CKD

SM－230584－A

# INSTRUCTION MANUAL

## CROSS ROLLER PARALLEL HAND

## HKP Series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

CKD Corporation

The 2nd edition

# For Safety Use

To use this product safety, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (to the level pursuant to JIS B 8370 Pneumatic System Rules).

We do not bear any responsibility for accidents caused by any person without such knowledge or arising from improper operation.

Our customers use this product for a very wide range of applications, and we cannot keep track of all of them. Depending on operating conditions, the product may fail to operate to maximum performance, or cause an accident. Thus, before placing an order, examine whether the product meets your applications, requirements, and how to use it.

This product incorporates many functions and mechanisms to ensure safety. However, improper operation could result in an accident. To prevent such accidents, **read this operation manual carefully for proper operation.**

Observe the cautions on handling described in this manual, as well as the following instructions:

## ⚠ Precautions:

- Before performing an overhaul inspection on the actuator, deactivate residual pressure completely.
- While the actuator is operating, do not step into or place hands in the driving mechanism.
- To prevent an electric shock, do not touch the electric wiring connections (exposed live parts) of the actuator equipped with a solenoid valve or switch. Perform an overhaul inspection with the power off. Also, do not touch these live parts with wet hands.

# INDEX

HKP Series

Cross Roller Parallel Hand

Manual No. SM-230584-A



1997. 03. 19

# 1. PRODUCT

## 1.1 Specifications

| Model code / Item | | HKP-32CS | HKP-40CS | HKP-50CS | HKP-63CS |
|---|---|---|---|---|---|
| Working fluid | | Compressed air | | | |
| Max. working pressure | MPa | 0.7 | | | |
| Min. working pressure | MPa | 0.3 ※1 | | | |
| Ambient temperature | ℃ | 5 to 60 | | | |
| Stroke | mm | 24 | 30 | 36 | 40 |
| Bore size | mm | φ32 | φ40 | φ50 | φ63 |
| Rod Diameter | mm | φ16 | φ20 | φ28 | φ32 |
| Volumetric capacity (reciprocating) | $cm^3$ | 25.3 | 49.5 | 89.4 | 162.9 |
| Repeatability (Initial valve) | mm | ±0.01 | ±0.01 | ±0.01 | ±0.01 |
| Product weight | kg | 1.36 | 1.95 | 4.2 | 5.4 |
| Lubrication | | Not required. (Use Turbine oil, Class 1, ISO VG32 when required.) | | | |

※1 : The min. working pressure of the parallel hand with a rubber cover (option) is 0.35.

## 1.2 Features

1) A cross roller guide ensures high-accuracy and smooth movement.

The cross roller bearing mechanism for the slide unit ensures high-accuracy and smooth movement.

2) Compact, highly rigid

The slide unit is held by an overlapping, long support mechanism, which is compact and can bear a large moment load.

3) A rubber cover (option) contributes to the improvement of environmental erosion.

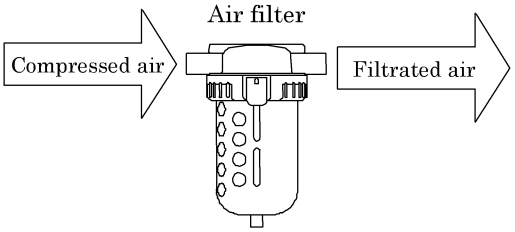
A rubber cover designed for the slide unit shuts out chips of 1 mm or larger in diameter and contributes to the improvement of environmental erosion.

2
CAUTION

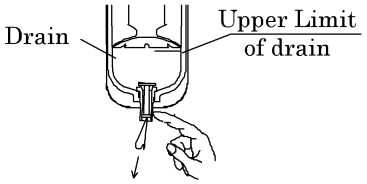
# 2. CAUTION

## 2.1 Fluid

1) It is necessary to use dehumidified air that has been filtered from compressed air. Carefully select an adequate filter that has an adequate filtration rate (preferably 5 $\mu$ m or less), flow rate and its mounting location (as nearest to the directional control valve as possible).




2) Be sure to drain out the accumulation in the filter periodically.



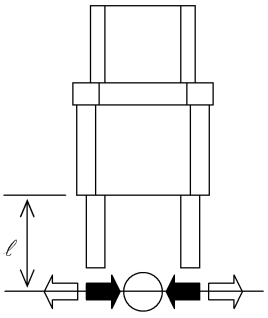

3) Note that the intrusion of carbide for the compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of the solenoid valve and the cylinder. Be sure to carry out thorough inspection and maintenance of the compressor.

4) This hand does not require lubrication. It is recommended, however, to use Turbine oil Class 1, ISO VG32 as lubricant if lubrication is preferred.

# 3. HOLDING POWER

## 3.1 Holding Power and Weight of Load

1) The table of Holding Power on the next page represents the force with Claw length of ℓ at either Opening motion or Closing motion and does not represent max. weight of load capable to hold.




2) Required holding power varies remarkably depending on numerous elements.

- Friction coefficient between Load and Claws
- Moment of inertia of Load during transference
- Relative position between center of gravity of Load and Clamp location, also width of Claws
- Structure and configuration of Claws

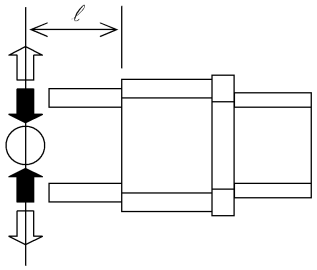
## 3.2 Guide line of Selecting appropriate model (required holding power) comparing with weight of Load

Safety coefficients for holding power against weight of Load are set as follows although it varies depending on Coefficient between Load and Claw, Shape of Load and Claws, transferring condition etc. Make that brief guide line for selecting models.

