

MOTOYAMA INSTRUCTION MANUAL

Intelligent Valve Positioner Model EA10S



Introduction

Thank you very much for choosing MOTOYAMA Intelligent Valve Positioner EA10S.

To use this product safely and to optimize its performance, it is recommended that following instruction should be read carefully and followed.

1 General

- 1 This instruction manual is made to be referred at operation of intelligent valve positioner EA10S. Before using this product, read this instruction manual carefully and fully understand it for operation.
- 2 This product is an exclusive accessory for control valves. Refer to our “instruction manual of control valves” and also this “instruction manual of EA10S” during work or operation with this product.
- 3 As a result of our continuous improvement and upgrade of this product, the content herein might be different from actual product in detail. If there are any questions about delivered products or this instruction manual, please contact MOTOYAMA sales office or agent before working.

2 For Safety Use

To use this product safely, this instruction manual describes symbols and signal terms in accordance with JIS Z2901 and ANSI Z535.1 which shall call your attention to keep safety manner or to give caution of handling, together with notes. Important information has been marked and emphasized with following symbols in this instruction manual.

Symbols & Signal Terms	Explanation
 WARNING	A direct endangerment of a person's health or life may occur if the Warning is not observed.
 CAUTION	If the Caution is not observed, minor personal injuries and/or property damages may result.
 IMPORTANT	Damage or malfunction of this product may result from nonconformance of the IMPORTANT.

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1. Safety instructions

1.1. IECEx / ATEX / NEPSI / KCs and TIIS Flameproof

1.1.1. Compliance with instructions



When handling and operating intelligent valve positioner EA10S (hereafter abbreviated as positioner EA10S), all safety instructions provided herein should be securely followed.

1.1.2. Conformance with specifications



Positioner EA10S (Flameproof explosion-protected construction) has been approved in accordance with the IECEx scheme, ATEX directive, NEPSI, KCs and TIIS regulations. The nameplate describing specifications required for explosion protection is attached to each approved positioner. Positioner EA10S shall be used under the condition corresponding to described specifications.

1.1.3. Applicable regulation

Below are regulations which are applied to this positioner.

(1) IECEx scheme

IEC60079-0:2011 Explosive atmospheres

Part 0 : Equipment – General requirements

IEC60079-1:2007 Explosive atmospheres

Part 1 : Equipment protection by flameproof enclosures “d”

Certified No. IECEx DEK 12.0037X

(2) ATEX directive 2014/34/EU ANNEX2

EN60079-0:2012 Explosive atmospheres

Part 0 : Equipment – General requirements

EN60079-1:2007 Explosive atmospheres

Part 1 : Equipment protection by flameproof enclosures “d”

Certified No. DEKRA 12ATEX0105X

(3) NEPSI

Certified No. GYJ20.1009X

(4) KCs

Certified No. 15-KB4BO-0065X

(5) TIIS

JNIO SH-TR-46-1, JNIO SH-TR-46-2 : 2015

Certified No. TC22178X

1.1.4. Prohibition of changing specifications and modifications



Changing specifications or modifications of positioner EA10S shall not be done by users.

1.1.5. Limitation of locations for installation



Flameproof explosion-protected instrumental devices are able to be installed and operated at hazardous area according to applicable gases of these devices. However, installation of these devices at zone 0 hazardous area shall be avoided.

Model No.	Type of protection	Equipment group	Temp class	Location for installation
EA10S	Flameproof enclosure	IIC	T6	All gases classified in group left excluding carbon disulfide(CS ₂) and zone 1 and zone 2 hazardous area

1.1.6. Maintenance during operation



It shall be clearly made sure that explosive gasses are not existent by a gas detector, etc. before and during maintenance of EA10S.

Maintenance in the event that it is impossible to check the existence of explosive gases shall be limited to visual checking or calibration without opening terminal box and cover such as operation of manual buttons.

In these cases, care should be taken not to generate impact spark.

1.1.7. Repairs



- (1) Flameproof explosion-protected instrumental devices shall be repaired after the power is off and these devices are brought to a safe location.
- (2) Both mechanical and electrical repairs shall be to restore to original conditions in principle.
- (3) Repairs by users are limited to work with general tools excepting soldering irons, etc.

 IMPORTANT	Repair of the flameproof enclosure surface is strictly prohibited.
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1.1.8. Fasteners



Property class of fasteners that are required for assembly of flameproof explosion-protected enclosures shall be A2-50.

1.1.9. Nameplate indication

Specification nameplate is attached on top of positioner case.

Safety certified seal nameplate is attached on the right end of specification nameplate.

Valve Positioner		MOTOYAMA ENG. WORKS, LTD.	
MODEL EA10S-LS3R		5-2, OHIRA AZA KAMEOKA, OHIRA-MURA, KUROKAWA-GUN, MIYAGI-KEN, JAPAN	
INPUT DC 4-20mA (9V)	Ex d IIC T6 Gb	IECEX DEK 12.0037X	15-KB4B0-0065X
SUPPLY 140-500kPa	DEKRA 12ATEX0105 X	15-KB4B0-0065X	
T6 -20°C ≤ Tamb ≤ +60°C	Ex II 2G	第TC22178X号	GYJXX.XXXXX
OUTPUT DC4-20mA	CE 0344	(株)本山製作所	
(SUPPLY DC10-28V)			
SERIAL NO. xxxxxxxx			

Nameplate indication and meaning

●MODEL No.

Basic No. of product and spec code are indicated. Details of spec code shall be referred to numbering system above.

●INPUT

Range of input signal is indicated. DC 4 to 20mA shall be used.

●SUPPLY

Range of air pressure which can be applied to product is indicated.

●AMB. TEMP

The ambient temperature range in which the product can be used is indicated.

●OUT PUT LS3R

Range of position transmitter current is indicated.

●(SUPPLY) LS3R

Range of supply voltage to position transmitter circuit is indicated DC10 to 28V shall be used.

●SERIAL No.

Number inherent to product for tracking delivered products is indicated as follows:

E 1 7 D X X X

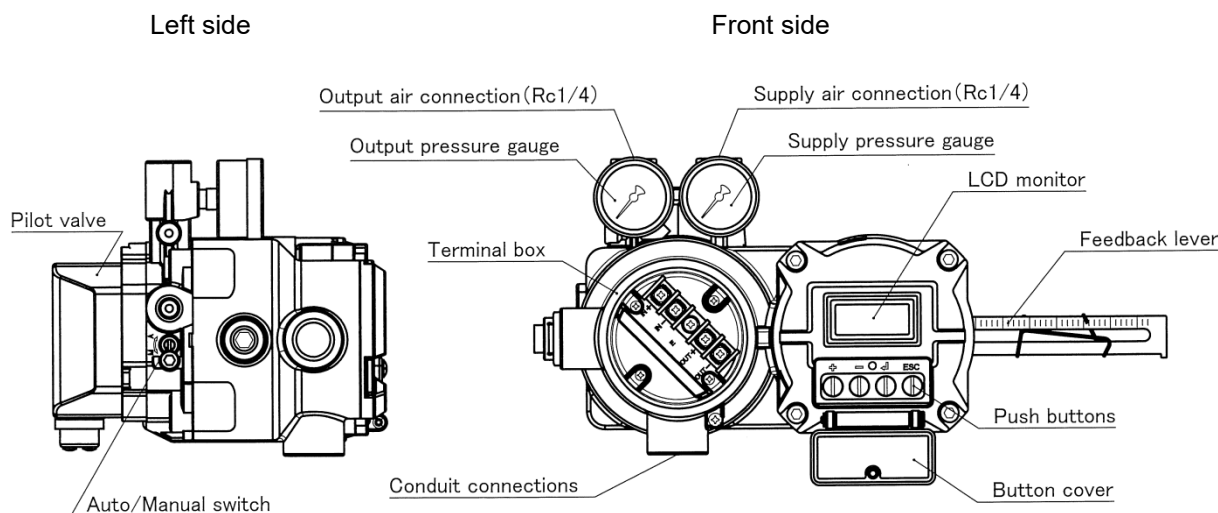
↓

means last two digits of production year

●Ex PROOF

Class of explosion protection applied to product is indicated in the right end of the nameplate.

1.1.10. Construction



Electrical connection type is G1/2 as standard. In case that NPT1/2 or M20 x 1.5 is required for electrical connection, an adapter will be attached to satisfy required connection type.

IMPORTANT

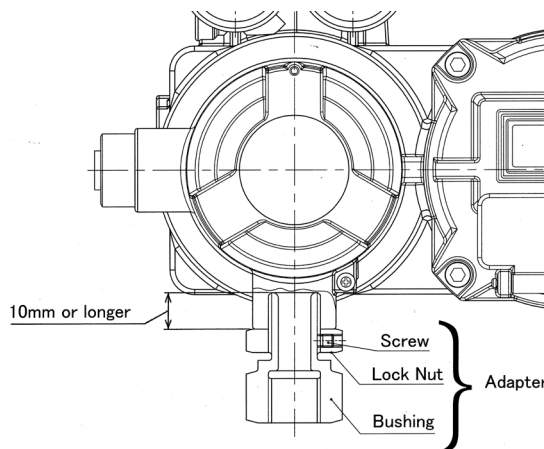
When an adapter is screwed into the connection, length of thread engagement shall be surely 10mm or longer.



“N” will be marked on NPT 1/2” adapter.



“M” will be marked on M20 x 1.5 adapter.



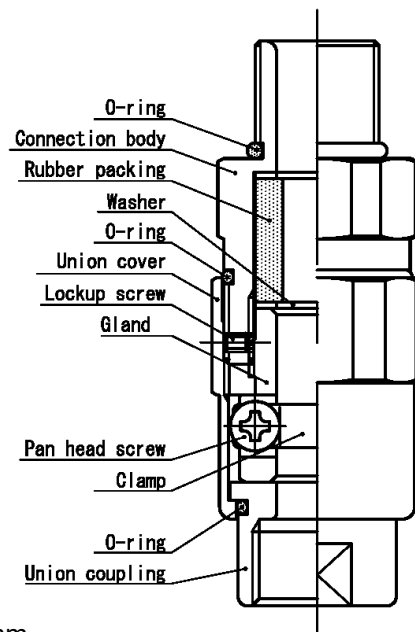
1.1.11. Cable gland (TIIS flameproof apparatus)

In the case of TIIS flameproof apparatus, cable gland must be placed in the cable entry of EA10S. KXBF-16, which is simultaneously certified with EA10S, shall be used as flameproof cable gland.

* Cable gland other than above model shall not be used.

* It is recommended to use polyethylene insulated cable for control “CE-” (JIS C3401), its equivalent or cables with higher specifications.

- (1) End of cables should be processed by putting crimping terminal. External diameters of cable are shown in the table below.
- (2) Connector itself should be screwed into terminal box and be fixed.
- (3) Gland, union coupling and union cover should be inserted through cable.
- (4) Then washer and rubber packing should be inserted, gland should be screwed tightly and clamp should be tightened.
- (5) Two types of rubber packing for cable are included.



Unit: mm

Nominal size of packing	Internal diameter of packing	External diameter of cable
10	φ10	φ9.1 to 10
11	φ11	φ10.1 to 11

- (6) Union coupling and union cover should be tightened.

1.2. FM Explosionproof

1.2.1. Compliance with instructions



When handling and operating intelligent valve positioner EA10S (hereafter abbreviated as positioner EA10S), all safety instructions provided herein should be securely followed.

1.2.2. Conformance with specifications



Positioner EA10S (Explosionproof apparatus) has been approved in accordance with FM. The nameplate describing specifications required for explosion protection are attached to each approved positioner. Positioner EA10S shall be used under the condition corresponding to described specifications.

1.2.3. Applicable regulation

Below are regulations which are applied to this positioner.

FM Class 3600:2018, FM Class 3615:2018, FM Class 3810:2018
ANSI/NEMA 250:2014, ANSI/IEC 60529:2004
Certified No. FM18US0310

1.2.4. Prohibition of changing specifications and modifications



Changing specifications or modifications of positioner EA10S shall not be done by users.

1.2.5. FM Explosionproof apparatus

Explosionproof

Class I ,Div1,GroupA,B,C and D T6
Ambient temperature: -20°C to +60°C
Protection class: NEMA Type4X, IP66

WARNING	① Install the apparatus only in hazardous (classified) locations for which the apparatus has been approved. ② Seal each conduit entering the apparatus enclosure within 18 inches (457mm) from the enclosure. ③ To reduce the risk of ignition of hazardous atmospheres, do not open the cover while circuits are live.
CAUTION	① Use supply wires suitable for 5°C above surrounding ambient. ② Under certain extreme circumstances, exposed (plastic including powder coating) and unearthed metal parts of the enclosure may store an ignition-capable level of electrostatic charge. Therefore, the user/installer shall implement precautions to prevent the buildup of the electrostatic charge, e.g. clean with a damp cloth.

1.2.6. Maintenance during operation



It shall be clearly made sure that explosive gases are not existent by a gas detector, etc. before and during maintenance of positioner EA10S.

Maintenance in the event that it is impossible to check the existence of explosive gases shall be limited to visual checking or calibration without opening terminal box and cover such as operation of manual buttons. In these cases, care should be taken not to generate impact spark.

1.2.7. Repairs



- Flameproof explosion-protected instrumental devices shall be repaired after the power is off and these devices are brought to a safe location.
- Both mechanical and electrical repairs shall be to restore to original conditions in principle.
- Repairs by users are limited to work with general tools excepting soldering irons, etc.

IMPORTANT	Positioner EA10S includes flamepass joints, consult with MOTOYAMA sales office or agent if repair of the flamepass joints is necessary.
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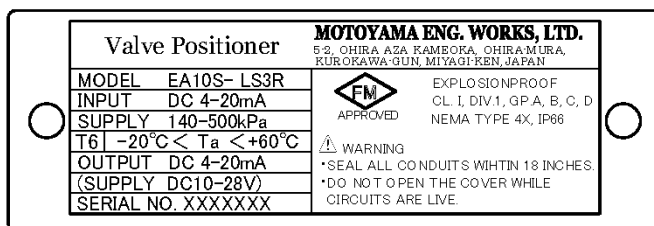
1.2.8. Fasteners



Property class of fasteners that are required for assembly of flameproof explosion-protected enclosures shall be A2-50.

1.2.9. Nameplate indication

Nameplate is attached on top of positioner case.



Nameplate indication and meaning

- **MODEL No.**
Basic No. of product and spec code are indicated. Details of spec code shall be referred to numbering system above.
- **INPUT**
Range of input signal is indicated. DC 4 to 20 mA shall be used.
- **SUPPLY**
Range of air pressure which can be applied to product is indicated.
- **AMB. TEMP**
Temperature of upper limit which product can be used with is indicated.

- **OUTPUT** LS3R
Range of position transmitter current is indicated.
- **(SUPPLY)** LS3R
Range of supply voltage to position transmitter circuit is indicated. DC 10 to 28 V shall be used.
- **SERIAL No.**
Number inherent to product for tracking delivered products is indicated as follows:



means last two digits of production year

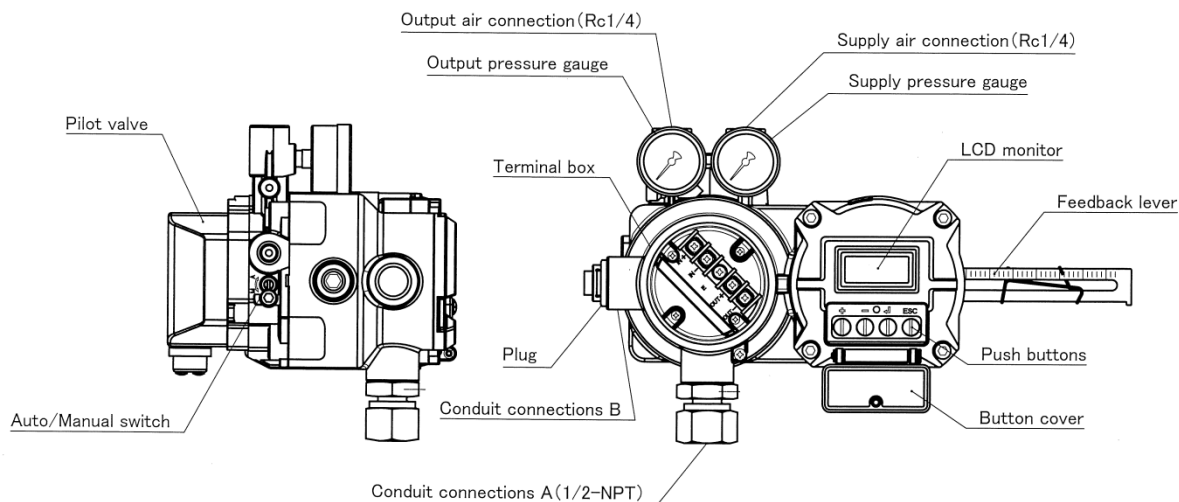
- **Ex PROOF**
Class of explosion protection applied to product is indicated.

1.2.10. Construction

LS1R

Left side

Front side



For conduit connection, A must be used. The conduit connection B is normally sealed with a plug. Never remove this plug.



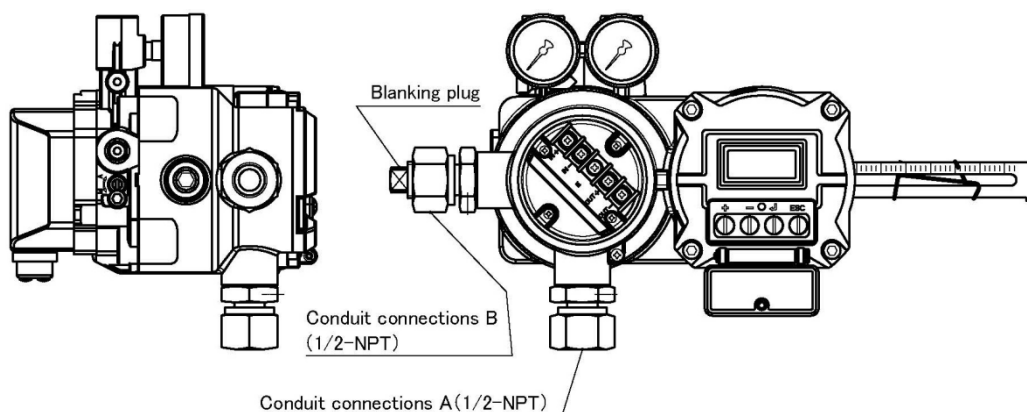
WARNING

Plug sealing conduit connection B should never be removed.

LS3R

Left side

Front side



The conduit connection B is normally sealed with a blanking plug. When using the position transmitter function, remove the blanking plug and connect it to conduit. If this connection is not used for the position transmitter function, the blanking plug must remain in place.



WARNING

The blanking plug must remain in place unless the connection B is used for the position transmitter function.

2. General information

2.1. Purpose

Positioner EA10S is a device which is mounted on control valves and controls valve travel precisely by exchanging electrical input signals from controller into pneumatic output. Besides microprocessors embedded in this positioner enable various functions such as auto calibration, optimized PID algorithm and HART® communication.

2.2. Standard specifications

Model		EA10S-LS	
Applicable Actuator Type		Linear motion ,Rotary motion (Single action)	
Input Signal		4 to 20mA DC ^{Note1}	
Input Resistance		Max. 455Ω equivalent (when input signal is 20mA)	
Supply Air Pressure		Max. 500kPaG	
Structure	Explosion Protection	TIIS Flameproof Ex d II C T6 Gb ^{Note2} IECEx Flameproof Ex d II C T6 Gb ATEX Flameproof II 2 G Ex d II C T6 Gb KTL Flameproof Ex d II C T6 NEPSI Flameproof Ex d II C T6 Gb FM Explosionproof Class I , Division1, Group A, B, C and D T6	
	Protection Class	IEC IP66	
	Lightning Protection	IEC61000-4-5, Performance Criteria: A@Level2 (1kV) B@Level4 (4kV) ^{Note5}	
Conne ⁻ ction	Air Piping Connection	Rc 1/4 or NPT 1/4 (adapter)	
	Electrical Connection	G1/2 or M20x1.5 (adapter) or NPT1/2 (adapter) ^{Note3}	
Characteristics and Performance	Standard Stroke	10 to 130mm, 60 to 90°	
	Linearity	≤±1.0% F.S.	
	Hysteresis Error	≤ 1.0% F.S.	
	Dead-band (Stand-alone)	≤ 0.2% F.S.	
	Repeatability	≤ 0.3% F.S.	
	Air Consumption	≤ 4ℓ/min Nor (Sup. 140kPaG Signal 50%), ≤ 5ℓ/min Nor (Sup.280kPaG, Signal 50%)	
	Max. Sup / Exhaust Air	≥ 55ℓ/min Nor (Sup. 140kPaG Signal 50%), ≥ 90ℓ/min Nor(Sup.280kPaG,Signal 50%)	
	Ambient Temperature	Non explosion protection : -20°C to +80°C Explosion Protection : -20°C to +60°C	
	Auto Calibration	Zero and stroke adjustment, PID parameter selection	
	Flow Characteristic Change	Linear, Equal %, Quick opening, User's definition	
	Cut Off	Setting value(s) for cutoff can be set arbitrarily	
	Diagnosis	Total valve operation, Turn over times, Shut-off times, Travel deviation alert	
	Communication	HART® communication	
Manual Operation		Applicable by Auto/Manual switch	
Body Material		Die-cast aluminum	
Painting Color		Blue	
Option		Position transmitter (4 to 20mA DC) ^{Note4}	
Weight		Approx. 3.6kg	

[Notes] 1. Current of 3.8mA or larger is constantly required for operating microprocessor inside positioner.

2. Cable gland (Model No.: KXBF-16) is attached when TIIS explosion is specified.

3. Electrical Connection: When NPT1/2" or M20 is required, the adapter is available on request.

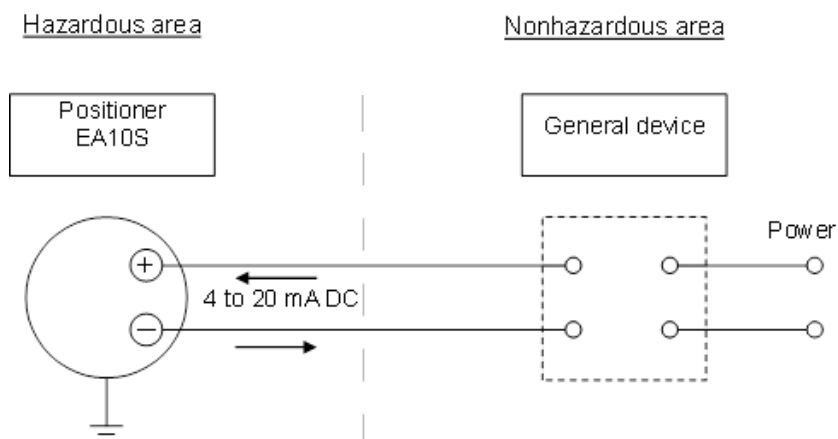
4. Position transmitter option requires an independent electric source of 10 to 28V DC.

5. Performance Criteria: A =No degradation during testing. B =Temporary degradation during testing, but is self-recovering.

2.3. Model Code Structure

Specifications		Spec Code				
Basic No.	—	EA10S-				
Action Type	Linear motion, Rotary motion		L			
Actuator Type	Single action			S		
Communication	HART® communication				1	
	Position transmitter (4 to 20mA DC) + HART®				3	
Air Piping Connection	Rc1/4					R

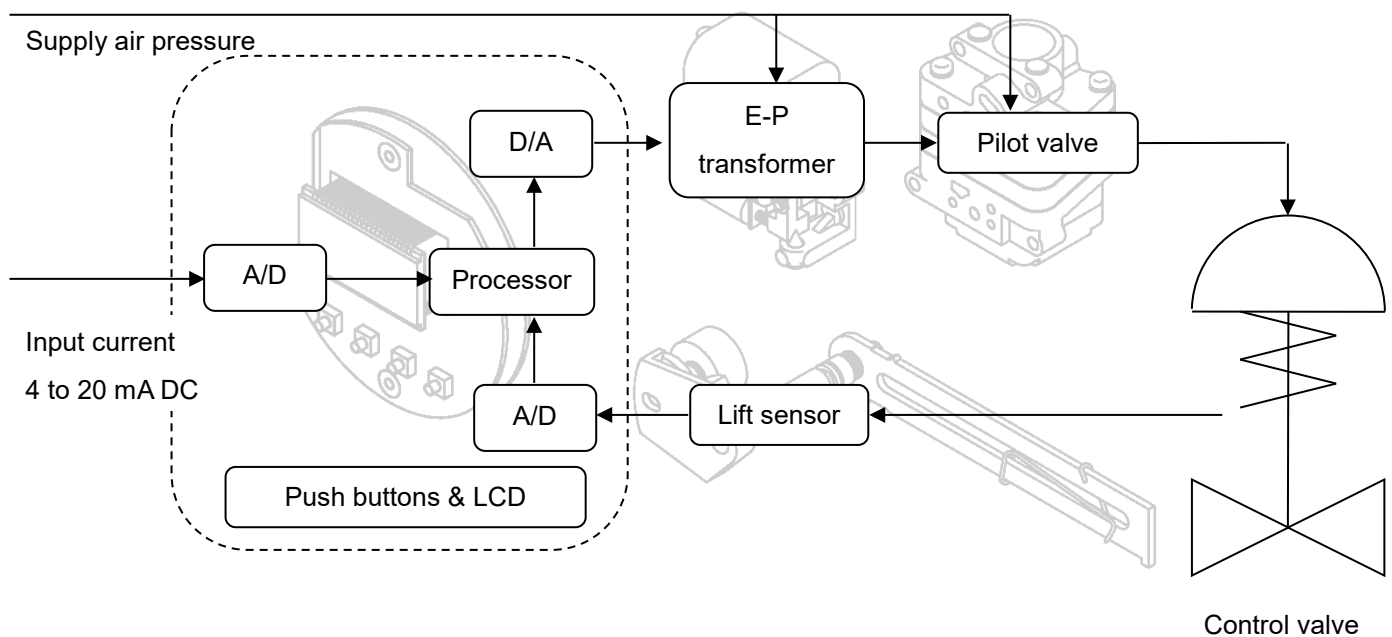
2.4. System configuration



3. Principle of operation

Signal current (4 to 20mA) from controller or manual operation device and feedback signal from lift sensor are respectively converted to digital values and transmitted to control processing part in microprocessor. Control processing part transmits control signal depending on deviation between the input and the feedback signal. E-P transformer generates air pressure signal proportional to the control signal. Pilot valve operates and transmits output air pressure for controlling valve travel depending on air pressure signal.

