GTS

Series

ROTATING PARALLEL GRIPPER

GTS Series

ROTATING PARALLEL GRIPPER

One gripper works for both chucking and rotation.
Most suitable for use at the finger tip of a robot hand.
The operating stroke and rotating angle can be changed as desired.

Representation

ROTATING PARALLEL GRIPPER

GTS20 - L - PB 2 - ☐
① ② ③ ④ ⑤

Switch only (Consists of : Switch, Screw & mounter)

PB8F ☐ - ☐
① ②

① Model No.

GTS5S GTS20S GTS20D

② Mounting

No mark	Without foot mounting
L	With foot mounting

③ Switch

No mark	Without switch
PB	With switch

④ Number of switch

No mark	Without switch
4	4 pcs.
3	3 pcs.
n	n pc(s).

⑤ Specifications for cable

No mark	Standard or switchless type
R	Flexible cable

① Switch type

No mark	Standard type (Black)
I	Different frequency type (Gray)

② Specifications for cable

No mark	Standard
R	Flexible cable

(Note)
① When using PARALLEL GRIPPER equipped with switch for rotatory applications, use a model PA8F-R or PA8FI-R equipped with flexible cable.
PARALLEL GRIPPER with flexible cable is made to order.
② In order to prevent mutual interference and malfunction of the switches, each product is supplied with a combination of PB8F (standard type) and PB8FI (different type). Both types can be used in the same manner.

Specifications

Model No.	Unit	GTS5S	GTS20S, GTS20D
Type of action		Double acting	
Average gripping force (at 0.5MPa [5kgf/cm²])	N [kgf]	45 [4.6]	137 [14]
Maximum stroke	mm	20	24
Rotating angle	Degree	30~180	30~180
Allowable energy	mJ[kgf•cm]	1.96 [0.02]	8.82 [0.09]
Port size		M5	Rc (PT) ⅛
Mass	g	630	1600
Fluid		Non-lubricated / lubricated air	
Pressure range	Mpa[kgf/cm²]	0.3~0.6[3~6]	
Temperature range	℃	0~60	

(Note) ① For gripping force for your application, refer to "Average gripping force (Effective value)" on Page K3.
② The operating stroke can be set at a 2-step or 3-step action within the specified range shown in the above table.
For "How to set the stroke", refer to Page K5.
③ Special care should be taken for freezing when operating a PARALLEL GRIPPER at a temperature below 5°C.
If water is completely removed from air using an air dryer, the PARALLEL GRIPPER can be operated at a temperature of -5°C.

Model with switch/ For detailed specifications of switches, refer to Page K11.

PB type proximity switch

Lead wire type

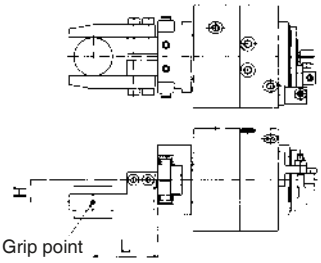
Model No.	Rated voltage (V)	Rated current range (mA)	Pilot lamp (Light up at ON)	Applications
PB8F PB8FI	DC12~24	100(max.)	O	Relay PLC IC circuit

Grip point

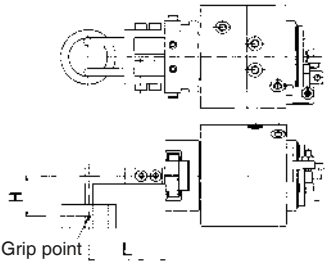
① Determine a work grip point within the grip point distance (L) and overhang length (H) according to supply pressure figured right.

② If the work grip point is set outside the limiting range, excessively imbalanced load is applied to the finger and guide, thus adversely affecting the life of the gripper.

O.D. gripping



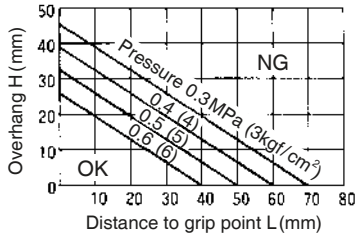
Bore gripping



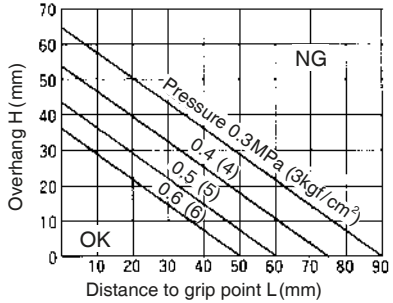
L : Distance to grip point
H : Overhang

Grip point range

GTS5S



GTS20S, GTS20D



How to determine gripping force

Effective gripping force varies with supply pressure, grip point and opening stroke of fingers.

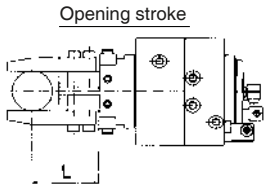
① Read average gripping force (effective value) corresponding to the supply pressure and grip point distance on the right charts.

② Read coefficient of gripping force corresponding to the opening stroke of the fingers on the charts on the bottom of this page.

