

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89

Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81

Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37

Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97

Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

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Технические характеристики на поворотные приводы М/162000/МІ, М/60280, М/60285 КОМПАНИИ **IMI NORGREN**

Виды товаров: с реечной передачей, поворотнo-лопастные двойного действия, мини-приводы и др.

- > **Torque at 6 bar**
0,13 ... 9,50 Nm
- > **Suitable for torques**
from 0,059 ... 16,6 Nm
- > **Compact design**
- > **Angle of rotation from**
90° ... 270°



Technical features

Medium:

Compressed air, filtered,
lubricated or non-lubricated

Operation:

Double acting rotary vane with
buffer cushioning
Single vane M/60280 ... M/60284
Double vane
M/60281/TI ... M/60284/TI

Operating pressure:

2 ... 7 bar (29 ... 101 psi)
M/60280, M/60281, .../TI,
M/60282, .../TI
2 ... 10 bar (29 ... 145 psi)
M/60283, ...TI, M/60284, .../TI

Air connections:

M5 M/60280, .../TI, M/60281, .../
TI, M/60282, .../TI, M/60283, .../TI
G 1/8 M/60284, .../TI

Rotation angle:

90°, 180° M/60280
90°, 180°, 270° M/60281 ...
M/60284
90° M/60281/TI ... M/60284/TI

Rotation tolerance:

0 ... +4° M/60280 to M/60283,
.../TI
0 ... +3° M/60284, M/60284/TI

Other features:

Featherkey supplied as standard
for M/60283/IE, M/60284/IE

Operating temperature:

-5° ... 60°C (+23° ... +140°F)
Air supply must be dry enough
to avoid ice formation at
temperatures below +2°C (+35°F)

Materials:

Body: cast aluminium
Shaft: steel
Shaft bearing: sintered bronze
Seals: NBR

Technical data, standard

Port size	Theoretical torque at 6 bar (Nm)	Permissible forces *1)		Permissible rotation energy *2) (Nm)	Maximum frequency *3) (l/m)	Air consumption (cm³)			Weight (kg)	Model
		axial (N)	radial (N)			90°	180°	270°		
M5	0,15	3	30	0,6 x 10 ⁻³	180 (at 180°)	1,4	1,4	-	0,04	M/60280
M5	0,38	4	40	1,5 x 10 ⁻³	150 (at 180°)	3,4	3,4	4	0,07	M/60281
M5	0,86	4	40	1,5 x 10 ⁻³	240 (at 90°)	2,8	-	-	0,08	M/60281/TI
M5	1,2	4	50	3,0 x 10 ⁻³	150 (at 180°)	9,8	9,8	12	0,14	M/60282
M5	2,54	4	50	3,0 x 10 ⁻³	240 (at 90°)	8,1	-	-	0,14	M/60282/TI
G 1/8	2,1	25	300	15,0 x 10 ⁻³	120 (at 180°)	17	17	21	0,25	M/60283
G 1/8	4,7	25	300	15,0 x 10 ⁻³	180 (at 90°)	15	-	-	0,26	M/60283/TI
G 1/8	4,1	30	400	25,0 x 10 ⁻³	90 (at 180°)	37	37	43	0,47	M/60284
G 1/8	9,5	30	400	25,0 x 10 ⁻³	180 (at 90°)	34	-	-	0,48	M/60284/TI

*1) Permissible load on rotary vane shaft

*2) Permissible rotational energy in Nm which may be applied to shaft. It can be calculated as follows: Permissible rotational energy $\geq 1/2 IXX2$, I =Angular moment, XX = Mean angular velocity

*3) Maximum frequency at 5 bar pressure, no load

Mini rotary vane actuators models with fixed or adjustable rotation angles

Rotation angle	Double vane	Single vane	Model
90°	180°	270°	
•	•	•	M/60280
•	•	•	M/60281
•	•	•	M/60281/TI
•	•	•	M/60282
•	•	•	M/60282/TI
•	•	•	M/60283
•	•	•	M/60283/TI
•	•	•	M/60284
•	•	•	M/60284/TI

Option selector

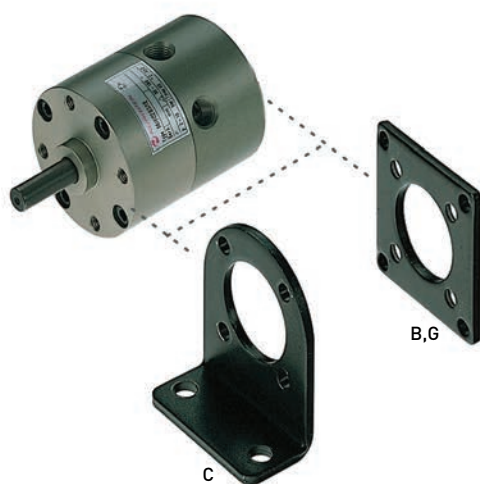
Size
0, 1, 2, 3, 4

M/6028★/★/★/★

Rotation	Substitute
Standard only	see table
Variants	Substitute
Single vane	None
Double vane, fixed	TI

Note: Disregard option positions not used

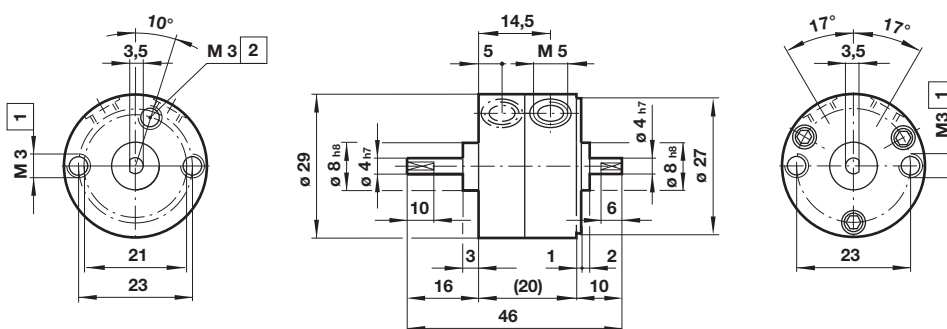
Mountings



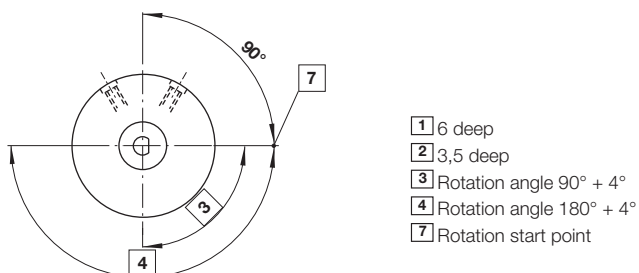
Model	B, G	C
		
	Page 5	Page 5
M/60280	QM/60280/22	QM/60280/21
M/60281, .../TI	QM/60281/22	QM/60281/21
M/60282, .../TI	QM/60282/22	QM/60282/21
M/60283, .../TI	QM/60283/22	QM/60283/21
M/60284, .../TI	QM/60284/22	QM/60284/21

Dimensions

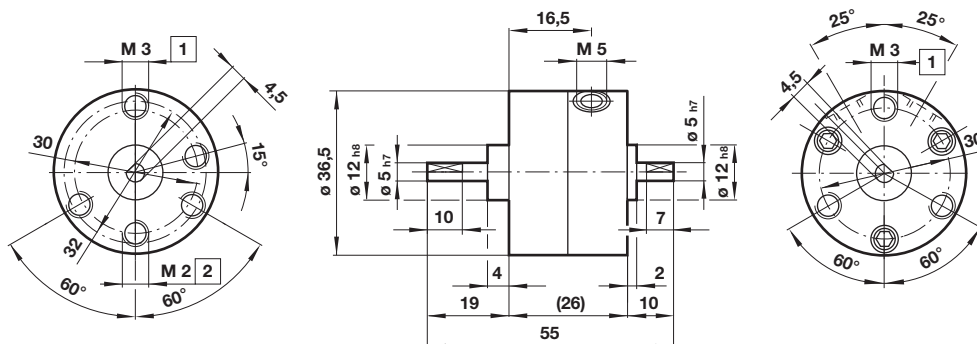
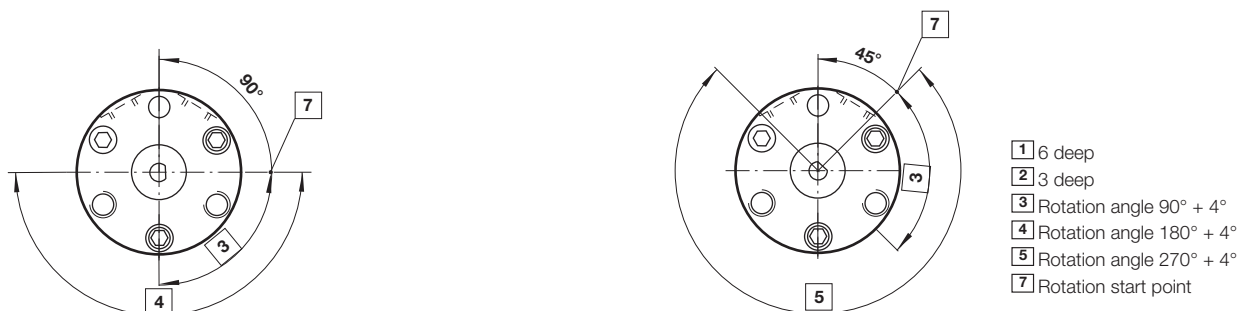
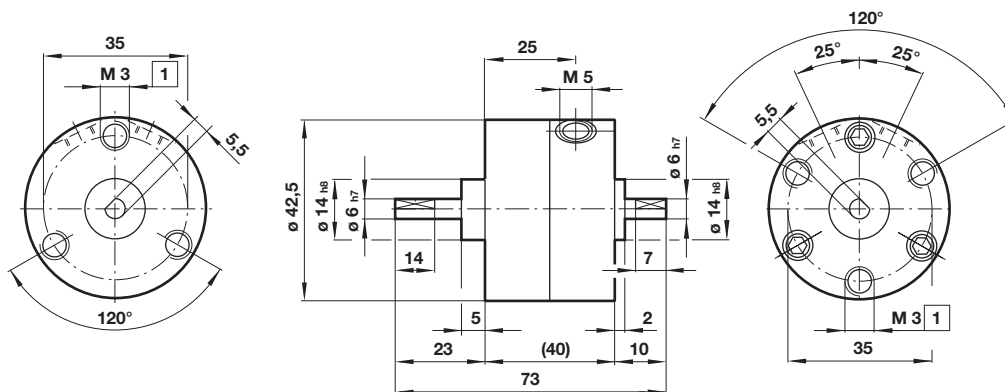
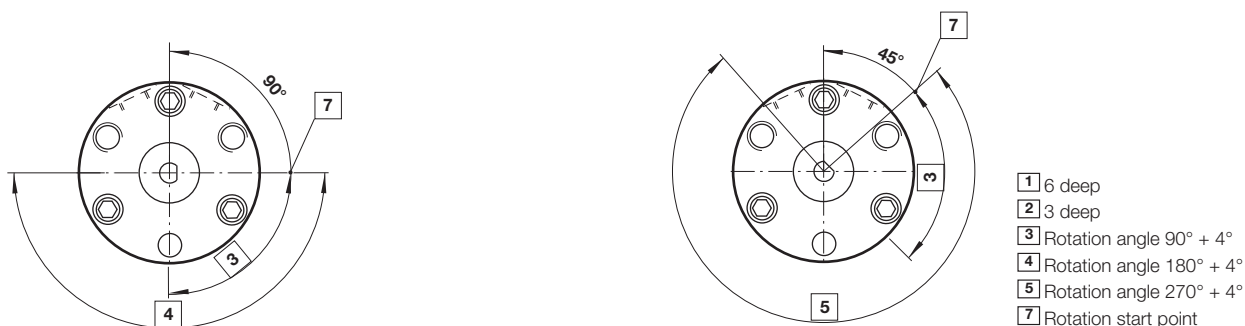
Dimensions in mm
Projection/First angle