- Holding only — 5 times or Over
- Normal transference — 10 times or Over
- Transference with high acceleration — 20 times or Over

## 3.3 Data of Holding Power

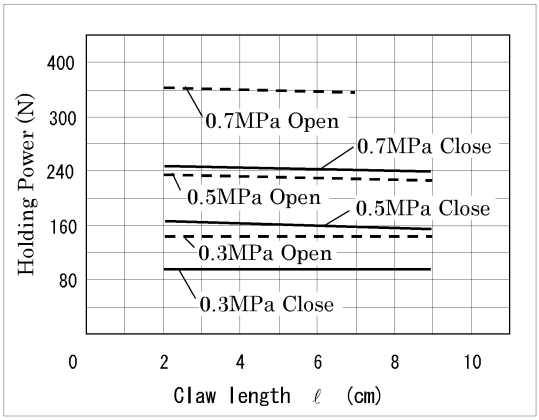
The following Tables represents the Holding power in either opening motion or closing motion with Claw length ℓ of hand at 0.3, 0.5 & 0.7MPa of Supplying pressure.



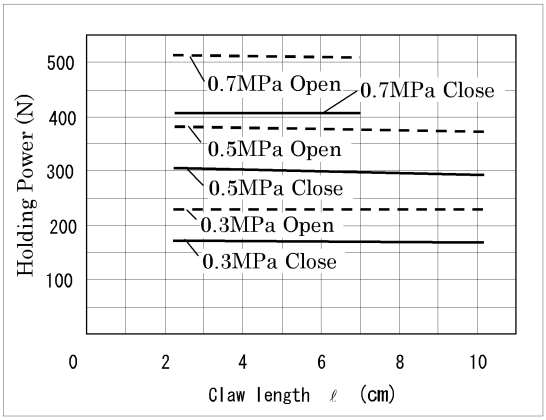

- Opening Motion ( ⇦ ) ---------- (Broken line)
- Closing Motion ( ➡ ) ———— (Full line)

(Note) Compared with the double acting type, the holding power of the O-type in the closing direction decreases by about 20 to 30%.
Compared with the double acting type, the holding power of the C-type in the opening direction decreases by about 10 to 20%.

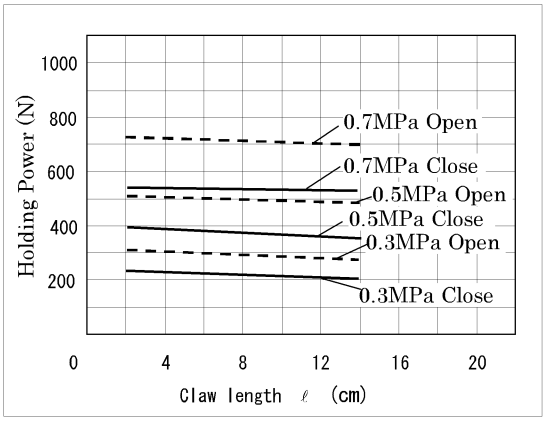
●HKP-32CS



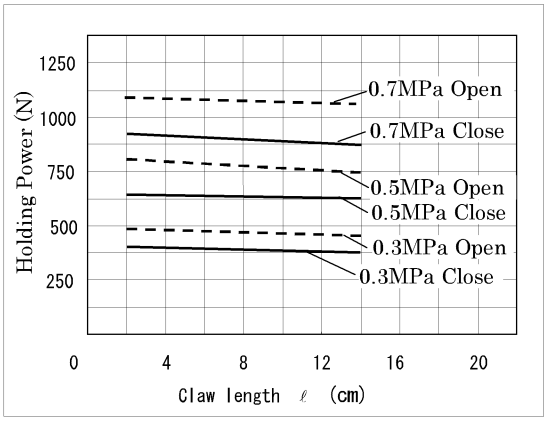

●HKP-40CS




●HKP-50CS

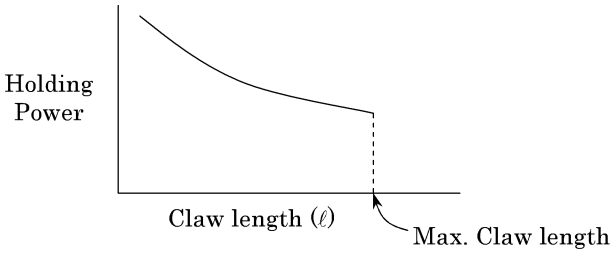



●HKP-63CS



## 3.4 Length and Weight of Claws

1) Make it short and light as much as possible because abrasion wear of moving parts of Master Jaw will be accelerated if claws are long and heavy.
2) Keep the claw length within the range to Tables.




3) The weight of the claws affects the life of the chuck. Use claws which meet the following weight requirement.

W < 1/4H (for one peace)

W : Weight of claws
H : Weight of HKP

# 4. INSTALLATION

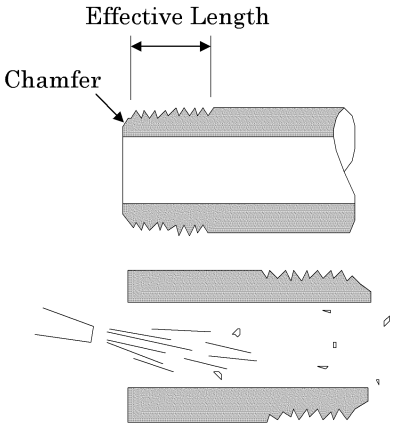
## 4.1 Piping

1) For piping beyond the filter, use pipes that hardly get corroded such as galvanized pipes, nylon tubes, rubber tubes, etc.

2) See to it that the pipe connecting cylinder and solenoid valve has effective cross-sectional area needed for the cylinder to drive at specified speed.

