CKD

SM－10428－A

INSTRUCTION MANUAL

CROSS ROLLER PARALLEL HAND

BHA 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 5th edition

For Safety Use

To use this product safety, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (ISO 4414 *1, JIS B 8370 *2).

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:

⚠ CAUTION :

- 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 connection (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.

*1) ISO 4414 : Pneumatic fluid power ··· Recommendations for the application of equipment to transmission and control systems.

*2) JIS B 8370 : General rule for pneumatic systems

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BHA Series
Cross roller parallel hand
Manual No. SM-10428-A

May. 1993
Revision: Oct. 15. 2002

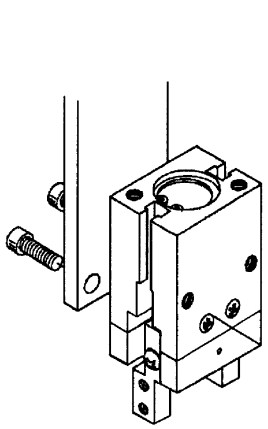
1. PRODUCT

1.1 Specifications

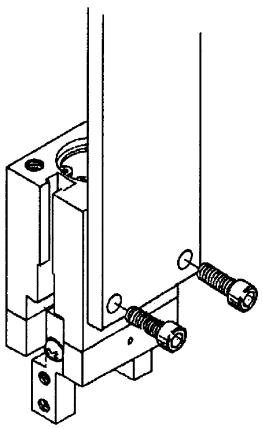
Item			BHA			
Size			01CS1	03CS1	04CS1	05CS1
Cylinder bore size		mm	ϕ 12	ϕ 16	ϕ 20	ϕ 25
Actuation			Double acting ・ Single acting			
Working fluid			Compressed air			
Max. working pressure		MPa	0.7			
Min. working pressure	Double acting	MPa	0.1			
	Normal open		0.3			
	Normal close					
Ambient temperature		℃	5 to 60			
Port size			M3	M5		
Operational stroke length		mm	5	9	11	15
Rod diameter		mm	ϕ 6	ϕ 8	ϕ 10	ϕ 12
Volumetric capacity (reciprocating)		cm^3	0.32	1.58	2.89	6.32
Repeatability		mm	±0.01			
Product weight		kg	0.100	0.145	0.253	0.420
Lubrication			Not required (For lubrication, use turbine oil class 1 ISO VG32)			

1.2 Characteristics of Unit

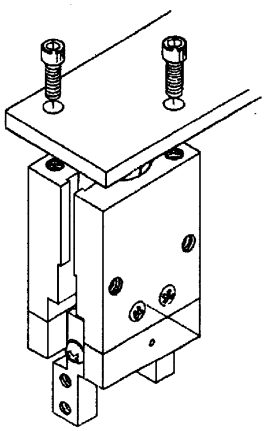
1) Use of cross-roller guide ensures highly precise and smooth actuation.
   A cross-roller guide is used for the sliding part. Highly precise and smooth actuation without play can be performed by applying the pre-pressure.
2) Compact yet powerful clumping.
   It bears large moment of load owing to the design of overlapping sliding part with long supporting arms.
3) Mounting the "Open-Close confirming switches" is available.
   Up to 2ea of solid state switches are able to be mounted on every model of units.
4) Easy installation in 3 different ways.
   Designing of overall facility is accomplished easily with no annoyance of lay-out owing to three side-mounting surfaces provided to the unit.



Rear mounting



Front mounting

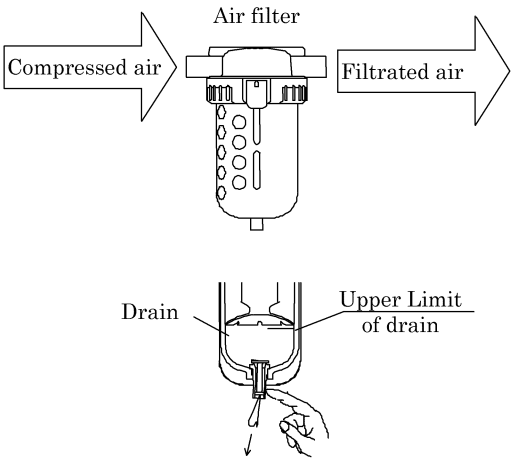


Top end mounting

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 μ 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.

