KGP5000 series
Smart valve positioner

HART Communication Operation Manual (for FDT DTM)

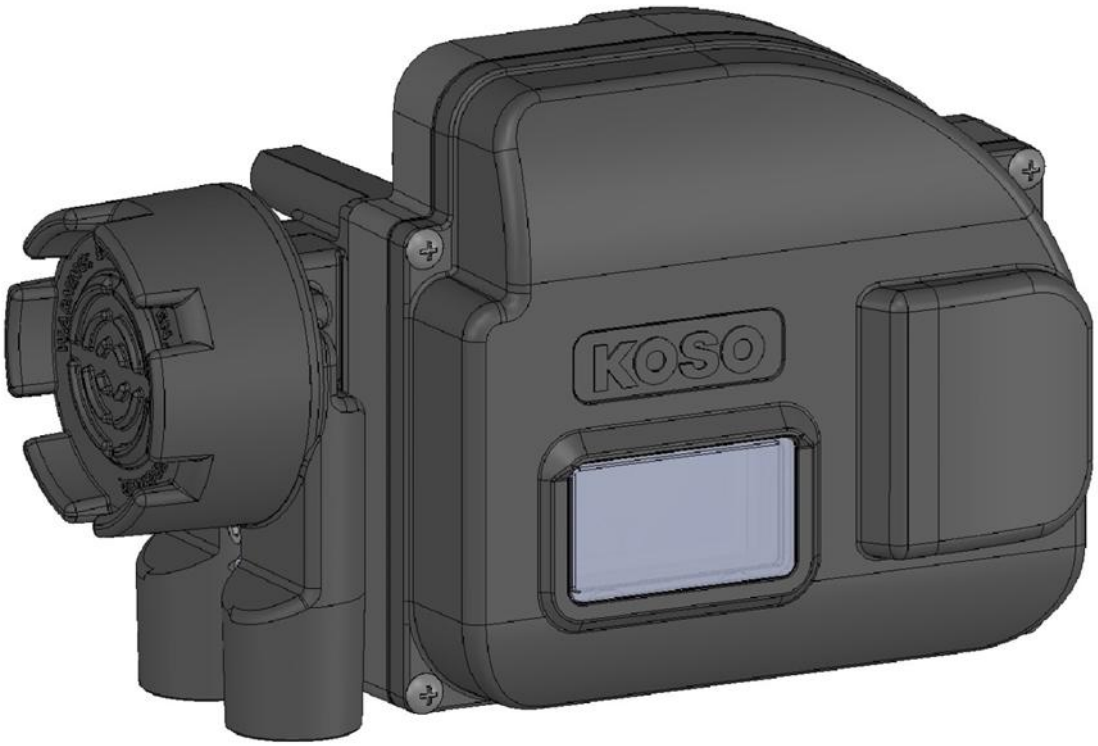


Table of Contents

1. Introduction

Please read carefully at first!

This operation manual includes getting information, calibration, maintenance steps, 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 : 1.0.0 and more

HART® FDT® DTM (※)
Version : 2 and more

※ HART® is a registered trademark of FieldComm Group.
FDT® is a registered trademark of FieldComm Group.

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 consider 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 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.

The figure1.4a below shows the layout of the entries for electrical connections and terminals.
There are a few different types of thread for entries.
You can identify the type of the thread by the engraved letter on the outside of entries. The letter “M” means M20X1.5, the letter ”N” means 1/2NPT and the letter “_” means G1/2.

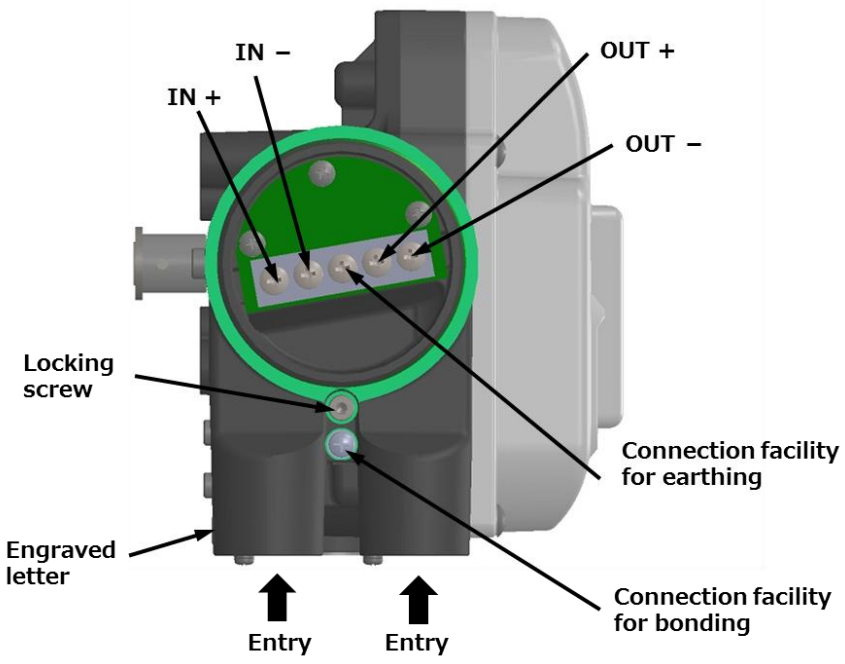


Figure1.4a Entries and Connection Facilities

Make wiring connections according to the following procedure.

1. Remove the terminal cover.
2. Lead a cable into the terminal box from the outside through the entries and the cable gland.
3. Connect wires of loop current, respectively, to IN+ and IN- of the positioner.
4. Connect wires of position transmitter, respectively, to OUT+ and OUT- of the positioner. ※ Model KGP5003 only
5. As illustrated in figure 1.4a, two connection facilities for earthing and bonding conductors are available. The two connection facilities are equipotential. Make wiring connections according to local electrical codes which apply to the application.
6. Fix a cable with the cable gland following the instruction manual of the cable gland manufacturer.
7. Replace the terminal cover.
8. Turn the cover locking screw counterclockwise to fix the terminal cover.

Field wiring diagram is shown in figure 1.4b and 1.4c.

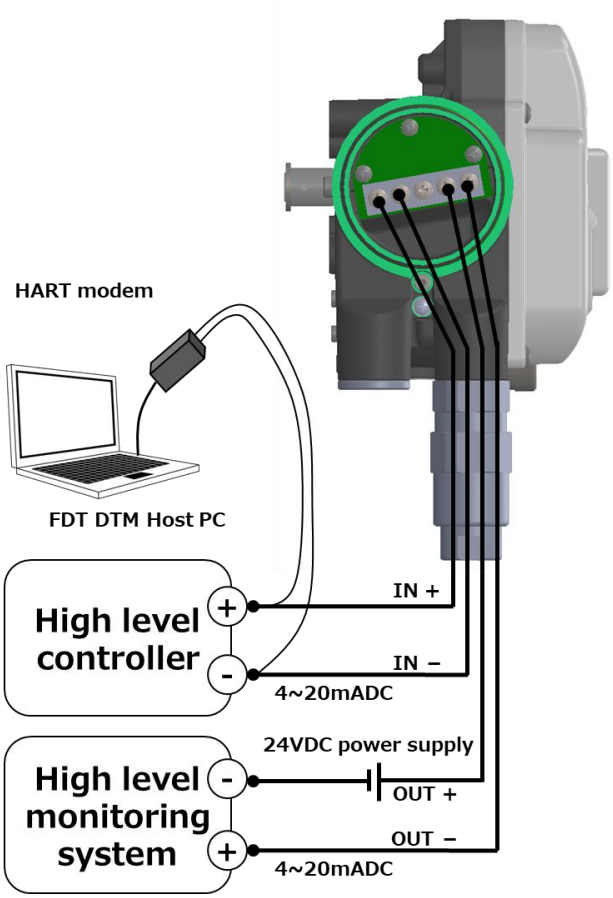


Figure 1.4b Field wiring diagram for 1 cable(4-core)

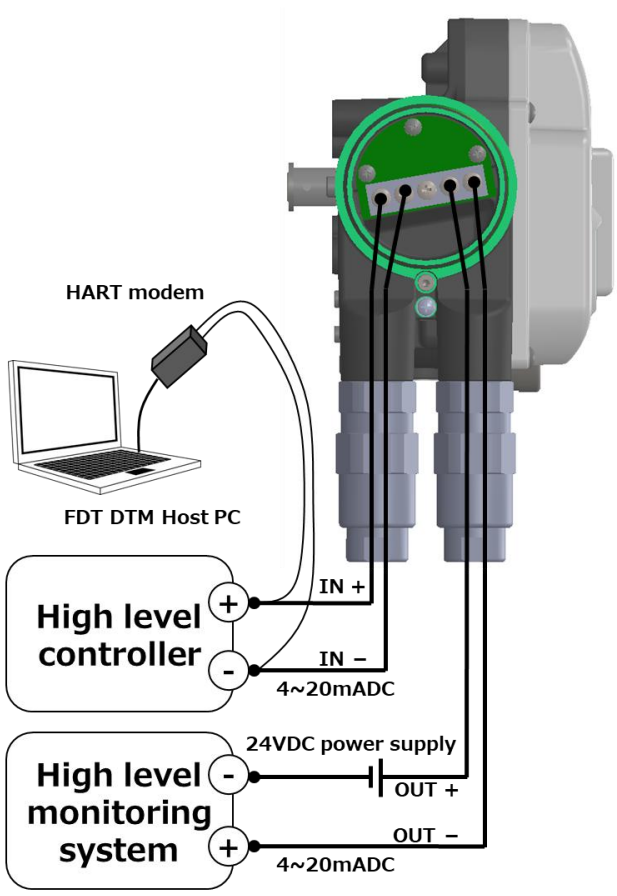


Figure 1.4c Field wiring diagram for 2 cable(2-core)

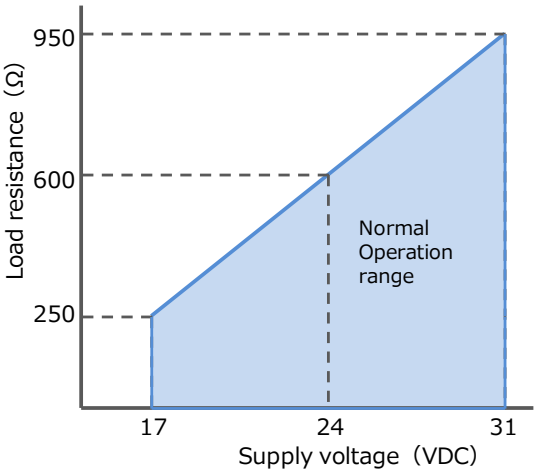


Figure 1.4d Load resistance to supply voltage relationship via the connection of position transmitter

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

Table 1.4a 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 db IIC Gb	-40℃～+70℃	-40℃～+73℃
KOSHA	1/2NPT	Ex d IIC	-20℃～+60℃	-20℃～+63℃
IECEx, CNS	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℃
EAC	1/2NPT or M20X1.5	1 Ex db IIC Gb	-40℃～+70℃	-40℃～+72℃

1.5. 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.

1.6. Preparation for HART communication

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

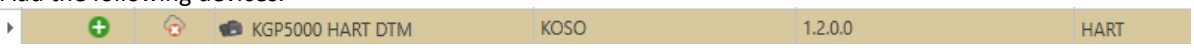
Note: Please contact the manufacturer to obtain and install the FDT host management software.
Note: Please check with the manufacturer for the installation of the HART modem driver.

The steps for obtaining FDT DTM and connecting to a PC are shown below.

1) Obtain FDT DTM for HART communication.
   You can use the FDT DTM from the CD that was included when you purchased this device unit.
   The FDT DTM can be downloaded from the KOSO's KGP5000 product site (in preparation).

2) Installation of FDT DTM.
   Unzip the obtained file KGP5000 HART DTM.zip file in any folder and execute KGP5000 HART DTM.exe in it.
   The installation wizard will start, so please follow the instructions on the screen to install.
   After installation, update the device catalog of the DTM host, and the KGP5000 DTM will be added to the HART Communication device.

   Add the following devices.



   For details, refer to the instruction manual of the FDT host management software you are using.

3) Connection
   Connect a communication tool (e.g. HART Communication tool or host controller...) to IN+ and IN- of the instrument as described in section 1.4.

2. Menu tree of the HART Communication

2.1. Menu type

This manual explains how to operate the KGP5000 via FDT DTM. It consists of the following menus:

Menu items	Description
① Process Variables	Process variables and information root menu
② Device Settings	Device settings menu
③ Maintenance	Maintenance root menu
④ Diagnostics	Diagnostics and Alarm root menu
⑤ Offline	Offline root menu

Table 2.1a Menu item

2.2. Menu structure

2.2.1. Process Variables menu

Select [Process Variables] in the Navigation menu to open the Process Variables menu.
For details on the Process Variables menu, see 4. Process Variables.

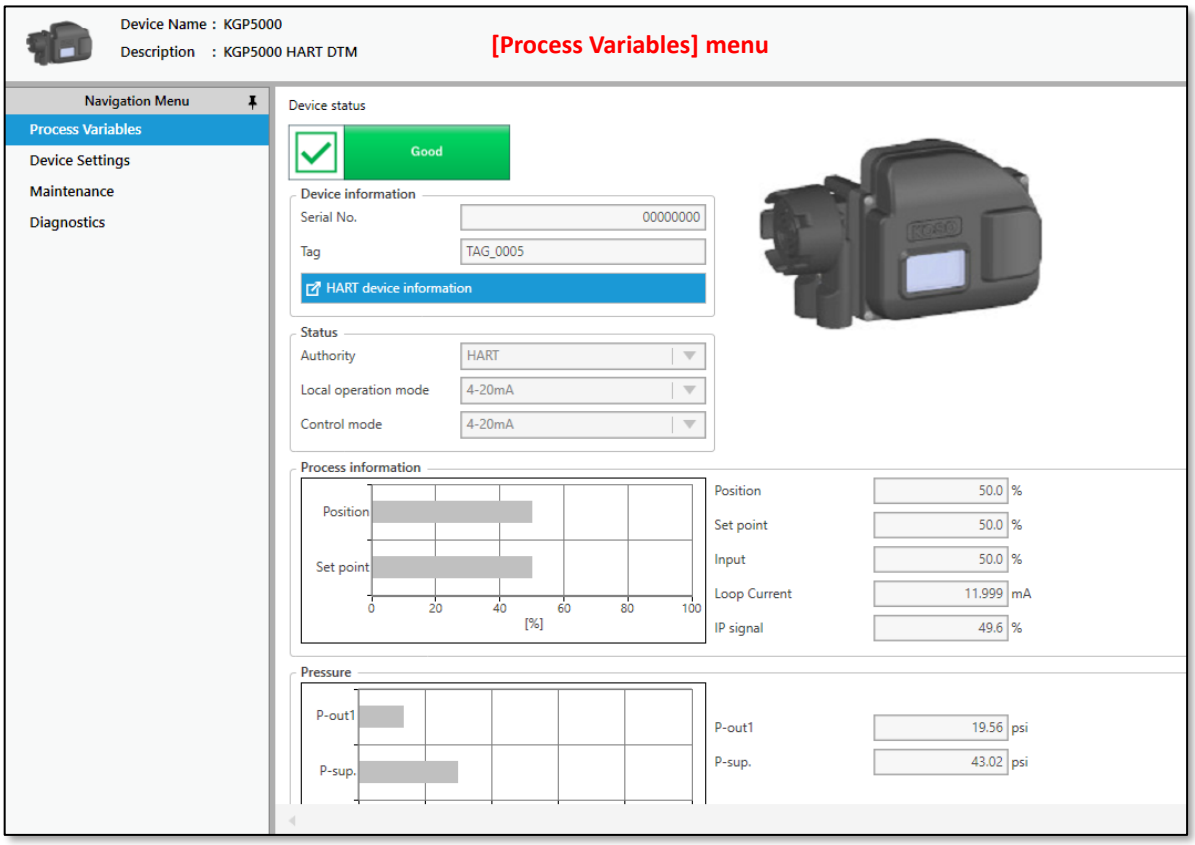


Figure 2.2.1a [Process Variables] menu

2.2.2. Device Settings menu

Select [Device Settings] in the Navigation menu to open the Device Settings menu.
For details on the Device settings menu, see 5. Device Settings.
This menu consists of the **[Device Settings] top menu** and the **[Extended device settings] menu** as a submenu.
The top menu displays an overview of the current settings. To check details or change settings, open the **[Extended device settings] menu**.

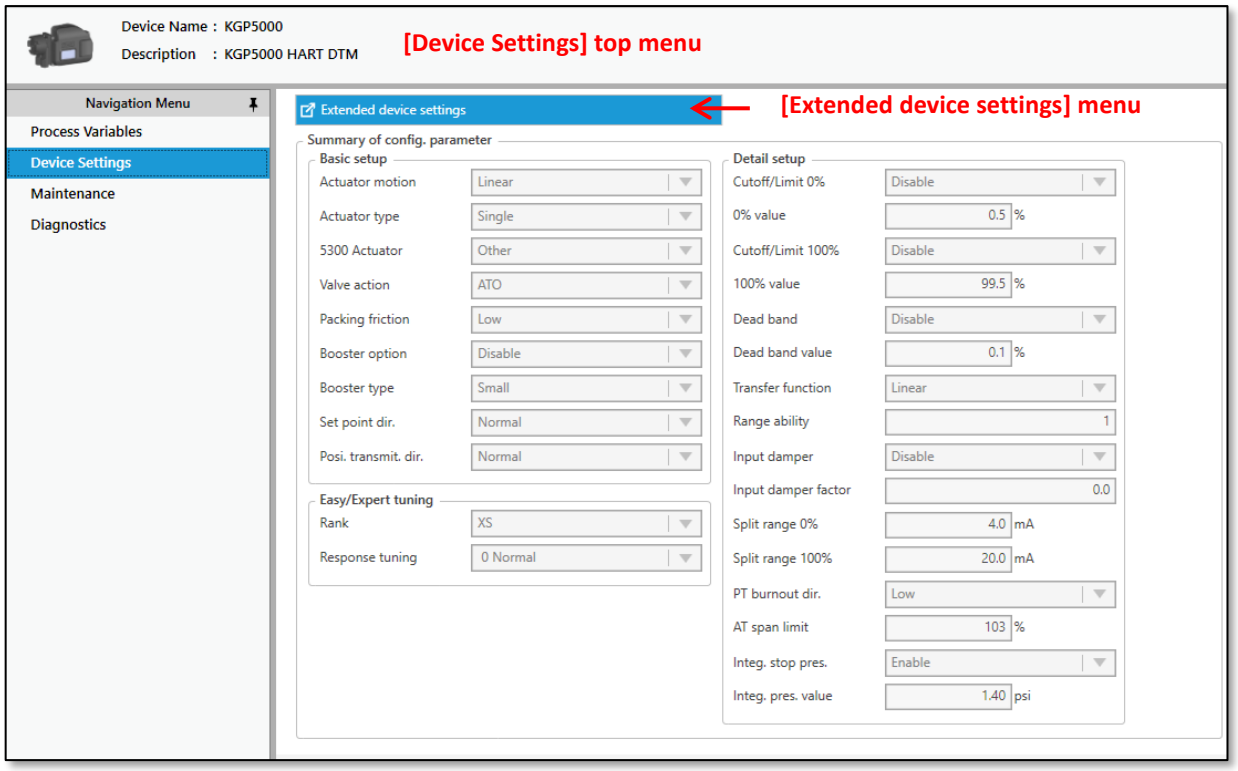


Figure2.2.2a [Device Settings] top menu

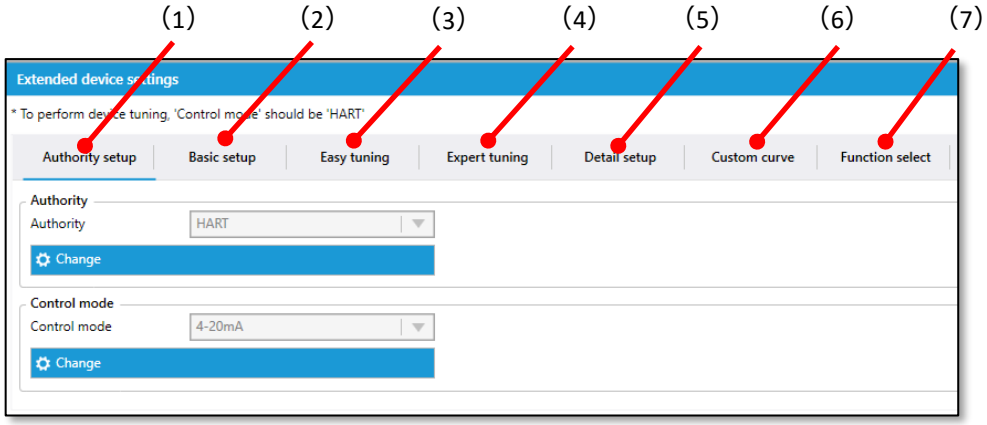


Figure.2.2.2b [Extended device settings] menu

[Extended device settings] menu consists of the following menus:

(1) Authority setup	See 3. Authority setup
(2) Basic setup	See 5.2. Basic setup
(3) Easy tuning	See 5.3. Easy tuning
(4) Expert tuning	See 5.4. Expert tuning
(5) Detail setup	See 5.5. Detail setup
(6) Custom curve	See 5.6. Custom curve
(7) Function select	See 5.7. Function select

2.2.3. Maintenance menu

Select [Maintenance] in the Navigation menu to open the Maintenance menu.
For details on the Maintenance menu, see 6. Maintenance.
This menu consists of the **[Maintenance] top menu** and the **[Extended maintenance] menu** as a submenu.
The top menu displays device basic information. To check details, change settings, perform calibration or …, open the **[Extended maintenance] menu**.

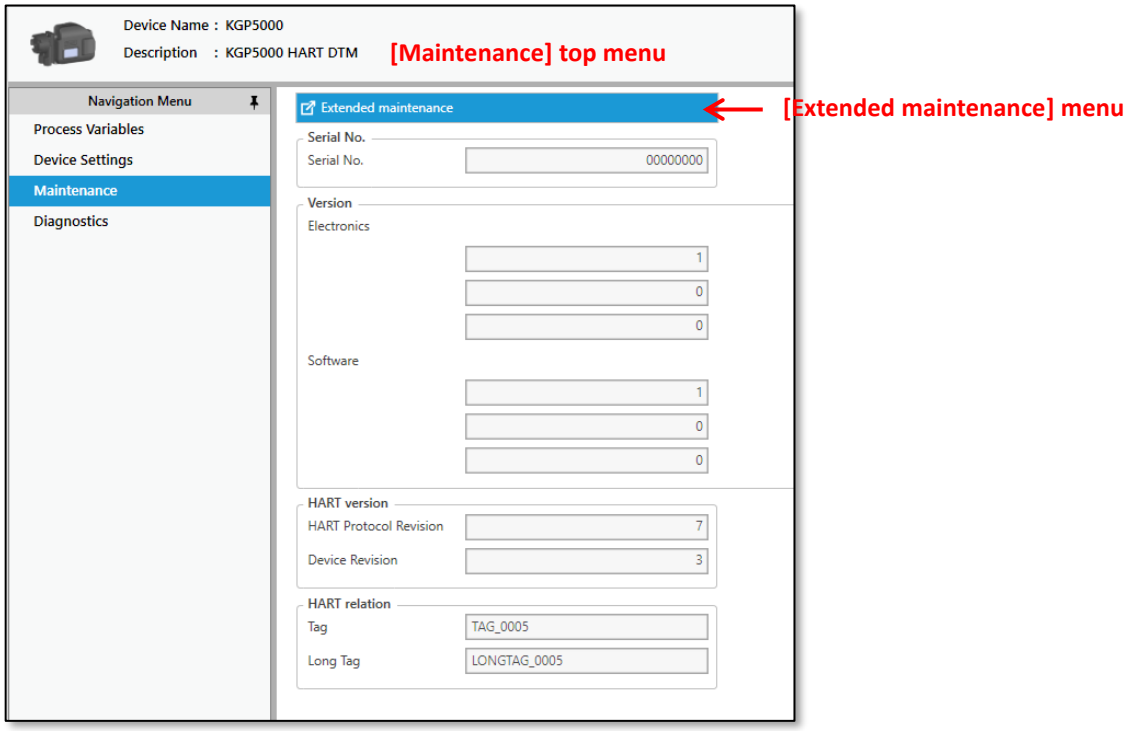


Figure 2.2.3a [Maintenance] top menu

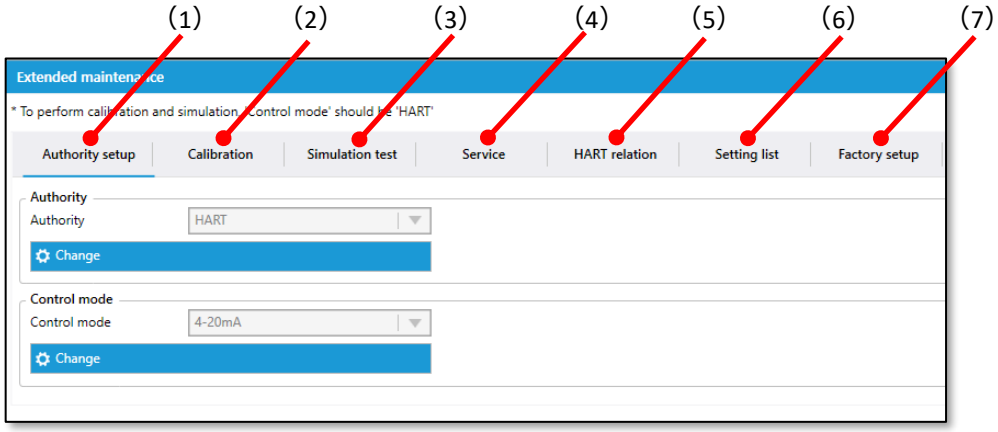


Figure 2.2.3b [Extended maintenance] menu

[Extended maintenance] menu consists of the following menus:

(1) Authority setup	See 3. Authority setup
(2) Calibration	See 6.2. Calibration
(3) Simulation test	See 6.3. Simulation test
(4) Service	See 6.4. Service
(5) HART relation	See 6.5. HART relation
(6) Setting list	See 6.6. Setting list
(7) Factory setup ※	See 6.7. Factory setup

※ This menu is not displayed by default.

2.2.4. Diagnostics menu

Select [Diagnostics] in the Navigation menu to open the Diagnostics menu.
For details on the Diagnostics menu, see 7. Diagnostics.
This menu consists of the **[Diagnostics] top menu** and the **[Extended diagnostics] menu** as a submenu.
The top menu displays diagnostics results. To check details, change settings, perform diagnostics, open the **[Extended diagnostics] menu**.

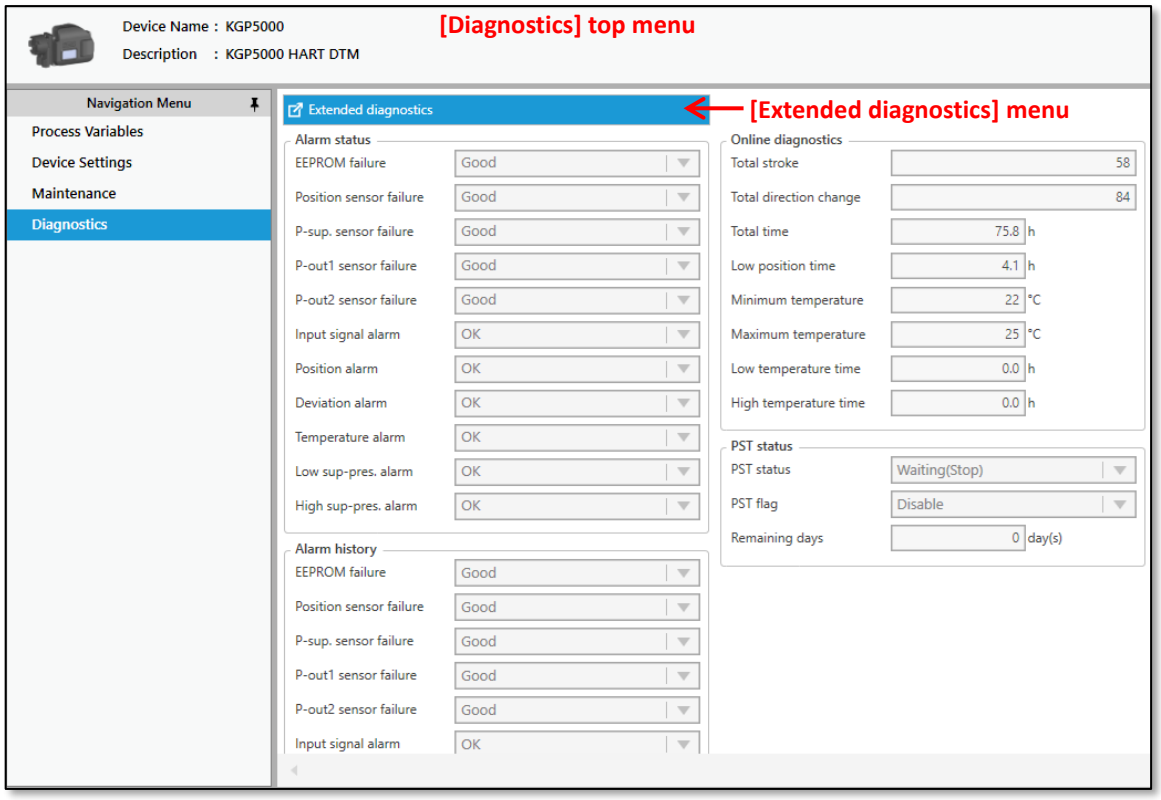


Figure 2.2.4a [Diagnostics] top menu

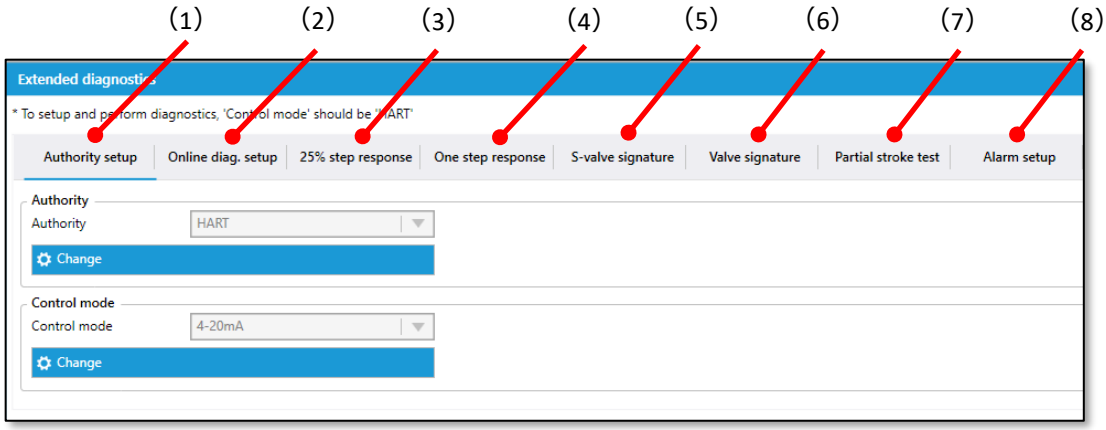


Figure 2.2.4b [Extended diagnostics] menu

[Extended diagnostics] menu consists of the following menus:

(1) Authority setup	See 3. Authority setup
(2) Online diag. setup	See 7.2. Online diag. setup
(3) 25% step response	See 7.3. 25% step response
(4) One step response	See 7.4. One step response
(5) S-valve signature	See 7.5. Simple valve signature
(6) Valve signature	See 7.6. Valve signature
(7) Partial stroke test	See 7.7. Partial stroke test (PST)
(8) Alarm setup	See 7.8. Alarm setup

2.2.5. Offline menu

For details on the Offline menu, see 8. Offline.

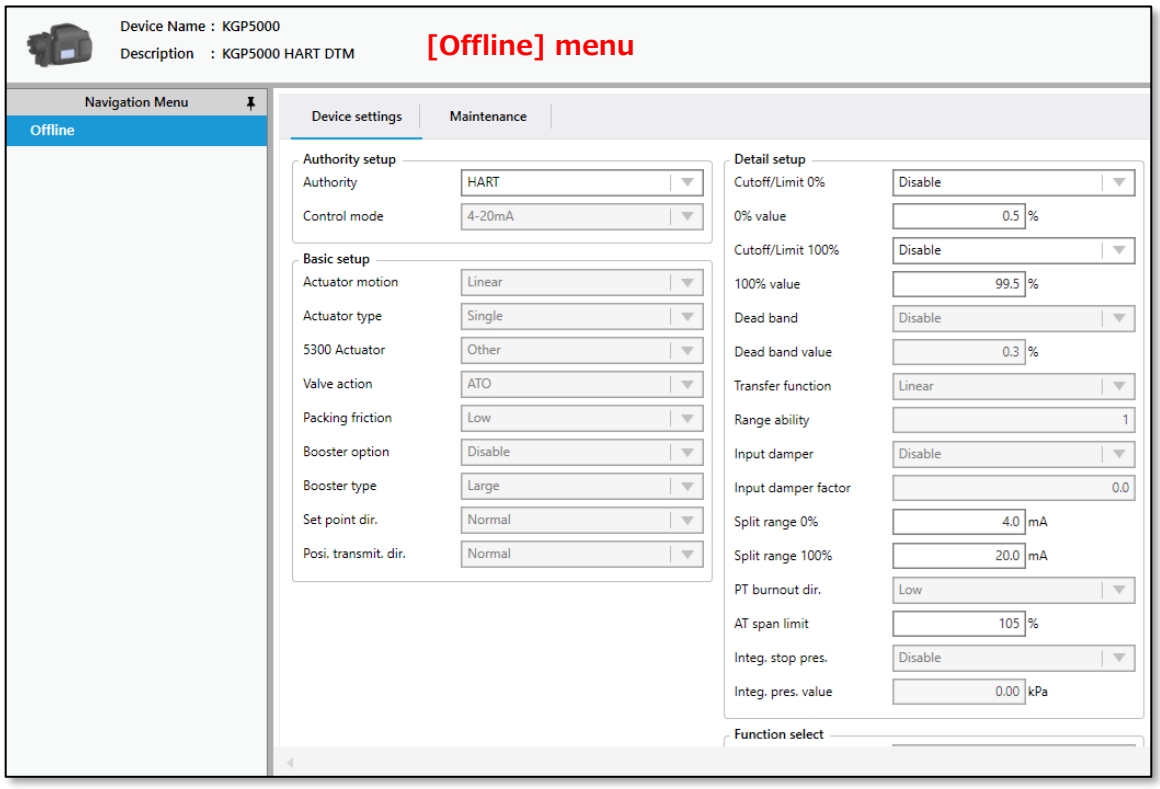


Figure.2.2.5a [Offline] menu

3. Authority setup

3.1. Operating and Setting authority from HART host controller

This device uses the "**Authority** (write authority)" parameter to change the authority to rewrite settings.
To change the positioner settings from HART host controller, change the "**Authority"** parameter to "HART" to remove the write protection.
Furthermore, to control special operations such as automatic adjustment, calibration, simulation, and offline diagnosis separately from input signals from HART host controller, it is necessary to change the "**Control mode"** (operation authority) parameter to "HART".

Table 3.1 List of selectable functions

Items	Description	Parameter	Default
Authority	Set write authority to HART communication. Select HART in case in which settings should be configured via not LUI but HART communication only. Once HART is selected, only 'Information' from 'TOP' menu will be able to be accessed through LUI. ※ If to change the setting back from HART to LUI, please get permission in advance from the person responsible for controlling the device via HART communication. ※ To reset from HART to LCD(LUI), the following special operation must be conducted. When a screen is displayed as shown below, MENU > Information > Monitor > Status 1. Press the up ⇧ and left ⇦ arrow keys simultaneously for four (4) seconds. 2. When a "Yes/No" confirmation is displayed, select "Yes". 3. The switching from HART to LCD(LUI) of access authority will be completed.	LCD / HART	LCD
Control mode	Set operational authority. Select "HART" to execute operations from HART host controller. Select "4-20mA" to execute operations from input signal.	4-20 mA/ HART	4-20 mA

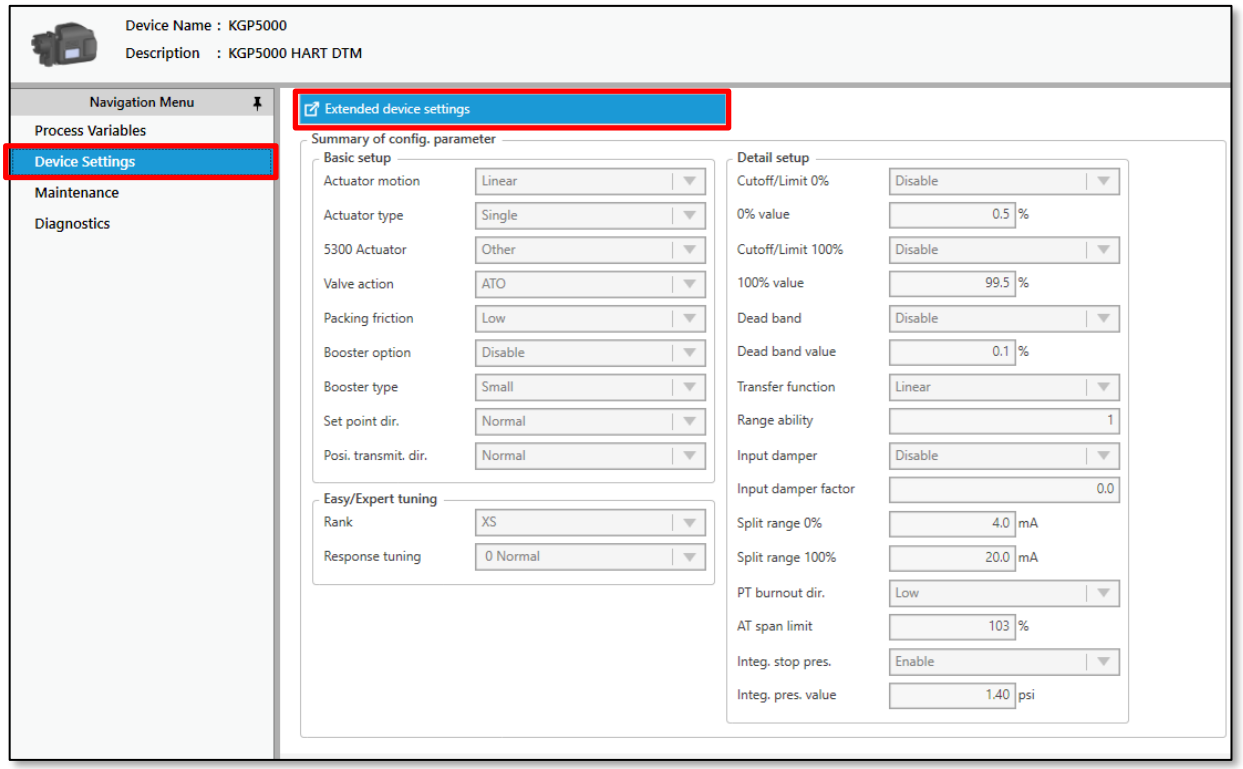
Note: To change **Authority** to "HART", the LUI (LCD) screen must be in the **TOP menu**, **Alarm status menu**, or **Information menu**.

3.1.1. Check “Authority” and “Control mode”

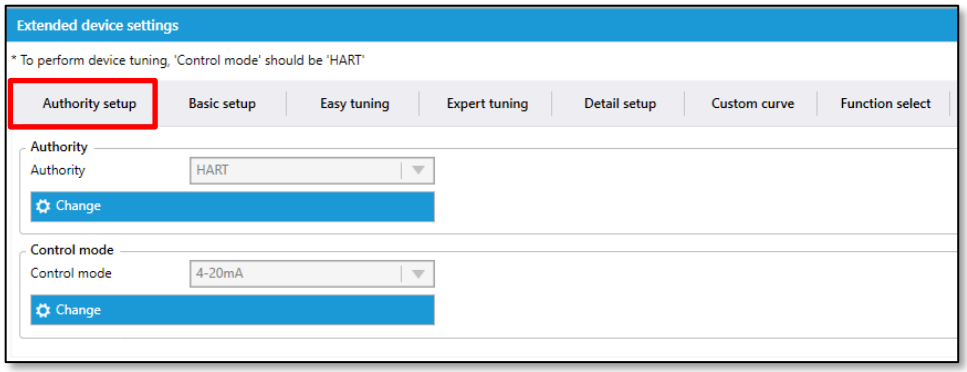
MENU) *Device Settings > Extended device settings > Authority setup*

① Select [Device Settings] in the Navigation Menu to open the [Device Settings] top menu.

② Click [Extended device settings] and open [Extended device settings] menu.



③ Select [Authority setup] menu tab.



※ Same menu also exist under the [Extended maintenance] menu and [Extended diagnostics menu].

MENU) *Maintenance > Extended maintenance > Authority setup*

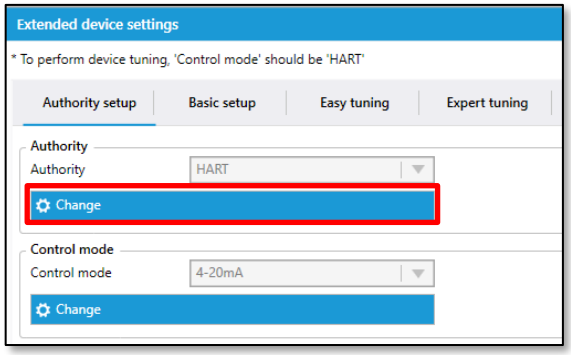
MENU) *Diagnostics > Extended diagnostics > Authority setup*

3.1.2. Change “Authority”

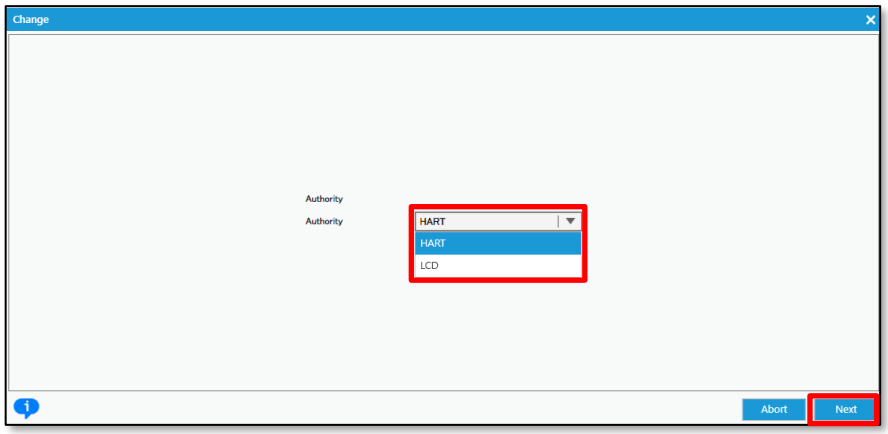
The steps to change “**Authority**” is shown below.

MENU) *Device Settings > Extended device settings > Authority setup > Authority*

① Click [Change] in the [Authority] menu group.



② If give authority to change configuration to the HART host controller, select "HART".
If do not give authority to change configuration to the HART host controller, select "LCD". Click [Next] to configure.

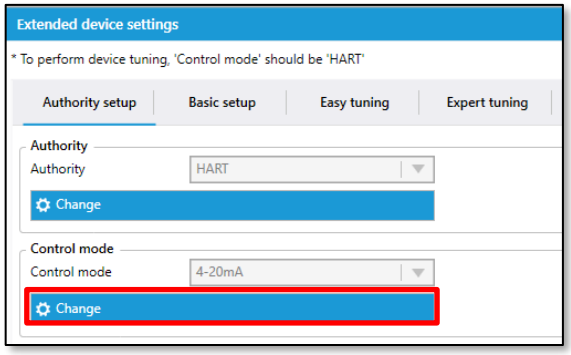


3.1.3. Change “Control mode”

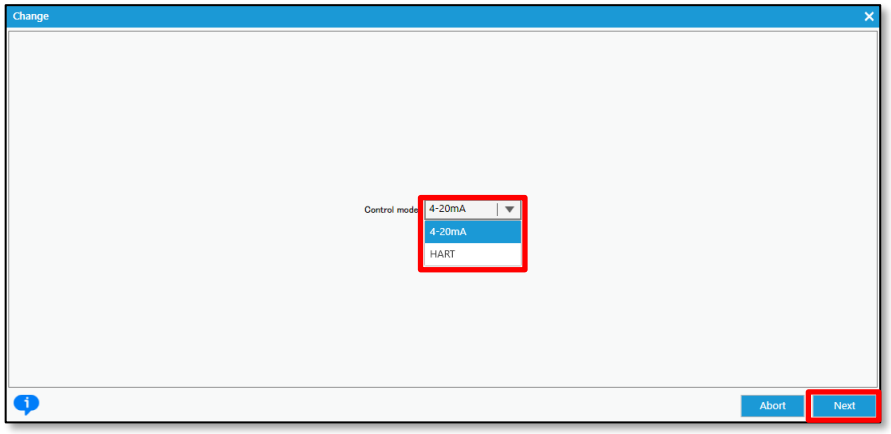
To change “**Control mode**” is shown below.
※ In order to change **“Control mode”**, the **“Authority”** setting must be “HART”.

MENU) *Device Settings > Extended device settings > Authority setup > Control mode*

① Click [Change] in the [Control mode] menu group.



② If give operational authority to the HART host controller, select "HART". If do not give operational authority to the HART host controller, select "4-20mA". Click [Next] to configure.

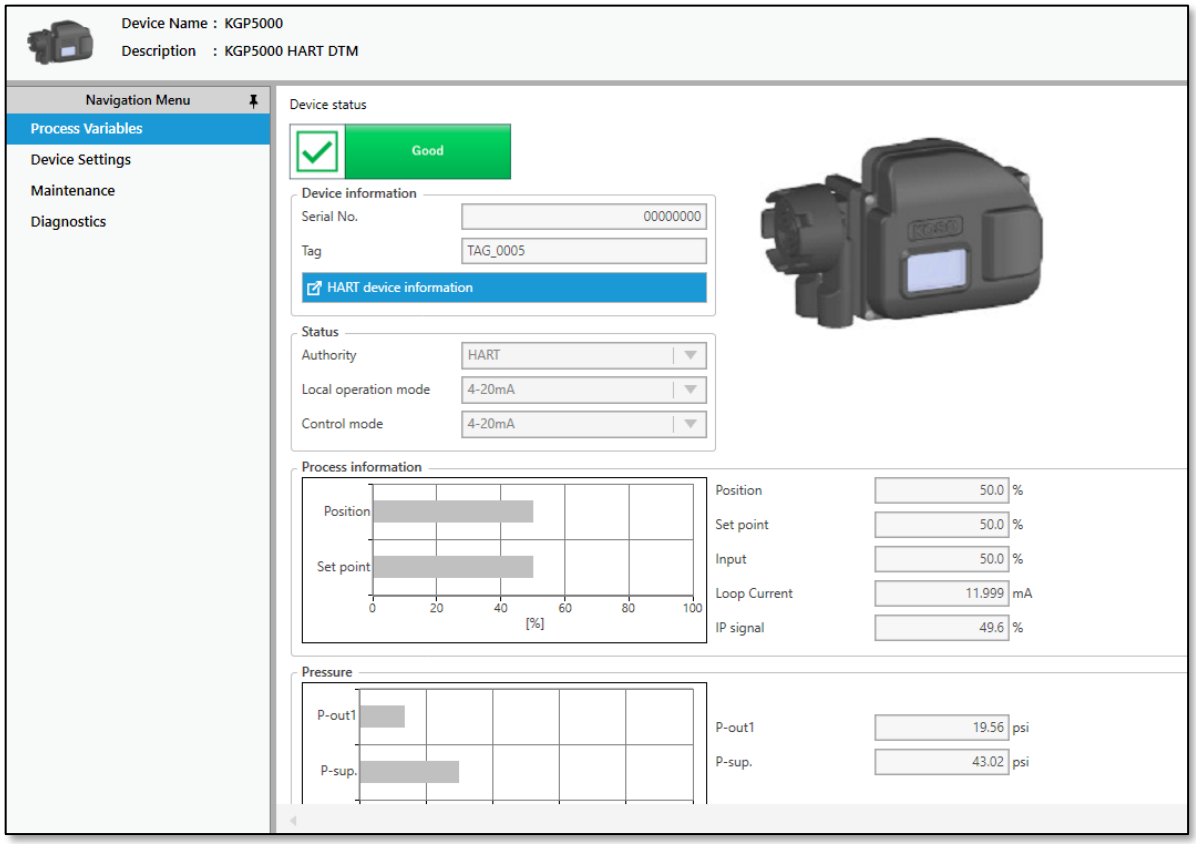


4. Process Variables

This menu offers to display the process variables and other basic information and control setpoints.

MENU) *Process Variables*

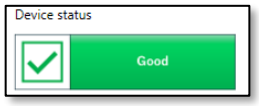
Select [Process Variables] in the Navigation menu to open the **[Process Variables] menu**.



This menu offers to confirm the following information.
Device status, Device Information, Monitor, Trend, Manual input, and Alarm information.

4.1. Device status

This status displays device health status.



4.2. Device information

This menu displays device information for the positioner.

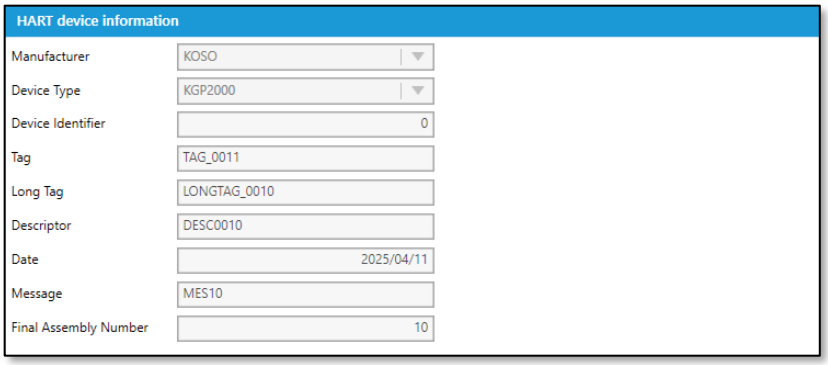
Displayed items are as follows:

Serial No.	: Serial number	Tag	: Tag number

To view detailed information, perform the following operations.

① Click [Device information] in the [HART device information] menu group.

② Open the detailed information menu.

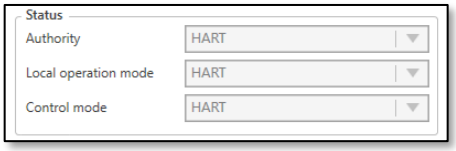


Displayed items are as follows:

Manufacturer	: Manufacturer	Descriptor	: Descriptor
Device Type	: Model	Date	: Date
Device Identifier	: Device Identifier	Message	: Message
Tag	: Tag number	Final Assembly Number	: Final Assembly Number
Long Tag	: Long Tag number		

4.3. Status

This menu displays the write authority, operational authority, and special control mode of the positioner.

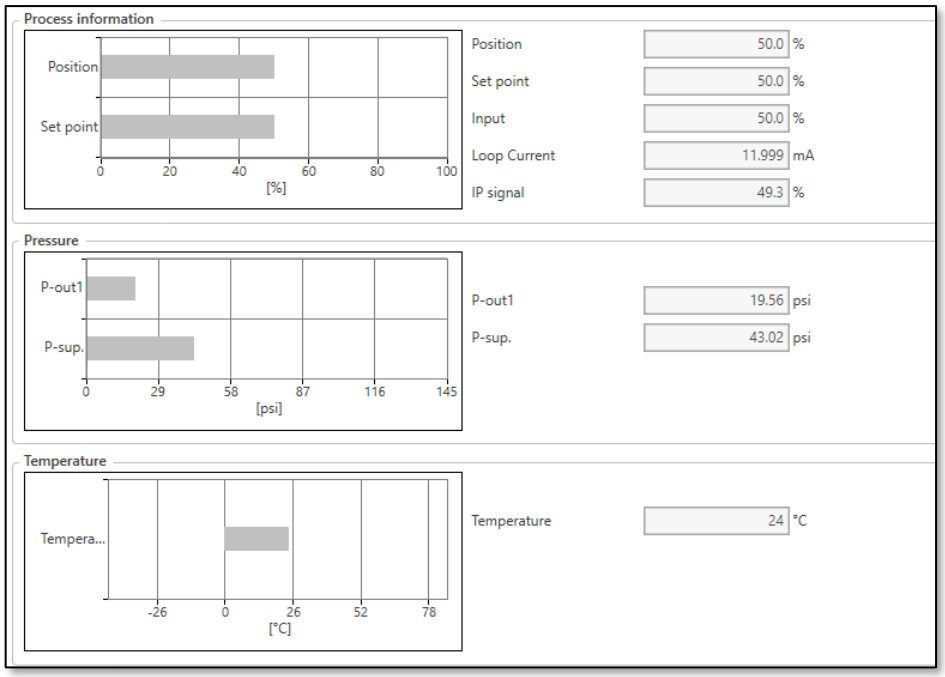


Displayed items are as follows:
[Status]

Authority	: Write authority	Control mode	: Operational authority
Local operation mode	: Special control mode		

4.4. Process information, Pressure, Temperature

This menu displays the current process information and temperature of the positioner.



Displayed items are as follows:

[Process information]

Set point	: Set point	Loop current	: Input current
Position	: Valve position	IP signal	: IP signal current
Input※	: Percentage of input signal		

※ When split range is set, the value displayed in “Input” differs from the actual valve opening.

[Pressure]

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

※This item displayed only when Actuator type is “Double”

[Temperature]

Temperature	: Temperature

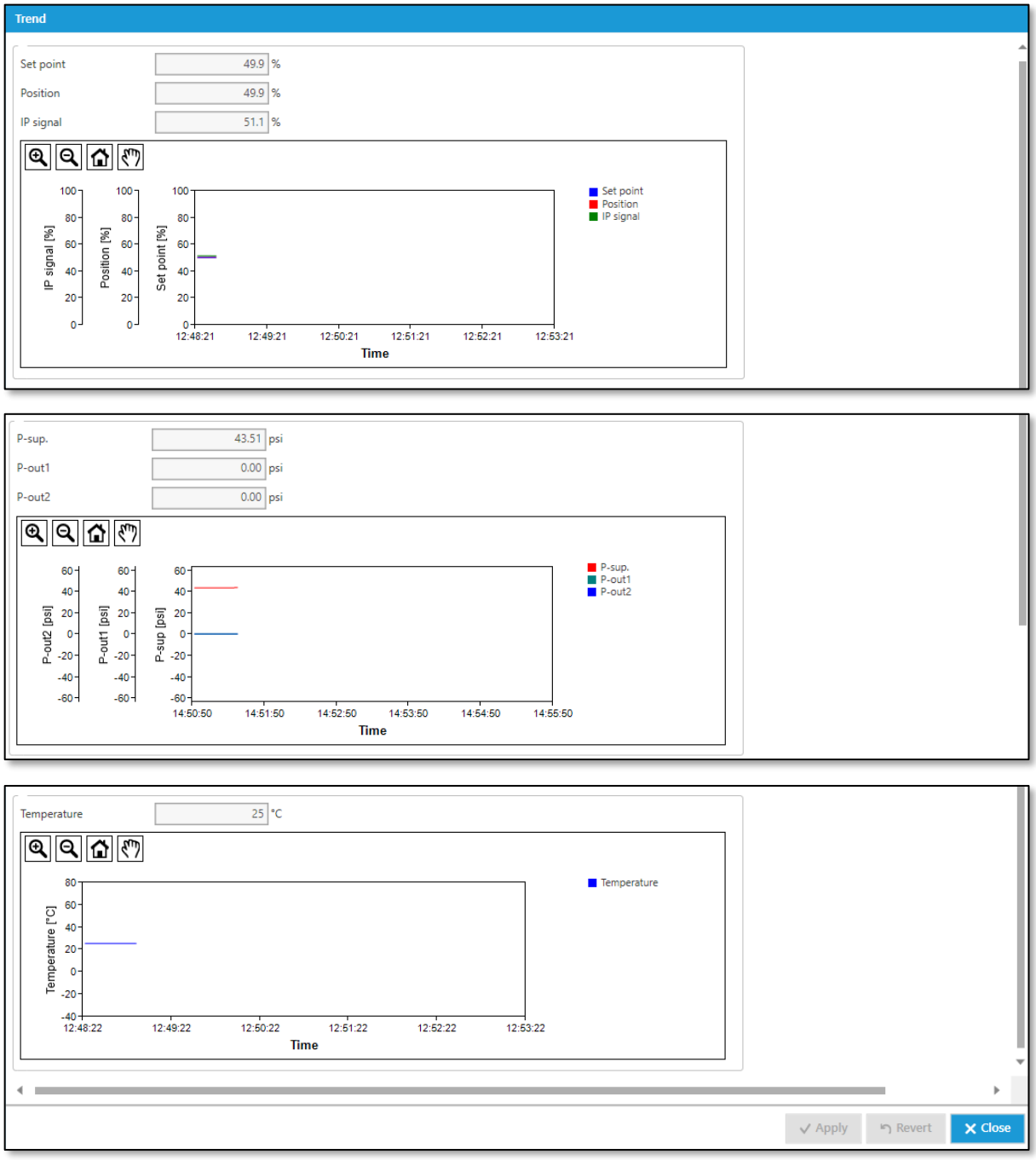
4.5. Trend

This menu offers to confirm status of positioner such as set point, valve position, IP signal, pressure and temperature.

MENU) *Process Variables > Trend*

① Click [Trend] in the [Trend] menu group.

② Trend graph is displayed.



Displayed items are as follows:

Set point	: Set point	Position	: Valve position
IP signal	: IP signal current	P-sup.	: Supply pressure
P-out1	: Output pressure 1	P-out2	: Output pressure 2※
Temperature	: Temperature		

※This item displayed only when Actuator type is “Double”

4.6. Manual setpoint

This menu offers the ability to control Setpoint from the HART host controller.

Caution

➢ To activate this function, "**Authority**" must be "HART".

MENU) *Process Variables > Manual setpoint*

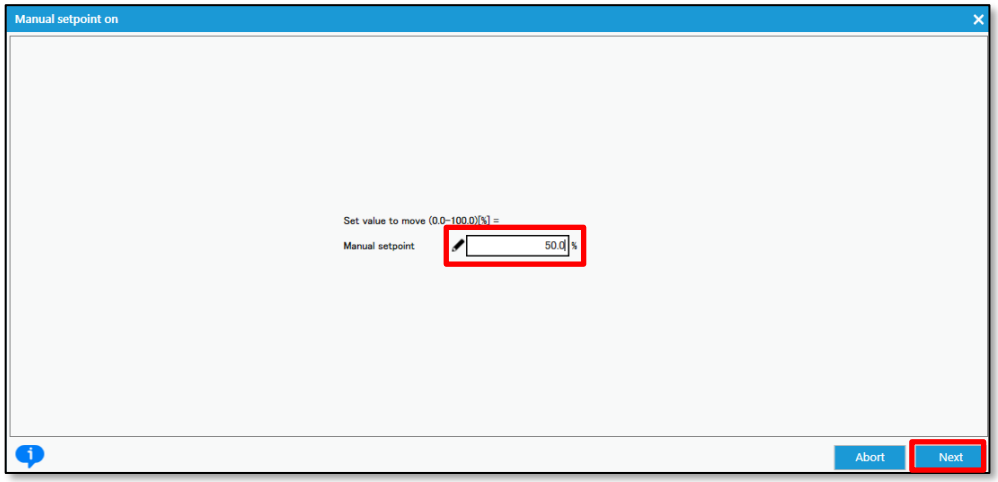
① Click [Manual setpoint] in the [Manual setpoint] group menu.