Rotation start point



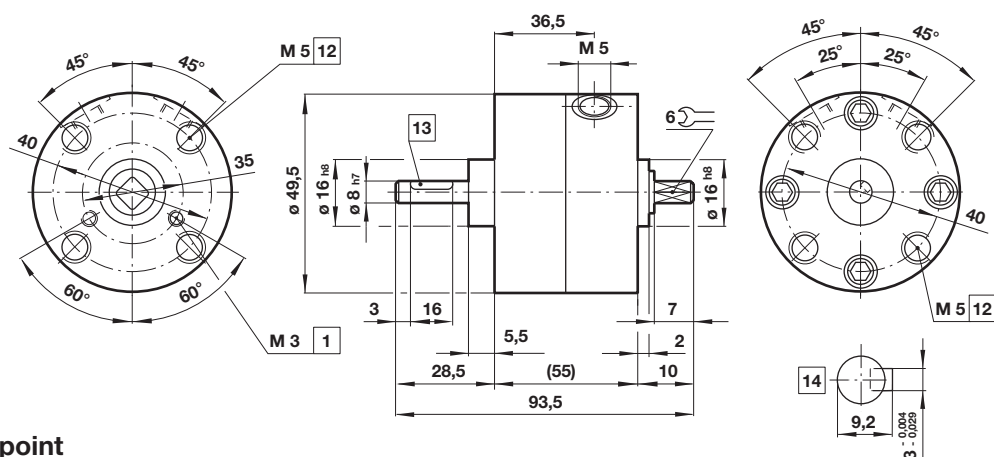
Dimensions
M/60281

 Dimensions in mm
 Projection/First angle

Rotation start point
M/60281/90, M/60281/180
M/60281/270, M/60281/TI

M/60282

Rotation start point
M/60282/90, M/60282/180
M/60282/270, M/60282/TI


Dimensions

M/60283

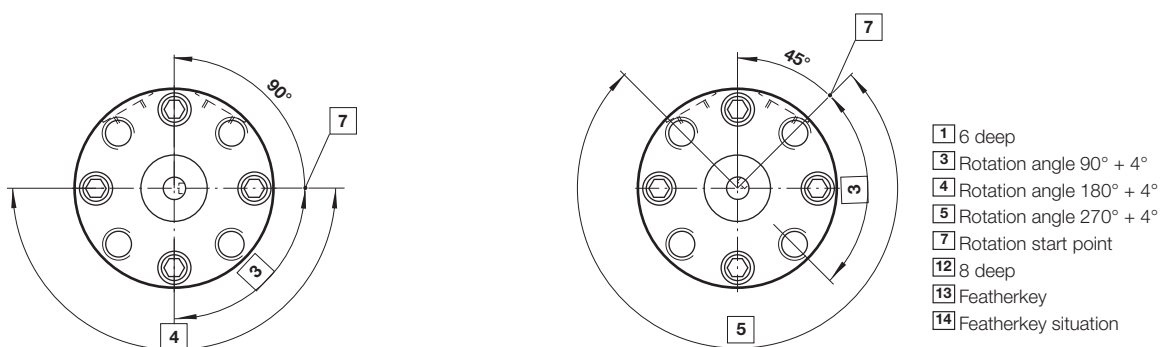
Dimensions in mm
Projection/First angle



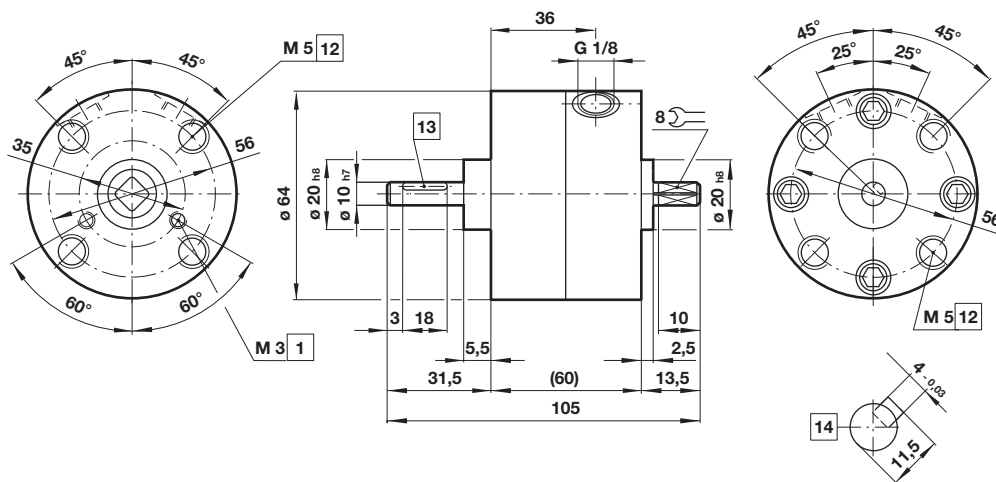
Rotation start point

M/60283/90, M/60283/180

M/60283/270, M/60283/TI



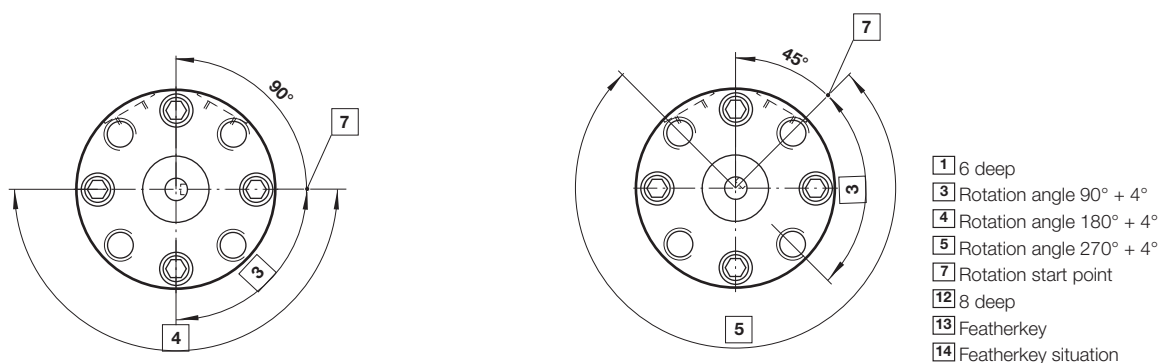
M/60284



Rotation start point

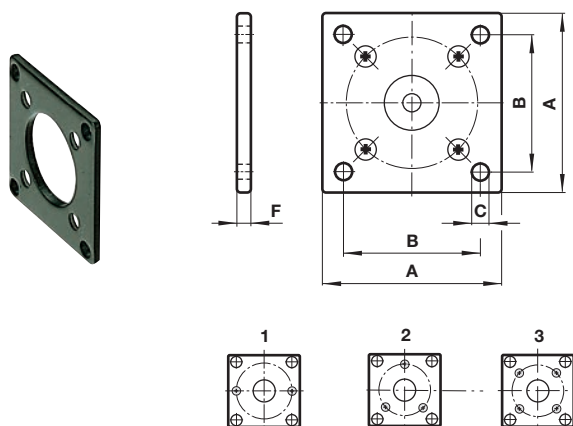
M/60284/90, M/60284/180

M/60284/270, M/60284/TI



Mountings

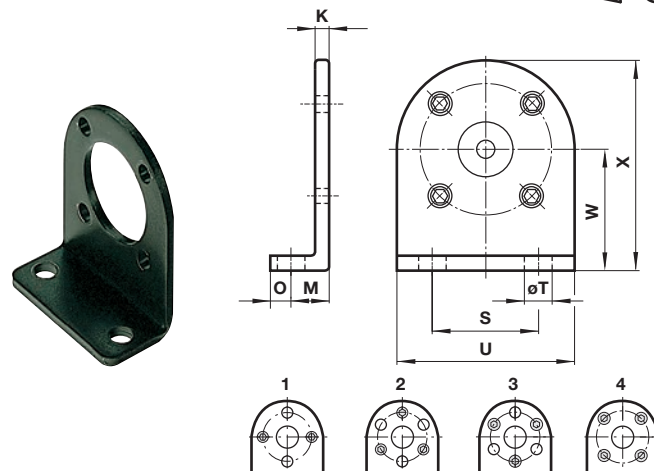
Rear flange B, Front flange G



A	B	Ø C	F	Hole pattern	Rotation angle	kg	Model
37	30	3,4	2,5	2	120°	0,07	QM/60281/22
42	34	3,5	3	2	120°	0,14	QM/60282/22
50	41	5,5	3,5	3	90°	0,36	QM/60283/22
64	52	5,5	3,5	3	90°	0,47	QM/60284/22

Foot C

Dimensions in mm
Projection/First angle



K	M	O	S	Ø T	U	W	X	Hole pattern	Rotation angle	kg	Model
2,5	11	7	26	4,8	36	25	43	2	60°	0,05	QM/60281/21
3	12	8	30	5,8	42	30	51	3	60°	0,09	QM/60282/21
3,5	15	10	36	7	49	34	58,5	4	90°	0,2	QM/60283/21
4,5	18	12	48	6,5	66	42	75	4	90°	0,2	QM/60284/21

Warning

These products are intended for use in industrial compressed air systems only. Do not use these products where pressures and temperatures can exceed those listed under

»Technical features/data«.

Before using these products with fluids other than those specified, for non-industrial applications, life-support systems or other applications not within published specifications, consult IMI NORGRN.

Through misuse, age, or malfunction, components used in fluid power systems can fail in various modes.

The system designer is warned to consider the failure modes of all component parts used in fluid power systems and to provide adequate safeguards to prevent personal injury or damage to equipment in the event of such failure.

System designers must provide a warning to end users in the system instructional manual if protection against a failure mode cannot be adequately provided.

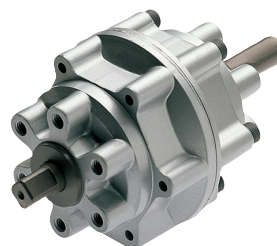
System designers and end users are cautioned to review specific warnings found in instruction sheets packed and shipped with these products.

M/60285 ... M/60288

Rotary vane actuators, double acting



- > Torque at 6 bar
5,78 ... 241,73 Nm
- > High torque from compact units
- > Rotation angles from 90 ... 270°
- > Suitable for torques from 1,23 ... 402,46 Nm



Technical features

Medium:

Compressed air, filtered, lubricated or non-lubricated

Operation:

Double acting rotary vane with buffer cushioning
M/60285 to M/60288 single vane
M/60285/TI to M/60288/TI double vane

Operating pressure:

2 ... 10 bar (29 ... 145 psi)

Rotation angle:

90°, 180°, 270° single vane
90° double vane

Rotation tolerance:

0 ... +3°

Other features:

Featherkey supplied as standard

Operating temperature:

-5°C ... +60°C (+23 ... +140°F)

Air supply must be dry enough to avoid ice formation at temperatures below +2°C (+35°F)

Materials:

Body: Cast aluminium
Shaft: Steel
Shaft bearing: Sintered bronze
Seals: NBR

Technical data, standard

Port size	Theoretical torque at 6 bar (Nm)	Permissible forces *1)		Permissible rotation energy *2) (Nm)	Maximum frequency *3)			Air consumption			Weight			Model
		axial (N)	radial (N)		90°	180°	270°	90°	180°	270°	90°	180°	270°	
G1/8	5,8	44,1	588	49 x 10 ⁻³	180	90	60	51	51	61	0,82	0,79	0,73	M/60285
G1/8	12,8				180			42			0,82			M/60285/TI
G1/4	18	88,2	1176	225,4 x 10 ⁻³	120	78	48	146	146	179	2	1,9	1,7	M/60286
G1/4	41,5				120			127			2			M/60286/TI
G3/8	34,5	147	1960	1078 x 10 ⁻³	90	60	42	244	283	352	3,7	3,7	3,7	M/60287
G3/8	83				90			244			4,3			M/60287/TI
G1/2	123	490	4900	3920 x 10 ⁻³	66	45	30	754	869	1036	12,7	12,2	11,2	M/60288
G1/2	247				66			754			12,7			M/60288/TI

*1) Permissible load on rotary vane shaft

*2) Permissible rotational energy in Nm which may be applied to shaft. It can be calculated as follows:
Permissible rotational energy $\geq 1/2 I \times \omega^2$, I = Angular moment, ω = Mean angular velocity

