

Contamination Indicator

1. Features

Filter elements are economically used only if their dirt holding capacity is fully exploited. This is achieved by using filter housings with a contamination indicator.

MAHLE manufactures contamination indicators of the following designs:

- Differential pressure indicators
- Pressure indicators/Pressure switches
- Vacuum switches/manometers

With any filter element the collection of dirt particles continuously reduces the number of open pores or, in other words: The open cross section for allowing the liquid to flow continuously reduced. Thus the pressure on the upstream side of the element (dirt side) increases continuously.

With pressure filters, the pressure is measured upstream and downstream of the filter element (differential pressure). With return line filters the pressure is measured only on the upstream side because, depending on the tank design, atmospheric pressure exits on the downstream side of the filter element is measured analog.

A piston with attached magnet is moved against the force of a spring, with which the indicating point is determined by the piston surface.

A homopolar poled magnet is fitted in the outer part in the indicating button.

The closer the pole-springs move towards each other, the stronger is the force with the magnet mutually repel, until finally the red button on the indicator pops out.

This red button remains visible until it is pushed in during daily check which is to be performed while the plant is at operating temperature. If the red button pops out immediately after being pushed in, the filter element must be replaced after the end of the shift.

This optical function may also be used for generating contactless electrical signals. For this purpose an electrical upper part incorporates all electrical switching elements.

- Optical and electrical indicator with standard check function
- Normally open/normally closed combination - standard feature
- Electrical function, easy to install at a later time
- Two-step indication, at 75 % and 100 % optional
- Signal lock out up to approx. 30 °C optional
- Pressure resistance, up to 10 bar (pressure/differential pressure), up to 160 bar (differential pressure), up to 450 bar (differential pressure)
- Rugged, non-bypass design
- Optimal element exploitation

