KGP5000 series

Smart valve positioner

HART Communication Operation Manual

For Text type

Table of Contents

1. Introduction

Please read carefully at first!
This operation manual includes getting information, calibration, maintenance procedures, diagnosis and so on for the KGP5000 series smart valve positioner by HART communication. Read this operation manual and an instruction manual carefully before using the positioner.

Please read this along with the instruction manual for the KGP5000 you are using.

※Please check the instruction manual (CD) included at the time of delivery.

※If you do not know the instruction manual for your device, check the positioner version / electronics version / software version of your device and order the latest version.

Notes regarding this operation manual;

- The user should read and understand this publication.
- The contents of this publication are subject to change without notice to improve specifications.
- The contents of this publication may not be reproduced or duplicated in whole or in part, without prior consent.
- This publication may not be revised so long as changes in structure and specifications have no effect on the operation of the positioner.
- The contents of this publication are described as correct as possible but if anything is unclear or you have any questions, please contact KOSO sales office.

1.1. Scope of this operation manual

This document is compatible with the following versions as below.

KGP5003
Electronics Version : 1.0.0 and more
Software Version : 0.6.1 and more

HART DD
Device Revision : 2 and more
DD Revision : 0 and more

1.2. Safety notices

This document describes safety notices by using warnings and cautions as below. The user should thoroughly review safety notices described in this operation manual prior to installation, operation, maintenance for the positioner.

Warning

Death or severe personal injury can occur if the user fails to keep safety precautions.

Caution

Minor personal injury or property damage, damages or breakdown of the positioner and the system equipped with the positioner can occur if the user fails to keep safety precautions.

It should be noted that this operation manual includes information for only this smart valve positioner. Therefore, it is the responsibility of the user to take into account safety considerations relate to any other installation methods or operation methods except the method provided herein.

1.3. Product summary

KGP5000 series smart valve positioner is a control device mounted on the pneumatic actuator for control valve, which positions a control valve according to a 4 to 20mA signal from a higher-level control system or a control device. Position feedback control system which receives feedback signal mapped to the desired valve travel and compares both input signal and feedback signal enables accurate positioning of a control valve.

In addition, it is possible to use this positioner in order to operate various types of pneumatic actuator such as linear or rotary motion actuators both of single and double acting.

Furthermore, the positioner utilizing digital techniques performs the functions of advanced PID controller, local user interface (LUI) using LCD, diagnosis utilizing sensing techniques with potentiometers and internal pressure sensors. Such features enable an easy installation and calibration, an effective monitoring and an efficient process management relevant to operations and maintenance.

This device can do the work of setting and adjustment by a communication tool of a HART communicator.

1.4. Electrical connections

Warning

- Disconnect the power supply before wiring connections.
- Wiring connections must be done in accordance with national electrical code requirements.
- Avoid wiring connection on wet weather days or in environments are saturated with water. They are liable to electric leakage or damage to the positioner.

Caution

- Close the unused entries for flameproof enclosures with blanking elements to avoid the intrusion of humidity, dust, etc.
- The entries shall be sealed with sealants to avoid the intrusion of water or rain
- Earthing and bonding conductor shall be connected by terminal lugs (Tinning copper).
- Earthing or bonding conductor shall be firmly connected by using screws with captive spring lock washer(M4) provided on the positioner in such a way to prevent loosening and twisting.
- When using the flame proof type, a conductor with a cross-sectional area of at least 1mm^2 shall be used for internal earthing.
- When using the flame proof type, a conductor with a cross-sectional area of at least 4mm^2 shall be used for external bonding.
- Check the specifications of cable glands and blanking elements to make sure to use only suitable Ex certificated cable glands and blanking elements. See Table 1.4a shows the suitable Ex certificated cable glands and blanking elements for each proof type.

Figure of the wiring connections and terminals is shown as below.

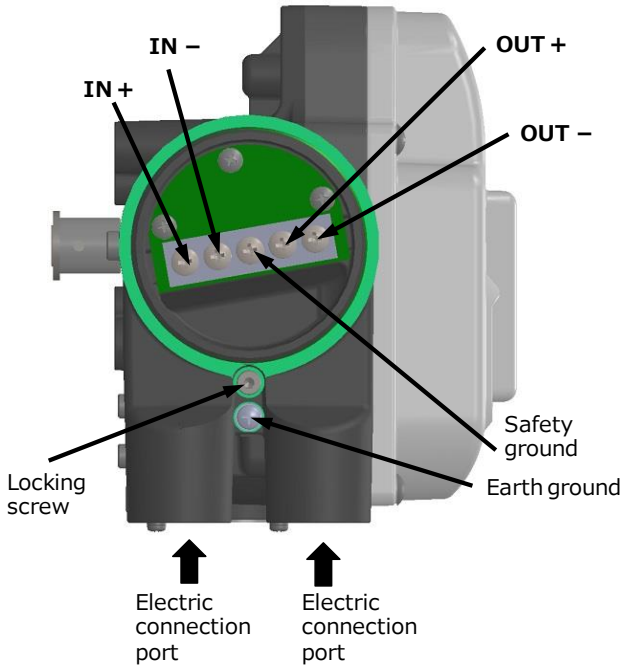


Figure 1.4a Wiring connections and terminals

The positioner uses a 4-20mA loop current and the HART communication is carried out through the digital signal which is superposed on this loop current.

Make wiring connections according to the following procedure.

1. Remove the terminal cover.
2. Then, draw cables of the facilities inside the terminal box. Use cable glands which are rated for the environment of installation and are in accordance with electrical codes which apply to the application. Since screw thread types of electrical connections may vary with specifications, make wiring connections after confirming specifications.
3. Connect cables of loop current, respectively, to IN+ and IN- of the positioner.
4. Connect cables of position transmitter, respectively, to OUT+ and OUT- of the positioner.
5. As illustrated in figure 1.4a, two ground terminals of a safety ground and earth ground are available. The safety ground and earth ground are electrically identical. Make wiring connections according to local electrical codes which apply to the application.
6. Replace the terminal cover.
7. Turn the cover locking screw counterclockwise to fix the terminal cover.

Field wiring diagram is shown in figure 1.4b.

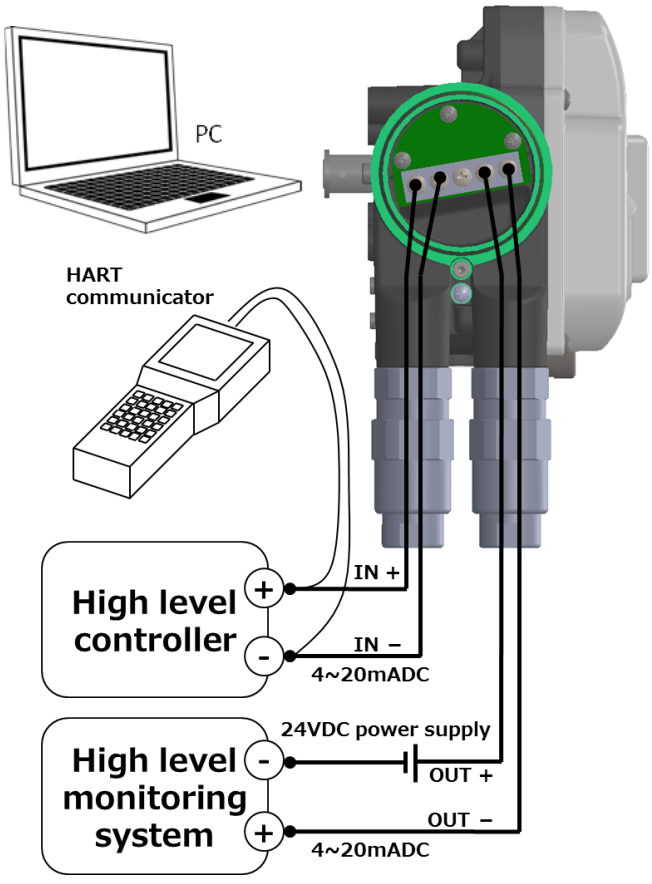


Figure 1.4b Field wiring diagram

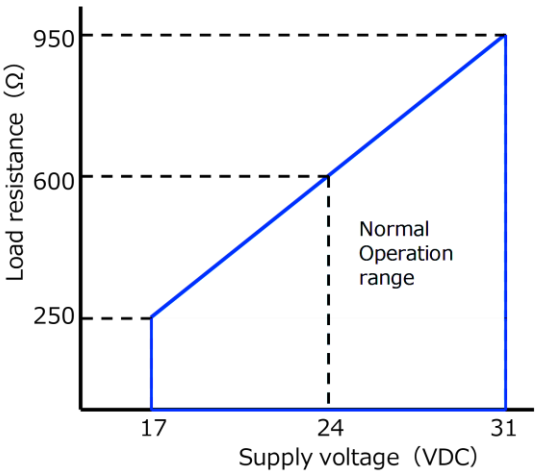


Figure 1.4c Load resistance to supply voltage relationship via the connection of position transmitter

Supply power to the positioner according to the load resistance. It should be noted that the supply power must not be exceed 40VDC.

Table 1.4 The suitable Ex certificated cable glands and blanking elements for each proof type

Proof type	Thread form of entries	Certification	Rated ambient temperature range	Service temperature range
TIIS	G1/2	Ex d IIC Gb	-20℃～+60℃	-20℃～+63℃
CCC(NEPSI)	1/2NPT	Ex d IIC Gb	-40℃～+70℃	-40℃～+73℃
KOSHA	1/2NPT	Ex d IIC	-20℃～+60℃	-20℃～+63℃
IECEx	1/2NPT or M20X1.5	Ex db IIC Gb	-40℃～+70℃	-40℃～+72℃
ATEX	1/2NPT or M20X1.5	II 2 G Ex db IIC Gb	-40℃～+70℃	-40℃～+72℃

SETUP AND INFORMATION

Warning

- Changes in parameters and so on owing to setup procedure may cause unexpected movements of the valve. Perform the setup in the conditions such as offline state which does not directly affect the process.
- Don't remove the terminal cover of the positioner during or after the passage of electric current. In case the terminal cover must be opened reluctantly, perform that after confirming that flammable, explosive gases are not present and the environment is not saturated with water or steam.
- Don't touch the moving parts during the setup procedure. It causes personal injury.
- **Keep away from a magnet material or a magnetic-tripped screwdriver.** It unexpectedly moves the control valve so that it may cause a serious damage.
- Don't use a wireless transceiver near the positioner.

1.5. Preparation for HART communication

A personal computer or communicator and a HART modem are required to acquire the information of this unit via HART communication and perform installation / setting work, maintenance, alarm setting / diagnosis. In addition, the HART modem driver and device description (DD) for KGP5000 communication must be installed on the PC.

※If you want to download and install DD to a communicator, please check with the communicator manufacturer.

※Please check with each manufacturer for the installation of the HART modem driver and management software.

※If the communicator uses the GUI type, refer to *OME-KGP5HG-01B_KGP5000 _HART GUI type Manual_EN* .

The procedure for connecting to a PC and downloading / installing DD is shown below.

1) Download DD for HART communication.
The DD for HART communication can be downloaded from the following FieldComm Group website.
You can also use the DD from the CD that was included when you purchased this unit.

Download to PC:

① Enter KGP5000 in the Search by Product Name section of the URL:
URL:https://www.fieldcommgroup.org/registered-products Search.

② Select the KGP5000 page and select [2] for DD VERSION.

③ Click EDD Download to start the download and save hart.0000cf.cf83.zip to any location.

④ Unzip the downloaded hart.0000cf.cf83.zip.

2) Installation of DD for HART communication.
The following shows the case where the application SDC625 is used as an example. For other, please check the instruction manual of the management software you are using.

Installation procedure on PC:

① Download to PC Save 0000cf of hart.0000cf.cf83 described in ④ to the folder of C: ¥ HCF ¥ DDL ¥ Library on your PC and complete the installation.

② When SDC625 is started, HART communication with this unit becomes possible.

The data saved in the 0000cf folder is as follows. Software Ver. The data corresponding to this unit is available. (DD in 0083 folder is a HART6 file)

Folder name：**cf83 ※In the case of HART7**
For software up to Ver 0.4.9 DD(Two files)
0103.fm8
0103.sym

For software Ver0.6.1 or later DD(Two files)
0200.fm8Two files
0200.sym

Folder name：0083 **※In the case of HART6**
For software up to Ver 0.4.9 DD(Two files)
0103.fm6
0103.sym

For software Ver0.6.1 or later DD(Two files)
0200.fm6
0200.sym

3) Connection

According to section 1.4, connect the IN+ and IN- of this device to a communication tool. For example HART communicator or a terminal of host controller.

2. Menu tree on the HART communication

2.1. Menu type

This document describes the text type DD.

- If you are using a GUI type communicator, refer to *OME-KGP5HG-01B_KGP5000_HART GUI type Manual_EN*.
- The menu types that correspond to GUI type menus and text type menus depend on the management software.
  For details, see the instruction manual of the management software you are using.
- Both GUI-type and text-type menus are available on the PC.

※ Menu ①②③ is a menu of management software set by GUI type.
Please refer to *OME-KGP5HG-01B_KGP5000 _HART GUI type Manual_EN* separately.

①Process Variables
②Device
③Diagnosis

※Menu ④ is a menu of management software set by text type.

④Root menu

Figure 2a menu type

2.2. Menu tree

Root Menu

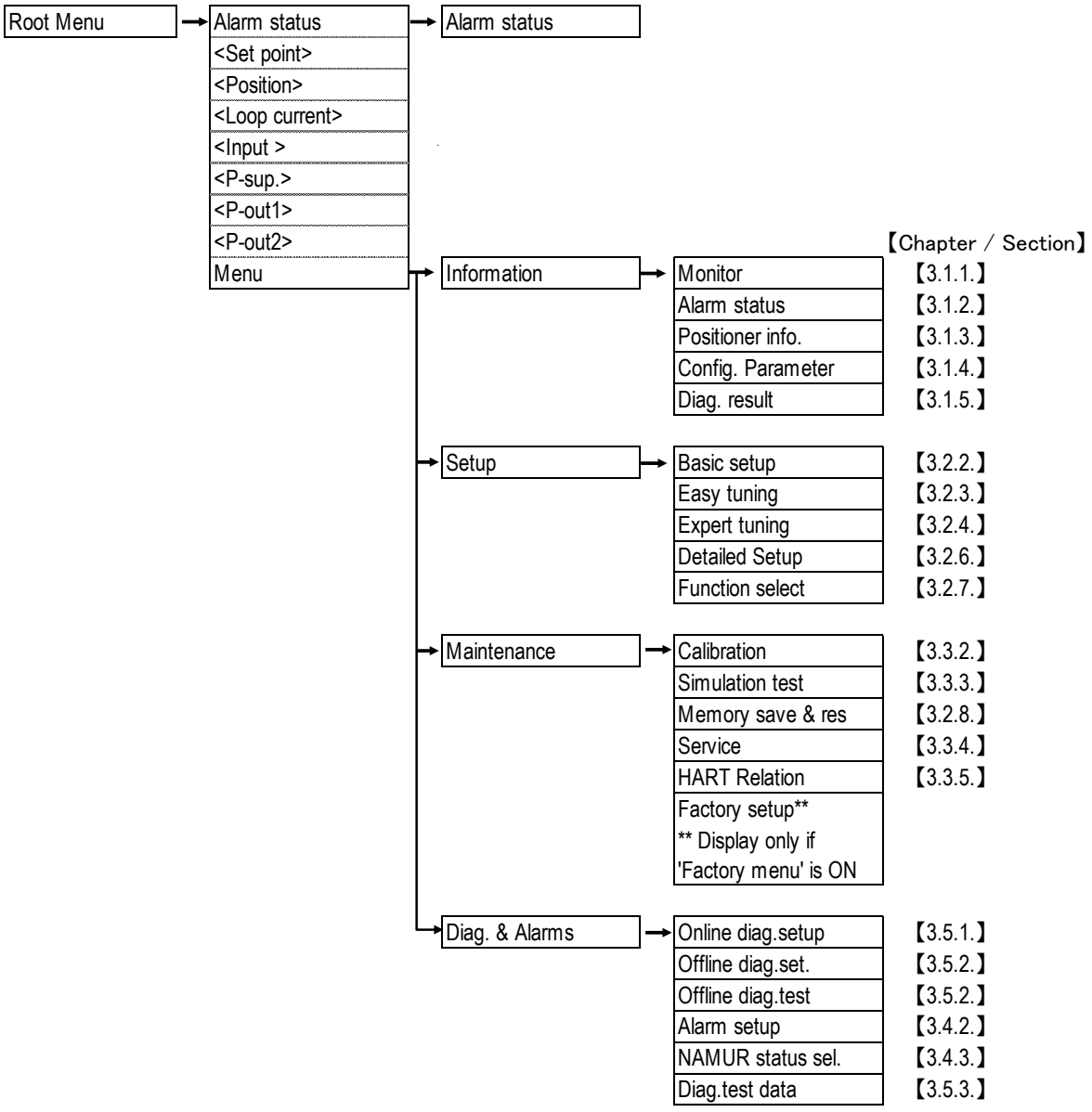


Figure 2b Root Menu

3. Root menu

Instructions for information obtaining, setting, maintaining, alerting, and diagnosing are provided with reference to SDC625.

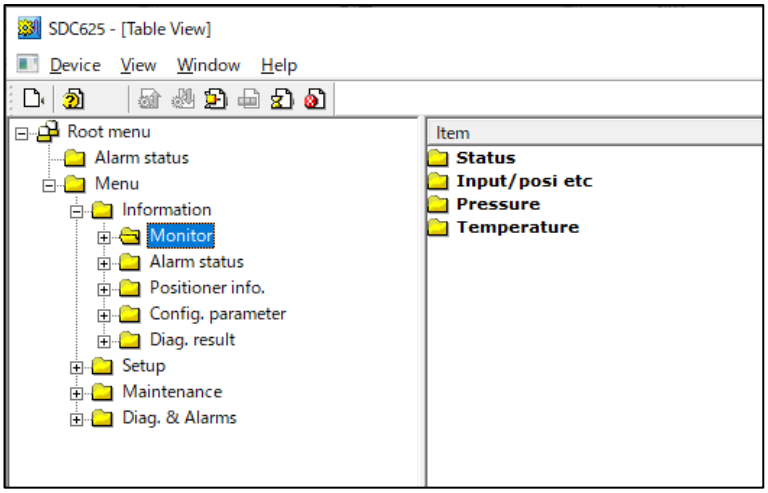
Left-click the menu tree displayed on the left side of the screen with the mouse to display selectable menus.
Select the displayed menu to display the screen for checking the status of the positioner, setting, adjusting, and diagnosing.
In addition, each item selected in the menu tree is displayed on the right side of the screen.
By left-clicking an item, you can conduct checking, setting, adjusting, diagnosing, etc. according to the selected menu item.

3.1. Information

3.1.1. Monitor

The operator can confirm the current status of the positioner.

MENU > Information > Monitor

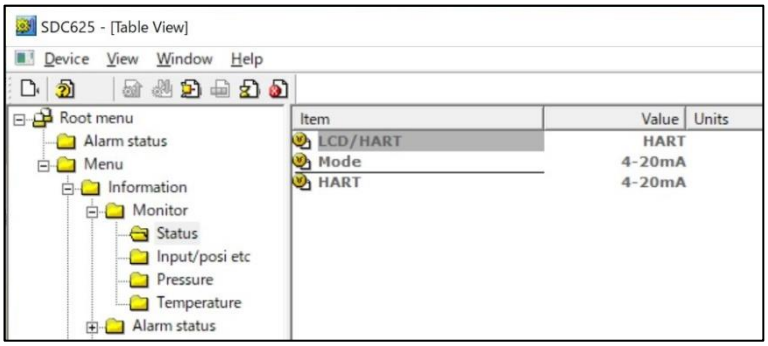


Menu items:
- Status
- Input/posi etc
- Pressure
- Temperature

3.1.1.1. Status

The operator can confirm the current authority and control mode status of the positioner.

MENU > Information > Monitor >Status



LCD/HART：Access authority

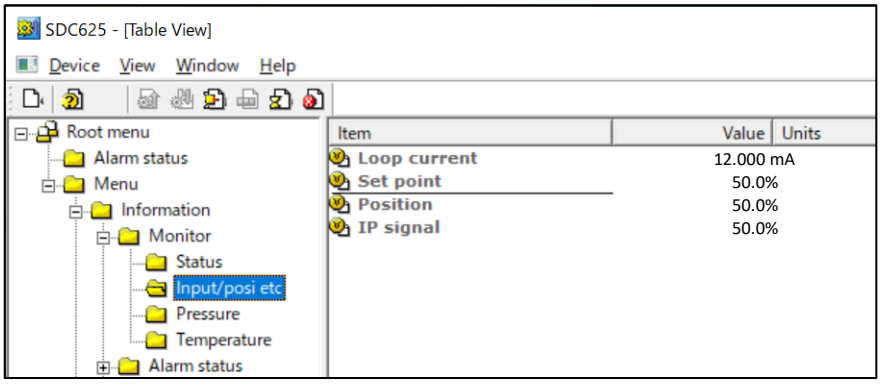
MODE：Mode on LUI(LCD) access

HART：Mode on HART access

3.1.1.2. Input signal/position etc,

The operator can confirm operating status of the positioner such as input signal, set point, valve position, IP signal.

MENU > Information > Monitor > Input / posi etc

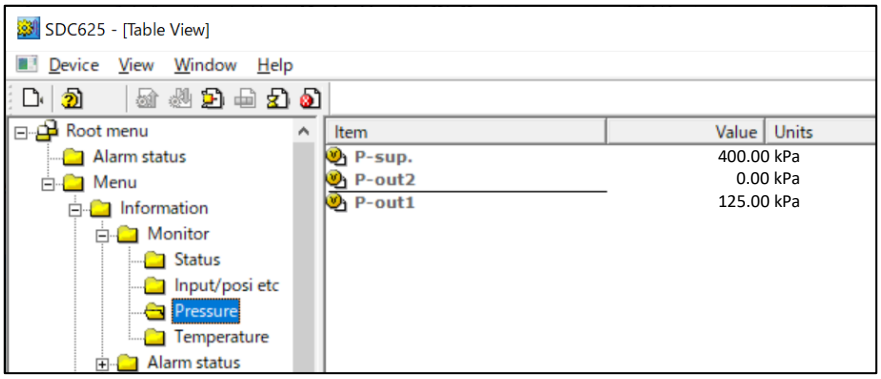


Loop current ：Loop current
Set point ：Set point
Position ：Valve position
IP signal ：IP signal current

3.1.1.3. Pressure

The operator can confirm the values of the current pressure.

