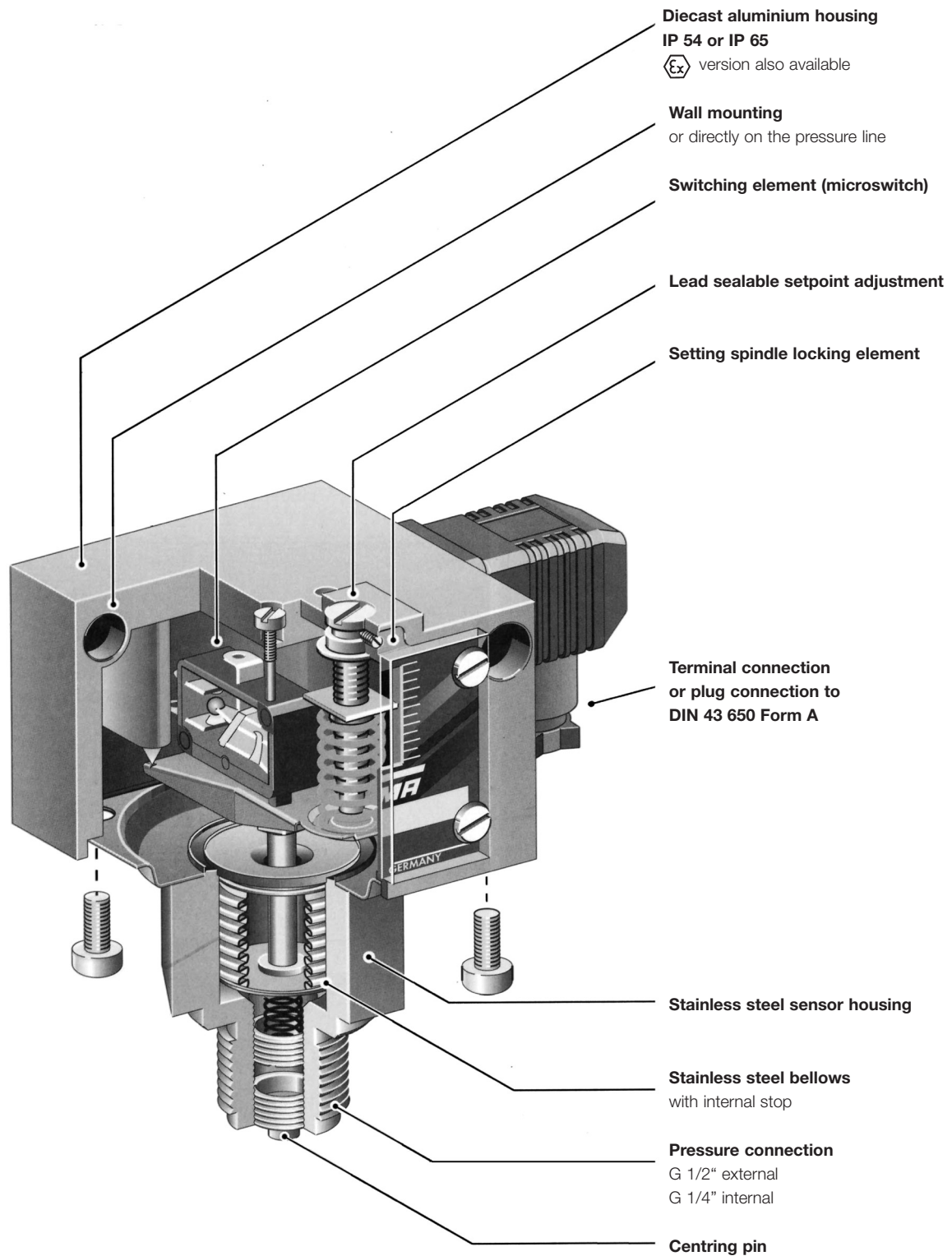


# Mechanical pressure switches

Technical features / Advantages



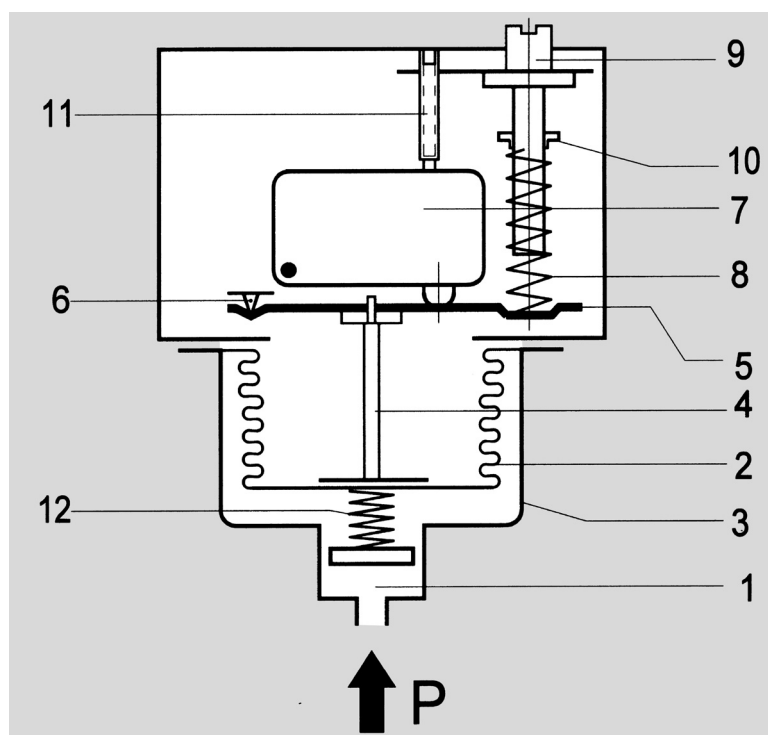
# Pressure switches

## 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 counterforce 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.

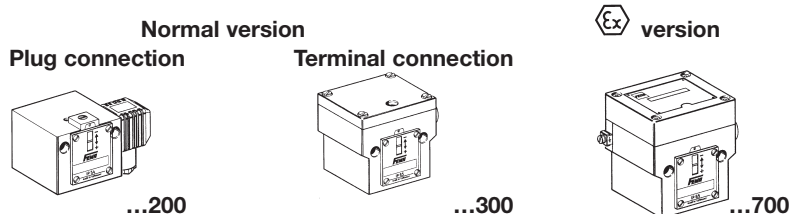
### Centring pin

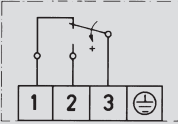
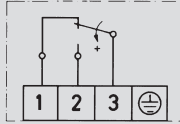
In the case of connection to the G 1/2 external thread with seal in the thread (i.e. without the usual sheet gasket on the pressure gauge connection), the accompanying centring pin is not needed. Differential pressure switches have 2 pressure connections (max. and min.) each of which are connected to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