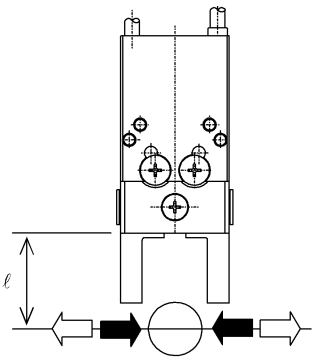
3) Note that the intrusion of carbide for the compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of the solenoid valve and the cylinder. Be sure to carry out thorough inspection and maintenance of the compressor.

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. GRIPPING POWER

3.1 Gripping Power and Mass of Load

1) The table of Gripping 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. mass of load capable to grip.



2) Required gripping 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 gripping power) comparing with mass of Load

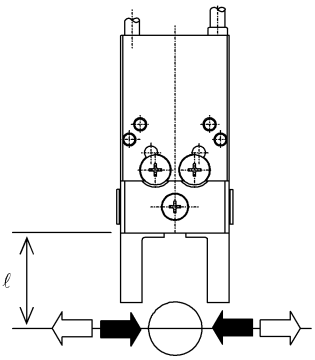
Safety coefficients for holding power against mass of Load are set as follows although it varies depending on Coefficient between Load and Claw, Shape of Load and Claws, transferring condition etc. Make those brief guide line for selecting models.

- Holding only W : (F×N) = 1 : 5
- Normal transference W : (F×N) = 1 : 10
- Transference with high acceleration W : (F×N) = 1 : 20

W	=	Workpiece weight
F	:	Gripping force (See also the gripping force performance data.)
N	:	Number of claws

3.3 Data of Clumping Power

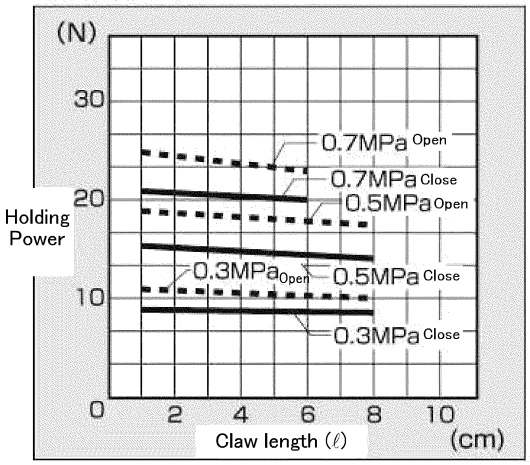
The following Tables represent the Gripping power in either opening motion or closing motion with Claw length ℓ of hand at 0.3, 0.5 & 0.7MPa of Supplying pressure.



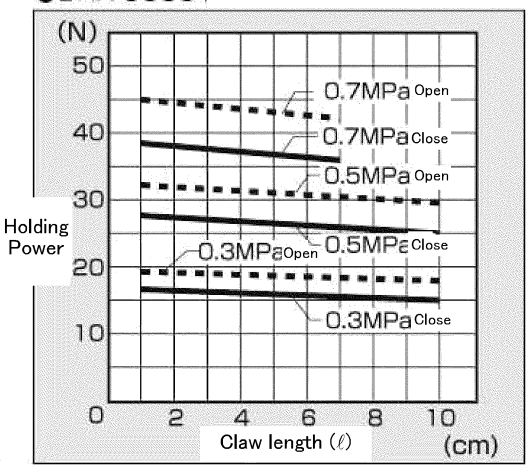
- Opening Motion (⇦) ---------- (Broken line)
- Closing Motion (➡) ———— (Full line)

(Note) Clumping power of O type, in the closing way, falls 20 to 30% lower than that of double acting type.
Clumping power of C type, in the opening way, falls 10 to 20% lower than that of double acting type.

