CKD

SM－245876－A

INSTRUCTION MANUAL

Table type Rotary actuator

GRC 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 3rd 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:

⚠ 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 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.

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1. UNPACKING

1) Make sure that the type No. on the nameplate of the delivered Super Micro Cylinder matches the type No. you ordered.

2) Check the appearance for any damage.

3) Stop up the piping port with a sealing plug to prevent the entry of foreign substances into the cylinder. Remove the sealing plug before piping.

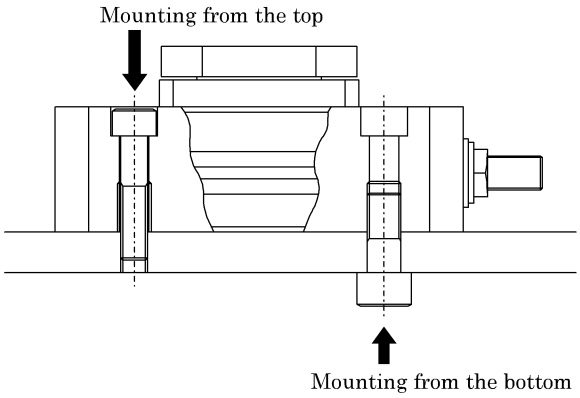
2. INSTALLATION

2.1 Installation

1) Operate Rotary actuator within the range (0℃ to 60℃, standard) of tolerance ambient temperature.

2) Install Rotary actuator directly on the mounting plate using hex. socket headed bolts.

3) The piping port can be selected from three surfaces. The piping ports other than those on the sides are filled with stoppers on shipment.

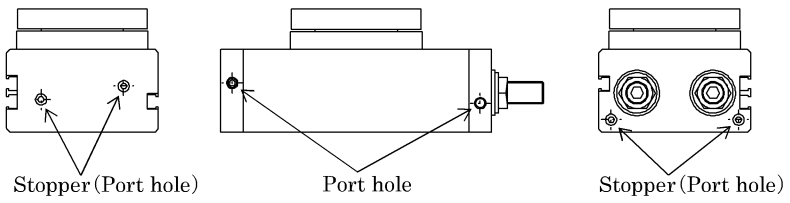


Replace the stoppers when using these piping port other than those on the sides. Be sure to apply a recommended bond to the holes for models GRC-5 to 30, or to apply a recommended bond or sealing tape for models GRC-50 and 80. Otherwise, air leakage may result.

Recommended bond

Loctite 222
[Loctite Japan Corp.]

ThreeBond 1344
[ThreeBond Co.]



4) Refer to the table1 for the tightening torque for the shock killer static nut. Applying excessive torque may cause the breakage of the shock killer.

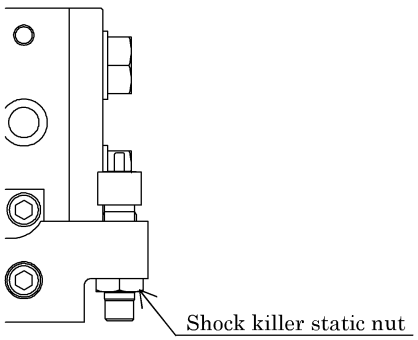
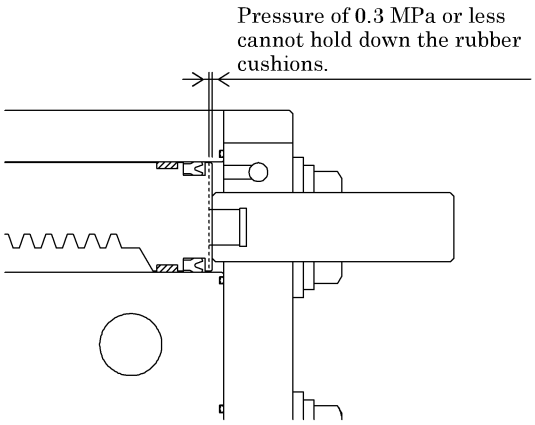


Table1

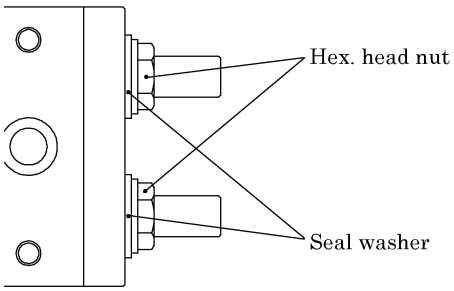
Size	5	10	20	30	50	80
Tightening torque (N·m)	1.47		1.96		5.14	8.58

5) Rubber cushions are embedded in the GRC (Basic type and High-precision type).
A pressure of 0.3 MPa or less may not be enough to hold down the rubber cushions. Be sure to use a pressure of more than 0.3 MPa to ensure accuracy at the end of oscillation.



6) When replacing the Seal washer sealing the Adjustable angle stopper bolt (Hex. head bolt for Equipped with external shock killer type), securely tighten the Hex. head nut (Hex. head bolt for Equipped with external shock killer type) accotdin to the tightening torque shown below. Otherwise, air leakage may result.

● Basic type･High-precision type



● Equipped with external shock killer

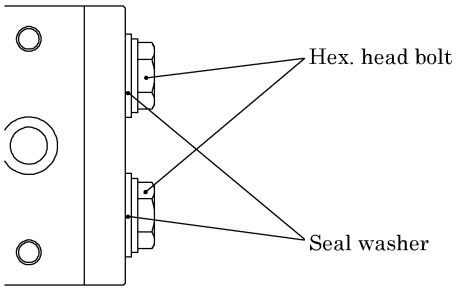


Table2

Size	Tightening torque (N･m)	
	Basic type･High-precision type	Equipped with external shock killer
5	5.9±10%	3.4±10%
10	9.4±10%	4.9±10%
20	11.8±10%	6.9±10%
30	11.8±10%	6.9±10%
50	22.1±10%	8.8±10%
80	22.1±10%	8.8±10%

2.2 Allowable Load

If a load is directly applied onto the table, limit it to within the value shown in the table3. If a composite load is applied, limit the total of the ratio between each applied load and the respective allowable load to 1.0 or less as shown in the equation.

