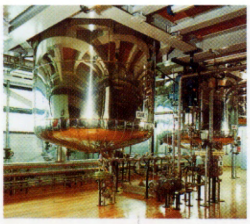
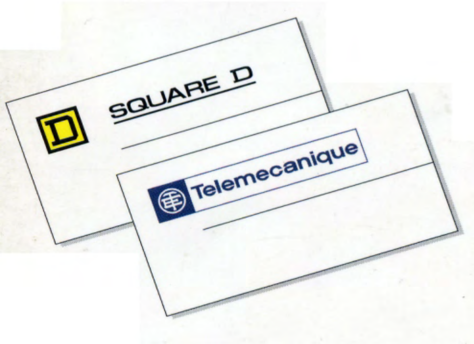
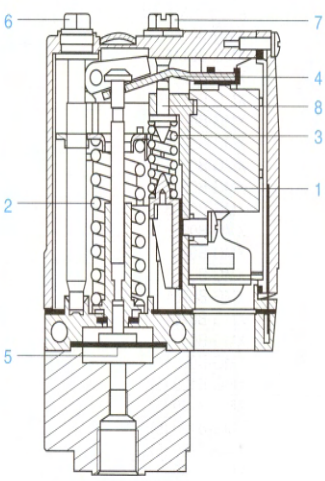
Nautilus

Pressure and vacuum switches
Analog pressure sensors





Description



1. Contact électrique du type rupture brusque
2. Ressort de réglage du point haut
3. Ressort de réglage de l'écart (sur XML-B uniquement)
4. Levier d'actionnement du contact
5. Capteur (membrane ou piston) qui reçoit la pression et transmet l'effort
6. Vis de réglage du point haut (rouge)
7. Vis de réglage de l'écart (sur XML-B uniquement) (verte)
8. Poussoir

單接點式

XML-AM01V2S11
-0.28~-1bar(-4.06~-14.5psi)
XML-A035A2S11
1.5~35bar(21.75~507.5psi)
XML-A070D2S11
5~70bar(72.5~1015bar)
XML-A160D2S11
10~160bar(145~2320bar)
XML-A300D2S11
20~300bar(290~4350bar)
XML-A500D2S11
30~500bar(435~7250bar)

雙接點型號為XML-B

Electromechanical pressure and vacuum switches

Nautilus®
For control circuits, type XML

Function

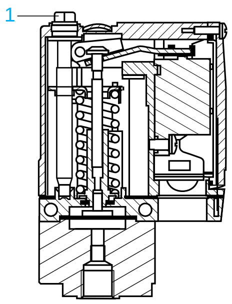
Pressure and vacuum switches type **XML** are switches for control circuits.
They are used to control the pressure of hydraulic oils, fresh water, sea water, air, steam, corrosive fluids or viscous products, up to 500 bar.

XML-A pressure and vacuum switches have a fixed differential and are for detection of a single threshold.
They incorporate a 1 C/O single-pole contact.
XML-B pressure and vacuum switches have an adjustable differential and are for regulation between 2 thresholds.
They incorporate a 1 C/O single-pole contact.
XML-C pressure and vacuum switches have an adjustable differential and are for regulation between 2 thresholds.
They incorporate 2 C/O single-pole contacts.
XML-D pressure and vacuum switches are dual stage switches, each stage with a fixed differential, and are for detection at each threshold.
They incorporate 2 C/O single-pole contacts (one per stage).

Setting

When setting XML pressure and vacuum switches, adjust the switching point on rising pressure (PH) first and then the switching point on falling pressure (PB).

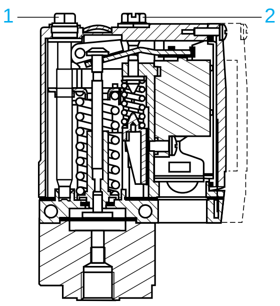
Pressure and vacuum switches with fixed differential, type XML-A



Switching point on rising pressure
The switching point on rising pressure (PH) is set by adjusting the red screw **1**.

Switching point on falling pressure
The switching point on falling pressure (PB) is not adjustable.
The difference between the tripping and resetting points of the contact is the natural differential of the switch (contact differential, friction, etc.).

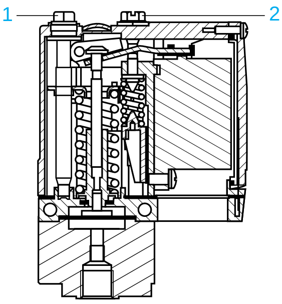
Pressure and vacuum switches with adjustable differential, types XML-B and XML-C



Switching point on rising pressure
The switching point on rising pressure (PH) is set by adjusting the red screw **1**.

Switching point on falling pressure
The switching point on falling pressure (PB) is set by adjusting the green screw **2**.

Dual stage pressure and vacuum switches with fixed differential for each threshold, type XML-D



Switching point on rising pressure of stage 1 and stage 2
The first stage switching point on rising pressure (PH1) is set by adjusting the red screw **1**.
The second stage switching point on rising pressure (PH2) is set by adjusting the blue screw **2**.

Switching points on falling pressure
The switching points on falling pressure (PB1 and PB2) are not adjustable.
The difference between the tripping and resetting points of each contact is the natural differential of the switch (contact differential, friction, etc.).