MENU > Information > Monitor > Pressure

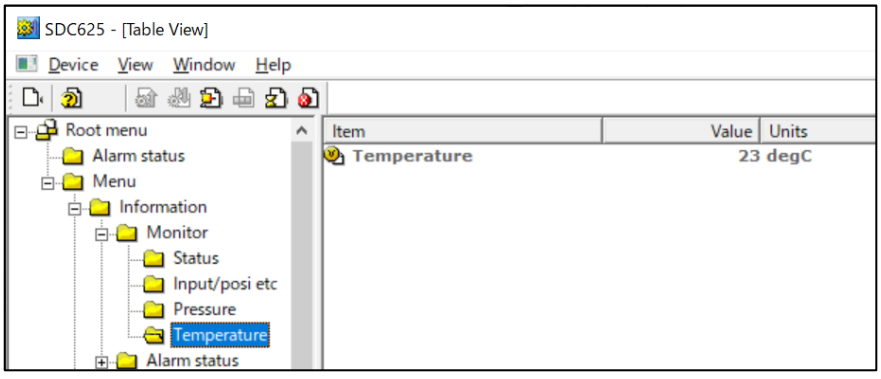


P-sup.：Supply pressure
P-out1：Output pressure 1
P-out2：Output pressure 2

3.1.1.4. Temperature

The operator can confirm the value of the current temperature inside the positioner.

MENU > Information > Monitor > Temperature



Temperature：Internal temperature

3.1.2. Alarm status

The operator can confirm the alarm status as below.

MENU > Information >Alarm status

- Position alarm
- Deviation alarm
- Temperature alarm
- S-pressure alarm
- Other failure※
- PST alarm

※For other failures, you can check the alarm status of the memory, angle sensor, and pressure sensor.

3.1.3. Positioner information

The operator can confirm the positioner information as below.

MENU > Information > Positioner info.

- Serial number
- Universal rev
- Manufactured date
- Version (Positioner, Electronics, Software)

3.1.4. Configuration parameter

The operator can confirm the configuration parameter information as below.

MENU > Information > Config. parameter

- Valve action
- Packing friction
- Booster option
- Set point direction
- Range ability
- PT burnout dir.
- Transfer function
- Position transmitter direction
- Actuator setup
- PID parameter set
- Cutoff or Limit
- Dead band
- Input damper
- Split range

3.1.5. Diagnosis results

The operator can confirm the configuration parameter information as below.

MENU > Information > Diag. result

- Total stroke
- Total dir. change
- Low position time
- Total time
- 25% step response test
- Pneumatic span
- PST setup info
- Pneumatic drift
- S-valve signature

3.2. Setup

3.2.1. Authority for setup and operation via HART communication

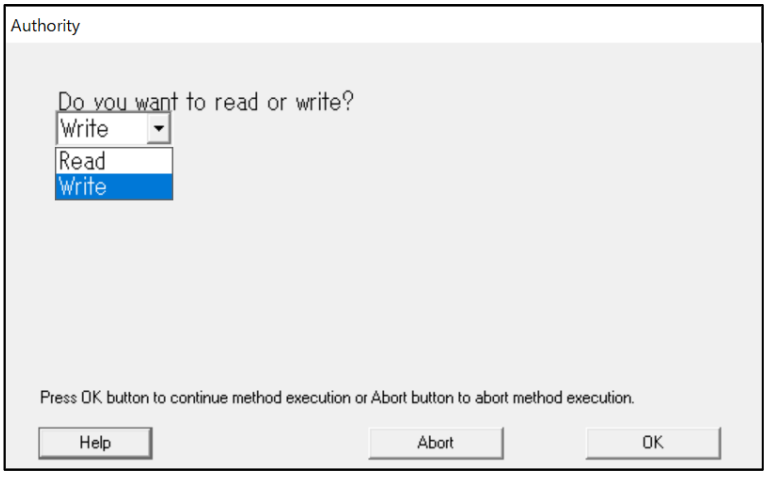
To change setting via HART communication, 'Authority' should be HART.
To do operations via HART communication, e.g. autotune, calibration and offline diagnosis, 'Control mode' of authority should be 'HART'.

3.2.1.1. Authority

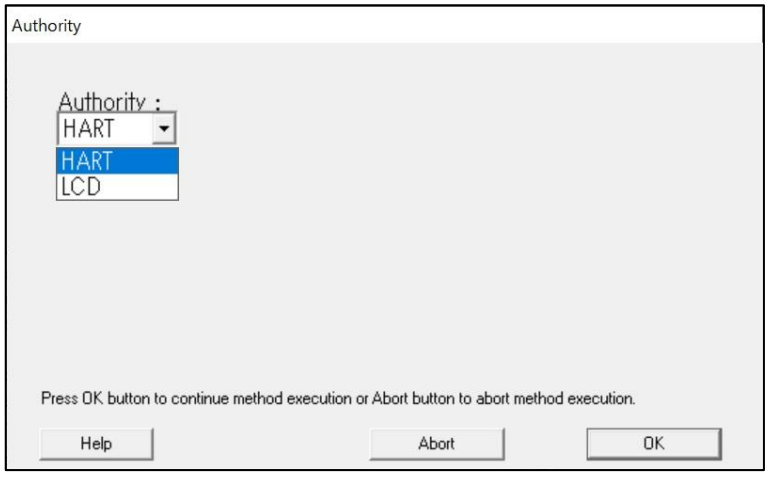
To change permissions to HART, the LUI (LCD) screen must be the top menu, alarm status menu, or info menu.

The procedure for changing is as follows.

MENU > Setup >Function select>Authority>Authority



① Select 'Write' and press 'OK'.

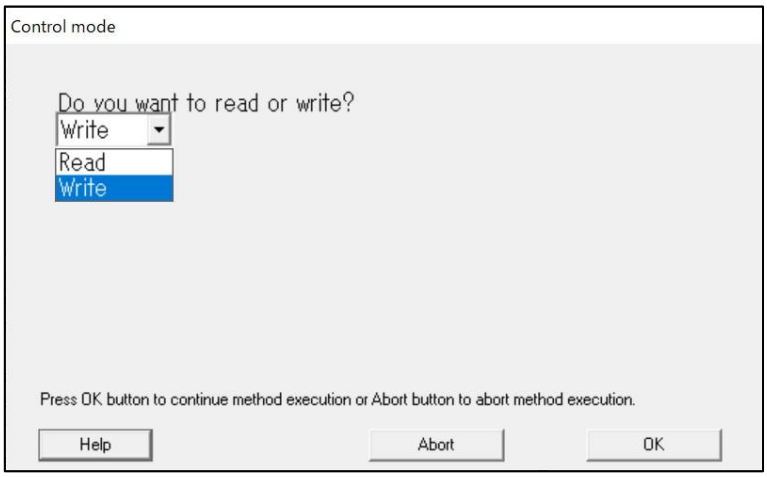


② Select 'HART' and press 'OK' to set.

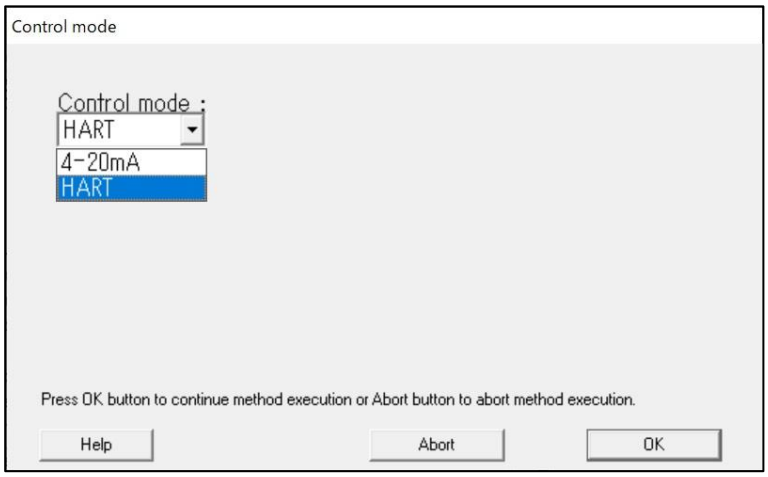
※When 'HART' is selected, only 'Information' in the TOP menu can be accessed from the LUI.

3.2.1.2. Control mode permissions

MENU > Setup >Function select>Authority>Control mode



① Select 'Write' and press 'OK'.



② Select 'HART' and press 'OK' to set.

※When conduct operation with a 4-20mA input signal, select 4-20mA.

3.2.2. Basic setup

Set the basic items required for control with the positioner. Be sure to do this before performing the tasks in the next section.

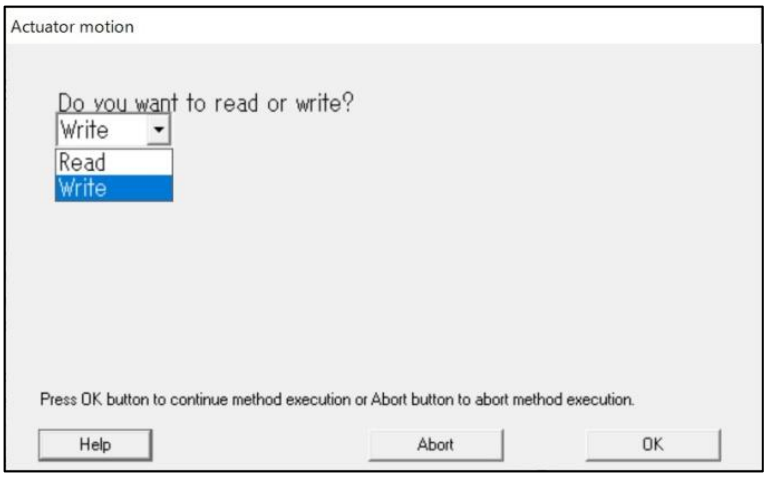
Table 3.2.2 Basic setup parameters

Key menu	Description	Parameters	Default
Actuator motion	Set stem motion type of a actuator	Linear / Rotary	※1
Actuator type	Set acting type of a actuator Single acting actuator : Single Double acting actuator : Double KOSO high power actuator : 5300	Single / Double / 5300	※1
Valve action	Set direction of a valve when Pout1 is output Air to Open : ATO Air to Close : ATC	ATO / ATC	ATO
Packing friction	Set packing material used for valve body Low friction material such as PTFE, etc：Low High friction material such as GRAFOIL, etc：High	Low / High	Low ※2
Booster option	Set the presence of booster Absence of booster：Without Presence of booster：With ※Unavailable setup right now on February, 2022	Without / With	Without ※2
Set point dir.	Set the direction to convert 4-20mA input signals to the percentage Normal：4mA→0%, 20mA=100% Reverse：4mA→100%, 20mA=0%	Normal / Reverse	Normal
Posi. Transmit.dir.	Set the direction to convert input signal to the percentage of the transmitter output signal Normal：4mA→0%, 20mA=100% Reverse：4mA→100%, 20mA=0%	Normal / Reverse	Normal

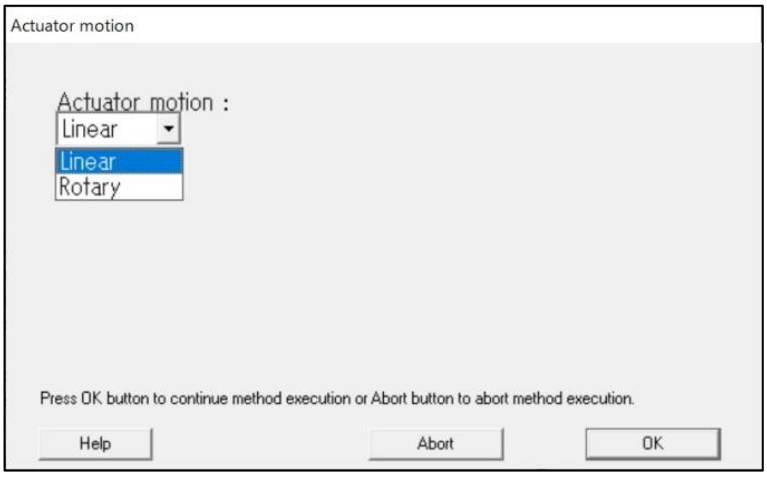
※1・・・The parameters setup is carried out according to the specified model code at the factory.

※2・・・When the factory mounts the positioner on the actuator, the parameters setup is carried out.

For example, Actuator motion setup procedure is shown as below.
MENU > Setup >Basic setup>Actuator motion



① Select 'Write' and press 'OK'.



② Select 'Linear' or 'Rotary', and press 'OK' to set.

3.2.3. Easy tuning

Caution

- HART communication takes more time than the operation using the LUI of this unit, so make sure that the operation is completed.

Easy tuning is the setup to ensure that the positioner is operated smoothly relative to the actuator on which the positioner is mounted. It is possible to perform easily zero/span adjustments of a control valve, selection of suitable PID parameters, setting of other parameters necessary to control.

Note

Before performing this operation (easy tuning), all parameters of basic setup described in section3.2.2 must be configured. If wrong parameters were configured, it is possible to choose unsuitable PID parameters.

3.2.3.1. Full autotune

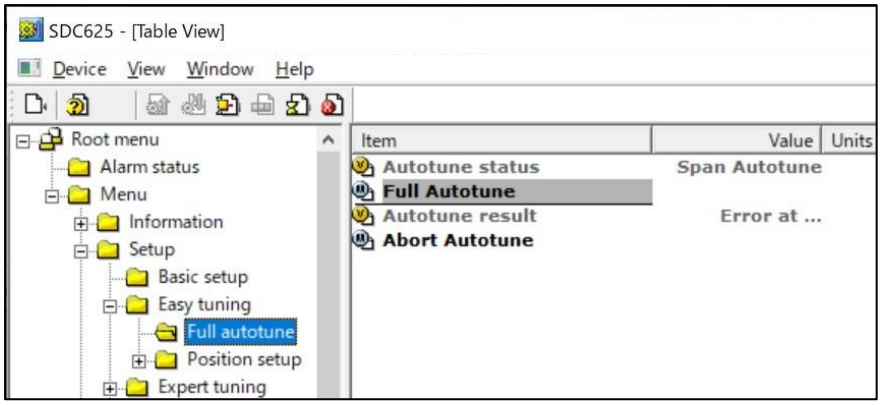
While performing a sequence of operations, it configures automatically settings such as detection and calibration of zero/span, selection of suitable PID parameters to apply the control, detection and calibration of IP signal current bias.

Note

The configuration time varies with actuator size.

1) Execute full autotune

MENU > Setup >Easy tuning > Full autotune



① Select 'Full Autotune' to start full autotune.

The progress are shown as below.

Autotune status: In-progress autotune status.

Autotune result: Autotune execution result . (Display error, if there is.)

② To abort autotune, select 'Abort Autotune'.

2) Confirm the result of the execution (full autotune)

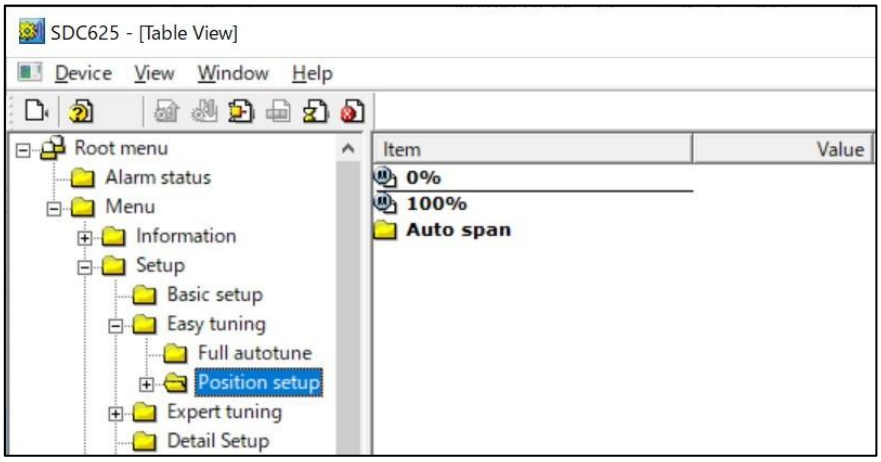
MENU > Setup >Easy tuning > Tuning result

3.2.3.2. Position setup

It is possible to perform Zero/span settings independently, otherwise full autotune. There are two different ways of Zero/span settings whether to specify Zero/span manually or to determine these automatically.

1) Manual calibration

MENU > Setup >Easy tuning > Position setup > 0% or 100%

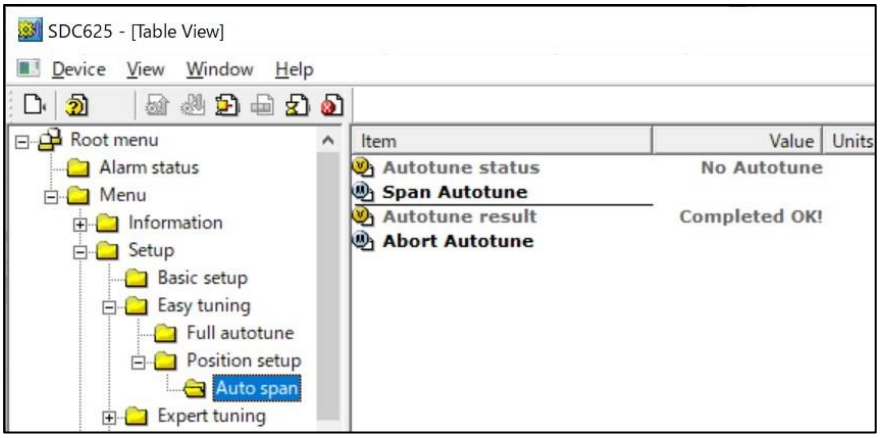


① Press the 'Move-' or 'Move+' to adjust 0% or 100% position of the valve travel.

② Press 'OK(set)', to set the position as 0% or 100% point of the valve travel.

2) Auto span

MENU > Setup >Easy tuning > Position setup > Auto span



① Select 'Span Autotune' to start auto span.
Progress are shown as below.
Autotune status: In-progress autotune status.
Autotune result: Autotune execution result. (Display error, if there is).

② To abort autotune, select 'Abort Autotune'.

3.2.3.3. Response tuning

This operation is used to perform an additional fine adjustment relevant to the control response after performing PID tuning.

MENU > Setup >Easy tuning > Response tuning

A. In case the higher response sensitivity is desired,
i.e., you wish to reduce response time by making the response quicker,
Select 'Aggressive' from 'Response tuning' menu and the most suitable stage among nine stages (+1～+9). The response sensitivity increases in proportion to number of the stage.

B. In case the lower motion sensitivity is desired,
i.e., you wish to decrease the overshoot by making the response slower,
Select 'Stable' from 'Response tuning' menu and the most suitable stage among nine stages (-1 ～-9). The response sensitivity decreases in proportion to number of the stage.

C. In case of restoring the response to standard settings
Select 'Normal' from 'Response tuning' menu.

3.2.4. Expert tuning

Caution

- HART communication takes more time than the operation using the LUI of this unit, so make sure that the operation is completed.

Use this setting in case in which the desired response has not been achieved through easy tuning. More suitable control parameters are configured according to each actuator by tuning individually parameters necessary to control the response.

3.2.4.1. PID parameter set

MENU > Setup >Expert tuning > PID parameter set

Caution

- If you change the rank by two or more, unexpected behavior (too slow response, too fast response) may occur, so perform a thorough test operation in advance and confirm that there are no problems.
- In general, lowering the proportional gain takes longer to start moving and delays reaching the target opening. On the other hand, increasing the proportional gain causes instability and hunting.

It is possible to select preset values prepared previously as PID parameter sets inside the device.

Parameter sets corresponding to maximum seven ranks defined as XS, SS, S, M, L, LL, XL are prepared previously in an ascending order of the proportional gain. Select the parameter set as necessary. If parameters are need to be specified individually through custom setting, select 'custom' menu.

To increase response sensitivity：select PID parameter set with higher proportional gain

To decrease response sensitivity：select PID parameter set with lower proportional gain

Table 3.2.4.1. Correspondence table between rank and each actuator size（※）

Rank	5200LA	6300LA	63D0RC(6300RB)	5300LA
XS	Φ218	Φ150	AT201U	-
SS	Φ270	Φ150	AT251U,AT301U	Φ270S
S	Φ270,Φ350	Φ200	AT351U,AT401U	Φ270S,Φ270L,Φ350S
M	Φ350,Φ450S	Φ300	AT451U,AT501U	Φ350S,Φ350L,Φ450S
L	Φ450S	Φ450	AT551U,AT601U	Φ450S,Φ450M,Φ450L
LL	Φ450L	Φ450,Φ600S	AT651U,AT701U	Φ450M,Φ450L
XL	Φ650	Φ450L,Φ600	-	-

※・・・Corresponding parameters may change due to differences in actuator stroke and air supply pressure.

3.2.4.2. Custom setting for PID parameter

Caution

- If you change the value of each parameter significantly, unexpected behavior (response is too slow, response is too fast) may occur, so please perform thorough testing in advance to confirm that there are no problems.
- In general, lowering the proportional gain takes longer to start moving and delays reaching the target opening. On the other hand, increasing the proportional gain causes instability and hunting.

It is possible to tune individually PID parameters shown as below.

Table 3.2.4.2. Customizable PID parameters

	Category	Type of pressure action	Description and applicable conditions	Value range
P D I	Outside parameter	Air-IN (Increase in output pressure)	When deviation is |e|≥b and Po1 output pressure increases, these parameters will be applied. P: Proportional gain, D: Derivative gain, I: Integral gain	0.1～99.9
rP rD rI		Air-OUT (Decrease in output pressure)	When deviation is |e|≥b and Po1 output pressure decreases, these parameters will be applied. rP: Proportional gain, rD: Derivative gain, rI: Integral gain	
Inside P Inside D Inside I	Inside parameter	Air-IN (Increase in output pressure)	When deviation is |e|≤b and Po1 output pressure increases, these parameters will be applied. Inside P: Maximum proportional gain, then, P(e)=Inside P+(P-Inside P)*e/b Inside D: Maximum derivative gain, then, D(e)=Inside D+(D-Inside D)*e/b Inside I: Integral gain	0.1～99.9
Inside rP Inside rD Inside rI		Air-OUT (Decrease in output pressure)	When deviation is |e|≤b and Po1 output pressure decreases, these parameters will be applied. Inside rP: Maximum proportional gain, then, rP(e)=Inside rP+(rP-Inside rP)*e/b Inside rD: Maximum derivative gain, then, rD(e)=Inside rD+(rD-Inside rD)*e/b Inside rI: Integral gain	
b			Set the deviation to switch between outside parameters and inside parameters, and which will be used to optimize the response. IF b is set to zero (0), the outside parameters are valid only.	0～10%

※Outside parameter means the parameters which are used when deviation is |e|≥b.
※Inside parameter means the parameters which are used when deviation is |e|≤b.