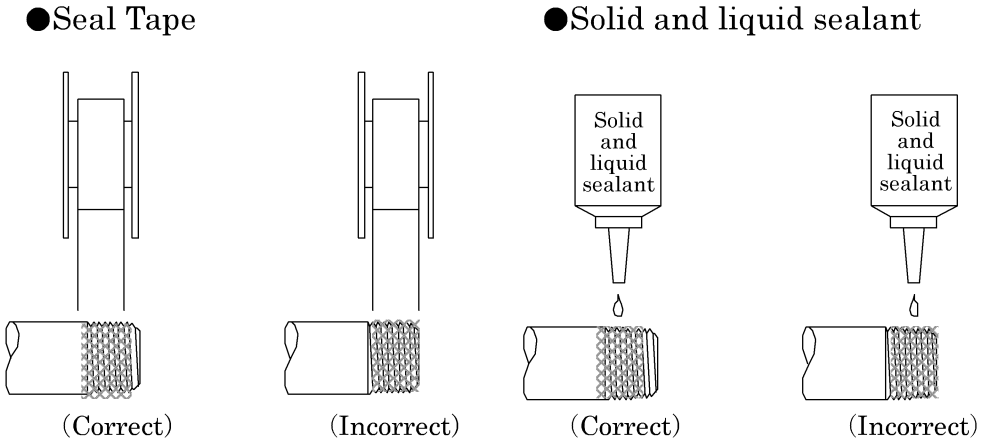
3) Install filter preferably adjacent to the upper-stream to the solenoid valve for eliminating rust, foreign substance in the drain of the pipe.

4) Be sure observe the effective thread length of gas pipe and give a chamfer of approx. 1/2 pitch from the threaded end.



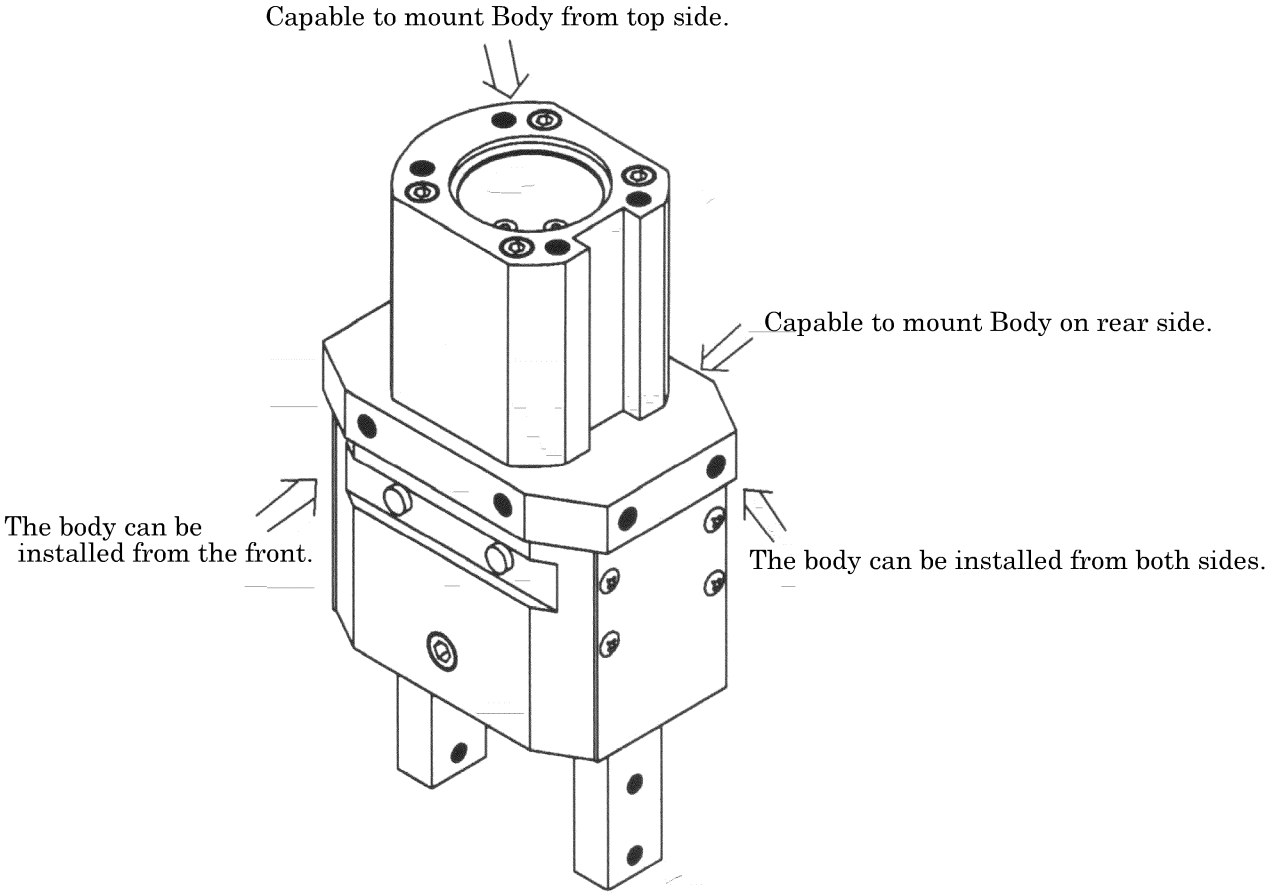

5) Flush air into the pipe to blow out foreign substances and chips before piping.

6) Refrain from applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.



## 4.2 Installation

1) Ambient Temperature
   The range of temperature is 5 to 60℃ witch the hand of this type is serviceable.
2) Environmental Condition
   Provide some protection to the system with such as cover etc in the environment where much dust exist and splash of water or oil is foreseen.
3) Installation of Body
   The body can be installed in five different directions (except the 50CS and the 60CS witch can only be mounted only two directions).

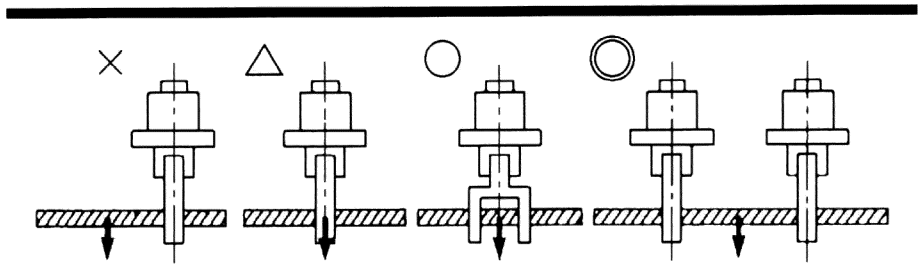



- Thread diameter and depth of Body mounting bolt

| Model | Diameter of thread and depth |
|---|---|
| HKP-32CS | M6, depth 12 |
| HKP-40CS | M6, depth 12<br>M8, depth 15 |
| HKP-50CS | M8, depth 12 |
| HKP-63CS | M10, depth 12 |

4) It case of handling long material

It is mandatory to grave it at the center of gravity for stable lifting, it may sometime be necessary to use dual hands for more stability.