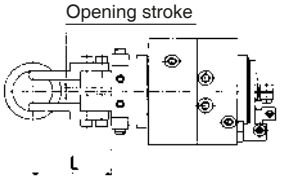
③ Effective gripping force is calculated as follows;

Average gripping force X Coefficience of gripping force

O.D. gripping

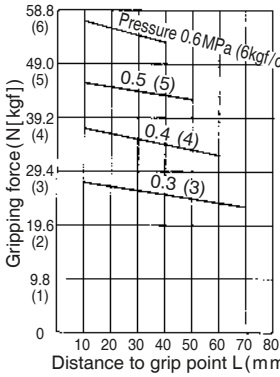


Bore gripping



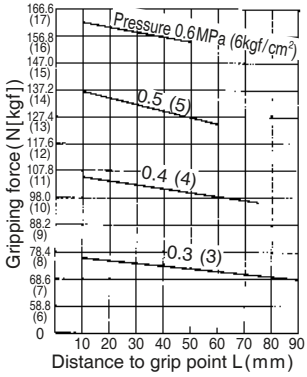
Average gripping force (Effective value)

GTS5S



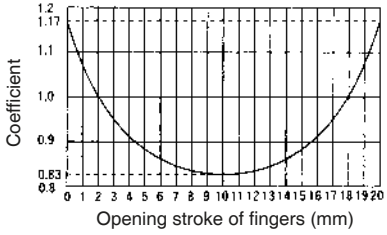
(Note)
Average gripping force (Effective value) means effective gripping force at opening of the finger where coefficient of gripping force becomes 1.

GTS20S, GTS20D

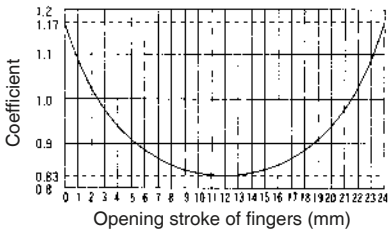


Coefficient of gripping force

GTS5S



GTS20S, GTS20D



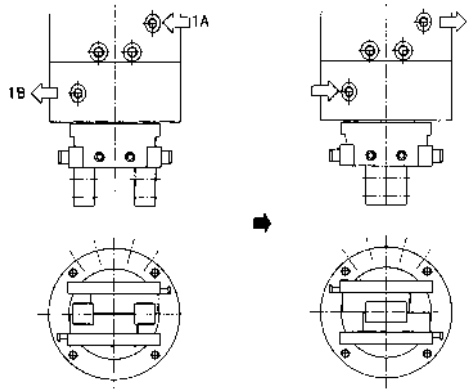
Rotating torque

(Unit : N•cm[kgf•cm])

Model No.	Operating pressure MPa[kgf/cm²]			
	0.29[3]	0.39[4]	0.49[5]	0.59[6]
GTS5S	116[11.8]	168[17.1]	223[22.8]	268[27.3]
GTS20S, GTS20D	274.4[28]	431.2[44]	563.5[57.5]	705.6[72]

Operating principle

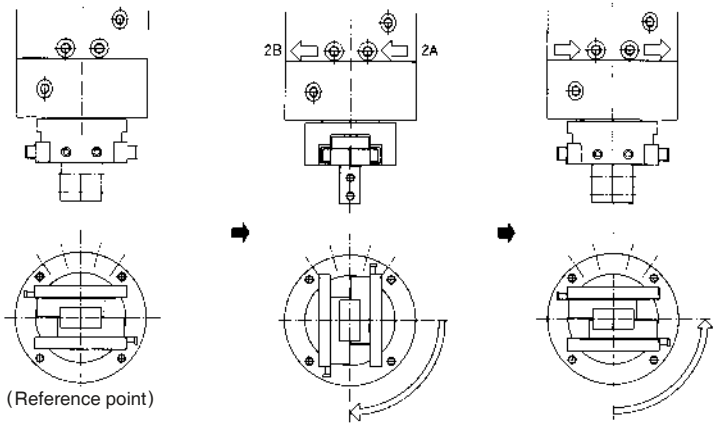
Gripping



1. Finger opens
When air is supplied from ports 1A and exhausted from ports 1B, the finger opens by the stroke preset with the stopper of the internal actuator.

2. Finger closes
When air is supplied from ports 1B and exhausted from ports 1A, the finger closes.

Rotation



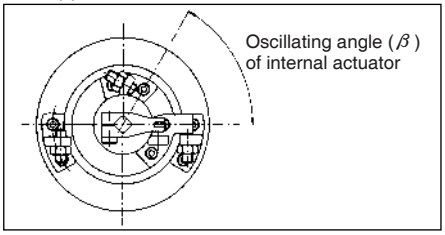
(Reference point)

1. Rotation
When air is supplied from ports 2A and exhausted from port 2B, the gripper rotates by the angle preset with the stopper of the external actuator (shown in the left.)

2. Rotation (Returning to the origin)
When air is supplied from ports 2B and exhausted from port 2A, the gripper rotates, returning to the origin.

How to set the stroke

The stroke of a gripper is set by changing the oscillating angle of the internal actuator using its stoppers.



Read oscillating angle (β) equivalent to the required stroke from the stroke-oscillating angle relationship graph on the right side.
Then, set the oscillating angle of the internal actuator at (β) with the stopper.
Set oscillating angle in accordance with the following conditions by referring to "How to set or change the angle" on Page K8.

① Oscillating angle setting range of internal actuator : 30°~90° (Pitch; 15°)

⚠ If it is set at more than 90°, the ball slide may be damaged or other trouble may happen.

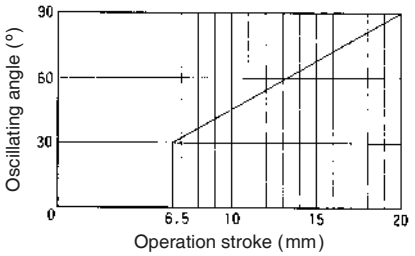
② The oscillating angle of the internal actuator can be finely adjusted within the range of -9° to +6° using the fine adjust screw of the stopper.

