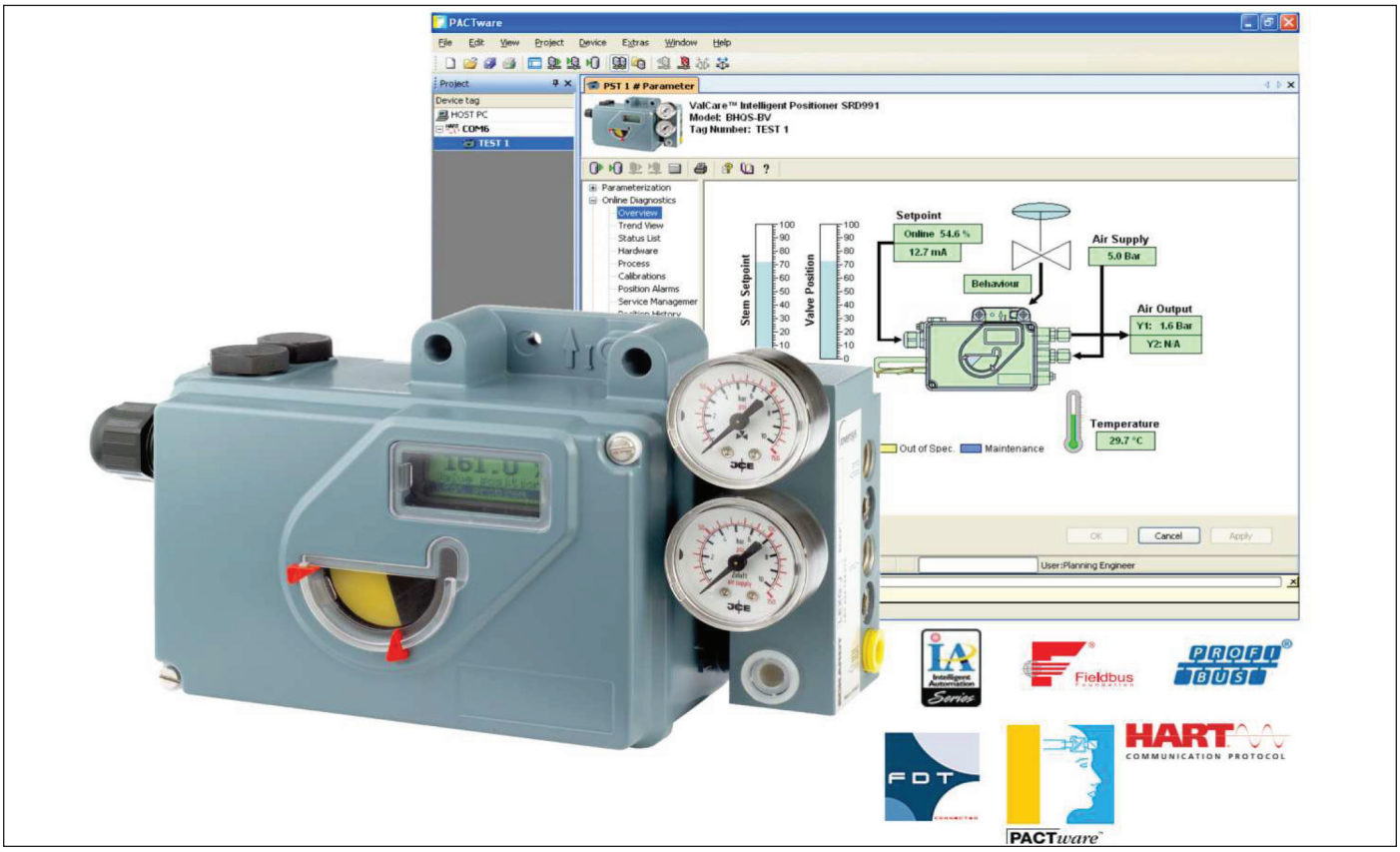
ValCare™ / Valve Monitor DTM for Positioners SRD991 / SRD960



The valve diagnostic softwares **ValCare**™or Valve Monitor are available as Device Type Manager (DTM) for integration into control systems based on the Field Device Tool (FDT) technology such as the Foxboro IA Series System. It is designed to support methods for evaluation of the valve health, operation and configuration. The DTMs support the communication protocols HART, Profibus PA and FOUNDATION Fieldbus (FF).

FEATURES

- Predictive Maintenance capabilities
- Intelligent Alarm Management
- Self-surveillance in accordance with NE107
- Service Management
- Histograms for Valve Position- and Response-History
- Data collected and stored inside positioner memory up to 60 months
- Determination of Valve Friction to prevent leakage and stuck stem
- Online calculation of the Friction every 200ms
- Histogram for Friction-History
- Partial Stroke Test function for ESD applications

CONTENTS

1 INTRODUCTION

The software available as Device Type Manager (DTM) for Field Device Tool (FDT) -compliant PC's or control systems is designed to provide the identical functionality for each Intelligent Positioner, independent of what communication protocol is used. All DTMs have the same look and feel and functionality. The following instruction shows details about the configuration, operation and diagnostics of the Intelligent Positioner.

1.1 Before Starting

The intelligent positioner is designed to operate pneumatic valve actuators. This includes versions with analog setpoint (4 to 20 mA) without communication or with superimposed HART signal; digital with FoxCom protocol, or fieldbus communication according to PROFIBUS-PA and FOUNDATION Fieldbus H1 based on IEC 1158-2 MBP acc. to FISCO. Before connecting electrical power and using the ValCare™ or Valve Monitor software to communicate with and operate the positioner, ensure that:

- All documentation such as the Product Specification Sheets (PSS) and the Master Instructions (MI) is thoroughly reviewed.
- The positioner is mounted on a valve / actuator per requirements of the MI. Of particular importance is the attachment of the feedback lever (linear actuators) or coupling (rotary actuators):
- For linear valves: The arrow on the positioner housing should be pointing towards the flat side of the spindle. When the valve is 50% open, the feedback lever should be approximately perpendicular to the valve yoke. To achieve this and 20 to 45 degree total travel of the feedback lever, choose the suitable mounting holes in the bracket and valve-actuator coupling.
- For rotary valves: The set screw of the coupling is tightened against the spindle's flat side by applying the screw to the hole marked "L" for counter clockwise turning and "R" for clockwise turning operation. Additionally, the arrow on the positioner housing should be pointing towards the one on the coupling at the beginning of the stroke.

Follow this step with the air supply directly connected to the actuator.

- The pneumatic connections, and boosters if used, are connected per MI requirements.
- The hazardous location safety requirements, as covered in the PSS, also need to be followed.

1.2 What is FDT / DTM

The FDT/DTM concept specifies a "frame application" with a uniform platform for software tools and provides the particular advantage of a simple, standardized and common implementation and engineering environment to integrate field devices into any FDT compliant control system.

It defines interfaces and mechanisms which provide a simple method of running a type of "printer driver" for field devices, the Device Type Manager (DTM). DTM describe the field device specific software component. ValCare™ or Valve Monitor are such "drivers" and support the communication protocols HART, Profibus PA, FOUNDATION Fieldbus and FoxCom. FDT supplements the DDL- technology and offers much more, a unified architecture for all devices in a plant. Benefit, the "driver" can be integrated into any FDT compliant control system.

2 INSTALLATION AND FIRST STEPS

2.1 Contents of Valcare™ Software

The ValCare™ -software package includes the following files:

PACTware with:
- PACTware Release 4.0
- ComDTM for the HART-Protocol (by Codewright)

srdinstall with:
- Device-DTM for SRD991 and SRD960 for HART, PROFIBUS and FOUNDATION FIELDBUS

modeminstall with:
- ComDTM for the FoxCom- EDCom- and IRCom-Protocol

Hardware Requirements

A computer with Pentium II 200 MHz processor or better, XGA Graphics and a Microsoft compatible mouse or an equivalent pointing device is recommended. [1]

Disk space requirements:

PACTware……..100 MByte

ComDTM…….40 MByte

DeviceDTM…….55 MByte

Main Memory……..50 MByte.

Software Requirements

PACTware runs under the operating system Windows XP, Windows XP SP1 to SP3, Windows Vista and Windows 7.

To use the print functions and Online Help MS Internet Explorer 4.0 or higher is required.

Windows 95, 98, ME, NT 4.0 and Windows 2000 are not supported by this PACTware release.

About the software

PACTware (Process Automation Configuration Tool) is a program which allows to select communication-capable field devices of different manufacturers from a device catalog and combine them in projects.

In accordance with the **FDT** Specification 1.2 (Field Device Tool Specification), PACTware is used as a frame program for the ValCare™- or any other **Device-DTM** (Device Type Manager). ValCare™ is a full version software for predictive maintenance, diagnosis, configuration and calibration.

Via **ComDTM** (Communication DTM) a communication with the field devices using protocols like e.g. the HART, PROFIBUS, FOUNDATION F. or FoxCom protocol is established.

ValCare™ includes Communication- and Device-DTMs:

	HART	PROFIBUS-PA	FOUNDATION F.	FoxCom / EDCom / IRCom
Communication-DTM	✓	[1])	[2])	✓ [3])
Device DTM				
SRD991	✓	✓	✓	✓
SRD960	✓	✓	✓	✓

[1]) Communication driver distributed by softing

[2]) Communication driver included in FBM

[3]) Communication driver included in modeminstall.exe

Required Modems and Interfaces

HART	HART-Modem (Serial or USB)
PROFIBUS-PA	PROFICard by Softing
FOUNDATION F.	ATFBus by National Instruments
FoxCom	PC10-Modem
EDCOM	EDC82- / EDC83-Modem
IRCOM	IR-Modem (Serial or USB)

How to order

The CD-Rom for the ValCare™ Software-package can be ordered under the No.: **EW 556 932 011**.

Or you can download the ValCare™ Software-package free of charge on our website
http://www.foxboro-eckardt.eu/download/FDT-DTMselector.html

2.2 Installation

The following files are available on the ValCare™ CD-Rom or our website.

If PACTware 4.0 is not yet installed, continue here

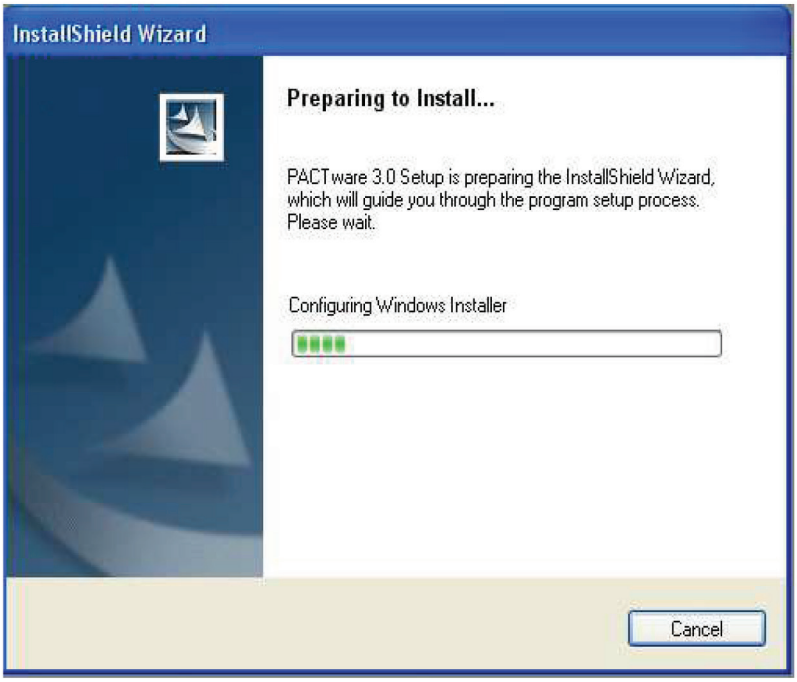
2.2.1 Installation of .net extension

Under Windows XP/Vista/7 Administrator Rights are required.
Before you install PACTware to the computer, close all running programs.
In addition, the **.net** Runtime Environment Version 2.0 must be installed on your PC before installing PACTware.

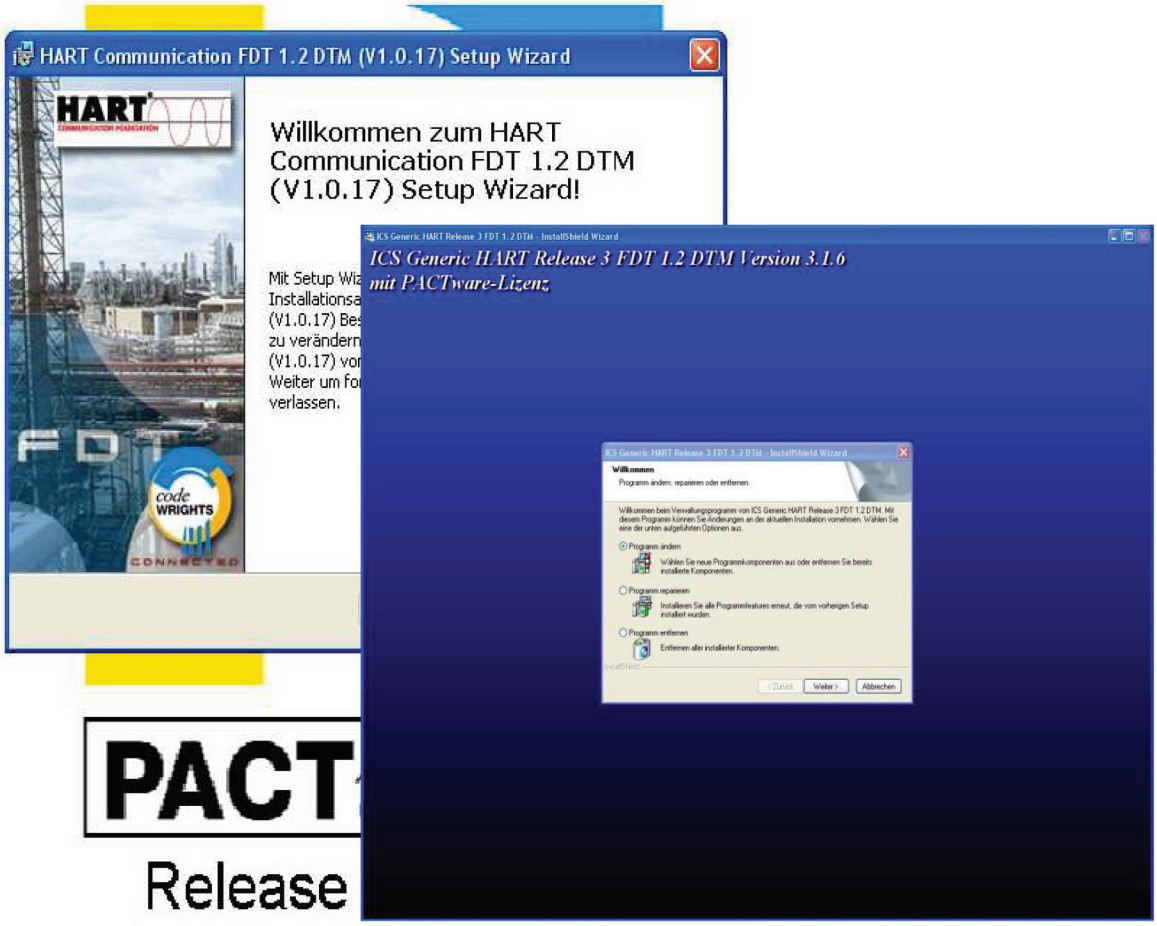
2.2.2 Installation of PACTware

After that continue installation of **PACTware** is started by executing **setup.exe**. After selecting the installation language and confirming the license agreement either the complete or the user-defined setup must be chosen.

The user-defined setup allows to specify a target directory for **PACTware** and to exclude some components from the installation.



The setup wizard will guide you through the installation.



If PACTware 4.0 is already installed, continue here

2.2.3 Installation of Comm-DTM

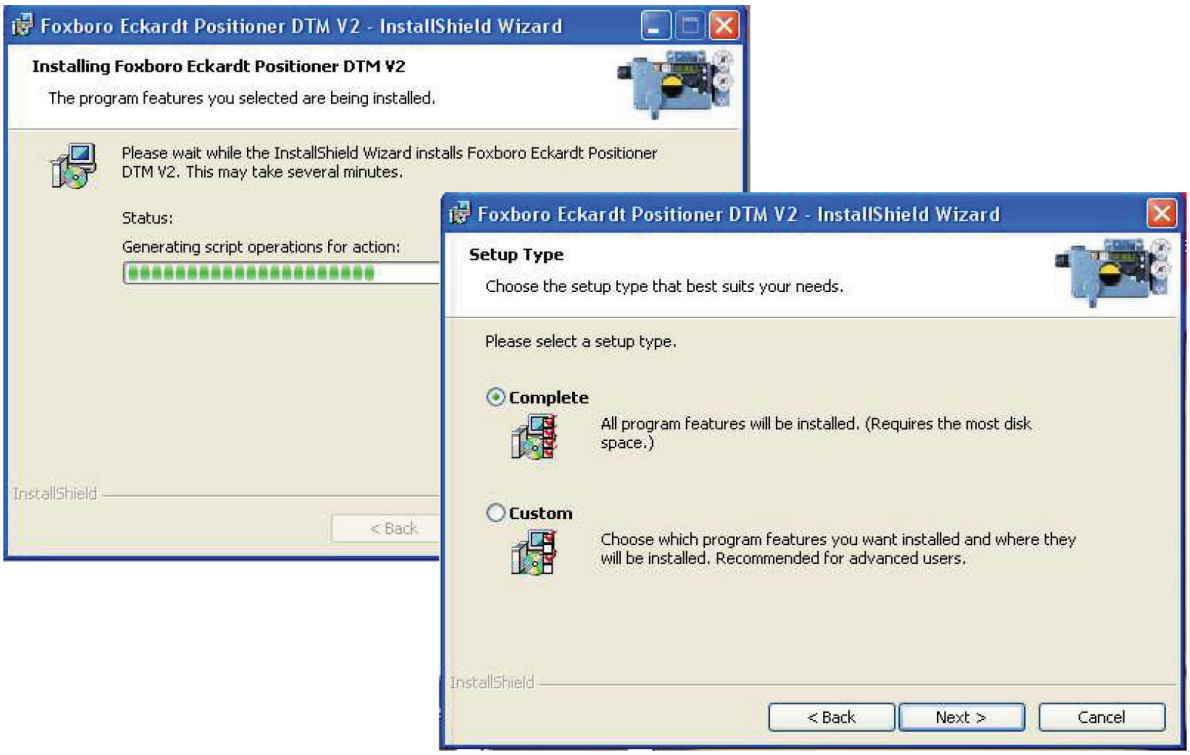
The installation of the **FoxCom-, EDCom-** and **IRCom-Device-DTM** is started by executing **modeminstall.exe**. After confirming the license agreement either the complete or the user-defined setup must be chosen.

The setup wizard will guide you through the installation.

2.2.4 Installation of SRD-DTM

The installation of the **SRD Device-DTM** is started by executing **srdinstall.exe**. After confirming the license agreement either the complete or the user-defined setup must be chosen.

We recommend using the "***Complete***" setup.



After selecting the setup type, the Foxboro DTM install shield will open.

After completion of the setup, the install shield will close automatically.

2.3 Starting PACTware

To start **PACTware**, execute the ***PACTware 4.0*** icon on your desktop.

The **PACTware Login** window will open.

To initially access the software you need to enter the User and the default Password.
Default settings:

User	Administrator
Password	**manager**

User Administration

To change the password, go to Extras → User Administration → change password

The Password Administrator will open

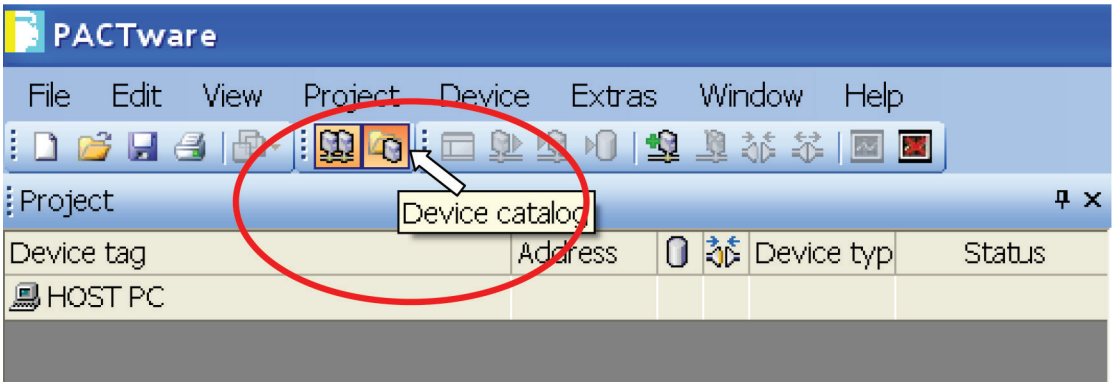
Password Administrator

We recommend not to use a password, by entering a blank in each window and then confirm with OK.

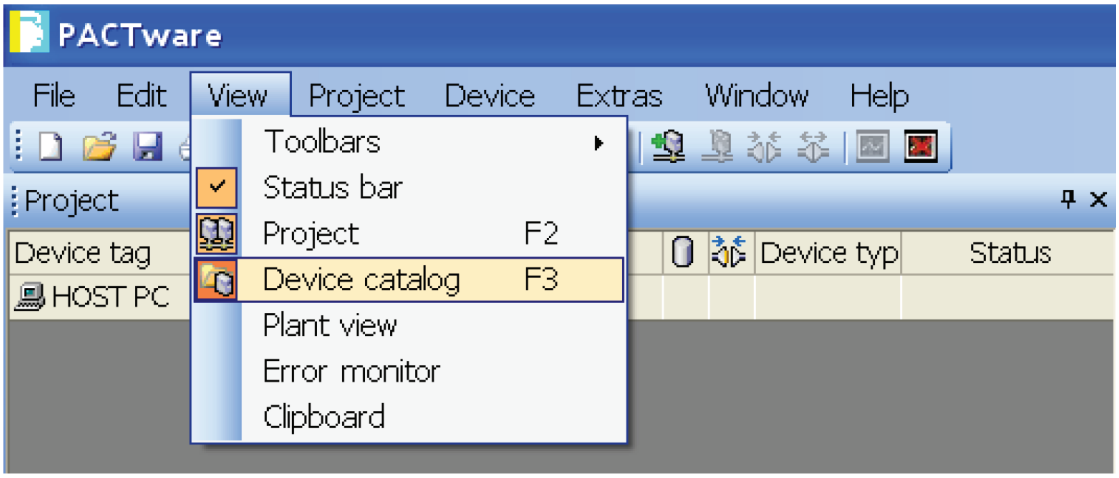
This enables each operator to access the above PACTware Login by just confirming with OK, without entering any password.

After initial installation of the Comm-DTM and SRD-DTM we recommend to “**Update the device catalog**” first, before opening a project.

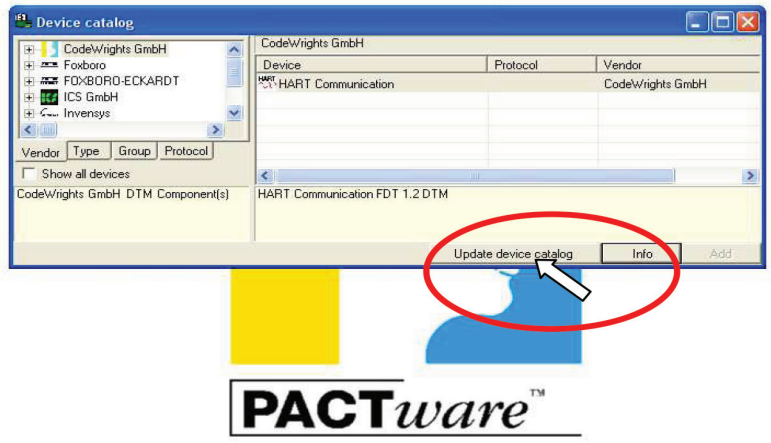
Execute the button for the Device catalog.