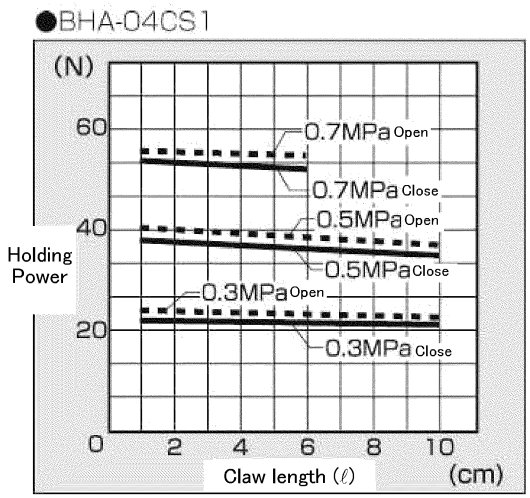
●BHA-01CS1



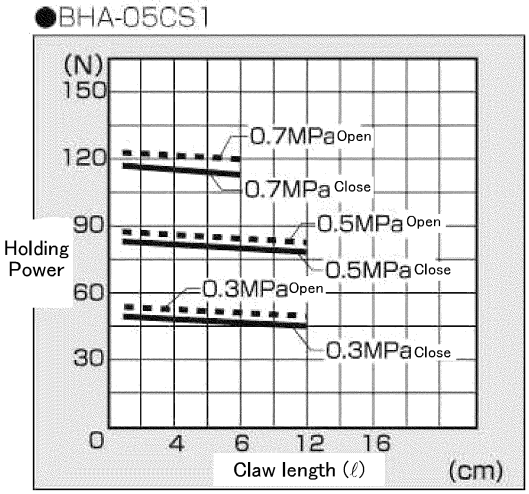
●BHA-03CS1



●BHA-04CS1



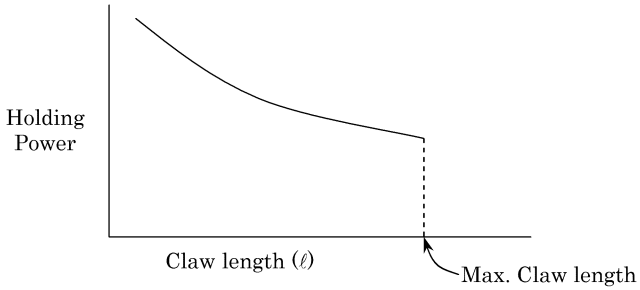
●BHA-05CS1



3.4 Length 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 above.



4. INSTALLATION

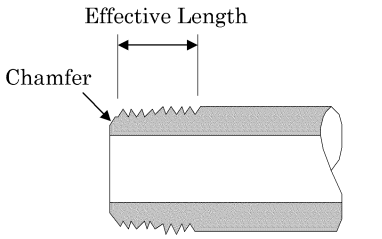
4.1 Piping

1) For piping beyond the filter, use pipes that are tough against corrosion such as galvanized pipes, nylon tubes, rubber tubes, etc.

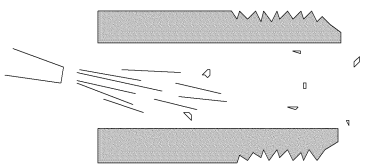
2) See to it that the pipe connecting hand and solenoid valve has effective cross-sectional area which is needed for the hand to drive at the specified speed.

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.

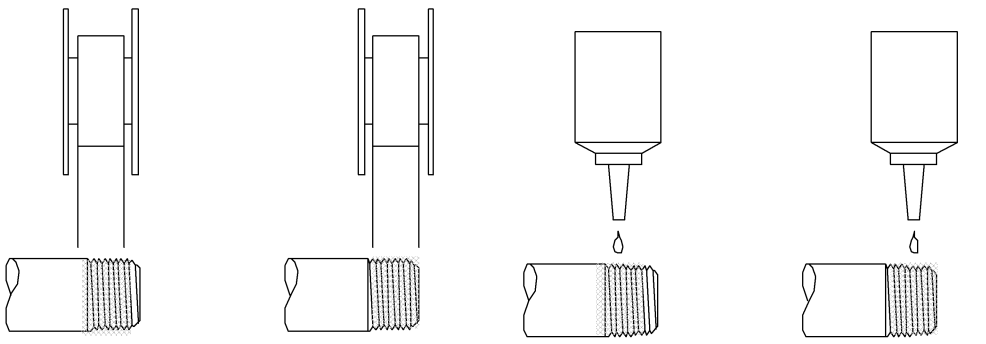


5) Flush air into the pipe to blow out foreign substances and chips before piping.



