



# Installation and Maintenance Manual

## IP6#00-0#1-X83 / IP6#00-0#1-X84

### Electropneumatic Positioner

## 1 SAFETY RECOMMENDATION

### 1.1 General recommendation

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger". To ensure safety, be sure to observe ISO4414 (Note1), JIS B 8370 (Note2) and other safety practices.

Note 1: ISO 4414: Pneumatic fluid power - Recommendations for the application of equipment to transmission and control systems. Note 2: JIS B 8370: Pneumatic system axiom.

**CAUTION:** Operator error could result in injury or equipment damage.

**WARNING:** Operator error could result in injury or loss of life.

**DANGER:** In extreme conditions, there is possible result of serious injury or loss of life.

### WARNING

- The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.**  
Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.
- Only trained personnel should operate pneumatically operated machinery and equipment.**  
Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.
- Do not service machinery/equipment or attempt to remove component until safety is confirmed.**
  - Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
  - When equipment is to be removed, confirm the safety process as mentioned above. Switch off air and electrical supplies and exhaust all residual compressed air in the system.
  - Before machinery/equipment is re-started, ensure all safety measures to prevent sudden movement of cylinders etc. (Supply air into the system gradually to create backpressure, i.e. incorporate a soft-start valve).
- Contact SMC if the product is to be used in any of the following conditions:**
  - Conditions and environments beyond the given specifications, or if product is used outdoors.
  - Installations in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
  - Applications, which have the possibility of having negative effects on people, properties or animals, requiring special safety analysis.

### 1.2 Conformity to standard

This product is certified to and complies with the following standards:

- EMC Directive 89/336/EEC
- EN61000-6-2:2001      Generic Standards - Immunity for Industrial environments
- EN61000-6-3:2001      Generic Standards - Emission standards for residential, commercial and light industrial environments
- EN55011:1998          Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical radio-frequency equipment and light-industrial environments

## 2 SPECIFICATIONS

Protect the unit from impact and dropping during transfer and when mounted. It may cause failure of the unit.

- Do not use the unit in places with high humidity & temperature. It may cause malfunctions.
- Do not use this positioner outside of the range of it's specifications as this can cause failure.

Item	IP6000		IP6100	
	Lever type lever		Rotary type cam	
Type	Single action	Double action	Single action	Double action
Input current	4~20mADC (Standard)*1			
Input resistance	235 ± 15Ω (4~20mADC)			
Supply air pressure	0.14~0.7MPa			
Standard stroke	10 ~ 85mm (External lever allowable runout angle 10° ~ 30°)		60° ~ 100°*2	
Sensitivity	Within 0.1%F.S.		Within 0.5%F.S.	
Linearity	Within ±1%F.S.		Within ±2%F.S.	
Hysteresis	Within 0.75%F.S.		Within 1%F.S.	
Repeatability	Within ±0.5%F.S.			
Thermal coefficient	Within 0.1%F.S./°C			
Output flow rate	80 l/min (ANR) or more (SUP=0.14MPa)*3			
Air consumption	Within 5 l/min (ANR) (SUP=0.14MPa)			
Ambient and using fluid temperature	-20°C ~ 80°C			
Air connection port	NPT1/4 FEMALE - IP6#00-0#1-X83 (Rc1/4 FEMALE - IP6#00-0#1-X84)			
Electric wiring connection port	G1/2 (FEMALE)			
Output Signal	4-20mADC			
Power supply	12 - 35V (for output current detection)			
Resistance Load	< Power Supply-12V 20mADC			
Output characteristic	±2% F.S.		±2% F.S.	
Hysteresis	2% F.S.		1% F.S.	
Temperature Coefficient	0.06% F.S./°C			
Material	Aluminium diecast for the body			
Mass	Approx. 2.6kg			
Classification of degree of protection	JISF8007 IP55 (conform to IEC pub.529)			

\*1 : 1/2 split range is possible with the standard type (by adjusting the span)  
 \*2 : The stroke is adjustable in 0~60° and 0~100°.  
 \*3 : Standard air (JIS B0120): temp.20°C, absolute press. 760mmHg, ratio humidity 65%.