If 'b' parameter is set, Gain P(e) is switched as shown below.

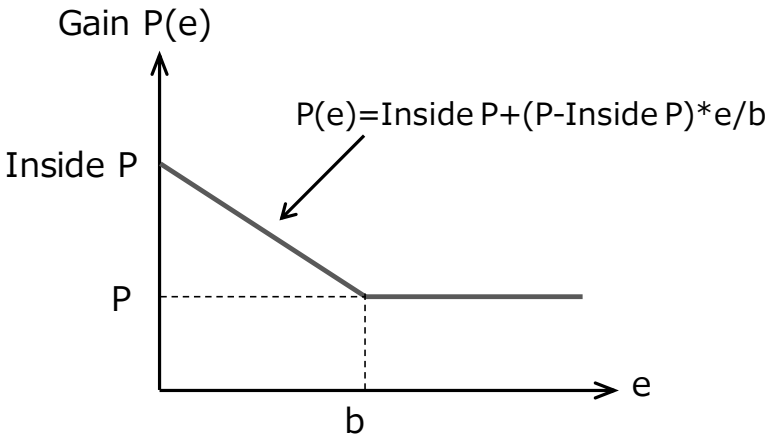
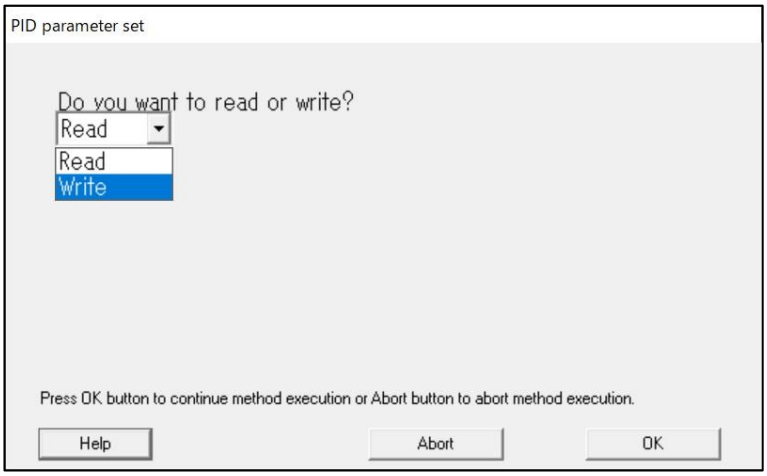


Figure 4.4.2. Gain switching (Example of proportional gain)

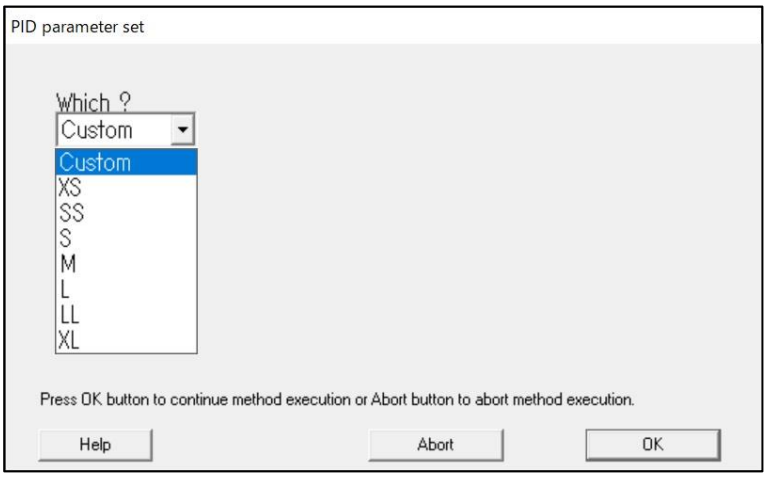
The procedure is shown as followings.

1) Set PID parameter set to 'Custom'

MENU > Setup >Expert tuning > PID parameter set



① Select 'Write' and press 'OK'.

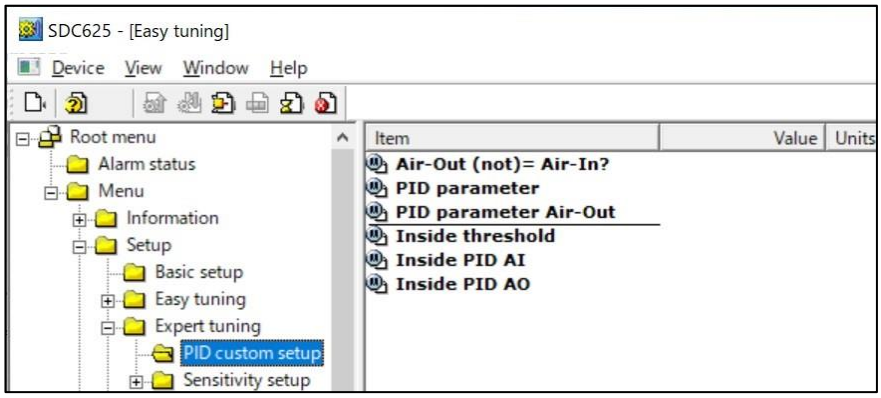


② Select 'Custom', and press 'OK'.

2) Set PID custom setup parameters

※If any other submenu except 'Custom' was selected in PID parameter menu, the value of parameters cannot be changed through the following procedure.

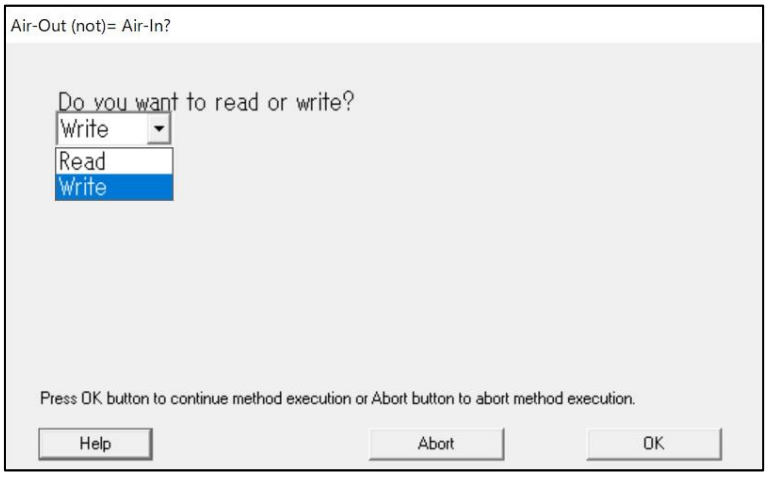
MENU > Setup >Expert tuning > PID custom setup



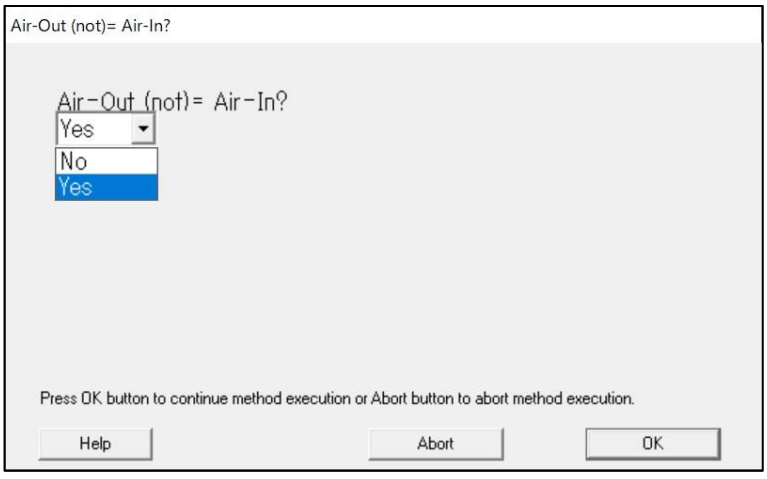
2-1) Set 'Air-Out (not)= Air-In?'.

Select whether or not Air-Out (decrease in output pressure) is same with Air-In (increase in output pressure).

MENU > Setup >Expert tuning > PID custom setup > Air-Out (not)= Air-In?



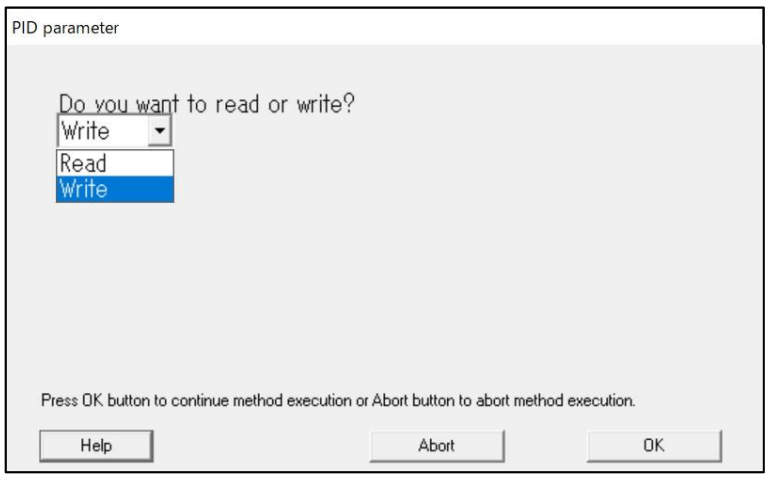
① Select 'Write' and press 'OK'.



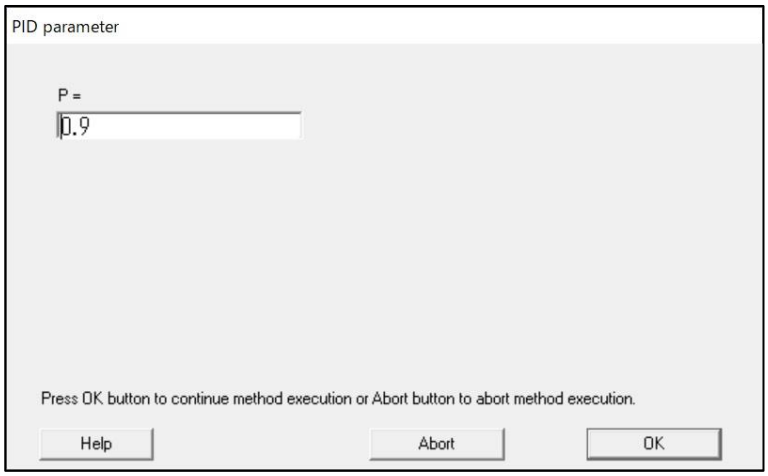
② Select 'Yes' or 'No', and press 'OK' to set.

2-2) Set PID parameter of Air-In.

MENU > Setup >Expert tuning > PID custom setup > PID parameter

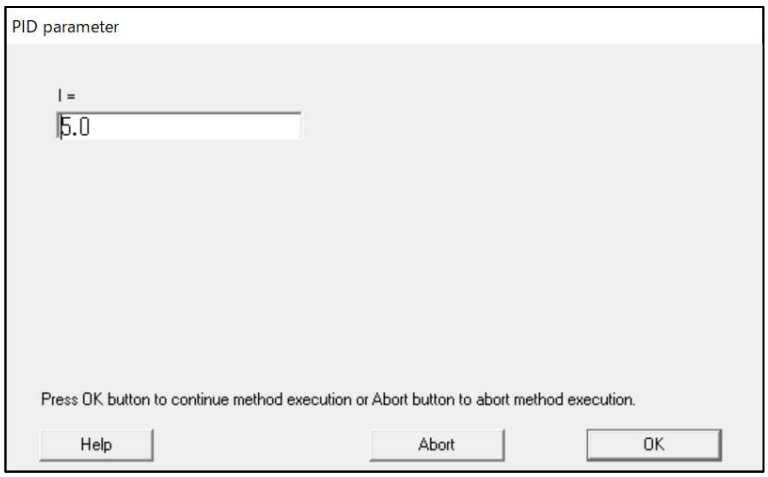


①Select 'Write' and Press 'OK'.



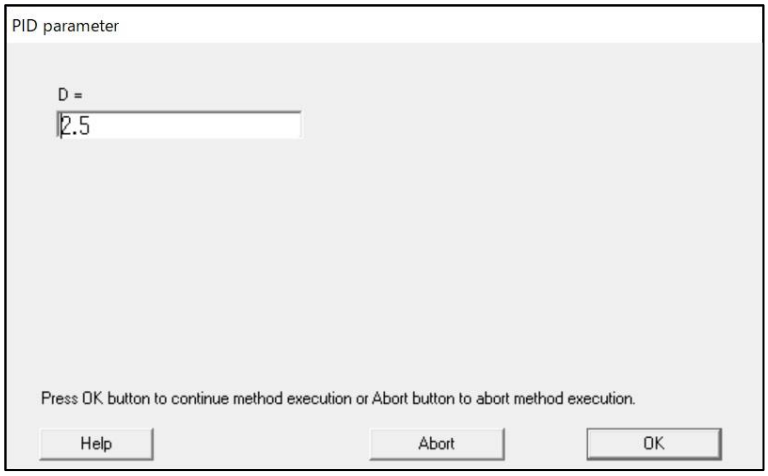
② Input P value of Air-In.

③ Press 'OK'.



④ Input I value of Air-In.

⑤ Press 'OK'.

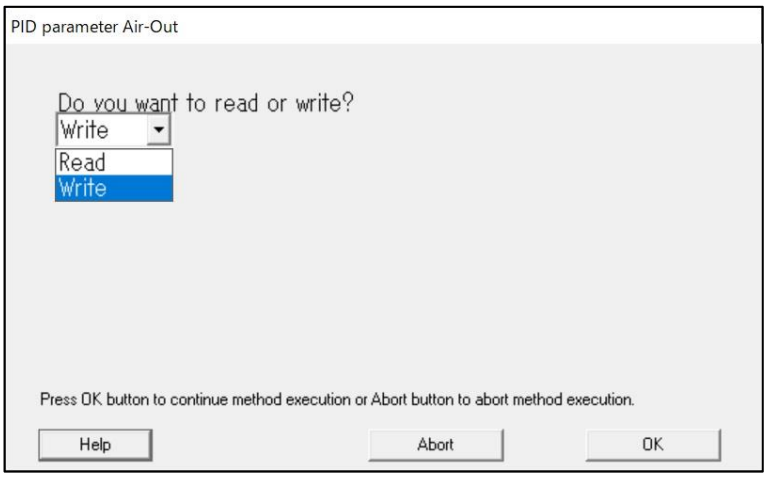


⑥ Input D value of Air-In.

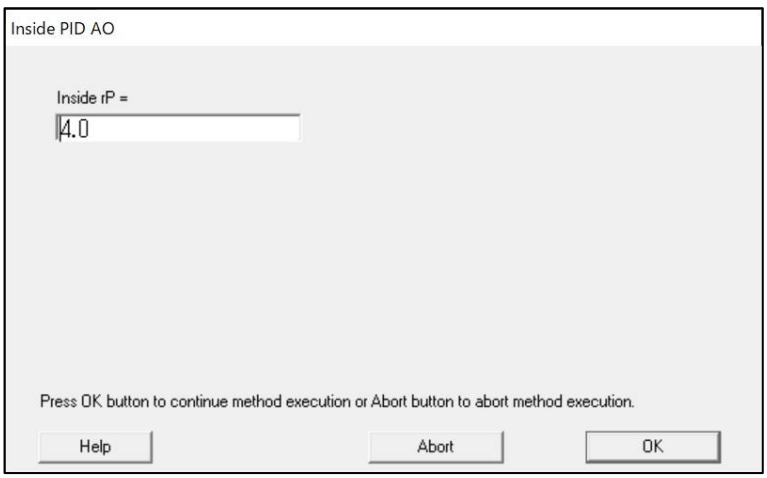
⑦ Press 'OK' to set.

2-3) Set PID parameter Air-Out.

MENU > Setup >Expert tuning > PID custom setup > PID parameter Air-Out ,

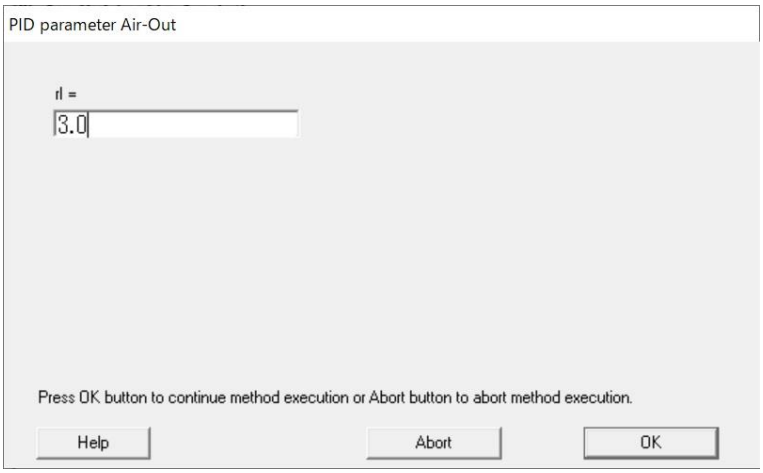


① Select 'Write' and press 'OK'



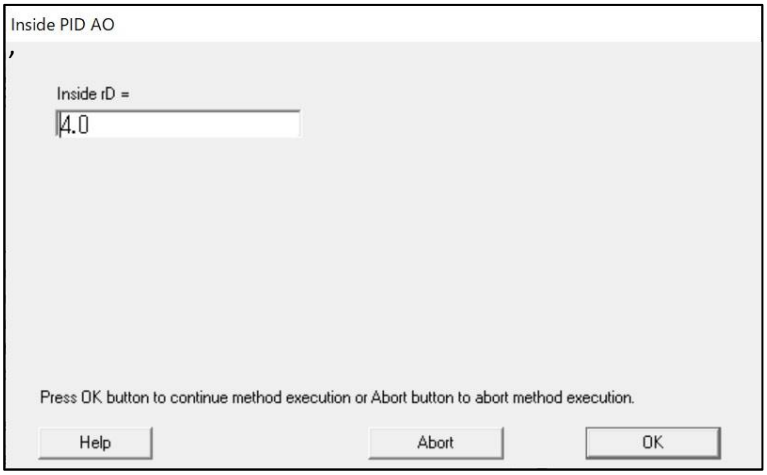
② Input rP value of Air-Out.

③ Press 'OK'



④ Input rI value of Air-Out.

⑤ Press 'OK'

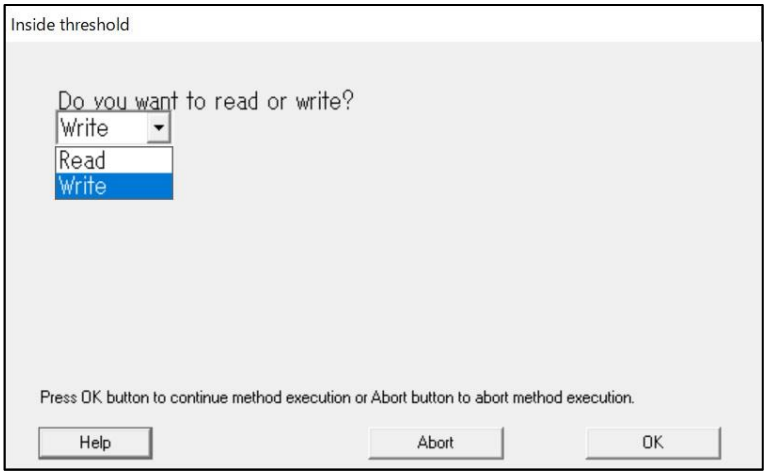


⑥ Input a rD value of Air-Out.

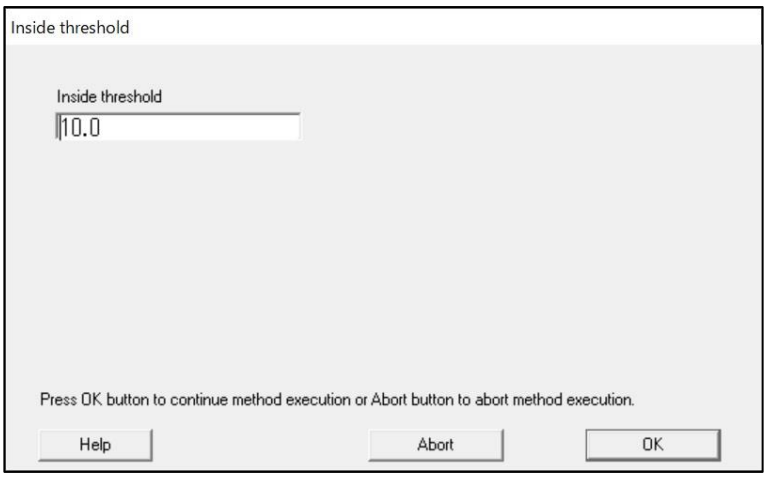
⑦ Press 'OK' to set.

2-4) Set inside threshold value.

MENU > Setup >Expert tuning > PID custom setup > Inside threshold



① Select 'Write' and Press 'OK'

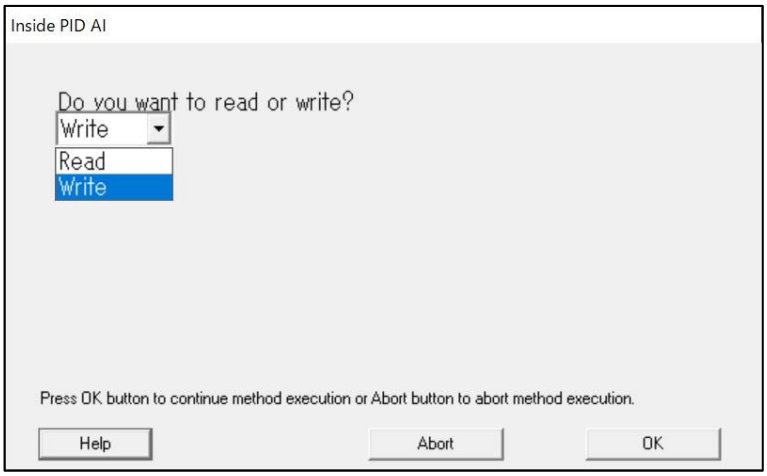


② Input an inside threshold value.