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.

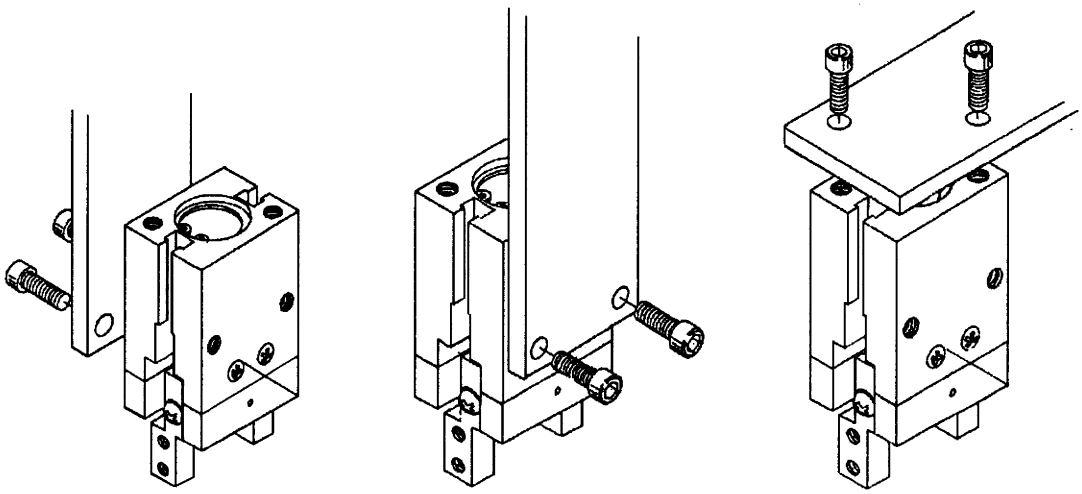
●Seal Tape　　●Sealant (Paste or liquid)



(Correct)　(Incorrect)　(Correct)　(Incorrect)

4.2 Installation

1) Ambient Temperature
   - The range of temperature is 5 to 60℃ where 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 dusts exist and splash of water or oil is foreseen.
3) Installation of Body
   - Body mounting from either one of three sides are available.
     Select an appropriate mounting method suitable for the customer's application.

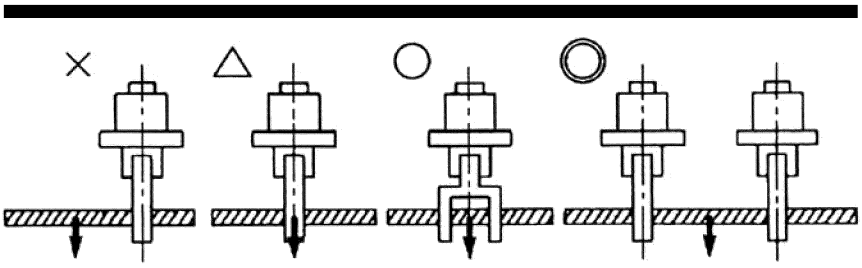


Rear mounting　　Front mounting　　Top end mounting

4) Thread diameter and depth of Body mounting bolt hole

Model	Diameter and Depth of threaded hole	
	Rear or front mounting	Top end mounting
BHA-01CS1	M3, Depth 7	M3, Depth 7
BHA-03CS1	M4, Depth 7	M4, Depth 8
BHA-04CS1	M5, Depth 8	M5, Depth 8
BHA-05CS1	M6, Depth 10	M6, Depth 10

5) In case of handling long material
It is mandatory to grip it at the center of gravity for stable lifting, it may sometime be necessary to use dual hands for more stability.



6) Others
Consult us prior to 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.