$$\frac{W_S}{W_{S\,max}} + \frac{W_R}{W_{R\,max}} + \frac{M}{M\,max} \leqq 1.0$$

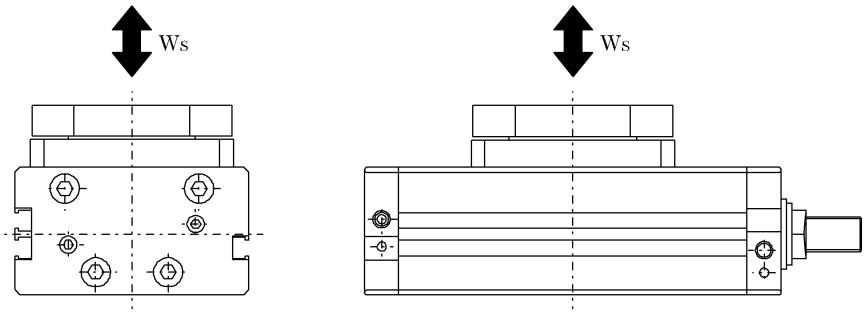
W_S : Thrust load (N)
W_R : Radial load (N)
M : Moment load (N・m)
$W_{S\,max}$: Allowable thrust load (N)
$W_{R\,max}$: Allowable radial load (N)
M max : Allowable moment load (N・m)

Table3

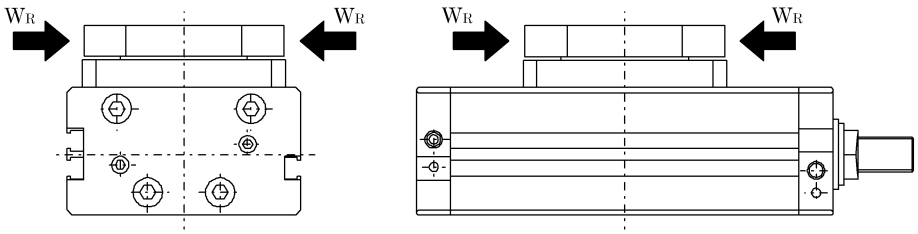
Size		5	10	20	30	50	80
Allowable thrust Load $W_{S\,max}$ (N)	Basic type	50	80	140	200	450	580
	High-precision type	—	120	220	440	550	650
Allowable Redial load $W_{R\,max}$ (N)	Basic type	30	80	150	200	320	400
	High-precision type	—	100	160	240	380	480
Allowable Moment load M max (N・m)	Basic type	1.5	2.5	4.0	5.5	10.0	13.0
	High-precision type	—	3.0	5.0	7.0	12.0	15.0

Loads are classified into the following three types. Calculate each load and check if each result is within the allowable load. Then, substitute the values in the equation on page 5 and check if the result is 1.0 or less.

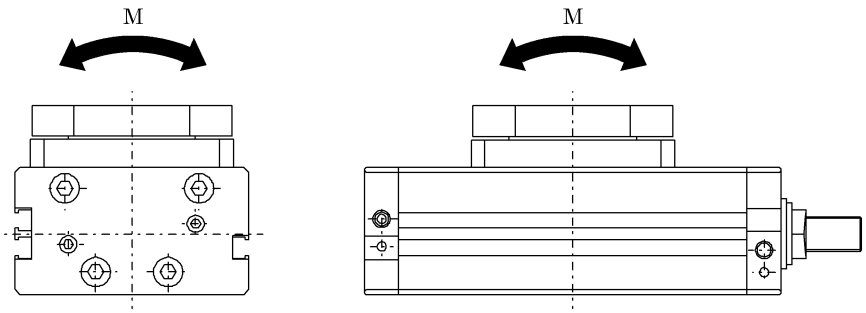
● Thrust load



● Radial load



● Moment load



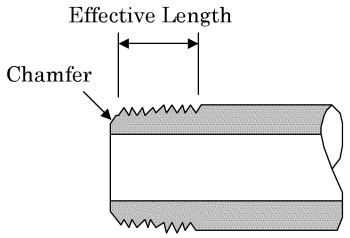
2.3 Piping

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

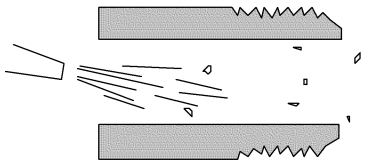
2) See to it that the pipe connecting cylinder and solenoid valve has effective cross-sectional area which is needed for the cylinder to drive at the specified speed.

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.

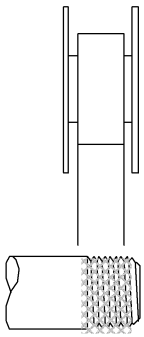


5) Flush air into the pipe to blow out foreign substances and chips before piping.

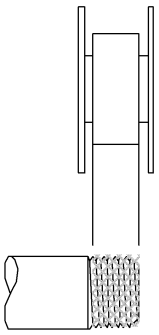


6) Refrain from applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.

●Seal Tape



(Correct)



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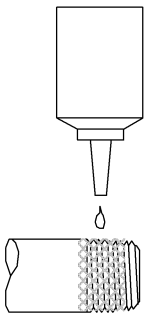
●Sealant (liquid)



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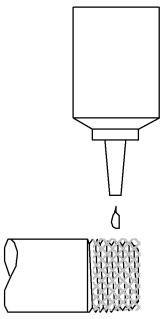
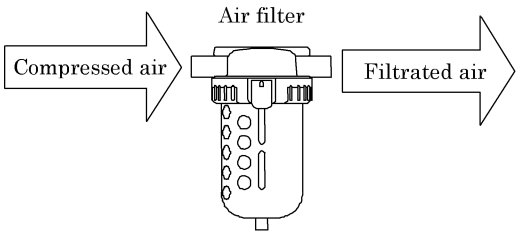


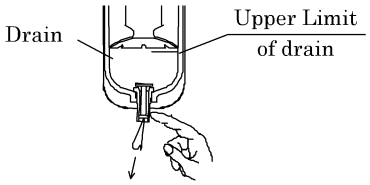
(Incorrect)

2.4 Fluid

1) It is necessary to use dehumidified air that has been filtered from com-pressed 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 car-bon 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.