Example of stroke setting

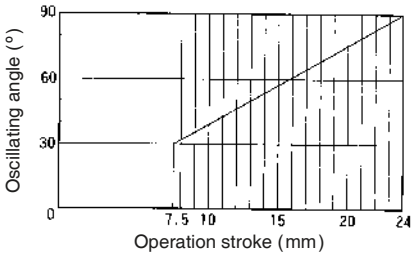
Operating stroke A (mm)		Oscillating angle β
GTS5S	GTS20S GTS20D	
6.5	7.5	30°
10	11.5	45°
13.5	16	60°
17	20	75°
20	24	90°

Stroke-oscillating angle relationship

GTS5S



GTS20S, GTS20D



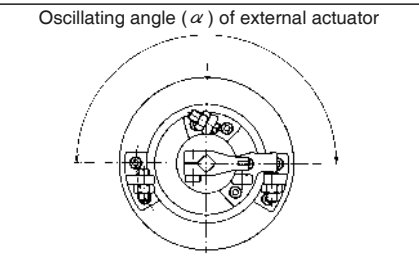
How to set the rotating angle

The rotating angle of a gripper can be set by changing the oscillating angle of the external actuator using its stopper.
Set oscillating angle (α) in accordance with the following conditions by referring to "How to set or change the angle" on Page K8.

① Oscillating angle setting range of external actuator : 30°~180° (Pitch; 10°)

② The oscillating angle of the external actuator is adjustable within the range of -6° to +4°" using the fine adjust screw of the stopper.

③ The reference point of oscillation (reference point of rotation) is adjustable within the range of ±5° using the fine adjust screw of the stopper. However, the adjustable range may be reduced according to actual angle setting.

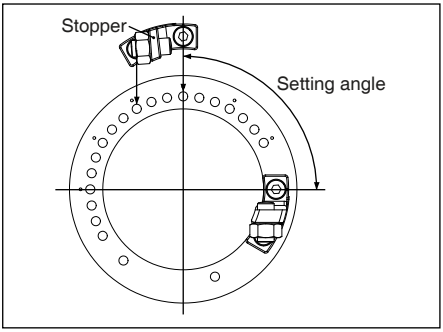


How to set or change the angle

When the angle is larger than the pitch

① Secure the stopper to the screw hole roughly corresponding to the desired angle.

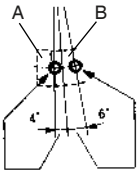
	Sitting angle (°)
For external actuator	30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180 (Pitch : 10°)
For internal actuator	30, 45, 60, 75, 90 (Pitch : 15°)



② Then, set the exact angle by turning the fine adjusting screw of the stopper.
After setting, be sure to tighten the lock nut.

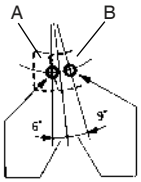
When the setting angle is less than the pitch

① When the desired angle is in between the pitch as shown in sketch below, secure the stopper to the respective position as indicated below.



In the case of external actuator

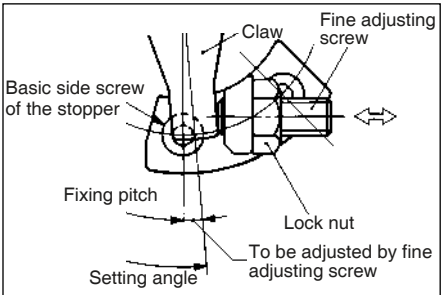
Secure the stopper at A, if the desired angle comes to within 4°as indicated.
Secure the stopper at B, if the desired angle comes to within the 6°as indicated.



In the case of internal actuator

Secure the stopper at A, if the desired angle comes to within 6°as indicated.
Secure the stopper at B, if the desired angle comes to within the 9°as indicated.

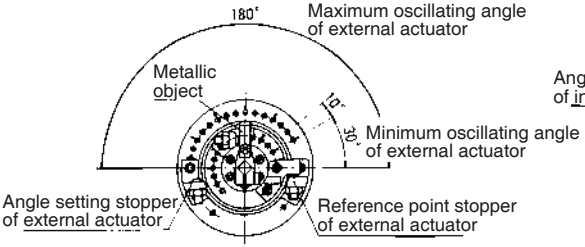
② Then, set the exact angle by turning the fine adjusting screw of the stopper.
After setting, be sure to tighten the lock nut.



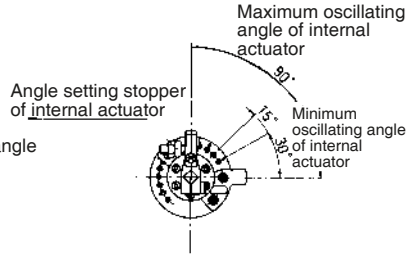
	Adjustable range
For external actuator	-6° ~ +4°
For internal actuator	-9° ~ +6°

GTS5S

(Unit: mm)

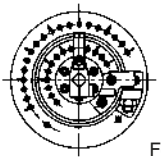


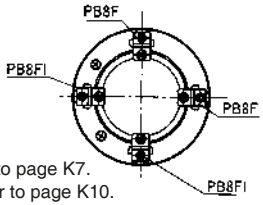
Rotating angle (External stopper)



Stroke (Internal stopper)