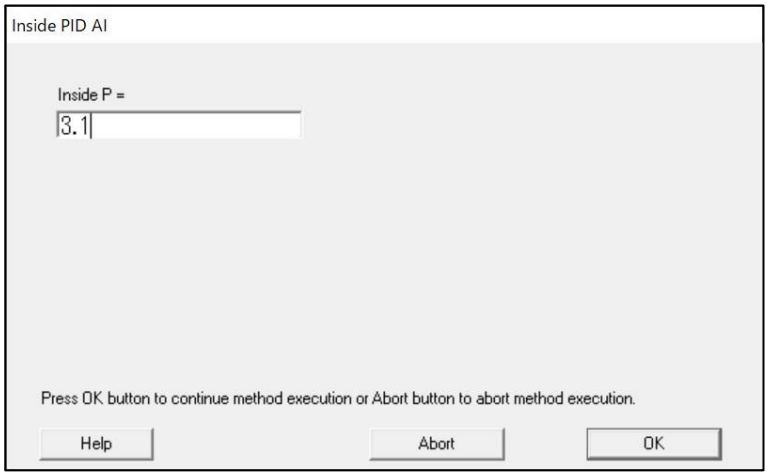
③ Press 'OK' to set.

2-5) Set inside PID Air-In.

MENU > Setup >Expert tuning > PID custom setup > Inside PID AI

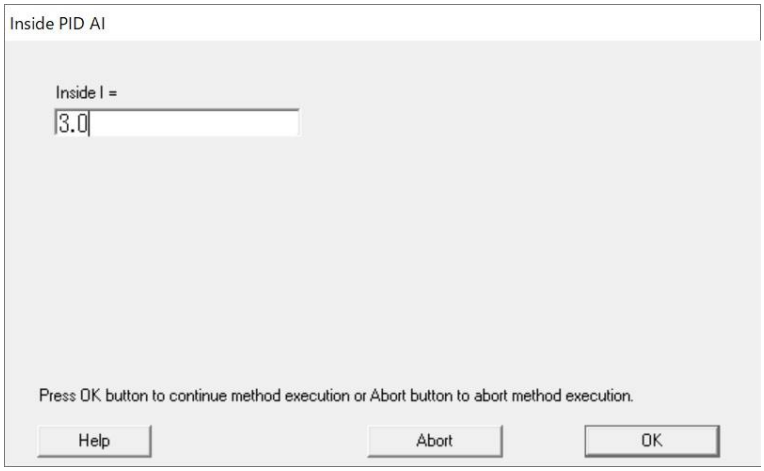


① Select 'Write' and press 'OK'



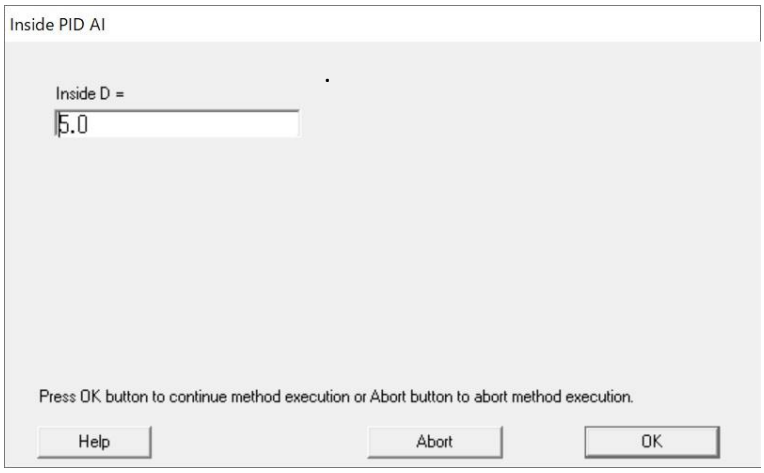
② Input a inside P value of Air-In.

③ Press 'OK'



④ Input a inside I value of Air-In.

⑤ Press 'OK'

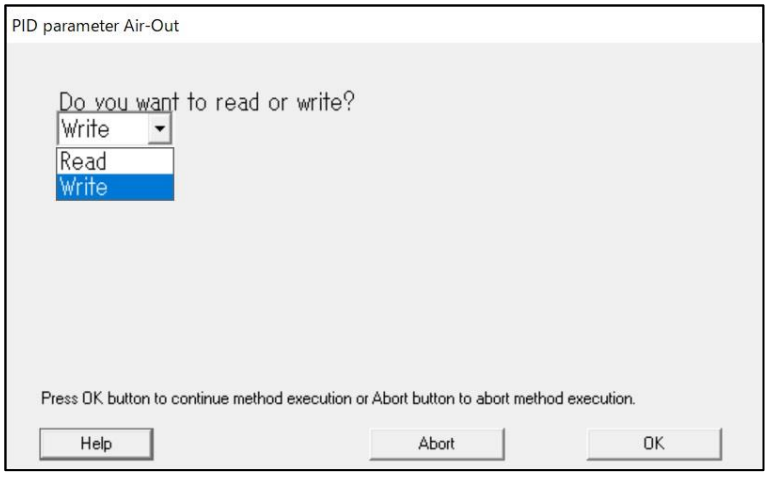


⑥ Input a inside D value of Air-In

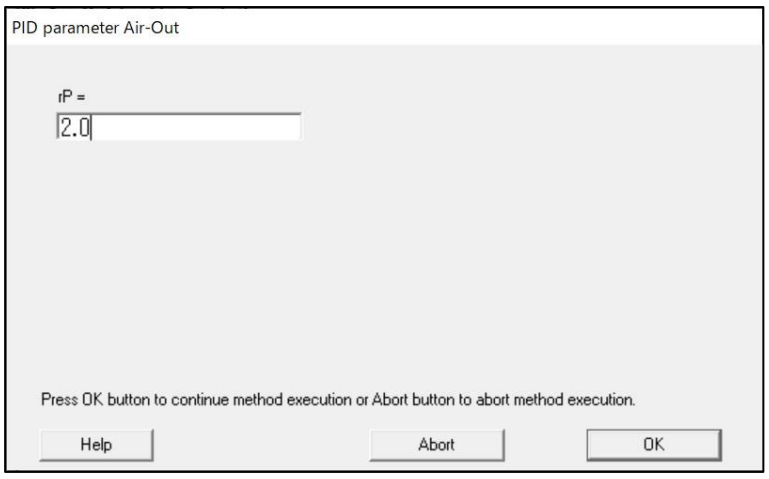
⑦ Press 'OK' to set.

2-6) Set inside PID Air-Out parameters

MENU > Setup >Expert tuning > PID custom setup > PID parameter Air-Out

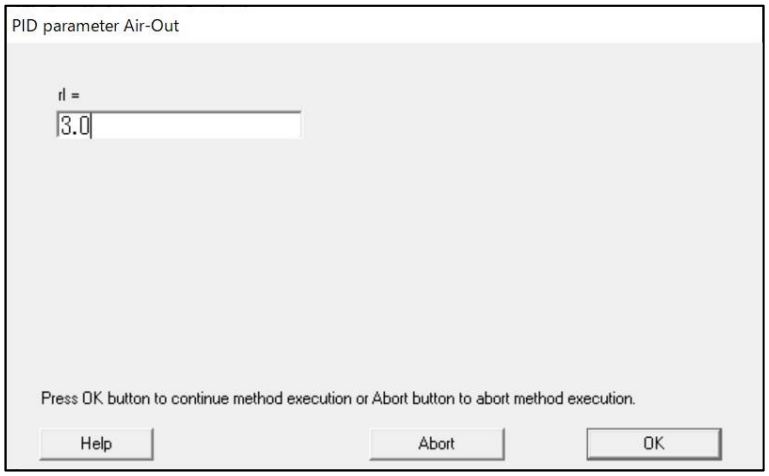


① Select 'Write' and press 'OK'



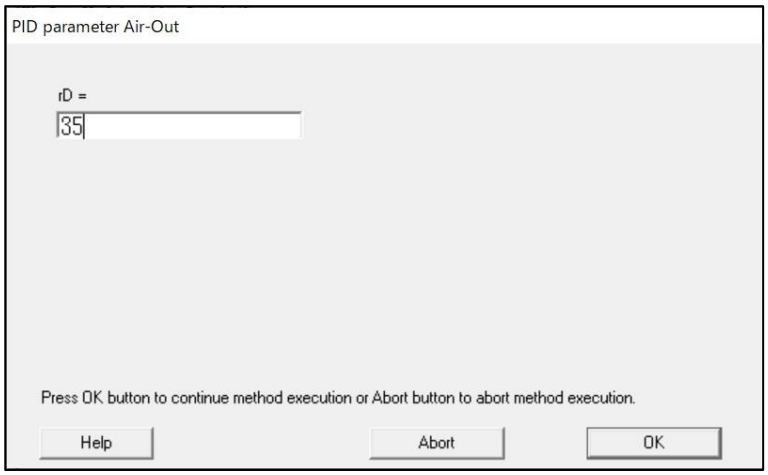
② Input an inside rP value of Air-out.

③ Press 'OK'



④ Input a inside rI value of Air-out.

⑤ Press 'OK'



⑥ Input a inside rD value of Air-out.

⑦ Press 'OK' to set.

3.2.4.3. Setup for IP signal current bias

IP signal current bias is the parameter necessary to determine the control output signal (IP signal) corresponding to an input signal.
There are two different ways whether to determine IP signal current bias automatically or to specify it manually.

1) Auto setup

MENU > Setup > Expert tuning > Sensitivity setup

A. Set IP signal current bias and PID parameters together.
Sensitivity setup > Auto bias & size select

B. Set IP signal current bias only.
Sensitivity setup > Auto bias

2) Manual setup

MENU > Setup > Expert tuning > Sensitivity setup > Manual Bias

Specify individually IP signal current bias of each position in 25% and 75% of the valve travel.

3.2.5. Error messages

If the problems cause during the operations such as full auto tune (Section 3.2.3.1), position setup 2) auto setup (Section 3.2.3.2), IP signal bias 1) automatic setting (Section 3.2.4.3), the following error messages will be displayed. and the performance will be stopped.

Table 3.2.5 List of error messages

Code	Error description and solution	
Error at closing	Meaning	**It does not reach the 0% travel position or steady state.**
	Possible causes	Lack in off-balanced pressure
	Solution	Confirm off-balanced pressure
Error at opening	Meaning	**It does not reach 100% travel position or the steady state.**
	Possible causes	Decrease or pulsation in supply pressure
	Solution	Confirm the supply pressure
Error at stopping	Meaning	**It does not reach IP signal bias value (point) or the steady state**
	Possible causes	Limit cycle causes by large packing friction Limit cycle causes by the fall of the tension spring
	Solution	➢ Set dead band or confirm the tension spring ➢ After changing the suitable PID parameters, perform the auto setup of position setup and IP signal bias.
Error at span measurement	Meaning	**It does not reach the span position (point).**
	Possible causes	Decrease or pulsation in supply pressure
	Solution	Confirm the supply pressure

※In addition to the possible causes of each error code, if five minutes is passed while performing the specified operation, the error codes will be displayed.

3.2.6. Detailed setup

Caution

- HART communication takes longer than the operation using the LUI of this unit, so be sure to complete the operation.

Set values which need to be changed to achieve the desired response.

MENU > Setup > Detailed setup

Table 3.2.6 Item list of the detailed setup

Key menu	Description	Parameters	Default
Cutoff	Set the control range which tracks the input signal 0% : If the input signal is lower than this value, IP signal will be cutoff to the low side. The range of values available is 0.1~50.0%. 100% : If the input signal is higher than this value, IP signal will be cutoff to the high side. The range of values available is 50.0~99.9%. ※1 The parameters setup is carried out according to the specified model code at the factory. Linear actuator : 0.5% at the 0% side Disable at the 100% side Rotary actuator : 0.5% at the 0% side 99.5% at the 100% side ※Choose either one Cutoff or Limit as shown below	Value/Disable	※1
	Handling precautions Be sure to use the cutoff setting if you want to control the mechanical hit position as 0% or 100%.		
Limit	Set high and low limit percentage of input signal which the positioner may recognize 0% : This value is a low limit above which the input signal is in effect. The range of values available is 0.1~50.0%. 100% : This value is a high limit below which the input signal is in effect. The range of values available is 50.0~99.9%. ※Choose either one Cutoff as shown above or Limit	Value/Disable	Disable
Dead band	Set the deviation value below which the integral action is disabled.	Value/Disable (0.1~2.0%)	Disable
Transfer function	Set the type of the flow characteristic curve Linear：Linear characteristics Equal percent Low : Low equal percentage characteristics (Rangeability 30:1) Equal percent Mid : Middle equal percentage characteristics (Rangeability 50:1) Equal percent Hig :	As shown on the left	Linear

Key menu	Description	Parameters	Default
	High equal percentage characteristics (Rangeability 100:1) Quick opening : Quick opening characteristics (Rangeability 30:1) Custom curve: Customized characteristics ※In case of using equal percent characteristic besides the rangeability mentioned above, input the value directly to “Range ability”.		
Custom curve set	Set the flow characteristic curve by specifying arbitrary 20 points. ※Since the 0% valve travel corresponds to the 0% input and the 100% valve travel corresponds to the 100% input, set points of the intervals between them. ※ Define the relationship in such a way that the valve travel monotonically increases as the input increases.	Value/Unused	Unused
Range ability	Specify a rangeability in relevant to the equal percentage characteristic curve. ※This setup is available on condition that the equal percentage characteristics from’ flow characteristic curve’ menu was selected previously. ※If the rangeability is set to 1, it becomes the value of each equal percent characteristics.	Value	1
Input damper	Set the damping coefficient to the input signal. As the value becomes lager, the response becomes slower because the primary delay time constant becomes larger.	Value/Unused (0.1~99.9%)	Unused
Split range	Set the input current value corresponding to 0% and 100% position. Example 1) If 0% is set to 4mA, 4mA becomes 0% input signal. If 100% is set to 12mA, 12mA becomes 100% input signal. Example 2) If 0% is set to 8mA, 4mA becomes 0% input signal . If 100% is set to 16mA, 16mA becomes 100% input signal.	0%/100%	0%=4mA 100%=20mA
PT burnout dir.	Set the burnout direction of output transmitter, when the alarm is activated. Low setting： When the current is lower than 3.6mA, the lower current (burnout signal) will flow	Low/High	Low

Key menu	Description	Parameters	Default
	High setting： When the current bigger than 21mA, the bigger current (burnout signal) will flow ※ If the input signal is zero, the current of Lo setting will flow regardless of above setting.		
AT span limit	Set the full mechanical limit of valve travel over the 100% travel position, when the positioner detects the 100% travel position. ※This value is valid only in condition when 'Linear' from 'actuator motion' menu is selected on the basic setup.	Value (100~150%)	105%
	⚠ Handling precautions When setting the overstroke value to 100%, be sure to enable the setting on the Cutoff 100% side. By setting the value according to the actuator, you can save the time of adjusting the span from the next time onward.		
Integ. stop press	When the supply air pressure falls below the set threshold value, the correction operation by integration is stopped. ※However, regardless of the setting, the integral correction operation stops at 10kPa or less.	Value/Unused (0~999kPa)	Unused

3.2.7. Function select

You can individually set permissions, control modes, password settings, screen savers, temperature units, and pressure units.

MENU > Setup > Function select

Table3.2.7 List of selectable functions

Key menu	Description	Parameters	Default
Authority > Authority	Set access permission to HART communication. Select 'HART' in case in which settings should be configured via HART communication. To change authority to 'HART', LUI(LCD) screen should be top menu, alarm status menu or information menu and below. <u>Once HART is selected, only 'Information' from 'TOP' menu will be able to be accessed through LUI(LCD).</u>	LCD / HART	LCD
Authority > Control mode	Set operations permission. Select 'HART' to do operations via HART communication.	4-20mA / HART	4-20mA
Password setup	Set password.	Three-digit	Unused

	Once the password is set, only 'Information' from 'TOP' menu will be able to be accessed unless you type the password. If forgetting the password, please inquire to the business office of this manual end.	integer	
Screen saver	Set the time for screen saver during which the LCD screen display will be turned off. It is possible to extend the life span of the LCD with a limited life by using screen saver.	Value/ Unused	Unused
Temperature unit	Set temperature unit displayed on the LCD.	Celsius / Fahrenheit	Celsius
Pressure unit	Set pressure unit displayed on the LCD.	kPa/bar/psi	※

※・・・The parameters setup is carried out according to the specified model code at the factory.

3.2.8. Memory management

3.2.8.1. Memory save

Save setting data to the memory.

MENU > Maintenance > Memory save & res. > Save

To save date, select 'OK' on confirmation screen.

3.2.8.2. Restore memory data

Restore setting data from the memory.

MENU > Maintenance > Memory save & res. > Restore

To restore date, select 'OK' on confirmation screen.

3.2.8.3. Restore factory default

Reset the setting data to factory settings.

MENU > Maintenance > Memory save & res.> Factory default

To restore date, select 'OK' on confirmation screen.

3.3. Maintenance

Warning

- If the exhaust port becomes clogged with contaminants, high pressure will be applied to the front cover. Then, removing it on the positioner causes of hazards. Before removing it, confirm that the exhaust port of the housing is surely opened.
- Always wear protective suit, gloves, and eyeglasses before performing any maintenance operation.

Caution

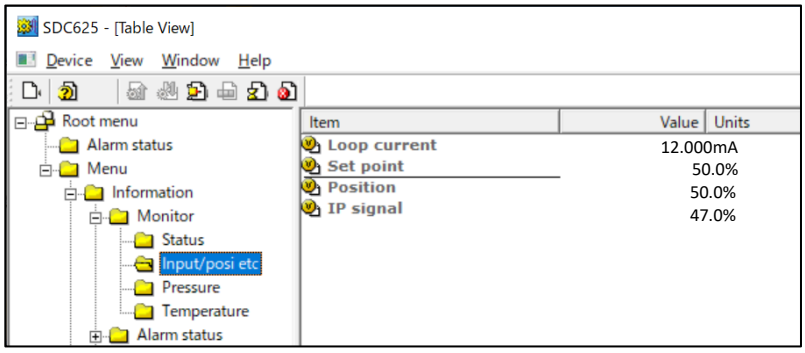
- Don't remove the fall prevention screws from pilot relay, A/M unit.
- HART communication takes longer than the operation using the LUI of this unit, so be sure to complete the operation.

3.3.1. Adjustment · switching

3.3.1.1. Torque motor adjustment

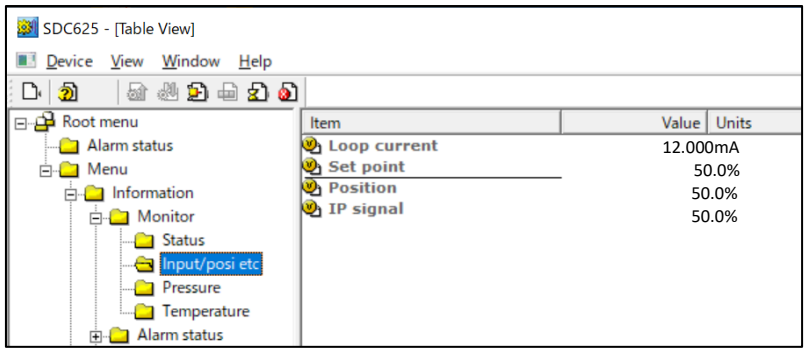
Adjust the gap of nozzle flapper parts, namely, nozzle and nozzle pad.
The procedure is shown as below.

MENU >Information >Monitor >Input/posi etc



① Display 'Input/posi etc' screen.

② Input the signal corresponding to the 50% travel position.



③ While turning the nozzle of the torque motor clockwise or counterclockwise, adjust the value of 'IP signal' to 50±2%. Then, the procedure is now complete.

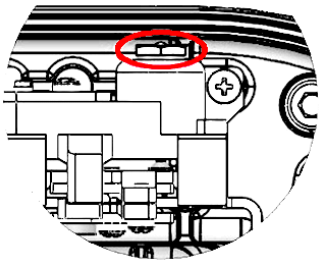


Figure 3.3.1.1 Nozzle adjustment of torque motor

3.3.1.2. Action switching of pilot relay

The operator can switch the pilot relay between single action mode and double action mode by turning the screw attached to the pilot relay.

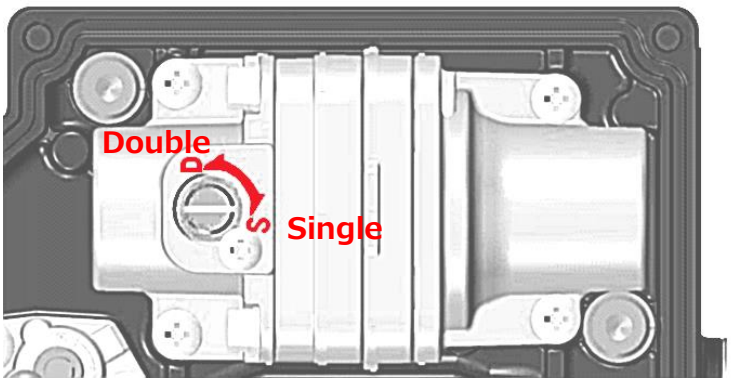


Figure 3.3.1.2. Action switching of pilot relay

Switching to single action mode;

Turn the switch screw clockwise until it reaches its end position.

Switching to double action mode;

Turn the switch screw counterclockwise until it hits the fall prevention screw.
Since a balance pressure becomes supply pressure at this time, subsequently, the operate need s to perform 「Adjustment of balance pressure」 operation described in next section.

3.3.1.3. Balanced pressure adjustment of pilot relay

When the pilot relay is used in double action mode, the operator needs to adjust the balanced pressure of the output pressure 1 and 2 by rotating switch screw. When turning the switch screw counterclockwise, the balanced pressure increases. On the other hand, when turning the switch screw clockwise, the balanced pressure decreases. Adjust the balanced pressure to 70-80% of the supply pressure.

Once set the following menu shown below, then, you can adjust it while confirming the values of the output pressure 1 and 2.
It should be noted that the larger the actuator, the more it takes time to adjust the pressure.

MENU > Maintenance > Calibration > Pilot relay adju.

Balanced air lower limit: Low limit of balanced pressure.
(70% of the supply pressure)
Balanced air upper limit: High limit of balanced pressure.
(80% of the supply pressure)

P-out1 : The current value of Pout1
P-out2 The current value of Pout2

3.3.2. Calibration

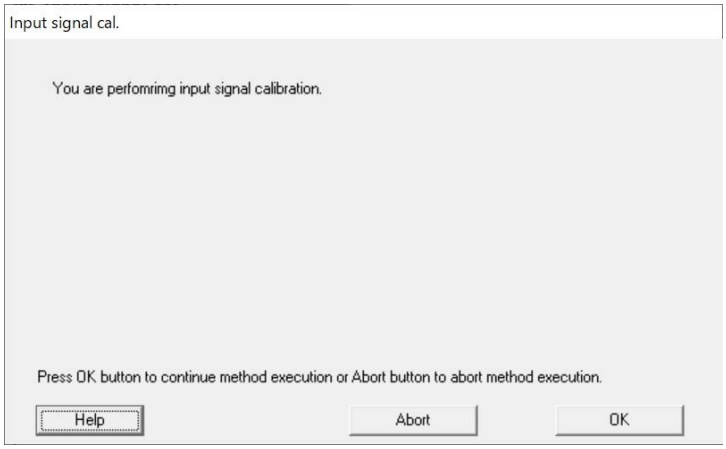
Since the operation described in this section is preset at the factory, generally, it is not necessary to repeat this. However, since there is a case in which a deviation is produced from long-term operation and so on, if necessary, perform this operation.