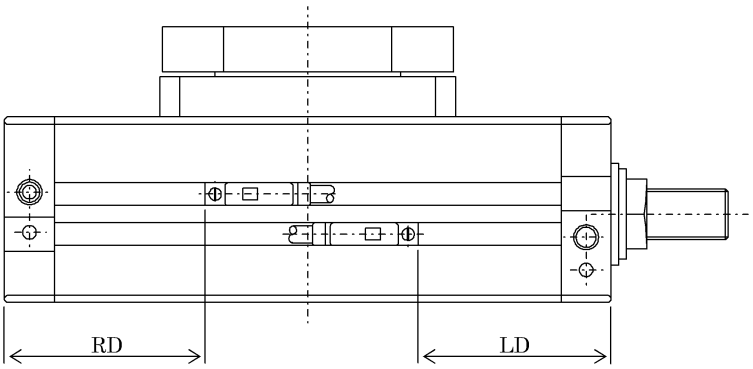
4) This Rotary actuator does not require lubrication. It is recommended, however, to use Turbine oil Grade 1, ISO VG32 as a lubricant, if and when lubrication is needed.

2.5 Location of mounting Switches on a Cylinder

1) Location of mounting switches on a cylinder.

(1) For stroke end operating
Install the switches to dimensions RD and LD in order to activate the switches at maximum sensitive positions.

(2) For intermediate position option
When using Rotary actuator within the angle of intermediate oscillation, fix the piston at the stopping position and slide the switches back and forth along the piston to find the first position where each switch turns on. The midpoint between the two positions is the most sensitive point for the current piston position. Install the switches at this point.

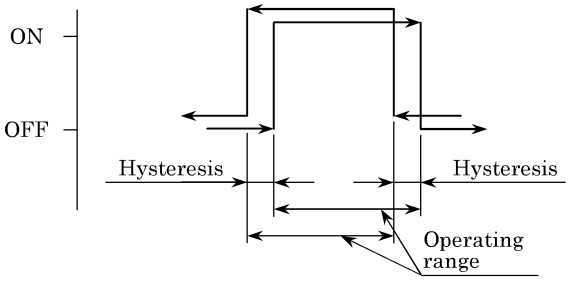


- How to slide switch
  Loosen its mounting screws then slide switch back and forth along cylinder tube. Tighten screws after locating the point to have switch installed.
- How to replace the switch
  Loosen its mounting screws then slide switch all the way out of the groove on the cylinder side. Slide new one back to the groove. Locate its setting point and tighten mounting screws. (Apply screw setting torque to 0.1～0.2N･m)

2) Operating range
The switch turns on first and turns off as the piston moves along its stroke. Precise operating range deviate slightly depending upon the direction of piston movement as shown right.
The center of the range is the mostly sensitive position. Setting switch at this point eliminates majority of external disturbance and provides the most stabile actuation of switch.

3) Hysteresis

Precise operating range deviate slightly depending upon the direction of piston movement as shown right. Switch is apt to be disturbed its accuracy by external effect when piston stops within this range. Carefully avoid designing stopping location of piston.



Maximum sensitive position (RD、LD)、Operating range and Hysteresis (Unit:mm)

Size	Angle	Solid state type							
		Maximum sensitive position				Operating range		Hysteresis	
		RD (mm)		LD (mm)					
		1-color type	2-color type	1-color type	2-color type	1-color type	2-color type	1-color type	2-color type
5	90°	21.5		22.5		1～4	4～4.5	1.5 or less	1 or less
	180°	25.5		25.5					
10	90°	24.5		26		1～4	4～4.5		
	180°	30.5		30.5					
20	90°	31		31		2～5.5	5～6		
	180°	37.5		37.5					
30	90°	38.5		40		2～5.5	5～6		
	180°	49.5		49.5					
50	90°	48.5		51		2～6	5～6		
	180°	61		61					
80	90°	51.5		54		2～6	5～6		
	180°	64		64					

※The values for the maximum sensitive position are obtained when the specification angle is set.

3. OPERATION

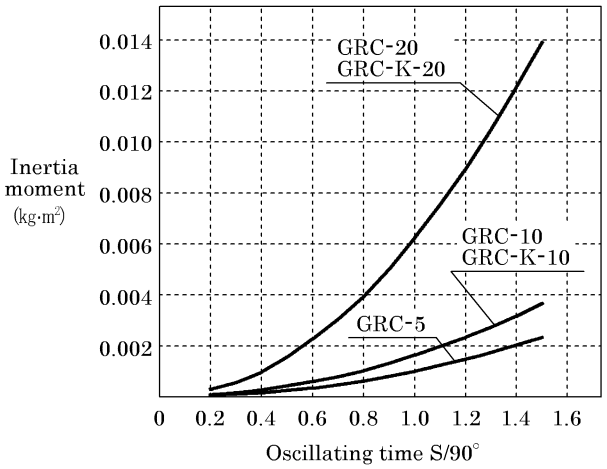
3.1 Operating the Cylinder

1) The working pressure for this type of cylinder is specified in "Product Specifications". Operate the system within this range.

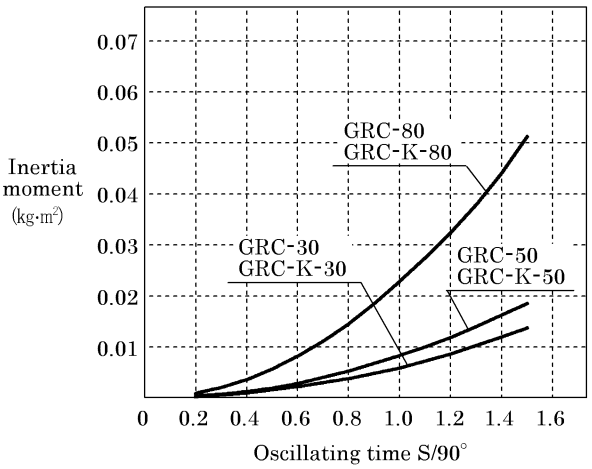
2) Although the Basic type and High-precision type are equipped with rubber cushions, provide external stoppers if large kinetic energy is applied. The relationship between the inertia moment and the oscillating time are shown below.

3) Install the speed controller to limit the oscillating time with in the specified range.