Worldwide distribution



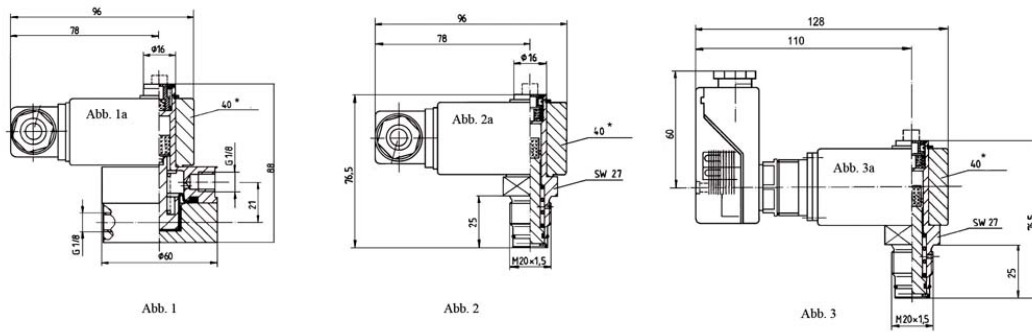
2. Differential pressure indicator

Differential pressure indicator									
Operating pressure	Temperature resistance	Type	Order number	Indicator setting [bar]	Indication	Contact type*	Fig.	Material lower section	Material upper section
10	- 10 to + 120 °C	PiS 3087	77738990	1.2	opt.	-	1	Al	PA 6
		PiS 3086	77737513		opt./electr.	1	1 + 1a		
		PiS 3104	78236994		opt./electr.	4	1 + 3a		
160	- 10 to + 120 °C	PiS 3098	77669971	2.2	opt.	-	2 + 2a	Al	PA 6
		PiS 3097	77669948		opt./electr.	1	2 + 2a		
		PiS 3116	78308074		opt./electr.	3	2 + 2a		
		PiS 3119	78309122	opt./electr.	2	2 + 2a			
		PiS 3012	78308454	1.7/2.2	opt./electr.	4	3 + 3a		
		PiS 3124	78383655		opt./electr.	5	3 + 3a		
		PiS 3098	77938582	3.5	opt.	-	2		
		PiS 3097	78236648		opt./electr.	1	2 + 2a		
		PiS 3098	77669989	5.0	opt.	-	2 + 2a		
		PiS 3097	77669955		opt./electr.	1	2 + 2a		
		PiS 3116	78308082		opt./electr.	3	2 + 2a		
		PiS 3119	78309130	3.7/5.0	opt./electr.	2	2 + 2a		
		PiS 3012	78308447		opt./electr.	4	2 + 2a		
		PiS 3124	78383663		opt./electr.	5	2 + 2a		
		400	- 10 to + 120 °C	PiS 3093	77669898	2.2	opt.		
PiS 3092	77669856			opt./electr.	1		3 + 3a		
PiS 3115	78308041			opt./electr.	3		3 + 3a		
PiS 3105	77970387			1.7/2.2	opt./electr.	2	3 + 3a		
PiS 3102	77942139				opt./electr.	4	3 + 3a		
PiS 3122	78383630				opt./electr.	5	3 + 3a		
PiS 3093	77669914			5.0	opt.	-	2		
PiS 3092	77669864				opt./electr.	1	2 + 2a		
PiS 3115	78308058				opt./electr.	3	2 + 2a		
PiS 3105	77970395			3.7/5.0	opt./electr.	2	2 + 2a		
PiS 3102	77942147				opt./electr.	4	3 + 3a		
PiS 3122	78383648				opt./electr.	5	3 + 3a		
PiS 3093	77669880			8.0	opt.	-	2		
PiS 3092	77669872				opt./electr.	1	2 + 2a		
PiS 3115	78308066				opt./electr.	3	2 + 2a		
450	- 10 to + 120 °C	PiS 3193	77844061	2.2	opt.	-	2	1.4301	PA 6
		PiS 3192	78308488		opt./electr.	1	2 + 2a		
		PiS 3193	78308538	5.0	opt.	-	2		
		PiS 3192	78308546		opt./electr.	1	2 + 2a		

* Contact type:

- 1) Normally open/normally closed, wiring box DIN EN 175301-803, max. 250 V AC/200 V DC, max. 1 A
- 2) Normally closed, 2 setting points (75 %/100 %); wiring box DIN EN 175301-803, max. 150 V, max. 1 A
- 3) Change over contact; wiring box DIN EN 175301-803, max. 150 V, max. 1 A
- 4) Change over contact; 2 setting points; LED; Mercedes-Benz-Norm DBL 9666 EA; wiring box DIN EN 175201-804, max. 150 V, max. 1 A
- 5) Normally closed; 2 setting points, signal suppression; wiring box DIN EN 175201-804, max. 10-30 V, max. 1 A

2. Differential pressure indicator



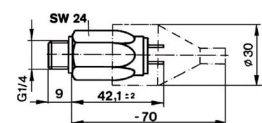
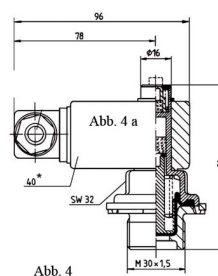
*wide

3. Pressure indicator/pressure switch

Pressure indicator/pressure switch									
Operating pressure	Temperature resistance	Type	Order number	Indicator setting [bar]	Indication	Contact type*	Fig.	Material Lower section	Material upper section
10	- 10 to + 80 °C	PiS 3084	77669781	1.2	opt.	-	4	PA 66	PA 6
		PiS 3085	77669807		opt./electr.	1	4 + 4a		
		PiS 3125	78308033		opt./electr.	3	4 + 4a		
		PiS 3106	78309155	0.9/1.2	opt./electr.	2	4 + 4a		
		PiS 3103	77942170		opt./electr.	4	4 + 3a		
		PiS 3123	78383671		opt./electr.	5	4 + 3a		
		PiS 3084	77737802	2.2	opt.	-	4		
		PiS 3085	77738032		opt./electr.	1	4 + 4a		
		PiS 3125	78308108		opt./electr.	3	4 + 4a		
		PiS 3106	78308850	1.7/2.2	opt./electr.	2	4 + 4a		
		PiS 3103	77970429		opt./electr.	4	4 + 3a		
PiS 3123	78383689	opt./electr.	5		4 + 3a				
10	- 25 to + 85 °C	DSS/1.2	77863814	1.2	electr.	normally open	5	galvanized steel	delivered with protection cap
		DSO/1.2	77870587		electr.	normally closed	5		
		DSS/2.2	77845845	2.2	electr.	normally open	5		
		DSO/2.2	77870595		electr.	normally closed	5		
		DSS/5	77863822	5.0	electr.	normally open	5		
		DSO/5	77870603		electr.	normally closed	5		