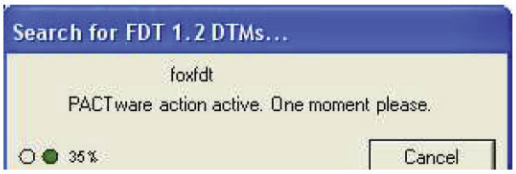
or



Then execute the button for “Update device catalog”.



The following window will appear and scroll through all device drivers (foxfdt…), to ensure that the drivers are updated.

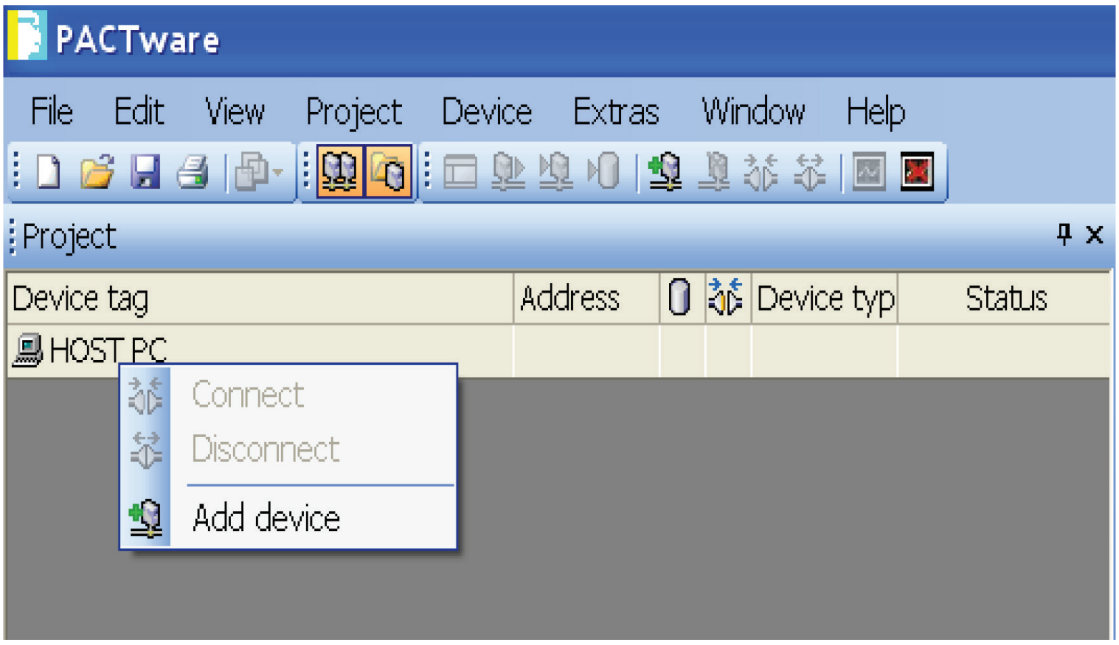


After the update a project can be opened.

2.4 Opening a project

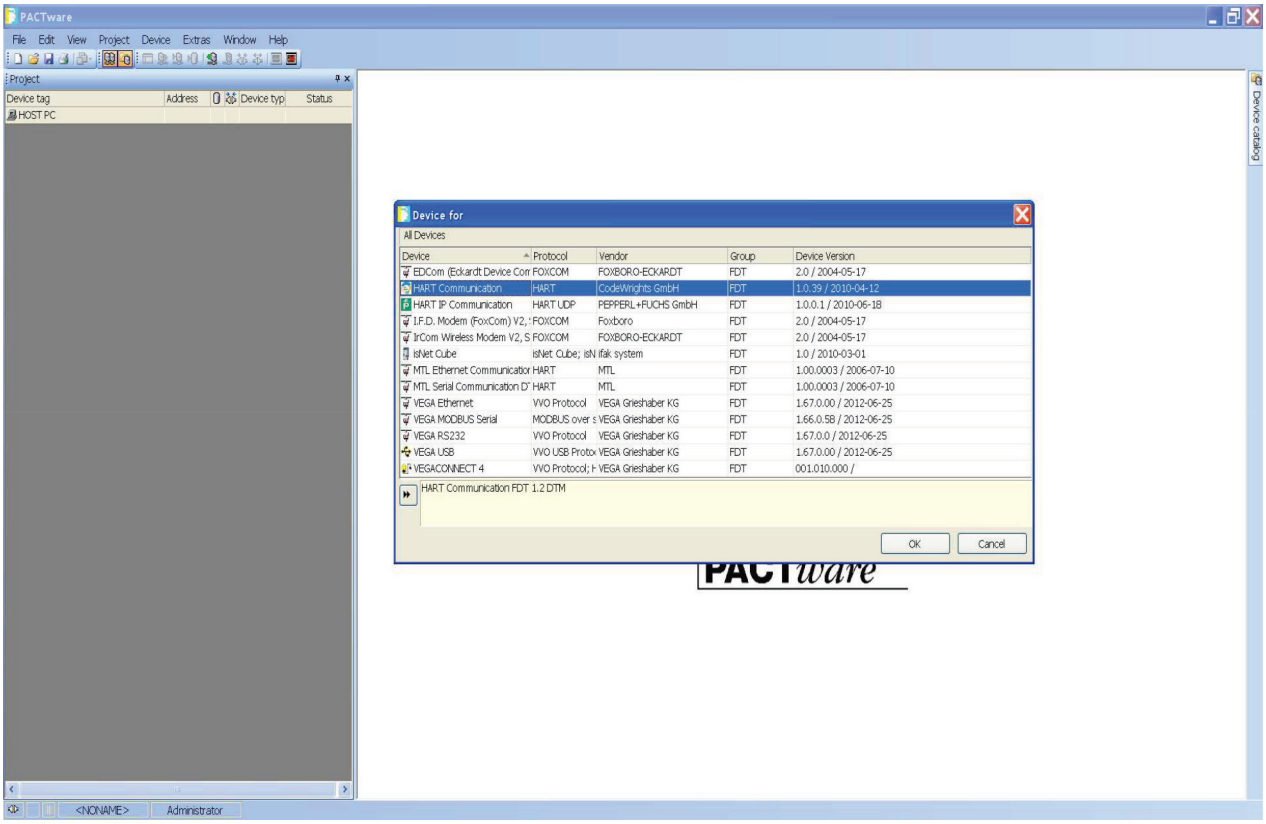
2.4.1 Start PACTware

Click right on HOST PC and “Add device”



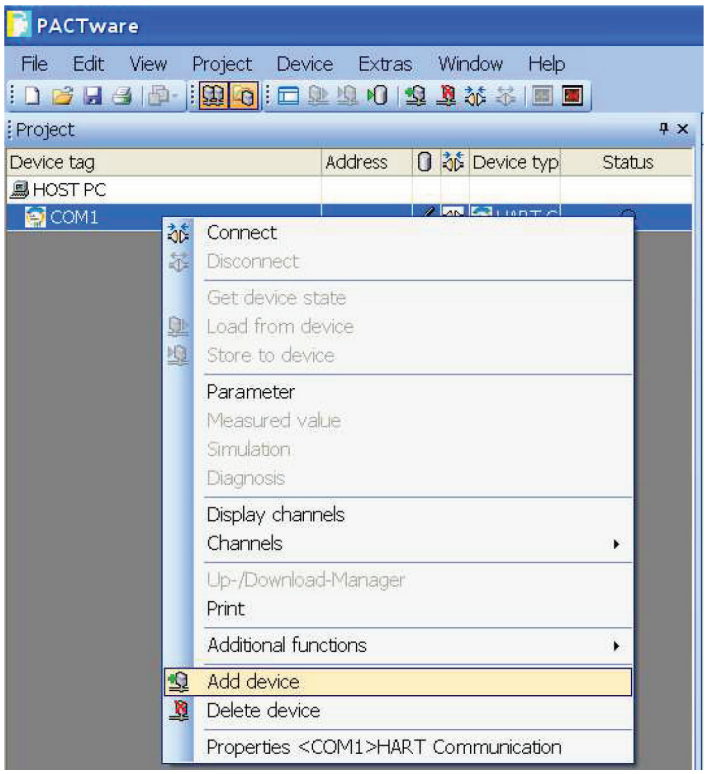
2.4.2 Add a communication driver to the HOST PC

Choose the driver

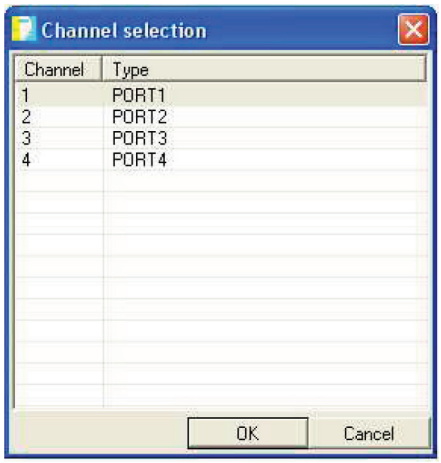


2.4 .3 Add an device-DTM to the communication-DTM

Click right on the driver and “Add device”



2.4.3.1 Selecting the port / channel



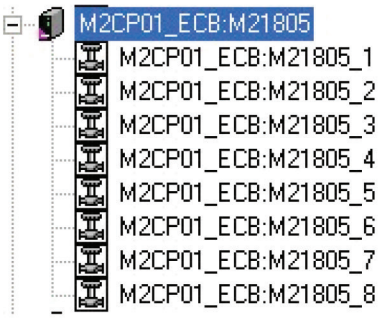
After adding the communication driver you need to address a ***PORT*** or channel.

If you are running ***PACTware*** e.g. on a PC the PORTs are respective to your COM-Ports. In this case the standard Serial Port might be COM1 = PORT1.

If you are running PACTware e.g. on the Foxboro I/A™ Series System in connection with a FBM215 for 8 HART outputs, you will see each individual channel of the FBM.

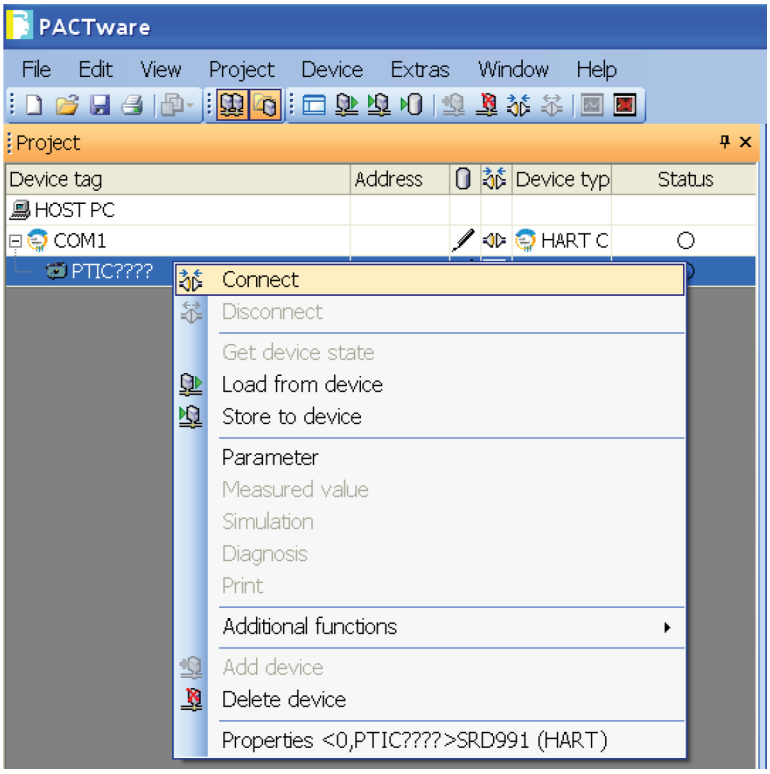
The displayed example represents the 8 channels (CHAN1…8) of a Field Bus Module (FBM) connected to a Control Processor (CP).

After browsing the channels of the individual FBM you will be able to assign a field device to each I/O.

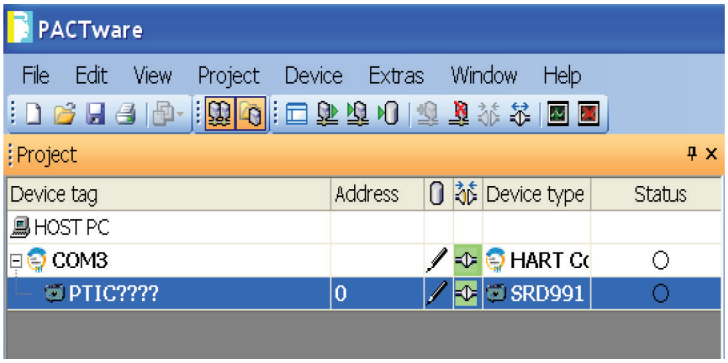


2.4.4 Connect the device

Click right on the device and “Connect”

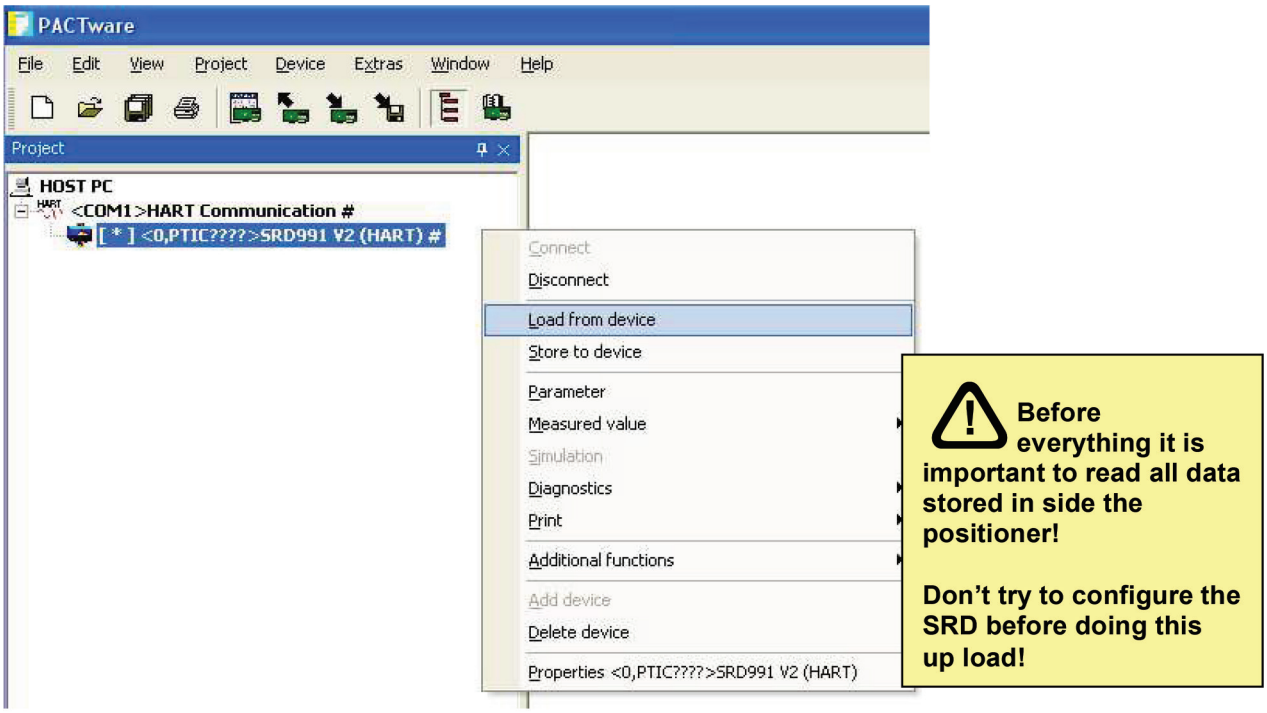


The “drivers” are succesfully connected when the lines turns bold and the connection signs turn green.

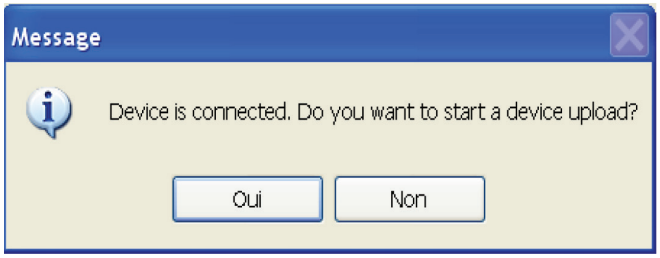


2.4.5 Load data from device

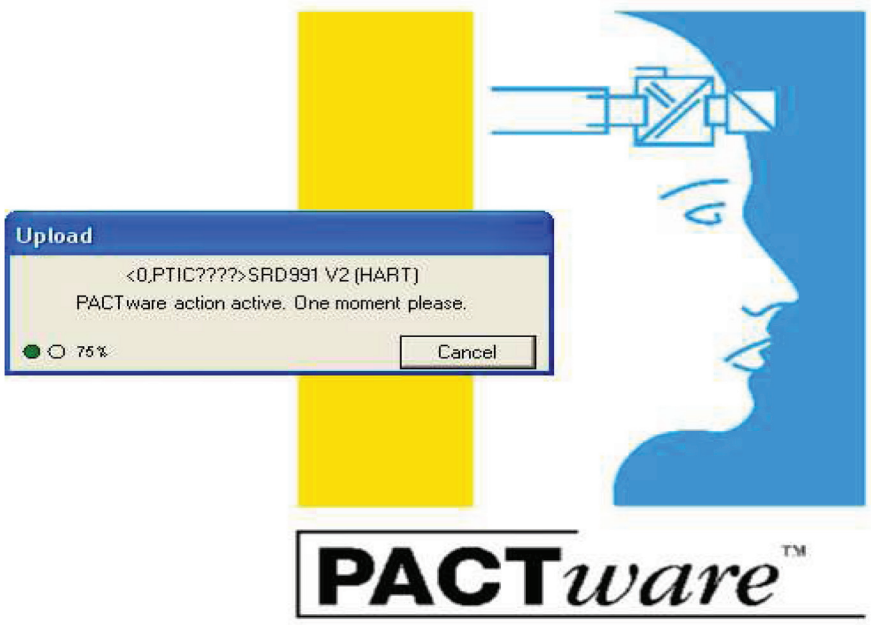
Before Pactware 4.0, load the data from the device.



Pactware 4.0 and after, you automatically get a windows asking for the upload

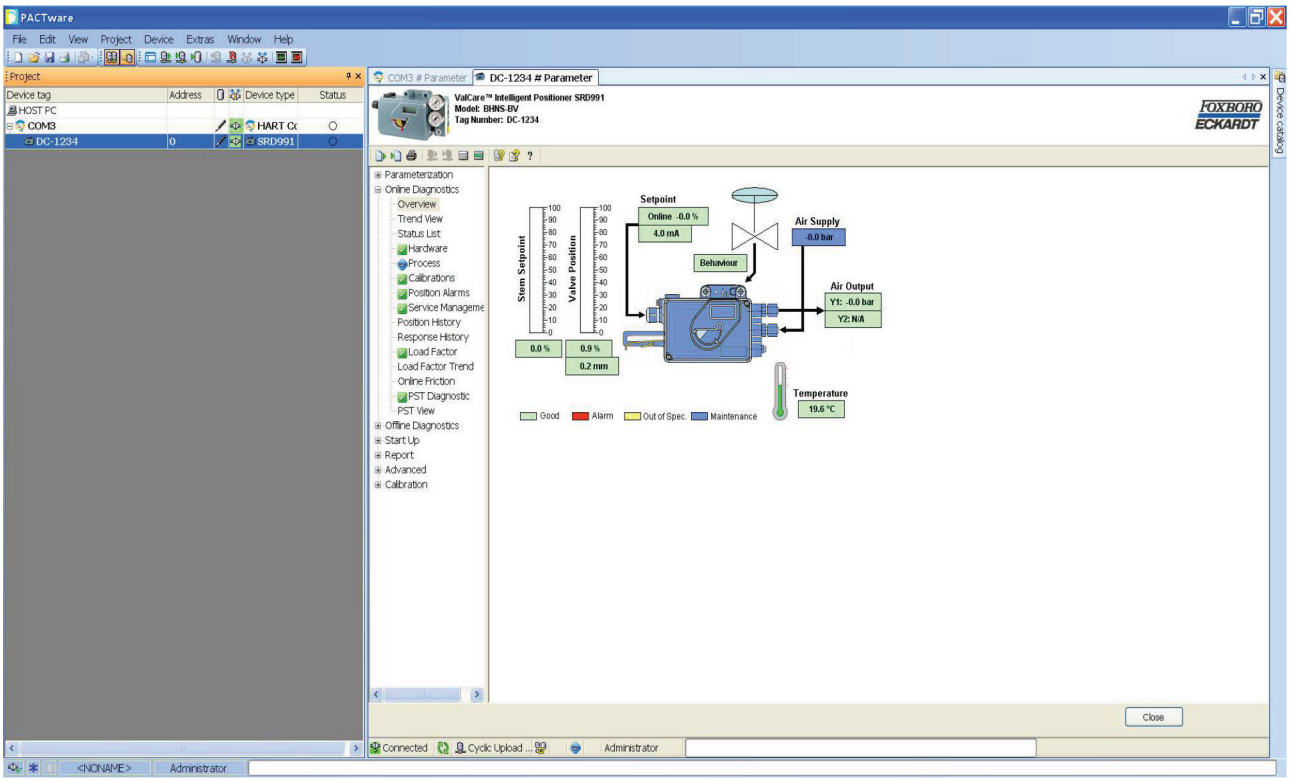


2.4.6 A progress bar indicates that the data is loaded from the device



2.4.7 The Project is now active

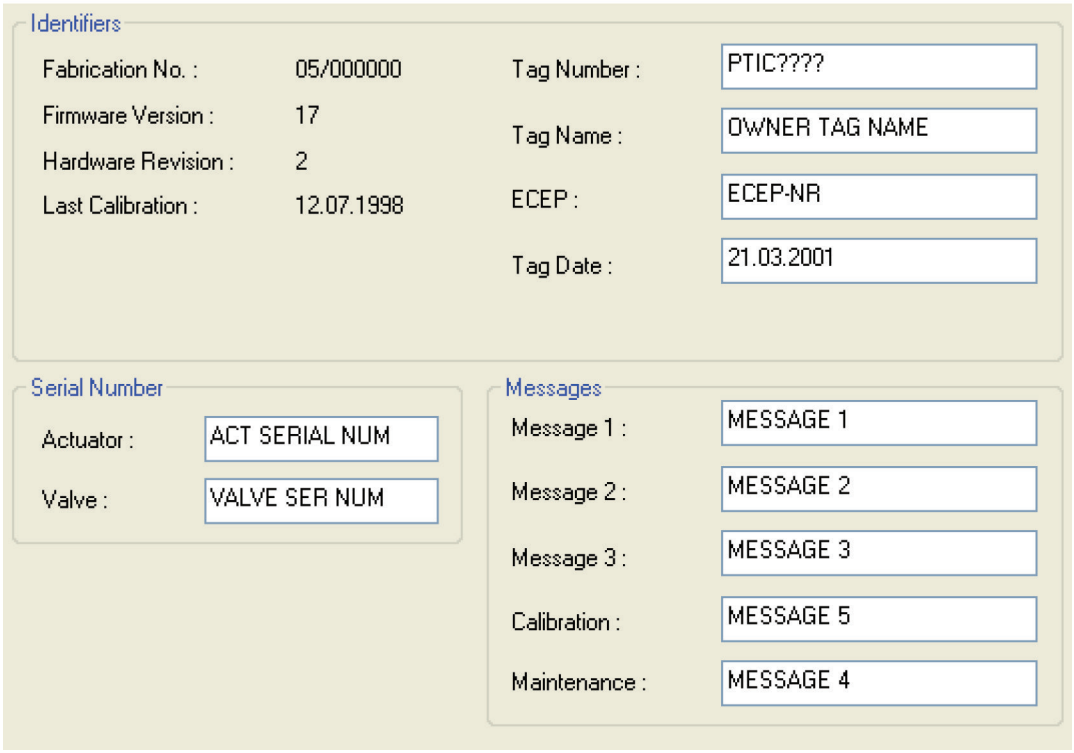
Double-click on the device to access to the homepage.