### 2.1 How to Order

IP 6  00 - 0  1 -  - X83 / X84 -

TYPE

0	LEVER TYPE
1	ROTARY TYPE

ACCESSORIES

NIL	NO ACCESSORIES (WITH STANDARD LEVER)
A	WITH PILOT VALVE ADDED DIA. 0.7mm ORIFICE FOR RESTRICTING OUTPUT.
B	WITH PILOT VALVE ADDED DIA. 1.0mm ORIFICE FOR RESTRICTING OUTPUT.
C	FORK LEVER ASSEMBLY, TYPE MX (P368010-36) -X83 FORK LEVER ASSEMBLY, TYPE M (P368010-24) -X84
D	FORK LEVER ASSEMBLY, TYPE SX (P368010-37) -X83 FORK LEVER ASSEMBLY, TYPE S (P368010-25) -X84
E	WITH LEVER FEEDBACK UNIT FOR STROKE 35 ~ 100mm, (WITHOUT STANDING LEVER)
F	WITH LEVER FEEDBACK UNIT FOR STROKE 50 ~ 140mm, (WITHOUT STANDING LEVER)
G	WITH GAIN SUPPRESSION SPRING (A). (WITHOUT STANDARD GAIN SUPPRESSION SPRING)

ACTION (IP6000 OPTION)

D	DIRECT ACTION
R	REVERSE ACTION

PRESSURE GAUGE (SUP, OUT1)

1	0.2 MPa (R1/8)
2	0.3 MPa (R1/8)
3	1.0 MPa (R1/8)

With 4-20mA Output

NOTE: WHEN MORE THAN 2 ACCESSORIES ARE REQUIRED THE SYMBOL SHOULD BE STATED IN ALPHABETICAL ORDER

## 3 INSTALLATION

### WARNING

- Do not install unless the safety instructions have been read and understood.
- Since zero-point varies depending on the mounting position, the zero point should be adjusted after installation.

- Avoid hitting the product with metallic objects!
- Avoid using this product in non-explosive environments which can become explosive due to air leakage!

### 3.1 Environment

#### WARNING

- Do not use in an environment where the product is directly exposed to corrosive gases, chemicals, salt water, water or steam.
- Do not mount the product in a location where it will be subject to strong vibrations and/or shock.
- Do not mount the product in a location where it is exposed to radiant heat.
- Allow sufficient space for maintenance and adjustment around the product when mounted.

### 3.2 Piping

#### CAUTION

- Before piping make sure to clean away all chips, cutting oil, dust etc.
- When installing piping or fitting into a port, ensure that sealant material does not enter the port inside. When using seal tape, leave 1.5 to 2 threads exposed on the end of the pipe/fitting.

### 3.3 Lubrication

#### CAUTION

- The positioner has a fixed orifice and nozzle, which contain fine paths in them. Use filtered, dehydrated air and avoid the use of lubricators as this may cause malfunction of the positioner. Ensure that the air supply system is filtered to 5 micron.

### 3.4 Handling

#### CAUTION

- Avoid giving impact to the body and torque motor of the positioner, and giving excessive force to the armature because this leads to failure. Handle with care during transport and operation.
- If you leave the positioner at the operation site for a long time without using it, put the cover on it so that rain water does not enter the positioner. If the atmosphere is of high temperature or humidity, take measures to avoid condensation inside. The condensation control measures must be taken thoroughly for export shipment.
- Avoid setting the positioner near magnetic fields because the characteristics are effected.

## 4 MOUNTING

### 4.1 Type IP6000

#### 4.1.1 Example of attaching to actuator

The Type IP6000 positioner is compatible with Type IP600 in the attaching pitch.

If you are using IP600 already, the bracket for IP600 can be used to attach IP6000 to the actuator.

**Fig.1 Example of directly attaching to diaphragm valve**  
Directly attach using the screw hole at the side of the positioner and the screw hole at the yoke side of the diaphragm valve.