3.3.2.1. Input signal calibration

Calibrate the value of input signal which the positioner is received.

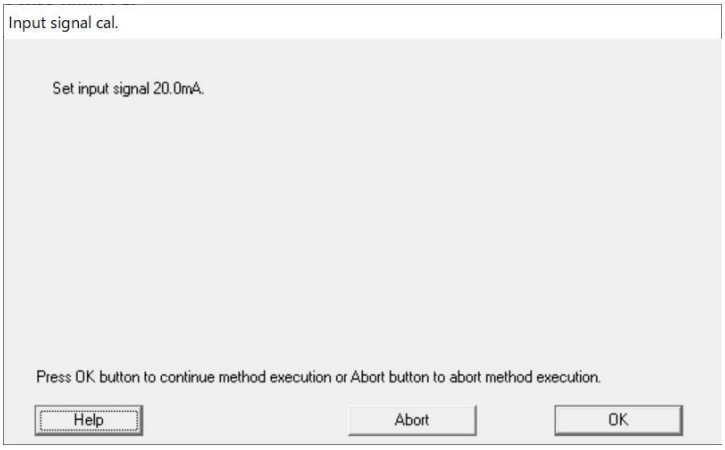
The procedure to calibration each value of 4mA and20mA is shown as below.

MENU > Maintenance > Calibration >Input signal cal.



① Confirm the message and press 'OK'

② Set input signal 4.0mA and press 'OK'



③ Set input signal 20.0mA and press 'OK'

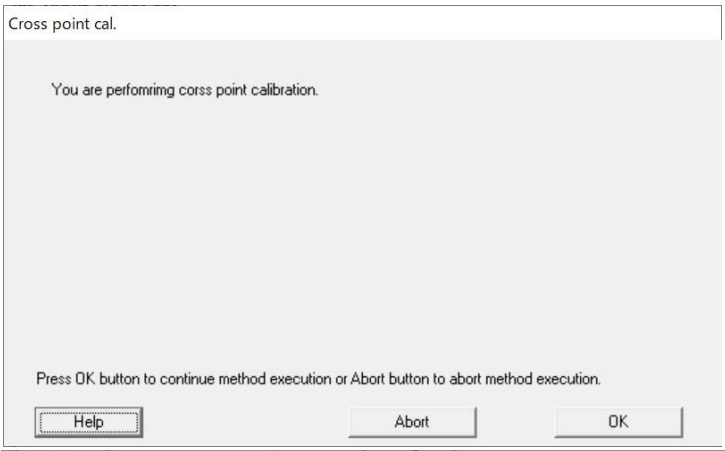
④ If the completion message is displayed, the calibration is completed.

3.3.2.2. Cross point calibration

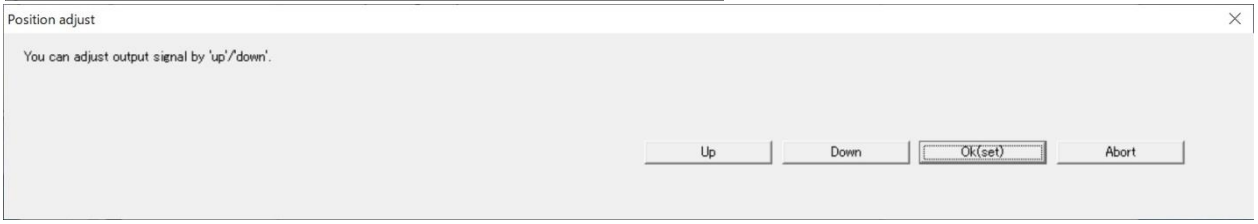
Calibrate the position which the feedback lever horizontal. It is necessary to perform it in order to precisely control the travel position. When a feedback lever isn't installed horizontally in the 50% position, this calibration will be required.

The procedure is shown below.

MENU > Maintenance > Calibration >Cross point cal.



① Confirm the message and press 'OK'



② Press the 'Down' or 'Up' to adjust position.

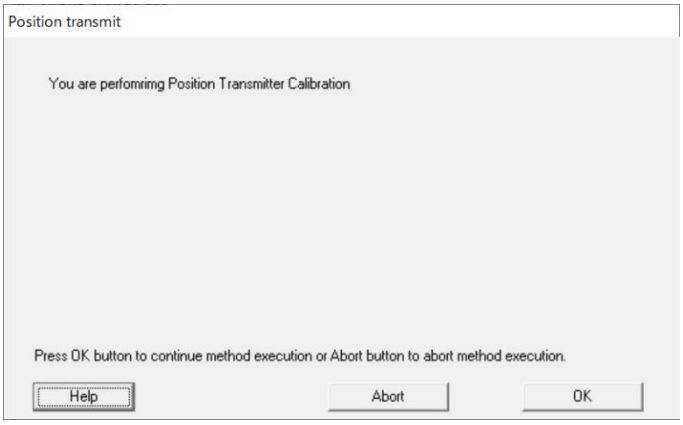
③ Press 'Ok(set)', to set the position as the crospoint.

3.3.2.3. Position transmitter calibration

Calibrate the position transmitter signal which the positioner send.

The procedure to calibrate individually the position transmitter signal of each position in 0% and 100% is shown below.

MENU > Maintenance > Calibration > Position transmit cal.



① Confirm the message and press 'OK'

② Select '0%-side' or '100%-side'.

③ Adjust position transmitter signal by 'Up' or 'Down'.

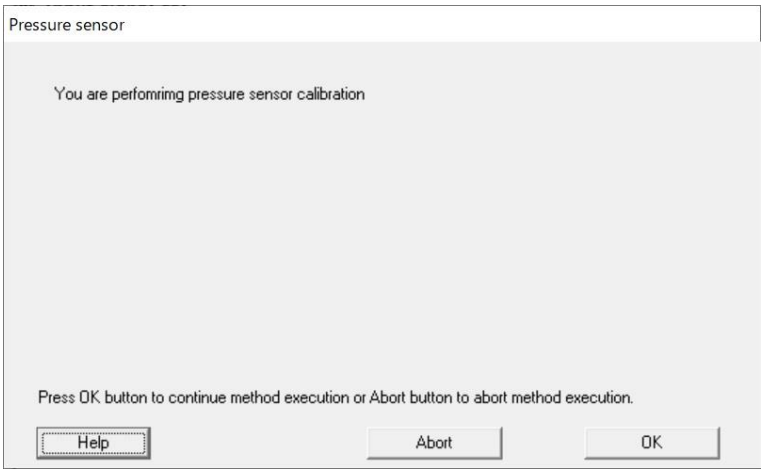
④ press 'OK' to set.

3.3.2.4. Pressure sensor calibration

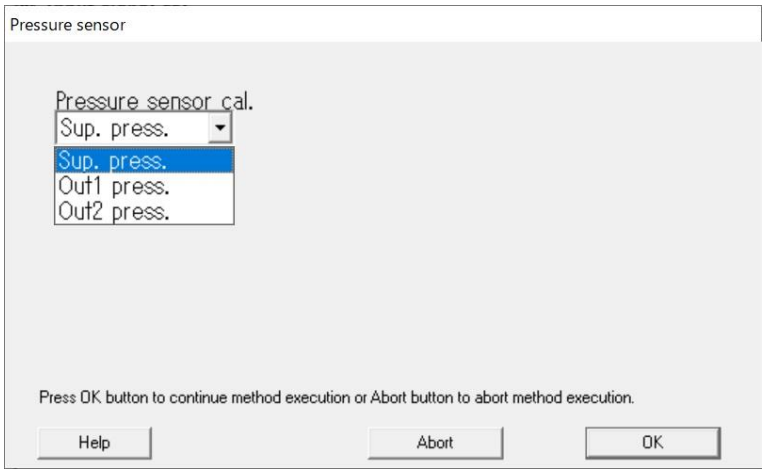
Calibrate three pressure sensors in the positioner. It is necessary to connect the positioner to a pressure measuring device of gauge pressure type which is used for pressure reference. It is required to calibrate both of the first order pressure (lower side) and the second order pressure (upper side) for each sensors.

The procedure to calibrate the supply pressure sensor is showed as below.

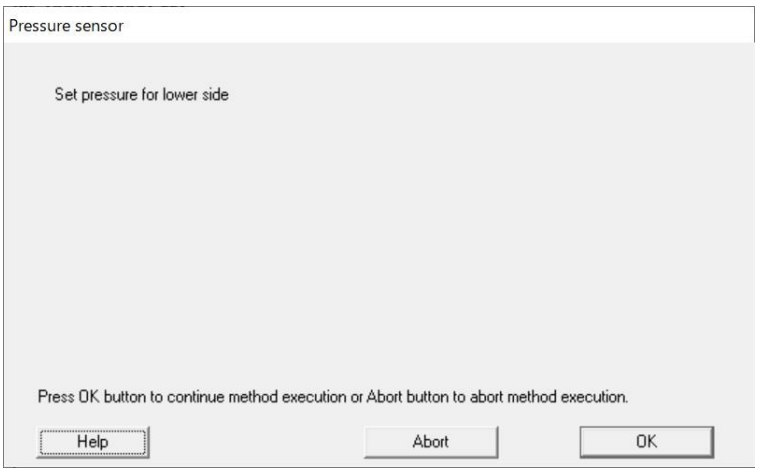
MENU > Maintenance > Calibration > Pressure sensor



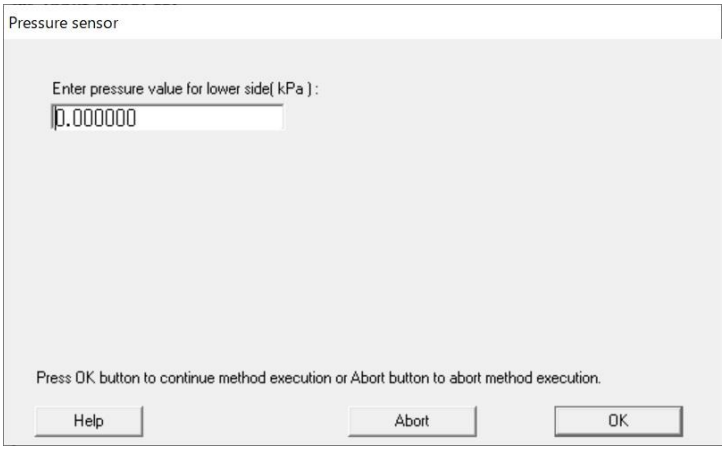
① Confirm the message and press 'OK'



② Select 'Sup. press.' and press 'OK'

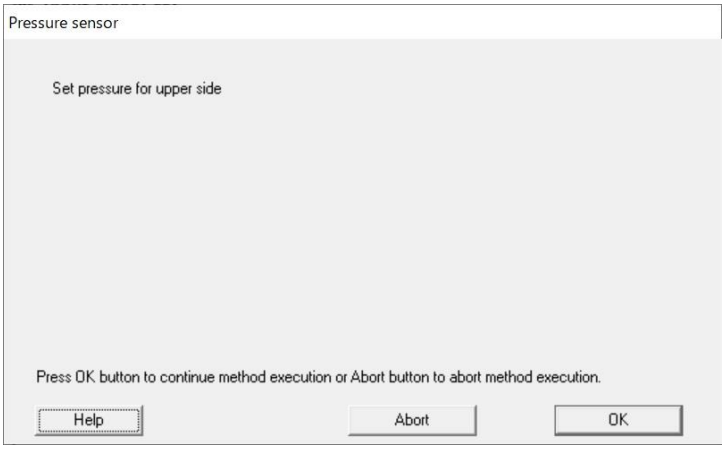


③ Set pressure for lower side and press 'OK'

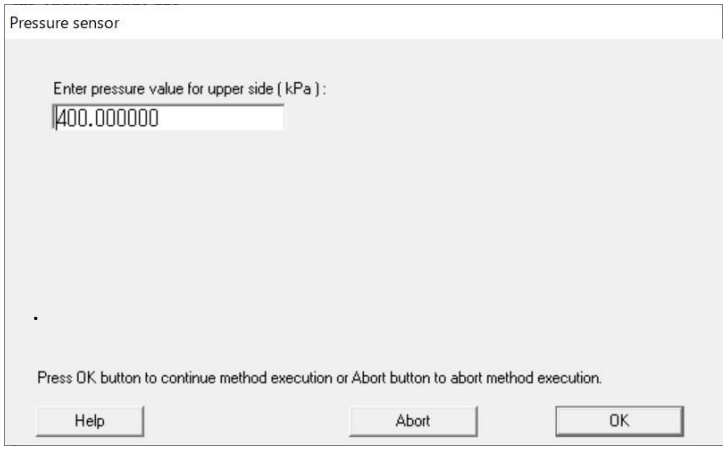


④Enter pressure value for lower side.

⑤ Press 'OK'



⑥ Set pressure for upper side and press 'OK'



⑦ Enter pressure value for upper side

⑧ Press 'OK' to set

3.3.3. Simulation test

Caution

- Simulation test is the function which enables the positioner to be operated regardless of the signal from a higher-level control system connected with the positioner. Prior to operating this function, make sure that the simulation will not affect the process.
- HART communication takes longer than the operation using the LUI of this unit, so be sure to complete the operation.

It is possible to simulate input signal, IP signal current and position transmitter output. And it is also possible to check the response by simulating ramp and step input signal internally.

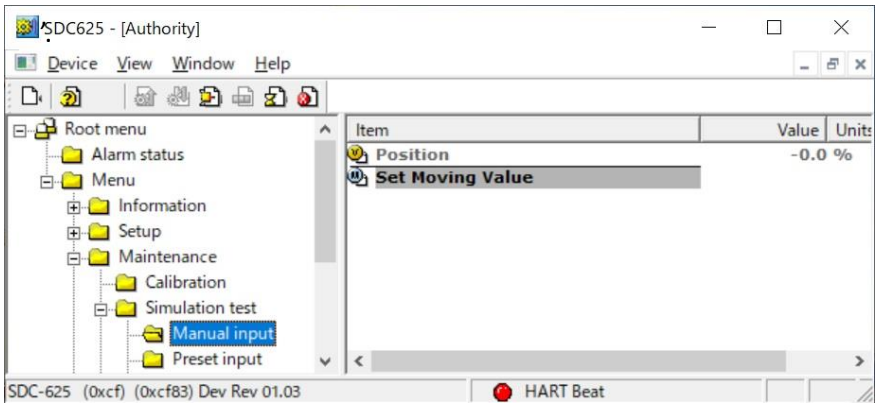
3.3.3.1. Input signal simulation

It is possible to move the control valve by providing the input signal which is similar to the desired signal.

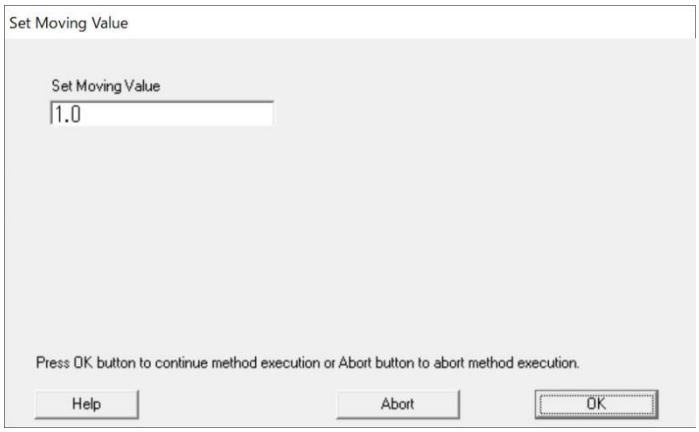
There are two modes in the simulation; manual mode or preset mode. The manual mode makes the positioner to detect continuously all the values among the process that the current value goes to the displayed (input) value. But the preset mode makes the positioner to detect only the displayed (input) value. The simulation of the ramp response and so on is suitable to use the manual mode and the simulation of the step response and so on is suitable to use the preset mode.

1) Manual mode

MENU > Maintenance > Simulation test > Manual input



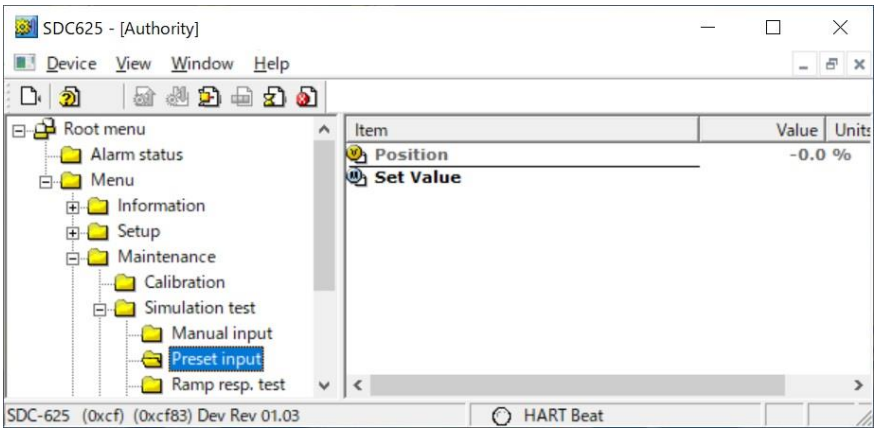
① Select 'Set Moving Value'.



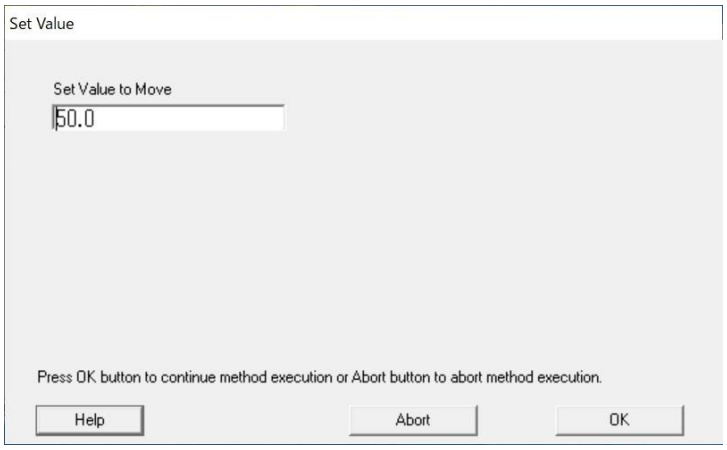
② Input a moving value.
(Value range: -10.0% - +10.0%)
③ Press 'OK'to execute.

2) Preset mode

MENU > Maintenance > Simulation test > Preset input



① Select 'Set Value'.



② Input a value.
(Value range: 0.0% - 100.0%)

③ Press 'OK' to execute.

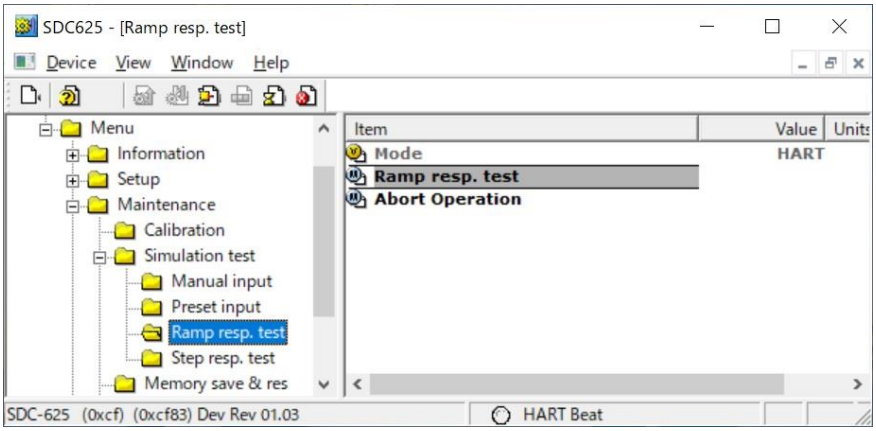
3.3.3.2. Ramp response simulation

It is possible to move the control valve by providing the ramp signal internally.

MENU > Maintenance > Simulation test > Ramp resp. test

Parameter	Description	Unit
Start Position	Set the start position of the valve travel	*[%]*
Stop Position	Set the end position of the valve travel	*[%]*
Ramp time	Set the one-way travel time of the ramp response	*[s]*
Wait time	Set the delay time required for the start of the ramp response	*[s]*
Repeat	Set the motion type whether or not to repeat the ramp response	*One time only /Repeat*

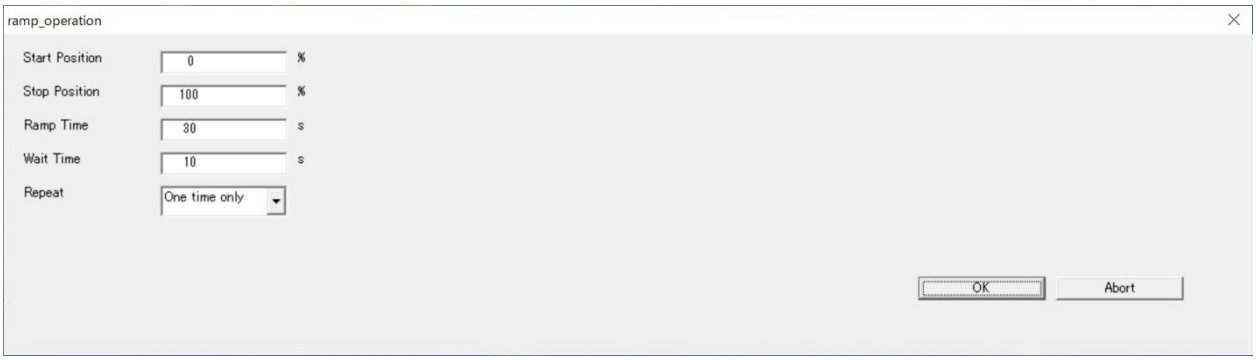
1) Start ramp resp. test



① Confirm the mode is ‘ HART’.

② Select ‘Ramp resp. test’.