*3) Maximum frequency at 5 bar pressure, no load

Hydro-cushion

Min. operating pressure (bar)	Operating temperature (C°)	Load range (kg x cm2)	Max. absorption energy (Nm)	Max. absorption energy per minute (Nm/min)	Absorbing angle (°)	Maximum collision angular velocity (°/s)	Weight (kg)	Model
3	+5 ... +50	981	2,9	20	11	850	0,24	QM/60285/60
3	+5 ... +50	2942	9,8	71	12	750	0,42	QM/60286/60
3	+5 ... +50	5884	19,6	137	14	650	0,78	QM/60287/60

Mini rotary vane actuators models with fixed or adjustable rotation angles

Rotation angle			Double vane	Single vane	Model
90°	180°	270°			
•	•	•		•	M/60285/*
•			•		M/60285/TI
•	•	•		•	M/60286/*
•			•		M/60286/TI
•	•			•	M/60287/*
•			•		M/60287/TI
•	•	•		•	M/60288/*
•			•		M/60288/TI
•			•		M/60284/TI

Option selector

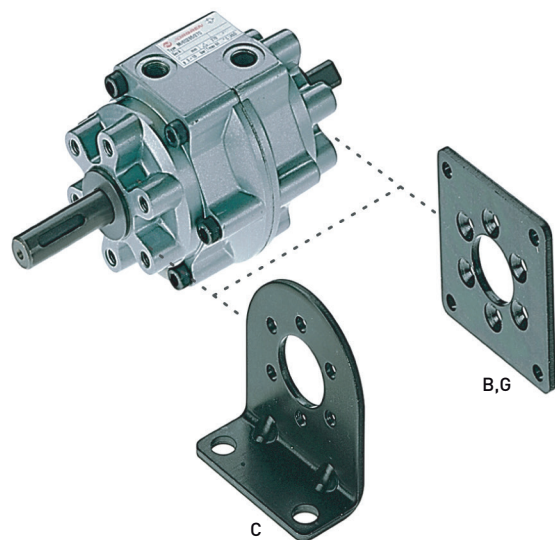
Size	Substitute
5, 6, 7, 8	X

M/6028★/★★/★★★

Rotation	Substitute
Standard only	see table
Variants	Substitute
Single vane, fixed	None
Double vane, fixed	Tl

Note: Please fill in only the numbers of digits required. Please order the mounting kit and hydro-cushion kit separately.

Mountings

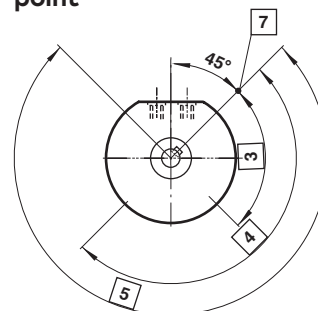


Model	B, G	C	Adaptor for Switches
			
	Page 4	Page 4	Page 4
M/60285, .../TI	QM/60285/22	QM/60285/21	M/P72487
M/60286, .../TI	QM/60286/22	QM/60286/21	M/P72487
M/60287, .../TI	–	QM/60287/21	M/P72487
M/60288, .../TI	–	QM/60288/21	M/P72487

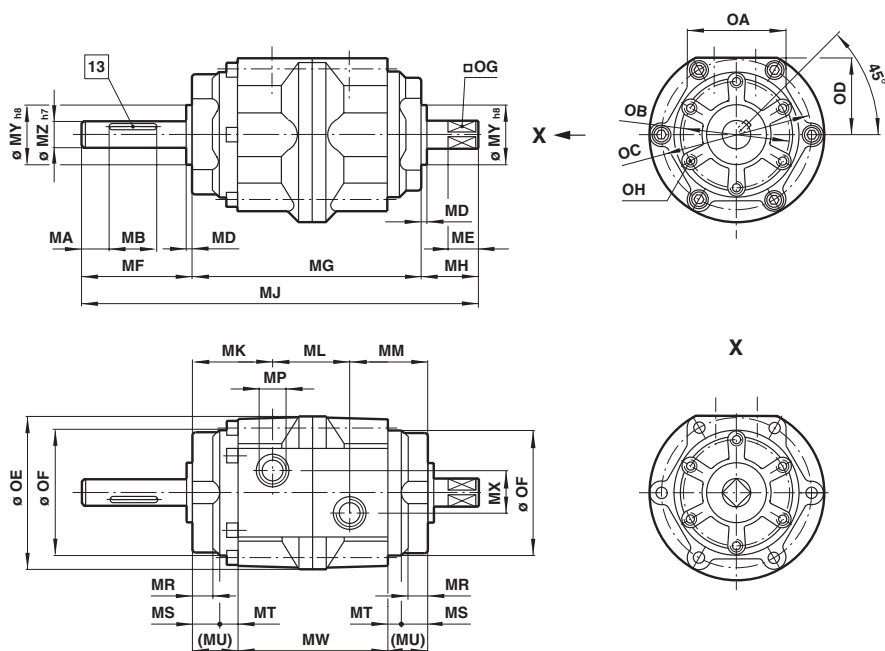
Basic dimensions

Dimensions in mm
Projection/First angle

Rotation start point



- 3** Rotation angle $90^\circ + 3^\circ$
- 4** Rotation angle $180^\circ + 3^\circ$
- 5** Rotation angle $270^\circ + 3^\circ$
- 7** Rotation start point
- 13** Featherkey

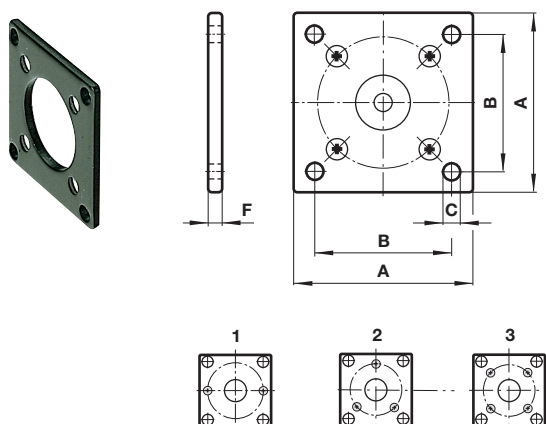


MA	MB	MD	ME	MF	MG	MH	MJ	MK	ML	MM	MP	MR	MS	MT	MU	Model
5	20	2,5	13	39,5	86	19,5	145	29	28	29	G1/8	11	14	6	20	M/60285/ .../TI
5	36	3	16	53,5	103	23,5	180	34,5	34	34,5	G1/4	10,5	15,5	8	23,5	M/60286/ .../TI
5	40	3,5	22	65	125	30	220	41,5	4	41,5	G3/8	13	17,5	10	27,5	M/60287/ .../TI
10	40	4,5	35	69,5	171	44,5	285	53,5	64	53,5	G1/2	14,5	21	11,5	32,5	M/60288/ .../TI
MW	MX	Ø MYh8	Ø MZ h7	OA	Ø OB	Ø OC	OD	Ø OE	Ø OF	OG -0,1	OH	Featherkey		(kg)	Model	
46	16	25	12	44	45	68	36	79	58	10	M6 x 9*1)	4 -0,03 x 2,5 + 0,1*1)		0,82	M/60285/ .../TI	
56	24	30	17	61	70	97	51	110	85,5	13	M8 x 12*1)	5 -0,03 x 3 + 0,1*1)		2	M/60286/ .../TI	
70	32	45	25	78	80	125	66	141,5	110	19	M10 x 15*1)	7 -0,038 x 4 + 0,2*1)		4,3	M/60287/ .../TI	
106	44	70	40	110	120	173	90	196	152	32	M12 x 18*1)	12 -0,043 x 5 + 0,2*1)		12,7	M/60288/ .../TI	

*1) depth

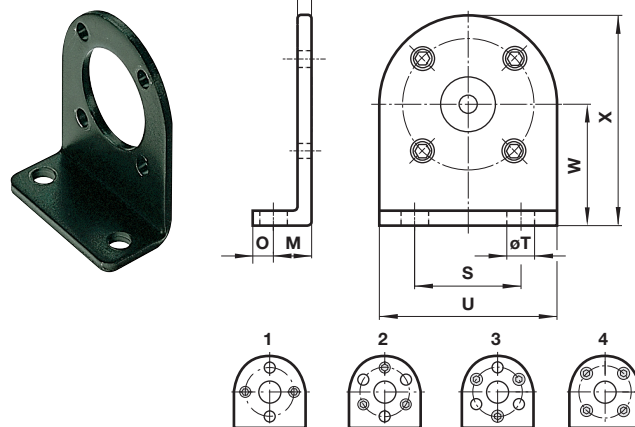
Mountings

Rear flange B, Front flange G



Foot C

Dimensions in mm
Projection/First angle



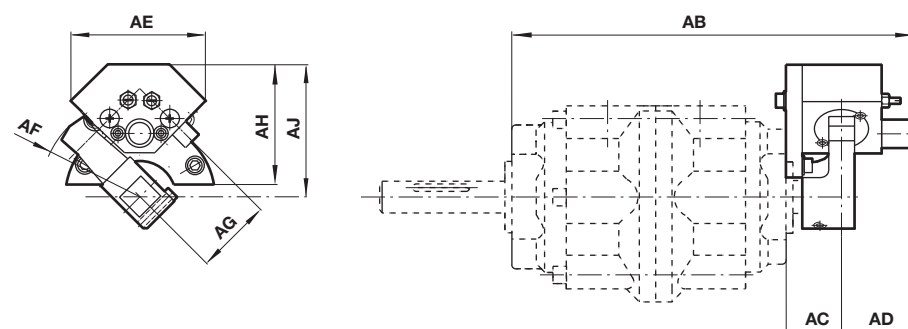
A	B	ø C	E	Rotation angle *2)	(kg)	Model
80	64	7	4,5	60°	0,2	QM/60285/22
110	88	9	6	60°	0,51	QM/60286/22

*2) The mountings can be rotated through the angels shown.

K	M	O	S	ø T	U	W	X	Rotation angle *2)	(kg)	Model
4,5	25	10	55	11	75	45	82,5	60°	0,26	QM/60285/21
10	28	12	80	13	110	65	115	60°	1,14	QM/60286/21
12	32	13	100	15	140	80	135	60°	1,24	QM/60287/21
15	35	15	140	15	200	110	200	60°	4,45	QM/60288/21

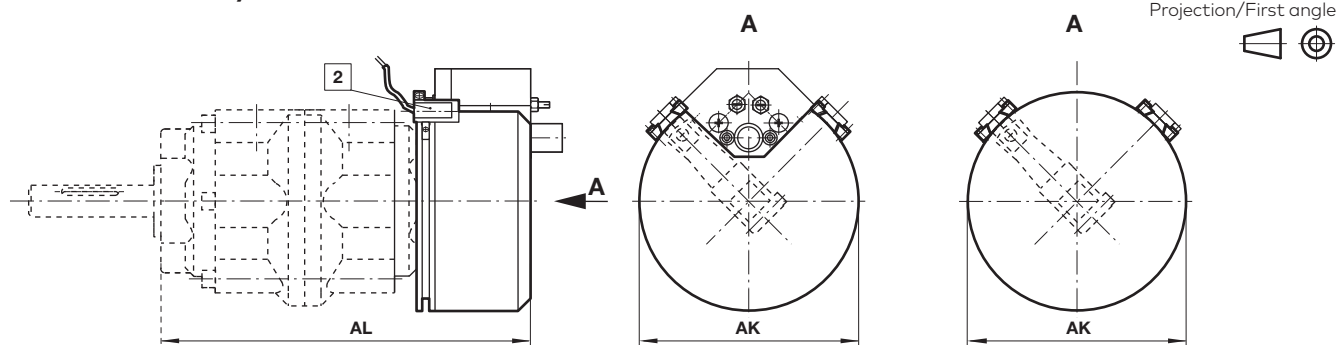
*2) The mountings can be rotated through the angels shown.