**Fig.2 Example of attaching using the L-shape bracket**  
Attach by using screw hole at the side of the positioner and the screw hole at the front mount of diaphragm valve.

**Fig.3 Example of attaching using front bracket**  
Attach by using screw hole at the back of the positioner and the screw hole at the front mount of diaphragm valve.

### 4.1.2 Connection with external feedback lever

**Fig.4 Attaching the feed back lever**

- Attach to the position that the valve stem and lever form the right angle when the input signal is 50% (distribute evenly with 50% input signal set as the reference).
- Attach to the position of the runout angle is within the range of 10° to 30°.
- To move the valve stem downward at the time of input current increase (normal actuation), attach to the position at which the tightening spring comes to the upper side of the connecting metal, as shown in Fig 11. To move the valve stem upward (reverse actuation), turn-over the feedback lever and attach to the position at which the tightening spring comes to the lower side of connecting metal.

**Fig.5 Use position for feedback lever**

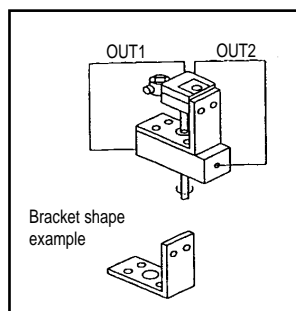
Fig.5 Use position for feedback lever

## 4.2 Type IP6100

### 4.2.1 Example of attaching to actuator

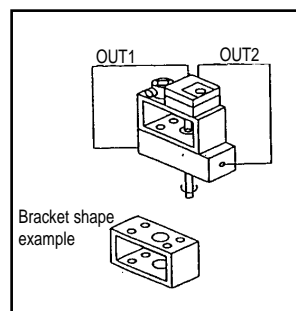
The Type IP6100 positioner is compatible with Typr IP610 in the attaching pitch.

If you are using IP610 already, the bracket for IP610 can be used to attach IP6100 to the actuator.



**Fig.6 Example of attaching using the positioner side screw**

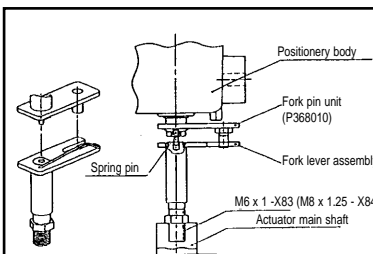
Attaching using the screw hole of a side of the positioner and the screw hole at the actuator top.



**Fig.7 Example of attaching using the positioner back screw**

Attaching using the screw hole at the positioner back and the screw hole at the actuator top.

### 4.2.2 Connection with feedback shaft

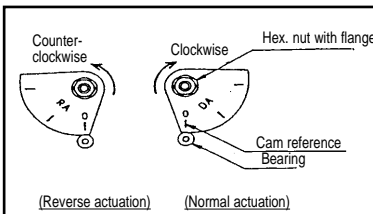


**Fig.8 Attaching the feed back lever**

- (1) Attach to the position at which the positioner feed back shaft and the rotary actuator main shaft are almost concentric (range in which the spring pin of feed back shaft edge enters the hole of fork lever assembly shaft edge).
- (2) If the seration joint type for IP6100 is made in a special specification, it can be used for this connection.

### 4.2.3 Cam attaching procedure

#### CAUTION



- (1) Use the DA face of the cam to turn the actuator main shaft clockwise (viewed from the positioner front cover side) at the time of input signal increase. Use the RA face to turn it counter-clockwise (reverse actuation). Correctly attach the cam to the flange part of feed back shaft.
- (2) Attach the cam in the procedure of loosening the hexagonal nut with flange first, setting the using actuorto the starting position and then setting the cam reference line and the bearing contact point of span adjusting arm unit to the matching position.
- (3) Do not apply the supply pressure when attaching the cam as otherwise it is very dangerous.

(4) When the positioner is shipped out of our plant, the cam is tentatively tightened to the shaft. Be sure to firmly lock the cam to the lock nut [tightening torque 2.0 ~ 2.5 Nm.

