

TSUBAKI

POWER CYLINDER

< G-Series >

Instruction Manual

ATTENTION

Make sure that this instruction manual is delivered
to the final user who uses this product.

NOTICE

In the case of special specification, it might be partially different from this
instruction manual.

Refer to the attached final drawing for “★” sections.

※The final drawing of standard specification is not attached, please check the
catalog or website as necessary.

Units described herein are SI {Gravitational}.
Figure in { } is for reference.

TSUBAKIMOTO CHAIN CO.

TSUBAKI
POWER CYLINDER G-series

Safety Precaution

- You must read this instruction manual and other attached documents prior to use (installation, operation, maintenance, inspection, etc). Understand the equipment and read all instructions thoroughly before installing or operating. Keep this manual visible to all users.
- Safety precautions in this manual are classified into two categories, “WARNING” and “CAUTION”. These are defined as follows:

	WARNING	Death or serious injury may result from misusing the product without following the instructions.
	CAUTION	Minor or moderate injury, as well as damage to the product may result from misusing the product without following the instructions.

Notice that under “CAUTION” lead to serious results depending on the surrounding situation. Therefore, this section is just as significant as the other, and requires much attention.

 WARNING
<p>General</p> <ul style="list-style-type: none"> • Do not handle POWER CYLINDER under live-wire condition. Before starting work, switch off the power supply, otherwise electrical shock may occur. • Transporting, installing, wiring, operating, maintaining and inspecting must be carried out by skilled and professional engineers, to avoid explosion, ignition, fire, electrical shock, or damage to the equipment. • When using with an equipment for transporting human, install a suitable protection device on that equipment for safety purposes. Otherwise an accident resulting in death, injury or damage to the equipment may occur due to accidental falling. • Keep the brake free from water or oil. Weak brake torque may cause accidents such as falling and disfunctioning of the product. • Do not use the standard POWER CYLINDER in an explosive atmosphere. Use explosion-proof type POWER CYLINDER in such environments, otherwise explosion, ignition, fire, electrical shock, or damage to the equipment may occur. <p>Transportation</p> <ul style="list-style-type: none"> • Do not stand under the product when it is lifted for transportation, otherwise the product may fall and result in death or serious injury. <p>Wiring</p> <ul style="list-style-type: none"> • If you do not connect the power cable according to the wiring diagram shown in the terminal or this instruction manual, electrical shock or fire may occur. (In case of no terminal box, insulate terminals completely.) • Do not bend, pull or pinch the power cable or motor lead wires, otherwise electrical shock may occur. • Make sure you ground the earth terminal to avoid electrical shocks.

Operation

- Always supply power as specified on the nameplate, otherwise burnout or fire may occur.
- Do not operate while the terminal box cover is removed. After wiring, fix the terminal box cover to its original place, otherwise electrical shock may occur.
- Do not stand by or touch any rotating portion (manual shaft, etc.) and rod during operation, otherwise injury may occur.
- In case of power failure, make sure the power is off. Otherwise power may come back suddenly and injure a person or damage the equipment.

Maintenance and safety check

- When inspecting the product during operation, do not approach or touch any rotating portion(manual shaft, etc.) and rod, otherwise accidents resulting in death or injury may occur.
- Do not remove the cover for internal inspection during operation. This may cause burns due to the splashing of high temperature oil.
- In the case of inspecting the tooth on gears and screw while the motor is not running, double check that all the gears and screw are also completely stopped. Otherwise you might be caught in the device, falling, uncontrollable operation, etc.
- When performing an internal inspection, make sure that the motor and all the gears are stopped, and that the inside of the machine is cool enough and well ventilated. Set personnel outside of the product to supervise and support the person inspecting inside. Internal parts are well lubricated. You must take safety measures to prevent accidents such as slipping.
- Do not operate without placing the safety cover back on. This can cause potentially hazardous situations.

Maintenance and safety check for brake

- Do not operate the POWER CYLINDER while the brake is released by manual release bolt, otherwise the equipment may fall over and/or disfunction.
- Before operating, turn the power on and off after stopping the rotation of the driven machine, and check the brake function. Otherwise, accidents may occur.
- After checking or adjusting the brake gap, do not operate the motor without the fan cover. Otherwise you might be caught in the equipment or accident may occur. In addition, injury and damage to the equipment may occur by fall and uncontrollable operation.
- When using for a lifting & lowering device, do not release the brake while loaded. This can cause the machine to jerk and drop the material it is carrying, which can lead to major accidents or damage to the equipments.



CAUTION

General

- Do not use the POWER CYLINDER beyond the capacity of those specified on its name plate or manufacturing specifications. Otherwise electrical shock, injury, damage to the equipment, etc. may occur.
- Do not insert your fingers or other objects in the opening of the POWER CYLINDER, otherwise electrical shock, injury, fire or damage to the equipment may occur.
- Do not use a damaged Power Cylinder continuously, otherwise injury, fire, etc. may occur.
- Do not remove the name plate.
- Any remodeling carried out by the customer is not covered by our guarantee and therefore we cannot be held responsible.
- Use within the travel stroke specified. If not, the product can potentially breakdown.

Upon receipt of the POWER CYLINDER you purchased

- Make sure the package is in upright position prior to opening.
- Check the Power Cylinder you received is exactly what you ordered. If an incorrect product is installed to your equipment, injury, damage to the equipment, etc. may occur.

Transportation

- Pay full attention not to drop or overturn the product during transportation. In such cases where the Power Cylinder is fitted with lifting rings, check that these rings are fastened securely before use. However, after installing the Power Cylinder to another equipment, do not lift the entire equipment by using these lifting rings. Confirm the weight of the Power Cylinder with an outline diagram or catalog before lifting. You must not lift the Power Cylinder if its weight exceeds the maximum rated weight assigned to the lifting device . This can cause accidents or damage to the equipment or Power Cylinder.

Installation

- Do not place any flammable objects around the POWER CYLINDER. Otherwise fire may occur.
- Do not place any obstacles which may block the ventilation around the POWER CYLINDER. Otherwise cooling of the POWER CYLINDER becomes less effective and burns or fire may occur due to abnormal overheating.
- Do not climb or hang on to the POWER CYLINDER, otherwise injury may occur.
- In case of operating manually with manual handle, operate without any load. Otherwise injury or damage to the equipment may occur.

Lubricant

- When the Power Cylinder is used for food processing machinery, etc. avoid contact with the lubricant oil by installing devices such as oil pans. Otherwise oil leaks from the Power Cylinder may damage the food products.

Wiring

- Make sure the wiring of the limit switch and the position of the travel stroke are appropriate before operating. Otherwise injury or damage to the equipment may occur.
- Do not touch the terminals when measuring insulation resistance, otherwise electrical shock may occur.
- Wire according to the general technical standards of electrical installations or those set forth by your company. Otherwise burnout, electrical shock, fire or injury may occur.
- Protection devices are not equipped with the POWER CYLINDER. Installation of the overload protection device is mandatory under the technical standards of Electrical Installations. Installation of other protection devices (such as ground-fault circuit breakers, etc.) in addition to the overload protection device is recommended. Without these devices, damage, electrical shock, fire or injury may occur.
- Before installing the Power Cylinder to another machine, check the traveling direction of rod. Incorrect traveling direction may cause injury or damage to the equipment.
- When using star-delta, use an electromagnetic switch on the primary side, and select from 3 contractros. Otherwise fire may occur.
- When 400V class inverter is used to drive the Motor, install a suppression filter or reactor to the inverter side or use one which is enhanced insulation on the motor side. Otherwise dielectric breakdown may cause fire or damage to the equipment.

- Do not mistake the starter condenser and the driving condenser. If the starter condenser is used for driving, the condenser will be damaged.
- Do not damage the vinyl cover of the starter condenser, otherwise electrical shock may occur.
- Keep the voltage drop of the wiring within 2%. Otherwise the POWER CYLINDER may not start due to voltage drop in case of a long wiring distance.
- When changing rotation direction, stop the motor completely and then reverse. Otherwise forwarding and reversing rotation by plugging may cause damage to the equipment.
- When using Power Cylinder with brake, do not supply the electricity to the brake coil continuously while the motor is turned off. Otherwise burnout of the brake coil or fire may occur.

Operation

- During operation, the surface temperature of the Power Cylinder becomes considerably high. Be careful not to touch the Power Cylinder, otherwise burn injury may occur.
- Stop the operation immediately when you suspect any problems, otherwise electrical shock, injury or fire may occur.
- Do not exceed the rated maximum load of the material loaded. Otherwise, injury, damage to your equipment or damage to the POWER CYLINDER may occur.
- During operation, do not loosen oil plug, otherwise burns may occur due to the splashing of high temperature oil.
- Do not touch the conductive portion of the starter condenser for single phase motor until discharged completely, otherwise electrical shock may occur.
- When changing the rotating direction of single phase motor, except reversible motor, be sure to stop the motor completely then reverse. Otherwise the direction may not be changed and be out of control.
- When used for an elevator or another lifting device, do not release the brake while the load is lifted. Otherwise accidents may occur.

Maintenance and safety check

- Do not touch the terminals when measuring the insulation resistance, otherwise electrical shock may occur.
- In case of changing lubricant, follow the instruction manual. Be sure to use the recommended lubricants, otherwise damage to POWER CYLINDER may occur.
- The surface temperature of the POWER CYLINDER becomes high. Do not touch with bare hands, otherwise burn injury may occur.
- Do not change the lubricant during operation or immediately after stopping the motor, otherwise burn injury may occur.
- When measuring insulation resistance of explosion-proof motors, make sure that it is performed in a non explosive gas or steam atmosphere, otherwise explosion or fire may occur.
- For abnormal situations, carry out diagnosis according to the instruction manual. Never resume operation until you investigate the cause of the problem.
- Where the brake gap exceeds that of the allowed limit, the coil may burn due to bad suction. Damage to the brake plate can also occur, due to the increased impact.

Disassembly & assembly

- Repair, disassembly and assembly of the POWER CYLINDER must be handled by specialists, otherwise electrical shock, injury or fire, ect. may occur.

Scrapping

- When scrapping the Power Cylinder or disposing the lubricant, dispose as general industrial waste.

Thank you for purchasing Tsubaki G Series Power Cylinder. This Power Cylinder utilizes high-performance ball screw or trapezoidal screws and nuts, and is provided with a brake motor as a standard component. It is a linear actuator capable of operating at higher speeds and frequency compared to conventional motor-driven cylinders.

G Series Power Cylinder is superior to existing general pneumatic and hydraulic cylinders and other linear actuators. To make the best use of this cylinder, it must be properly installed, operated, and maintained.

This instruction manual describes the procedures necessary for everything from installation to maintenance. Carefully read this manual to get the most out of your G Series Power Cylinder.

If you have any questions, consult the distributor where you purchased the Power Cylinder or the Tsubaki sales office nearest you. Please have the data shown on the nameplate on the main body of the Power Cylinder when contacting your distributor or our sales office.