Electromechanical pressure and vacuum switches

Nautilus®
For control circuits, type XML

Environment

Conforming to standards		CE, IEC/EN 60947-5-1, UL 508, CSA C22-2 n° 14
Product certifications		UL, CSA
Protective treatment		Standard version "TC". Special version "TH".
Ambient air temperature	**°C**	Operation : - 25…+ 70. Storage : - 40 …+ 70
Fluids or products controlled		Hydraulic oils, air, fresh water, sea water (0…+ 160 °C), depending on model Steam, corrosive fluids, viscous products (0…+ 160 °C), depending on model
Materials		Case : zinc alloy Component materials in contact with fluid : see pages 30369/2 and 30369/3
Operating position		All positions
Vibration resistance		4 gn (30 to 500 Hz) to IEC 68-2-6 except **XML-●L35●●●●●**, **XML-●001●●●●●** and **XML-BM03●●●●●** : 2 gn
Shock resistance		50 gn conforming to IEC 68-2-27 except **XML-●L35●●●●●**, **XML-●001●●●●●** and **XML-BM03●●●●●** : 30 gn
Electric shock protection		Class I conforming to IEC 1140, IEC 536 and NF C 20-030
Degree of protection		Screw terminal models : IP 66 conforming to IEC/EN 60529 Connector models : IP 65 conforming to IEC/EN 60529
Operating rate	**Operating Cycl/min.**	Piston version switches : ≤ 60 (for temperatures > 0 °C) Diaphragm version switches : ≤ 120 (for temperatures > 0 °C)
Repeat accuracy		< 2 %
Fluid connections		G 1/4 (BSP female) conforming to NF E 03-005, ISO 228 or 1/4" NPTF (consult your Regional Sales Office)
Electrical connections		Screw terminal models : entry tapped for n° 13 (DIN Pg 13.5) cable gland. For an entry tapped M20 x 1.5, replace the last number of the reference by 2 (example : XMLA010A2S11 becomes XMLA010A2S12). For an entry tapped 1/2" NPT, please consult your Regional Sales Office. Connector models : either type DIN 43650 A or M12 connector (please consult your Regional Sales Office).

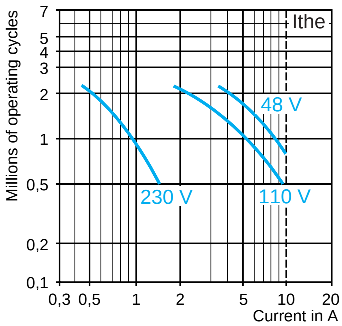
Contact block characteristics

Rated operational characteristics		∼ AC-15 ; B300 (Ue = 240 V, Ie = 1.5 A - Ue = 120 V, Ie = 3 A) ⎓ DC-13 ; R300 (Ue = 250 V, Ie = 0.1 A) conforming to IEC 947-5-1 Appendix A, EN 60 947-5-1
Rated insulation voltage		Ui = 500 V conforming to IEC/EN 60947-1 Ui = 300 V conforming to UL 508, CSA C22-2 n° 14
Rated impulse withstand voltage		U imp = 6 kV conforming to IEC/EN 60947-1
Contact operation		Silver tipped contacts **XML-A** and **XML-B** : 1 C/O single-pole contact (4 terminal), snap action **XML-C** : 2 C/O single-pole contacts (8 terminal), simultaneous, snap action **XML-D** : 2 C/O single-pole contacts (8 terminal), staggered, snap action
Resistance across terminals	**mΩ**	< 25 conforming to NF C 93-050 method A or IEC 255-7 category 3
Terminal referencing		Conforming to CENELEC EN 50013
Short-circuit protection		10 A cartridge fuse type gG (gl)
Cabling		Screw clamp terminals. Clamping capacity, min. : 1 x 0.2 mm^2, max. : 2 x 2.5 mm^2

Electrical durability
conforming to IEC 947-5-1 Appendix C
Utilisation categories AC-15 and DC-13

Operating rate : 3600 operating cycles per hour
Load factor : 0.5

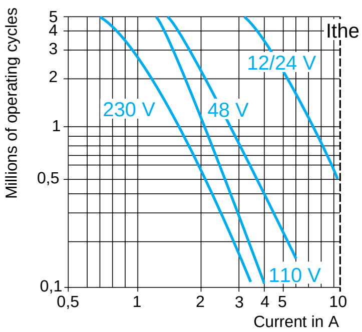
XML-A and XML-B
a.c. supply ∼ 50/60 Hz
Inductive circuit Ithe = 10 A



d.c. supply ⎓
Power broken in W
for 1 million operating cycles

Voltage	V	**24**	**48**	**120**
Inductive	W	31	29	26

XML-C and XML-D
a.c. supply ∼ 50/60 Hz
Inductive circuit Ithe = 10 A



d.c. supply ⎓
Power broken in W
for 5 million operating cycles

Voltage	V	**24**	**48**	**120**
Inductive	W	10	7	4

Electromechanical pressure and vacuum switches

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Function

The function of pressure and vacuum switches is the control or regulation of pressure or vacuum levels in hydraulic or pneumatic systems.
They transform the pressure change into an electrical signal and when a preset pressure or vacuum is reached, the output contact of the switch changes state.

Switches for power circuits

Switches with power electrical contacts, either 2-pole or 3-pole, designed for direct switching of single-phase or 3-phase motors (pumps, compressors, etc.).

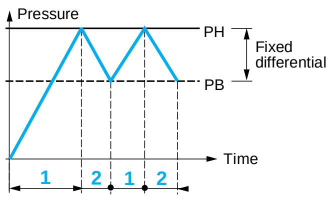
Switches for control circuits

Switches with standard electrical contacts, designed for control of contactors, relays, power valves, PLC inputs, etc.