**Fig.9 Example of cam attaching**

	IP6000 (Lever type)	IP6100 (Rotary type)
	Single action	Double action
Normal actuation	<p>Actuation: The stem moves in the arrow direction when the input current increases.</p>	<p>Actuation: The actuator main shaft turns clockwise when the input signal increases.</p>
Reverse actuation	<p>Actuation: The stem moves in the arrow direction when the input current increases. (Reverse actuation using the normal actuation drive unit).</p>	<p>Actuation: The actuator main shaft turns counter-clockwise when the input signal increases.</p>

**Fig.10 Direct / Reverse actuation**

## 5 ADJUSTMENT

### CAUTION

Check the following prior to start the adjustment.

- (1) Check that the pipeline is correctly connected with the pressure supply port and OUT1 and OUT2 ports.
- (2) Check that the actuator and positioner are sturdily connected.
- (3) Check that the span adjusting lever of internal feed back (Type IP6000) is attached to the correct (normal or reverse) position. (Refer to Tables 2.)
- (4) Check for locking of the auto/manual changeover screw of pilot valve (fully tightened in the clockwise direction).
- (5) Check for correct use of the cam face (normal or reverse) in Type IP6100 and that the flange nut is firmly locked. (Refer to Table 2.)
- (6) Check that the wires are connected correctly with the (+), (-) and grounding terminals.

	Type IP6000	Type IP6100
Zero point adjustment	<p>Zero adjusting knob</p> <p>Too small starting point</p> <p>Starting point OK</p> <p>Too large starting point</p> <p>Move clockwise to span adjustment</p> <p>Move counter-clockwise</p>	<p>When the zero adjusting knob is turned clockwise, the starting point increases. When it is turned counter-clockwise, the starting point decreases.</p> <p>Decrease of starting points</p> <p>Increase of starting points</p> <p>Counter-clockwise turn</p> <p>Stroke</p> <p>Input current</p>
Span adjustment	<p>Span adjusting screw</p> <p>Lock screw</p> <p>Too small span</p> <p>Span OK</p> <p>Too large span</p> <p>Move clockwise</p> <p>Move counter-clockwise</p>	<p>Span adjusting screw</p> <p>Too small span</p> <p>Span OK</p> <p>Too large span</p> <p>Move counter-clockwise</p> <p>Move clockwise</p>
Adjusting procedure	<ol style="list-style-type: none"> <li>(1) Set the input current to 0% (4mADC in the standard specification) and turn the zero adjusting knob by hand to set it to the actuator starting point.</li> <li>(2) Then set the input current to 100% (20mADC in the standard specification) and check the actuator stroke. At this point depending on the span is too large or too small, loosen the lock screw and adjust the span as shown in the illustration above.</li> <li>(3) Set the input current to 0% and conduct the zero point adjustment, as done in Step (1) again.</li> <li>(4) Repeat the above operations until the predetermined stroke of the actuator is obtained to the input current.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Set the input current to 0% (4mADC in the standard specification) and turn the zero adjusting knob by hand to set it to the actuator starting point.</li> <li>(2) Then set the input current to 100% (20mADC in the standard specification) and check the actuator stroke. At this point depending on the span is too large or too small, loosen the lock screw and adjust the span as shown in the illustration above.</li> <li>(3) Set the input current to 0% and conduct the zero point adjustment, as done in Step (1) again.</li> <li>(4) Repeat the above operations until the predetermined stroke of the actuator is obtained to the input current.</li> </ol>

**Fig.11 Zero / Span adjustment**

- \*1 When the span adjusting screw is turned clock-wise with a slothead(-) screwdriver, the span increases. When it is turned counter-clockwise, the span decreases.
- \*2 When the span adjusting screw is turned clock-wise with a slothead(-) screwdriver, the span decreases. When it is turned counter-clockwise, the span increases.