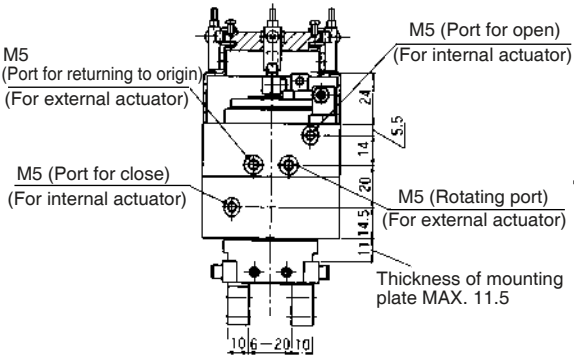
Stopper setting range

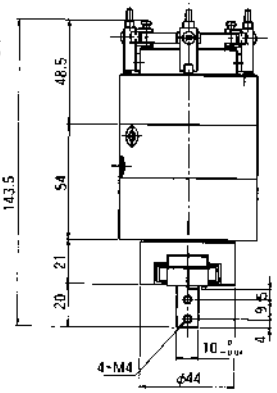




(Note)
For setting of the stoppers, refer to page K7.
For setting of the foot mounting, refer to page K10.

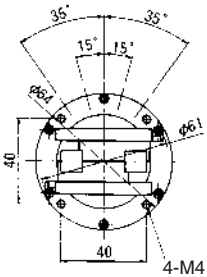
With switch

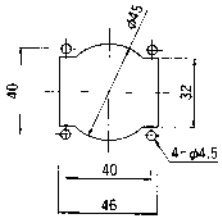




Gripper mounting hole

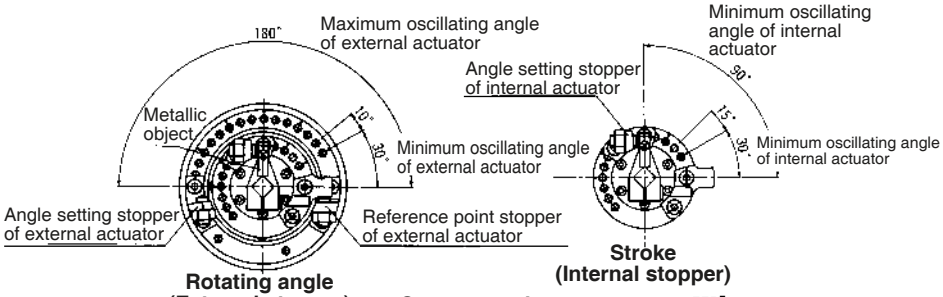
*Use this hole pattern for flange mount.



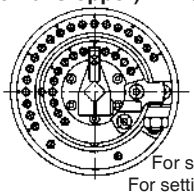


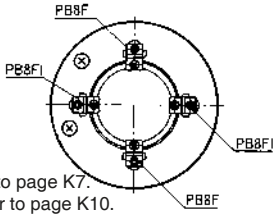
GTS20S, GTS20D

(Unit: mm)



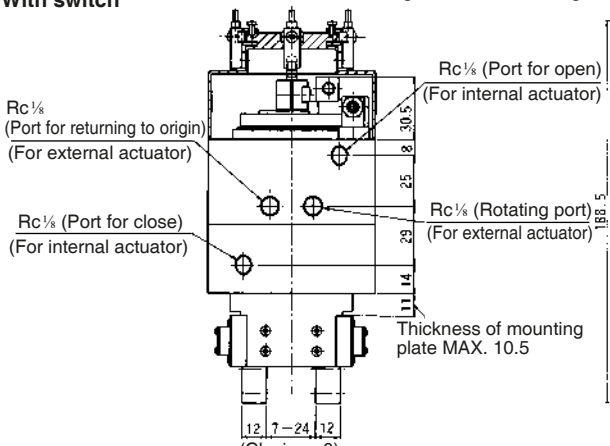
Stopper setting range

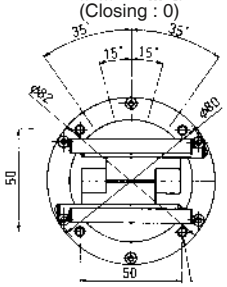




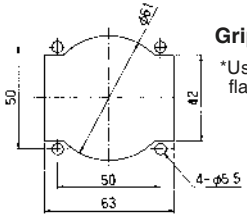
(Note)
For setting of the stoppers, refer to page K7.
For setting of the foot mounting, refer to page K10.

With switch





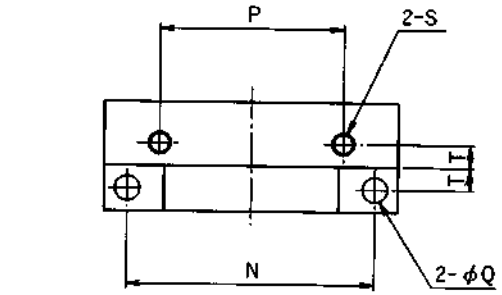
4-M5 depth 8
(Mounting hole)

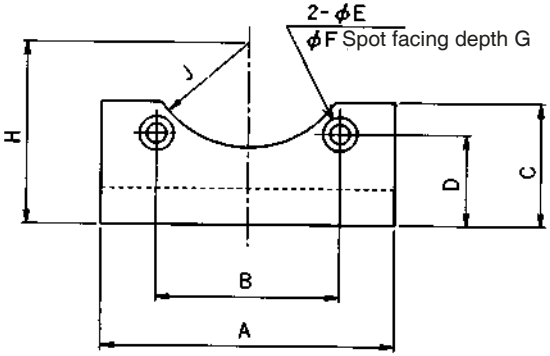


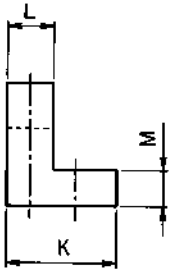
Gripper mounting hole

*Use this hole pattern for flange mount.