*Contact type:

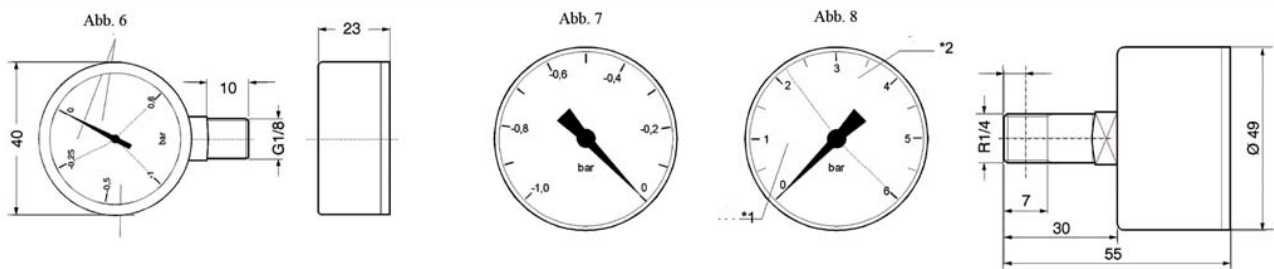
- 1) normally open/normally closed, wiring box DIN 43650, max. 230 V, max. 2.5 A
- 2) normally closed, 2 setting points (75 %/100 %); wiring box DIN 43650, max. 150 V, max. 1 A
- 3) change over contact; wiring box DIN 43650, max. 150 V, max. 1 A
- 4) change over contact; 2 setting points (75 %/100 %); 3 LED; wiring box DIN 43651, 10–30 V, max. 1 A
- 5) normally closed, 2 setting points (75 %/100 %), signal suppression; wiring box DIN 43651, 10–30 V, max. 1 A



4. Vacuum meter/manometer

Vacuum meter/manometer

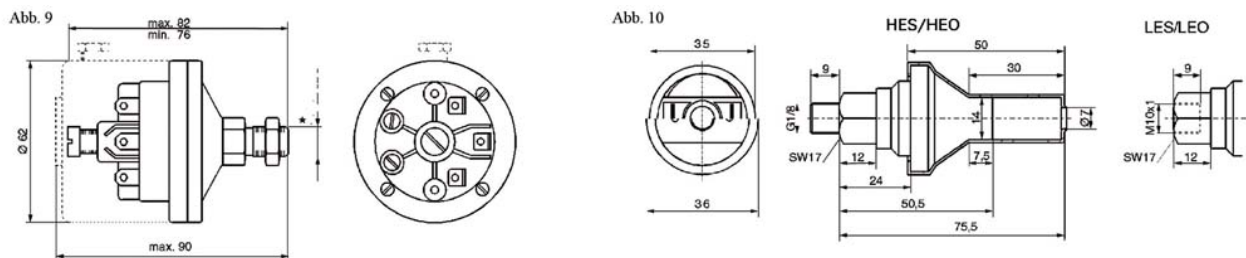
Nominal size (NG) [mm]	Specification	Indicating range [bar]	Fig.	Connection size	Order-number	Class	Dial face
40	Vacuum meter	- 1 to + 1.5	6	R 1/8 (conical)	76388714	min 2.5	white
		- 1 to + 0.6		G 1/8	77545908		Red/Green area, sep. line 0.25 bar
50	Manometer	0 to - 1	7	R 1/4 (conical)	77617558		white
		0 to 6	8		78381998		Red/Green area, sep. line 0.25 bar