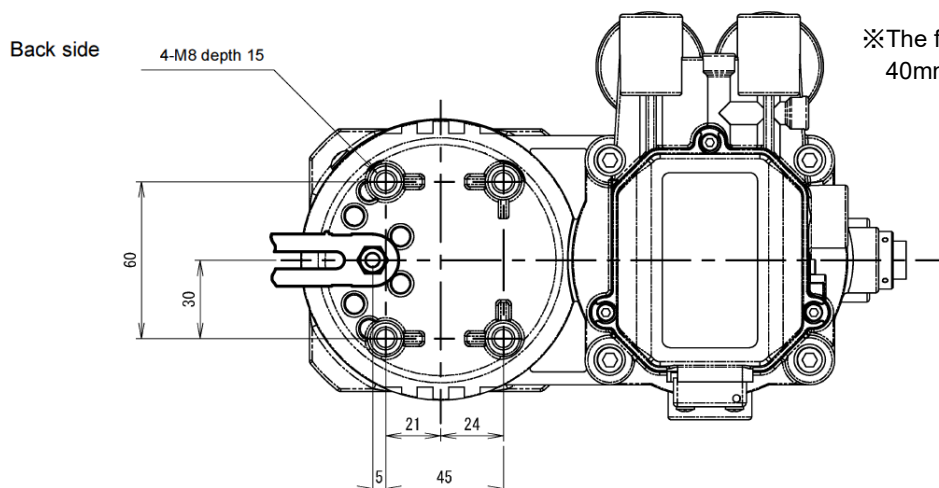
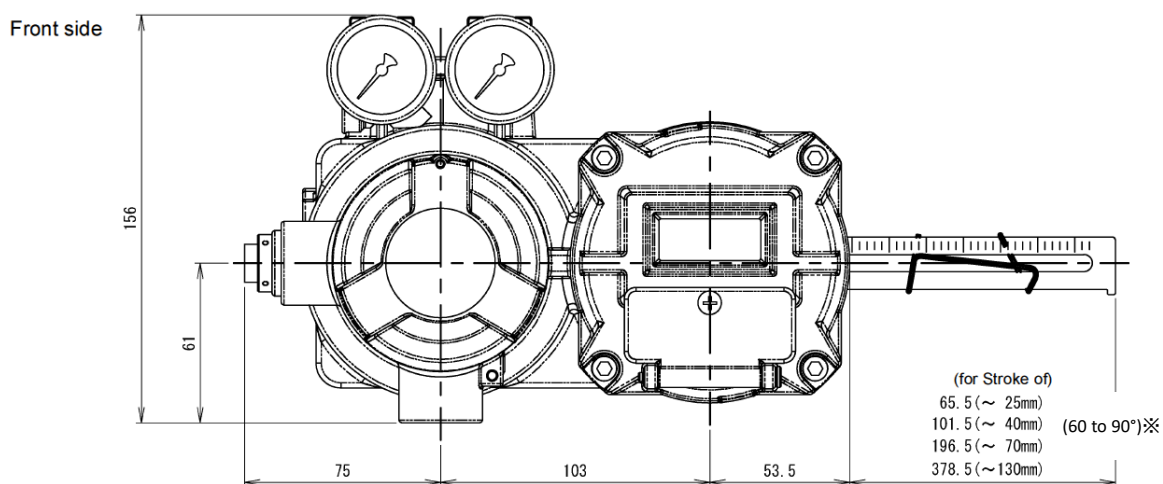
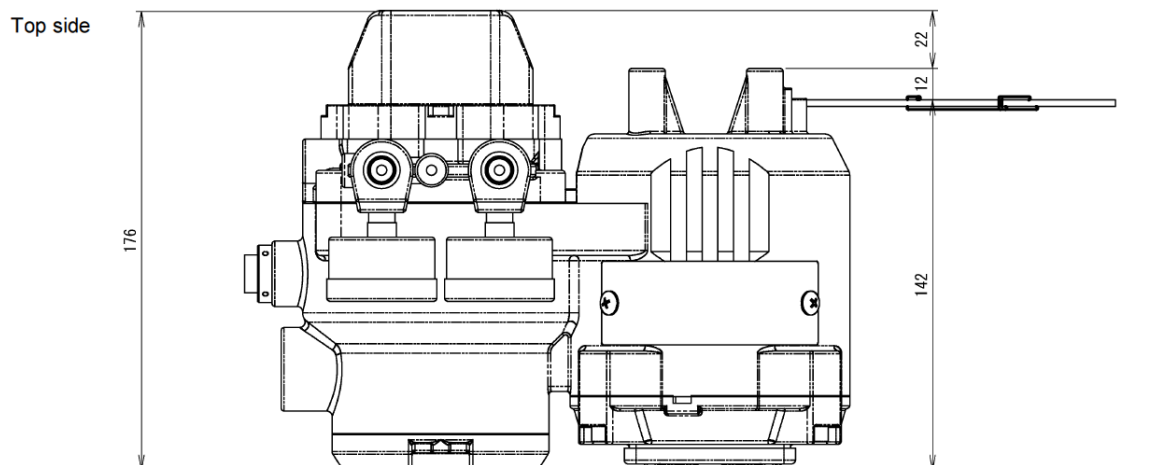
E-P transformer internally changes magnetic flux of armature in torque motor coil depending on increase and decrease of control signal. Rotary torque is generated in the armature due to flux change and varies distance between nozzle and flapper. As a result, air pressure signal proportional to the control signal increases and decreases, and pilot valve reacts accordingly.



4. Installation

4.1. Major dimensions

Unit: mm



※The feedback-lever for stroke of 40mm is useful for rotary valve, too.

4.2. Installation conditions

4.2.1. Location of installation

Positioner EA10S of flameproof explosion protection is able to be installed and operated at hazardous area according to applicable gases of these devices.

4.2.2. Environmental condition

Required environmental condition for location of installation is as following table.

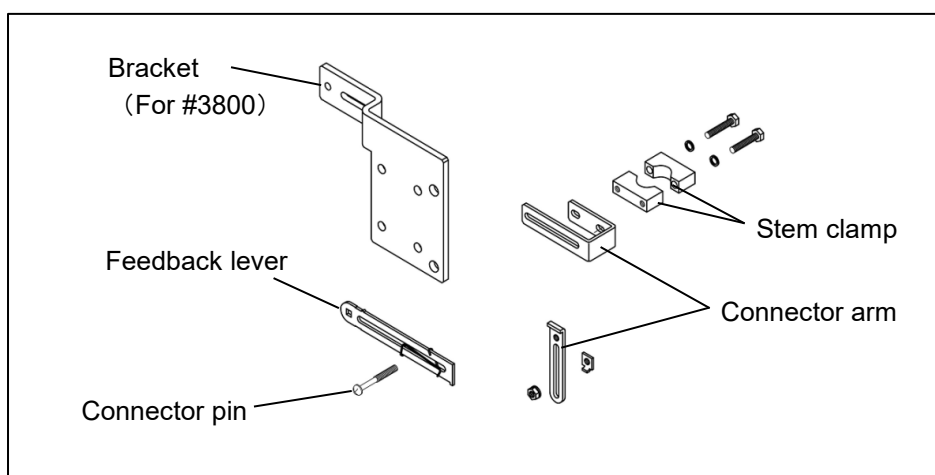
	Non explosion protection	Explosion protection T6
Ambient temperature	-20°C to 80 °C	-20°C to 60 °C
Atmospheric pressure	80 to 110 kPa Abs.	

 CAUTION	①Thermal insulation measure shall be taken in case that high ambient temperature is expected due to heat radiation from plant equipments, etc. ②Protection from special conditions (like vibration, corrosive atmosphere and location exposed to drain steadily) shall be taken if necessary.
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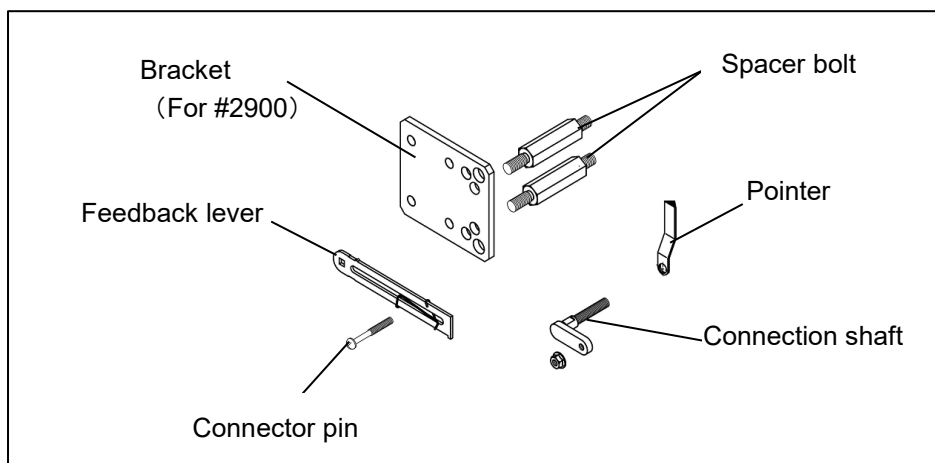
* It is recommended to consult our sales office or agent in such cases as ①and ②.

4.3. Pre-installation checking

- (1) Confirmation of nameplate: specifications, explosion protection.
Consistency of nameplate attached on positioner with ordering specifications should be confirmed.
- (2) Confirmation of appearance
It should be confirmed if there is some damage by transportation or not.
- (3) Confirmation of accessories: Bracket, Stem clamp, Connector arm, Feedback lever and Connector pin.
 - ① For linear motion actuator
It should be confirmed that Bracket, Stem clamp, Connector arm, Feedback lever and Connector pin are prepared.



- ② For rotary motion actuator
It should be confirmed that Bracket, Connection shaft, Spacer bolt, Pointer, Feedback lever and Connector pin are prepared.



- (4) Confirmation of pressure gauge

 IMPORTANT	Pressure gauges adapted to supply pressure are installed. It should be taken care not to give an excessive pressure.
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4.4. Installation to linear motion actuator

Positioner should be installed by using threaded holes at backside of positioner and threaded holes at the front of actuator.

- (1) Connector arm should be attached to stem clamp and these assembled parts should be clamped to top stem.



IMPORTANT

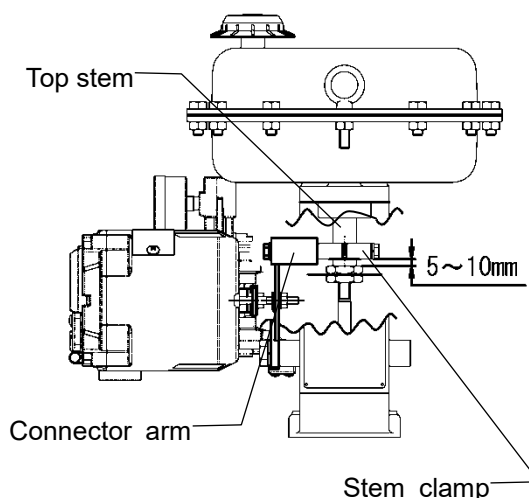
At this time, clamped position should be approximately 5 to 10 mm upper from locknut. Besides, fixing clamp should be carried out so that connector arm is parallel to front face of actuator.

- (2) Bracket should be installed to positioner.
- (3) Bracket should be installed to actuator.
- (4) Instrumental air piping should be installed.
- (5) After turning Auto/Manual switch to M(manual), air regulator should be adjusted to gain 50 % valve travel.
- (6) Connector pin should be fixed to connector arm.
- (7) Return the Auto/Manual switch to A (auto).



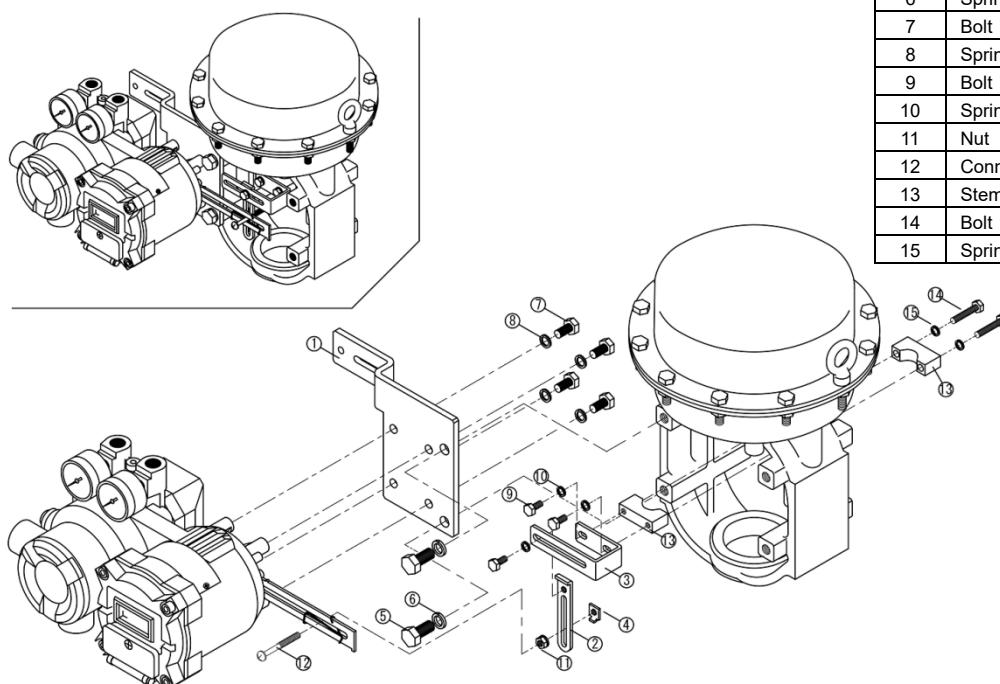
IMPORTANT

- ① Connector pin and a part of connector arm should be adjusted so that feedback lever is placed horizontal at 50 % valve travel and that connector pin is fixed to feedback lever at the place where reading of feedback lever scale accords with valve stroke.
- ② Position of spring to fix connector pin should be adjusted so that connector pin is fixed at middle of the spring.



No.	Part Name	Qty.
1	Bracket	1
2	Connector arm B	1
3	Connector arm A	1
4	Connector guide	1
5	Bolt	2
6	Spring washer	2
7	Bolt	4
8	Spring washer	4
9	Bolt	3
10	Spring washer	3
11	Nut	1
12	Connector pin	1
13	Stem clamp	1set
14	Bolt	2
15	Spring washer	2

Installation diagram to Model 3800 actuator



4.5. Installation to rotary motion actuator

- (1) Connection shaft should be installed.

Locknuts, pointer and spring washer should be put through connection shaft and the assembled parts should be screwed into M8 thread hole of valve shaft.

- (2) Pointer and connection shaft should be fixed.

Valve action (air failure to open or air failure to close) should be confirmed and then pointer should be fixed by tightening locknut so that pointer indicates correct valve travel in indicator scale. At this time, pointer should be fixed so that connection shaft and pointer are placed orthogonally each other.

- (3) Bracket should be installed to actuator.

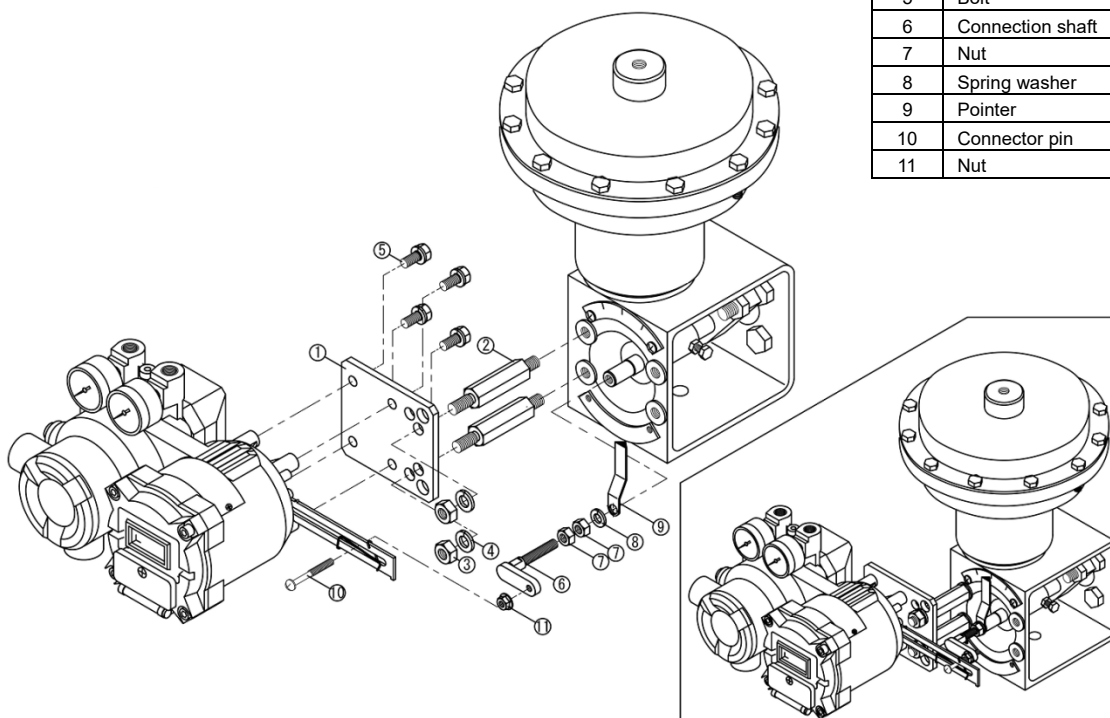
- (4) Positioner should be installed to bracket.

Positioner should be installed to bracket after fixing spacer bolts on positioner. At this time, it should be confirmed that both two pins of feedback shaft are coupled with connection shaft.

- (5) Instrumental air piping should be installed.

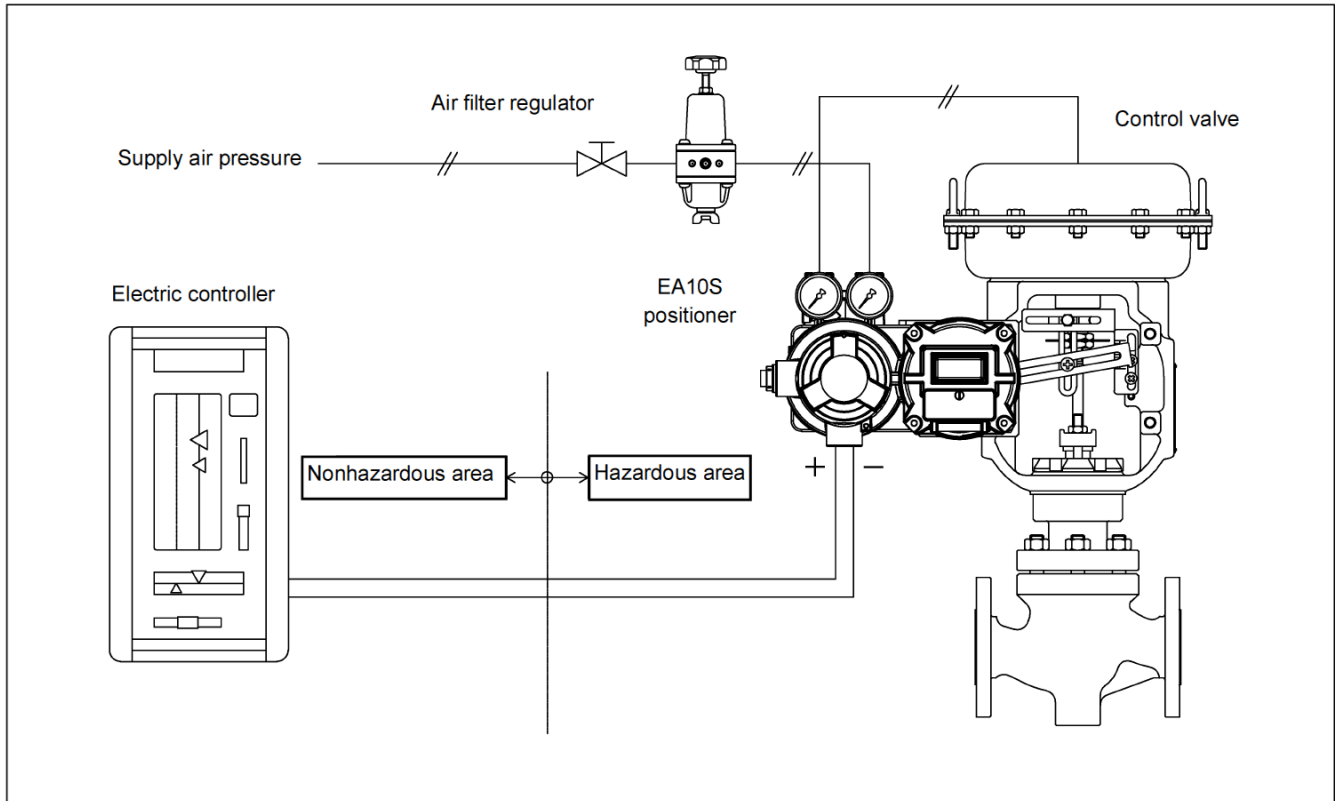
Installation diagram to Model 2900 actuator

No.	Part Name	Qty.
1	Bracket	1
2	Spacer bolt	2
3	Nut	2
4	Spring washer	2
5	Bolt	4
6	Connection shaft	1
7	Nut	2
8	Spring washer	1
9	Pointer	1
10	Connector pin	1
11	Nut	1



5. External connection

5.1. Piping and wiring systems



IMPORTANT

- ① Contaminants like water, oil or rust should be removed by purging pipes sufficiently before piping work.
- ② Dehumidified, dust-free and clean air should be used as supply air.

5.2. Pneumatic piping

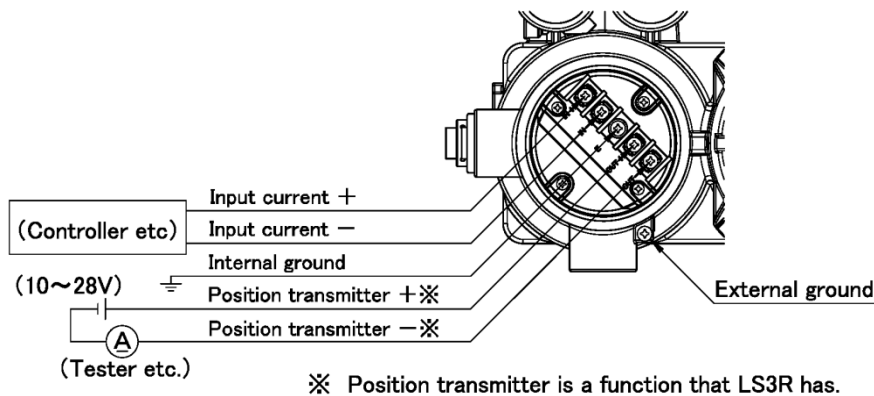
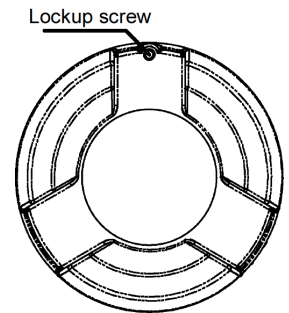
- (1) Positioner EA10S has two connectors for supply air (SUP) and output air (OUT1). Connection type is Rc 1/4 or NPT 1/4 thread.
- (2) Piping from air filter regulator should be constructed to supply (SUP) connector.
- (3) Piping from output (OUT1) connector should be constructed to actuator.
- (4) Diameter of copper tube should be general $\phi 6/4$ or $\phi 8/6$. (PVC coated copper tube is adopted as standard.)
- (5) It should be confirmed that air connections are free from leakage after completing piping work.

5.3. Electrical wiring

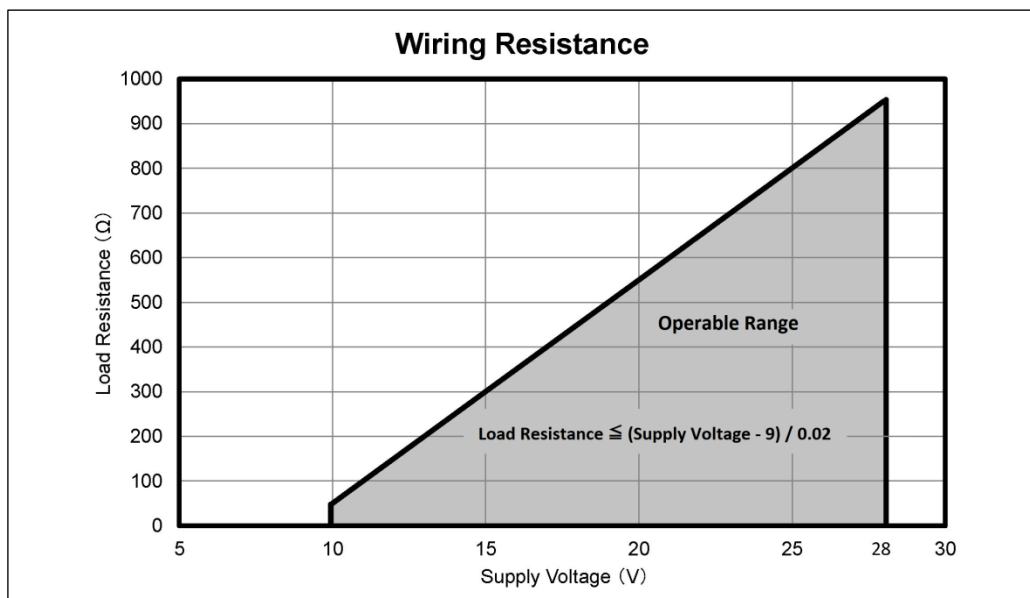
Shielded cable should be used when influence of noise is expected.

Connection of wires should be based on the diagram in chapter 5.1. and below.

- (1) Terminal cover should be taken out after loosening lockup screw (M3 hexagon socket set screw).
- (2) Cable should be connected to terminal block. Terminal screw size: M4
- (3) Terminal cover should be screwed and lockup screw should be locked after completing connection work.

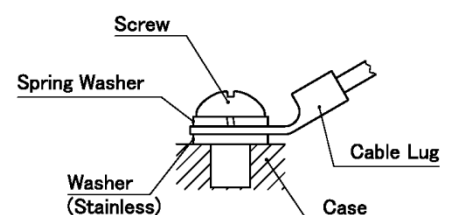


Select the power supply of position transmission and wiring resistance referring to the figure below.



IMPORTANT

- ① When connecting a ground wire with a terminal of external ground, the wire shall be firmly connected by using a cable lug and installed in such a way to prevent twisting.
- ② Internal and external ground wires shall be equipped with cable lugs so that the wires may not directly contact with a case of the positioner.



6. Calibration

 WARNING	① Terminal box cover shall not be opened while the power is on. In case of opening terminal box cover while the power is on due to the necessity, it shall be clearly made sure that explosive gases are not existent by a gas detector, etc. before opening the cover. ② Button cover can be opened for checking or calibration even while the power is on, but terminal box cover shall not be opened. ③ Sufficient care should be taken to prevent from impact spark during work above.
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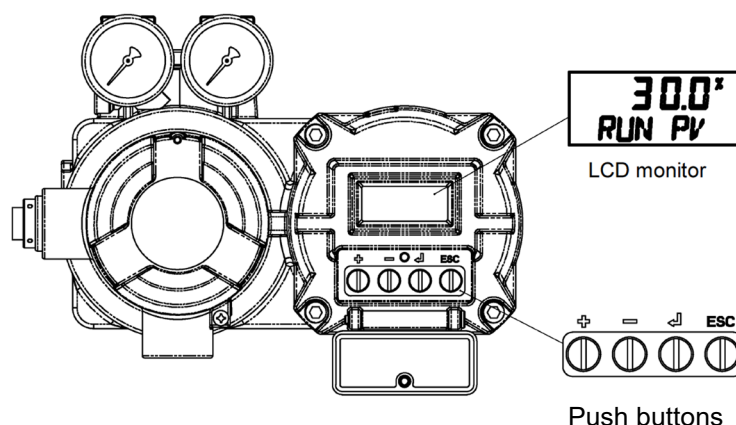
6.1. Checking before calibration

Note: Valve should be isolated from process system prior to auto calibration so that valve action does not affect process because calibration accompanies movement of valve and actuator.

6.2. Location of buttons

Positioner EA10S is equipped with LCD monitor and four push buttons at the front.

Positioner EA10S can be calibrated by operating buttons with button cover opened and LCD indication confirmed.



Arrangement of push buttons from the left is as table below shows.

Button	Function
+	To proceed to the next menu or increase parameter values
-	To return to the previous menu or decrease parameter values
ENTER	To select a menu item or fix parameter values
ESC	To cancel changes of parameters or return to the upper class in menu hierarchies

6.3. Quick calibration

Positioner EA10S has a function of quick calibration which can be used in regular maintenance.

This function enables basic calibration of positioner without entering some menu levels.

Procedure for quick calibration is indicated below.

(1) Current generator should be connected to input terminals with input of 12 mA.

(2) <+> button should be pressed continuously after indication of "RUN PV".

(3) LCD monitor will display countdown as "3", "2", "1".

Button can be released when "STEP1" is displayed, which means start of quick calibration.

(4) LCD monitor will display status in the order of "STEP1", "FIND V_0", "STEP2", "STEP3", "STEP4", "GET_BIAS", "GET_MIN" and "GET_MAX".

Quick calibration is completed when "COMPLETE" is indicated.

(Display will automatically go back to "RUN PV")

(5) Next is stroke adjustment.

Current of 20 mA for reverse action actuator and 4 mA for direct action actuator should be input.

(6) <+> or < - > button should be pressed continuously when output air pressure is not enough or too enough respectively for gaining rated stroke.

(7) Valve will start to move after countdown.

Button should be released when valve reaches to a travel to gain rated stroke.