1) Enable manual setpoint

The steps for specifying setpoint from the HART host controller is shown below.

① Click [Manual setpoint on].

② Enter the setpoint value and click [Next].



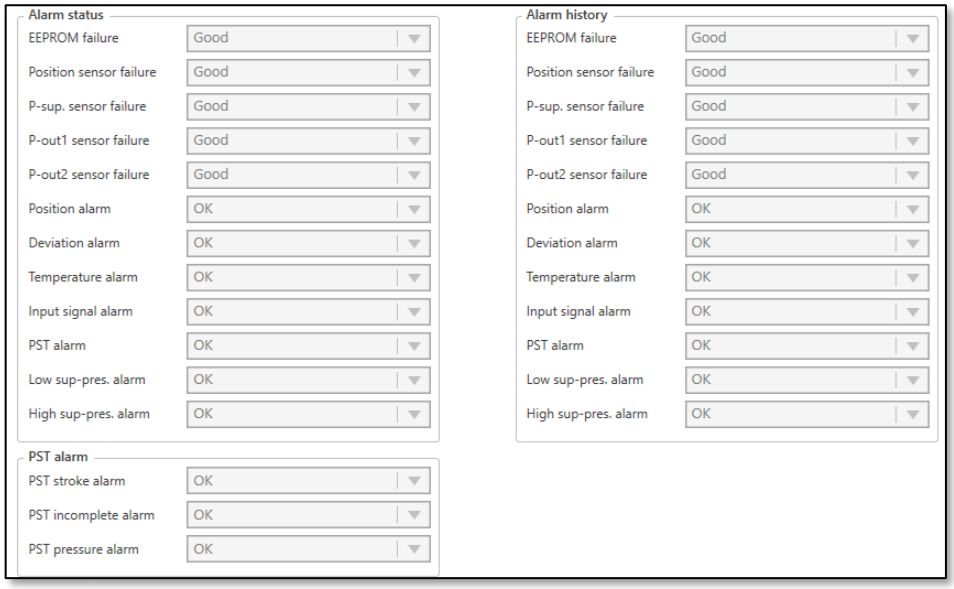
2) Disable manual setpoint

To return device control to input signals, perform the following operations.

① Click [Manual setpoint off].

4.7. Alarm status, Alarm history, PST alarm

This menu displays alarm status and history information of the positioner.



Displayed items are as follows:

[Alarm status / Alarm history]

EEPROM failure	: Memory failure	Deviation alarm	: Deviation alarm
Position sensor failure	: Position sensor failure	Temperature alarm	: Temperature alarm
P-sup. sensor failure	: Supply pressure sensor failure	Input signal alarm	: Input signal alarm
P-out1 sensor failure	: Output pressure 1 sensor failure	PST alarm	: PST alarm
P-out2 sensor failure	: Output pressure 2 sensor failure	Low sup-pres. alarm	: Low supply pressure alarm
Position alarm	: Valve position alarm	High sup-pres. alarm	: High supply pressure alarm

[PST alarm]

PST stroke alarm	: PST stroke alarm	PST incomplete alarm	: PST incomplete alarm
PST pressure alarm	: PST pressure alarm		

5. Device Settings

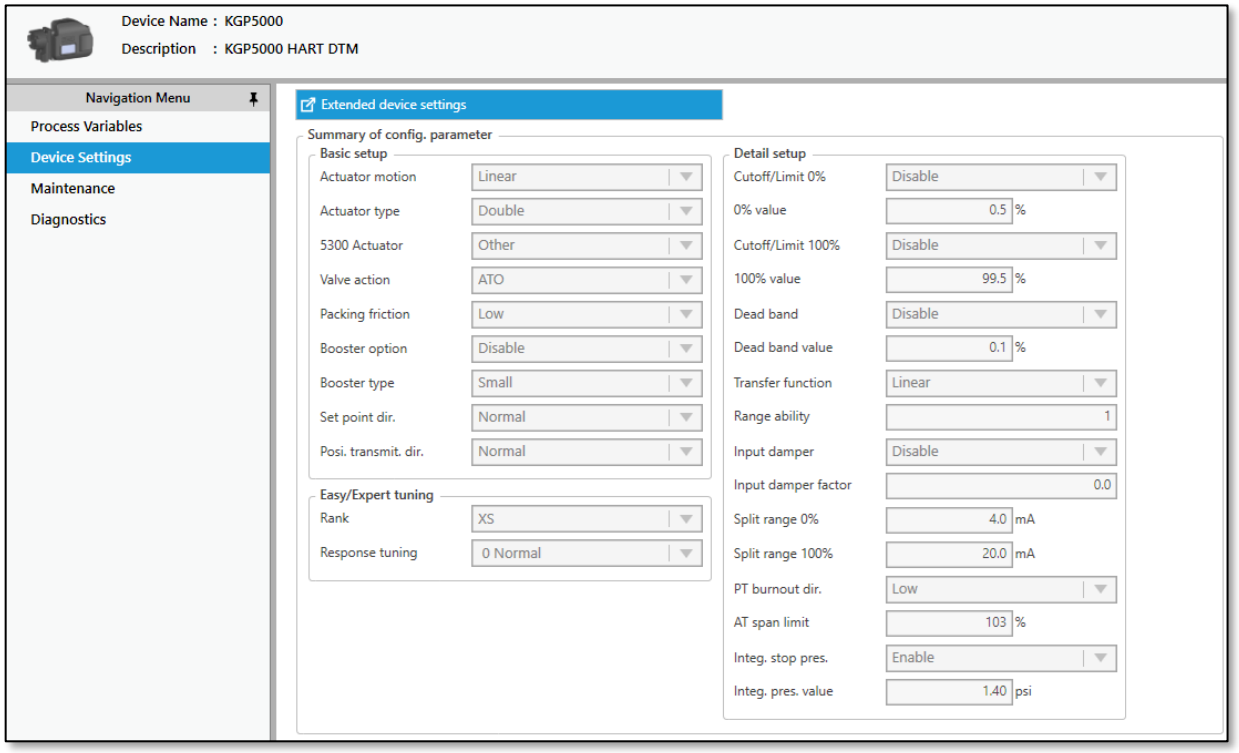
This menu offers the setup of the essential items and the detailed items required for control with the positioner.

Caution

➢ To change the settings, "**Authority**" must be "HART".

MENU) *Device Settings*

① Select [Device Settings] in the Navigation menu to open the **[Device Settings] top menu**.
Displays an overview of the current device settings.



Display items are as follows:
[Summary of config. parameters]
[Basic setup]

Actuator motion	: Stem motion type	Actuator type	: Acting type
5300 Actuator	: KOSO high power actuator	Valve action	: Direction of a valve when Pout1 is output
Packing friction	: Packing material	Booster option	: Booster option enable/disable
Booster type	: Booster type	Set point dir.	: Setpoint direction
Posi. transmit. dir.	: Position transmitter direction		

[Easy/Expert tuning]

Rank	: Rank of the PID parameter	Response tuning	: Response tuning

[Detail setup]

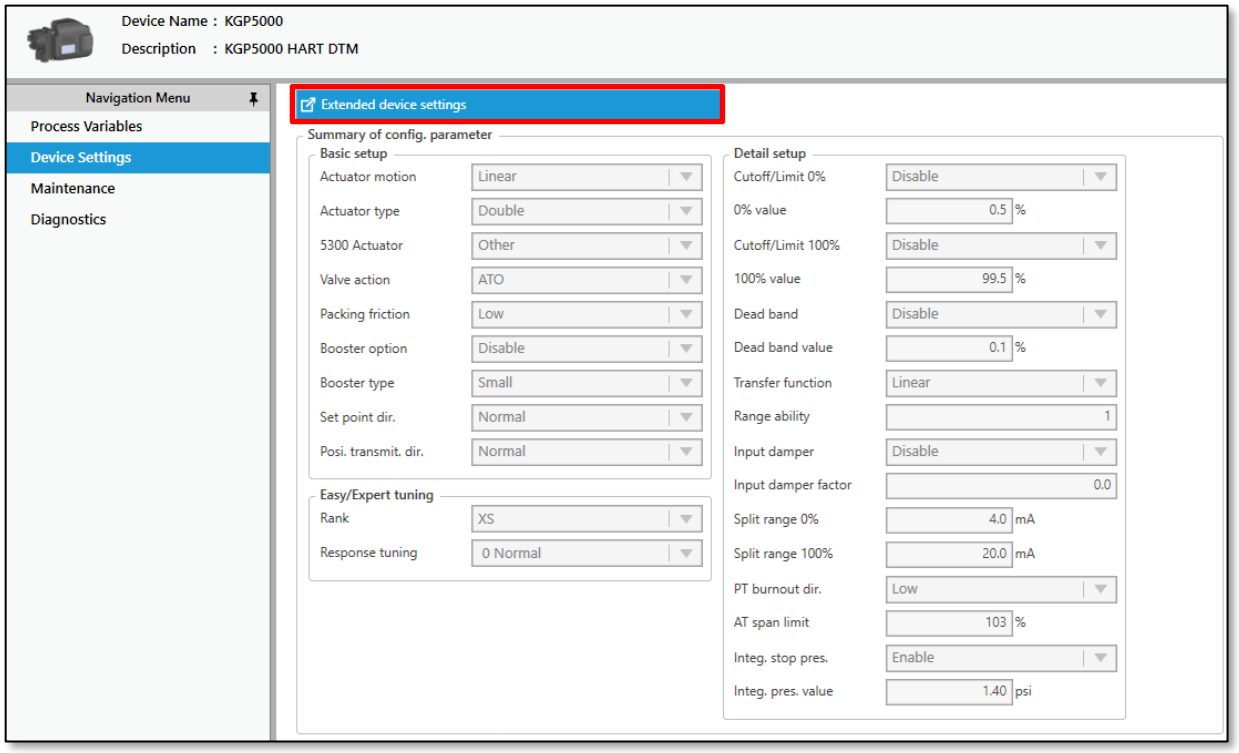
Cutoff/Limit 0%	: Cutoff/Limit 0% side enable/disable	0% value	: Cutoff/Limit 0% side value
Cutoff/Limit 100%	: Cutoff/Limit 100% side enable/disable	100% value	: Cutoff/Limit 100% side value
Dead band	: Deadband enable/disable	Dead band value	: Deadband value
Transfer function	: Transfer function	Range ability	: Range ability
Input damper	: Input dumper enable/disable	Input damper factor	: Input damper factor
Split range 0%	: Split range 0% side	Split range 100%	: Split range 100% side
PT burnout dir.	: Burnout direction of the Position transmitter	AT span limit	: Autotune span limit value
Integ. stop pres.	: Integral stop pressure enable/disable	Integ. pres. value	: Integral stop pressure threshold value

5.1. Extended device settings

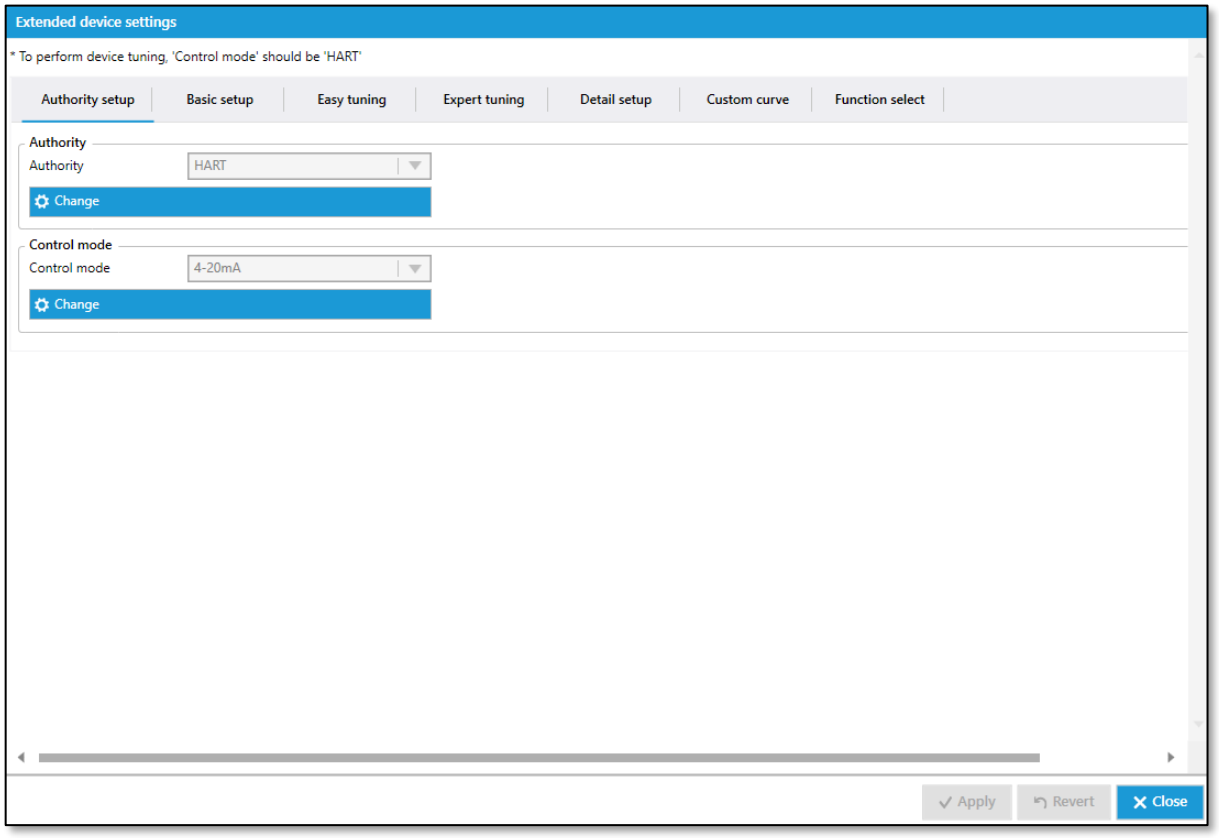
This menu is an extended menu for basic settings, tuning, detailed settings, and function settings for controlling the positioner.

MENU) *Device Settings > Extended device settings*

① Click [Extended device settings] in the [Device Settings] top menu.



② Open the [Extended device settings] menu.



Menu items are as follows:

(1) Authority setup	See 3. Authority setup
(2) Basic setup	See 5.2. Basic setup
(3) Easy tuning	See 5.3. Easy tuning
(4) Expert tuning	See 5.4. Expert tuning
(5) Detail setup	See 5.5. Detail setup
(6) Custom curve	See 5.6. Custom curve
(7) Function select	See 5.7. Function select

Click on the tab to open each menu.

5.2. Basic setup

Select essential parameters necessary for the control of the positioner.

※ Perform basic setup surely before performing the following setup (easy tuning) in next section.

Caution

➢ To change the settings, "**Authority**" must be "HART".

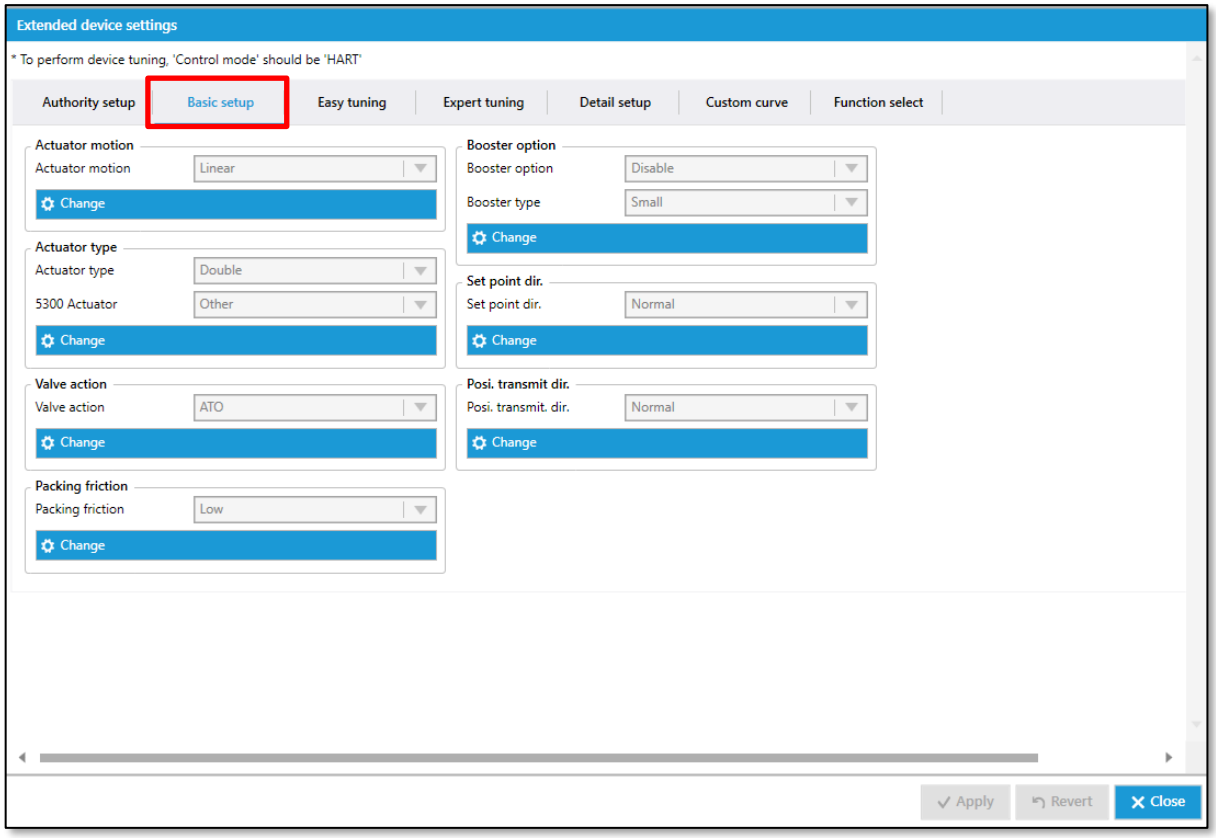
Setup items are as follows:

Actuator motion	: Stem motion type	Actuator type	: Acting type
Valve action	: Valve direction	Packing friction	: Packing material
Booster option	: Booster option	Set point dir.	: Setpoint direction
Posi. transmit. dir.	: Direction of Position transmitter		

※ For details on each item, refer to the KGP5000 instruction manual.

MENU) *Device Settings > Extended device settings > Basic setup*

① Select the [Basic setup] tab in the [Extended device settings] menu to open the [Basic setup] menu.



Click [Change] within each menu group to change the current settings.

5.3. Easy tuning

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.

Caution

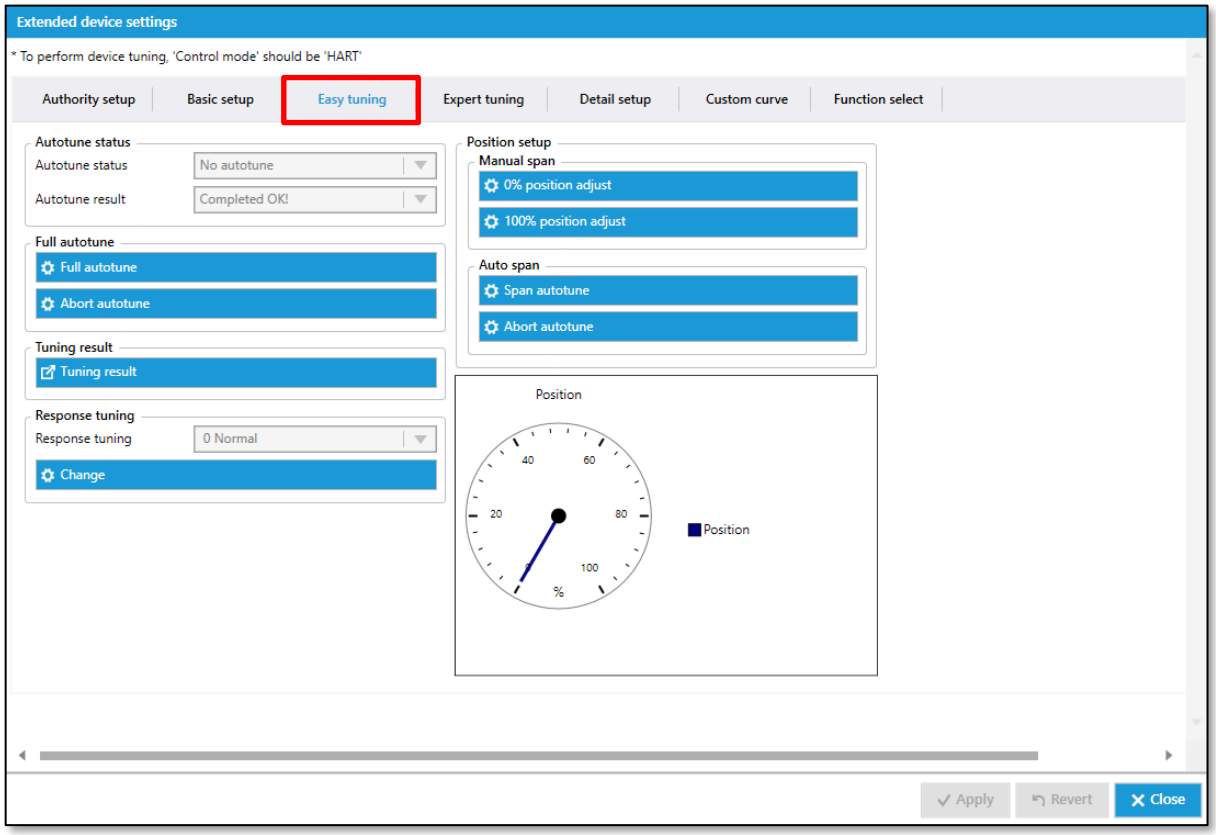
- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing **Full autotune**, **Position setup**, and **Auto span**, set the "**Control mode**" to "HART".

Note

Before performing operation of this section, all parameters of basic setup described in **5.2 Basic setup** must be configured. If wrong parameters were configured, it is possible to choose unsuitable PID parameters.

MENU) *Device Settings > Extended device settings > Easy tuning*

① Click [Easy tuning] tab in the [Extended device settings] and open the [Easy tuning] menu.



5.3.1. 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

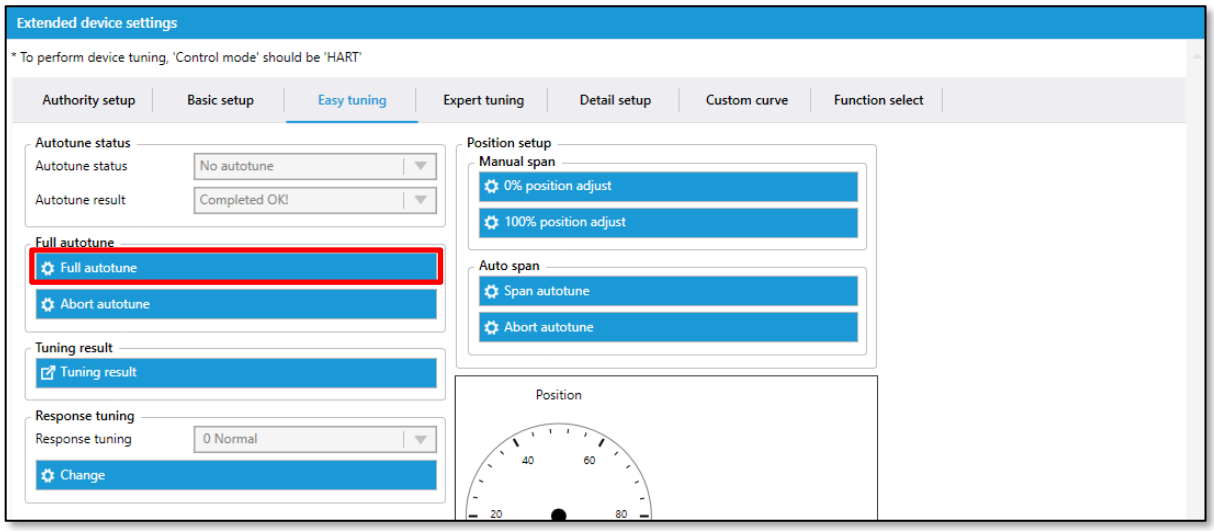
The configuration time varies with actuator size.

5.3.1.1. Execute full autotune

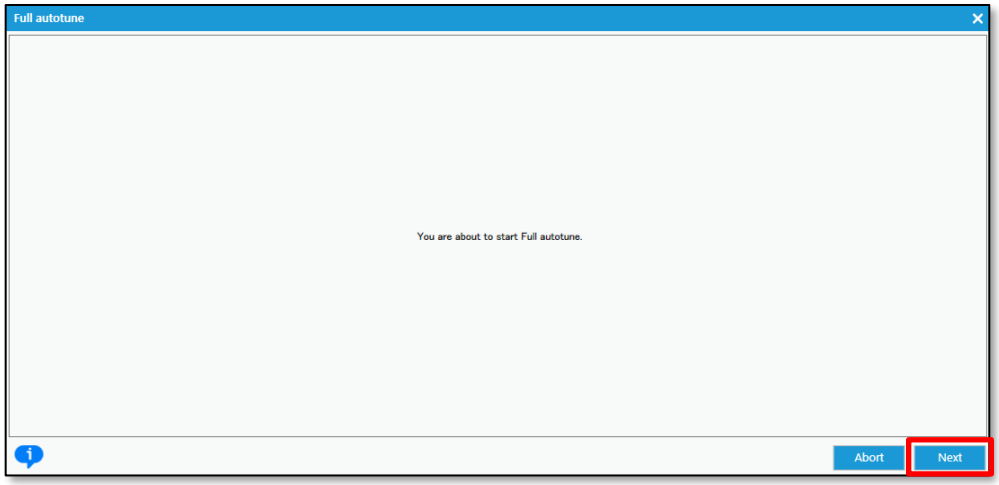
MENU) *Device Settings > Extended device settings > Easy tuning > Full autotune*

① Click [Full autotune] in the [Full autotune] menu group.

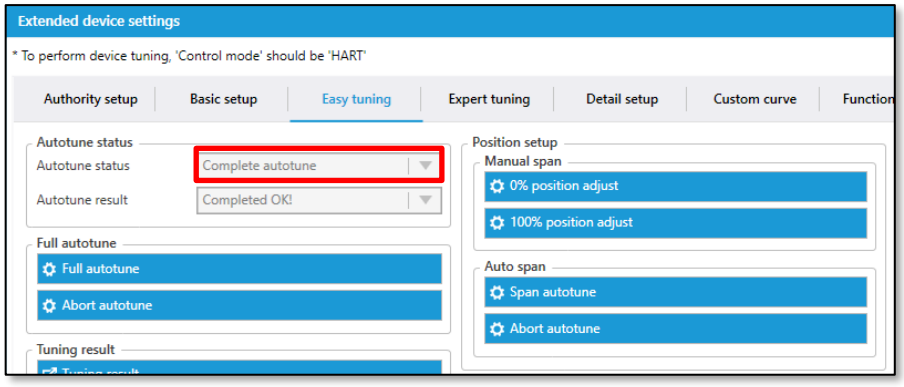
※ Click [Abort autotune] to cancel full autotune.



② Confirm the message and click [Next].



③ Wait until "Autotune status" field becomes "Complete autotune".

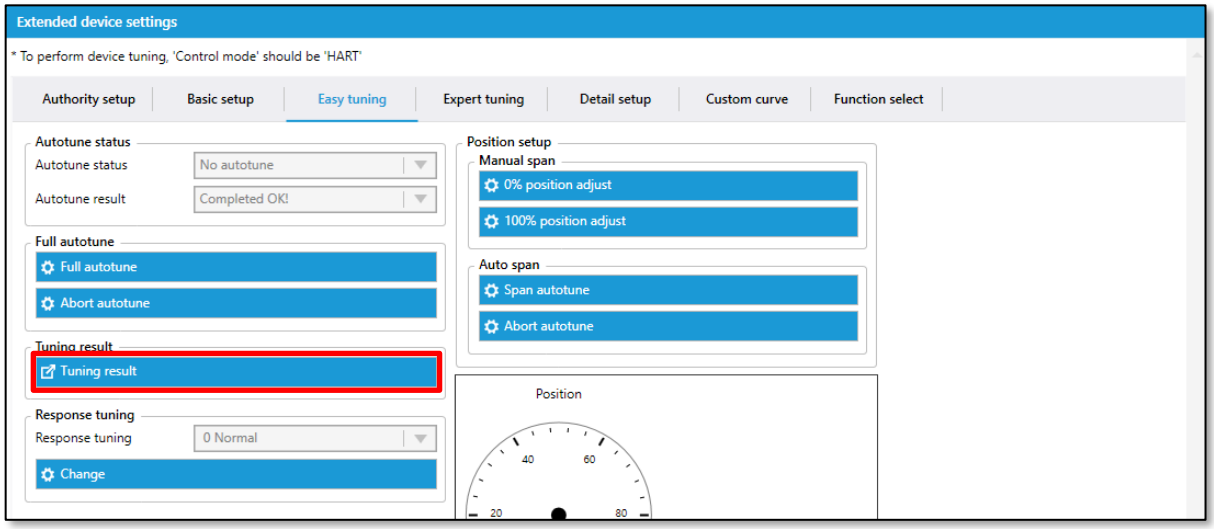


※ If a problem occurs during the operation, an error message will be displayed in the "Autotune result" field and operation will be stopped. For error details, refer to **Appendix B. Error Messages**.

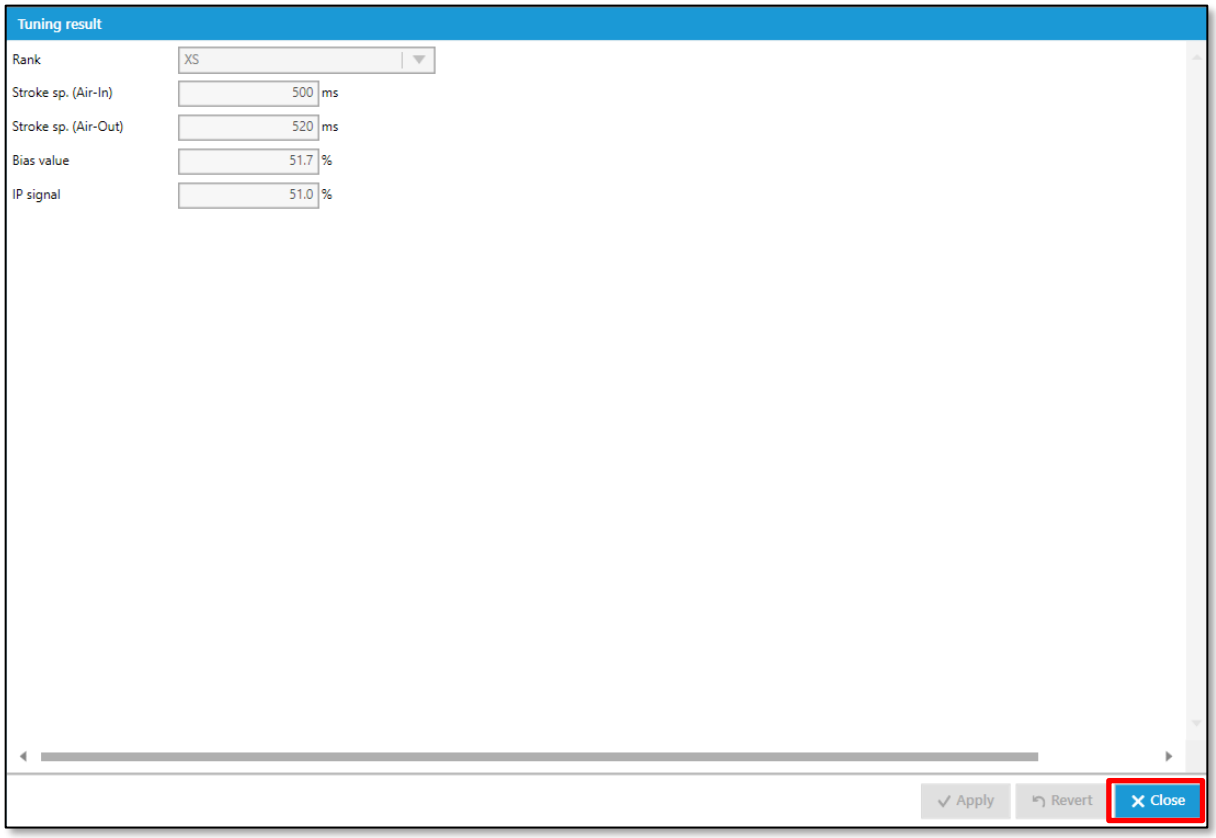
5.3.1.2. Display full autotune result

MENU) *Device Settings > Extended device settings > Easy tuning > Tuning result*

① Click [Tuning result] in the [Tuning result] menu group and display the autotune result.



② Click [Close] to close the menu.



5.3.2. Position setup

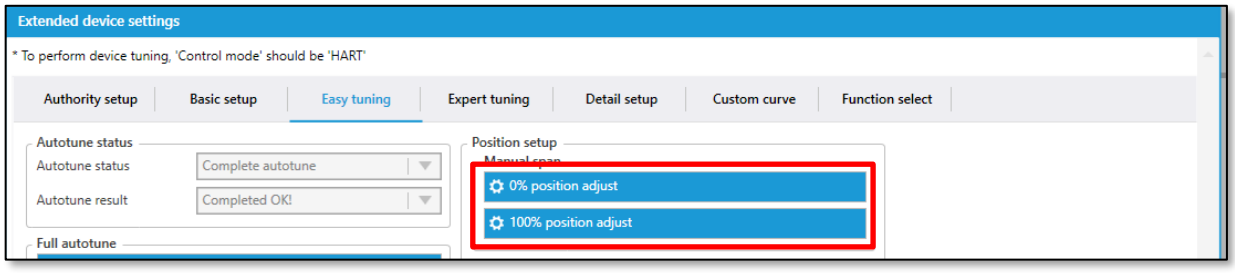
Only zero/span settings can be performed independently, independent of full autotune. There are two different ways of Zero/span settings whether to specify Zero/span manually or to determine these automatically.

5.3.2.1. Manual calibration of Zero/span point

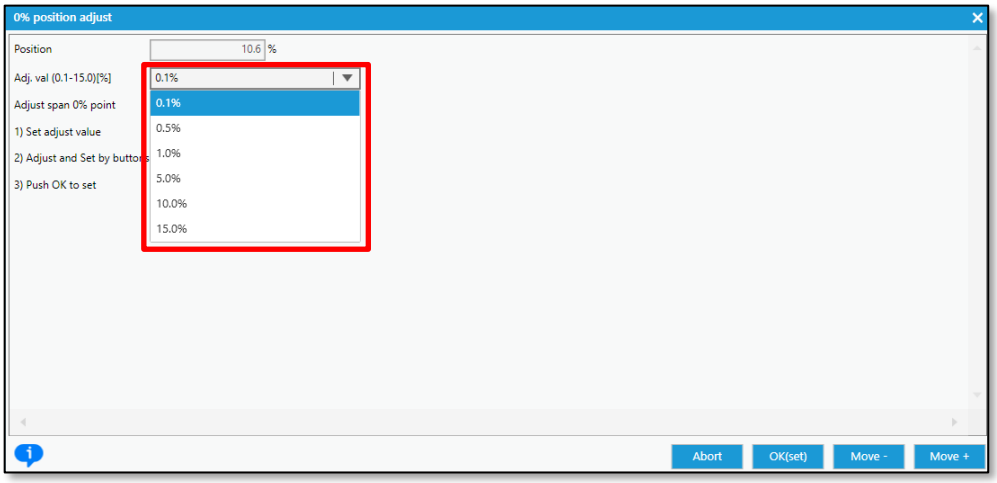
Only the zero point and span point of the control valve are set manually.

MENU) *Device Settings > Extended device settings > Easy tuning > Position setup > Manual span > 0% or 100% position adjust*

① Click [0% position adjust] or [100% position adjust] in the [Manual span] menu group.

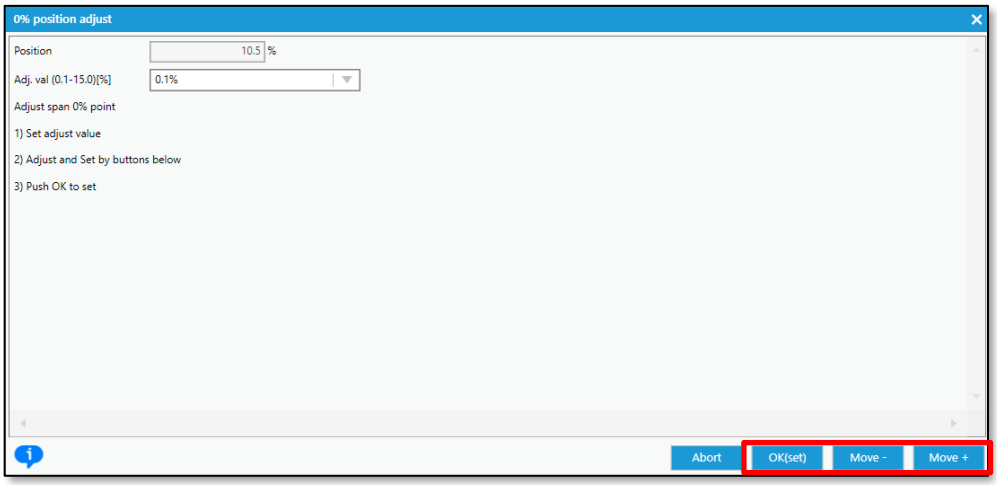


② Select the amount of adjustment per button click in the “Adj. val” field.



③ Click [Move-] or [Move +] and adjust individually the value of each position in 0% and 100% of the valve travel.

④ After adjustment, click [OK(set)] to configure the 0% or 100% valve opening position.

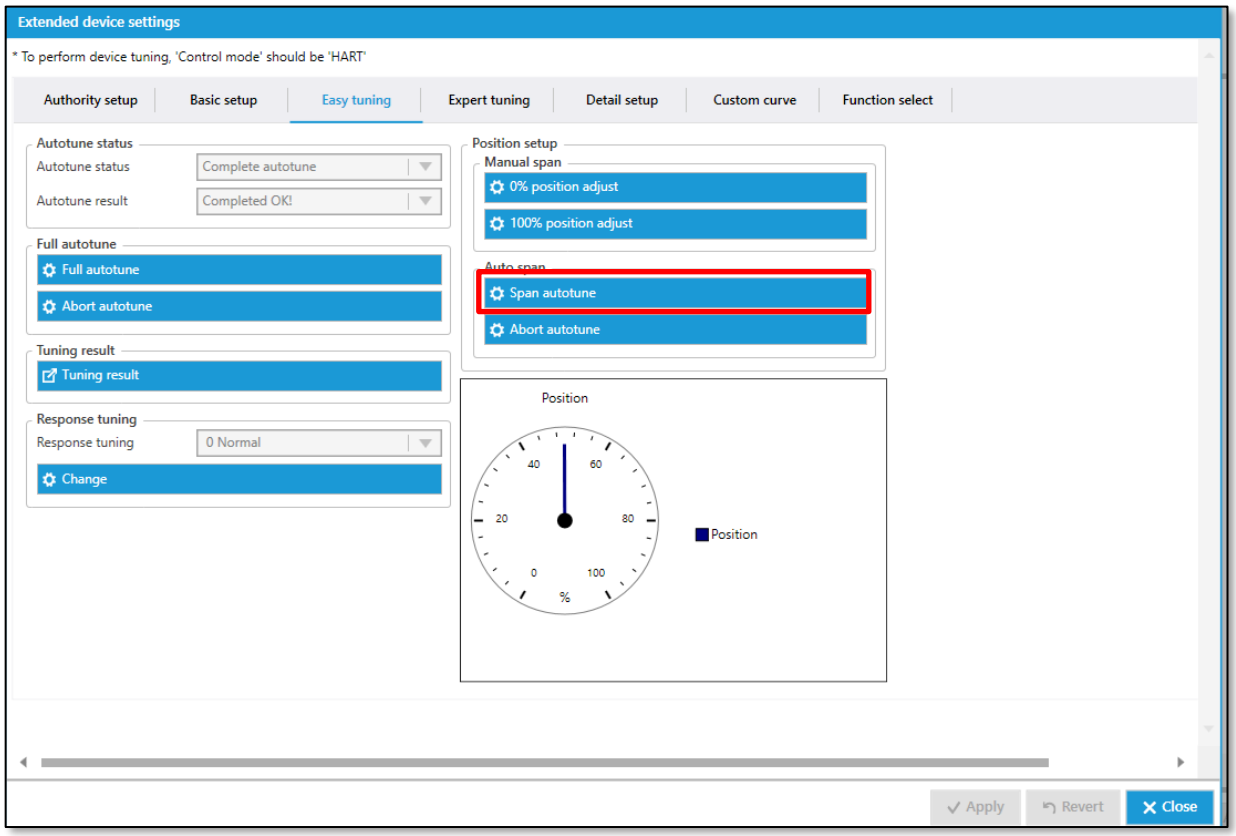


5.3.2.2. Auto calibration of Zero/span point

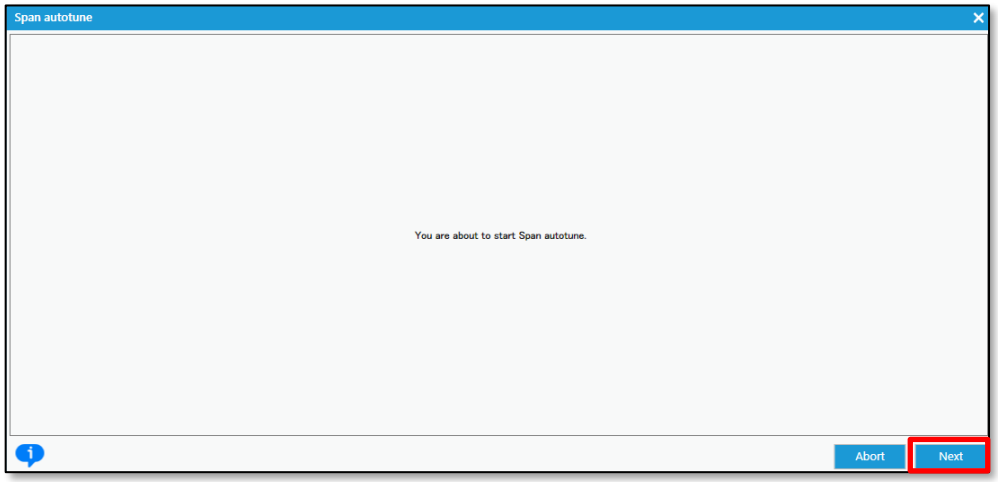
Only the zero point and span point of the control valve are set automatically.

MENU) *Device Settings > Extended device settings > Easy tuning > Position setup > Auto span > Span autotune*

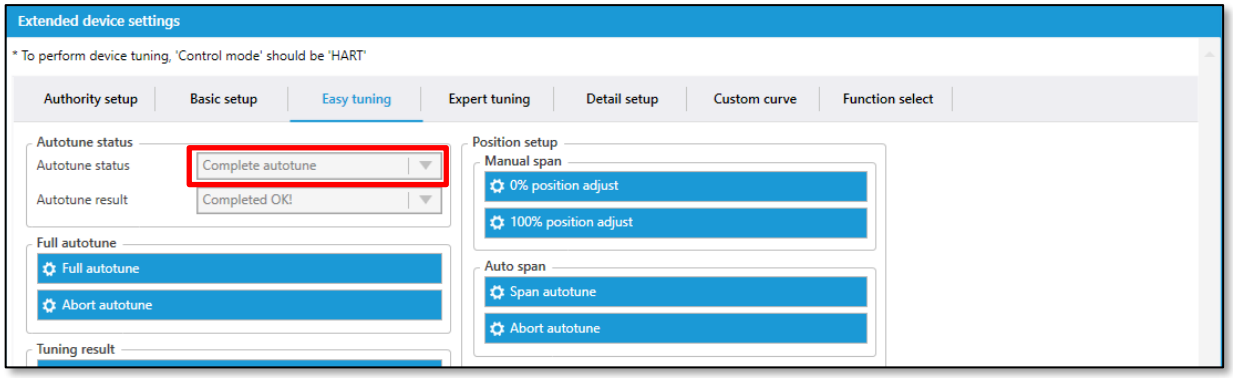
① Click [Span Autotune] in the [Auto span] menu group.
※ Click [Abort autotune] to cancel Span autotune.



② Confirm the message and click [Next].



③ Wait until “Autotune status” field becomes “Complete autotune”.



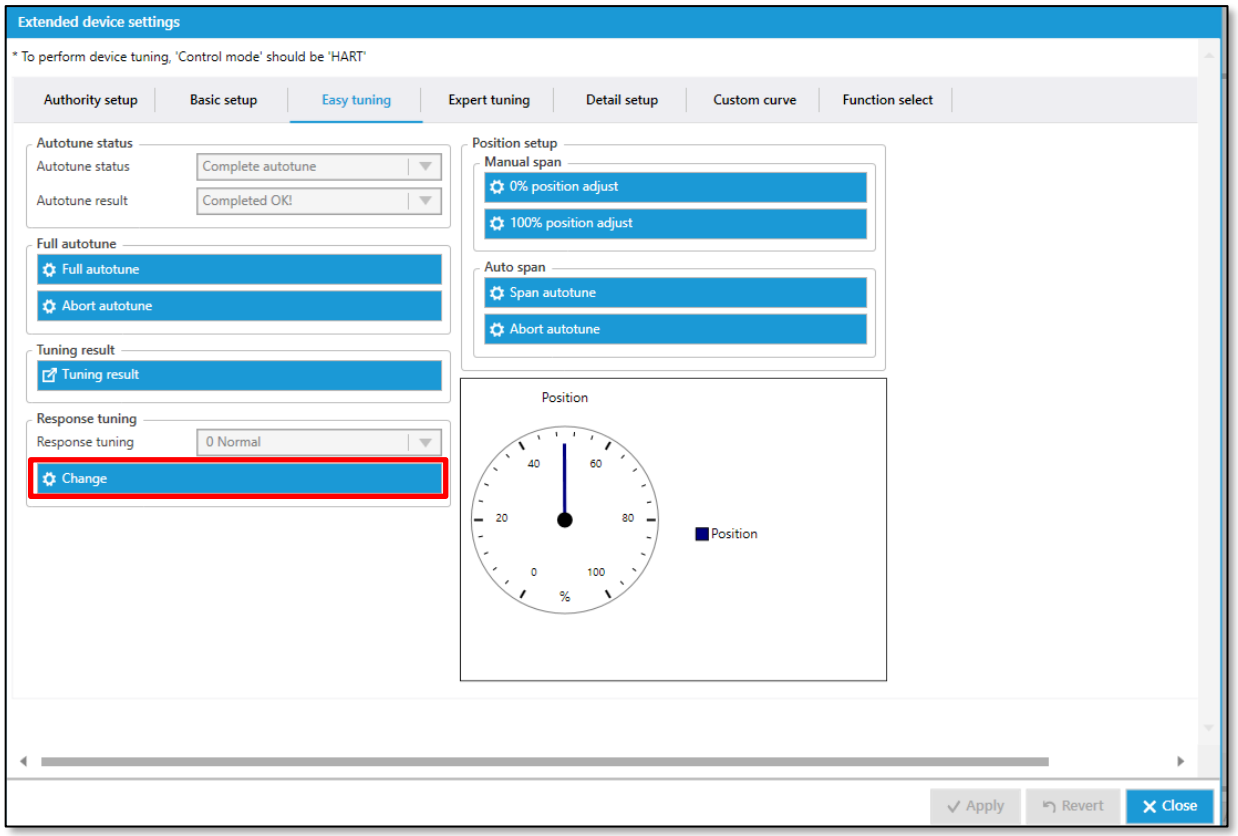
※ If a problem occurs during the operation, an error message will be displayed in the "Autotune result" field and operation will be stopped. For error details, refer to **Appendix B. Error Messages.**

5.3.3. Response tuning

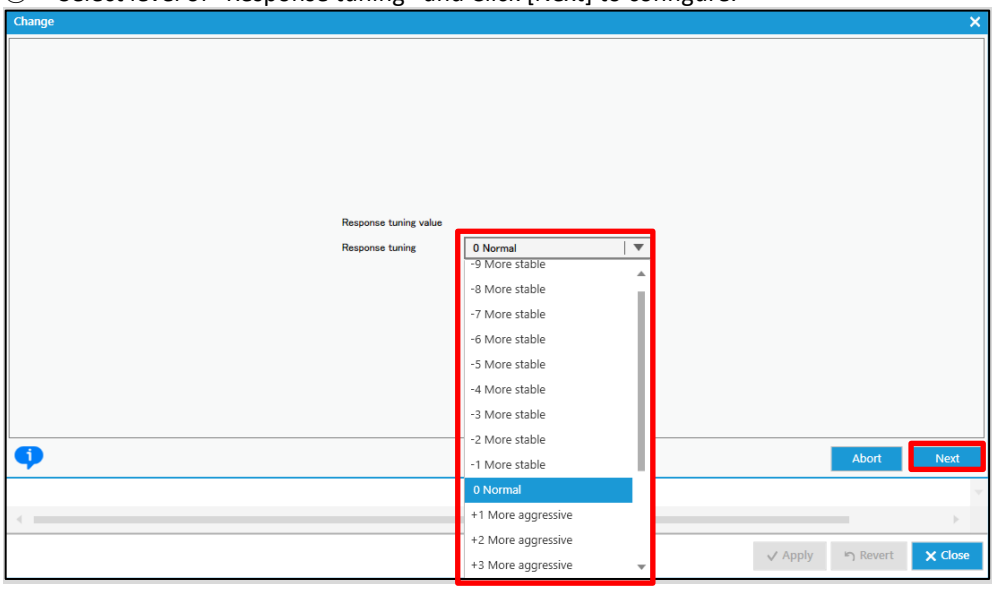
This operation is used to perform an additional fine adjustment relevant to the control response after performing PID tuning.

MENU) *Device Settings > Extended device settings > Easy tuning > Response tuning*

① Click [Change] int the [Response tuning] menu group.



② Select level of “Response tuning” and Click [Next] to configure.



A. In case the higher response sensitivity is desired,
i.e., you wish to reduce response time by making the response quicker,
Select “+ More aggressive” 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 “- More stable” 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 original settings,
Select “0 Normal”.

5.4. Expert tuning

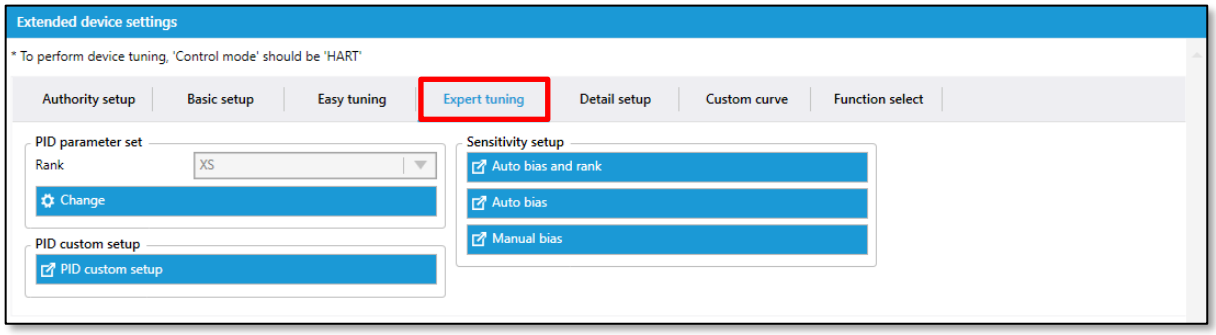
Use this setting in case in which the desired response has not been achieved through easy tuning. More suitable control parameters are configured according to each actuator by tuning individually parameters necessary to control the response.

Caution

- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing IP signal current bias (Auto), set the “**Control mode”** to “HART”.

MENU) *Device Settings > Extended device settings > Expert tuning*

① Click [Expert tuning] menu tab in the [Extended device settings] menu and open the [Expert tuning] menu.



5.4.1. Preset setting for PID parameter

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

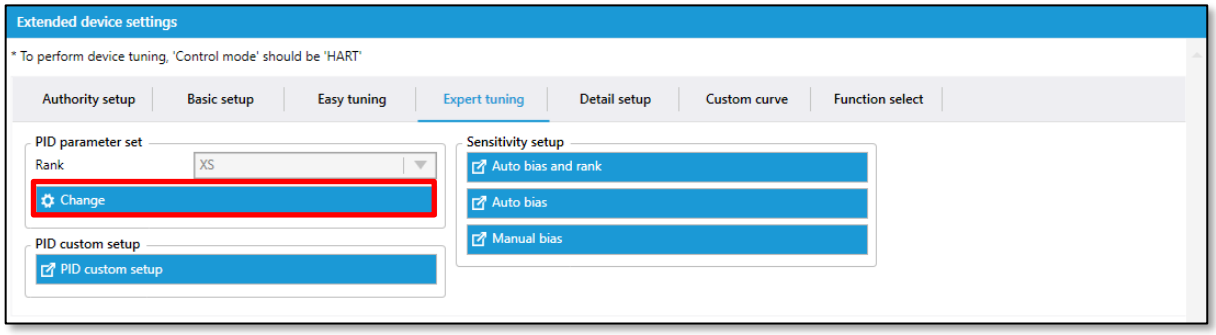
Caution

- If 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.

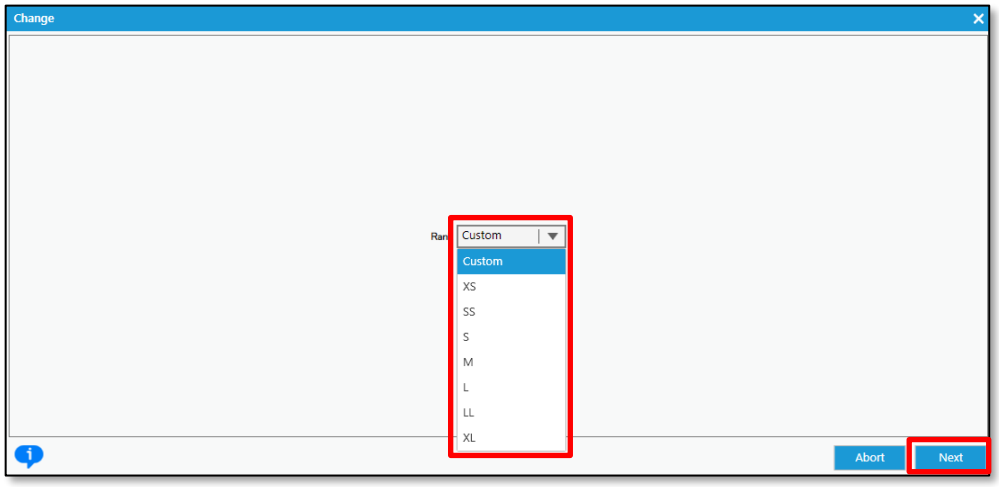
MENU) *Device Settings > Extended device settings > Expert tuning > PID parameter set*

The steps for change the rank of PID parameter set is below.

① Click [Change] in the [PID parameter set] menu group.



② Select rank and click [Next] to configure.



5.4.2. Custom setting for PID parameter

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

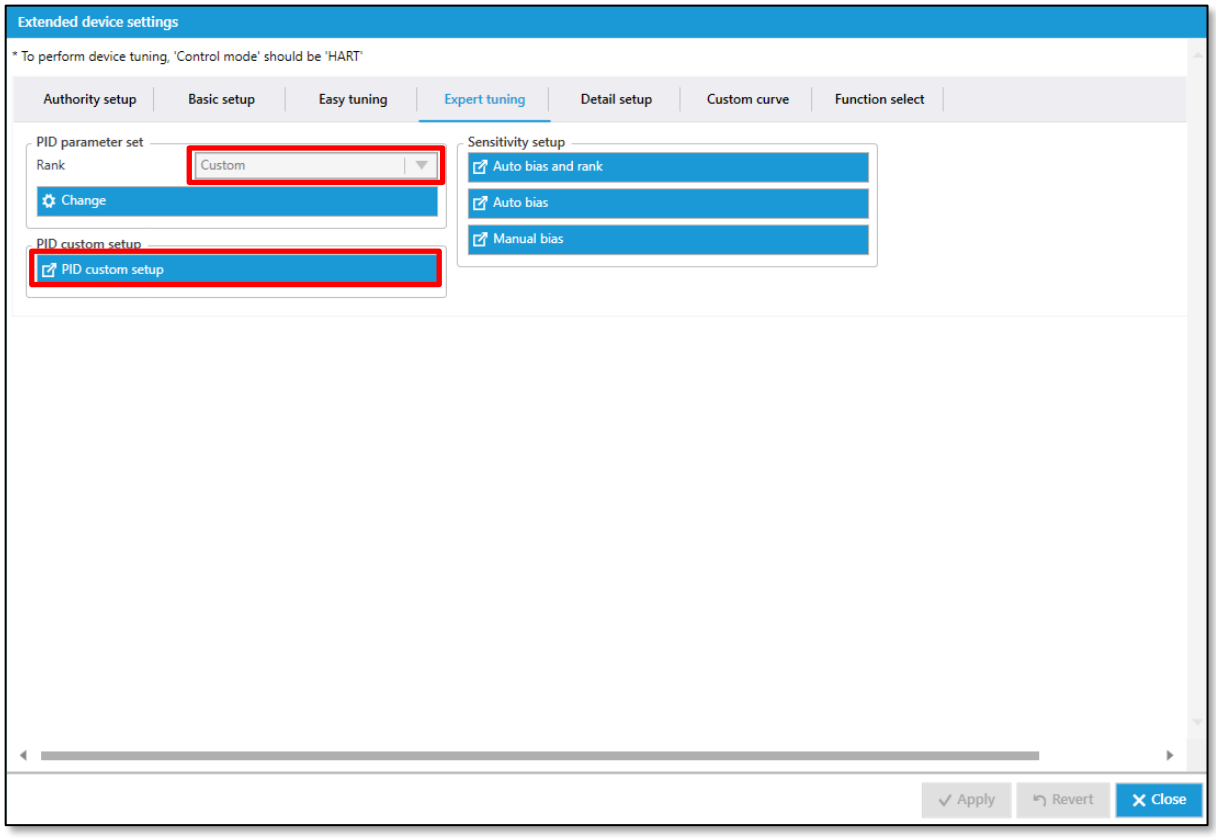
Caution

➢ If the rank setting in the [PID parameter set] menu is other than "**Custom**", cannot change the parameter value using the following steps.