Hydro-cushion kit



AB	AC	AD	AE	AF	AG	AH	AJ	Model
136,5	20,5	30	56	38	34	50	54	QM/60285/60
159,5	22,5	34	80	51	46	62	71,5	QM/60286/60
187,5	25,5	37	95	68	62	87	96	QM/60287/60

Brackets for switches M/50

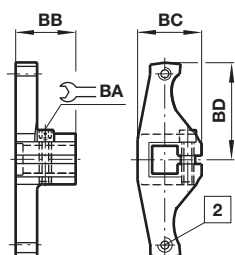


2 Switch

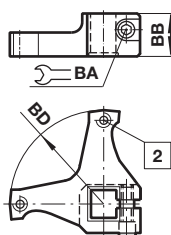
ø AK	AL	Brackets for 2 switches without hydro-cushion	Brackets for 2 switches with hydro-cushion
85	123	QM/60285/22/64	QM/60285/23/64
111	143	QM/60286/22/64	QM/60286/23/64
145	169	QM/60287/22/64	QM/60287/23/64

Claw (for hydro-cushion and magnetic sensing)

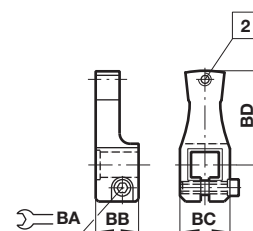
Rotation start point



Rotation start point



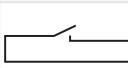
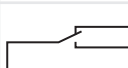
Rotation start point



2 M4 (6 mm deep)

Model	Actuator	BA	BB	BC	BD
M/P70088 (90°), M/P70089 (180°), M/P70090 (270°)	M/60285	4	18	23	38
M/P70091 (90°), M/P70092 (180°), M/P70093 (270°)	M/60286	5	20	28	51
M/P70094 (90°), M/P70095 (180°), M/P70096 (270°)	M/60287	6	23,5	40	68

Technical data - Reed switches - additional informations see data sheet N/en 4.3.005

Symbol	Voltage		Current maximum (mA)	Function	Temperature (°C)	LED	Protection class	Plug	Cable length (m)	Cable type	Weight (g)	Model
	(V a.c.)	(V d.c.)										
	10 ... 240	10 ... 170	180	Closer	-25 ... +80	•	IP66	—	2, 5 or 10	PVC 2 x 0,25	37	M/50/LSU/*V
	10 ... 240	10 ... 170	180	Closer	-25 ... +80	•	IP66	—	5	PUR 2 x 0,25	37	M/50/LSU/5U
	10 ... 240	10 ... 170	180	Closer	-25 ... +150	—	IP66	—	2	Silicon 2 x 0,25	37	TM/50/RAU/2S
	10 ... 240	10 ... 170	180	Changeover	-25 ... +80	—	IP66	—	5	PVC 3 x 0,25	37	M/50/RAC/5V
	10 ... 60	10 ... 60	180	Closer	-25 ... +80	•	IP66	M8 x 1	0,3	PVC 3 x 0,25	16	M/50/LSU/CP *1)

* Insert cable length; *1) Plug-in connector Color code: BK = black, BN = brown, BU = blue

Drawings

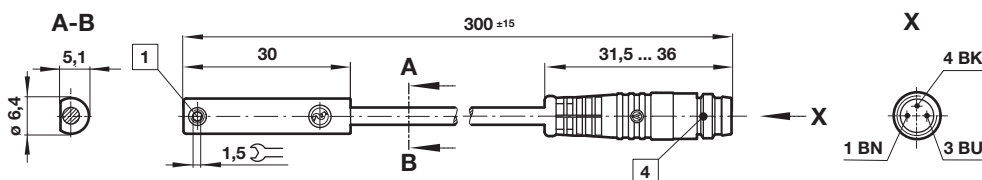
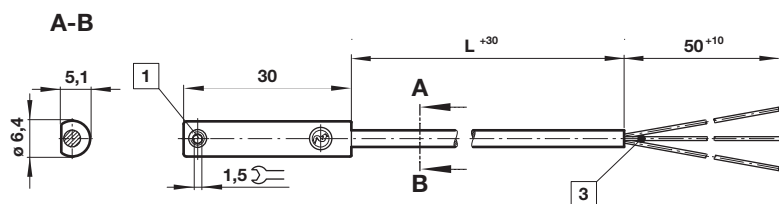
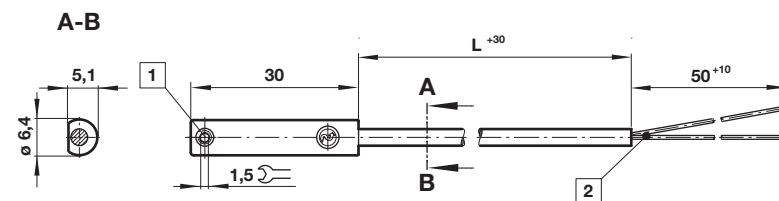
M/50/LSU/*V, M/50/LSU/5U,
TM/50/RAU/2S
Cable length L = 2, 5 or 10 m



M/50/RAC/5V
Cable length L = 5 m



M/50/LSU/CP



- 1 Fixing screw
- 2 + BN = brown; - BU = blue (output)
- 3 - BK = black; + BN = brown; - #BU = blue
- 4 Plug M8 x 1, color code: BK = black; BN = brown; BU = blue

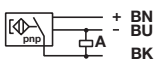
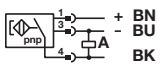
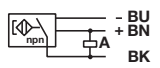
Accessories

Plug-in connector cable with nut



Outer cover	Cable length (m)	Weight (kg)	Connector	Connector
PVC 3x0,25	5 m	0,18	M8 x 1	M/P73001/5
PUR 3x0,25	5 m	0,18	M8 x 1	M/P73002/5
PUR 3x0,34	5 m	0,21	M12 x 1	M/P34594/5

Technical data - Solid state - additional informations see data sheet N/en 4.3.007

Symbol	Voltage (V d.c.)	Current maximum (mA)	Temperature (°C)	LED	Protection class	Plug	Cable length (m)	Cable type	Weight (g)	Model
	10 ... 30	150	PNP	-40 ... +80	•	IP67	—	2, 5 or 10	37	M/50/EAP/*V
	10 ... 30	150	PNP	-40 ... +80	•	IP68	—	5	37	M/50/EAP/SU
	10 ... 30	150	PNP	-40 ... +80	•	IP67	M8 x 1	0,3	16	M/50/EAP/CP *1)
	10 ... 30	150	PNP	-40 ... +80	•	IP67	M12 x 1	0,3	16	M/50/EAP/CC *1)
	10 ... 30	150	NPN	-40 ... +80	•	IP67	—	2, 5 or 10	37	M/50/EAN/*V
	10 ... 30	150	Closer	-40 ... +80	•	IP67	M8 x 1	0,3	16	M/50/EAN/CP *1)

* Insert cable length; *1) Plug-in connector; Color code: BK = black, BN = brown, BU = blue

Drawings

M/50/EAP/*V,
M/50/EAN/*V

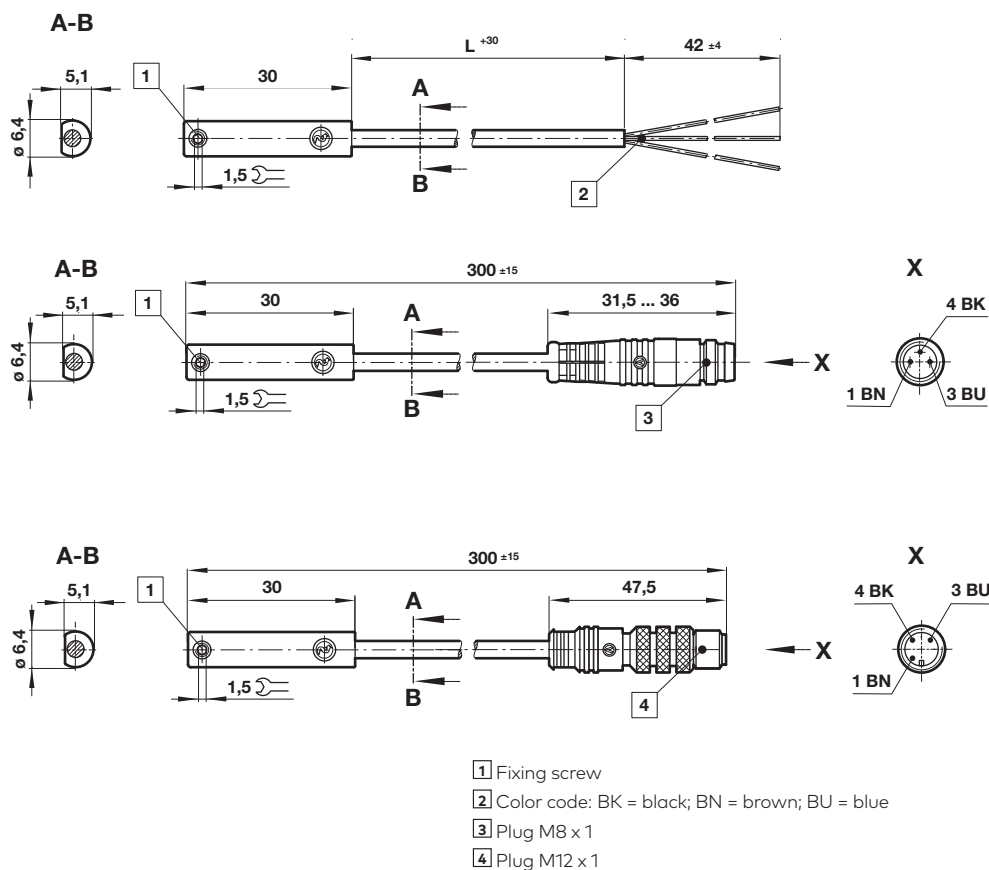
Cable length L = 2, 5 or 10 m



M/50/EAP/CP,
M/50/EAN/CP



M/50/EAP/CC



Warning

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- > **Torque at 6 bar**
0,35 ... 9,31 Nm
- > **Suitable for torques**
from 0,15 ... 16,27 Nm
- > **Modern and compact design**
- > **Angle of rotation infinitely adjustable**
between 30° to 270°



Technical features

Medium:

Compressed air, filtered, lubricated or non-lubricated

Operation:

Double acting rotary vane with buffer

Principle:

.../IE single vane
.../TE double vane

Operating pressure:

2 ... 7 bar (29 ... 101 psi)
M/60281/IE, M/60282/IE
2 ... 10 bar (29 ... 145 psi)
M/60283/IE, M/60284/IE, .../TE

Air connections:

M5 – M/60281/IE, M/60282/IE,
M/60283/IE
G1/8 – M/60284/IE, .../TE

Rotation angle:

180° (30 ... 180° adjustable)
M/60281/IE, M/60282/IE,
M/60283/IE
270° (30 ... 270° adjustable)
M/60284/IE
90° (30 ... 90° adjustable)
M/60284/TE

Rotation tolerance:

-9° ... +6° – M/60281/IE,
M/60282/IE, M/60283/IE
-9° ... +3° – M/60284/IE, .../TE
(fine adjustment, range and maximum angle setting)
±3° (fine adjustment, rotation reference point)
Operating temperature:
-5°C ... 60°C (+23 ... +140°F)
Air supply must be dry enough to avoid ice formation at temperatures below +2°C (+35°F)

Materials:

Housing: aluminium
Shaft: steel
Shaft bearings: sintered bronze,
Seals: NBR

Other features:

Featherkeys supplied as standard parts

Technical data, standard

Port size	Theoretical torque at 6 bar (Nm)	Permissible forces *1)		Permissible rotation energy *2) (Nm)	Maximum frequency *3) (l/m)	Air consumption (cm³)	Weight (kg)	Model
		axial (N)	radial (N)					
M5	0,38	4	40	1,0 x 10 -3	180 (at 180°)	4	0,09	M/60281/IE
M5	1,2	4	50	2,0 x 10 -3	150 (at 180°)	12	0,17	M/60282/IE
M5	2,1	25	300	3,0 x 10 -3	120 (at 180°)	21	0,28	M/60283/IE
G 1/8	4,1	30	400	7,0 x 10 -3	60 (at 270°)	43	0,51	M/60284/IE
G 1/8	9,5	30	400	7,0 x 10 -3	180 (at 90°)	34	0,53	M/60284/TE

*1) Permissible load on rotary vane shaft

*2) Permissible rotational energy in Nm which may be applied to shaft. It can be calculated as follows: Permissible rotational energy $\geq 1/2 \cdot I \cdot \omega^2$, I=Angular moment, ω = Mean angular velocity

*3) Maximum frequency at 5 bar pressure, no load

Mini rotary vane actuators models with fixed or adjustable rotation angles

Rotation angle	Double vane	Single vane	Model
90°			
180°			
270°			
•	•*1)		M/60281/IE
•	•*1)		M/60282/IE
•	•*1)		M/60283/IE
•		•*2)	M/60284/IE
•			M/60284/TE
•	•*3)		