Accessories
Foot mounting



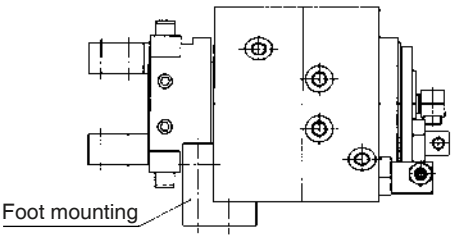


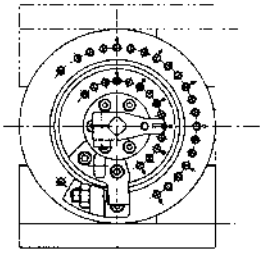


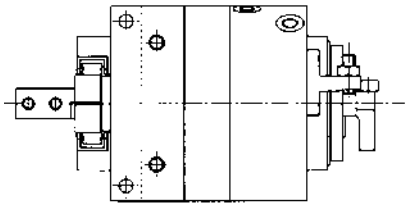
(Unit: mm)

Model No.	Applicable Parallel gripper	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	S	T
G5-L	GTS5S	64	40	27	20	4.3	7.5	4.5	40	23	24	10	7.9	54	40	5.5	M5	5
G20-L	GTS20S, GTS20D	82	50	31	25	5.3	9	5.5	50	30.5	28	10.5	8.9	70	60	6.5	M6	5

Foot mounting can be fitted onto 3 sides by rotating 90° in each direction as shown below :







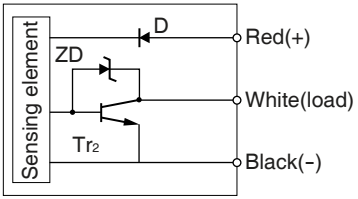
Model No.	Mass (g)
G5-L	60
G20-L	90

PB type proximity switch

Switch specification

Model No.	Unit	PB8F(Black) PB8FI(Grey)
Application		Relay, PLC, IC circuit
Type of contact	V	NPN transistor. Open collector
Voltage range		DC12 to 24V±10% (Ripple p-p, less than 10%)
Power consumption	mA	Max.15
Switching current	mA	Max.100
Internal voltage drop.	v	Less than 1 (At 100mA input) Less than 0.4 (At 16mA input)
Leakage currect	uA	Less than 5
Mean response time	msec	1
Indicator lamp		Red LED (Light turning on)
Protection grade		IP67
Vibration	G	980
Temperature range	°C	-10 to 55
Lead wire		Oil proof 3-core black, 1m length

Internal circuit of switch

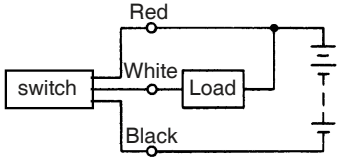


D : Diode for reverse polarity
Z_D : Zenor diode for surge suppresion
Tr_2 : NPN transistor

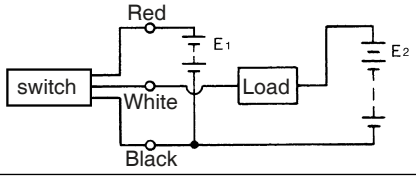
(Note) Lead wire colors will be changed to new colors according to the revision of JIS for lead wire colors. Red->Brown, White->Black, Black->Blue (Present color->New color)

How to connect the switch

When power supply to load is common to power supply to switch :

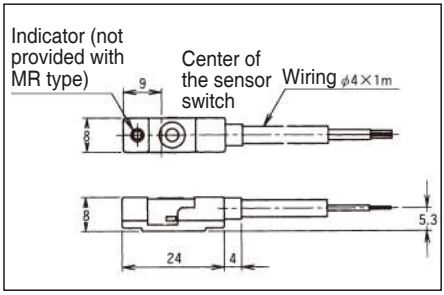


When power supply to load is not common to power supply to switch :



Dimensions of switch

(Unit: mm)



Technical information of switch

① Be sure turn off power supply before conducting wiring work. Purge compressed air from the equipment completely.

② Since the switch is temporarily fitted to the product before it leaves our factory, avoid using it directly.
Mount the switch correctly in accordance with "How to mount the switch" (Page K12).

③ When using the switch, be sure to check load currect.

④ If some metal comes near to PARALLEL GRIPPER separate the switch from the metal by more than 10mm.

⑤ Do not accumulate metallic powder or dust on the switch.

⑥ Be careful not to mistake the polarity of red lead (+) and black lead (-) when connecting them.
Lead wire colors will be changed to new colors according to the revision of JIS for lead wire colors.
Red -> Brown, White -> Black, Black -> Blue (Present color -> New color)

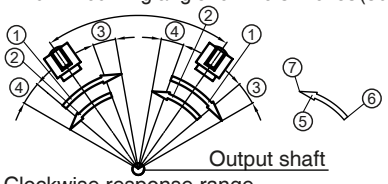
⑦ Avoid connecting the white lead of the switch directly to power supply.
(It is advisable to connect it to relay load etc.)

⑧ This switch is designed to meet IEC Standard "IP67 Structure" (JIS C0920 : Oil/water-proof structure).
However, the water tightness of the switch is limited in a surrounding condition where the switch is directly exposed to water and oil for long time.
So, provide a cover or take other proper means to prevent water and oil from splashing on the switch.