Pressure switch operating principle

Detection of a single threshold

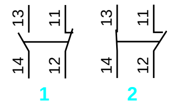
The switches for detection of a single threshold (fixed differential) have a single adjustable setting point (PH).
The differential between the high and low points (PH - PB) depends upon the natural characteristics of the switch. It is not adjustable.



— Adjustable value
--- Non adjustable value

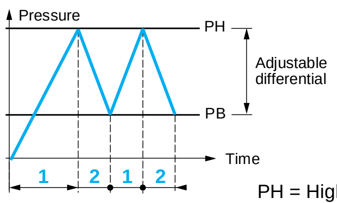
PH = High point
PB = Low point

Example: contact schematics of XML-A



Regulation between 2 thresholds

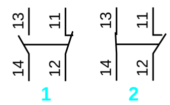
The switches for regulation between 2 thresholds (adjustable differential) have both a high point setting (PH) and a low point setting (PB). Both of these points can be independently adjusted.



— Adjustable value

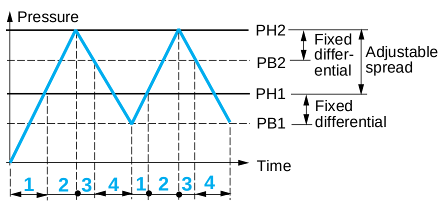
PH = High point
PB = Low point

Example: contact schematics for XML-B



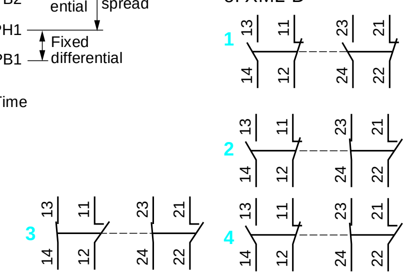
Detection of 2 thresholds

The dual stage switches, for detection at each threshold, have an adjustable high point setting for each stage (PH1 and PH2). Both of these points can be independently adjusted.



— Adjustable value
--- Non adjustable value
PH = High point
PB = Low point

Example: contact schematics of XML-D



Electromechanical pressure and vacuum switches

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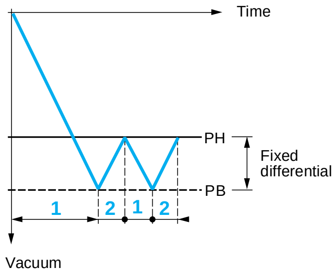
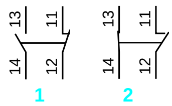
Vacuum switch operating principle

Detection of a single threshold

The switches for detection of a single threshold (fixed differential) have a single adjustable setting point (PH).
The difference between the high and low points (PH - PB) depends upon the natural characteristics of the switch. It is not adjustable.



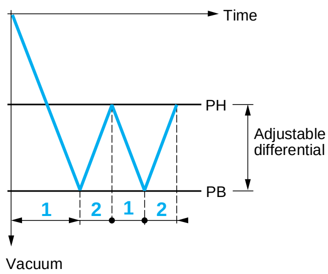
Example: contact schematics of XML-A



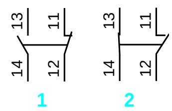
—— Adjustable value
- - - - Non adjustable value
PH = High point
PB = Low point

Regulation between 2 thresholds

The switches for regulation between 2 thresholds (adjustable differential) have both a high point setting (PH) and a low point setting (PB). Both of these points can be independently adjusted.



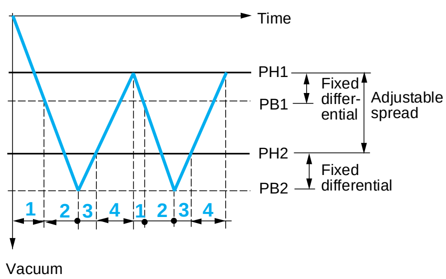
Example: contact schematics of XML-B



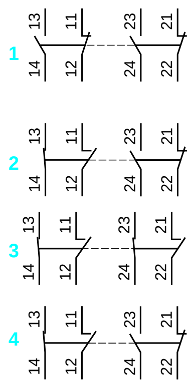
—— Adjustable value
PH = High point
PB = Low point

Detection of 2 thresholds

The dual stage switches, for detection at each threshold, have an adjustable high point setting for each level (PH1 and PH2). Both of these points can be independently adjusted.



Example: contact schematics of XML-D



—— Adjustable value
- - - Non adjustable value
PH = High point
PB = Low point

Electromechanical pressure and vacuum switches

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Terminology

Operating range

The difference between the minimum low point (PB) and the maximum high point (PH) setting values.

Size

Pressure switches and vacuum-pressure switches (vacu-pressure switches)
Maximum value of the operating range.
Vacuum switches
Minimum value of the operating range.

Switching point on rising pressure (PH)

Pressure switches
The upper pressure setting at which the pressure switch will actuate the contacts on rising pressure.

Vacuum switches
The lower vacuum setting at which the vacuum switch will reset the contacts on rising pressure.

Switching point on falling pressure (PB)

The pressure at which the switch output changes state on falling pressure.

Switches with fixed differential
The lower point (PB) is not adjustable and is entirely dependent on the high point setting (PH) and the natural differential of the switch.

Switches with adjustable differential
The adjustable differential enables the independent setting of the lower point (PB).

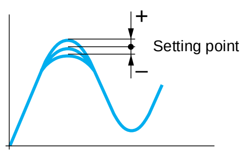
Differential

The difference between the switching point on rising pressure (PH) and the switching point on falling pressure (PB).

Spread

For dual stage switches, the spread indicates the difference between the 2 switching points on rising pressure (PH2 and PH1) and, for vacuum switches, the difference between the 2 switching points on falling pressure (PB2 and PB1).