-Contents-

1. Checking the package	---	P.7
2. Installing	---	P.8
3. Connection of brake motor	---	P.10
4. Caution before operation	---	P.11
5. Classification of protection device	---	P.12
6. Connection of optional equipment	---	P.13
7. General cautions	---	P.18
8. Maintenance	---	P.20
9. Reference circuit diagram	---	P.26
10. Brake motor	---	P.27
11. Warranty	---	P.28

Caution for handling the products

1. Operation manual

- Deliver this instruction manual to the final customer who uses the Power Cylinder. Read the instruction manual carefully, and use the product properly.
- In case the instruction manual is not at hand, request the distributor where you purchased the product, or our sales office with the information of product name and model number.

2. For safety

- If you suspect danger during operation, take safety precautions immediately, to avoid serious accidents.
- Consider and plan ahead, so that danger will not be a factor, in case the operation becomes abnormal.

3. When performing maintenance or inspection

- Wear proper working clothes and protective equipment (safety device, gloves, shoes, etc.).
- Make sure the environment is appropriate, before performing maintenance and inspection to avoid secondary disaster.
- Make sure the power is switched off, and the machine has stopped completely before carrying out maintenance and inspection. Be careful so that nobody turns the power back on.
- Comply with Ordinance on Labor Safety Law by government.

4. Storage

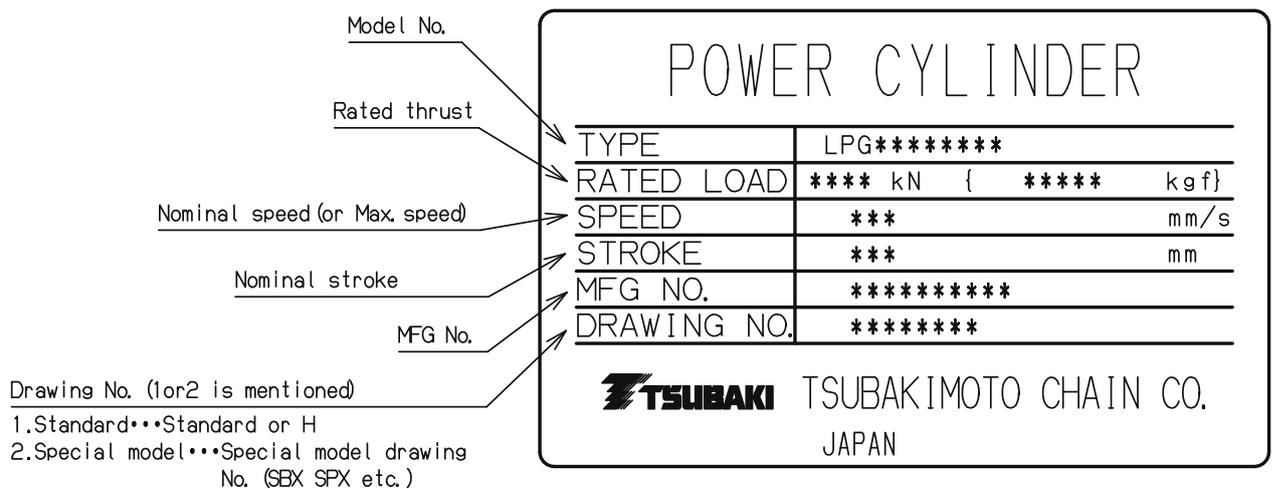
- Though Power Cylinder is an entirely enclosed structure, store in a dry & well-conditioned room indoors to avoid rust. In case Power Cylinder is left outdoor with tentative wiring after installing equipment, cover it with vinyl sheet to protect from rain, water, or moisture. If it is stored in a place prone to sudden temperature change, dew condensation may cause damage or rust.
- It is dangerous to pour liquid such as water, or place metal pieces inside the product. Do not put any foreign particles inside the Power Cylinder and your equipment.
- Do not store or use in corrosive or flammable atmosphere.
- Do not store or use as disassembled parts, because this can damage the product, and /or cause electrical shock.
- Do not use in a sealed container where heat radiation cannot be expected.
- The Power Cylinder can produce large power. Do not bring hands, feet and body to the moving parts of the entire equipment including Power Cylinder. Otherwise they can get caught in the machine, and cause hazardous situations.
- Shut down the power source immediately, perform safety procedure, and contact the distributor from whom you purchased the product or our sales office, in case of malfunction (abnormal odor, heat generation, noise and vibration).

1. Checking the package

Upon receiving the Power Cylinder, check the following.

1. Confirm that the thrust, speed, stroke, voltage, etc. printed on the nameplate and the accessories correspond to your requirements.
2. Check whether any part of the product has been damaged during delivery.
3. Check whether the screws and bolts are fastened securely.

In case of malfunction, contact the distributor where you purchased the product, or our sales office with the information of nameplate.



- ※ Please check “TYPE”, “MFG No.” and “DRAWING No.” of the nameplate when inquiring so that we can support smoothly.
- ※ Even if you return the product, please contact distributor you purchased and let them know “TYPE”, “MFG No.” and “DRAWING No.”.

2. Installation

To use the Power Cylinder efficiently for a long time, proper installation is important. Install it according to the following instructions.

★2-1. Installation location

Though Power Cylinder is an entirely enclosed structure, suitable for standard outdoor use, appropriate cover is required at all time in case of snow or thick vapor. For location exposed to sea breezes and salt, it is require for some specification such as painting specifications, structure of limit switch to be changed. Ambient temperature is usually $-15\text{ }^{\circ}\text{C}\sim+40\text{ }^{\circ}\text{C}$. (Low temperature may cause poor performance.) When using out of this range, be sure to use an insulation cover.

※ For the special specification, please confirm the final drawing because use conditions such a use environment or ambient temperature might be different.

★2-2. Installation direction

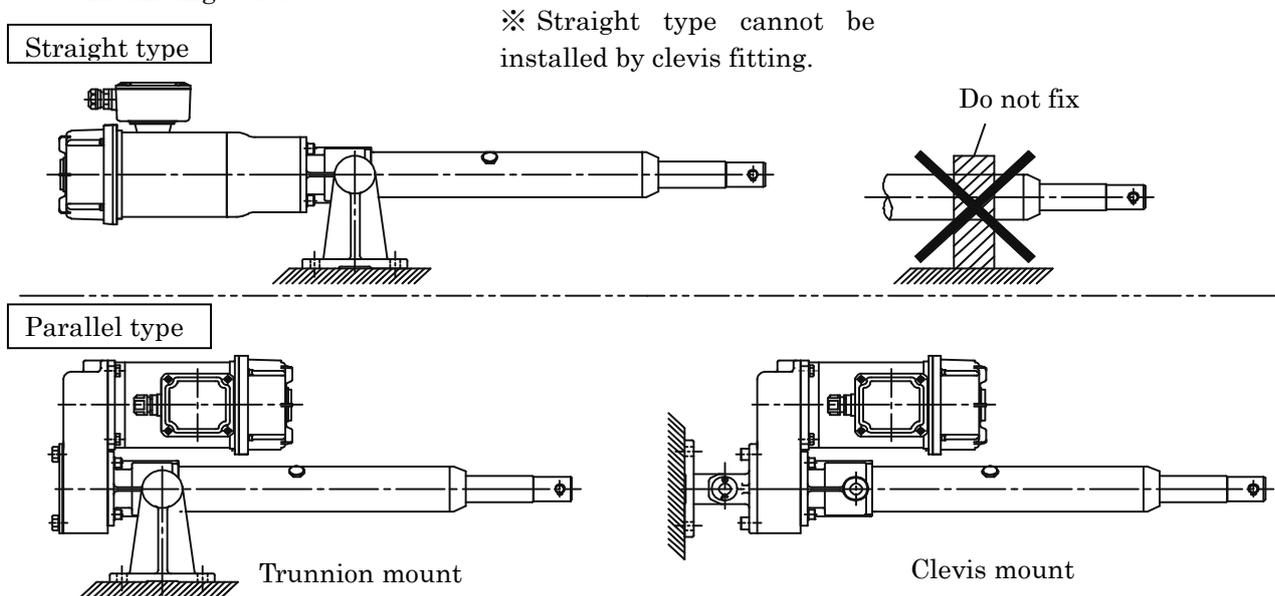
Install the Power Cylinder onto your equipment in any direction you wish.

※ If the direction is specified on the outline drawing, follow the instructions.

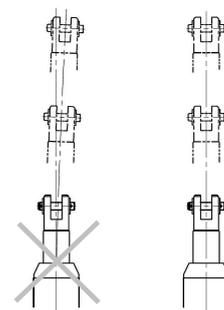
★2-3. Installation procedure

Install with the trunnion mounting or clevis mounting (parallel type only) method. (See the figures below.) In either case, never tighten the outer cylinder of the Power Cylinder from the outside.

- Apply grease to the trunnion pin, trunnion hole, connecting pin of the end fitting and connecting pin for clevis mounting before installing.
- When the trunnion pin or connecting pin for the clevis or the end fitting is directed in the vertical direction (when the cylinder laid horizontally), and the main body swings, take countermeasures for wear such as inserting a bearing member into the trunnion hole, the clevis fitting, or the side part of the end fitting.
- When the power cylinder with thrust detecting mechanism (LPGC type) is used with press (pull) stop, strength of the mating equipment shall be 250% or more of the rated thrust.
- For the mounting bolts of trunnion, use 10.9 or more when load applies directly to the mounting bolts.



- Make sure that install with mating equipment is properly at full stroke.
- After installing, make sure that trunnion and cylinder is swinging smoothly without interfere.
- For side load, be sure to use guide so that not to apply load or bending momentum directly.



★2-4. Prevention of rod rotation (except types with rod lock: option code M)

The rod builds up the rotational force along with the thrust. Prevent this rotation by using your equipment/ machine. The rotational torque generated by rod is shown in Table 1.

- ※ For the special specification such as anti-rod rotation, might be different from following table, so please confirm the final drawing.

Table 1

Type	Speed	Motor	Rod rotation torque N·m{kgf·m}
LPGA070 LPGB070 LPGC070	L	0.1kW	1.54 {0.16}
	M	0.2kW	2.31 {0.24}
	H	0.4kW	1.54 {0.16} ※ 1
	U	0.4kW	0.99 {0.10}
LPGA100 LPGB100 LPGC100	L	0.1kW	2.20 {0.22}
	M	0.2kW	3.29 {0.34}
	H	0.4kW	2.20 {0.22} ※ 2
	U	0.4kW	1.41 {0.14}
LPGA150 LPGB150 LPGC150	L	0.2 kW	3.29 {0.34}
	M	0.4kW	4.94 {0.50}
	H	0.4kW	4.94 {0.50}
LPGA300 LPGB300 LPGC300	L	0.4 kW	6.59 {0.67}
	M	0.2 kW	4.24 {0.43}
	H	0.4 kW	4.24 {0.43}

- ※ For LPGC070H only, motor is 0.2kW, rod rotational torque is 2.31 N·m {0.24kgf·m}
- ※ For LPGC100H only, motor is 0.2kW, rod rotational torque is 3.29 N·m {0.34kgf·m}

2-5. Setting the stroke

Set the stroke using the limit switches (LS) you purchased fitted on the equipment or the optional limit switches of the Power Cylinder. Before each setting, be sure to take safety precautions. Never operate the cylinder with only temporarily wiring of the motor. When checking the stroke, make sure that the wiring of the limit switches is correct (set up the limit switches near the middle of the stroke, and then make sure that the forward motion of the rod is stopped by activating the forward limit switch and that the backward motion of the rod is stopped by activating the backward limit switch) There is coasting after limit switch is operated until the cylinder stops. Set the detectors, such as the limit switches, by adjusting them before the end of the stroke taking into consideration the movement by inertia. For coasting amount, refer to the table that shows reference value of coasting distance on page 9. At the end, ascertain the actual distance under actual loaded conditions. See Section 6 "Connection of Optional Devices" for the procedures for connecting optional limit switches.