### CAUTION

- (1) For this positioner, span and zero point adjustment of each actuator is necessary. Adjustment shall be done based on each actuator size.
- (2) Keep in mind that span and zero point adjustment interfere in each other.
- (3) Characteristics changes due to change of mounting position, ambient temperature and supply pressure.
- (4) If it takes along time until the operation after initial adjustment, check and adjust this product.
- (5) Sensitive adjustment is effective for only double acting actuator.
- (6) Manual change function is effective for single acting actuator which is controlled by using OUT1.

### 5.1 Electrical Wiring

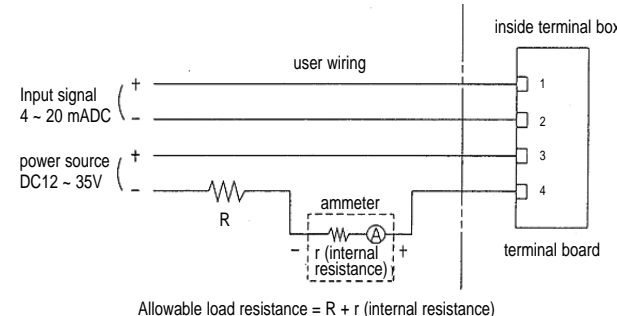
This product has a potentiometer and p.c.board built into it. This is for confirming the actuator's opening by a 4-20mADC output signal produced by supplying initial power to the pcb. This supply power can be set freely between DC12-35V.

According to the operating direction of the actuator or feed back lever, the clockwise potentiometer direction gives regular operation, and the counter-clockwise direction gives opposite operation.

#### 5.1.1 Wiring of Input signal & Power source

- (1) Connect the input signal (for Positioner control) to 1(+) and 2(-) of the terminal board in the terminal box.

- (2) Connect power source (for detecting output current) to 3(+) and 4(-) of the terminal board.
- (3) Connect an ammeter in series between (+) side and 3(+) of terminal board or (-) side and 4(-).



### NOTE ! Allowable load resistance depends on supply voltage

- (4) The allowable load resistance is obtained by the formula below.  
Allowable load resistance ≤ (Supply voltage-12V) / 20mADC-(1)

Normal output current is not obtained if the load resistance value exceeds the results of the formula. Please confirm internal resistance when selecting an ammeter.

### 5.2 Zero / Span adjustment (output)

Zero point / Span adjustment of the output current of the positioner (with potentiometer) should be carried out after initial zero / span adjustments in Fig 11.

This product requires zero / span adjustment of the output current according to the actuator's rotating angle (Rotary type), or the stroke of the actuator (Lever type), i.e. oscillating angle of the feed back lever.

Please follow the procedure below.

- (1) Set actuator's output opening or stroke to 0% after adjusting the zero / span.
- (2) Adjust zero / span with the variable resistor on the p.c.board.
- (3) Adjust zero point and span alternately and repeatedly as they interact with each other. Since this variable resistor can be wound endlessly, do not overwind otherwise internal equipment might be broken. Adjust while monitoring output signal.

### CAUTION

- To mount the IP6000 (Lever type) positioner to the actuator, the valve stem and lever should be set at right angles when the input signal is 50% (Fig.5). If this angularity is out more than +/-5°, there are some cases where zero adjustment cannot be achieved. Do not change the fixed position of the potentiometer, but instead change the zero adjustment (Refer to Fig.11).

### 5.3 Change of Operating direction (IP6000 Linear)

The IP6000 linear positioner needs accurate mounting & adjustment to satisfy its performance. The following are 2 points to note :-

- (1) The potentiometer is difficult to adjust, therefore the operating direction should not be changed by the end user. This is factory set for Direct / Reverse action.

IP6000-0#1-#-X83(84) -D	Direct Action : Valve stem moves down when input current increased.
IP6000-0#1-#-X83(84) -R	Reverse Action : Valve stem moves up when input current increased.

- (2) Do not loosen the potentiometer set screw, because it may cause operation failure or result in the decline of the positioner accuracy.