Accuracy (switches with setting scale)



The tolerance between the point at which the switch actuates its contacts and the value indicated on the setting scale. Where very high setting accuracy is required, it is recommended to use separate measuring equipment (pressure gauge, etc.).

Electromechanical pressure and vacuum switches

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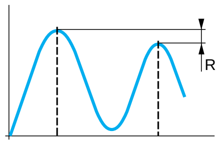
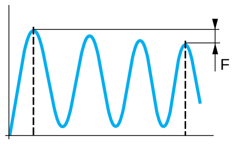
Terminology (continued)

Repeat accuracy (R)



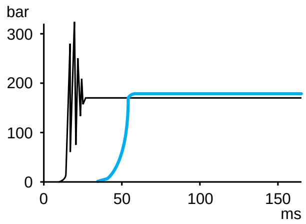
The tolerance between two consecutive switching operations.

Drift (F)

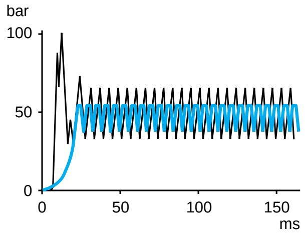


The tolerance of the switching point throughout the entire service life of the switch.

Accidental overpressure



Example 1 : with destructive pressure level.



Example 2 : with destructive pressure level and destructive pressure oscillations.

—— without damping device
—— with damping device

This is an accidental pressure surge of very short duration (a few milliseconds). If accidental overpressures occur and their duration is less than 50 milliseconds, the pressure damping device incorporated in the XML switches (sizes 10 bar and greater) will diminish the effect.

Maximum permissible pressure per cycle (Ps)

A pressure switch can withstand this pressure, without detrimental effect, on each cycle throughout its service life.
Its minimum value is at least equal to 1.25 times the switch size.

Maximum permissible occasional surge pressure

The permissible occasional surge pressure is at least equal to 2.25 times the switch size.

Destruction pressure

The maximum guaranteed pressure that the switch will withstand before its destruction, i.e. bursting, rupturing, component failure, etc.
Its value is at least equal to 4.5 times the switch size.

Electromechanical pressure and vacuum switches

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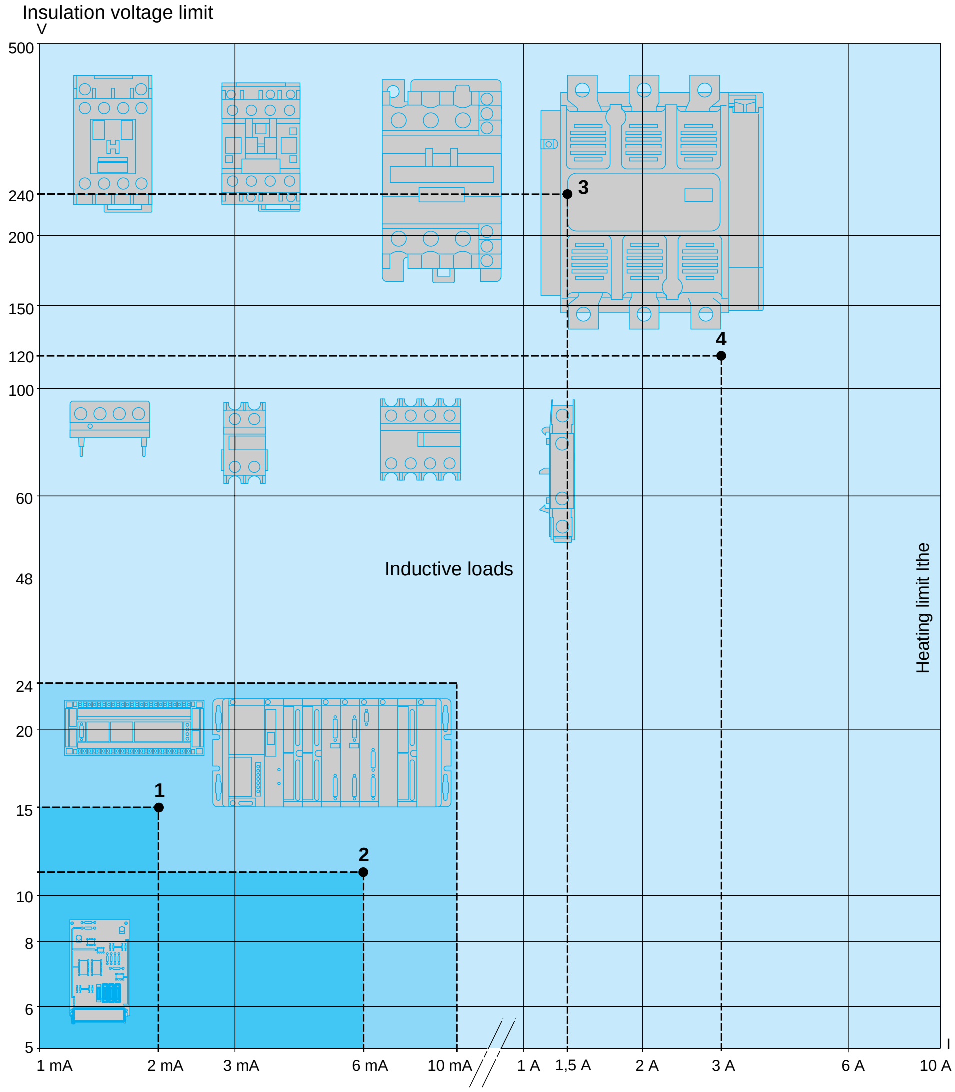
Application range of pressure and vacuum switches types XML, XMA and XMX, for control circuits

