®

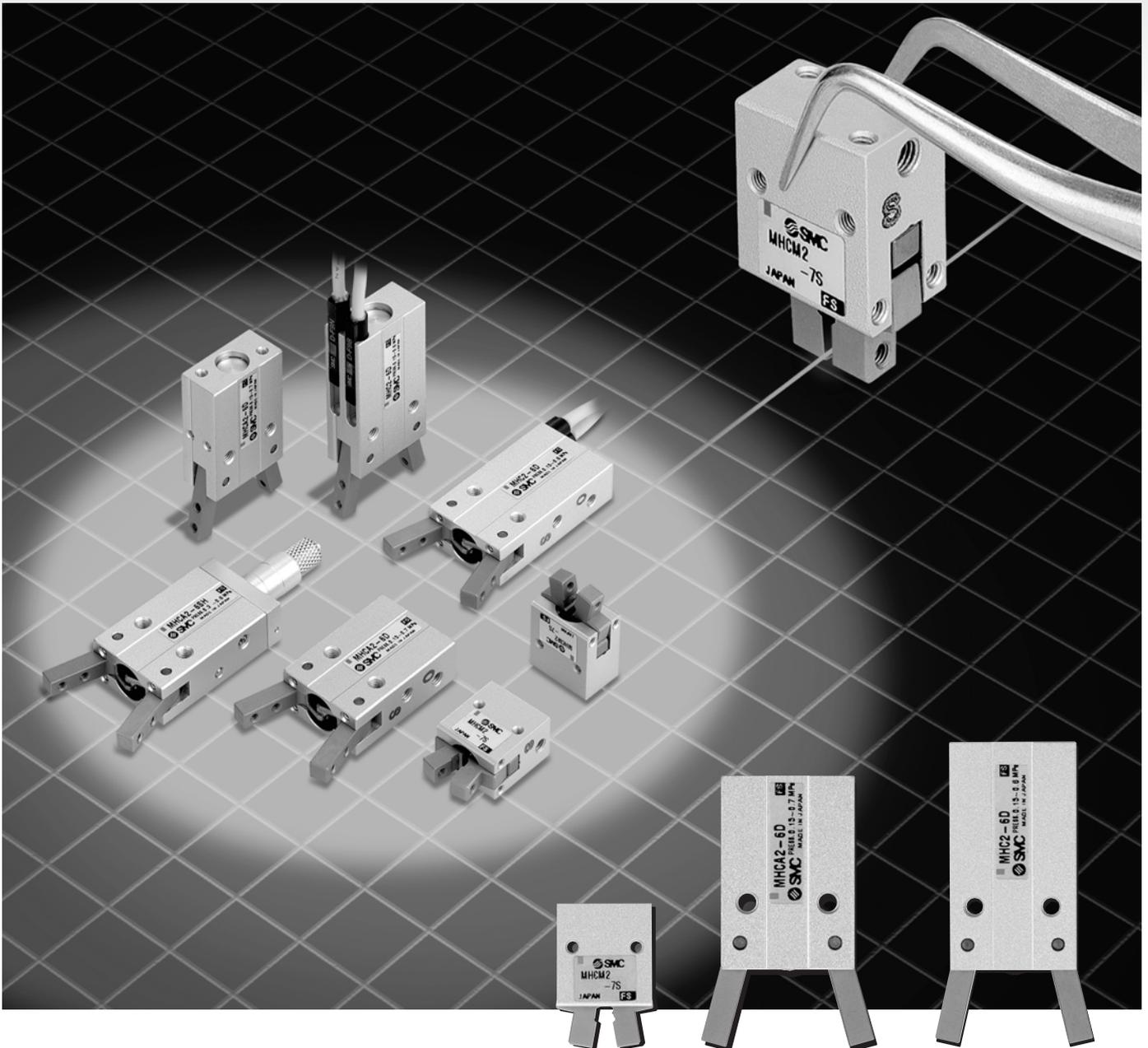# Angular Air Gripper

Angular style air gripper **Series MHC** now also available in ø6 size.
Series MHCM2 now available for further miniaturisation.
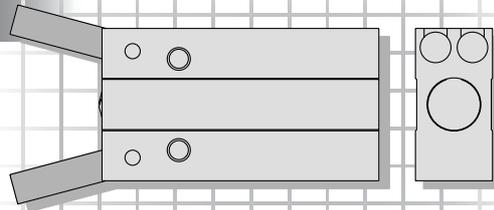
Series **MHC2/MHCA2/MHCM2**

SMC

Angular air gripper

Series *MHC2/MHCA2/MHCM2*

MHC2-6 □

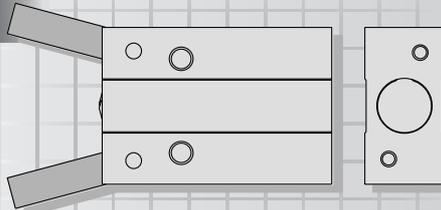**Auto switch is attachable.**

48mm x 20mm x 10mm 22g

(Full size)
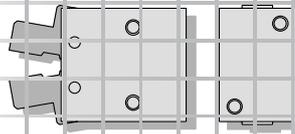
MHCA2-6 □

Short body.
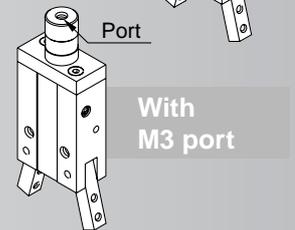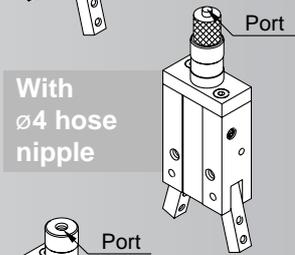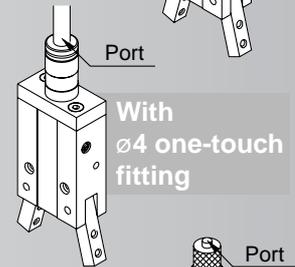
41mm x 20mm x 10mm 19g

(Full size)

MHCM2-7S

Smallest size and lightest weight in MHC series.

23mm x 15mm x 10mm 9.5g

(Full size)

Body option
(Only for MHCA2-6)

Side piping — Port

With ø4 one-touch fitting — Port

With ø4 hose nipple — Port

With M3 port — Port
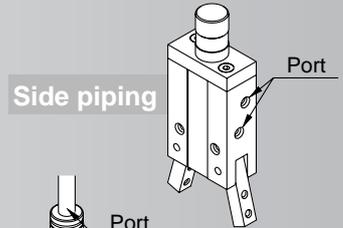
Variations

Model	MHC2-6□	MHCA2-6□	MHCM2-7S
Cylinder bore	ø6	ø6	ø7
Action	Double acting Single acting (normally open)		Single acting (normally open)
Opening / Closing angle (both sides)	30° to −10°		20° to −7°
Holding moment (at 0.5 MPa)	0.038N·m (double acting) 0.024N·m (single acting)		0.017N·m
Repeatability	±0.02mm		
Maximum operating frequency	180c.p.m		
Weight	22g Note)	19g	9.5g
Auto switch	Solid state switch (2-wire, 3-wire)	—	—
Body option	—	End boss type	—

Note) Not including auto switch weight.