⑨ When the cable of the switch undergoes bending force, select and use a switch with a flexible cable.

Hysteresis and response range

Minimum mounting angle for two switches (30°)



① Clockwise response range
② Counterclockwise response range
③ Clockwise hysteresis
④ Counterclockwise hysteresis
⑤ Arrow : Indicates direction of rotation of output shaft
⑥ Switch make position
⑦ Switch break position

When the output shaft of PARALLEL GRIPPER rotates, the switch is turned on (lamp is on) at the respective switch make positions in the direction of rotation.
When the output shaft returns in the reverse direction, the switch is turned off (lamp is off) at the switch break position in its direction of rotation.
This position shifts from the make position, causing hysteresis.

PARALLEL GRIPPER	Response range	Hysteresis
GTS5S	Approx. 20°	Approx. 1°
GTS20S, GTS20D	Approx. 20°	Approx. 1°

Assembling the switch unit and adjusting the switch

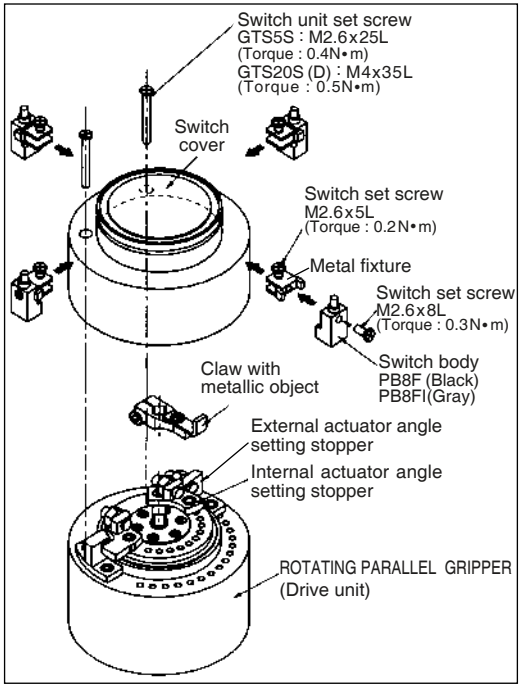
ROTATING PARALLEL GRIPPER with switch is designed to detect the position of the sensor fitted to the finger of the output shaft of the internal actuator by means of proximity switch.
Since the output shaft stops at 4 (3) positions during operation, 4 (3) switches are provided.

Mounting the switch unit

① Loosen the switch unit set screw and remove the switch unit.
② Then set at the correct angle by rotating the fine adjust screws provided on the reference point stopper and angle setting stopper respectively.
After completion of angle setting, be sure to tighten the lock nut.
Refer to "How to set the angle" (Page K7).
③ Make sure that the center of ROTATING PARALLEL GRIPPER does not shift from the center of the Switch unit and retighten the Switch unit set screw.
If misaligned, the switch cannot properly detect the respective stop positions or the cover may be broken.
For clamping torque of the set screw, refer to the table below.

Adjusting the switch position

① The switch has been temporarily fitted when the product leave our factory.
Loosen the switch set screw, slide the switch together with the metal fixture to check the detecting position and then retighten the switch set screw to fix the switch at a clamping torque shown in the table right.
Excessive tightening the screw will result in a damage to the unit.
Make a final adjustment by checking that LED is on at the respective detected stop positions.
② The minimum angle between the adjacent switches is 30°.
In order to prevent mutual interference, fit the standard type switch (PB8F : black) and the different frequency type switch (PB8FI : gray) alternately.



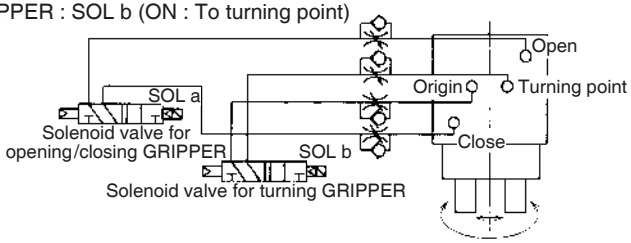
Replacing the switch

Remove the switch set screw and replace the switch. Mount a switch to the metal fixture with the switch set screw at a clamping torque shown in the table right side. At this time, be sure to check that LED is on at the respective detected stop positions.

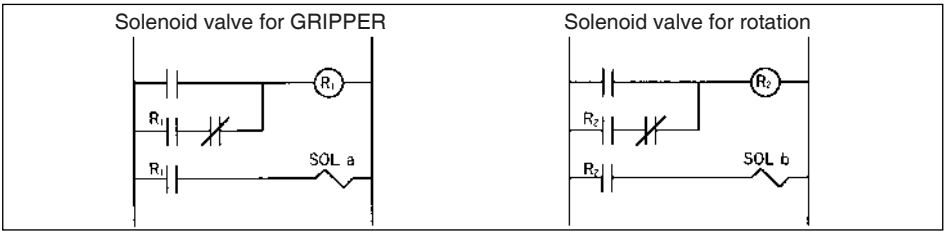
Example of switch circuit

Pneumatic circuit

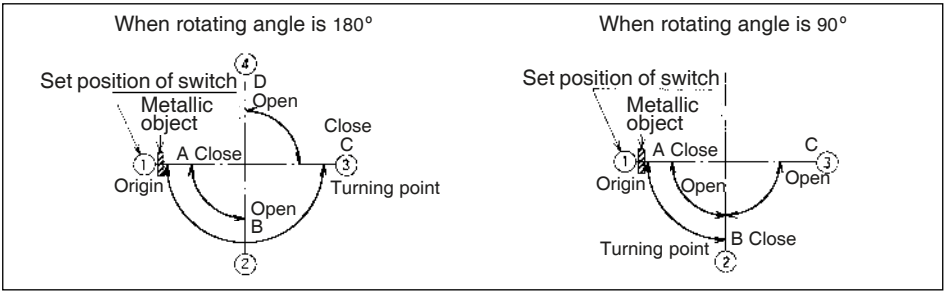
Solenoid valve for opening/closing GRIPPER : SOL a (ON : Close)
Solenoid valve for turning GRIPPER : SOL b (ON : To turning point)
Relay for operating SOL a : R^1
Relay for operating SOL b : R^2