On standard loads

Continuous duty, frequent switching



1 Standard PLC input, type 1
2 Standard PLC input, type 2
3 Switching capacity conforming to IEC 947-5-1, utilisation category AC-15, DC-13
B300 240 V 1.5 A
R300 250 V 0.1 A
4 Switching capacity conforming to IEC 947-5-1, utilisation category AC-15, DC-13
B300 120 V 3 A
R300 125 V 0.22 A
PLC : Programmable Logic Controller

Pressure switches	Application range		
XML-A/B/C/D, XMX, XMA			
XML-E			

On small loads

The use of electromechanical pressure and vacuum switches with programmable logic controllers is becoming more predominant.
On small loads, the reliability of the switches maintain a failure rate of less than 1 for 100 million operating cycles.

Electromechanical pressure and vacuum switches

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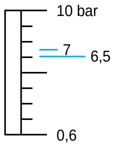
Selection of switch size

After establishing the type of switch required for the application (single threshold detection or regulation between 2 thresholds), the selection of its size will depend on the following criteria :
- the differential : difference between the high point (PH) and the low point (PB),
- the maximum pressure permissible per cycle,
- repeat accuracy, precision and minimum drift.

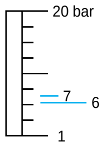
Examples of a fixed differential pressure switch selection, for detection of a single threshold

Principle criterion : minimum differential

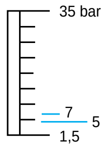
Example : for a selected high point (PH) of 7 bar



XML-A010●●●●●
Differential = 0.5 bar



XML-A020●●●●●
Differential = 1 bar

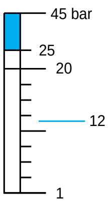


XML-A035●●●●●
Differential = 2 bar

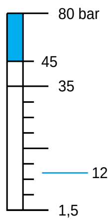
Select an XML-A010●●●●● (the lowest size)

Principle criterion : tolerance to high overpressures

Example : for a selected high point (PH) of 12 bar



XML-A020●●●●●
Permissible occasional surge pressure = 45 bar

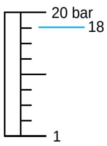


XML-A035●●●●●
Permissible occasional surge pressure = 80 bar

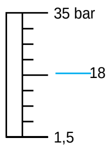
Select an XML-A035●●●●● (the highest size)

Principle criterion : repeat accuracy, precision and minimum drift

Example : for a selected high point (PH) of 18 bar



XML-A020●●●●●
Adjustable, 1 to 20 bar



XML-A035●●●●●
Adjustable, 1.5 to 35 bar

As a general rule, working at the upper or lower limits of the operating range should be avoided.

Select an XML-A035●●●●●

Units of pressure conversion table

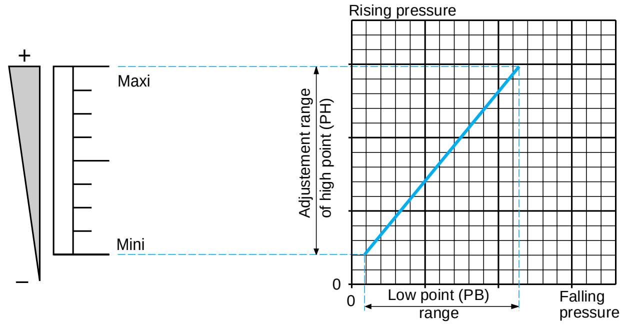
	psi	kg/cm²	bar	atm	mm Hg (Torr)	mm H_2O	Pa
psi	1	0.07031	0.06895	0.06805	51.71	703.7	6895
kg/cm²	14.22	1	0.98066	0.96784	735.55	10,000	98,066
bar	14.50	1.0197	1	0.98695	750.06	10,197	10^5
atm	14.70	1.0333	1.0132	1	760.0	10,333	101,325
mm Hg (Torr)	0.01934	1.360×10^{-3}	1.333×10^{-3}	1.316×10^{-3}	1	13.59	133.3
mm H_2O	1.421×10^{-3}	10^{-4}	$\sim 10^{-4}$	$\sim 10^{-4}$	0.07361	1	~ 9.80
Pa	1.45×10^{-4}	1.0197×10^{-5}	10^{-5}	9.8695×10^{-6}	7.5×10^{-3}	0.10197	1

Example : 1 bar = 14.50 psi = 10^5 Pa

Electromechanical pressure and vacuum switches

Fixed differential switches, for detection of a single threshold

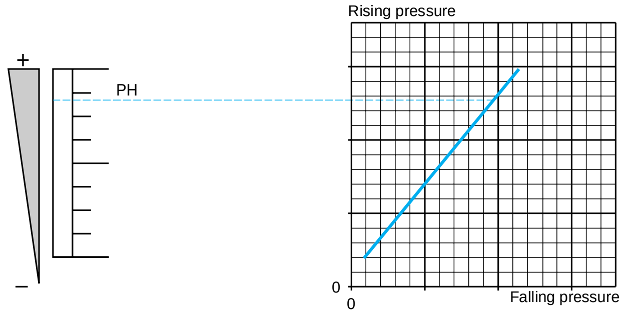
Adjustment range of the high point



Defined by the difference between the minimum and maximum high point (PH) setting values.

For a high set point (PH), the lower point (PB) is fixed and cannot be adjusted.
For a low set point (PB), the higher point (PH) is fixed and cannot be adjusted.