5. Vacuum switch

Vacuum switch

Permissible over-pressure max.	Temperature resistance	Indicator setting	Contact type	Fig.	Connection size	Type	Order Number	Material lower section	Material upper section
0.5 bar	- 10 to + 70 °C	- 10 to - 80 mbar	single pole double-throw cut-out switch	9	G 1/4	PiS 3070	77669690	GD-Al	PA 6
1 bar		- 50 to - 600 mbar			G 1/8		77669724	GD-Al	PA 6
0.1 bar	- 20 to + 80 °C, 120 °C	- 200 mbar ± 10	normally open	10	G 1/8 (outside)	HES 2200 BP	78308892	GD-ZnAl	Polycarbonat
		- 200 mbar ± 10	normally closed			HEO 2200 BP	78308900	GD-ZnAl	Polycarbonat
		- 50 mbar ± 4	normally open		LES 250 I	78308918	GD-ZnAl	Polycarbonat	
		- 50 mbar ± 4	normally closed		LEO 250 I	78308926	GD-ZnAl	Polycarbonat	



* connection G

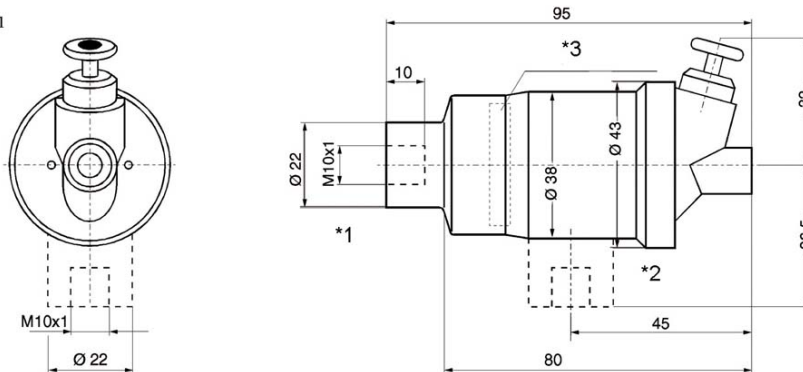
Types HES/HEO for hydraulic application, Types LES/LEO for air application

6. Vacuum indicator/air filter

Vacuum indicator/air filter

Indicator setting ± 10 %	Temperature resistance	Fig.	Execution	Type	Order-number	Indication
- 50 mbar	- 40 to + 110 °C	11	1	TB 745	78309056	optical indication - self locking -
- 65 mbar			2	TB 745/1	78309064	
				TB 746/1	78309049	

Abb. 11



*1 Execution 2

*2 Execution 1

*3 Indication: Position of display at nominal value in mbar

Standard sealing material: NBR

Sealing material types LES/LEO: Silicone rubber

7. Accessories

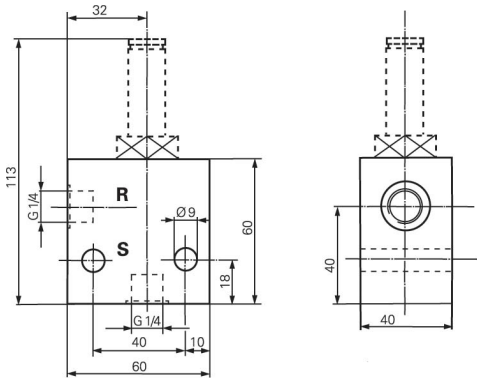
7.1 Seal kits			
Type	Order number NBR	Order number FPM	Order number EPDM
PiS 3092, 3093, 3102, 3105, 3115, 3122, 3192, 3193	77760275	77760283	77760291
PiS 3012, 3019, 3024, 3097, 3098, 3116	77760309	77760317	77760325
PiS 3084, 3085, 3103, 3106, 3123, 3125	78383382	78383390	78383408
PiS 3086, 3087, 3104	77760242	77760259	

7.2 Electrical upper sections	
Specification	Order number
Electrical upper section normally open/ normally closed for PiS 3084, 3087, 3093, 3098, 3193 (Contact type 1)	7536550
Wiring box with lamp insert 12 - 230 V for electrical upper section normally open (according to DIN EN 175301-803)	8307548
Electrical upper section Change over contact for PiS 3084, 3087, 3093, 3098, 3193 (Contact type 3)	8308017
Wiring box with 2 LEDs 10 - 30 V for electrical upper section Change over contact (according to DIN EN 175301-803)	8308025
Electrical upper section normally closed with signal suppression PiS 3003	7765357