● Basic type・High-precision type

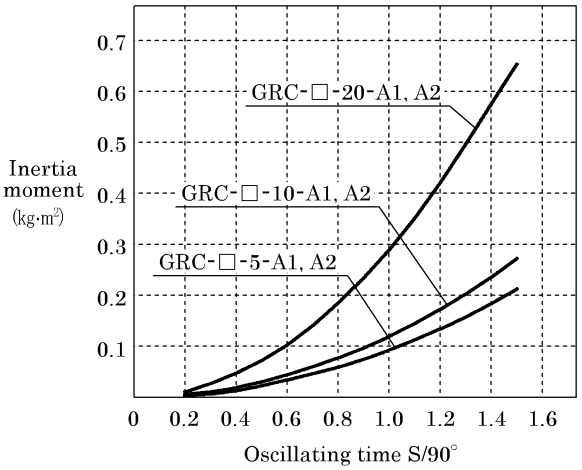


Size 5, 10, 20

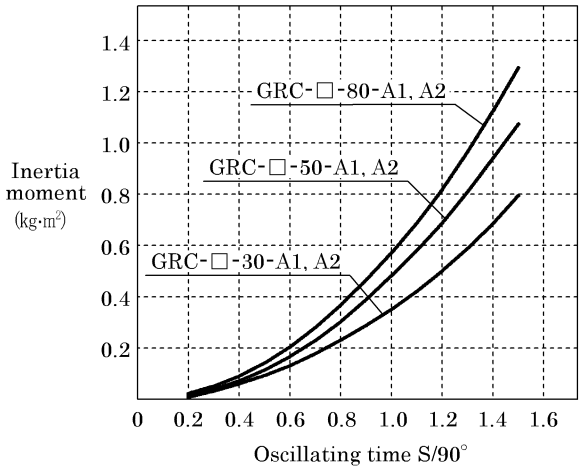


Size 30, 50, 80

● Equipped with external shock killer



Size 5, 10, 20



Size 30, 50, 80

3.2 How to use the Switches

3.2.1 Common items

1) Magnetic environment
Avoid installation of switches within the area where strong magnetic field or large current (such as large magnet or spot welding equipment) exist. There may be a certain influence over sensing accuracy due to the interference of each magnetic field in case of parallel connection of cylinders with switch or when a magnetized article very much closely passes by the cylinder switch.

2) Lead wire wiring
Carefully perform the wiring so that a bending stress or tensile strength does not apply to the lead wire repeatedly.
Additionally, connect wires for robot having the bending resistance to movable parts.

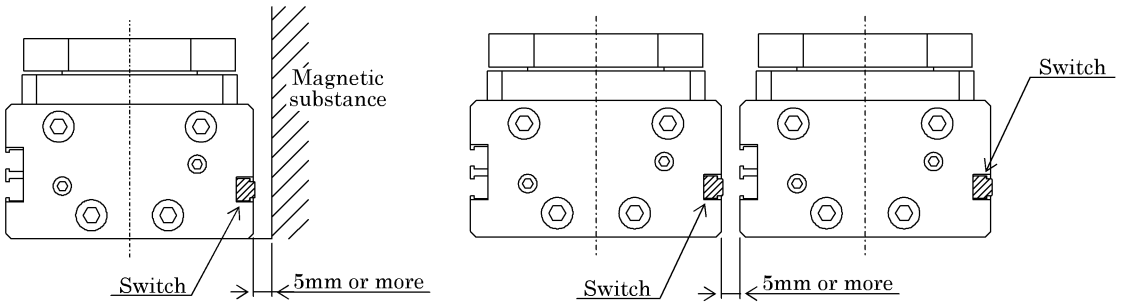
3) Operating temperature
Do not operate the product at a high temperature (Over than 60℃).
Always avoid operation of the product in a hot place due to temperature characteristics of magnetic and electronics parts.

4) Intermediate position detection
When activating the switch halfway of the stroke, the relay may not respond if the working piston speed is too fast.

5) Impact
Do not apply a large vibration or impact to the product when transporting the cylinder, or mounting or adjusting the switch.

6) Magnetizable material such as an iron plate nearby the cylinder switch is apt to cause malfunction of the cylinder switches. Keep it at least 5mm a way from the cylinder surface. (This is applicable for all bore sizes of tube.)

7) It usually causes malfunction of the cylinder switches when plural cylinders are laid adjacent. Keep a space between them as illustrated to the right. (This is applicable for all bore sizes of tube.)



3.2.2 Operational Cautions, Solid state switch (T2, T3)

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

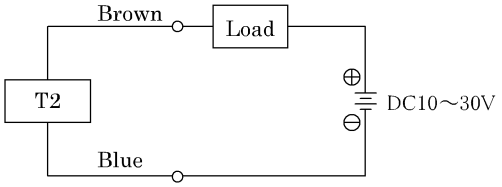


Fig.1 Fundamental circuit Example

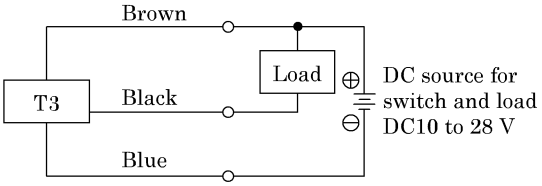


Fig.2 Fundamental circuit Example (1)
(In case the same source of power is used.)

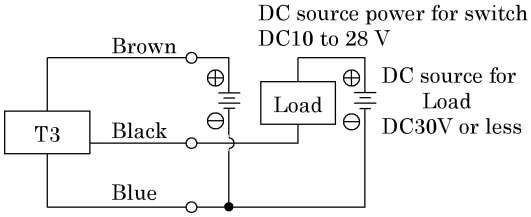


Fig.3 Fundamental circuit Example (2)
(In case individual sources of power are used.)

2) Protection of output circuit

Install some protective circuit as illustrated in Fig. 4 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. 5 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. 6 or 7 (in case of model T2) and Fig 8 (in case of model T3).

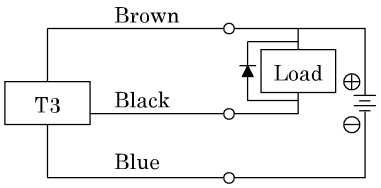
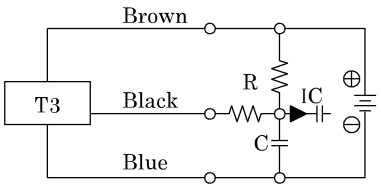


Fig.4 An example of using inducing load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.)