③ To escape from this screen, press ‘OK’ or ‘Abort’



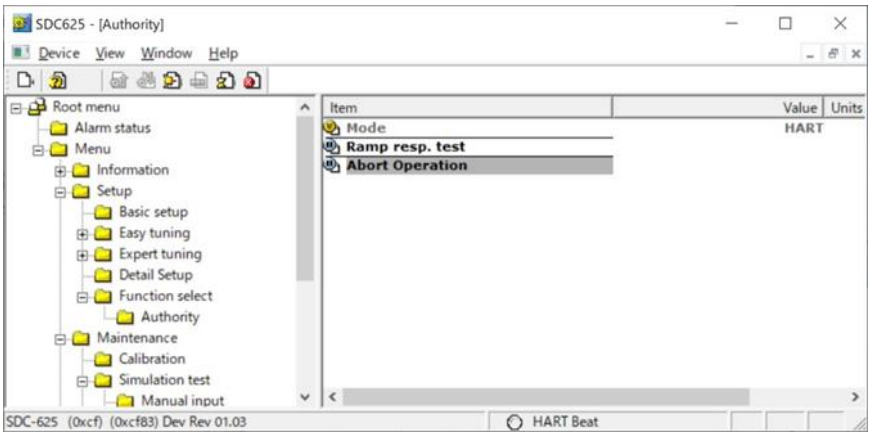
④ To modify the parameter, select each item.

⑤ Confirm all parameters are correct.

⑥ Press ‘OK’

⑦ Press ‘OK’ on confirmation screen to execute.

2) Abort ramp resp. test



① Select 'Abort Operation'.

② Press 'OK' on confirmation screen to abort ramp resp test.

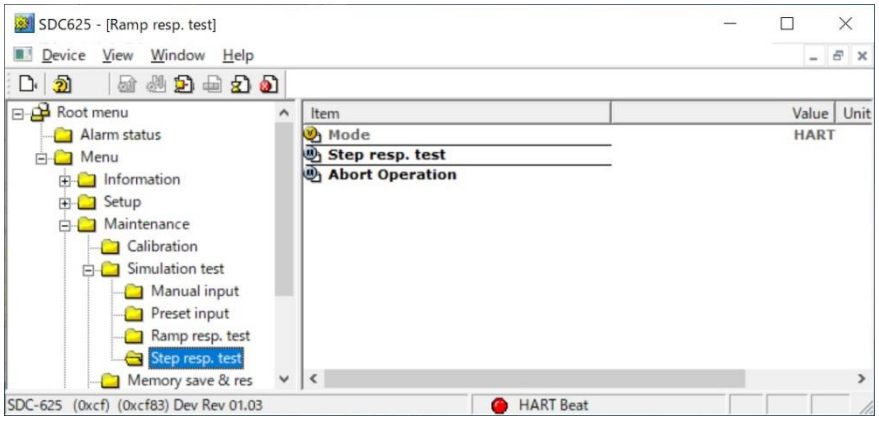
3.3.3.3. Step response simulation

It is possible to move the control valve by providing the step signal internally.

Parameter	Description	Unit
Step	Set the interval of the step response	*[%]*
Start	Set the start position of the valve travel	*[%]*
End	Set the end position of the valve travel	*[%]*
Time	Set the delay time required for the start of the step response	*[s]*
Repeat	Set the motion type whether or not to repeat the step response	*One time only /Repeat*

MENU > Maintenance > Simulation test > Step resp. test

1) Start step resp. test



① Confirm the mode is ' HART'.

② Select 'Step resp. test'.

③ To escape from this screen, select 'OK' or 'Abort'

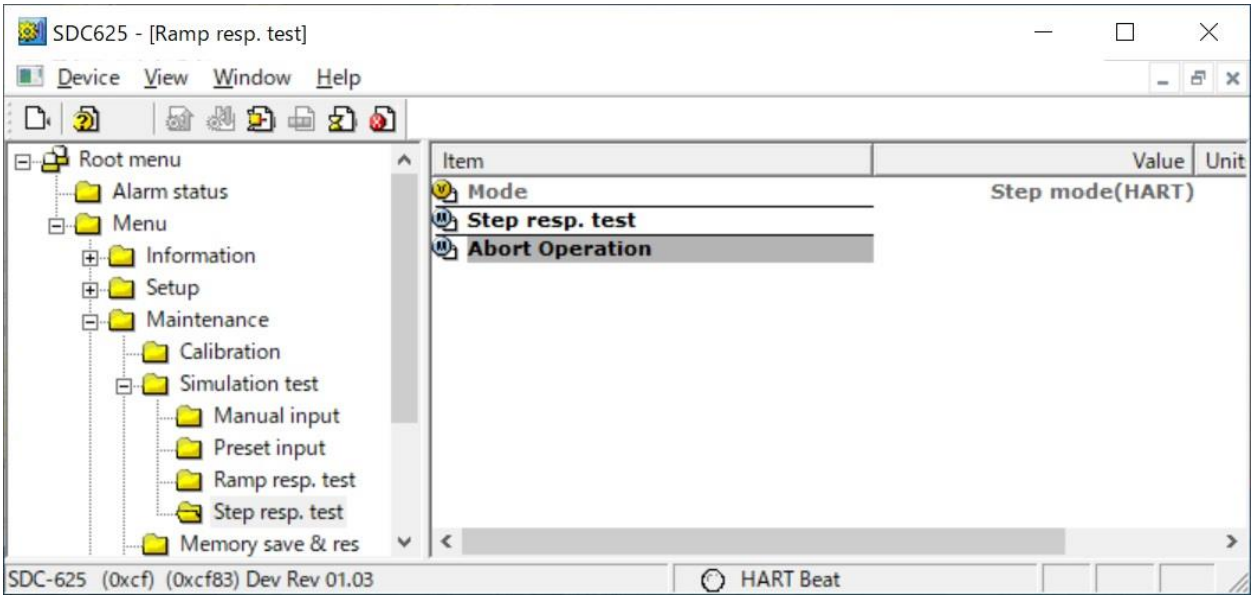
④ To modify the parameter, select each item.

⑤ Confirm all parameters are correct.

⑥ Press 'OK'

⑦ Press 'OK' on confirmation screen to execute.

2) Abort step resp. test.



① Select 'Abort Operation'.

② Press 'OK' on confirmation screen to abort step resp. test.

3.3.4. Service

3.3.4.1. Identification of internal parameters

While entering the following menu as below, the operator can identify A/D converted values, value of potentiometer angle, set value of cross point, time stamp of software, current values of PID parameters.

MENU > Maintenance > Service

3.3.4.2. Switching of factory setup

> **Caution**
>
> Since the suitable parameters are configured at the factory, in general, do not perform switching of factory setup and the reconfiguration on its menu. The reconfiguration of the values causes the case that the desired response may not be achieved.

MENU > Maintenance > Service > Factory menu

3.3.5. HART relation

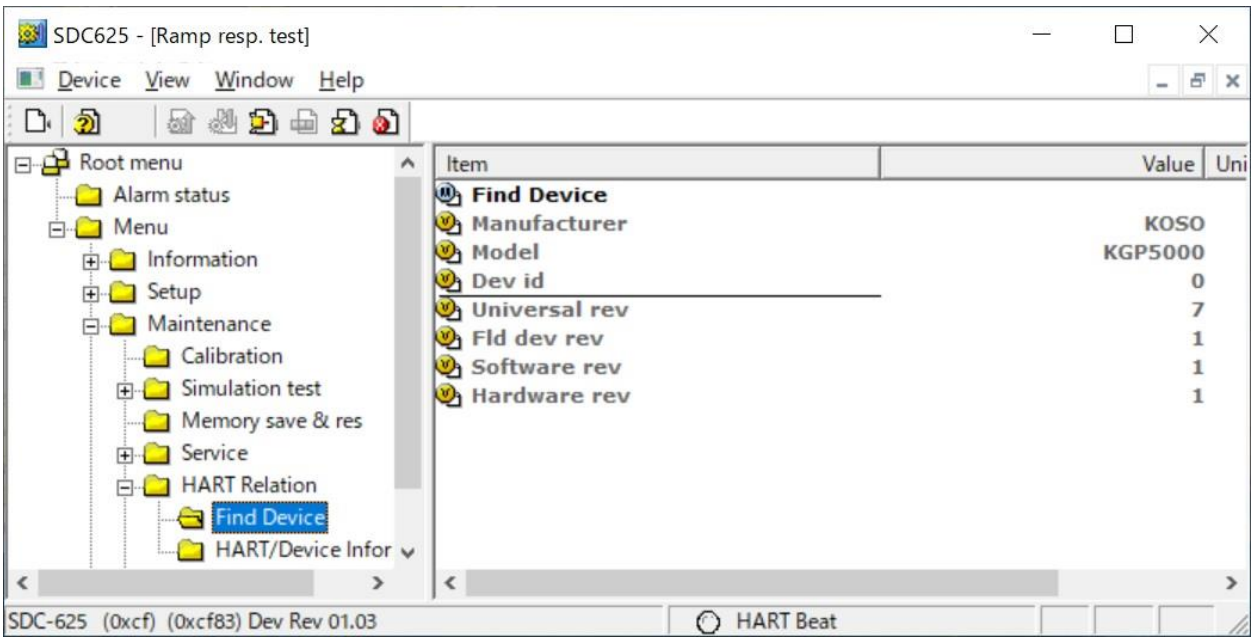
Functions related with HART communication.

3.3.5.1. Find device

By using this command, you can read device information from the armed device.

※ If no armed devices are found, communication will be disconnected.

MENU > Maintenance > HART relation > Find device



Commands:
Find Device

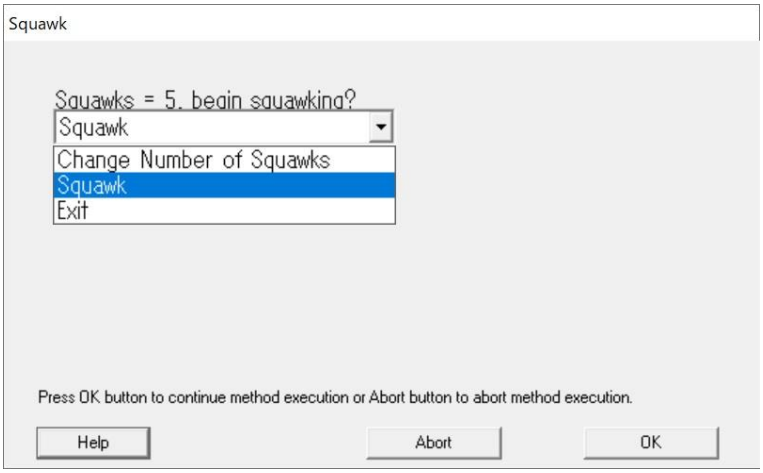
Device information:

Manufactur	Model
Dev id	Universal revision (HART)
Field device revision	Software revision
Hardware revision	

3.3.5.2. Squawk

By using this command, the ”Squawk ON !!” or " Squawk ONCE ON " is indicated(blinked) on a LCD screen of the device. To indicate the sign, screen on the LCD should be top menu or ‘HART relation > Squawk’ menu.

MENU > Maintenance > HART Relation > Squawk> Squawk



① If you want to change number of squawking, Select ‘Change Number of Squawks’ and ‘OK’. Then input the number.

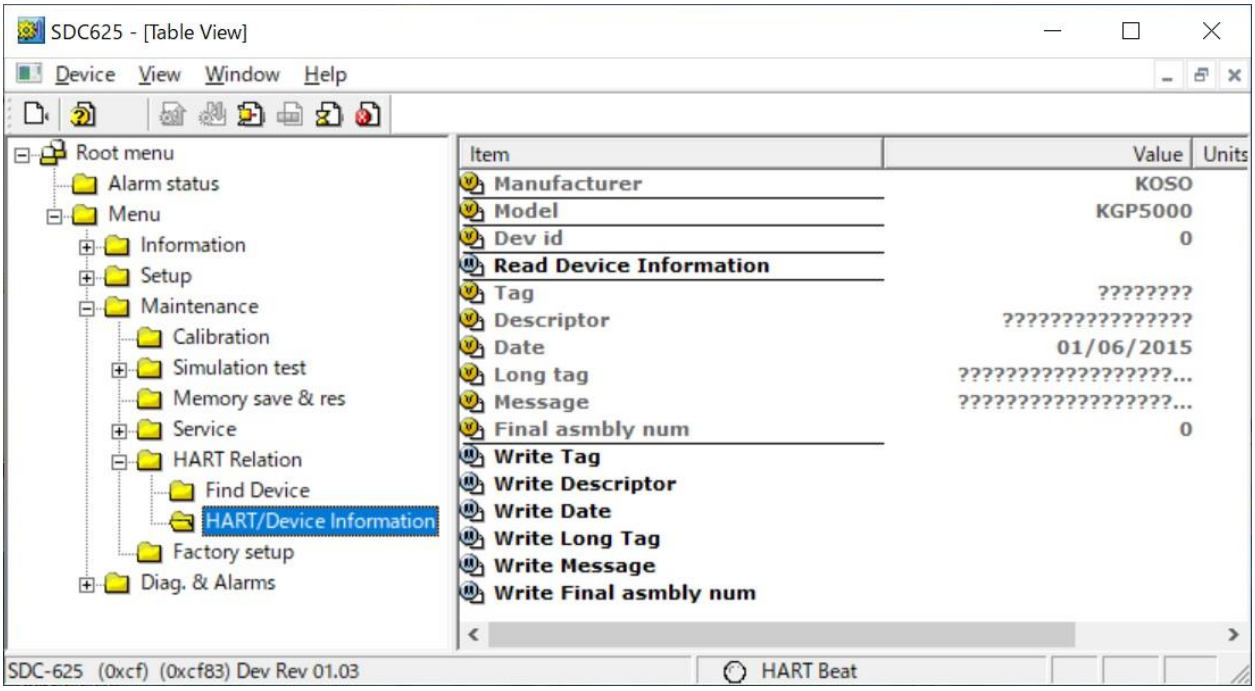
② To do squawking, select ‘Squawk’.

③ To exit from this screen, select ‘Exit’.

3.3.5.3. HART device information

By using the following commands, the device information on HART communication can be read and written.

MENU > Maintenance > HART Relation > HART/Device Information



Device information:

Manufacture*	Model*
Dev id*	Tag
Descriptor	Date
Long tag	Message
Final asmbly num	

*Read only information

Commands:

Read Device information	
Write Tag	Write Descriptor
Write Date	Write Long Tag
Write Message	Write Final assembly num

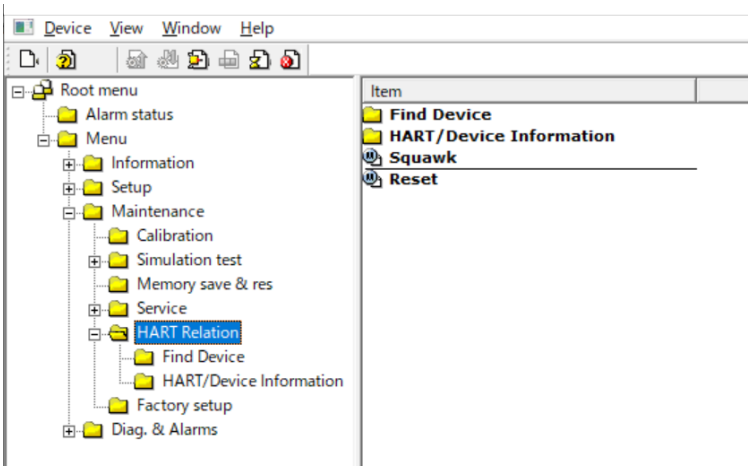
3.3.5.4. Reset

Warning

Reset causes the device shuts down for a few seconds. It may cause communication loss.

This is a function for restarting the device.
To reset the device, use the following command.

MENU > Maintenance > HART Relation > Reset



①Confirm the message and press 'OK'

3.4. Alarms

When detecting a breakdown of internal memory and sensors, this positioner announces an alarm by self-diagnostic function as well as shutdown an IP signal current off compulsorily and moves toward fail safe direction.
Additionally, it's possible to set the alarm condition optionally about the valve position, the deviation, the temperature and the pressures. Moreover, it'll be possible to assign the status category defined in NAMUR107 and to make LCD indicate a symbol mark to the respective alarms.

Note
The cause of alarm is taken as well as an alarm has to be released to return when an IP signal current signal blocked off compulsorily by an alarms.

Status symbols defined in NAMUR107 are shown in Table3.4.

Table3.4. NAMUR status

Symbol mark	Category	Description / Action to take
	Maintenance required	The problem caused by degradation and wear-out of the device out has occurred. Action) Adjust device or replace parts
	Check function	The problem caused by setting and adjustment of the device out has occurred. Action) Check setting and adjust device
	Out of specification	The problem caused by environment in which the device is used has occurred. Action) Remove environmental condition
	Failure	The problem caused by internal defects of the device has occurred. Action) Replacement of device or parts

3.4.1. Summary of alarms

Alarms unable to change setting;
Alarms caused by a breakdown inside the positioner are shown in Table 3.4.1a.

Table.3.4.1a. Alarms caused by a breakdown (unable to change setting)

Contents	Cause	Action to take
Memory failure	Failure of EEPROM	Replace the device or inquire to our office
Potentiometer failure	Failure of angle sensor	

After detecting these failures, the symbol marks of failure based on NAMUR107 are indicated on LCD. (Refer to right symbol mark)

Alarm of input signal level is shown in Table 3.4.1b.

Table 3.4.1b. Alarms caused by a breakdown (unable to change setting)

Contents	Description	Purpose to use
Input signal alarm "4-20 signal"	When the input signal of 4-20mA drops below 3.6mA, an alarm is occurred.	To detect a drop of the input signal level.
	Set-value; None (※Unable to change threshold) Status category; Out of specification (※Unable to change) 	

Alarms able to change setting (User selectable);

The description, the purpose to use, the setting about user selectable alarms are shown in Table.6.4.1b. It's possible to set a threshold of alarm according to the user's conditions for use, and also to assign a symbol mark based on NAMUR107 and to indicate on LCD.

Table. 3.4.1c. Alarms (able to change setting)

Contents	Description	Purpose to use
Position alarm	When the valve position exceeded an upper and lower threshold, an alarm is occurred.	To detect drifts of zero and span caused by wear-out and defect of control valves
	Set-value; 0% side threshold[%], 100% side threshold [%] Status category; Check function(default) 	
Deviation alarm	When the deviation of input signal and valve position exceeded a threshold, an alarm is occurred.	To detect sticking of control valve or actuator and air leakage of piping
	Set-value; Deviation threshold[%], Judgment time of deviation occur[s] Status category; Check function(default) 	
Temperature alarm	When the temperature exceeded an upper and lower threshold, an alarm is occurred.	To detect use by the temperature outside the specification which leads to early degradation of parts
	Set-value; Low temp. threshold [Celsius, Fahrenheit], High temp. threshold [Celsius, Fahrenheit] Status category; Out of specification(default) 	
High supply pressure alarm	When the supply pressure exceeded an upper threshold, an alarm is occurred.	To detect use by high supply pressure which leads to break of actuator diaphragm
	Set-value; High pressure threshold[kPa,bar,psi] Status category; Out of specification(default) 	
Low supply pressure alarm	When the supply pressure exceeded a lower threshold, an alarm is occurred and integral terms accumulation is stopped	To detect use by low supply pressure that leads to lack of actuator output. And, to suppress uncontrollability caused by saturation of the integral term, by

Contents	Description	Purpose to use
	and their correction is held.	stopping integral terms accumulation.
	Set-value; Low pressure threshold[kPa,bar,psi] Default status category; Out of specification 	
Failure of pressure sensors alarm	When the A/D value of pressure sensors exceeded a threshold, an alarm is occurred.	To detect abnormality of pressure sensors.
	Set-value; Disable / Enable (※Unable to change threshold) Status category; Failure (※Unable to change)  ※To disable under failure condition, once, remove the input signal. (Cycle the power.)	

3.4.2. Alarm setting / Check and Clear of result

It's possible to operate setting, check of a result and clear of each alarm by following menu.

1) Setting

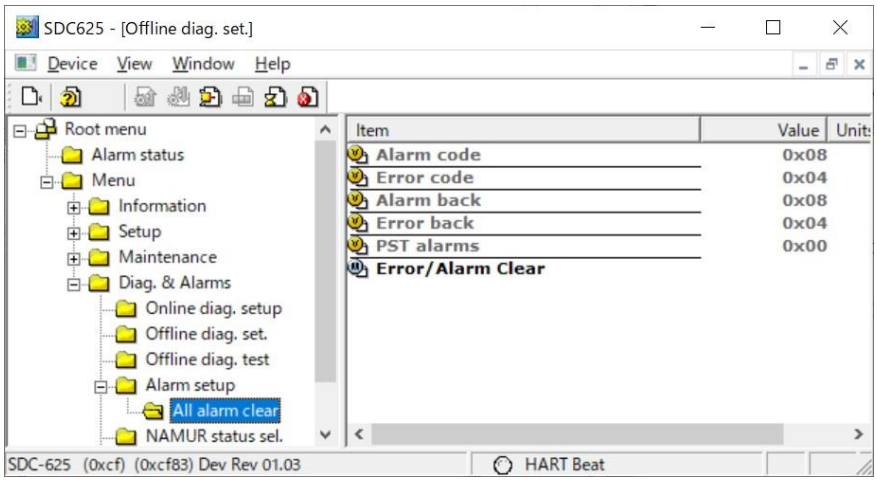
MENU > Diag. & Alarms > Alarm setup

2) Check of results

MENU > Information > Alarm status

3) Clear of results

MENU > Diag. & Alarms > Alarm setup > All alarm clear



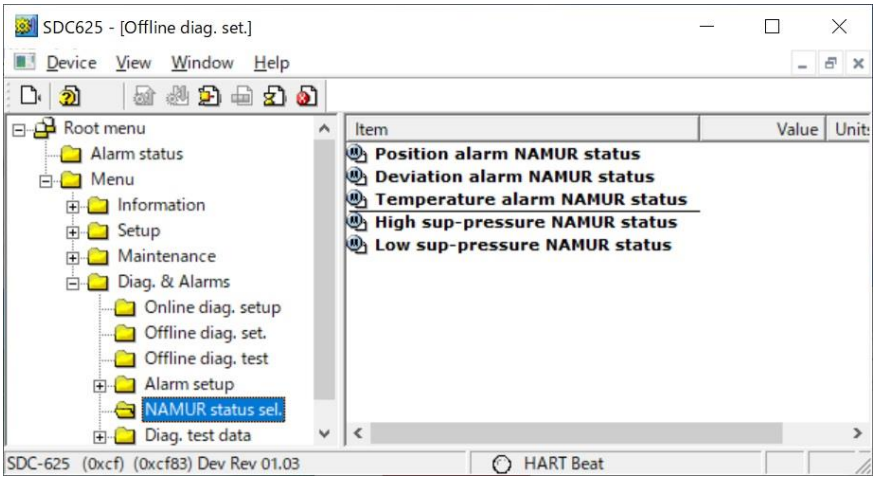
① Select 'Error/Alarm Clear'

3.4.3. NAMUR status select

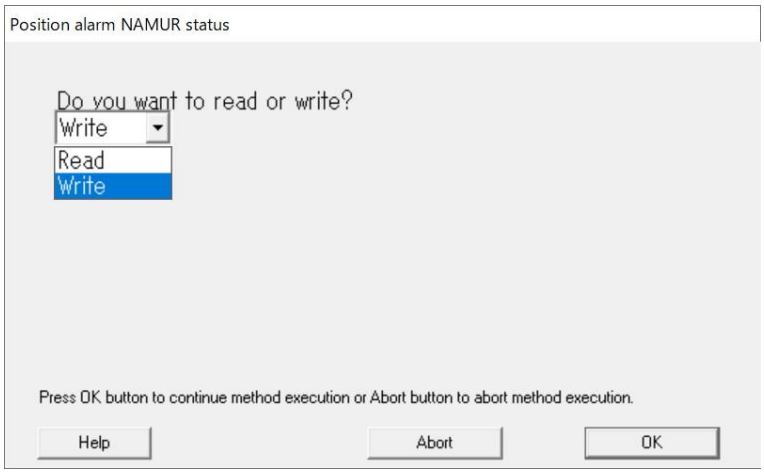
The NAMUR status category related to each alarm can be selected voluntarily.