7. Accessories

7.3 Mounting block for differential pressure indicators (M 20 x 1,5)

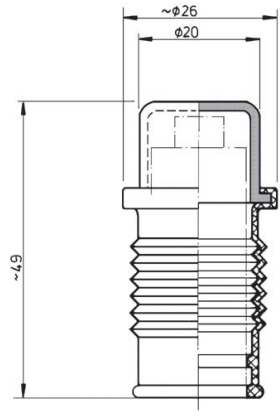
Specification	Order number
Mounting block (Material St)	77809098
Mounting block (Material 1.4301), 450 bar	77698517



R = clean side
S = dirt side

7.4 Protection cap

Specification	Order number
Protection cap for all optical differential pressure and pressure indicators: Resistant to: gasoil, purifying agent, insolation, dust, salt, water, concret Temperature range: - 20 °C to + 80 °C	78285330

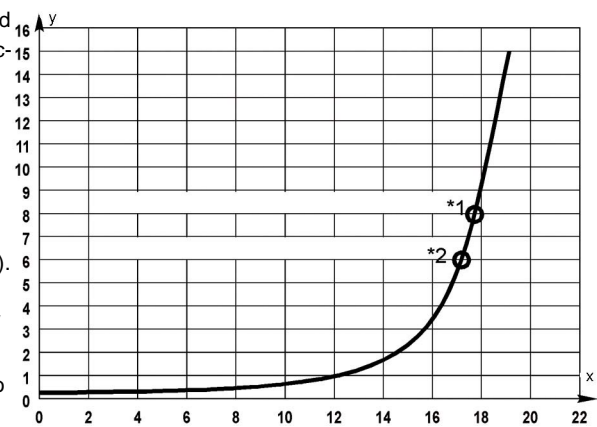


8. Function

The magnetic field as previously described, contactless operates reed contacts in the electrical upper part. The desired contact type is selected by inverting upper part. Another option keeping the electrical signal electronically suppressed up to 30 °C operating temperature is also available. This eliminates false electrical signal during the cold start phase.

For efficient servicing it is desirable to have a pre-warning device (so that the filter element can be replaced, e.g. with the next tool change). For this purpose electrical upper parts with two indicating points, i.e. at 75 % and at 100 % of the indicator setting are available. Pressure/vacuum manometers give an analog reading of the existing state of contamination of the filter elements. They require continuous control to ensure that the service time and reserve capacity are not unduly exceeded. If the contamination signal is disregarded, the filter element may collapse or, if a bypass valve is installed, part of the contamination fluid may reach the hydraulic components via the bypass valve and cause failure of the hydraulics.

Pressure/vacuum switches are provided with snap action switches, which ascertains that signal are issued only when the limit values have been fully reached.



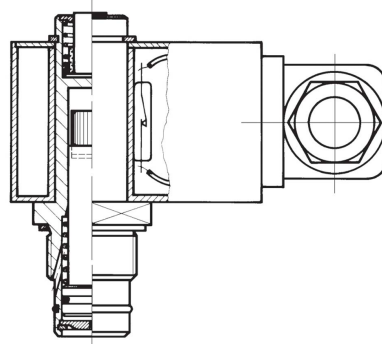
Dirt holding capacity - Δp curve

x = dirt holding capacity [g]

y = differential pressure Δp

*1 signal step contamination indicator 100 %

*2 signal step contaminatin indicator 75 %



9. Specifications

9.1 Contact type normally open/ normally closed

Types PiS 3085, 3086, 3092, 3097,
3192

Maximum voltage:

Maximum current on contact:

Maximum contact load:

Protection type:

Contact type:

Cable connection:

250 V AC/200 V DC

1 A

70 W

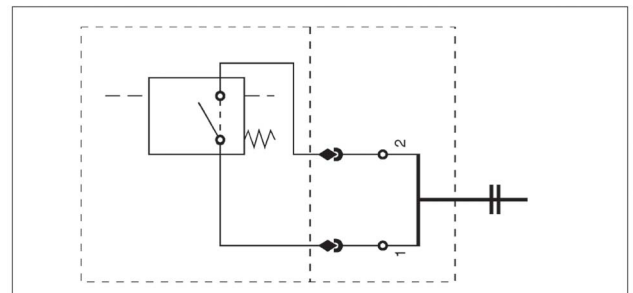
IP 65 when inserted

and secured

normally open/
normally closed

M 20 x 1,5

The switching function can be changed by turning the electric upper part by 180° (normally open contact or normally closed contact). The state on delivery is a normally closed contact. The use of quenching circuits must be checked in case of inductivity in the DC current circuit. Electrical parts are isolated (plastic casing).