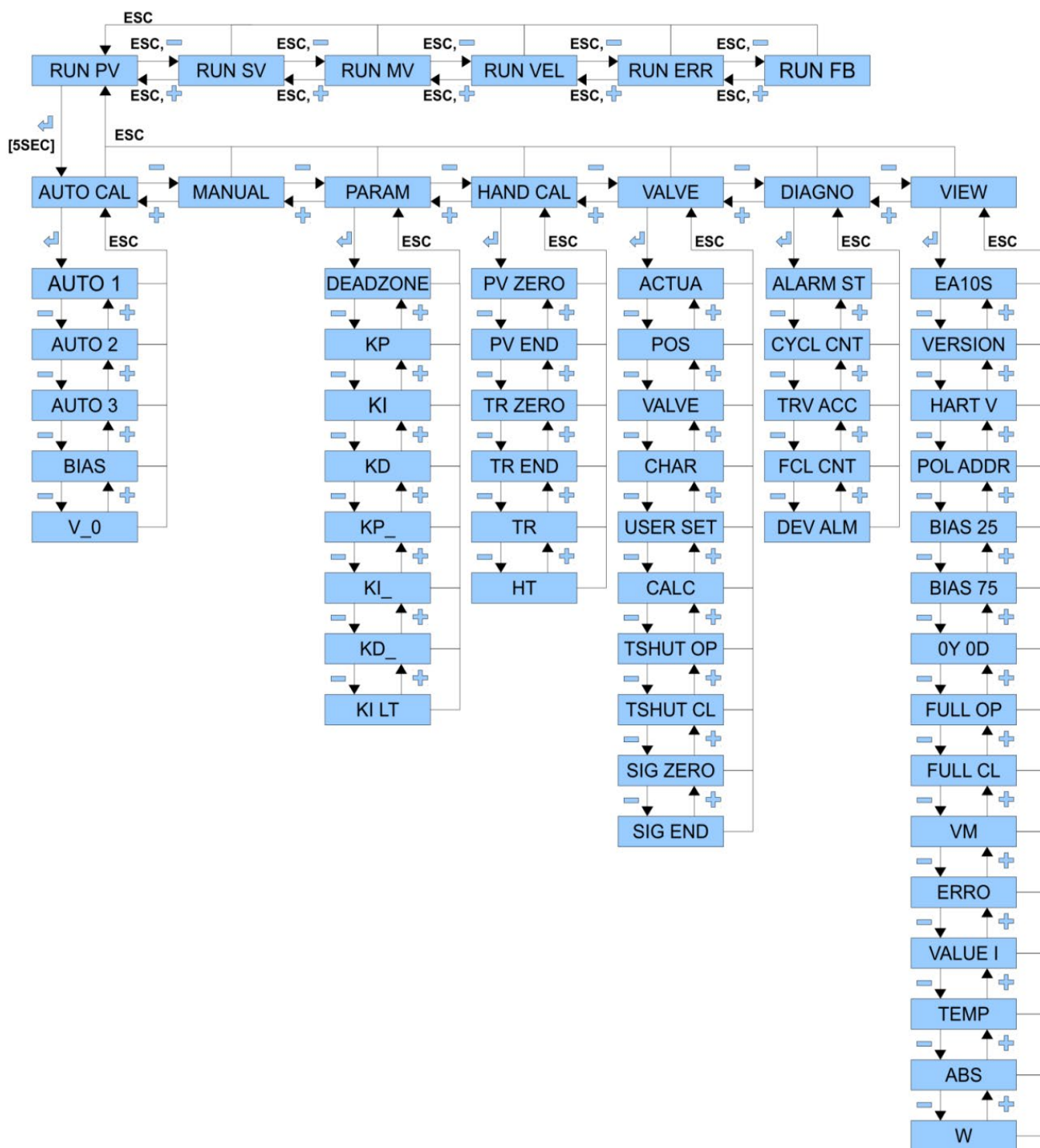
The above is all of the procedure.

Chapter of "Software configuration" in the next page should be referred for detailed adjustment or calibration.

6.4. Software configuration

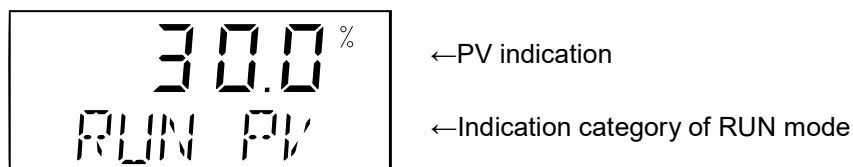
Software of positioner EA10S is configured as follows.

Operation can be conducted by means of push buttons.



6.5. RUN mode

LCD indication about 6 seconds after signal is input to positioner EA10S will be as follows.



Display of “RUN” at left below in the monitor is showing that current status is normal RUN mode, which is to control valve travel depending on input signal from outside (DC 4 to 20 mA). Display of “PV” at right below indicates what upper value is. 7 kinds of status indication are available under RUN mode.

No.	Indication	Category	Meaning
①	RUN PV	Process Value	Valve travel (%)
②	RUN SV %	Set Value	Input signal (0 to 100 %)
③	RUN SV mA	Set Value	Input signal (4 to 20 mA)
④	RUN MV	Manipulate Value	Motor control amount (Digit)
⑤	RUN VEL	Velocity	Velocity of valve stem (Digit)
⑥	RUN ERR	Error	Deviation between SV and PV (%)
⑦	RUN FB	Feedback	Sensor feedback value (Digit)

To change indication mode, <--> button should be pressed with <ESC> button pressed. Indication will be changed each time <--> button is pressed. Pressing <ESC> button alone will lead to “RUN PV” indication.

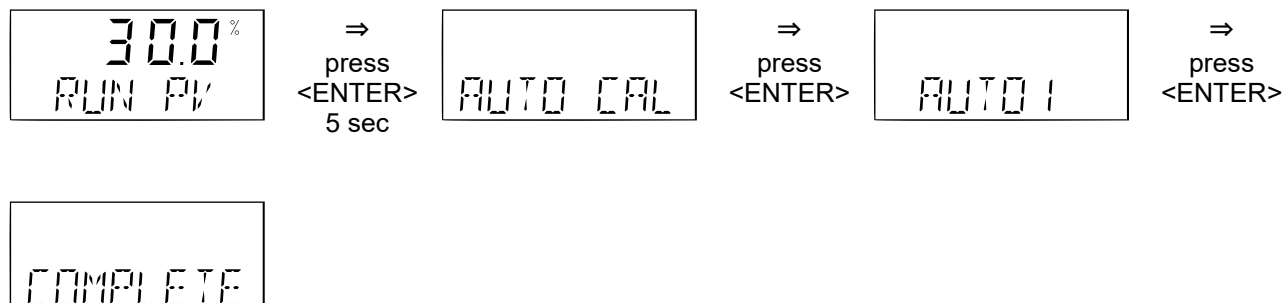
6.6. AUTO CAL

Use of auto calibration enables easy calibration without special setting. 3 kinds of auto calibration are prepared. It will take about 3 to 5 minutes to complete auto calibration. The time actually depends on actuator size.

	Stroke adjustment	Control parameter	Actuator action
AUTO1	○	—	—
AUTO2	○	○	○
AUTO3	—	○	○

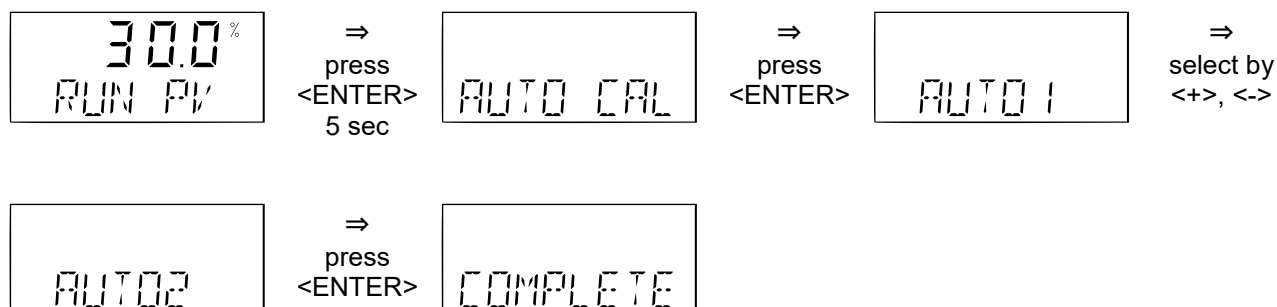
AUTO1

All parameters required for valve operation will be recalibrated. However PID parameters do not change. This auto calibration is recommended for recalibration with valve, which was already calibrated before shipment, after the valve is installed on site.



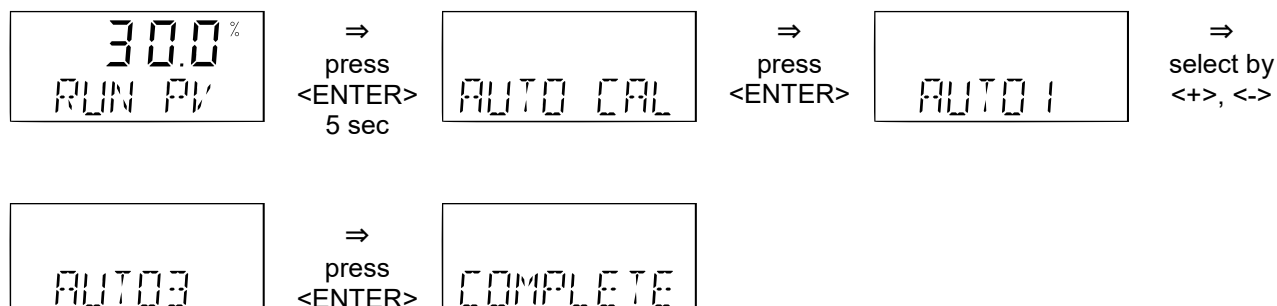
AUTO2

All parameters required for valve operation will be calibrated. This auto calibration is recommended for initial calibration after positioner EA10S is installed on valve.



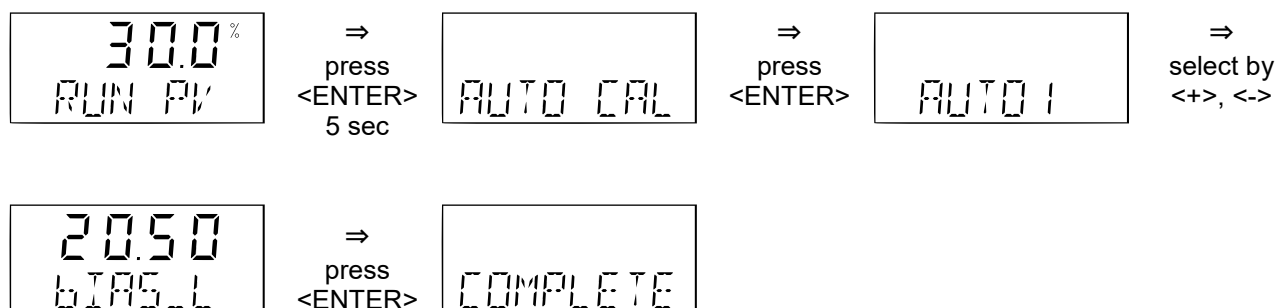
AUTO3

All parameters required for valve operation will be calibrated. However settings for valve zero point and terminal point do not change. This auto calibration is recommended for calibration without changing valve stroke.



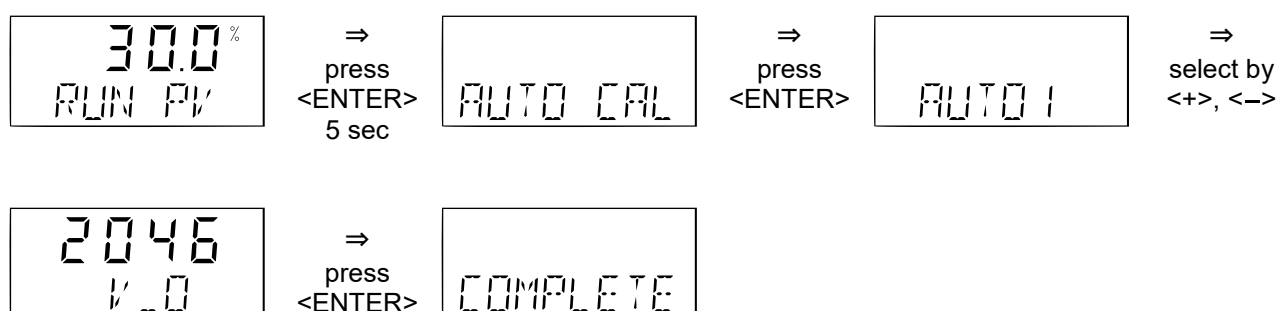
BIAS

Standard value of motor used inside positioner will be set. This calibration is normally conducted during auto calibration (AUTO2, AUTO3). However this BIAS calibration should be used when KP value was manually changed or when supply air pressure was changed.



V_0

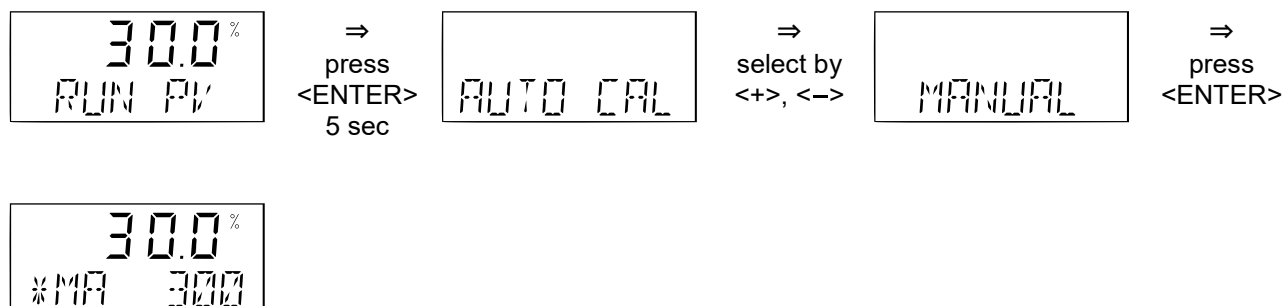
Standard value for judgment of valve velocity will be acquired. This velocity calibration is recommended when an indicated value of "RUN VEL" of RUN mode during valve stillness is beyond range of -5 to 5.



6.7. MANUAL

This can be used for manual valve operation independent of input signal.

At first it is required to enter manual mode.



Output will gradually increase by pressing <+> button in this state. Similarly, output will gradually decrease by pressing <-> button. Output will change fast by pressing <ENTER> button together with <+> or <-> button. <ESC> button should be pressed twice when manual operation is completed to go back to RUN mode.

6.8. PARAM

Most appropriate control parameters are selected by conducting auto calibration. However, favorable results might not be gained by auto calibration in some cases such as special actuators or valves with large friction. In that case, operation can be improved by calibrating PID parameters or dead zone manually.

Type of parameters

There are 4 kinds of parameters; dead zone (DEADZONE), proportional gain (KP), integral constant (KI), differential constant (KD).

Dead zone (DEADZONE)

Dead zone is a band setting (%) where integration control halts to a target value. In such cases that hunting is occurring due to large friction of gland packing, hunting can be prevented by setting dead zone.

Proportional gain (KP)

Deviation between target value and valve travel can be reduced quickly by increasing proportional gain. However, increasing the gain too much will lead to hunting.

Integral constant (KI)

Time to correct deviation between target value and valve travel can be shortened by increasing integral constant. However, increasing the constant too much will lead to hunting.

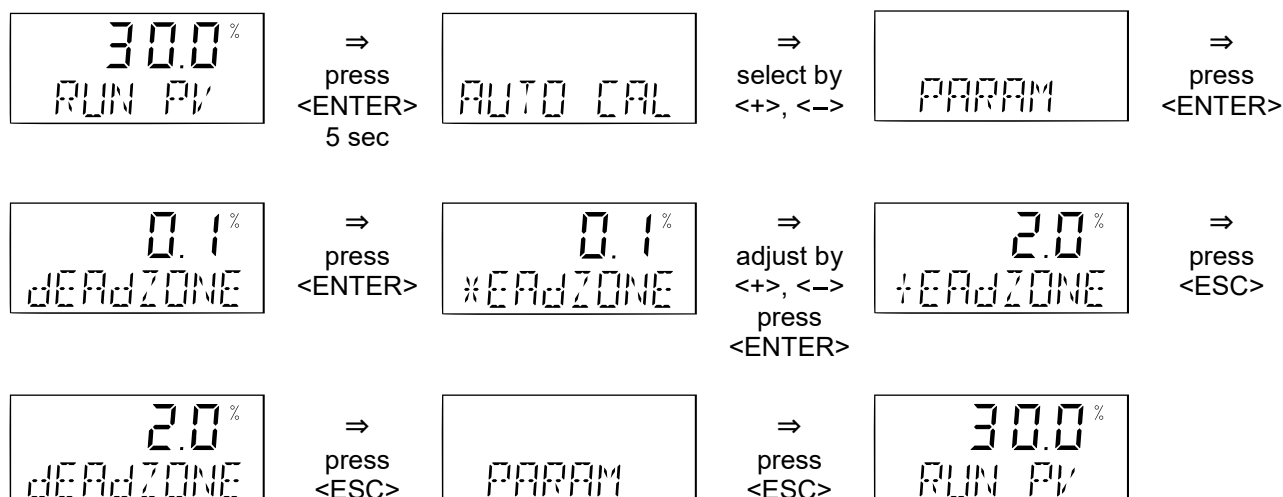
Differential constant (KD)

Time to reach target value can be shortened by increasing differential constant. However, increasing the constant too much will lead to hunting.

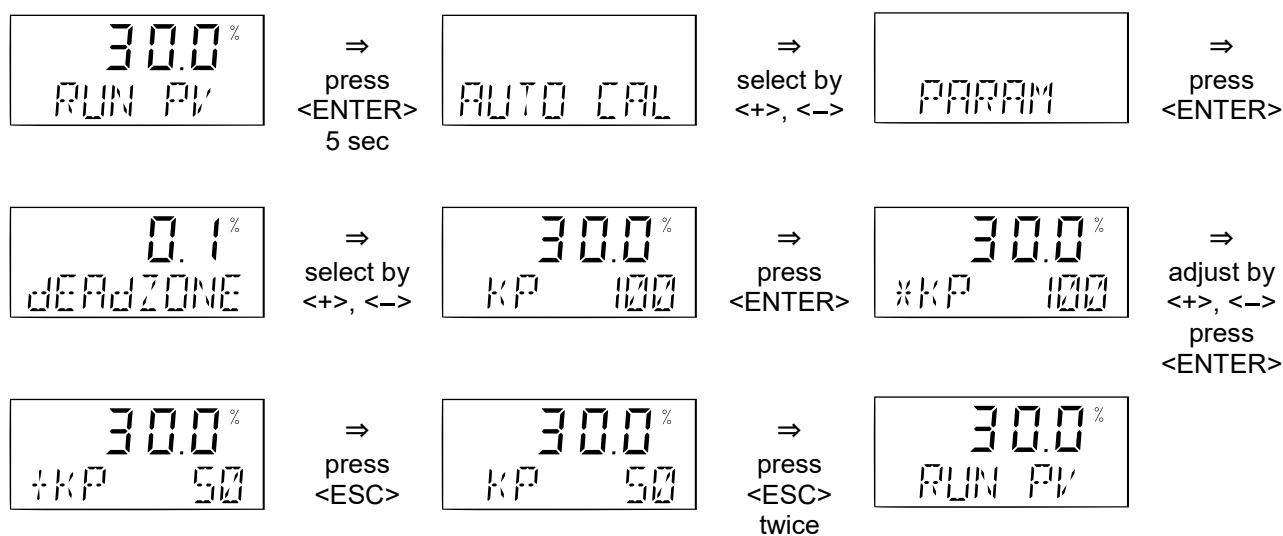
“KP_”, “KI_” and “KD_” are parameters to change intensity of each PID parameter while deviation between target value and valve travel is within 1%. Standard value is 10. For example, if “KP_” parameter is changed to 12, proportional gain becomes 120% of original parameter setting while deviation between target value and valve travel is within 1%.

“KI LT” is a parameter to set a time interval in seconds from a state that valve is seated to a beginning of valve movement. It is not necessary to change the parameter since the parameter is normally set by auto calibration.

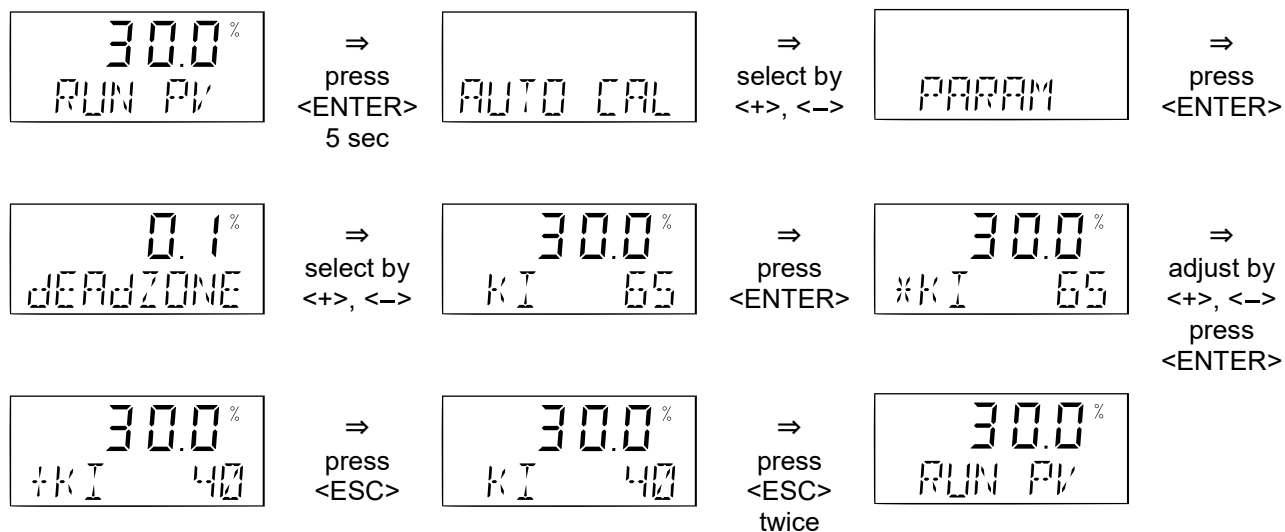
Example of changing dead zone (DEADZONE)



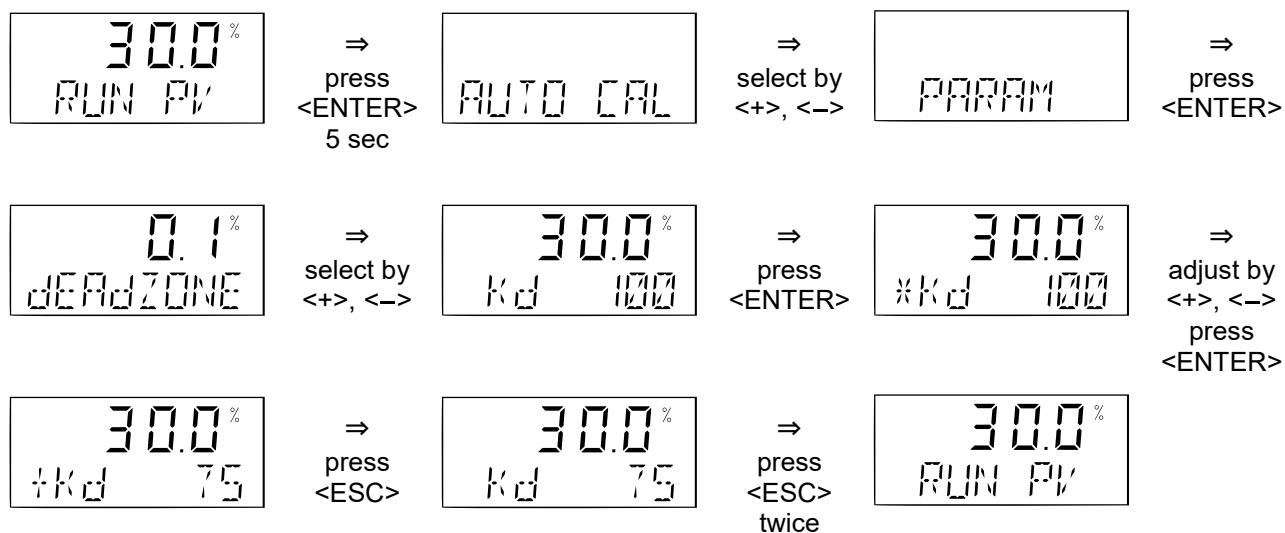
Example of changing proportional gain (KP)



Example of changing integral constant (KI)



Example of changing differential constant (KD)



6.9. HAND CAL

Calibration of stroke is automatically completed mostly by conducting auto calibration. Besides, hand calibration is able to be used in case that precise calibration is desired.

Furthermore, hand calibration also enables precise calibration of 4 to 20 mA position transmitter, reversing output direction and inversion of position indication in HART[®] communication.

Hand calibration (HAND CAL) includes following items.

PV_ZERO : Position data at 0% point (close) in the valve stroke

PV_END : Position data at 100% point (open) in the valve stroke

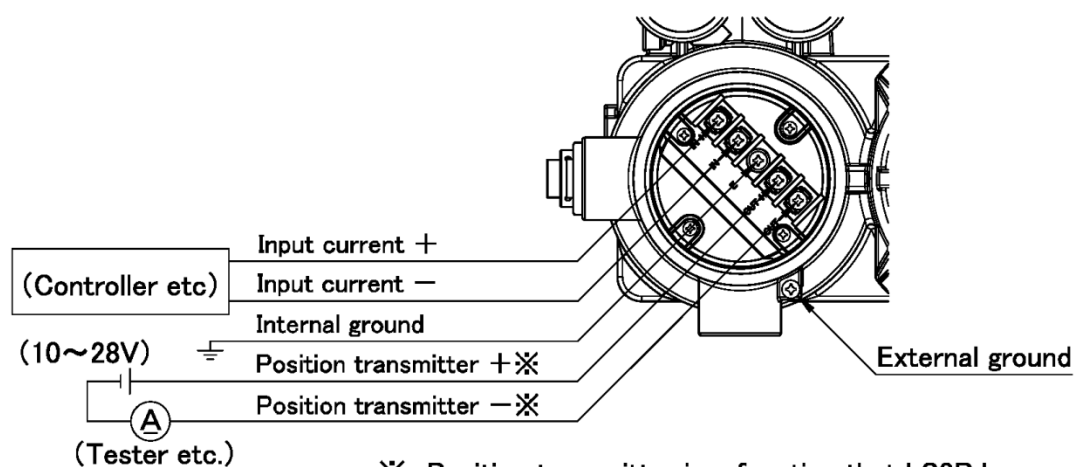
TR_ZERO : Data at 0% point (4 mA) for position transmitter

TR_END : Data at 100% point (20 mA) for position transmitter

TR : Direction of position transmitter (NORM/REVS)

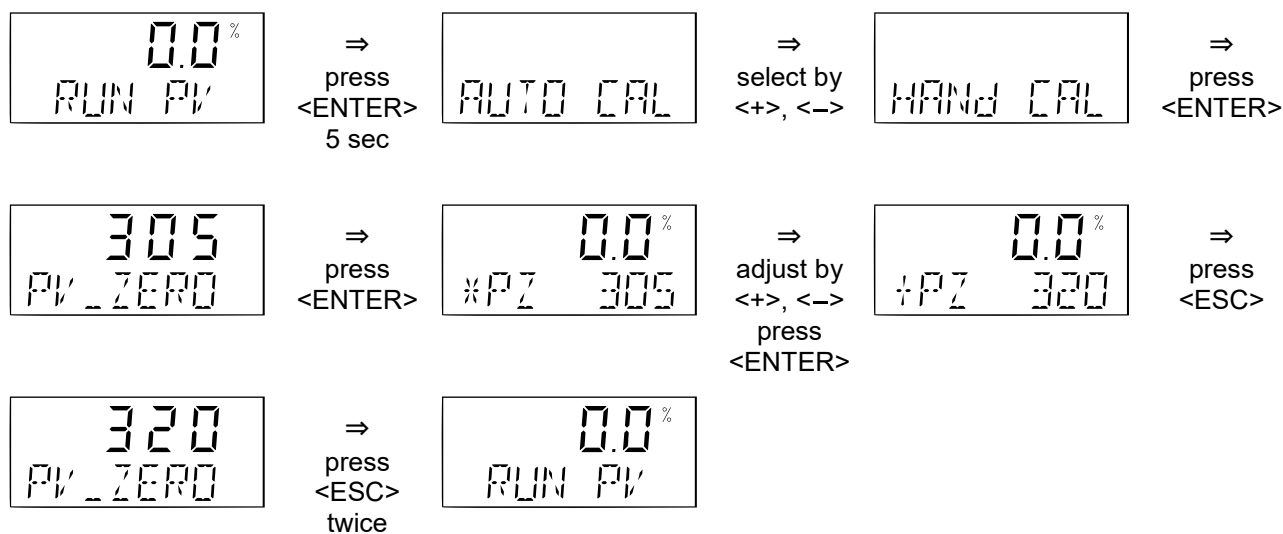
HT : Direction of position indication in HART[®] communication[†] (NORM/REVS)

Power source and tester to confirm current are required for data setting of position transmitter.