Model Selection

Model Selection

Selection procedure

| Step 1 | Confirm gripping force | → | Step 2 | Confirmation of inertial moment of attachment |

Step 1 Confirmation of gripping force

| Confirmation of conditions | → | Calculation of required gripping force | → | Model selection from gripping force graph |

Example Work piece weight: **0.01kg** →

Model selection criteria with respect to work piece weight
● Although differences will exist depending on factors such as shape and the coefficient of friction between the attachments and work pieces, select a model which will provide a gripping force 10 to 20 times [Note 1] the weight of the work piece.
(Note 1) Refer to the model selection illustration for more information.
● Furthermore, in cases with high acceleration or impact, etc., it is necessary to allow an even greater margin of safety.
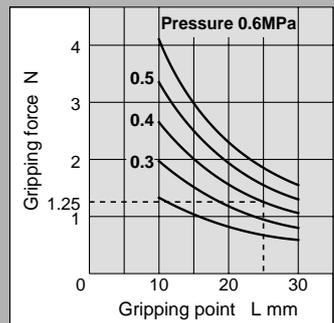**Example**: When it is desired to set the gripping force at 10 times or more the work piece weight.
Required gripping force = $0.01\text{kg} \times 10 \times 9.8\text{m/s}^2$
= Approx. 0.98N or more

Gripping method: External gripping →

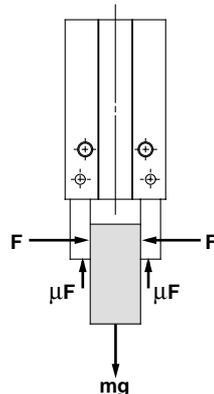Length of gripping point: **25mm** →

Operating pressure: **0.4MPa** →

MHC2-6D/MHCA2-6D

● Selecting the MHC2-6D. The gripping force of 1.25N is obtained from the intersection point of gripping point distance L = 25mm and pressure of 0.4MPa.
● The gripping force is 12.7 times greater than the work piece weight, and therefore satisfies a gripping force setting value of 10 times or more.

Model selection illustration

When gripping a work piece as in the figure to the left and with the following definitions,
F: Gripping force (N)
μ: Coefficient of friction between attachments and work piece
m: Work piece mass (kg)
g: Gravitational acceleration (= 9.8m/s^2)
mg: Work piece weight (N)

the conditions under which the work piece will not drop are

$$\underline{2 \text{ x } \mu \text{ F}} > \text{mg}$$
└── **Number of fingers**

and therefore,
$$\text{F} > \frac{\text{mg}}{2 \text{ x } \mu}$$
With "a" as the safety margin, F is determined as follows:
$$\text{F} = \frac{\text{mg}}{2 \text{ x } \mu} \text{ x a}$$

Gripping force at least 10 to 20 times the work piece weight
The "10 to 20 times or more of the work piece weight" recommended by SMC is calculated with the safety margin of a = 4, which allows for impacts that occur during normal transportation, etc.

When μ = 0.2	When μ = 0.1
$\text{F} = \dfrac{\text{mg}}{2 \text{ x } 0.2} \text{ x } 4$	$\text{F} = \dfrac{\text{mg}}{2 \text{ x } 0.1} \text{ x } 4$
= 10 x mg	= 20 x mg
↑	↑
10 x work piece weight	20 x work piece weight

(Note) · Even in cases where the coefficient of friction is greater than μ = 0.2, for safety reasons, SMC recommends selecting a gripping force which is at least 10 to 20 times the work piece weight.
· It is necessary to allow a greater safety margin for high accelerations and strong impacts, etc.

SMC

Step 1 **Effective gripping force: Series MHC□2 External gripping force**

● Expressing the effective gripping force
The effective gripping force shown in the graphs to the right is expressed as F, which is the thrust of one finger when both fingers and attachments are in full contact with the work piece as shown in the figure below.
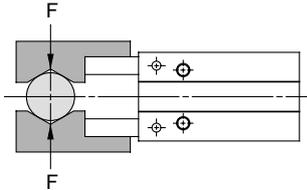
External gripping
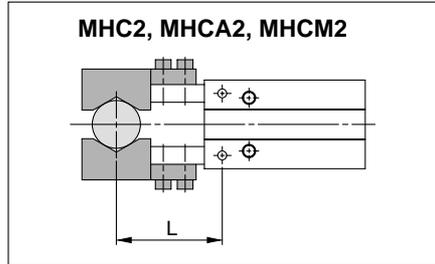
MHC2, MHCA2, MHCM2

MHC2-6D/MHCA2-6D

MHC2-6S/MHCA2-6S

MHCM2-7S

Series *MHC2/MHCA2/MHCM2*

Confirmation of inertial moment of attachment

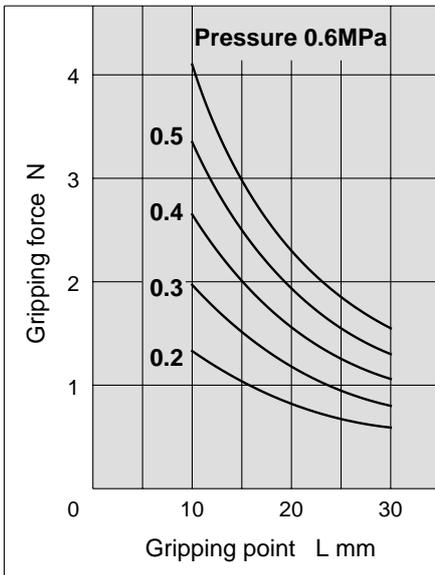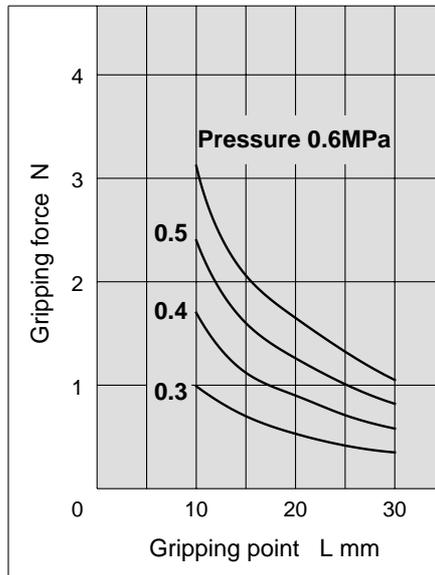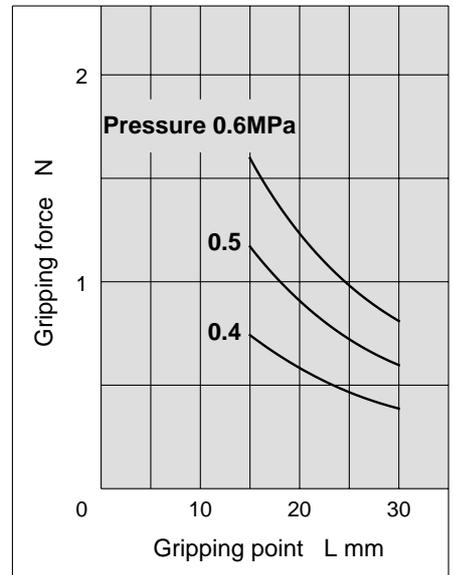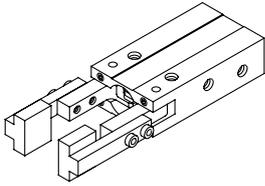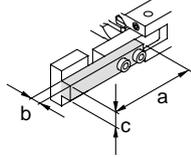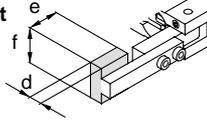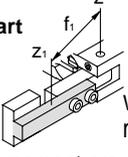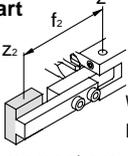Confirm the inertial moment of one of the two attachments.
For example, in calculating the inertial moment of an attachment in the picture on the right, divide it into 2 rectangular parallelepipeds, A part and B part.