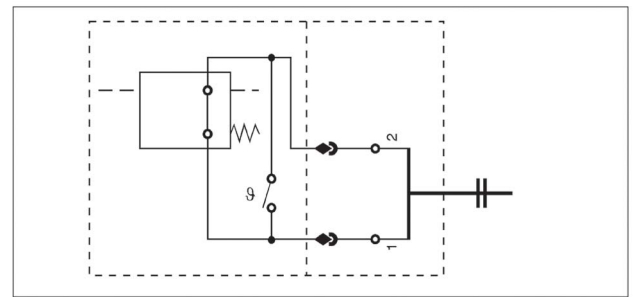
9.2 Contact type normally closed/signal lock-out

Type PiS 3003

Signal lock-out by thermorelay,

Signal is released at + 30 °C,

for further technical detail see 9.1



9.3. Contact type normally closed 2 step

Types PiS 3105, 3106, 3199

1. Indicating at 75 %

2. Indicating at 100 % of the indicating pressure

Maximum voltage:

Maximum current on contact:

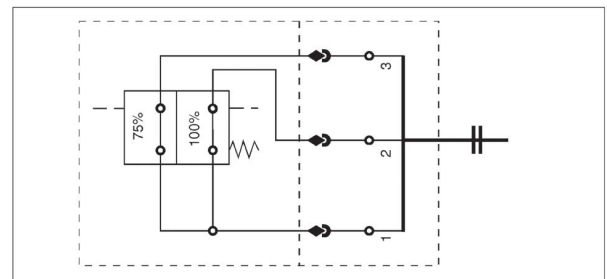
Maximum contact load:

for further technical details see 9.1

150 V AC/DC

1 A

20 VA/20 W



9.4 Contact type normally closed 2 step/signal lock-out

Types PiS 3122, 3123, 3124

Maximum voltage:

Maximum current on contact:

Maximum contact load:

Signal lock-out by thermorelay

Signal is released at + 30 °C

Reset at + 20 °C

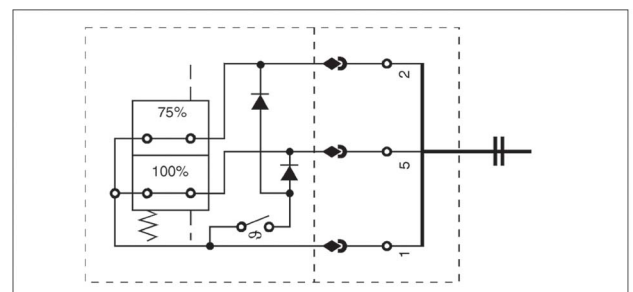
1. Indicating at 75 %

2. Indicating at 100 % of the indicating pressure

10 - 30 V AC/DC

1 A

20 W



for further details see 9.1

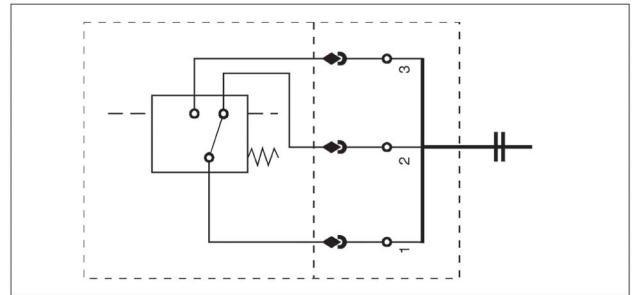
9. Technische Daten

9.5 Contact type change-over contact

Types PiS 3115, 3116, 3125

Maximum voltage:
Maximum current on contact:
Maximum contact load:
for further details see 9.1