3 DTM FEATURES

3.1 PARAMETRIZATION

3.1.1 Identification page



The **Parameterization** page displays the identifiers and basic information of the SRD991. The data on the top half of the page shows the factory configured ID-information of the SRD991, including the Fabrication Number ***(Fab. Number)***, ***Firmware Version, Hardware-revision*** and the ***Last Calibration***. All white fields can be changed, such as ***Tag Number, Tag Name, ECEP*** and ***Tag Date***.

The second half of the **Parameterization** page is provided for filling in the necessary reference information, comments and notes. All white fields can be changed, such as ***Message 1, Message 2, Message 3,*** **Calibration Information**, ***Maintenance Information*** as well as the ***Serial numbers for the actuator and the valve***.

Device

This is a single-byte field that contains the positioner's model code. For the SRD991, this must always be 36 decimal, and the value is set at the factory. That code identifies the positioner to all possible hosts as a SRD991.

Since SRD991 positioner only responds to secure commands, a 5-byte Device ID is read during the initial handshake. All other communications are done with this Device ID used to insure that only the correct device responds to the particular request. This ID includes 5 bytes defined as follows:

- Device's Serial Number (2 bytes)
- Device's Julian Date of Manufacture (2 bytes)
- Device (1 byte)

Serial Number
This is a two-byte field that forms the first part of the Device ID.

Positioners only respond to secure commands. This means that after the initial handshake is passed, everything else will calculate a CRC based on the 5 byte Device ID that was read earlier. This ID includes 5 bytes defined as follows:

- Device's Serial Number (2 bytes)
- Device's Julian Date of Manufacture (2 bytes)
- Device (1 byte)

Fabrication Number
This is a 4-byte number that is permanently set at the factory. It is the unique positioner fabrication number and can be used to ferry information back to the factory about issues with the positioner in the field. It is used for tracking the positioner.

Firmware Revision
The two-byte field, firmware revision, is initialized at the factory on fabrication. It consists of two parts, the major revision number and the minor revision number. For example, it might read v1.108, where the major number is 1 and the minor is 108. Any bug reports should include this version number for quicker response.

Hardware Revision
This single byte field is pre-set at the factory to show the revision of the electronics within the positioner. It is currently set to zero. (That is, Revision 0 electronics).

Date of Manufacture
Positioners only respond to secure commands. This means that after the initial handshake is passed, everything else will calculate a CRC based on the 5 byte Device ID that was read earlier. This ID includes 5 bytes defined as follows:

- Device's Serial Number (2 bytes)
- Device's Julian Date of Manufacture (2 bytes)
- Device (1 byte)

On fabrication, the date of manufacture is initialized. While the date is entered in normal form, 15-May-97, it is converted into a two-byte field inside the positioner.

Last Calibration
This field allows the user to track the last date of calibration of the intelligent device. Used in conjunction with the calibration information field, it provides ample space to record the latest data so that future maintenance can be planned and work can be checked. It accepts dates in the normal format, 15-May-97, and converts them to a packed two-byte field:

The Calibration Date is initially set at the factory during the positioner build, prior to shipping.

Tag Number / Tag Name
This field allows the user to identify the device.

ECEP Number
The ECEP number is special construction number. It encompasses up to 16 characters.

Instrument Model Number
The instrument model number is factory preset and not changeable. It encompasses 14 characters maximum.

Actuator Model Number
The positioner may be mounted on a different actuator in the field, so the actuator model or serial number is user definable. Up to 14 characters may be entered.

Valve Model Number

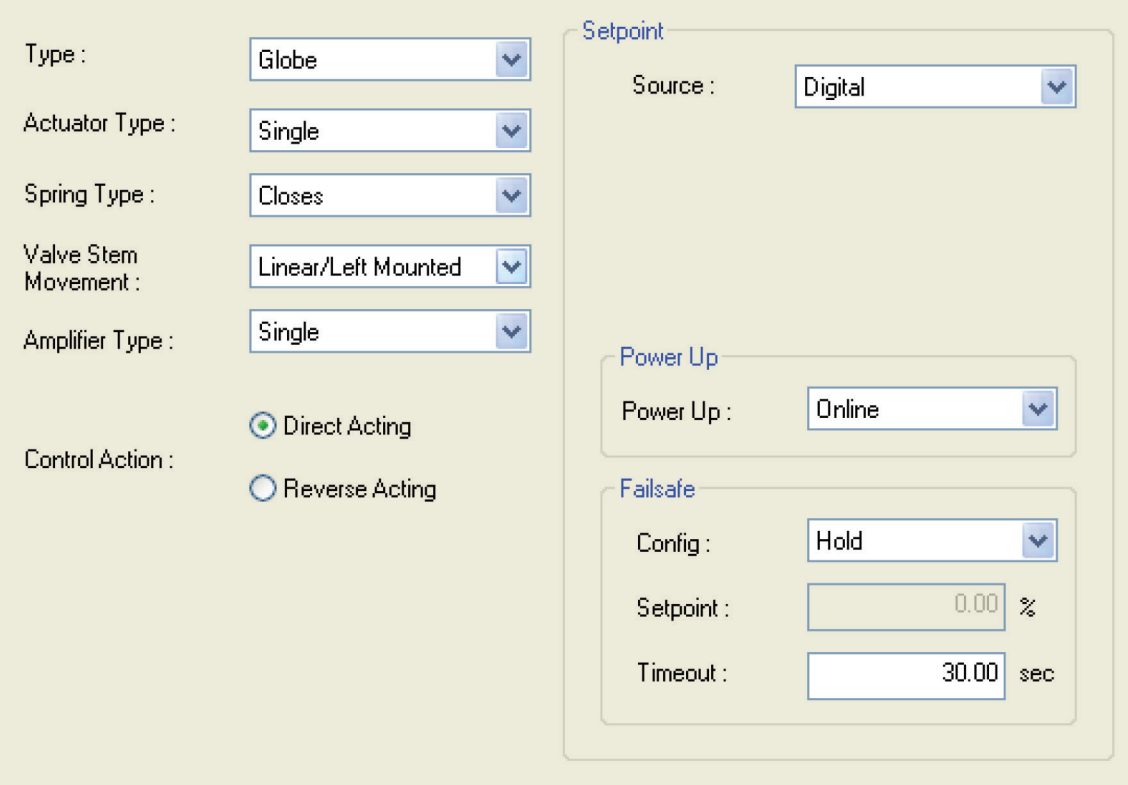
The positioner may be mounted on a different valve in the field, so the valve model or serial number is user definable. Up to 14 characters may be entered.

Scratch Message 1, 2, 3
This is a 14-byte field that is a pure scratch area. It is initialized to “Message 1/2/3” and the user can write anything at all into it. It is intended for a short note that needs to be written into the positioner EPROM.

Maintenance Information
This is a 14-byte field that is a pure scratch area. It is initialized to “Message 4” and it is user definable. It is intended for a short note that needs to be written into the positioner EPROM that reflects when and who did the last maintenance on the positioner.

Calibration Information
This is a 14-byte field that is a pure scratch area. It is initialized to “Message 5” and it is user definable. It is intended for a short note that needs to be written into the positioner EPROM that reflects when and who did the last calibration on the positioner. When a calibration is requested from the software, this field automatically opens-up to allow the user to enter data.

3.1.2 Configuration Page



Unless the configuration parameters are to be downloaded from an existing file, information relevant to the control valve needs to be entered by the user in configuring the positioner.
A typical configuration of a new positioner will include the following steps:

- Go to the navigation tree and select **Parameterization** page.
- Fill the necessary tag and location information in the **Parameterization** page. Note that some device specific information such as serial number and firmware revision, etc. is directly uploaded from the positioner.
- Fill in the necessary reference information, comments and notes in the **Parameterization** page. Again, positioner model code and fabrication number will be directly uploaded.
- The **Configuration** page includes information about the valve ***Type, Power Up Function*** (Only for Digital), ***Actuator Type, Spring Type, Valve Stem Movement / Mounting, Amplifier Type, Control Action, Setpoint Source*** and ***Fail Safe*** configurations.
  - Choose the proper valve ***Type***. Note that this field is only for information and does not impact the positioner's dynamic control behavior.
  - Five types are defined: ***Globe, Rotary, Plug, Butterfly, Ball,*** and ***Diaphragm.*** "Globe" is the default.
  - For Digital input, set the ***Power up*** mode to either ***On-line or Fail safe.*** **On-line** allows positioner to start responding to setpoint from control system as connection is achieved. When using **Fail safe**, user can define the exact position of the control valve upon ***Power Up***. Available options, listed under ***Fail Safe*** **Config** are as follows:
  - ***Hold*** (hold last position)
  - ***De-energize*** (spring uncompressed in single acting actuators)
  - ***Fall-back position*** (allows valve to go to a specified ***Position***, in ***Time-out*** seconds after power-up).
- The ***Actuator actio***n is automatically defined by the Modelcode. It can be ***Single*** (for spring return actuators), ***Double*** (for double acting actuators).

- The ***Spring Type*** is automatically determined during the ***Autostart*** procedure. For single acting with ***Closes*** or ***Opens***; for double-acting with ***None***.
- Select the ***Valve stem movement*** from the following options;
  - ***Linear, left mounted*** (globe valve, positioner spindle to the left of the valve stem)
  - ***Linear, right mounted*** (globe valve, positioner spindle to the right of the valve stem)
  - ***Rotary, CCW*** (quarter turn, counter-clockwise to open)
  - ***Rotary, CW*** (quarter turn, clockwise to open)

  Note that if the ***type*** field above show a globe valve, this field will default to ***Linear, left mounted.***
  A rotary valve in the ***type*** field will yield ***Rotary, CCW*** as the default.

This feature is also available in the push button menu of positioner's PCB.

- The ***Amplifier Type*** identifies what amplifier is installed. This field is automatically identified by the Modelcode with ***single***, ***double*** or ***spool***.
- Select ***Control Action*** to be either ***Direct acting*** (increasing setpoint increases pneumatic output) or ***Reverse acting*** (increasing setpoint lowers the pneumatic output). This feature is also available in the push button menu of positioner's PCB.
- The **Setpoint source** can be configured to be **Digital** (FoxCom-Digital, Foundation Fieldbus or Profibus) or **Analog (Intelligent w/o communication or HART)**. This field is automatically identified by the Modelcode.
- Modelcodes for Intelligent Positioner:

FoxCom-Digital:	**- xFxx**	**Digital**
HART:	**- xHxx**	**Analog**
PROFIBUS:	**- xPxx**	**Digital**
FOUNDATION Fieldbus:	**- xQxx**	**Digital**
w/o Communication:	**- xDxx**	**Analog**

- The Split Range can only be configured for analog devices. In this case define the two thresholds for the **split-range** applications, the **High** and the **Low** limits for the input signal.

For additional information, see:

<u>Valve Type</u>
This is a single-byte field with values that defines the type of valve attached to actuator.
Five types are defined:

- ***Globe,***
- ***Rotary,***
- ***Plug,***
- ***Butterfly,***
- ***Ball,*** and
- ***Diaphragm***

"Globe" is the default.

Choose the proper valve ***Type***.

Note that this is for reference purposes only - the selected option does not impact positioner's control behavior.

Power Up Action
This is a single byte parameter that controls the positioner behavior with digital input when power is applied. This parameter controls what the positioner does when the digital setpoint is lost. On-line is the default.

Please note, even though the positioner is 'on-line', it will not enable the fail safe timer until it sees the very first setpoint communication from the host.

Actuator Action
This is a single-byte parameter. It defines the type of pneumatic actuator that is either spring loaded or an actuator with pressure applied to both sides. The ***Actuator action*** is automatically defined by the Modelcode. It can be ***Single*** (for spring return actuators), ***Double*** (for double acting actuators).

Amplifier Type
The Amplifier Type identifies what amplifier is installed. This field is automatically identified by the Modelcode with ***single, double*** or ***spool***.

Spring Type
The user may specify the single-byte parameter for ***Spring type***. The ***Spring type*** is automatically determined during the ***Autostart*** procedure. For single acting with ***Closes*** or ***Opens***; for double-acting with None.

Valve Stem Movement
This field is used to define Select the ***Valve stem movement*** from the following options;

- ***Linear, left mounted*** (globe valve, positioner spindle to the left of the valve stem)
- ***Linear, right mounted*** (globe valve, positioner spindle to the right of the valve stem)
- ***Rotary, CCW*** (quarter turn, counter-clockwise to open)
- ***Rotary, CW*** (quarter turn, clockwise to open)

Note that if the ***type*** field above show a globe valve, this field will default to Linear, left mounted.

A rotary valve in the ***type*** field will yield ***Rotary, CCW*** as the default.

This feature is also available in the push button menu of positioner's PCB.

Control Action
This is a one-byte flag with only two possible values. The parameter Control Action can be configured either to Direct acting (increasing setpoint increases pneumatic output) or Reverse acting (increasing setpoint lowers the pneumatic output). This feature is also available in the push button menu of positioner's PCB.

Setpoint Source
This is a single byte field. The user may specify one of three options.

The **Setpoint source** can be configured to be **Digital** (FoxCom-Digital) or **Analog (Intelligent w/o communication or HART)**. This field is automatically identified by the Modelcode.

- Modelcodes for Intelligent Positioner:

FoxCom-Digital:	-xFxx	Digital
HART:	-xHxx	Analog
PROFIBUS	-xPxx	Digital
FOUNDATION Fieldbus	-xQxx	Digital
w/o Communication:	-xDxx	Analog

Fail Safe
This is a single-byte parameter.

For Digital input, the operator may configure the ***Power up*** mode to ***Fail safe***. When using ***Fail safe***, the operator can define the exact position of the control valve upon ***Power up***. Available options, listed under ***Fail Safe*** **Config** are as follows:

Hold (hold last position)
De-energize (spring uncompressed in single acting actuators)
Fall-back position (allows valve to go to a specified ***Position,*** in ***Time-out*** seconds after power-up).

This parameter is not available for analog operation.

The configuration “hold” is the default setting.

One of the important features of the FoxCom system is to detect when problems occur and to properly handle them. For example: if the system loses power, the actuators all de-energize and send their associated valves either to full open or full closed depending on the definition of ‘energized’.

However, a more interesting case is when the FBM ceases to communicate with the positioner. Each valid setpoint command resets a fail-safe timer on arrival. If the FBM stops sending setpoints, this timer increments until it hits a user specified value. At that point the positioner will automatically move the valve to a fail-safe position (typically the de-energized position) and go into a fail-safe mode. The next arrival of a setpoint resets the timer, and kicks the system back into the mode it held prior to the fail-safe.

During fail-safe mode, the status bits are changed to reflect the condition.

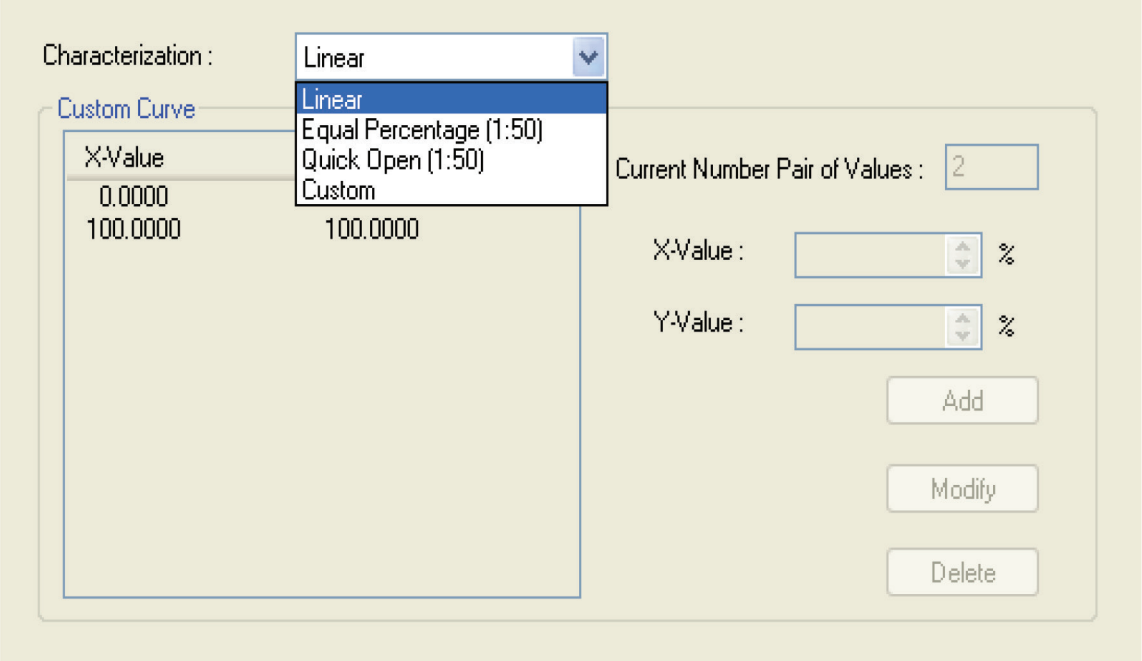
For additional information, see:

Watchdog Timer
This is a 4-byte real. The parameter represents how long, in seconds, the SRD991 positioner will tolerate no setpoint commands in communication before it enters a Fail-safe state. Zero is a special case and forces the positioner to wait forever - that is, it will never time out and enter fail-safe. 10 seconds is the default time out period.

Fallback Position
This parameter is a 4-byte real. It represents the position that the Valve will move to when it is in Fail-safe Spring Type and the Fallback Option have been set to use the Fallback Position. The units are position in %. Default value is 0%.

Split Range High / Split Range Low
The ***Split Range*** can only be configured for analog devices. In this case define the two thresholds for the ***split-range*** applications, the **High** and the **Low** limits for the input signal.

3.1.3 Characterization Page



Valve Position vs. Input Signal characteristics of the positioner can be defined in the ***Characterization*** page **(Edit ->Configuration)**.

Available options are:

- ***Linear,***
- ***Equal percentage (1:50),***
- ***Quick Open (50:1),***
- ***Custom *.***

* The custom curve can be activated via the local push buttons, but needs to be configured via software.

Characteristics of Curve:

Equal-percentage (1:50)

X	Y
0,00%	0,00%
0,20%	2,16%
13,20%	3,35%
23,20%	4,96%
27,60%	5,89%
32,00%	6,99%
36,00%	8,18%
40,00%	9,56%
43,60%	11,01%
47,20%	12,67%
50,40%	14,37%
53,60%	16,28%
56,80%	18,45%
59,60%	20,59%
62,40%	22,97%
65,20%	25,63%
68,00%	28,60%
70,40%	31,41%
72,80%	34,50%
75,20%	37,90%
77,60%	41,63%
80,00%	45,73%
82,40%	50,23%
84,40%	54,32%
86,40%	58,74%
88,40%	63,52%
90,40%	68,69%
92,40%	74,28%
94,40%	80,32%
96,40%	86,86%
98,40%	93,93%
100,00%	100,00%

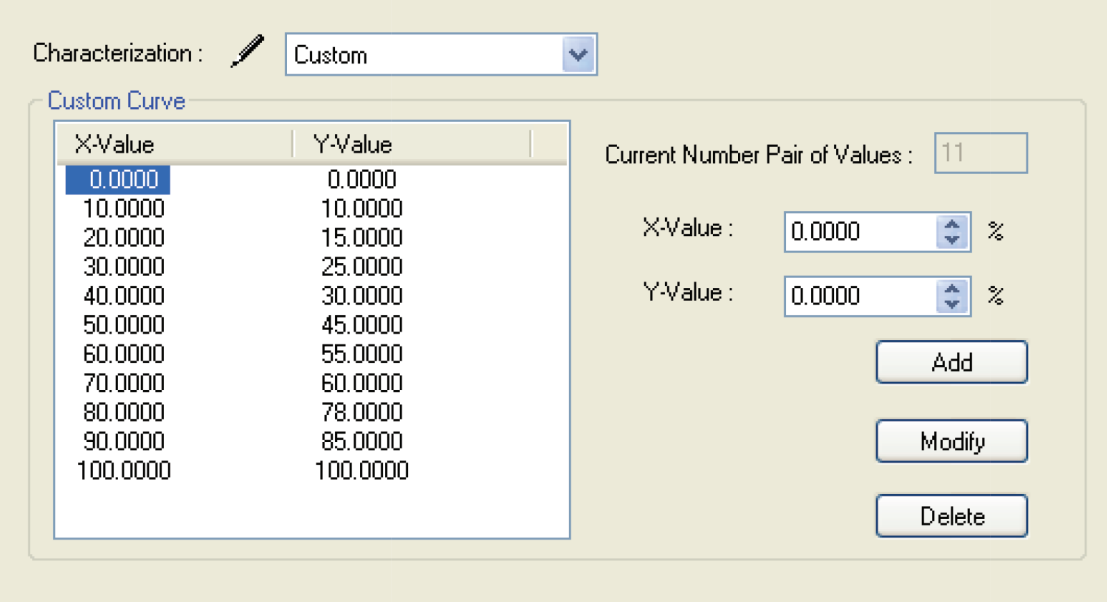
Invers Equal-percentage (50:1)

X	Y
0,00%	0,00%
2,00%	0,00%
2,40%	4,66%
2,80%	8,60%
3,20%	12,01%
3,60%	15,02%
4,00%	17,72%
4,40%	20,15%
4,80%	22,38%
5,60%	26,32%
6,00%	28,08%
6,80%	31,28%
8,00%	35,44%
9,20%	39,01%
10,80%	43,11%
12,40%	46,64%
14,00%	49,74%
16,00%	53,15%
18,00%	56,17%
20,40%	59,37%
22,80%	62,21%
25,20%	64,77%
28,00%	67,46%
31,20%	70,23%
34,40%	72,72%
38,00%	75,27%
41,60%	77,58%
45,60%	79,93%
50,00%	82,28%
54,40%	84,44%
64,00%	88,59%
74,80%	92,58%
86,80%	96,38%
100,00%	100,00%

Equal-percentage (1:25)

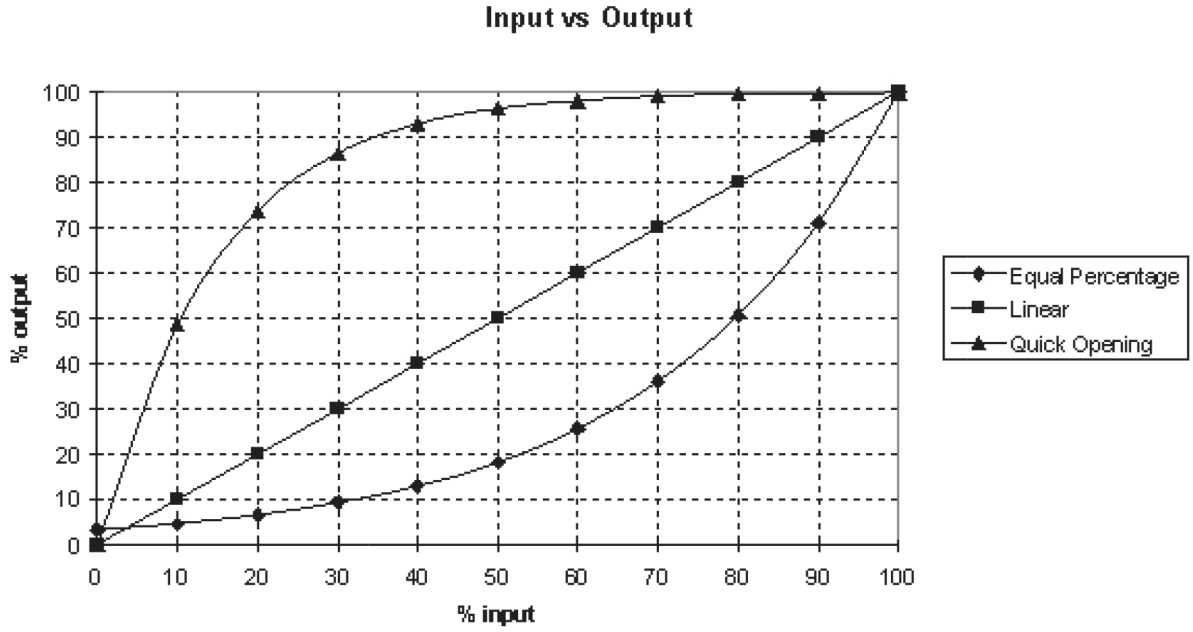
X	Y
0,00%	0,00%
2,00%	4,27%
12,00%	5,89%
21,20%	7,91%
29,60%	10,37%
37,20%	13,25%
44,40%	16,70%
50,80%	20,52%
56,80%	24,90%
62,80%	30,20%
68,40%	36,16%
73,60%	42,75%
78,40%	49,90%
80,80%	53,91%
83,20%	58,24%
87,60%	67,10%
90,00%	72,49%
92,00%	77,31%
94,00%	82,45%
96,00%	87,93%
98,00%	93,78%
100,00%	100,00%

Custom Curve



The **Custom Curve** allows the operator to define up to 22 input, output pairs. To add a new pair of values select **Custom** enter the X- and Y-Value and press **Add**. The input value pair will be sorted in increasing order of the **X-Values**. To modify a value pair select the X-Value in the list box, modify the value and press **Modify**. To delete a value pair select the X-Value in the list box and press **Delete**.