5) Others

Consult us prior to start additional machining work on unit to prevent such troubles as malfunction or air leakage etc.

# 5. MAINTENANCE

## 5.1 Periodic Inspection

In order to upkeep the Hand chuck in optimum condition, carry out periodic inspection every half a year or at every 500,000 times of actuation.

1) Inspection items
   (1) Apply grease to sliding portion.
   (2) Check whether its operation is smooth.
   (3) Check for any air leakage.
   (4) Check for any slackened bolts
   (5) Check for any play to master jaws.
   (6) Check if there are any abnormal strokes.

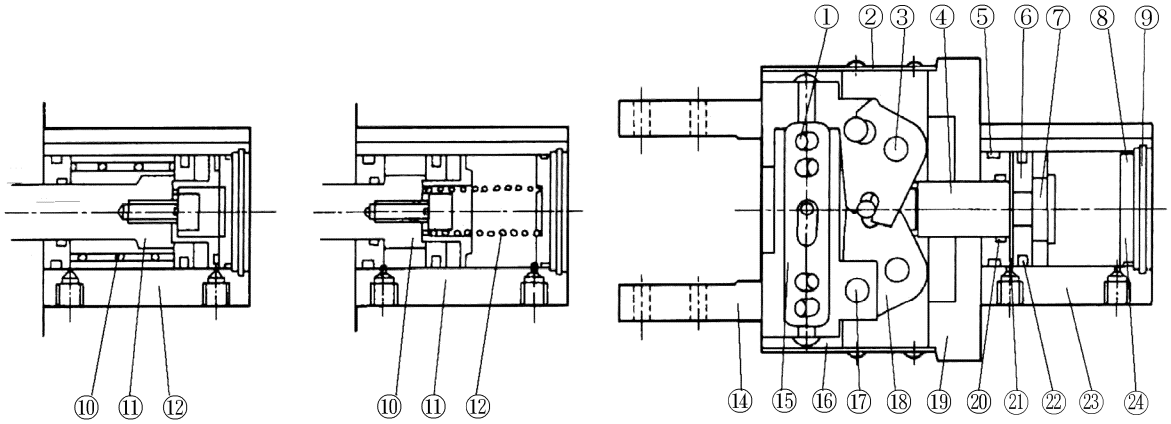
See "5.2 Trouble shooting", should there be any trouble found, also carry out additional tightening if bolts, nuts, etc. are slackened.

## 5.2 Trouble Shooting

| Trouble | Possible Cause | Countermeasure |
|---|---|---|
| Does not operate | No pressure or inadequate pressure | Provide an adequate pressure source. |
| | Signal is not transmitted to direction control valve | Correct the control circuit |
| | Broken parts | Refer to Table of Damage or Deformation |
| | Broken packing | Replace the packing. |
| Does not function smoothly | Insufficient pressure | Increase the pressure. |
| | Chip or foreign particles caught | Clean and remove chips or particles. |
| | Broken packing | Replace packing. |
| Breakage and/or deformation | Too heavy Claws | Make claws light. |
| | Too long Claws | Make claws short. |
| | Exertion working pressure | Reduce the pressure. |
| | External load is charged | 1) Take some remedy to remove charging external load.<br>2) Review the model and the way using it. Correct the misusage. |

## 5.3 Internal Structure and Lists of Parts

### 1) Internal Structure




| No. | Parts | Material | Remarks |
|---|---|---|---|
| ① | Cross roller | | |
| ② | Side cover | Stainless | |
| ③ | Supporting shaft | Carbon steel | |
| ④ | Piston rod | Stainless | |
| ⑤ | Cylinder gasket A | | |
| ⑥ | Piston A | Aluminum | |
| ⑦ | Piston B | Stainless (40 to 63CS)<br>Acetal resin (32CS) | |
| ⑧ | Cylinder gasket B | | |
| ⑨ | Snap ring | | |
| ⑩ | Spring | | C type only |
| ⑪ | Piston | | |
| ⑫ | Cylinder | | |
| ⑬ | Spring | | C type only |
| ⑭ | Master jaw | Carbon steel | |
| ⑮ | Retainer | Stainless | |
| ⑯ | Bearing guide | Carbon steel | |
| ⑰ | Operating shaft | Carbon steel | |
| ⑱ | Arm | Carbon steel | |
| ⑲ | Body | Aluminum | |
| ⑳ | Rod packing | | |
| ㉑ | Cushion | Resin | |
| ㉒ | Piston packing | | |
| ㉓ | Cylinder | Aluminum | |
| ㉔ | Cylinder cover | Aluminum (32CS, 50 to 63CS)<br>Acetal resin (40CS) | |

# 6. OPEN-CLOSE CONFIRMATION SWITCH

## 6.1 Characteristic of Unit with Solid state Switch

1) Reliable detection accuracy
   Reliability is highly maintained due to being solid state switch having no moving components.
2) No chattering
   There is no chattering generated due to being solid state switch.
3) Remarkable saving of wiring man-hours (S2)
   Because of the same wiring as for reed switch is serviceable due to being two-wire type, it saves wiring man-hours remarkably.
4) No requirement of an independent source of power for switch (S2)
   Due to being two-wire type, no individual source of power for switch is required.
5) Bulk capacity of Load Open and Close
   S3 type directly Opens and Closes the load, max, 200mA, DC30V
6) Semi permanent service life
   Its service life is almost semi permanent, of course.
7) Compact
   S model switches have been improved further compactly to such dimensions as 5.5mm wide and 21mm long.