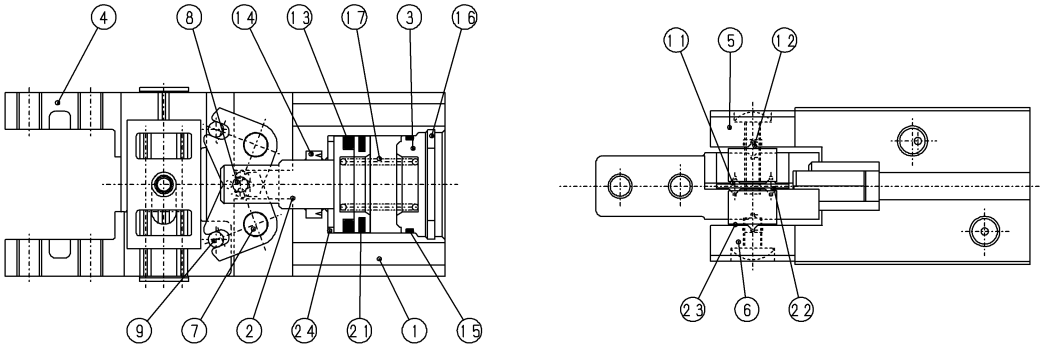
1) Inspection items
(1) Apply grease to sliding portion.
(2) Check whether its operation is smooth.
(3) Check for any air leakage.
(4) Check for any slackened bolts
(5) Check for any play to master jaws.
(6) Check if there is any abnormal strokes.

Inspect the above items.

5.2 Internal Structure and Lists of Parts and Packings

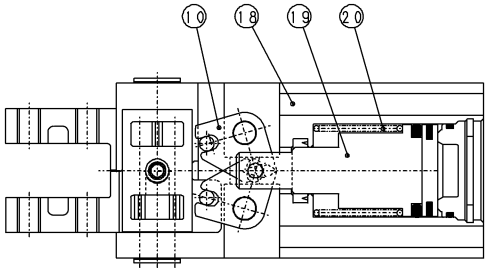
1) Internal Structure

Standard (Double acting), O type (Single acting: Normally Open type)



※ No spring ⑰, is used for standard (double acting) hands.

C type (Single acting: Normally Close type)



2) Parts List

No.	Name of parts	Material	Note	No.	Name of parts	Material	Note
①	Body	Aluminum		⑬	Piston seal		
②	Piston	Stainless steel		⑭	Rod packing	Nitrile rubber	
③	Cylinder cover	Aluminum		⑮	Cylinder gasket	Nitrile rubber	
④	Master key	Carbon steel		⑯	Snap ring		
⑤	Bearing guide A	Carbon steel		⑰	Spring	Stainless steel wire	For O type only
⑥	Bearing guide B	Carbon steel		⑱	Body	Aluminum	
⑦	Fulcrum shaft	Carbon steel		⑲	Piston	Stainless steel	
⑧	Function shaft A	Carbon steel		⑳	Spring	Stainless steel wire	
⑨	Function shaft B	Carbon steel		㉑	Magnet		
⑩	Arm	Carbon steel		㉒	Retainer A		
⑪	Cross roller A			㉓	Retainer B		
⑫	Cross roller B			㉔	Cushion		

6. OPEN-CLOSE CONFIRMATION SWITCH

6.1 Features

1) Solid state switch
   Service life is almost infinite, also Open-close load capacity is large.
2) Indicator light
   It makes confirmation of actuation or maintenance inspection easy.
3) No restriction regarding its mounting location
   Its relocation is also carried out easily by just loosening fixing screw.

6.2 Specifications

Model / Item	T2H-T2V	T3H-T3V
Type	Solid state switch	
Applications	Exclusively for Programmable controller	For Programmable controller or Relay
Power supply voltage	—	DC10V to DC28V
Load voltage	DC10V to DC30V	DC30V or lower
Load current	5 to 20mA (Note 1)	100mA or lower
Indicator light	Red LED is lit while source of power is ON	
Kind of lead wire	Oil-resistant PVC insulated and cabtyre cable, 2-cord 0.2mm²	Oil-resistant PVC insulated and cabtyre cable, 3-cord 0.2mm²
Ambient temperature	-10 to 60℃	
Current consumption	—	10mA or lower at DC24V (When the power is ON)
Leakage current	1mA or lower	10 μA or lower
Degree of protection	IEC Standard IP67 JISC0920 (water tight type), Oil resistance	
Shock resistance	980m/s²	
Insulation resistance	20MΩ on DC500V megger tester	
Withstand voltage	Should withstand for 1 minute under AC1,000V	
Hysteresis (Single claw)	1.0mm or less	
Mass of unit with attachment	20g	

Note1 : Maximum value of load current specified as above is at 25℃. The value falls lower when ambient temperature of switch raises higher than 25℃.
(Example: 5mA to 10mA at 60℃ for T2 type.)

