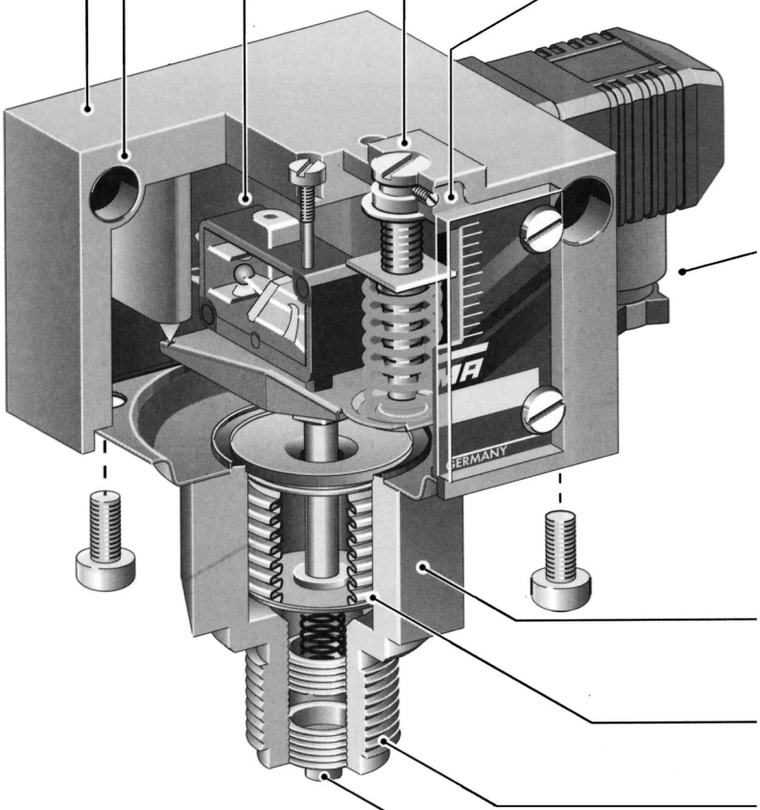
Mechanical pressure switches

Technical features / Advantages



Diecast aluminium housing
IP 54 or IP 65
Ex version also available

Wall mounting
or directly on the pressure line

Switching element (microswitch)

Lead sealable setpoint adjustment

Setting spindle locking element

Terminal connection
or plug connection to
DIN 43 650 Form A

Stainless steel sensor housing

Stainless steel bellows
with internal stop

Pressure connection
G 1/2“ external
G 1/4” internal

Centring pin

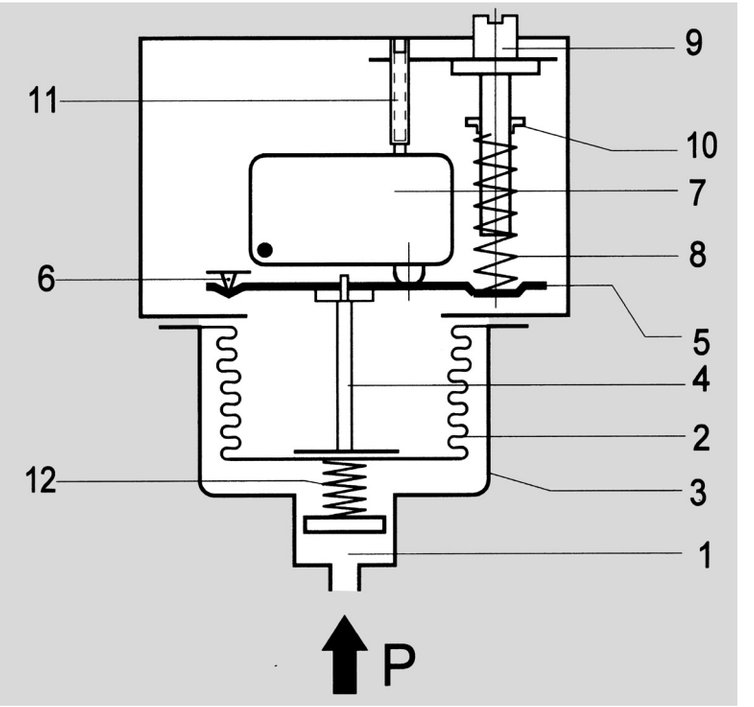
Pressure switches

General description

Operating mode

The pressure occurring in the sensor housing (**1**) acts on the measuring bellows (**2**). Changes in pressure lead to movements of the measuring bellows (**2**) which are transmitted via a thrust pin (**4**) to the connecting bridge (**5**). The connecting bridge is frictionlessly mounted on hardened points (**6**). When the pressure rises the connecting bridge (**5**) moves upwards and operates the microswitch (**7**). A counter-force is provided by the spring (**8**) whose pretension can be modified by the adjusting screw (**9**) (switching point adjustment). Turning the setting spindle (**9**) moves the running nut (**10**) and modifies the pretension of the spring (**8**). The screw (**11**) is used to calibrate the microswitch in the factory. The counter-pressure spring (**12**) ensures stable switching behaviour, even at low setting values.