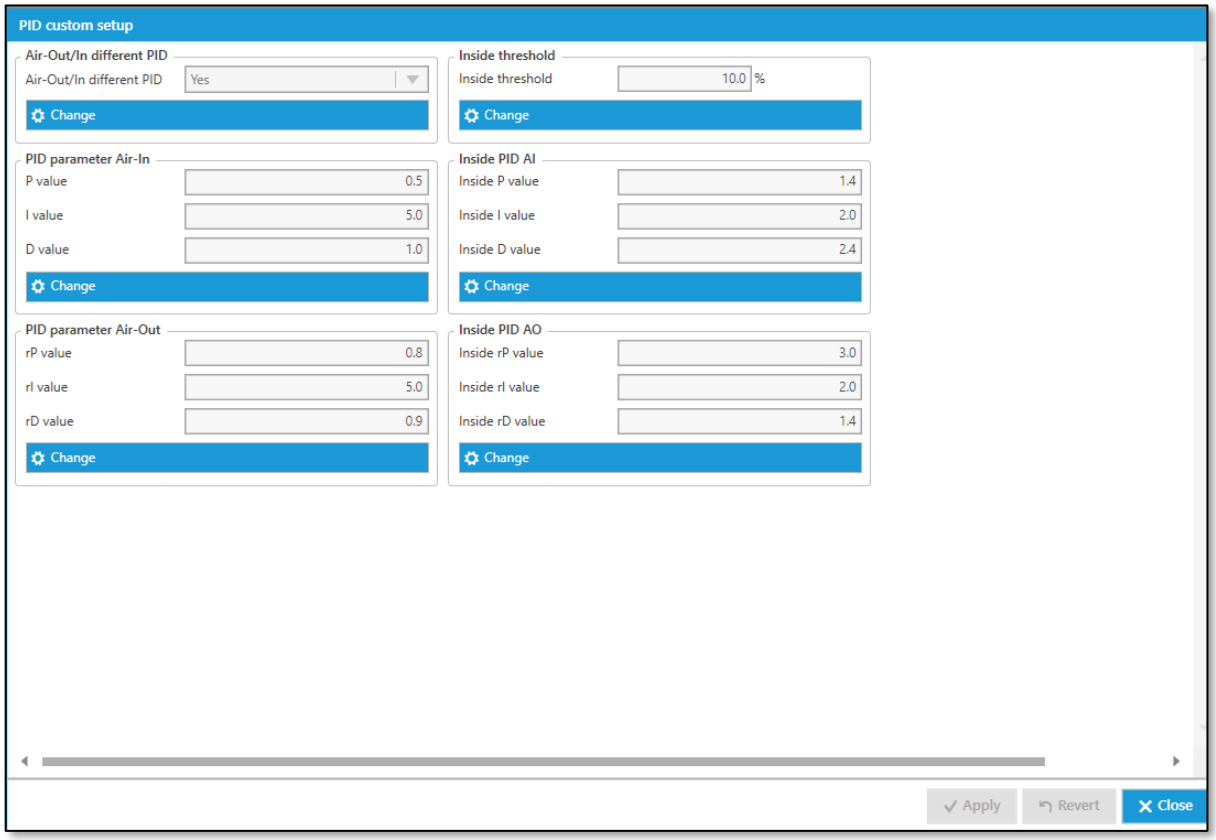
※ For details and precautions for each parameter., refer to the KGP5000 instruction manual.

MENU) *Device Settings > Extended device settings > Expert tuning > PID custom setup*

① Click [PID custom setup] in the [PID custom setup] menu group.



② [PID custom setup] menu opens.



To change the current settings, click [Change] within each menu group.

5.4.3. Setup for IP signal current bias

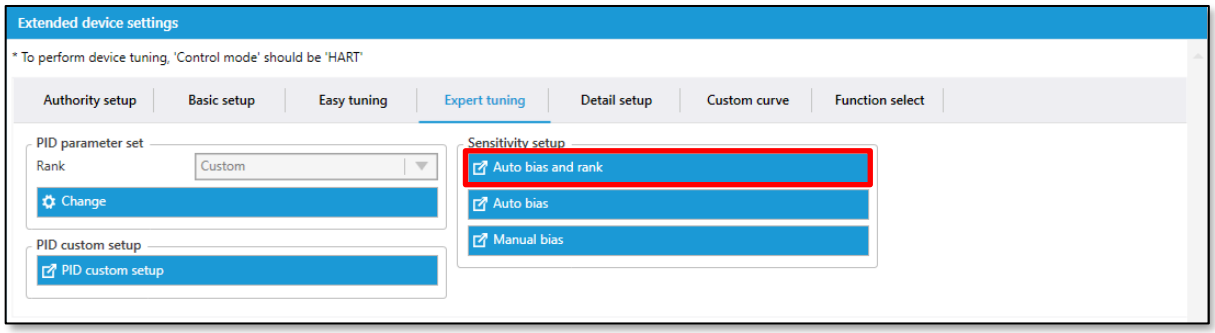
IP signal current bias is the parameter necessary to determine the control output signal (IP signal) corresponding to an input signal inside the device.
There are two different ways whether to determine IP signal current bias automatically or to specify it manually.

5.4.3.1. Auto setup for IP signal current bias

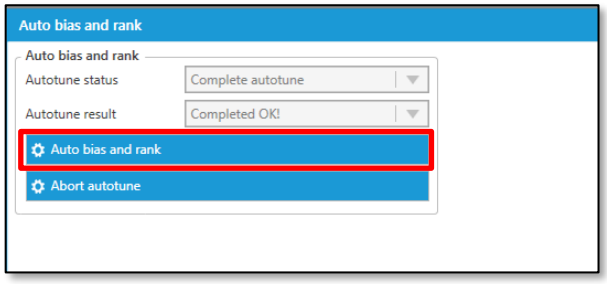
1) Set IP signal current bias and PID parameters together

MENU) *Device Settings > Extended device settings > Expert tuning > Sensitivity setup > Auto bias and rank*

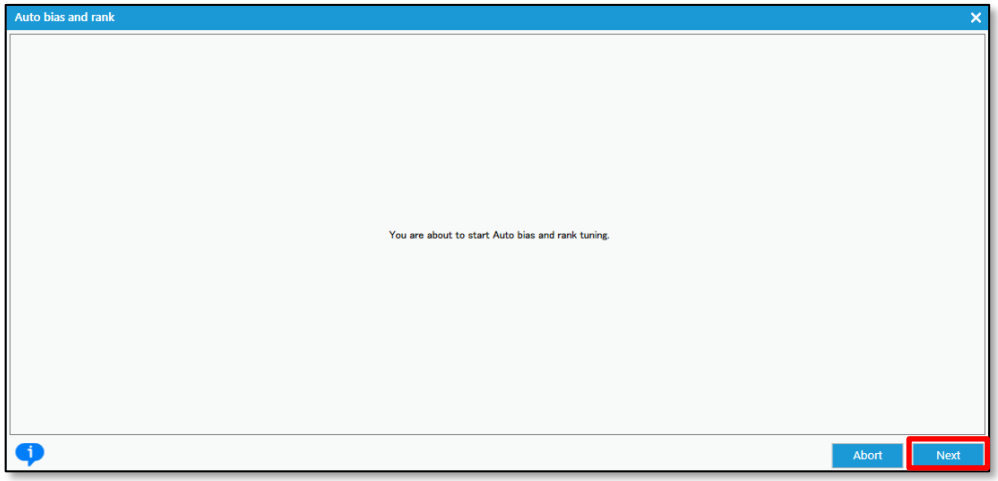
① Click [Auto bias and rank] in the [Sensitivity setup] menu group.



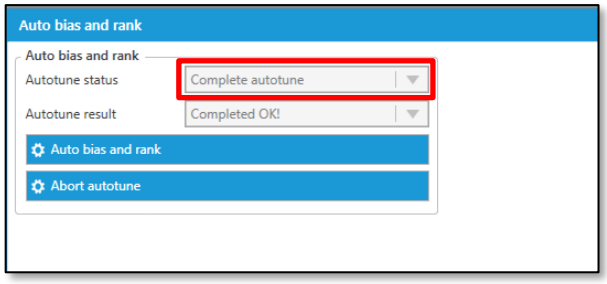
② Click [Auto bias and rank] in the [Auto bias and rank] menu group.
※ Click [Abort autotune] to cancel **Auto bias and rank**.



③ Confirm the message and click [Next].



④ Wait until "Autotune status" field becomes "Complete autotune".

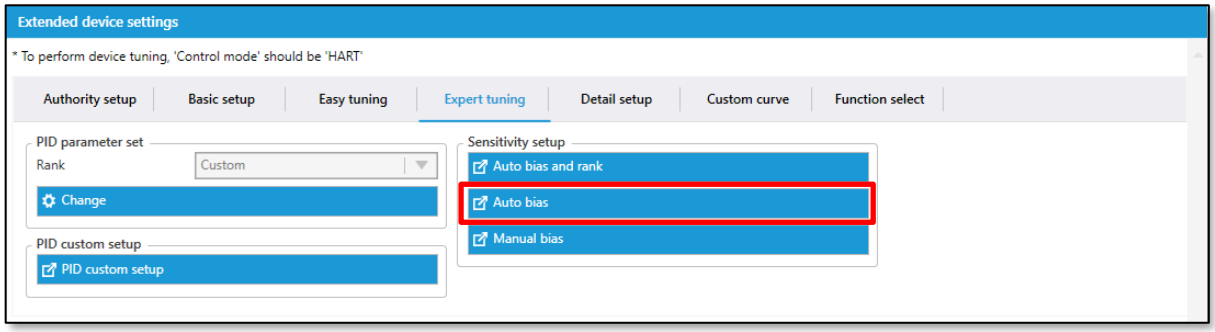


※ If a problem occurs during the operation, an error message will be displayed in the "Autotune result" field and operation will be stopped. For error details, refer to **Appendix B. Error Messages**.

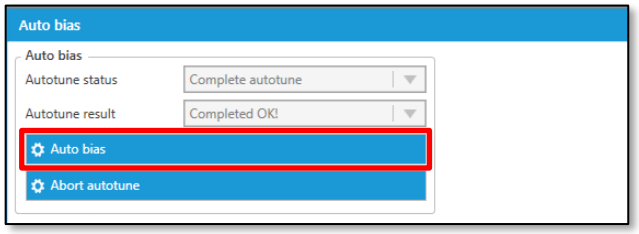
2) Set IP signal current bias only

MENU) *Device Settings > Extended device settings > Expert tuning > Sensitivity setup > Auto bias*

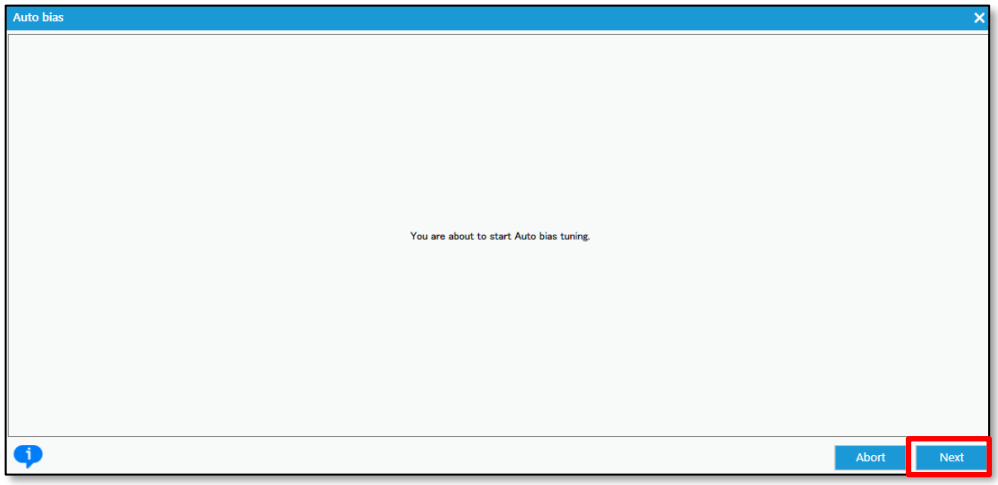
① Click [Auto bias] in the [Sensitivity setup] menu group.



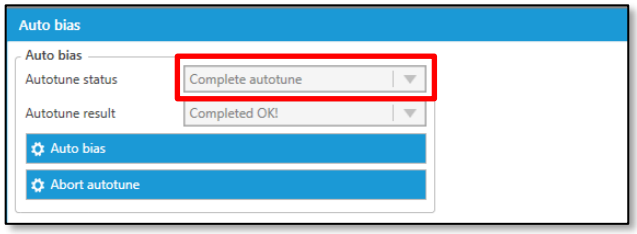
② Click [Auto bias] in the [Auto bias] menu group.
※ Click [Abort autotune] to cancel **Auto bias**.



③ Confirm the message and click [Next].



④ Wait until “Autotune status” field becomes “Complete autotune”.



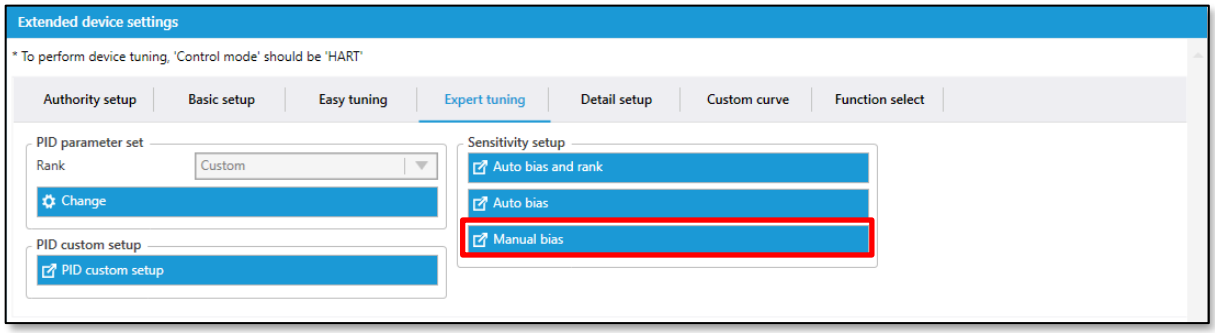
※ If a problem occurs during the operation, an error message will be displayed in the "Autotune result" field and operation will be stopped. For error details, refer to **Appendix B. Error Messages**.

5.4.3.2. Manual setup for IP signal current bias

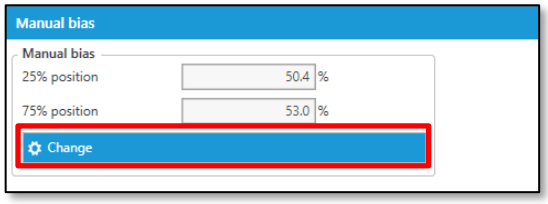
Specify individually IP signal current bias of each position in 25% and 75% of the valve travel.

MENU) *Device Settings > Extended device settings > Expert tuning > Sensitivity setup >Manual bias*

① Click [Manual bias] in the [Sensitivity setup] menu group.



② Click [Change] in the [Manual bias] menu group and enter setting value.



5.5. Detail setup

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

Caution

- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- To change the settings, "**Authority**" must be "HART" (See **3. Authority setup**).

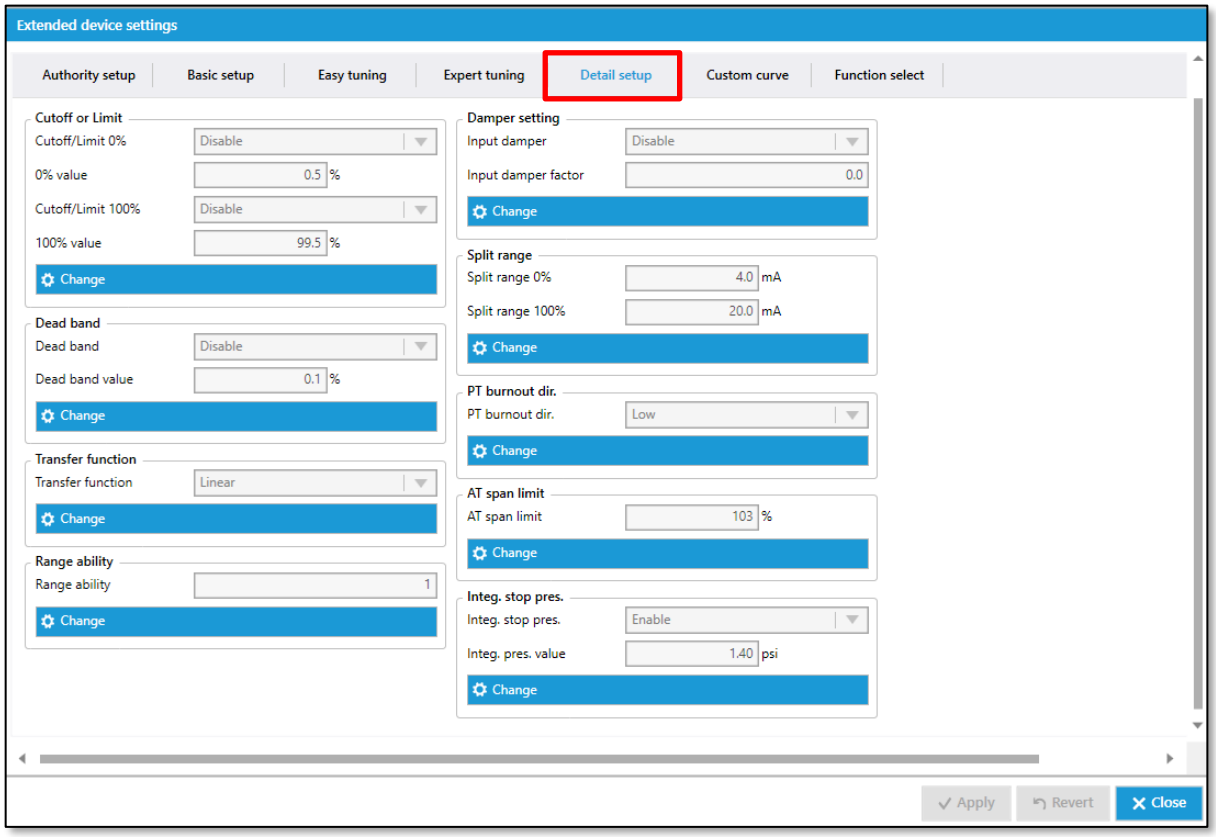
Setup items are as follows:

Cutoff/Limit	: Cutoff/Limit
Dead band	: Deviation value below which the integral action is disabled.
Transfer function	: Type of the flow characteristic curve
Range ability	: Rangeability in relevant to the equal percentage characteristic curve
Damper setting	: Damping coefficient to the input signal.
Split range	: Split range
PT burnout dir.	: Burnout direction of position transmitter
AT span limit	: Full mechanical limit of valve travel over the 100% travel position
Integ. stop pres.	: Integral stop pressure

※ Refer to the KGP5000 instruction manual for details and precautions for each parameter.

MENU) *Device Settings > Extended device settings > Detail setup*

① Click [Detail setup] tab menu in the [Extended device settings] menu. [Detail setup] menu opens.



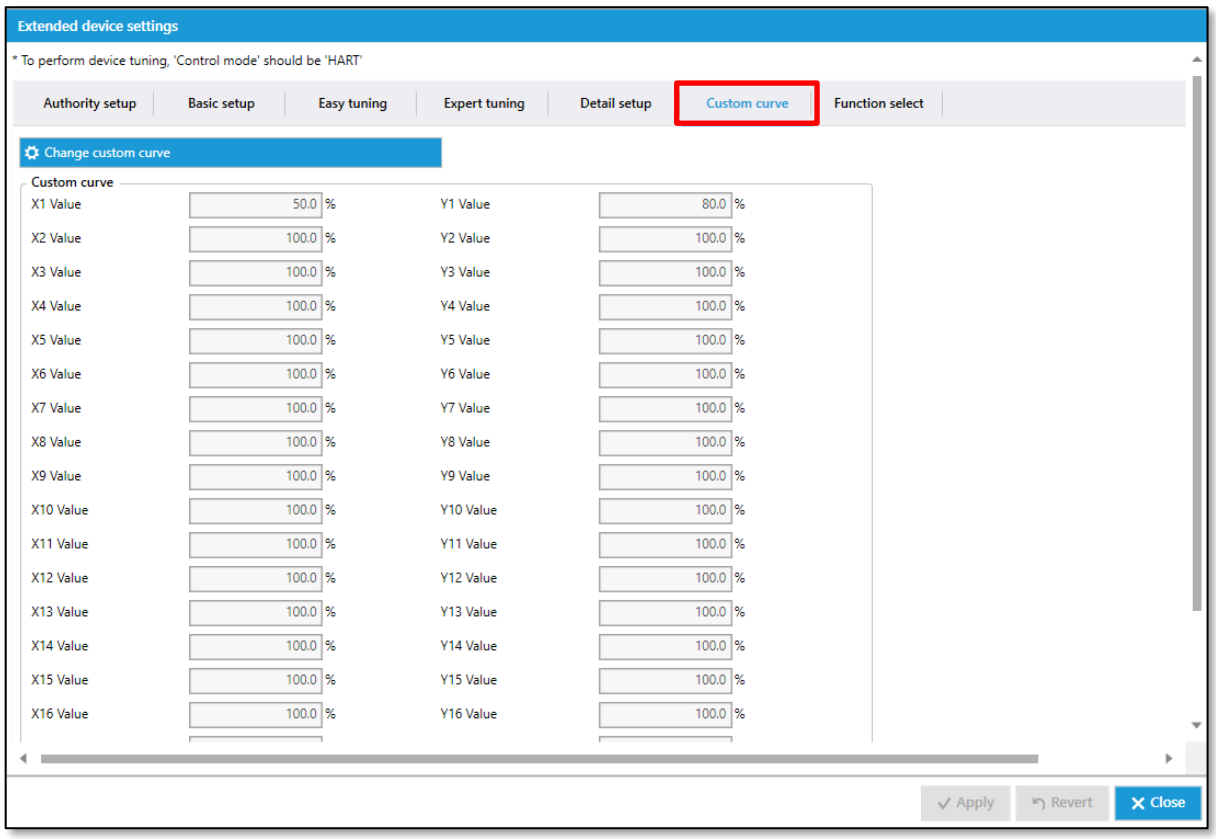
To change the current settings, click [Change] within each menu group.

5.6. Custom curve

Set the flow characteristic curve by specifying arbitrary 19 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.

MENU) *Device Settings > Extended device settings > Custom curve*

① Click [Custom curve] tab menu. [Custom curve] menu opens.



To enter the setting value, click [Change custom curve] and enter the setting value.

5.7. Function select

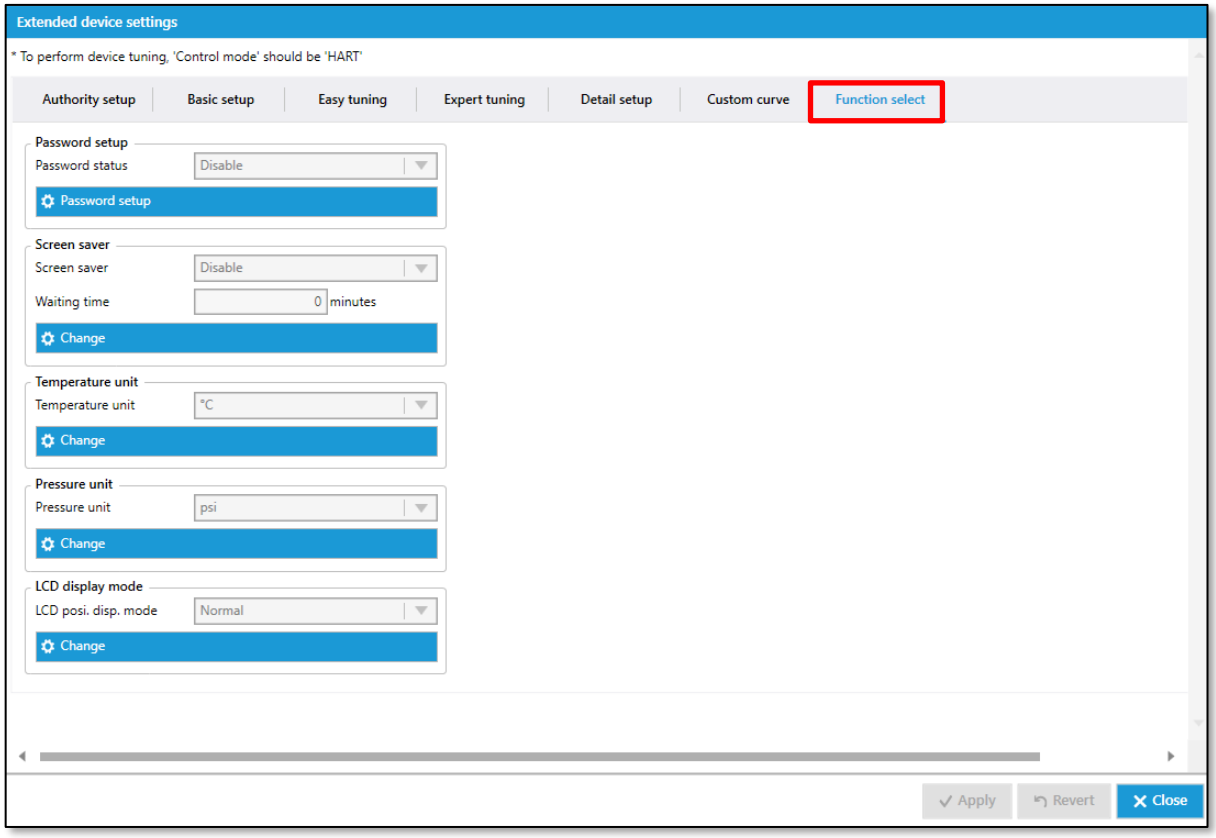
The following functions can be set individually.

Password setup	: Password setup
Screen saver	: Screen saver
Temperature unit	: Temperature unit
Pressure unit	: Pressure unit
LCD display mode	: LCD display mode of valve position

※ See KGP5000 instruction manual for details and precautions for each parameter.

MENU) *Device Settings > Extended device settings > Function select*

① Click [Function select] menu tab in the [Extended device settings] menu. [Function select] menu opens.



To change the current settings, click [Change] within each menu group.

※ For password settings, refer to **Appendix D. Password setup**.

6. Maintenance

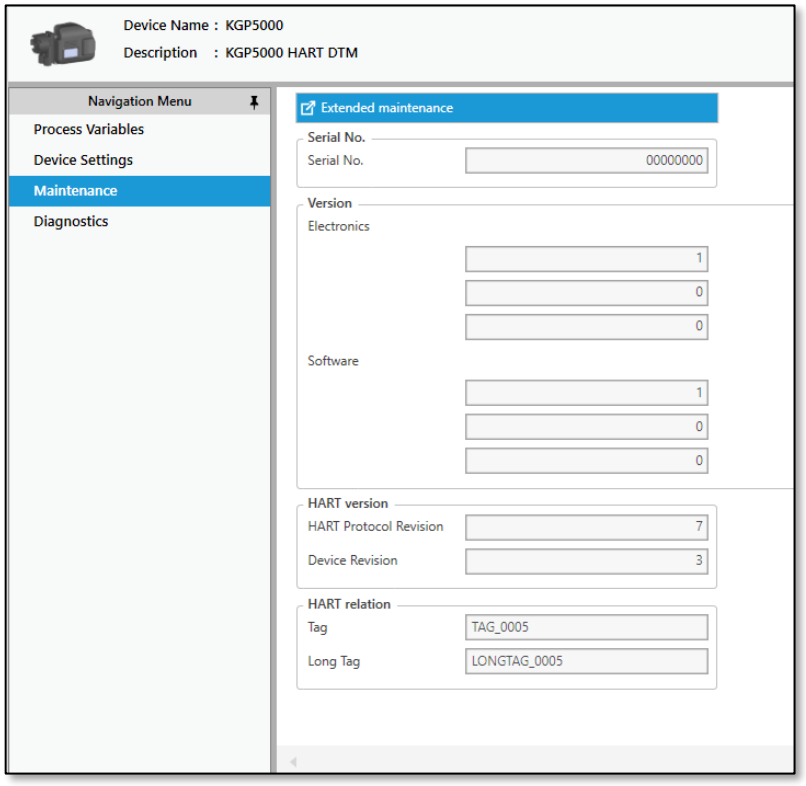
This menu offers maintenance, adjustment, and HART-related settings for the positioner.

Caution

➢ To change the settings, "**Authority**" must be "HART".

MENU) *Maintenance*

① Click [Maintenance] menu in the Navigation menu to open the [Maintenance] menu. Displays an overview of the current settings.



Display items are as follows:

[Serial No.]

Serial No.	: Serial number

[Version]

Electronics	: Hardware revision	Software	: Software revision

[HART version]

HART Protocol Revision	: HART protocol version	Device Revision	: Field device revision

[HART relation]

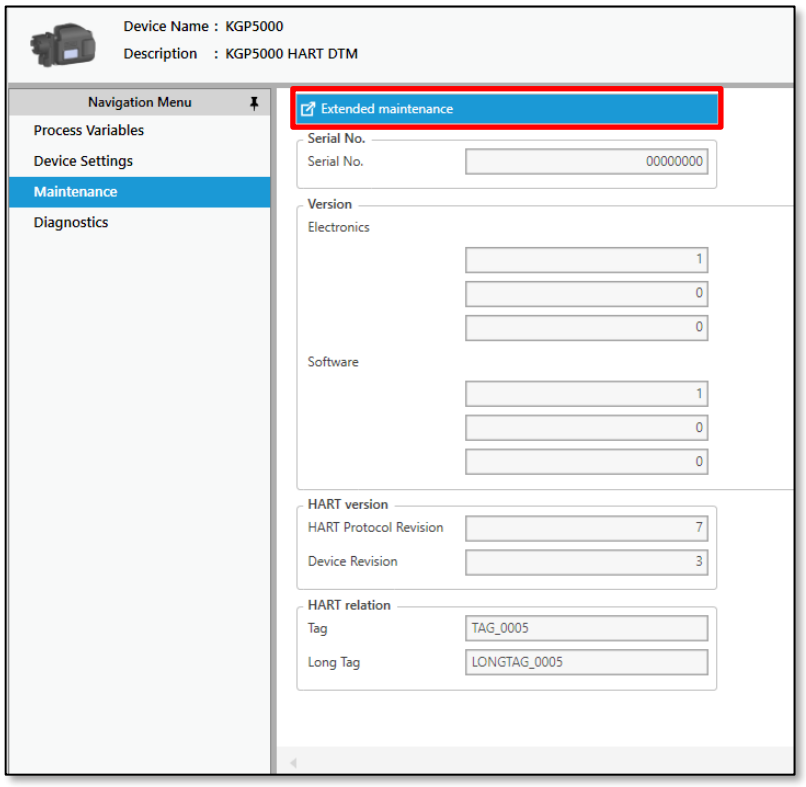
Tag	: Tag number	Long Tag	: Long Tag number

6.1. Extended maintenance

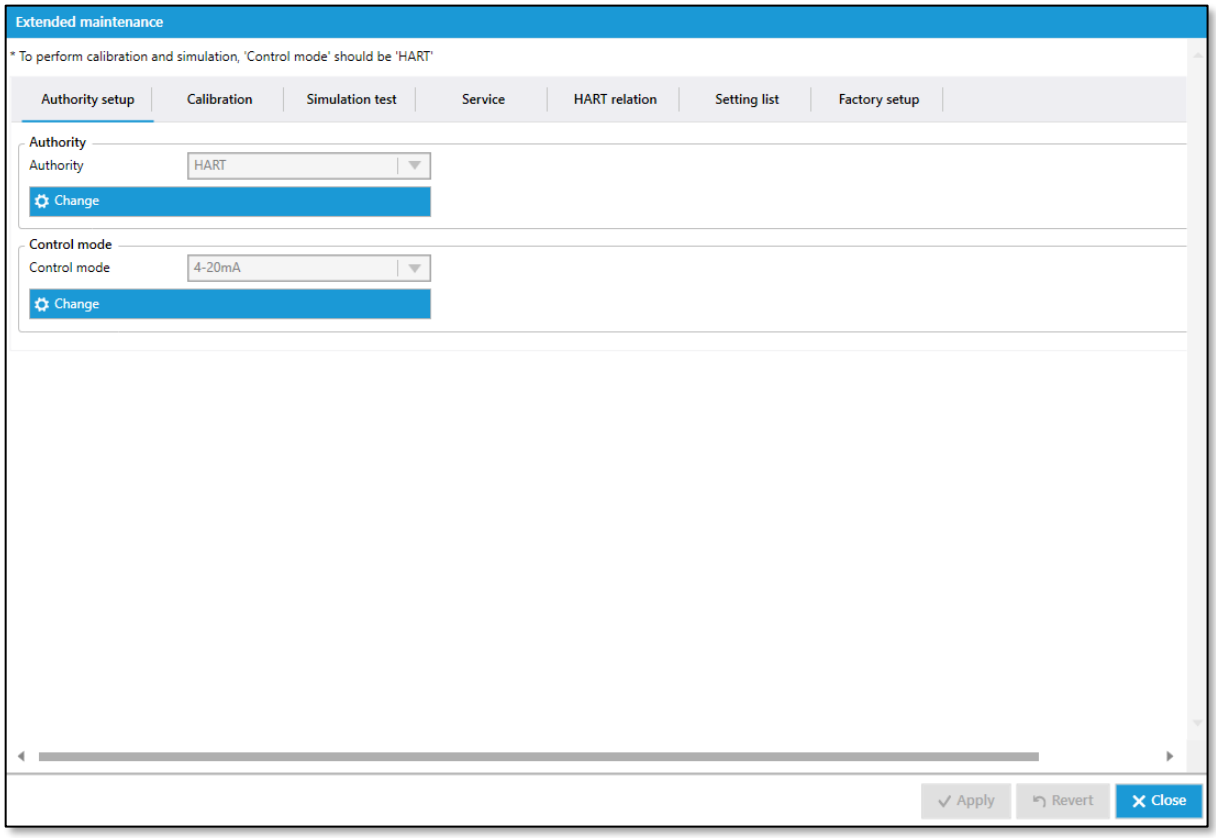
This menu offers maintenance, adjustment, and HART-related settings for the positioner.

MENU) *Maintenance > Extended maintenance*

① Click [Extended maintenance] in the [Maintenance] top menu.



② [Extended maintenance] menu opens.



Menu items are as follows:

(1) Authority setup menu	See 3. Authority setup
(2) Calibration menu	See 6.2 Calibration
(3) Simulation test menu	See 6.3 Simulation test
(4) Service menu	See 6.4. Service
(5) HART relation menu	See 6.5. HART relation
(6) Setting list menu	See 6.6. Setting list
(7) Factory setup menu	See 6.7. Factory setup ※

※ This menu is displayed only when the “Factory setup” field is “ON” in the [Maintenance] > [Service] > [Factory menu].

Click on the tab to open each menu.

6.2. Calibration

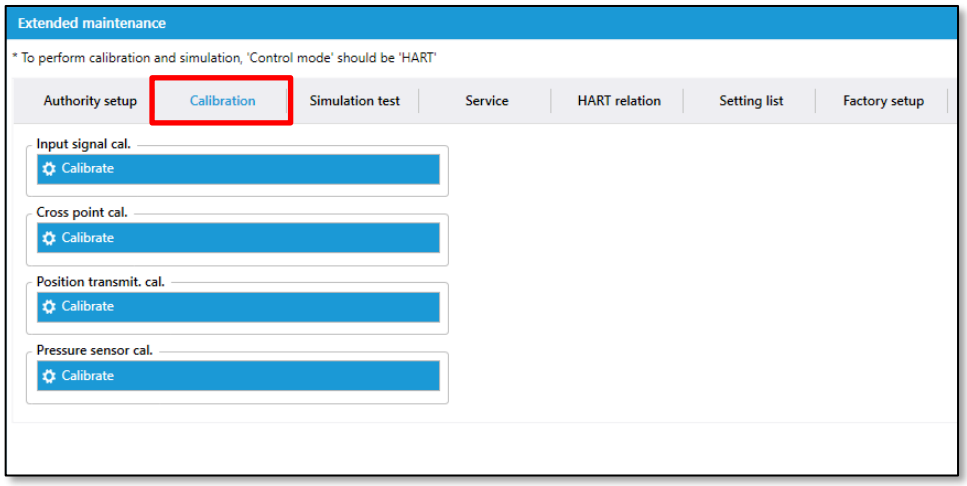
Since the operation described in this section is preset from the factory, generally, it is not necessary to repeat this. However, since there is a case in which a deviation is produced from long-term operation and so on, if necessary, perform this operation.

Caution

HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
Before performing calibration, set "**Control mode"** to "HART".

MENU) *Maintenance > Extended maintenance > Calibration*

Click [Calibration] menu tab in the [Extended maintenance] menu. [Calibration] menu opens.



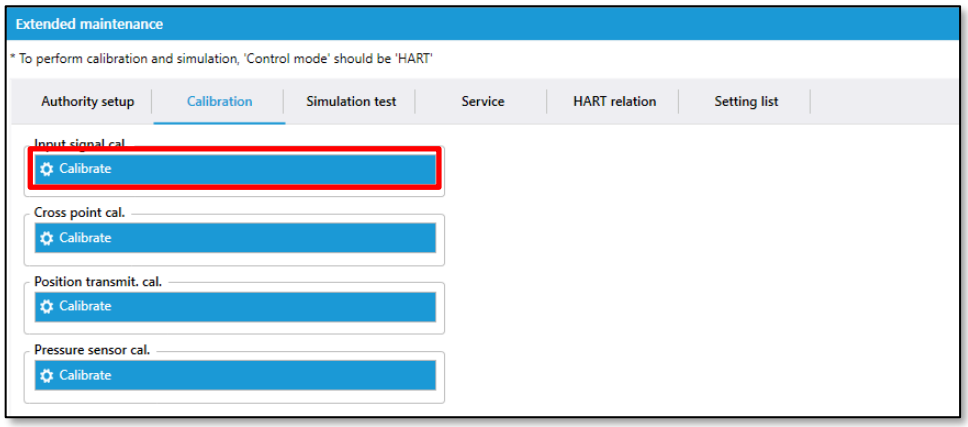
6.2.1. Input signal calibration

Calibrate the value of input signal which the positioner can receive.

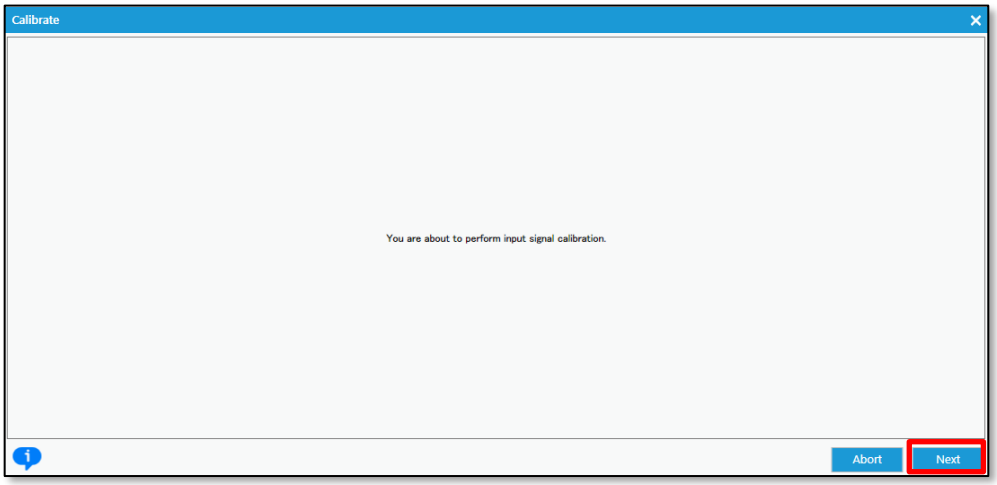
The steps to calibration each value of 4mA and 20mA is shown as below.

MENU) *Maintenance > Extended maintenance > Calibration > Input signal cal.*

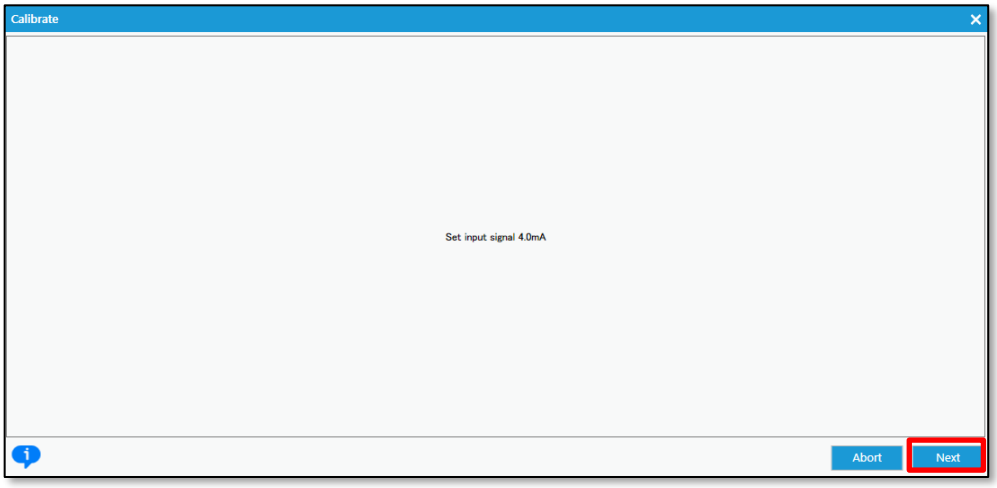
① Click [Calibrate] in the [Input signal cal.] menu group.



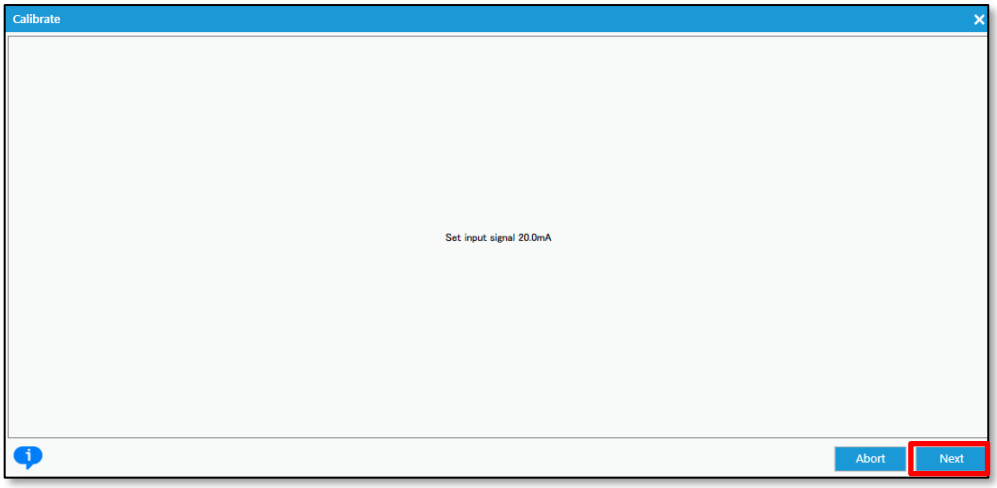
② Confirm the message and click [Next].



③ Set the input signal to 4mA and click [Next].



④ Set the input signal to 20mA and click [Next].



⑤ Calibration is complete when the message “Input signal calibration is completed” is displayed.

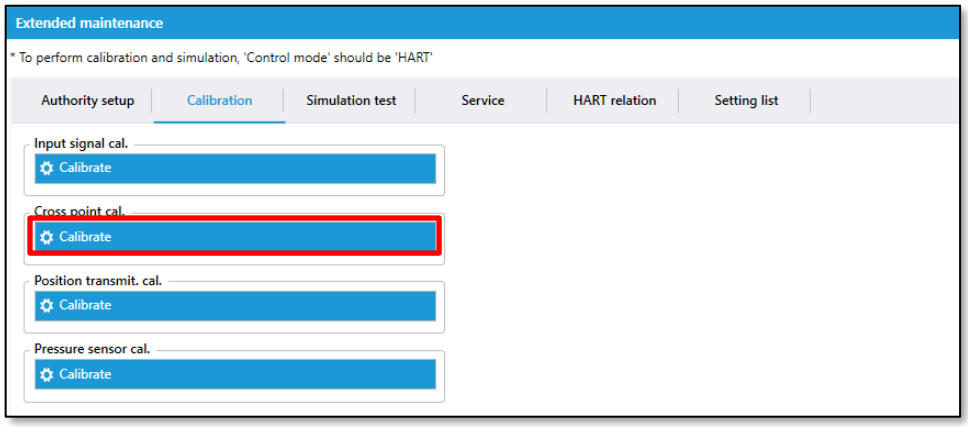
6.2.2. Cross point calibration.

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

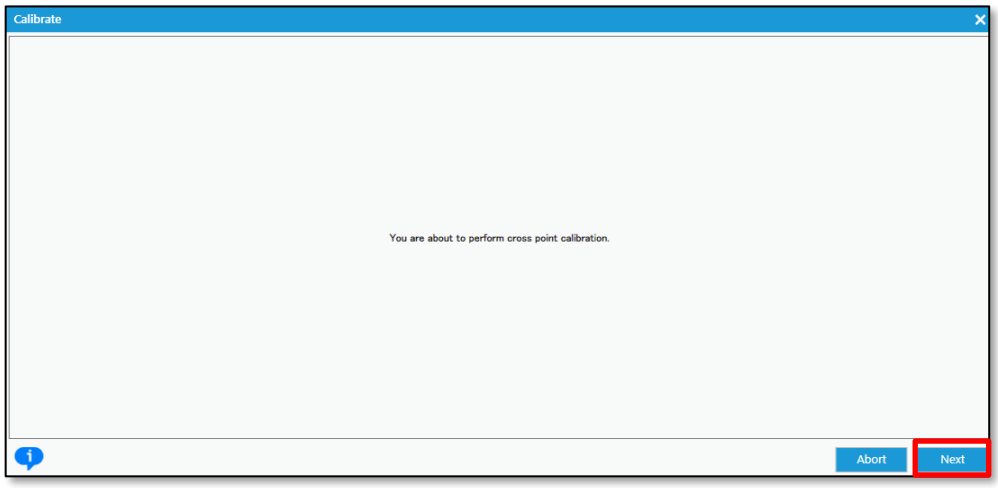
The steps are shown below.

MENU) *Maintenance > Extended maintenance > Calibration > Cross point cal.*

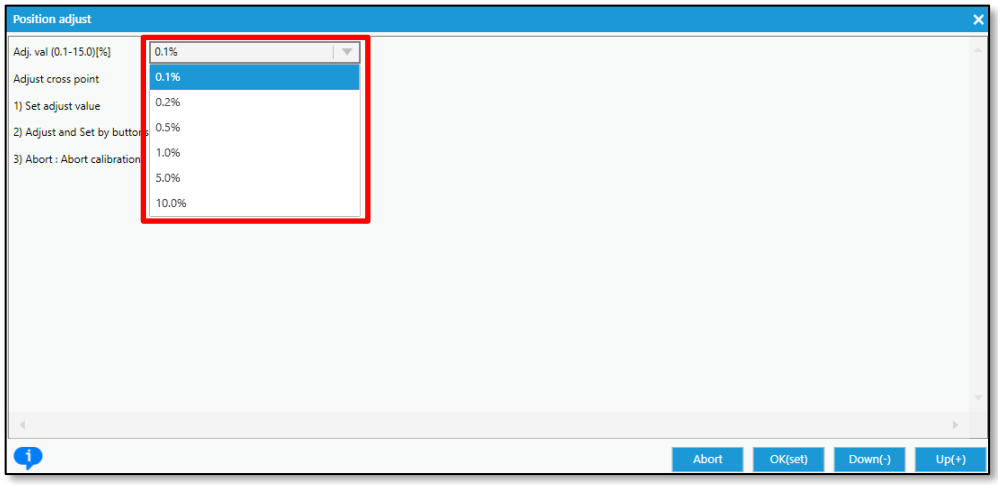
① Click [Calibrate] menu tab in the [Cross point cal.] menu group.



② Confirm the message and click [Next].

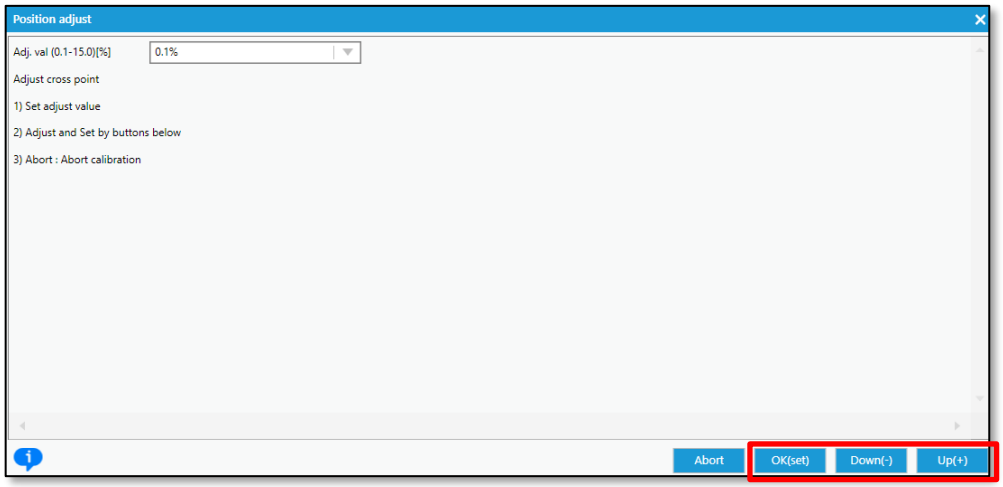


③ Select the amount of adjustment with one button click in the “Adj. val” field.



④ Click [Up(+)] or [Down(-)] to make the feedback lever horizontal.

⑤ When reach the horizontal position, click [Ok(set)] to complete the crosspoint calibration.

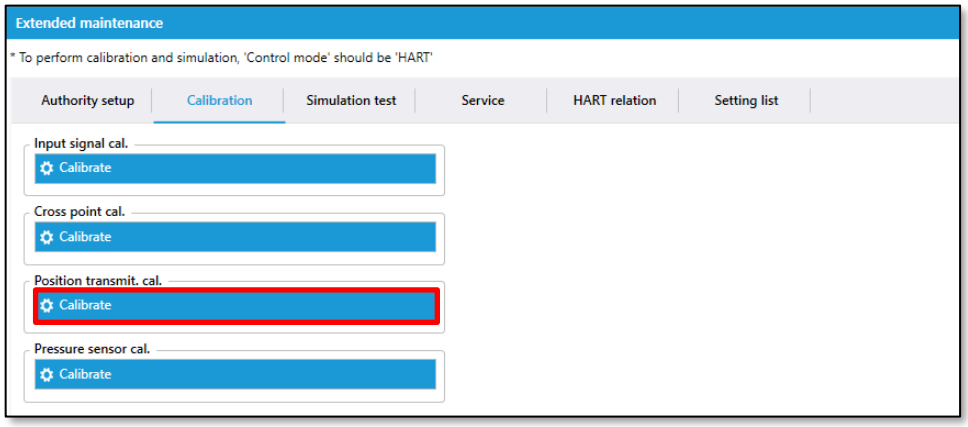


6.2.3. Position transmitter calibration

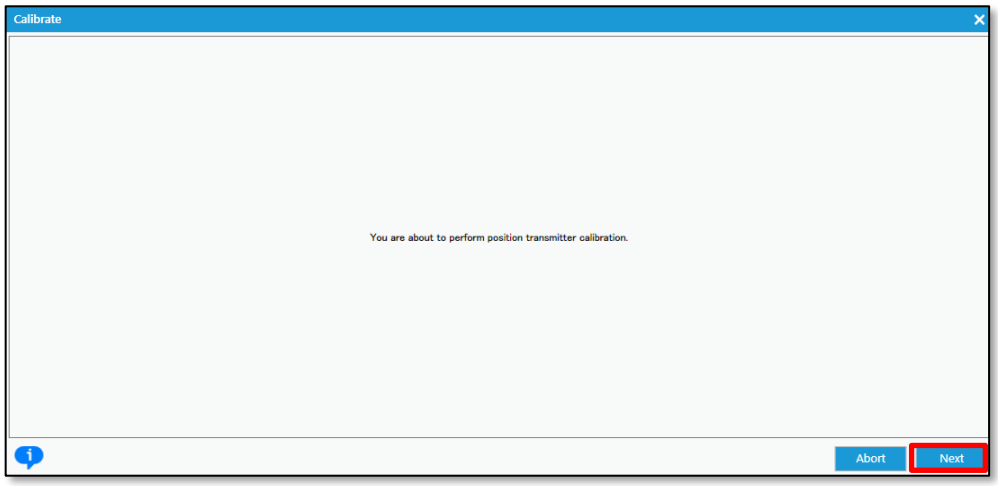
Calibrate the position transmitter signal which the positioner may send.
The steps to calibrate the position transmitter signal of both position 0% and 100% is shown below.

MENU) *Maintenance > Extended maintenance > Calibration > Position transmit. cal.*

① Click [Calibrate] in the [Position transmit. cal.] menu group.

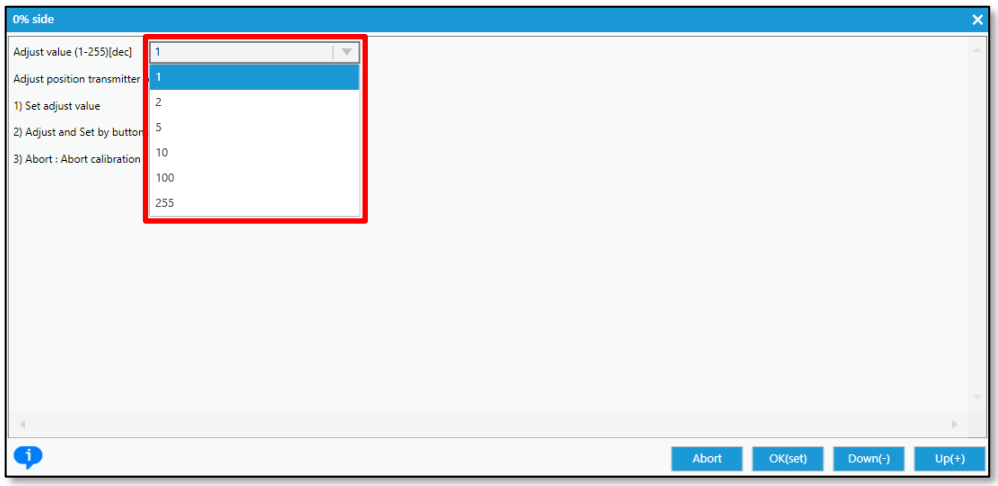


② Confirm the message and click [Next].

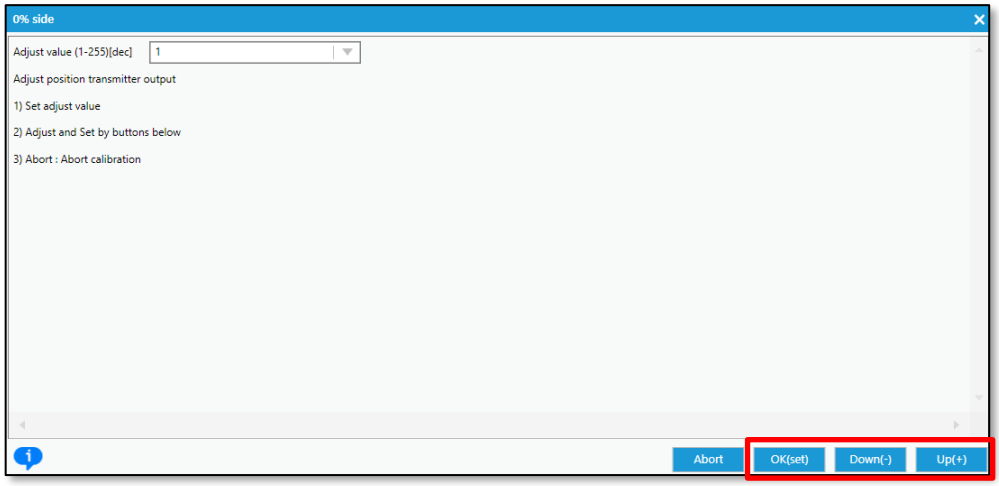


<u>First, perform calibration on the 0% side.</u>

③ Select the amount of adjustment with one button click in the “Adjust value” field.

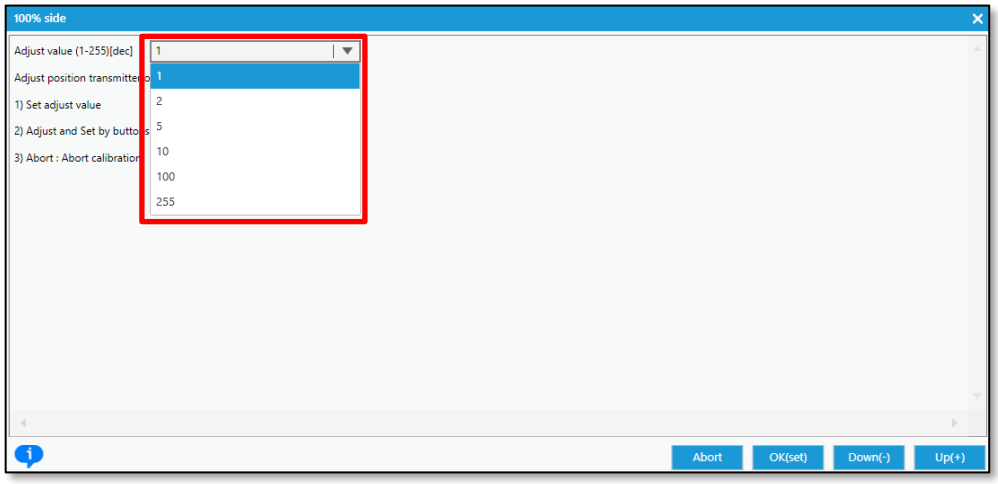


④ Click [Up(+)] or [Down(-)] to adjust position transmitter signal. After completing the adjustment, click [OK(set)] to configure.

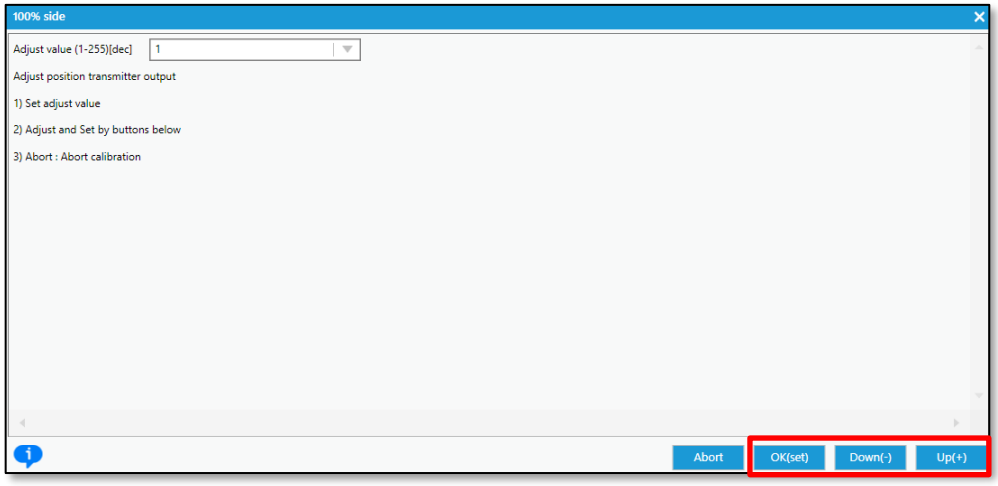


Next, perform calibration on the 100% side.