150 V AC/DC
1 A
20 VA/20 W

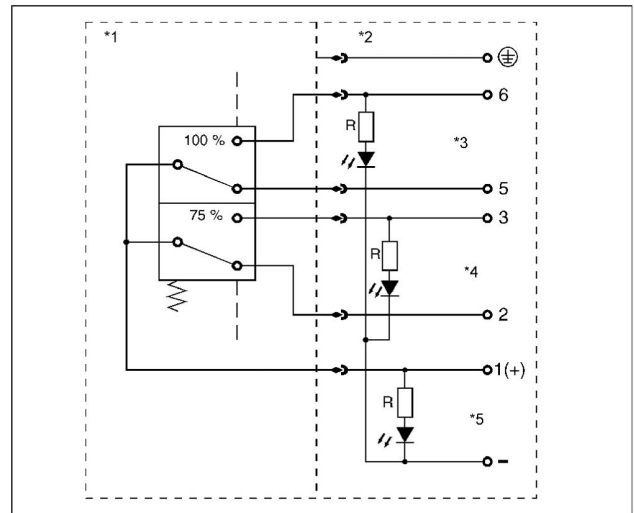


9.6 Contact type change-over contact/2step LED

Types PiS 3012, 3102, 3103

Maximum voltage:
Maximum current on contact:
Maximum contact load:
1. Indicating at 75 %
2. Indicating at 100 % of the indicating pressure
for further details see 9.1

10 - 30 V DC
1 A
20 VA/20 W

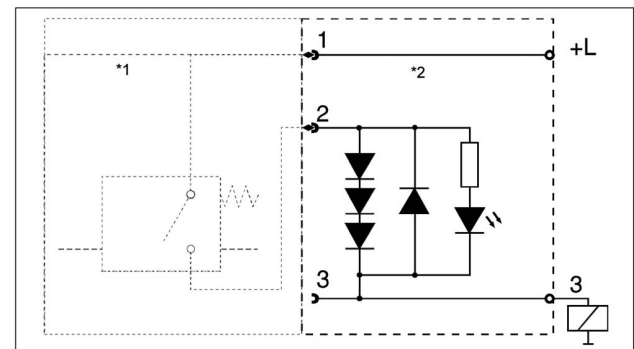


*1 switch over *2 connector
*3 indicator setting 100 % LED red
*4 indicator setting 75 % LED red
*5 stand-by indication LED green

9.7 Wiring box with lamp insert

Will be supplied instead of standard connection.
Voltage:
Not to combine with indicators with 2 setting points

12 - 230 V AC/DC

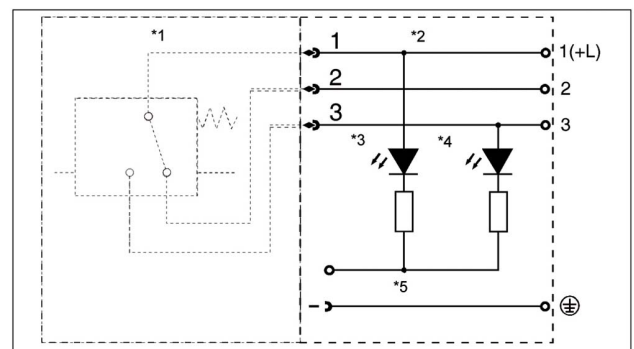


*1 switch cover
*2 connector

9.8 Wiring box with lamp insert

Will be supplied instead of standard connection plug.
Voltage:
To combine with PiS 3115, 3116, 3125