1 = Pressure connection
2 = Measuring bellows
3 = Sensor housing
4 = Thrust pin
5 = Connecting bridge
6 = Pivot points
7 = Microswitch or other switching elements
8 = Setting spring
9 = Setting spindle (switching point adjustment)
10 = Running nut (switching point indicator)
11 = Microswitch calibration screw (factory calibration)
12 = Counter pressure spring



Pressure sensors

Apart from a few exceptions in the low-pressure range, all pressure sensors have measuring bellows, some made of copper alloy, but the majority of high-quality stainless steel. Measured on the basis of permitted values, the measuring bellows are exposed to a minimal load and perform only a small lifting movement. This results in a long service life with little switching point drift and high operating reliability. Furthermore, the stroke of the bellows is limited by an internal stop so that the forces resulting from the overpressure cannot be transmitted to the switching device. The parts of the sensor in contact with the medium are welded together without filler metals. The sensors contain no seals. Copper bellows, which are used only for low pressure ranges, are soldered to the sensor housing. The sensor housing and all parts of the sensor in contact with the medium can also be made entirely from stainless steel 1.4571 (DNS series). Precise material data can be found in the individual data sheets.

Pressure connection

The pressure connection on all pressure switches is executed in accordance with DIN 16288 (pressure gauge connection G 1/2A). If desired, the connection can also be made with a G 1/4 internal thread according to ISO 228 Part 1. Maximum screw-in depth on the G 1/4 internal thread = 9 mm.

Centring pin

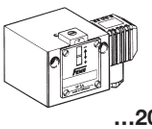
In the case of connection to the G 1/2 external thread with seal in the thread (i.e. without the usual sheet gasket on the pressure gauge connection), the accompanying centring pin is not needed. Differential pressure switches have 2 pressure connections (max. and min.) each of which are connected to a G 1/4 internal thread.

General technical data

with microswitches of the DCM, VCM, DNM, DNS and DDC series.
The technical data of type-tested units may differ slightly.
(please refer to type sheet)

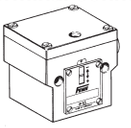
Normal version

Plug connection



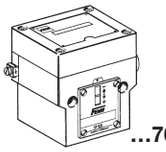
…200

Terminal connection

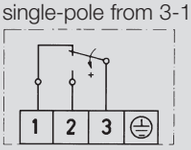
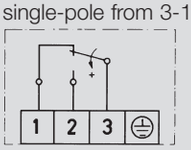


…300

Ex version



…700

Switch housing	Diecast aluminium GD Al Si 12	Diecast aluminium GD Al Si 12
Pressure connection	G 1/2 external thread (pressure gauge connection) and G 1/4 internal thread G 1/4 internal thread for DDCM differential pressure switches	
Switching function and connection diagram (applies only to version with microswitch)	Floating changeover contact. With rising pressure switching single-pole from 3-1 to 3-2. 	Floating changeover contact. With rising pressure switching single-pole from 3-1 to 3-2. 
Switching capacity (applies only to version with microswitch)	8 A at 250 VAC 5 A at 250 VAC inductive 8 A at 24 VDC 0.3 A at 250 VDC min. 10 mA, 12 VDC	3 A at 250 VAC 2 A at 250 VAC inductive 3 A at 24 VDC 0.03 A at 250 VDC min. 2 mA, 24 V DC
Mounting position	preferably vertical (see technical data sheet)	vertical
Degree of protection (in vertical position)	IP 54; (for terminal connection …300 IP 65)	IP 65
Ex degree of protection	–	EEx de IIC T6 tested to EN 50014/50018/50019 (CENELEC)
PTB approval Electrical connection	–	PTB 02 ATEX 1121
Cable entry	Plug connection to DIN 43 650 (200 series) or terminal connection (300 series)	Terminal connection
Ambient temperature	PG 11 / for terminal connection M 16 x 1.5	M 16 x 1.5
Switching point	See data sheets	–15 to +60°C
Switching differential	Adjustable via spindle. On switching device 300 the terminal box cover must be removed	Adjustable via spindle after the terminal box lid is removed
Lead seal	Adjustable or not adjustable (see Product Summary)	Not adjustable
Medium temperature	Only possible on plug connection housing 200	
Vacuum	Max. 70°C, briefly 85°C Higher medium temperatures are possible provided the above limits for the switching device are ensured by suitable measures (e.g. siphon).	Max. 60°C
Repetition accuracy of switching points	All pressure switches can operate under vacuum. This will not damage the device.	
Vibration strength	< 1% of the working range (for pressure ranges > 1 bar)	
Mechanical life	No significant deviations up to 4 g. With sinusoidal pressure application and room temperature, 10 x 106 switching cycles. The expected life depends to a very large extent on the type of pressure application, therefore this figure can serve only as a rough estimate. With pulsating pressure or pressure impacts in hydraulic systems, pressure surge reduction is recommended.	
Isolation values	Overvoltage category III, contamination class 3, reference surge voltage 4000 V.	
Oil and grease-free	Conformity to DIN VDE 0110 (01.89) is confirmed. The parts of all pressure switches with sensors made from steel or stainless steel are oil and grease-free. The sensors are hermetically encapsulated. They contain no seals. (See also additional function ZF 1979 Special Packing)	