For example, the procedure for setting the position alarm is as follows.

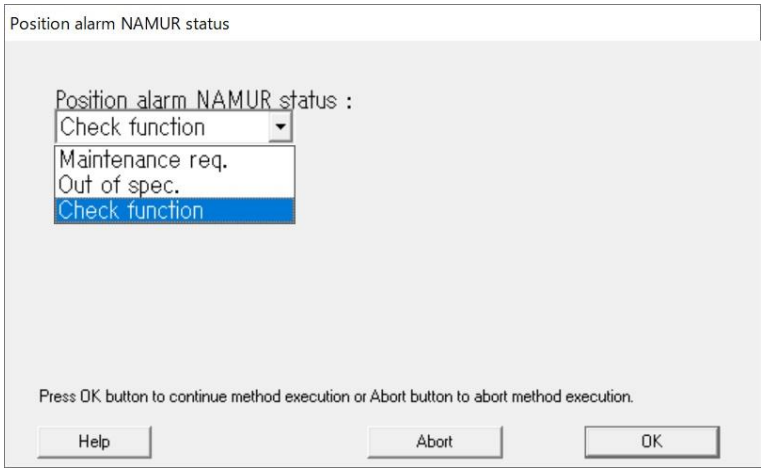
MENU > Diag. & Alarms > NAMUR status sel.



① Select the 'Position alarm NAMUR status'



② Select 'Write' and press 'OK'



③ Select NAMUR status category and press 'OK'

NAMUR status category:

Maintenance require
Out of specification
Check function

3.5. Diagnosis

Caution

- HART communication takes longer than the operation using the LUI of this unit, so be sure to complete the operation.

This positioner is equipped with the on-line diagnosis which acquires and estimates data during plant operation and the offline diagnosis performed in maintenance. Through appropriate diagnosis settings based on an operating condition of the installation environment and a process, it's possible to do efficient prevention and forecast preservation.

3.5.1. Online diagnosis

3.5.1.1. Summary of online diagnosis

Summary and set value of online diagnosis is indicated in Table 3.5.1.

Table 3.5.1. Online diagnosis

Items	Summary of online diagnosis
Total stroke	When a valve travel change beyond a threshold has happened, its displacement is accumulated, and it's indicated. It's possible to use it for a prediction of long-term deterioration such as wear of packing and damage of spring.
	Indicated value; The 200% valve position change is counted as 1. Ex) The five times full stroke of 100% equals to the 5 counts. It's indicated until at most about 4,200,000,000 counts, and when this is exceeded, it's reset by a zero. Set value; Criteria [%]: A threshold of the position change to accumulate is set.
Total direction change	When a valve travel direction change beyond a threshold has happened, its number of times is accumulated, and it's indicated. It's possible to use it for a prediction of long-term deterioration such as wear of packing and damage of spring.
	Set value; Criteria [%]: A change width to judge direction change is set.
Low position time	Time when the valve travel was in the range of threshold is accumulated, and it's indicated. It's possible to use it for a prediction of damage of the valve body caused by control by the low position.
	Set value; Criteria [%]: A position to judge low position is set.
Maximum temperature time	Time when the temperature was over threshold is accumulated, and it's indicated. It's possible to use it for a prediction of degradation and damage of a part caused by high temperature environment.
	Set value; Criteria [Celsius / Fahrenheit]: A temperature to judge high temperature is set.
Minimum temperature time	Time when the temperature was under threshold is accumulated, and it's indicated. It's possible to use it for a prediction of degradation and damage of a part caused by low temperature environment.
	Set value; Criteria [Celsius / Fahrenheit] : A temperature to judge low temperature is set.
Partial stroke test	Test to move such emergency shutdown valves partially and periodically, and to confirm its safety functions. It's possible to give a partial valve travel change and to check the defective performance of sticking of a valve periodically.
	Set value;

Items	Summary of online diagnosis

Disable / Enable : Select a periodical execution or not
Stroke size [%] : Set a position width to move
Completion stroke [%] : Set a stroke to judge movement completion
Start stroke [%] : Set a stroke to judge movement start

Abort time limit [s] : Set a time to judge movement cancellation before movement completion
Start time limit [s] : Set a time to judge movement cancellation before movement start
Abort pressure [kPa,bar,psi] : Set a output pressure 1(Pout1) change to judge movement cancellation
Interval day [day] : Set an interval of periodical execution
Direction : Set a direction to move

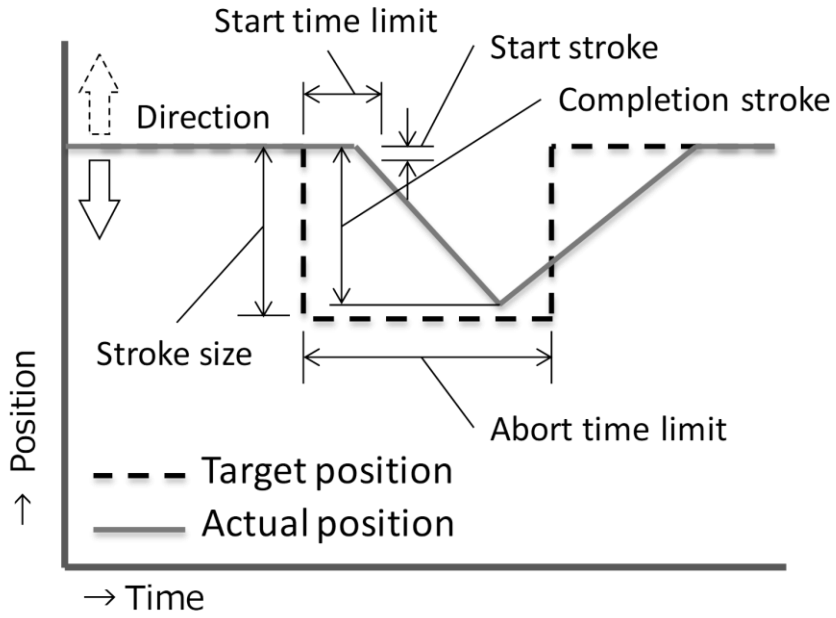


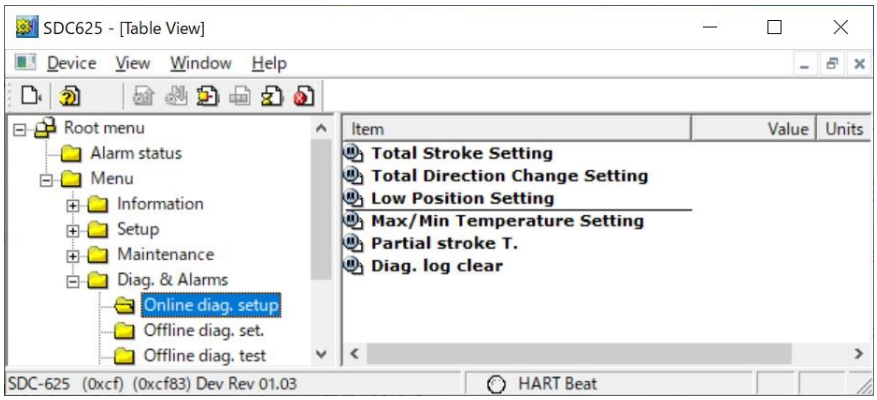
Fig. 3.5.1. Conceptual diagram of each parameters

3.5.1.2. Online diagnosis setup

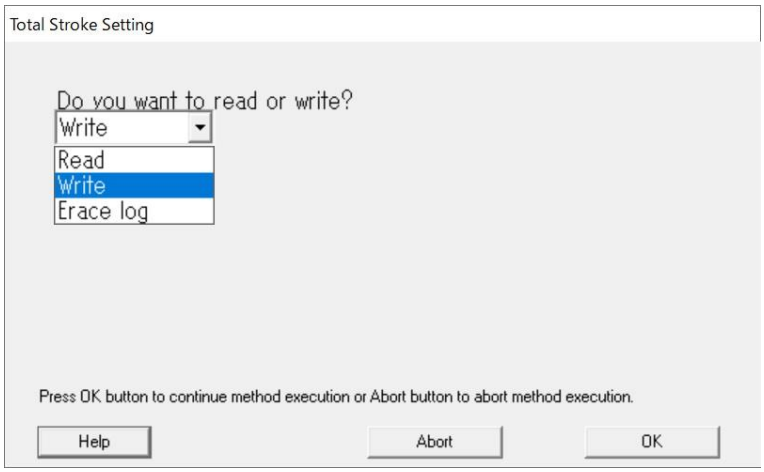
For example, the procedures for setting the total stroke parameter and erasing its log are as follows.

1) Setting the total stroke parameter.

MENU > Diag & Alarms > Online diag. setup



① Select the 'Total Stroke Setting'



② Select 'Write' and press 'OK'

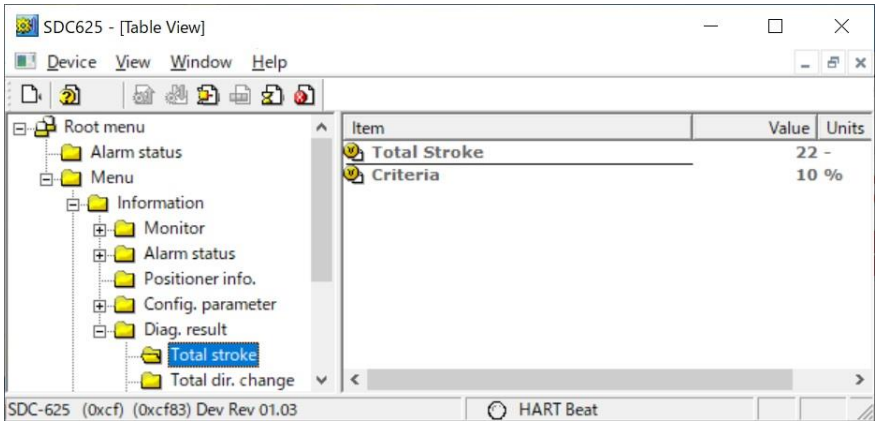
③ Select 'Criteria

④ Input a criteria value. (Value range: 1% - 50%)

⑤ Press 'OK' to set.

2) Check of results.

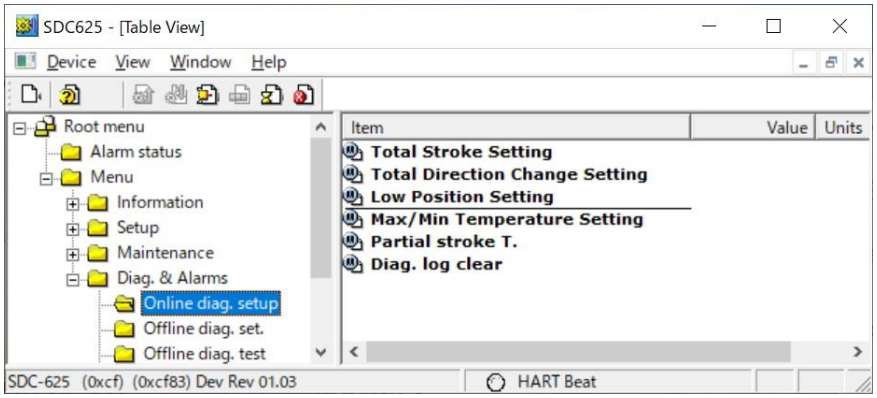
MENU > Information > Diag. resul > Total Stroke



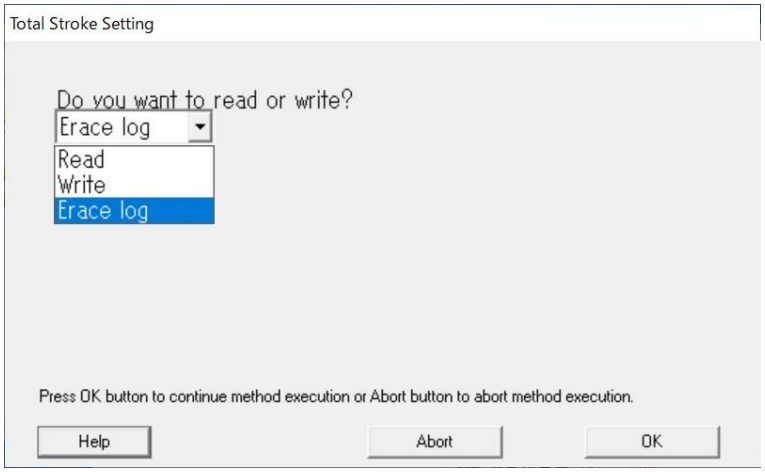
Total Stroke : Present total stroke value
Criteria : Set value

3) Erasing the total stroke log

MENU > Diag & Alarms > Online diag. setup



① Select the 'Total Stroke Setting'



② Select ‘Erase log’ and press ‘OK’

③ Press ‘OK’ on confirmation to execute.

3.5.1.3. Clear of diagnosis logs

The procedures for clearing diagnosis logs is as follows.

MENU > Diag & Alarms > Online diag. setup > Diag. log clear

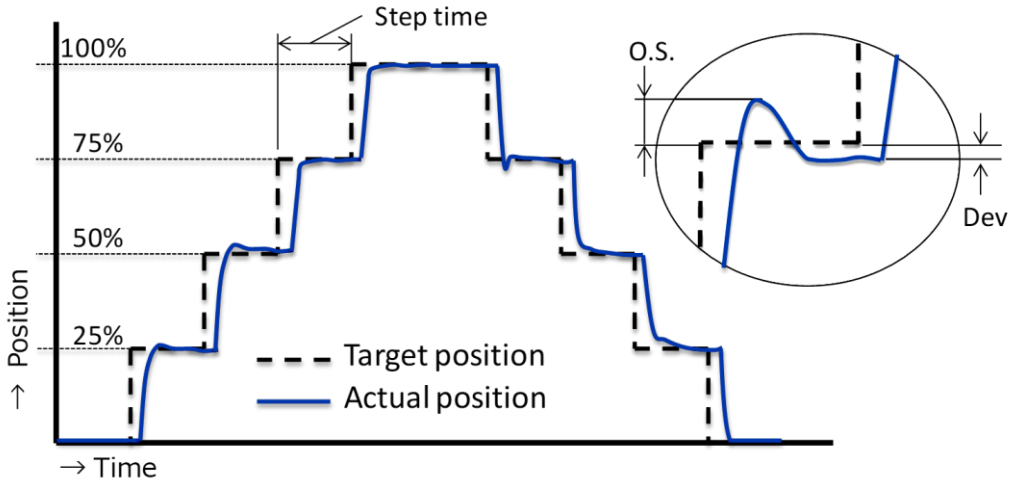
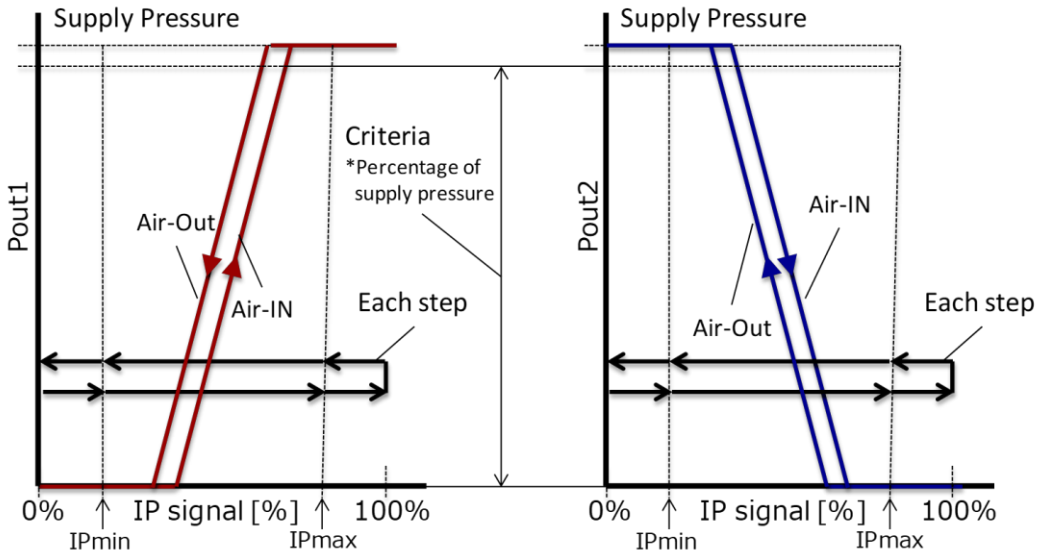
① Select 'OK' on confirmation screen to execute.

3.5.2. Offline diagnosis setup

3.5.2.1. Summary of offline diagnosis

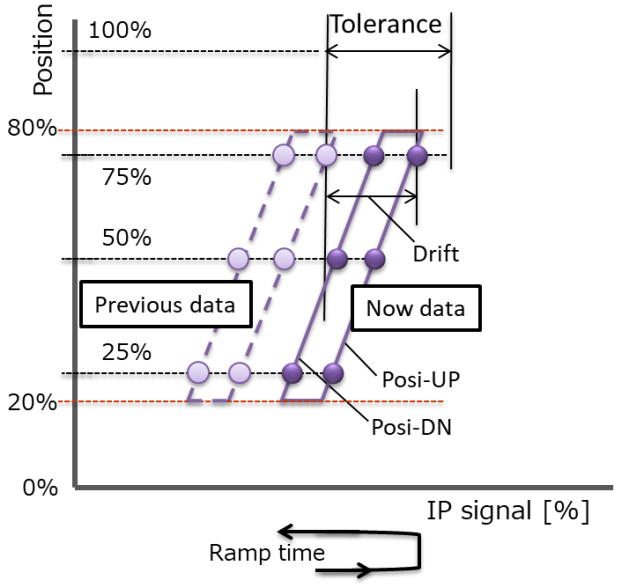
Summary and set value of offline diagnosis is indicated in Table 6.5.2.

Table3.5.2. Offline diagnosis

Items	Summary of offline diagnosis
25% step response	The 25% step response is executed, and the maximum overshoot (O.S.) and the final deviation (Dev.) are recorded. The degradation over time in step response can be checked by comparing initial values, previous values and present values. 
	Set value; Step time [s]: Set a waiting time per 1 step. Initial value: 60s
Pneumatic circuit span	Output pressure in the minimum value (IPmin) and the maximum value (IPmax) of the IP signal current used for control is measured, and it's checked whether the enough air pressure span is obtained or not. The degradation over time in a pneumatic circuit can be checked by comparing initial values, previous values and present values. 
	Set value; Step time [s]: Set a waiting time per 1 step. Initial value:20s Criteria [%]: Set a percentage of output width of output pressure to supply pressure Initial value: 95% ※Please set sufficient time for the position to become stable

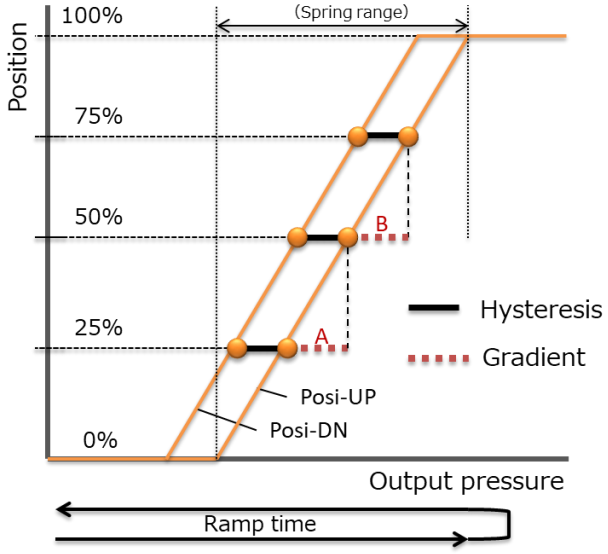
<table>
<tr><th>Items</th><th>Summary of offline diagnosis</th></tr>
<tr><td rowspan="2">Pneumatic circuit drift</td><td>IP signal current to control 25%, 50% and 75% position are measured, and it's checked whether the drift is in tolerance or not.

The degradation over time in a pneumatic circuit can be checked by comparing initial values, previous values and present values.

 
</td></tr>
<tr><td>Set value; Ramp time [s]: Set a time to fully stroke by ramp input. Initial value: 30s
Tolerance [%]: Set a tolerance of drifts of IP current. Initial value: 15%</td></tr>
<tr><td rowspan="2">Simple valve signature</td><td>Output pressure at 25%, 50% and 75% position are measured, and a hysteresis and pressure gradient of control valve are calculated, and it's checked whether the values are in tolerance or not.

It'll be a simple version of general valve signature.

The degradation of packing and spring in control valve can be checked by comparing initial values, previous values and present values.

Reference) The approximate hysteresis of the actuator can be calculated in% by the following formula.

Single acting type actuator : $\frac{\text{Hysteresis}}{(\text{GradientA} + \text{GradientB}) \times 2}$

Double acting type actuator : $\frac{\text{Hysteresis}}{\text{Supply air pressure}}$</td></tr>
<tr><td>Set value;
Ramp time [s]: Set a time to fully stroke by ramp input. Initial value: 60s
Hysteresis limit [kPa,bar,psi]: Set limit of pressure hysteresis. Initial: 50kPa
Gradient limit H [kPa,bar,psi]: Set upper limit of pressure gradient(pressure difference)
Initial value: 80kPa</td></tr>
</table>

3.5.2.2. 25% step response test

For setting and executing the 25% step response test are as follows.

1) Setting the 25% step response test

MENU > Diag & Alarms > Offline diag. set. > 25% step response

① Select 'Write' and press 'OK'

② Input a step time value.