## 6.2 Characteristic of Unit with Reed Switch

1) Models S0 and S5 have been improved to be able connected with all port sizes.
2) Double duty for AC/DC concurrently
   Structures of models have been unified to serve for relays and programmable controllers of AC as well as DC.

## 6.3 Specifications of switch

| Type · Model / Item | Solid state Switch | |
|---|---|---|
| | S2 | S3 |
| Applications | For use exclusively with programmable controller | For use with programmable controller, relay |
| Power supply voltage | — | DC10V to 28V |
| Load voltage | DC10V to 30V | DC30V or less |
| Load current | 5 to 30mA (Note 2) | 100mA or less |
| Current consumption | — | 10mA or less at DC24V (ON lighting) |
| Internal voltage drop | 4V or less | 0.5V or less |
| Indicator light | LED (Lights while power is ON) | |
| Leakage current | 1mA or less | 10 μA or less |
| Lead wire length (Note 1) | 1m (Oil-resistant PVC insulated and cabtire cord 2 conductor 0.2mm²) | 1m (Oil-resistant PVC insulated and cabtire cord 3 conductor 0.2mm²) |
| Shock resistance | 100G | |
| Insulation resistance | 100MΩ or more measuring with DC500V megger tester | |
| Withstand voltage | No abnormality permissible after applying 1000V AC for 1 minute. | |
| Ambient temperature | 5 to 60℃ | |
| Degree of protection | IEC Standard IP67, JIS C 0920 (Watertight Type), oil-resistant | |

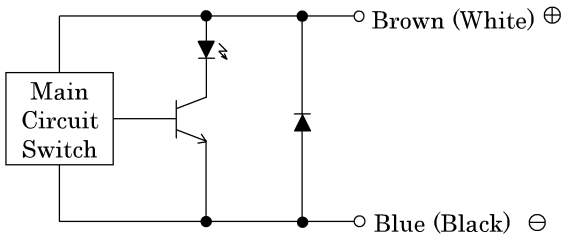
| Type · Model / Item | Reed Switch | | | |
|---|---|---|---|---|
| | S0 | | S5 | |
| Applications | For use exclusively with programmable controller | | For use with programmable controller, relay | |
| Power supply voltage | — | | | |
| Load voltage | DC12/24V | AC100V | DC12/24V | AC100V |
| Load current | 5 to 50mA | 7 to 20mA | 50mA or less | 20mA or less |
| Current consumption | — | | 10mA or less at DC24V (ON lighting) | |
| Internal voltage drop | 2.4V or less | | 0V | |
| Indicator light | LED (Lights while power is ON) | | Without | |
| Leakage current | 0mA | | | |
| Lead wire length (Note 1) | 1m (il-resistant PVC insulated and cabtire cord 2 conductor 0.2mm²) | | | |
| Shock resistance | 30G | | | |
| Insulation resistance | 100MΩ or more measuring with 500V megger tester | | | |
| Withstand voltage | No abnormality permissible after applying 1000V AC for 1 minute. | | | |
| Ambient temperature | 5 to 60℃ | | | |
| Degree of protection | IEC Standard IP67, JIS C 0920 (Watertight Type), oil-resistant | | | |

Note 1 : 3m or 5m long lead wire is optionally available.

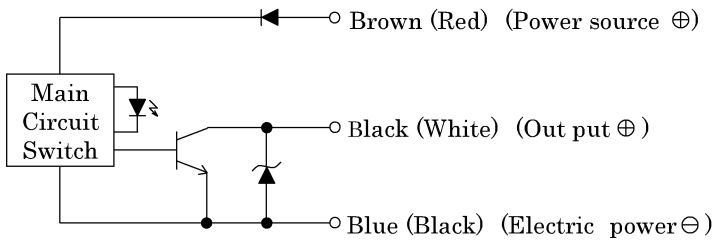
Note 2 : Maximum load current capacity posted above is that of when ambient temperature is 25℃. Current capacity will drop less than this valve when temperature exceeds 25℃. (for S2 type : 5 to 15mA at 60℃)

## 6.4 Internal Structure of Switch

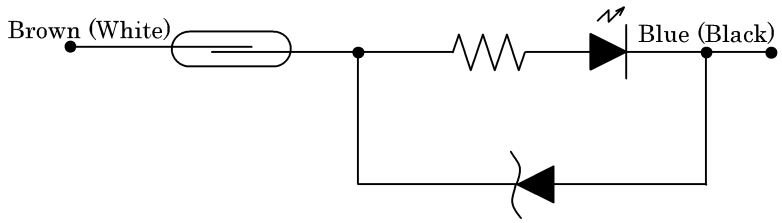
●S2



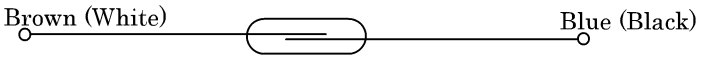

●S3




●S0

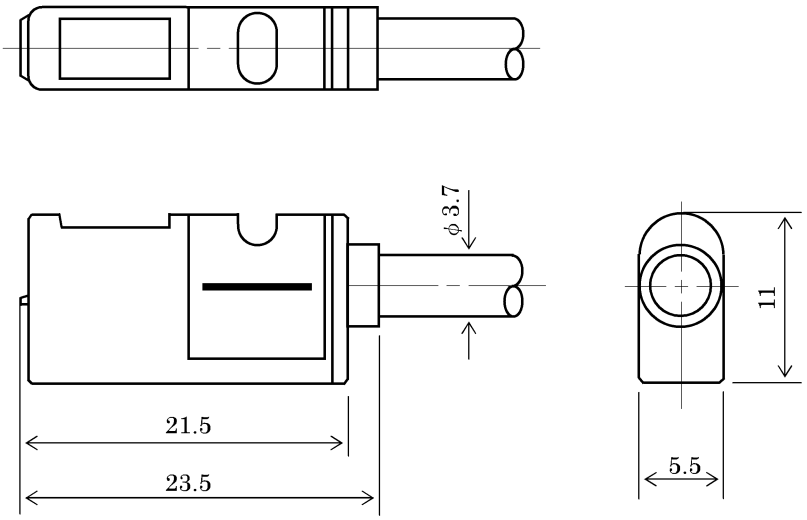



●S5



## 6.5 External dimensions of switches

●S※series



## 6.6 Operational Cautions, Solid state switch, Model S2 and S3

1) Connections of lead cord

Comply with the color-coding specified on the illustrations. Be sure to turn the power off before starting connecting work.