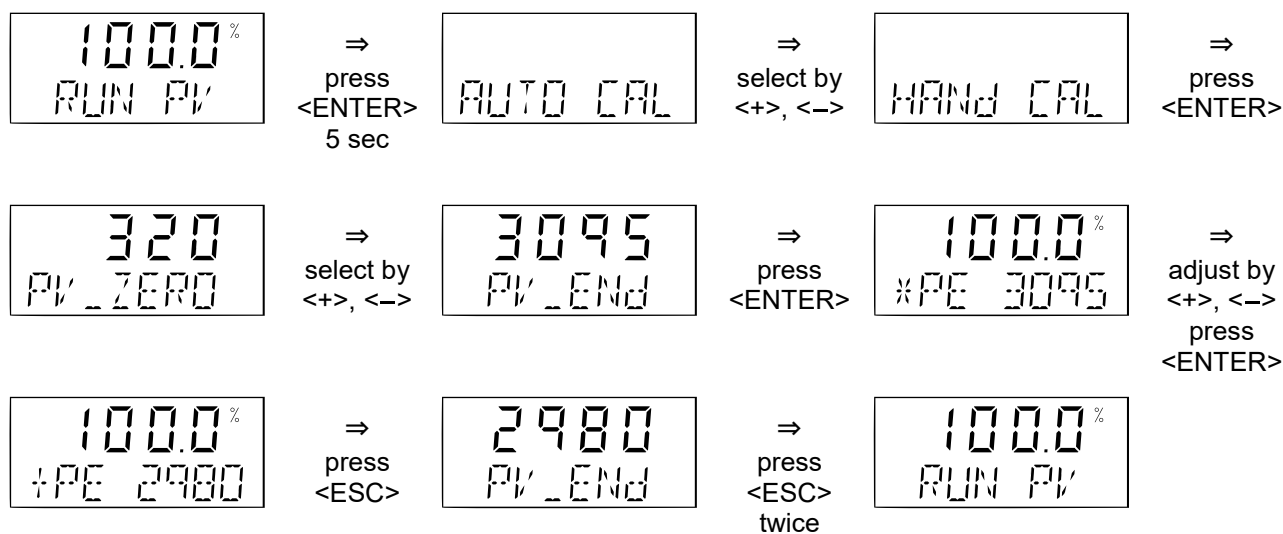


※ Position transmitter is a function that LS3R has.

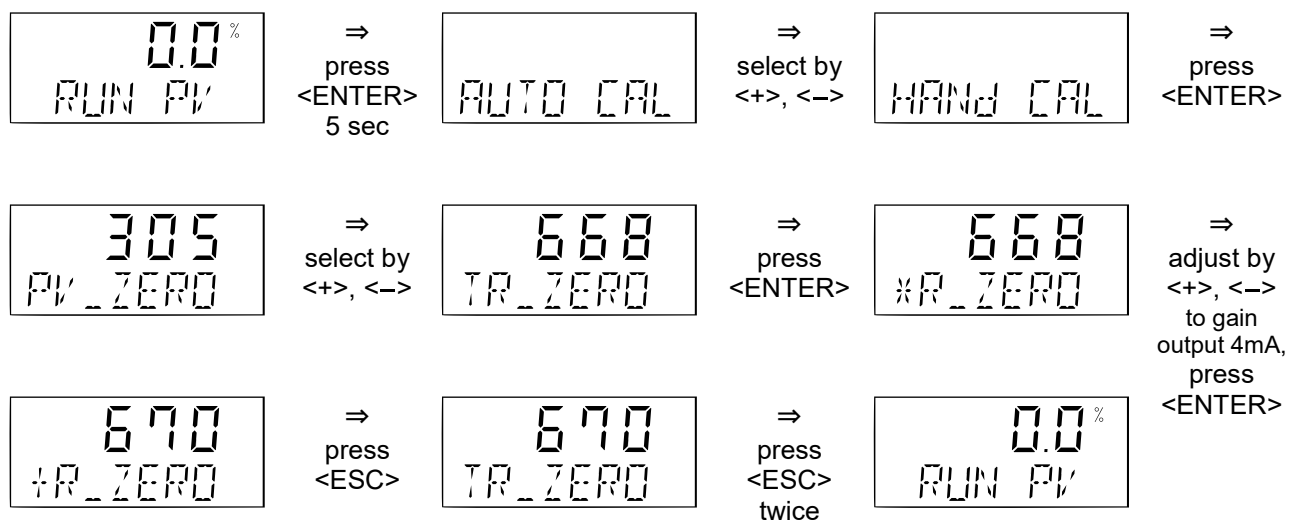
Example of changing "PV_ZERO"



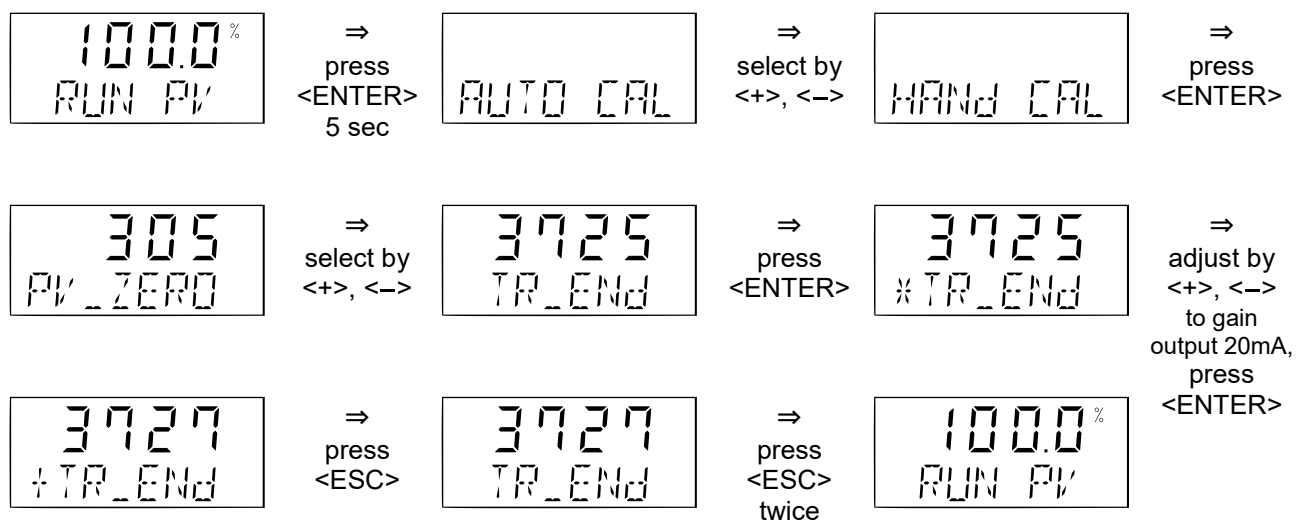
Example of changing "PV_END"



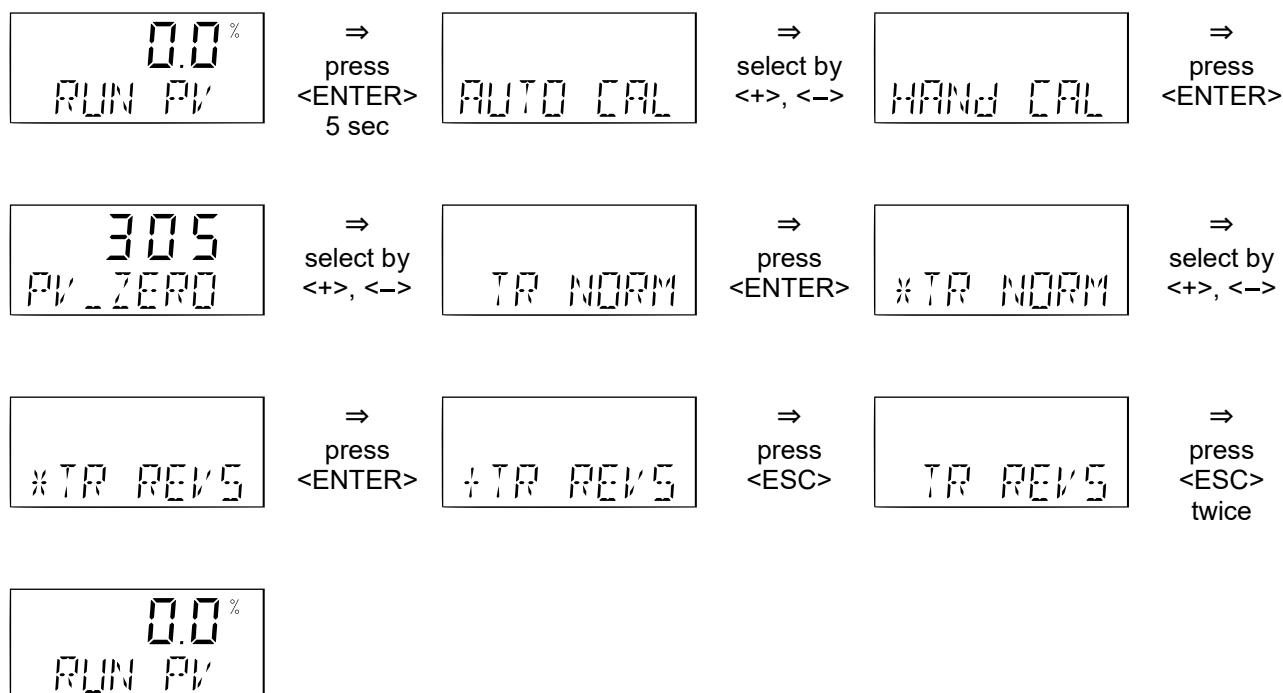
Example of changing "TR_ZERO"



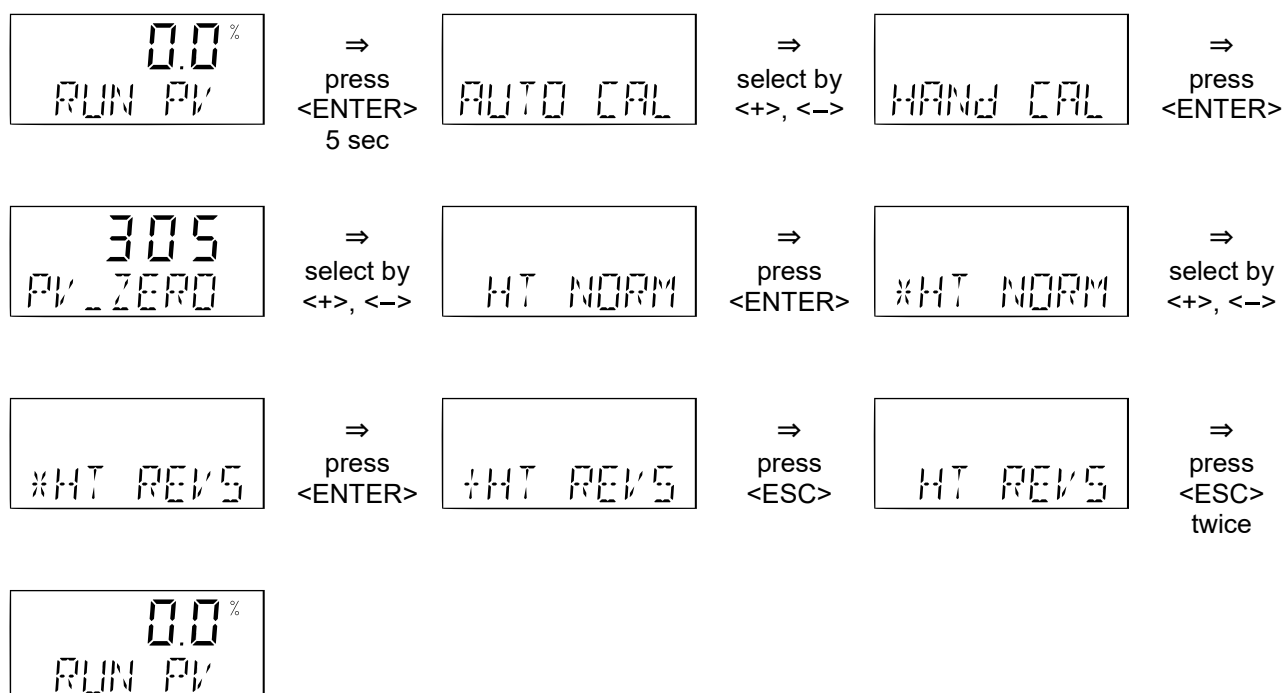
Example of changing "TR_END"



Example of changing “TR” NORM/REVS



Example of changing “HT” NORM/REVS



6.10. VALVE

Here it is possible to set operation direction of valve or positioner, flow characteristic, cut-off and signal band.

Control valve (VALVE) includes following items.

ACTUA	: Actuator operation; It is automatically set in AUTOCAL if actuator is DA or RA type.	
POS	: Switching operation direction of positioner	(standard: NORM)
VALVE	: Setting of seat direction of control valve	(standard: DA)
CHAR	: Setting of flow characteristic	(standard: LIN)
USER SET	: Setting of data in user's definition characteristic	
TSHUT OP	: Setting of cutoff position at full open side	(standard: 100%)
TSHUT CL	: Setting of cutoff position at full close side	(standard: 0.3%)
SIG ZERO	: Setting of input current corresponding to 0%	(standard: 4 mA)
SIG END	: Setting of input current corresponding to 100%	(standard: 20 mA)

ACTUA

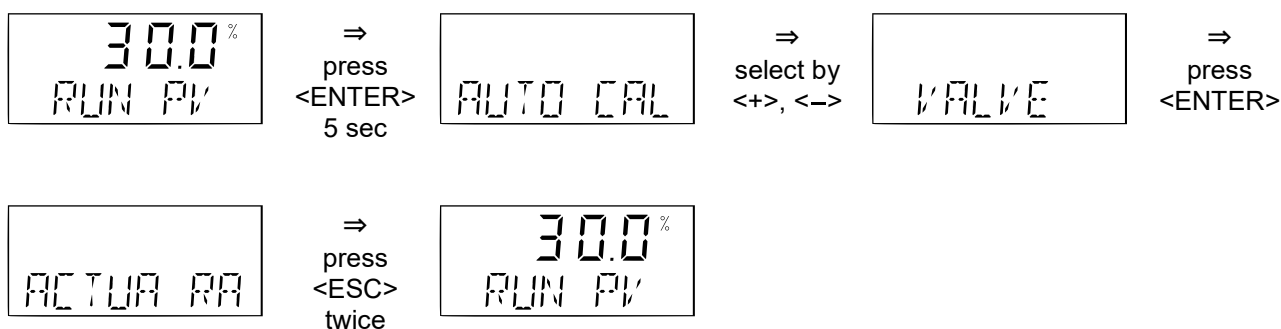
This indicates operation direction of actuator.

"DA" is indicated if valve stem goes down to body (linear motion) or rotates clockwise viewed from positioner side (rotary motion) with increase of air pressure inside actuator.

"RA" is indicated if valve stem goes up to actuator (linear motion) or rotates counterclockwise viewed from positioner side (rotary motion) with increase of air pressure inside actuator.

It is not necessary to change this parameter normally. This parameter is set during AUTOCAL.

Confirmation of ACTUA



POS

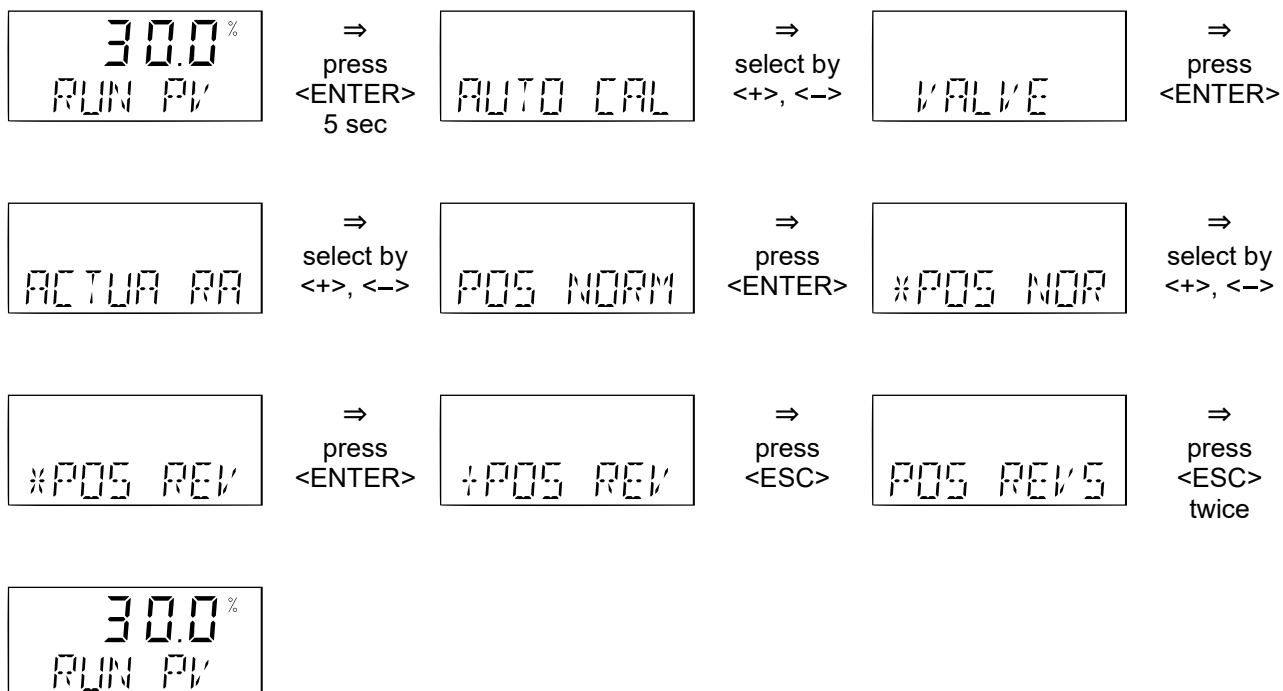
This indicates operation direction of positioner.

NORM : OUT1, output air pressure of positioner increases with increase of input signal

REVS : OUT1, output air pressure of positioner decreases with increase of input signal

Normal setting is "NORM".

Example of changing "POS"



VALVE

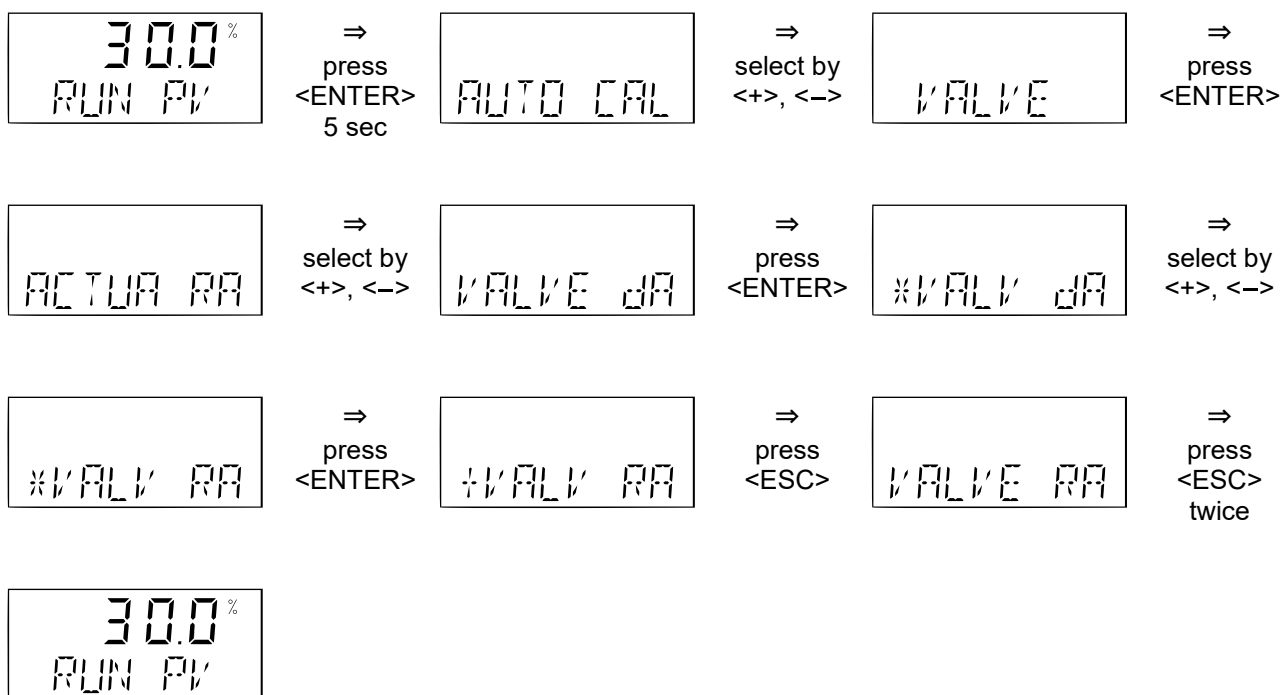
This indicates operation direction of valve.

DA : Valve closes with valve stem going down (linear motion)
or with valve shaft rotating clockwise (rotary motion).

RA : Valve closes with valve stem going up (linear motion)
or with valve shaft rotating counterclockwise (rotary motion).

Normal setting is "DA".

Example of changing "VALVE"

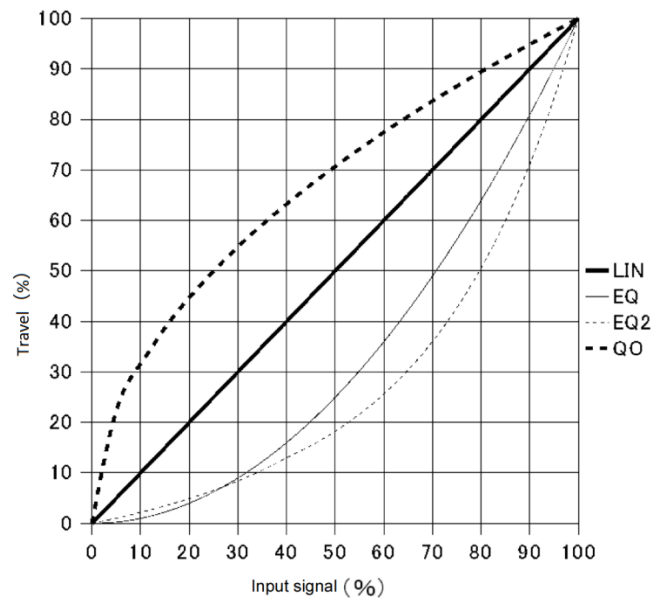


CHAR

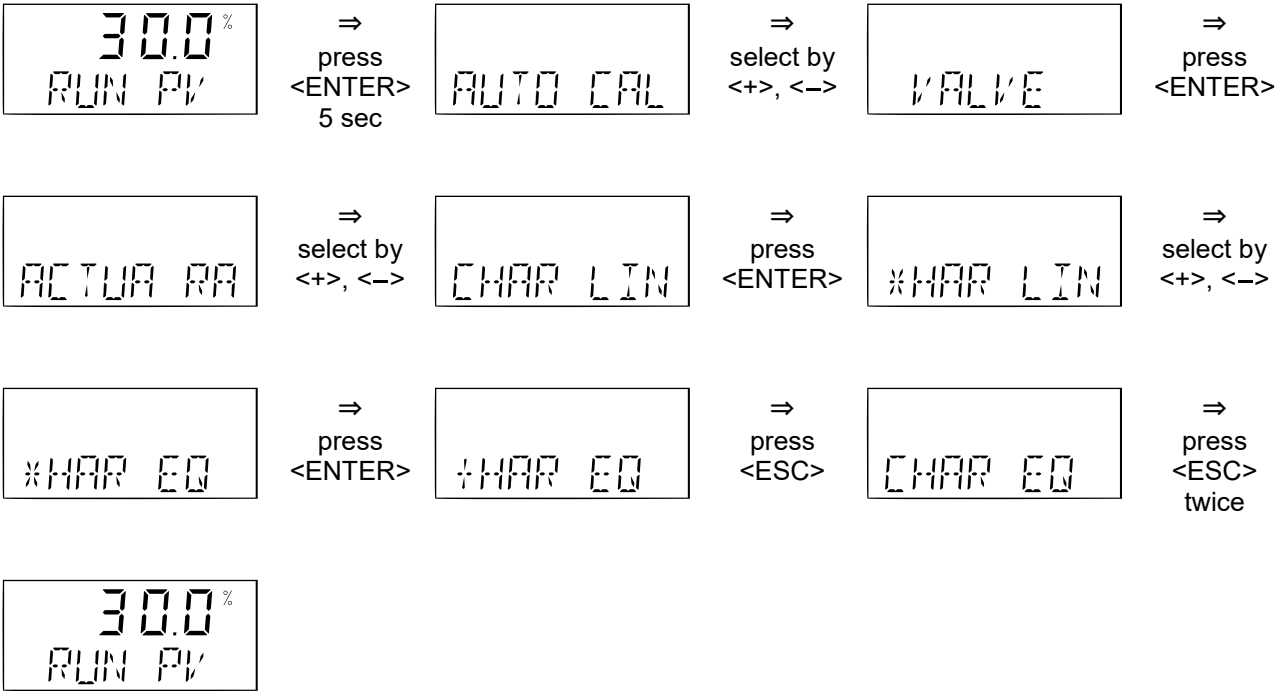
Here it is possible to set flow control characteristic of positioner.

- LIN : Linear
- EQ : Equal percentage
- EQ2 : Equal percentage
(customized for valve 92-A)
- QO : Quick opening
- USR : User's definition

Normal setting is "LIN".



Example of changing "CHAR"



USER SET

Here it is possible to define flow characteristic.