<b>Switch housing</b>	Diecast aluminium GD Al Si 12	Diecast aluminium GD Al Si 12
<b>Pressure connection</b>	G 1/2 external thread (pressure gauge connection) and G 1/4 internal thread G 1/4 internal thread for DDCM differential pressure switches	
<b>Switching function and connection diagram</b> (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. 
<b>Switching capacity</b> (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
<b>Mounting position</b>	preferably vertical (see technical data sheet)	vertical
<b>Degree of protection</b> (in vertical position)	IP 54; (for terminal connection ...300 IP 65)	IP 65
<b>Ex degree of protection</b>	–	EEx de IIC T6 tested to EN 50014/50018/50019 (CENELEC)
<b>PTB approval Electrical connection</b>	–	PTB 02 ATEX 1121
<b>Cable entry</b>	Plug connection to DIN 43 650 (200 series) or terminal connection (300 series)	Terminal connection
<b>Ambient temperature</b>	PG 11 / for terminal connection M 16 x 1.5	M 16 x 1.5
<b>Switching point</b>	See data sheets Adjustable via spindle. On switching device 300 the terminal box cover must be removed	–15 to +60°C Adjustable via spindle after the terminal box lid is removed
<b>Switching differential</b>	Adjustable or not adjustable (see Product Summary)	Not adjustable
<b>Lead seal</b>	(see Product Summary)	
<b>Medium temperature</b>	Only possible on plug connection housing 200 Max. 70°C, briefly 85°C	Max. 60°C
<b>Vacuum</b>	Higher medium temperatures are possible provided the above limits for the switching device are ensured by suitable measures (e.g. siphon). All pressure switches can operate under vacuum. This will not damage the device.	
<b>Repetition accuracy of switching points</b>	< 1% of the working range (for pressure ranges > 1 bar)	
<b>Vibration strength</b>		
<b>Mechanical life</b>	No significant deviations up to 4 g. With sinusoidal pressure application and room temperature, 10 x 10 <sup>6</sup> 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.	
<b>Isolation values</b>	Overvoltage category III, contamination class 3, reference surge voltage 4000 V.	
<b>Oil and grease-free</b>	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)	

# ZF additional functions — Pressure switches and pressure monitors

## Example for ordering:

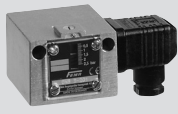

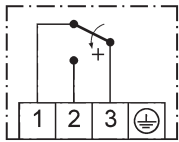
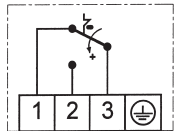
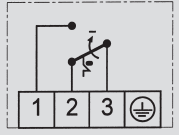
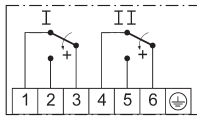
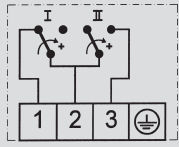
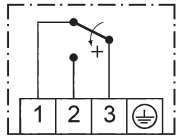
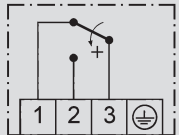
**DWR 6-205**

Code of additional function (e.g. maximum limiter)  
Code for pressure range  
Sensor system

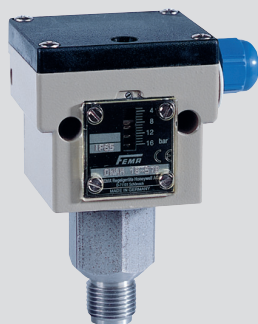
## How to order:

Pressure switch  
DWR 6-205  
or DWR 6  
with ZF 205

## Additional functions / Connection diagrams

	Plug connection 200 series (IP 54)	Terminal connection 300 series (IP 65)	Connection diagram	Explanation
<b>Normal version (plug connection)</b> Microswitch, single pole switching Switching differential not adjustable				
<b>Terminal connection – housing (300)</b>		...301		
<b>Unit with adjustable switching differential</b>	ZF 203			
<b>Maximum limiter</b> with reclosing lockout <b>Interlocking with rising pressure</b>	ZF 205			see DWR series
<b>Minimum limiter</b> with reclosing lockout <b>Interlocking with falling pressure</b>	ZF 206			see DWR series
<b>Two microswitches</b> , switching in parallel or in succession. Fixed switching interval, only possible with terminal connection housing. <b>State the switching interval</b> (not possible with all pressure switches, see data sheet p. 2, pp. 40 - 43)		ZF 307 *		
<b>Two microswitches, 1 plug</b> switching in succession. adjustable switching interval <b>Please indicate switching scheme*</b> (not possible with all pressure switches, see data sheet p. 2, pp. 40 – 43)	ZF 217 *			
<b>Gold-plated contacts</b> , single pole switching (not available with adjustable switching differential).	ZF 213			<b>Permitted contact load:</b> <b>Max: 24 VDC, 100 mA</b> <b>Min: 5 VDC, 2 mA</b>
<b>Switch housing with surface protection</b> (chemical version).		ZF 351		

\*Switching point adjustment: Please specify **switching point and direction of action** (rising or falling pressure).



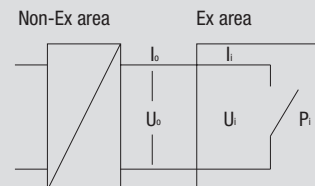
DWAM...-576

## Additional functions for EEx-i equipment ZF 5...

- Housing (300) with terminal connection (IP 65), "blue" cable entry and terminals.
- Also available with resistor combination for line break and short-circuit monitoring (with isolating amplifier Ex 041).

### Important:

All pressure switches with the ZF 5... additional functions listed here can only be operated in combination with a suitable isolating amplifier (see pages 60 – 61).



For ZF513, ZF576, ZF574:  
 $U_i = 15 \text{ V DC}$ ,  $I_i = 60 \text{ mA}$ ,  
 $P_i = 0.9 \text{ W}$ ,  $C_i < 1 \text{ nF}$ ,  $L_i < 100 \text{ } \mu\text{H}$