Use within the stroke range. Do not operate the cylinder, before wiring to Limit Switch. It may results the Power Cylinder is broken due to the biting or stroke overextension.

3. Connection of Brake Motor

★3-1. Wiring

1. Perform the wiring work according to the electric equipment technical standard and the regulations of the electric power company. The wiring distance becomes longer, the voltage drop may increase. Generally, you should use electric wire that has proper thickness and length that will not cause the voltage to drop 2% or more. Be careful that in case the brake is not released due to the voltage drops.
2. Be sure to use a cable with a diameter in this range. Use of a thinner cable may not maintain waterproof qualities.
3. Make sure that mounting screw of terminal cover and connector are completely tighten after wiring.

Table 2. Motor Terminal Box

Motor capacity	Shape of connector	Applicable cable outer diameter	Connector mounting part	Grounding terminal size
0.1~0.4kW	SK-14L	φ11~φ13	G1/2	M4

※ Special specification might be different from the above table. Confirm the final drawing for special motor.

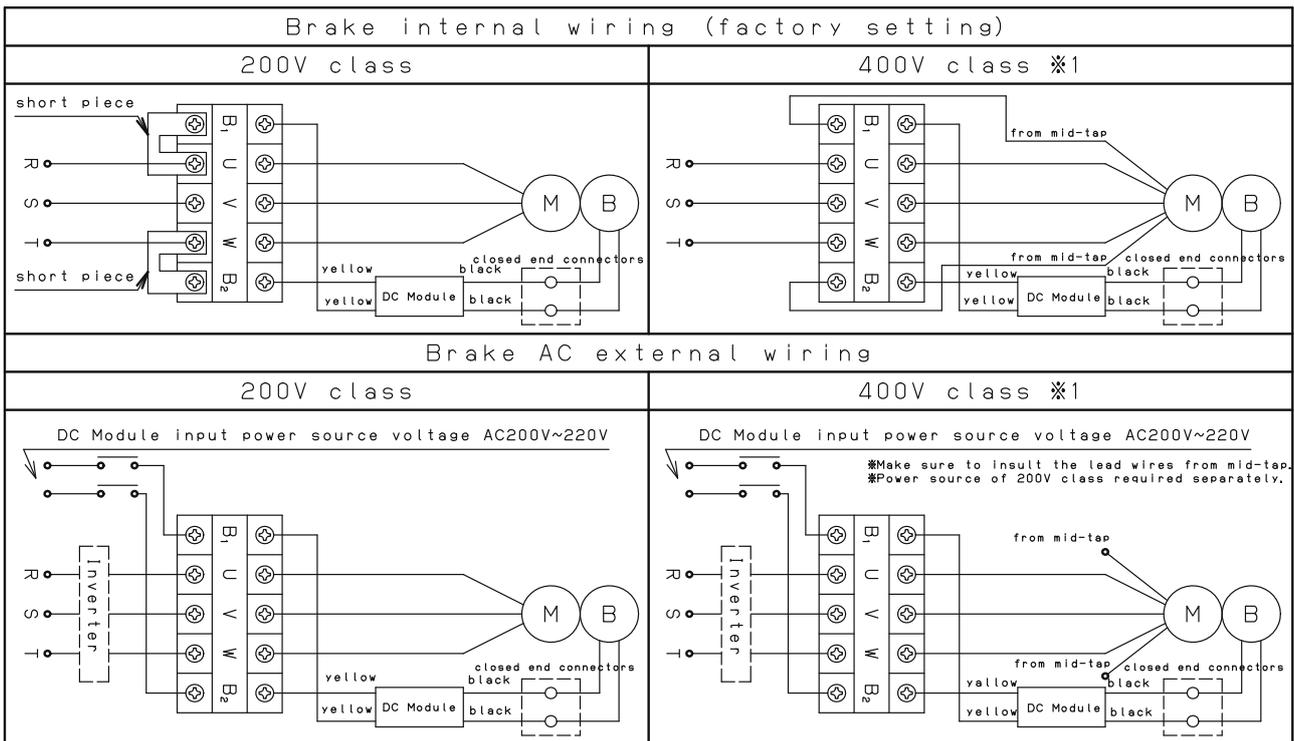
3-2. Grounding

After installing the POWER CYLINDER, ground the motor. (Earth work in class 3 or higher)

★3-3. Wiring motor and brake

Confirm regulations of the power provider regarding switch and fuse.

0.1~0.4kW



※1 Including 400V class Different voltage (380V/50Hz, 380V/60Hz, 415V/50Hz, 480V/60Hz).

※ The following figures show the relation between the motor connection and the forward and backward movements of the cylinder. These figures refer to the straight body type cylinders. Cylinders with the parallel body type will move in the opposite directions.

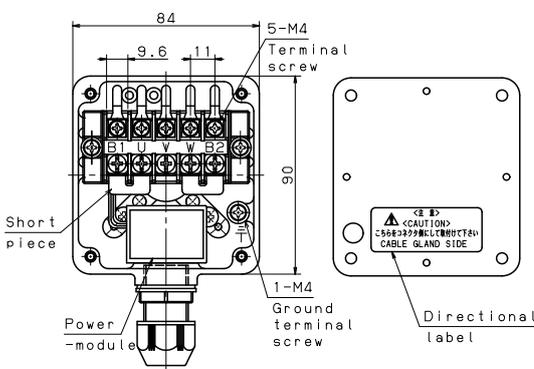
Straight type	Cylinder extend	Cylinder retract
Parallel type	Cylinder retract	Cylinder extend

※ Special specification might be different connection from the above. Confirm the final drawing. Also expansion and contraction direction might be different due to normal wiring.

★3-4. Connection when inverter is used

1. When the motor is operated with an inverter, remove the short-circuiting piece as shown below, and apply the usual supply of voltage, instead of inverter output, to the brake power supply module. Conduct at 60Hz(1800r/min) or less during braking.
2. For motors up to 0.4kW/ 400V class, remove the wire from the mid-tap and insulate it, and apply 200 to 220V to the DC Module for the brake. In case a power source of 200 to 220V is not available, use a transformer to step-down the voltage to the necessary 200 to 220V. The capacity of the transformer should be 90VA and bigger, and be sure that no voltage drop.
3. Use a rated load of AC250V, 7A and larger for the electro-magnetic switch of the 200V class brake. Use a contact voltage of AC400 - 440V, with an inductive load of 1A and larger (ex. magnetic contactor for 2.2kW motor) for the 400V class brake. The DC Module has a surge absorption protective device. Add necessary protective devices to each contact site.
4. If separate DC wiring is required, please contact us.
 ※ Special specification might be different from the above. Confirm the final drawing.

★3-5. Dimensions of terminal box unit

Output	Dimensions	
0.1kW ~ 0.4kW		<p>1. Terminal screw: M4 Tighten torque: 1.4 N·m {13.7 kgf·cm}</p> <p>2. Ground terminal screw: M4 Tighten torque: 1.2 N·m {12.2 kgf·cm}</p> <p>※ This figure will be the terminal box of 200V class. When installing the terminal box cover, make sure that the directional label is connector side</p>

4. Caution before operation

Confirm the following before operation

4-1. Wiring and Power source

Check whether the wiring is correct, specifically the relation between the phase of motor (rotational direction) and limit switches for stroke adjustment.

Put the rod at the middle of the stroke, then turn on the power and check by inching. Make sure the forward button works for forward motion, and make sure the limit switch works for stop, and the same for reverse motion.

4-2. Connection to the machine/equipment

Make sure that there is no lateral load to the cylinder rod. In case it swings at all strokes, check the interference at the end fixture and the other portion.

5. Classification of protection device

★5-1. Torque limiter (for LPGB type), parallel type only

It consists of 2 pieces of dish springs, which produce friction to hold the gear. When the torque exceeds the preset level, the gear slips, and works as overload protection. Torque is set when shipping, so no need to adjust. If the torque limiter slipping is continue, wear, surface-modified and reduce of set thrust will occur, and the power cannot be transmitted. Since the motor becomes overload at the time of the torque limiter slip, detect this electrically and stop the cylinder. It is recommended to use with “TSUBAKI Shock Relay” or “TSUBAKI Shock Monitor” as an electrical overload protection device.

★5-2. Thrust LS (for LPGC type)

To connect the limit switches of the thrust detector, use the enclosed cab tire cable. The thrust detecting load has been adjusted before shipment. Do not change it.

Precaution for use

- When the speed type (speed M , H) is used in such a way that the cylinder is stopped by pressing/pulling, the thrust limit switch cam may be returned by the impact after the limit switch functions. Therefore, set the limit signal in the self-holding position on the control circuit.
- When the thrust detector type (LPGC) is used in such a way that the cylinder is stopped by pressing/pulling, the strength of the mating machine must be 250% or more of the rated thrust.
- When the potentiometer and rotary encoder of the optional position detecting unit are used together, take into consideration that the signal deviates by the deflection of the spring (up to MAX. 7 mm) when the thrust detector functions.



CAUTION

Do not operate the motor, before wiring to thrust LS. It may results the Power Cylinder is broken.

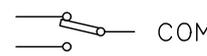
SPECIFICATION		OF LIMIT SWITCH	
		FOR DETECTING THRUST 推力検知用	
TYPE	形式	D2SW-3L2D (相当品/or equivalent)	
MAKER	メーカー	OMRON CO. オムロン (株)	
CONTACT ARRANGEMENT	回路構成	前進用 FORWARD 1 (BLACK) 3 (RED) 2 (WHITE)	後進用 BACKWARD 4 (GREEN) 5 (YELLOW) 6 (BROWN)
LOAD RATING	電気定格	AC250V 2A (COS ϕ =0.4)	
CONNECTOR	コネクタ	SCS10B (Ø8.5~10.5) SEIWA ELECTRIC CO., LTD. 星和電機 (株)	
CABLE	ケーブル	0.5mm ² ×6C 1000mm	

※ Special specification might be different type from the above. Confirm the final drawing.

6. Connection of optional devices

★6-1. Stroke adjusting external limit switch (option code L)

Use a cable $\phi 5.8$ to $\phi 7.6$ in outer diameter. Use of a thinner cable may not maintain waterproof qualities.

SPECIFICATION OF LIMIT SWITCH		FOR ADJUSTING STROKE ストローク 調整用
TYPE 形式		D4E-1B20N (相当品/or equivalent)
MAKER メーカー		OMRON CO. オムロン (株)
CONTACT ARRANGEMENT 回路構成		NC  NO 
LOAD RATING 電気定格		AC250V 3A (cos ϕ =0.4)
CONNECTOR コネクター		専用コネクター ($\phi 5.8 \sim 7.6$)

※ Special specification might be different type from the above. Confirm the final drawing.