A custom curve which is stored in the device can be activated by selecting **Custom** or deactivated by switching to **Linear, Equal Percentage (1:50) or Quick Open (50:1**).



It is important to note that the flow characteristics of the valve will depend on both the positioner and valve trim characteristics. For example, if the positioner ***Characteristic*** is set to ***Linear*** and the valve has an ***Equal percentage*** trim, then (Cv/Cv.max) vs. input signal will also be ***Equal percentage***.

For additional information, see:

Characterizer

This is a single-byte field. The Valve's position characteristic is determined here. There are four options: ***linear, equal percentage, quick opening*** (inverse equal percentage), and ***custom***. If custom characterization is chosen, it enables to freely define up to 22 points to create a new characteristic for the setpoint changes. Linear is the default.

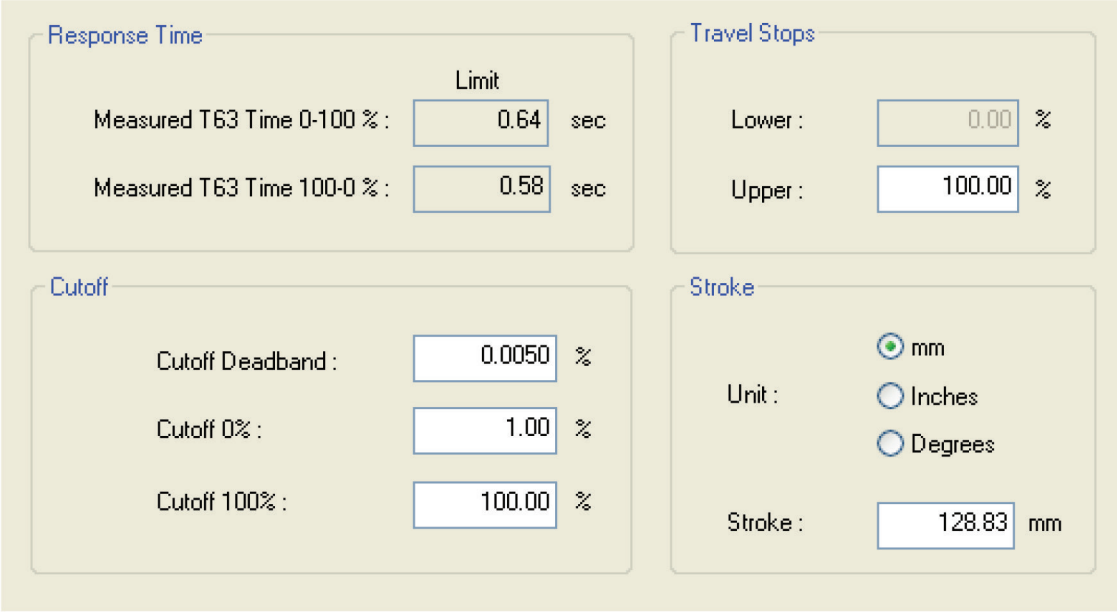
Number of Points
This is a single byte field. The user is allowed to specify how many straight line segments will comprise the characterization curve. If ***custom*** characterizer is enabled, this value sets the number of points. The default value is 2 (one line segment). This is also the minimum. If one of the standard options is selected, the custom points are disabled and turned off.

Select Point
With this Combobox the user selects the Points for output and input.

X Values / Y Values
This is a 4-byte real that is used as the input to the ***custom*** characterizer function. It is only enabled if the characterization is '***custom***', not for any other option. Xn and Yn represent the input signal and the valve position respectively. Between Xn and Xn+1, a straight line interpolation of Yn to Yn+1 is defined. Similarly, between Xn-1 and Xn, a straight line interpolation of Yn-1 to Yn is developed. Xn must be larger than Xn-1.

3.1.4 Travel Page

Travel limits can be set in the **Travel** page (**Parameterization -> Travel**). ***Lower*** and ***Upper Travel stops*** work just like mechanical stops, they define the travel limits. If the positioner is in analogue mode, they can also be set using the push button menu of the positioner's PCB. **Response times,** represented by the time constants for 0 to 100% and 100 to 0% travel, are displayed in this page. Time constants are determined only if the positioner is calibrated by ***Autostart***.



For additional information, see:

Lower Travel Stop
Travel limits can be set in the **Travel** page (**Parameterization -> Travel**). ***Lower*** and ***Upper Travel stops*** work just like mechanical stops, they define the travel limits. This parameter defines the lower stop.

If the positioner is in analogue mode, they can also be set using the push button menu of the positioner's PCB. The 4-byte real minimum has a default of 0%.

Upper Travel Stop
Travel limits can be set in the **Travel** page (**Parameterization -> Travel**). ***Lower*** and ***Upper Travel stops*** work just like mechanical stops, they define the travel limits. This parameter defines the upper stop.

If the positioner is in analogue mode, they can also be set using the push button menu of the positioner's PCB. The 4-byte real maximum has a default of 100%.

Cutoff
Cut off 0%
Cutoff* 0%** allows the user to specify at what point the valve can be completely closed. For example, when set at 2%, any input signal below this value will be treated as 0%. The amount of hysteresis allowed in the ***Cutoff is defined by the ***Cutoff Deadband.*** Following the above example with 2% ***Cutoff,*** 0.5% ***Cutoff Deadband*** will allow valve to close at 2% input signal, but it starts to re-open at 2.5%.

Default value is 1%.
It is a 4-byte real, expressed as percentage.

Cut off 100%
Cutoff* 100%** allows the user to specify at what point the valve can be completely open. For example, when set at 98%, any input signal above this value will be treated as 100%. The amount of hysteresis allowed in the ***Cutoff is defined by the ***Cutoff Deadband.*** Following the above example with 98%

Cutoff, 0.5% ***Cutoff Deadband*** will allow valve to fully open at 98% input signal, but it starts to move again at 97.5%.

Default value is 100%.
It is a 4-byte real, expressed as percentage.

Cutoff Deadband

Cutoff allows the user to specify at what point the valve can be completely closed/completely open. For example, when the cutoff 0% is set at 2%, any input signal below that will be treated as 0%. The amount of hysteresis allowed in the ***Cutoff*** is defined by the ***Cutoff deadband***. Following the above example with 2% ***Cutoff***, 0.5% ***Cutoff deadband*** will allow valve to close at 2% input signal, but it starts to re-open at 2.5%.

Default value is 0.0050%.
It is a 4-byte real, expressed as percentage.

Travel Position Units

This byte-wide field is used for determining how the valve position is expressed. There are three options:

- ***mm*** (millimetres),
- ***in*** (inches),
- ***degrees*** (the default)

Note that “degrees” represent the amount of rotation of the positioner spindle, which is also equal to valve rotation for quarter-turn applications. If the calculations are in degrees, modification of Stroke is not possible. In the other two cases, it is.

Stroke

The travel span, or ***stroke***, is a 4-byte parameter in the units selected in **Travel Position Units**. It shows how much units of travel is equivalent to one full stroke.

An alarm can then be set based on the total amount of travel. ***Travel Sum Limit*** is the total accumulated travel, in full strokes, that will trigger this alarm. Small valve movements will be accumulated. To avoid including small continuous motion around the setpoint to ***Travel Sum, a Travel Sum Dead Band*** may be specified as well.

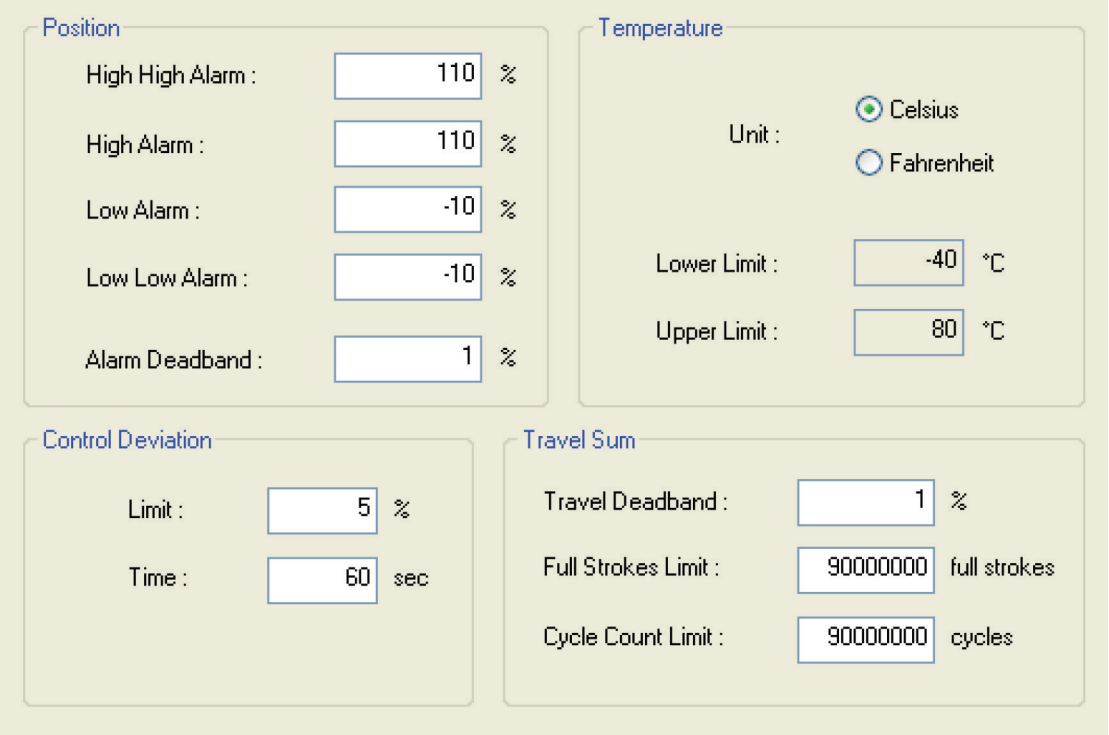
Increasing Response Time / Decreasing Response Time

Response times are the time constants for 0 to 100% and 100 to 0% travel. Time constants are determined only if the positioner is calibrated by ***Autostart***. Since the dynamic behavior of air and spring strokes may be different, they are individually characterized.

To modify the control valve dynamics, ***Travel Time Limits*** may be changed. Inputting values higher than the default (0.4 sec) will slow down the response.

3.1.5 Alarms Page

This ***Alarms*** page is used to define the alarm values and to define thresholds, when an alarm shall be executed. These alarms are then activated on the designated pages under ***ONLINE DIAGNOSTICS***.



For additional information, see:

High Alarm, High High Alarm, Low Alarm, Low Low Alarm

Alarms can be set in the **Alarms** page (**Parameterization ->Alarms**). Triggered by **Position**, both a warning (***High Alarm***) and full alarm (***High High Alarm***) can be set for the upper travel limits. ***Dead Band Alarm*** can be used to specify a dead band region so that continuous switching on and off of an alarm can be avoided.

Alarm is a 4-byte real, expressed as percentage of stroke. When the valve position exceeds this parameter, the Hi Alarm status bit in the secondary device status will be set. Default is 110% for High and High High Alarm, -10% for Low and Low Low Alarm.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

Cycle Count Limit

This is a 4 byte integer parameter. Its value contains the number of cycles necessary to trigger an alarm condition. When the cycle count equals or exceeds this number, an alarm bit is raised in the SRD991 additional status. Default value is 90,000,000.

Cycle Count Limit can be used as a criterion to set up a maintenance alarm. Each cycle is a change in valve direction, any movement up and down, that exceed the sensitivity of the device. This sensitivity level is set in ***Control Gap***.

7	6	5	4	3	2	1	0
NOT USED	Trim Feedback	Trim Loop	**Cycle Count**	Travel Sum	Config invalid	Temp low	Temp high

Travel Sum Limit / Travel Sum Deadband

An alarm can be set based on the total amount of travel. ***Travel Sum Limit*** is the total accumulated travel, in full strokes, to trigger an alarm. Small valve movements will be accumulated. To avoid including small continuous motion around the setpoint to ***Travel Sum***, a ***Travel Sum Dead Band*** is specified. The default for the 4-byte real Travel Sum Deadband is 1%.
The Travel Sum Limit is a 4-byte integer parameter. The parameter default is 90,000,000.

7	6	5	4	3	2	1	0
NOT USED	Trim feedback	Trim Loop	Cycle Count	**Travel Sum**	Config invalid	Temp low	Temp high

Alarm Deadband

Alarms can be set in the **Alarms** page (**Edit ->Configuration**). Triggered by **Position**, either a warning (***Low Alarm, High Alarm***) or full alarms (***Low Low Alarm, High High Alarm***) can be set for both lower and upper travel limits. ***Alarm Dead Band*** can be used to specify a dead band region so that continuous switching on and off of an alarm can be avoided.

This 4-byte real, expressed as percentage. As an example, if the Low alarm is set to 8%, and this parameter is set to 1%, the default, then if the Low Alarm has occurred, the positioner needs to move back to 9% in order for the alarm to be cleared from the secondary status.

Please note, the alarm is also recorded in the historical status. Thus it is possible to check if an alarm had occurred since the last reset of historical status.

7	6	5	4	3	2	1	0
Control Diff	**LoLo Alarm**	**HiHi Alarm**	**Low Alarm**	**High Alarm**	NOT USED	More Status	Fail safe time out

Temperature Units

This single-byte field specifies whether temperature information by the internal temperature sensor is expressed in ℃ (degrees Celsius) or ℉ (degrees Fahrenheit) scales. The default is ℃. Since the internal calculations are done in ℃, it must also be used during the temperature sensor calibration.

Minimum Temperature / Maximum Temperature

This is a four byte real field that allows the user to set a minimum/maximum value for the internal electronics temperature. If the internal temperature of the positioner is outside the **Lower/Higher Temperature Limit** displayed in the alarms page, an alarm will be raised. The diagnostic bit remains set as long as the condition is valid.

Default values are -40 degrees Celsius (-40 Fahrenheit) and is 80 degrees Celsius (176 Fahrenheit). Operating the positioner below this limit may cause damage to the instrument.

Control Difference Limit

The difference between the setpoint and position, defined as the ***Control Difference***, is another variable which can be used to setup an alarm. If this error exceeds the ***Control Difference Limit*** **(%)** for more than a specified time in seconds (***Control Difference Time***), then an alarm will be triggered. A positioner which is not calibrated (***Autostart*** or **Endpoint Calibration** not done yet) may cause a high ***Control Difference.***

Default for this parameter is 5%. This is a 4-byte real, expressed as a percentage.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

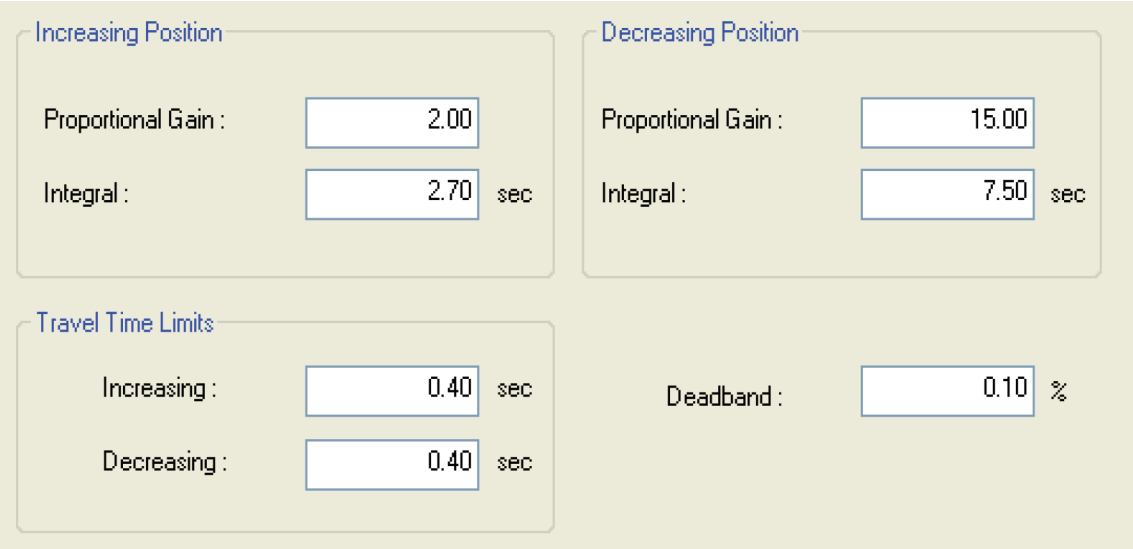
Control Difference Time

The difference between position and setpoint, defined as the ***Control Difference*** is another variable which can be used to setup an alarm. If this error exceeds the ***Control Difference Limit* (%)** for more than a specified time in seconds (***Control Difference Time***), then an alarm will be triggered. A positioner which is not calibrated (***Autostart*** or **Endpoint Calibration** not done yet) may cause a high ***Control Difference.***

Default for this parameter is 60 seconds. This is a 4-byte real.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

3.1.6 Tuning Page



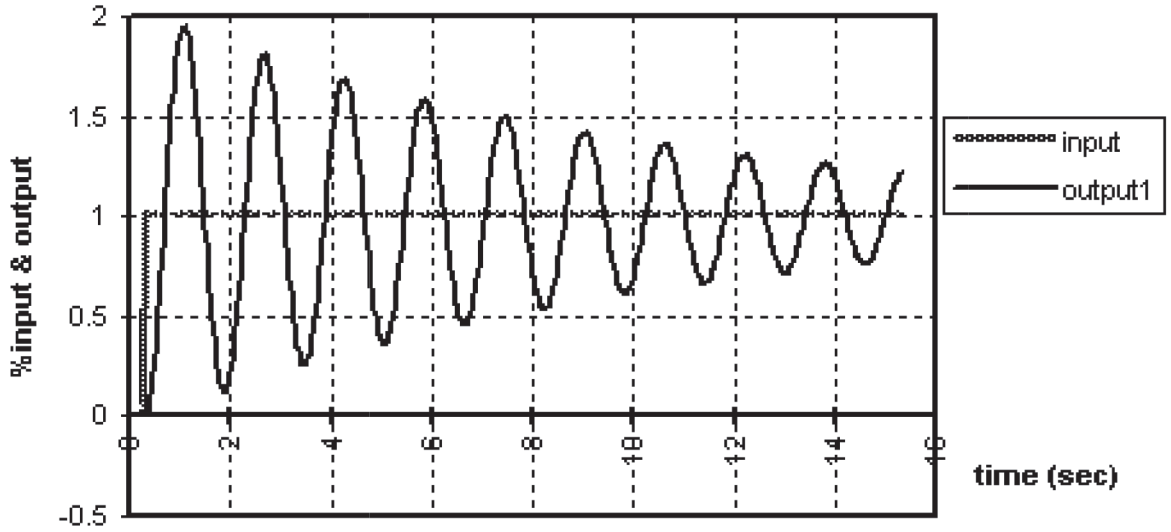
The Intelligent Positioner SRD991 uses a **PID** (Proportional-Integral-Derivative) algorithm for position control. The PID tuning parameters are determined automatically during the **Autostart** process or can be entered manually by user.

To view or manually change the tuning parameters, the **Tuning** page (**Edit ->Configuration**) must be used. Since there might be differences in the dynamic behavior of the control valve when the Positioner output is **increasing** vs. **decreasing**, two different sets are available. Each set has ***Proportional*** (proportional gain, unit-less), ***Integral*** (reset time, sec) and ***Derivative*** (derivative time, sec). These fields are automatically populated after ***Autostart*** is run.

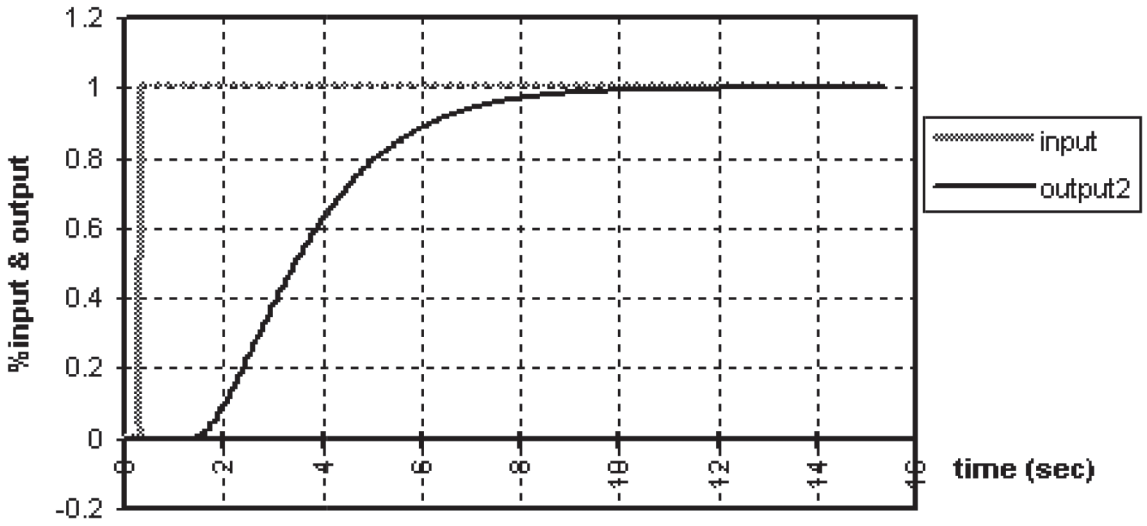
Derivative term, since it may lead to instability if not properly defined, is set to 0 when the tuning parameters are determined by ***Autostart*** . Users are encouraged against inputting high derivative times since loop stability may be sacrificed.