*1) Adjustable from 30° ... 180°

*2) Adjustable from 30° ... 270°

*3) Adjustable from 30° ... 90°

Option selector

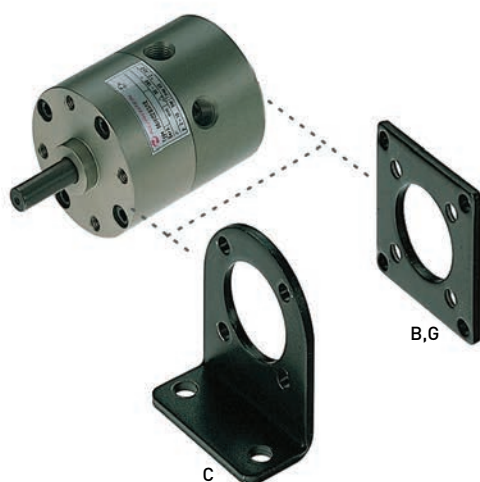
Size
1, 2, 3, 4

M/6028★/★/★/★

Rotation	Substitute
Standard only	see table
Variants	Substitute
Single vane, adjustable	IE
Double vane, adjustable	TE

Note: Disregard option positions not used

Mountings



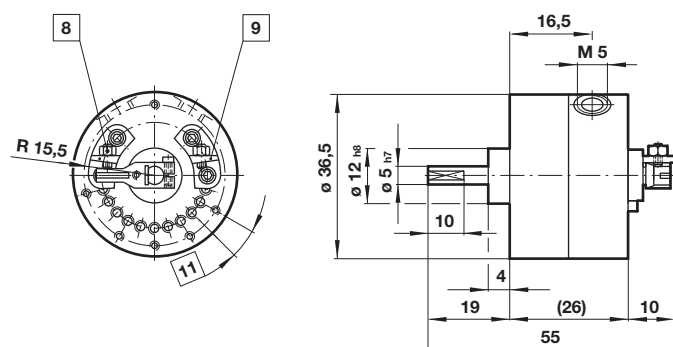
Model	B, G	C
		
	Page 6	Page 6
M/60281/IE	QM/60281/22	QM/60281/21
M/60282/IE	QM/60282/22	QM/60282/21
M/60283/IE	QM/60283/22	QM/60283/21
M/60284/IE, .../TE	QM/60284/22	QM/60284/21

Dimensions

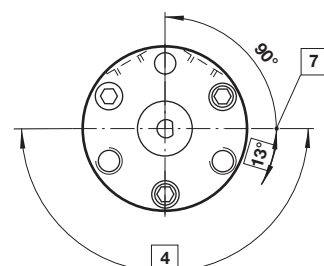
Dimensions in mm
Projection/First angle



M/60281/IE



Rotation start point



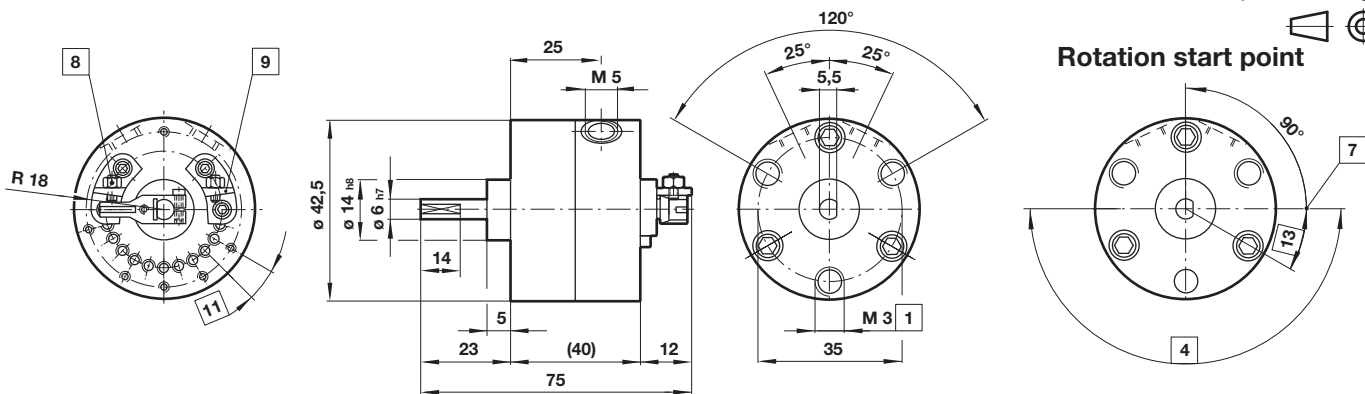
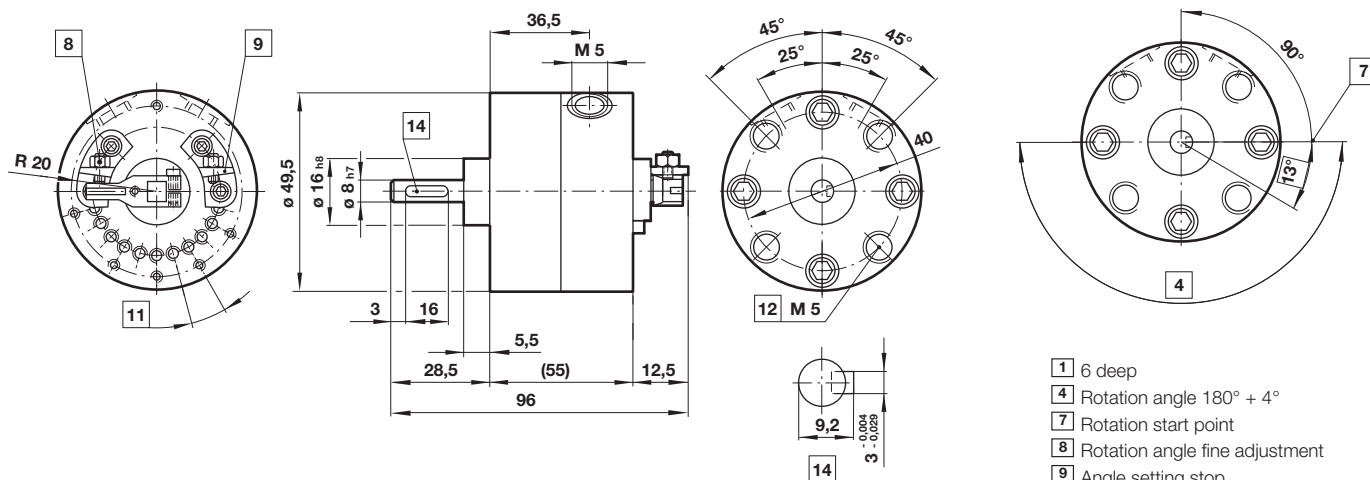
- 1 6 deep
- 4 Rotation angle $180^\circ + 4^\circ$
- 7 Rotation start point
- 8 Rotation angle fine adjustment
- 9 Angle setting stop
- 11 Angle of rotation setting range 15°

M/60282/IE

Dimensions in mm
Projection/First angle



Rotation start point

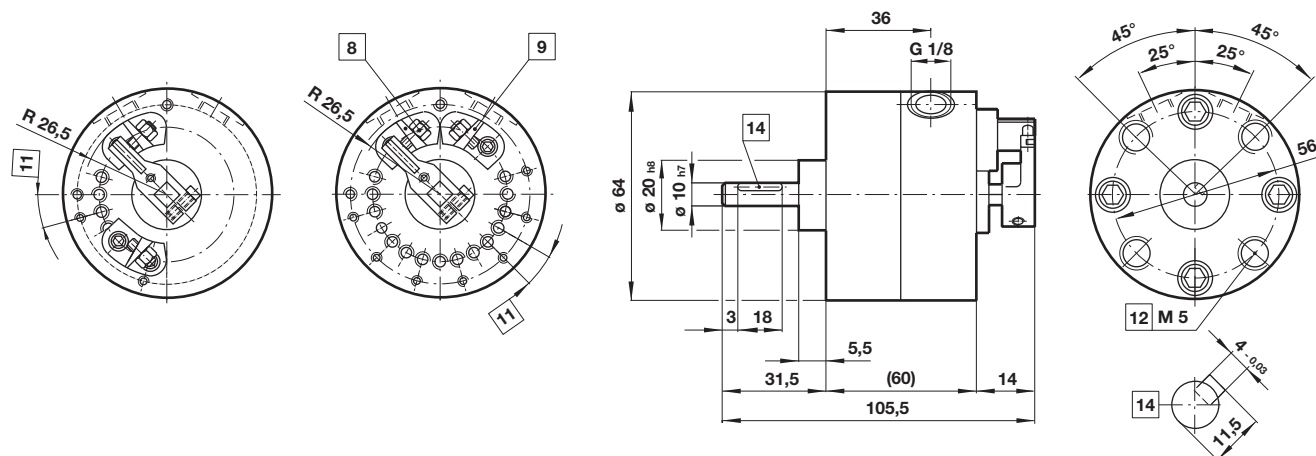

M/60283/IE


- 1** 6 deep
- 4** Rotation angle 180° + 4°
- 7** Rotation start point
- 8** Rotation angle fine adjustment
- 9** Angle setting stop
- 11** Angle of rotation setting range 15°
- 12** 8 deep
- 13** Rotation angle 30° min
- 14** Featherkey situation

Dimensions

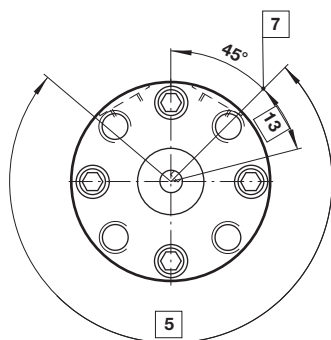
M/60284/IE and M/60284/TE

Dimensions in mm
Projection/First angle

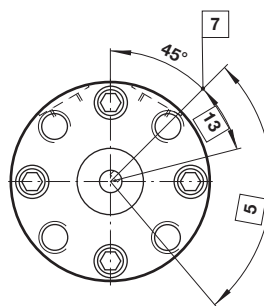


Rotation start point

M/60284/IE



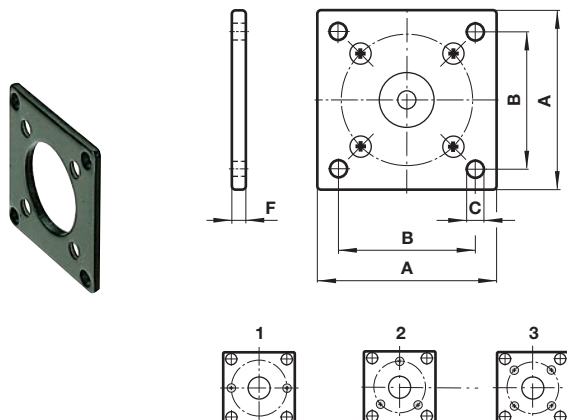
M/60284/TE



- 1 6 deep
- 4 Rotation angle $180^\circ + 4^\circ$
- 7 Rotation start point
- 8 Rotation angle fine adjustment
- 9 Angle setting stop
- 11 Angle of rotation setting range 15°
- 12 8 deep
- 13 Rotation angle 30° min
- 14 Featherkey situation

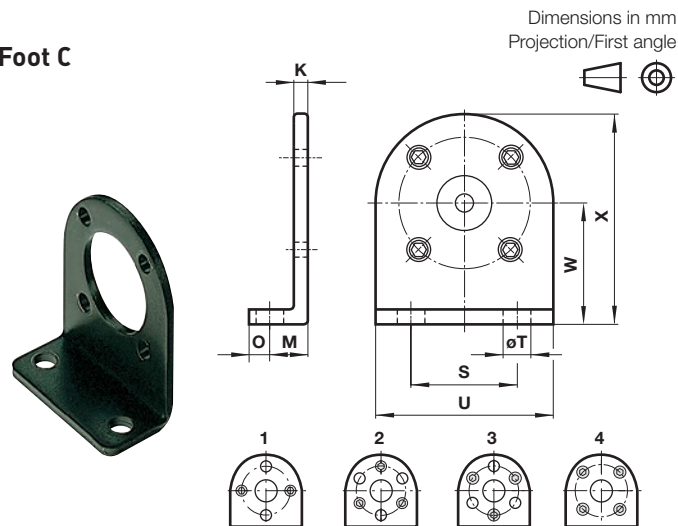
Mountings

Rear flange B, Front flange G



A	B	Ø C	F	Hole pattern	Rotation angle	kg	Model
37	30	3,4	2,5	2	120°	0,07	QM/60281/22
42	34	3,5	3	2	120°	0,14	QM/60282/22
50	41	5,5	3,5	3	90°	0,36	QM/60283/22
64	52	5,5	3,5	3	90°	0,47	QM/60284/22