Additional functions for EEx-i equipment		Connection diagram	Isolating amplifier
<b>Gold-plated contacts</b> , single-pole switching. Switching differential fixed (not adjustable). Switching capacity: max. 24 VDC, 100 mA, min. 5 VDC, 2 mA.	<b>ZF 513</b>		<b>Ex 011</b>
<b>Versions with resistor combination for line break and short-circuit monitoring in control current circuit, see DBS series, pages 54 – 56:</b>			
Normally closed contact with resistor combination for <b>maximum pressure monitoring</b> , gold-plated contacts, plastic-coated housing (chemical version).	<b>ZF 576</b>		<b>Ex 041</b>
Normally closed contact <b>with reclosing lockout</b> and resistor combination, for <b>maximum pressure monitoring</b> . Plastic-coated housing (chemical version).	<b>ZF 577</b>		<b>Ex 041</b>
Normally closed contact with resistor combination for <b>minimum pressure monitoring</b> , gold-plated contacts, plastic-coated housing (chemical version).	<b>ZF 574</b>		<b>Ex 041</b>
Normally closed contact <b>with reclosing lockout</b> and resistor combination, for <b>minimum pressure monitoring</b> . Plastic-coated housing (chemical version).	<b>ZF 575</b>		<b>Ex 041</b>
<b>Other additional functions</b>		Plug connection <b>200 series</b>	Terminal connection <b>300 series</b>
<b>Adjustment according to customer's instruction:</b> <b>one</b> switching point <b>two</b> switching points or defined switching differential	<b>ZF 1970*</b> <b>ZF 1972*</b>		<b>ZF 1970*</b> <b>ZF 1972*</b>
<b>Adjustment and lead sealing according to customer's instruction:</b> <b>one</b> switching point <b>two</b> switching points or defined switching differential	<b>ZF 1971*</b> <b>ZF 1973*</b>		– –
<b>Labelling of units</b> according to customer's instruction with sticker	<b>ZF 1978</b>		<b>ZF 1978</b>
<b>Special packing for oil and grease-free storage</b>	<b>ZF 1979</b>		<b>ZF 1979</b>

**Documents:** Additional documents, e.g. data sheets, operating instructions, TÜV, DVGW or PTB certificates.

### Test certificates according to EN 10 204

Factory certificate 2.2 based on non-specific specimen test	<b>WZ 2.2</b>	<b>WZ 2.2</b>
Acceptance test certificate 3.1 based on specific test	<b>AZ 3.1</b>	<b>AZ 3.1</b>
Acceptance test certificate for ZFV separating diaphragms	<b>AZ 3.1 –V</b>	<b>AZ 3.1 –V</b>

\***Switching point adjustment:** Please specify **switching point and direction of action** (rising or falling pressure).



## Setting instructions

### Factory calibration of pressure switches

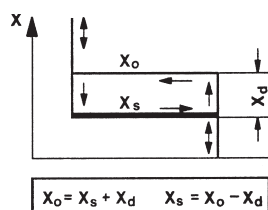
In view of tolerances in the characteristics of sensors and springs, and due to friction in the switching kinematics, slight discrepancies between the setting value and the switching point are unavoidable. The pressure switches are therefore calibrated in the factory in such a way that the setpoint adjustment and the actual switching pressure correspond as closely as possible in the middle of the range. Possible deviations spread to both sides equally.

The device is calibrated either for falling pressure (calibration at lower switching point) or for rising pressure (calibration at higher switching point), depending on the principal application of the type series in question.

Where the pressure switch is used at other than the basic calibration, the actual switching point moves relative to the set switching point by the value of the average switching differential. As FEMA pressure switches have very small switching differentials, the customer can ignore this where the switching pressure is set only roughly. If a very precise switching point is needed, this must be calibrated and checked in accordance with normal practice using a pressure gauge.

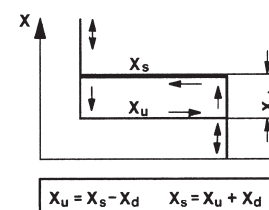
#### 1. Calibration at lower switching point

Setpoint  $x_s$  corresponds to the lower switching point, the upper switching point  $x_o$  is higher by the amount of the switching differential  $x_d$ .

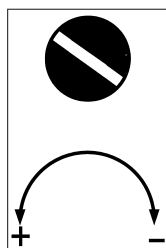


#### 2. Calibration at upper switching point

Setpoint  $x_s$  corresponds to the upper switching point, the lower switching point  $x_u$  is lower by the amount of the switching differential  $x_d$ .



The chosen calibration type is indicated in the technical data for the relevant type series.



Clockwise:  
lower switching  
pressure

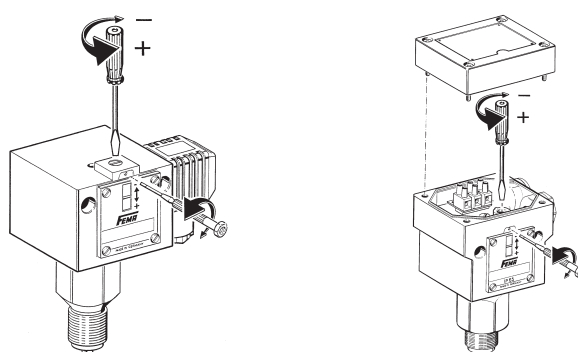
Anticlockwise:  
higher switching  
pressure

**Direction of action of setting  
spindle**

### Setting switching pressures

Prior to adjustment, the securing pin above the scale must be loosened by not more than 2 turns and retightened after setting. The switching pressure is set via the spindle. The set switching pressure is shown by the scale.

To set the switching points accurately it is necessary to use a pressure gauge.

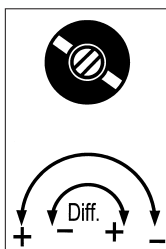


### Changing the switching differential (only for switching device with suffix "V", ZF 203)

By means of setscrew within the spindle. The lower switching point is not changed by the differential adjustment; only the upper switching point is shifted by the differential. One turn of the differential screw changes the switching differential by about 1/10 of the total differential range. The switching differential is the hysteresis, i.e. the difference in pressure between the switching point and the reset point.

### Lead seal of setting spindle (for plug connection housing 200 only)

The setting spindle for setting the desired value and switching differential can be covered and sealed with sealing parts available as accessories (type designation: P2) consisting of a seal plate and capstan screw. The sealing parts may be fitted subsequently. The painted calibration screws are likewise covered.



Clockwise:  
greater  
difference  
Anticlockwise:  
smaller  
difference

**With pressure switches of the  
DWAMV and DWR...-203 series,  
the direction of action of the  
differential screw is reversed.**

## Explanation of type designations – type codes

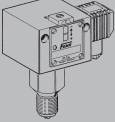
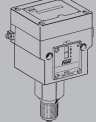
The type designations of FEMA pressure switches consist of a combination of letters followed by a number denoting the setting range. Additional functions and version variants are indicated by a code which is separated from the basic type by a hyphen. Ex versions (explosion protection EEx-d) are identified by the prefix “Ex” in front of the type designation.