⑤ Select the amount of adjustment with one button click in the “Adjust value” field.



⑥ Click [Up(+)] or [Down(-)] to adjust position transmitter signal. After completing the adjustment, click [OK(set)] to complete calibration.



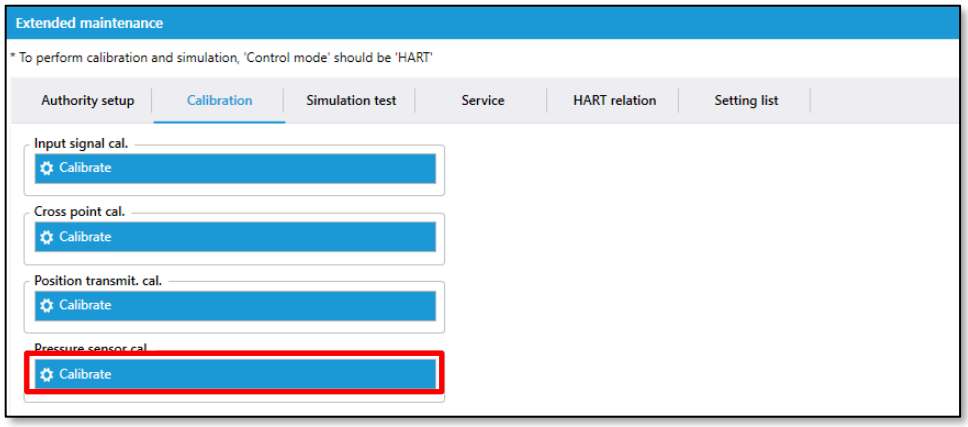
6.2.4. Pressure sensor calibration

Calibrate three pressure sensors attached 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 first order pressure (1st-P) and the second order pressure (2nd-P) for each sensor.

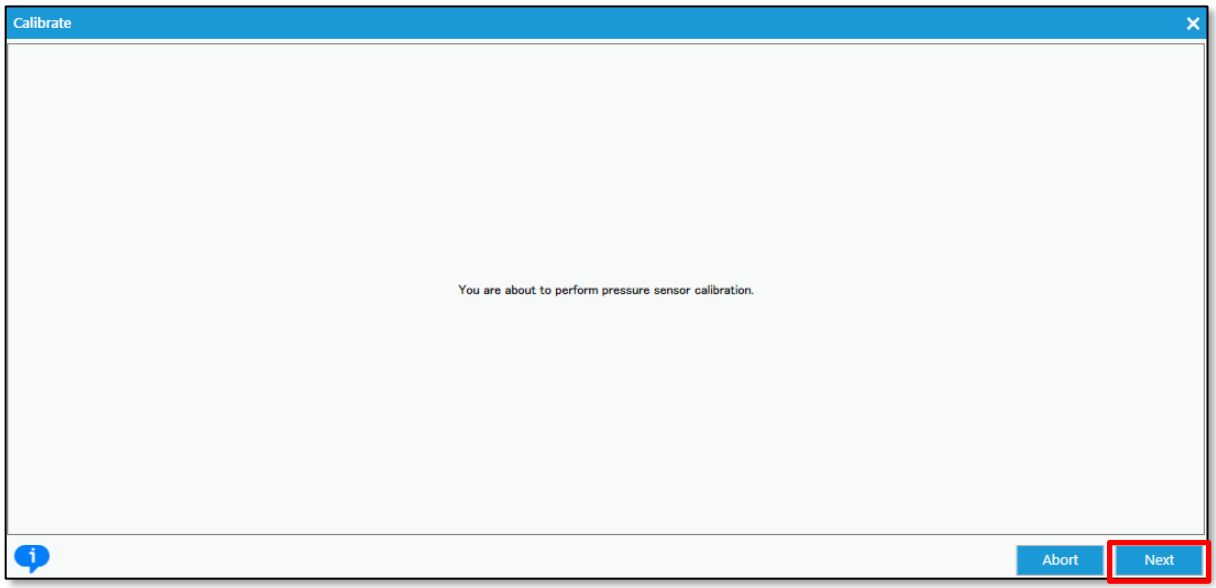
The steps to calibrate the supply pressure sensor is showed as below.

MENU) *Maintenance > Extended maintenance > Calibration > Pressure sensor cal.*

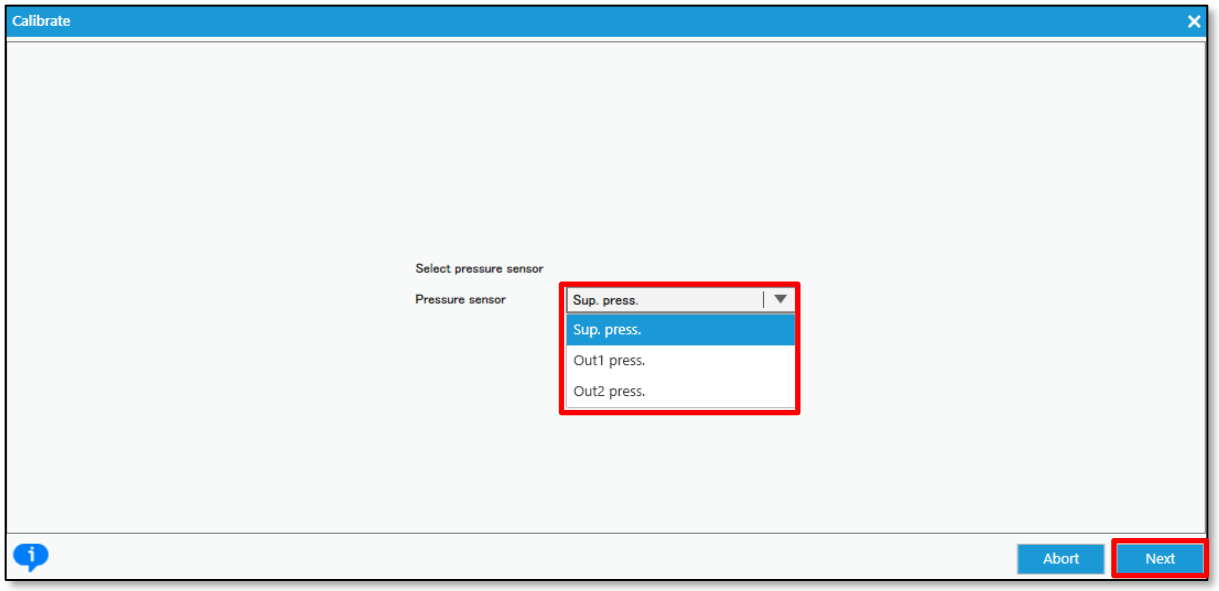
① Click [Calibrate] in the [Pressure sensor cal.] menu group.



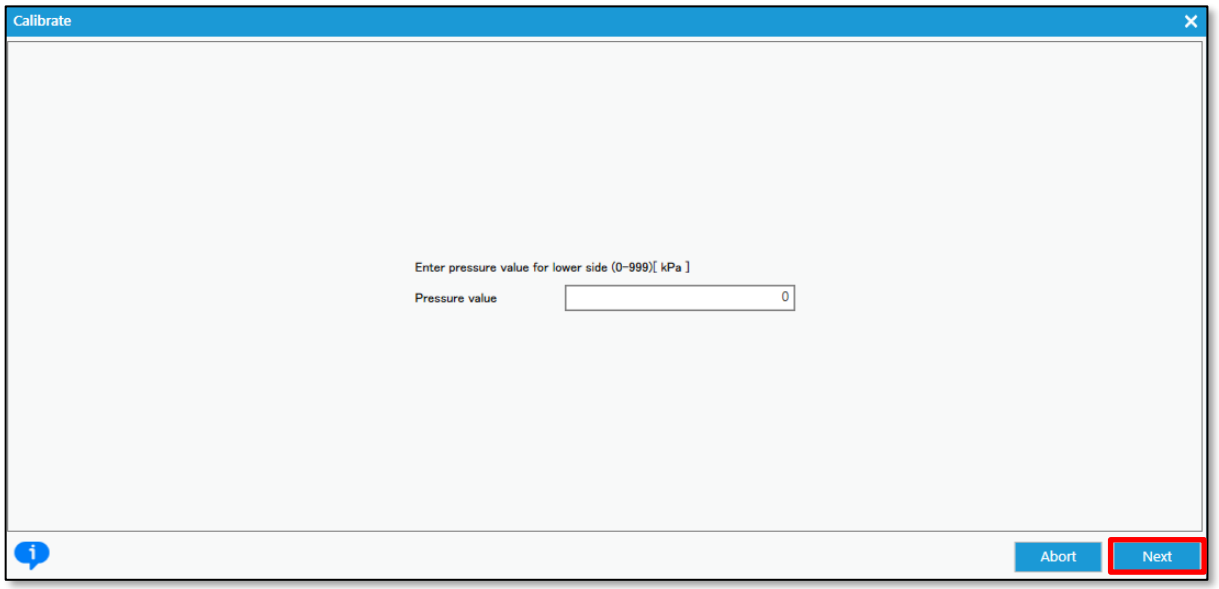
② Confirm the message and click [Next].



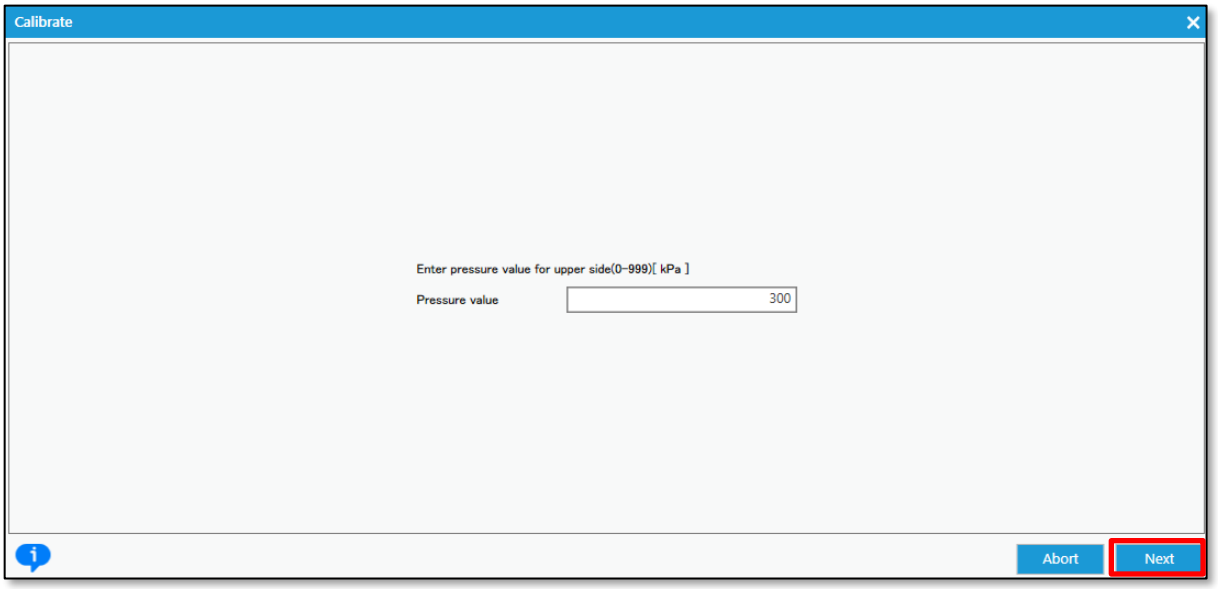
③ Select ”Sup. press.” In the “Pressure sensor” field and Click [Next].



④ Stop pressure supply, enter pressure value in the “Pressure value” field and Click [Next].



⑤ Resume pressure supply, enter pressure value in the “Pressure value” field and Clic[Next] to complete calibration.



6.3. Simulation test

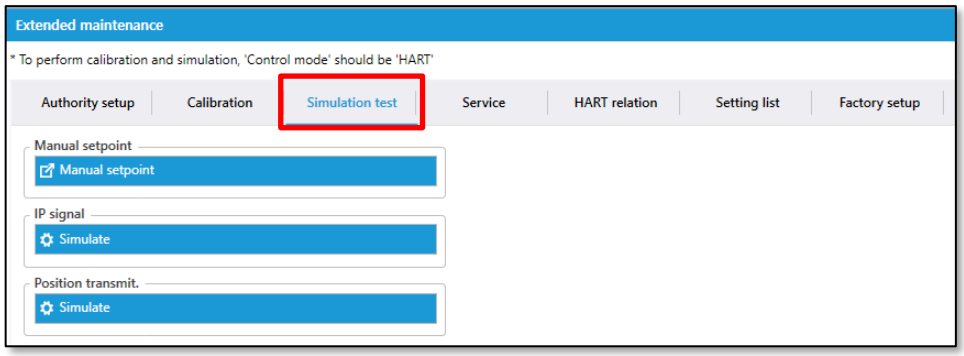
It is possible to generate input signal, IP signal current and position transmitter output in similar manner with the desired control.

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 more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing simulation test, set "**Control mode**" to "HART".

MENU) *Maintenance > Extended maintenance > Simulation test*

① Click [Simulation test] menu tab in the [Extended maintenance] menu. [Simulation test] menu opens.

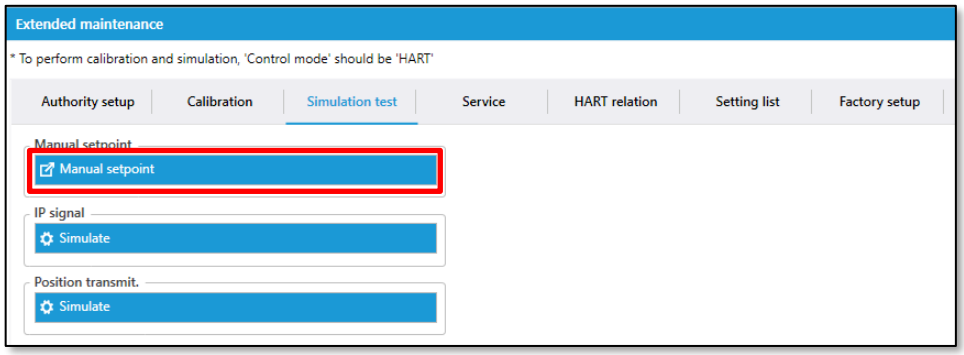


6.3.1. Manual setpoint simulation

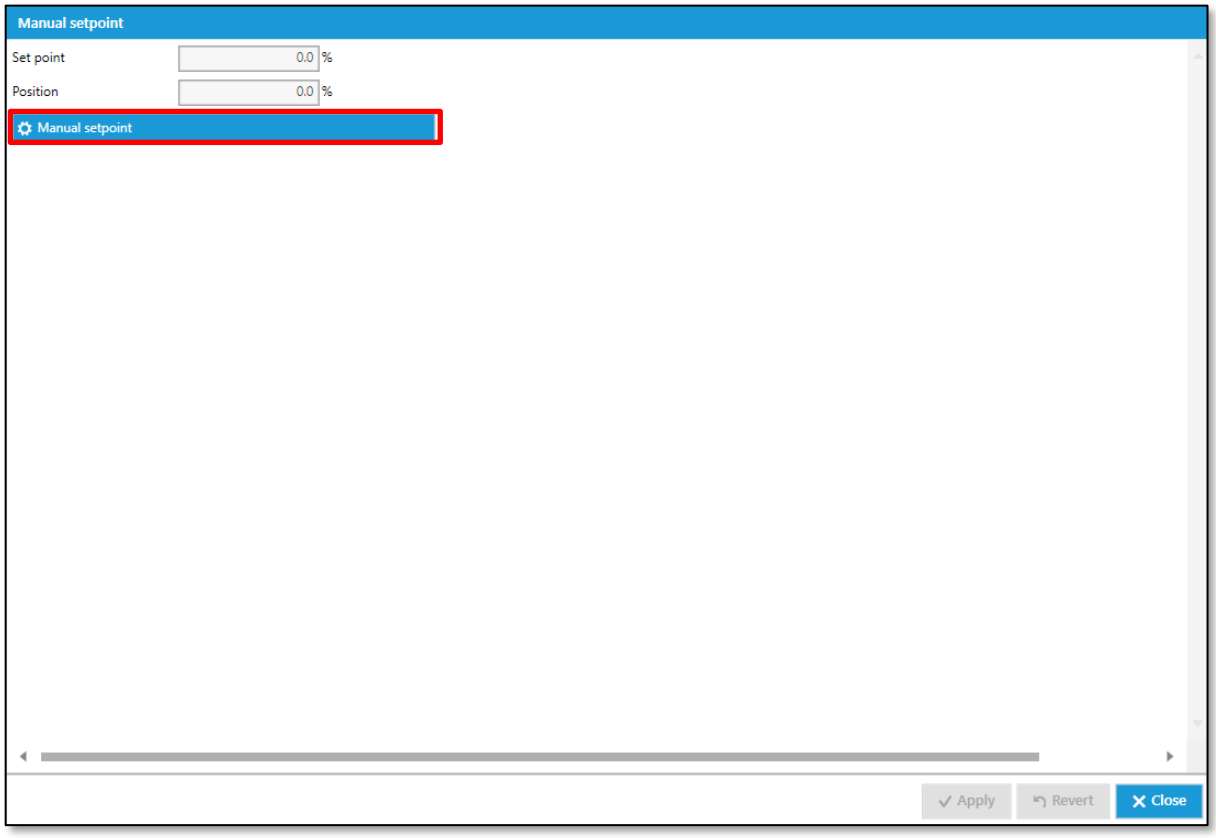
It is possible to operate the control valve by pseudo input signal.

MENU) *Maintenance > Extended maintenance > Simulation test > Manual setpoint*

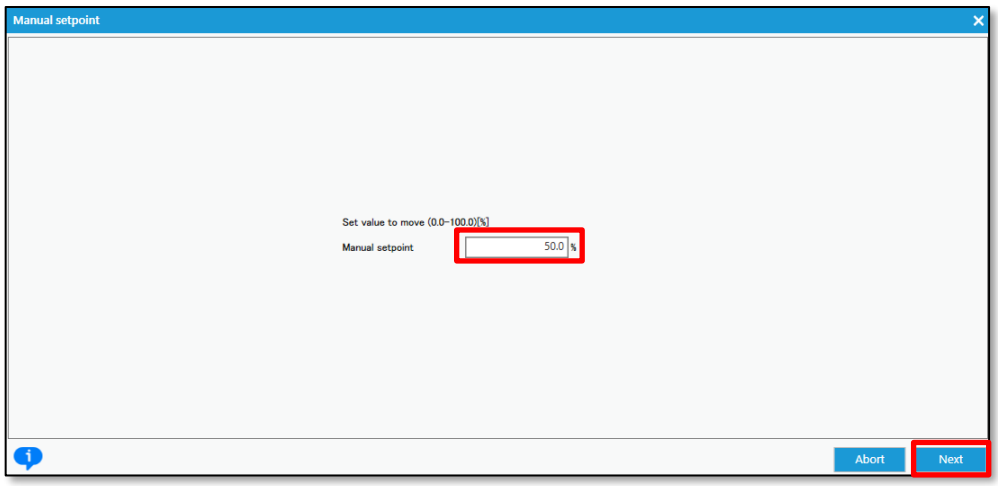
① Click [Manual setpoint] in the [Manual setpoint] menu group. Another menu opens.



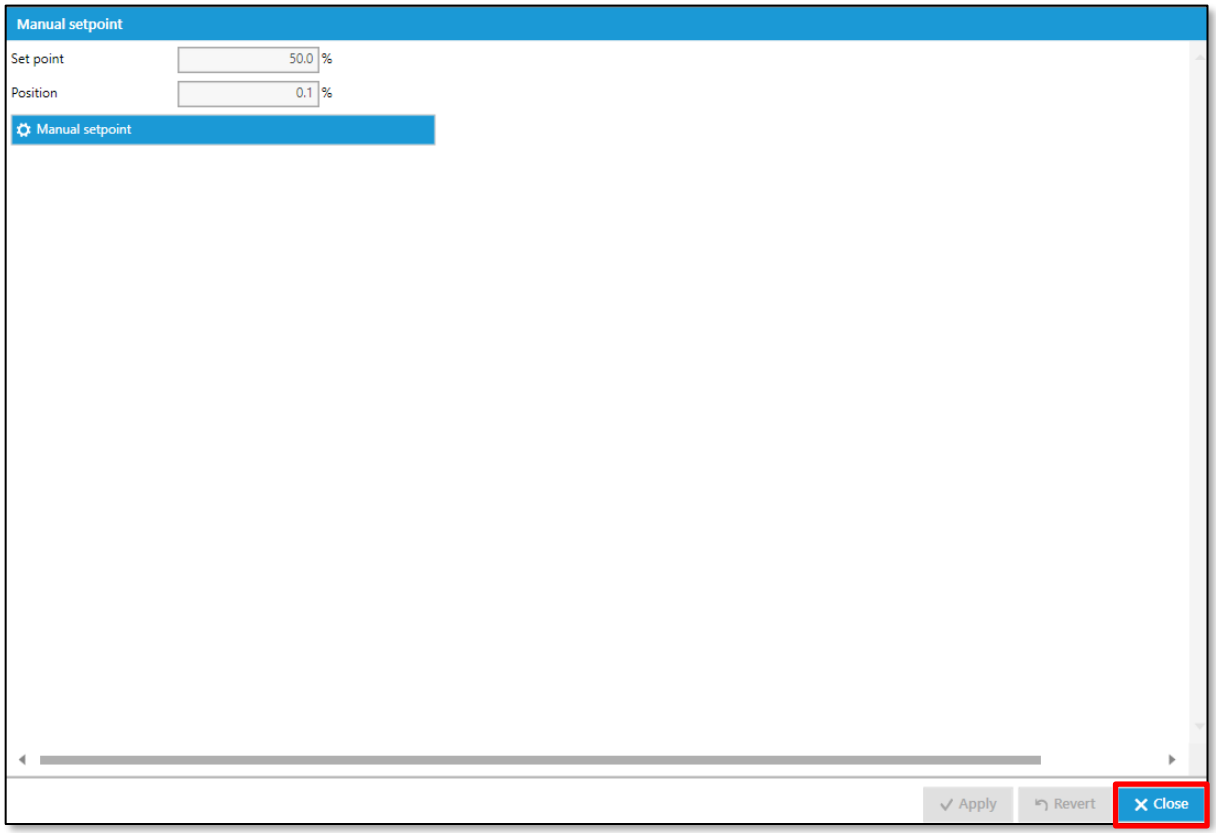
② Click [Manual setpoint] in the [Manual setpoint] menu group, [Manual setpoint] sub menu opens.



③ Enter setpoint value in the “Manual setpoint” field and click [Next]. Perform simulate manual setpoint and return menu of ②.



④ Click [Close], return to the [Simulation test] menu.

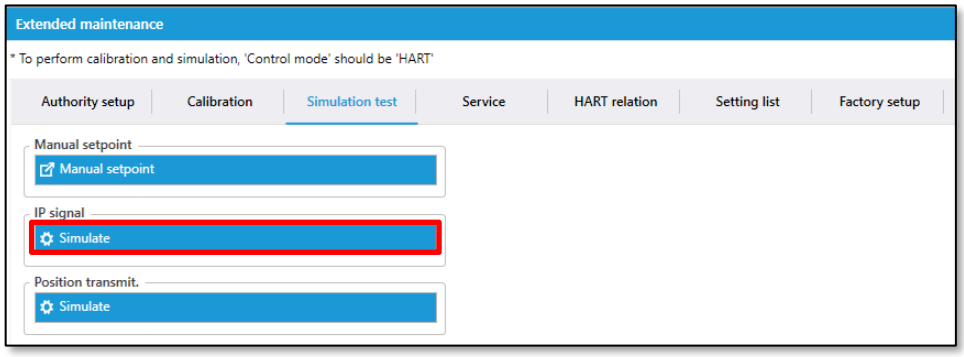


6.3.2. IP signal simulation

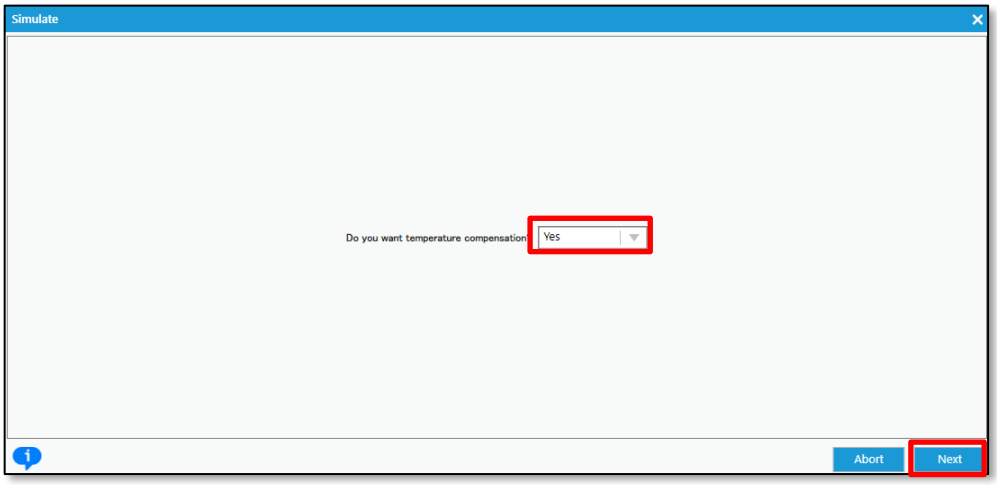
It is possible to operate the control valve by providing the IP signal directly to the torque motor unit.

MENU) Maintenance > Extended maintenance > Simulation test > IP signal

① Click [Simulate] in the [IP signal] menu group.

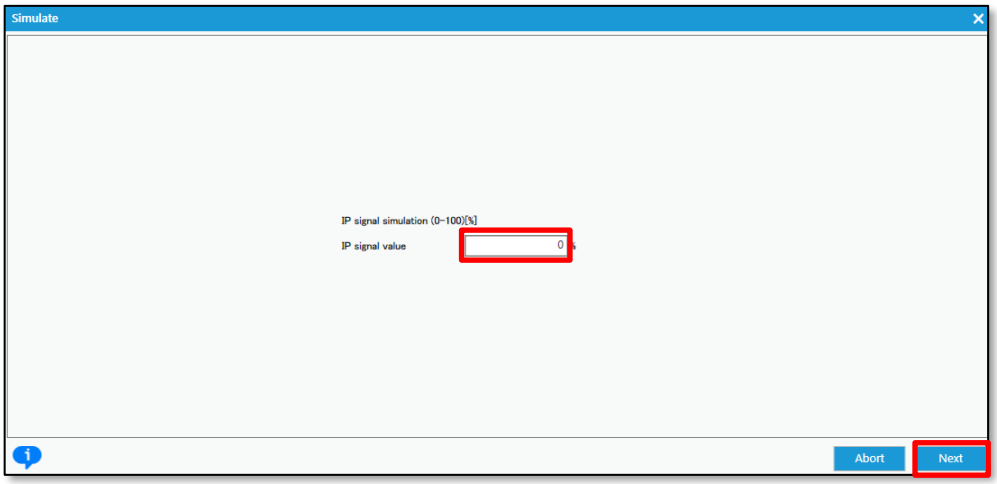


② Select whether or not to adjust temperature. In general, select “Yes” and click [Next].



③ Enter the IP signal values in the “IP signal value” field and click [Next]. Perform simulation.

④ To return to the normal control, click [Abort].

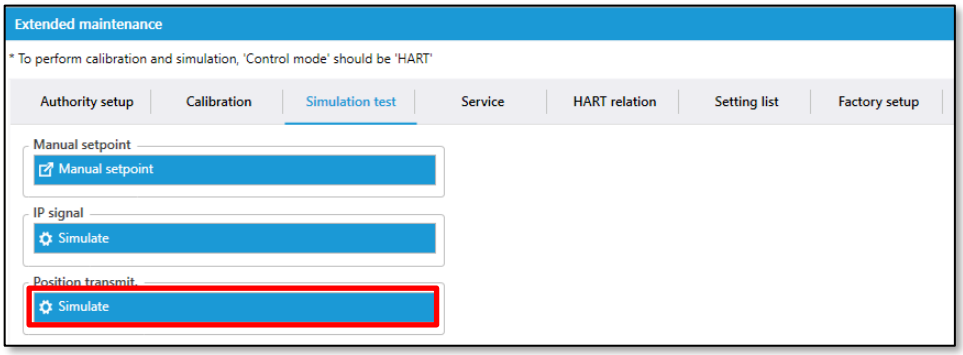


6.3.3. Position transmitter simulation

It is possible to output the position transmitter signal with a pseudo-set position transmitter value.

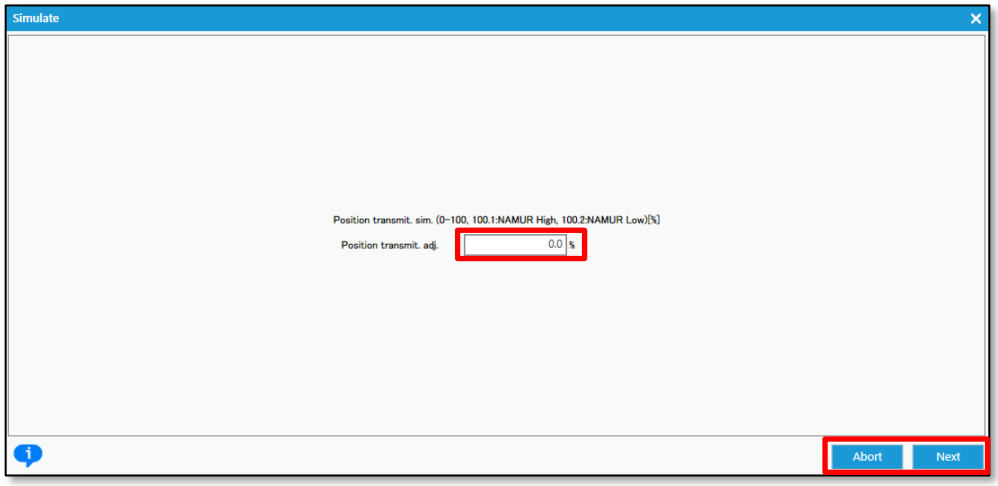
MENU) Maintenance > Extended maintenance > Simulation test > Position transmitter

① Click [Simulate] in the [Position transmitter] menu group.



② Enter position transmitter value in the “Position transmit adj.” field and click [Next]. Perform simulation.

Any position transmitter value from 0-100% can be output.
If set 100.1%, positioner outputs NAMUR Burnout High signal.
If set 100.2%, positioner outputs NAMUR Burnout Low signal.
To return to the normal output, click [Abort].

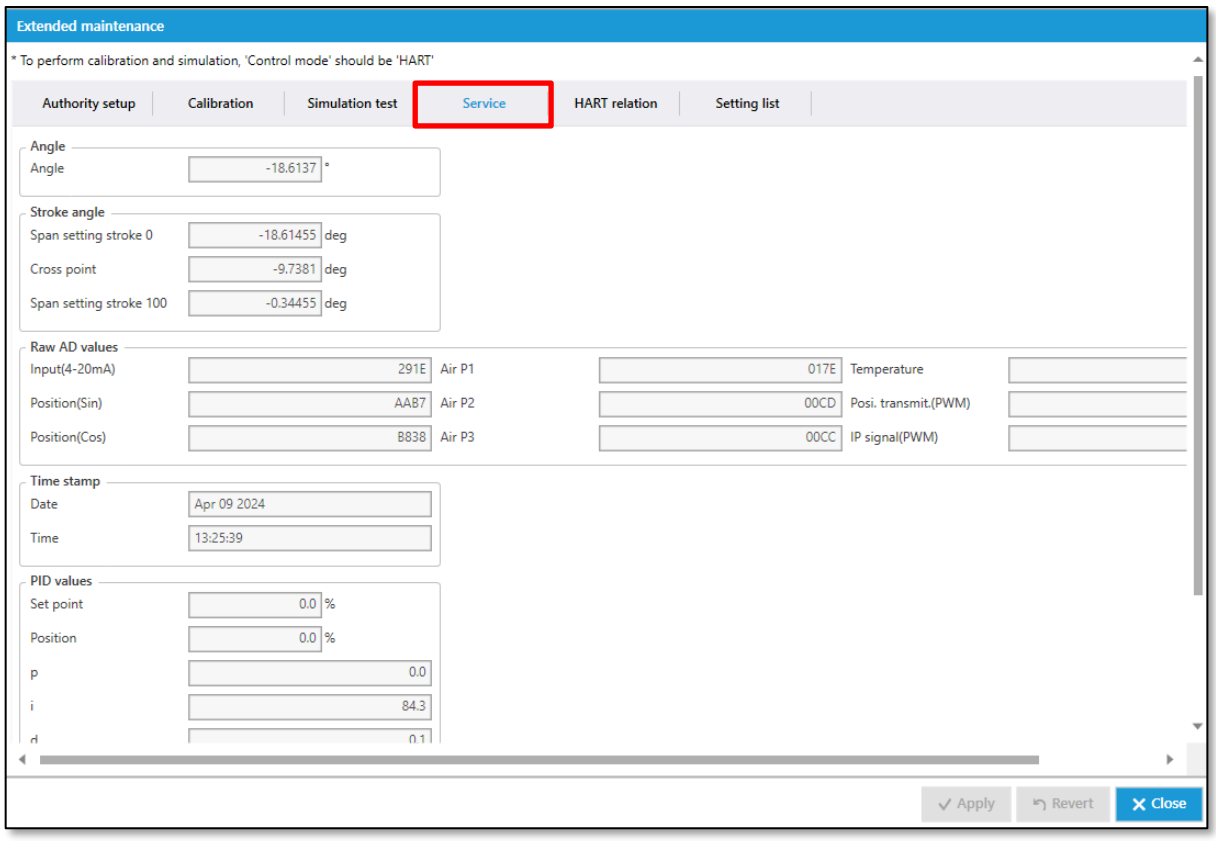


6.4. Service

The operator can identify the current internal control variables as follows.

MENU) *Maintenance > Extended maintenance > Service*

① Click [Service] menu tab in the [Extended maintenance] menu and open the [Service] menu.



Display items are as follows:

[Angle]

Angle	: Angle of potentiometer

[Stroke angle]

Span setting stroke 0	: Angle value at 0% span	Cross point	: Angle of cross point
Span setting stroke 100	: Angle value at 100% span		

[Raw AD Value]

Input(4-20mA)	: AD value of Input signal	Position(Sin)	: AD value of valve position(sin)
Position(Cos)	: AD value of valve position(cos)	Air P1	: AD value of pressure sensor 1
Air P2	: AD value of pressure sensor 2	Air P3	: AD value of pressure sensor 3
Temperature	: AD value of temperature	Posi. transmit.(PWM)	: PWM value of position transmitter
IP signal (PWM)	: PWM value of IP signal current		

[Time stamp]

Date	: Firmware time stamp - Date	Time	: Firmware time stamp - Time

[PID values]

Set point	: Set point	Position	: Valve position
p	: Proportional gain	i	: Integral coefficient
d	: Differential gain		

6.4.1. Switching of Factory setup menu

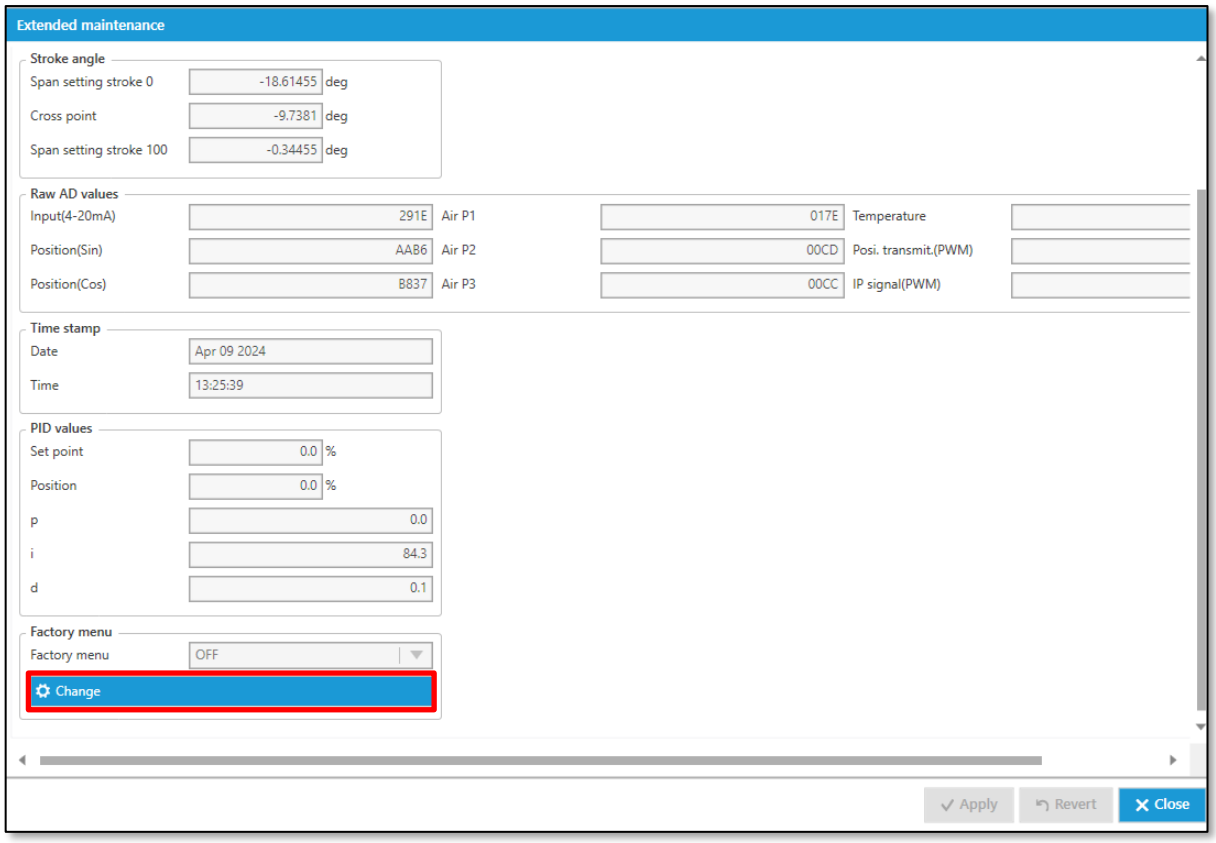
Enable/Disable the [Factory setup] menu.

Caution

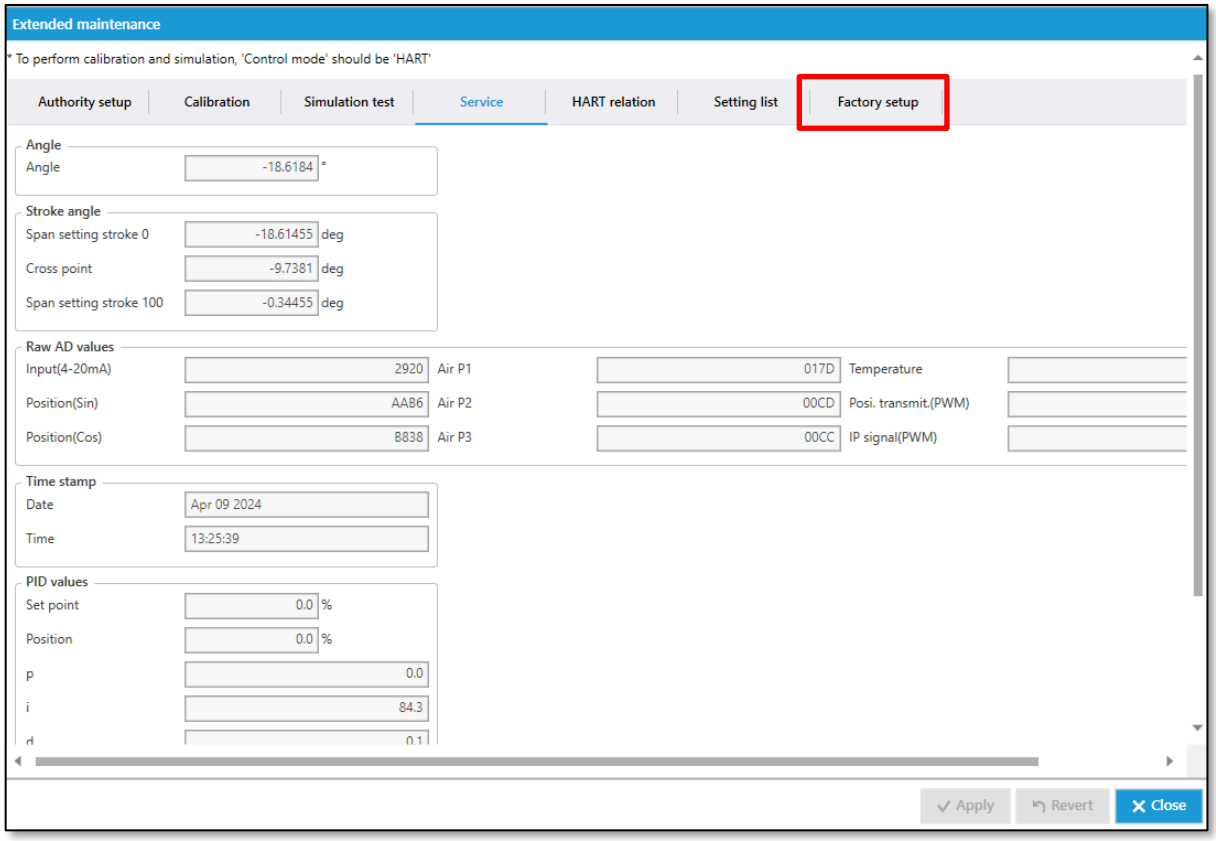
- Since the suitable parameters are configured at the factory, in general, do not perform switching of factory setup and the reconfiguration on its menu. The reconfiguration of the values causes the case that the desired response may not be achieved.

MENU) *Maintenance > Extended maintenance > Service > Factory menu*

① Click [Change] in the [Factory menu] menu group and select “ON”.



② [Factory setup] tab menu is added in the [Extended maintenance] menu.

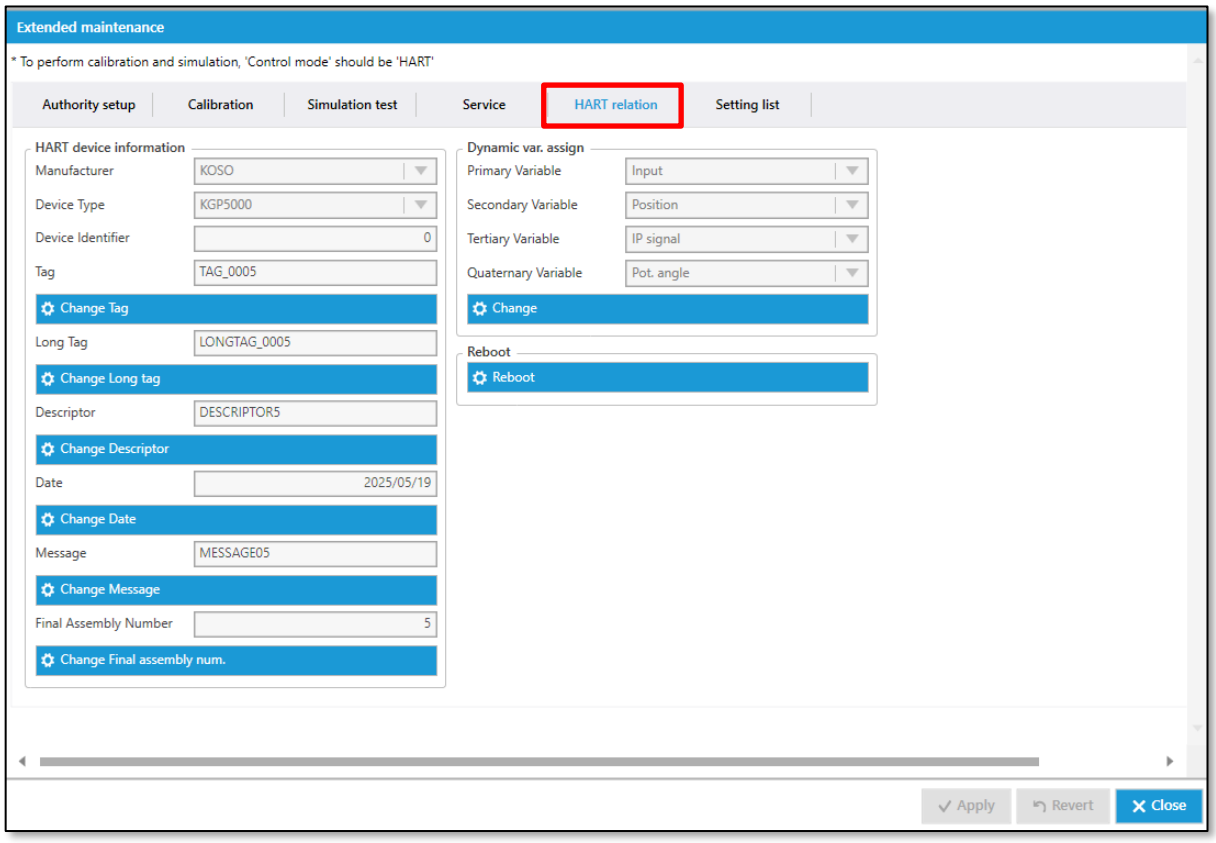


6.5. HART relation

Display and configure information related to HART communication.

MENU) *Maintenance > Extended maintenance > Service*

① Click [HART relation] menu tab in the [Extended maintenance].



Display items are as follows:

[HART device information]

Manufacture	: Manufacture	Device Type	: Model
Device Identifier	: Device Identifier	Tag	: Tag number
Long Tag	: Long Tag number	Descriptor	: Descriptor
Date	: Date	Message	: Message
Final Assembly Number	: Final Assembly Number		

[Dynamic var. assign]

Primary Variable	: Primary Variable	Secondary Variable	: Secondary Variable
Tertiary Variable	: Tertiary Variable	Quaternary Variable	: Quaternary Variable

6.5.1. HART/Device Information

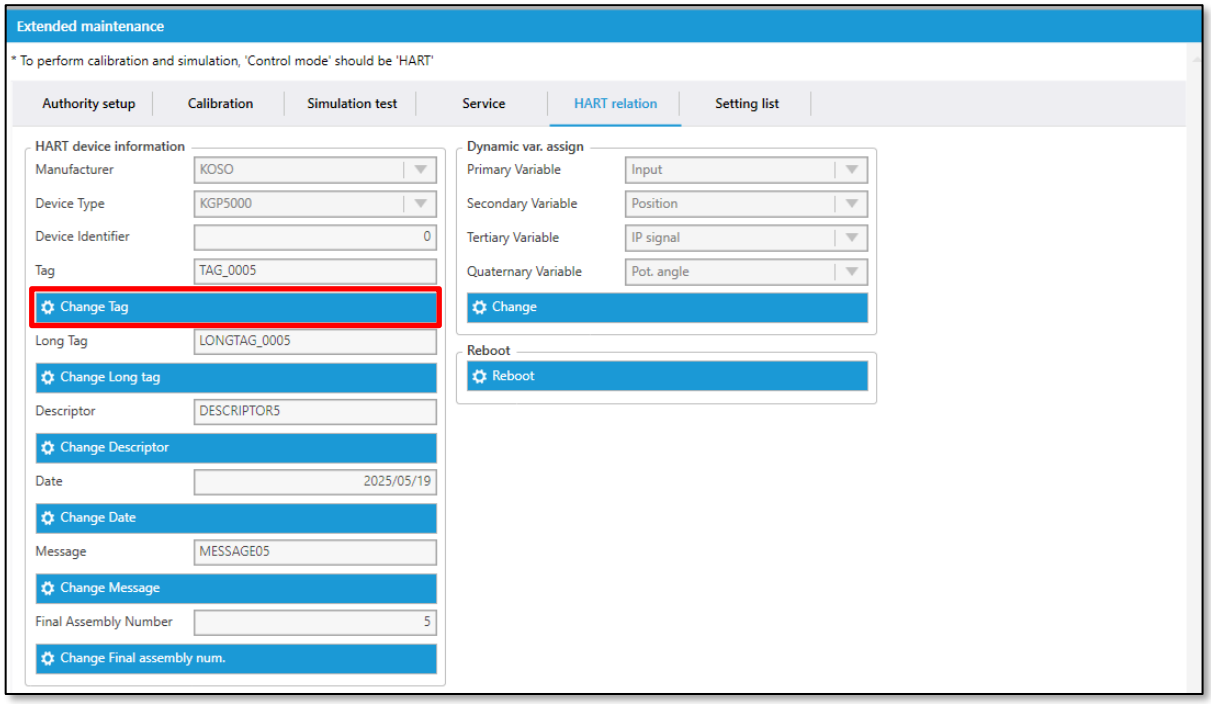
Some HART device information can be changed.

The changeable items are as follows:

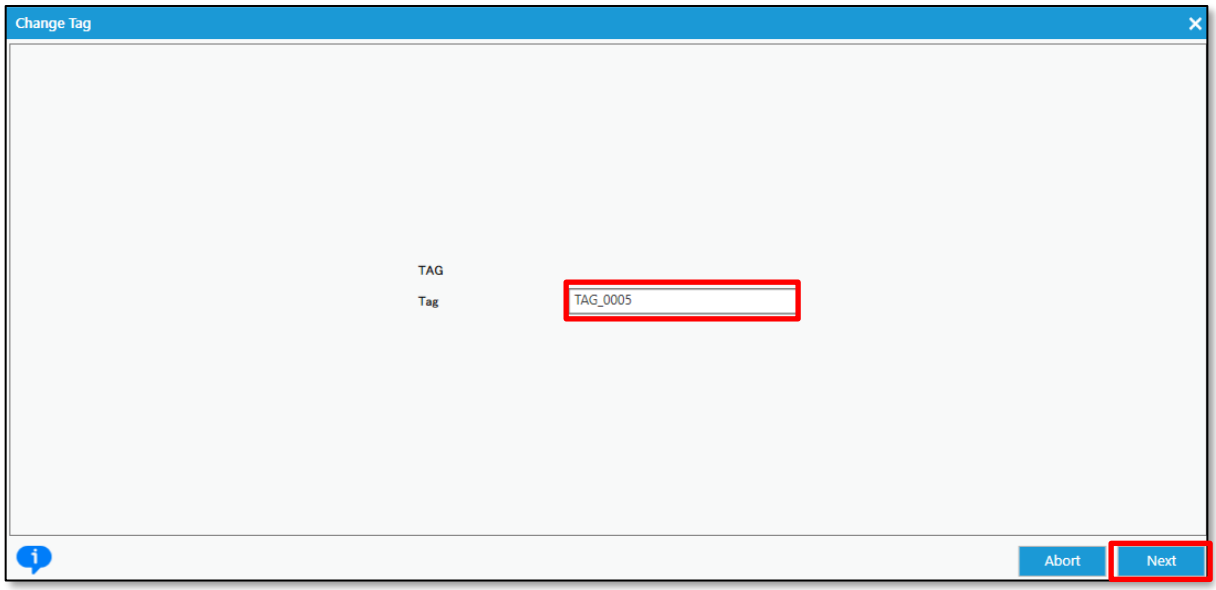
Tag	: Tag number	Long Tag	: Long Tag number
Descriptor	: Descriptor	Date	: Date
Message	: Message	Final Assembly Number	: Final Assembly Number

The following explains how to change “Tag” as an example.
“Long Tag”, “Descriptor”, “Date”, “Message”, and “Final Assembly Number” can also be changed in the same way.

① Click [Change Tag] in the [HART device information] menu group.



② Enter any 8-digit alphanumeric character or symbol and click [Next]



6.5.2. Reboot

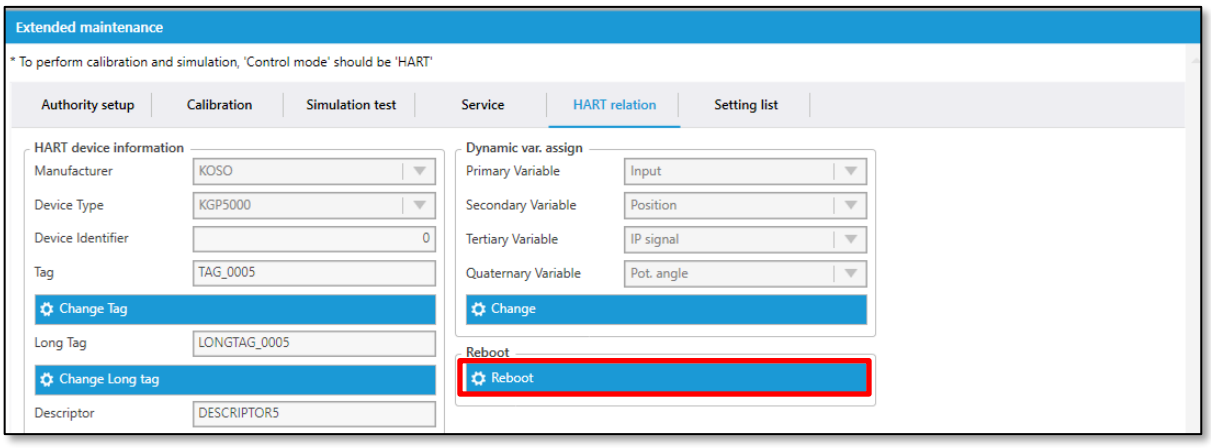
This is a function to restart the positioner.

Warning

➢ After reboot, the positioner will shut down for a few seconds. Communication may be interrupted.

To reboot the positioner, do the following:
MENU) *Maintenance > Extended maintenance > HART relation > Reboot*

① Click [Reboot] in the [Reboot] menu group.



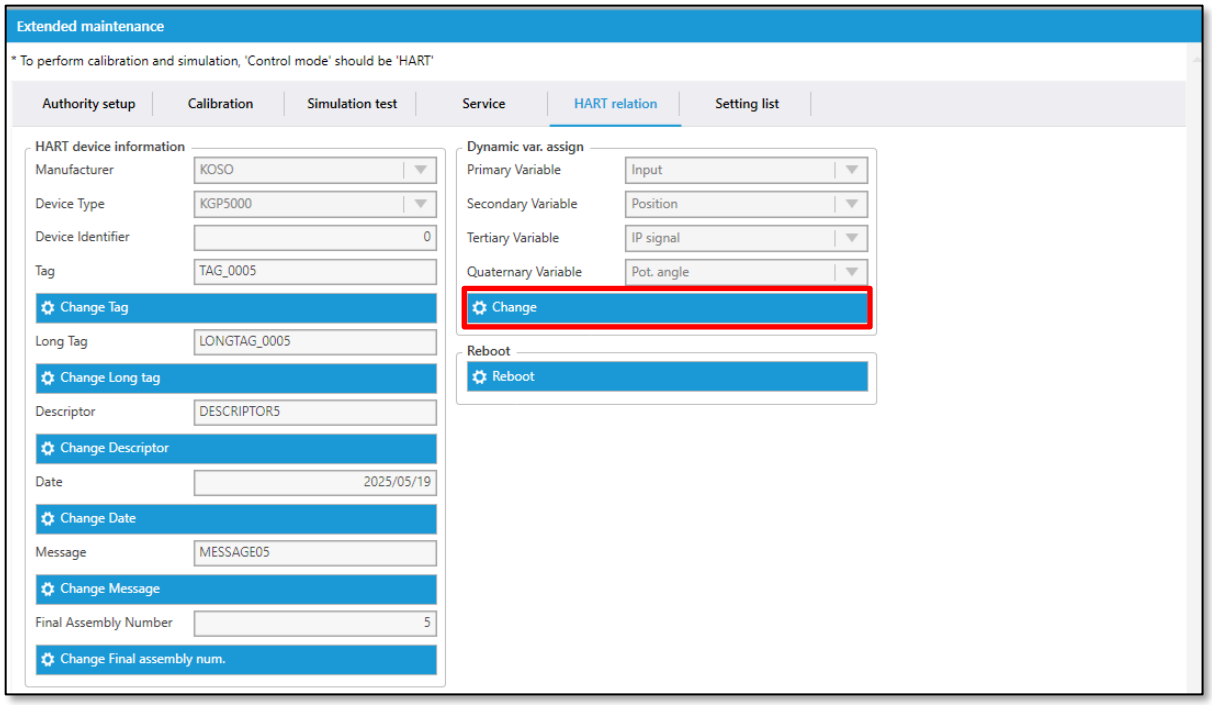
② A confirmation message will be displayed twice, so click [Next] if execute it.

6.5.3. Dynamic Variables assignment

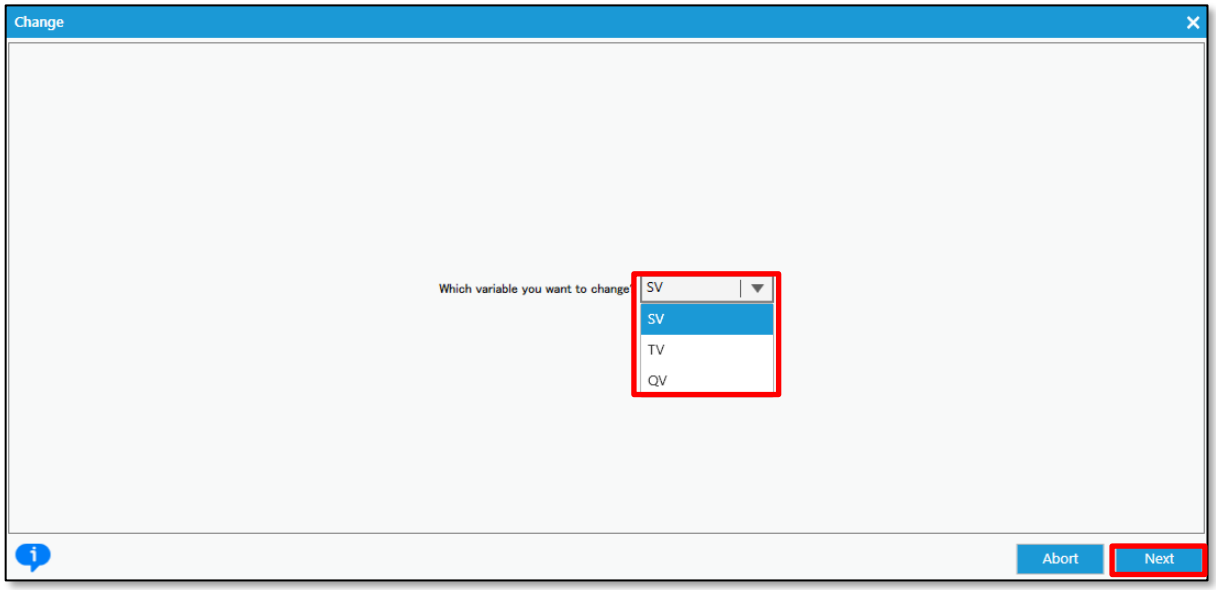
Among dynamic variables, Secondary Variable (SV), Tertiary Variable (TV), and Quaternary Variable (QV) can be assigned to another variable.