To check valve's control behavior after the calibration cycle, setpoint changes can be applied to the positioner. (Warning: Changing valve position may upset the process). This can be done by choosing **Set Setpoint** from **Start up** in the menu structure. The overshoot in the response, size of minimum step in input to cause an output change, approximate time delays and times required to complete steps can all be used as criteria to judge control behavior. The **Simulation** can also be done by means of the local push buttons under Menu 8. Here the **Simulation** can be done manually in steps of 12.5% or 1%.

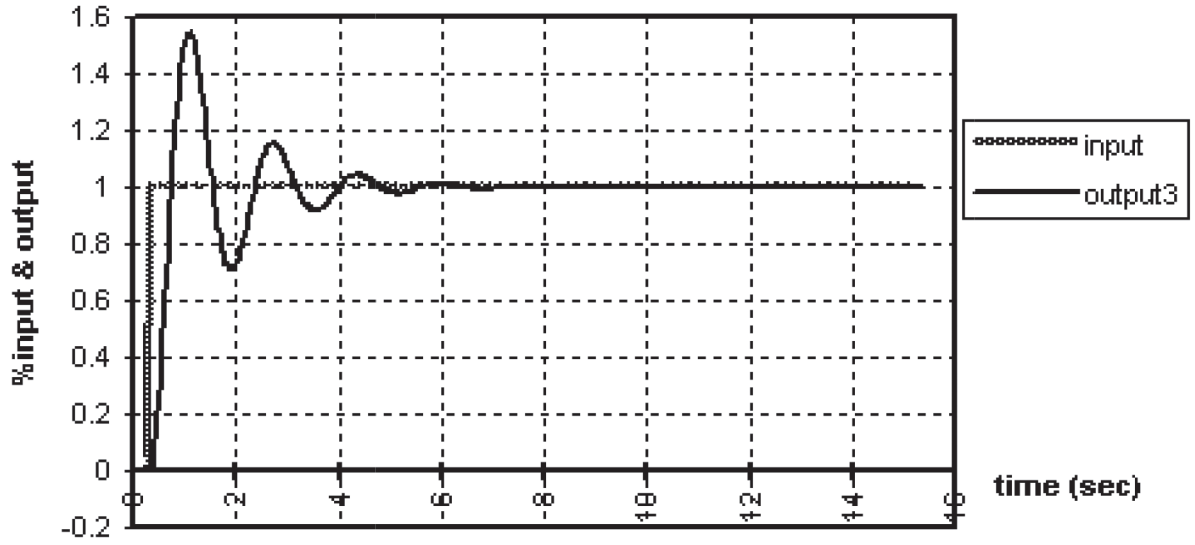
In general, too much gain (by proportional, integral and derivative terms) will lead to instability in the form of continuous or decaying oscillation as shown in the figure below.



Slow or sluggish response, as shown in output2, may be caused by inadequate positioner gain.



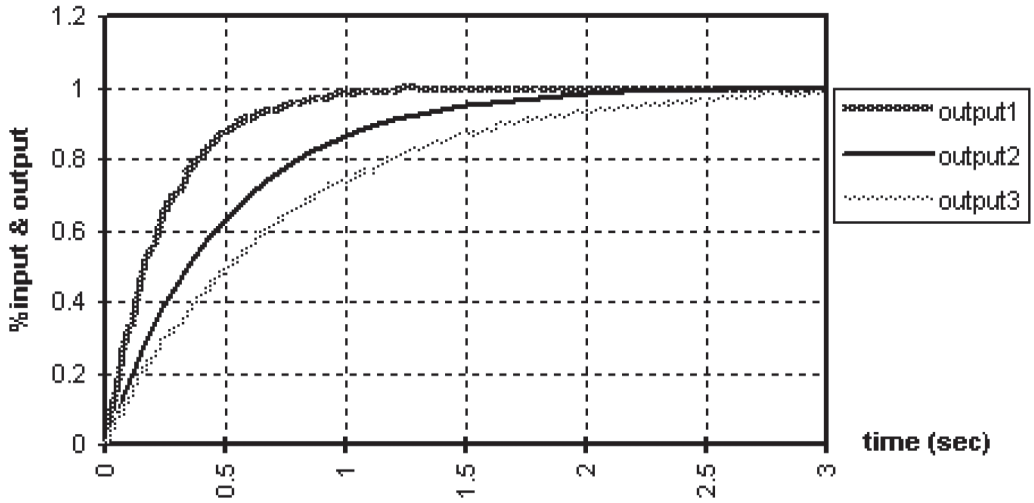
A “reasonable” tuning set may yield response similar to output3 of the next figure.



As mentioned before, too much derivative action may yield stability problems, therefore it should be handled carefully. Most of the time, Proportional and Integral action (PI controller) may yield acceptable control behavior. In certain cases (i.e integrating processes), Integral gain may also cause poor stability in the form of limit cycling and thus should be limited.

In searching for the optimal tuning parameters, it is recommended that only one parameter is changed at a time (i.e. Proportional gain, Reset Time, etc.) The tuning sets for increasing and decreasing positioner outputs will generally be different. Accordingly, both “up” and “down” steps need to be applied for checking response with different tuning parameters.

If the stability of the control valve may not be improved by tuning sets alone, another way to “slow” the positioner down is by changing the ***Travel Time Limits*** in the **Tuning** page **(Parameterization Tuning)**. Inputting times longer than the defaults will make the positioner response slower.



In the above example,

Travel time limit (output3) > Travel time limit (output2) > Response time limit

If stability cannot be achieved by tuning or travel time limit, then damping adjustments in the pneumatic amplifiers may be made to reduce air output capacity of positioner. This is only applicable to actuators with small volume since reducing air capacity would lead to sluggish response in large actuators. On the other hand, if valve response is too slow regardless of tuning set, which may be the case with large actuators, then positioner’s output capacity might have to be increased by utilizing pneumatic boosters.

For additional information, see:

Proportional Gain (Incr.) / (Decr.), Integral (Incr.) / (Decr.), Derivative (Incr.) / (Decr.)
Since there might be differences in control valve dynamic behavior when the **Positioner output i**s **increasing** vs. **decreasing**, two different sets are used. Each set has ***Proportional*** (proportional gain, unit-less), ***Integral*** (reset time, sec) and ***Derivative*** (derivative time, sec). These fields are automatically populated if ***Autostart*** is used.

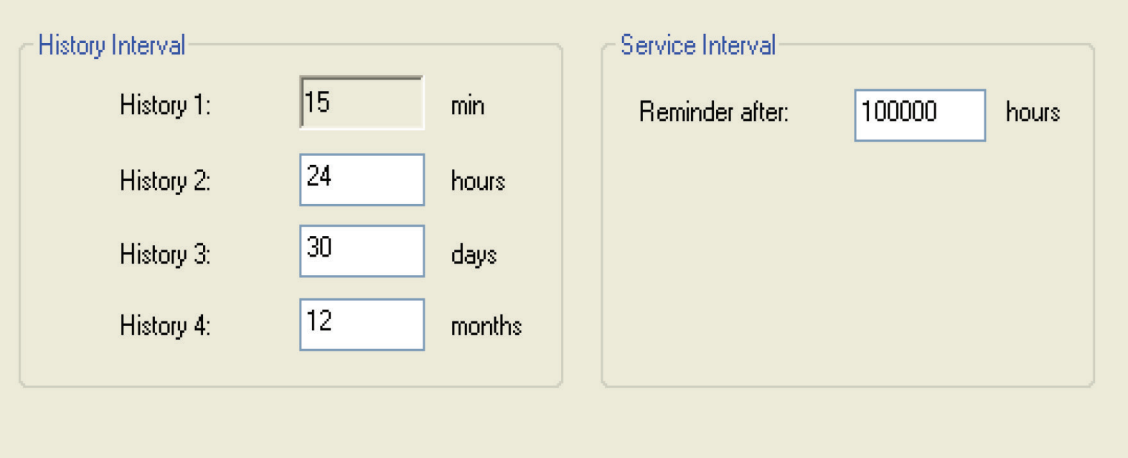
Most of the time, Proportional and Integral action (PI controller) may yield acceptable control behavior. In certain cases (i.e integrating processes), Integral gain may also cause poor stability in the form of limit cycling and thus should be limited. Too much derivative action may yield stability problem, therefore it should be handled carefully.

Ramping (Incr.) / (Decr.)
To modify the control valve dynamics, ***Travel Time Limits*** may be changed. Inputting values higher than the default (0.4 sec) will slow down the response.

Control Gap / Deadband

Control Gap defines the sensitivity of the positioner such that no corrective action will be taken if the Control Difference is less than the defined limit. The default is 0.1%.

3.1.7 Maintenance Page - History Interval



The **History Intervals** are used to configure the 4 different Historians for the ***Position History*** and the ***Response History.*** These Historians allow to store and later upload the data from the positioner memory for the specific time windows. Later in operation this enables to see what happened within the process, showing the last 15 Minutes (History 1), up to 24 hours (History 2), up to 30 days (History 3) and up to 60 months / 5 years (History 4).

Warning!
Once the History Intervals are set, they should not be reconfigured during operation, because this will delete all stored data of each Historian.

History 1
Preset to 15 Minutes. This History shows the last 15 minutes of the process for the ***Position History*** and the ***Response History.*** The interval cannot be re-configured.

History 2
Preset to 24 hours. This History shows the last 1 to 24 hours of the process for the ***Position History*** and the ***Response History.***. The interval can be configured between 1 to 24 hours.

History 3
Preset to 30 days. This History shows the last 1 to 30 days of the process for the ***Position History*** and the ***Response History.*** The interval can be configured between 1 to 30 days.

History 4
Preset to 12 months. This History shows the last 1 to 12 months of the process for the ***Position History*** and the ***Response History.*** The interval can be configured between 1 to 60 months.

Service Interval
The ***Service Reminder*** [in hours] is used in connection with the value for the ***Actual Time*** in Operation [in hours]. The ***Actual Time in Operation*** provides the information how long the total operation time of this unit is. Once this value exceeds the value configured under ***Service Reminder,*** a status bit is set, informing that the device needs to be serviced. In addition the ***Status of Service Interval*** will switch from ***Good*** to ***Service.*** The device also shows the ***Time Since Last Service*** [in hours].

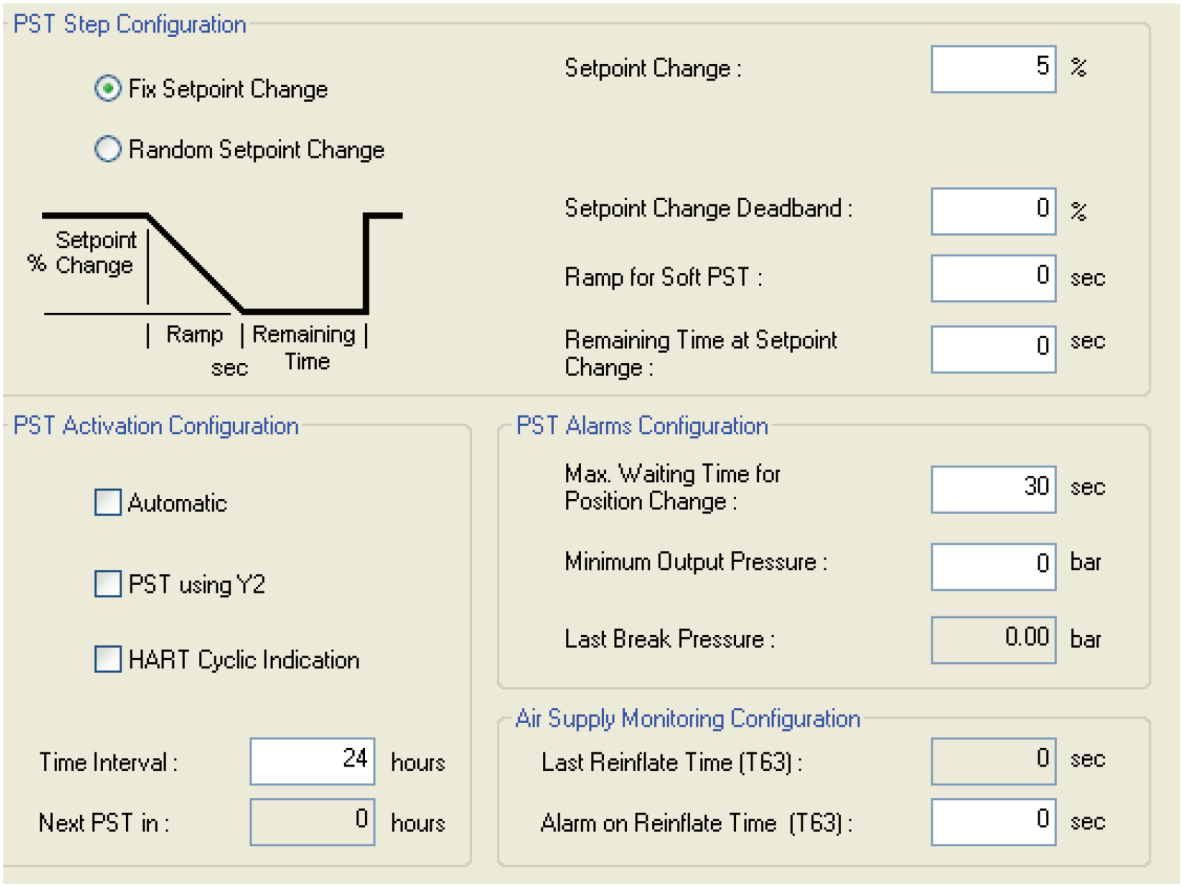
Reminder After:

Preset to *100.000 hours*. This ***Service Interval Reminder*** **influences the Status of Service Interval, after this value exceeds the *Actual Time in Operation*.**

years	months	days	hours
0.5	6	182.5	**4380**
1	12	365	**8760**
2	24	730	**17520**
3	36	1095	**26280**
4	48	1460	**35040**
5	60	1825	**43800**
10	120	3650	**87600**

3.1.8 PST Page

- **PST Step Configuration**



Setpoint Change

The ***Setpoint Change*** is the percentage of the valve movement from the fully open valve position. If this value e.g. is set to 10%, the ***Setpoint Change*** will move the valve from fully open at 100% to 90% valve position.
The interval can be configured between 1 to 100 % (complete closure). The value is preset to 30%.

Fix Setpoint Change

The Setpoint Change can be configured fix, by checking the box. In this case, the value of the setpoint change will be the value indicated in the field “Setpoint change”. The positioner will do the same Step at each test.

Random Setpoint Change

The Setpoint Change can be configured randomly, by checking the box. In this case, the value of the setpoint change will be defined randomly for each PST, between the value indicated in the field “Minimum Setpoint Change” and the value indicated in the field “Setpoint change”. The set point change can be e.g. 22% or 27% in the above configuration.

Setpoint Change Deadband

The Setpoint Change Deadband is the tolerance through with the setpoint is considered to be reached. As soon as the valve arrives inside the deadband, the timer of PST is stopped and the output is no more regulated. When the valve reaches the Setpoint Change +/- Deadband, within the Maximum Waiting Time, the test is considered successful.

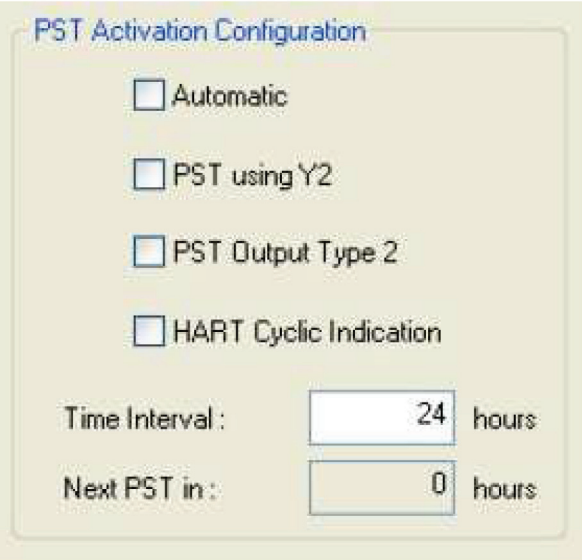
Ramp for Soft PST

The ramp for Soft PST is the time available for reaching the Setpoint. This ramp is designed in order to totally avoid overshooting.

Remaining Time at Setpoint Change

The Remaining Time at Setpoint Change is the time which defines how long the valve will remain at the ***setpoint change*** in stable position. After that, the valve will re-open at full speed.

- **PST Activation Configuration**



Activation of Partial Stroke Test

The ***Partial Stroke*** Test can only be activated if the setpoint and the valve position are higher than 99%. If the setpoint and the valve position are below 99% the ***Testing Status: Restricted*** will be shown.

Automatic

The Partial Stroke Test can be set to ***Automatic,*** by checking the box. In this case, the ***Time Interval*** has to be configured. Then, as ***Automatic,*** is selected, the Positioner will execute the PST alone automatically and at a certain ***Time Interval***. When Automatic is not selected, the PST needs an external command to be executed.

Time Interval

The Time Interval is the period of repetition of the PST, when the Test is set to Automatic. The table shows some rough time-intervals. E.g.: The ***Time Interval*** is configured with 4380 hours. In this case every 4380 hours a ***Partial Stroke*** Test is executed.
The interval can be configured between 0.1 to x hours. The value is preset to 24 hours.

years	months	days	hours
0.5	6	182.5	**4380**
1	12	365	**8760**
2	24	730	**17520**
3	36	1095	**26280**
4	48	1460	**35040**
5	60	1825	**43800**
10	120	3650	**87600**

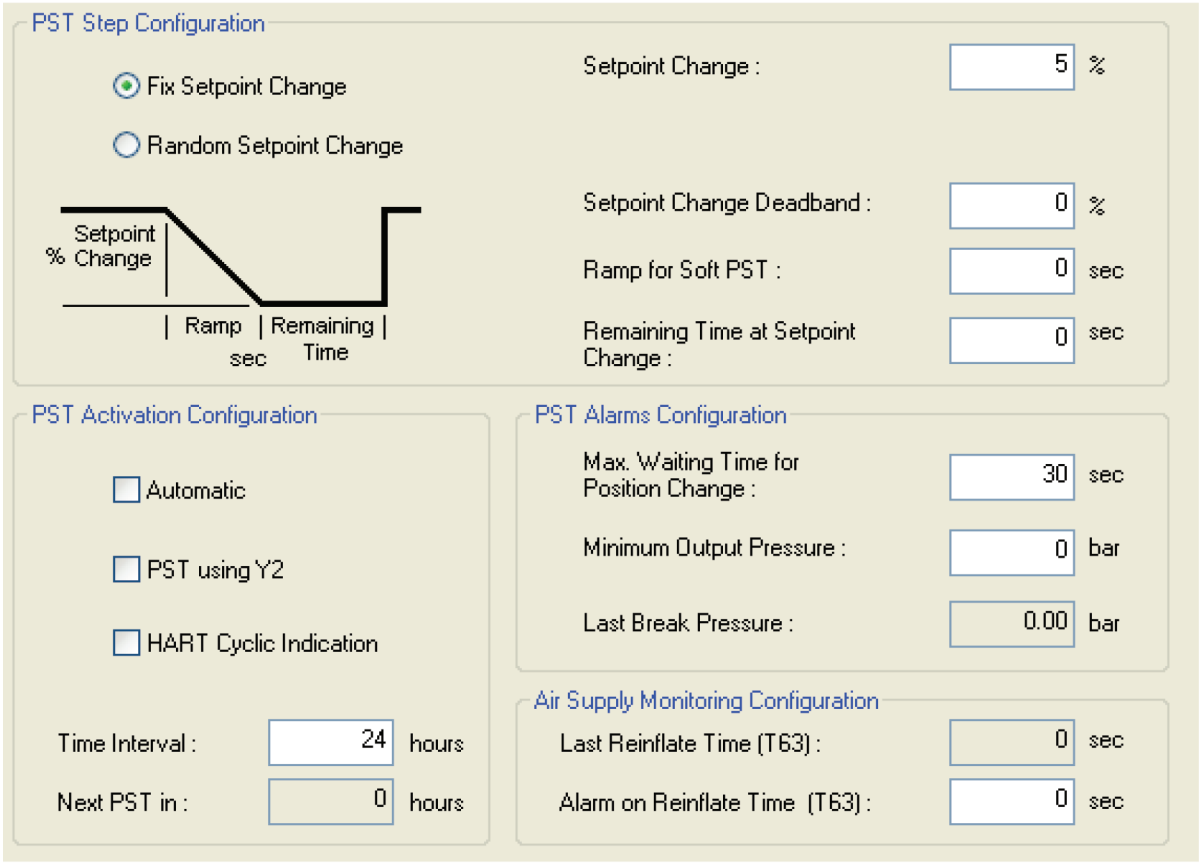
Next PST in:
Only for information. When PST is configured in Automatic, the countdown of the next PST is visualized in this field.

PST using Y2
To be selected only if you want to perform a PST on a single acting actuator using the output Y2 of a double acting positioner.