Basic version (based on the example of DCM series)	with additional function	Ex-version
DCM XXX	DCM XXX-YYY	Ex-DCM XXX

DCM	—————>	Series code (e.g. DCM)
XXX	—————>	Codes for pressure range
YYY	—————>	Code for additional functions
Ex	—————>	Code for Ex version

Switch housing version	
DCM XXX	Basic version with plug connection housing
DCM XXX-2...	Basic version with plug connection housing
DCM XXX-3...	Terminal connection housing (300)
Ex-DCM XXX	EEx-d switching device (700)
DCM XXX-5...	EEx-i version

### Which additional function goes with which pressure switch?

	Plug connection, 200 series 			Terminal connection, 300 series 					
	Additional function ZF			Additional function ZF					
	203	213	217	301	307	513	574 576	575 577	EEx-d
DCM/VCM	• <sup>1</sup>	•	• <sup>1</sup>	•	• <sup>1</sup>	•			•
VNM/DNS/VNS	•	•	•	•	•	•			•
DWAM		•		•		•	•	•	
DDCM		•	• <sup>2</sup>	•	• <sup>2</sup>	•			•
DWR	•	•		•		•	•	•	•
DGM		•		•		•	•	•	•

• available

<sup>1</sup> except DCM 4016, DCM 4025, VCM 4156 and DCM 1000

<sup>2</sup> except DDCM 252, 662, 1602, 6002

**Ex-versions (EEx-d) can only be supplied in basic form.  
Additional functions are not possible.**



## Pressure switches “of special construction”

### Definitions and information

Pressure monitoring and pressure limiting in

- Steam boilers
- District heating systems
- Oil pipelines
- Liquid gas installations etc.
- Hot water heating systems
- Gas installations
- Firing systems

is extremely important with regard to safety.

TÜV



DVGW



### Component testing

Pressure monitoring devices for safety-critical applications must work reliably and be tested according to the relevant directives in each case. **The reliability of pressure monitors and pressure limiters must be certified by a component test** which is performed by the testing agencies responsible in each case (e.g. TÜV and DVGW). The following section deals with the FEMA product range for safety-critical pressure monitoring in thermal and process engineering systems.

### Special construction

The term “of special construction” originates from the **VdTÜV Memorandum “Pressure 100/1”, issue 04.83**, which defines the requirements for **pressure monitors and pressure limiters for steam boilers and hot water systems**. Originally used only for pressure monitoring in the area of steam and hot water, the “special construction” characteristic is increasingly used as a quality and safety argument for other applications as well. The following section describes the requirements for pressure limiters “of special construction”. Recommendations for the correct selection of pressure limiters are given by reference to safety analyses.

### Definitions of the VdTÜV Memorandum “Pressure 100/1”:

#### Pressure monitors (DW)

Pressure monitors are devices which switch off the heating system on exceeding and / or falling below a predefined pressure limit and release the heating system again only after a change in pressure.

#### Pressure limiters (DB)

Pressure limiters are devices which switch off the heating system on exceeding and / or falling below a predefined pressure limit and lock it to prevent automatic restarting.

#### Pressure limiters “of special construction” (SDB)

Pressure limiters “of special construction” perform the same tasks as pressure limiters. In addition they must satisfy the extended safety requirements of section 3.3 (of “Pressure 100/1”).



### Safe condition

According to DIN VDE 0660, Part 209, the safe condition of the system is reached if a cut-off command is present at the output contact which means that in the safe condition, the microswitch in the pressure limiter is actuated (opened) and the control circuit is interrupted. Series connected switching devices must react in the same way. The operating mode of the safety pressure limitation thus corresponds to the **closed circuit principle**.

### Additional requirements for pressure limiters “of special construction”

#### Section 3.3 of VdTÜV Memorandum “Pressure 100/1”:

Pressure limiters “of special construction” **must, in the event of a breakage in the mechanical part of the measuring element, lead to cut-off and interlock of the heating**. This requirement is also fulfilled if the mechanical part of the measuring element is calculated for vibrating stress **or has withstood a test with 2 million operating cycles and the pressurized parts of the measuring element are made of corrosion-resistant materials**.

(Abbreviated excerpt from VdTÜV Memorandum “Pressure 100/1”).

#### Therefore there are two possible ways of meeting the requirements for pressure limiters “of special construction”:

- By a self-monitoring pressure sensor which is designed so that a breakage in the mechanical part of the measuring element leads to cut-off to the safe side (see Fig. 1)
- By certification of endurance testing with 2 million operating cycles during the component test (see Fig. 2)

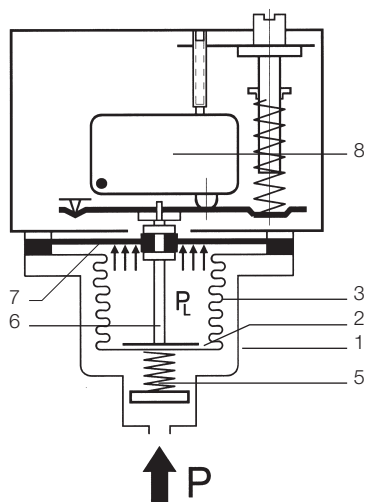
#### a) Self-monitoring pressure sensor with safety diaphragm (for maximum pressure monitoring only)

Fig. 1 is a cross-sectional diagram of a pressure sensor which fulfils the “special construction” requirements. The measuring chamber is bordered by the housing (1), base (2) and measuring bellows (3). All parts are made of stainless steel and are welded together without filler metals. When the pressure rises the measuring bellows (3) moves upwards, supported by the back pressure spring (5). The setpoint spring installed in the switching device acts as a counterforce. A transfer bolt (6) which transfers the pressure-dependent movements of the measuring bellows (3) to the switching device located above is placed on the inside of the base. A plastic diaphragm (7), which is not in contact with the medium and in normal operation follows the movements of the measuring bellows but itself has no influence on the position of the bellows, is clamped in the upper part of the base. On breakage of the measuring bellows (3), the medium can escape into the interior of the bellows. The medium pressure is now on the underside of the diaphragm (PL). An additional force is generated because of the far larger effective area of the diaphragm compared with the bellows, and this pushes the transfer bolt (6) upwards. This results in cut-off to the safe side. The cut-off condition thus achieved is normally interlocked electrically or mechanically, so that the system also remains cut off when the pressure drops again. The plastic diaphragm (7) is not a pressure-bearing part; it has no function in normal operation and is effective only if a leakage occurs to the measuring bellows. Safety diaphragms of the described design are permissible up to 32 bar. This should be sufficient for most applications.

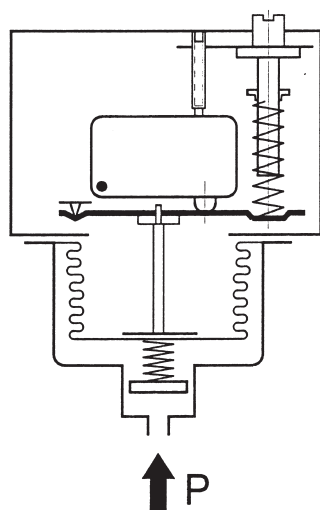
#### b) Pressure sensors with certification of 2 million operating cycles (DWR series)

In this design it is assumed that the pressure sensors which have withstood dynamic loading of 2 million operating cycles during component testing can be considered as reliable elements. They do not have an additional safety device in the sensor. Although the units are produced and tested with very great care, maximum pressure limiters without additional safety device can lead to dangerous conditions if errors which cannot be detected in the tests occur due to secondary effects. These may be caused by hole corrosion due to deposited metal particles on the (usually very thin-walled) bellows of the pressure sensor, material defects in the pressure bellows or a broken weld seam. Despite careful production and testing, a residual risk remains in the case of maximum pressure monitoring. It is ultimately up to the user and operator of the systems themselves to decide on the degree of safety to which pressure vessels should be monitored.