1) Hysteresis
   There is hysteresis to cylinder switch as well as it is to micro switch.

(It is a distance between where switch turns ON while piston moves a certain direction and where the said switch turns OFF as piston reverses its stroke.)

6.3 Internal Structure of Switch and Wire Connection

1) Connection of lead cord

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

An erroneous wiring or short circuiting of load causes damage to not only switches, but also load side circuit. Wiring work without shutting electricity off may cause damage to the load side circuit

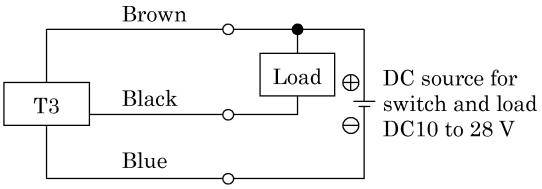


Fig.1 Fundamental circuit Example of T3 (1)
(In case the same source of power is used.)

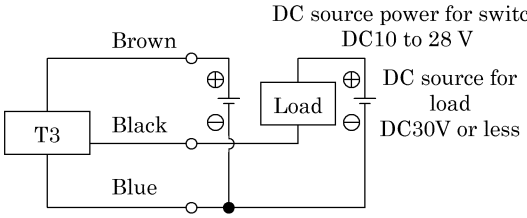


Fig.2 Fundamental circuit Example of T3 (2)
(In case individual sources of power are used.)

2) Protection of output circuit

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

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

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

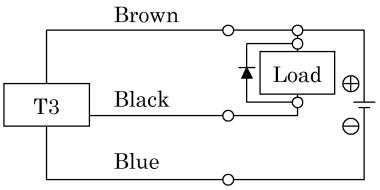
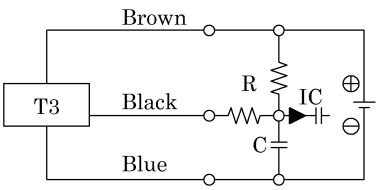


Fig.3 An example of using inducing load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.)



Flg.4 An example of using capacitor type load together with current regulating resister R.
Comply with the following formula to figure out required R.

$$\frac{V}{0.05} = R(\Omega)$$

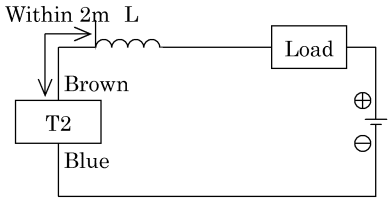


Fig.5 ・Choke coil
L= a couple hundred μ H to a couple mH surpassing high frequency characteristic
・Install it near by a switch (within 2m).

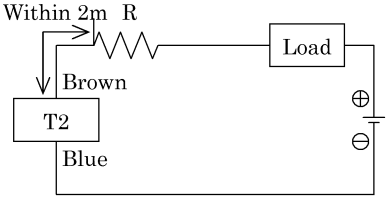


Fig.6 ・Dash current restriction resister.
R= As much large resister as the load circuit can afford.
・Install it near by a switch (within 2m).

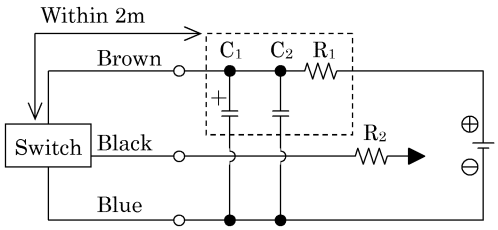


Fig7・ Electric power noise absorptive circuit.
C_1=20 to 50 μF electrolytic capacitor
(Withstand voltage 50V or more)
C_2=0.01 to 0.1 μF ceramic capacitor
R_1=20 to 30 Ω

・ Dash current restriction resister.
R_2=As much large resister as the load circuit can afford.
・ Install it nearby the 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.