10 - 30 V DC

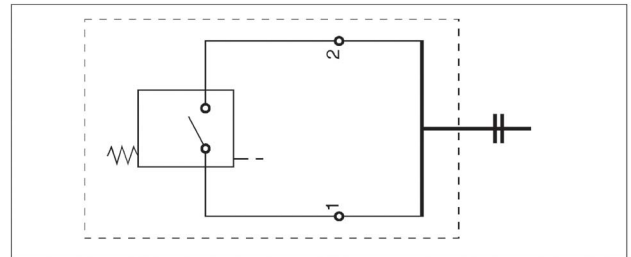


*1 switch cover
*2 connector
*3 green
*4 yellow
*5 screw clamp

9. Specifications

9.9 Vacuum switch HES/LES

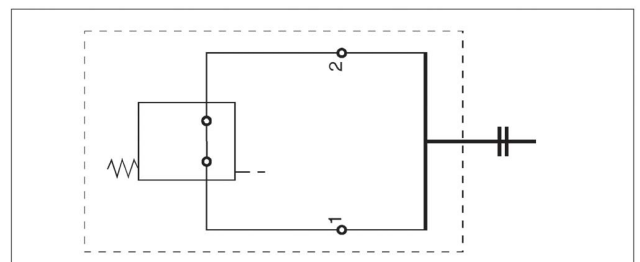
Contact type:	normally open
Contact load:	HES: 42 V/6W at resistive load
Maximum contact load:	load
Type of protection:	LES: 24 V/6W at resistive load
Electrical connection:	load
	IP 54 - with protecting cap
	AMP 6.3 DIN 46248,
	DIN 46247



9.10 Vacuum switch HEO/LEO

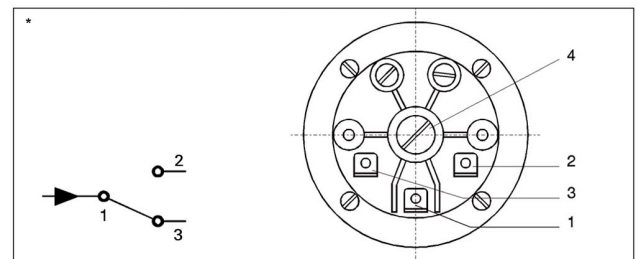
Contact type:	normally closed
Contact load:	HEO: 42 V/6W at resistive load
	LEO: 24 V/6W at resistive load

for further technical detail see 9.9



9.11 Vacuum switch PiS 3070

Maximum voltage:	230 V AC/DC
Maximum current on contact.:	6A
Contact type:	single pole changeover switch
Electrical connection:	AMP 6,3 DIN 46248, DIN 46247
Position of installation:	individual (with adjusted setting point, position of installation needs to be advised)
Type of protection:	IP 00 - without cover IP 54 - with cover



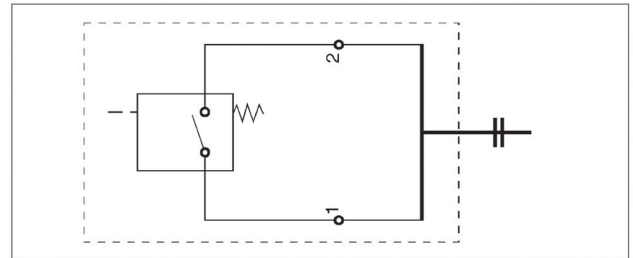
* Connection scheme:

1. Supply line
2. Operating contact
3. Normally closed contact
4. Adjusting screw

9. Specification

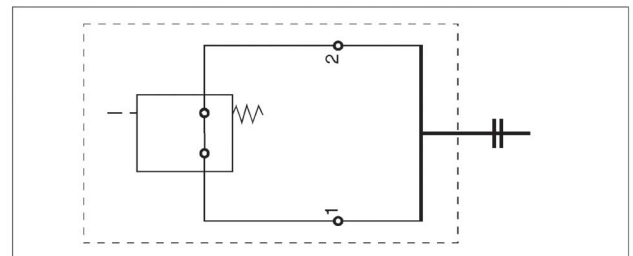
9.12 Pressure switch DSS

Contact type:	normally open
Maximum voltage:	42 V
Maximum current on contact:	2 A
Contact load:	100 VA
Duty classification:	200 / min
Type of protection:	IP 65 - with protecting cap
Electrical connections:	AMP 6,3 DIN 46248 for attachable sleeve according to DIN 46247, (switching mode bi-pole)



9.13 Pressure switch DSO

Contact type:	normally closed
for further information see 9.12	



Contamination indicators PiS 3084, 3087, 3093, 3098, 3193 can be mounted in 45°.

We draw attention to the fact that all values indicated are average values which do not always occur in specific cases of application: Our products are continually being further developed. Values, dimensions and weights can change as a result of this. Our specialized department will be pleased to offer you advice.

When using our filters in areas which are to be classified according to EU directive 94/9 EG (ATEX), we recommend prior discussion with us. The standard version can be used for liquids based on mineral oil /corresponding to the fluids in Group 2 of Directive 97/23 EG Articlel 9). Please consult with us if using other media.

Subject to technical alterations without prior notice.

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