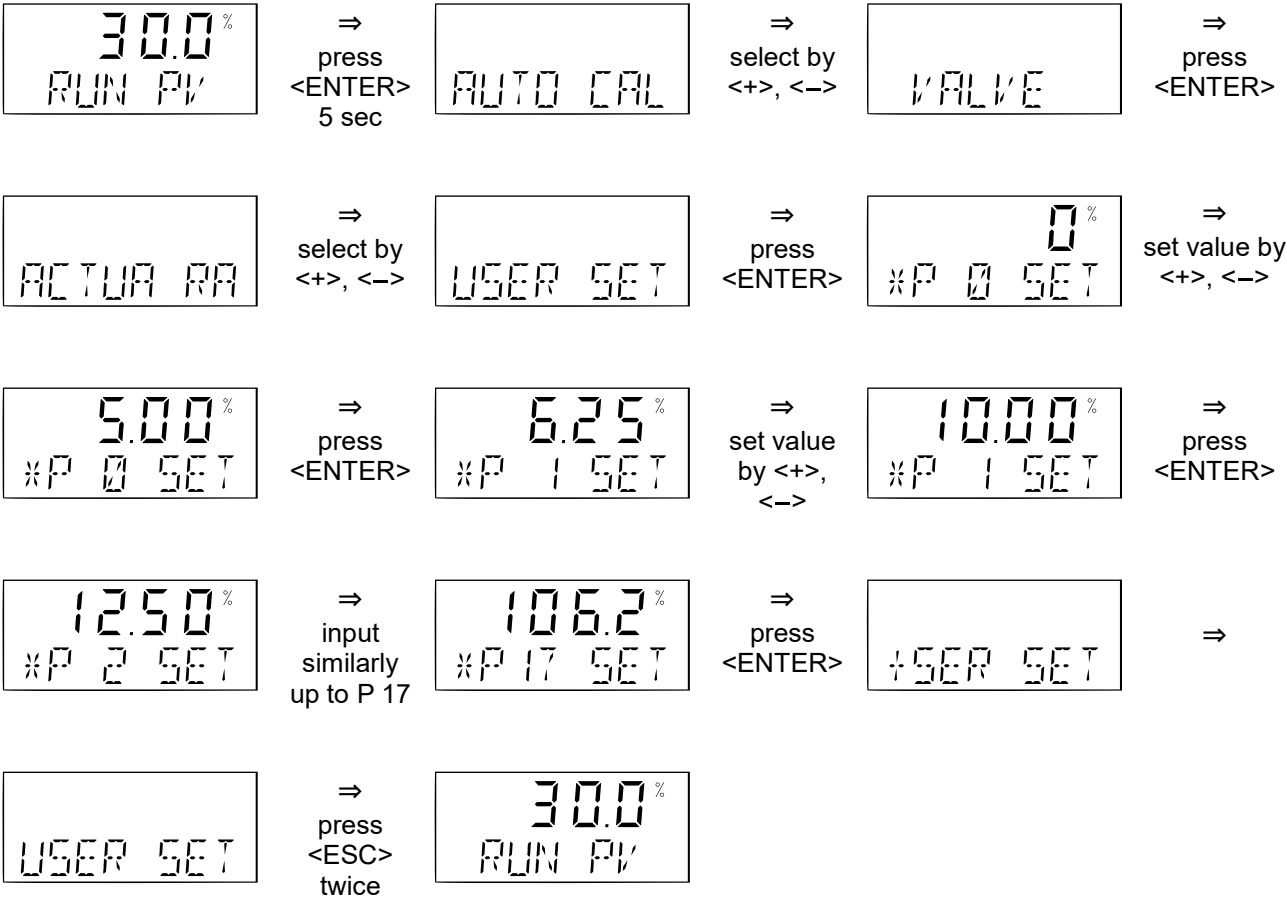
Valve travels can be input for 18 points from P 0 (0%) to P 17 (106.25%) at intervals of 6.25% (equivalent to 1mA).

Travels should be input so that gradients in each point become smooth.

It is possible to use flow characteristic of input by selecting “USR” in CHAR.

P 0	Valve travel (%) at input of 0.00%
P 1	Valve travel (%) at input of 6.25%
P 2	Valve travel (%) at input of 12.50%
P 3	Valve travel (%) at input of 18.75%
P 4	Valve travel (%) at input of 25.00%
P 5	Valve travel (%) at input of 31.25%
P 6	Valve travel (%) at input of 37.50%
P 7	Valve travel (%) at input of 43.75%
P 8	Valve travel (%) at input of 50.00%
P 9	Valve travel (%) at input of 56.25%
P 10	Valve travel (%) at input of 62.50%
P 11	Valve travel (%) at input of 68.75%
P 12	Valve travel (%) at input of 75.00%
P 13	Valve travel (%) at input of 81.25%
P 14	Valve travel (%) at input of 87.50%
P 15	Valve travel (%) at input of 93.75%
P 16	Valve travel (%) at input of 100.00%
P 17	Valve travel (%) at input of 106.25%

Example of changing “USER SET”

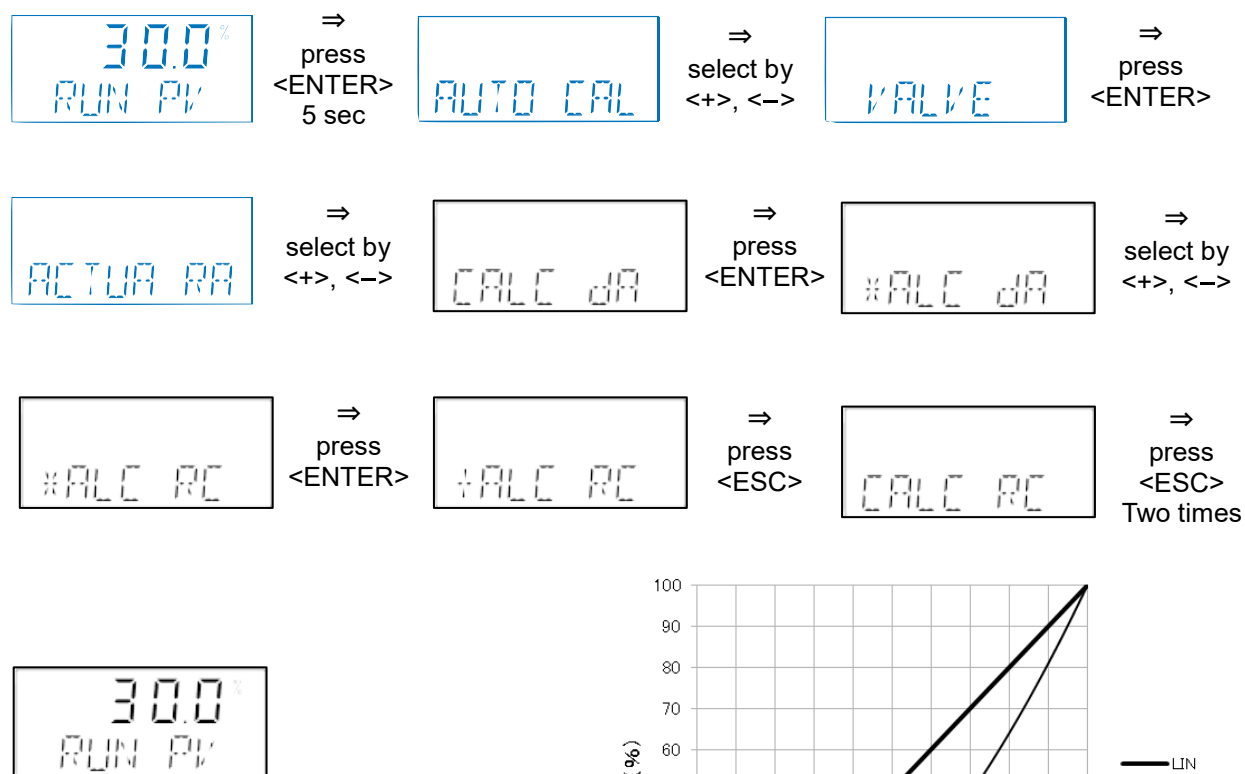


CALC (Version 1.5.11 or later)

Here it is possible to set the calculation method of the valve travel (%) to be displayed on the LCD monitor.

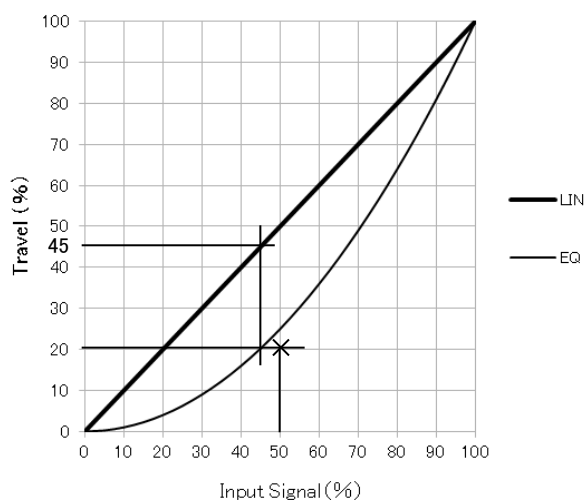
Normal setting is DA, which means that the valve travel (%) is displayed on the LCD as it is. By changing this parameter to RC when the flow characteristic is not LIN, the valve travels (%) displayed on the LCD is displayed as a value corresponding to the flow characteristic.

Example of changing "CALC"



Example of display

When flow characteristic (CHAR) is EQ



- When CALC setting is DA

Input signal 50% , Valve travel 20% → LCD display 20%
(Reference travel 25%)

If the input signal is 50% and the valve travel is 20%, the LCD displays the valve travel 20% as it is.

- When CALC setting is RC

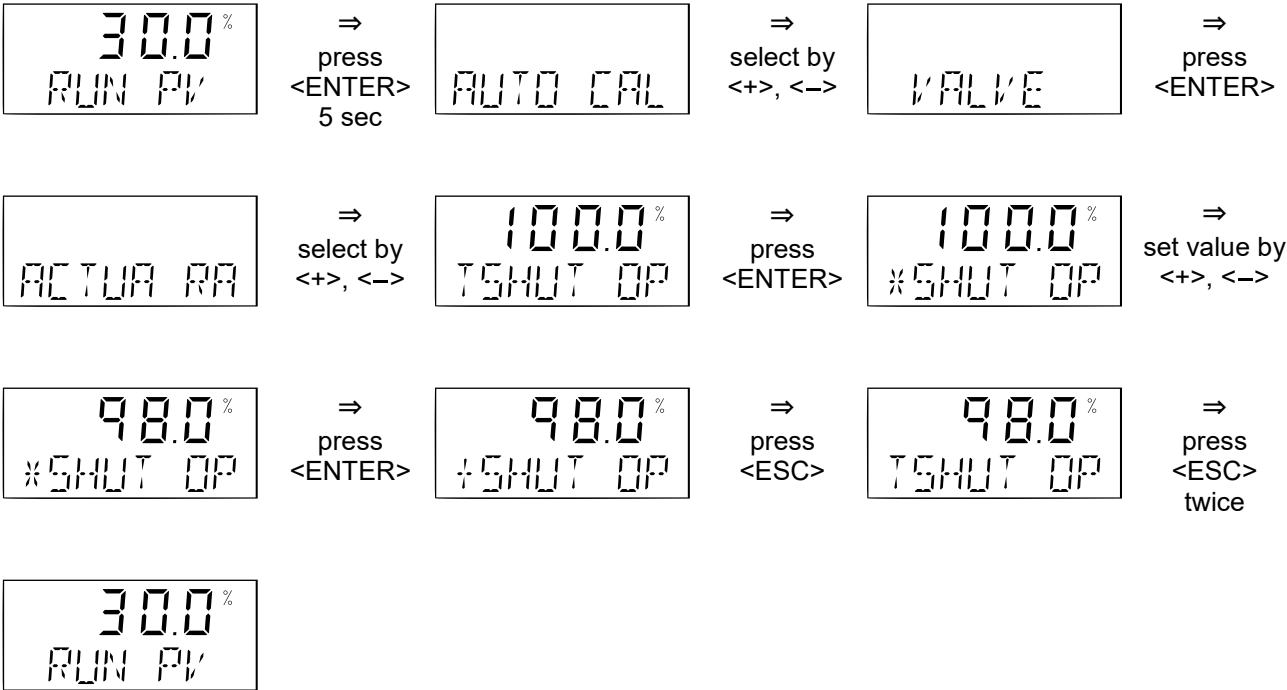
Input signal 50% , Valve travel 20% → LCD display 45%
(Reference travel 25%)

If the input signal is 50% and the valve opening is 20%, the valve travel is converted to the LIN characteristic value and displayed as 45%.

Bulletin No. MIE-B6111E

Here it is possible to set an input value where control valve is fully opened forcefully.
Normal setting is 100%, which means that this function is practically voided.
This function becomes effective when a parameter less than 100% is input.

Example of changing “TSHUT OP”



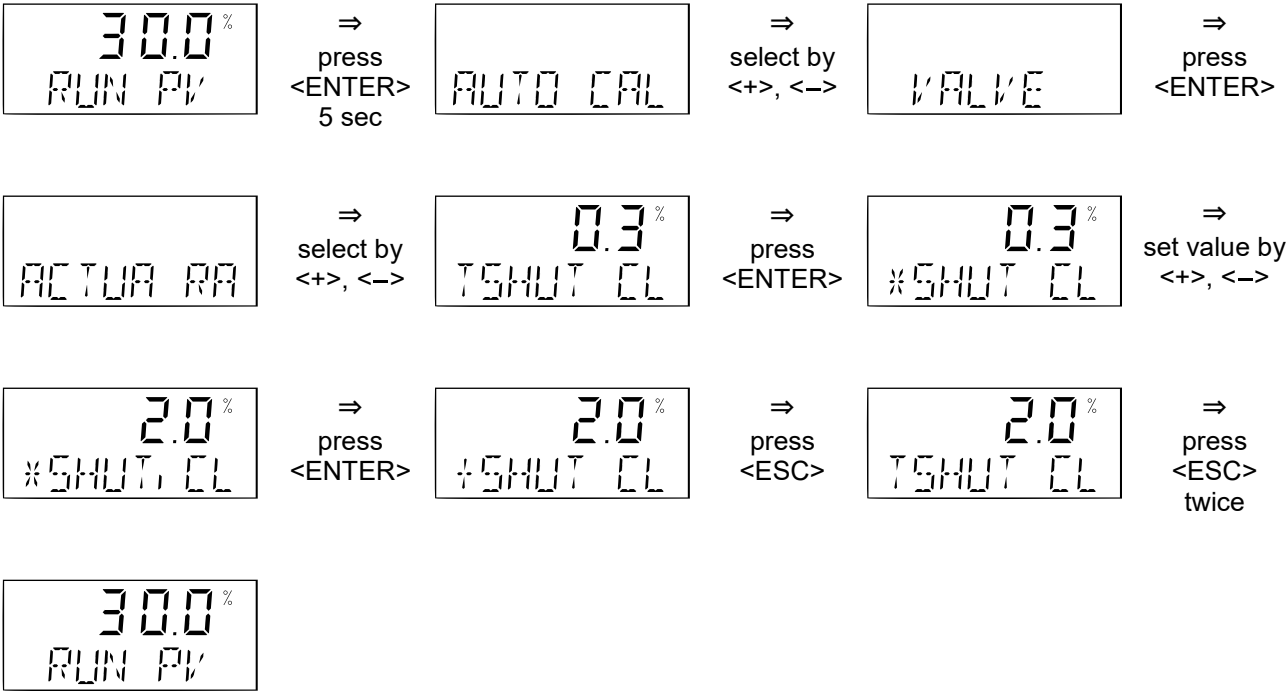
TSHUT CL

Here it is possible to set an input value where control valve is fully closed forcefully.

Normal setting is 0.3%.

This function becomes void when a parameter of 0% is input.

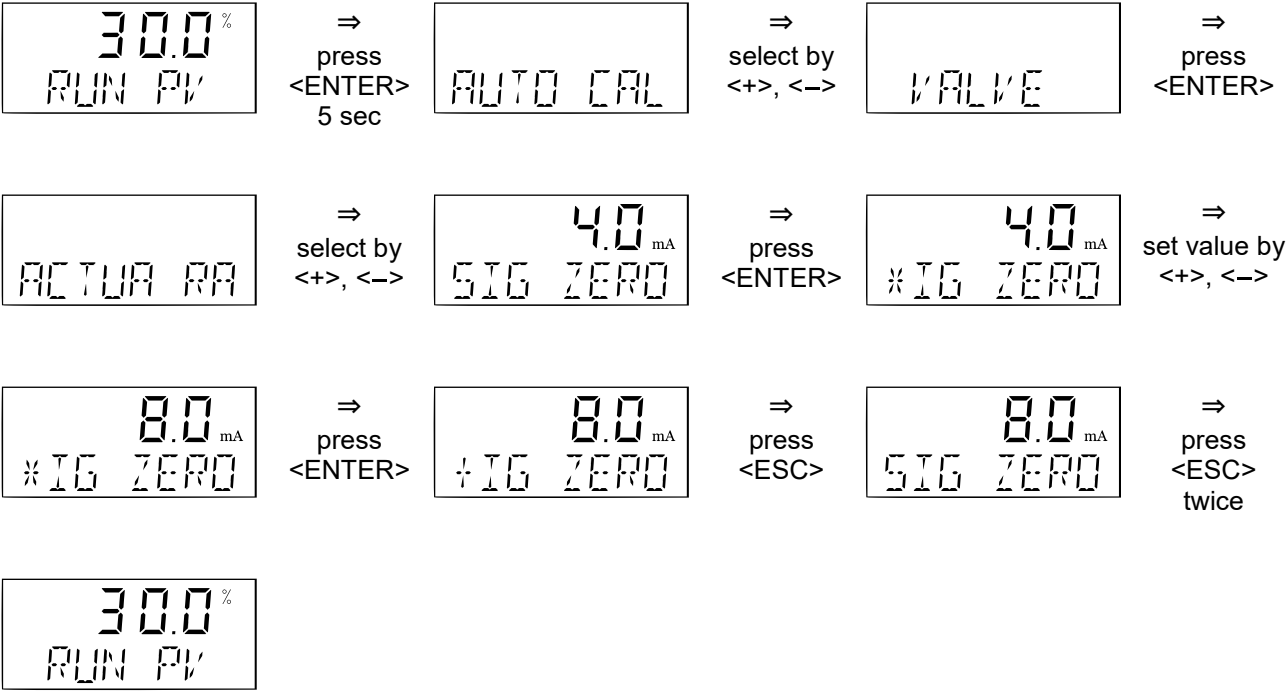
Example of changing “TSHUT CL”



SIG ZERO

Here it is possible to set an input current which corresponds to 0% output.
Normal setting is 4.0 mA.

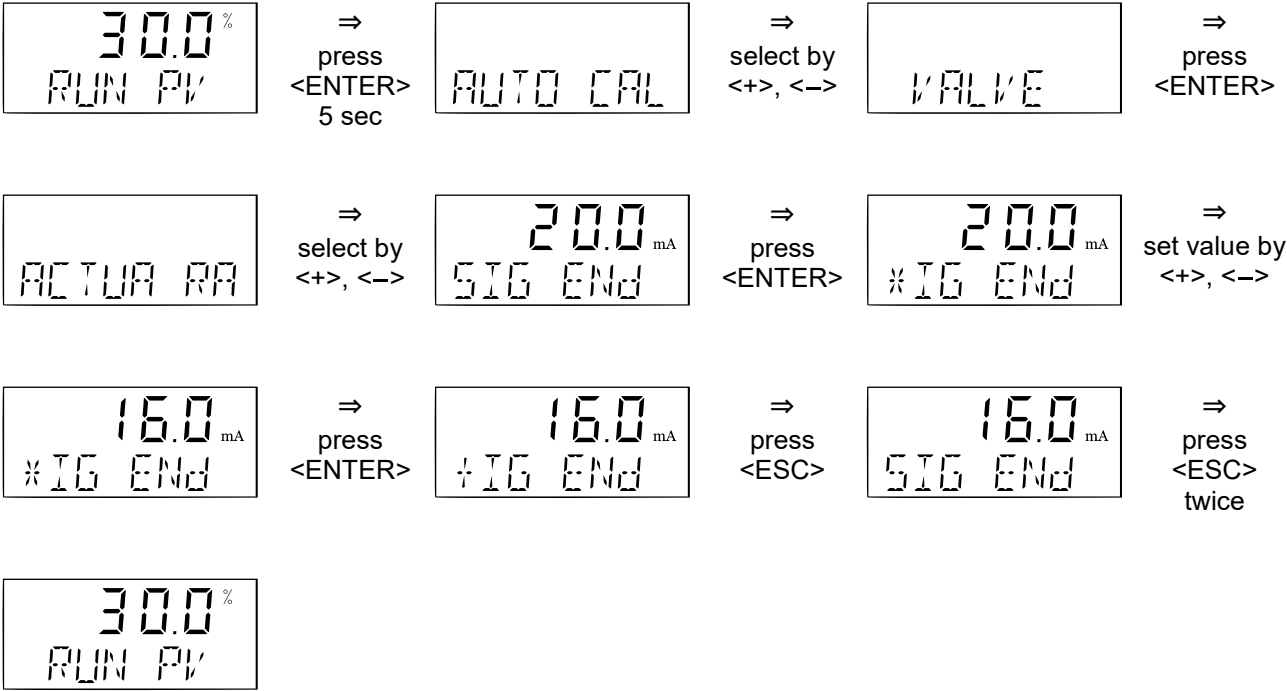
Example of changing “SIG ZERO”



SIG END

Here it is possible to set an input current which corresponds to 100% output.
Normal setting is 20.0 mA.

Example of changing “SIG END”

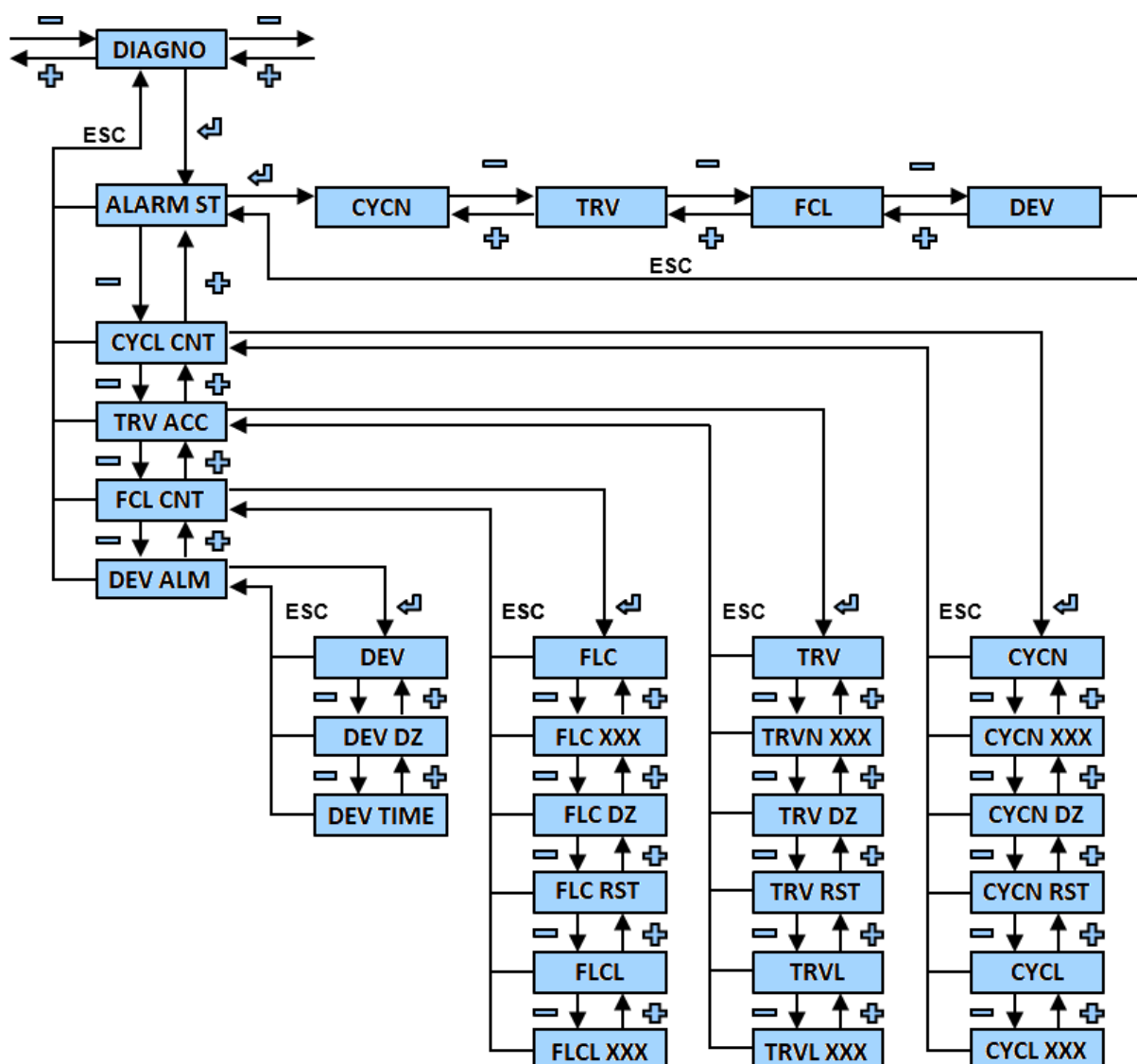


6.11. DIAGNO (Since Version 1.5)

Within this menu, you can set the positioner to measure the actuation amount of the travel valve, the number of actuation cycle count, and the total closing count. In addition, it is possible to set the alarm setting when the measured value exceeds the set threshold, reset the measured value, the upper limit of the deviation that displays the alarm at the time of control, and so on.

ALARM ST	:	Confirm alarm occurrence status
CYCL CNT	:	Cycle counter measurement setting, count check, alarm setting and measurement value reset
TRV ACC	:	Measurement setting of travel amount, alarm setting and measurement value reset
FCL CNT	:	Measurement setting of full close counter, alarm setting and measurement value reset
DEV ALM	:	Deviation alarm setting

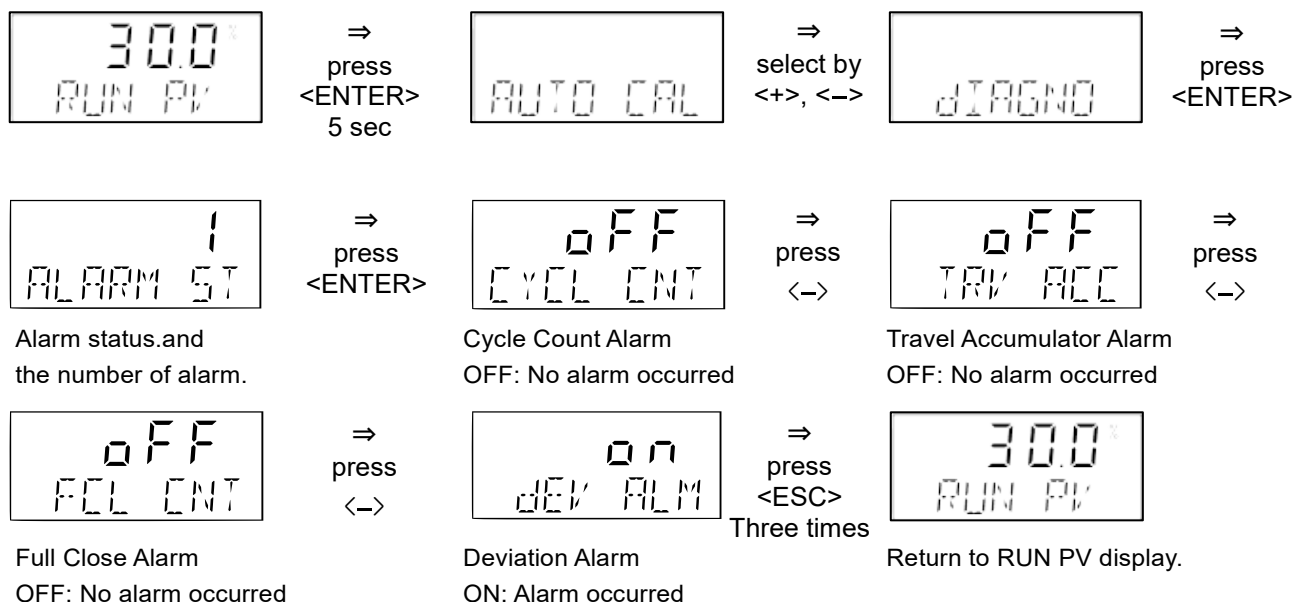
Menu Structure



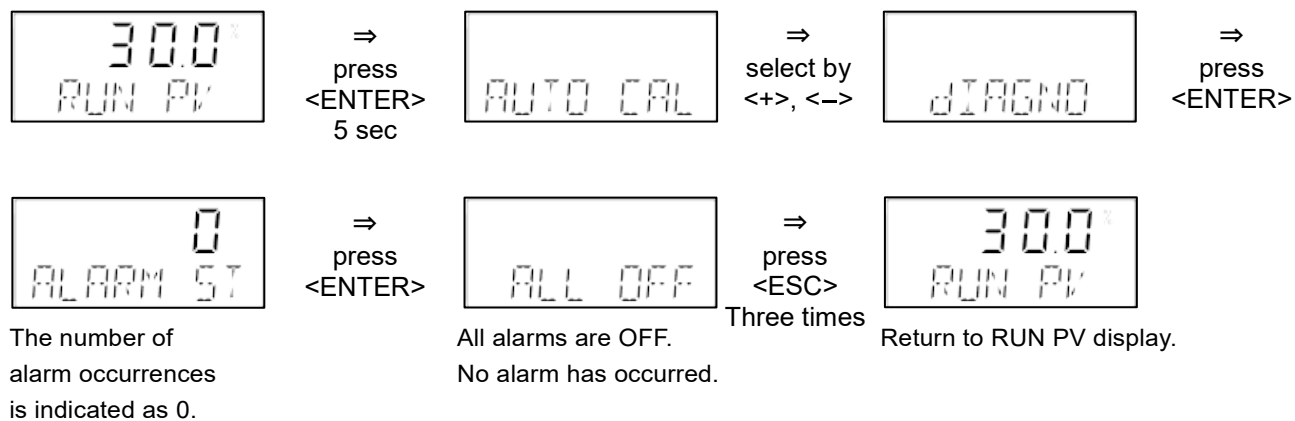
ALARM ST (Alarm Status)

Check alarm occurrence status.