General information about explosion protection

Basic principle

The basic principle of explosion protection is that:

a) combustible materials (gas, vapour, mist or dust) in dangerous quantities
b) air (or oxygen)
c) ignition sources

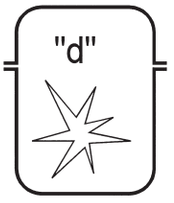
must not occur in the same place.

The permanent or temporary occurrence of explosive mixtures as per a) and b) is often unavoidable, therefore when operating electrical installations care must be taken to ensure that no ignition sources can occur.
With this in mind, the CENELEC technical committee has adopted the following European standards which are recognized in all EU member states.

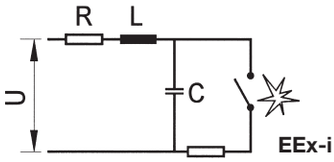
· General requirements	**EN 50 014**	**· Pressure resistant encapsulation “d”**	**EN 50 018**
· Oil encapsulation “o”	**EN 50 015**	**· Increased safety “e”**	**EN 50 019**
· Overpressure encapsulation “p”	**EN 50 016**	**· Intrinsic safety “i”**	**EN 50 020**
· Sand encapsulation “q”	**EN 50 017**	**· Cast encapsulation “m”**	**EN 50 028**

The guidelines relevant to FEMA products – besides the **“General Requirements EN 50 014”** – are **“Pressure resistant encapsulation d”** and **“Intrinsic safety i”**.

In addition, all explosion protection guidelines issued up to the present time have been combined into a single European Ex-Protection Directive 94/9EC. The aim of this new harmonized directive is to bring the explosion protection regulations of European member states into line with one another and eliminate barriers to trade between partner states. The new Directive 94/9EC (ATEX 100a), which came into force on 1 July 2003, replaces all previous directives.
All FEMA ex-pressure switches and ex-thermostats meet the requirements of the new European Ex-Protection Directive 94/9EC (ATEX 100a).



EEx-d



EEx-i

Pressure resistant encapsulation “d”
Switching elements and other electrical function units capable of igniting an explosive mixture are cast in a housing capable of withstanding the explosive pressure caused by an explosion indoors and preventing transmission to the surrounding atmosphere.

Intrinsic safety “i”
The equipment used in the area at risk of explosion contains only intrinsically safe electric circuits. An electric circuit is only intrinsically safe if the quantity of energy is so small that no spark or thermal effect can occur.

The term “simple electrical equipment”
In view of the use of simple microswitches without additional capacitance or inductance generating components, our pressure switches and thermostats designed for protection type Ex-i fall in the category of “simple electrical equipment”. These are not subject to testing or certification requirements within the meaning of Directive 94/9EC. The units may only be used in conjunction with ATEX-tested isolating amplifiers in areas at risk of explosion. We equip all units which are explicitly designed for such use with microswitches having gold contacts, a grounding screw and — for ease of identification — a blue cable entry.