A part   **B part**

Procedure	Formula	Example
1.Calculate the operating conditions and attachment dimensions.	**A part** **B part** e, f, d	Operating equipment: MHC2-6D $a = 20$ (mm) $b = 3$ (mm) $c = 4$ (mm) $d = 4$ (mm) $e = 5$ (mm) $f = 6$ (mm)
2.Calculate the inertial moment of the attachment.	**A part** Weight calculation $m_1 = a \times b \times c \times$ Relative density Inertial moment around Z1 axis $I_{Z1} = \{m_1 (a^2 + b^2) / 12\} \times \underline{10^{-6}}_{*}$ Inertial moment around Z axis $I_A = I_{Z1} + m_1 r_1^2 \times \underline{10^{-6}}_{*}$ **B part** Weight calculation $m_2 = d \times e \times f \times$ Relative density Inertial moment around Z2 axis $I_{Z2} = \{m_2 (d^2 \times e^2) / 12\} \times \underline{10^{-6}}_{*}$ Inertial moment around Z axis $I_B = I_{Z2} \times m_2 r_2^2 \times \underline{10^{-6}}_{*}$ Thus, the total inertial moment is $I = I_A \times B$ (∗: Unit conversion constant)	Assuming the attachment material is aluminium alloy (relative density=2.7), $r_1 = 16.4$ (mm). $m_1 = 20 \times 3 \times 4 \times 2.7 \times 10^{-6}$ $\quad = 6.48 \times 10^{-4}$ (kg) $I_{Z1} = \{6.48 \times 10^{-4} \times (20^2 + 3^2)/12\} \times 10^{-6}$ $\quad = 2.21 \times 10^{-8}$ (kg·m²) $I_A = 2.21 \times 10^{-8} + 6.48 \times 10^{-4} \times 16.4^2 \times 10^{-6}$ $\quad = 0.20 \times 10^{-6}$ (kg·m²) $r_2 = 23.5$ (mm) $m_2 = 4 \times 5 + 6 \times 2.7 \times 10^{-6}$ $\quad = 3.24 \times 10^{-4}$ (kg) $I_{Z2} = \{3.24 \times 10^{-4} \times (4^2 + 5^2) / 12\} \times 10^{-6}$ $\quad = 1.11 \times 10^{-9}$ (kg·m²) $I_B = 1.11 \times 10^{-9} + 3.24 \times 10^{-4} \times 23.5^2 \times 10^{-6}$ $\quad = 0.18 \times 10^{-6}$ (kg·m²) $I = 0.20 \times 10^{-6} + 0.18 \times 10^{-6}$ $\quad = 0.38 \times 10^{-6}$ (kg·m²)
3.Confirm from the table that the inertial moment of one attachment is within the allowable range.	**MHC2-6D/MHCA2-6D** (see table below)	Attachment inertial moment 0.38×10^{-6} (kg·m²) < Allowable inertial moment without speed controller 0.5×10^{-6} (kg·m²) Therefore, the attachment can be used without a speed controller.

MHC2-6D/MHCA2-6D

Finger opening and closing speed	Allowable inertial moment of attachment
Without speed controller	0.5×10^{-6} Kg·m²
With speed controller 3/4 to 1 and 1/2 reverse rotation from fully close state	1.5×10^{-6} Kg·m²

Attachment inertial moment > Allowable inertial moment

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Symbol

Symbol	Definition	Unit
Z	Central axis of finger rotation	—
Z_1	Axis which contains center of gravity of attachment A part and is parallel to Z	—
Z_2	Axis which contains center of gravity of attachment B part and is parallel to Z	—
I	Total inertial moment of attachment	$kg \cdot m^2$
I_{Z1}	Inertial moment around Z1 axis of attachment A part	$kg \cdot m^2$
I_{Z2}	Inertial moment around Z2 axis of attachment B part	$kg \cdot m^2$
I_A	Inertial moment around Z axis of attachment A part	$kg \cdot m^2$
I_B	Inertial moment around Z axis of attachment B part	$kg \cdot m^2$
m_1	Weight of attachment A part	kg
m_2	Weight of attachment B part	kg
r_1	Distance between axes Z and Z1	mm
r_2	Distance between axes Z and Z2	mm

Limiting range of attachment inertial moment

MHC2-6D/MHCA2-6D

Finger opening and closing speed	Allowable inertial moment of attachment	Weight (Guide)
Without speed controller Note)	0.5×10^{-6} $kg \cdot m^2$	2g or less
With speed controller 3/4 to 1 and 1/2 reverse rotation from fully close state	1.5×10^{-6} $kg \cdot m^2$	3.5g or less

MHC2-6S/MHCA2-6S

Finger opening and closing speed	Allowable inertial moment of attachment	Weight (Guide)
Without speed controller Note)	0.5×10^{-6} $kg \cdot m^2$	2g or less
With speed controller 3/4 to 2 reverse rotation from fully close state	1.5×10^{-6} $kg \cdot m^2$	3.5g or less

MHCM2-7S

Finger opening and closing speed	Allowable inertial moment of attachment	Weight (Guide)
Without speed controller Note)	0.3×10^{-6} $kg \cdot m^2$	2g or less
With speed controller 1/2 to 1 3/4 reverse rotation from fully close state	1.0×10^{-6} $kg \cdot m^2$	3.3g or less

∗Applicable speed controller ——— Air gripper direct connection type AS1211F-M3
Use a meter-in type.
Note) In case of MHCM2-7S, provide a run off space
because the speed controller protrudes from the body
top surface by 0.6 mm.

Note) Sometimes the work piece may not be gripped precisely because of excessive speed in
finger opening and closing. Therefore, use a meter-in type speed controller to adjust the
finger opening and closing speed.

Angular Air Gripper
Series **MHC2-6/MHCA2-6**

How to Order

MHC 2－6 D －M9PV ☐

MHC A 2－6 D ☐

Short body
(Auto switch not attachable)

Number of fingers

2	2 finger

Bore size (mm)

6	6

Action

D	Double acting
S	Single acting (Normally open)

Body option (End boss type)

Number of auto switches

Nil	2 pcs.
S	1 pc.

Auto switch type

Nil	Without auto switch (Built-in magnet)

∗ Select an applicable auto switch model from the table below.

