive atmospheres caused by gases, vapours or mists, and/or the letter „D“ for areas, in which dust can form a potentially explosive atmosphere,
- all other information essential to their safe use.

Example:

E.L.B. – Ex-Geräte Bachmann GmbH + Co  
 D-64625 Bensheim  
 Type EEx-p Controller F-351.\_.\_  
 Ex I/II 2G  
 EEx p me [ia] IIC T4  
 TÜV 02 ATEX 1801

### 9.9 GRP (Glass-Fibre Reinforced Plastic)

Glass-fibre reinforced plastic is used in manufacturing the enclosure of the control unit. It has a surface conductivity of less than  $10^9 \Omega$ .

### 9.10 Ingress Protection (IP) Code

The IP Code (DIN EN 60529: 1992) describes the protection an enclosure affords against external influences. The code consists of the letters IP and two digits. The first digit indicates the protection against solid substances, the second the protection against liquids.

First digit	Protection against	Second digit	Protection against
0	No protection	0	No protection
1	Objects > 50 mm	1	Water drops falling vertically
2	Objects > 12 mm	2	Water drops falling at an angle (75 – 90°)
3	Objects > 2,5 mm	3	Water-spray at an angle up to 60°
4	Objects > 1,0 mm	4	Water-spray from all directions
5	Protected against dust	5	Water jets
6	Dust-tight	6	Strong water jets (heavy seas)
		7	Effect of immersion
		8	Prolonged immersion

Example: IP65 means that the equipment is dust – tight and protected against water jets.

In some countries, a third digit is used to describe the protection against mechanical impact:

Third digit (as per NFC 20-010)	Third digit (as per IEC529 – BS EN 60529;1991)	Protection against
0	0	No protection
1	1	Impact < 0.225 J
2	2	Impact < 0,375 J
3	3	Impact < 0,5 J
4	–	Not defined
5	4	Impact < 2,0 J
6	–	Not defined
7	5	Impact < 6,0 J
8	–	Not defined
9	6	Impact < 20 J

The IP Codes have their approximate equivalents – this is not a 1:1 correspondence!!! – in the NEMA codes commonly used in the USA and Canada:

IP	NEMA *)
23/30 *)	1
30/31 *)	2
32	3R
55	12
64	3
65	12K and 13
66	4 and 4X
67	6

\*) different assignments, depending on source

### 9.11 NEMA Codes

See also IP Codes. The types of protection for enclosure according to the standards of NEMA (National Electrical Manufacturing Association) are in common use in the USA and Canada (Publication No. 250 Enclosures for Electrical Equipment 1000 Volts Maximum). In comparison with the types of protection of the IEC (IP Codes) the Nema Codes cover additional influences such as installation location, corrosion, icing up and hail.

Code	Type of protection	Location
1	Against accidental (hand) contact with energized equipment.	inside
2	Against limited amounts of falling dirt and water.	inside
3	Against ingress of windblown dust, rain and hail. No damage from external formation of ice on the enclosure.	inside
3R	Against ingress of rain and hail. No damage from external formation of ice on the enclosure.	inside
3S	Against ingress of hail as well as windblown dust and rain. External mechanisms remain operable when ice laden.	inside
4	Against falling rain, splashing water and hose-directed water. No damage from external formation of ice on the enclosure.	inside or outside
4X	Against falling rain, splashing water and hose-directed water. No damage from external formation of ice on the enclosure. Corrosion protection.	inside or outside
5	Against dust, falling dirt and dripping non-corrosive liquids.	inside
6	Against ingress of dust and hose – directed water and against water during occasional temporary submersion at a limited depth. No damage from external formation of ice on the enclosure.	inside or outside
6P	Against ingress of dust and hose – directed water and against water during occasional temporary submersion at a limited depth. No damage from external formation of ice on the enclosure.	inside or outside
7	Against potentially explosive atmospheres classified as Class I, Groups A,B,C or D.	inside
8	Against potentially explosive atmospheres classified as Class I, Groups A,B,C or D.	inside or outside
9	Against potentially explosive atmospheres classified as Class II, Groups E,F or G.	inside
10	Enclosure must be constructed to meet the requirements of the Mine Safety and Health Administration.	Mining
11	Against ingress of dripping water and corrosion protection against submersion in oil.	inside
12, 12K	Against ingress of dust, dirt and dripping water.	inside
13	Against ingress of dust, splashing water, oil and non-corrosive liquids.	inside

NEMA Codes have their approximate equivalents – as shown clearly in the table below, this is not a 1:1 correspondence!!! – in the IP protection codes. Since the requirements for the types of protection according to NEMA meet, or are higher than, the IP types of protection, the table cannot be used to convert the NEMA codes to corresponding IEC protection codes.

NEMA	IP *)
1	10, 23, 30
2	11, 30, 31
3	54, 64
3R	14, 32
3S	54
4	56, 66
4X	56, 66
5	52
6	67
6P	68
12	52, 55
12K	52, 65
13	54, 65

\*) different assignments, depending on source

The NEMA codes 7 to 11 have no corresponding IP codes.