General information about explosion protection

Zone classification

Explosion risk areas are grouped into zones according to the likelihood of a dangerous explosive atmosphere **according to EN 1127-1** occurring.
When assessing the explosion hazard, i.e. when identifying explosion risk areas, the “Guidelines for the Avoidance of Danger due to Explosive Atmospheres with Examples (ExRL)” of the German Insurance Association for the Chemical Industry [Berufsgenossenschaft Chemie] must be taken into account.
If the situation concerns a special case or if doubts exist as to the definition of explosion risk areas, the matter shall be decided by the supervisory authorities (Trade Supervisory Office [Gewerbeaufsichtsamt], where applicable with the assistance of the Insurance Association or the Technical Control Boards [Technische Überwachungsvereine]).
In Zones 0 (20) and 1 (21), only electrical equipment for which a type test certificate has been issued by a recognized testing agency may be used. In Zone 0 (20), however, only equipment expressly authorized for that zone may be used. Equipment approved for use in Zones 0 (20) and 1 (21) may also be used in Zone 2 (22). Under the new European Directive 94/9 EC (ATEX 100a), a distinction is made between **gas atmospheres** and **dust atmospheres**. This results in the following zone classifications:

Gas	**Zone 0**	**continuously or for long periods**	**Zone 0** (gas) is a place in which a dangerous explosive atmosphere is present continuously or for long periods. This normally includes only the interior of containers or the interior of apparatus (evaporators, reaction vessels etc.), if the conditions of Zone 0 are fulfilled. Continuous danger > 1000 hours/year.
	Zone 1	**occasionally**	**Zone 1** (gas) is a place in which a dangerous explosive atmosphere can be expected to occur occasionally in normal operation. This may include the immediate vicinity of Zone 0. Occasional danger = 10 to 1000 hours/year.
	Zone 2	**seldom and for short periods**	**Zone 2** (gas) is a place in which a dangerous explosive atmosphere can be expected to occur only rarely and then only for short periods. This may include areas surrounding Zones 0 and/or 1. Danger only under abnormal operating conditions < 10 hours/year.
Dust	**Zone 20**	**continuously or for long periods**	**Zone 20** (dust) is a place in which a dangerous explosive atmosphere in the form of a cloud of dust in air is present continuously or for long periods, and in which dust deposits of unknown or excessive thickness may be formed. Dust deposits on their own do not form a Zone 20. Continuous danger > 1000 hours/year.
	Zone 21	**occasionally**	**Zone 21** (dust) is a place in which a dangerous explosive atmosphere in the form of a cloud of dust in air may occasionally occur in normal operation, and in which deposits or layers of inflammable dust may generally be present. This may also include the immediate vicinity of Zone 20. Occasional danger = 10 to 1000 hours/year.
	Zone 22	**seldom and for short periods**	**Zone 22** (dust) is a place in which a dangerous explosive atmosphere may be expected to occur only rarely and then only for short periods. This may include areas in the vicinity of Zones 20 and 21. Danger only under abnormal operating conditions < 10 hours/year.

General information about explosion protection

Explosion group

The requirements for explosion-protected equipment depend on the gases and/or vapours present on the equipment and on the dusts lying on, adhering to and/or surrounding the equipment. This affects the gap dimensions required for pressure-proof encapsulation and, in the case of intrinsically safe circuits, the maximum permitted current and voltage values. Gases, vapours and dusts are therefore subdivided into various explosion groups.
The danger of the gases rises from explosion group IIA to IIC. The requirements for electrical equipment in these explosion groups increase accordingly. Electrical equipment approved for IIC may also be used for all other explosion groups.

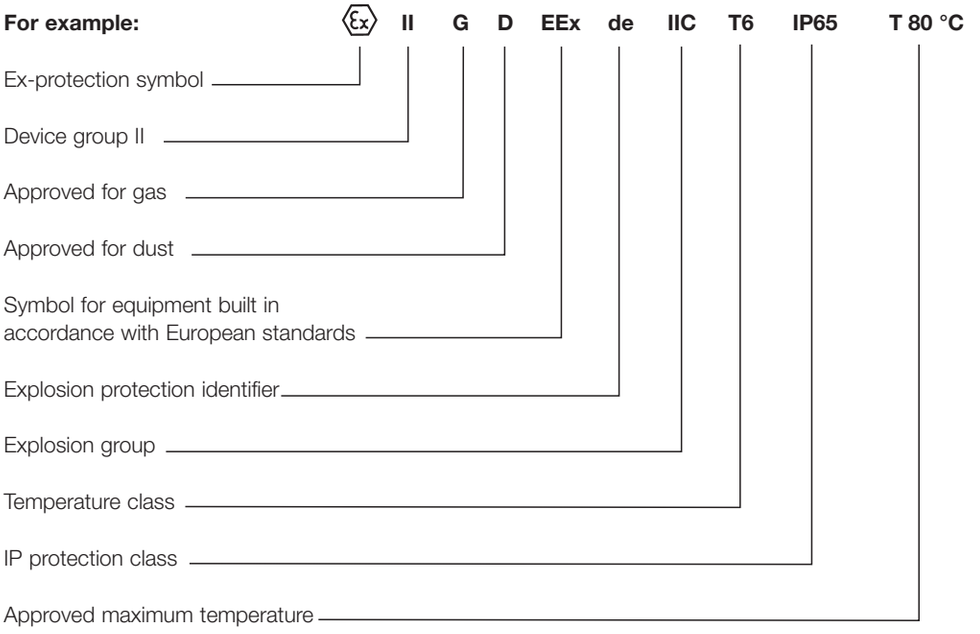
Temperature class

The maximum surface temperature of an item of equipment must always be lower than the ignition temperature of the gas, vapour or dust mixture. The temperature class is therefore a measure of the maximum surface temperature of an item of equipment.