③ Press 'OK' to set

2) Executing the 25% step response test

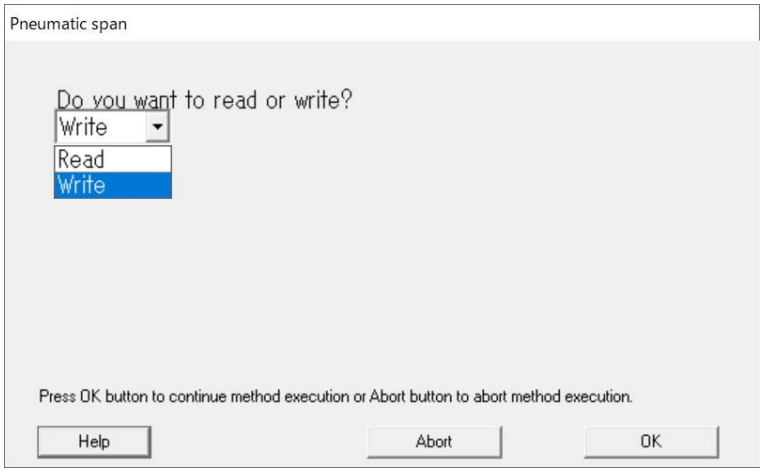
MENU > Diag & Alarms > Offline diag. test > 25% step response

① Press 'OK' on confirmation screen to execute.

3.5.2.3. Pneumatic circuit span

1) Setting

MENU > Diag & Alarms > Offline diag. set. > Pneumatic span



① Select 'Write' and press 'OK'

② Select 'Step time'

③ Input a step time value.

④ Select 'Criteria'

⑤ Input a criteria value.

⑥ Press 'OK'

2) Execution;

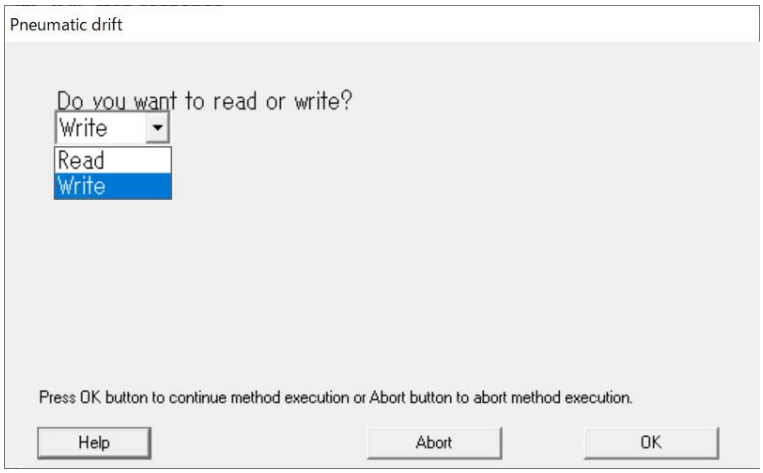
MENU > Diag & Alarms > Offline diag. test > Pneumatic span

① Select 'OK' on confirmation screen.

3.5.2.4. Pneumatic circuit drift

1) Setting

MENU > Diag & Alarms > Offline diag. set. > Pneumatic drift



① Select 'Write' and press 'OK'

② Select 'Ramp time'

③ Input a ramp time value

④ Select 'Tolerance'

⑤ Input a tolerance value.

⑥ Press 'OK' to set.

2) Execution

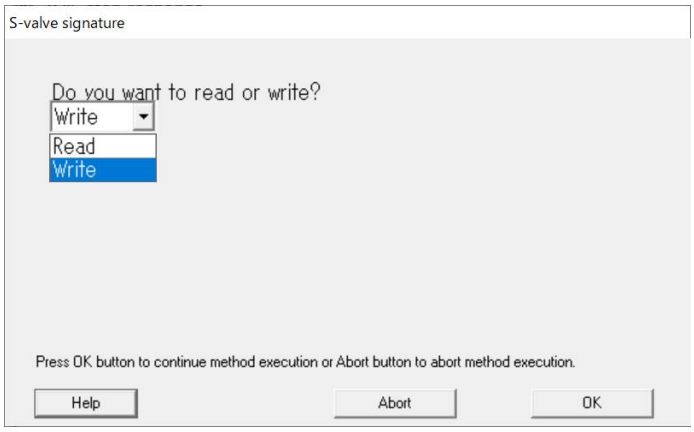
MENU > Diag & Alarms > Offline diag. test > Pneumatic drift

Press 'OK' on confirmation screen to execute.

3.5.2.5. Simple valve signature

1) Setting

MENU > Diag & Alarms > Offline diag. set. > S-valve signature



① Select 'Write' and press 'OK'

② Select 'Ramp time'

③ Input a ramp time value.

④ Select 'Hysteresis limit'

⑤ Input a hysteresis limit value.

Hysteresis limit(kPa) :
Sets the pressure hysteresis tolerance. For details, see Table 3.5.2.1. Offline diagnosis.

⑥ Select 'Gradient limit H'

⑦ Input a gradient limit high value.

Gradient limit H(kPa)：
Sets the upper limit of the pressure gradient tolerance. See Table 3.5.2.1 for more information.

⑧ Select 'Gradient limit L'

⑨ Input a gradient limit low value.

⑩ Press 'OK' to set.

Gradient limit L(kPa)：
Sets the upper limit of the pressure gradient tolerance. See Table 3.5.2.1 for more information.

2) Execution

MENU > Diag & Alarms > Offline diag. test > S-valve signature

Press 'OK' on confirmation screen to execute.

3.5.3. Check and Save of online diagnosis results (Diag.test data)

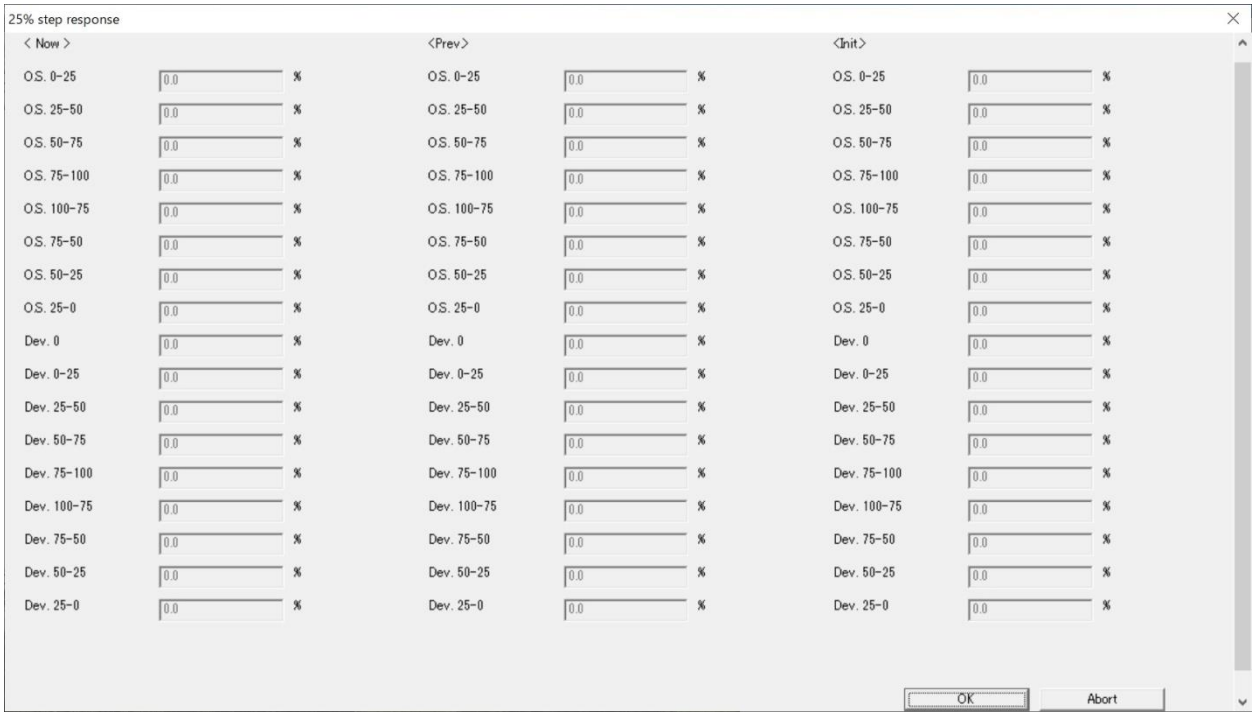
In this section, confirmation and save of diagnosis results are explained. It'll be the same operation with each diagnosis. Therefore, for instance, the 25% step response is explained here.

1) Check of result

It's possible to indicate a result data in following menu.

MENU > Diag & Alarms > Diag.test data > 25% step response

A list of result is indicated.



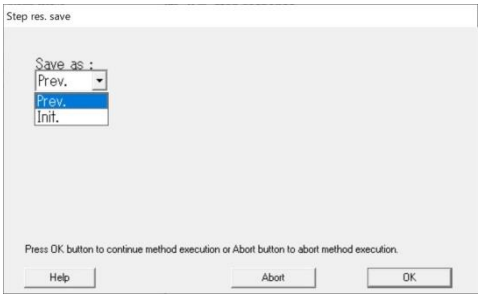
It's possible to indicate a result data from following menu.

MENU > Information > Diag. result > 25% step response

2) Save of result

You can save a result data as a previous data or an initial data from following menu.

MENU > Diag & Alarms > Diag.test data > Step res. save



① Select 'Prev.' or 'Init'

② Press 'OK' to save.

4. Troubleshooting

When problems occurred at the operation starting or during operation, please refer to the following table and take an action appropriately.

Table 4 Trouble shooting

Phenomenon	Assumed cause	Action
Does not move Move too slow Does not move fully	Loss of electrical power, disconnection or miswiring	✓ Check input current ✓ Check wiring
	Drop of supply pressure or loss	✓ Check supply pressure ✓ Check air regulator
	Leak from air piping	✓ Check piping
	Actuator abnormality / Handle is in manual mode	✓ Set handle to auto mode
	Actuator abnormality / Packing sticking or wear out	✓ Replace packing
	Lack of actuator output	✓ Replace actuator
	Forced shut down by positioner alarm	✓ Check alarm status
	Mistake of setting	✓ Check setting parameters ✓ Check PID parameter ✓ Check mode of A/M-unit
	Adjustment difference	✓ Cleaning of restriction ✓ Cleaning of nozzle flapper ✓ Adjustment of torque motor
	Breakdown of positioner	Inquire to our office
Hunting Overshoot	Abnormality of positioner	✓ Cleaning of restriction ✓ Cleaning of nozzle flapper
	Mismatch of PID parameter	✓ Check PID parameter
Bad accuracy	Abnormal attachment	✓ Check there are no backlashes ✓ Check whether a feedback lever becomes horizontal at 50% position ✓ Readjust cross point
	Abnormal control	✓ Check PID parameter ✓ Check dead band setting
	Actuator abnormality / Packing sticking or wear out	✓ Replace packing
LCD does not work	Loss of electrical power, disconnection or miswiring	✓ Check input current ✓ Check wiring
	Temperature is too low	✓ Check indication in the LCD specification temperature range.
	Breakdown of positioner	Inquire to our office
Position transmitter signal does not output or drifts	Loss of electrical power, disconnection or miswiring	✓ Check input voltage ✓ Check wiring
	Adjustment difference	✓ Implement position transmitter current calibration
Leak from valve seat of CVs	Lack of actuator output	✓ Increase actuator output (Raise actuator size)
	Corrosion, erosion or defect in valve seat	✓ Overhauling of valve

5. Menu item

1st hierarchy	2nd hierarchy	3rd hierarchy	4th hierarchy	5th hierarchy	6th hierarchy	reference (chapter)
Root Menu	Alarm status	Alarm status				3.1.2.
	<Set point>					
	<Position>					
	<Loop current >					
	<Input >					
	<P-sup. >					
	<P-out1 >					
	<P-out2 >					
	Menu	Information	Monitor	Status		3.1.1.1.
				Input/posi etc		3.1.1.2.
				Pressure		3.1.1.3.
				Temperature		3.1.1.4.
			Alarm status	Position alarm		3.1.2.
				Deviation alarm		
				Temperature alarm		
				S-pressure alarm		
				Other failure		
				PST alarm		
			Positioner info.	< Serial No.>		3.1.3.
				< Universal rev>		
				< Manufacture date>		
				Version		
			Config. Parameter	<Valve action>		3.1.4.
				<Packing friction>		
				<Booster option>		
				<Set point dir.>		
				Range ability		
				<PT burnout dir.>		
				<Transfer Function>		
				<Posi.transmit.dir>		
				Actuator setup		
				PID parameter set		
				Cutoff or Limit		
				Dead band		
				Input damper		
				Sprit range		
				Integ. stop press.		
			Diag. result	Total stroke		3.1.5.
				Total dir. change		
				Low position time		
				Total time		
				25% step response		
				Pneumatic span		
				PST setup info		
				Pneumatic drift		
				S-valve signature		

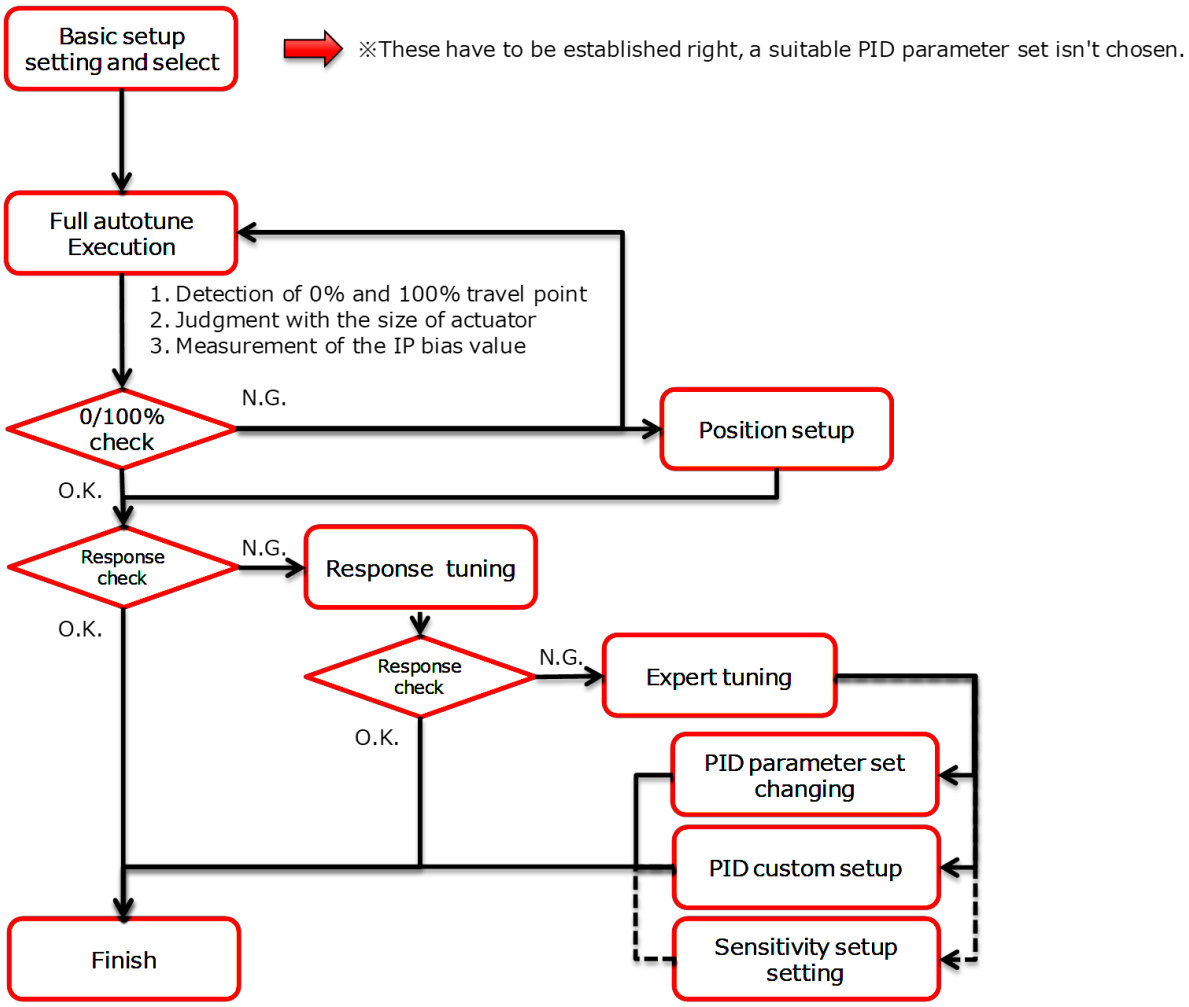
1st hierarchy	2nd hierarchy	3rd hierarchy	4th hierarchy	5th hierarchy	6th hierarchy	reference (chapter)
		Setup	Basic setup	Actuator motion	Linear	3.2.2.
					Rotary	
				Actuator type	Single	
					Double	
					5300	
				Valve action	ATO	
					ATC	
				Packing friction	Low	
					High	
				Booster option		
				Set point dir.	Normal	
					Reverse	
				Position transmit.dir	Normal	
					Reverse	
			Easy tuning	Full autotune	<Autotune status>	3.2.3.1.
					Full Autotune	
					<Autotune result>	
					Abort Autotune	
				Position setup	0%	3.2.3.2.
					100%	
					Auto span	
				Tuning result		3.2.3.1.
				Response tuning	Response tuning value	3.2.3.3.
			Expert tuning	PID parameter set	Custom /XS～XL	3.2.4.1.
				PID custom setup	Air-Out (not)= Air-In?	3.2.4.2.
					PID parameter Air-In	
					PID parameter Air-Out	
					Inside threshold	
					Inside PID AI	
					Inside PID AO	
				Sensitivity setup	Auto bias & size	3.2.4.3.
					Auto bias	
					Manual Bias	
			Detail Setup	Cutoff or Limit	Disable	3.2.6.
					Cutoff	
					Limit	
				Dead band	Disable/Enable	
				Transfer function	Linear	
					Equal percent Low	
					Equal percent Mid	
					Equal percent Hig	
					Quick opening	
					Custom curve	
				Custom Curve	Disable/Enable	
				Range ability		
				Input damper	Disable/Enable	
				Split range		
				PT burnout dir.	Low	
					High	
				AT span limit		
				Integ. stop press.		

1st hierarchy	2nd hierarchy	3rd hierarchy	4th hierarchy	5th hierarchy	6th hierarchy	reference (chapter)
		Setup	Function select	Authority	Authority	3.2.7.
					Control mode	
				Password setup	Disable/Enable	
				Screen saver	Disable/Enable	
				Temperature unit	Celsius	
					Fahrenheit	
				Pressure unit	kPa	
					psi	
					bar	
		Maintenance	Calibration	Input signal cal.		3.3.2.1.
				Cross point cal.		3.3.2.2.
				Position transmit		3.3.2.3.
				Pressure sensor	Sup.press.	3.3.2.4.
					Out1 press.	
					Out2 press.	
				Pilot relay adju.		3.3.1.3.
			Simulation test	Manual input	<Position>	3.3.3.1.
					Set Moving Value	
				Preset input	<Position>	
					Set Value	
				Ramp resp. test	<Mode>	3.3.3.2.
					Ramp resp. test	
					Abort Operation	
				Step resp. test	<Mode>	3.3.3.3.
					Step resp. test	
					Abort Operation	
			Memory save & res	Save		3.2.8.1.
				Restore		3.2.8.2.
				Factory default		3.2.8.3.
			Service	<Angle>		3.3.4.1.
				<Cross Point>		
				A/D values		
				Time stamp		
				PID values		
				Factory menu		3.3.4.2.
			HART Relation	Find Device		3.3.5.1.
				HART/Device information***		
				Squawk		3.3.5.2.
			*** HART only menu	Reset***		3.3.5.4.
			Factory setup**	IP signal range		
				IP signal factor		
			** Display only if 'Factory menu' is ON	Virtual DIP SW		
				Cutoff IP signal		

1st hierarchy	2nd hierarchy	3rd hierarchy	4th hierarchy	5th hierarchy	6th hierarchy	reference (chapter)
		Diag.& Alarms	Online diag.setup	Total Stroke Setting		3.5.1.2.
				Total Direction Change Setting		3.5.1.1.
				Low Position Stting		
				Max./Min Tmperature Setting		
				Partial stroke T.		
				Diag. log clear		3.5.1.3.
			Offline diag.set.	25% step response		3.5.2.2.
				Pneumatic span		3.5.2.3.
				Pneumatic drift		3.5.2.4.
				S-valve signature		3.5.2.5.
			Offline diag.test	<Mode>		
				25% step response		3.5.2.2.
				Pneumatic span		3.5.2.3.
				Pneumatic drift		3.5.2.4.
				S-valve signature		3.5.2.5.
				PST (offline)		3.5.1.1.
			Alarm setup	Position alarm		3.4.1.
				Deviation alarm		
				Temperature alarm		
				High sup-pres.AL		
				Low sup-pres.AL		
				Pressure failure		
				All alarm clear		3.4.2.
			NAMUR status sel.	Position alarm NAMUR status		3.4.3.
				Deviation alarm NAMUR status		
				Temperature alarm NAMUR status		
				High sup-pressure NAMUR status		
				Low sup-pressure NAMUR status		
			Diag.test data	25% Step response		3.5.3.
				Step res. save		
				Pneumatic span		
				Pneu. span save		
				Pneumatic drift		
				Pneu. drift save		
				S-valve signature		
				S-Valve sig. save		
				PST alarm result		

A) APPENDIX / Flow chart of settings procedure

In case of the purchase of a control valve with the positioner, settings described in this section are completed at the factory. Accordingly, it is not necessary to repeat the settings. However, if the positioner is specified on the order or it is separated from the control valve for maintenance, if necessary, perform the setting according to the following procedure.



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Pacific Seismic Products.Inc., CA, U.S.A.	Tel. (1) 661-942-4499	Fax (1) 661-942-0999
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Korea KOSO Engineering Co., Ltd., Seoul, Korea	Tel. (82) 2-539-9018	Fax. (82) 2-566-5119
KOSO Controls Asia Pte Ltd., Singapore	Tel. (65) 67472722	Fax. (65) 67467677
KOSO India Private Limited	Tel. (91) 253-2383111	Fax. (91) 253-2384413
KOSO Control Europe s.r.o. Czech	Tel. (420) 513-035-180	Fax. (420) 545-422-529
KOSO Italy	Tel. (39) 02-93162165	Fax. (39) 02-9306847
KOSO Gulf	Tel. (968) 2443-7695	