PST output type 2
To be selected if you want the status Output Type 2 (flashing when PST is running)

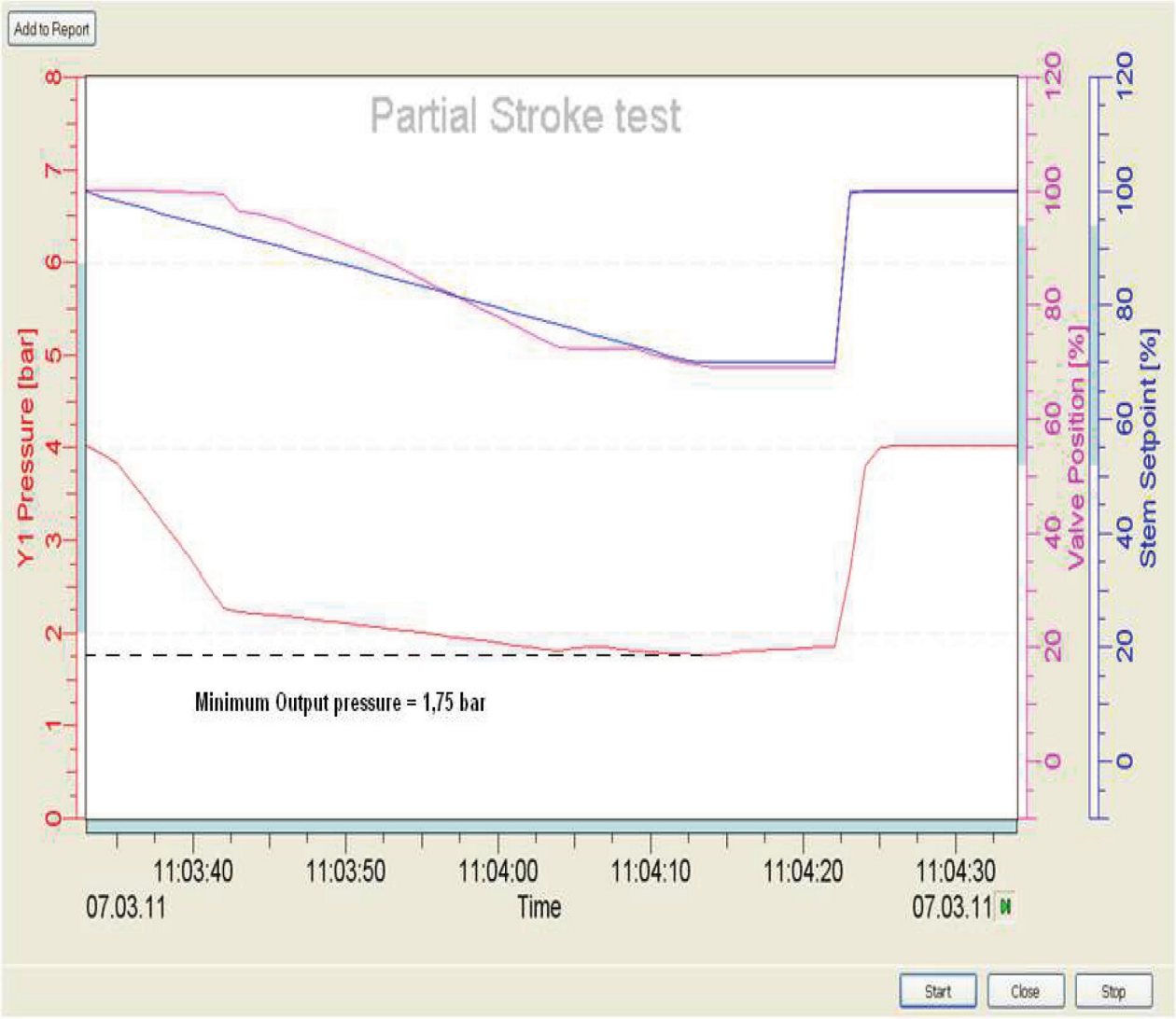
Hart Cyclic Indication
To be selected only if you want to have the status of PST in the HART Cyclic feedback information.

- **PST Alarms Configuration**



Maximum Waiting Time for Position Change
The ***Maximum Waiting Time for Position Change*** is the time in Seconds how long the positioner will keep the ***Setpoint Change*** active. If the valve is not stuck, the positioner will perform the setpoint change and return back to the fully open 100% position immediately. In the case the valve should have a sluggish reaction, be sticky or stuck then the positioner will continue to apply the ***Setpoint Change*** as long as the configured ***Maximum Waiting Time for Position Change***. If after that time the valve doesn't move, the positioner will discontinue the test and execute the ***Testing Status: Error***. The interval can be configured between 1 to 600 Seconds. Be careful to configure the ***Maximum Wait Time for Position Change*** greater than the ***Ramp*** given!

Minimum Output Pressure Limit



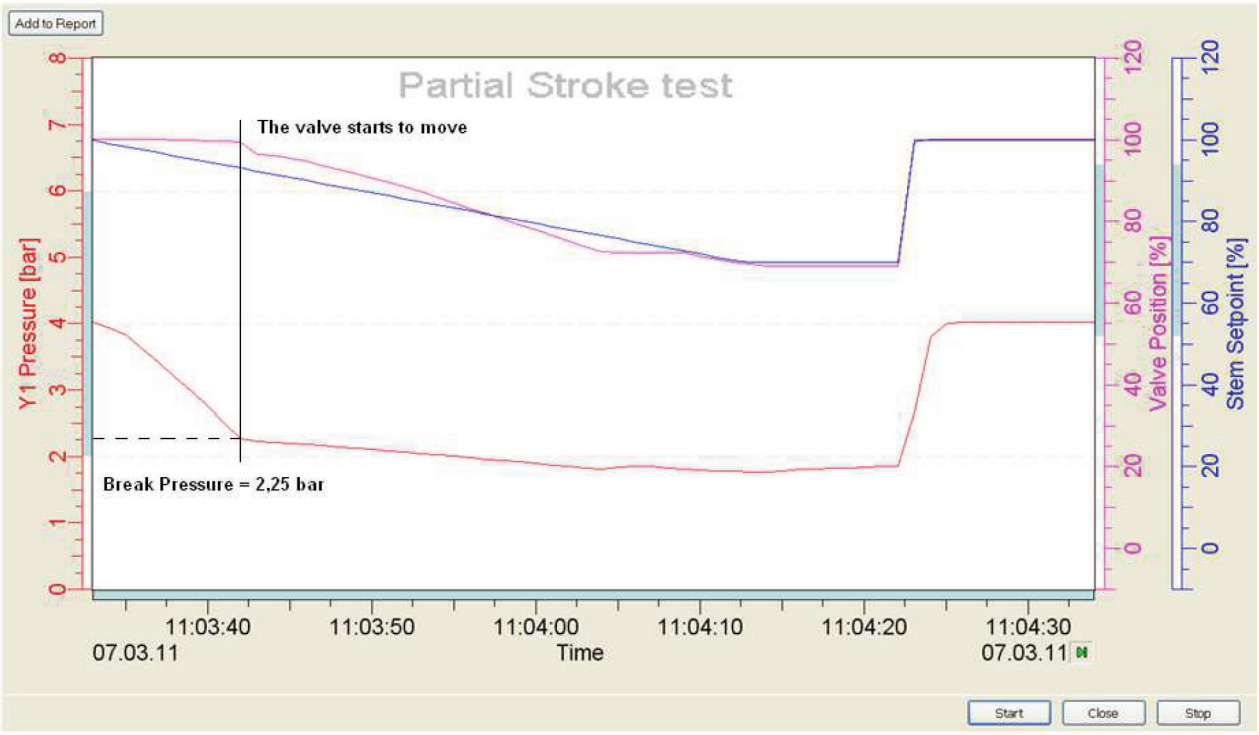
At any time the positioner monitors the input and output pressure. If the input air supply pressure falls below a certain level, an alarm can be set to indicate that some maintenance should be done on the air supply line.

On the output pressure, a minimum pressure is also set in order to interrupt the PST. That is how the positioner avoids a possible overshoot in case that the valve is stuck.

The configuration of the ***Minimum Output Pressure Limit*** is very important in order to avoid overshooting in case the valve starts to jam.

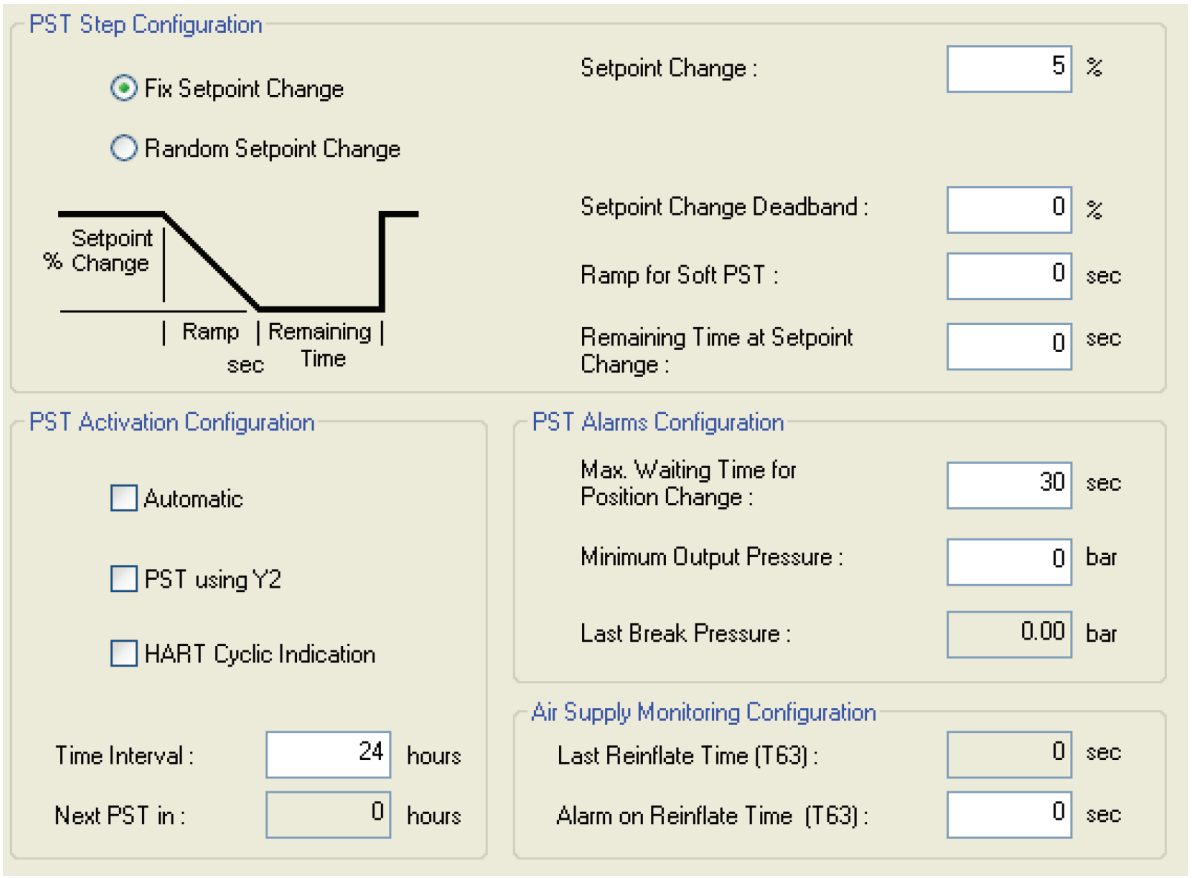
Do several PST in charge and observe which ***Last Minimum Output Pressure*** should reach the positioner to do the movement. Configure the ***Minimum Output Pressure Limit*** a little bit under this value.

Last Break Pressure



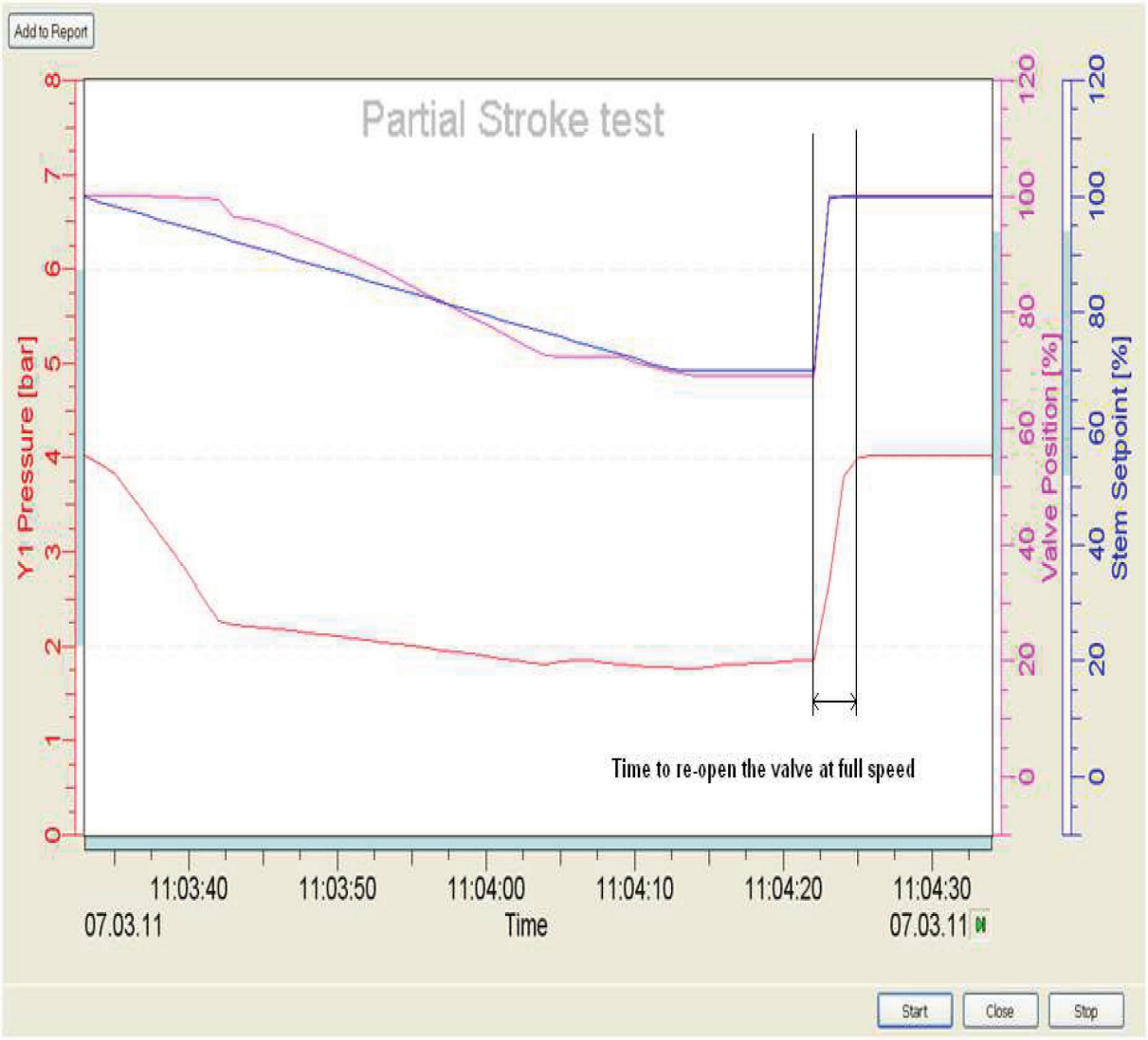
Last Minimum Output Pressure is only information that should help to configure the ***Minimum Output Pressure Limit.*** After a PST, this value is recalculated when the data are updated in page "PST Diagnostic".

- **Air Supply Monitoring Configuration**



Last Reinflate Time (T63)

Last Reinflate Time is the measured time (T 63 – i.e. at 63% of jump) in second to re-open fully the valve (at 100%) after a Partial Stroke Test.

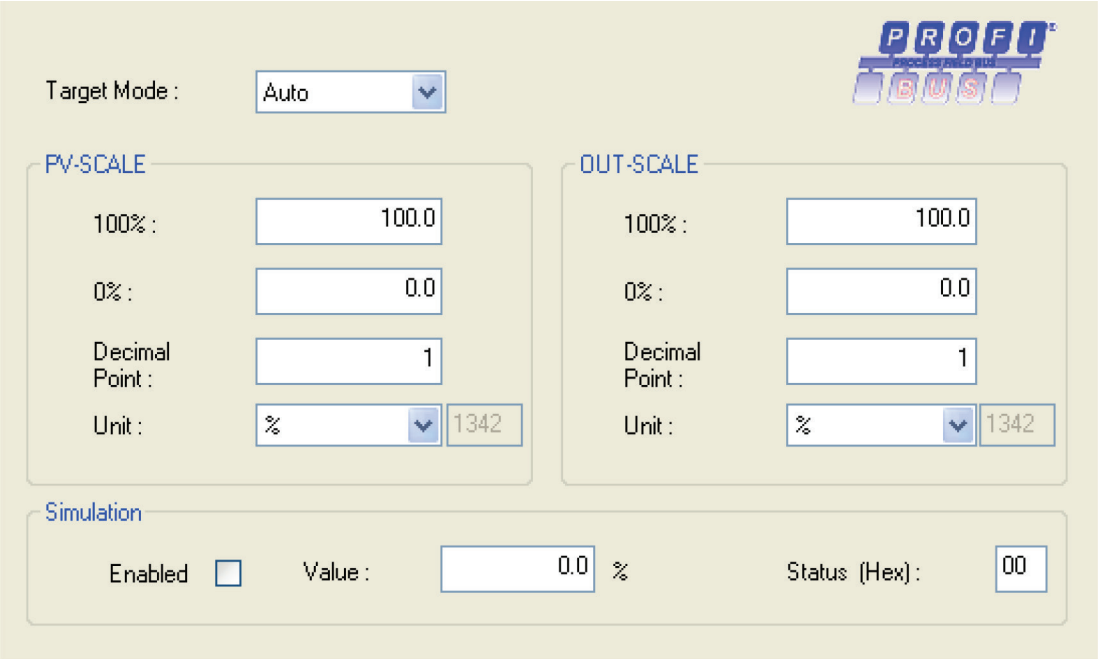


Last Reinflate Time is only information that should help to configure the ***Alarm on Reinflate Time (Parameterization → Partial Stroke Test Page).*** After a PST, the ***Last Reinflate Time*** can be retrieved by pressing ***Update***.

Alarm on Reinflate Time (T63)

Alarm on Reinflate Time is an alarm of time to see in how many second the valve go back to its 100%. To configure the Alarm, first perform a PST and read the ***Last Reinflate Time***. Then define the Alarm according to your needs but at least higher than the ***Last Reinflate Time*** value.

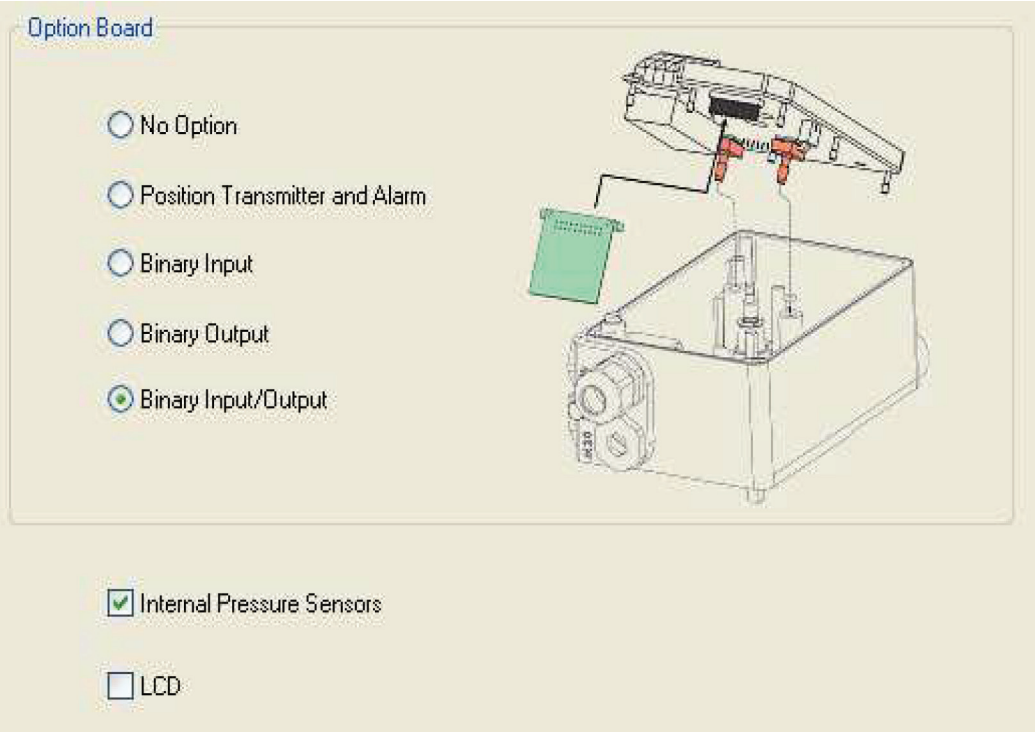
3.1.9 Profibus Function Block Page



For the detailed configuration of the Profibus Function Block parameters the Profibus Function Block Page is used.

Fields	Entries
Target Mode	Contains the desired mode of the function block: Out of Service, Manual, Auto or RCAS
PV-SCALE:	Conversion of a process value in the defined engineering units to a normalized value in percent as the input value of the function block. It contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point. As default, PV-PSCALE is configured to percent, meaning that the Variables SP, Readback, RCAS_IN and RCAS_OUT, which are depending on PV-SCALE, are displayed in the range 0-100%.
OUT-SCALE:	Conversion of the normalized Output Signal (in percent) of the function block to the OUT parameter in the defined engineering units. It contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point. As default, OUT- SCALE is configured to percent, meaning that the Variable OUT is displayed in the range 0-100%.
Simulation	Allows definition of a value and a status. When Simulation is enabled, this value and status is given in Readback instead of the real position of the actuator/valve. This set of parameters is intended only for commissioning and maintenance reasons.

3.1.10 Options Page



The **Option Board** page displays the options of the positioner. Only in the workshop security level it is possible to change the option settings and write it into the device. This factory configuration has to be done carefully and only options which are installed in the positioner may be selected. In all other security levels it is only possible to view the options information.

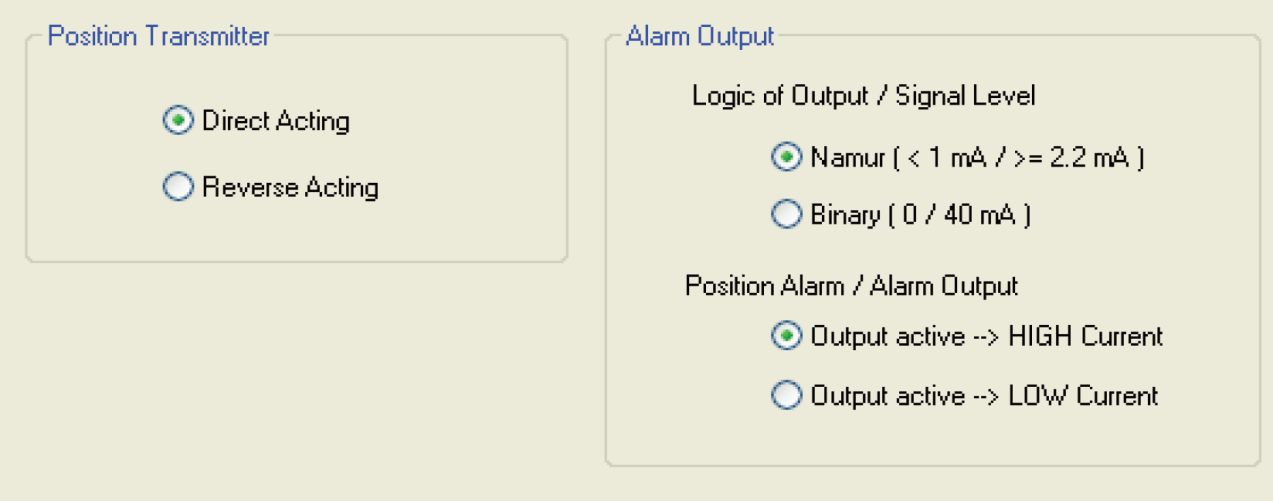
Though, each option can be activated offline, to see the capabilities and functionality behind each option.

Technical Note

This is a single-byte parameter with each bit representing different options that may have been added to this particular SRD991. Currently there are five bits defined as follows:

7	6	5	4	3	2	1	0
Extern Binary Input / Output	NOT USED	NOT USED	NOT USED	Extern Binary Output	Extern Binary Input	Intern Press Sensors	Extern Posit Xmit

3.1.10.1 Position Transmitter Page (Pos.Transmitter)



The ***Position Transmitter*** page is an optional feature that can be connected to the electronic board in the factory or retrofit. In the event that the Option Board is retrofit, the positioner will execute an alarm indicating and Option Board error (Diagnosis Message: *Optionboard err*). In this case the alarm needs to be confirmed and the electronic is reconfigured to support this Option Board.