Temperature class °C	Ignition temperature °C	Maximum surface temperature
T1	> 450	450
T2	> 300	300
T3	> 200	200
T4	> 135	135
T5	> 100	100
T6	> 85	85

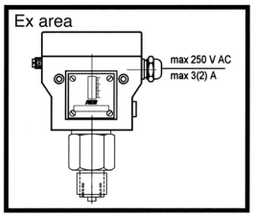
Identification of explosion-protected electrical equipment

In addition to normal data (manufacturer, type, serial number, electrical data), data relating to the explosion protection must be included in the identification.
Under the new Directive 94/9EC (ATEX 95), based on IEC recommendations, the following identification is required:



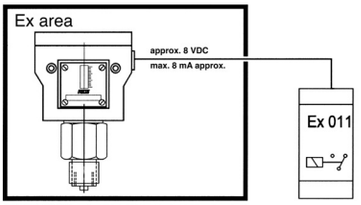
Pressure monitoring in explosion risk areas Zone 1, 2 and 21, 22

Specially equipped pressure switches can also be used in **explosion risk areas Zone 1, 2** and **21, 22**. The following alternatives are possible:



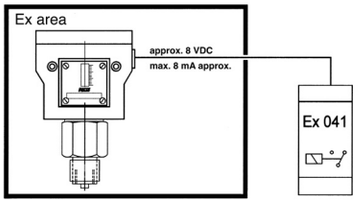
1. Pressure-proof encapsulated switching device, explosion protection EEx de IIC T6, PTB 02 ATEX 1121

The pressure switch with pressure-proof encapsulation can be used directly in the explosion risk area (Zone 1 and 2 or 21 and 22). The maximum switching voltage, switching capacity and ambient temperature must be taken into account and the rules for installation in the explosion risk area must be observed. All pressure switches may be equipped with explosion-proof switching devices. However, special circuits and designs with an adjustable switching differential or internal interlock (reclosing lockout) are not permitted.



2. EEx-i pressure switches

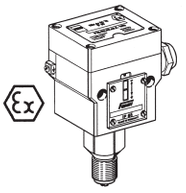
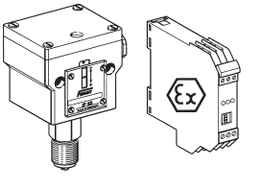
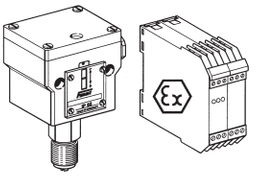
All pressure switches of normal design can be used in explosion risk areas Zone 1 and 2 or 21 and 22, if they are integrated into an “intrinsically safe control current circuit”. Intrinsic safety is based on the principle that the control current circuit in the explosion risk area carries only a small quantity of energy which is not capable of generating an ignitable spark.
Isolating amplifiers, e.g. type Ex 011 or Ex 041, must be tested by the Physikalisch-Technische Bundesanstalt (PTB) and approved for use in explosion risk areas. Isolating amplifiers must always be installed outside the explosion risk zone.
Pressure switches designed for EEx-ia installations may be provided with blue connection terminals and cable entries. In view of the low voltages and currents carried via the contacts of the microswitches, gold-plates contacts are recommended (additional function ZF 513).



3. Pressure switches with microswitch and resistor combination for short-circuit and line break monitoring (see DBS series)

A combination of a pressure switch with mechanical microswitch connected to a 1.5 kOhm series resistor and a safety-engineered isolating amplifier (type Ex 041) may also be used in explosion risk zones 1, 2 and 21, 22 (explosion protection EEx-ia).
The safety-engineered isolating amplifier produces a separate intrinsically safe control current circuit and at the same time monitors the supply conductors between the isolating amplifier and the pressure switch for short-circuit and line break. In this regard, see also the section on pressure limiters for safety-critical applications and data sheet Ex 041.