Nil: Basic   **E**: Side ported (double acting/ single acting)   **K**: Axial port with One-touch fitting (single acting)   **H**: Axial port with ø4 hose nipple (single acting)   **M**: Axial M3 port (single acting)

MHC2   MHCA2   Port   Port   Port   Port   Port

Applicable auto switches

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage		Auto switch type		Lead wire length (m)∗			Note 1) Flexible lead wire (-61)	Applicable loads
							Electrical entry direction		0.5 (Nil)	3 (L)	5 (Z)		
					DC	AC	Perpendicular	In-line					
Solid state switch	—	Grommet	Yes	3-wire (NPN)	24V	12V	—	M9NV	M9N	●	●	○	○	Relay PLC
				3-wire (PNP)				M9PV	M9P	●	●	○	○	
				2-wire				M9BV	M9B	●	●	○	○	

∗Lead wire length symbol: 0.5m········Nil (Example) M9N
                 3m··········· L (Example) M9NL
                 5m··········· Z (Example) M9NZ

∗Auto switches marked "O" are produced upon receipt of order.
Note 1) For the flexible wire specification, enter -61 after the part number.

(Example)   When ordering with air gripper   When ordering only auto switch

MHC2-6D-M9NVS-61   D-M9PL-61

●**Flexible wire**   ●**Flexible wire**

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MHC2-6□

MHCA2-6□
Axial port
(With hose nipple)

Specifications

Fluid		Air
Operating pressure	Double acting	0.15 to 0.6MPa
	Single acting: Normally open	0.3 to 0.6MPa
Ambient and fluid temperature		−10 to 60℃
Repeatability		±0.02mm
Maximum operating frequency		180c.p.m
Lubrication		Non-lube
Action		Double acting, Single acting (Normally open)
Auto switch (Optional) Note)		Solid state switch (3-wire, 2-wire)

Note) Refer to page 6-15 for auto switch specifications.

Model

Action	Model	Cylinder bore (mm)	Holding moment Note) (Effective value) N·m	Opening/Closing angle (Both sides)	Weight Note 2) g
Double acting	**MHC2-6D**	6	0.038	30° to −10°	22
	MHCA2-6D	6			19
Single acting (Normally open)	**MHC2-6S**	6	0.024	30° to −10°	22
	MHCA2-6S	6			19

Note 1) At the pressure of 0.5MPa
Note 2) Excluding the auto switch weight.

Option

●Body option/End boss type

Symbol	Piping position	Piping port type MHCA2-6	Applicable model Double acting	Applicable model Single acting
Nil	Standard	M3	●	●
E	Side ported	M3	●	●
K	Axial port	With ø4 one-touch fitting	—	●
H	Axial port	With ø4 hose nipple	—	●
M	Axial port	M3	—	●

Symbol

Double acting
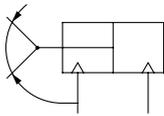
Single acting
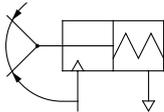
Series MHC2-6/MHCA2-6

Construction

MHC2-6

Double acting/with fingers open **Double acting/with fingers closed** **Single acting**
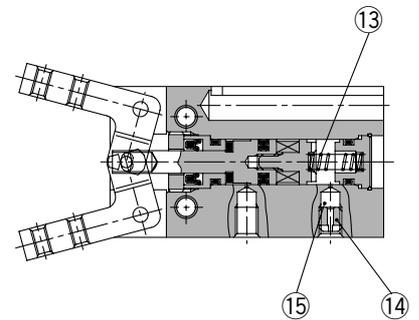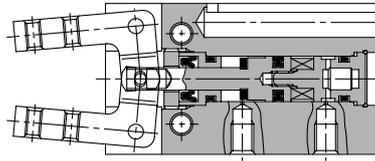
Parts list

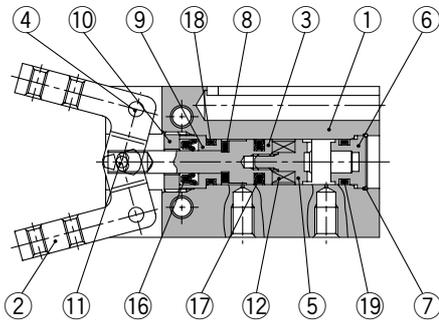| No.	Description	Material	Note
1	**Body**	Aluminium alloy	Hard anodized
2	**Finger**	Stainless steel	Heat treatment
3	**Piston**	Stainless steel	
4	**Lever shaft**	Stainless steel	Nitriding
5	**Magnet holder**	Stainless steel	
6	**Cap**	Aluminium alloy	Hard anodized
7	**Clip**	Stainless steel	
8	**Bumper**	Urethane rubber	
9	**Holder**	Brass	Electroless nickel plated
10	**Holder lock**	Stainless steel	

Parts list

No.	Description	Material	Note
11	**Needle roller**	High carbon chromium bearing steel	
12	**Magnet**	Rare earth magnet	Nickel plated
13	**NO spring**	Piano wire	Zinc chromated
14	**Exhaust plug**	Brass	Electroless nickel plated
15	**Exhaust filter**	Resin	
16	**Rod seal**	NBR	
17	**Piston seal**	NBR	
18	**Gasket**	NBR	
19	**Gasket**	NBR	

Replacement parts

Description	Kit no.	Main parts	Note
Seal kit	MHC6-PS	16, 17, 18, 19	

MHCA2-6 (Short body)

Double acting/with fingers open **Double acting/with fingers closed** **Single acting**
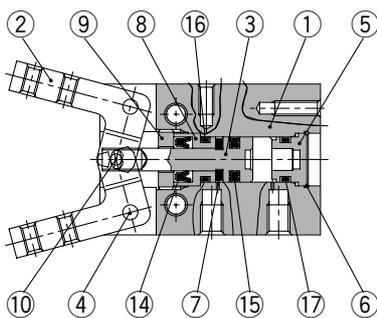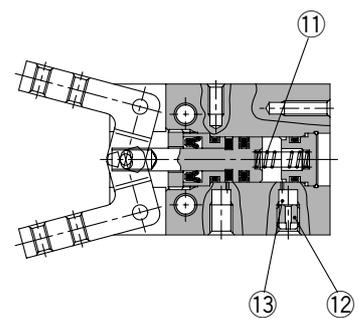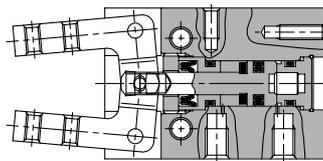
Parts list

No.	Description	Material	Note
1	**Body**	Aluminium alloy	Hard anodized
2	**Finger**	Stainless steel	Heat treatment
3	**Piston**	Stainless steel	
4	**Lever shaft**	Stainless steel	Nitriding
5	**Cap**	Aluminium alloy	Hard anodized
6	**Clip**	Stainless steel	
7	**Bumper**	Urethane rubber	
8	**Holder**	Brass	Electroless nickel plated
9	**Holder lock**	Stainless steel	

Parts list

No.	Description	Material	Note
10	**Needle roller**	High carbon chromium bearing steel	
11	**NO spring**	Piano wire	Zinc chromated
12	**Exhaust plug**	Brass	Electroless nickel plated
13	**Exhaust filter**	Resin	
14	**Rod seal**	NBR	
15	**Piston seal**	NBR	
16	**Gasket**	NBR	
17	**Gasket**	NBR	