Flg.5 An example of using capacitor type load together with current regulating resister R.
Comply with the following formula to figure out required R.

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

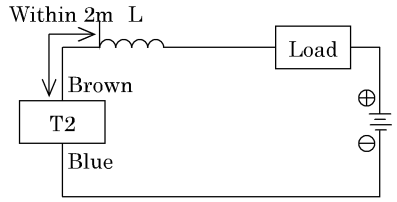


Fig.6 ・Choke coil
L = a couple hundred μH to a couple mH surpassing high frequency characteristic
・Install it near by a switch (within 2m).

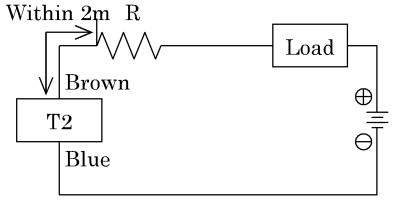


Fig.7 ・Dash current restriction resister.
R = As much large resister as the load circuit can afford.
・Install it near by a switch (within 2m).

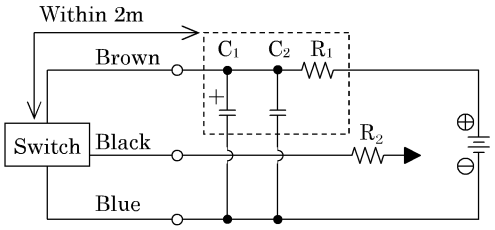


Fig8 ・Electric power noise absorptive circuit.
C_1=20 to 50 μF electrolytic capacitor
(Withstand voltage 50V or more)
C_2=0.01 to 0.1 μF ceramic capacitor
R_1=20 to 30 Ω

・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. 9 to 13 respectively.

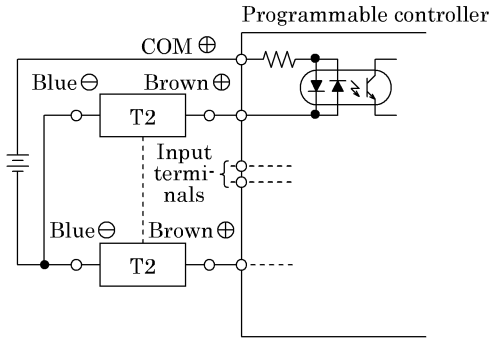


Fig.9 An example of T2 connection to source input type (an external power source)

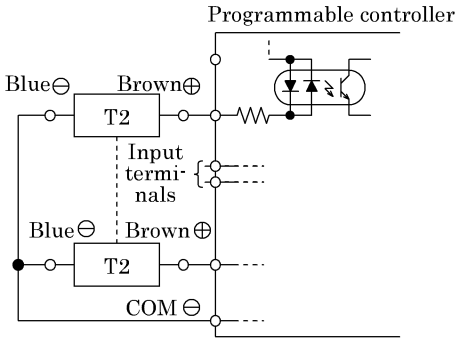


Fig.10 An example of T2 connection to source input type (an internal power source)

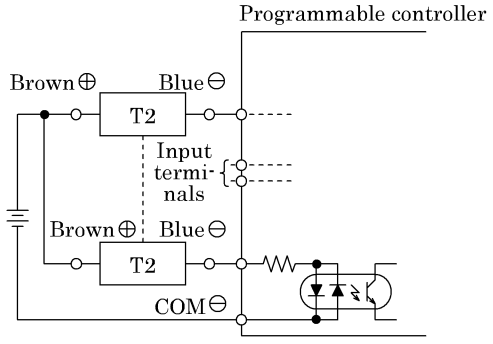


Fig.11 An example of T2 connection to source input type

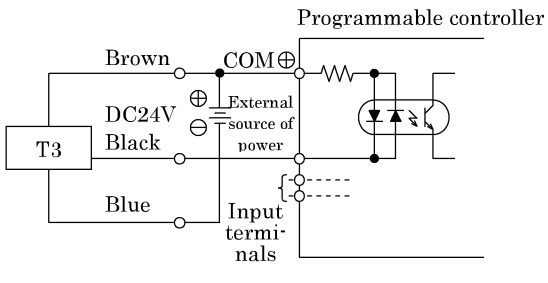


Fig.12 An example of T3 connection to source input type (an internal power source)

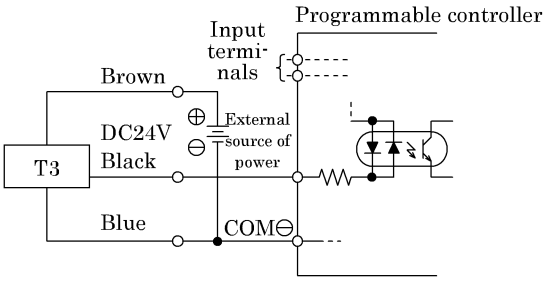


Fig.13 An example of T3 connection to source input type (an internal power source)

4) 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 μ A, then leakage may occur. Usually dimming and failure of the indicator light do not occur.

4. MAINTENANCE

4.1 Periodical Inspection

1) In order to upkeep the Rotary actuator in optimum condition, carry out periodical inspection once or twice a year.

2) Inspection items

(1) Check the bolts and nuts fitting for looseness.
(2) Check to see that the cylinder operates smoothly.
(3) Check any change of the oscillating time and cycle time.
(4) Check for internal and external and external leakage.
(5) Check the oscillating angle for abnormality.

See “TROUBLE SHOOTING”, 5, should there be any trouble found, also carry out additional tightening if bolts, nuts, etc. are loose.

4.2 Disassembling

1) Rotary actuator of this type is able to be disassembled. Disassemble it, referring to the exploded chart, should there be any disorder such as sir leakage then replace the expendable parts refer to Exp. Parts list posted below.

2) Refer to the following diagram for disassembly.