Pressure monitoring in explosion risk areas Zone 1 (21) and 2 (22)

		
Ex-D…	**D…-513 + Ex 011**	**DWR…-576 + Ex 041**
Pressure-proof encapsulated	**Intrinsically safe**	**Intrinsically safe, line break and short-circuit monitoring**
Explosion protection: EEx de IIC T6 PTB approval for the complete switching device. Switching capacity at 250 V/3 A. The pressure switch can be installed within the Ex-Zone.	Explosion protection: EEx-ia PTB approval for isolating amplifiers Ex 041 Pressure switch with gold-plated contacts, blue terminals and blue cable entries. The isolating amplifier must be installed outside the Ex-Zone.	Explosion protection: EEx-ia PTB approval for isolating amplifiers Ex 041 Pressure switch with safety sensor, positive opening microswitch, gold-plated contacts, blue terminals and blue cable entries. The isolating amplifier must be installed outside the Ex-Zone.

DNS 3-201

DNS 6-351

DNS type series

Pressure switch with stainless steel sensor system, with optional plastic-coated housing

Pressure switches of the DNS series are suitable for monitoring and controlling pressures in chemical plants, process engineering and any situation where the pressure of aggressive liquids and gases must be monitored.

All components of the sensor system are made from high-quality stainless steel (1.4571) and welded using the latest methods without filler metals. The pressure sensor is hermetically encapsulated and contains no sealing materials.

Technical data

Pressure connection
External thread G 1/2 (pressure gauge connection) according to DIN 16 288 and internal thread G 1/4 according to ISO 228 Part 1.

Switching device
Robust housing (200) made of seawater-resistant diecast aluminium GD Al Si 12.

Degree of protection
IP 54, in vertical position.
IP 65, for EEx-d version.

Pressure sensor materials
Pressure bellows and all parts in contact with medium. X 6 Cr Ni Mo Ti 17122 Material no. 1.4571

Mounting position
Vertically upright and horizontal.

Max. ambient temperature at switching device
–25…+70 °C.
For EExd versions: –15…+60 °C.

Max. medium temperature
The maximum medium temperature at the pressure sensor must not exceed the permitted ambient temperature at the switching device. Temperatures may reach 85°C for short periods (not EEx-d).
Higher medium temperatures are possible provided the above limit values for the switching device are ensured by suitable measures (e.g. siphon).

Mounting
Directly on the pressure line (pressure gauge-connection) or on a flat surface with two 4 mm Ø screws.

Switching pressure
Adjustable from outside with screwdriver.

Switching differential
For values see Product Summary.

Contact arrangement
Single-pole changeover switch.

Switching capacity	250 VAC (ohm)	250 VAC (ind)	250 VDC (ohm)	24 VDC (ohm)
Normal	8 A	5 A	0.3 A	8 A
EEx-d	3 A	2 A	0.03 A	3 A

Plastic coating
The diecast aluminium housing in GD Al Si is chromated and stove-enamelled with resistant plastic. Corrosion tests with 3% saline solution and 30 temperature changes from +10 to +80°C showed no surface changes after 20 days.

Product Summary

Type	Setting range	Switching differential (mean values)	Max. permissible pressure	Dimensioned drawing
Switching differential not adjustable				
VNS 301-201	-250…+100 mbar	45 mbar	3 bar	1 + 15
VNS 111-201	-1*…+0.1 bar	50 mbar	6 bar	
DNS 025-201	0.04…0.25 bar	30 mbar	6 bar	
DNS 06-201	0.1…0.6 bar	40 mbar	6 bar	
DNS 1-201	0.2…1.6 bar	60 mbar	6 bar	
DNS 3-201	0.2…2.5 bar	0.1 bar	16 bar	1 + 18
DNS 6-201	0.5…6 bar	0.15 bar	16 bar	
DNS 10-201	1…10 bar	0.3 bar	16 bar	1 + 16
DNS 16-201	3…16 bar	0.5 bar	25 bar	
…-203 types Adjustable switching differential Plastic-coated housing				
VNS 301–351	–250…+100 mbar	45 mbar	3 bar	2 + 15
VNS 111–351	–1*…+0.1 bar	50 mbar	6 bar	
DNS 025–351	0.04…0.25 bar	30 mbar	6 bar	
DNS 06–351	0.1…0.6 bar	40 mbar	6 bar	
DNS 1–351	0.2…1.6 bar	60 mbar	6 bar	
DNS 3–351	0.2…2.5 bar	0.1 bar	16 bar	2 + 18
DNS 6–351	0.5…6 bar	0.15 bar	16 bar	
DNS 10–351	1…10 bar	0.3 bar	16 bar	2 + 16
DNS 16–351	3…16 bar	0.5 bar	25 bar	
Ⓔx version, (housing 700), explosion protection EEx-d				
Ex-VNS 301	–250…+100 mbar	45 mbar	3 bar	3 + 15
Ex-VNS 111	–1*…+0.1 bar	50 mbar	6 bar	
Ex-DNS 025	0.04…0.25 bar	30 mbar	6 bar	
Ex-DNS 06	0.1…0.6 bar	40 mbar	6 bar	
Ex-DNS 1	0.2…1.6 bar	60 mbar	6 bar	
Ex-DNS 3	0.2…2.5 bar	0.1 bar	16 bar	3 + 18
Ex-DNS 6	0.5…6 bar	0.15 bar	16 bar	
Ex-DNS 10	1…10 bar	0.3 bar	16 bar	3 + 16
Ex-DNS 16	3…16 bar	0.5 bar	25 bar	