Replacement parts

Description	Kit no.	Main parts	Note
Seal kit	MHCA6-PS	14, 15, 16, 17	

◎SMC

Dimensions

MHC2-6□

$4 \, ^{-0.005}_{-0.025}$

M3
∗Finger opening port

1.6

7

18

M3
Finger closing port
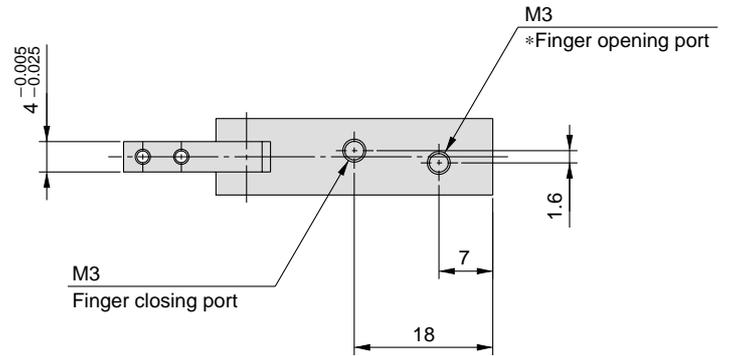
∗In the case of MHC2-6S, finger opening port is a breathing hole.

Attachment mounting limiting range

16

11

2.5

5

2

2

When open 30°

When closed 10°

2 x M3 through
Prepared hole dia. 2.6 through

14

12

4

6

36

(48)

4.8

ø4

2.5

20

Auto switch mounting groove dimensions

10 ±0.05

ø7H8 $^{+0.022}_{0}$ depth 1.5

4 x M2 through
(Attachment mounting threads)
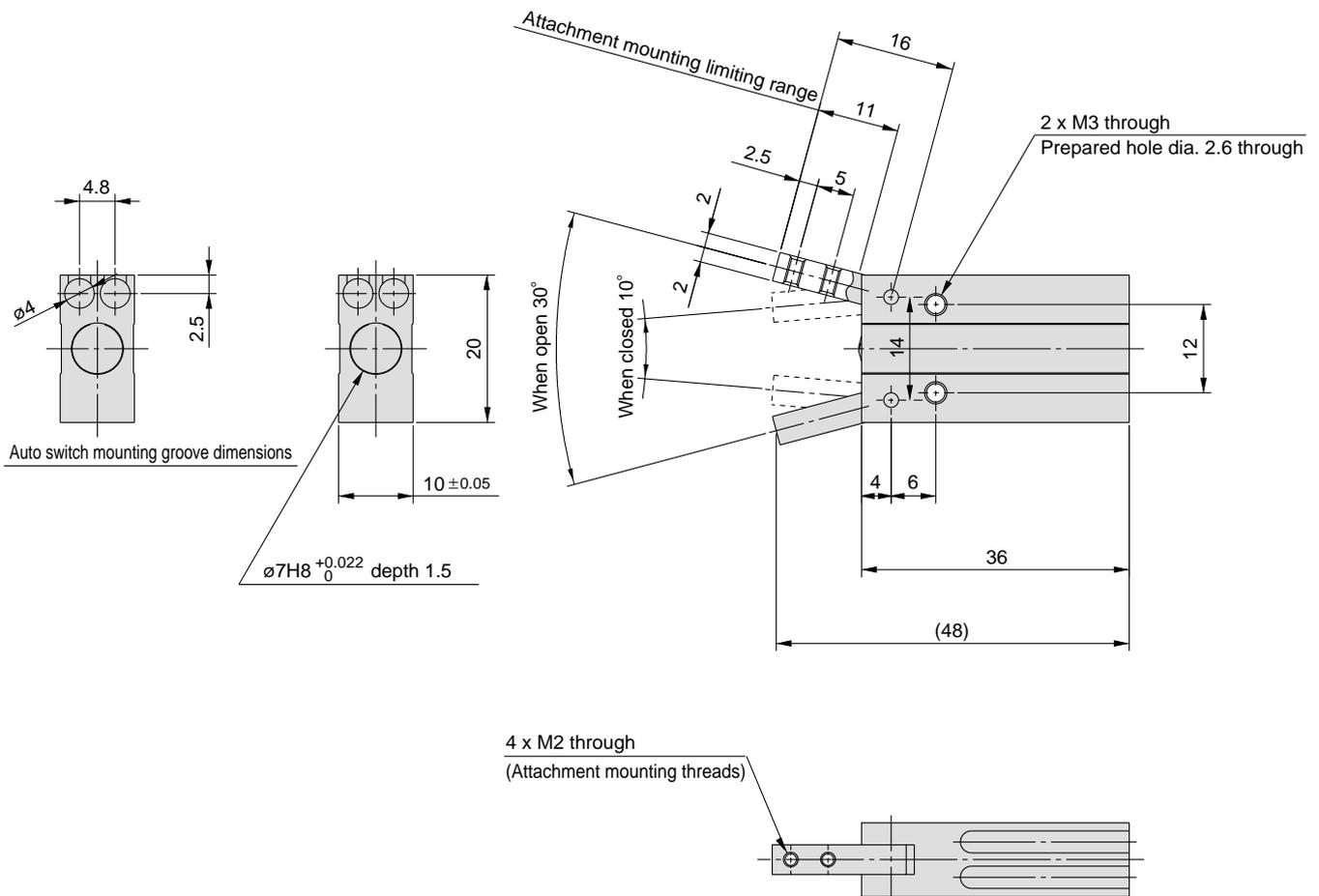
Dimensions

MHCA2-6☐ (Short body)

M3
∗(Finger opening port)

$4^{-0.005}_{-0.025}$

0.8

1.3

M3
Finger closing port

5.5

14.3
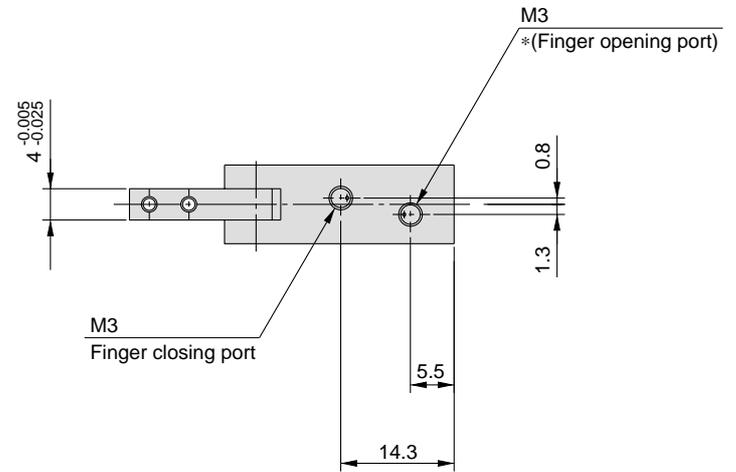
∗In the case of MHCA2-6S, finger opening port is a breathing hole.