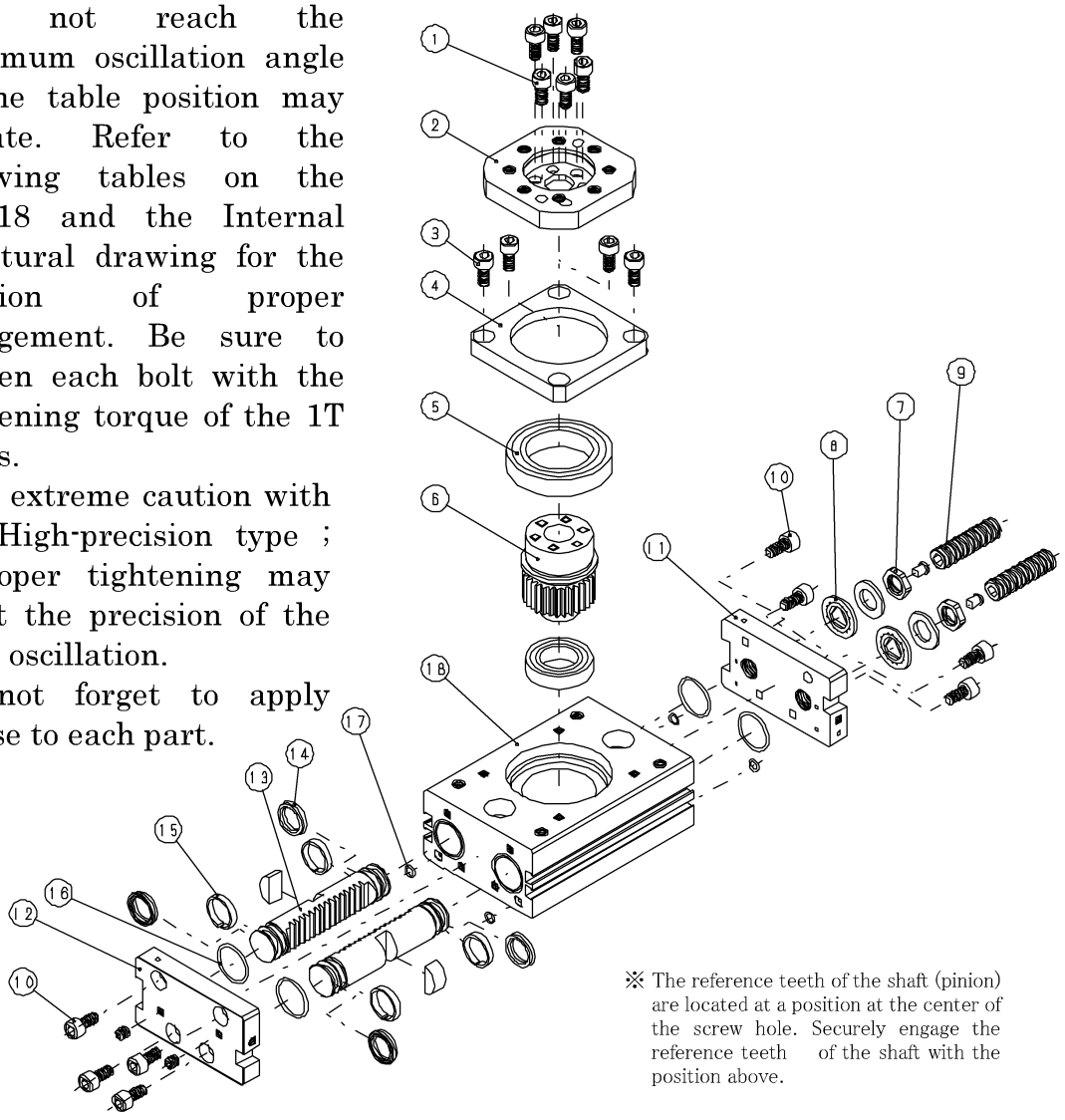
[Disassembly procedure]

(1) Take out Bolts①, take out Table②.
(2) Take out Bolts③, take out Bearing cover④, take out Bearing⑤ and Shaft⑥.
(3) Removing Hex.nut⑦, take out Stopper bolts⑨.
(4) Take out Bolt⑩, Take out Head cover⑪ and ⑫.
(5) Remove Piston⑬ from main Cylinder unit⑱. To assemble the parts, reverse the procedure above. Be extremely careful of the engagement position of the teeth of Shaft⑥ and piston ⑬.

If the engagement is improper, the oscillation may not reach the maximum oscillation angle or the table position may deviate. Refer to the following tables on the page18 and the Internal structural drawing for the position of proper engagement. Be sure to tighten each bolt with the tightening torque of the 1T series.

Take extreme caution with the High-precision type ; improper tightening may affect the precision of the table oscillation.

Do not forget to apply grease to each part.



※ The reference teeth of the shaft (pinion) are located at a position at the center of the screw hole. Securely engage the reference teeth of the shaft with the position above.

Tightening torque of bolts

(N·m)

Size	① Hexagon socket head cap screw	③ Hexagon socket head cap screw	⑩ Hexagon socket head cap screw
5	0.59±10%	0.59±10%	0.59±10%
10	0.59±10%	0.59±10%	1.37±10%
20	1.37±10%	1.37±10%	2.84±10%
30	2.84±10%	2.84±10%	2.84±10%
50	4.8±10%	4.8±10%	4.8±10%
80	4.8±10%	4.8±10%	11.96±10%

Size	Engagement position of rack
5	At fourth bottom of rack
10	At fourth bottom of rack
20	At third bottom of rack
30	At fourth bottom of rack
50	At third bottom of rack
80	At fourth bottom of rack

Expendable parts kit (Specify the kit No. when ordering.)

Part No. / Kit No.	⑯ Cylinder gasket	⑭ Piston gasket	⑮ Wear ring	⑰ For air passage gasket	⑧ Seal washer
GRC-5K	P12115-1049079	MYP-10	F4-174964	P12115-0400100	DT-1-6
GRC-10K	P12115-1330080	MYP-12	F4-659141	P12115-0400100	DT-1-8
GRC-20K	P12115-1674081	MYP-16	F4-162726	P12115-0400100	DT-1-10
GRC-30K	P12115-1674081	MYP-16	F4-162726	P12115-0400100	DT-1-10
GRC-50K	P12115-2100080	MYP-20	F4-125610	P12115-0700100	DT-1-12
GRC-80K	P12115-2600080	F4-325922	F4-161716	P12115-0700100	DT-1-12

5. TROUBLE SHOOTING

1) Rotary actuator

Trouble	Causes	Remedies
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.
	Improper or misalignment of installation.	Correct the installation state and/or change the mounting style.
	Broken piston packing	Replace the cylinder.
Does not function smoothly.	Speed is below the low speed limit	Limit the load variation.
	Improper or misalignment of installation.	Correct the installation state and/or change the mounting style.
	Exertion of transverse (lateral) load.	Install a guide. Revise the installation state and/or change the mounting style.
	Excessive load.	Increase the pressure itself and/or the inner diameter of the tube.
	Speed control valve is built in the way of "Meter in" circuit.	Change the installation direction of the speed control valve.
Breakage and/or deformation	Impact force due to high speed operation	Turn the speed down. Reduce the load and/or install a mechanism with more secured cushion effect (e.g.external cushion mechanism).
	Exertion of transverse load.	Install a guide. Reverse the installation state and/or change the mounting style.