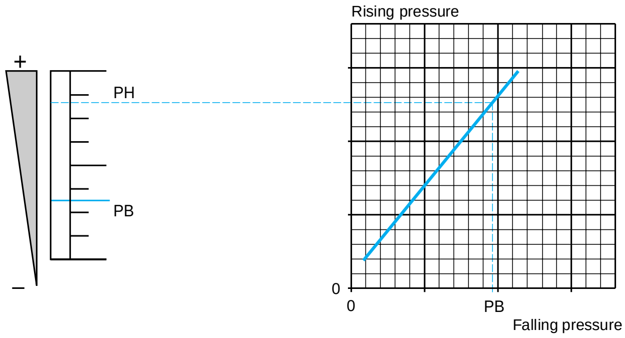
Switching point on rising pressure (PH)



The upper pressure setting at which the pressure or vacuum switch will actuate the contacts on rising pressure.

Adjustable throughout the range on rising pressure.

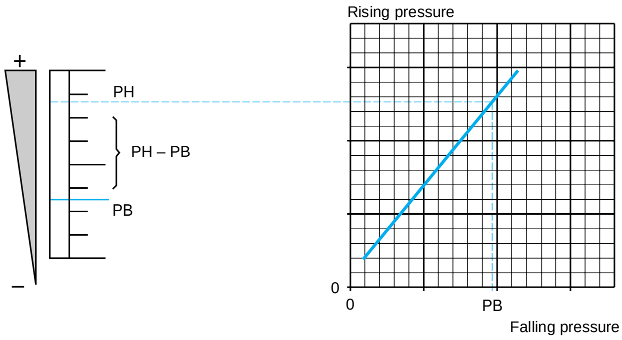
Switching point on falling pressure (PB)



The pressure at which the switch contact changes state on falling pressure.

The lower point (PB) is not adjustable and is entirely dependent on the high point (PH) setting and the natural differential of the switch.

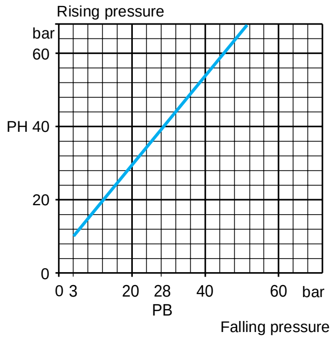
Differential



PH - PB = natural differential
The difference between the switching point on rising pressure (PH) and the switching point on falling pressure (PB).

This point is not adjustable and therefore, the value of the differential is fixed.
It is the natural differential of the switch (contact differential, friction, etc).

Example



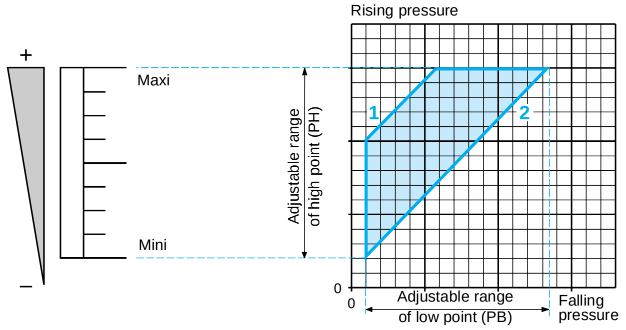
- Consider a switching point on rising pressure (PH) of 40 bar (set value at which the contact will change state on rising pressure).
- It can be seen that the switching point on falling pressure (PB) is 28 bar (fixed value at which the contact will return to its original state).

Conclusion :
- The differential will be 40 - 28 = 12 bar.

Electromechanical pressure and vacuum switches

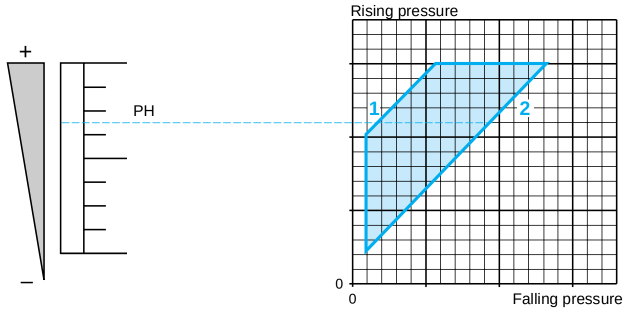
Adjustable differential switches, for regulation between 2 thresholds

Adjustment range of the high point



Defined by the difference between the minimum and maximum high point (PH) setting values.

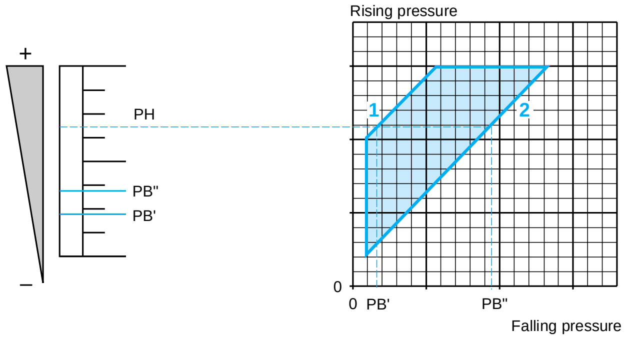
Switching point on rising pressure (PH)



The upper pressure setting at which the pressure or vacuum switch will actuate the contacts on rising pressure.

Adjustable throughout the range on rising pressure.