MENU) *Maintenance > Extended maintenance > HART relation >Dynamic var. assignment*

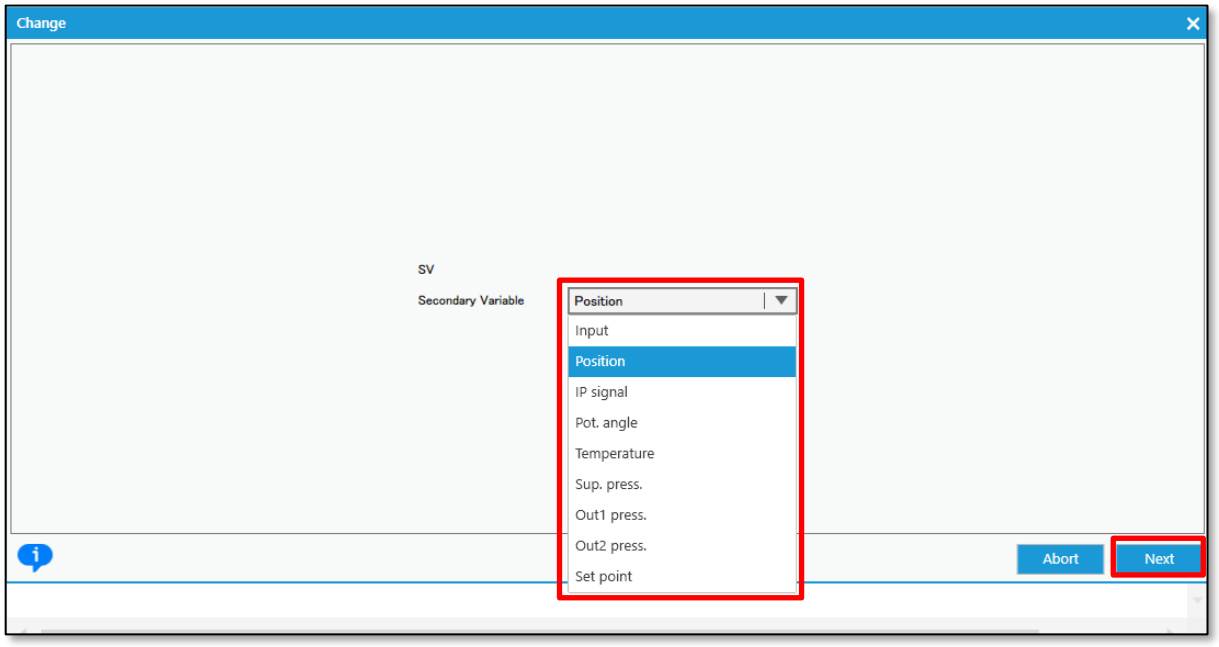
① Click [Change] in the [Dynamic var. assign] menu group.



② Select the Dynamic Variables to change and click [Next].



③ Select variables to assign and click [Next].

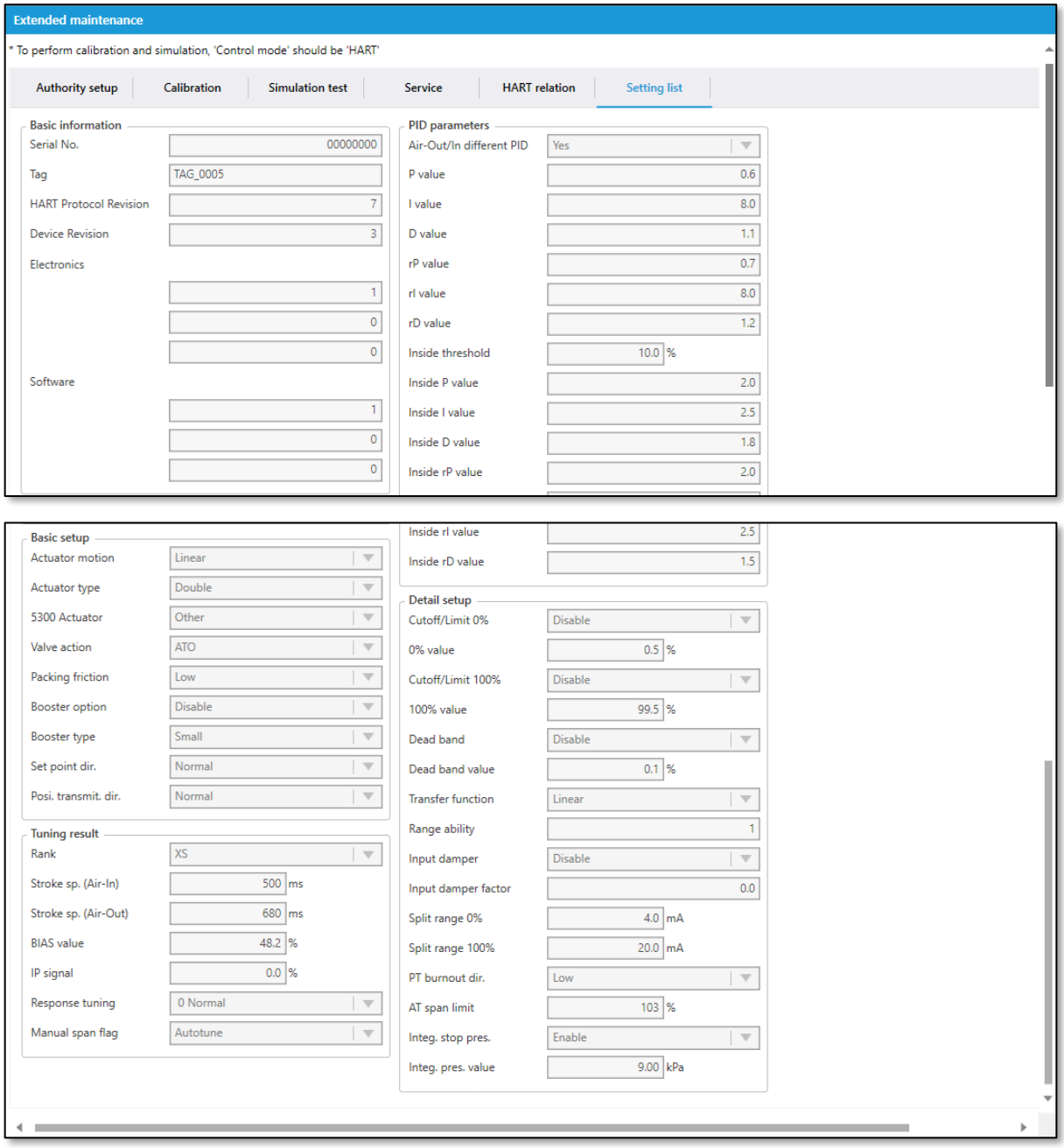


The variables that can be set are as follows:

Input	: Percentage of Input signal
Position	: Valve position
IP signal	: IP signal current
Pot. angle	: Angle of potentiometer
Temperature	: Temperature
Sup. press.	: Supply pressure
Out1 press.	: Output pressure 1
Out2 press.	: Output pressure 2
Set point	: Set point

6.6. Setting list

Displays the current main settings.



6.7. Factory setup

Caution

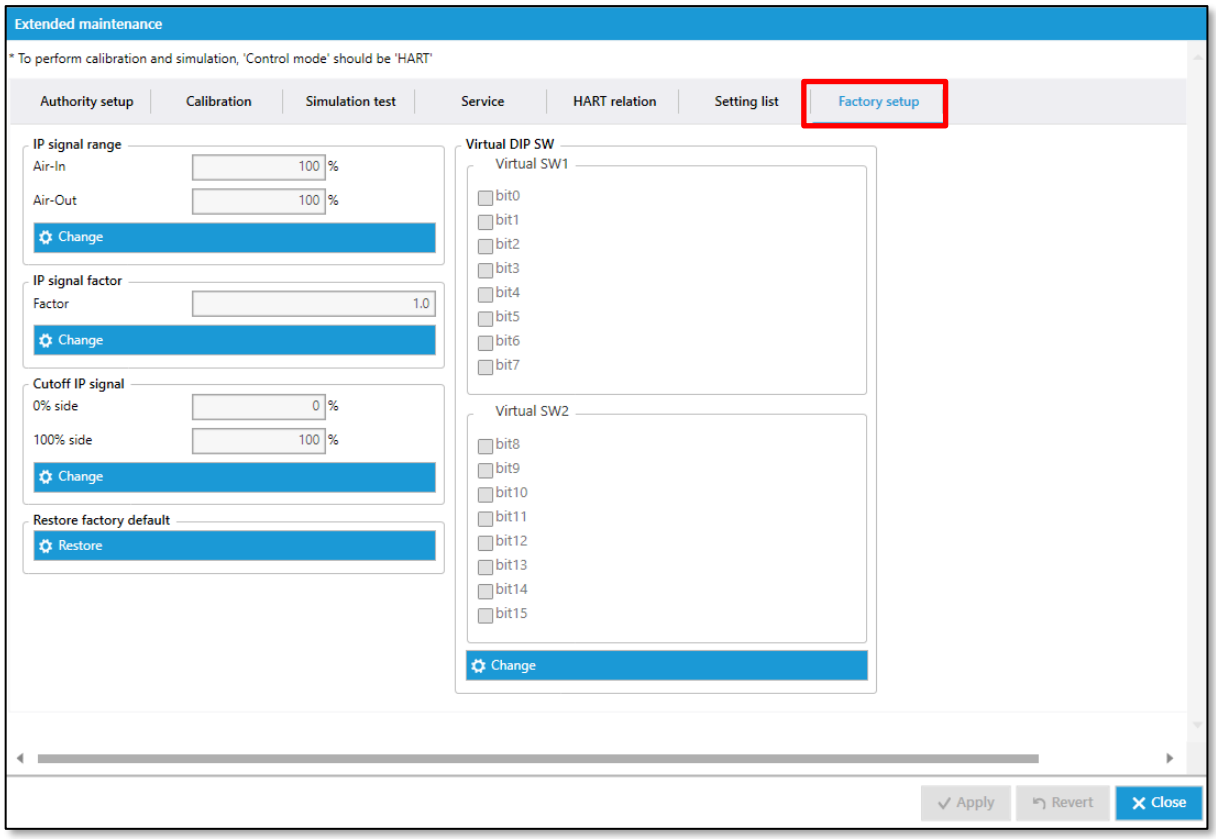
➢ Since the suitable parameters are configured at the factory, in general, do not perform switching of factory setup and the reconfiguration on its menu. **The reconfiguration of the values causes the case that the desired response may not be achieved.**

※ The menu is displayed only when the “Factory setup” field is “ON” in the “[Maintenance] > [Service] > [Factory menu]”.
The items that can be set are as follows:

IP signal range	: IP signal range
IP signal factor	: IP signal factor
Cutoff IP signal	: Cutoff IP signal
Restore factory default	: Restore factory default setting
Virtual DIP SW	: Setting of Virtual DIP SW

※ For details on each item, see KGP5000 instruction manual.

① Click [Factory setup] menu tab in the [Extended maintenance] menu and open the [Factory setup] menu.



To change the current settings, check the setting values for each item group and click [Change].

6.7.1. Restore factory default

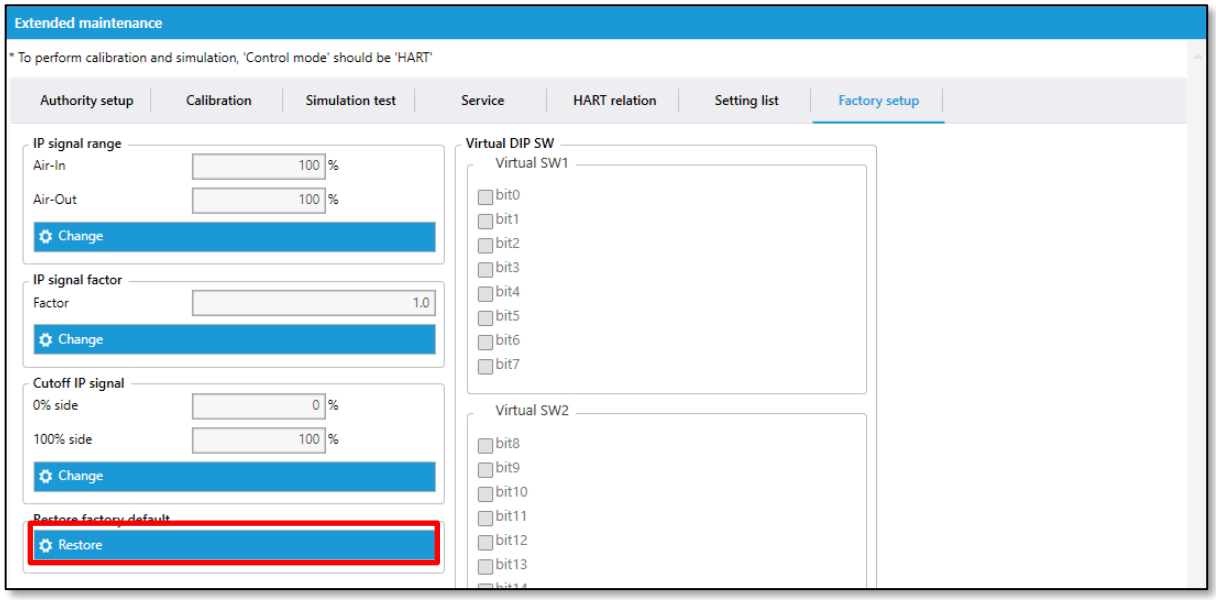
Return to factory default settings.

Caution

➢ All current setting values will be overwritten to the factory settings.

MENU) *Maintenance > Extended maintenance > Factory setup > Restore factory default*

① Click [Restore] in the [Restore factory default] menu group.



② A confirmation message will be output twice, so click [Next] if execute.

③ Read the factory default settings and overwrite the current settings.

7. Diagnostics

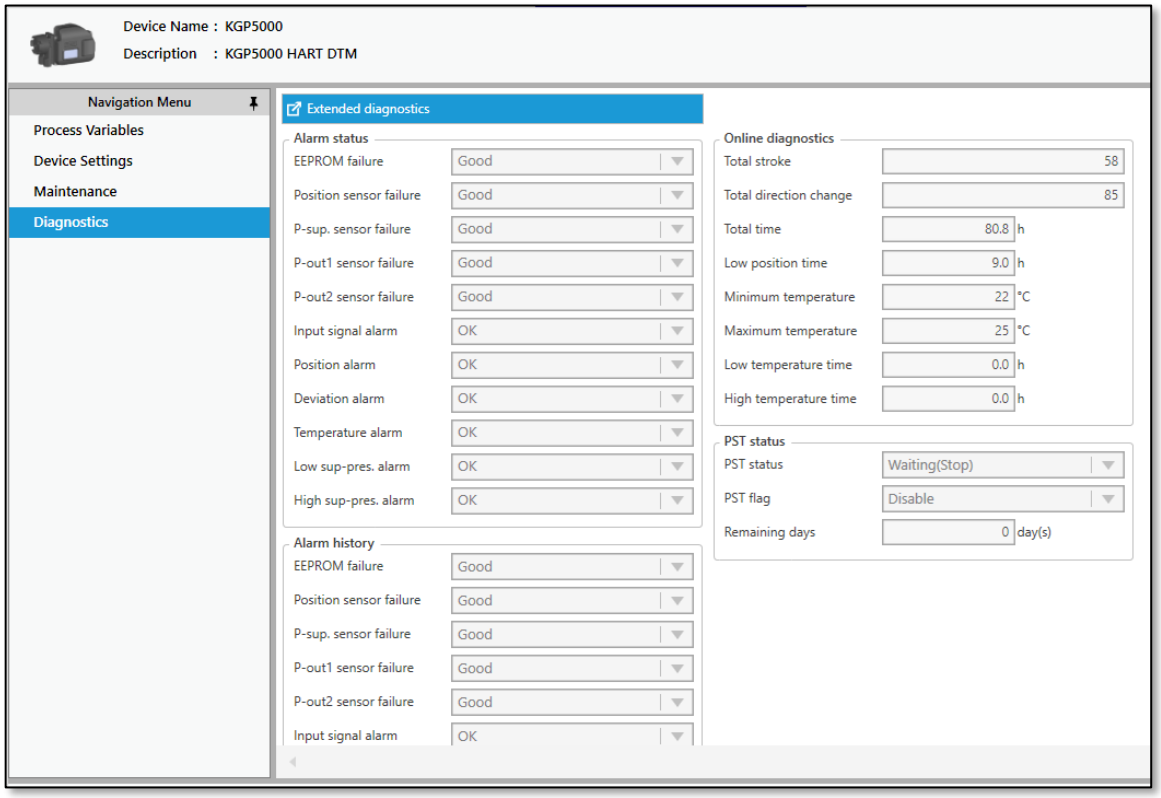
This positioner is equipped with the on-line diagnostics which acquires and estimates data during plant operation and the offline diagnostics performed in maintenance. Through appropriate diagnostic settings based on an operating condition of the installation environment and a process, it's possible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

Caution

➢ To change the settings, "**Authority**" must be "HART".

MENU) *Diagnostics*

① Click [Diagnostics] menu in the Navigation Menu to open the [Diagnostics] top menu.



Displays alarm status, alarm history, PST alarm, and online diagnostic status.

The displayed items are as follows:
[Alarm status / Alarm history]

EEPROM failure	: Memory failure	Position sensor failure	: Position sensor failure
P-sup. sensor failure	: Supply pressure sensor failure	P-out1 sensor failure	: Output pressure 1 sensor failure
P-out2 sensor failure	: Output pressure 2 sensor failure		
Input signal alarm	: Input signal alarm	Position alarm	: Valve position alarm
Deviation alarm	: Deviation alarm	Temperature alarm	: Temperature alarm
Low-sup-pres. alarm	: Low supply pressure alarm	High-sup-pres. alarm	: High supply pressure alarm

[PST alarm]

PST stroke alarm	: PST stroke alarm	PST incomplete alarm	: PST incomplete alarm
PST pressure alarm	: PST pressure alarm		

[Online diagnostics]

Total stroke	: Total stroke	Total direction change	: Total direction change
Total time	: Total time	Low position time	: Low position control time
Minimum temperature	: Minimum temperature	Maximum temperature	: Maximum temperature
Low temperature time	: Ambient low temperature time	High temperature time	: Ambient high temperature time

[PST status]

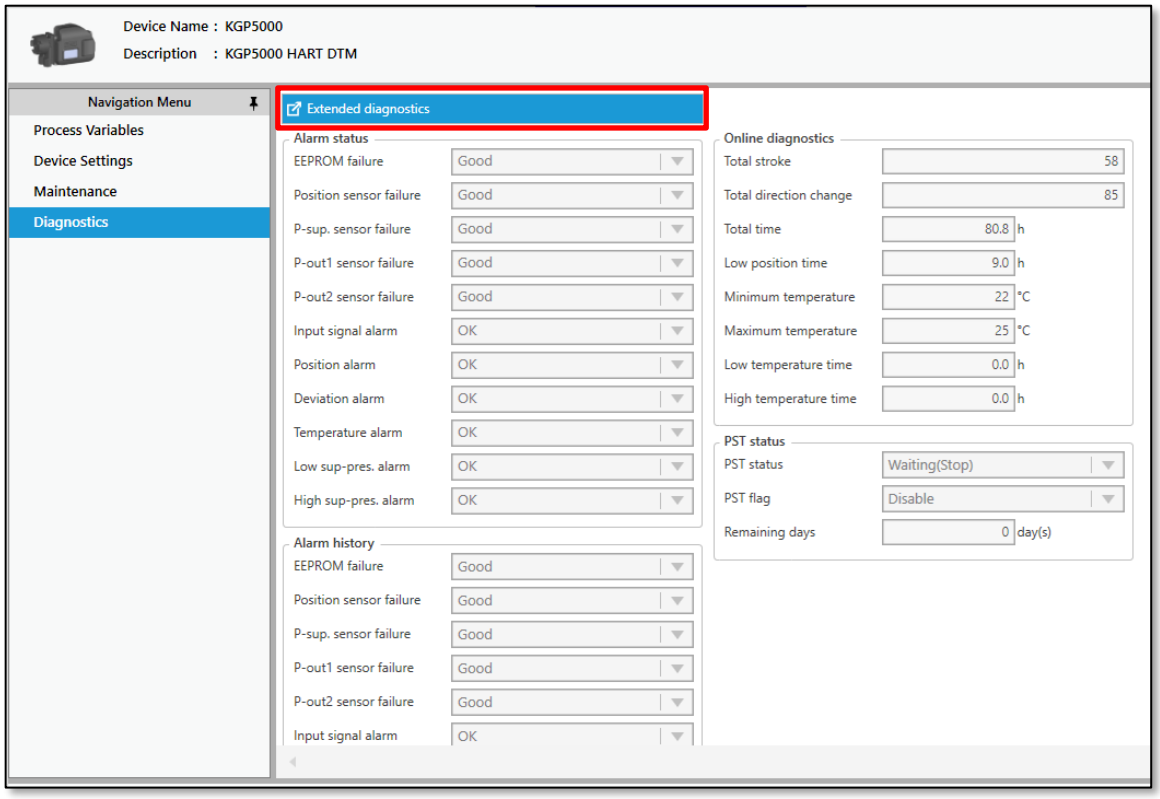
PST status	: PST status	PST flag	: PST Disable/Enable flag
Remaining days	: Remaining days		

7.1. Extended diagnostics

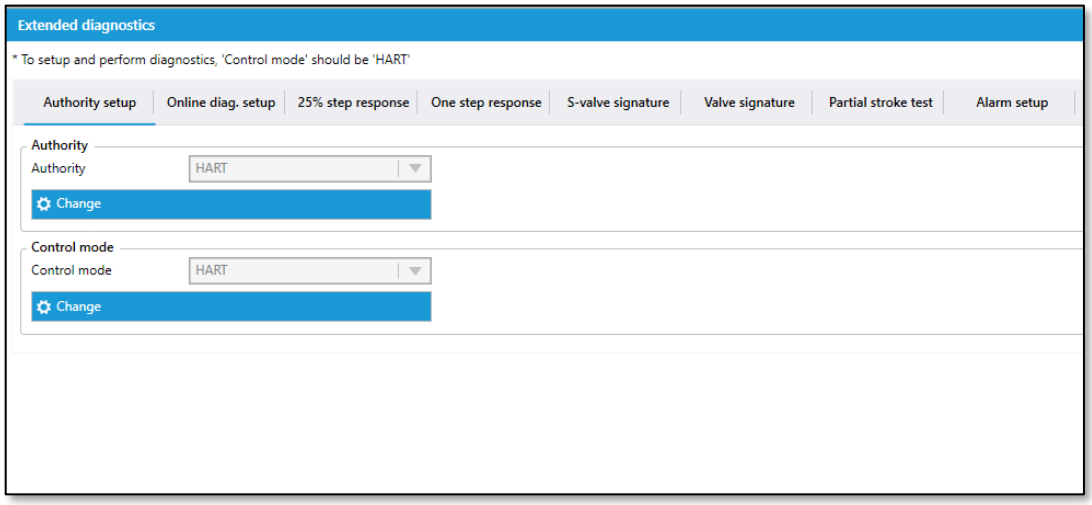
This menu is an extended menu for configuring diagnosis related settings, diagnosis execution, and alarm settings.

MENU) *Diagnostics > Extended diagnostics*

① Click [Extended diagnostics] menu tab in the [Diagnostics] top menu.



② [Extended diagnostics] menu opens.



Menu items are as follows:

(1) Authority setup menu	See 3. Authority setup
(2) Online diag. setup menu	See 7.2. Online diagnostics setup
(3) 25% step response menu	See 7.3. 25% step response
(4) One step response menu	See 7.4. One step response
(5) S-valve signature menu	See 7.5. Simple valve signature
(6) Valve signature menu	See 7.6. Valve signature
(7) Partial stroke test menu	See 7.7. Partial stroke test (PST)
(8) Alarm setup menu	See 7.8. Alarm setup

Click on the tab to open each menu.

7.2. Online diagnostics setup

Configure settings related to online diagnosis.
Setup items are as follows:

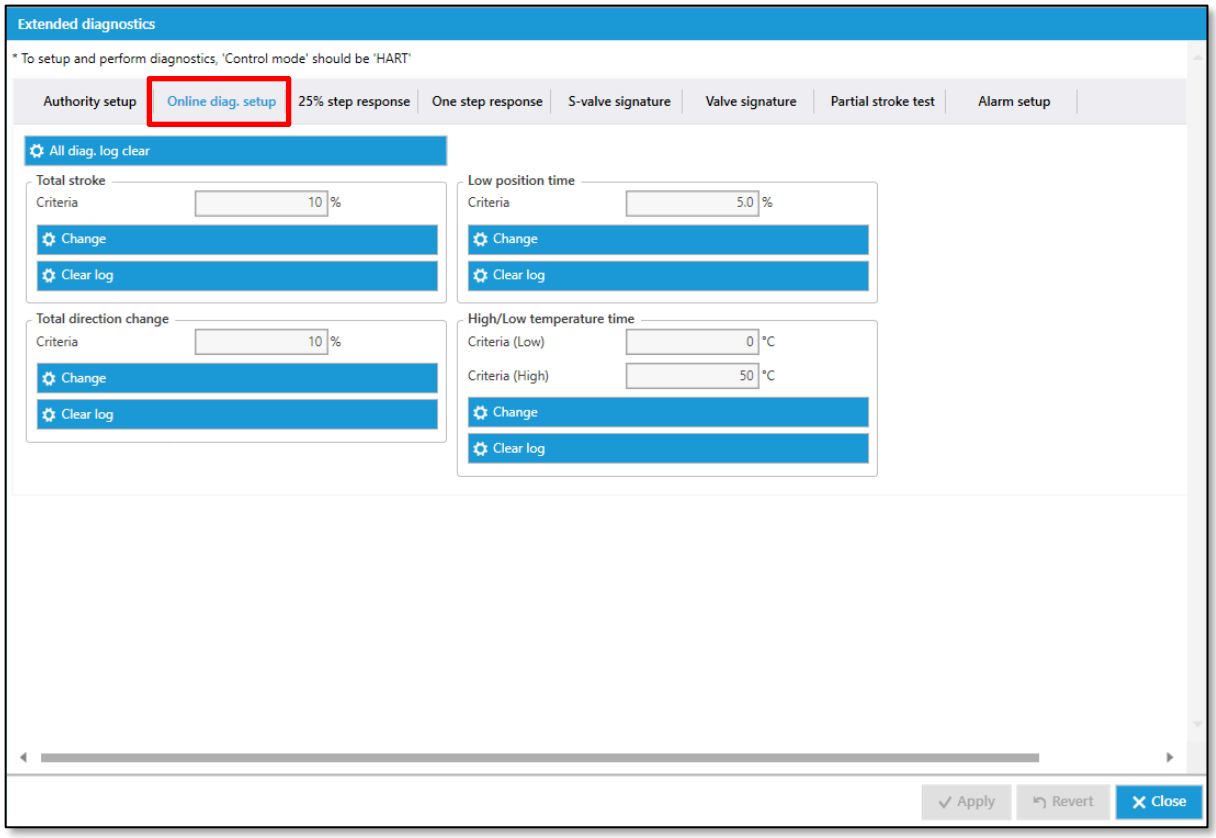
Total stroke	: A threshold of the position change to accumulate is set.
Total direction change	: A change width to judge direction change is set.
Low position time	: A position to judge low position is set.
High/Low temperature time	: A temperature to judge high/low temperature is set.
Partial stroke ※	: Partial stroke

※ For settings related to Partial stroke test, see 7.7. Partial stroke test (PST) .

※ For details on each item, see KGP5000 instruction manual.

MENU) *Diagnostics > Extended diagnostics > Online diag. setup*

① Click [Online diag. setup] menu tab in the [Extended diagnostics] menu. [Online diag. setup] menu opens.



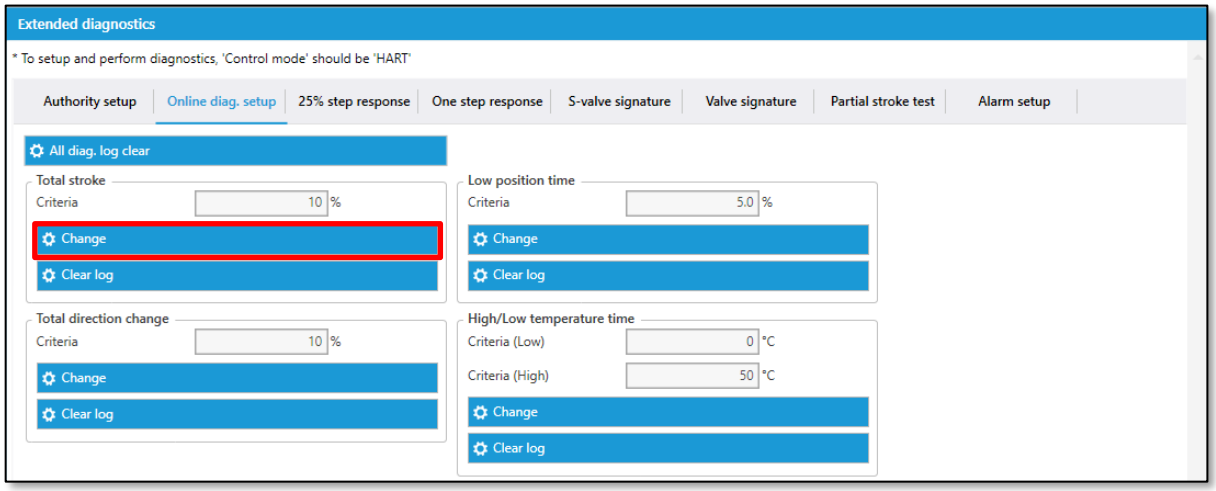
7.2.1. Online diagnostics setting / Confirmation and Clear of results

The following is an explanation using a total stroke as an example.

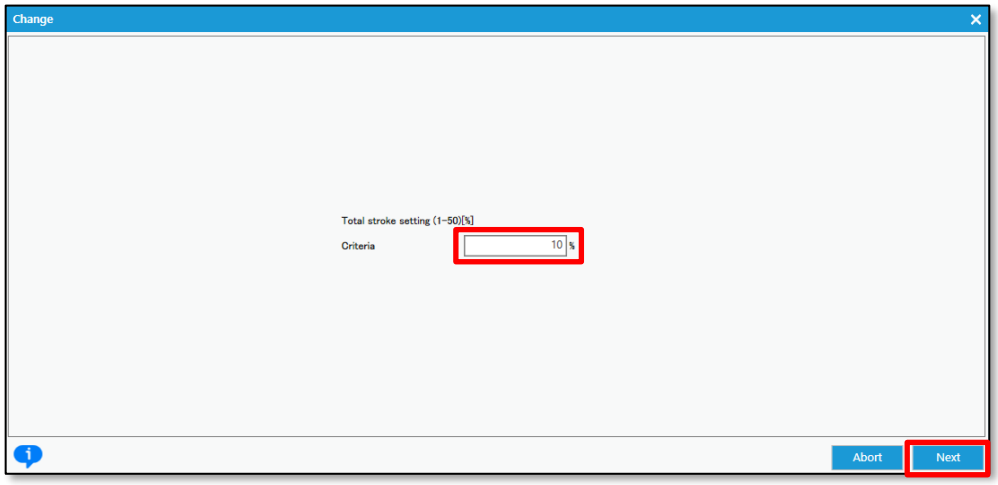
1) Setting of total stroke criteria

MENU) *Diagnostics > Extended diagnostics > Online diag. setup> Total stroke*

① Click [Change] in the [Total stroke] menu group.



② Enter the criteria value in the “Criteria” field and click [Next].

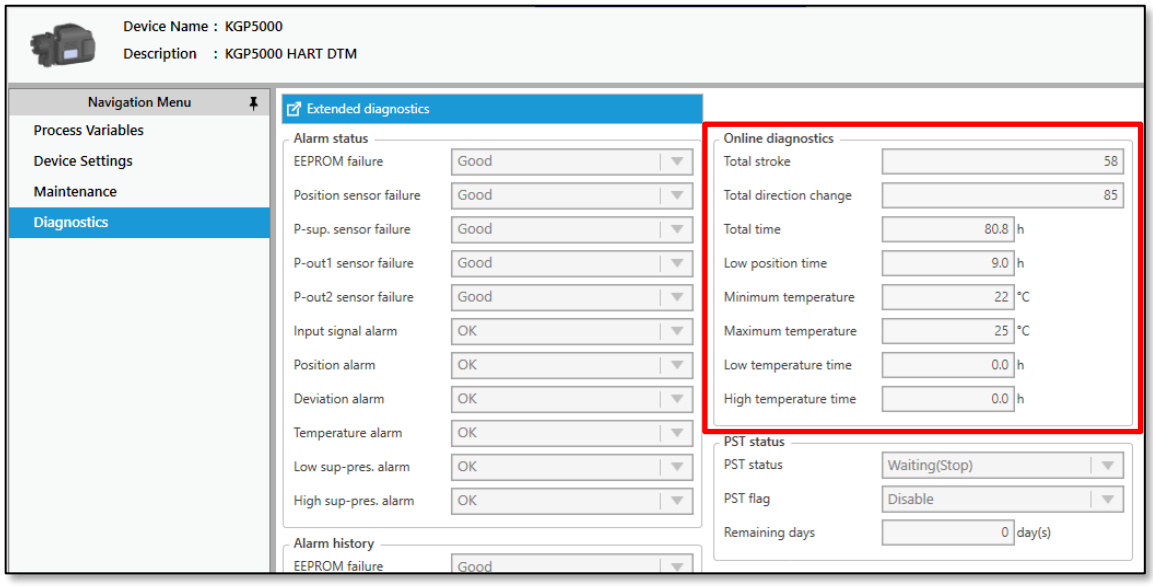


2) Check the results

Diagnostics result can confirm in the [Diagnostics] top menu.

MENU) *Diagnostics*

① Click [Diagnostics] menu tab from top menu. [Diagnostics] top menu opens.



The displayed items are as follows:

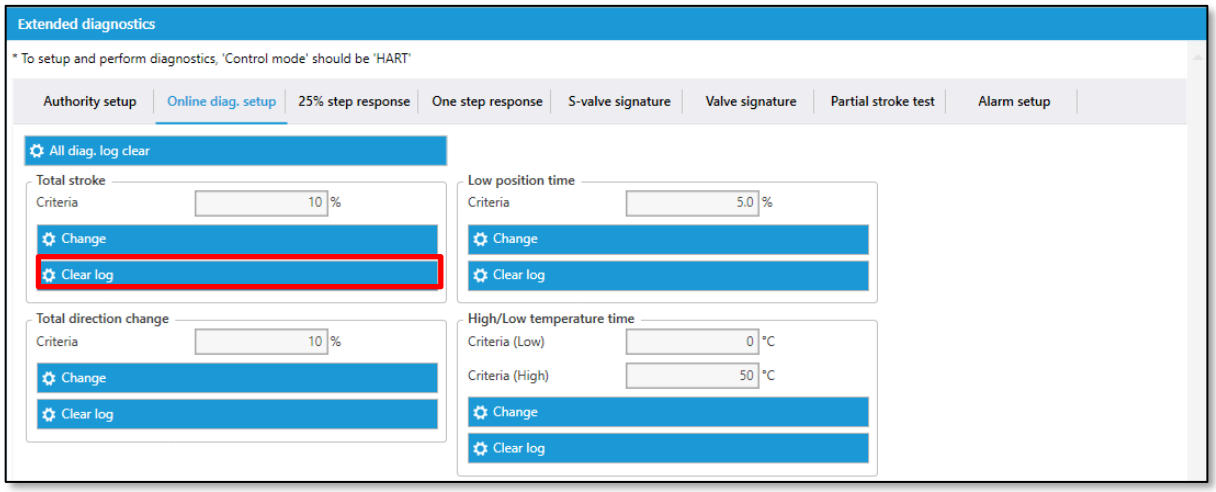
[Online diagnostics]

Total stroke	: Total stroke	Total direction change	: Total direction change
Total time	: Total time	Low position time	: Low position control time
Minimum temperature	: Minimum temperature	Maximum temperature	: Maximum temperature
Low temperature time	: Ambient low temperature time	High temperature time	: Ambient high temperature time

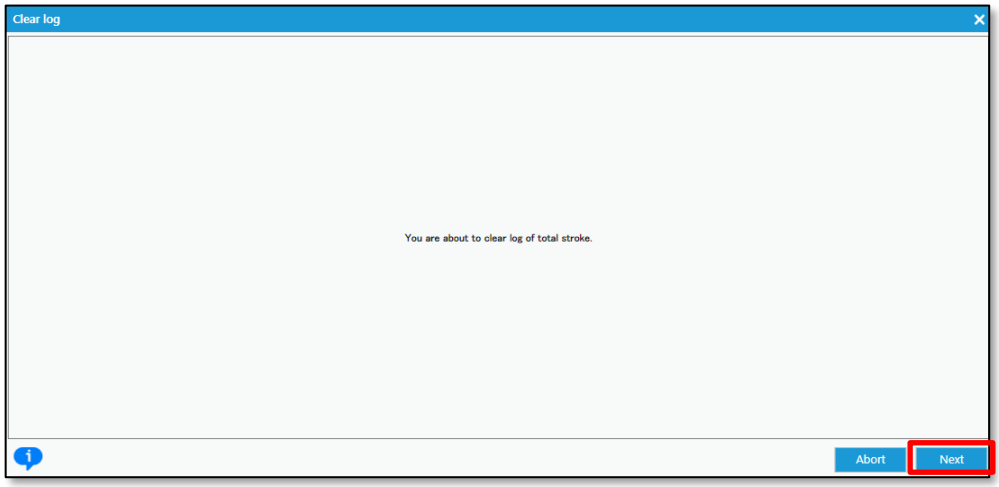
3) Clear Total stroke log

MENU) *Diagnostics > Extended diagnostics > Online diag. setup> Total stroke*

① Click [Clear log] in the [Total stroke] menu group.



② Confirm the message and click [Next] to clear the log of total stroke diagnostics results.

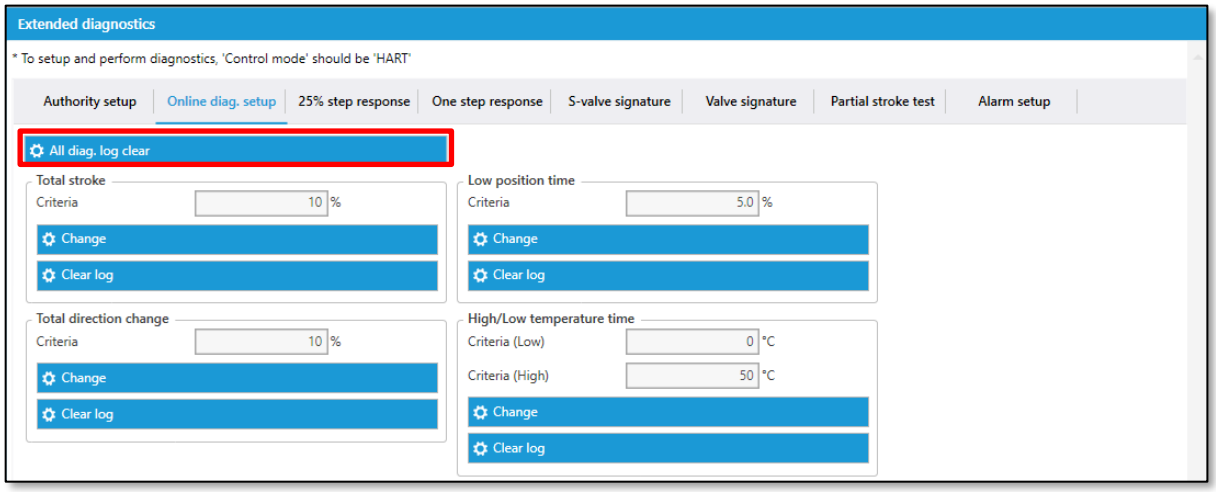


7.2.2. All diagnostics log clear

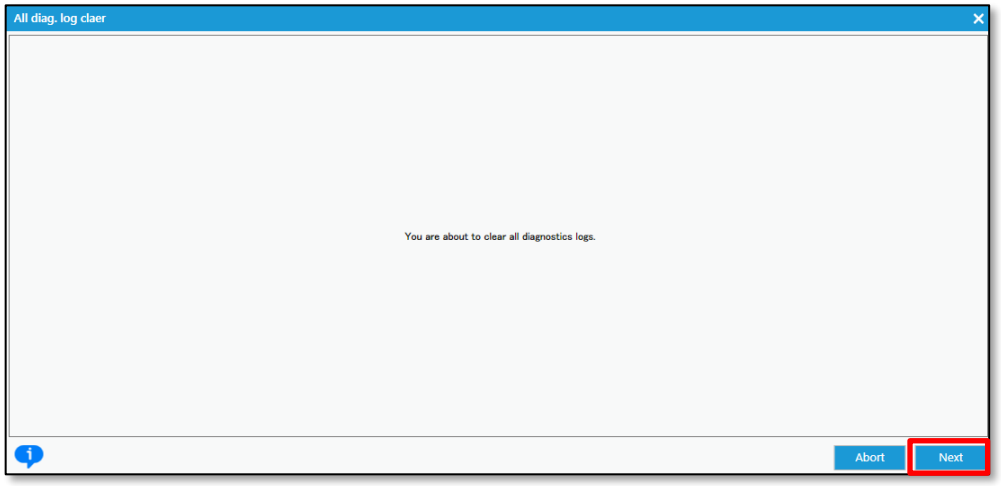
The steps to clear all diagnostic logs are as follows.

MENU) *Diagnostics > Extended diagnostics > Online diag. setup> All diag. log clear*

① Click [All diag. log clear] in the [Online diag. setup] menu.

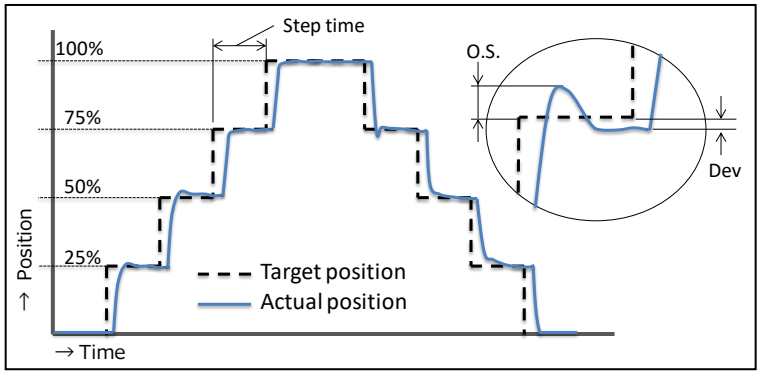


② Confirm the message and click [Next] to clear all logs of diagnostics results.



7.3. 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.

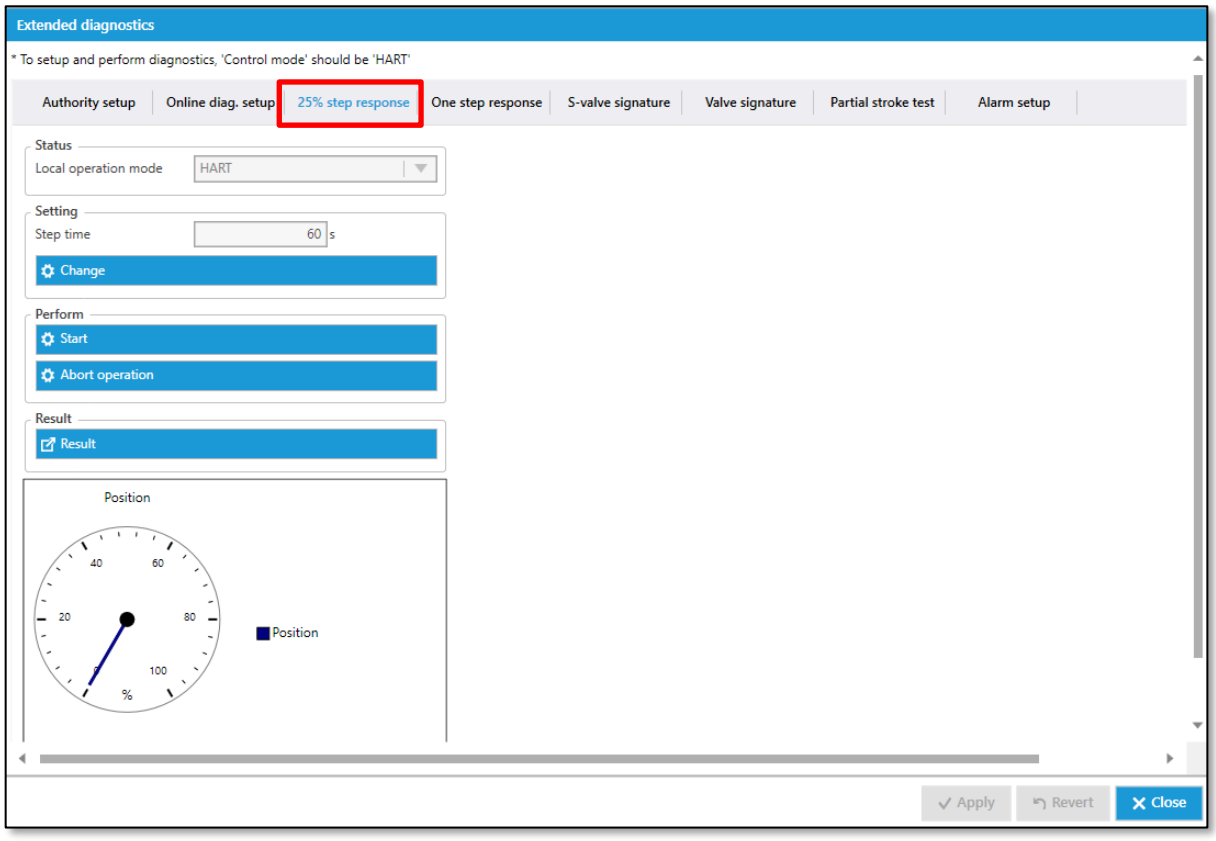


Caution

- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing 25% step response, set "**Control mode"** to "HART".

MENU) *Diagnostics > Extended diagnostics > 25% step response*

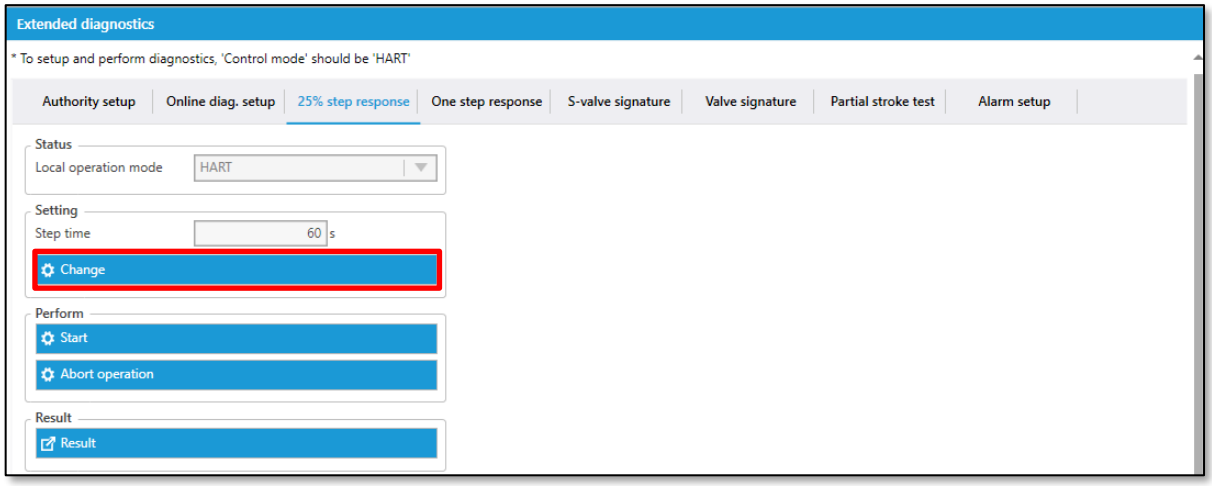
① Click [25% step response] menu tab in the [Extended diagnostics] menu. [25% step response] menu opens.



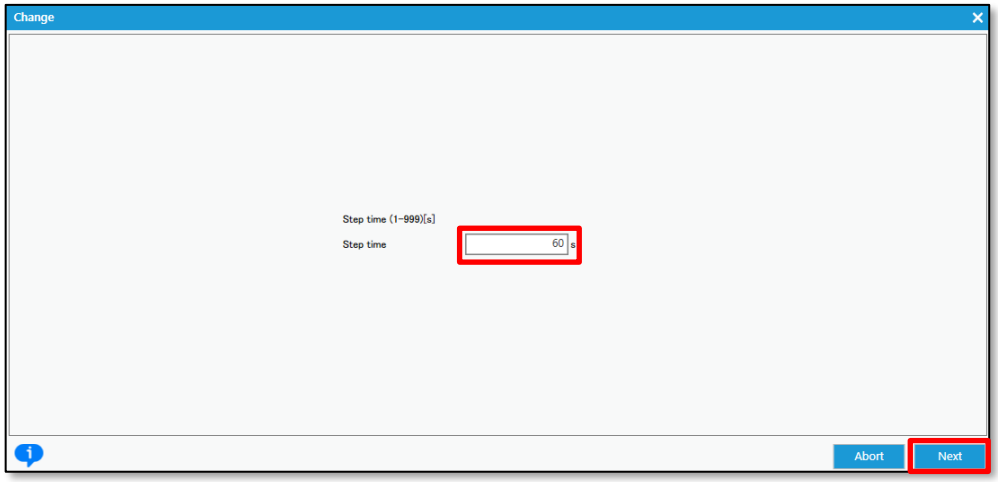
The steps for setting, executing, displaying the result and saving the 25% step response are shown below.

1) Settings of 25% step response

① Click [Change] in the [Setting] menu group.



② Enter step time value in the “Step time” field and click [Next].



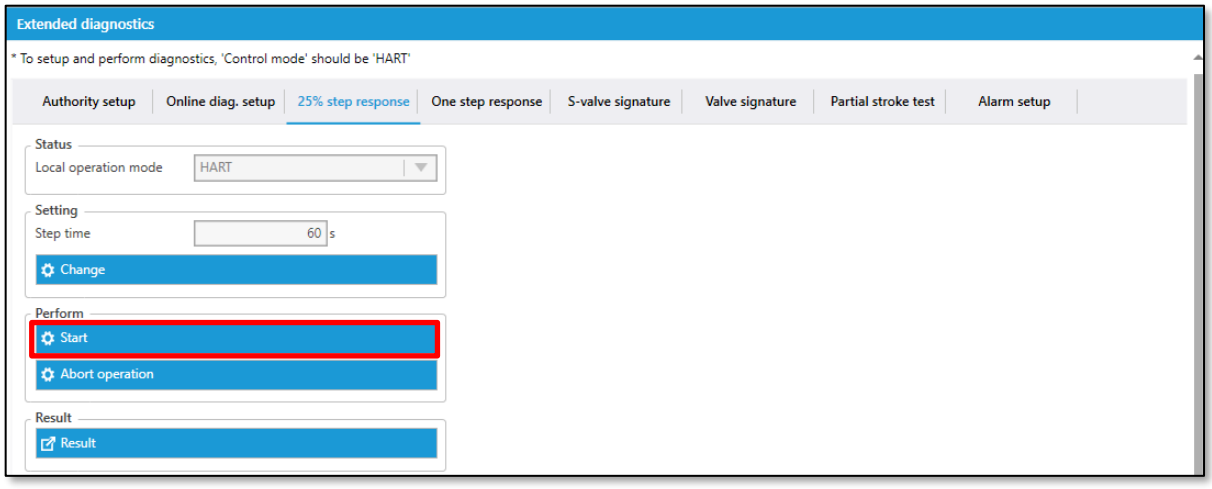
Setting value is as follows:

Step time [s]	: Set a waiting time per 1 step. Initial value: 60sec

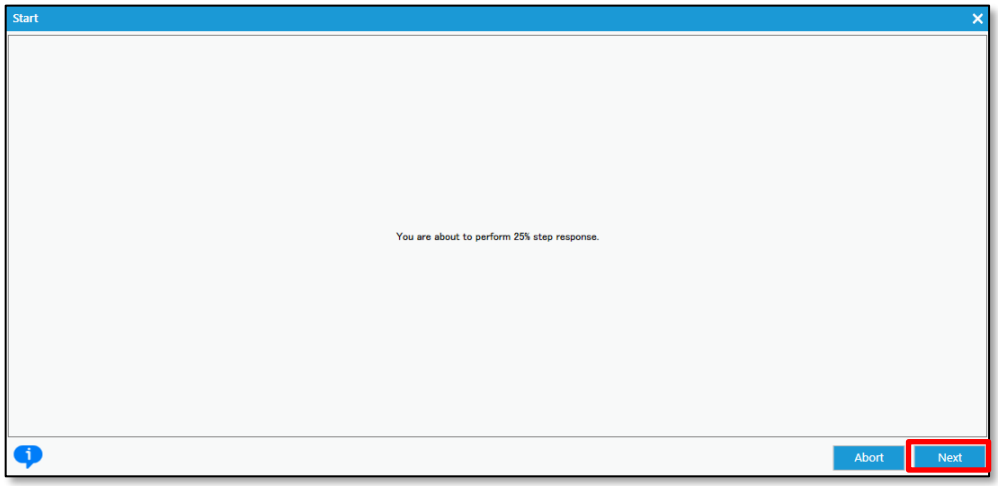
2) Execution of 25% step response

① Click [Start] in the [Perform] menu group.

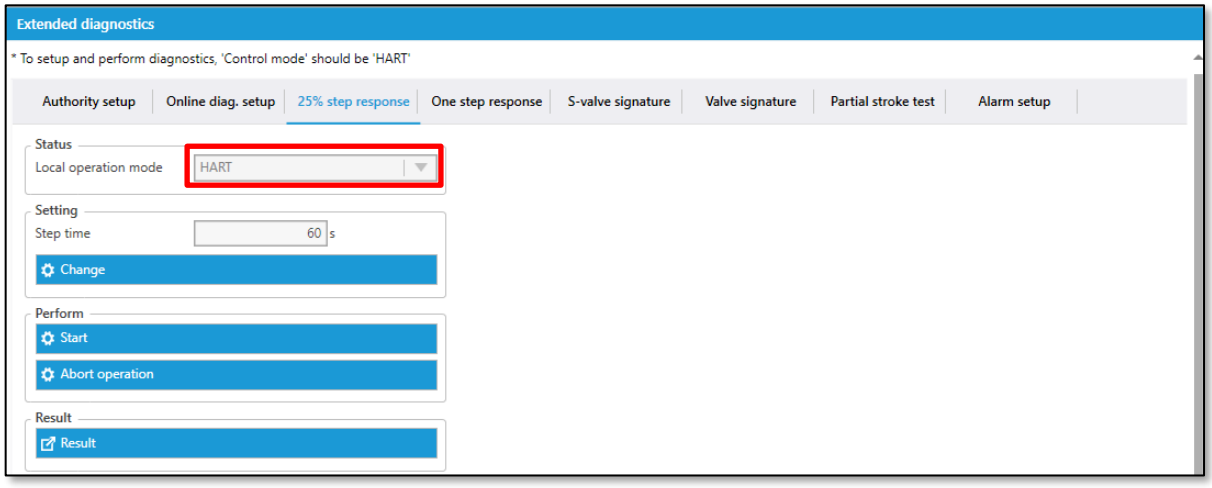
※ Click [Abort operation] to cancel operation.



② Confirm the message and click [Next].

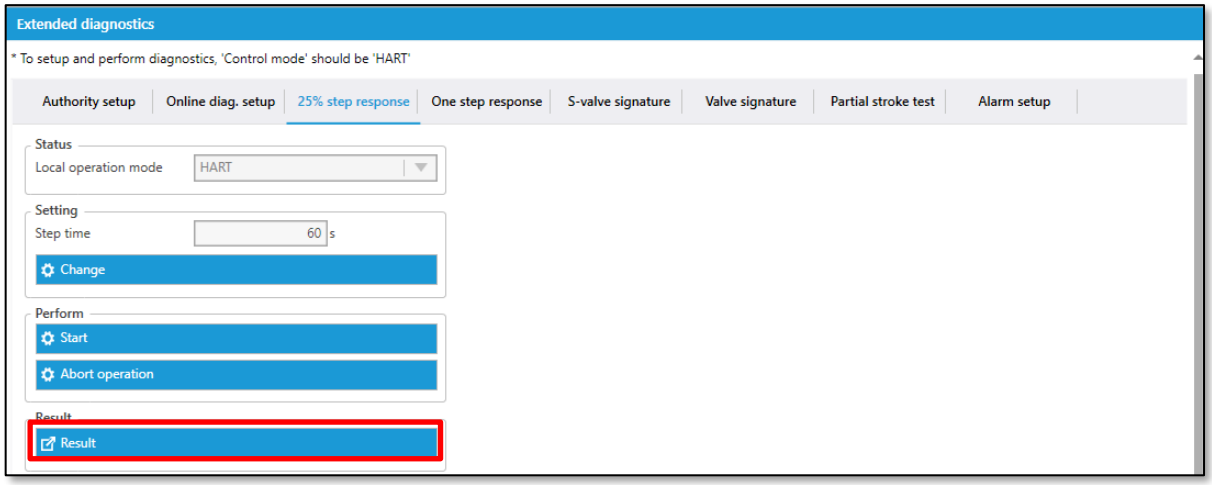


③ Wait until “Local operation mode” field in the [Status] menu group becomes “HART”.