2) Switch

Troubles	Causes	Remedies
Indicator light is not lit.	Deposited contact point	Replace the switch.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
	Damaged indicator light	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
Switch does not function right.	Broken circuit	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
	Improper voltage	Correct voltage to specified.
	Incorrect location of switch	Correct its location.
	Aberrant position of switch	Set it back to original position and tighten the mounting device.
	Incorrect direction of switch mounting	Correct the direction of the switch mounting.
	Relay is unable to respond properly	Turn the speed down. Replace the relay with a recommended one.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
Switch does not return.	Piston is not moving	Make the piston move.
	Deposited contact point	Replace the switch
	Excessive load (relay) than rated capacity	Replace the relay with a recommended one or replace the switch.
	The ambient temperature is out of the specification range	Adjust the ambient temperature within the range of -10 to 60℃
	Existence of a foreign magnetic field	Shield the magnetic field.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.

6. HOW TO ORDER

6.1 Product Number Coding

● With out switch

GRC – 10 – 90 ——————————— A1

● With switch

GRC – 30 – 180 – T2H※ – R – A2

(a) (b) (c) (d) (e) (f)

(a) Model part number		(b) Torque size (at 0.5MPa)				(c) Oscillating angle	
GRC	Basic type	Model part number		GRC	GRC-K	90	90°
GRC-K	High-precision type	5	0.5 (N·m)	●	—	180	180°
		10	1.0 (N·m)	●	●		
		20	2.0 (N·m)	●	●		
		30	3.0 (N·m)	●	●		
		50	5.0 (N·m)	●	●		
		80	8.0 (N·m)	●	●		

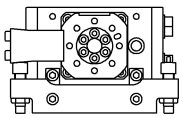
(d) Switch model code					(e) Qty. of switch	
Lead wire straight type	Lead wire L-shaped type	Switch type	Indicator light	Lead wire	R	Clockwise rotation, 1ea.
					L	Counter clockwise rotation, 1ea
T2H※	T2V※	Solid state	1 color indicator	2-wire	D	Switches, 2ea
T3H※	T3V※			3-wire		
T2YH※	T2YV※		2 color indicator	2-wire		
T3YH※	T3YV※			3-wire		
T2YFH※	T2YFV※		Preventive maintenance output	3-wire		
T3YFH※	T3YFV※			4-wire		
T2YMH※	T2YMV※			3-wire		
T3YMH※	T3YMV※			4-wire		

※ Lead wire length	
No code	1m (Standard)
3	3m (option)
5	5m (option)

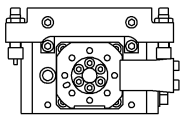
(f) Option	
No code	Hex. socket set screw-type stopper with urethane
A Equipped with external shock killer	
A1	Mounting position ①
A2	Mounting position ②
A3	External shock killer retrofitting type (equipped with mounting groove)

Mounting position drawing of equipped with external shock killer

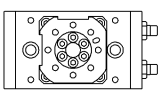
GRC-※-A1 (Mounting position ①)



GRC-※-A2 (Mounting position ②)



GRC-※-A3 (Mounting position ③)



Note1 : The port holes of the Basic and High-precision types are located on the side, Other port holes are filled with stoppers.
Note2 : An external shock killer can not be retrofitted to the Basic and High-precision types. If there is a possibility of a retrofit, select the A3 type option.
Note3 : The A3 type option retrofitted with an external shock killer is the same as the A1 type. Contact us to retrofit an external shock killer to the A2 type.

6.2 Component parts Model coding

(1) Switch model coding

● Switch alone

SW – T2H3

(d)

→ Switch model
(Refer to (d) on preceding page)

(2) Expendable parts kit Model coding

● Set of Consumable parts such as packing

GRC – 5 K

(b)

→ Torque size
(Refer to (b) on preceding page)

(3) External shock killer set Model coding

● Set of Plate, Shock killer, and Lever

● Used when an external shock killer is installed to the A3 type option

GRC – 5 – A 2

(b) (c)

→ Torque size
(Refer to (b) on preceding page)

(c) Oscillating angle	
1	For 90 degrees specification angle
2	For 180 degrees specification angle

Specify "1" or "2" in the (c) section.
Note : The contents of the set are different between the 90-degree and the 180-degree set. The diagram shows the 90-degree set.

(4) Adjustable angle Stopper bolt set Model coding

● Set of Hex. socket set screw with urethane and Hex. nut, Plain washer

● Used when the external shock killer is used separately

GRC – 5 S

(b)

→ Torque size (Refer to (b) on preceding page)

(5) Seal washer set Model coding

● Used When the seal washer is replaced

● Two seal washer are contained.

GRC – 5 D

(b)

→ Torque size (Refer to (b) on preceding page)

(6) Adjustable angle Shock killer set Model coding

● Set of Shock killer and Stopper

GRC – 5 – A01

(b)

→ Torque size (Refer to (b) on preceding page)