Foot C



K	M	O	S	Ø T	U	W	X	Hole pattern	Rotation angle	kg	Model
2,5	11	7	26	4,8	36	25	43	2	60°	0,05	QM/60281/21
3	12	8	30	5,8	42	30	51	3	60°	0,09	QM/60282/21
3,5	15	10	36	7	49	34	58,5	4	90°	0,2	QM/60283/21
4,5	18	12	48	6,5	66	42	75	4	90°	0,2	QM/60284/21

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M162000/M, Rotary cylinders (Rack & pinion version)

Magnetic piston, double acting



- > Ø 32 ... 125 mm
- > Torques from 1,2 ... 510 Nm
- > Rotation angles 90°, 180°, 270°, 360°
- > Reed or solid state switches can be mounted flush with the profile barrel
- > ISO 15552 pitch to use standard mountings
- > High performance adaptive cushioning system "ACS"



Technical features

Medium:

Compressed air, filtered, lubricated or non-lubricated

Operation:

M/162000/M: Double acting, magnetic piston, adjustable cushioning

Operating pressure:

1 ... 10 bar (14,5 ... 145 psi)

Rotation angles:

90, 180, 270, 360°

Fixed up to +8°

Adjustable ±5°

Additional angles on request

Operating temperature:

-5° ... 80°C (+23° ... +176°F)

Air supply must be dry enough to avoid ice formation at temperatures below +2°C (+35°F)

Materials:

Profile barrel: anodized aluminium

End covers: pressure diecast aluminium

Central body: anodized aluminium

Rack: normalized steel

Pinion: surface hardened high strength steel

Pinion bearings: ball bearings

(Ø 32 PTFE bronze bearings)

Rack guide shoe: acetal resin

Piston seals: PUR

O-rings: NBR

Technical data, standard

Cylinder Ø (mm)	32	40	50	63	80	100	125
Theoretical torque (Nm) at 6 bar	7,2	13,8	23,4	43,8	94,2	157,8	306
Cushion length (mm)	19	22	24	24	27	34	41
Initial cushion volume (cm ³)	12,3	20,7	36	64	11	24	45

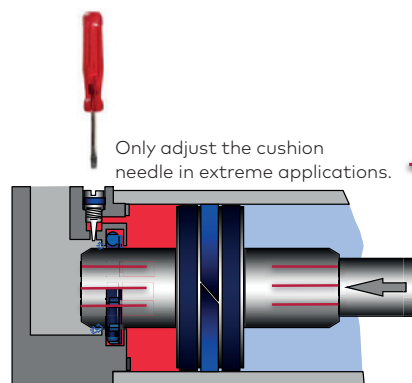
Rotation angle*

Ø	90°	180°	270°	360°
32	•	•	•	•
40	•	•	•	•
50	•	•	•	•
63	•	•	•	•
80	•	•	•	•
100	•	•	•	•
125	•	•	•	•

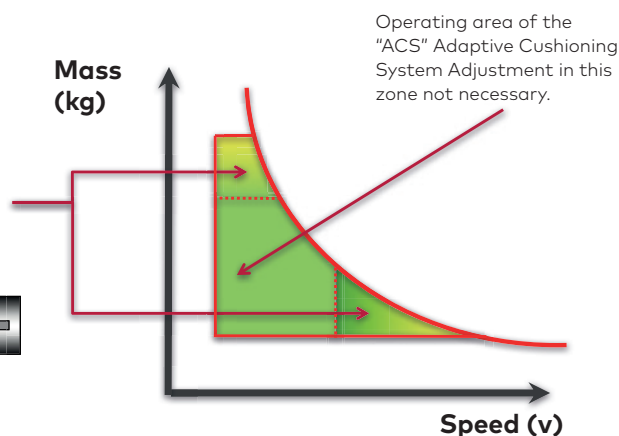
* other angles of rotation on request

The function

The new "ACS" Adaptive Cushioning System provides a high performance pneumatic damping function. The system will automatically cushion for a wide range of general applications as delivered. Manual adjustment is still possible for extreme applications.



Only adjust the cushion needle in extreme applications.



Cylinder variants

Symbol	Model with magnetic piston	Description	Dimensions Page
	M/162000/MI	Rotary cylinders with fixed angle (+8°) and male pinion	3
	M/162000/MIX	Rotary cylinders with fixed angle (+8°) and female pinion	3
	M/162000/ME	Rotary cylinders with adjustable angle (±5°) and male pinion	4
	M/162000/MEX	Rotary cylinders with adjustable angle (±5°) and female pinion	4

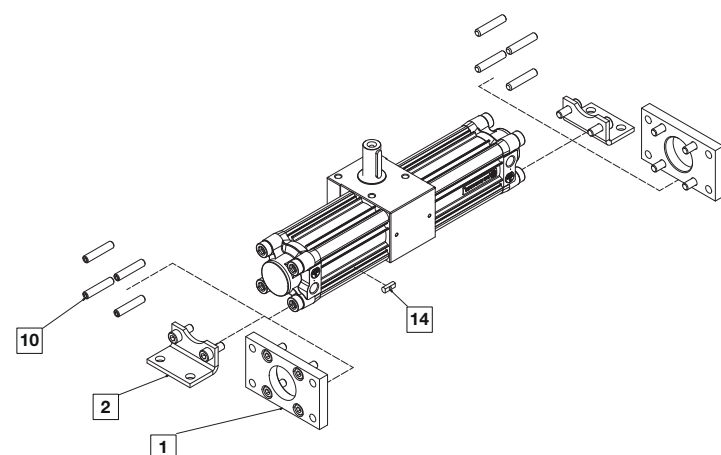
M/162*/*/*/*/*/*/***

Cylinder diameters (mm)	Substitute
32	032
40	040
50	050
63	063
80	080
100	100
125	125
Cylinder variants	Substitute
Magnetic piston	M

Standard rotation angle	Substitute
90°	90
180°	180
270°	270
360°	360
Pinion variants	Substitute
Male pinion	None
Female pinion	X
Tolerances of rotation angle	Substitute
Adjustable ± 5°	E
Fixed up to +8°	I

Note: If option is not required, disregard option position within part number eg. M/162100/ME/90 This options selector explains only the cylinder variants. Additional variants/options are not possible

Mountings

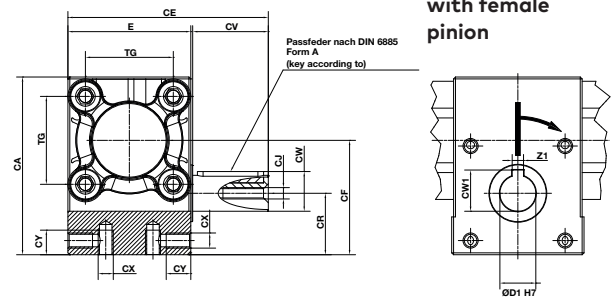
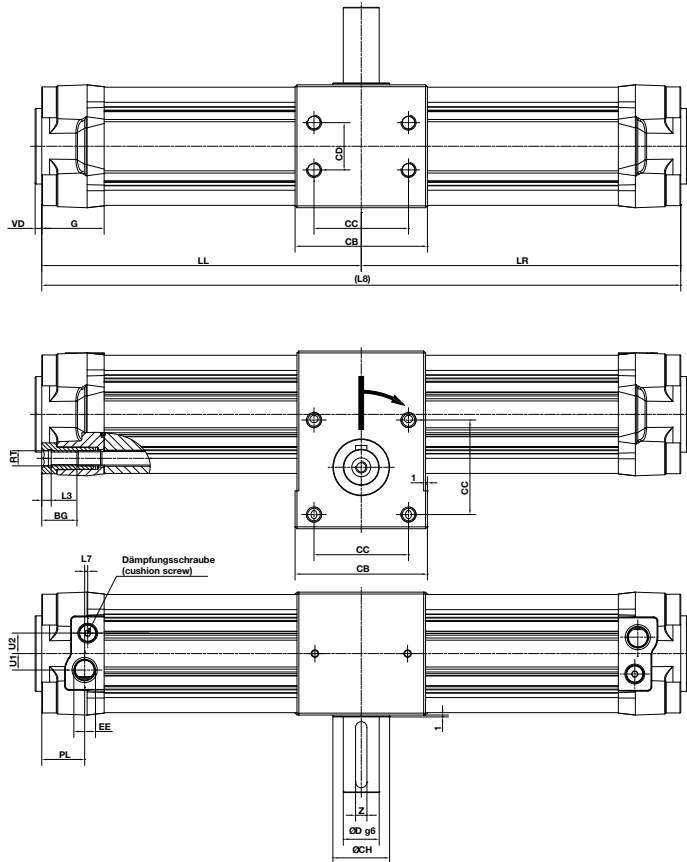


Cyl.	A	B, G	C	Groove key	Magnetically operated switches
					
	10	1	2	14	
Ø	Page 5	Page 5	Page 5	Page 5	Page 6 & 7
32	QM/8032/35	QA/8032/22	QA/8032/21	M/P72816	
40	QM/8032/35	QA/8040/22	QA/8040/21	M/P72816	
50	QM/8050/35	QA/8050/22	QA/8050/21	M/P72816	
63	QM/8050/35	QA/8063/22	QA/8063/21	M/P72816	
80	QM/8080/35	QA/8080/22	QA/8080/21	M/P72816	
100	QM/8080/35	QA/8100/22	QA/8100/21	M/P72816	
125	QM/8125/35	QM/8125/22	QM/8125/21	M/P72816	

Dimensions

M/162000/MI* - Rotary cylinders with fixed angle (up to +8°)

Dimensions in mm
Projection/First angle



Rotary cylinders with female pinion

Ø	ØB _{d11}	BG min.	CA	CB	CC	CD	CE	CF	ØCH	CJ	CR	CV	CW	CW1	CX	CY	ØD _{g6}	ØD1 _{H7}	E	EE	G	L3	L7	Model
32	30	16	71,5	50	33	18	81	46,5	25	M5	25	30	16	16,3	M6	10	14	14	50	G 1/8	29	4	6,6	M/162032/.
40	35	16	82	60	40	22	91	54,5	25	M5	30	30	16	16,3	M6	10	14	14	60	G 1/4	34,5	4	5,6	M/162040/.
50	40	16	94	70	50	25	106	60,5	30	M6	32,5	40	21,5	21,8	M8	13	19	19	65	G 1/4	33	5	1,6	M/162050/.
63	45	16	110	75	60	35	116	71	30	M8	37	40	27	21,8	M8	13	24	19	75	G 3/8	36,5	5	3,6	M/162063/.
80	45	17	142	99	80	50	150	93,5	45	M8	50	50	31	27,3	M10	16	28	24	99	G 3/8	42	-	1,8	M/162080/.
100	55	17	156,5	115	80	60	166	99	50	M10	54	50	41	31,3	M10	16	38	28	115	G 1/2	42	-	3,8	M/162100/.
125	60	20	188	125	90	70	191	118	60	M10	60	50	41	31,3	M12	20	38	28	140	G 1/2	54	-	1,8	M/162125/.