Attachment mounting limiting range

16

11

2.5

5

2

2

2 x M3 through
Prepared hole dia. 2.6 through

When open 30°

When closed 10°

2 x M2 depth 6
(Mounting thread)

4

13.6

20

14

12

10 ±0.05

ø7H8 $^{+0.022}_{0}$ depth 1.5

4

6

29

(41)

4 x M2 through
(Attachment mounting thread)

2 x M2 thread depth 4
(Mounting thread)

5

10

⊜SMC
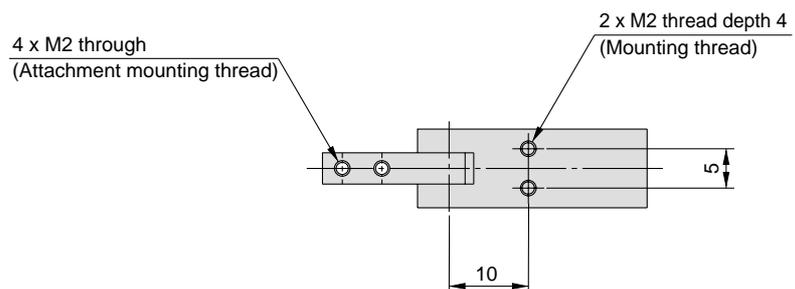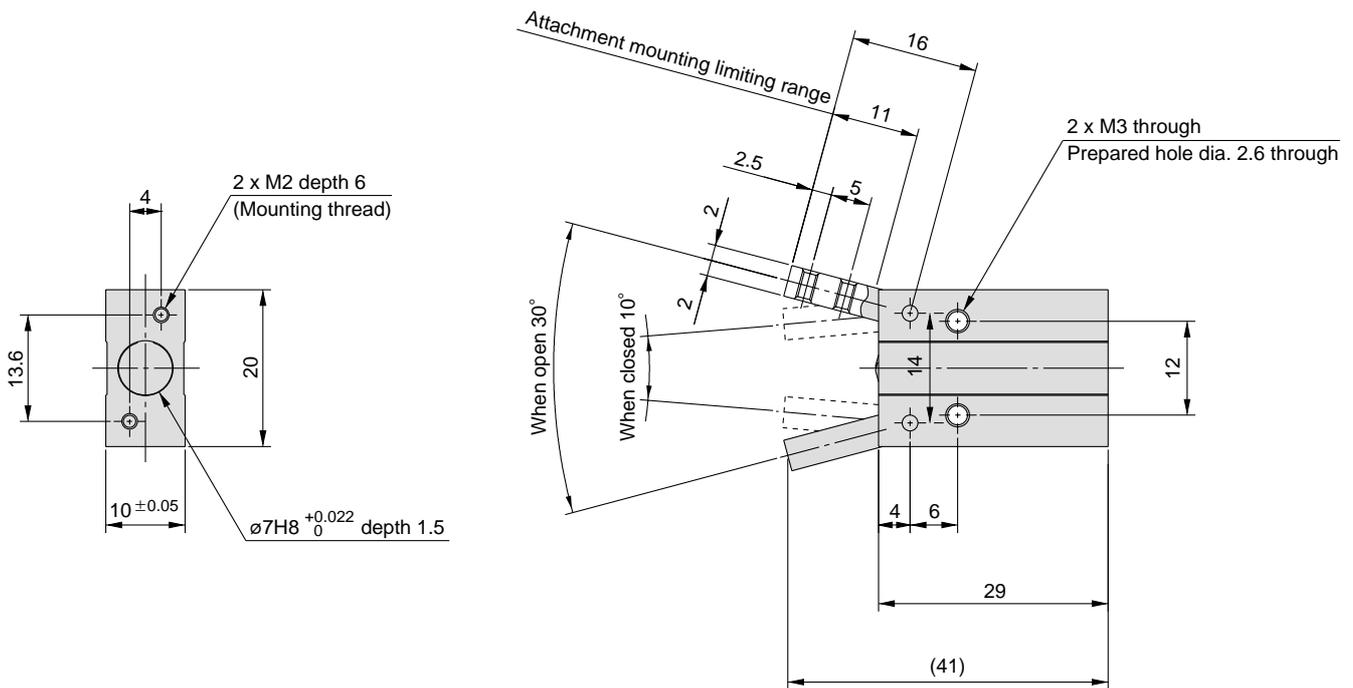
Auto Switch Hysteresis
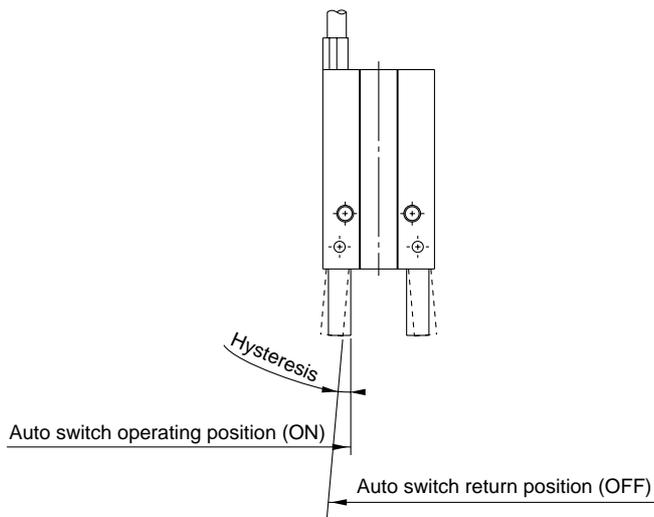
Hysteresis

Model	D-M9☐(V)
MHC2-6☐	4°

Auto Switch Mounting
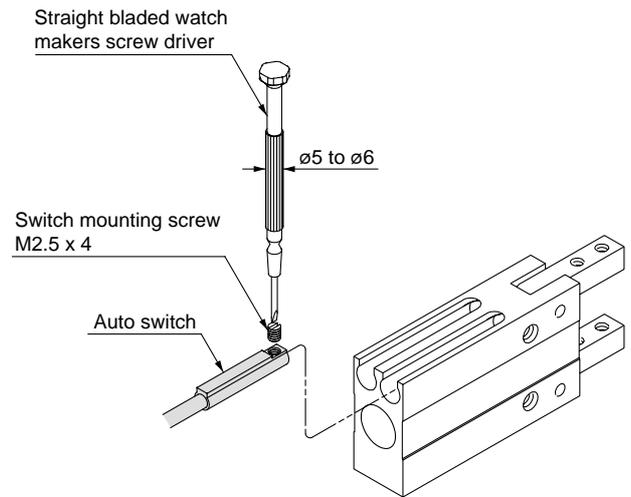
Note) Use a screwdriver with a grip diameter of 5 to 6 mm to tighten the auto switch mounting screw. The tightening torque should be about 0.05 to 0.1N·m. When you begin to feel that the screw is being tightened, turn it further by 90˚.

Auto Switch Protrusion from the Body End Surface

● The amount of auto switch protrusion from the body end surface is shown in the table below.
● Use this as a standard when mounting, etc.