In connection with the ***Position Transmitter*** additional two channels of this Option Board are available for the ***Alarm Output***. This output can be used to display alarms from the positioner in a remote distance.

- **Position Transmitter Signal**

The feedback signal of the ***Position Transmitter*** can be configured to ***Direct Acting*** or to ***Reverse Acting***. Under ***Direct Acting*** the feedback signal is increasing to the increasing valve position. Under ***Reverse Acting*** the feedback signal is increasing to the decreasing valve position.

- **Alarm Output**

The ***Alarm Output*** function allows configuring the ***Logic of Output*** and ***the Signal Level*** of the alarm.

Logic of Output- / Signal-Level

It can be selected if the signal level of the output shall be according to ***Namur*** (<1 mA / > 2.2 mA) or ***Binary*** (0 / 40 mA). Tick one box to select.

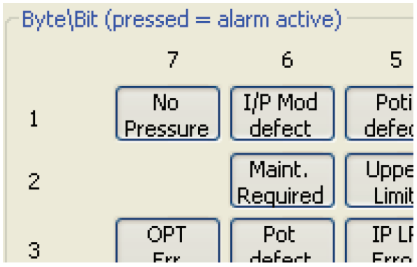
Position Alarm / Alarm Output

In the event that an alarm has been activated, the signal can be configured that the value shows a HIGH Current or a LOW Current. Tick one box to select.

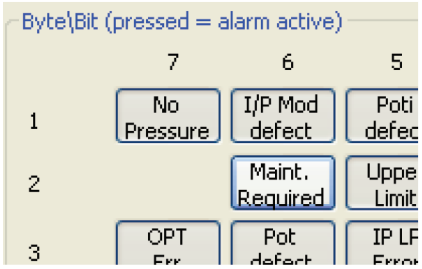
These pre-settings can be configured via communication.

3.1.10.2 Alarm Link Page

The ***Alarm Link*** page allows an easy configuring of the different alarms. This enhances the functionality for the operator to activate or de-activate specific alarms.
{bml alarm_link_page.bmp}
Each alarm bit can be activated or de-activated by simply pressing on the buttons. E.g.: The illustration below shows the "Maintenance Required" alarm active



E.g.: The illustration below shows the "Maintenance Required" alarm de-activated

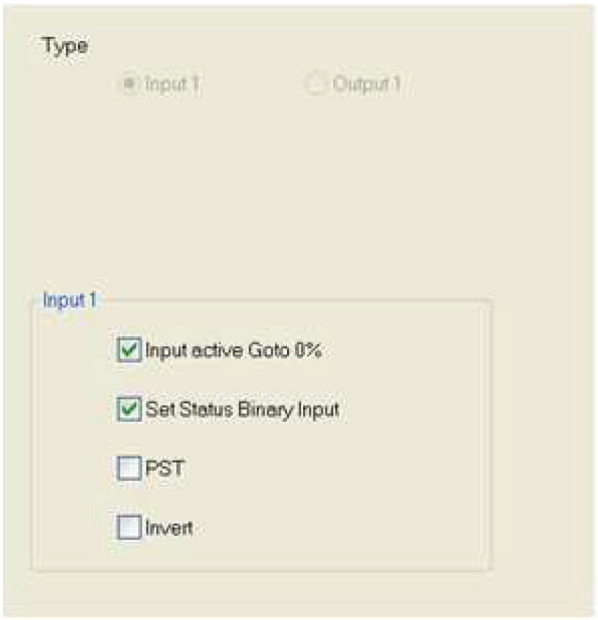


Alarms' description

No pressure	The air supply pressure is below the recommendation (1,4 bar)
I/P Mod defect	Cable of I/P motor not connected to electronic
Poti defect	Connection of potentiometer to electronic board failed
Invalid Current	Current is out of the specifications (operating range= 3.6 to 21.5mA)
Invalid Calib	Calibration is not compatible with hard of the positioner
Bad CRC	Bad Cyclic Redundancy Check – Transmission Error
Write Protect	Write protected and a operator look for to change any configuration
Maint. Required	The Service Interval count has exceeded the limit configured
Upper Limit	Upper travel limit
Lower Limit	Lower travel limit
CDL	Control Difference (between valve position and stem setpoint) out of limit
Option Board	Change of option board or when Option board is faulty
Autostart Error 2	Configuration to single-acting instead of double-acting actuator
Autostart Error 1	Wrong mounting or configuration
OPT Err	Option Board error - Option Board not configured or failed
Pot defect	Connection of potentiometer to electronic board failed
IP LP Error	Connection of I/P converter to electronic board failed
ACT OOL	Actuator OOL Position is not within permissible range (-5% ... +105%)
ADC defect	AD Converter Defect - Converter function not controllable
EPROM Error	Error Writing positioner EPROM
EEPROM Error	Error Writing positioner EEPROM
RAM failure	Error Writing positioner memory
BinIn high	The binary input is activated
Trim Feedb	Feedback unit requires calibration
Trim Loop	Input signal requires calibration
Cycle Count	Cycle Count has exceeded the limit configured
Traval Sum	Travel sum has exceeded the limit configured

Config invalid	Invalid configuration
Temp low	Temperature below allowed limit (≤-40°C)
Temp high	Temperature above allowed limit (≥80°C)
Outp P Alarm	The positioner cannot regulate the Output Pressure
Air Supp Alarm	The Air Supply Pressure falls below the configured Lower Limit (PST)
Autostart failed	No Autostart was done or Autostart was run and did not complete successfully
Contrl Diff	The positioner exceeded the allowable control difference for the allowed duration. Control is either sluggish or un-optimized
LoLo Alarm	Travel Position low low alarm. The valve position is below the minimum allowed.
HiHi Alarm	Travel Position high high alarm. The valve position is above the maximum allowed.
Lo Alarm	Travel Position low alarm. The valve position has gone below the user specified point.
Hi Alarm	Travel Position high alarm. The valve position has gone above the user specified point.
PST Alarm	Partial Stroke Test has shown an error
Backlash Alarm	Reserved for future development
Load Fac high	The Load factor is above the maximum allowed
Load Fac low	The Load factor is below the minimum allowed
Service Interval	The Service Interval count has exceeded the limit configured
Pwr Supp high	Power Supply above allowed limit 4-20 mA / HART: Operation above 22 mA Fieldbus / FoxCom: Operation above 12 mA
Pwr Supp low	Power Supply below allowed limit. 4-20 mA / HART: Operation below 3.8 mA Fieldbus / FoxCom: Operation below 9 mA

3.1.10.3 External Binary Input Page



The Binary Input is used for externally operating two independent binary switches. These switches are connected to the two inputs which are supplied by the basic device. The binary inputs can be used for diagnostics or also configurable for the control functions. The enclosed table shows the control functions of the switches, if function ***Goto 0%*** and ***Goto 100%*** are selected.

Switch 1	Switch 2	Actuator control function
close	close	normal operation
open	close	go to stop at 0%
close	open	go to stop at 100%
open	open	hold last poition

In addition, a binary input can be used for triggering a Partial Stroke Test (PST).

Configure Binary Input Signals
Both switches need to be closed (bridged) for normal operation. If one of each switch is opened, the positioner will move to one designated valve position. If both switches are open (not bridged), the positioner will Hold Last Value.

Input 1 Active
There are two functions that can be activated for the Binary Input.
If the function ***Goto 0%*** is activated and the binary contact is operated, the valve will move to the 0% valve position. If the function ***Set Status Binary Input*** is activated and the binary contact is operated, a status bit will be executed and displayed under ***Process/Binary Input***.
Both functions can be activated separately or together.
The operation of the Binary Input ignores travel limits and is predominate to the setpoint signal.

Input 2 Active
There are two functions that can be activated for the Binary Input.
If the function ***Goto 100%*** is activated and the binary contact is operated, the valve will move to the 100% valve position. If the function ***Set Status Binary Input*** is activated and the binary contact is operated, a status bit will be executed and displayed under ***Process/Binary Input***.
Both functions can be activated separately or together.
The operation of the Binary Input ignores travel limits and is predominate to the setpoint signal.

Input 1 Active and Input 2 Active
There are two functions that can be activated for each Binary Input.

If the function ***Goto 0%*** and ***Goto 100%*** is activated and the binary contact is operated, the valve will ***Hold Last Value*** of the valve position. If the function ***Set Status Binary Input*** is activated and the binary contacts are operated, a status bit will be execute and displayed under ***Process/Binary Input***. Both functions for each switch can be activated separately or together. The operation of the Binary Input ignores travel limits and is predominate to the setpoint signal.

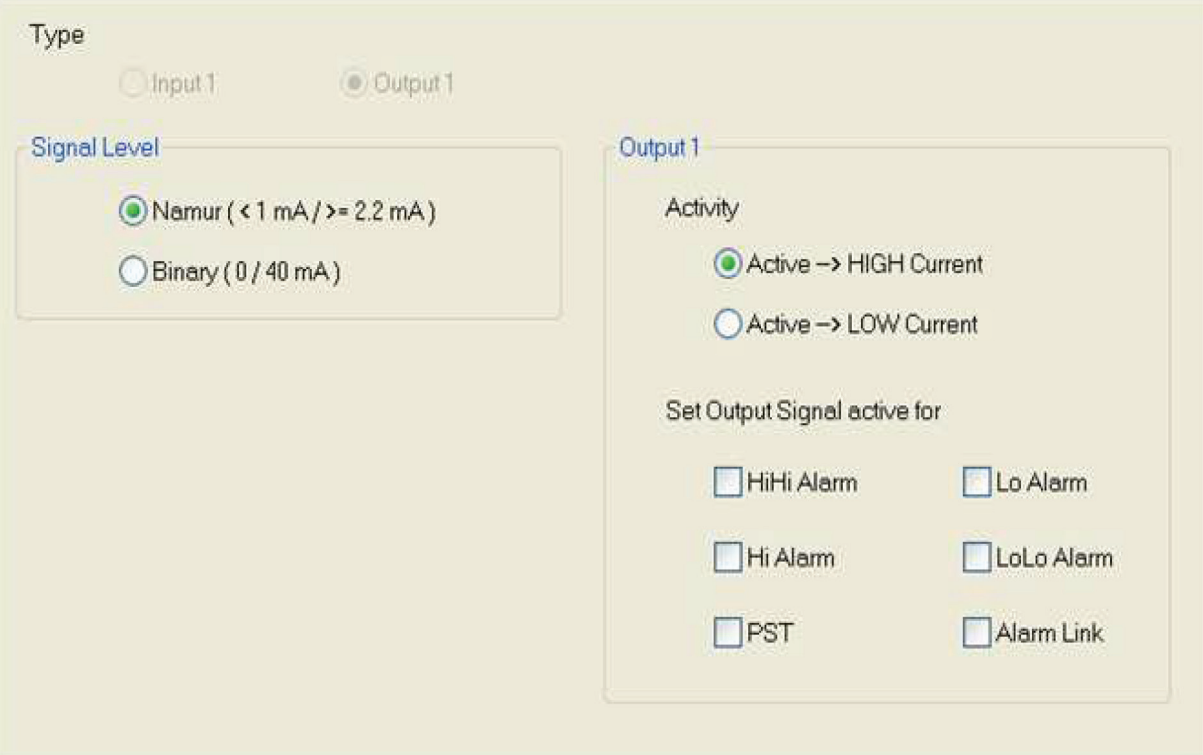
PST
If the function ***PST*** is activated and the binary input contact is operated, a Partial Stroke Test is triggered.

Invert
The operation of the input is inverted.

Binary Input
The value ***Binary Input*** allows defining the kind of contact used for activating these actions or the alarm. The Binary Input can be used as a Limit Switch for protection against overflow of tanks or for an emergency operation to close the valve.

Message	Status	Description / Explanation	Recommended Action
Binary Input (Freely definable)	INFO	An external mechanical switch has activated the Binary Input.	Depending on the reason for activating the switches

3.1.10.4 External Binary Output Page



The ***Binary Output*** function allows configuring the ***Logic of Output- / Signal-Level***, the ***Position Alarm / Alarm Output*** -level of the alarm and selecting the ***Output Signal*** that shall be activated.

Logic of Output- / Signal-Level
It can be selected if the signal level of the output shall be according to ***Namur*** (<1 mA / > 2.2 mA) or ***Binary*** (0 / 40 mA). Tick one box to select.

Position Alarm / Alarm Output
In the event that an alarm has been activated, the signal can be configured that the value shows a ***HIGH Current*** or a ***LOW Current***. Tick one box to select.

The **Signal Output** for the **Binary Output** can be configured for the following cases:

- **HiHi Alarm**
- ***Hi Alarm***
- ***LoLo Alarm***
- ***Lo Alarm***

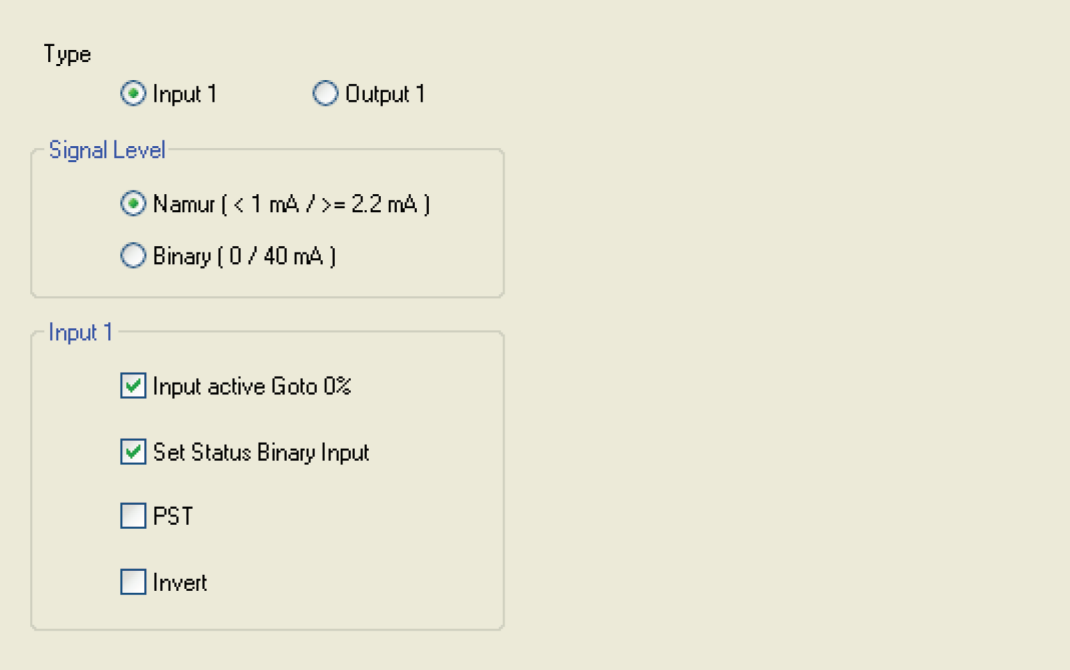
Tick one box to select

3.1.10.5 External Binary Input / Output Page

The Binary Input / Output is a universal option board with two channels free configurable (via the two configuration taps **Bin. InOut 1** and **Bin. InOut 2**) as input or output.

Signal Level
It can be selected if the **Signal Level** of the input / output shall be according to ***Namur*** (<1 mA / > 2.2 mA) or ***Binary*** (0 / 40 mA). Tick one box to select.

A. Configuration as Input



The Binary **Input** can be used for diagnostics or also configurable for the control functions. The following table shows its ports and control functions, depending which channel is selected as input:

Switch 1	Switch 2	Actuator control function
close	close	normal operation
open	close	go to stop at 0%
close	open	go to stop at 100%
open	open	hold last poition

Input active Goto *%
If the function ***Goto 0%*** (for tap **Bin. InOut 1**) or ***Goto 100%*** (for tap **Bin. InOut 2**) is activated and the binary input is operated, the valve will move to the desired position.

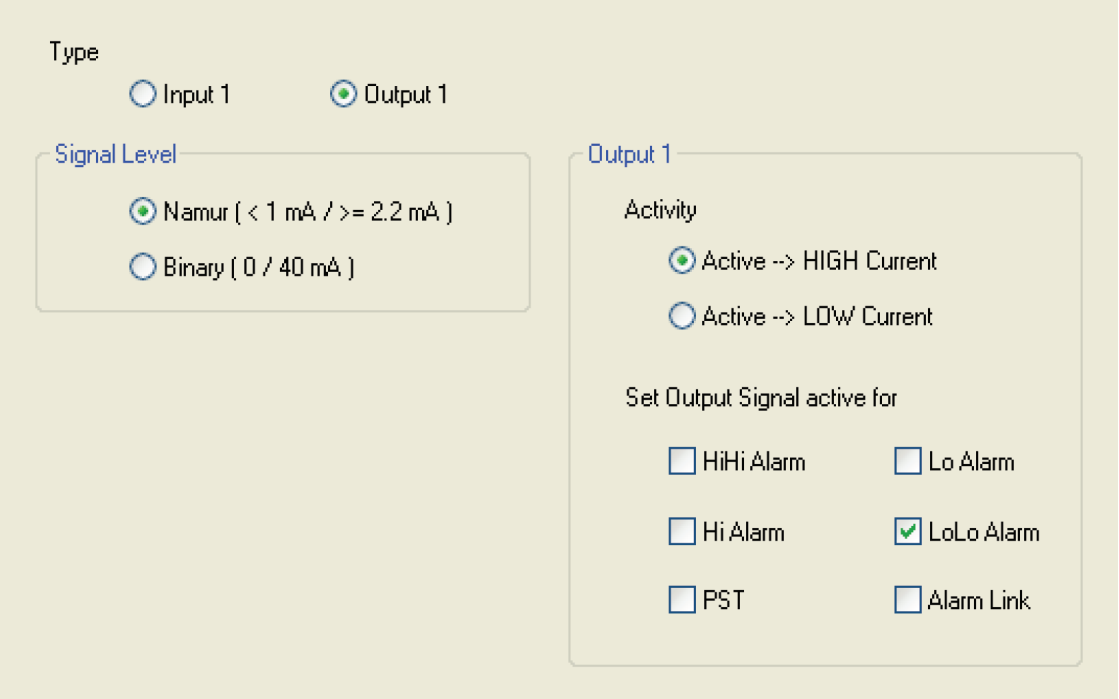
This operation ignores travel limits and is predominate to the Setpoint signal.

Set Status Binary Input
If this function is activated and the binary input is operated a status bit will be executed and displayed under ***Process/Binary Input***.

PST
If the function ***PST*** is activated and the binary input contact is operated, a Partial Stroke Test (PST) is triggered.

Invert
The operation of the input is inverted.

B. Configuration as Output



The Binary **Output** can be used for indication of process information or diagnostic functions.

Activity
In the event that an alarm has been activated, the signal can be configured that the value shows a ***HIGH Current*** or a ***LOW Current***. Tick one box to select.

Set Output Signal active for
The **Signal Output** can be configured for the following process information:

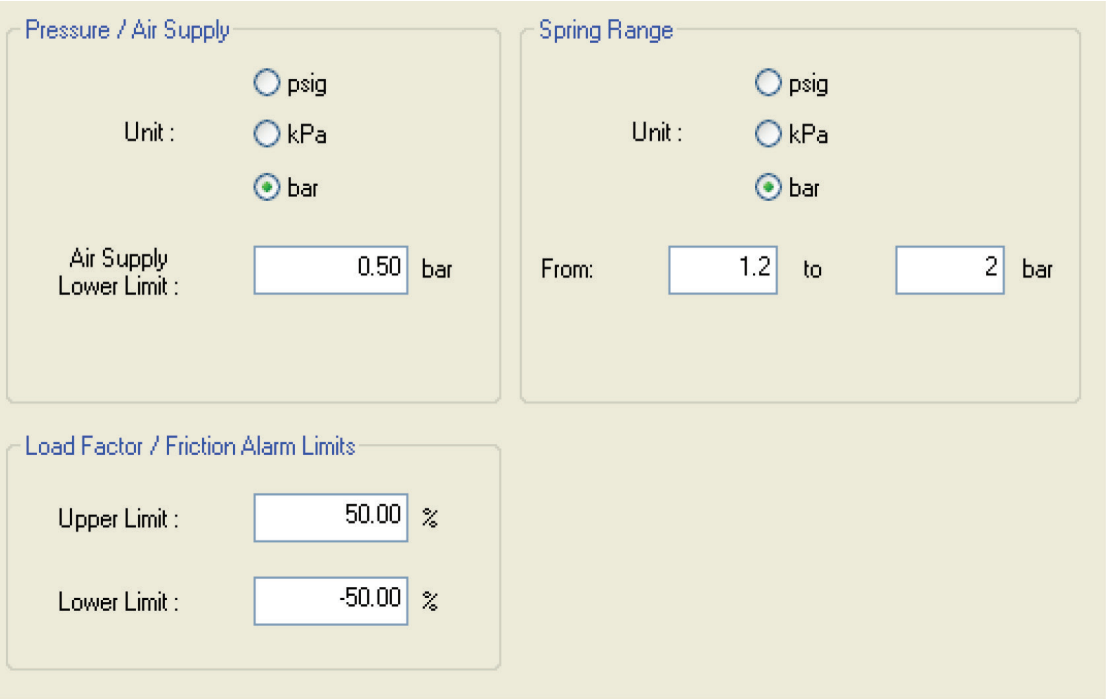
- ***HiHi Alarm***
- ***Hi Alarm***
- ***LoLo Alarm***
- ***Lo Alarm***

If ***PST*** is selected the following information is shown:

- Output active, if Partial Stroke Test is performed OK.
- Output inactive, if Partial Stroke Test is running or performed with error.

If ***Alarm Link*** is selected, the output channel is connected to the alarm link functionality.

3.1.10.6 Press / Load Factor Page



Pressure / Air Supply

Unit
The pressure sensors measure magnitude of the air supply pressure and of the air pressure in the actuator.

This field indicates the units of measure for the pressure. Values expressed are in gauge, not absolute. Choices are:

- psig - Pounds Per Square Inch (Gauge).
- kPa - Kilopascals (Pascal is Newton per square metre).
- Bar (default)

Following conversions exist between these units:

- 1 bar = 100,000 Pa
- 1 bar = 14.5 psig

Air Supply Lower Limit
This is a 4-byte real, expressed in the units defined by the **Units** check boxes. It specifies the lower limit of the air supply pressure. If the air supply pressure falls below this limit a status bit will be set.