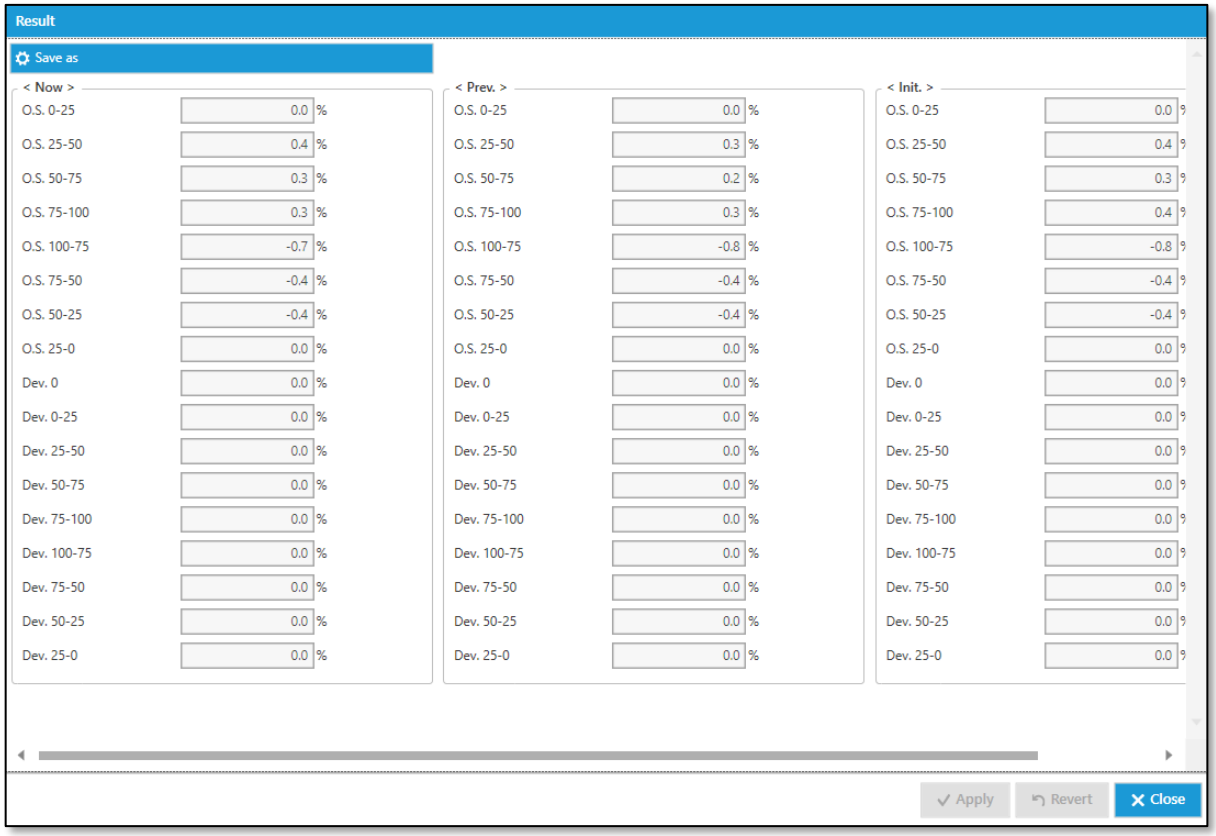


3) Check the results of 25% step response

① Click [Result] in the [Result] menu group.

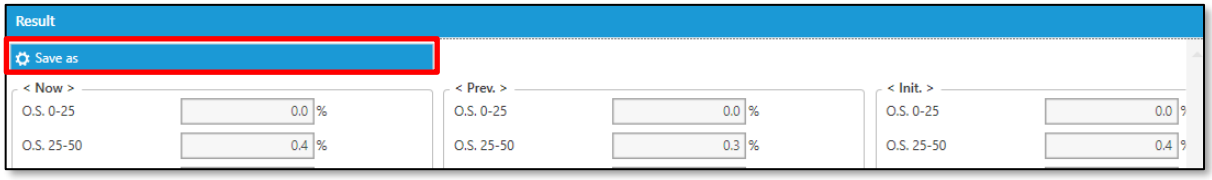


② The execution results are read from the positioner, and display the test result.

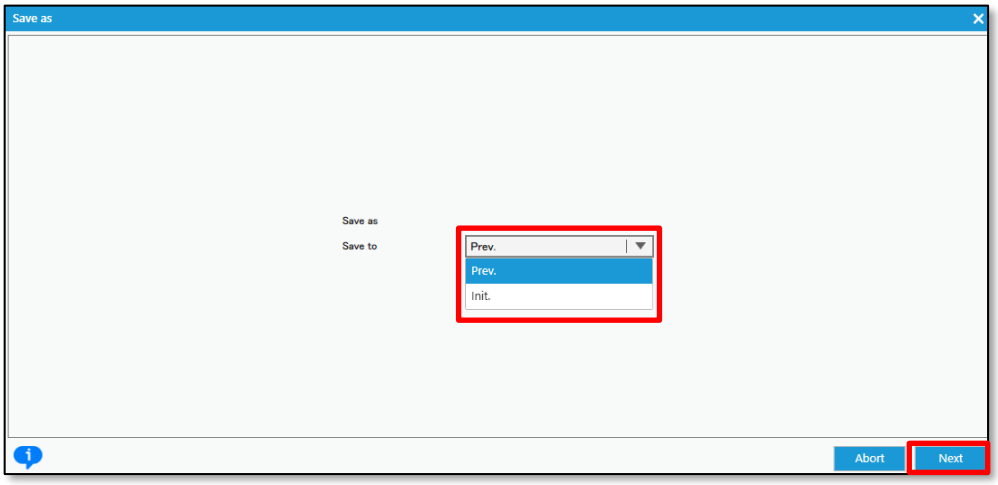


4) Save the execution results

① Click [Save as] in the [Result] menu group.

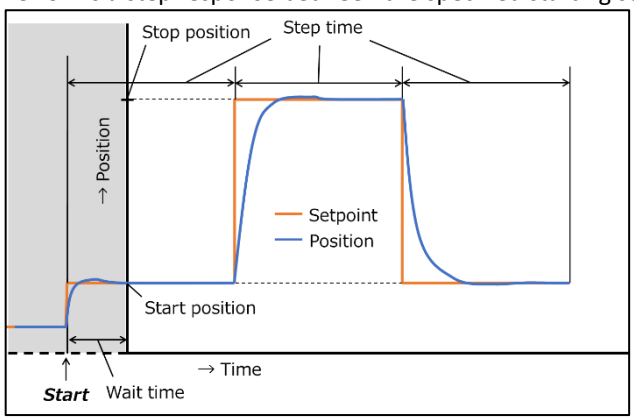


② Select the previous data “Prev” or the initial data “Init” as the data save destination. Click [Next] to save the results.



7.4. One step response

Performs a step response between the specified starting setpoint and ending setpoint and displays it on a graph.

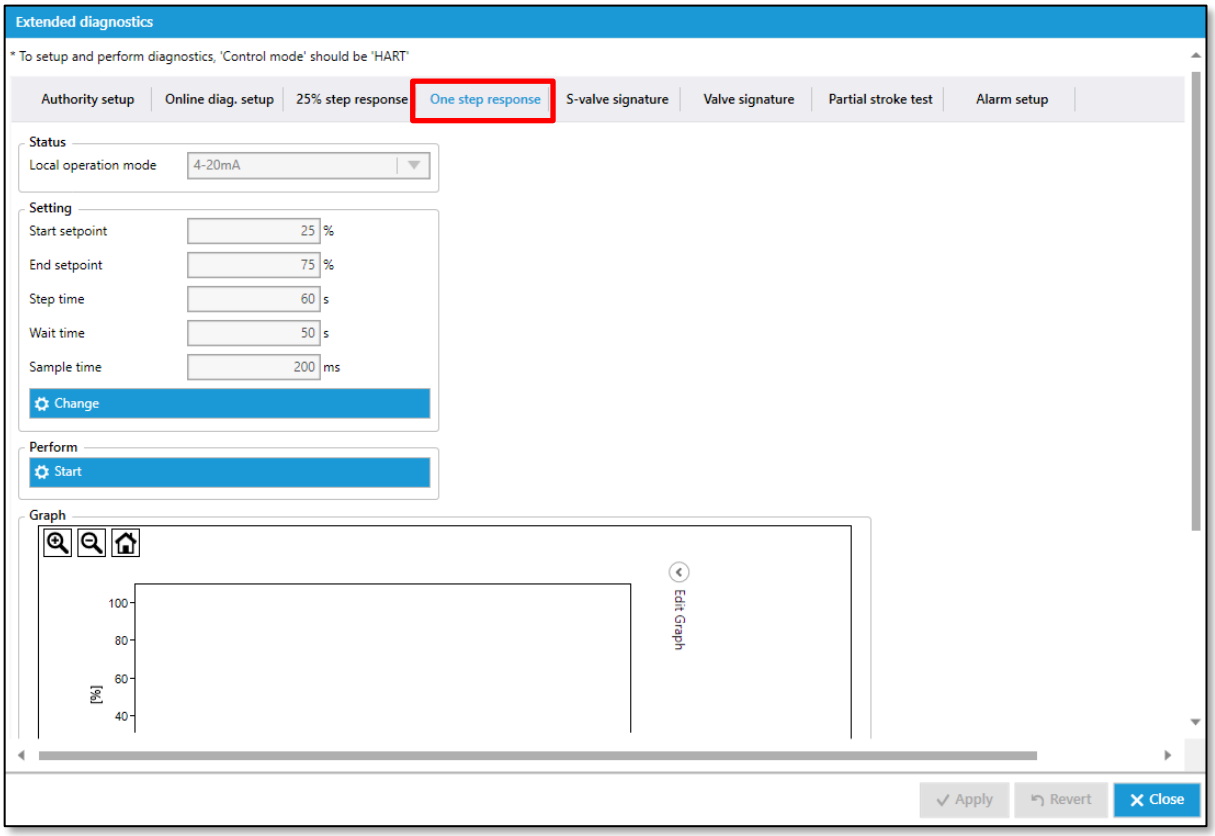


Caution

- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing one step response, set "**Control mode**" to "HART".

MENU) *Diagnostics > Extended diagnostics > One step response*

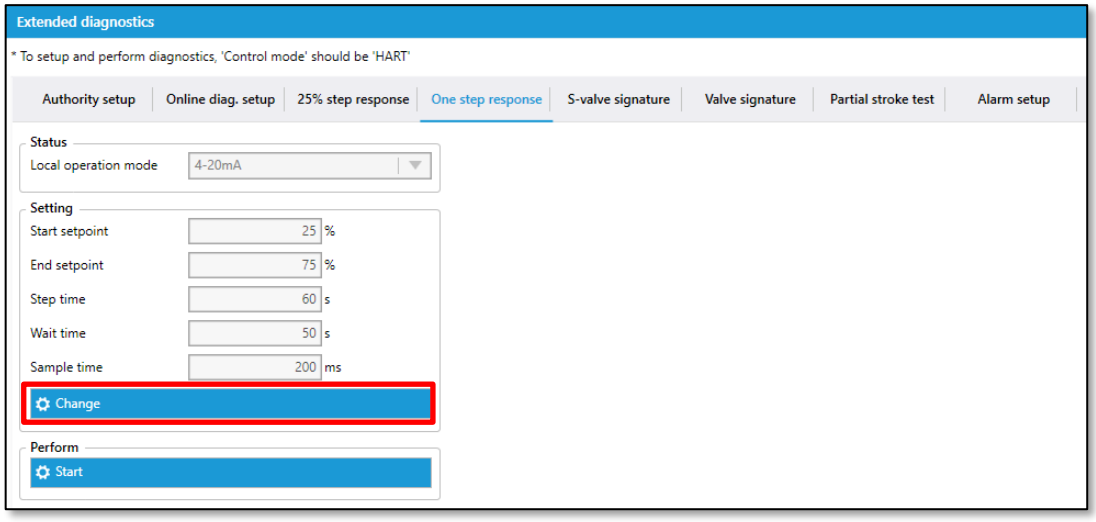
① Click [One step response] tab menu in the [Extended diagnostics] menu. [One step response] menu opens.



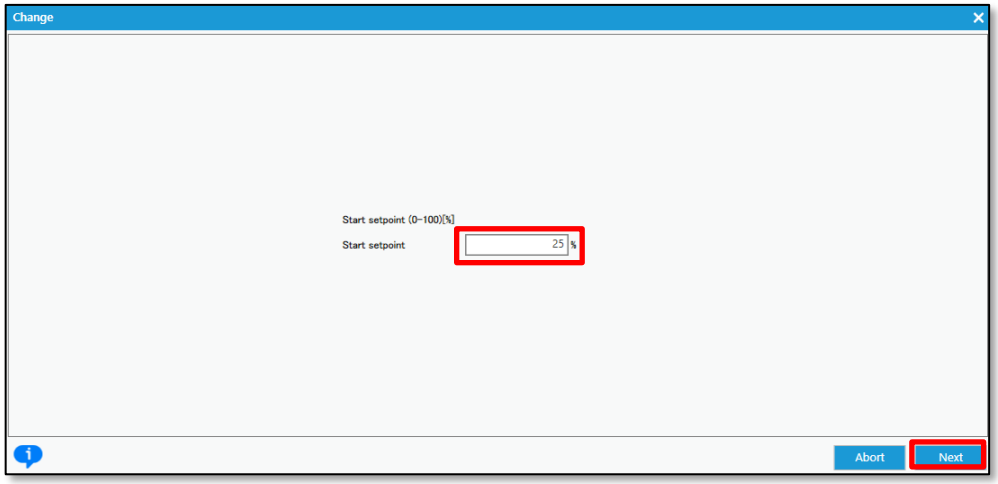
The steps for setting, executing, displaying, and clearing the results of the one step response are shown below.

1) Settings of one step response

① Click [Change] in the [Setting] menu group.

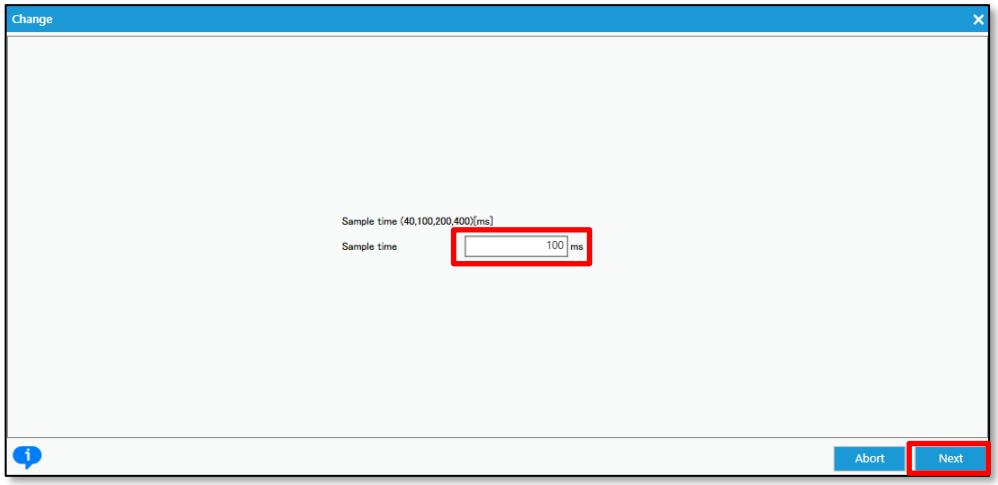


② Ente setting value int the “Start setpoint” field and click [Next].



③ Next, enter the setting values for “End point”, “Step time”, and “Wait time” and click [Next].

④ Enter the setting value in the “Sample time” field and click [Next].



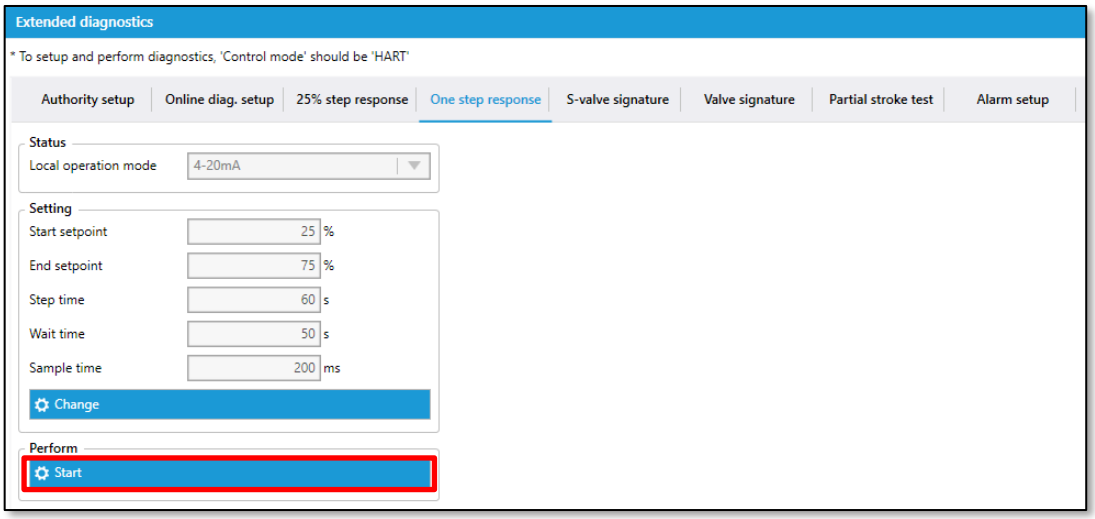
Setting values are as follows:

Start setpoint [%]	: Set a start setpoint. Initial value: 25%
End setpoint [%]	: Set an end setpoint. Initial value: 75%
Step time [s]	: Set a waiting time per 1 step. Initial value: 20sec
Wait time [s]	: Set a waiting time from start to data acquisition. Initial value: 0sec
Sample time [ms]	: Se a sampling time. Set the interval for acquiring position data. Initial value: 100msec

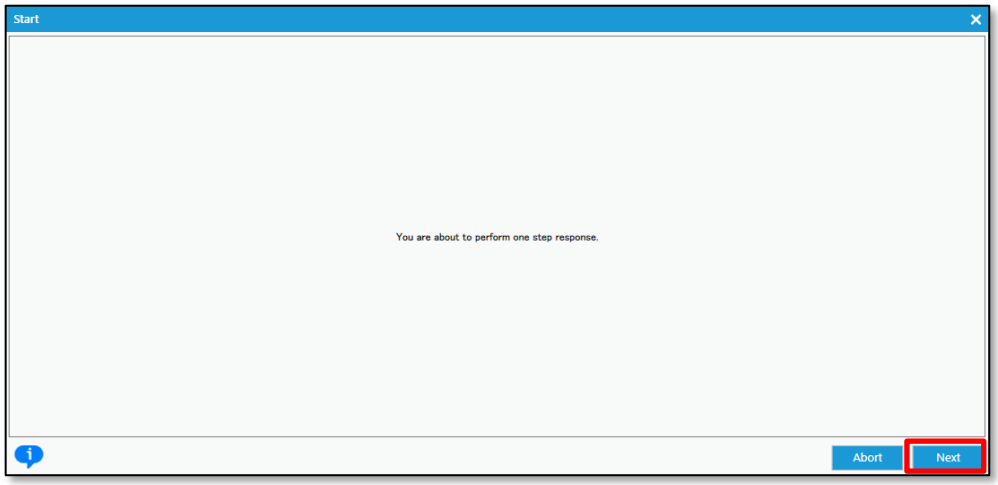
※ Processing ends when Step time x 3 times have elapsed or data for 600 samplings has been acquired.
Therefore, set the optimal value according to the operating speed of the connected actuator.
If Sample time = 100(msec), 0.1(s) x 600 = 60(s), and the data acquisition time is 60 seconds.

2) Execution of the one step response

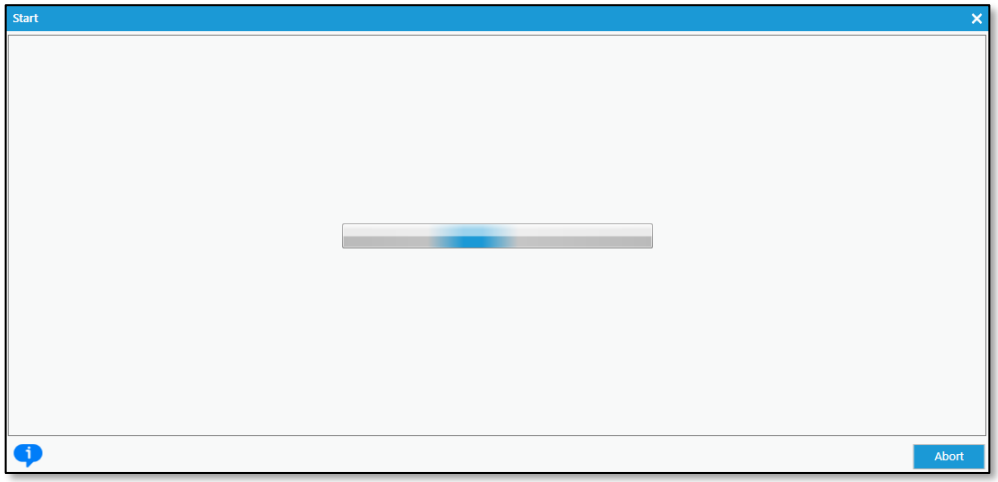
① Click [Start] in the [Perform] menu group.



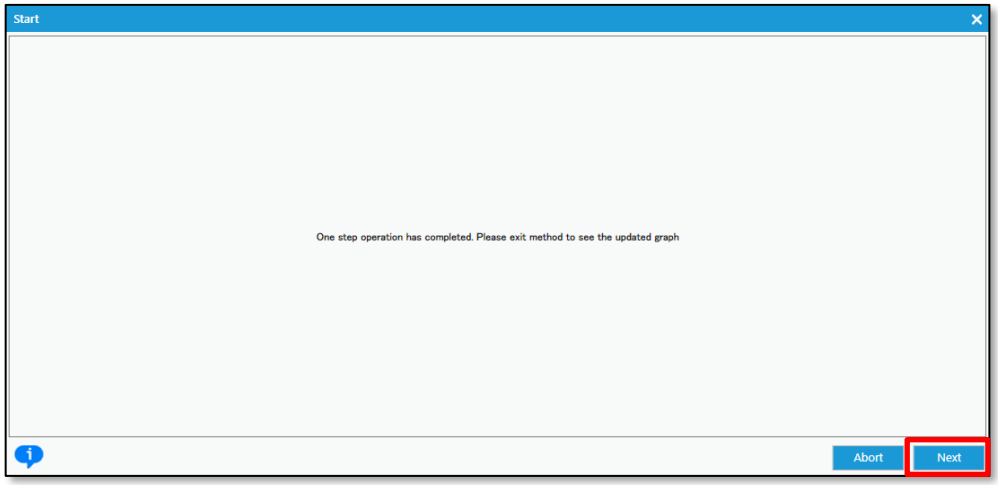
② Confirm the message and click [Next]. Start one step response.



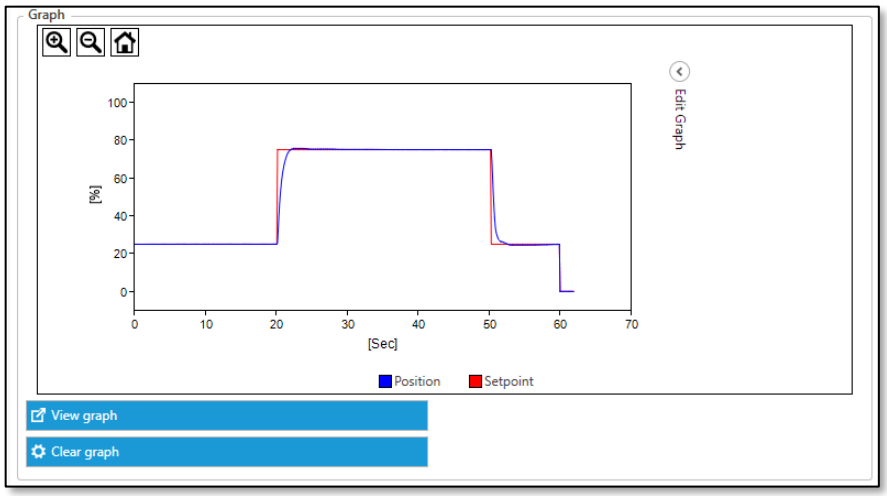
③ Wait until the execution completion message is displayed.
※ Click [Abort] to cancel operation.



④ Confirm completion massage and click [Next] to complete process.

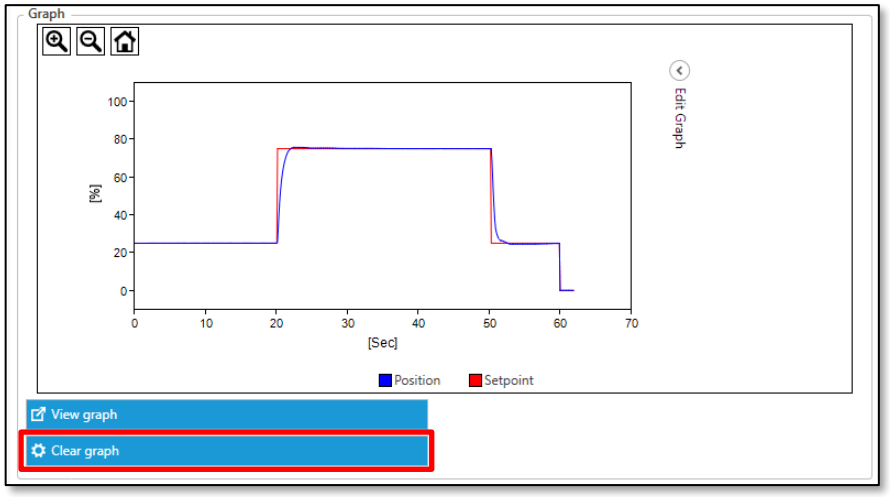


⑤ The graph updates.



3) Clear the one step response graph display data

① Click [Clear graph] in the [Graph] menu group and initialize the graph data.



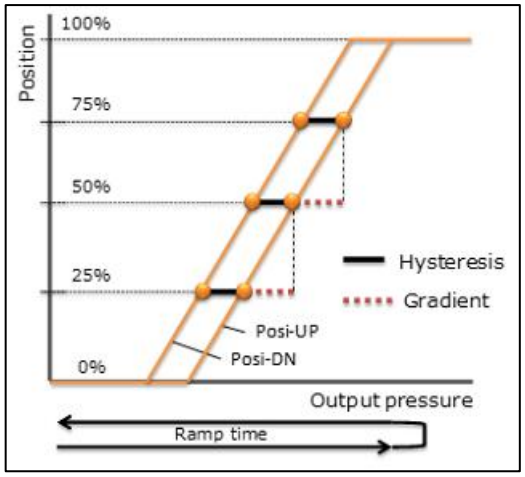
② Graph will be cleared to initial condition.

※ As One step response data is not saved, it will be cleared when exit the application.

7.5. Simple valve signature

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.

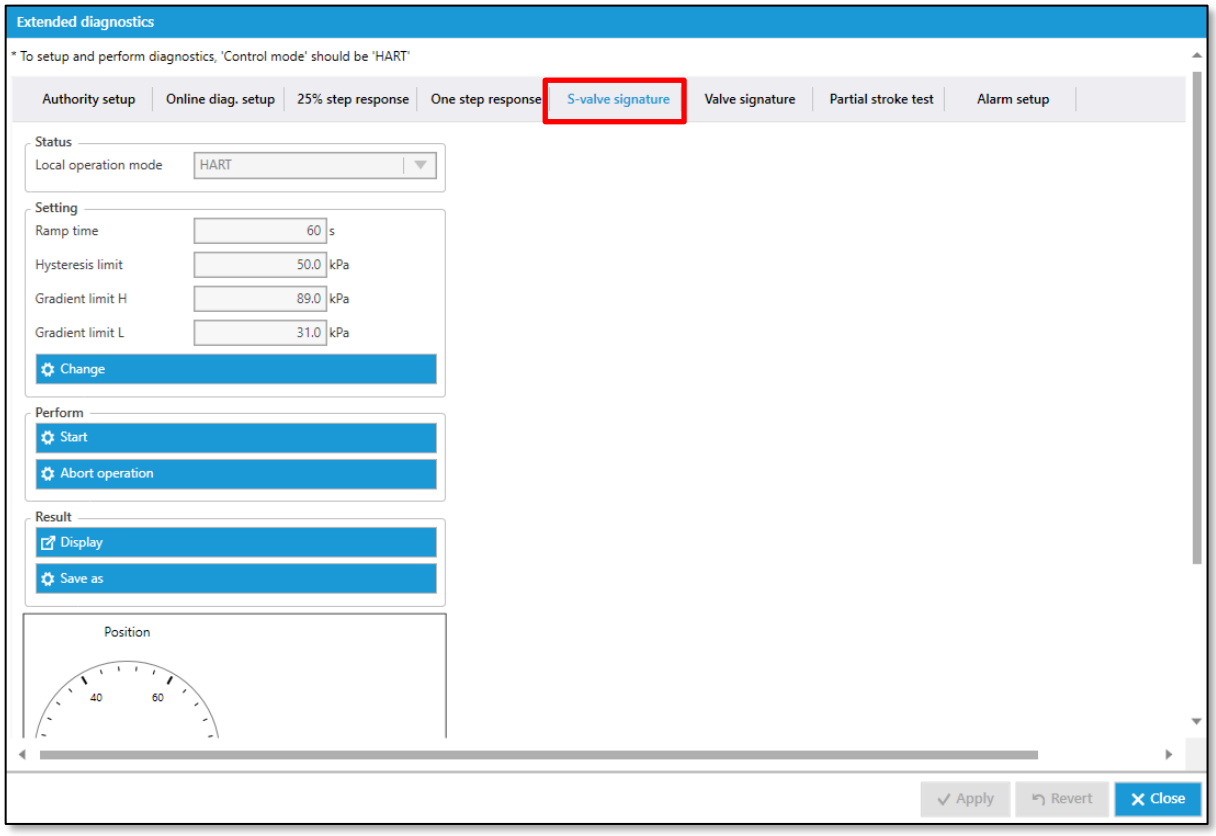


Caution

- HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.
- Before performing simple valve signature, set "**Control mode**" to "HART".

MENU) *Diagnostics > Extended diagnostics > S-valve signature*

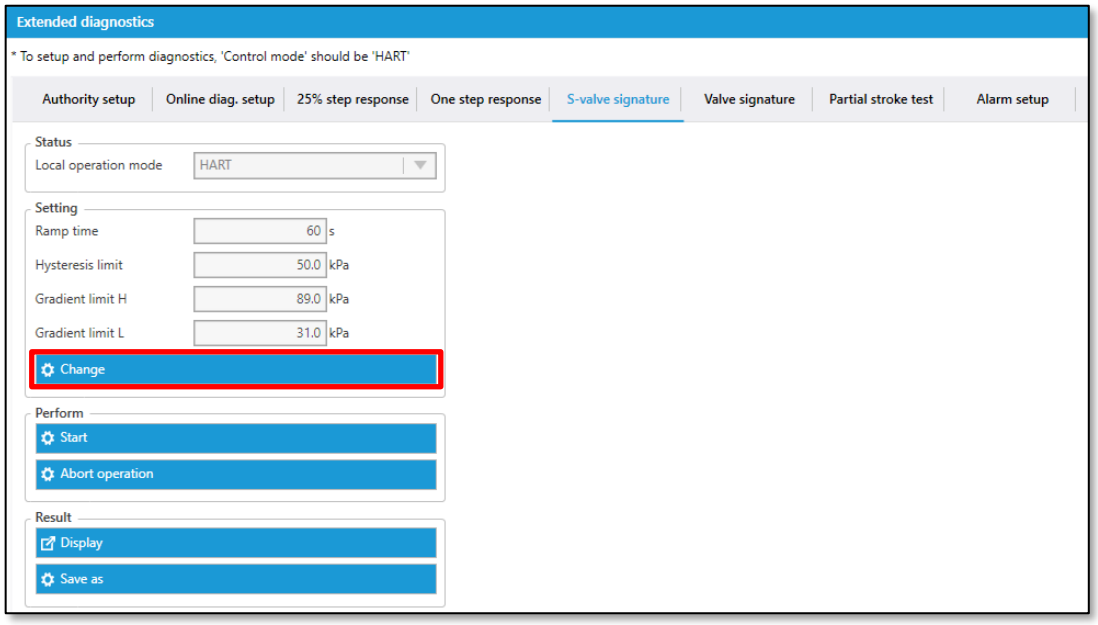
① Click the [S-valve signature] menu tab in the [Extended diagnostics] menu. [S-valve signature] menu opens.



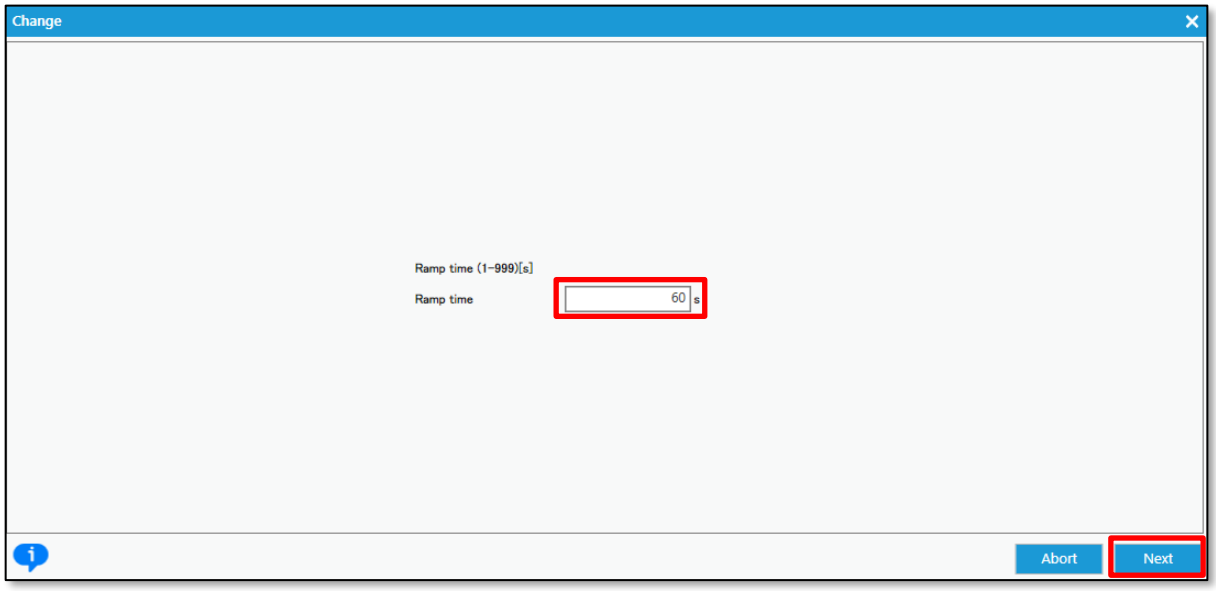
The steps for setting, executing and displaying result to the simple valve signature are shown below.

1) Settings of Simple valve signature

① Click [Change] in the [Setting] menu group.

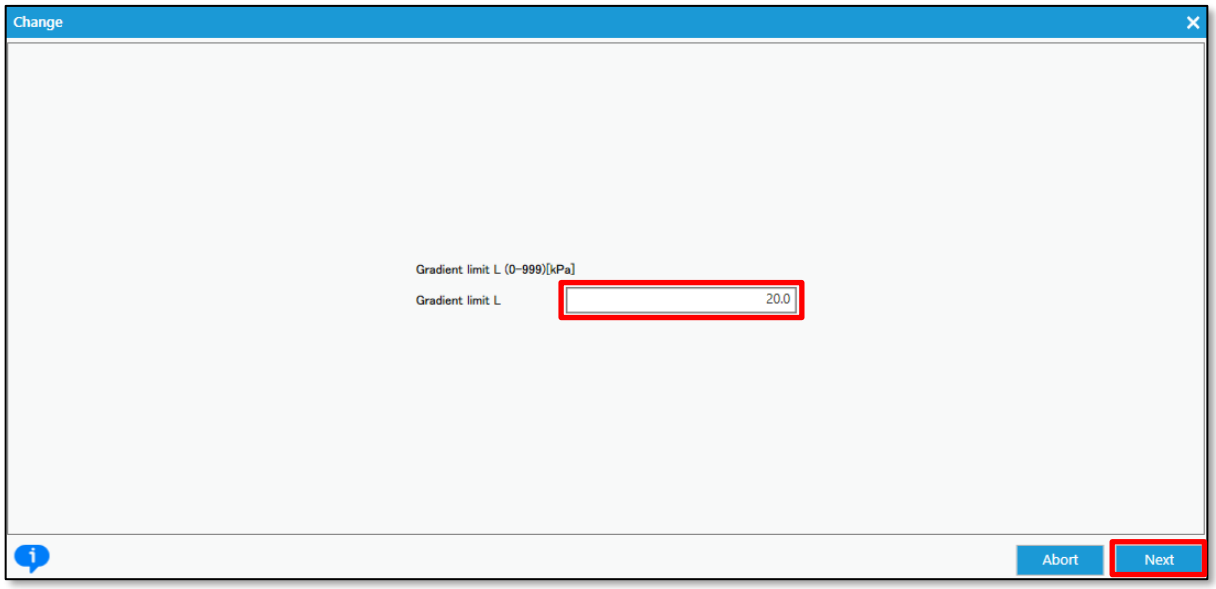


② Enter the ramp time value in the “Ramp time” field and click [Next].



③ From then on, enter the setting values for “Hysteresis limit, Gradient limit H,” in the same way.

④ Finally, enter the setting value of gradient limit low value in the “Gradient limit L” field and click [Next].

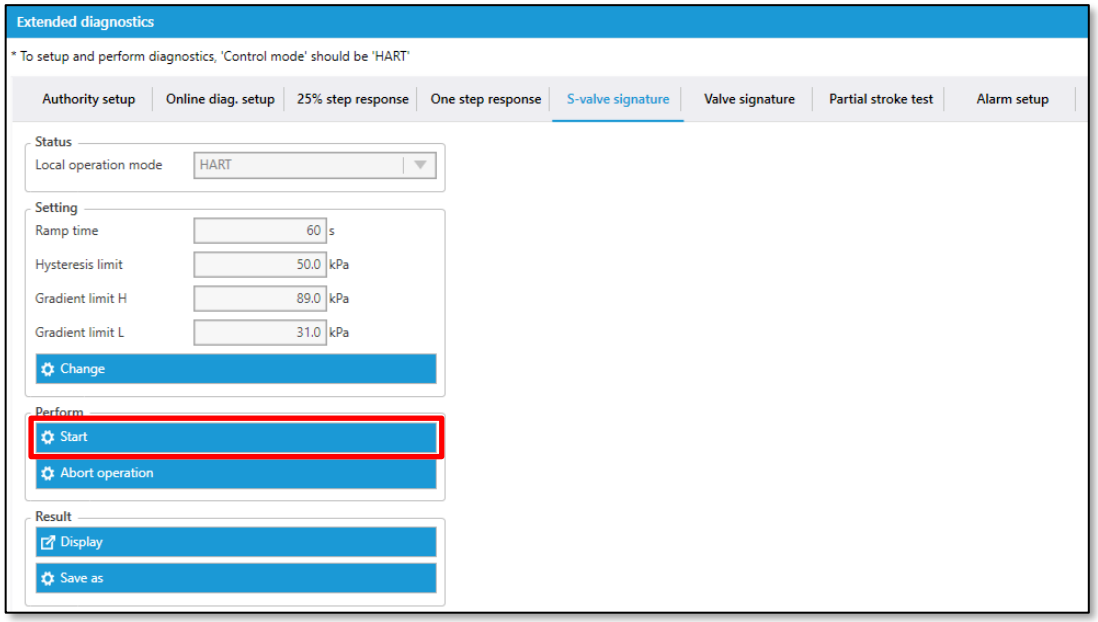


Setting values are as follows:

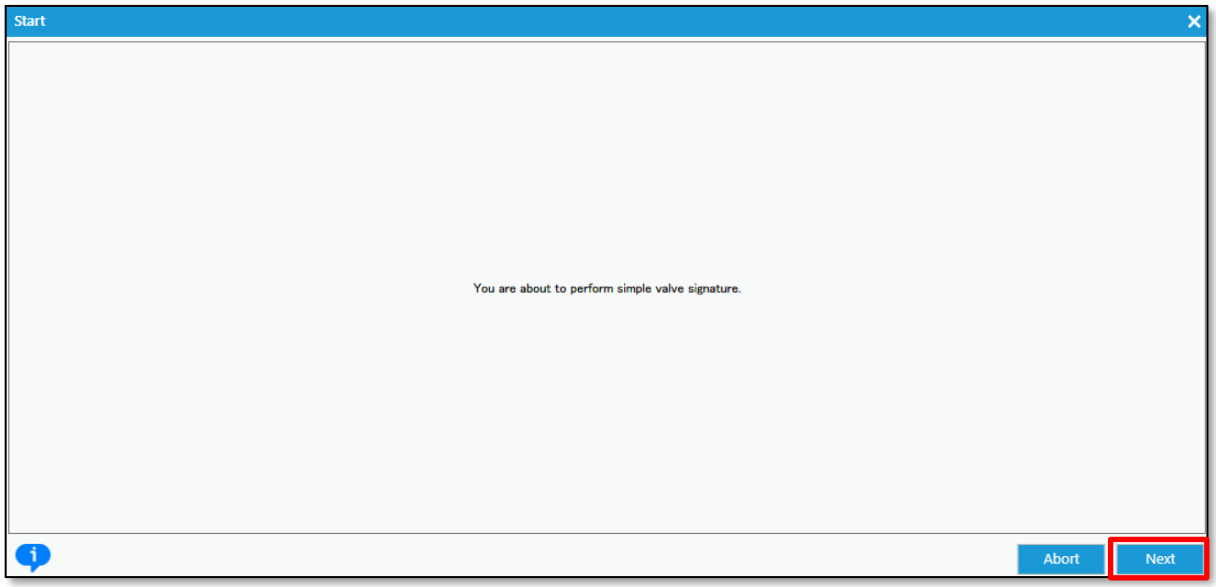
Ramp time[s]	: Set a time to fully stroke by ramp input. Initial value: 60sec
Hysteresis limit [kPa,bar,psi]	: Set limit of pressure hysteresis. Initial: 50kPa
Gradient limit H [kPa,bar,psi]	: Set upper limit of pressure gradient (pressure difference) Initial value: 80kPa
Gradient limit L [kPa,bar,psi]	: Set lower limit of pressure gradient (pressure difference) Initial value: 20kPa

2) Execution of Simple valve signature

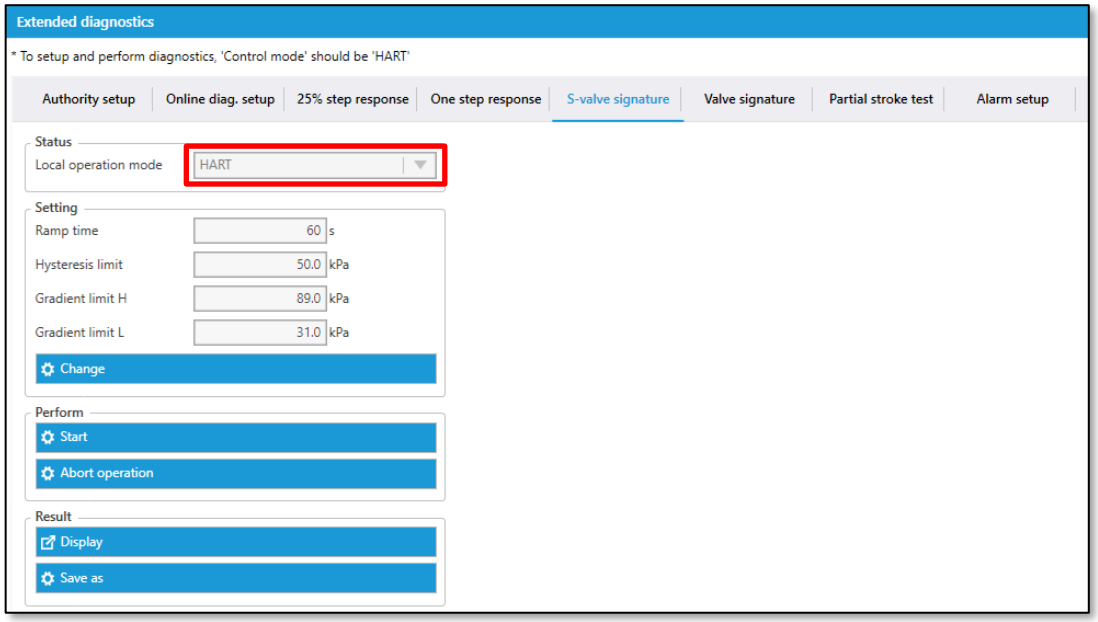
① Click [Start] in the [Perform] menu group.



② Confirm the message and click [Next].

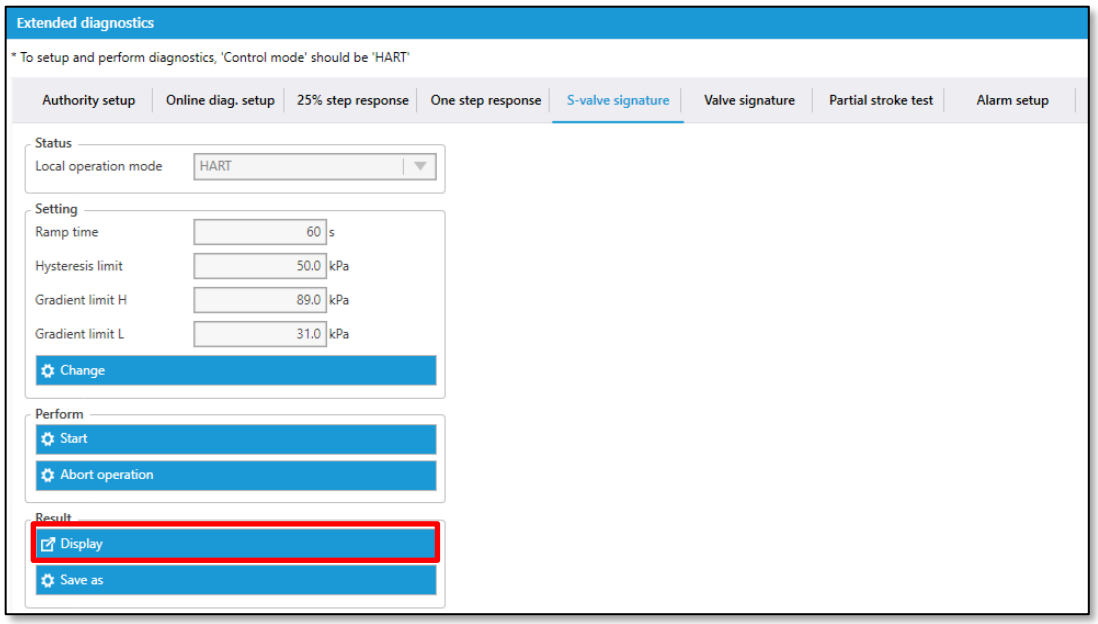


③ Wait until “Local operation status” field in the [Status] menu group becomes “HART”.
※ Click [Abort operation] to cancel operation.

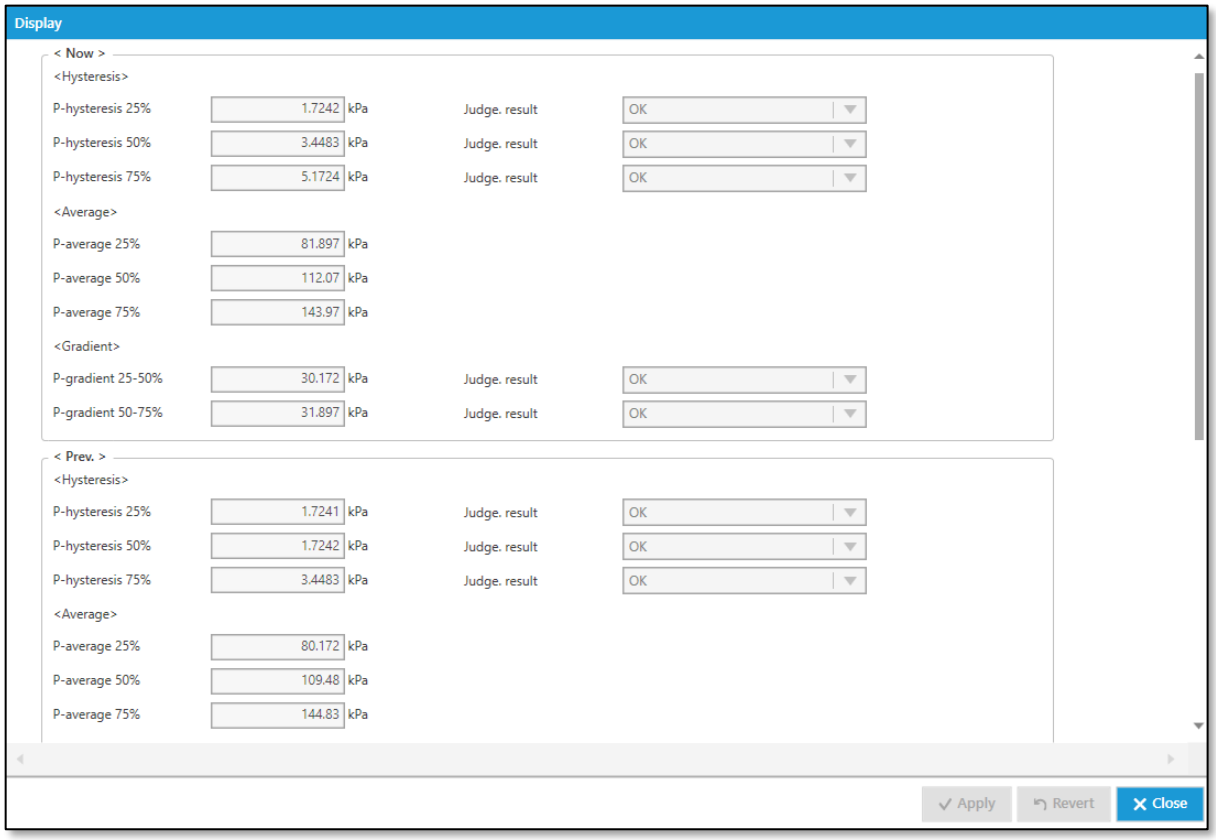


3) Check the result of simple valve signature

① Click [Display] in the [Result] menu group.

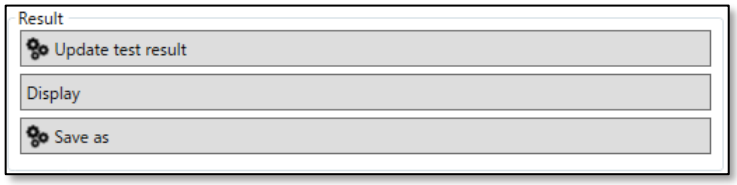


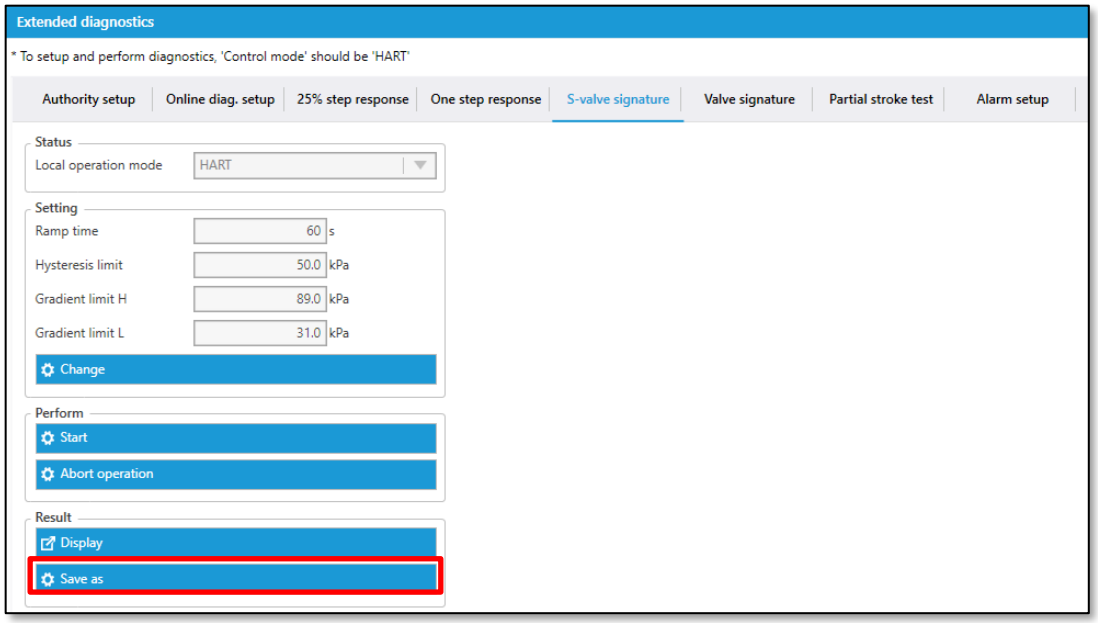
② Execution results are displayed.



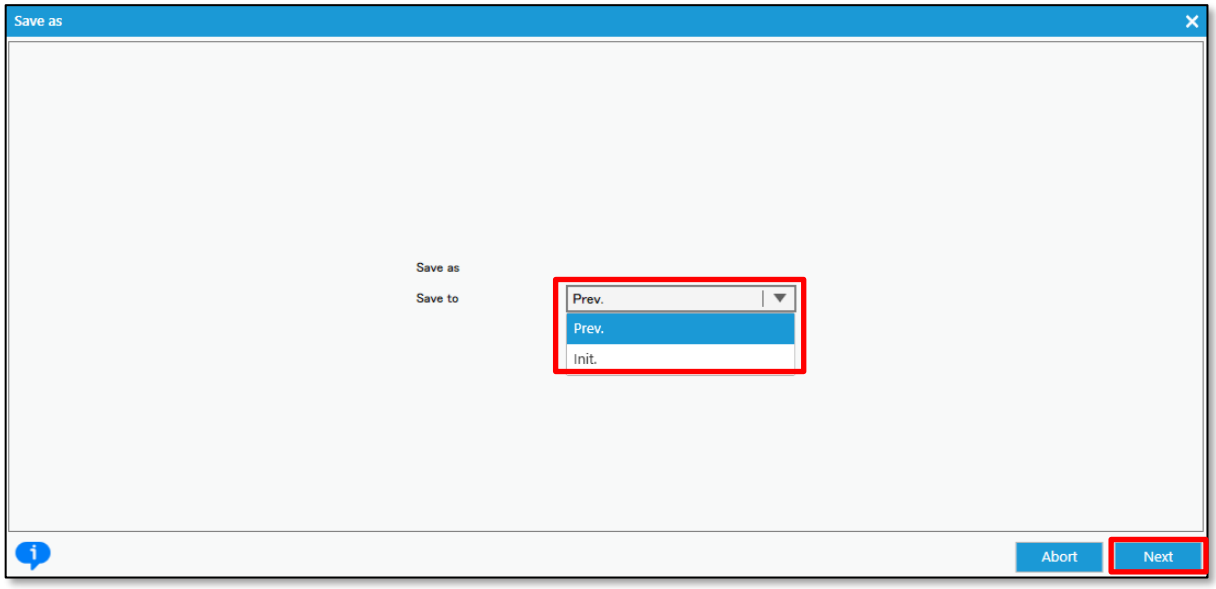
4) Save the execution result

① Click [Save as] in the [Result] menu group.





② Select the previous data “Prev” or the initial data “Init” as the data save destination. Click [Next] to save the results.



7.6. Valve signature

The valve signature shows the relationship between the operating pressure and the valve position when the valve is moved. And it shows the characteristics of a valve and an actuator.

From the data, various events occurring in the valve, such as irregular frictional force, can be found.

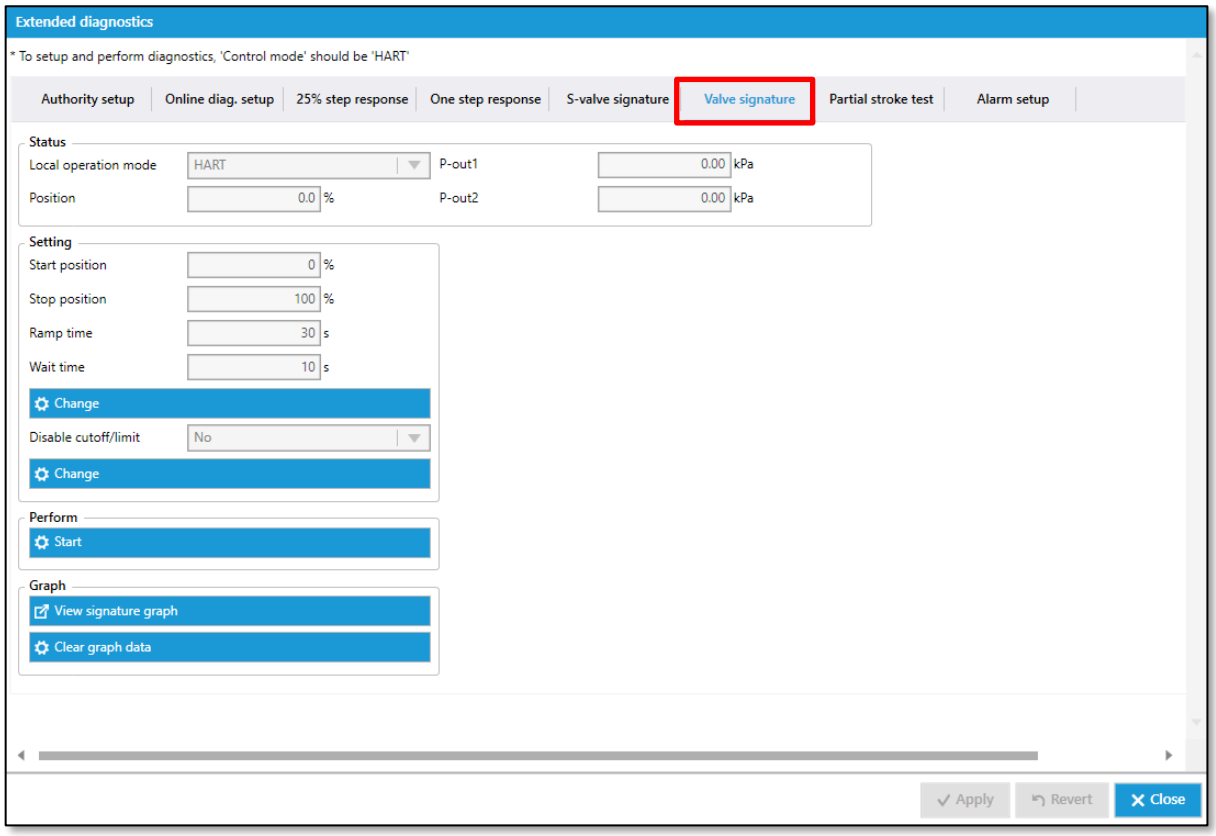
Measures the output air pressure at the specified starting and ending valve position and obtains and displays the signature data of the control valve.

Caution

➢ HART communication takes more time than operating the device's LUI, so be sure to check that the operation is complete.

MENU) *Diagnostics > Extended diagnostics > Valve signature*

① Click [Valve signature] menu tab in the [Extended diagnostics] menu. [Valve signature] menu opens.