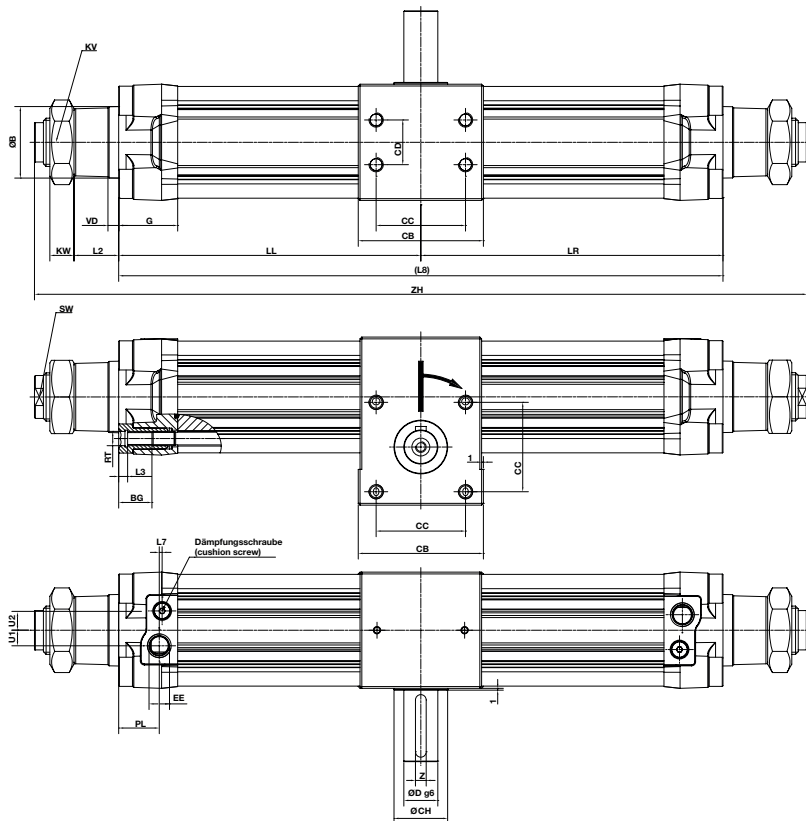
LL	LR	(L8)	Model
Ø ≤ 90° ≤ 180° ≤ 270° ≤ 360° 0° ... 90°	90° ... 180°	180° ... 270°	270° ... 360°
32 112,9 136,5 160,0 183,6 89,3 ... 112,9	112,9 ... 136,5	136,5 ... 160,0	160,0 ... 183,6
40 129,7 158,0 186,4 214,7 101,3 ... 129,7	129,7 ... 158,0	158,0 ... 186,4	186,4 ... 214,7
50 137,5 169,0 200,5 232,0 106,0 ... 137,5	137,5 ... 169,0	169,0 ... 200,5	200,5 ... 232,0
63 161,7 199,0 236,4 273,7 124,3 ... 161,7	161,7 ... 199,0	199,0 ... 236,4	236,4 ... 273,7
80 194,5 244,0 293,5 343,0 145,0 ... 194,5	194,5 ... 244,0	244,0 ... 293,5	293,5 ... 343,0
100 204,6 258,0 311,5 364,9 151,1 ... 204,6	204,6 ... 258,0	258,0 ... 311,5	311,5 ... 364,9
125 237,1 303,0 369,0 435,0 171,1 ... 237,1	237,1 ... 303,0	303,0 ... 369,0	369,0 ... 435,0

Ø	PL	RT	SW	TG	U1	U2	VA	Z	Z1	Model
32	15	M6	15	32,5	4,6	6,3	3,5	5	5	M/162032/.
40	21,5	M6	17	38	5,8	9,2	3,5	5	5	M/162040/.
50	22,7	M8	22	46,5	8,7	10,8	3,5	6	6	M/162050/.
63	24,2	M8	22	56,5	10	12,8	3,5	8	6	M/162063/.
80	29,7	M10	24	72	12	14,5	3,5	8	8	M/162080/.
100	27,7	M10	24	89	9	14,5	3,5	10	8	M/162100/.
125	39,7	M12	27	110	12	17	5,5	10	8	M/162125/.

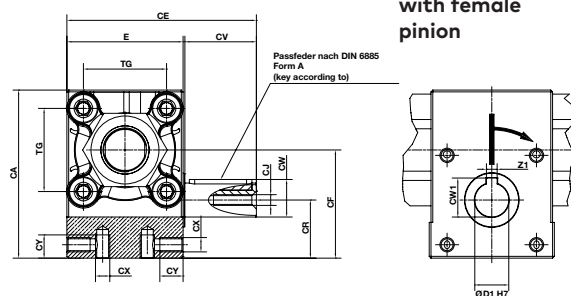
Dimensions

M/162000/ME* - Rotary cylinders with adjustable angle (±5°)

Dimensions in mm
Projection/First angle



Rotary cylinders with female pinion



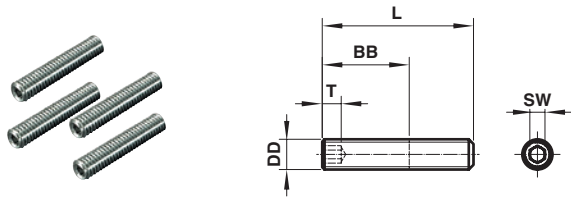
Ø	ØB	BG	CA	CB	CC	CD	CE	CF	Ø	CJ	CR	CV	CW	CW1	CX	CY	ØD	ØD1	E	EE	G	KV	KW	L2	L3	L7	Model
	d11	min.							CH								g6	H7									
32	30	16	71,5	50	33	18	81	46,5	25	M5	25	30	16	16,3	M6	10	14	14	50	G 1/8	29	SW30	10	19,5	4	6,6	M/162032/.
40	35	16	82	60	40	22	91	54,5	25	M5	30	30	16	16,3	M6	10	14	14	60	G 1/4	34,5	SW32	11	22	4	5,6	M/162040/.
50	40	16	94	70	50	25	106	60,5	30	M6	32,5	40	21,5	21,8	M8	13	19	19	65	G 1/4	33	SW41	13,5	25	5	1,6	M/162050/.
63	45	16	110	75	60	35	116	71	30	M8	37	40	27	21,8	M8	13	24	19	75	G 3/8	36,5	SW41	13,5	25	5	3,6	M/162063/.
80	45	17	142	99	80	50	150	93,5	45	M8	50	50	31	27,3	M10	16	28	24	99	G 3/8	42	SW46	15	33	-	1,8	M/162080/.
100	55	17	156,5	115	80	60	166	99	50	M10	54	50	41	31,3	M10	16	38	28	115	G 1/2	42	SW46	15	35	-	3,8	M/162100/.
125	60	20	188	125	90	70	191	118	60	M10	60	50	41	31,3	M12	20	38	28	140	G 1/2	54	SW55	18	44	-	1,8	M/162125/.

	LL				LR				(L8)				
Ø	≤ 90°	≤ 180°	≤ 270°	≤ 360°	0° ... 90°	90° ... 180°	180° ... 270°	270° ... 360°	90°	180°	270°	360°	Model
32	112,9	136,5	160,0	183,6	89,3 ... 112,9	112,9 ... 136,5	136,5 ... 160,0	160,0 ... 183,6	225,8	273	320	367,2	M/162032/.
40	129,7	158,0	186,4	214,7	101,3 ... 129,7	129,7 ... 158,0	158,0 ... 186,4	186,4 ... 214,7	259,4	316	372,8	429,4	M/162040/.
50	137,5	169,0	200,5	232,0	106,0 ... 137,5	137,5 ... 169,0	169,0 ... 200,5	200,5 ... 232,0	275	338	401	464	M/162050/.
63	161,7	199,0	236,4	273,7	124,3 ... 161,7	161,7 ... 199,0	199,0 ... 236,4	236,4 ... 273,7	323,4	398	472,8	547,4	M/162063/.
80	194,5	244,0	293,5	343,0	145,0 ... 194,5	194,5 ... 244,0	244,0 ... 293,5	293,5 ... 343,0	389	488	587	686	M/162080/.
100	204,6	258,0	311,5	364,9	151,1 ... 204,6	204,6 ... 258,0	258,0 ... 311,5	311,5 ... 364,9	409,2	516	623	729,8	M/162100/.
125	237,1	303,0	369,0	435,0	171,1 ... 237,1	237,1 ... 303,0	303,0 ... 369,0	369,0 ... 435,0	474,2	606	738	870	M/162125/.

										ZH max.									
Ø	PL	RT	SW	TG	U1	U2	VD	Z	Z1	90°	180°	270°	360°	Model					
32	15	M6	15	32,5	4,6	6,3	6	5	5	305,8	353	400	447,2	M/162032/.					
40	21,5	M6	17	38	5,8	9,2	6	5	5	353,4	410	466,8	523,4	M/162040/.					
50	22,7	M8	22	46,5	8,7	10,8	6	6	6	375	438	501	564	M/162050/.					
63	24,2	M8	22	56,5	10	12,8	6	8	6	424,9	499,5	574,3	648,9	M/162063/.					
80	29,7	M10	24	72	12	14,5	6	8	8	514	613	712	811	M/162080/.					
100	27,7	M10	24	89	9	14,5	6	10	8	538,2	645	752	858,8	M/162100/.					
125	39,7	M12	27	110	12	17	8	10	8	631,2	763	895	1027	M/162125/.					

Mountings

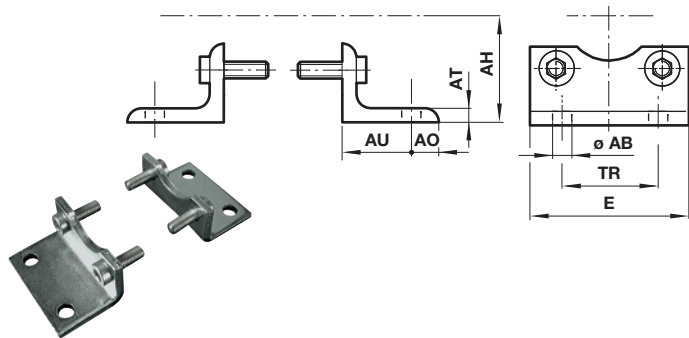
Front or rear stud mounting A



ø	BB	DD	L	SW	T (min)	(kg)	Model (A)
32/40	17	M6	30	3	3,5	0,02	QM/8032/35
50/63	23	M8	40	4	5	0,05	QM/8050/35
80/100	28	M10	45	5	6	0,08	QM/8080/35
125	34	M12	60	6	8	0,14	QM/8125/35

Foot mounting C

Conforms to ISO 15552, type MS1

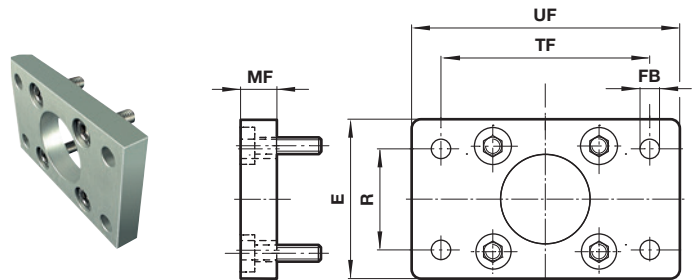


ø	ø AB	AH	AO	AT	AU	E	TR	(kg)	Model (C)
32	7	32	8	4	24	48	32	0,15	QA/8032/21
40	10	36	9	4	28	53	36	0,18	QA/8040/21
50	10	45	10	5	32	64	45	0,30	QA/8050/21
63	10	50	12	5	32	74	50	0,39	QA/8063/21
80	12	63	19	6	41	98	63	0,80	QA/8080/21
100	14,5	71	19	6	41	115	75	0,95	QA/8100/21
125	16	90	20	9	45	140	90	2,40	QM/8125/21

Front flange B, G

Conforms to ISO 15552, type MF1 and MF2

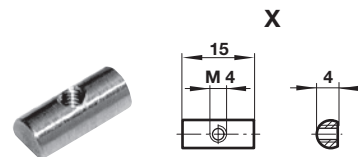
Dimensions in mm
Projection/First angle



ø	E	ø FB	MF	R	TF	UF	(kg)	Model (B, G)
32	50	7	10	32	64	80	0,10	QA/8032/22
40	55	9	10	36	72	90	0,12	QA/8040/22
50	65	9	12	45	90	110	0,21	QA/8050/22
63	75	9	12	50	100	125	0,27	QA/8063/22
80	100	12	16	63	126	154	0,63	QA/8080/22
100	120	14	16	75	150	186	0,89	QA/8100/22
125	140	16	20	90	180	224	1,59	QM/8125/22

Groove key M/P72816

Weight: 0,01 (kg)



- > **Magnetically operated reed switch - Round style**
- > **Suitable for all cylinder ranges with magnetic piston**
- > **Switches can be mounted flush with the delivered special adaptor**
- > **LED indicator on LSU models**
- > **Alternative variants allow a wide range of application**



Technical features

Operation:

M/50/LSU Normally open with LED (yellow)

Switching voltage (Ub):

10 ... 240 VAC/170 VDC

Switching voltage output:

Ub - 2,7 V

Switching current

(see graph overleaf):

0,18 A max.