7. SPECIFICATION

7.1 Product specifications

Item			GRC					
			GRC-5	GRC-10 GRC-K-10	GRC-20 GRC-K-20	GRC-30 GRC-K-30	GRC-50 GRC-K-50	GRC-80 GRC-K-80
Size			5	10	20	30	50	80
Logical torque (Note1)		MPa	0.5	1.0	2.0	3.0	5.2	8.1
Actuation			Rack & pinion type					
Working fluid			Compressed air					
Max. working pressure		MPa	1.0					
Min. working pressure (Note2) MPa	Basic type		0.10					
	High-precision type		—	0.15		0.10		
	Equipped with external shock killer		0.25	0.20	0.15			
Proof pressure		MPa	1.6					
Ambient temperature		℃	0～60 (No freezing)					
Cushion	Basic type・High-precision type		Rubber cushion					
	Equipped with external shock killer		Shock killer					
	Shock killer model code		NCK-0.3		NCK-0.7		NCK-1.2	NCK-2.6
Allowable energy absorption J	Basic type・High-precision type		0.005	0.008	0.03		0.04	0.11
	Equipped with external shock killer		0.46	0.59	1.41	1.71	2.33	2.78
Shock killer stroke		mm	3.5	3.5	5	5	5.5	6.5
Lubrication			Not required (Use Grade 1 ISO VG 32 Turbine oil, if lubrication is preferred)					
Volumetric capacity (Note3)		90°	1.3	3.5	7.0	10.5	18.1	28.3
		180°	3.4	6.6	13.4	20.0	34.4	53.7
Adjustable range of oscillating angle (Note4)	Basic type・High-precision type	90°	0° ～100°					
		180°	90° ～190°					
	Equipped with external shock killer	90°	90° ±6°					
		180°	180° ±6°					
Oscillating angle adjusting range (Note5)		s/90°	0.2～1.5					
Table deflection (Reference value)	Basic type		±0.17°			±0.23°	±0.26°	±0.32°
	High-precision type		—	±0.026°				

Note1. Theoretical torque is at 0.5MPa of the working pressure.
Note2. It is necessary to adjustable the working pressure to 0.3MPa or more to face out rubber cushion built into basic type・high-precision type
Note3. Internal capacity is at the maximum oscillating angle within the adjustable range of oscillating angle.
Note4. The value for the adjustable range of oscillating angle are obtained after adjustment of the stopper bolts. (shock killers)
Note5. Adjustable range of oscillating time is at 0.5MPa of the working pressure.

7.2 Switch specifications

Type・Model / Item	Reed switch			
	T2H, T2V	T2YH, T2YV	T3H, T3V	T3YH,T3YV
Applications	For use exclusively with programmable controller		For use with programmable controller, relay	
Power supply voltage	—		DC10 to 28V	
Load voltage	DC10 to 30V		DC30V or less	
Load current	5 to 20mA (Note1)		100mA or less	50mA or less
Current consumption	—		10mA or less at DC24V	
Internal voltage drop	4V or less		0.5V or less	
Indicator light	LED (ON lighting)	Red／Green LED (ON lighting)	LED (ON lighting)	Red／Green LED (ON lighting)
Leakage current	1mA or less		10μA or less	
Lead wire length	Standard 1m (Oil-proof vinyl cabtyre cord, 2-wire, 0.2mm²)		Standard 1m (Oil-proof vinyl cabtyre cord, 2-wire, 0.3mm²)	
Shock resistance	980m/s²			
Insulation resistance	20MΩor more by DC500Vmegger	100MΩor more by DC500Vmegger	20MΩor more by DC500Vmegger	100MΩor more by DC500Vmegger
Withstand voltage	No abnormalities should occur after applying AC1,000V for 1 minute			
Ambient temperature	−10 to 60℃			
Degree of protection	IEC Standard IP67, JIS C0920 (water tight type), Oil resistance			

Note1 : Maximum value, 20mA is at 25℃ of ambient temperature. Load current decreases less than 20mA when the ambient temperature exceeds 25℃. (For example: it may be 5 to 10mA at 60℃)

Type・Model / Item		Reed switch	
		T2YFH, T2YFV	T2YMH, T2YMV
Applications		For use exclusively with programmable controller	
Indicator light	Mounting position adjustment part	Red／Green LED (ON lighting)	
	Preventive maintenance output part	—	Yellow LED (ON lighting)
Output part	Voltage of source of power	—	
	Load voltage	DC10 to 30V	
	Load current	DC5 to 20mA	
	Internal voltage drop	4V or less	
	Current consumption	—	
	Leakage current	1mA or less	
Preventive maintenance output part	Load voltage	DC30V or less	
	Load current	DC20mA or less	DC5 to 20mA
	Internal voltage drop	0.5V or less	4V or less
	Leakage current	10μA or less	
	Signal holding (T on)	—	Turns ON(0. 4±0. 2) seconds after the red LED turns ON at Mounting position adjustment part
	Signal release (T off)	—	Turns OFF(0. 7±0. 2) seconds after the red LED turns ON at Mounting position adjustment part
Lead wire length (Note1)		Standard 1m (Oil-proof vinyl cabtyre cord, 3-wire, 0.2mm²)	
Shock resistance		980m/s²	
Insulation resistance		100MΩ or more measuring with DC500V megger tester	
Withstand voltage		No abnormalities should occur after applying AC1,000V for 1 minute	
Ambient temperature		−10 to 60℃	
Degree of protection		IEC Standard IP67, JIS C0920 (water tight type), Oil resistance	

7 SPECIFICATION

Type・Model		Solid state type switch	
Item		T3YFH, T3YFV	T3YMH, T3YMV
Applications		For use with programmable controller, relay	
Indicator light	Mounting position adjustment part	Red／Green LED (ON lighting)	
	Preventive maintenance output part	—	Yellow LED (ON lighting)
Output part	Voltage of source of power	DC10 to 28V	
	Load voltage	DC30V	
	Load current	DC50mA or less	
	Internal voltage drop	0.5V or less	
	Current consumption	10mA or less	
	Leakage current	10μA or less	
Preventive maintenance output part	Load voltage	DC30V or less	
	Load current	DC50mA or less	
	Internal voltage drop	0.5V or less	2.4V or less
	Leakage current	10μA or less	
	Signal holding (T on)	—	Turns ON(0. 4±0. 2) seconds after the red LED turns ON at Mounting position adjustment part
	Signal release (T off)	—	Turns OFF(0. 7±0. 2) seconds after the red LED turns ON at Mounting position adjustment part
Lead wire length (Note1)		Standard 1m (Oil-proof vinyl cabtyre cord, 4-wire, 0.2mm²)	
Shock resistance		980m/s²	
Insulation resistance		100MΩ or more measuring with DC500V megger tester	
Withstand voltage		No abnormalities should occur after applying AC1,000V for 1 minute	
Ambient temperature		−10 to 60℃	
Degree of protection		IEC Standard IP67, JIS C0920 (water tight type), Oil resistance	