Pressure sensors without safety diaphragm are self monitoring when used in minimum pressure monitoring applications.



Self-monitoring maximum pressure limiter with safety diaphragm  
DWAM..., DWAMV..., SDBAM...



Pressure limiter without safety-diaphragm (not self-monitoring for maximum pressure) DWR...

## Safety analysis for maximum pressure monitoring

### Observing the direction of action

The preceding description and safety considerations relate to the monitoring of maximum pressure. The safe side here means: The energy supply is cut off (e.g. burner is turned off) to avoid a further pressure rise. Minimum pressure monitoring requires an entirely different approach. The safe side here means: Preventing the pressure from falling further (for example: hotwater systems with external pressure retention or monitoring of water level in heating systems). Based on a safety analysis, a pressure limiter without safety diaphragm is clearly the best option. In the event of leakage in the sensor, "low pressure" is signalled and the system switches over to the safe side. A pressure sensor without safety diaphragm is therefore "of special construction" within the meaning of Memorandum "Pressure 100/1", if it is used as a minimum pressure limiter. On the other hand, it is clear from the above that pressure sensors with safety diaphragms, which offer considerable advantages in maximum pressure monitoring, should never be used for minimum pressure monitoring. Incorrect use can create a dangerous condition. It is therefore essential for users and planners to observe the direction of action when selecting pressure limiters.

#### In summary it may be said:

Pressure limiters "of special construction" with safety diaphragms (self-monitoring pressure sensors) offer the highest degree of safety in maximum pressure monitoring. Such devices must not however be used for minimum pressure monitoring. Pressure limiters "of special construction" with certification of 2 million operating cycles are self-monitoring in the case of minimum pressure monitoring, even without a safety diaphragm. In the case of maximum pressure monitoring, however, a residual risk remains.

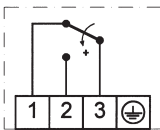
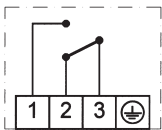
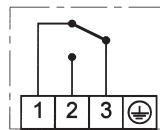
### Safety analysis for maximum pressure monitoring

If one considers the switch positions in the possible operating conditions, the difference compared with pressure sensors "of special construction" becomes clear. The left column shows normal operation in which the switch connects terminals 3 and 1. The cut-off condition when pressure is too high is shown in column 2. The control circuit is interrupted via terminals 3 and 1.

The difference in safety terms is clear from column 3, which shows the switch position in the event of a leak in the pressure sensor. With a safety-engineered sensor the control circuit is interrupted, whereas in the case of a sensor without a safety diaphragm the control circuit remains closed, and thus a "dangerous condition" can arise.

#### Devices with safety diaphragm (DWAM, DWAMV, SDBAM)

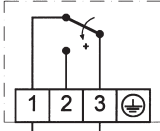
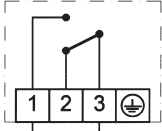
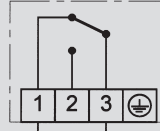
In pressure limiters "of special construction" which are equipped with **safety sensors**, different operating conditions occur in the following switch positions:

1	2	3
Normal operation	Limit exceeded	Leakage in pressure sensor
		
Control circuit closed	Control circuit interrupted	Control circuit interrupted

#### Device without safety diaphragm

"Special construction" must also be proven by an **endurance test with 2 million operating cycles**. In the case of breakage/leakage (e.g. material defect, fault in weld seams, hole corrosion), the system **does not cut off to the safe side (no self-monitoring)**.

In the different operating conditions the following switch positions occur **in the case of maximum pressure monitoring**: In the event of leakage in the pressure sensor, the pressure monitors/limiters according to b) are not safe. A "dangerous condition" can arise.

Normal operation	Limit exceeded	Leakage in pressure sensor
		
Control circuit closed	Control circuit interrupted	Control circuit interrupted <b>Dangerous condition!</b>

## Further observations and summary

### Minimum pressure

All **minimum pressure monitors and minimum pressure limiters are self-monitoring** within the meaning of “Pressure 100/1” (with or without safety diaphragm).

### Pressure limiters must interlock the cut-off state

Memorandum “Pressure 100/1” specifies that pressure limiters must cut off and interlock against automatic restarting. For this purpose, pressure limiters are offered with integrated mechanical interlock (reclosing lockout). The direction of action is also important in the selection of the interlock. Depending on the direction of action it is necessary to determine whether the interlock should operate on rising (maximum pressure monitoring) or falling (minimum pressure monitoring) pressure.

### External interlock is also possible

A pressure monitor can become a pressure limiter if an electrical interlock is connected in series. The figures on page 29 show suggested interlock circuits for maximum pressure and minimum pressure monitoring. The direction of action must be observed when deciding the circuit. For the combination of pressure monitor with external interlock to be considered as a limiter “of special construction”, the pressure monitor itself must satisfy the “special construction” requirements.

### Other considerations

#### “Special construction” — not just for steam and hot water systems

According to current standards, pressure limiters “of special construction” are mandatory for steam - boilers according to TRD 604 and for heating systems according to DIN 4751 Part 2. They are considered to be failsafe elements within the meaning of TRD 604 and can therefore be used on installations in 24-hour operation and 72-hour operation (for further information see TRD 604). It is clearly advantageous to transfer the positive experience from pressure monitoring of steam boilers to other applications. In the interest of greater safety it is desirable to incorporate the requirements for pressure limiters “of special construction” used in safety-critical monitoring applications into other standards as well. This applies particularly to applications in the field of gas, which are covered by DIN 3398 Parts 1 and 3, and liquid fuels, covered by DIN 3398 Part 4.

#### For even greater safety:

##### Positive opening contacts

In maximum pressure monitoring, safety can be further increased through additional measures. The microswitches, normally equipped with a spring contacts, can be fitted with **positive opening contacts (to protect against contact sticking)**.

##### Line break and short-circuit monitoring

The power supply to the pressure limiter is monitored for short-circuit and interruption by an external isolating amplifier (EX 041). In the case of faults in the power supply, the system cuts off to the safe side. EEx-d and EEx-i versions, where applicable combined with sensors “of special construction”, open up a wide range of possibilities in the field of Ex applications for **process engineering systems and gas engineering**. See DBS series.

### Summary

It is apparent that safety can be improved significantly and numerous causes for the occurrence of dangerous conditions can be eliminated through the appropriate use of technical measures. However, it is also apparent that a residual risk remains. Careful planning and conscientious maintenance and testing of existing systems are absolutely essential for reliable pressure monitoring on pipelines and pressure vessels.

## Standards – Directives – Component tests

VdTÜV  
Pressure 100/1

### Steam and hot water

Pressure monitors and pressure limiters for steam and hot water in systems to DIN 4751 T2 and TRD 604. Series DA and DWR.