Switching power:

10 W/10 VA max.

Contact resistance:

150 mΩ

Response time:

1,8 ms

Operating temperature:

-25 ... +80 °C (-13 ... +176 °F)

High temperature version:

+150 °C max.(+302 °F)

Protection rating (EN 60529):

IP66

Shock resistance:

50 g (during 11 ms)

Vibration resistance:

35 g (at 2000 Hz)

Cable type:

2 x 0,25: PVC, PUR or silicone

3 x 0,25 PVC

Cable length:

2, 5 or 10 m

Electromagnetic compatibility

according to:

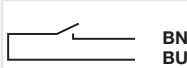
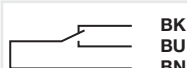
EN 60947-5-2

Materials:

Body: plastic

Cable: see table below

Technical data - Reed switches - additional information see data sheet en 4.3.005

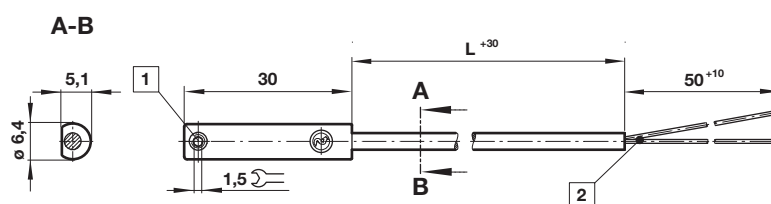
Symbol	Voltage (VAC)	Voltage (VDC)	Current maximum (mA)	Function	Operating temperature (°C)	LED	Protection class	Plug	Cable length (m)	Cable type	Weight (g)	Model
	10 ... 240	10 ... 170	180	Normally open	-25 ... +80	•	IP 66	—	2, 5 or 10	PVC 2 x 0,25	37	M/50/LSU/*V
	10 ... 240	10 ... 170	180	Normally open	-25 ... +80	•	IP 66	—	5	PUR 2 x 0,25	37	M/50/LSU/SU
	10 ... 240	10 ... 170	180	Normally open	-25 ... +150	—	IP 66	—	2	Silicon 2 x 0,25	37	TM/50/RAU/2S
	10 ... 240	10 ... 170	180	Changeover	-25 ... +80	—	IP 66	—	5	PVC 3 x 0,25	37	M/50/RAC/5V
	10 ... 60	10 ... 60	180	Normally open	-25 ... +80	•	IP 66	M8 x 1	0,3	PVC 3 x 0,25	16	M/50/LSU/CP *1)
	10 ... 60	10 ... 60	180	Normally open	-25 ... +80	•	IP 66	M12 x 1	0,3	PVC 3 x 0,25	16	M/50/LSU/CC *1)

* Insert cable length; *1) Plug-in connector see page 39

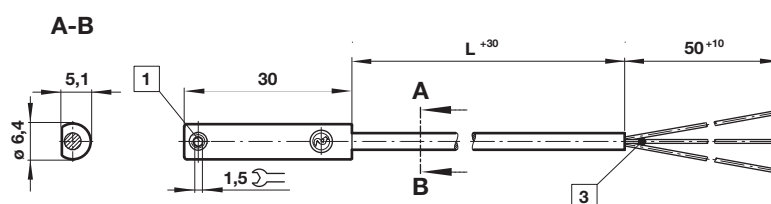
Dimensions

M/50/LSU/*V, M/50/LSU/SU,
TM/50/RAU/2S
Cable length L = 2, 5 or 10 m

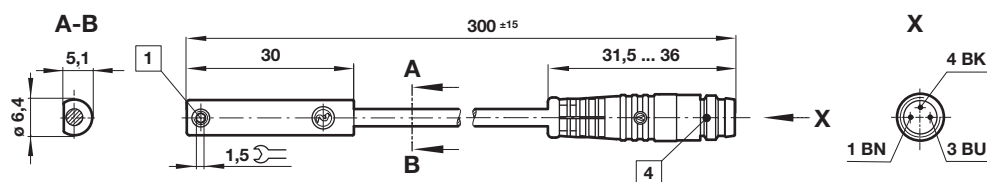
Dimensions in mm
Projection/First angle



M/50/RAC/5V
Cable length L = 5 m



M/50/LSU/CP
M/50/LSU/CC



- 1 Fixing screw
- 2 + BN = brown; - BU = blue (output)
- 3 - BK = black; + BN = brown; - #BU = blue
- 4 Version CP: Plug M8 x 1, color code: BK = +; BN = -; BU = output
Version CC: Plug M12 x 1, color code: BK = +; BN = -; BU = output

Accessories

Plug-in connector cable with nut



Outer cover	Cable length (m)	Weight (kg)	Connector	Connector
PVC 3 x 0,25	5	0,18	M8 x 1	M/P73001/5
PUR 3 x 0,25	5	0,18	M8 x 1	M/P73002/5
PUR 3 x 0,34	5	0,21	M12 x 1	M/P34594/5

- > Magnetically operated solid state switch - round style
- > IO-Link version available
- > Suitable for all cylinder ranges with magnetic piston
- > Switches can be mounted flush in all profile cylinders
- > Reliable switching with a very fast response time
- > Particularly suited for use in high levels of vibration
- > LED indicator as standard
- > CE certified
- > UL listed



 **IO-Link**



Technical features

Operation:

M/50/EAP (PNP) open collector output with LED (yellow)
M/50/EAN (NPN) grounded emitter output with LED (yellow)
M/50/IOP (PNP) Easy IO-Link open collector output with LED (yellow)

Switching voltage (U_b):

10 ... 30 VDC

Switching voltage output:

U_b - 2 V

Inducted voltage:

0,5 V

Switching current (see graph overleaf):

100 mA max.

Switching power:

3,0 W max.

Response time:

< 0,5 ms for EAP switch

< = 1 ms for IOP switch

Operating frequency:

1 kHz

Protection rating (EN 60529):

IP67 (standard)

IP68 for type: M/50/EAP/5U

Operating temperature:

-40 ... +80 °C (-40 ... 176 °F)

(IP67 & IP68)

Cable type:

PVC 3 x 0,12 (standard)

PUR 3 x 0,14 (M/50/EAP/5U)

Cable length:

2, 5 and 10 m

Electromagnetic compatibility

according to:

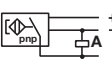
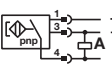
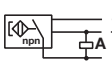
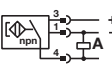
EN 60947-5-2

Materials:

Body: plastic

Cable: see table below

Technical data - Solid state

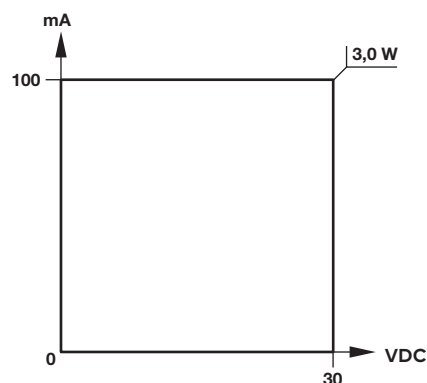
Symbol	Voltage (VDC)	Current maximum (mA)	Function	IO-Link *2)	Operating temperature (°C)	LED	Protection class	Plug	Cable length (m)	Cable type	Weight (g)	Model
	10 ... 30	100	PNP		-40 ... +80	•	IP67	—	2, 5 or 10	PVC 3 x 0,12	37	M/50/EAP/*V
	10 ... 30	100	PNP	•	-40 ... +80	•	IP67	—	5	PVC 3 x 0,12	37	M/50/IOP/5V
	10 ... 30	100	PNP		-40 ... +80	•	IP68	—	5	PUR 3 x 0,14	37	M/50/EAP/5U
	10 ... 30	100	PNP		-40 ... +80	•	IP67	M8 x1	0,3	PVC 3 x 0,14	16	M/50/EAP/CP *1)
	10 ... 30	100	PNP	•	-40 ... +80	•	IP67	M8 x1	0,3	PVC 3 x 0,14	16	M/50/IOP/CP *1)
	10 ... 30	100	PNP		-40 ... +80	•	IP67	M12 x1	0,3	PVC 3 x 0,14	16	M/50/EAP/CC *1)
	10 ... 30	100	NPN		-40 ... +80	•	IP67	—	2, 5 or 10	PVC 3 x 0,12	37	M/50/EAN/*V
	10 ... 30	100	NPN		-40 ... +80	•	IP67	M8 x1	0,3	PVC 3 x 0,14	16	M/50/EAN/CP *1)

* Insert cable length; *1) Plug-in connector below; Color code: BK = black, BN = brown, BU = blue

IO-Link function *2)

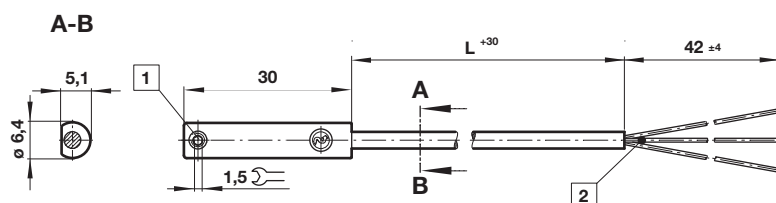
- Visual installation aid
- Counter
- Temperature diagnostic
- Power LED

Switching current and switching voltage



Dimensions

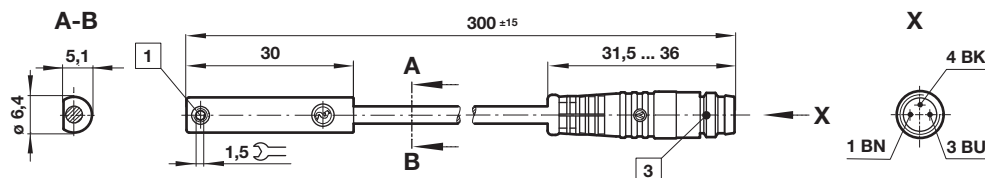
M/50/EAP/*V,
M/50/EAN/*V
M/50/IOP/5V
Cable length L = 2, 5 or 10 m



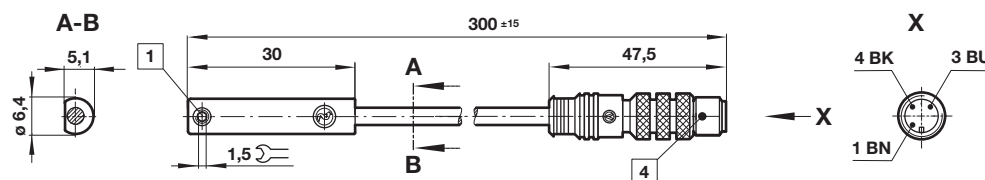
Dimensions in mm
Projection/First angle



M/50/EAP/CP,
M/50/EAN/CP
M/50/IOP/CP



M/50/EAP/CC



- 1 Fixing screw
- 2 Color code: BK = black; BN = brown; BU = blue
- 3 Plug M8 x 1
- 4 Plug M12 x 1

Accessories

Plug-in connector cable with nut



Outer cover	Cable length (m)	Weight (kg)	Connector	Connector
PVC 3 x 0,25	5	0,18	M8 x 1	M/P73001/5*1)
PUR 3 x 0,25	5	0,18	M8 x 1	M/P73002/5*1)
PVC 3 x 0,25	5	0,18	M8 x 1	M/P34615/5*2)
PUR 3 x 0,25	5	0,18	M8 x 1	M/34596/5*2)
PUR 3 x 0,34	5	0,21	M12 x 1	M/P34594/5*1)

*1) Straight connector

*2) 90 ° Connector

Warning

These products are intended for use in industrial compressed air systems only. Do not use these products where pressures and temperatures can exceed those listed under »Technical features/data«.

Before using these products with fluids other than those specified, for non-industrial applications, life-support systems or other applications not within published specifications, consult Norgren Ltd.

Through misuse, age, or malfunction, components used in fluid power systems can fail in various modes.

The system designer is warned to consider the failure modes of all component parts used in fluid power systems and to provide adequate safeguards to prevent personal injury or damage to equipment in the event of such failure.

System designers must provide a warning to end users in the system instructional manual if protection against a failure mode cannot be adequately provided.

System designers and end users are cautioned to review specific warnings found in instruction sheets packed and shipped with these products.

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