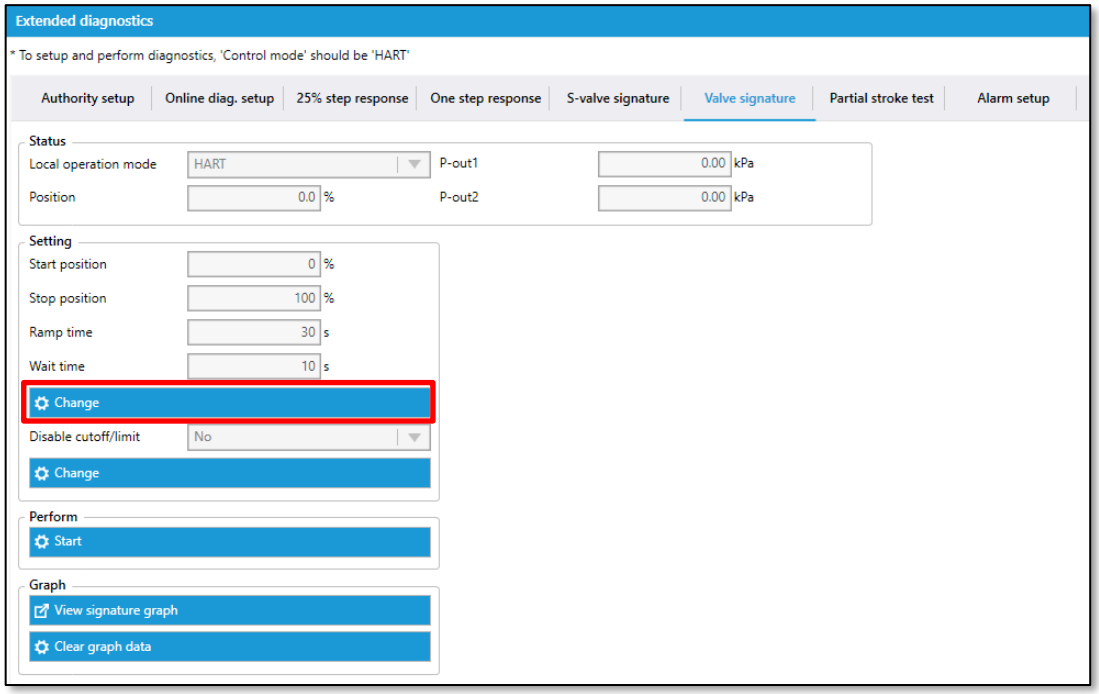


Z

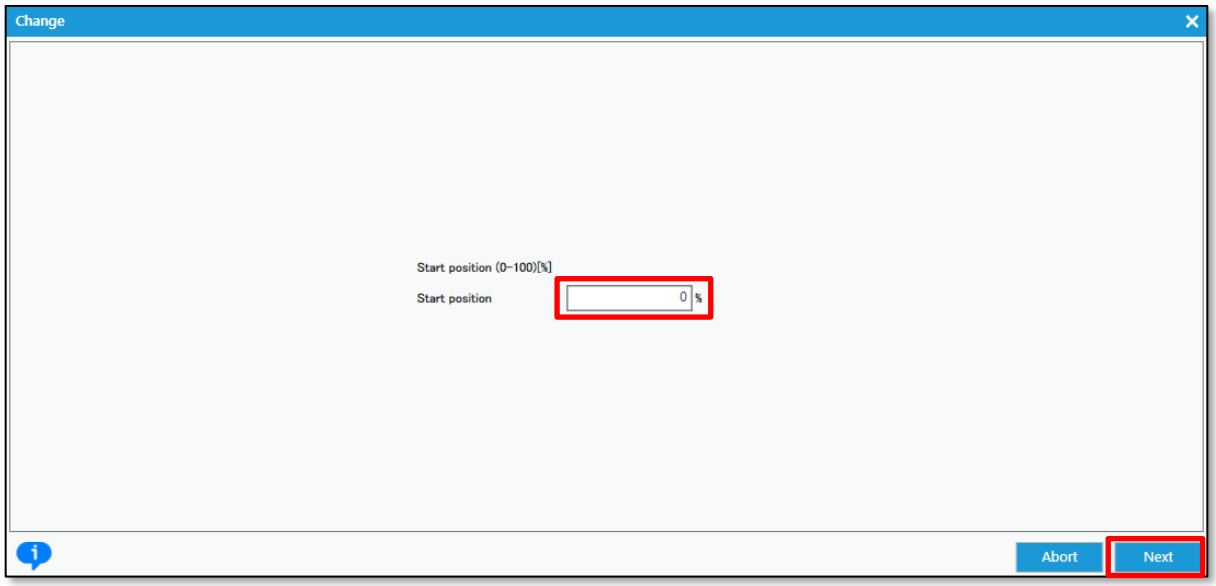
The steps for setting, executing, and displaying the Valve signature are shown below.

1) Settings of Valve signature

① Click [Setting] in the [Setting] menu group.

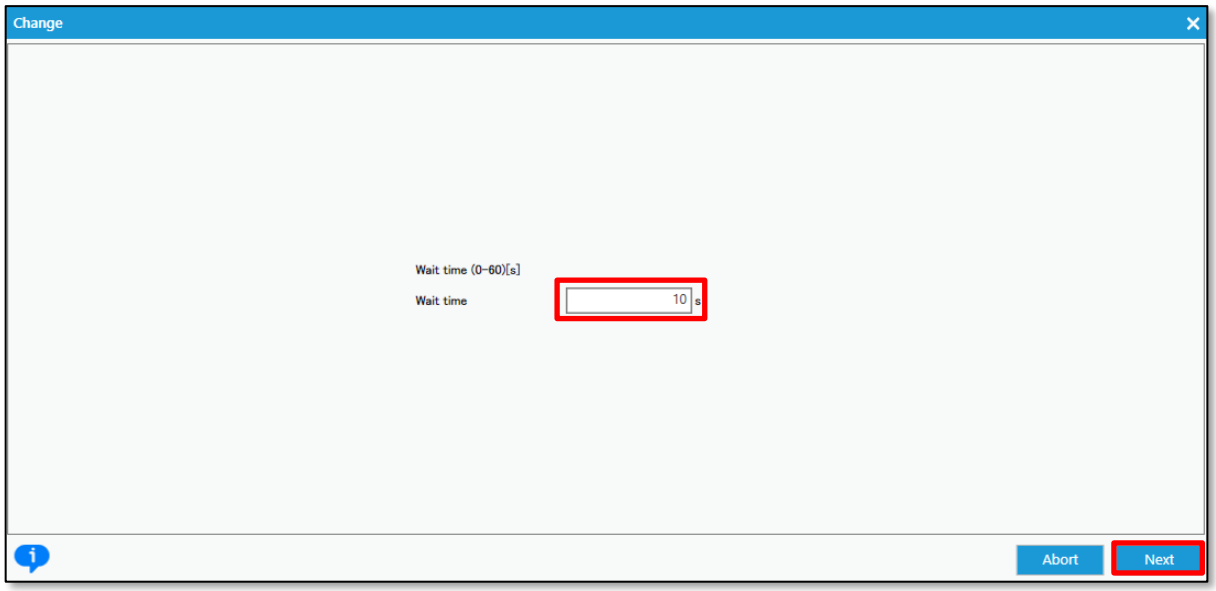


② Enter start position in the “Start position field and click [Next].



③ From then on, enter the setting values for “Stop position” and “Ramp time” in the same way.

④ Finally, enter the wait time value in the “Wait time” field and click [Next].



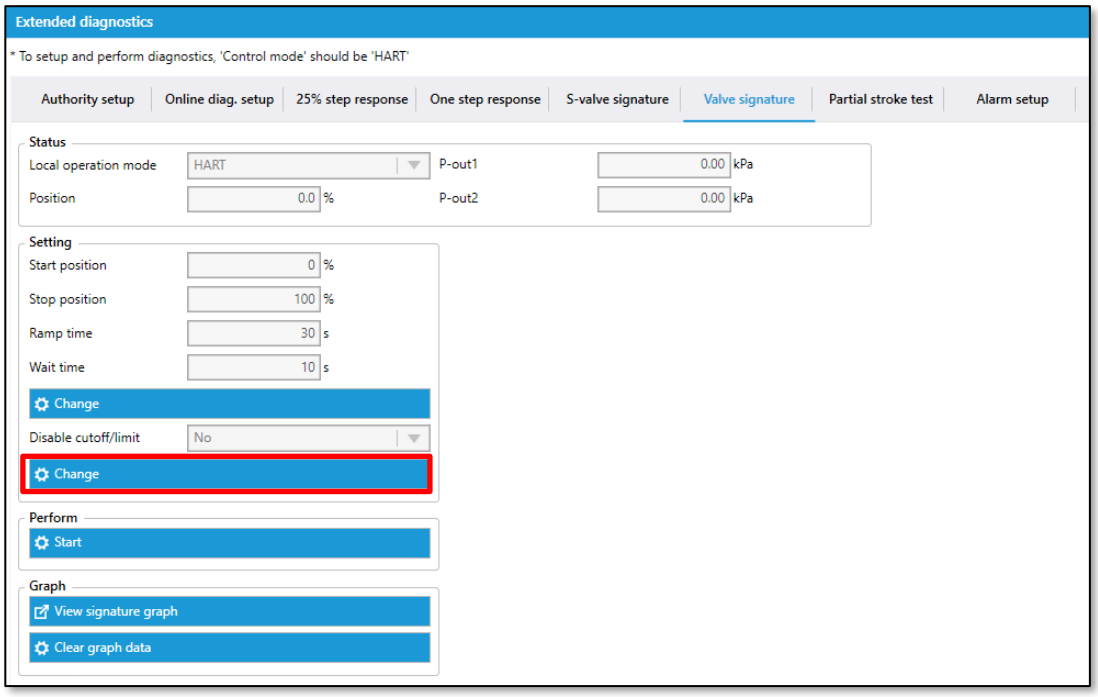
Setting values are as follows:

Start position [%]	: Set the valve position to start ramp operation. Initial value: 0%
Stop position [%]	: Set the valve position to end ramp operation. Initial value: 100%
Ramp time [s]	: Set the ramp time. Initial value: 30sec
Wait time [s]	: Set the wait time. Initial value: 10sec

2) Disable cutoff / limit setting

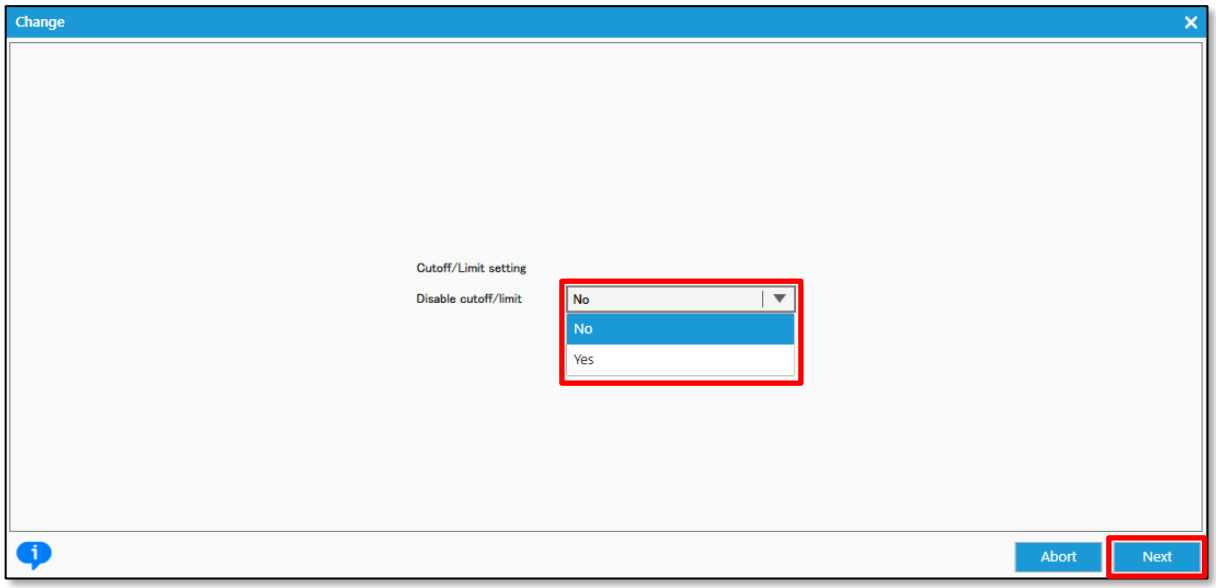
When executing a valve signature, you can temporarily disable the cutoff setting.

① Click [Change] under “Disable cutoff/limit” item in the [Setting] group.



② Select "Yes" to disable the Cutoff/Limit settings during execution, or "No" to leave them enabled.

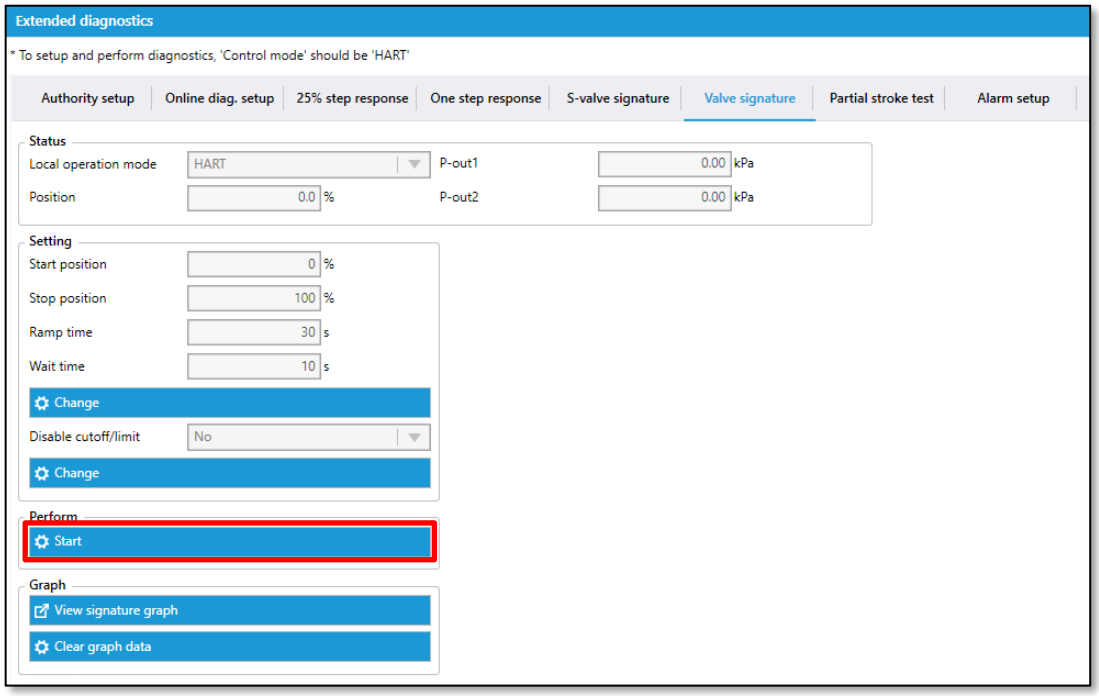
③ Click [Next] to set.



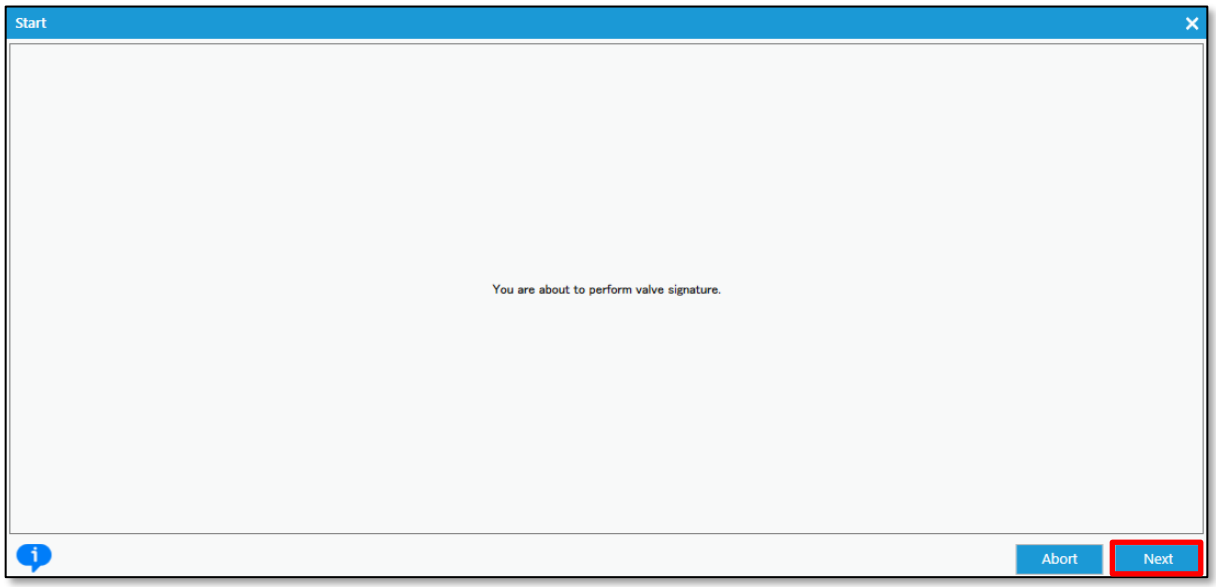
3) Execution of Valve signature

Executes a Valve signature. The execution steps are as follows:

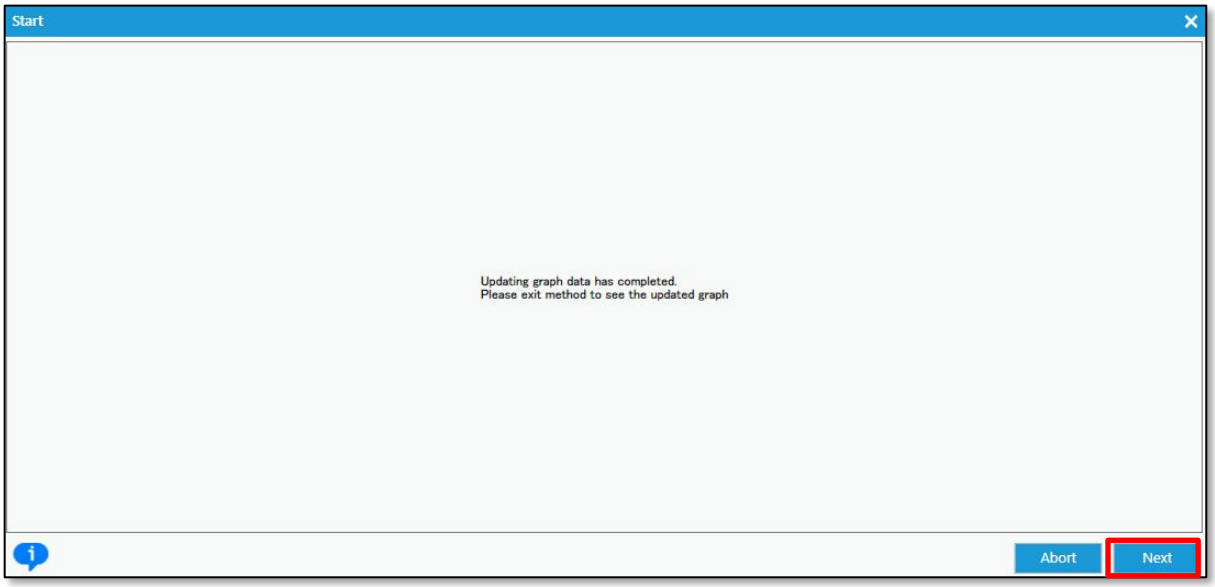
① Click [Start] in the [Perform] menu group.



② Confirm the message and click [Next].



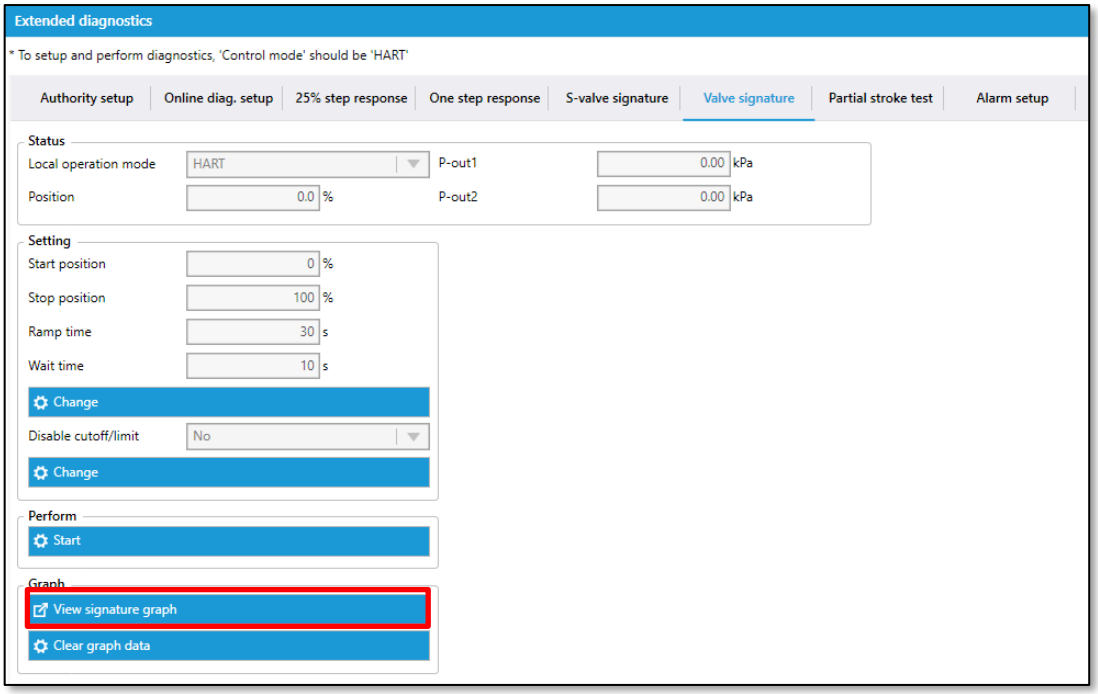
③ Wait for the following message to display when the execution is complete and click [Next].



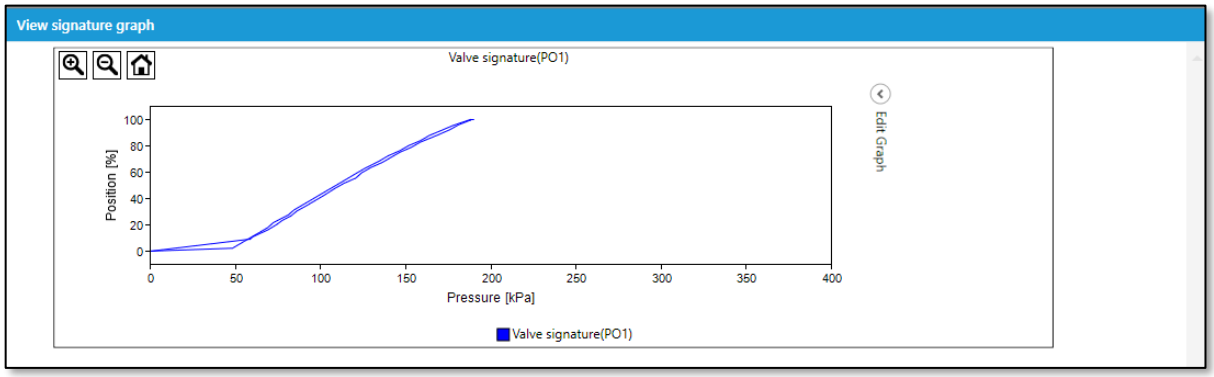
4) Display the Valve signature graph

The following operations are required to display the valve signature graph.

① Click [View signature graph] in the [Graph] menu group.

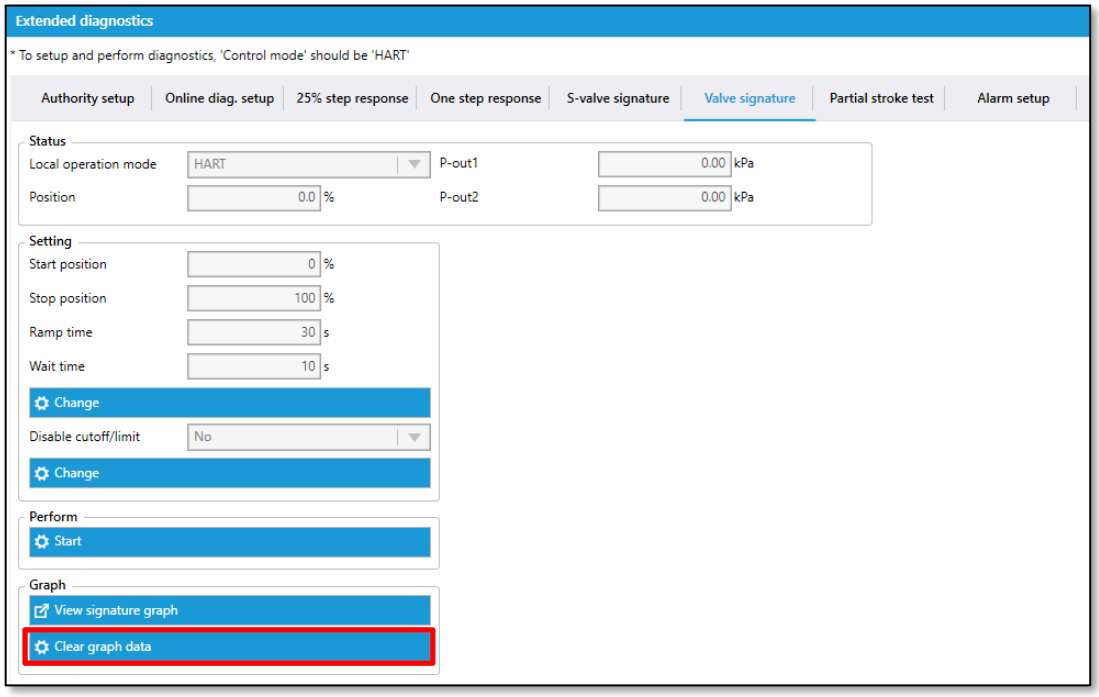


② The execution results are drawn in the [Graph] area.



5) Clear the Valve signature graph display data

① Click [Clear graph] in the [Graph] menu group to initialize the graph data.

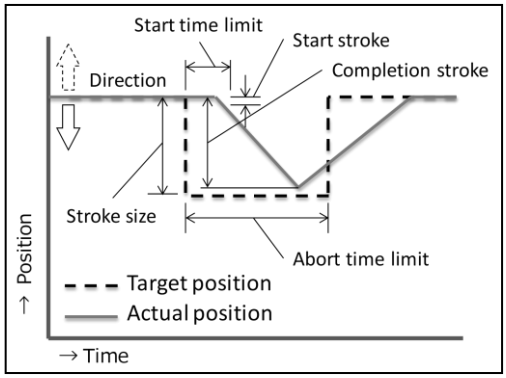


② Graph will be cleared to initial condition.

※ As valve signature data is not saved, it will be cleared when exit the application.

7.7. Partial stroke test (PST)

This function is operated the setting position range at the set time interval (Executed online).
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.

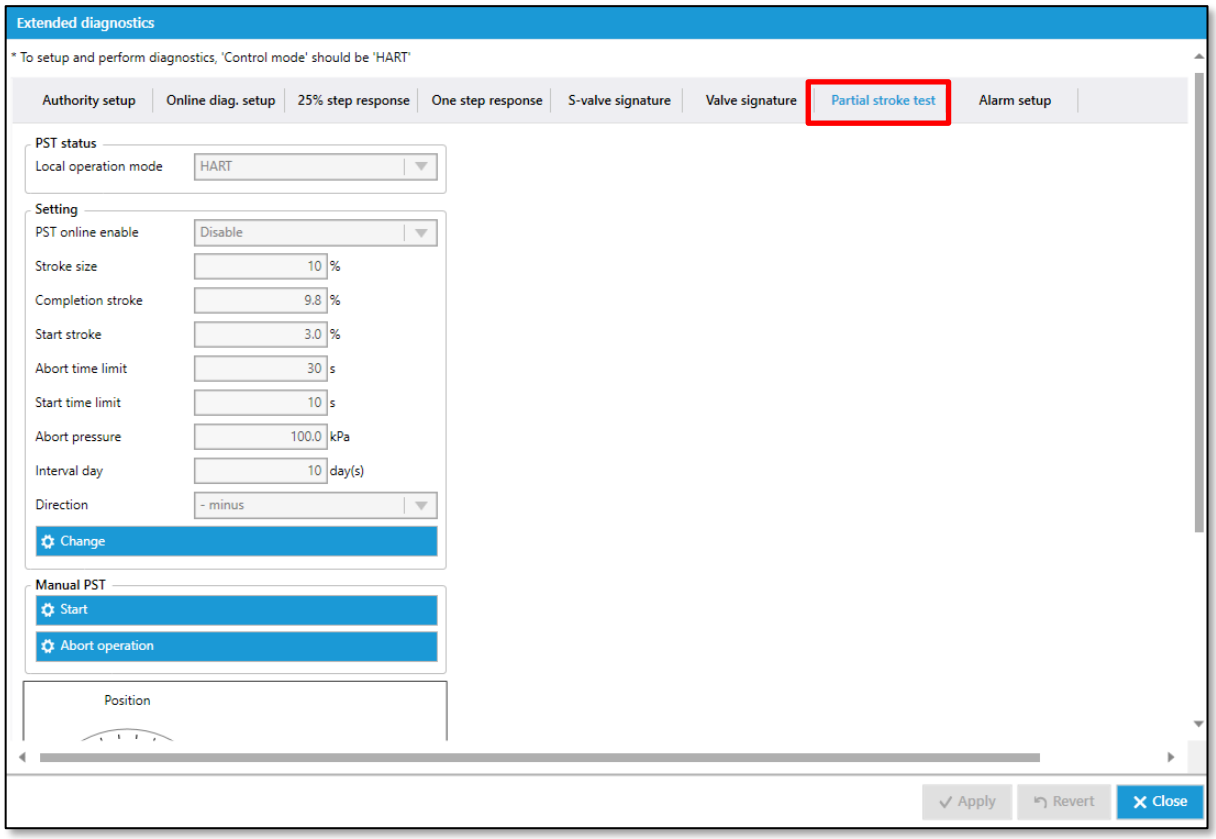


Caution

➢ Before manually running the partial stroke test, set "**Control mode**" to "HART".

MENU) *Diagnostics > Extended diagnostics > Partial stroke test*

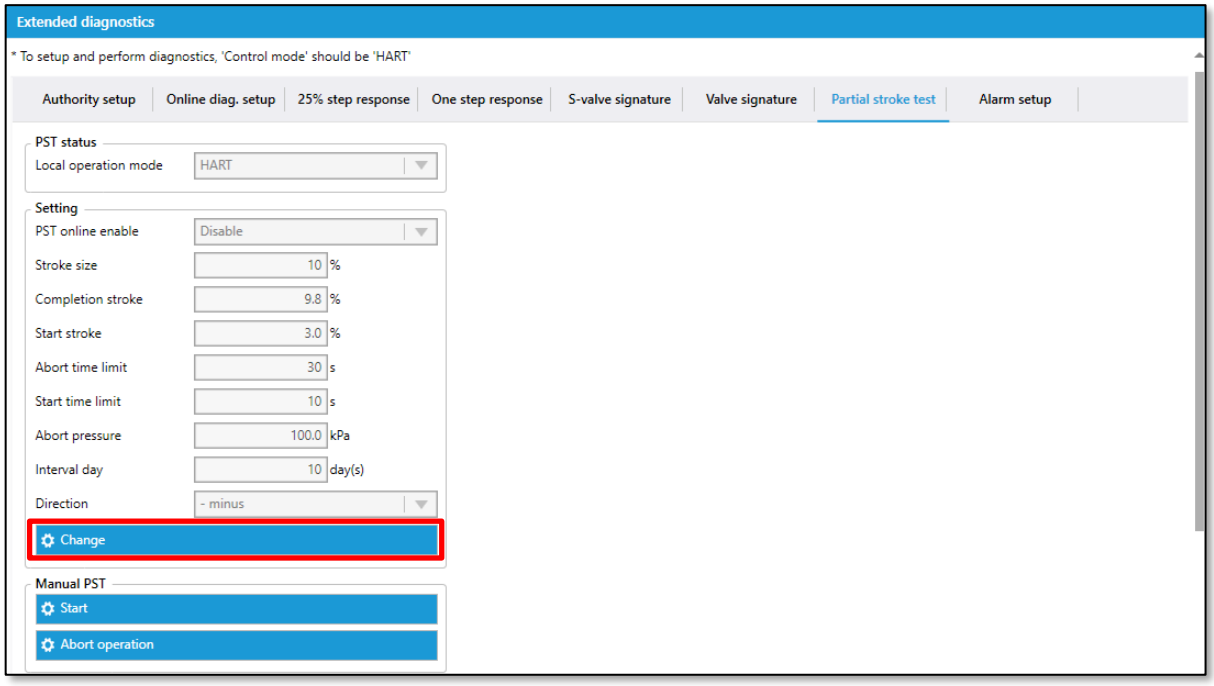
① Click [Partial stroke test] in the [Extended diagnostics] menu tab. [Partial stroke test] menu opens.



The steps for setting, executing at online, and displaying the result for Partial stroke test are shown below.

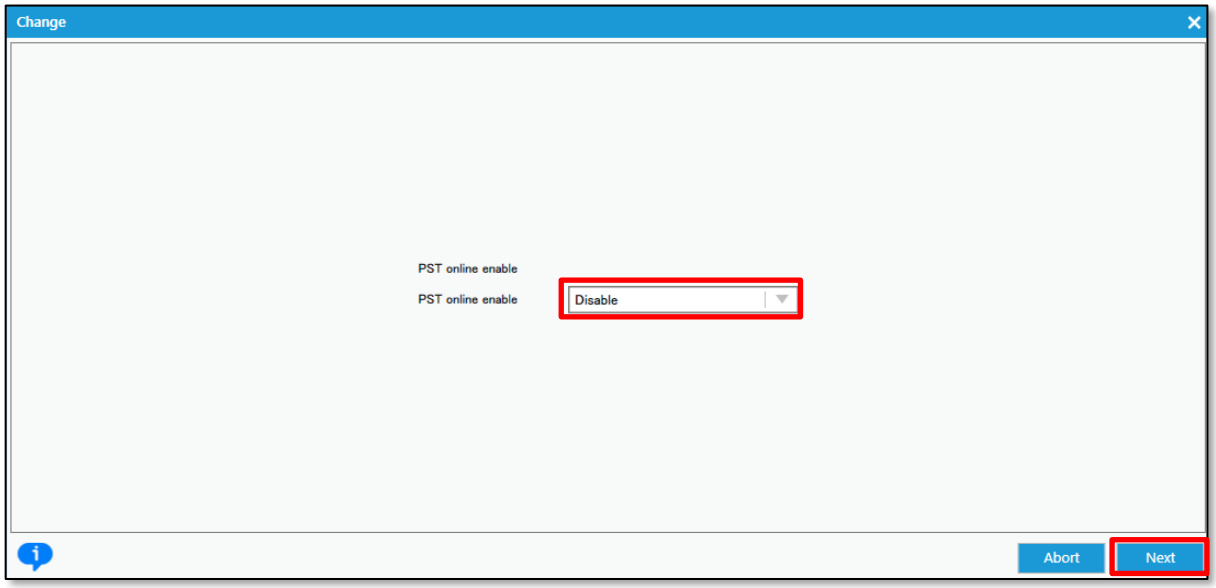
1) Settings of the Partial stroke test

① Click [Change] in the [Setting] menu group.



② Select whether execute PST online or not in the “PST online enable” field and click [Next].

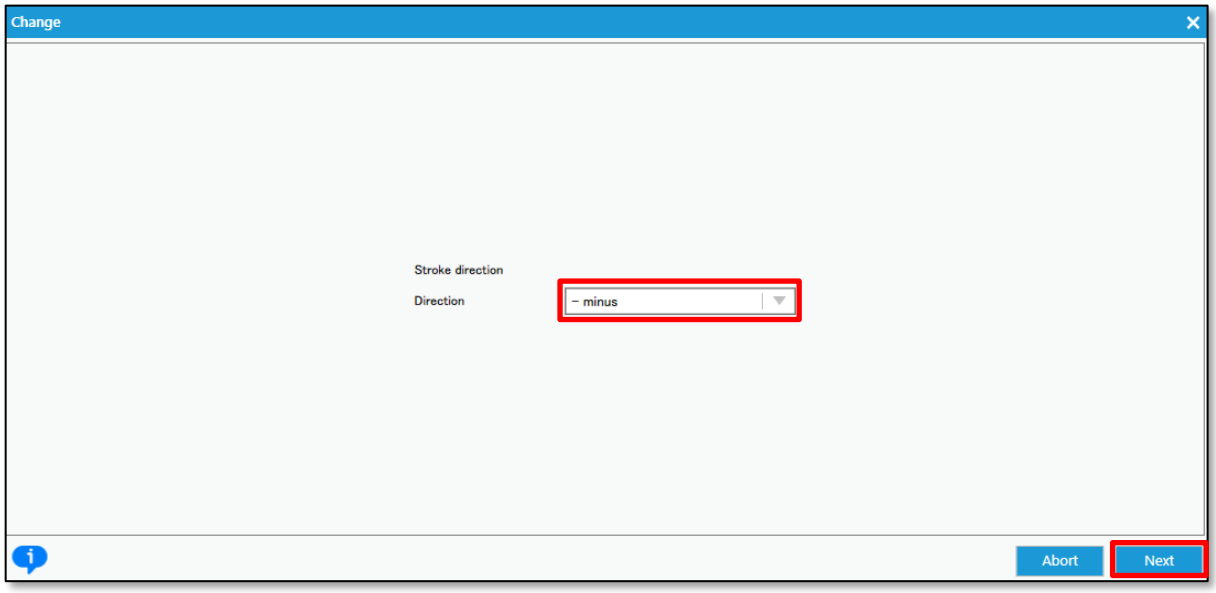
※ This setting is ignored when execute offline.



③ From then on, enter the setting values for “Stroke size”, ”Completion stroke”, “Start stroke”, “Abort time”, “Start time limit”, ”Abort pressure”, ”Interval day” in the same way.

※ Setting of “Interval day” is ignored when execute online.

④ Finally, select the direction in the “Direction”” field and click [Next].



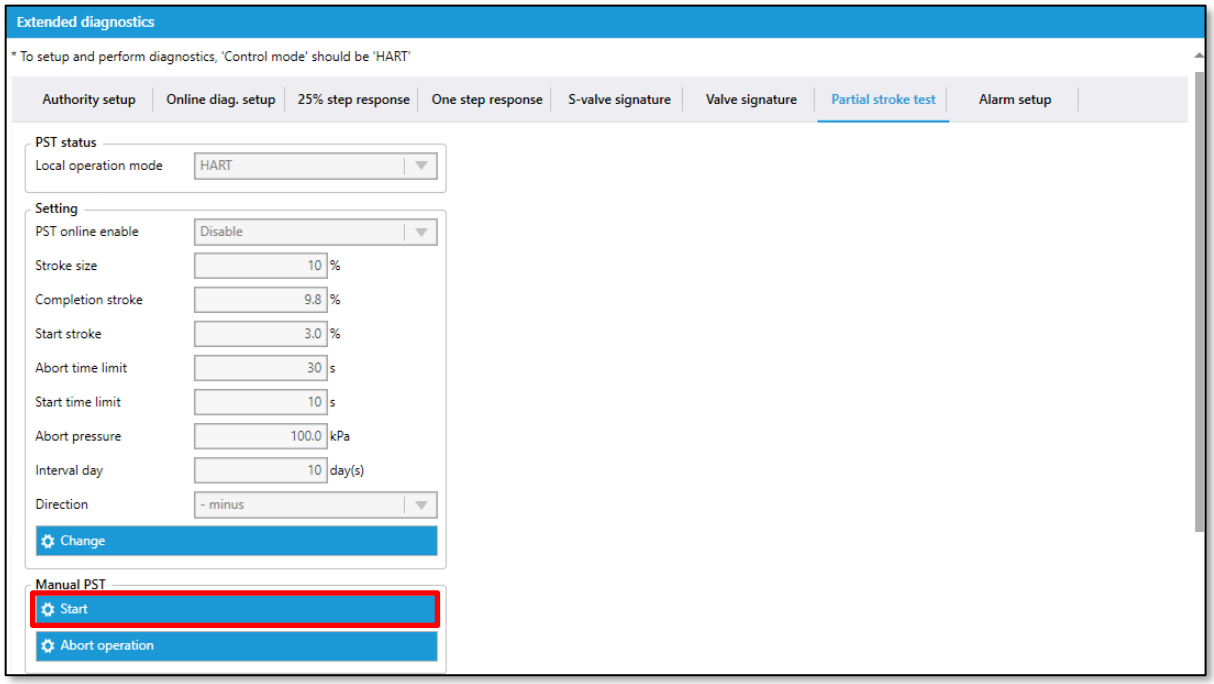
Setting values are as follows:

Disable / Enable	: Select a periodical execution or not. Initial value Disable
Stroke size [%]	: Set a position width to move. Initial value 10%
Completion stroke [%]	: Set a stroke to judge movement completion. Initial value 9.8%
Start stroke [%]	: Set a stroke to judge movement start. Initial value 2.0%
Abort time limit [s]	: Set a time to judge movement cancellation before movement completion. Initial value 30sec
Start time limit [s]	: Set a time to judge movement cancellation before movement start. Initial value 10sec
Abort pressure [kPa/psi/bar]	: Set an output pressure 1(Pout1) change to judge movement cancellation. Initial value 100.0kPa
Interval day [day(s)]	: Set an interval of periodical execution. Initial value 1day
Direction	: Set a direction to move. Initial value -minus

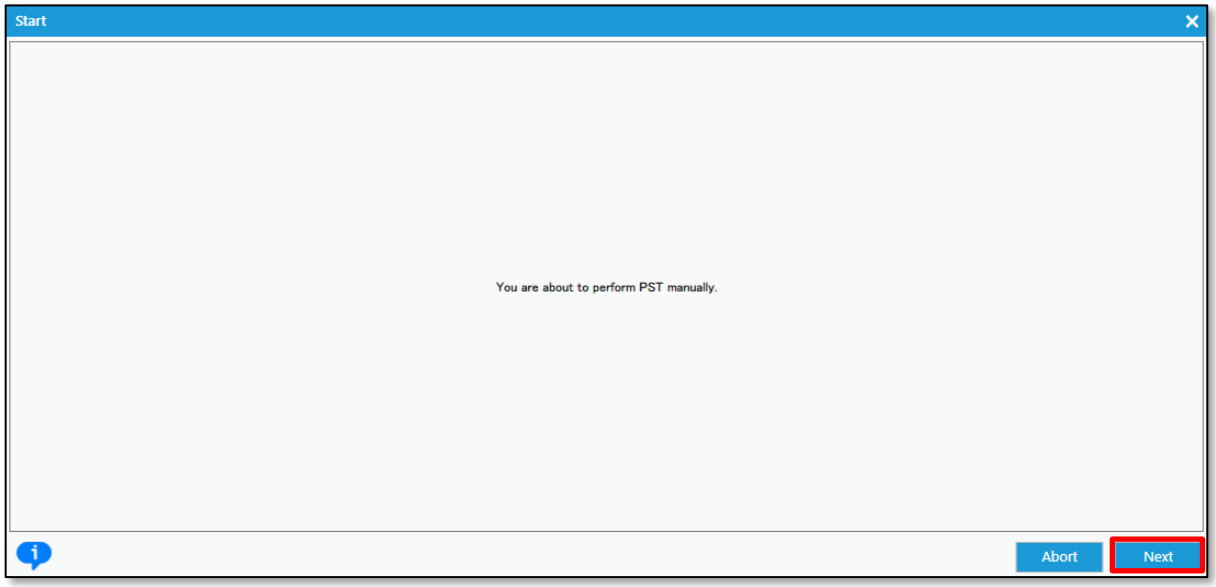
6) Execution of Partial stroke test

Partial stroke tests can be performed manually offline. The execution method is as follows.

① Click [Start] in the [Manual PST] menu group.



② Confirm the message and click [Next].



7.8. Alarm setup

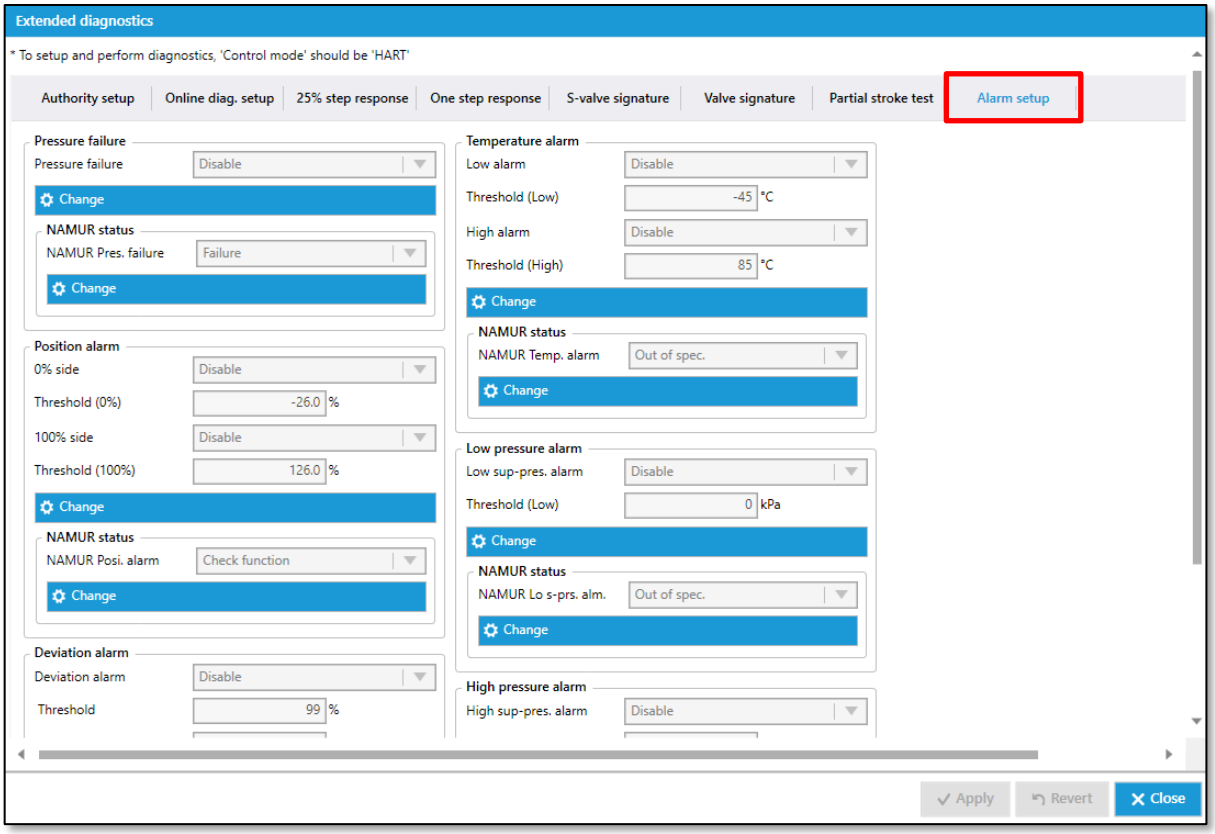
This device has a self-diagnosis function that generates an alarm.
Alarm conditions related to valve position™, deviation, temperature, and pressure can be set arbitrarily.
In addition, when a severe failure of memory or sensors is detected, the IP signal is forcibly cut off and the system operates in a fail-safe manner. Additionally, the position transmitter outputs a burnout signal.

The alarm items that can be set are as follows:

Pressure failure	: Pressure sensor failure
Position alarm	: Valve position alarm
Deviation alarm	: Deviation alarm
Temperature alarm	: Temperature alarm
Low pressure alarm	: Low supply pressure alarm
High pressure alarm	: High supply pressure alarm

MENU) *Diagnostics > Extended diagnostics > Alarm setup*

① Click [Alarm setup] menu tab in the [Extended diagnostics] menu. [Alarm setup] menu opens.



Displays the current alarm settings and NAMUR status settings.

※ See KGP5000 instruction manual for details for each alarm item.

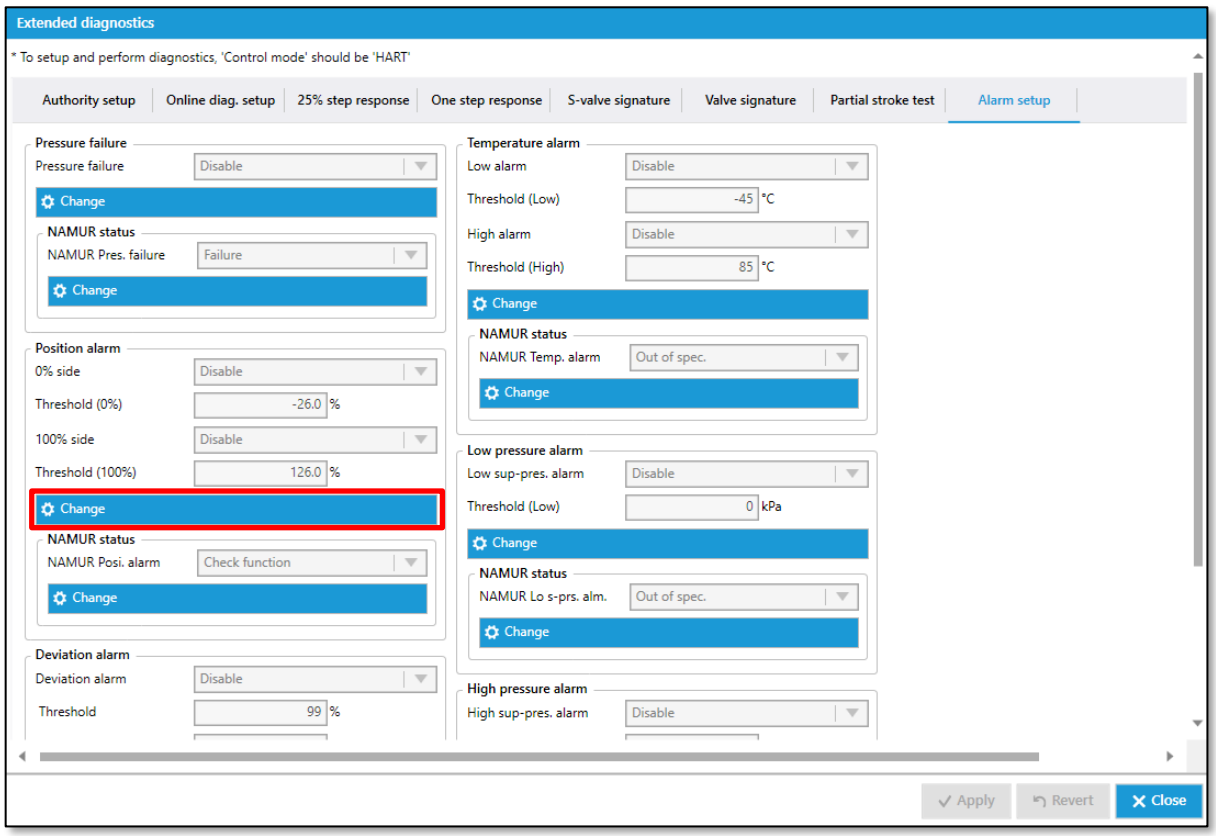
7.8.1. Alarm setup, check status, and clear

The position alarm is shown below as an example.

1) Alarm setup

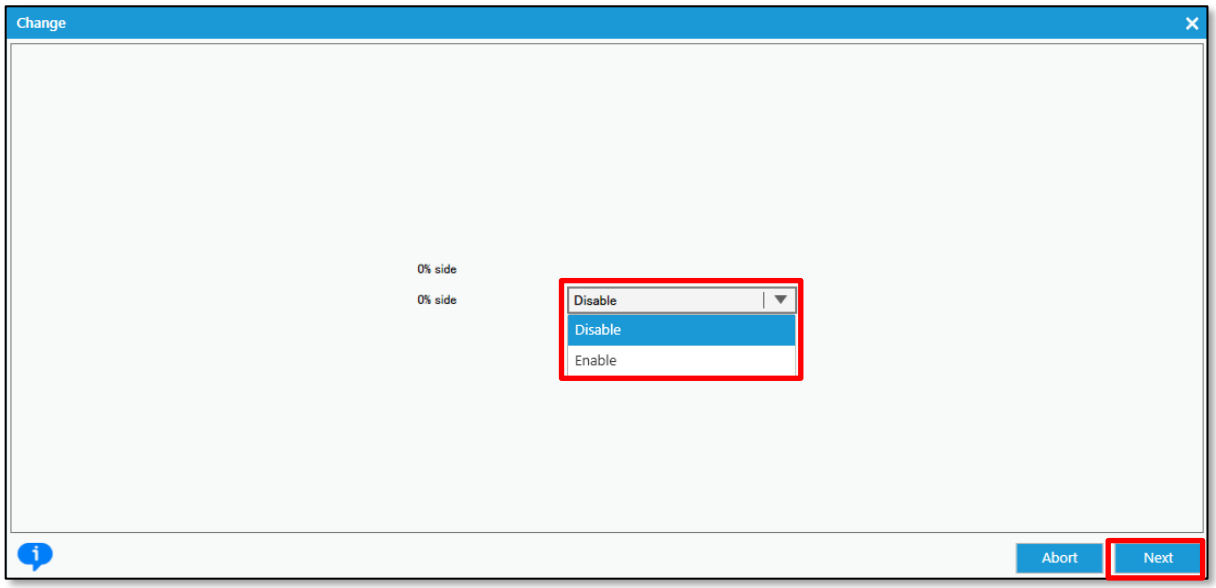
MENU) *Diagnostics > Extended diagnostics > Alarm setup*

① Click [Change] in the [Position alarm] menu group.

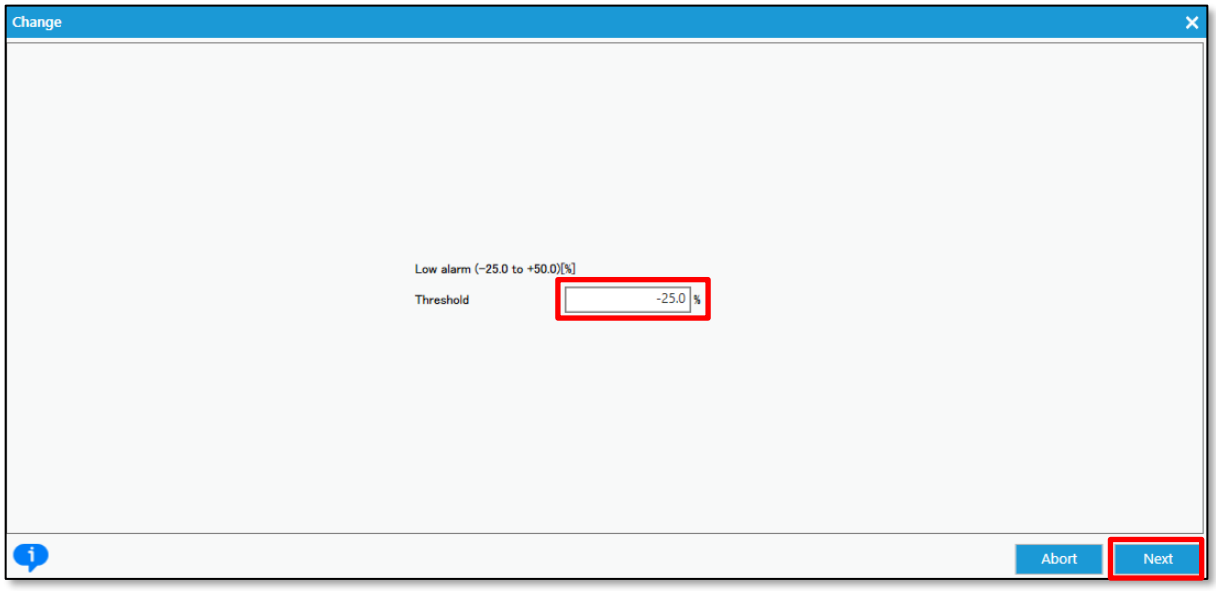


② Select “Disable” or ”Enable” in the “0% side(Low alarm)” field and click [Next]. Here is an example where "Enable" is selected.

※ If “Disable” is selected, move to the “100%　side(High alarm)” setting screen in ④.

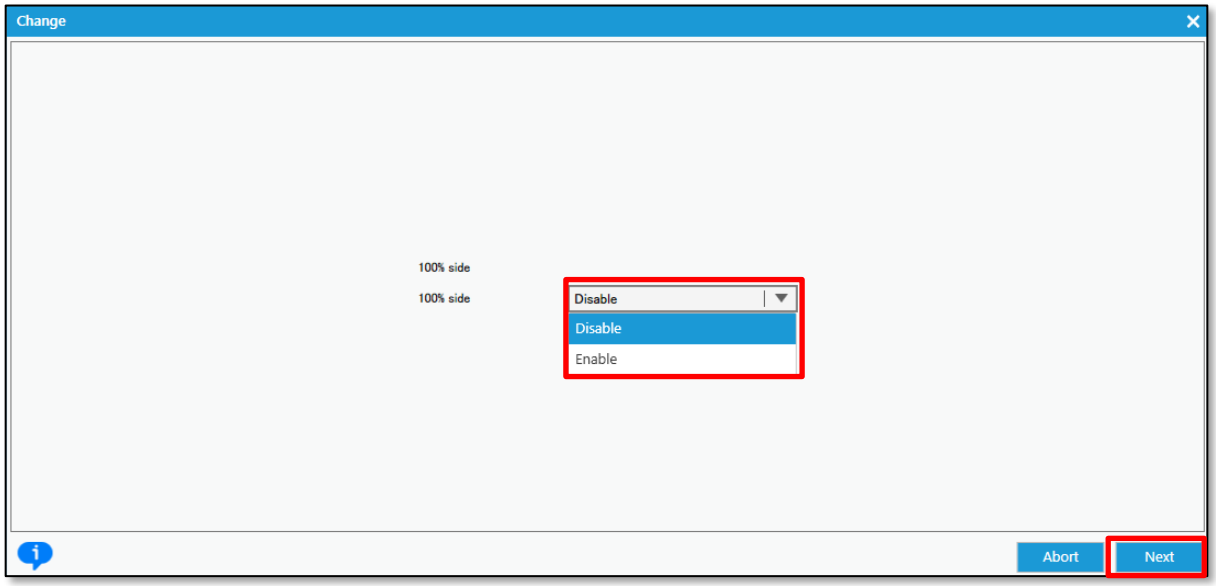


③ Enter the threshold value of the position to be set as low position alarm in the “Threshold” field and click [Next].