Example check “ALARM ST” (An example where only deviation alarm occurred.)



Example of check “ALARM ST” (An example where all alarms have not occurred.)

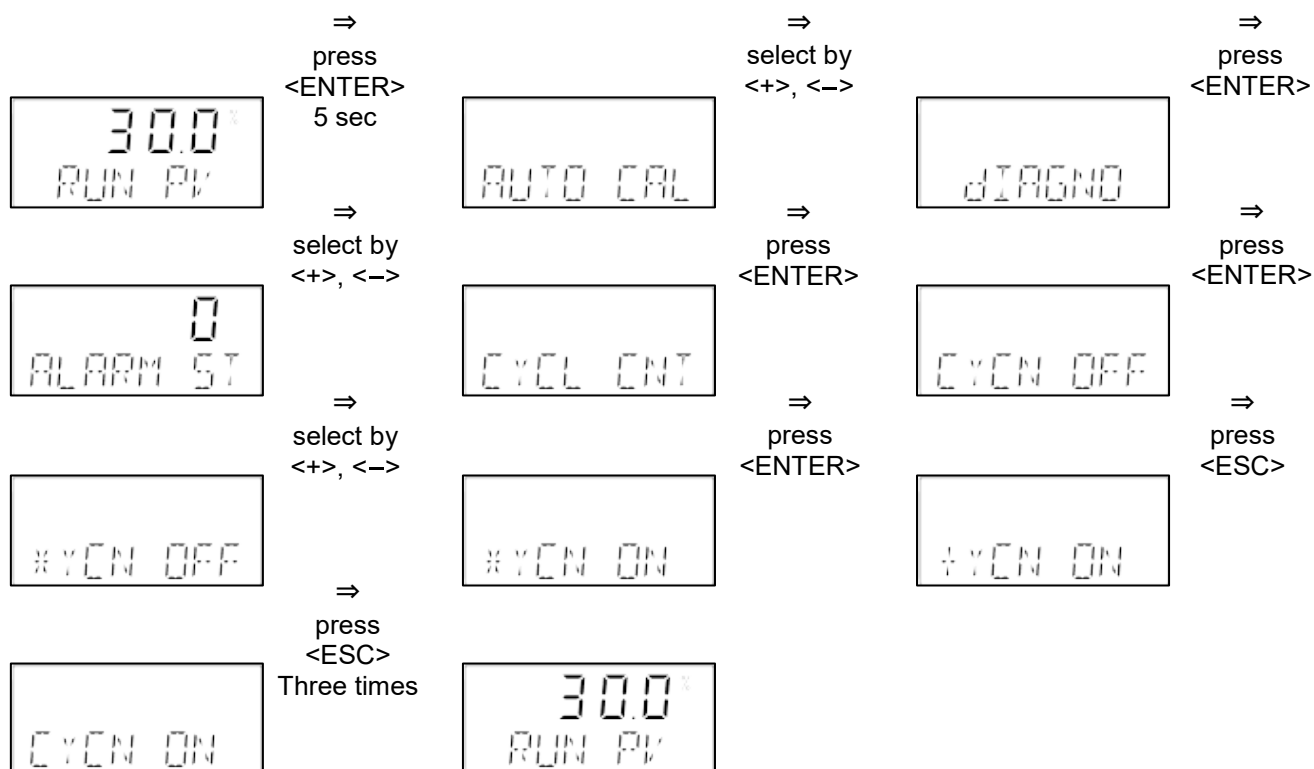


CYCL CNT (Cycle Count)

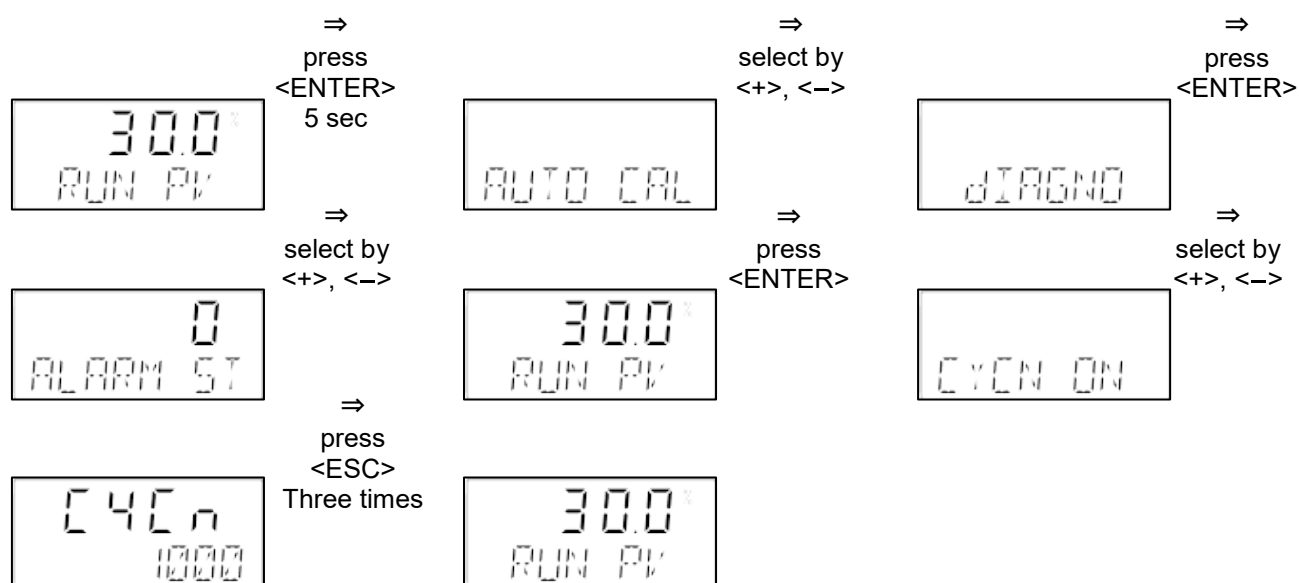
Total accumulated number of times that the valve operation direction turned over.

Alarms will be indicated when the value exceeds the number set by the user.

Example of changing "CYCL CNT" (Turn on the measurement function)

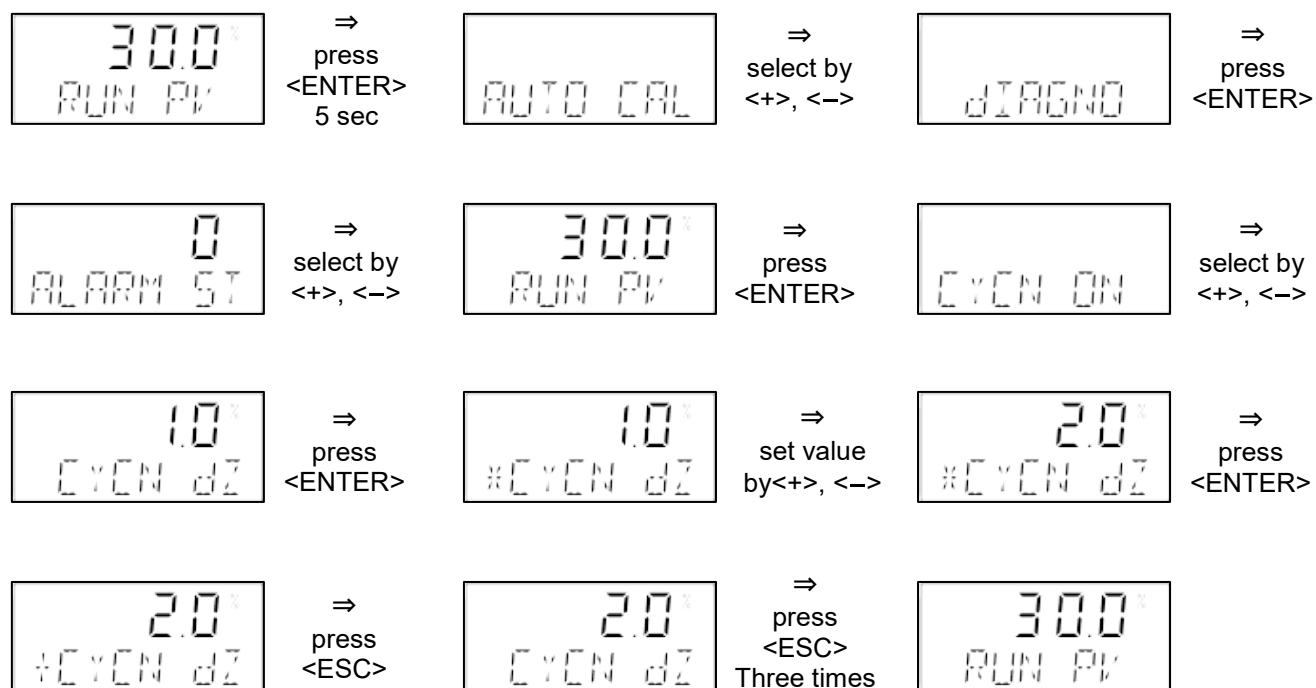


Example of check "CYCL CNT" (Check turn over times)

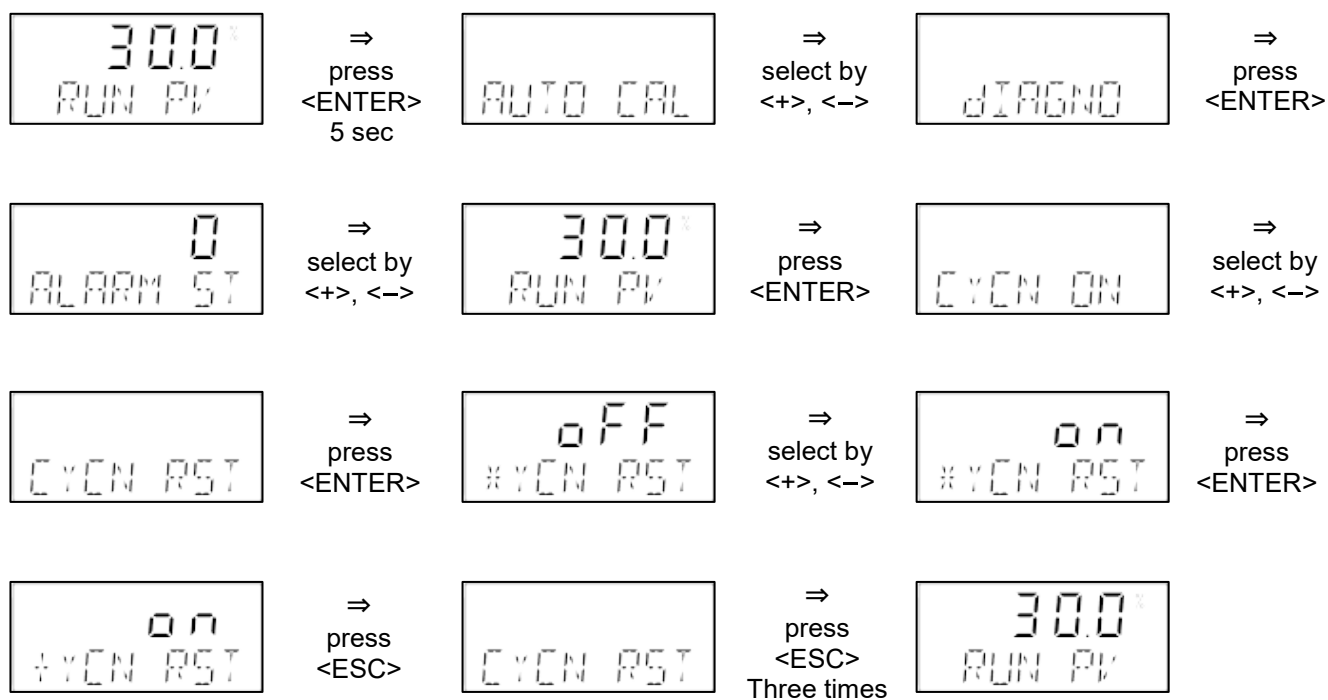


Example of changing “CYCL CNT” (Change dead zone from 1% to 2%)

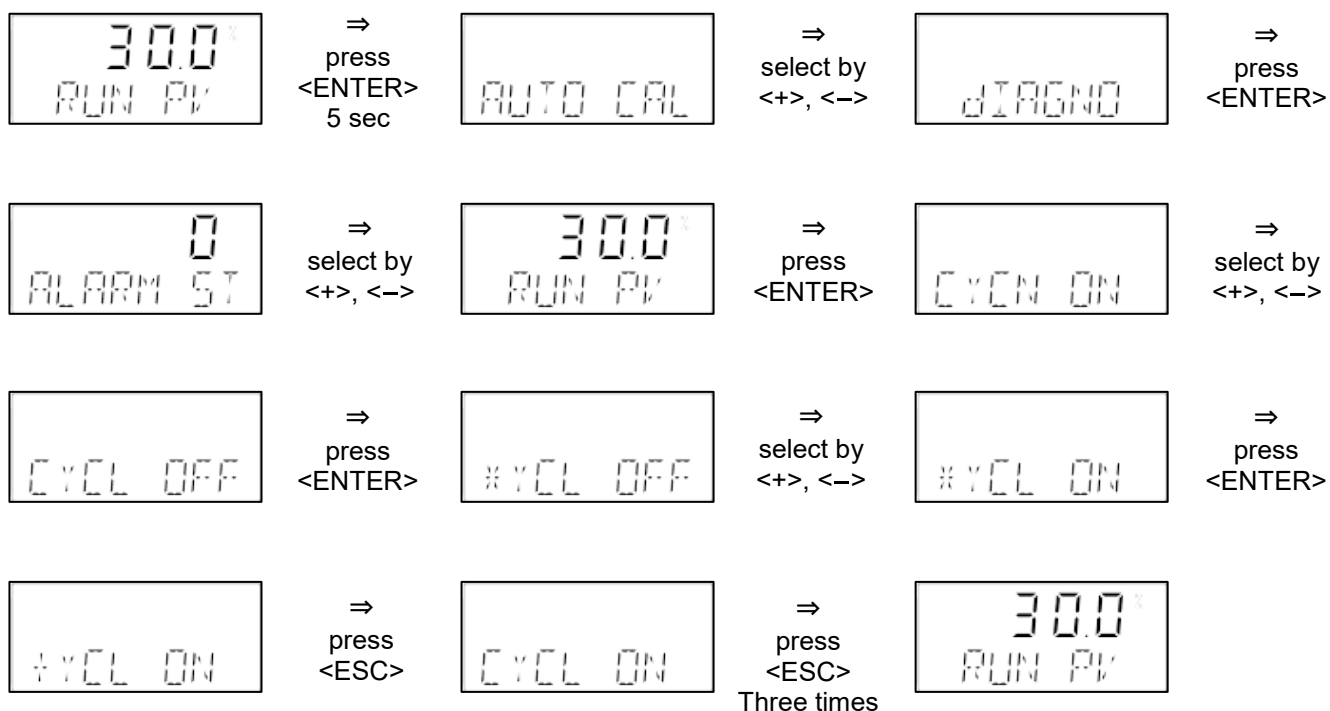
Operations within the dead zone are not counted.



Example of changing “CYCL CNT” (Reset measured value)

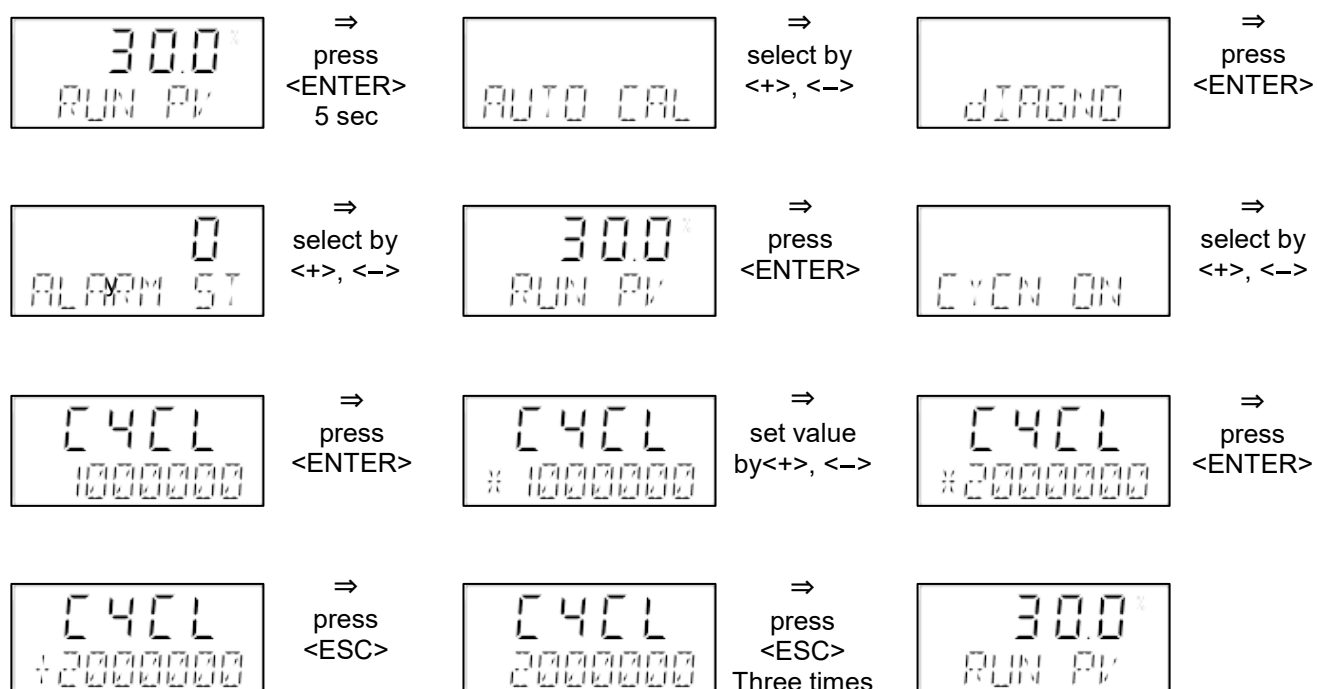


Example of changing “CYCL CNT” (Turn on the alarm function)



Example of changing “CYCL CNT” (Change threshold from 1,000,000 to 2,000,000)

Threshold: When CYCL CNT becomes bigger than this value, an alarm is sent.



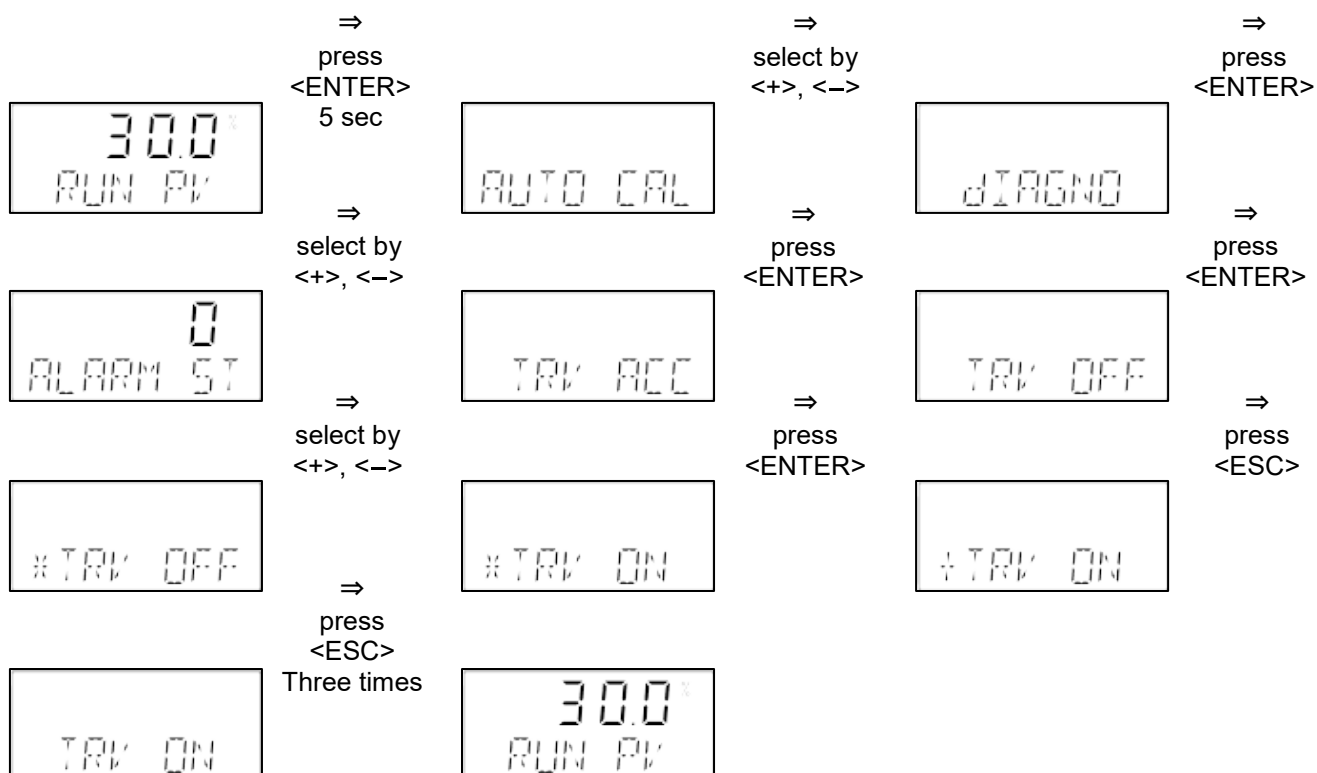
TRV ACC (Travel Accumulation)

Total accumulation of control valves travel change

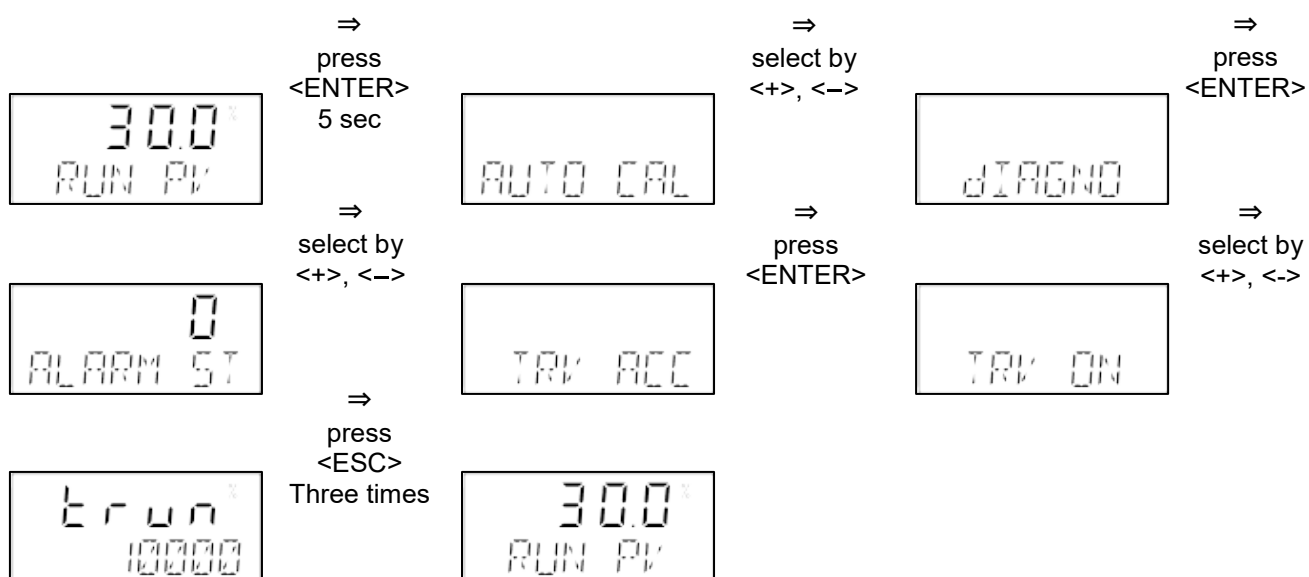
The unit is shown as % of the rated travel.

Alarms will be indicated when the value exceeds the threshold (%) set by the user.