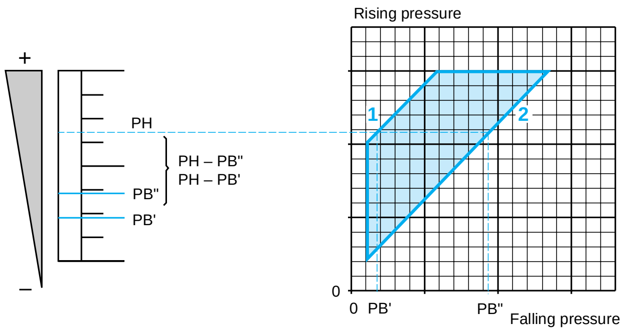
Switching point on falling pressure (PB)



The pressure at which the switch output changes state on falling pressure.

The adjustable differential enables the independent setting of the lower point (PB).

Differential

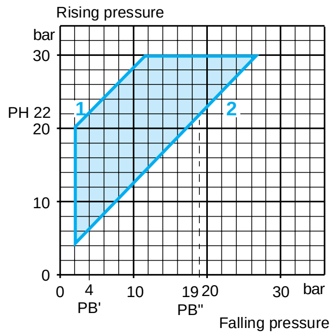


Low point < High point
PH - PB' = maximum differential
PH - PB" = minimum differential

The difference between the switching point on rising pressure (PH) and the switching point on falling pressure (PB).

Note : the low point can be set at any value between PB' and PB".

Example



1 Minimum differential
2 Maximum differential

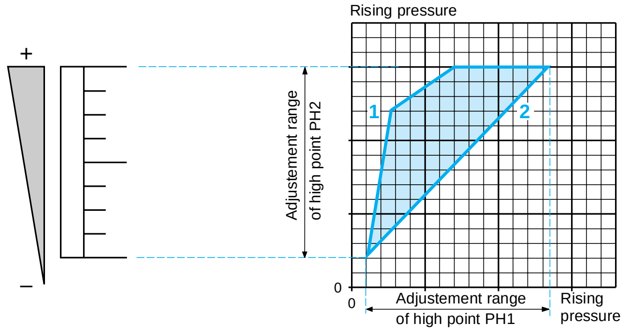
- Consider a switching point on rising pressure (PH) of 22 bar (set value at which the contact will change state on rising pressure).
- It can be seen that the switching point on falling pressure (PB) can be between 4 and 19 bar inclusive (set value at which the contact will return to its original state).

Conclusion :
- max. differential will be 22 - 4 = 18 bar,
- min. differential will be 22 - 19 = 3 bar.

Electromechanical pressure and vacuum switches

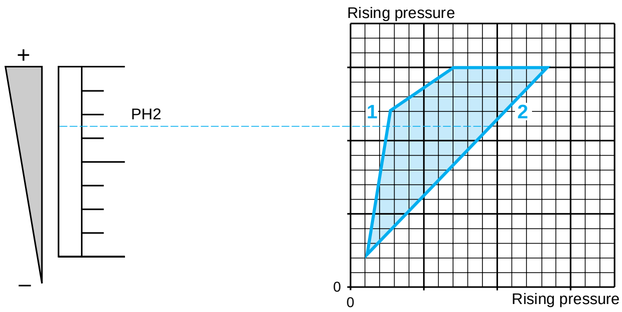
Dual stage, fixed differential switches, for detection at each threshold

Adjustment ranges of the switching points PH1 and PH2 on rising pressure



Defined by the difference between the minimum and maximum high point setting values of each level (PH1 and PH2).

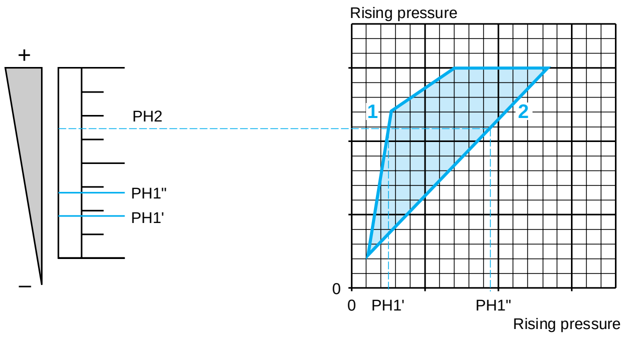
Switching point PH2 on rising pressure



The upper pressure setting at which the pressure or vacuum switch will actuate contact 2 on rising pressure.

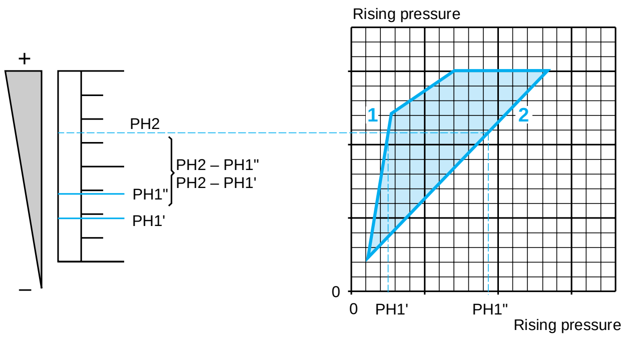
Adjustable throughout the range on rising pressure.

Switching point PH1 on rising pressure



The upper pressure setting at which the pressure or vacuum switch will actuate contact 1 on rising pressure.

Spread

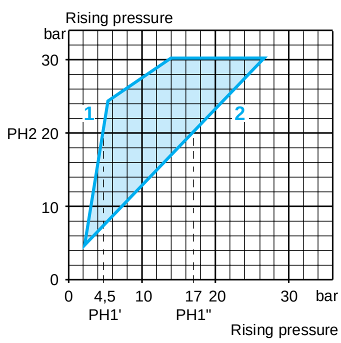


PH1 < PH2
PH2 - PH1' = maximum spread
PH2 - PH1" = minimum spread

The difference between switching points PH2 and PH1 on rising pressure.