DVGW  
DIN 3398 T.1 and 3

### Fuel gases

Pressure monitors and limiters for fuel gases in accordance with DVGW Worksheet G 260. Series DGM and DWR.

TÜV  
DIN 3398 T.4

### Liquid fuels

Pressure monitors and pressure limiters for liquid fuels (heating oil) Series DWR.

TÜV, Pressure 100/1  
(DIN 3398 T.3 and 4)

### Safety-engineered pressure limiters

For safety-critical pressure monitoring in liquid gas systems, chemical and process engineering systems.

PED 97/23EC

### Pressure Equipment Directive 97/23EC

Pressure monitors and limiters to DIN 3398 Parts 3 + 4 fall into Category IV of the PED

ATEX 94/9 EC

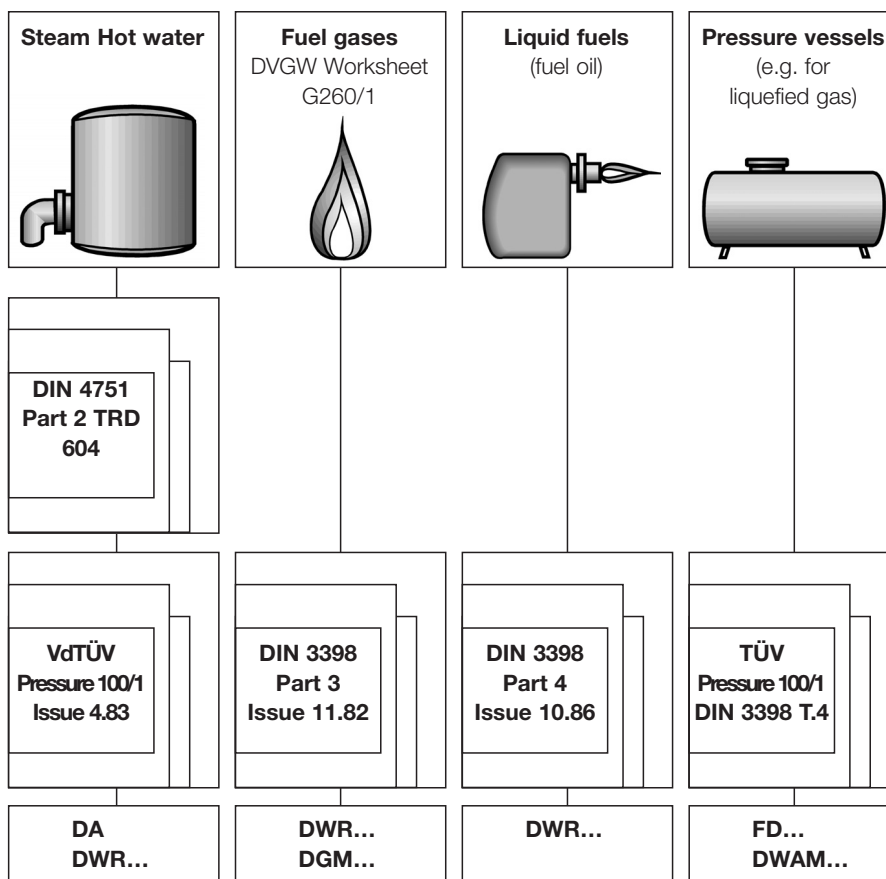
### -versions

For Ex areas Zones 1 and 2, all pressure switches can be supplied in pressure-proof encapsulated design (Ex degree of protection EEx de IIC T 6).

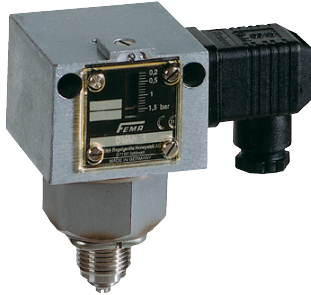
PTB approval: PTB 02 ATEX 1121

For intrinsically safe control circuits (Ex degree of protection EEx-ia), pressure switches with gold contacts, proximity switches and the blue terminals and cable entries customary in EExi areas can be supplied. In addition to the pressure switch, an isolating amplifier which transfers the control commands of the pressure switch from an intrinsically safe control circuit (EEx-ia) to a non-intrinsically safe active circuit is required

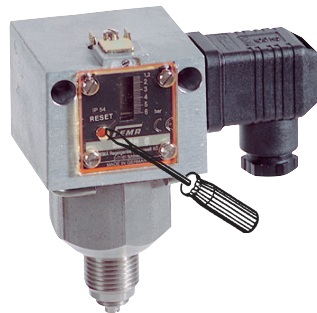
Medium



## Selection according to function and application



Pressure monitor



Pressure limiter with internal interlock

Application / Function	Steam and hot water systems to TRD 604 and DIN 4751 T.2	Fuel gases to DVGW-Worksheet G 260	Heating oil and other liquid fuels	Other media (check compatibility with the materials used)
<b>Pressure monitoring</b>	DWAM...	DGM...	DWR...	DWAM...
<b>Pressure regulation</b> (e.g. burner or pump control)	DWAMV... DWR... DWR...-203	DWR... DWR...-203	DWR...-203	DWAMV... DWR... DWR...-203
<b>Maximum pressure limitation</b> with internal interlock	SDBAM... DWR...-205	DGM...-205 DWR...-205	DWR...-205	SDBAM... DWR...-205
with external interlock	DWAM... DWR...	DGM... DWR...	DWR...	DWAM... DWR...
<b>Minimum pressure limitation</b> with internal interlock	DWR...-206	DGM...-206 DWR...-206	DWR...-206	DWR...-206
with external interlock	DWR... DWR...	DGM... DWR...	DWR...	

...The code number for the pressure range must be inserted here (see datasheets). A final number of 2... (e.g. DWR...-205) means a plug connector according to DIN 43650.

### DWR series

The DWR series covers all the applications mentioned above.

### DA series (self-monitoring sensor)

DWAM, DWAMV and SDBAM are **only suitable for maximum pressure monitoring**. They offer **additional safety** due to the **safety diaphragm (selfmonitoring sensor)**. They are TÜV-tested for steam and hot water, but thanks to the self-monitoring sensor can also be recommended for other, **particularly safety-critical applications** (e.g. in process engineering).

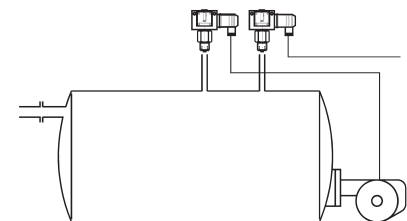
Sensors of the DWR series are self-monitoring when used in minimum pressure monitoring applications.