Example of changing “TRV ACC” (Turn on the measurement function)

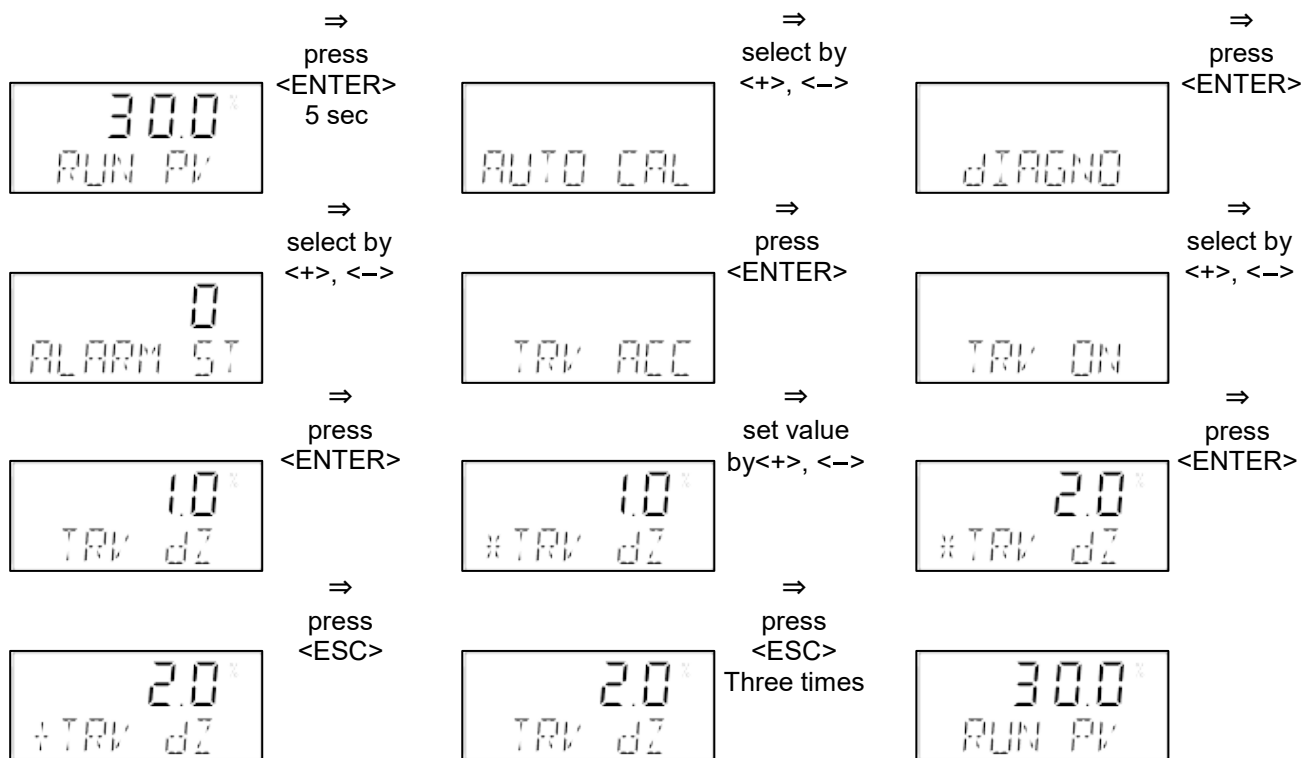


Example of check “TRV ACC” (Check travel accumulation)

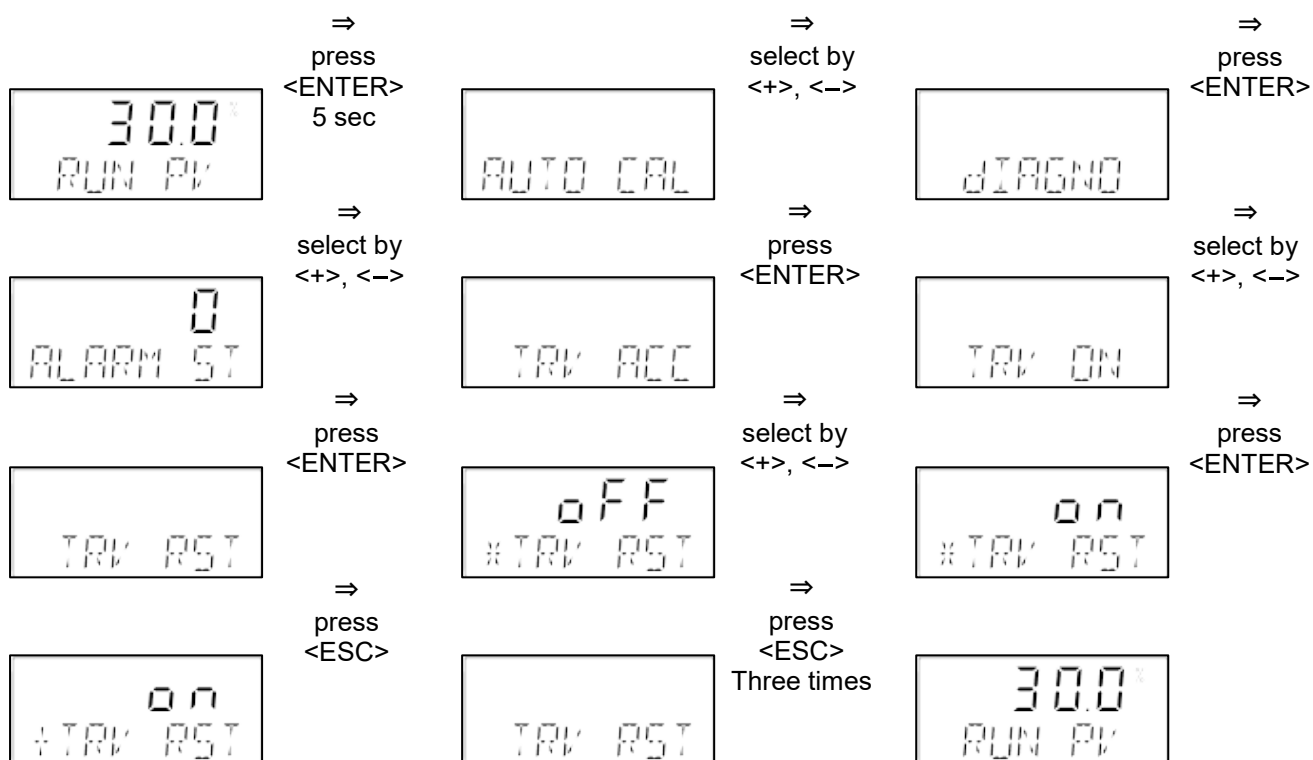


Example of changing "TRV ACC" (Change dead zone from 1% to 2%)

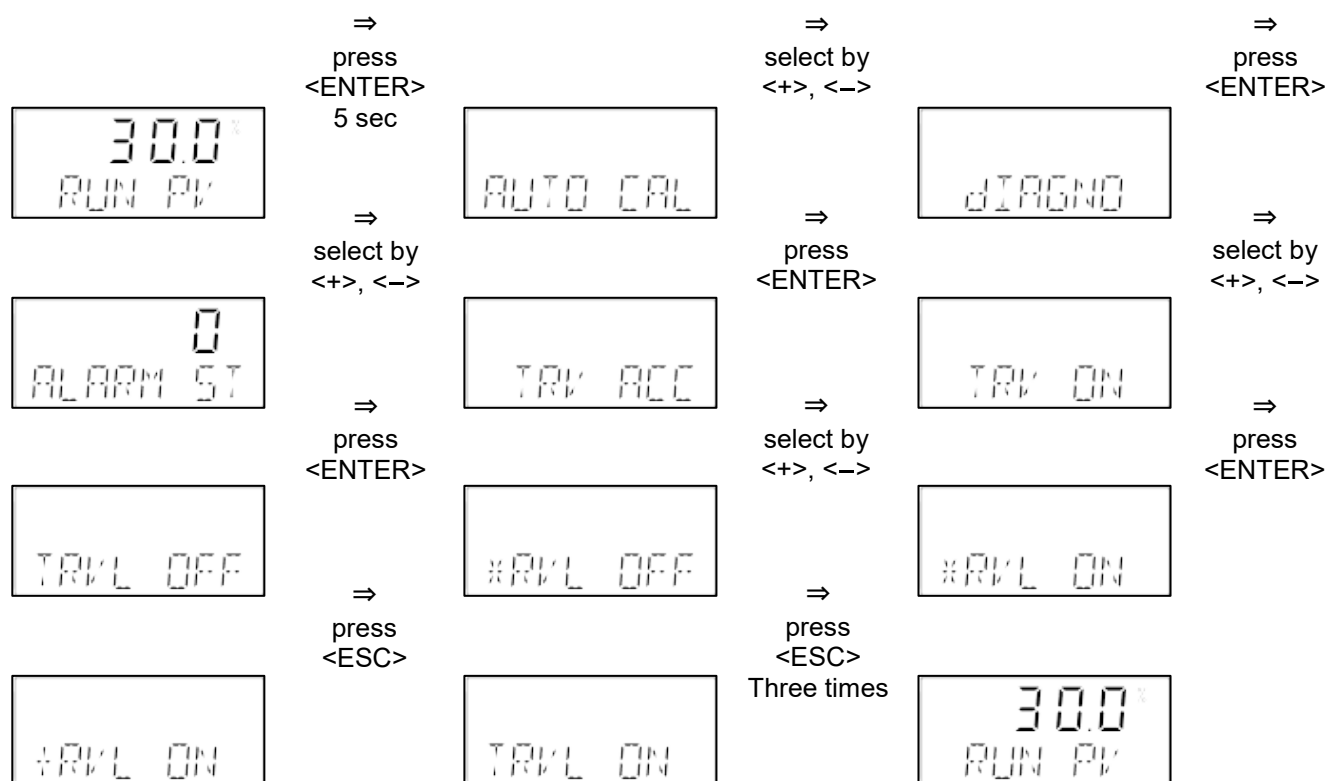
Travel within the dead zone is not accumulated.



Example of changing "TRV ACC" (Reset measured value)

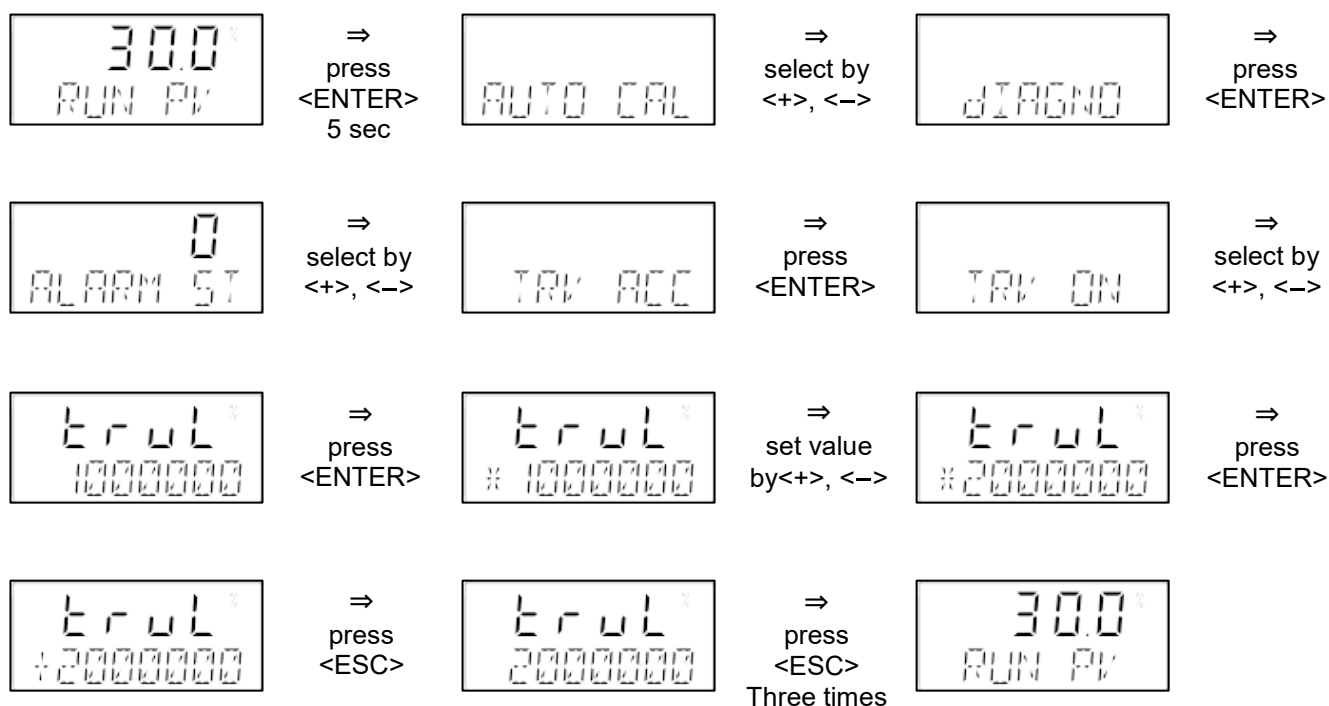


Example of changing "TRV ACC" (Turn on the alarm function)



Example of changing "TRV ACC" (Change threshold from 1,000,000 to 2,000,000)

Threshold: When CYCL CNT becomes bigger than this value, an alarm is sent.

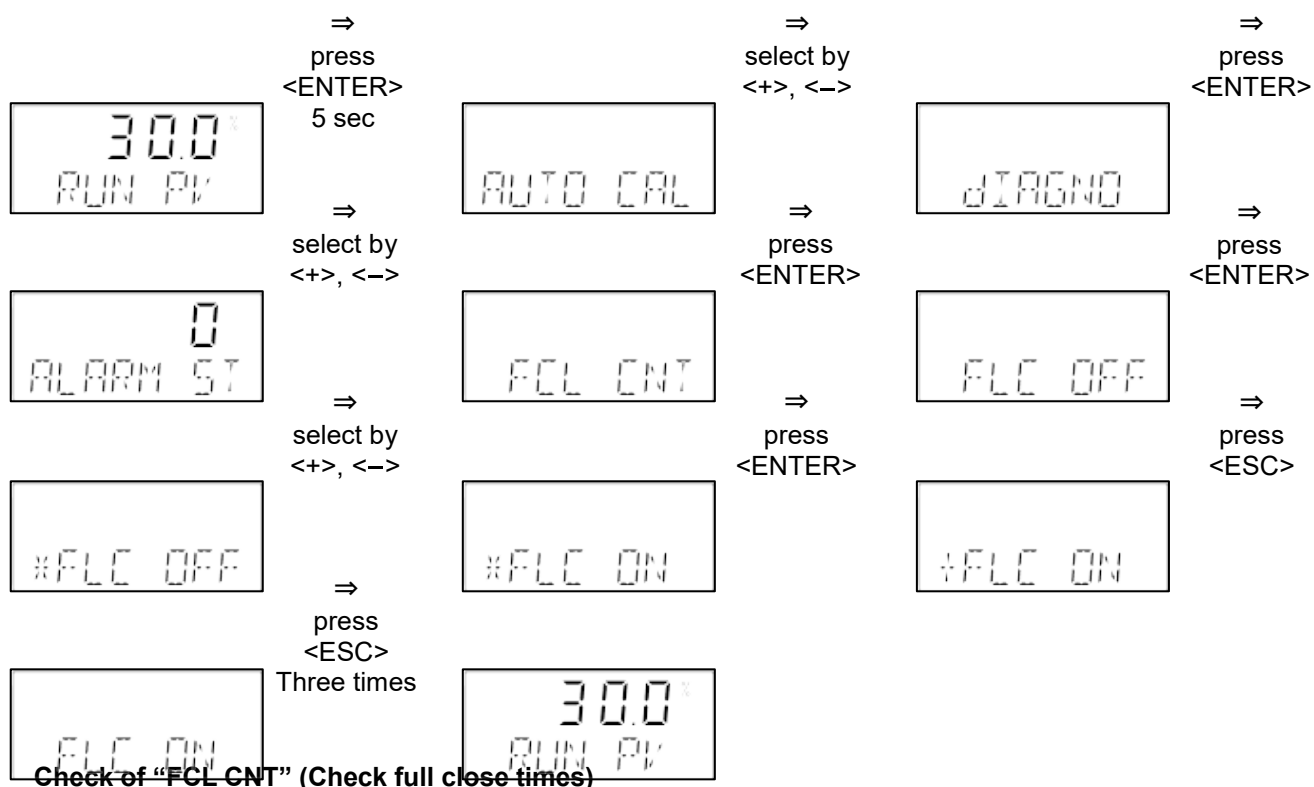


FCL CNT (Full Close Count)

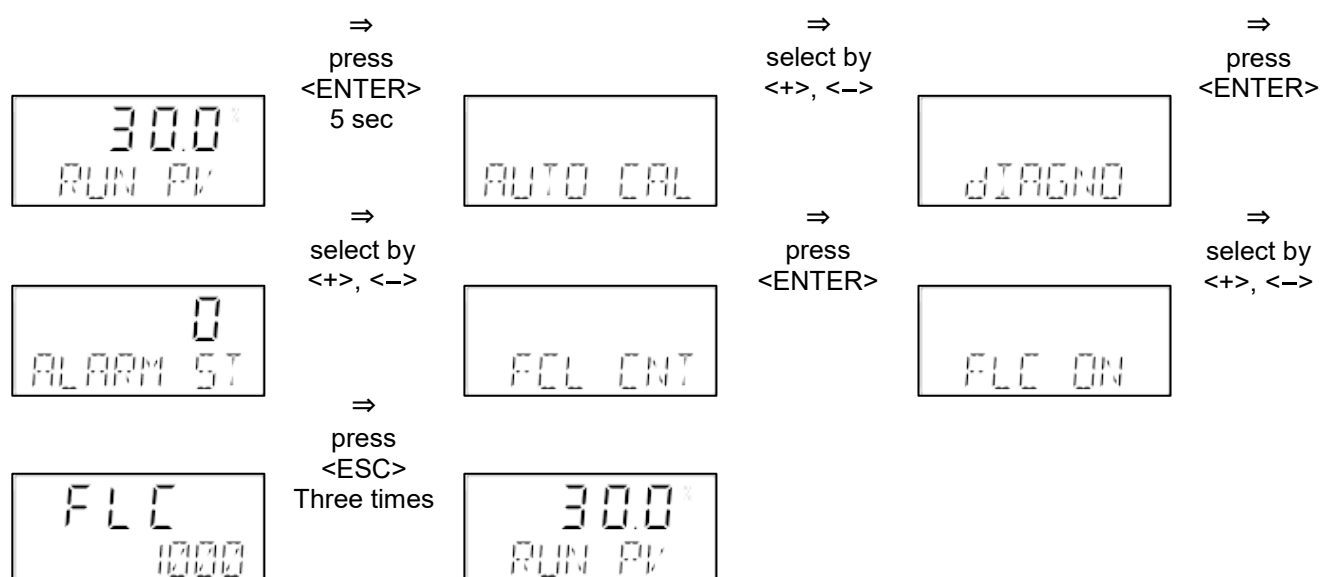
Total accumulated number of times that the valve fully closed.

Alarms will be indicated when the value exceeds the number set by the user.

Example of changing “FCL CNT” (Turn on the measurement function)

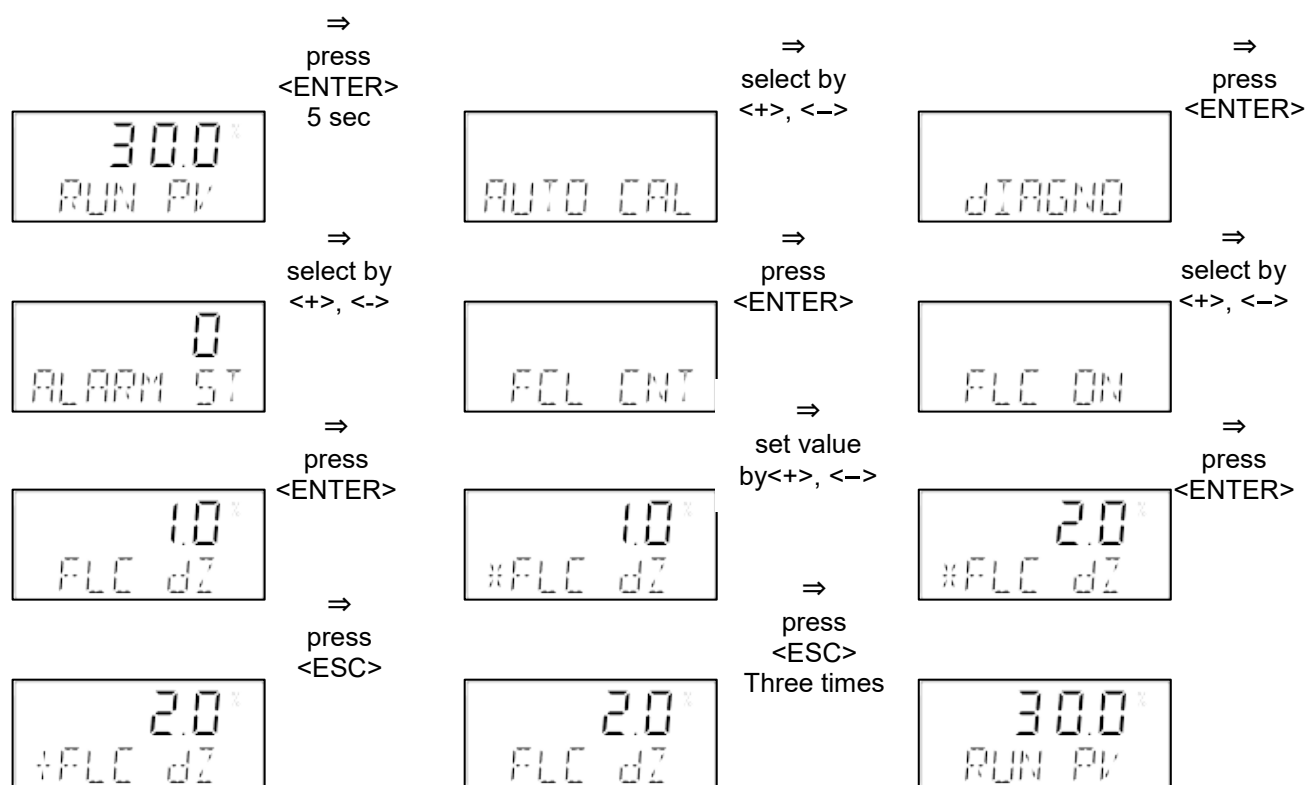


~~Check of "FCL CNT" (Check full close times)~~

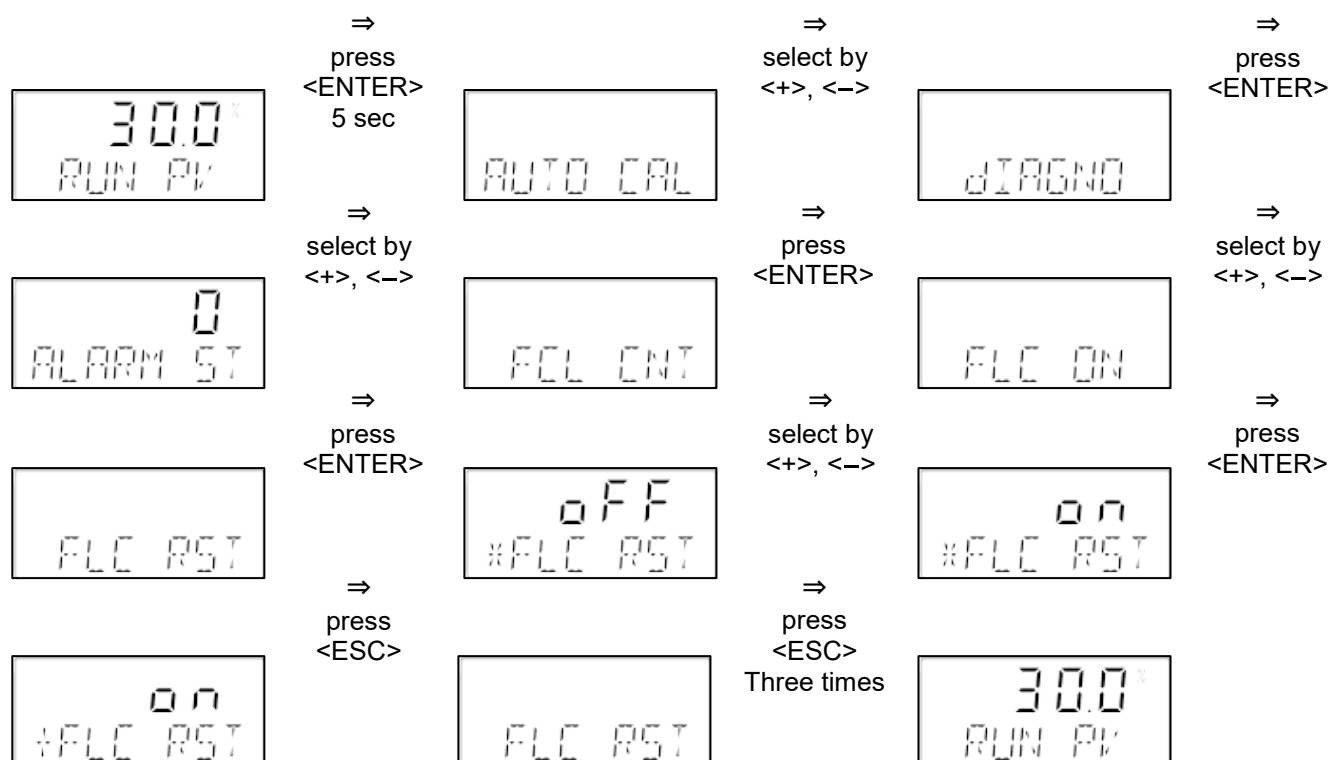


Example of changing “FCL CNT” (Change dead zone from 1% to 2%)

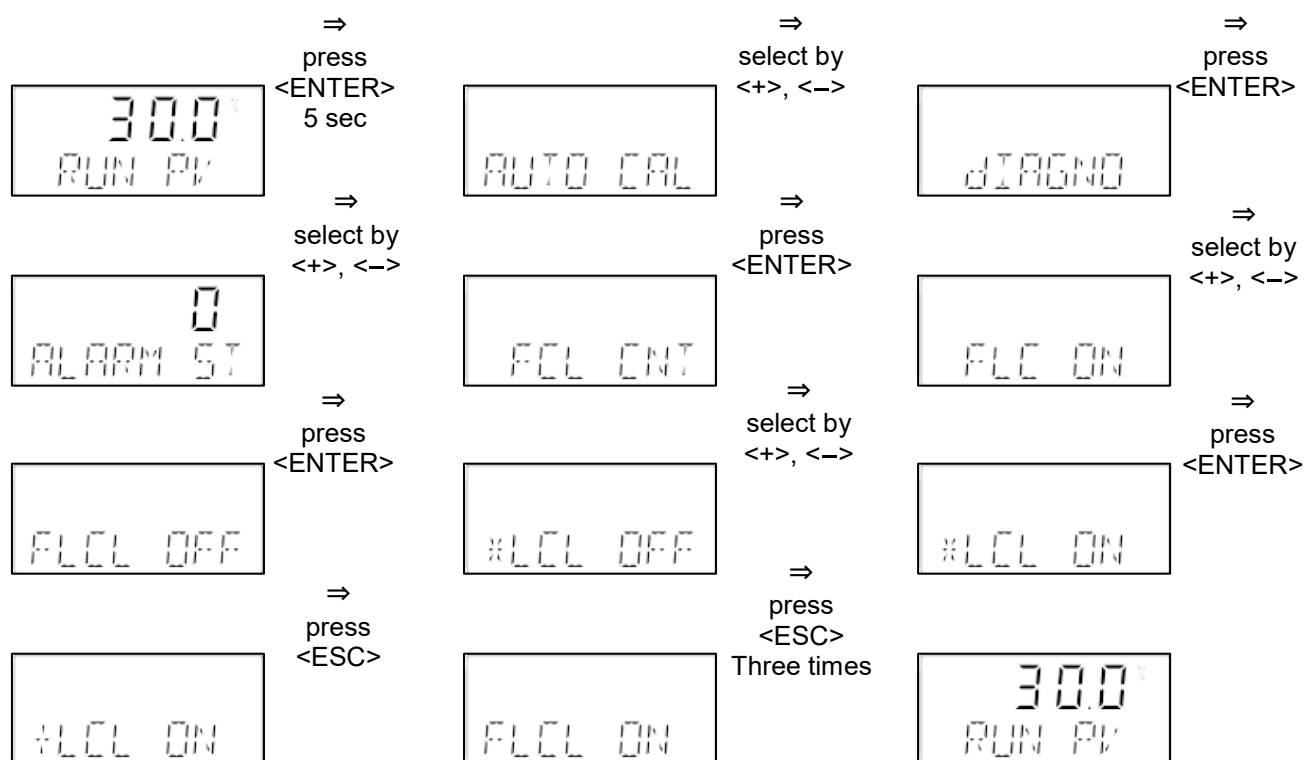
If the valve opening is in the dead zone range, it is judged to be full close.