Explosion protection EEx-i with ZF 513
Example for ordering: DNS…-513

* At very high vacuums, close to the theoretical maximum of –1 bar, the switch may not be usable in view of the special conditions of vacuum engineering. However, the pressure switch itself will not be damaged at maximum vacuum.

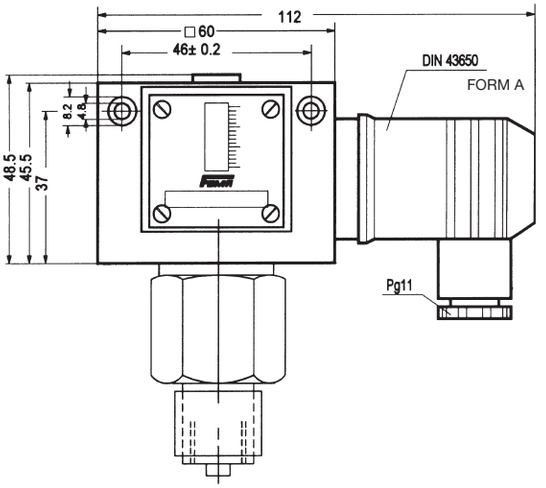
Calibration
The **DNS** and **VNS** series are calibrated for falling pressure. This means that the adjustable switching pressure on the scale corresponds to the switching point at falling pressure. The reset point is higher by the amount of the switching differential. (See also page 30, 1. Calibration at lower switching point).