Lead wire type		In-line entry	Perpendicular entry
Illustration			
Model		D-M9	D-M9☐V
MHC2-6☐	Open	6.5	4.5
	Close	9	7

Body Option: End Boss Type

Applicable Model

Symbol	Piping position	Piping port type	Applicable model	
			Double acting	Single acting
E	Side ported	M3	●	●
H	Axial port	With ø4 hose nipple	—	●
K		With ø4 one-touch fitting	—	●
M		M3	—	●

Side Ported [E]

MHCA2-6□E
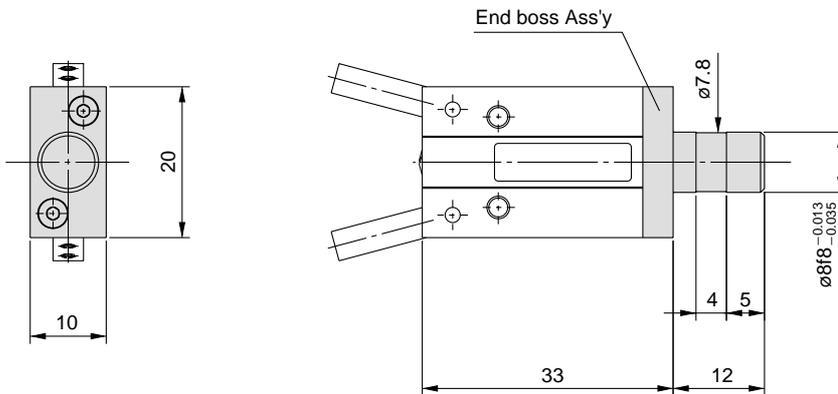
End boss Ass'y

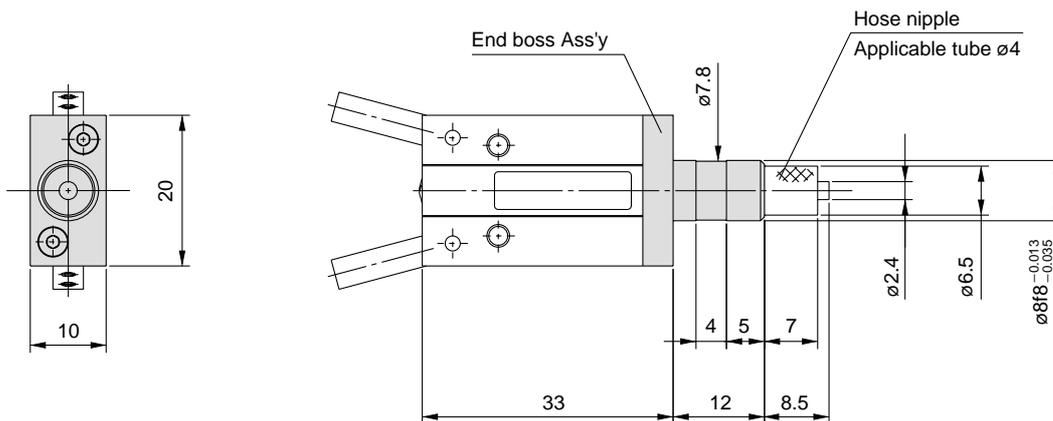ø7.8

$\text{ø8f8}^{-0.013}_{-0.035}$

20

10

4　5

33

12

∗The specifications and dimensions not given above are identical with those of the standard type.

Axial Port (with hose nipple) [H]

MHCA2-6SH

End boss Ass'y

Hose nipple
Applicable tube ø4

ø7.8

ø2.4

ø6.5

$\text{ø8f8}^{-0.013}_{-0.035}$

20

10

4　5　7

33

12

8.5

∗The specifications and dimensions not given above are identical with those of the standard type.

Applicable tube

Description/Model Specifications	Nylon tube	Soft nylon tube	Polyurethane tube	Polyurethane coil tube
	T0425	TS0425	TU0425	TCU0425B-1
Outside diameter mm	4	4	4	4
Max. operating pressure MPa	1.0	0.8	0.5	0.5
Min. bending radius mm	13	12	10	—
Operating temperature ℃	−20 to 60	−20 to 60	−20 to 60	−20 to 60
Material	Nylon 12	Nylon 12	Polyurethane	Polyurethane

SMC

Axial Port (with One touch fitting) [K]

MHCA2-6SK

End boss Ass'y

ø7.8

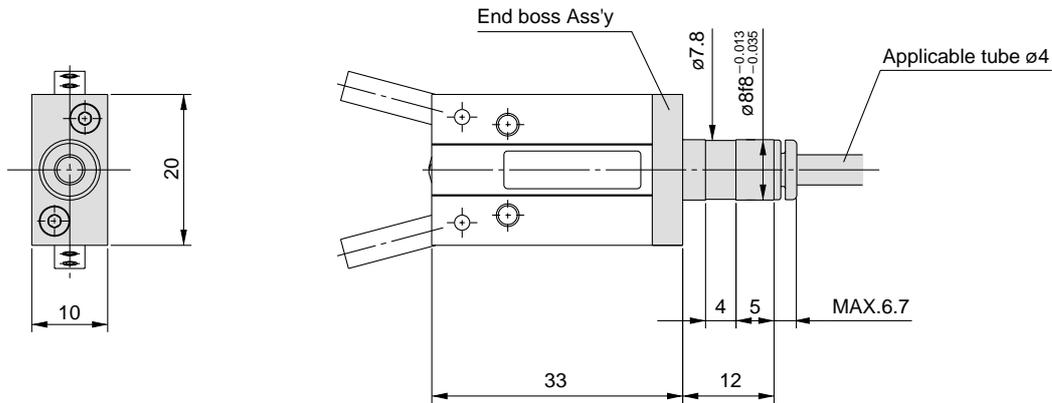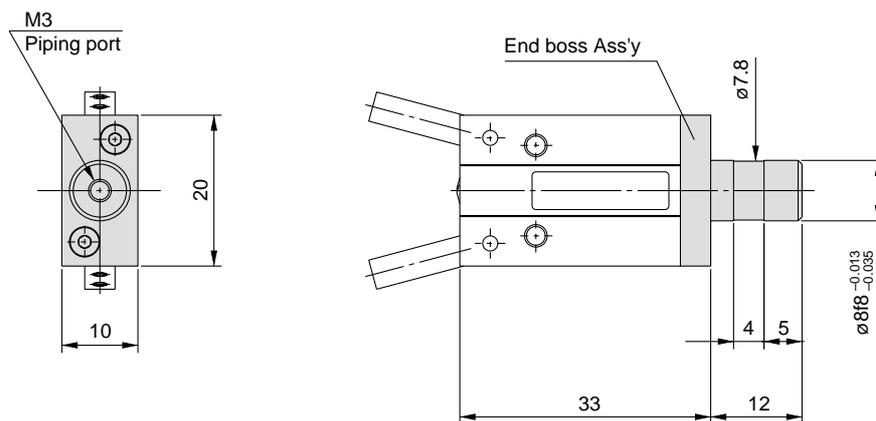ø8f8 $_{-0.035}^{-0.013}$

Applicable tube ø4

20

10

4　5　MAX.6.7

33　12

∗The specifications and dimensions not given above are
identical with those of the standard type.