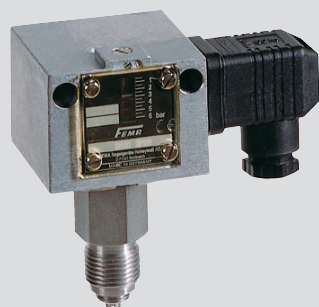
## Equipment of a boiler with pressure monitor and pressure limiter

**Pressure monitor for burner control:** **DWAM... or DWR...** (without adjustable switching differential)  
or  
(better, because switching differential adjustable) **DWAMV... or DWR...-203**

**Pressure limiter for safety monitoring:** **SDBAM... or DWR...-205** (with internal interlock, unlocking button on the pressure limiter)  
or  
**DWAM... or DWR...** (with external interlock in the control cabinet)  
Suggested connection for the external interlock, see page 31.

Pressure monitor  
DWAM...  
or DWR...  
Pressure limiter  
SDBAM... or  
DWR...-205





DWR 625

## DWR series

Pressure monitors for steam and hot water, fuel gases and liquid fuels

### Technical data

#### Pressure connection

External thread G 1/2 (pressure gauge connection) to DIN 16 288 and internal thread G 1/4 to ISO 228 Part 1 (for gas applications internal thread permissible only up to 4 bar).

#### Switching device

Rugged housing (200) made of seawater-resistant diecast aluminium.

#### Materials

Pressure bellows: Material no. 1.4571  
Sensor housing: Material no. 1.4104 Switch housing: GD Al Si 12 (DIN 1725)

#### Mounting position

Vertically upright and horizontal. In Ex version only vertical.

#### Ambient temperature at switching device

-25 to +70°C,  
for EEx-d version -15 to +60°C.  
Medium temperature -25 to +70°C. 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.

#### Calibration

The DWR series is calibrated for rising pressure. This means that the adjustable switching pressure on the scale corresponds to the switching point at rising pressure. The reset point is lower by the amount of the switching differential. (See also page 30, 2. Calibration at upper switching point). In version ...-203 the switching differential is adjustable. The basic calibration is maintained.

#### Bursting pressure

For all types ≥ 100 bar, verified by TÜV test.

**Switching differential** For values see Product Summary.

**Contact arrangement** Single pole changeover switch.

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

**Degree of protection** IP 54 according to DIN 40 050

IP 65 (alternative version)

#### Ex protection

EEx de IIC T6, approval PTB 02 ATEX 112, EEx-i with ZF 513

**Degree of protection of EEx-d version**  
IP 65, installation position only vertical.



### Component tested for

#### Steam

#### Hot water

#### Fuel gases

#### Liquid fuels

#### Registration no.

ID: 000 000 7042

NG-4347AQ1411

3 C028/05

Pressure monitor or pressure limiter (with external interlock)

**For maximum and minimum pressure monitoring (DWFS, SDBFS)**

"of special construction" by testing with 2 million cycles.

Systems according to TRD 604

Systems according to DIN 4751, T. 2

DVGW Worksheet G 260

e.g. fuel oils

**TÜV  
DVGW**



### Testing basis

Pressure 100/1, Issue 4.83

DIN 3398, T. 3, Issue 11.92

DIN 3398, T. 4, Issue 10.86

### Function

### Direction of action

### Sensor

### Product Summary

Type	Setting range	Switching differential (mean values)	Maximum working pressure		Dimensioned drawing
			1*	2*	
<b>Pressure monitors without differential adjustment</b>					
DWR 06	0.1...0.6 bar	0.04 bar	6 bar	6 bar	1 + 15
DWR 1	0.2...1.6 bar	0.06 bar			
DWR 3	0.2...2.5 bar	0.1 bar	10 bar	16 bar	1 + 18
DWR 6	0.5...6 bar	0.2 bar			
DWR 625	0.5...6 bar	0.25 bar	20 bar	25 bar	1 + 17
DWR 16	3...16 bar	0.5 bar			
DWR 25	4...25 bar	1.0 bar	50 bar	63 bar	1 + 16
DWR 40	8...40 bar	1.3 bar			
EEx-ia versions with ZF 513 (page 29)					
<b>Switching differential adjustable</b>					
DWR 06-203	0.1...0.6 bar	0.08...0.5 bar	6 bar	6 bar	1 + 15
DWR 1-203	0.2...1.6 bar	0.15...0.6 bar			
DWR 3-203	0.2...2.5 bar	0.17...1.2 bar	10 bar	16 bar	1 + 18
DWR 6-203	0.5...6 bar	0.3...1.4 bar			
DWR 625-203	0.5...6 bar	0.4...2.5 bar	20 bar	25 bar	1 + 17
DWR 16-203	3...16 bar	0.75...3.15 bar			
DWR 25-203	4...25 bar	1.3...6.0 bar	50 bar	63 bar	1 + 16
DWR 40-203	8...40 bar	2.3...6.6 bar			
<b>Ex-versions (EEx de IIC T6) e.g. for fuel gases (housing 700)</b>					
Ex-DWR 06	0.1...0.6 bar	0.04 bar	6 bar	6 bar	3 + 15
Ex-DWR 1	0.2...1.6 bar	0.06 bar			
Ex-DWR 3	0.2...2.5 bar	0.1 bar	10 bar	16 bar	3 + 18
Ex-DWR 6	0.5...6 bar	0.2 bar			
Ex-DWR 625	0.5...6 bar	0.25 bar	20 bar	25 bar	3 + 17
Ex-DWR 16	3...16 bar	0.5 bar			
Ex-DWR 25	4...25 bar	1.0 bar	50 bar	63 bar	3 + 16
Ex-DWR 40	8...40 bar	1.3 bar			

\* max. working pressure

Column 1: For devices according to DIN 3398, Part 3 (gas pressure monitors)

Column 2: For devices according to "Pressure 100/1" and DIN 3398, Part 4 (for steam, hot water and liquid fuels)