Ladder drawing for solenoid valve



Operating position of ROTATING PARALLEL GRIPPER with switch and switch position



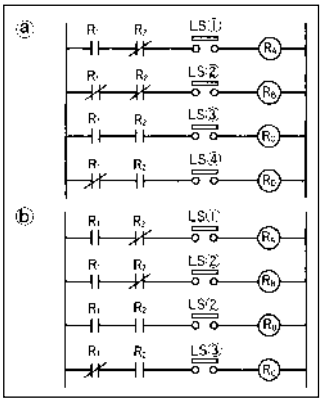
Operation of ROTATING PARALLEL GRIPPER and ladder drawing of switch (Example)

ⓐin case of 180° rotation

Position of metallic object	Switch No.	GRIPPER (R_1)	Turning position (R_2)
A	①	Close	Origin
B	②	Open	Origin
C	③	Close	Turning position
D	④	Open	Turning position

ⓑin case of 90° rotation

Position of metallic object	Switch No.	GRIPPER (R_1)	Turning position (R_2)
A	①	Close	Origin
B	②	Open	Origin
B	②	Close	Turning position
C	③	Open	Turning position



⚠ Precautions for handling

When using pneumatic components, obey JIS B8370-1988(ISO4414) for General rule for pneumatic systems. Before proceeding the works, you should first thoroughly read below mentioned precautions.

Environmental conditions

① Do not use the components in places where corrosive gas, chemicals, seawater, water or aqueous vapor are permeating.
② Special care should be taken foe freezing when operating a PARALLEL GRIPPER at a temperature below 5°C.
If water is completely removed from air using an air dryer, the PARALLEL GRIPPER can be operated at a temperature of -5°C.
③ PARALLEL GRIPPERs are intended for use in industrial compressed air systems only. They must not be used where pressure or temperature may exceed maximum rated operating conditions.
See specifications.
In lubrication applications, some oil mist may escape from the point of use into the surrounding atmosphere.
Users are referred to OSHA safety and health standards for limiting oil mist contamination and utilization of protecting equipment.

Quality of air

① Use a filter with element of 5um or fine. Use of a coalescing filter and sludge filter together will improve the quality of air even more.
② Take sufficient care of the filter drain.
③ If sludge contaminates the compressor oil, it will cause the pneumatic equipment to malfunction. Always keep the compressor will-conditioned.

Piping

① Thoroughly flush the inside of pipes before connecting them.
② When screwing pipes and fittings, use care to prevent threaded chips and sealants from entering the pipes.
③ When screwing pipes and fittings, use an appropriate torque shown below.

Thread size	Clamping torque (kgf•cm)
M3	0.3~0.5(3~5)
M5	1.5~2.0(15~20)
Rc ⅛	7~10(70~100)

Lubrication

As the unit is coated with the lubricant, no lubrication is required.

Maintenance

Before doing maintenance service, close the shut off valve on Supply line, then exhaust residuum pressure from the pneumatic line.

Mounting the angle setting stopper

Since the standard of ROTATING PARALLEL GRIPPER/MULTIPLE STORKE TYPE PARALLEL GRIPPER is supplied with an angle setting stopper, be sure to set it at the intended set angle.

- For MULTIPLE STROKE TYPE PARALLEL GRIPPER, set the angle setting stopper so that setting angle (β) of the internal actuator may be larger than setting angle (α) of the external actuator. ($\alpha \leqq \beta$)
  Also set it so that the sum of setting angles of the external and internal actuators ($\alpha + \beta$) may be less than 90°. If the oscillating angle is over 90°, the ball slide may be damaged or other trouble may be caused.
- For ROTATING PARALLEL GRIPPER, set the angle of the internal actuator at 90° or less. If the oscillating angle is over 90°, the ball slide may be damaged or other trouble may be caused.

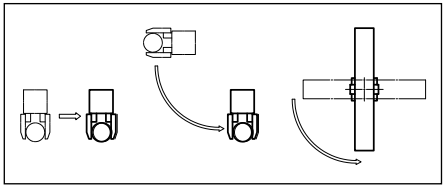
When PARALLEL GRIPPER is operated without mounting an angle setting stopper, PARALLEL GRIPPER may be damaged.

Changing the angle

① The reference point stopper is fixed and it cannot be moved. However, it is adjustable within a range of ±5° by means of the fine adjust screw.
The adjustable width may be sometimes reduced according to setting angle.
② Use the reference point stopper and angle setting stopper with them mounted on ROTATING PARALLEL GRIPPER/MULTIPLE STROKE TYPE PARALLEL GIPPER without fail.
Otherwise, the vane or seal may be broken, causing a defective operation.

Moving and rotating PARALLEL GRIPPER

When moving, rotating and turning PARALLEL GRIPPER with work gripped, pay attention to a shock produced at the stroke end.
If a great shock is produced, the ball slide may be damaged or other trouble may be caused.