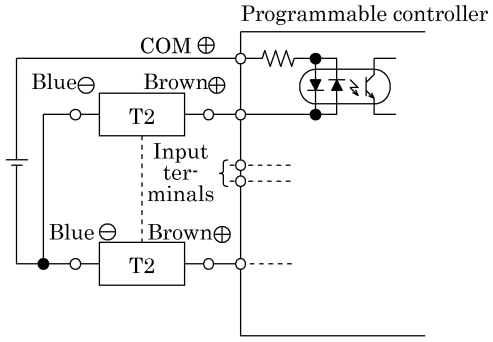


Fig.8 An example of T2 connection to source input type (an external power source)

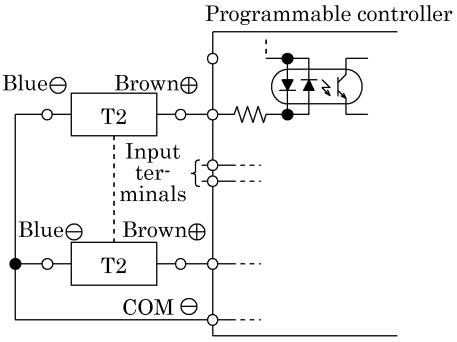


Fig.8 An example of T2 connection to source input type (an internal power source)

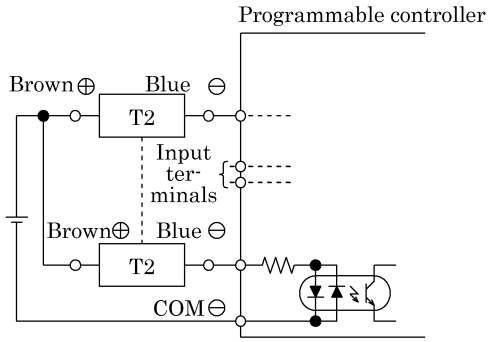


Fig.10 An example of T2 connection to source input type

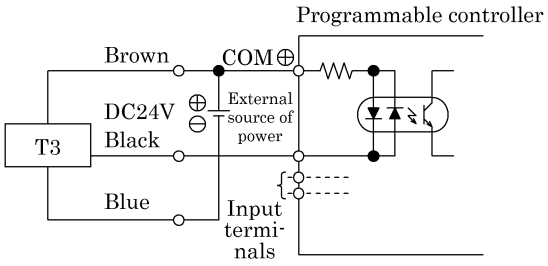


Fig.11 An example of T3 connection to source input type (an internal power source)

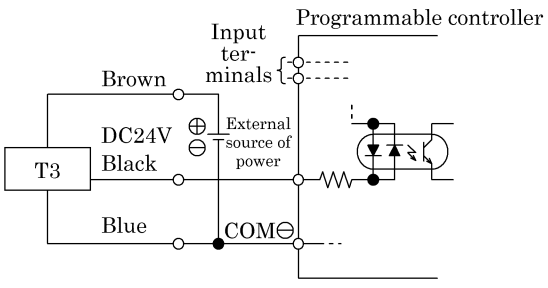


Fig.12 An example of T3 connection to source input type (an internal power source)

4) Magnetic environment
Do not operate this product in a place where a strong magnetic field or large current (large magnet or spot welder, etc.) exists. If a cylinder with the switch is installed in parallel to this product or the magnetic substance moves near the cylinder, the mutual interference may occur and affect the detection accuracy.

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

6) Series connection
The total voltage will decrease when the T2 switches connections have a leak. Therefore, confirm the input specifications for the programmable controllers, which are the connecting load. However, dimming or total failure of the indicator light may exist.
T3 switches hardly ever leak. When less than 10 μA, then leakage may occur. Usually dimming and failure of the indicator light do not occur.