Cautions when controlling the stroke with the limit switches

- On the speed types (speed classes M, H and U) in the G Series, because the moving distance from inertia is long, the striker may ride through the limit switch. When the cylinder stroke is short, the internal limit switch in the position detecting unit may be restored because the limit switch cam rotates at a high speed. Therefore, set the limit signal in the self-holding position on the control circuit. The brake power supply module that has been mounted as a standard unit has a built-in relay so that the time lag has been reduced almost to the minimum. To further reduce the time lag, remove the short-circuiting piece from the terminal block, and operate with another MC.
- Set the positions of the limit switches taking into consideration the inertia of the cylinder. Refer to the reference table that shows inertia moving distances below, and ascertain the actual distance under actual loaded conditions.
- When two or more cylinders are operated simultaneously, provide limit switches on each cylinder to stop each motor.

Table 3. Reference values showing inertia moving distances:
(values calculated at rated load when damping delay time is 0.03 sec) Unit: mm

		When load goes up		When load goes down	
		50Hz	60Hz	50Hz	60Hz
LPGA070 LPGB070 LPGC070	L	6.9	10.0	10.6	14.9
	M	15.0	21.5	21.8	30.1
	H	15.4	21.7	23.7	32.7
	U	34.2	47.9	60.6	81.2
LPGA100 LPGB100 LPGC100	L	6.1	9.0	10.6	14.9
	M	13.8	19.8	22.1	30.5
	H	14.1	19.8	23.8	32.7
	U	32.0	45.0	66.9	88.2
LPGA150 LPGB150 LPGC150	L	4.6	6.6	7.1	9.8
	M	10.6	14.7	15.6	21.3
	H	13.7	19.0	21.8	30.0
LPGA300 LPGB300 LPGC300	L	3.3	4.6	5.1	6.9
	M	8.6	12.4	23.2	29.4
	H	9.4	13.1	19.0	25.0

※ The table above shows the values for the parallel types. For other types, the distances are shorter than these values.

※ The moving distance by inertia varies depending on the loading of the application (particularly the inertia of the load) and the operating circuit.

6-2. Position detection unit (option)

Configuration

Position detection can be built in 3 different ways.

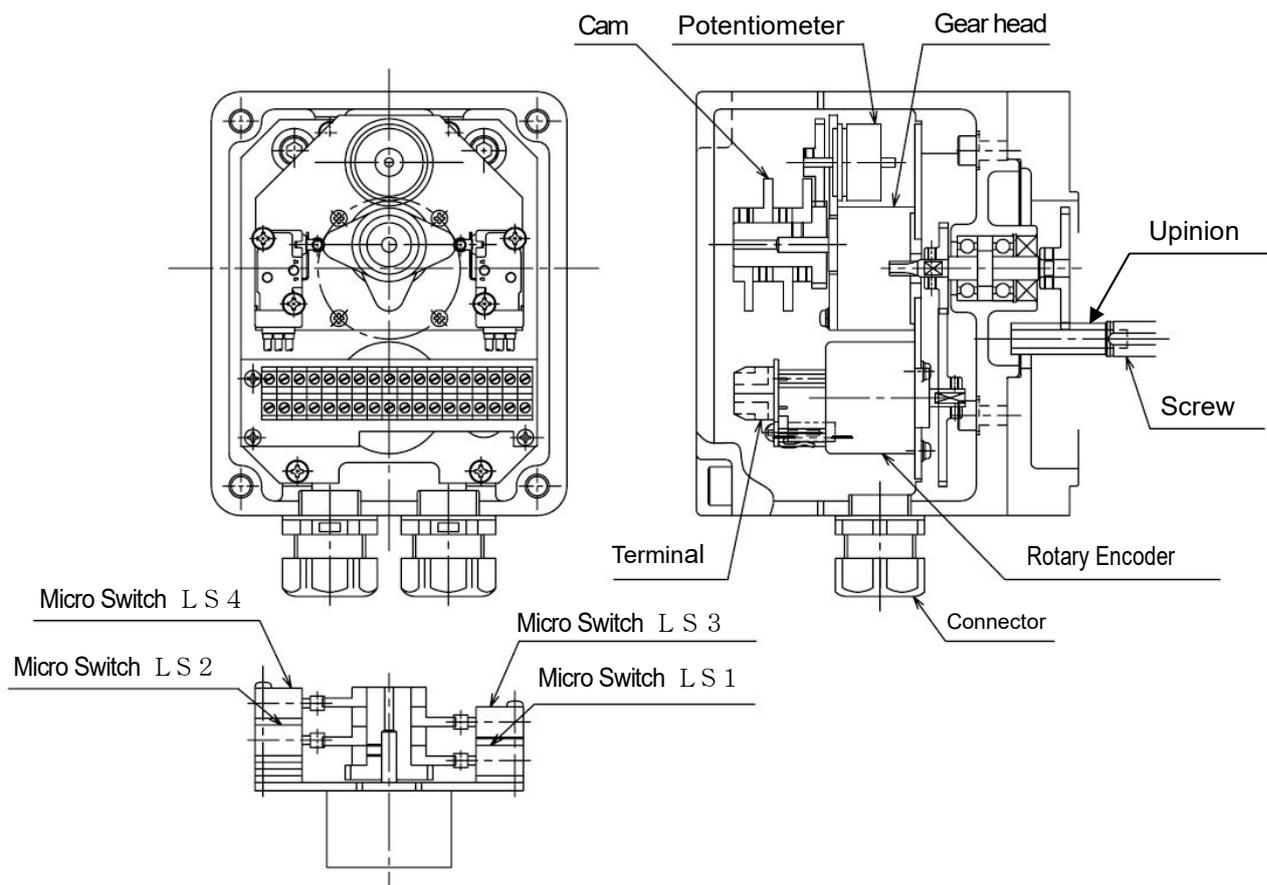
Micro switch: 4 pieces.

Potentiometer: 1 pc.

Rotary encoder: 1 pc.

Structure

Following shows the unit diagram consisting of micro switch, potentiometer and rotary encoder.



General caution

- 1) Micro switch itself is tested before shipping, but stroke adjustment by micro switch is not done. Adjust the stroke by micro switch after installing Power Cylinder to equipment. Do not allow the screw shaft to rotate after adjustment because the setting will deviate if the screw shaft is rotate with the screw shaft fixed.
- 2) Position detection unit consists of precision parts. Never apply shock or vibration.
- 3) Never rotate LS cam strongly after fixing it by the set of screws. Otherwise, built in reducer can brake.
- 4) When the LS cam overruns micro switch by coasting, please take a self-hold on the circuit.



CAUTION

Do not operate the motor, before wiring to thrust LS. It may results the Power Cylinder is broken.

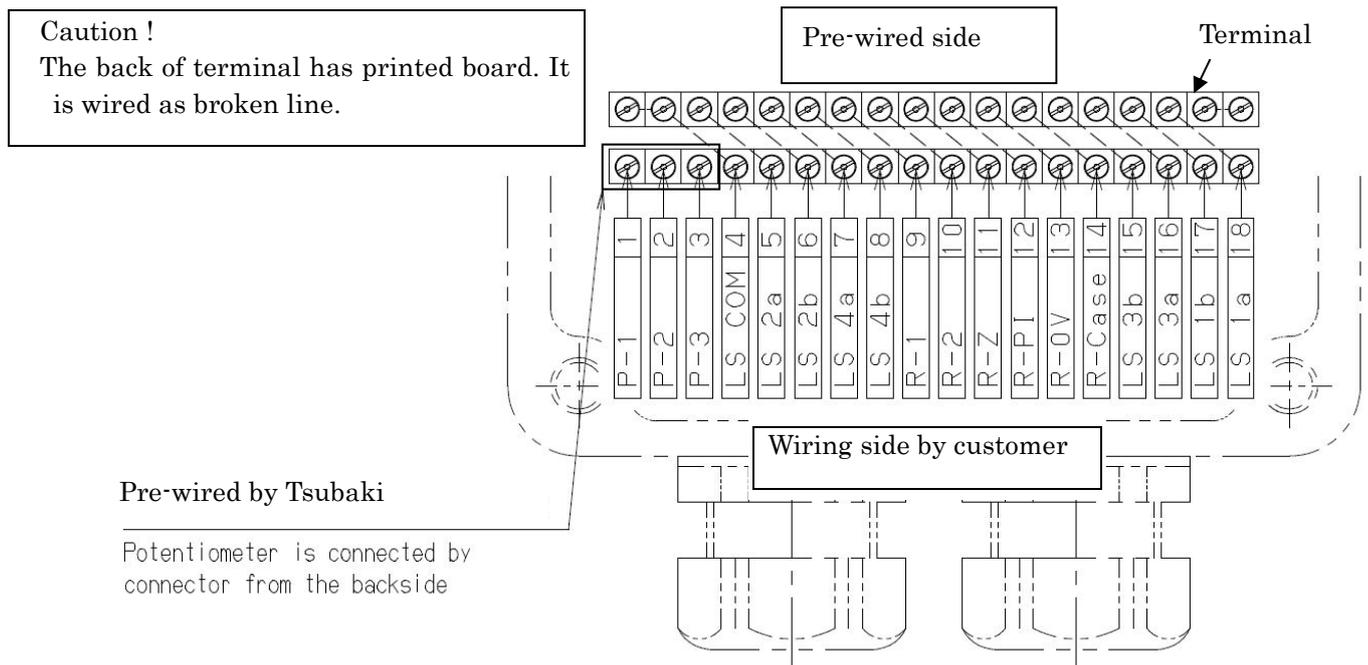
★Connection

- 1) Connection of each detector to terminal block is previously completed. Use the bottom half of terminal block (“wiring side by customer” as below) in the unit for the connection to each detector.
- 2) In case of long distance wiring, signal loss can get worse.
- 3) Make sure to ground the shield wire of the detector unit and signal.
- 4) Locate the signal and power line separately. Put noise filter, shield the signal line, in case there is a source of noise. (Use shield wire for wiring rotary encoder.)
- 5) Use suitable diameter of cable, which corresponds to the connector of position detection unit. In case of smaller diameter cable or bulk cable, waterproof is poor.
Accommodate cable diameter: SCL14B (φ12.5 to φ14.5)
- 6) In case of wiring in rain or other wet environment, avoid water from entering the position detection unit. It will damage the product.
- 7) **After connection, confirm that the bolt for the cover mounting is tighten. Pay special attention to use under the water environment.**



CAUTION

When leaving it while tentative wiring, cover it with vinyl sheet etc. in order to protect from rain, water, and moisture. If it is stored in a place prone to sudden temperature change, dew condensation may cause damage or rust.



★Specification of each position detector

1) Micro switch (Option code: K2 or K4)

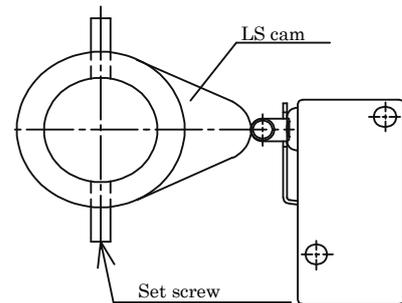
SPECIFICATION OF LIMIT SWITCH	
Type	D2VW-5L2A-1M or equivalent
Maker	OMRON CO.
Contact Configuration	 () shows terminal #
Capacity	250V AC / 4A (COS φ=0.7)

※ Special specification might have different model number, specifications, quantity etc. Confirm the final drawing.