Applicable tube

Description, model Specifications	Nylon tube	Soft nylon tube	Polyurethane tube	Polyurethane coil tube
	T0425	TS0425	TU0425	TCU0425B-1
Outside diameter mm	4	4	4	4
Max. operating pressure MPa	1.0	0.8	0.5	0.5
Min. bending radius mm	13	12	10	—
Operating temperature ℃	−20 to 60	−20 to 60	−20 to 60	−20 to 60
Material	Nylon12	Nylon12	Polyurethane	Polyurethane

Axial Port (with M3 port) [M]

MHCA2-6SM

M3
Piping port

End boss Ass'y

ø7.8

20

10

ø8f8 $_{-0.035}^{-0.013}$

4　5

33　12

∗The specifications and dimensions not given above are
identical with those of the standard type.

Weights

Unit: g

Model	End boss type (symbol)			
	E	H	K	M
MHCA2-6□□	23	23	23	23

Compact Type
MHCM2-7S

How to Order

MHC **M** **2**－**7** **S**

Compact type ●

Number of fingers ●
2	2 finger

● Action
S	Single acting (Normally open)

● Bore size (mm)
7	7

Symbol
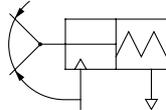
Specifications

Fluid	Air
Operating pressure	0.4 to 0.6MPa
Ambient and fluid temperature	−10 to 60℃
Repeatability	±0.02mm
Maximum operating frequency	180c.p.m.
Lubrication	Non-lube
Action	Single acting (Normally open)

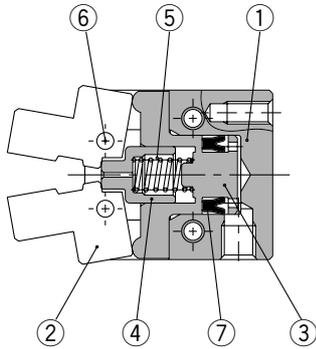## Model

Action	Model	Cylinder bore (mm)	Holding moment [Note] (Effective value) N·m	Opening/Closing angle (Both sides)	Weight g
Single acting (Normally open)	**MHCM2-7S**	7	0.017	20° to −7°	9.5

Note) At the pressure of 0.5MPa

⊜SMC

Construction/MHCM2-7S (Compact type)

Single acting/with open

With closed
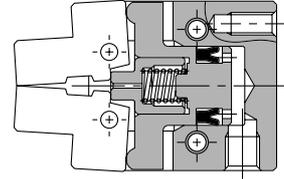
Parts list

No.	Description	Material	Note	Replacement parts order no.
1	**Body**	Aluminium alloy	Hard anodized	
2	**Finger**	Stainless steel	Heat treatment	
3	**Piston**	Stainless steel	Heat treatment	
4	**Pusher**	Stainless steel		
5	**Spring**	Piano wire	Zinc chromated	
6	**Needle roller**	High carbon chromium bearing steel		
7	**Piston seal**	NBR		MYN-4

Dimensions

MHCM2-7S

2 x M2 thread
(Attachment mounting threads)

M3
(Finger closing port)

$4_{-0.03}^{0}$

4.5

3

2 x M2 depth 4
(Mounting threads)

15

11

6

10±0.05

8.3

5.2

2.5

1.5

2

When open 20°

When closed 7°

2 x M2 thread
(Mounting threads)

6

10

1.8

7.7

16.5

(23)
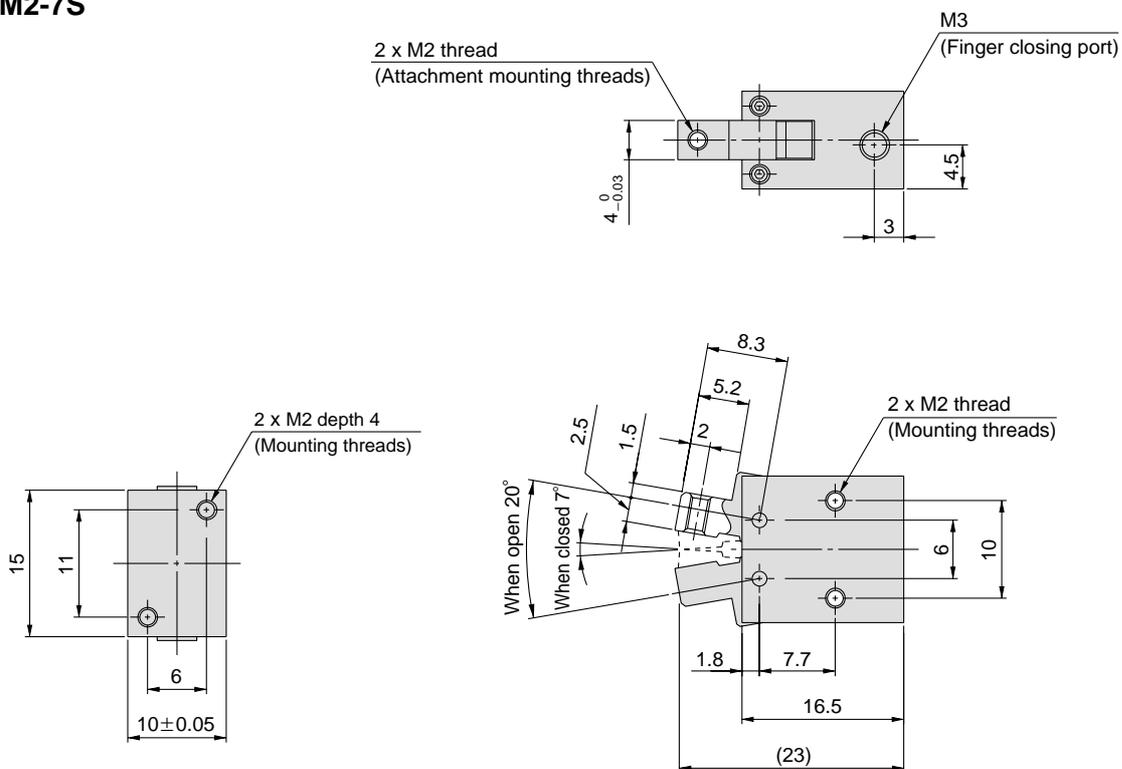
Auto Switch Common Specifications

Type	Solid state switch
Operating time	1ms or less
Shock resistance	1000m/s^2
Insulation resistance	50MΩ or more at 500VDC (Between lead wire and case)
Withstand voltage	1000VAC for 1min. (Between lead wire and case)
Ambient temperature	−10 to 60℃
Enclosure	IEC529 standard IP67, JISC0920 watertight construction

Lead Wire Length

Lead wire length indication

(Example)

D-M9P L

● **Lead wire length**

Nil	0.5m
L	3m
Z	5m

Note 1) Lead wire length Z: 5m applicable auto switch
   Solid state switch: All models are produced upon receipt of order
      (as standard).
Note 2) For the flexible wire specification, enter -61 after the part number.

(Example) D-M9PL- 61

● **Flexible wire specifications**

Lead Wire Colour Changes

The lead wire colors of SMC auto switches have been changed as shown below to satisfy IEC947-5-2 standards for production beginning September, 1996 and thereafter.
Take special care regarding wire polarity during the time that old colors still coexist with the new colours.

2-wire

	Old	New
Output (+)	Red	Brown
Output (−)	Black	Blue

3-wire

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black

SMC