Example of changing “FCL CNT” (Reset measured value)

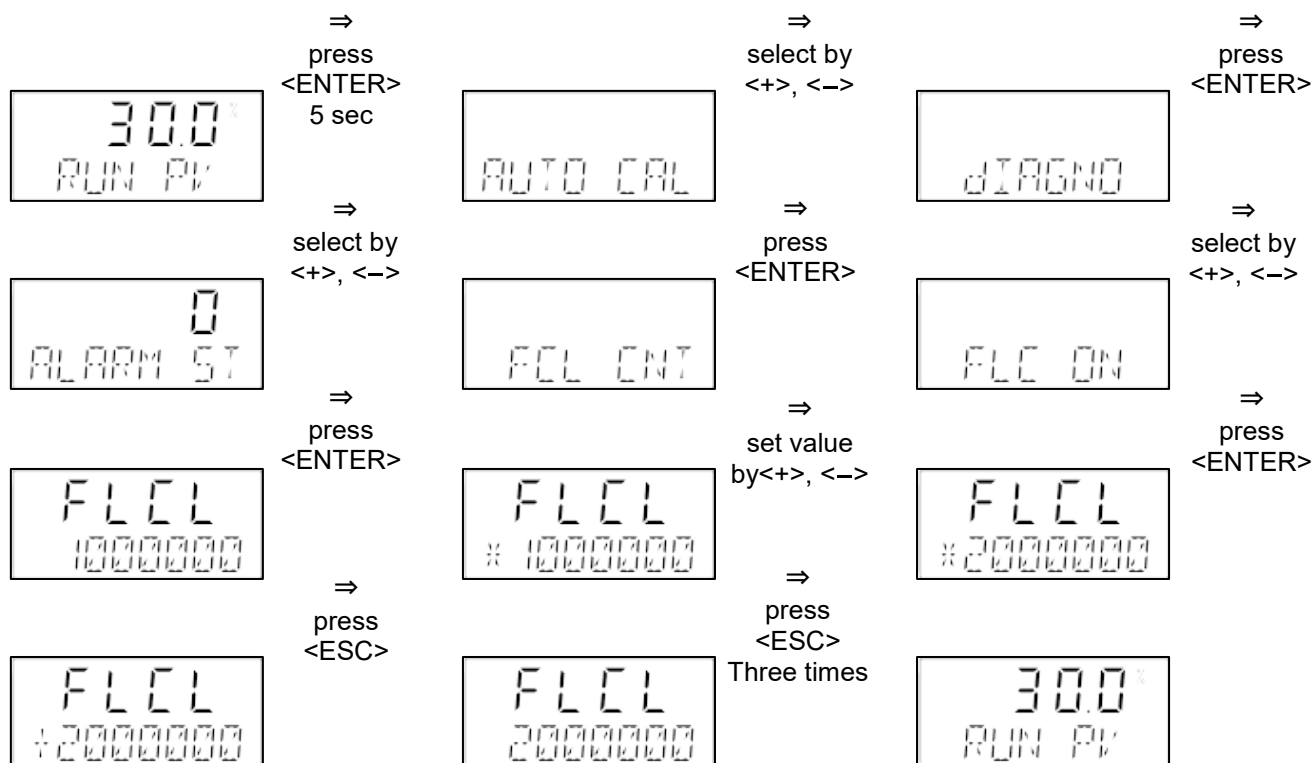


Example of changing “FCL CNT” (Turn on the alarm function)



Example of changing “FCL CNT” (Change threshold from 1,000,000 to 2,000,000)

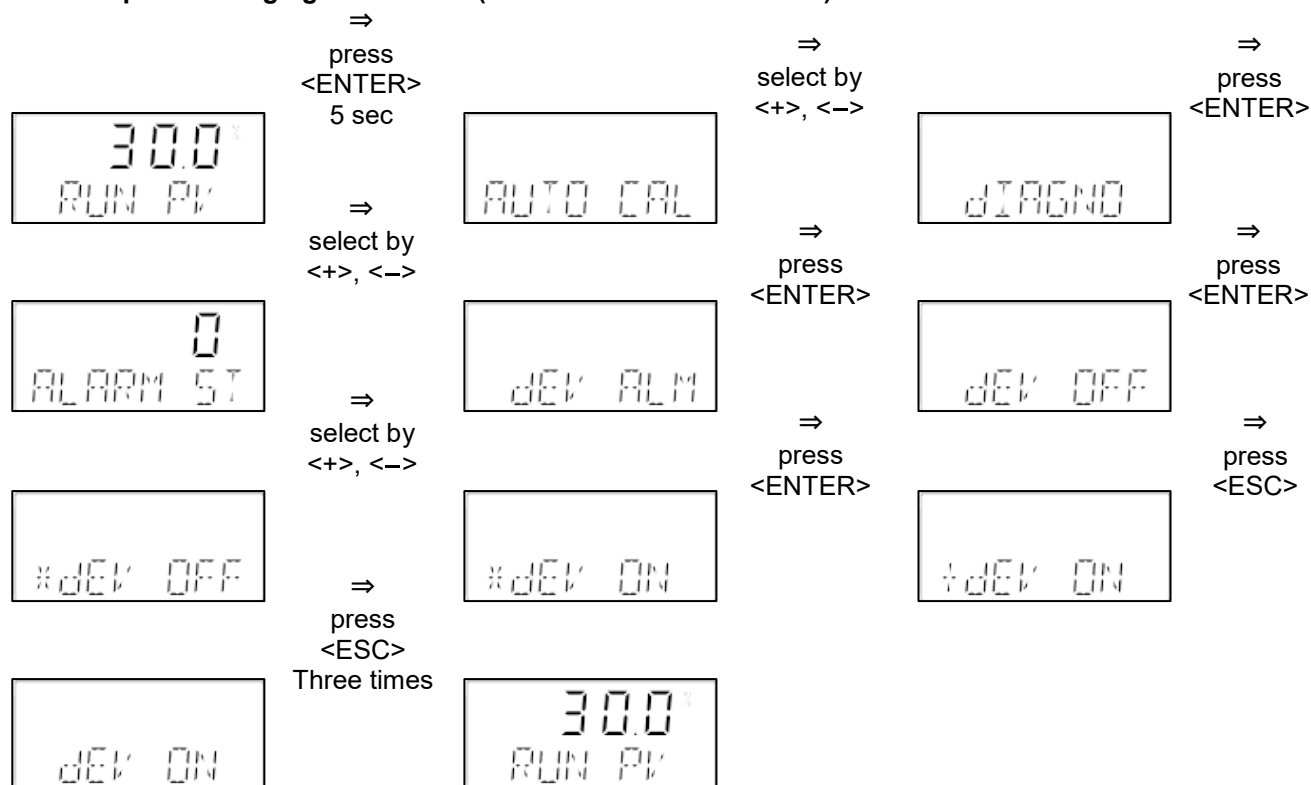
Threshold: When CYCL CNT becomes bigger than this value, an alarm is sent.



DEV ALM (Deviation Alarm)

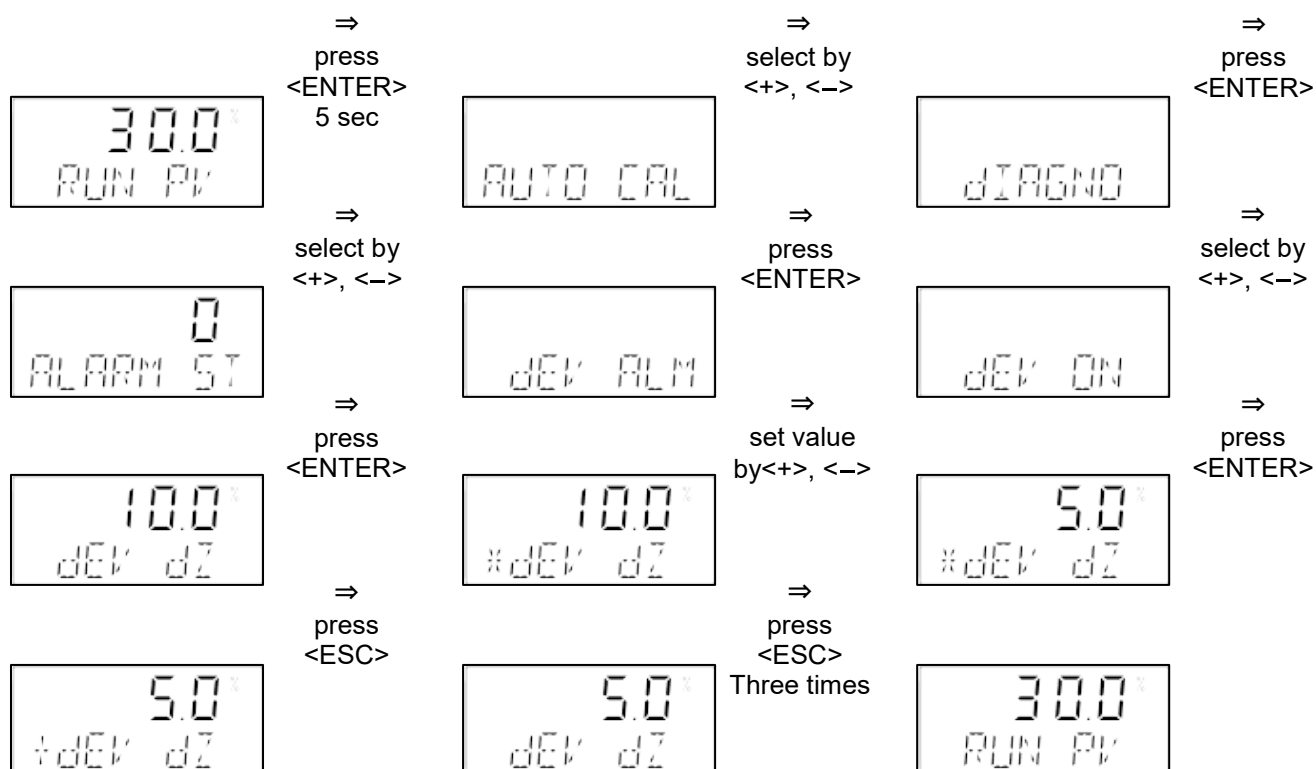
Alarms will be indicated when the deviation between input signal (%) and valve travel (%) exceeds the pre-set value for the pre-set time.

Example of changing “DEV ALM” (Turn on the alarm function)



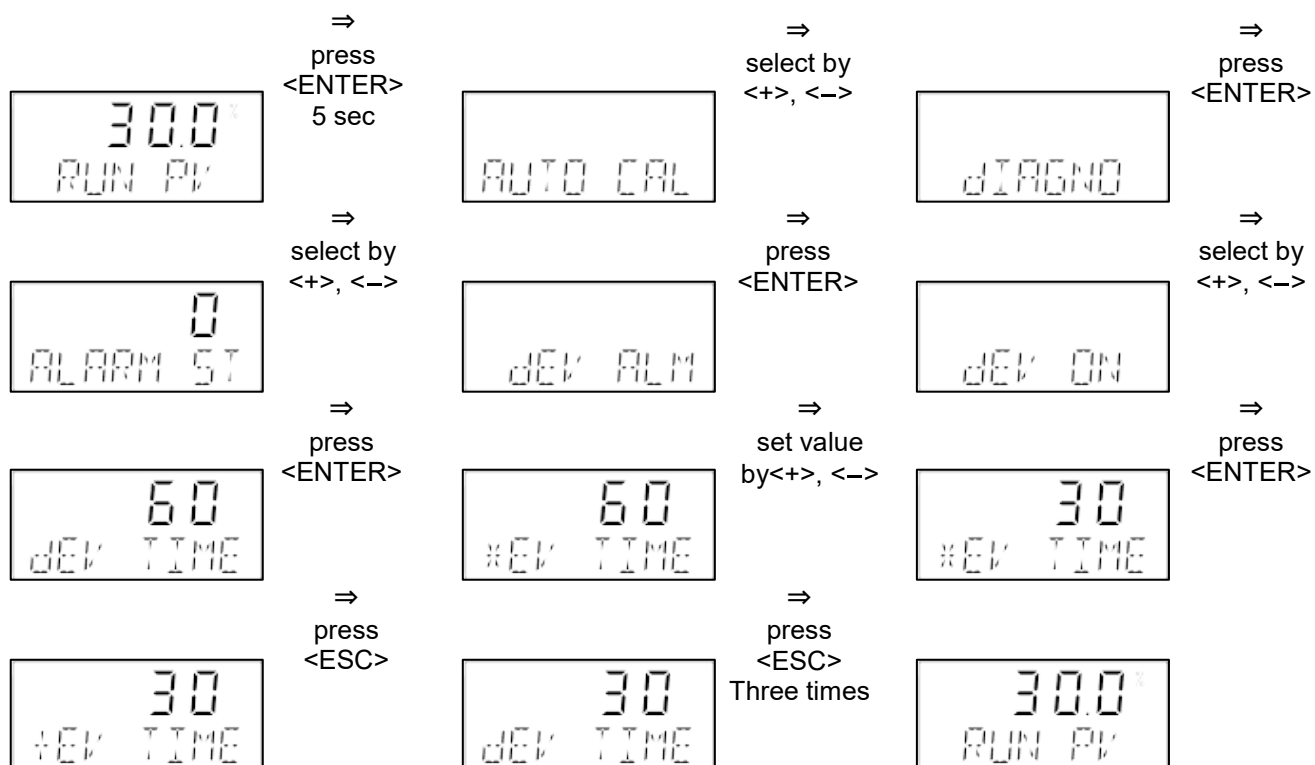
Example of changing “DEV ALM” (Change threshold from 10% to 5%)

Threshold: When the deviation becomes bigger than this value for the pre-set time, an alarm is sent.



Example of changing “DEV ALM” (Change time from 60s to 30s)

Time: When the condition that the deviation is bigger than the threshold continues longer than this time, an alarm is sent.



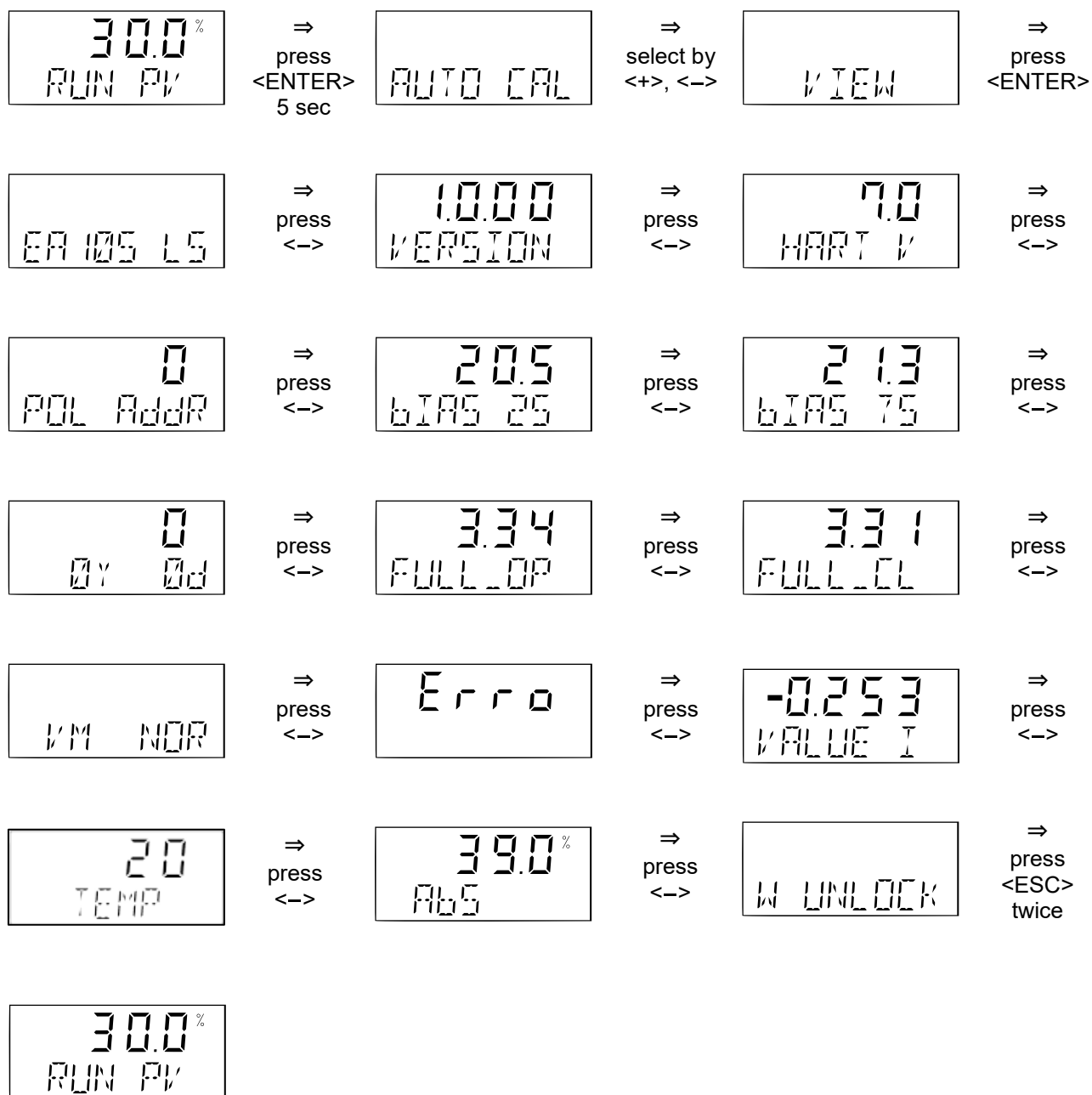
6.12. VIEW

Information inside positioner can be viewed under this menu.

Following information can be confirmed under VIEW menu.

EA10S : Model number of this product
VERSION : Version of software
HART V : Version of HART[®] protocol
POL ADDR : HART[®] address
BIAS 25 : Bias value
BIAS 75 : Bias value
0Y 0D : Operation time length after input of power
FULL OP : Operation time of control valve (full close to full open)
FULL CL : Operation time of control valve (full open to full close)
VM NOR : Monitor setting (normal)
ERRO : Error indication
VALUE I : Current integration value inside
TEMP : Temperature inside the positioner
ABS : Current location of position sensor
W : Status of write protection (locked or unlocked)

Example of display under “VIEW”

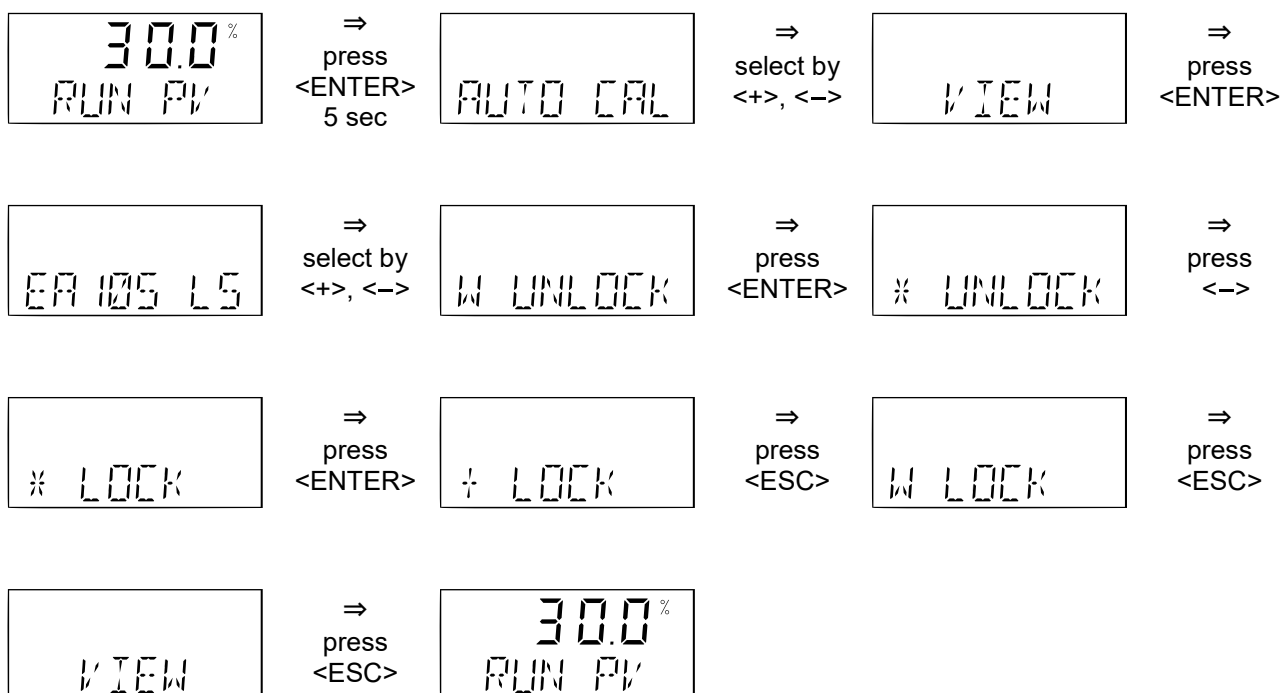


6.13. Write protection

Positioner EA10S is equipped with write protection function to protect information contained inside.

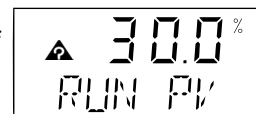
Although normal setting is UNLOCK (no protection), changing status to LOCK (protection) enables prohibition of conducting auto calibration or changing parameters.

Example of changing writes protection



6.14. Error and warning code

 (or ) Mark is indicated on LCD when abnormality is found during operation of this product. In such a case, what the abnormality is can be confirmed by “ERRO” display in VIEW menu.



Error code (ERROR CODE)

Error code is indicated when valve becomes uncontrollable.

Error code	Meaning and cause	Measure
MT ERR L	Positioner is installed in the wrong way. Feedback lever is not located horizontally at 50% input signal.	Positioner should be reinstalled so that feedback lever does not interfere with stopper of positioner at 0% or 100% signal.
MT ERR H	Positioner is installed in the wrong way. Feedback lever is not located horizontally at 50% input signal.	Positioner should be reinstalled so that feedback lever does not interfere with stopper of positioner at 0% or 100% signal.
CHK AIR	Valve never moves even though signal for full open is input during auto calibration.	It should be confirmed if air pressure is properly supplied.
RNG ERR	Operation angle of feedback lever is too small due to wrong installation.	Operation angle of feedback lever should be increased by adjusting fittings.
C	Deviation exceeding 10% continues longer than 1 min. ⇒Valve never moves. ⇒Significant increase of valve friction ⇒Change of regulator setting	BIAS calibration should be conducted. Output pressure of regulator should be reset.
D	I value reaches maximum or minimum limit. ⇒Change of valve friction ⇒Change of regulator setting	Auto calibration should be conducted. Output pressure of regulator should be reset.

Warning code (WARNING CODE)

Warning code is indicated when malfunction or degradation of operation accuracy is expected while the system is controllable.

Warning code	Meaning and cause	Measure
B	Difference (PV Span - PV Zero) is 500 or smaller. ⇒Operation angle of feedback lever is small.	AUTO1 calibration should be conducted after readjusting angle of feedback lever.
F	Time to reach full open or close is within 1 sec. ⇒Actuator size is too small.	⇒Aperture (orifice) should be inserted. ⇒Larger actuator should be installed.
G	Setting of PV is 100 or smaller. ⇒Operation angle of feedback lever is too large.	AUTO1 calibration should be conducted after readjusting angle of feedback lever.
H	Setting of PV is 4000 or larger. ⇒Operation angle of feedback lever is too large.	AUTO1 calibration should be conducted after readjusting angle of feedback lever.

7. Maintenance



Maintenance work which accompanies parts exchange and repair work shall be surely conducted after the positioner is brought to a nonhazardous location.

7.1. Periodic checking

Periodic maintenance and checking will contribute to prevention of nonconformance and increased durable years of this product.

Periodic checking should be conducted referring to the following checklist of periodic checking.

Checklist of periodic checking

* Following items should be checked after confirming there is no damage or abnormality in appearance, rust, air leakage, etc.

Check items		Period of checking (year)		Remark
		1.0	2.0	
Pneumatic part	Pressure gauge		○	Presence of damage, check of accuracy
	Restriction (fixed aperture)	○		Check of clogging and contamination (cleaning, exchange)
	Pilot valve	○		Check of operation (exchange)
	Gasket	○		Exchange the gasket when exchanging the pilot.
Guiding part	Feedback lever		○	Presence of wear
	Connector pin		○	Presence of wear
	Spring to fix pin		○	Presence of wear

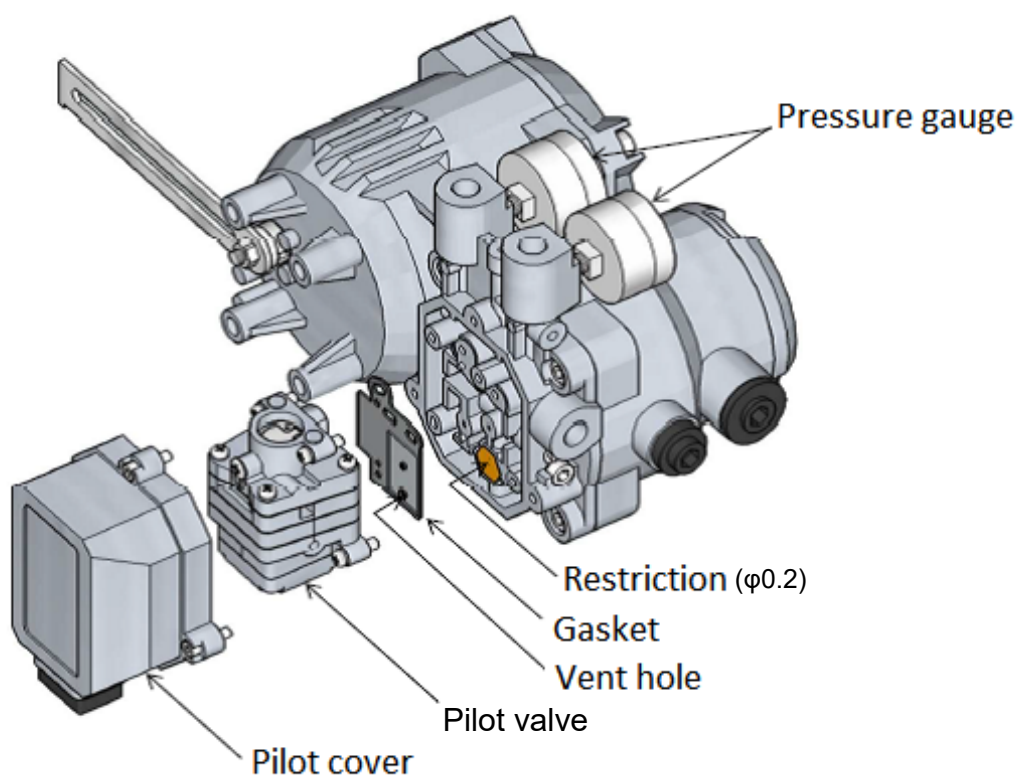
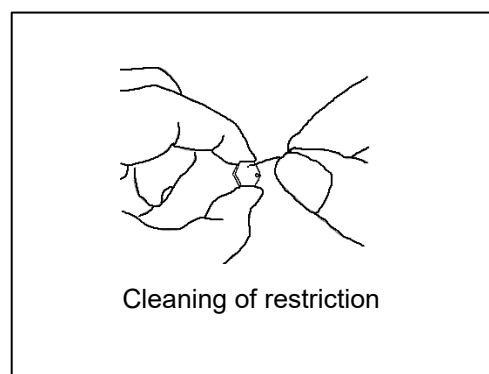
* For filter regulator, periodic blowing of drain (approx. once in half a year) and cleaning of filter (approx. once a year) should be done.

7.2. Maintenance Procedure

Clogging and dirt of the restriction in the positioner might cause failer. Clean the restriction periodically.

- (1) Set supply air pressure at zero.
- (2) Loosen the drain cock of the filtered pressure reducing valve. Then, drain and purge properly.
- (3) Remove the restriction referring to the figure below.
- (4) Clean the restriction by inserting a wire thinner than $\phi 0.2$ mm into the restriction.
- (5) Apply a coating of silicon grease thinly and uniformly when assembling.
- (6) Take reverse procedure when reassembling. Be careful to match the position of $\phi 0.2$ mm hole of the restriction to the vent hole of gasket.

 IMPOTANT	After checking each part, be sure to check by performing the operating test and loop test.
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8. Troubleshooting

Following problems and causes are non-conformances expected to encounter in routine operation.

Take following remedy if the non-conformances are encountered.

Troubleshooting Chart

	Problem	Cause	Corrective Action
Control valve does not operate	LCD does not display anything.	Input signal does not provide normally.	Check that the input signal is 3.8 mA or more.
	LCD does not display anything.	Abnormality in electronic circuit	Please contact our sales office or sales agency.
	Output pressure does not increase.	Supply air does not serve properly.	Check supply air filter regulator. Check air pipe for leakage.
	Output pressure does not increase.	Restriction is clogged.	Check if the restriction is clogged. Clean the restriction to remove clogging.
	Output pressure does not increase. Exhaust noise is loud.	Air piping connection error	Check if incorrect connection between supply air and output air.
	Output pressure does not increase. Exhaust noise is loud.	Abnormality in pilot valve	Replace pilot valve.
	Output air pressure is normal but the valve does not operate.	Abnormality in control valve	Please contact our sales office or sales agency.
	Output air pressure does not change even if the input signal is changed.	Manual switching screw is set to "M" side.	Change to "A" side. (See 1.1.10 Construction)
Control valve does not operate properly	The valve travel cannot be controlled and the valve operates fully open or fully closed.	Abnormality in feedback mechanism	Check if the feedback lever is properly connected.
	Although the input signal is constant, the valve opening changes suddenly.	Abnormality in feedback mechanism	Check if the feedback mechanism's mounting or tightening part is loosened.
	Input signal and valve opening do not match.	Abnormality in feedback mechanism	Check if the feedback mechanism's mounting or tightening part is loosened.
	Input signal and valve opening do not match.	Supply air does not serve properly.	Check supply air filter regulator. Check air pipe for leakage.
	Input signal and valve opening do not match.(Input signal and RUN PV value of the LCD match.)	Zero position is dislocated.	Run auto calibration again.

	Problem	Cause	Corrective Action
Control valve does not operate properly	Input signal and valve opening do not match.(The input signal and the RUN PV value of the LCD do not match.)	Abnormality in control valve or setting data in positioner.	Please contact our sales office or sales agency.
	Hunting occurs	Improper setting of PID parameters	Set the PID parameters again.
	Hunting occurs only at a specific valve opening	Abnormality in position sensor	Please contact our sales office or sales agency.
	Valve operates with sticky motion.	Abnormality in control valve	Please contact our sales office or sales agency.
	Auto calibration not complete.	Abnormality in feedback mechanism	Check if the feedback mechanism's mounting or tightening part is loosened.

※Since the positioner should be installed under several conditions, non-conformance that is difficult to predict might occur. If con-conformance occurs, contact our sales office or sales agency.



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