Finger opening/closing speed

Adjust finger opening/closing speed using speed controller so that it may not be excessively increased.
If opening/closing speed is excessively high, the ball slide will receive a great shock, causing a defective operation.

HOW TO SELECT A PNEUMATIC GRIPPER

SELECTING A PARALLEL GRIPPER GTS SERIES

① Although gripper force varies according to the material and configuration of work or attachments, select a model that can provide gripping force 10 to 20 times as much as the weight of work.
② When great force produced by acceleration or shock is applied to work, it is necessary to select a larger model.
③ Check that the grip point is within the grip point range by the graph (on Page K3).
④ Minimize the weight of finger attachment by referring to the following table.

PARALLEL GRIPPER	Weight of attachment (g/pc.)
GTS5S	100
GTS20S, GTS20D	120

⑤ Determine rotating angle, rotating time and operating pressure.
Set rotating time within the range shown in the table below, if it is set outside this range, a stick-and-slip may occur so that smooth operation cannot be attained.
Rotating angle θ(rad) 90° =1.5708rad
Rotating time t (s) 180° =3.1416rad
Operating pressyre P(MPa)

PARALLEL GRIPPER	Rotating time (s)
GTS5S	0.08~0.8
GTS20S, GTS20D	0.11~1.1

⑥ Calculate moment of inertia from configuration and weight of work and attachment.
For calculating formula, refer to the table of moment of inertia.
I (kg•cm²)
⑦ Calculating angular velocity

$$\omega = \frac{\theta}{t} \quad (rad/s)$$

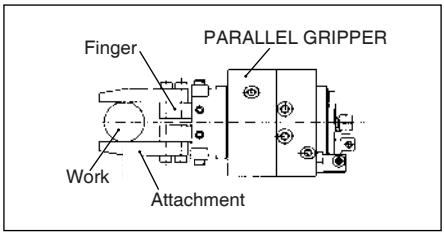
θ: Rotating angle (rad)
t: Rotating time (s)
⑧ Calculating energy of inertia of work and attachment

$$E = \frac{1}{2} \times I \times \omega^2 \times 10^{-1} \quad (mJ)$$

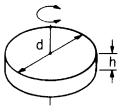
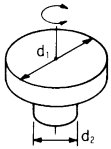
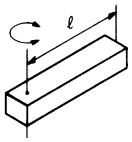
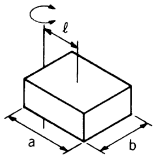
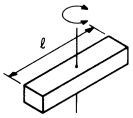
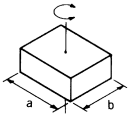
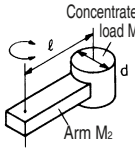
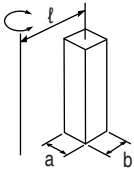
I: Moment of inertia of work and attachment (kg•cm)
⑨ Check that energy (E) of inertia of work and attachment is less than the allowable energy of ROTATING PARALLEL GRIPPEA.

PARALLEL GRIPPER	Allowable energy
GTS5S	1.96mJ (0.02kgf•cm)
GTS20S,GTS20D	8.82mJ (0.09kgf•cm)

When energy (E) of inertia of work and attachment is over the allowable energy, make slow the rotating speed or take otter countermeasures.



Calculating the moment of inertia

Shape	Sketch	Requirement	Moment of inertia $I\ (kg \cdot cm^2)$	Radius of gyration K_1^2	Remarks
Disc		• Diameter d (cm) • Mass M (kg)	$I = M \cdot d^2/8$	$d^2/8$	
Stepped disc		• Diameter d_1 (cm) d_2 (cm) • Mass : Partion d_1 M_1 (kg) Partion d_2 M_2 (kg)	$I = M_1 \cdot d_1^2/8 + M_2 \cdot d_2^2/8$		When portion d_2 is much smaller than portion d_1, value of d_2 is negligible.
Bar		• Bar length ℓ (cm) • Mass M (kg)	$I = M \cdot \ell^2/3$	$\ell^2/3$	If the ratio of the bar width : length is over 0.3, use formula for rectangle.
Rectangular parallelepiped		• Side length a (cm) b (cm) • Distance between the center of gravity and rotation ℓ (cm) • Mass M (kg)	$I = M[\ell^2 + (a^2+b^2)/12]$	$\ell^2 + (a^2+b^2)/12$	
Bar		• Bar length ℓ (cm) • Mass M (kg)	$I = M \cdot \ell^2/12$	$\ell^2/12$	If the ratio of the bar width : length is over 0.3, use formula for rectangle.
Rectangular parallelepiped		• Side length a (cm) b (cm) • Mass M (kg)	$I = M \cdot (a^2+b^2)/12$	$(a^2+b^2)/12$	
Concentrated load		• Shape of concentrated load Disc • Arm length ℓ (cm) • Mass of concentrated load M_1 (kg) • Mass of arm M_2 (kg)	$I = M_1 \cdot \ell^2 + M_1 \cdot K_1^2 + M_2 \cdot \ell^2/3$	Select K_1^2 from among asterisked ones (*) in the table according to the configuration of concentrated load	When M_2 is much smaller than M_1, assume M_2 to be 0 for calculation.
Attachment		• Offset of attachment ℓ (cm) • Mass of attachment M (kg) • Side a (cm) b (cm)	$I = M_1(\ell^2 + M_1^2)$	$(a^2+b^2)/12$	Double the value for both attachments