CE Ⓔx

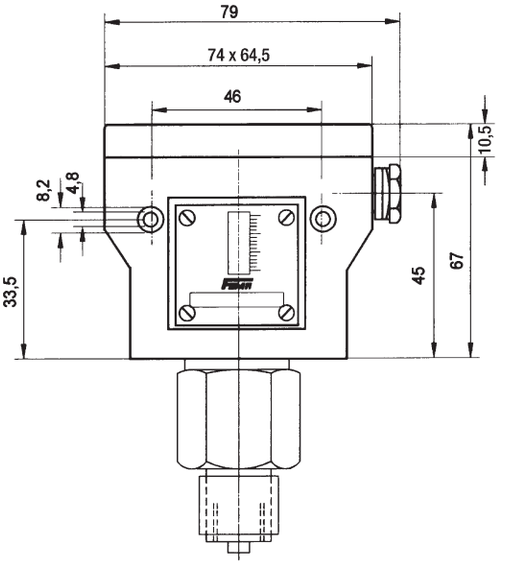
Degree of protection: IP 54/65

Dimensioned drawings of switch housings

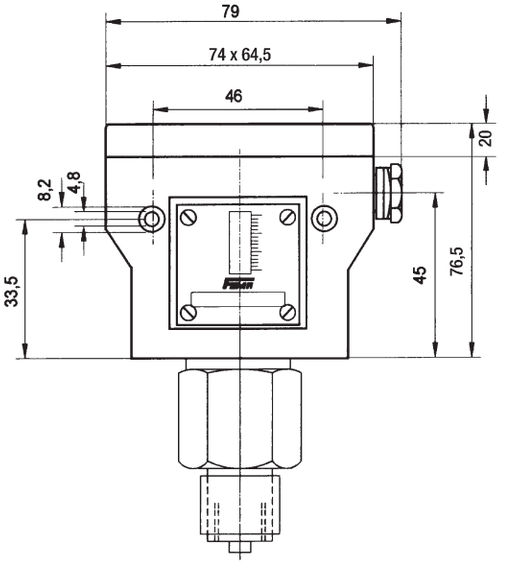
1 **Housing 200 (plug connection)**



2 **Housing 300 and 500 (terminal connection)**

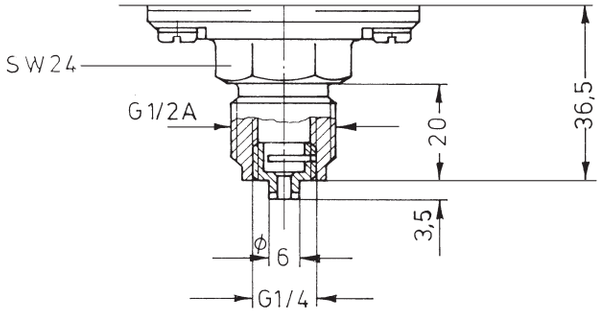


3 **Housing 700 (Ex)**

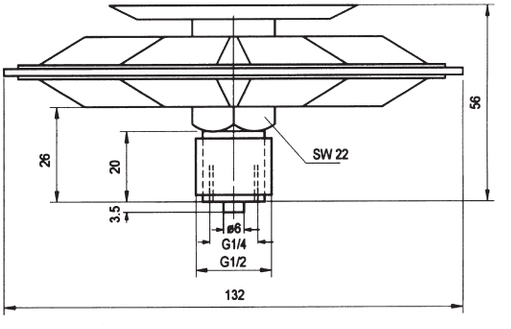


Dimensioned drawings of pressure sensors

10

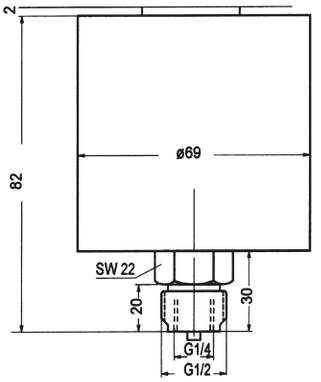


11

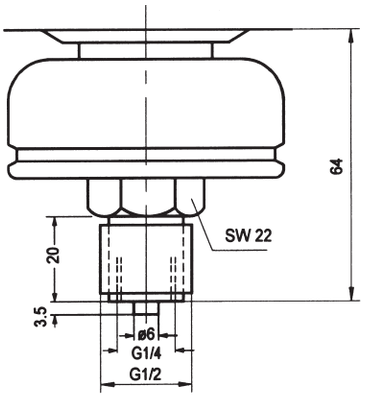


Dimensioned drawings of pressure sensors

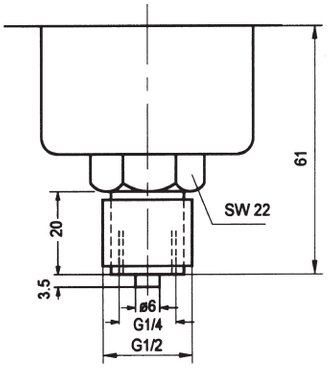
12



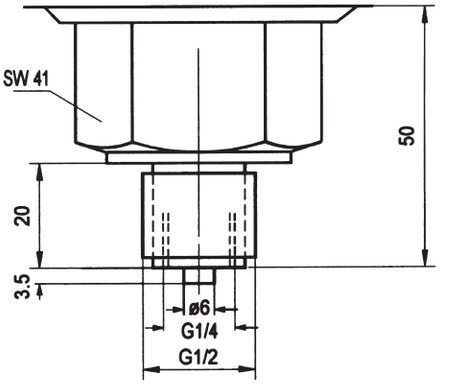
13



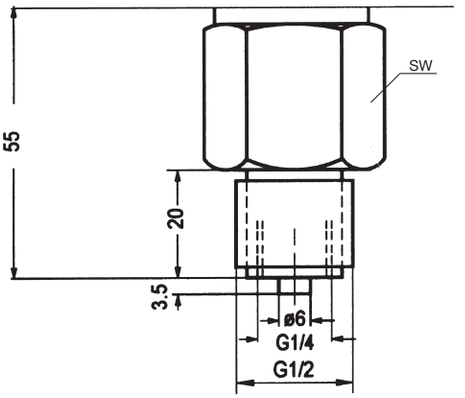
14



15

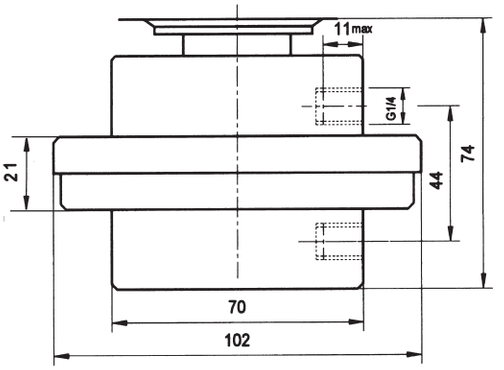


16 – 19



Dimensioned drawing	SW
16	22
17	24
18	30
19	32

20



21