Note : switching point PH1 can be set at any value between PH1' and PH1".

Example : Determining switching points on rising pressure of the 2 stages



1 Maximum spread
2 Minimum spread

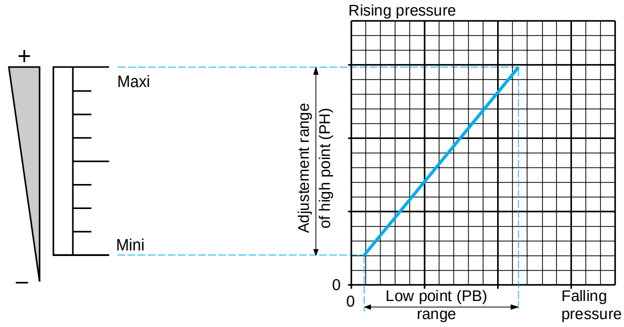
- Consider a 2nd stage switching point on rising pressure (PH2) of 20 bar (set value at which contact 2 will change state on rising pressure).
- It can be seen that the 1st stage switching point (PH1) can be set between 4.5 and 17 bar on rising pressure.

Conclusion:
- the maximum spread will be : 20 - 4.5 = 15.5 bar,
- the minimum spread will be : 20 - 17 = 3 bar.

Electromechanical pressure and vacuum switches

Dual stage, fixed differential switches, for detection at each threshold

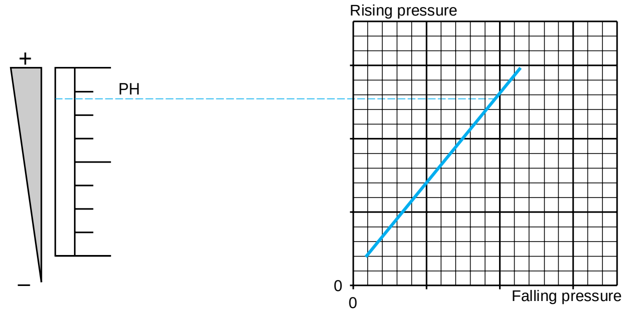
Adjustment range of the high point (PH1 or PH2)



Defined by the difference between the minimum and maximum high point (PH1 or PH2) setting values for each stage.

For a high set point (PH1 or PH2), the lower point (PB1 or PB2) is fixed and cannot be adjusted.
For a low set point (PB1 or PB2), the higher point (PH1 or PH2) is fixed and cannot be adjusted.

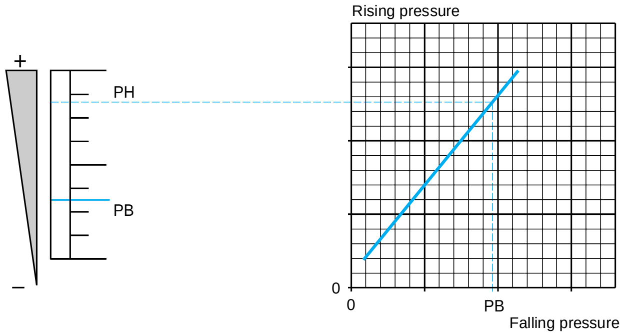
Switching point on rising pressure (PH1 or PH2)



The upper pressure setting at which the pressure or vacuum switch will actuate the contact, for each stage, on rising pres- sure.

Adjustable throughout the range on rising pressure.

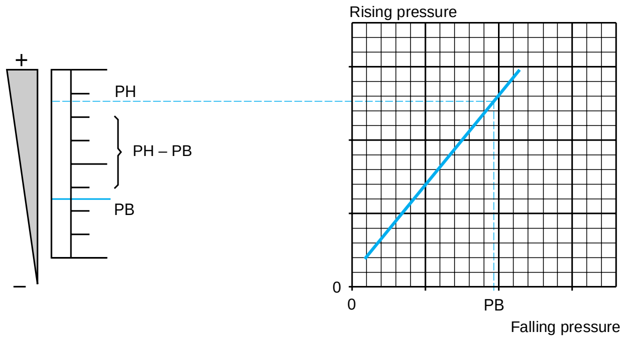
Switching point on falling pressure (PB1 or PB2)



The pressure at which the switch contact changes state, for each stage, on falling pressure.

The lower point (PB) is not adjustable and is entirely dependent on the high point (PH) setting and the natural differential of the switch.

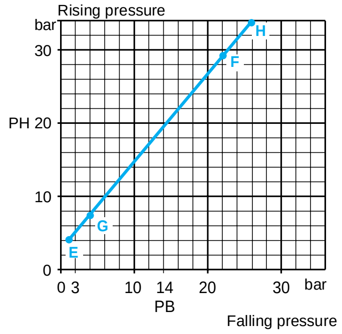
Differential



PH - PB = natural differential
The difference between the switching point on rising pressure (PH) and the switching point on falling pressure (PB), for each stage.

This point is not adjustable and therefore, the value of the differential is fixed.
It is the natural differential of the switch (contact differential, friction, etc.) for each of its 2 stages.

Example :
stage 1 = segment EF
stage 2 = segment GH



For stage 2 (segment GH) :
- Consider a switching point on rising pressure (PH2) of 20 bar (set value at which contact 2 will change state on rising pressure).
- It can be seen that the switching point on falling pressure (PB2) is 14 bar (fixed value at which contact 2 will return to its original state).

Conclusion : for stage 2, the differential will be 20 - 14 = 6 bar.
Repeat the same procedure for stage 1 (segment EF).