Setting of internal LS (Option code: K2 or K4)

2 or 4 pieces of micro switches as internal LS can be installed in the position detection unit. Rotation of screw is transferred to cam rotational angle through reduction unit, and stroke is adjusted by cam and micro switches.

1. Make sure the connection is correct when adjusting the stroke.
2. At the middle of the stroke, make sure the micro switch for forward end is activated by cam and stopped by pushing the rod forward. The micro switch for backward end is activated by cam and stopped by pulling the rod backward.
3. There is a coast until rod stops after micro switch is activated. Take this coast into consideration when adjusting the position by micro switch.
4. Rotary cam is fixed to the shaft, which is directly connected to the reducer with 2 pieces of setscrew. Loosen these 2 pieces of screws and rotate the cam when adjusting. Built in reducer can be broken, if the cam is rotated without loosening these set screws. (Use hex wrench, “named 2”).
5. Set the cam in order from the inmost. (Backside of the cam cannot move if you set its front side first.) Tighten the setscrew after setting.



2) Potentiometer (Option code: P)

Potentiometer Specification		Terminal #
Type	CP-30	 () shows terminal #
Maker	Sakae	
Total resistance	1.0kΩ	
Power rating	0.75W	
Insulation rating	1000V AC (1min)	
Effective electrical angle	355°	
Effective angle of rotation	360°(infinite)	

- 1) Potentiometer is set at half of the resistance(500Ω) at the middle of the stroke, unless otherwise specified.
- 2) After the stroke adjustment, please never rotate the rod (inner tube) whereas the screw shaft is fixed, because it will change setting of the stroke. When the resistance is incorrect, reset 500 Ω at the middle of stroke.

※ Potentiometer can output the stroke of the POWER CYLINDER as the change of the value of resistance.

※ Special specification might have different model number or total resistance value from the above. Confirm the final drawing.

3) Rotary encoder (Option code: R)

Encoder Specification		
Type	TS5305N251	
Maker	Tamagawa Seiki Co., Ltd	
Output pulse	600C / T	
Output type	Open collector	
Output wave	90° phase difference, 2 phase square wave,— home position signal	
Output voltage	H	—
	L	1V or less
Power supply	DC5V to 24V 100mA or less	

※ Output is set at 20 pulse per stroke 1 mm.

※ In case of the special specification, confirm the final drawing because model number or specification might be different.

Output connection

Signal 1	Signal 2	Signal Z	+5 to 24V	OV	Case
(9)	(10)	(11)	(12)	(13)	(14)

() represents the terminal number.

※Use with an equipment like sequencer or program controller, which controls the stroke as a digital signal.

1. Incremental type encoder is built in for standard unit.
2. It is possible to set an accurate home position of the machine in combination with a limit switch because home position output is read out every 600 pulses.
3. Because the output is open collector type, output signal can be obtained when connected to a pull up resistor.

Output voltage for signal 1 and 2: “H” is “(supply voltage - 1)V or more”, “L” is “1V or less”.

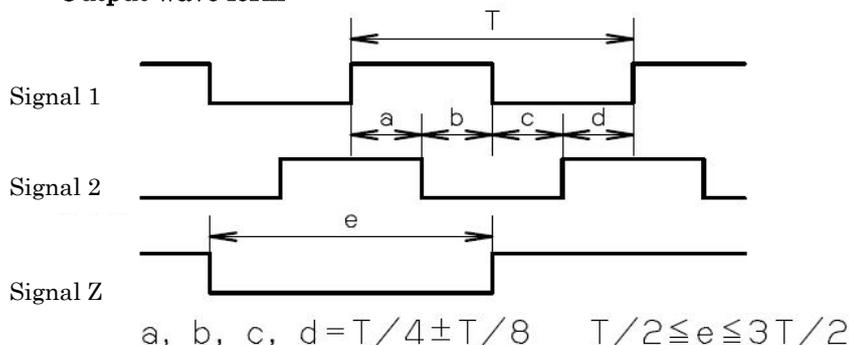
Reference for pull up resistance: DC 5V: 220Ω

DC12V: 470Ω

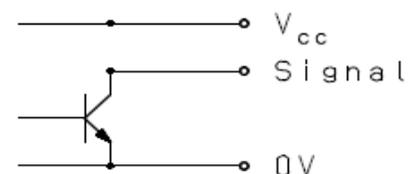
DC24V:1kΩ

4. Rotary encoder is a precision instrument. Never apply vibration or shock.
5. Use shield wire for wiring of rotary encoder.

Output wave form



Output circuit



7. General Cautions

★7-1. Variation in voltage and frequency

When the voltage and frequency applied to the motor are not the specified values, the characteristics will change. Pay attention to them. The motor has been designed so that it can withstand instantaneous changes in the voltage less than approx. +10% of the rated voltage and in the frequency less than approx. +5% of the rated frequency. Generally, the supply voltage is slightly lower than the specified value, and if the voltage is reduced considerably, the following nonconformities may occur.

- 1) The motor cannot start because the brake is not released.
- 2) The starting torque (thrust on starting) is released, and the motor becomes difficult to start.
- 3) The motor cannot withstand an overload.
- 4) The motor generates more heat.

※ Servo motor and special motor might be different from the above.

7-2. Load

The following loads can degrade the efficiency of the Power Cylinder, adversely affect the service life of the motor and the trapezoidal screws, and damage the reduction gears, rod and outer cylinder. Avoid applying such loads.

- 1) Traverse load and force (traverse load) which can bend the rod must not be applied.
- 2) Impact load
- 3) Overload
- 4) Constraint load (in operating direction), Avoid keeping pressing or retracting while an article is in the stopped state.
- 5) Stopping by hitting (allowable with respect to LPEC type)

7-3. Operation upon occurrence of abnormality

If any abnormality is found during operation, immediately stop the operation, and check the cylinder after taking the appropriate measures to prevent lifted objects from falling and other accidents. For example, if the cylinder is kept operating with the motor burnt out, the brake will be released, and the motor output will not be given. Therefore, a load cannot be supported, which may result in an accident.

★7-4. Manual operation

When manually moving the rod, turn off the power. If the power switch is separated from the main body, take care that the power will not be turned on by mistake. Make sure that no load is applied to the rod.

To manually operate the rod, remove the cap on the rear of the brake cover, and directly rotate the motor shaft end with a socket wrench or similar tool. After ensuring safety, release the brake before operating. See [Section 10, 3 “Manual Release of Brake”](#) for the procedure for releasing the brake.

Make sure to completely tighten the brake cover cap after manual operation, otherwise the sealing for brake cover may not perform efficiently.

When the main body has a straight shape, turn the shaft clockwise when viewed from the back of the brake motor, and the rod will move backward. Turn it counterclockwise, and the rod will move forward. When the main body has a parallel shape, the rod will move in opposite directions.

The movement of the rod per rotation of the manual handle is shown below (common to all the types).

Table 4. Rod movement per turn of manual shaft

Unit: mm

Model	LPGA070 LPGB070 LPGC070				LPGA100 LPGB100 LPGC100				LPGA150 LPGB150 LPGC150			LPGA300 LPGB300 LPGC300		
	L	M	H	U	L	M	H	U	L	M	H	L	M	H
Movement	1.0	3.0	4.0	8.0	1.0	3.0	4.0	8.0	1.0	3.0	4.0	1.0	2.0	2.7

※ For servo motor and special motor, there is specifications that cannot be manual operation, and expansion and contraction direction might be different from the above according to the handle rotation direction.

★7-5. Frequency of Use and Duty Factor

The allowable frequency of use and the allowable duty factor are shown in below. Use the Power Cylinder at a frequency and duty factor lower than these values. In case of high frequency usage, consider the life of cylinder.(For details, refer to the selection section of catalog.)

Table 5

Number of motor starts	10 times/min.
Working time rate	25%ED

The duty factor is determined as the ratio of the operating time to the standard time, 10 minutes.

The duty factor is determined by the following formula.

$$\text{Duty factor (\%ED)} = \frac{\text{Working time per cycle}}{\text{Working time per cycle} + \text{Stopping time per cycle}} \times 100 (\%)$$

8. Maintenance and Inspection

When checking and doing maintenance on the cylinder, turn off the power, and make sure that the cylinder has completely stopped. Take care that the power is not turned on accidentally. If the main body is disassembled or the brake is manually released, the Power Cylinder cannot hold a load, which may result in an accident. Remove any load before starting maintenance.

★8-1. Lubricating

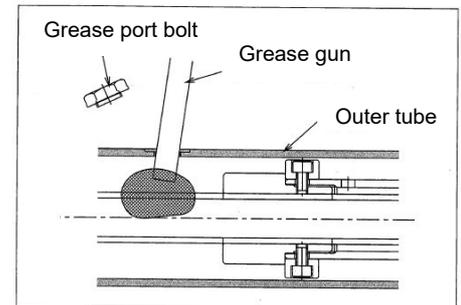
The Power Cylinder is supplied with grease and it can be used without additional lubrication. After starting to use the Power Cylinder, add grease depending on the frequency of use and traveling distance (every 5km).

1) Lubricating the threaded shaft

To lubricate the threaded shaft, remove the greasing port bolt on the outer cylinder, make the rod run a full stroke forward, apply grease to the periphery of the threads using a grease gun, and make the rod move forward and backward in the stroke range. Repeat this operations 2 or 3 times. The total amount of grease is 10 to 15g per 100 mm of stroke. The lubricating cycle is shown below.

Table 6. lubrication cycle for screw shaft

Frequency of use	Lubrication of cycle	
101 times or more/ day	one to three months	or every 5km
11 to 100 times/ day	three to six months	
up to 10 times/ day	six month to one year	



Note) The above values are for longer use, and do not indicate life.

The recommended grease are shown below. ※ initial application grease

Maker	Name of Grease
※IDEMITSU KOSAN	DAPHNE EPONEX SR NO.2
NIPPON GREASE	NIGULUBE EP-2K
EXXON MOBILE	MOBILUX EP No.2
COSMO OIL LUBRICANTS	COSMO GREASE DYNAMAX EP NO.2
SHOWA SHELL	SHELL ALVANIA EP GREASE 2

※ Make sure to use lithium system grease. A different kind grease may cause early wear.

2) Greasing the cylinder rod periphery

Apply lubrication to the rod periphery so that the oil film is not broken. Use the same lubricant that is applied to the threaded portion.

3) Greasing on reduction part

Grease has been applied on the tooth surfaces in advance, therefore, use the decelerating part as it is.

Initial tooth surface application grease

Planetary gear (straight type): Moly gear grease No.1 (SUMICO LUBRICANT CO.,LTD.)

Helical gear (parallel type): Moly gear grease No.1 (SUMICO LUBRICANT CO.,LTD.)

4) Greasing on swinging part (trunnion pin, linkage pin etc.)

As a guide for greasing period to screw shaft, check the swinging part and grease on it as required. Use the same lubricant that is applied to the threaded portion.

★8-2. Guide for life

As a guide for duration of life for Power Cylinder G series, number of operation times of brake is 2 million times. However, gap adjustment is required. Main body part is based on 25km in cylinder (nut) travelling distance.(at rated thrust of Power Cylinder)

Wear life for screw and nut is depend on the conditions of use required and lubricating.