7) Series connection

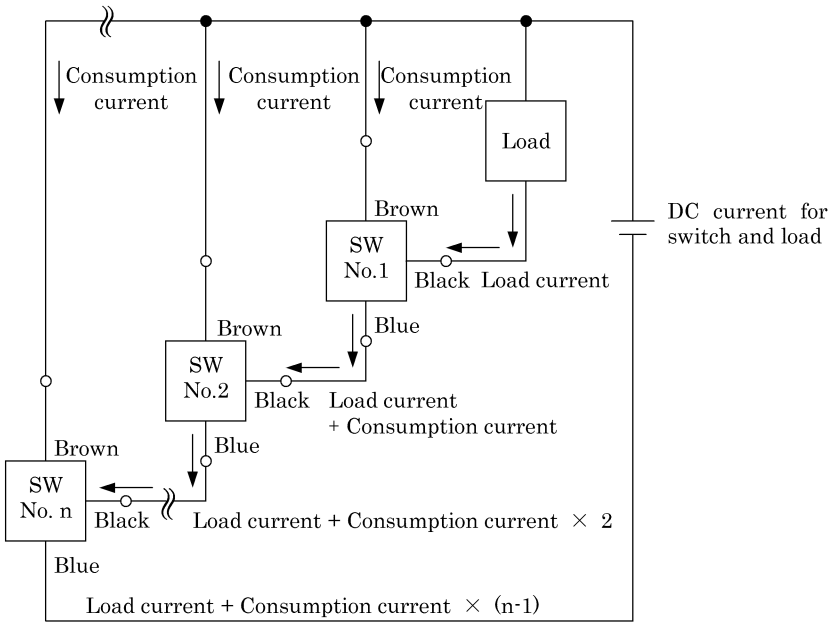
When connecting multiple T2 switches in series, the voltage drop at the switch becomes the sum of voltage drop levels of all connected switches.

The voltage applied to the load side is that the voltage drop at the switch is subtracted from the power supply voltage. Therefore, the number of switches to be connected is determined while carefully checking the load specifications.

When connecting multiple T3 switches in series, the voltage drop at the switch becomes the sum of voltage drop levels of all connected switches in the same manner as described for the T2 switch.

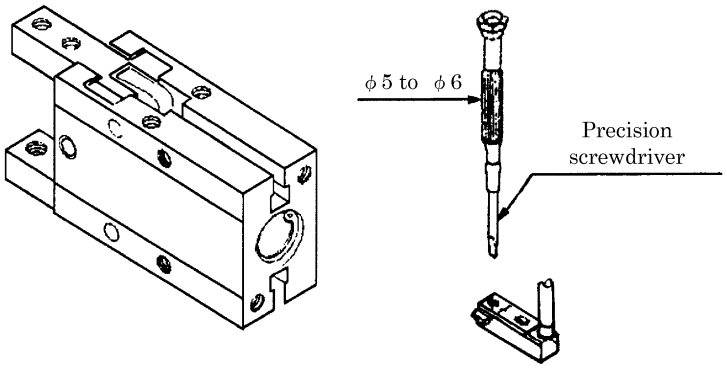
Additionally, the current flowing through the switch is the sum of the Current consumption and load current of the connected switches as shown in the Fig. below.

Therefore, the number of switches to be connected is determined while carefully checking the load specifications so that the current does not exceed the maximum load current of the switch.



6.4 Switch Adjustment

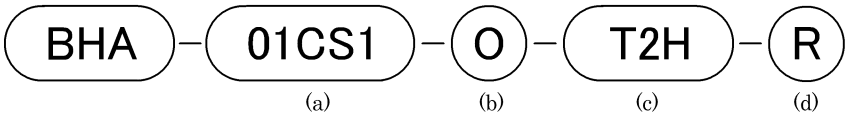
To adjust the Open-close confirmation Switch, side the switch first to find the location where indicator light turns ON. Keep sliding the switch for further 0.3 to 0.5mm further away, then fix the switch at that position.



Note) Precision screwdriver as illustrated with handle diameter of approx. 5mm to tighten up the mounting screws.
Apply tightening torque of 10 to 20N･cm

7. HOW TO ORDER

7.1 Model of Product itself



(a) Size	(b) Option		(c) Switch model			
01CS1	No code	Standard (Double acting)	Shape of lead connection		Switch type	Lead wire
03CS1	O	Single acting (Normally open)	Straight type	L type		
04CS1	C	Single acting (Normally closed)	T2H	T2V	Solid state	2-wire
05CS1	Y1	With Small jaw, material (S50C)	T3H	T3V		3-wire
	Y2	With Small jaw, material (MC Nylon)	※ Length of Lead wire			
			No code	1m (Standard)		
			3	3m (Optional)		
			5	5m (Optional)		

(d) Q'ty of switches	
R	Open side, 1ea on
H	Close side, 1ea on
D	2ea