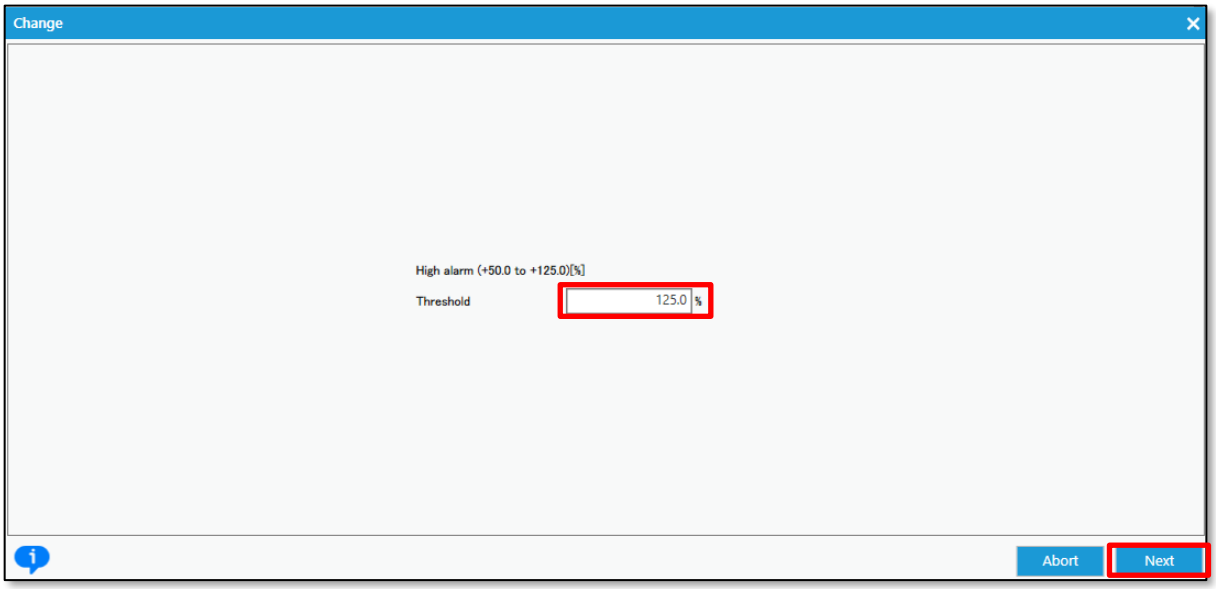


④ Select “Disable” or ”Enable” in the “100% side(High alarm)” field and click [Next]. Here is an example where "Enable" is selected.

※ If select “Disable”, the input values up to this point will be set.



⑤ Enter the threshold value of the position to be set as high position alarm in the “Threshold” field and click [Next].

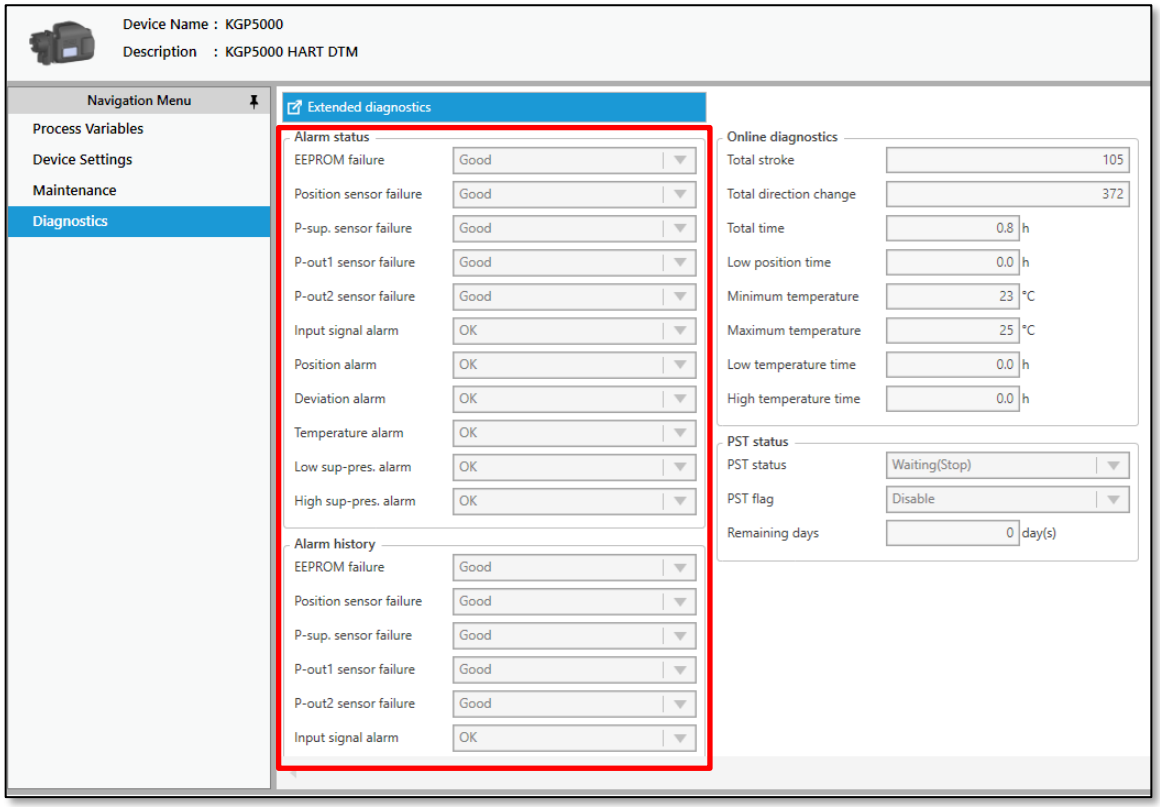


※ The actual alarm is output based on the *OR* condition of the “Low alarm” setting and “High alarm” setting.

2) Alarm status / Alarm history check

Alarm status and history can check in the **[Process Variables] menu** or **[Diagnostics] top menu.**

① Click [Diagnostics] menu or [Process Variables] menu in the Navigation menu.



Display items are as follows:

[Alarm status / Alarm history]

EEPROM failure	: Memory failure	Position sensor failure	: Position sensor failure
P-sup. sensor failure	: Supply pressure sensor failure	P-out1 sensor failure	: Output pressure 1 sensor failure
P-out2 sensor failure	: Output pressure 2 sensor failure		
Input signal alarm	: Input signal alarm	Position alarm	: Valve position alarm
Deviation alarm	: Deviation alarm	Temperature alarm	: Temperature alarm
Low sup-pres. alarm	: Low supply pressure alarm	High sup-pres. alarm	: High supply pressure alarm

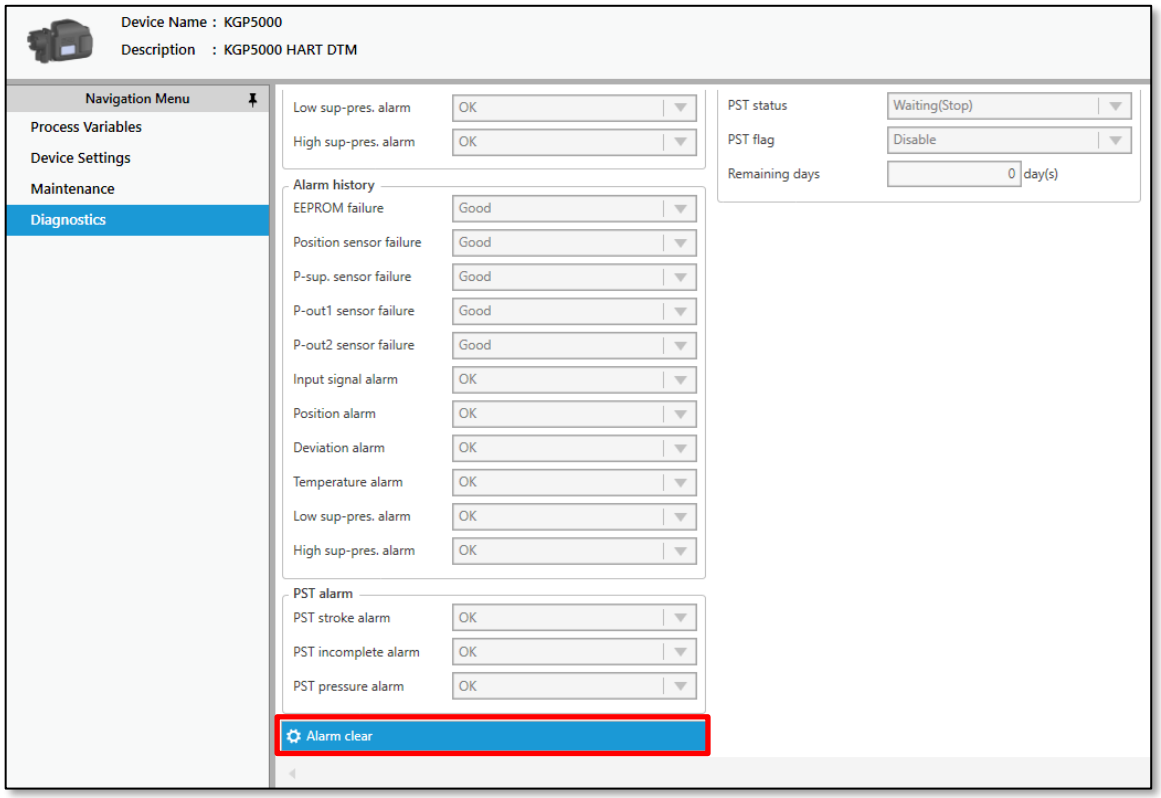
[PST alarm]

PST stroke alarm	: PST stroke alarm	PST incomplete alarm	: PST incomplete alarm
PST pressure alarm	: PST pressure alarm		

3) Alarm clear

MENU) *Diagnostics > Extended diagnostics >Alarm clear*

① Select [Diagnostics] menu tab from TOP menu and open [Diagnostics] top menu.
Click [Alarm Clear] in the [Diagnostics] top menu. All alarm status is cleared.



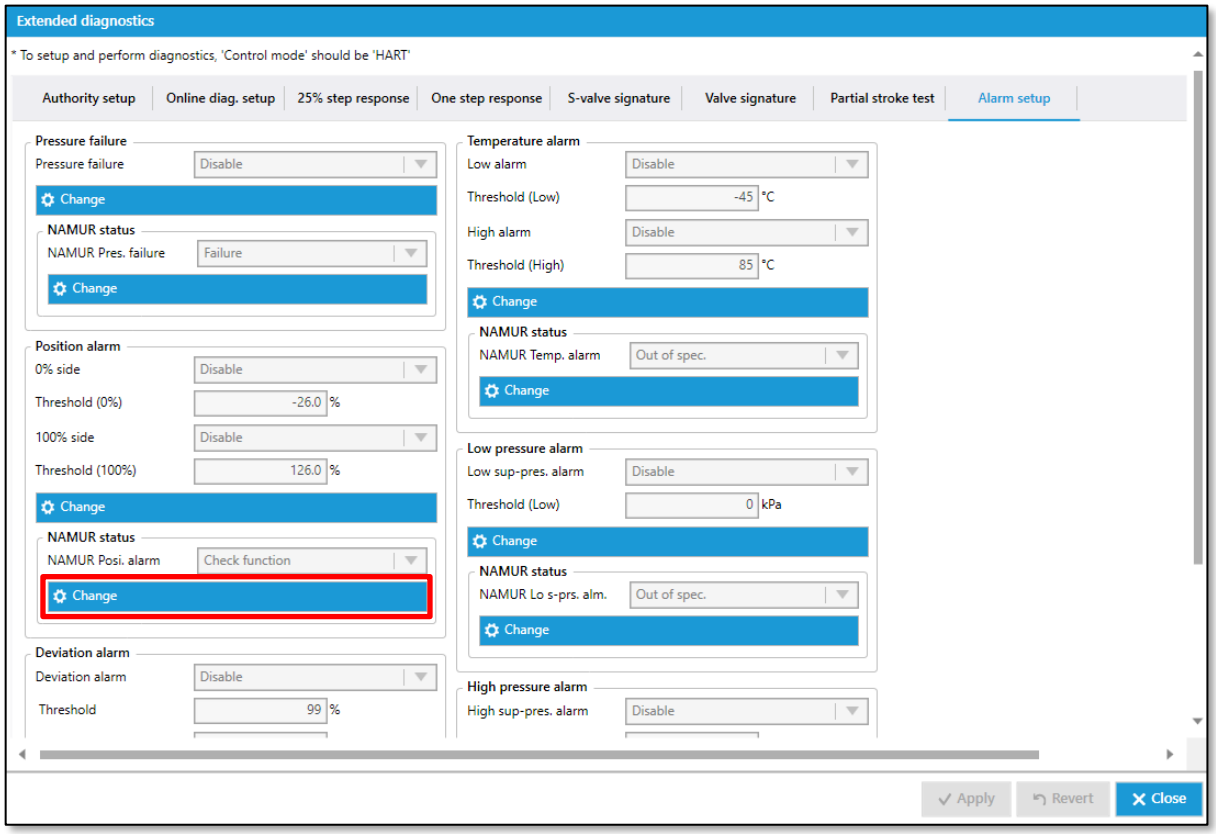
7.8.2. NAMUR status assignment

The NAMUR status classification associated with each alarm can be arbitrarily selected.

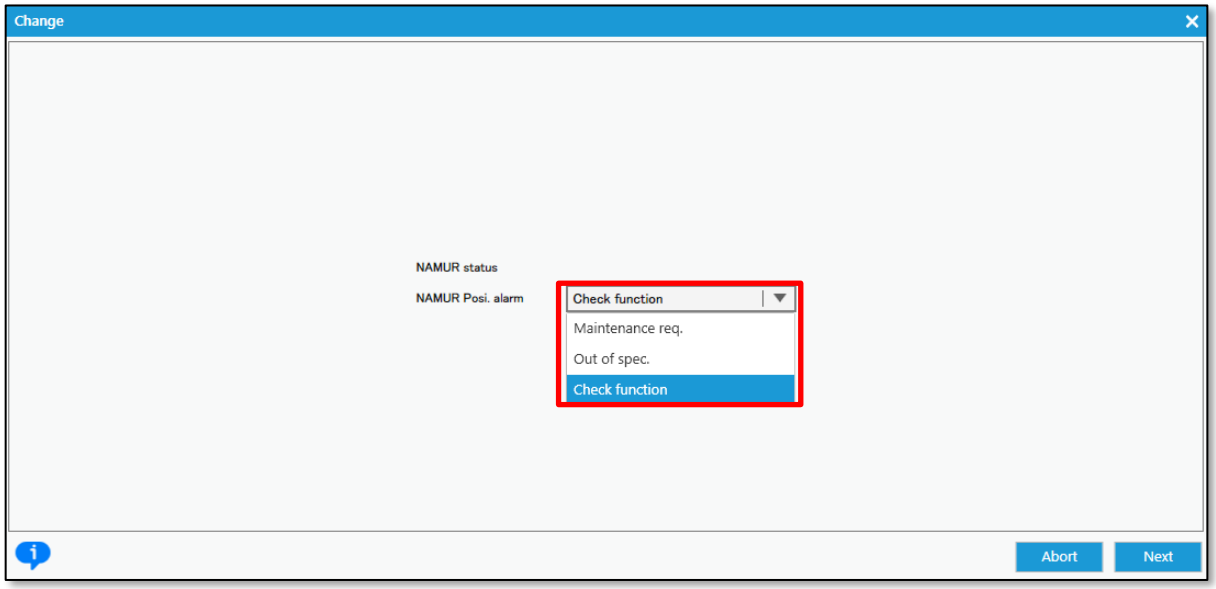
The position alarm is shown below as an example.

MENU) *Diagnostics > Extended diagnostics > Alarm setup*

① Click [Change] for NAMUR Position alarm in the [Position alarm] menu group.



② Select the type of NAMUR status category to be assigned to the Position alarm and click [Next].



The category of NAMUR status that can be selected are as follows.

Maintenance req.	: Maintenance required
Out of spec.	: Out of specification
Check function	: Check function

8. Offline

It is possible to set the settings of the main unit in advance when HART communication is not connected and then change the settings all at once after the connection is established.

※ The names of the menu items for this function vary depending on the FDT host.

Data is updated using the following combinations.

1) Transfer parameters from device to offline data set
2) Update Offline data set
3) Transfer offline data set to device

1) Transfer parameters from device to offline data set

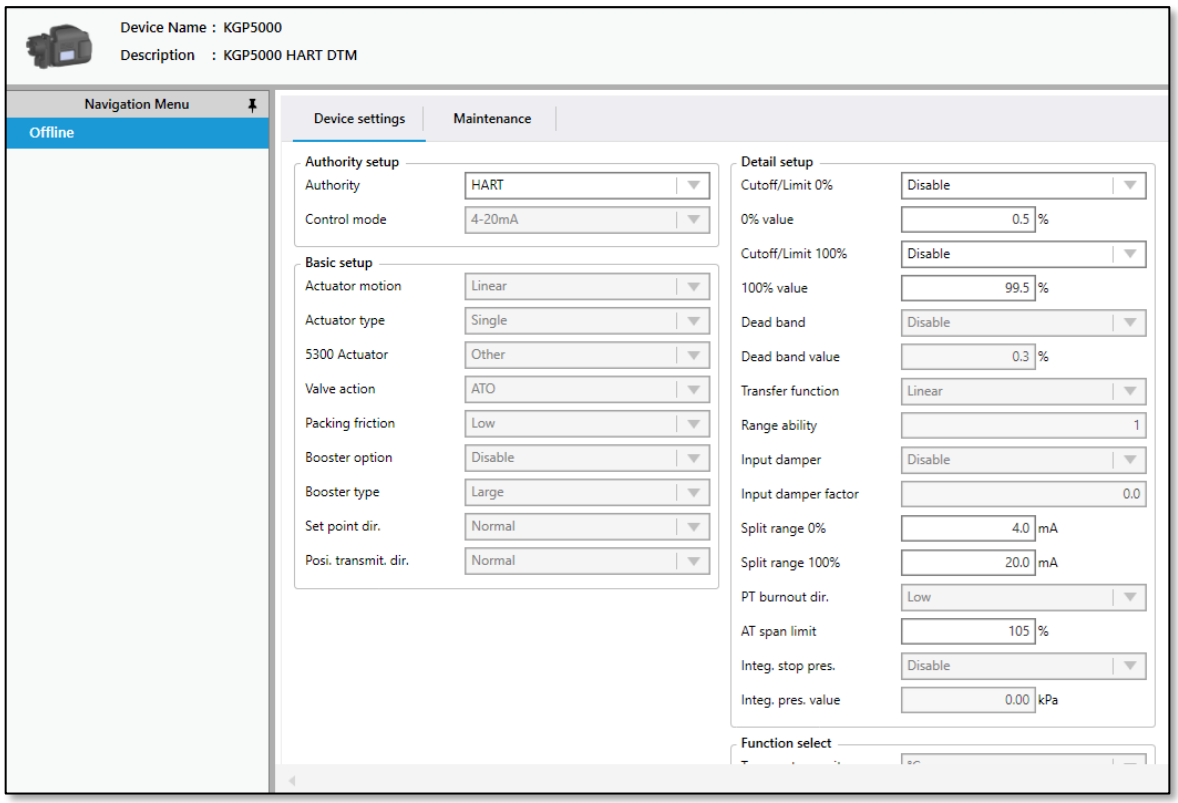
When connected to a device, it reads parameter data from the device and updates the offline database.

2) Update Offline data set

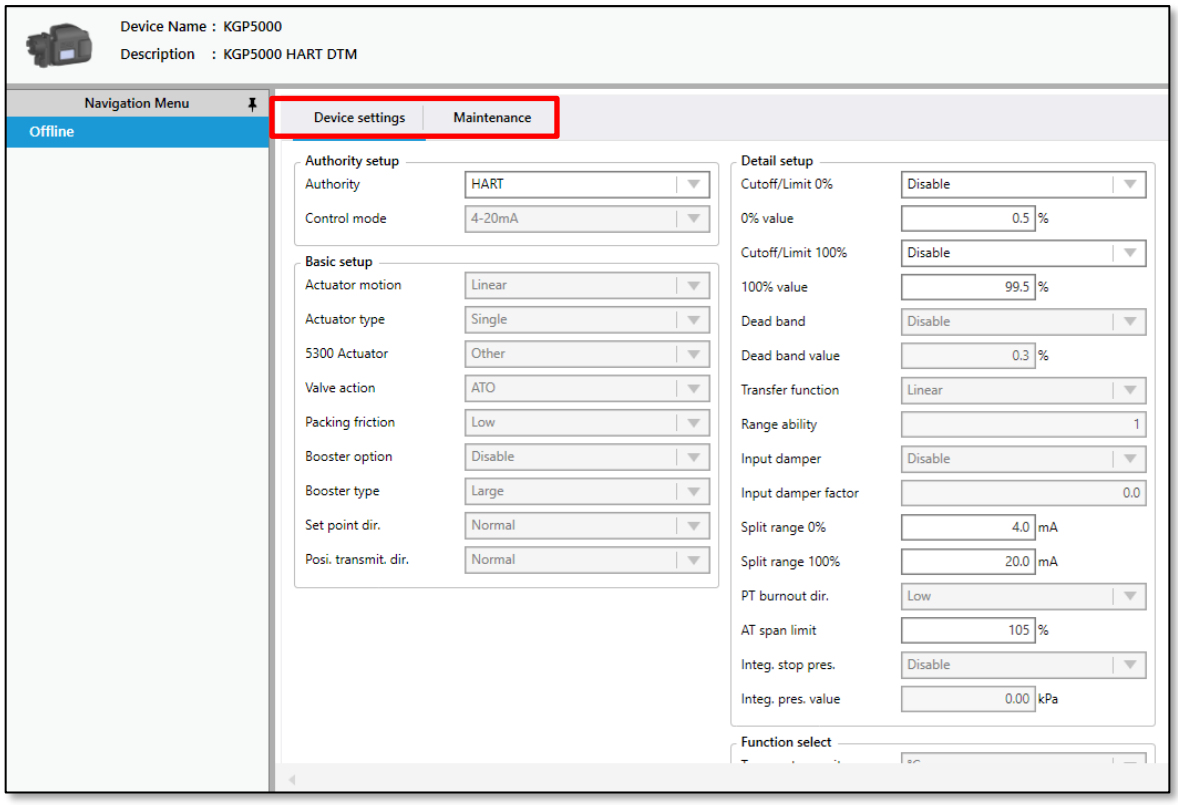
Updates the offline database of parameter data when the device is not connected.
※ This operation does not update the positioner data.

MENU) *Offline*

① Click [Offline] menu in the Navigation menu to open the Offline menu.



The [Device Settings], and [Maintenance] tab menus will open as shown below.

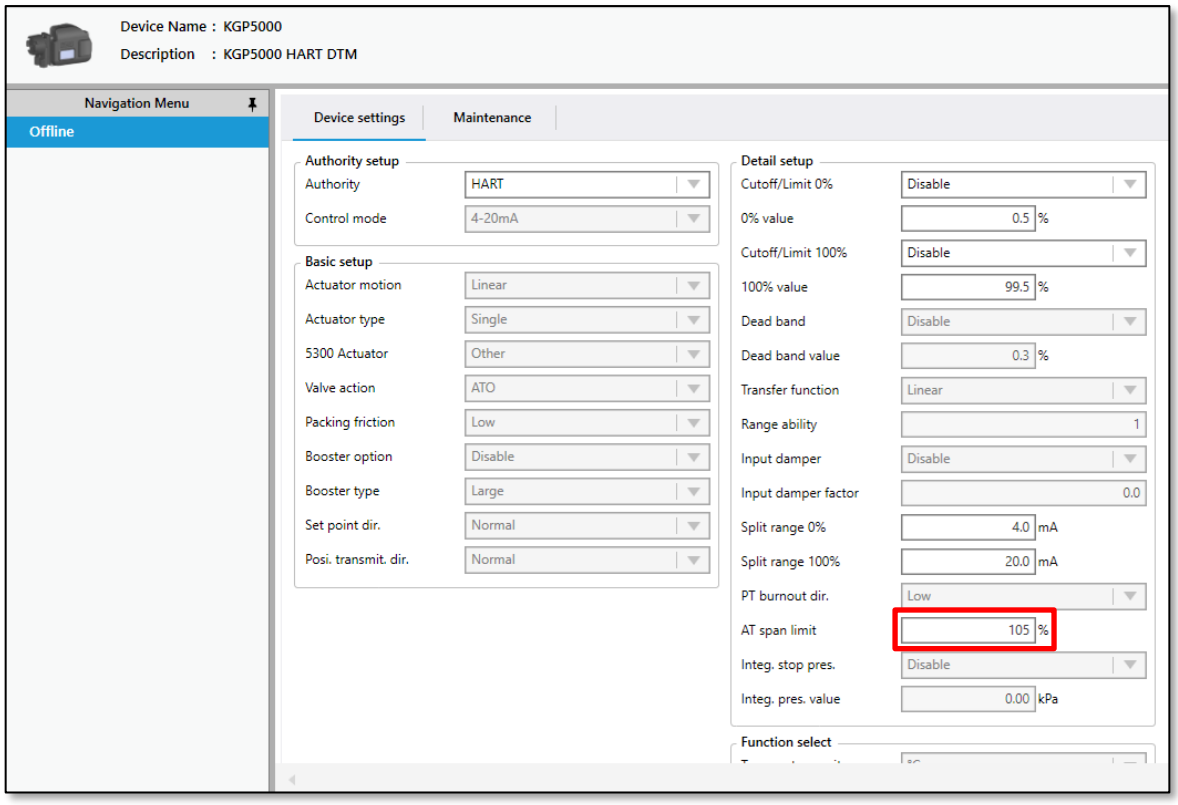


The following shows how to change and update setting values using "AT span limit" in the [Detail setup] menu as an example.

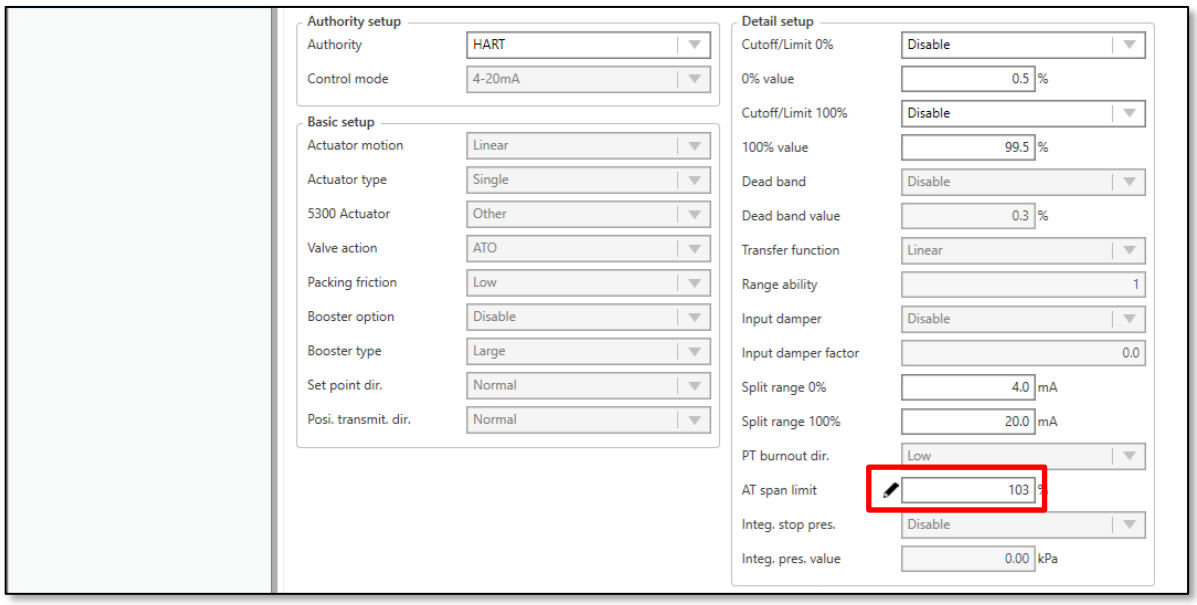
① Click [Device settings] menu tab and open the [Device settings] menu.

② Click▼button of the item “AT span limit” in the [Detail setup] menu group.

※Greyed out items whose settings cannot be changed.

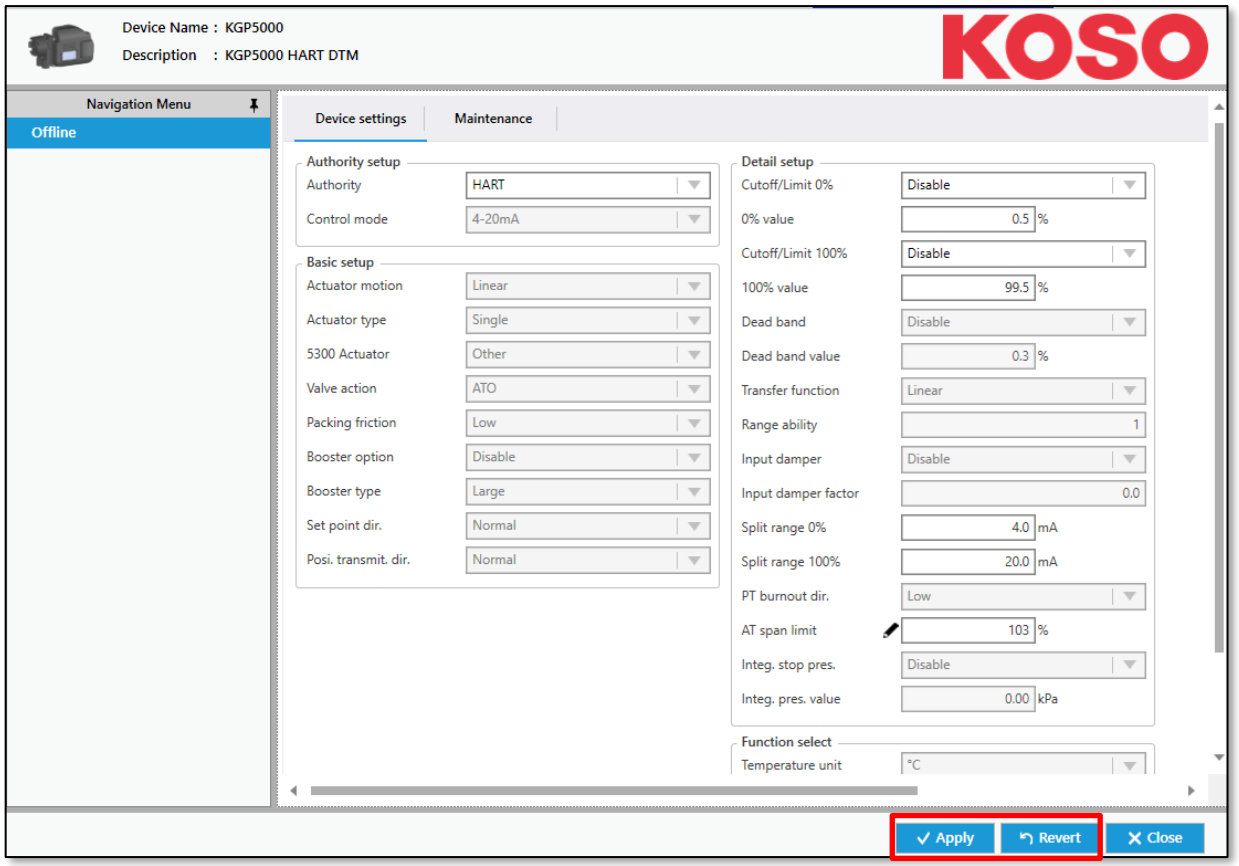


③ Change setting value (set “103”% here).



④ A mark indicating “edited” will be displayed where the settings have been changed.

⑤ Also, the [Apply] button and [Revert] button at the bottom right become active.



If click the [Apply] button, the edited values will be reflected in the offline database.
If click the [Revert] button, the offline database will be restored to the settings before editing.
※ Does not affect the device settings yet.

3) Transfer offline data set to device

When connected to a device, sends the offline database parameter data to the device and rewrites the device data.

Caution

➢ To change the settings, "**Authority**" must be "HART".

※ To perform this operation, must set "HART" to the value in the "**Authority**" field in the [Offline] > [Device settings] > [Authority setup] menu group.

9. Trouble shooting

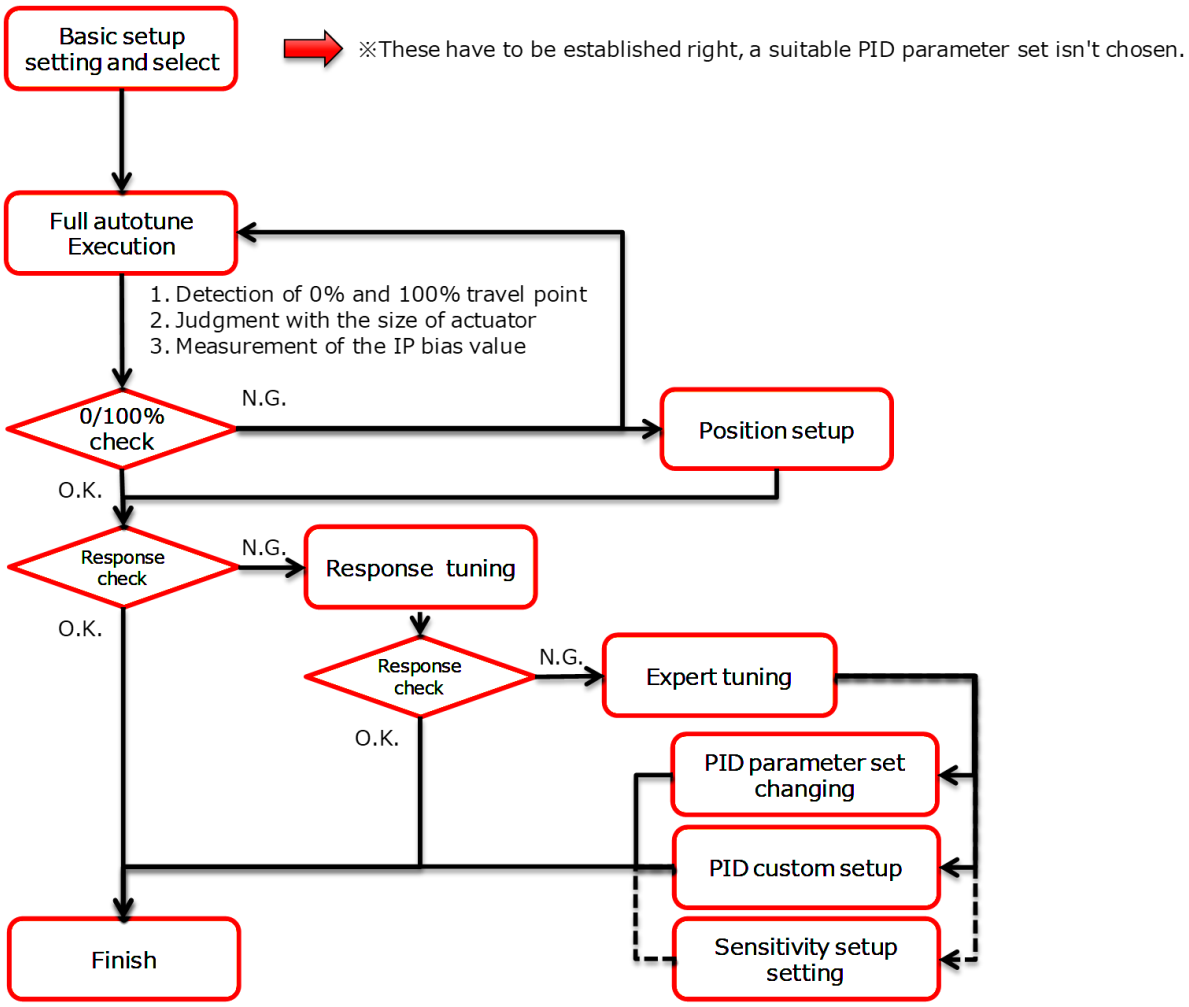
When problems occurred at the operation starting or during operation, please refer to the following table and take an action appropriately.

Table 10. 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

Appendix A. 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.



Appendix B. Error message

If the problems cause during the operations such as 5.3.1. Full autotune, 5.3.2 Position setup, 5.4.2. Custom setting for PID parameter, the following error messages will be displayed, and the performance will be stopped.

Table B.1 List of error messages

Error		内容
Error at closing	Phenomenon	**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	Phenomenon	**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 stopping	Phenomenon	**It does not reach 100% travel position or the steady state.**
	Possible causes	・Valve friction is large and a limit cycle is occurring. ・A limit cycle has occurred due to mechanical backlash such as the tension spring falling off or the screw loosening. ・The appropriate PID parameters are not set.
	Solution	➢ Set dead band ➢ Remove mechanical backlash ➢ After changing the suitable PID parameters, perform the setup of position setup and IP signal bias.
Error at span measurement	Phenomenon	**It does not get correct span. Span is too narrow.**
	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.

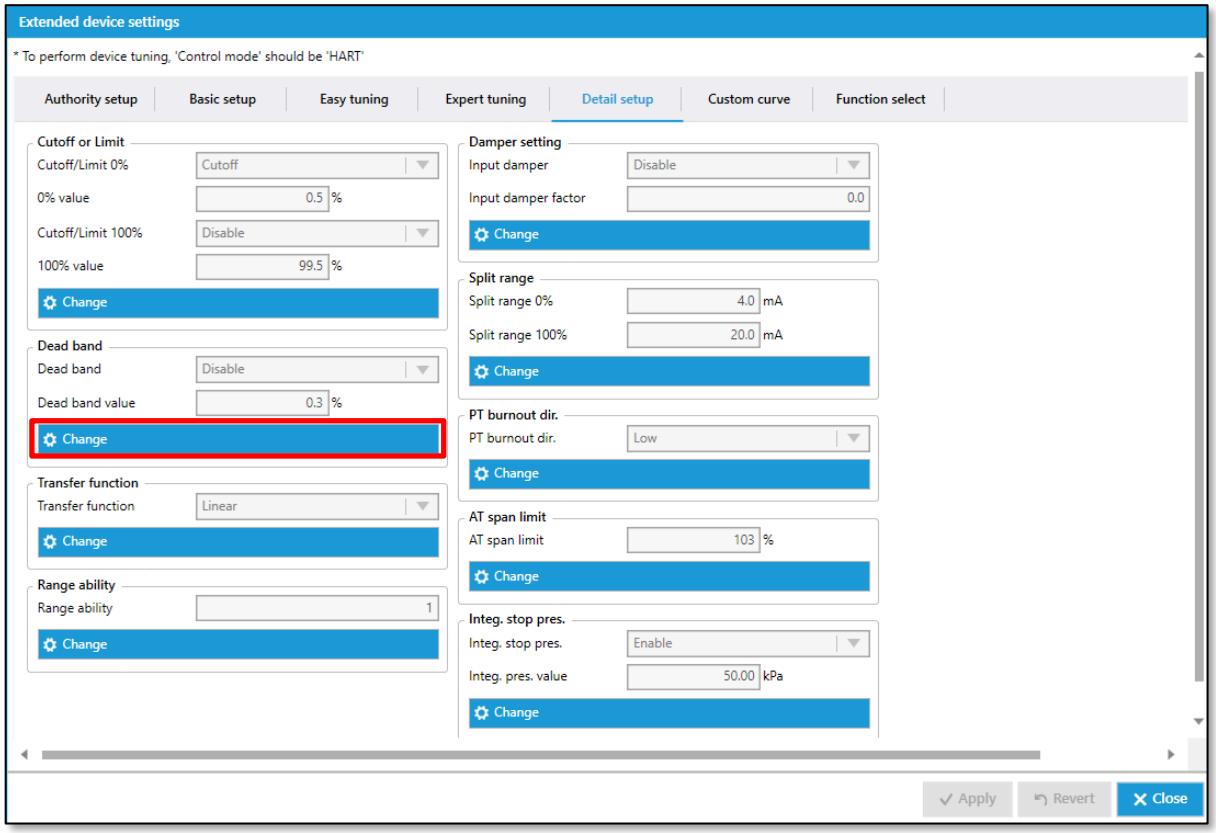
Appendix C. How to change the settings of the menu

An example of how to operate and explain how to set it up.

C-1) Numeric input, list selection type

As an example of how to input numeric values and select a list, show how to change the "Dead band" and change the list and numeric value from the [Device setting] > [Extended device settings] > [Detail setup] menu.

① Confirm current setup value in the [Dead band] menu group. If need to make change, click [Change].

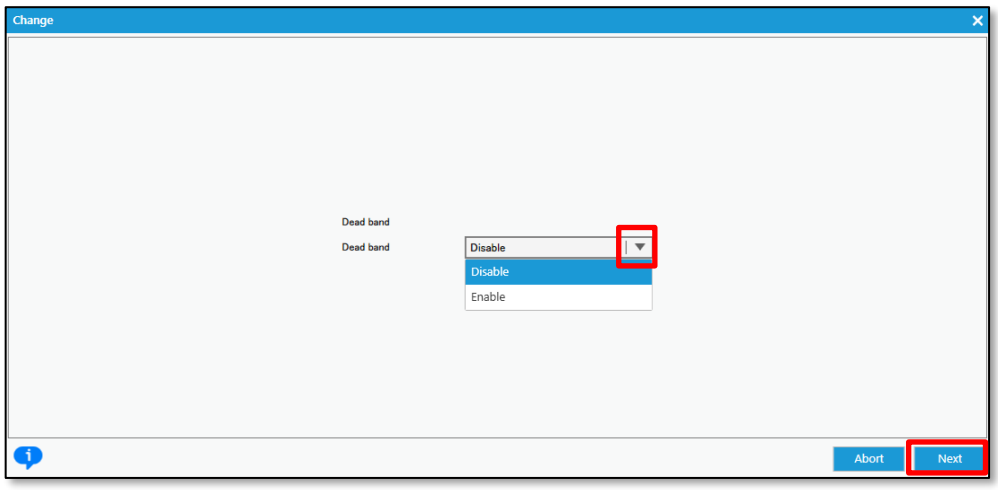


② The setting value input menu will open.

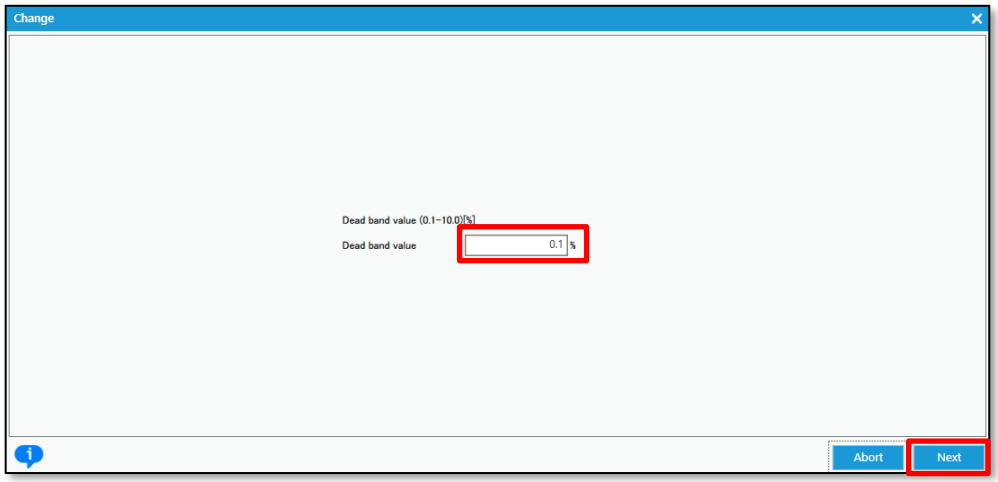
③ Click ▼, select “Enable” in the list (list selection type).

④ Click [Next] to determine ※1

※ If select "Disable", this setting will be determined and the menu will close.



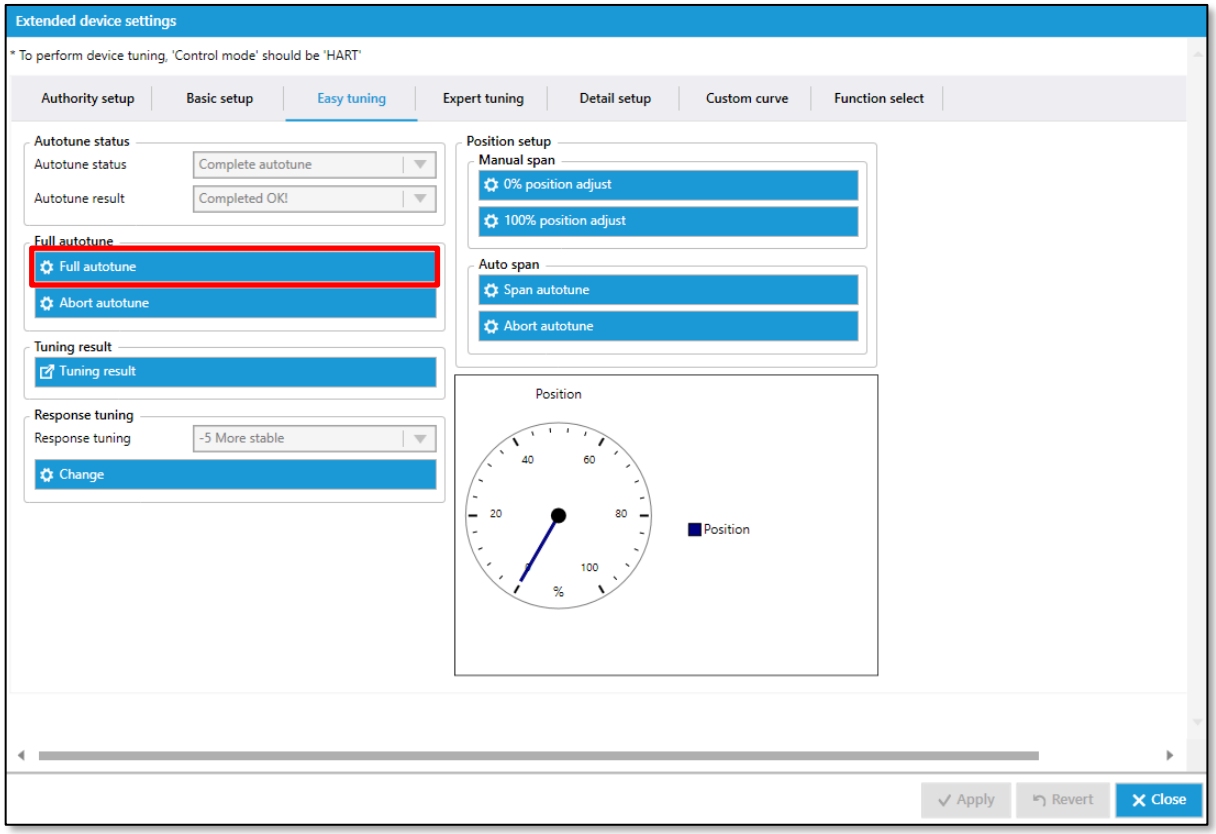
⑤ Next, enter the deadband value in the “Dead band value” field (enter a number type).
※ Enter a value within the displayed valid range (0.1-10.0[%] in this example).
⑥ Click [Next] to determine ※1
⑦ The setting change is complete, and the data is set in the positioner.



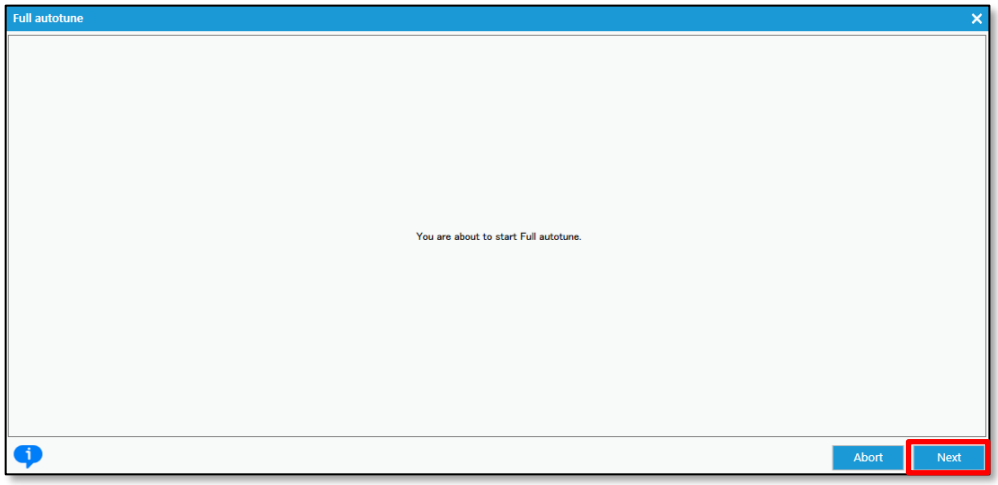
C-2) Execution type

As an example of the execution type operation, show how to perform full auto tuning from the [Device settings] > [Extended device settings] > [Easy tuning] menu.

① Click [Full autotune] in the [Full autotune] menu group.

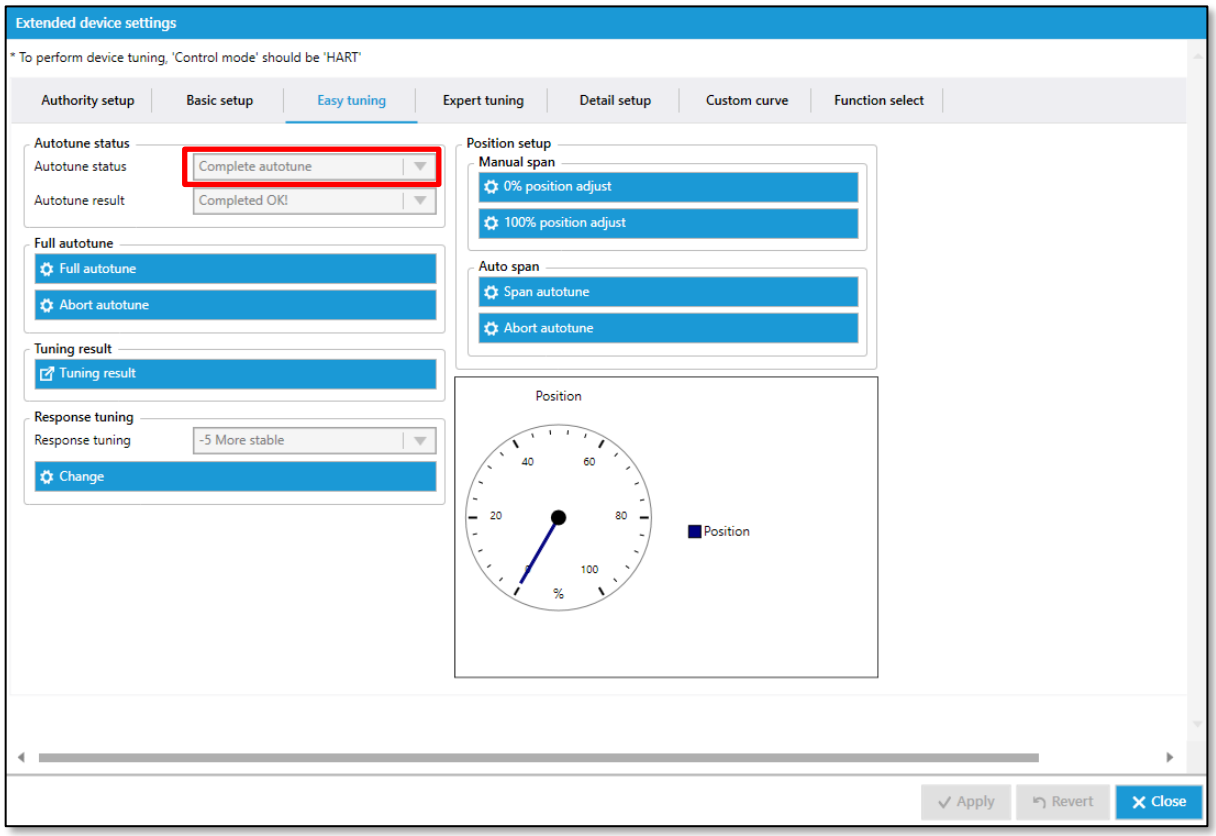


② A confirmation dialog will be displayed, so click [Next].



③ Full autotuning will start on the positioner.

④ Check the progress during execution in the “Autotune status” field. When it becomes “Complete autotune”, full autotune is complete.



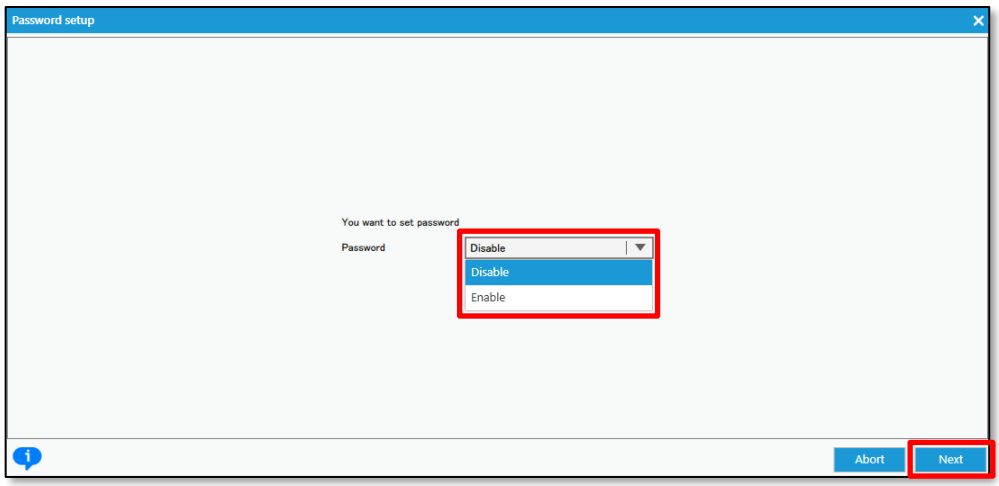
Appendix D. Password setup

This device allows to set a password with a three-digit integer.
If set a password, only be able to access the information on each top menu without entering the password.

① Click [Change] in the [Password setup] menu.

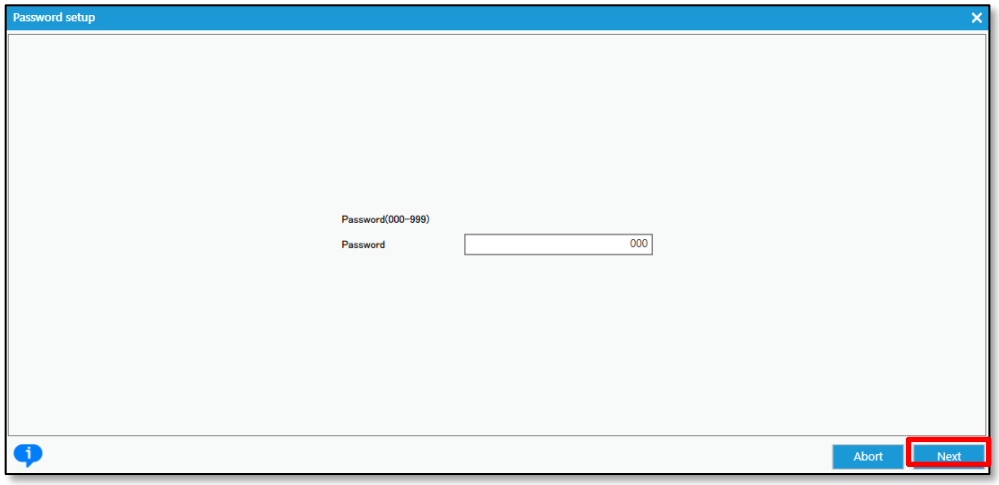
② Select “Enable” to enable the password, or “Disable” to disable the password, then click [Next].

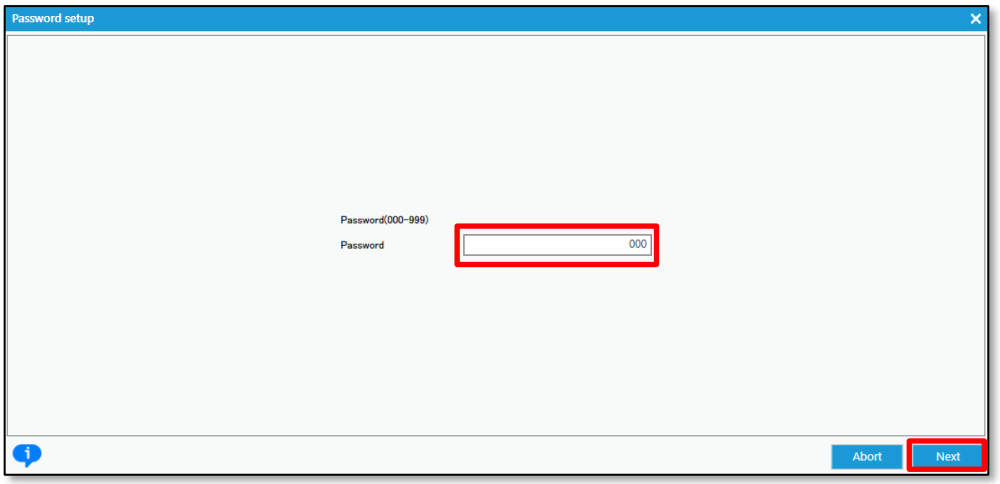
※ If select “Disable”, set this value.



③ If select “Enable”, confirm the message and click [Next]. it.

④ Enter a three-digit password and click [Next] to set.





※ When locked with a password, the settings menu will be locked as shown below, and the menu will not be displayed unless enter the correct password in the [Open protected menu] menu.

Or,

※ The [Open force clear password menu] is a rescue menu if you forget the password. A secret code is required to unlock it, so if you have forgotten the password, please contact the sales office listed on the back of this manual.

■ **WORLD-WIDE NETWORK (Sales, Manufacturing, Services)**

Sales, Manufacturing, Services	TEL	FAX
Nihon KOSO Co., Ltd., Tokyo Japan	Tel. (81) 3-5202-4300	Fax. (81) 3-5202-4301
Paris Office	Tel. (33) 1-73-75-23-1	Fax. (33) 1-73-75-23-1
Moscow Office	Tel. (7) 495-775-8531	Fax. (7) 495-787-2758
Abu Dhabi Branch	Tel. (971) 2-639-06-55	Fax. (971) 2-639-08-89
KOSO M-Mac International Inc., CA, U.S.A.	Tel. (1) 661-942-4499	Fax. (1) 661-942-0999
KOSO America Inc. Boston, U.S.A	Tel. (1) 774-517-5300	Fax. (1) 774-517-5230
REXA Inc. Boston, U.S.A	Tel. (1) 508-584-1199	Fax. (1) 508-584-2525
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KOSO Kent Introl. Ltd., U.K.	Tel. (44) 0-1484-710311	Fax. (44) 0-1484-407407
KOSO Control Engineering (Wuxi) Co., Ltd., China	Tel. (86) 510-85101567	Fax. (86) 510-85122498
Wuxi KOSO Fluid Control Co., Ltd., China	Tel. (86) 510-85585118	Fax. (86) 510-85585119
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Hangzhou Hangyang KOSO P & V Co., Ltd.	Tel. (86) 571-85869508	Fax. (86) 571-85343203
KOSO-AACI (Anshan) Co., Ltd., China	Tel. (86) 412-8812686	Fax. (86) 412-8814582
KOSO Control Instrument (Anshan) Co., Ltd., China	Tel. (86) 412-8829518	Fax. (86) 412-8968860
Korea KOSO Co., Ltd., Seoul, Korea	Tel. (82) 2-539-9011	Fax. (82) 2-566-5119
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
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