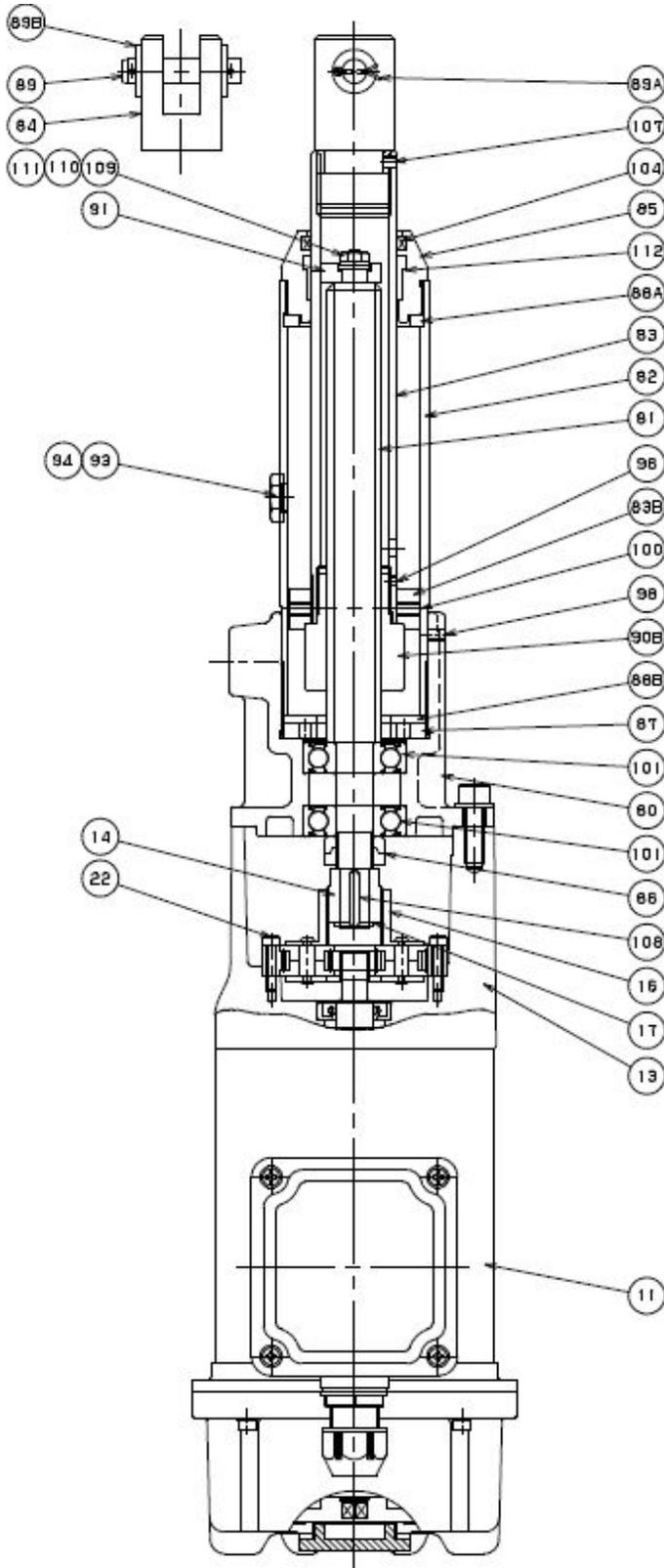
★8-3. Trouble shooting

Refer to the following table in case of trouble.

Trouble	Possible Cause	Action
Does not work even if the start button is pressed	<ol style="list-style-type: none"> 1. Wrong wiring of motor, limit switch, control unit 2. Disconnection of motor stator winding and lead wire 3. Failure of the electro-magnetic contactor, control unit 4. Failure of limit switch 	<p>Check wiring</p> <p>Repair and replace</p> <p>Repair</p> <p>Replace</p>
Does not rotate even though the motor sounds like running	<ol style="list-style-type: none"> 1. Single phase operation 2. Voltage drop in power source 3. Too much stroke of electromagnet of brake 4. Burn out of brake lining 5. Slip of torque limiter(GB type) 	<p>Check the wiring</p> <p>Increase power source capacity, consider power source size.</p> <p>Adjustment</p> <p>Replace brake motor</p> <p>Adjust and replace the friction facing</p>
Does not generate specified thrust	<ol style="list-style-type: none"> 1. Voltage drop in power source 2. Decrease of the setting of torque limiter(GB type) 3. Bad connection of equipment 4. Failure of brake release 	<p>Increase capacity of power source, consider power source size</p> <p>Adjust and replace the friction facing</p> <p>Repair</p> <p>Adjust the gap or replace brake motor.</p>
Unable to stop accurately	<ol style="list-style-type: none"> 1. Wear of brake lining 2. Oil, water penetration to friction facing of the brake 3. Forget manual brake release 4. Excessive load 	<p>Adjust the gap or replace brake motor</p> <p>Replace brake motor</p> <p>Set the correct position</p> <p>Reduce the load, consider the capacity</p>
Motor is overheated	<ol style="list-style-type: none"> 1. Excessive load 2. Too much frequency 	<p>Reduce the load, consider the capacity</p> <p>Consider the capacity</p>
Damage to the equipment	<ol style="list-style-type: none"> 1. Impact load 2. Lateral load 	<p>Repair</p> <p>Repair</p>

Basic drawing (LPGA, Straight type)

Configuration slightly vary depending on the models.

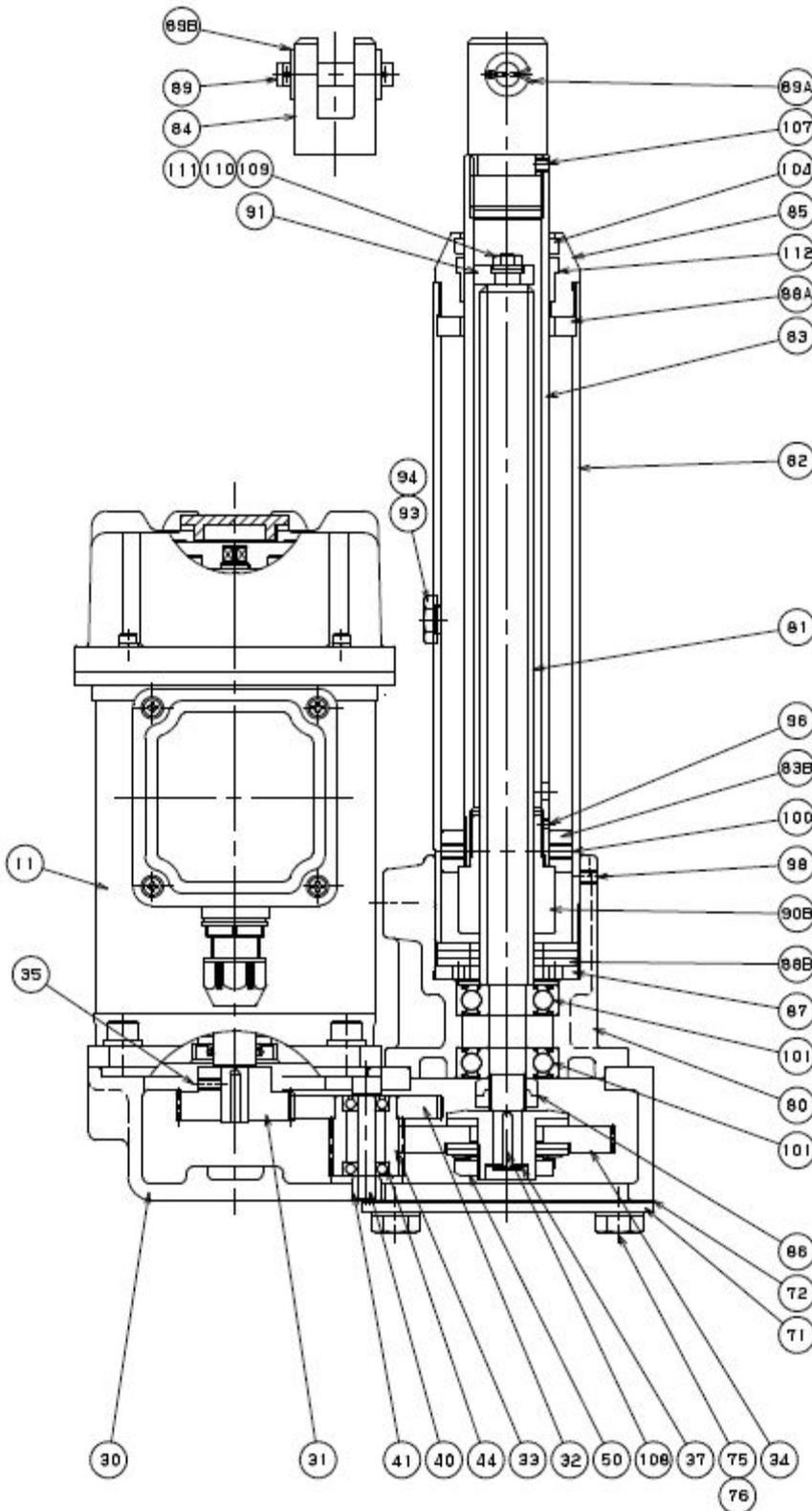


112	Tube rest
111	Hexagon nut
110	Washer
109	Spring washer
108	Woodruff key
107	Set screw
104	Scraper
101	Ball bearing
100	Set screw
98	Set screw
96	Set screw
94	Seal washer
93	Grease port bolt
91	Tip guide
90B	Acme screw nut
89B	Washer
89A	Cotter pin
89	Linkage pin
88B	Rubber for retract
88A	Rubber for extend
87	Stopper plate
86	Lock nut
85	Tube rest holder
84	U-type end fitting
83B	Inner tube collar
83	Inner tube
82	Outer tube
81	Screw shaft
80	Bracket A
22	Hexagon socket head screw
17	S-type snap ring
16	Planetary gear
14	MX joint
13	M Bracket
11	Brake motor

Basic Drawing (LPGB, Parallel type)

Configuration slightly vary depending on the models.