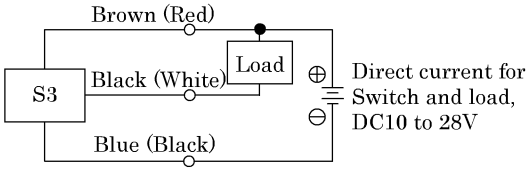



Fig1. An example (1) of fundamental circuit of S3 (In case the power for switch and load is the same.)

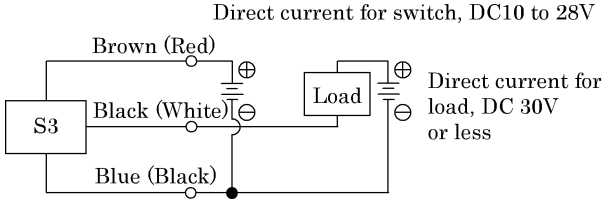



Fig2. An example (2) of fundamental circuit of S3 (In case the power for switch and load is independent.)

2) Protection of output circuit

Install some protective circuit as per illustrated in Fig.3 when inducing type load (Relay or solenoid valve) are to be used because those types apt to generate surge current at turning switch off.

Install some protective circuit as per illustrated in Fig.4 when capacitor type load (Capacitor type) are to be used because those types apt to generate dash current at turning switch ON.

Install some protective circuit as per illustrated in Fig.5 or 6 (in case of model T2) and Fig.7 (in case of model T3).

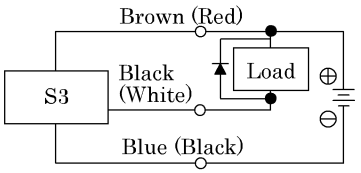



Fig3. An example of using inducting load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.

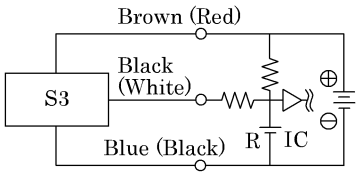



Fig4. An example of using capacitor type load together with current regulating resister R. Company with the following formula to figure out required R.

$$\frac{V}{0.15} = R(\Omega)$$

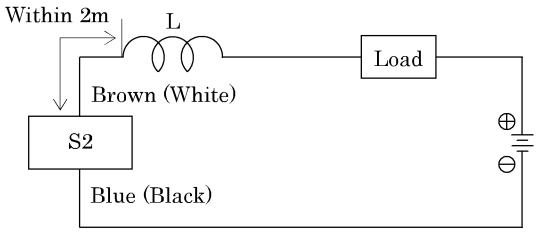



Fig5. ●Choke coil L
L = a couple hundred $\mu$H ～ a couple mH surpassing high frequency characteristic
●Install it near by a switch (within 2m).

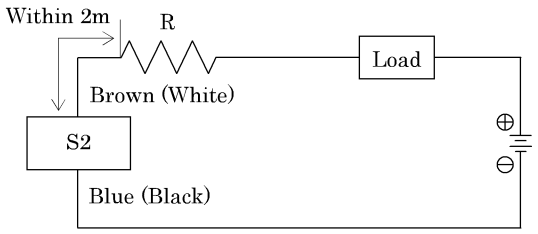



Fig6. ●Rush current restriction resister
R = As much large resister as the load circuit can afford.
●Install it near by a switch (within 2m).

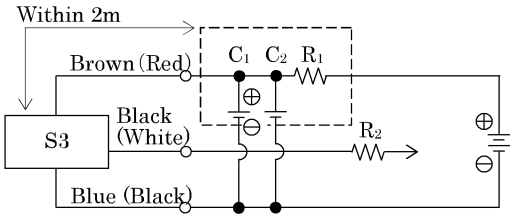



Fig.7

- Electric power noise absorptive circuit C1
  $C_1$ = 20～50 μF electrolytic capacitor
  (Withstand voltage 50V or more)
  $C_2$ = 0.01～0.1 μF ceramic capacitor
  R1 = 20～30 Ω
- Dash current restriction resister R2
  $R_2$ = As much large resister as the load circuit can afford
- Install it near by a switch. (within 2m)

3) Connection to a programmable controller (Sequencer)

Type of connection varies depending upon the model of the programmable controller. Refer to the following Fig.8 to 12 respectively.

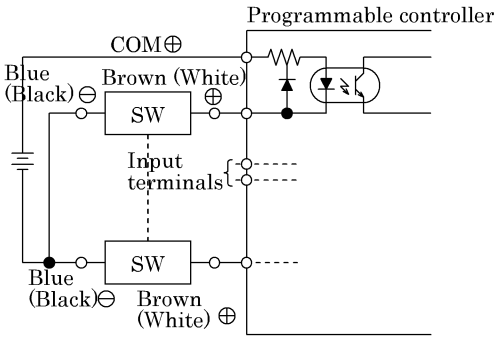



Fig8. An example of S2 model connection to source load input type (an external power of source).

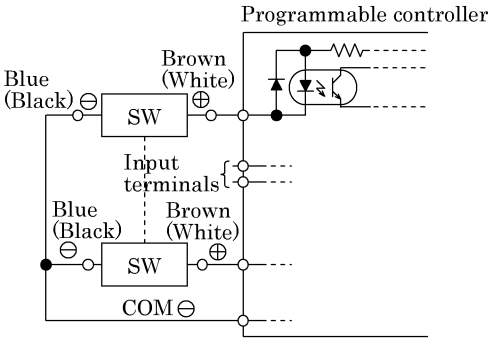



Fig9. An example of S2 model connection to source load input type (an external power of source).