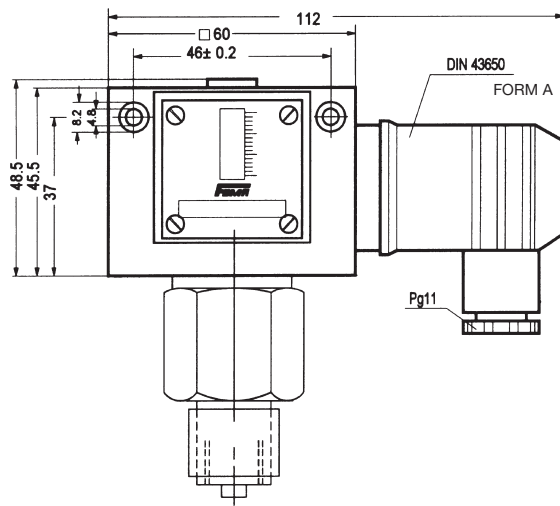


Degree of protection:  
IP 54/65

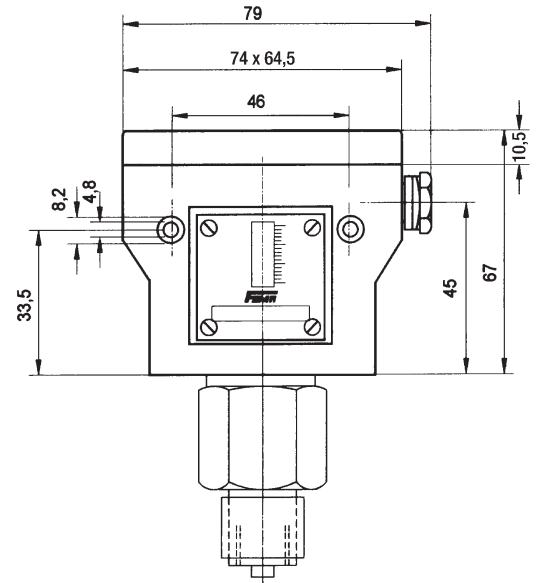


## Dimensioned drawings of switch housings

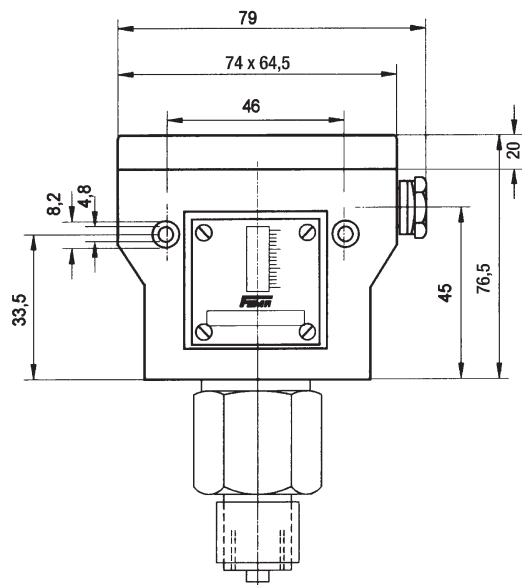
1 Housing 200 (plug connection)



2 Housing 300 and 500 (terminal connection)

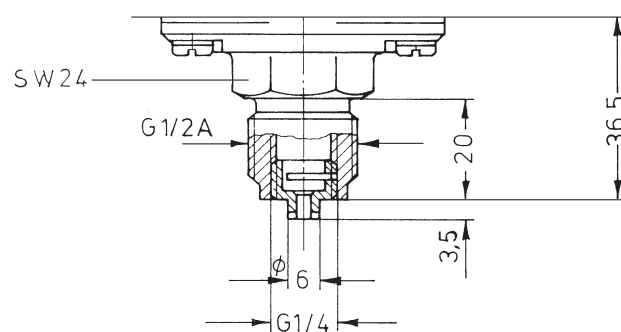


3 Housing 700 (Ex)

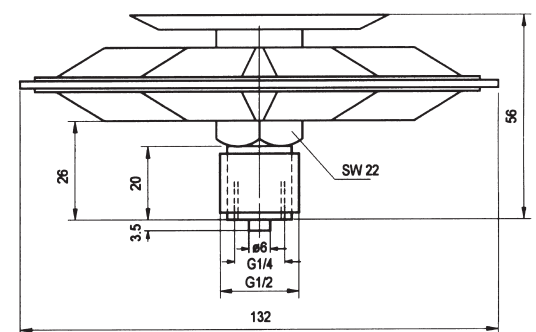


## Dimensioned drawings of pressure sensors

10



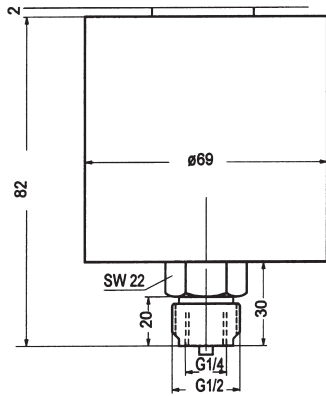
11



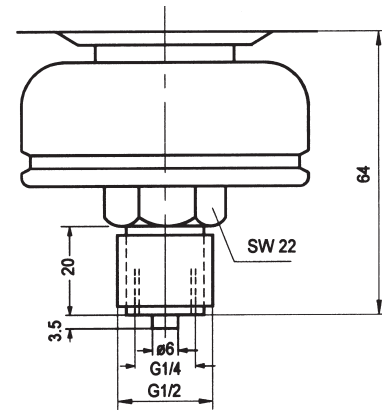


# Dimensioned drawings of pressure sensors

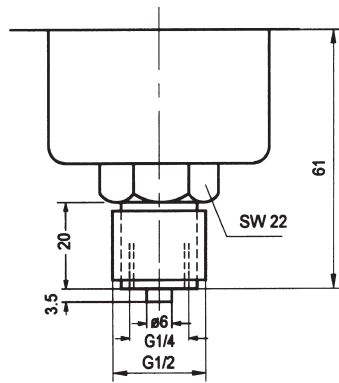
12



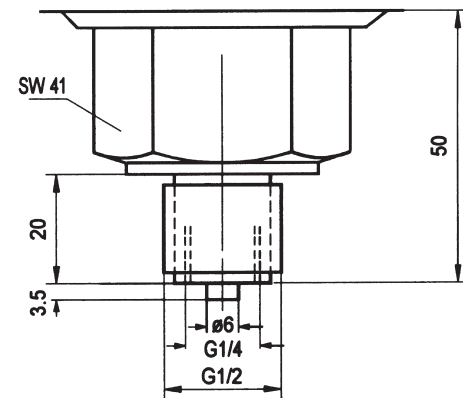
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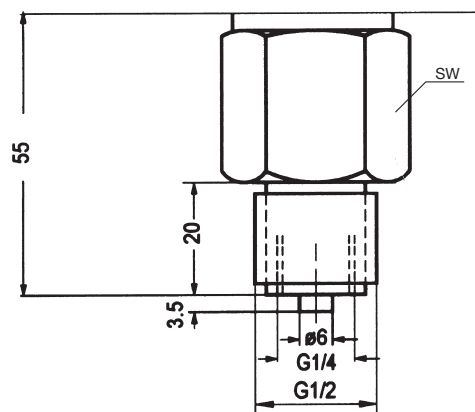
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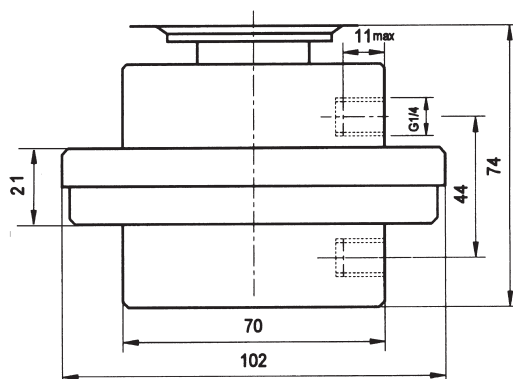


16-19



Dimensioned drawing	SW
16	22
17	24
18	30
19	32

20



21