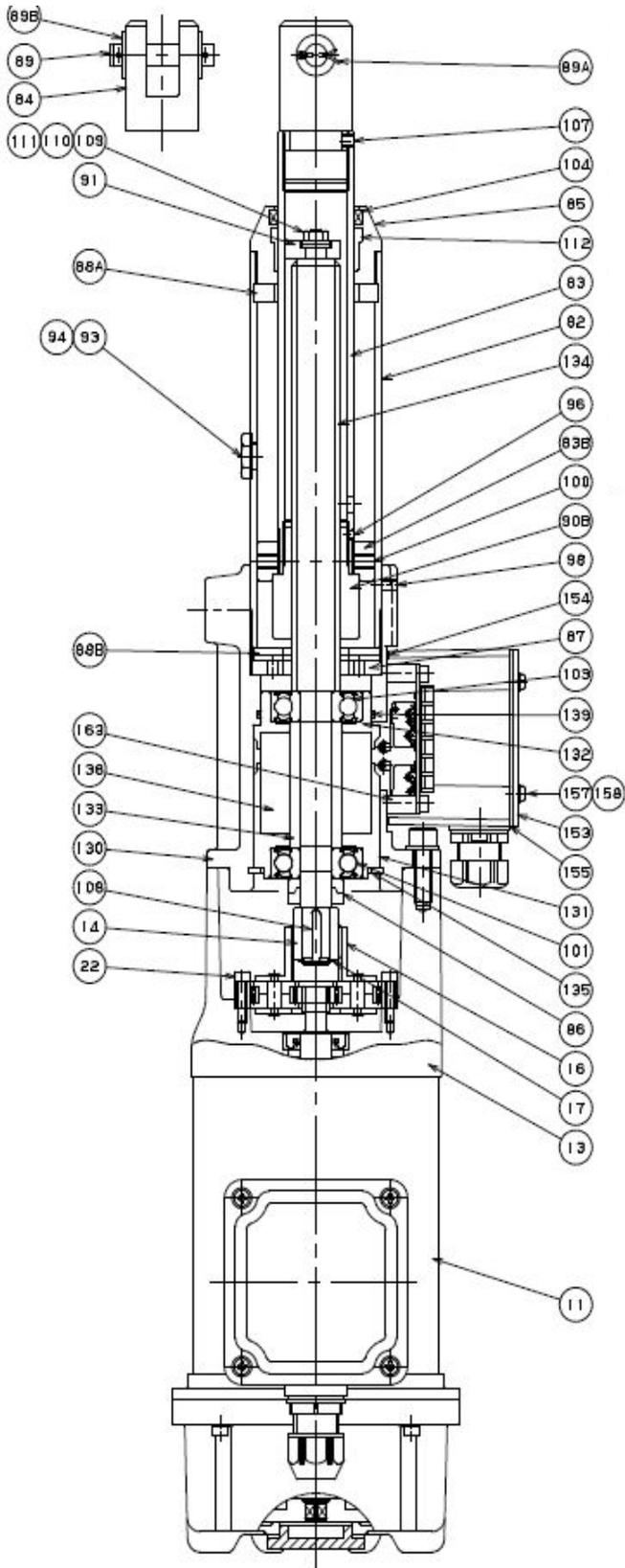
When there is a position detecting unit optionally, refer to page 14.



112	Tube rest
111	Hexagon nut
110	Washer
109	Spring washer
108	Woodruff key
107	Set screw
104	Scraper
101	Ball bearing
100	Set screw
98	Set screw
96	Set screw
94	Seal washer
93	Grease port bolt
91	Tip guide
90B	Acme screw nut
89B	Washer
89A	Cotter pin
89	Linkage pin
88B	Rubber for retract
88A	Rubber for extend
87	Stopper plate
86	Lock nut
85	Tube rest holder
84	U-type end fitting
83B	Inner tube collar
83	Inner tube
82	Outer tube
81	Screw shaft
80	Bracket A
76	Seal washer
75	Hexagon head bolt
72	Cover packing
71	Gear case cover
50	Torque limiter
44	Ball bearing
41	Intermediate shaft collar
40	Intermediate shaft
37	S-type snap ring
35	Set screw
34	2 wheel
33	2 pinion
32	1 wheel
31	1 pinion
30	Gear case
11	Brake motor

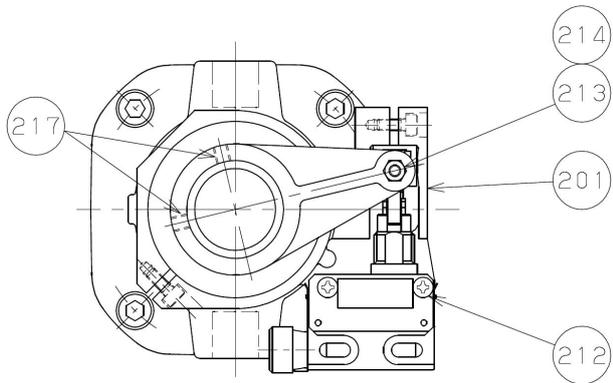
Basic drawing (LPGC, Straight type)

Configuration slightly vary depending on the models.

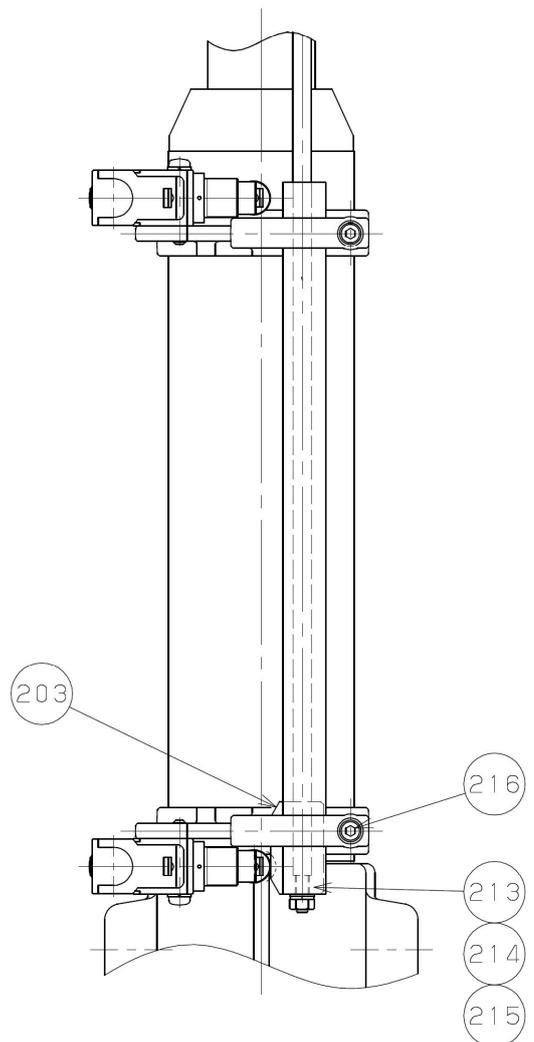
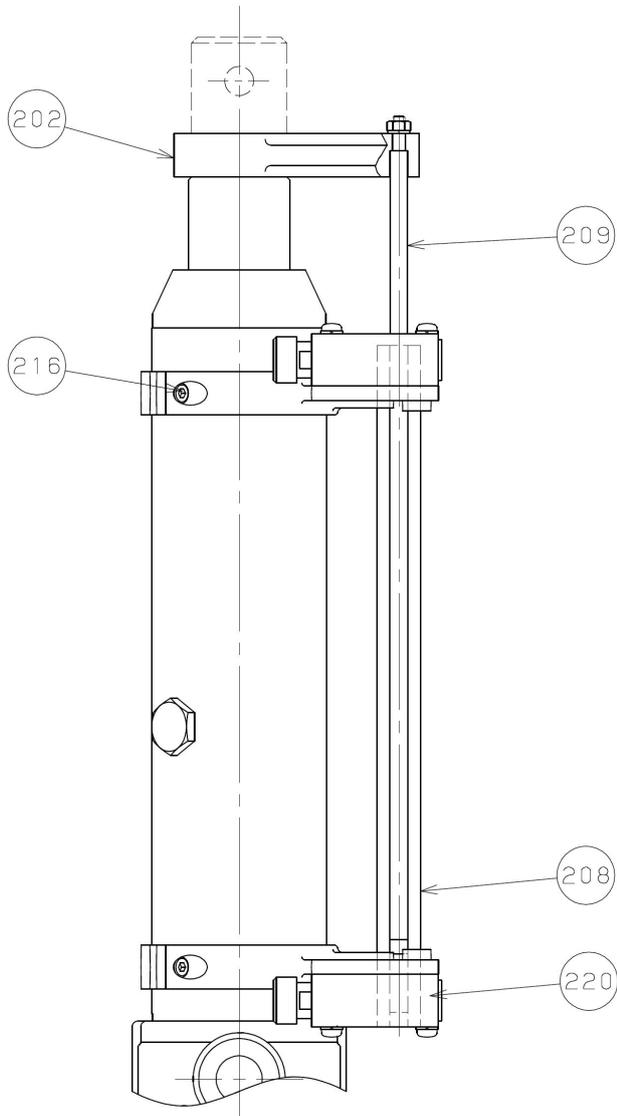


134	Screw shaft	133	Spring guide
135	Spirolox	132	Bear holder B
138	Coil spring	131	Bear holder 70A
139	O-ring	130	Bracket C
150	Thrust LS case	112	Tube rest
153	LS case cover	111	Hexagonal nut
154	Thrust LS case packing	110	Washer
155	LS cover packing	109	Spring washer
156	Hexagon socket head screw	108	Woodruff key
157	Screw	107	Set screw
158	Seal washer	104	Scraper
162	Thrust detecting LS unit	103	Ball bearing
163	Spacer	101	Ball bearing
164	Hexagon socket head screw	100	Set screw
170	Connector	98	Set screw
		96	Set screw
		94	Seal washer
		93	Grease port bolt
		91	Tip guide
		90B	Acme screw nut
		89B	Washer
		89A	Cotter pin
		89	Linkage pin
		88B	Rubber for retract
		88A	Rubber for extend
		87	Stopper plate
		86	Lock nut
		85	Tube rest holder
		84	U-type end fitting
		83B	Inner tube collar
		83	Inner tube
		82	Outer tube
		22	Hexagon socket head screw
		17	S-type snap ring
		16	Planetary gear
		14	MX joint
		13	M Bracket
		11	Brake motor