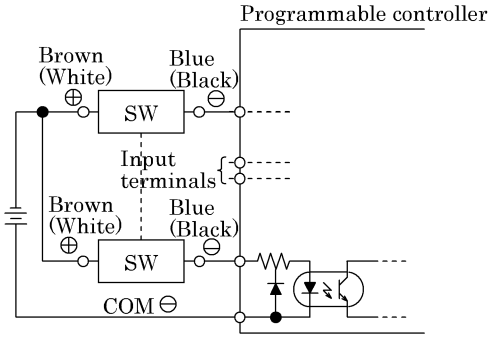



Fig10. An example of S2 model connection to sink load input type.

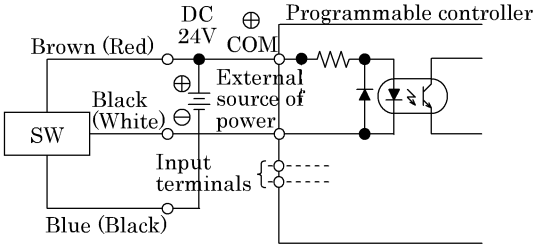



Fig11. An example of S3 model connection to source load input type (an external power of source).

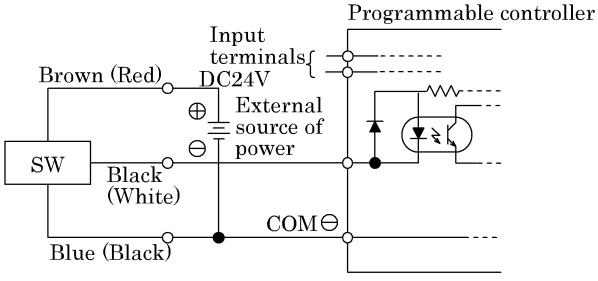



Fig12. An example of S3 model connection to source load input type (an external power of source). S3 switch is, however, unable to be connected to the sink load input sequencer.

※SW=Switch

4) Series connection

The total voltage loss when serial connected S2 switches equals to the sum of respective voltage loss of each switch. Load side voltage is only the residual after total voltage loss. Therefore, confirm the required voltage to the programmable controller input before deciding the number of switches connected in series. It is recommended of consulting us prior to have plural number of S3 switches connected.

5) Parallel connection

When connecting S2 switches in parallel, leakage current multiplies by the number connected. Also, the other switches tentatively become incapable to turn ON while one switch within the parallel connection is turned ON due to the voltage between switch terminals dropping down to the programmable controller input before deciding the number of switches as connected load.

S3 on the contrary, connection of these switches creates very rare problem of multiplied leakage due to almost negligible leakage (less than 10 $\mu$A) or individual switch. It sometimes causes dimmed indicator light or no indicator light lit.

6) Magnetic environment

Avoid usage of these switches within the area where a strong magnetic field or large current exists. (such as a large magnet or spot welding equipment) Position censoring errors will be resulted when installing many cylinders with switch in parallel or magnetized piece come across the cylinder due to intervention among each other.

7) Protection of lead wire

Pay consideration to eliminate repeating bending stress or stretching of the lead cord while laying the cord. To the moving portion, use such cord of flexibility as for building a robot.

## 6.7 Operational Cautions, Reed switch, Model S0 and S5

1) Connections of lead wire

Instead of connecting a cord to the power source directly, always connect to the load in series. In case of model S0 connection, pay the following precautions.

Ⓐ For DC connection, use such polarities of cords as white + and black - . The switch still functions right with reversed polarities but indicator light is not lit.

Ⓑ For AC connection to either relay or input terminal to programmable controller, Switch indicator light sometimes is not lit in case when half-wave rectification is being carried out. Indicator light is lit, in this occasion, when polarities of cords for switch are reversed.

2) Contact protection

Avoid using a load exceeding the max. capacity of contact points. On the other hand, in case of S0 model, switch indicator light may not be lit sometimes when current is lower than rated current.

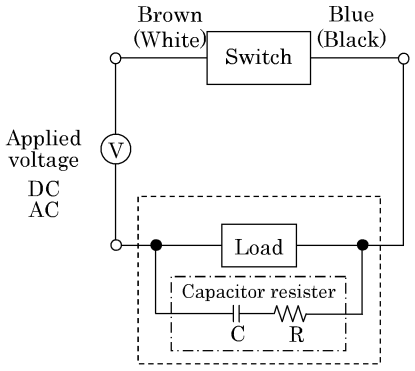
3) Contact protection

Install such protective circuit as illustrated in either Fig.1 or 2, on the following page, when inducing type load such as relay is to be used.

Furthermore, install such protective circuit as illustrated in either Fig.3 or 4, on the following page, in case the cord length exceeds the length per the table 1, right.

Table 1

| Current | Cord length |
|---|---|
| DC | 50m |
| AC | 10m |

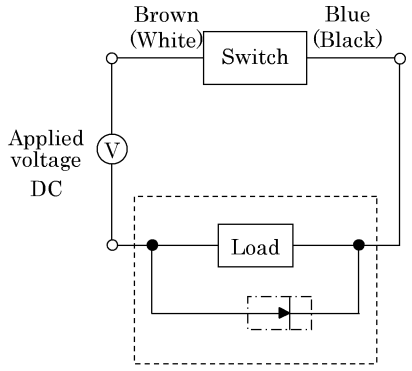



User circuit

Protective circuit (Spark absorbing circuit)

Recommended valve C (Capacitor) = 0.033 to 0.1 μF
R (Resister) = 1 to 3kΩ
KEB1K1 Okaya Denki Mfg. or equivalent

Fig.1 When capacitor resister is used.