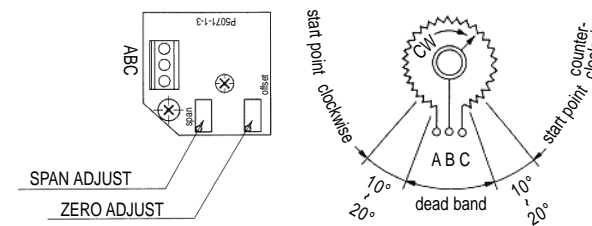
### 5.4 Change of Operating direction (IP6100 Rotary)

- (1) The Output signal is configured to increase in normal operation (clockwise) when shipped.
- (2) To apply the positioner in reverse operation (counter-clockwise), swap terminals 'A' and 'C' (refer to Fig.12).
- (3) Loosen potentiometer set screw while applying power and ensuring output current, then rotate the potentiometer 10-20° away from the dead band (see Fig.13) to decide the start point. Settle the potentiometer with the screws again.

### CAUTION

#### (Setting potentiometer)

- (1) The Output signal does not operate at the dead band of the potentiometer.
- (2) If the start point is set at 4mADC, the border line of resistance portion and the dead band, malfunction might occur.
- (3) If the Output current is 0mADC during opening, the potentiometer may be set across the border between the resistance and the dead band. Follow step above noting the potentiometer rotation direction.
- (4) When the rotary positioner is used in reverse action, adjust the potentiometer fixing position to avoid clashing of the cam and potentiometer lead wire.



**Fig.12 P.C. board**

**Fig.13 Potentiometer (IP6100)**

## 6 MAINTENANCE

### WARNING

- (1) After installation, repair and disassembly, connect compressed air and perform a proper function test and leak test. If bleed noise is louder than the initial state, or operation is abnormal, stop operation and check if installation is correct or not.

### CAUTION

- (1) Check if supply air is clean or not. Inspect compressed air cleaning system periodically so that dust, oil and humidity, which can cause malfunction and failure of the unit, do not enter the equipment
- (2) If handled improperly, compressed air can be dangerous. Maintenance and replacement of unit parts should only be performed by trained and experienced personnel for instrumentation equipment, as well as following the product specifications.
- (3) Check the positioner once a year. When an excessively worn diaphragm, O-ring or other packing of any unit that has been damaged is found, replace with new ones. Treatment at an early stage is especially important if the positioner is used in a place of severe environment, such as coastal areas.
- (4) Before removing the positioner for maintenance, or replacing unit parts after installation, ensure the supply pressure is shut off and all residual air pressure is released from the piping.
- (5) When the fixed orifice is clogged with carbon particles or other material, remove the pilot valve Auto/Manual change over screw (built in fixed aperture) and clean it by inserting a 0.3mm diameter wire into the aperture.
- (6) When you disassemble the pilot valve, coat the O-ring of the sliding section with grease. (Use the TORAY SILICONE SH45 grease.)
- (7) Check for air leaks from the compressed air piping. Air leaks could lower the performance characteristics of the positioner. Air is normally discharged from a bleed port, but this is necessary air consumption based on the construction of the positioner, and is not an abnormality if the air consumption is within the specified range.

## 7 CONTACTS

To enquire about the product, please contact the following :-

### SMC Corporation

AUSTRIA	(43) 2262-62 280	ITALY	(39) 02-92711
BELGIUM	(32) 3-355 1464	NETHERLANDS	(31) 20-531 8888
CZECH REP.	(420) 5-414 24611	NORWAY	(47) 67 12 90 20
DENMARK	(45) 70 25 29 00	POLAND	(48) 22-548 50 85
FINLAND	(358) 9-859 580	PORTUGAL	(351) 22 610 89 22
FRANCE	(33) 1-64 76 1000	SPAIN	(34) 945-18 4100
GERMANY	(49) 6103 4020	SWEDEN	(46) 8-603 0700
GREECE	(30) 1- 342 6076	SWITZERLAND	(41) 52-396 3131
HUNGARY	(36) 1-371 1343	TURKEY	(90) 212 221 1512
IRELAND	(353) 1-403 9000	UK	(44) 1908-56 3888

### Websites

SMC Corporation  
www.smcworld.com

SMC Europe  
www.smceu.com