External limit switch part for stroke adjustment

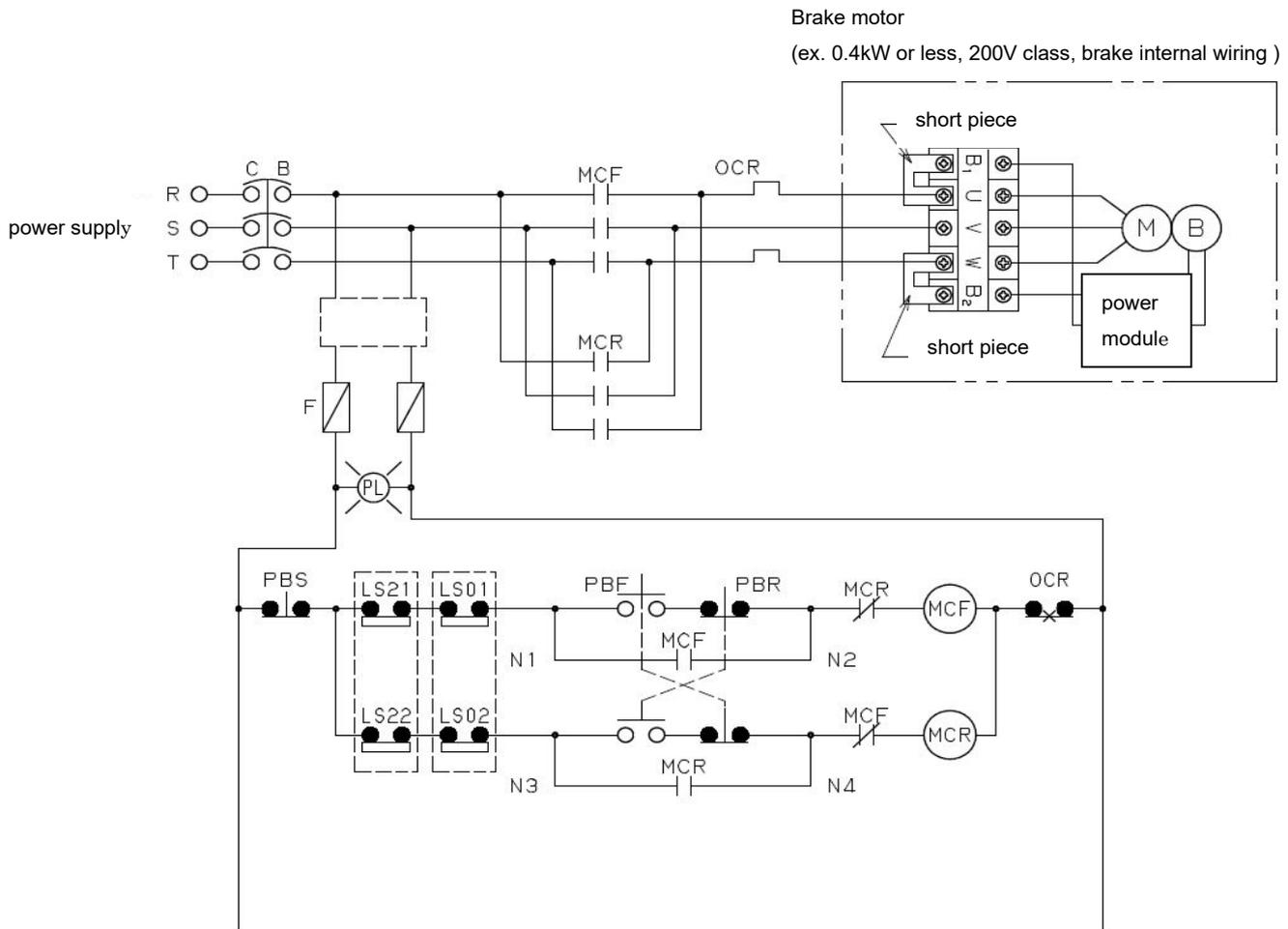


220	Limit switch
217	Set screw
216	Hexagon socket head screw
215	Washer
214	Spring washer
213	Hexagonal nut
212	Sems screw SW
209	LS rod
208	LS guide rail
203	Striker
202	Connecting fitting
201	LS flange



9. Reference circuit diagram

Following shows reference circuit for thrust detection LS and with external LS.
Please consult us if motor capacity or optional control devices are different.



LS01: Stroke adjusting external limit switch for extending

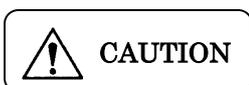
LS21: Thrust detecting limit switch for extending

LS02: Stroke adjusting external limit switch for retracting

LS22: Thrust detecting limit switch for retracting

NOTE :

- 1) This diagram is an example when the thrust detecting limit switch is used for overload protection.
- 2) This diagram shows a single-acting circuit. When using in an inching circuit, remove wire connection between N1 and N2, N3 and N4 and short-circuit the PBS.
- 3) If the power source voltage for the motor is different from the control voltage, place a transformer into a [] portion in the diagram.
- 4) The lead wires B1 and B2 for the brake are connected to the motor terminal blocks U and W using short piece.
- 5) When individually turning off the brake, remove the short piece and apply a normal power source voltage other than inverter output to B1 and B2 from the outside.



In order to stop the cylinder immediately, please take a circuit to reduce the electrical time lag.

※If the electrical time lag is large, the cylinder stops will be delayed, and damage to equipment or shorter life may occur.

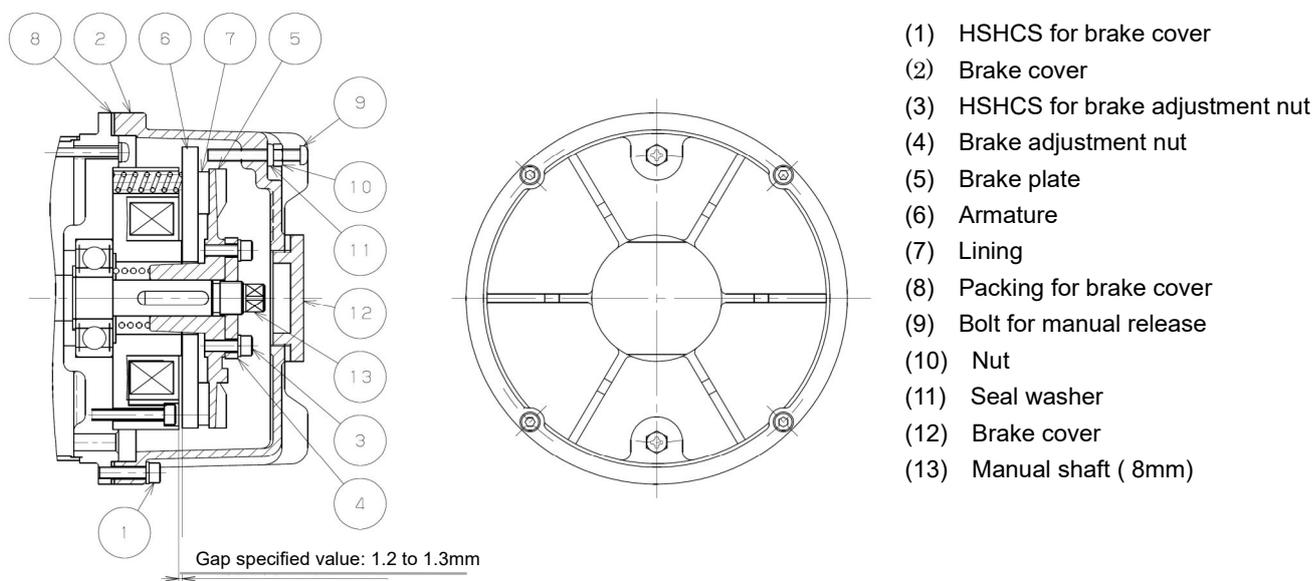
10. Brake Motor

★ For 0.1~0.4kW

It is usually sufficient to monitor the operational status of the brake on your own, but please be aware of the following:

- The brake lining becomes worn because of the force of friction between the brake plate and the lining. It is necessary to change brake motor after 2 times of 'Gap adjustments'.
- It is necessary to clean up the brake twice a year because it accumulates a lot of dust and particles due to the continuous wearing of the brake lining.

1) Brake Structure



2) Detection of brake, gap adjustment procedure

1. Unfasten 4 HSHCS' (1), then remove the brake cover (2).
2. Unfasten 2 HSHCS' (3).
3. Adjust the gap within the regulated 1.2 to 1.3 mm by adjusting the nut (4). Use a thickness gauge for adjustment. (Limitation of gap is 1.5 mm)
4. Apply anti-loosening liquid to 2 HSHCS' (3), then affix the brake plate (5) at a tightening torque of 294 to 392 N·cm {30 to 40 kgf·cm}.
5. Turn on the power source, and make sure the brake works normally. If the gap is small, the armature (6) will make contact with the lining (7) when it's turning. Re-adjust the gap in this case.
6. Affix the brake cover packing (8) to the matching surface of the brake cover, then fasten to the motor with 4 HSHCS' (1).

[Note] In case the brake cover packing develops a crack or is cut, change to new packing or apply silicone bond to maintain sealing performance. When the grooves in the brake lining wear out, it is no longer effective.

3) Manual release operation

Conduct the following in the case the brake is released manually without turning on the brake power. Never apply any load to the rod when manually releasing it.

1. Loosen the 2 nuts (9) until they come in contact with the head of the bolt.
2. By screwing the 2 bolts (9) in evenly, the tip of the bolt will make contact with the armature (6), causing it to suddenly become heavy. And then, screw it for several millimeter using "Philips screwdriver", the brake will be released.



CAUTION

Forcefully screwing in the bolts may deform the armature or damage the bolts and/or the tap holes at brake cover.

3. With the above-mentioned operation, when the brake lining (7) separates from the armature (6), the braking force ablates.
4. When resetting to the original brake operation state, loosen the brake cover bolts (9) and return to their original position. Move the nut (10) to its original position and tighten. Once finished, conduct a test run to ensure the brake is running as normal.

Note: Make sure the nut (10) and brake cover (12) are tightened properly to ensure a good seal.

11. Warranty

11-1. Warranty period without charge

18 months effective the date of shipment or 12 months effective the first use of Goods, including installation of Goods to Buyer's equipment or machines - whichever comes first.

11-2. Warranty coverage

Should any damage or problem with the Goods arise within the warranty period, given that the Goods were operated and maintained under instructions provided in the manual, Seller would repair and replace at no charge once the Goods are returned to Seller. The following are excluded from the warranty.

- 1) Any cost related to removal or re-installation of Goods from the Buyer's equipment or machines to repair or replace parts.
- 2) Cost to transport Buyer's equipment or machines to the Buyer's repair shop.
- 3) Costs to reimburse any profit loss due to any repair or damage and consequential losses caused by the Buyer.

11-3. Warranty with charge

Seller will charge any investigation and repair of Goods caused by:

- 1) Improper installation by failing to follow the instruction manual.
- 2) Insufficient maintenance or improper operation by the Buyer.
- 3) Incorrect installation of Goods into other equipment or machines.
- 4) Structure change of the Goods by any modifications or alterations by the Buyer.
- 5) Any repair by engineers other than the Seller or those designated by the Seller.
- 6) Operation in inappropriate environment not specified in the manual.
- 7) Force Majeure or forces beyond the Seller's control such as natural disaster and injustice done by third party.
- 8) Secondary damage or problem incurred by the Buyer's equipment or machines.
- 9) Defected parts supplied, or specified by the Buyer.
- 10) Incorrect wiring or parameter setting by the Buyer.
- 11) The end of life cycle of the Goods under normal use condition.
- 12) Losses or damages not liable to the Seller

11-4. Dispatch the Seller's engineer

Service to dispatch Seller's engineer for investigation, adjustment or trial testing, etc. of Seller's Goods are at Buyer's expense.

TSUBAKI POWER CYLINDER
China RoHS Instruction

本资料是中国ROHS的必备资料 (China RoHS requisite document)

LPGA, LPGB, LPGC

Part Name	Hazardous Substances or Elements									
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯 醚 (PBDE)	邻苯二甲 酸二(2- 乙基)乙 酯 (DEHP)	邻苯二甲 酸丁苯酯 (BBP)	邻苯二甲 酸二正丁 酯 (DBP)	邻苯二甲 酸二异丁 酯 (DIBP)
Motor	×	○	○	○	○	○	○	○	○	○
Aluminum Parts around the Bracket)	×	○	○	○	○	○	○	○	○	○
Position Detecting Unit)	×	○	○	○	○	○	○	○	○	○
Aluminum Parts of Stroke adjusting external LS	×	○	○	○	○	○	○	○	○	○

Note 1: The symbol of ‘○’ indicates that the content of harmful substances in all homogeneous materials of the component does not exceed the requirements of the national standard for the restriction of the use of harmful substances in electrical and electronic products.
The symbol of ‘×’ indicates that the content of harmful substances in at least one homogeneous material of the component exceeds the requirements of the national standard for the restriction of the use of harmful substances in electrical and electronic products.

Note 2: For components not listed above ‘Note 1’ , the content of harmful substances does not exceed the requirements of the national standard for the restriction of the use of harmful substances in electrical and electronic products.



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