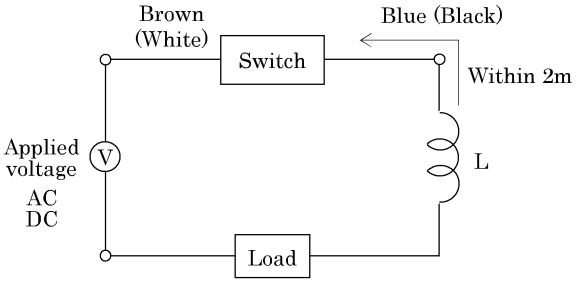



User circuit

Protective circuit

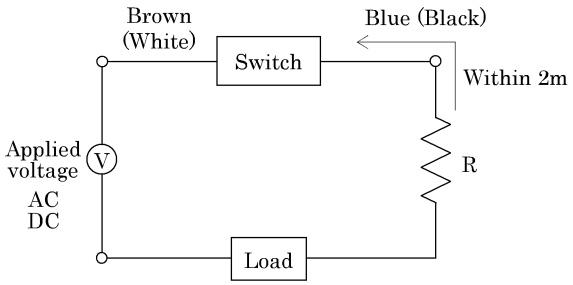
Rectifying diode, general use
Hitachi Mfg. product V06C or equivalent

Fig.2 When Diode is used..




- Choke coil L
  L = a couple hundred μH to a couple mH surpassing high frequency characteristic
- Install it near by a switch (Within 2m).

Fig.3




- Dash current restriction resister R
  R = As much large resister as the load circuit can afford.
- Install it near by a switch (Within 2m).

Fig.4

4) Relay

Use such products as specified below or equivalent.

- ○ OMRON Corporation·····model MY
- ○ FUJI ELECTRIC CORP·····model HH5
- ○ Panasonic, Ltd.·····model HC

5) Serial connection

Total voltage loss, when connected S0 switches in series, equals to the sum of respective voltage loss of each switch. The total voltage loss becomes equivalent to one S0 (approx. 2.4V) when connecting the combination of one S0 for actuation confirming and rest of switches S5. Indicator light is lit only when all switches turn on.

6) Parallel connection

There is no restriction in parallel connection number of switches of these types. Multi number connection of model S0, sometimes, cause dimmed indicator light or no indicator light lit.

7) Magnetic environment

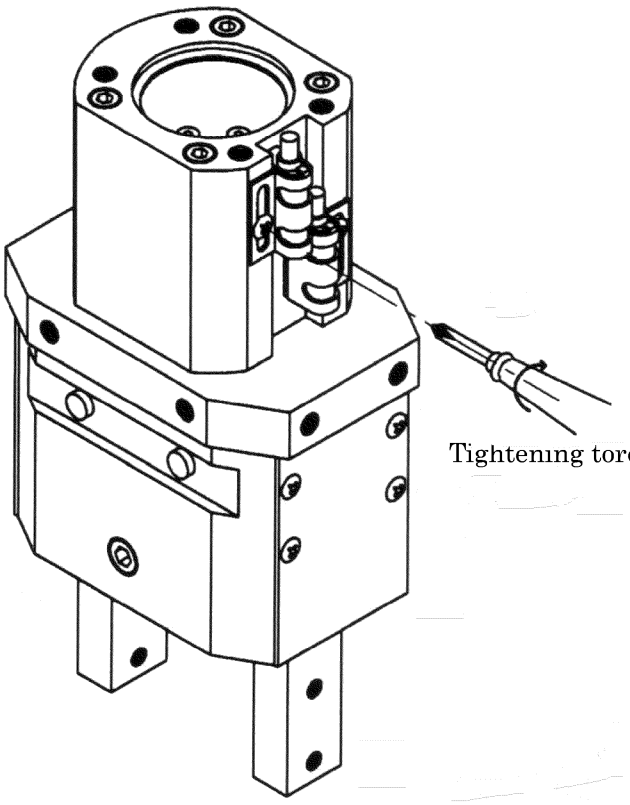
Avoid usage of these switches within the area where a strong magnetic field or large current exists. (such as a large magnet or spot welding equipment) Position censoring errors will be resulted when installing many cylinders with switch in parallel or magnetized piece come across the cylinder due to intervention among each other.

8) Protection of lead wire

Pay consideration to eliminate repeating bending stress or stretching of the lead cord while laying the cord. To the moving portion, use such cord of flexibility as for building a robot.

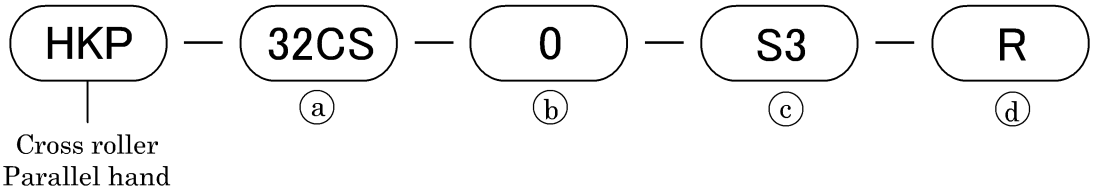
## 6.8 Switch Adjustment

To adjust the Open-close confirmation Switch, slide the switch first to find the location where Indicator light turns ON. Keep sliding the switch for further 0.3 to 0.5 further away, and then fix the switch at that position.



# 7. MODEL CODE

## 7.1 Model Code of Product itself




| (a) Size | (b) Option | | (c) Model code of Switch | | (d) Qty of Switches | |
|---|---|---|---|---|---|---|
| 32CS | No code | Standard (Double action) | S2※ | Rees・ 2-wire | R | Open side, 1 ea. |
| 40CS | O | Single action (Normally Open) | S3※ | | H | Close side, 1 ea. |
| 50CS | C | Single action (Normally Closed) | S0※ | Solid state・ 3-wire | D | 2 ea. |
| 63CS | G | With rubber cover (nitrile rubber) | S5※ | | | |

| ※ Length of Lead cord | |
|---|---|
| No mark | 1m (Standard) |
| 3 | 3m (Optional) |
| 5 | 5m (Optional) |