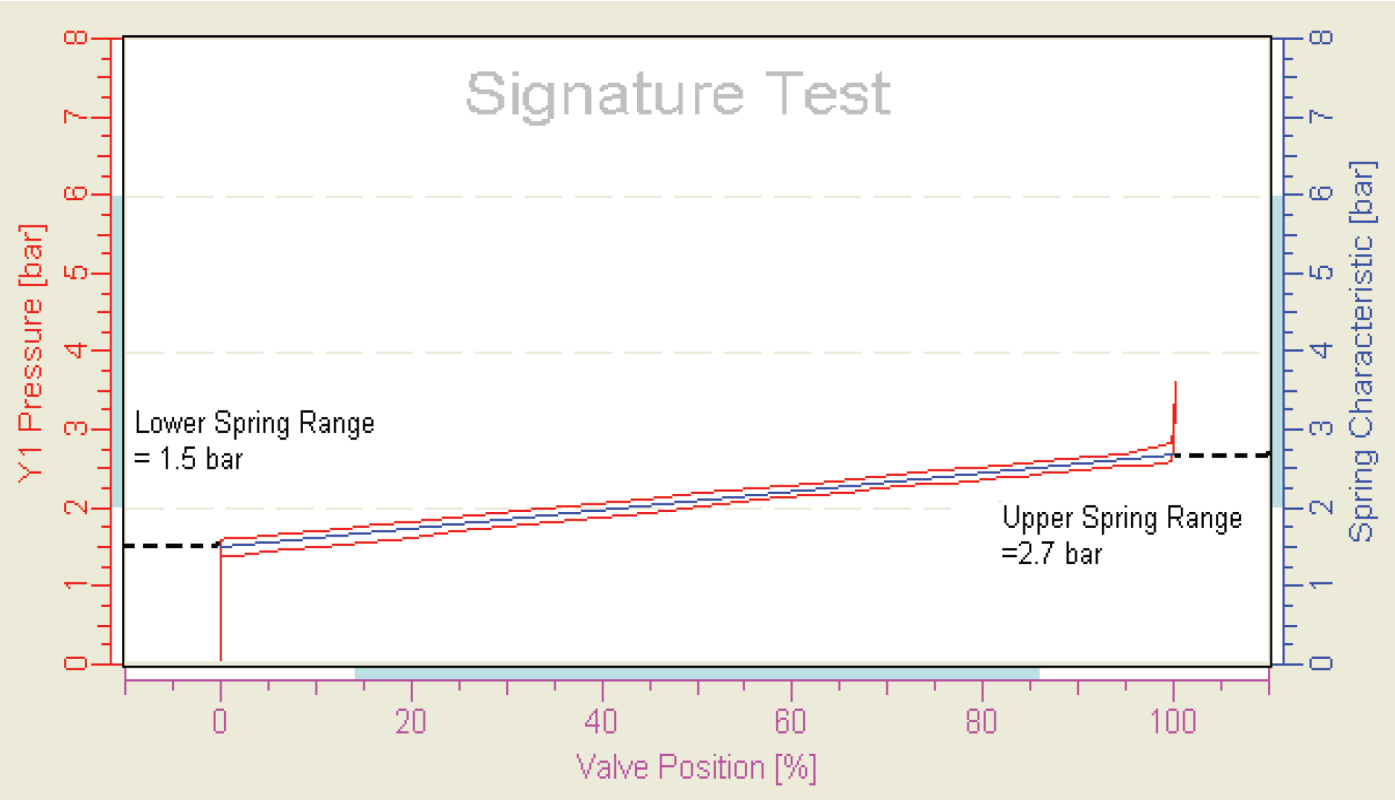
Friction Configuration

The ***Friction*** is a value to determine the force / friction between the stem and the packing during a movement. This measurement requires the optional ***pressure sensors*** to measure the ***supply pressure*** and the ***output pressure(s)***. Each time the stem or shaft moves, the positioner measures the pressure overshoots caused by the stick-slip effect and calculates within Milliseconds the values for the friction of the movement displayed as the ***Load Factor Value***.

Spring Range
Before an accurate friction measurement can take place, the value of the ***Spring Range*** that is listed on the valve label needs to be entered. The ***Spring Range*** is only applicable to single-acting (spring loaded) actuators and is defined with a lower and upper value. First select the ***Unit*** in ***psig, kPa or bar*** of how the ***Spring Range*** is defined then enter the ***Range***. The ***Range*** is configured as ***[lower value]*** to ***[higher value] psig/kPa/bar*** and identifies the valve movement from fully closed (at e.g. lower value 1.5 bar) to fully open (at e.g. upper value 2.7 bar).

From the software revision H17.50, the Spring range is automatically calculated by the positioned during the Autostart

In case the ***Spring Range*** is not available, it can also be determined using the Valve Footprint test (Offline Diagnostic → Test Overview). After an ***Autostart*** has been executed, launch the Valve Footprint test. Notice the pressure when the valve starts moving (Lower Spring Range) and the pressure when the valve is fully open (Upper Spring Range).



The default setting of the Spring Range is 1.2 bar – 2.0 bar. After configuration press ***Apply***.

Load Factor / Friction Alarm Limits

The ***Load Factor Alarm Limits*** can be freely defined and configured. The default setting of the ***Load Factor Alarm Limits*** is at 50% increase and -50% decrease in comparison to the ***Reference Value.*** Alarms are activated once the online measurement has exceeded the alarm thresholds defined under the upper- and lower limit.

3.1.10.7 LCD Page

The **LCD** page is used to configure the ***Text Orientation*** and the ***Language*** of the ***LCD***.

Text Orientation
This function defines if the reading of the LCD shall be Normal or Flipped.

Language
This function defines if the active menu language of the LCD shall be in English, German or in a third definable language.

Download of the Language Files from the Internet.
In order to download a new menu language into the device, you first have to download the required menu language from our internet. Go to the main page for the respective positioner and select under ***Text Files for LCD in foreign languages*** the ***download*** button next to it.

A window will open, showing several language files differentiated by the Hardware-Rev of the positioner. Select the desired menu language and download by using the right mouse button and by saving the file with ***save as*** in a freely definable file such as LCD menu-languages.

If you accidentally click onto this file with the left mouse button, the text file will open. This file cannot be downloaded. Go one step back then and redo this procedure correctly.

Positioner LCD Language Files
Texte für LCD-Anzeige in fremden Sprachen
for download --> PC --> SRD991/SRD960

The positioner with version LCD full text graphic has menu languages available in 3 languages. Standard programmed are English and German, the third menu language is freely definable and programmed according to customer order.
If a different third language than programmed is requested, you can **download** here the required language file:
Click (with right mouse button) onto the required language in the applicable rev. and select in the download window "save as".
Then download this file via PC20 / PC50 software from PC into the SRD.
[PC20: EDIT /Change Text Language / Select: File *.PLF]

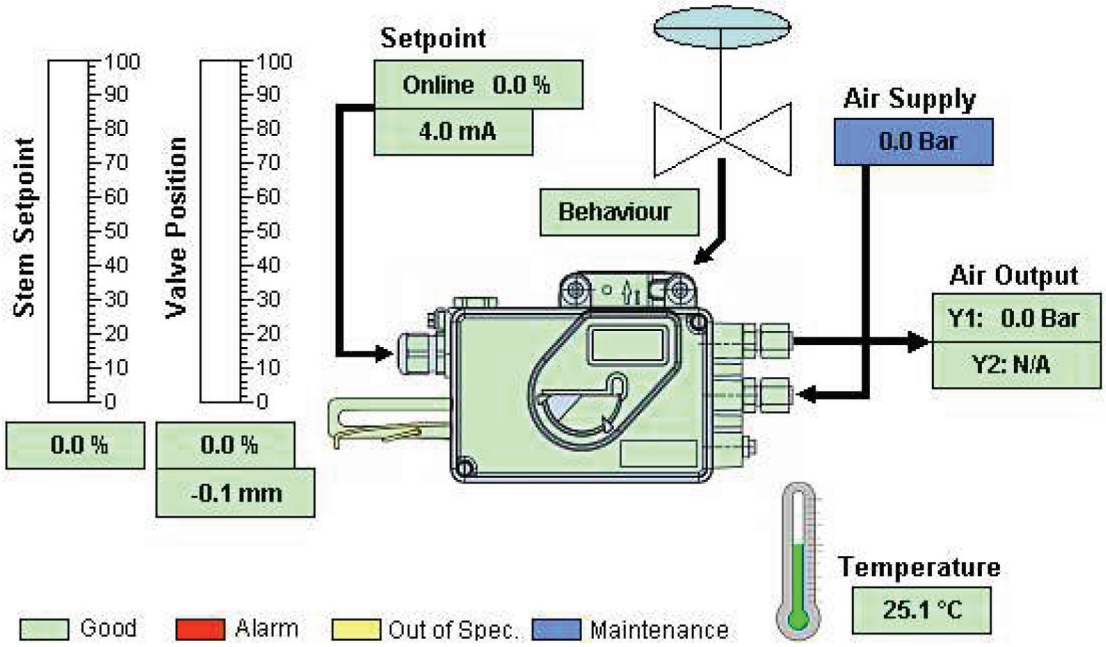
Im Stellungsregler mit LCD-Anzeige sind die Text-Darstellungen in 3 Sprachen eingespeichert. Fest eingestellt sind Englisch und Deutsch, die dritte Menüsprache ist wählbar und wurde nach Auftrag des Kunden eingespeichert.
Wenn eine andere 3.Sprache gewünscht wird als eingespeichert, so können Sie die entsprechende Sprachfile hier **downloaden**:
Klicken Sie (mit der rechten Maustaste) auf die gewünschte Sprache in der richtigen Rev. und wählen im download-Fenster "speichern unter".
Überspielen Sie dann diese File mittels PC20 / PC50 - Software vom PC in den SRD.
[PC20: EDIT /Change Text Language / Auswahl: File *.PLF]

Device Gerät		from Rev 3.3 ab Rev. 3.3	up to Rev 3.2 bis Rev. 3.2
SRD991 SRD960	CZ	czech	
	NL	dutch	
	E	espanol	espanol
	F	francais	francais
	I	italiano	italiano
	H	magyar	magyar
	MAL	malay	
	PL	polski	polski
	P	portuguese	portuguese
	RUS	russie	
	YU	srpski	srpski
	FIN	suomi	suomi
	SV	svenska	svenska

After the files have been downloaded to your computer, you can start the download into the positioned with the menu ***Advanced -> Language Download***.

3.2 ONLINE DIAGNOSTICS (DEVICE DATA)

3.2.1 Overview



Device data are displayed in the **Online Diagnostics** screen, in which major device measurements such as setpoint, position, temperature and air supply etc. are shown and cyclically updated.

For additional information, see:

Setpoint

This is a 4-byte real, expressed as percent. Since it is the digital setpoint, Setpoint source should be set to **Digital** in the configuration screen. This parameter provides a read back of the setpoint value that the positioner is currently using. (Default range is: 0.0 to 100.0 %). If the valve does not move upon a setpoint change, the user should check the following:

- Calibration (***Autostart*** or **Endpoint**) not done yet.
- I/P motor or preamplifier not functioning properly.
- Pneumatic amplifier not functioning properly.
- Hardware problem.
- Wrong setpoint source.
- Device in offline, calibrate or fail mode.

Valve Position

This is a 4-byte real, expressed as percentage. The normal operating range for the valve **position** is 0 to 100% of the full scale. If the valve position does not go to fully open or close, check:

- Inadequate supply pressure.
- Leakage in the pneumatic circuit (I/P motor, preamplifier, amplifier). Ensure all o-rings and restrictor plates are in place. Clean restrictors.
- Travel limits incorrectly defined.
- Cannot hold actuator pressure due to leakage in connection.
- Autostart or Endpoint calibration not conducted yet.

If the valve position exhibits unstable behavior check:

- ***Autostart*** is not complete.
- Positioner mounting problem.
- Tuning problem.
- Additional damping required.
- Hardware problem.

Stem Setpoint
This is a 4-byte real, expressed as percentage. The ***Stem setpoint*** corresponds to the ***Setpoint*** with in addition all the configurations affecting the travel, such as cutoff, limit or characterization.
For example, the ***Stem setpoint*** corresponding to a 98% ***Setpoint*** with a cutoff at 95% is 100% ; the ***Stem Setpoint*** corresponding to a 50% ***Setpoint*** with Equal Percentage characterization is 14,3%.

Control Difference
This is a 4-byte real parameter. This measurement indicates the difference between the setpoint and actual position. The calculation is done by the Control Processor.

The difference between position and setpoint, defined as the ***Control Difference*** is another variable which can be used to setup an alarm. If this error exceeds the ***Control Difference Limit*** **(%)** for more than a specified time in seconds (***Control Difference Time***), then an alarm will betriggered.

Travel Position
The travel position is a 4-byte real which shows the valve position in the units selected in the **Units** screen.

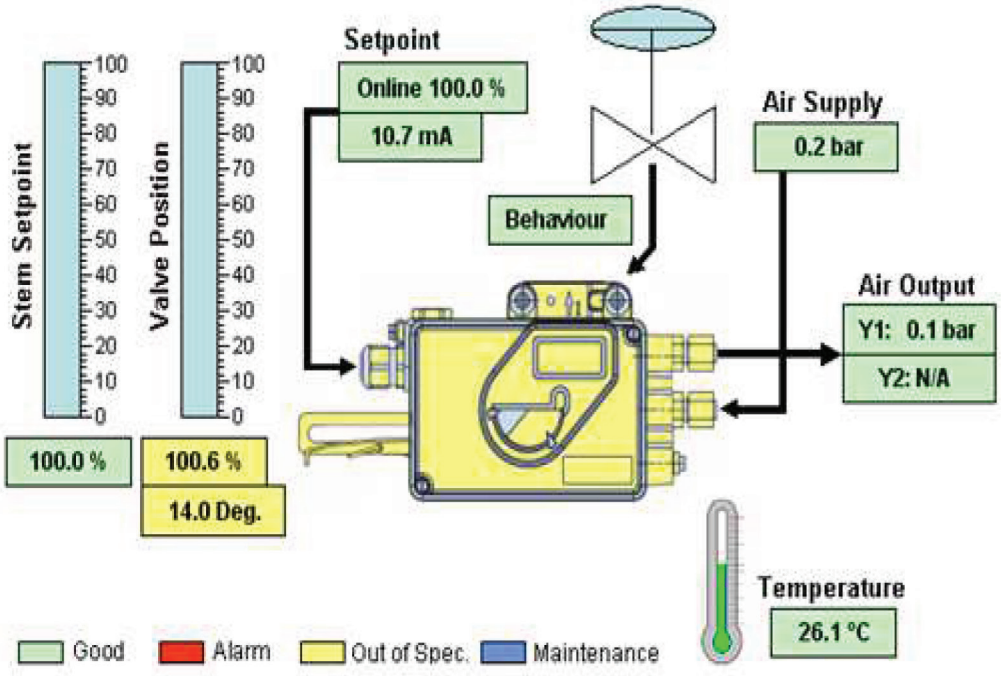
Internal Temperature
This is a 4-byte real parameter. Its value represents the PCB temperature in degrees Celsius. If the internal temperature of the positioner is outside the **Upper and Lower Temperature Limits** displayed in the alarm page, an alarm will be raised.
Warning: Operating the positioner outside these limits may cause permanent damage and violate hazardous safety conditions.

Air Supply Pressure
This is a 4-byte real. The measurement reflects the current value on the optional air supply pressure sensor.

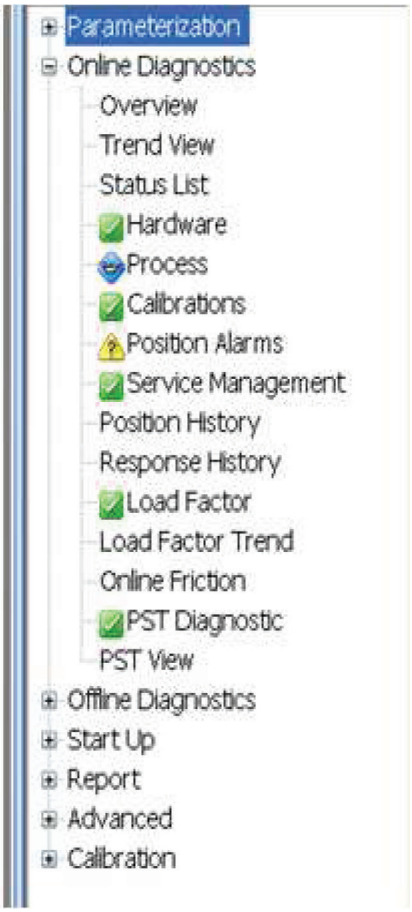
Output Pressure
This is a 4-byte real. The measurement reflects the current value on an optional output pressure sensor.

Analog Setpoint
This parameter provides the analog setpoint in mA which is currently applied to the positioner.
For digital positioners (FoxCom, Profibus, Foundation Fieldbus (FF)) the actual loop current is displayed.
To configure the Setpoint Source, see Configuration Page

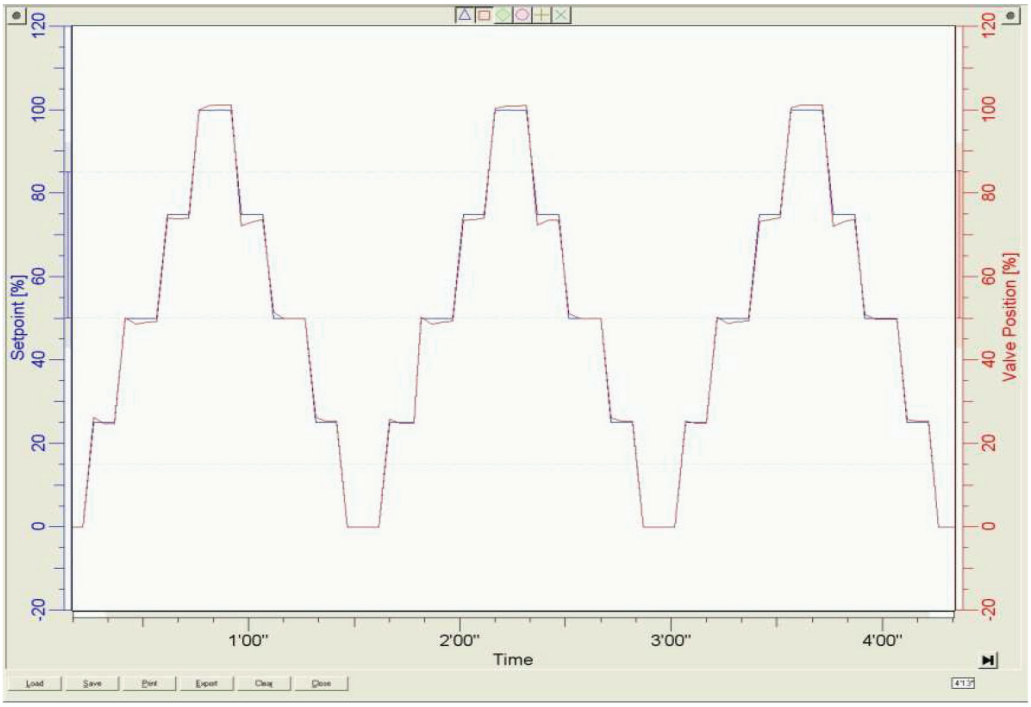
For the SRD991 there are a plenty of data defined in the device to provide information about the device status, control behavior, measurement healthy and history trend. The device picture shown in the centre of the **Online Diagnostics** screen is used to collect all such information and enables an overview on the status of the whole device. The picture remains green if the status is good, and turns red, blue or yellow if the device has error.



In case of error the device needs to be diagnosed. The pages under the **Online Diagnostics** item provide further information to help locating the error. Such information is grouped into **process**, **hardware**, **calibration** and **service management** and so on. The green logo in front of the affected field turns red or blue or yellow according to the error's nature. For example, for the following case, the Process page has a Maintenance error and the Position Alarm has an Out of Spec. error.



3.2.2 Trend view



With the ***Trend Viewer*** the different values over time can be displayed. This trending tool collects and displays important 'live' data of the positioner. The graphs could be used to check the control behavior and the 'valve health'.

With the Setpoint function it is possible to change the setpoint of the valve and display the measured data of the positioner. It is possible to print and store the tending results.

3.2.3 Status list (NE107)

With this ***Diagnostic Status List*** the SRD offers the most enhanced self surveillance and diagnosis monitoring capabilities available on the market.

Self-surveillance and diagnosis monitoring is following the ***Namur Recommendation NE107***. This recommendation defines unified status messages for field devices, providing the user with information about the state of the field instrument. The available information indicates clearly what device-alarm was activated, where the alarm initiated from, possible reason for the alarm and what corrective actions need to be initiated to restore a normal operating state. In the illustration the realization is shown. All alarms are generated in the positioner and can be uploaded at any time. The columns show the displayed status messages, e.g. control difference, air supply pressure alarm, high friction alarm, current or historical message, a full text description explaining the possible reason for the status message, and the actions for maintenance

Status	Current	Historical	Category	Description	Action	#
Position High Alarm	(1) INFO	(1) INFO	Position	Position above High Alarm Setpoint.	Monitor situation or correct cause.	256
Position Low Alarm (Hist)	(0) OK	(1) INFO	Position	Position below Low Alarm Setpoint.	Monitor situation or correct cause.	33554432
Zero-Point-Deviation Warning (Hist)	(0) OK	(5) Maintenance Required	Position	The plug or seat of the valve shows signs of a wear. The deviation is according to the specified value under Position Low Alarm. A) Globe Valves: There is a possibility of a leakage. The valve might not close correctly. B) Rotary-/ Butterfly-Valves: There is a possibility of a leakage.	Actions might need to take place. Please be aware of differencies between globe and butterfly valves. A) Globe valves: The valve needs to be inspected very soon. B) Rotary-/ Butterfly-Valves: The valve needs to be inspected very soon.	33554432
Position High High Alarm	(1) INFO	(1) INFO	Position	Position above High High Alarm Setpoint.	Monitor situation or correct cause.	1024
Position Low Low Alarm (Hist)	(0) OK	(1) INFO	Position	Position below Low Low Alarm Setpoint.	Monitor situation or correct cause.	134217728
Zero-Point-Deviation Alarm (Hist)	(0) OK	(6) Failure	Position	The plug or seat of the valve shows signs of a wear. The deviation is according to the specified value under Position Low Low Alarm. A) Globe valves: The plug or seat of the valve shows inadmissible signs of a wear. The pre-alarm limit has been exceeded. There is a possibility of a leakage. The valve might not close correctly. B) Rotary-/ Butterfly-Valves: There is a possibility of a leakage.If the nominal travel at 0% of the actuator / valve has been reconfigured, this alarm can be identification for a fully shut valve.	Actions might need to take place. Please be aware of differences between globe and butterfly valves. A) Globe valves: The valve needs to be inspected now. B) Rotary-/ Butterfly-Valves: Actions might need to take place.	134217728
Control Diff OOL	(5) Maintenance Required	(5) Maintenance Required	Mechanics	Difference between applied digital or analog setpoint and actuator-/valve-position exceeds allowed limit for a user specified time	Check to ensure that there is adequate supply pressure. Verify tuning parameters. Check mechanics of actuator and valve. Refer to troubleshooting sectoin of MI EVE 0105 A.	4096
Air Supply Pressure Alarm	(5) Maintenance Required	(5) Maintenance Required	Process	The Air Supply Pressure falls below the configured Lower Limit.	Check to ensure that there is adequate supply pressure.	16384
Output 1 Pressure Alarm	(5) Maintenance Required	(5) Maintenance Required	Process	The positioner can not regulate the Output Pressure.	Check pneumatics.	32768
Pneumatic Failure	(6) Failure	(6) Failure	Process	This Alarm indicates a critical state for the operation of the device. The supply pressure has failed and caused a remaining control deviation.	Check if the filters are obstructed. Restore the supply pressure and check the control behavior.	16384
Actuator Leakage	(6) Failure	(6) Failure	Process	This Alarm indicates a critical state for the operation of the device. The supply pressure can be measured, but the valve cannot be moved. The positioner identifies a remaining control deviation.	Check the pneumatics and the piping to the actuator.	32768
Actuator OOR	(6) Failure	(6) Failure	Mechanics	This Alarm indicates a critical state for the operation of the device. The valve position is not within permissible range of mechanical stops that were determined during the initial start-up. The fingerprint data differ and are outside the allowed range (valve-position: < -5% / > +105%).	Check mechanical connection between the positioner and the actuator / valve. Perform Endpoints Calibration. This can also be a sign of wear on the plug or seat. Check if they are still in tact.	16
Service Management	(5) Maintenance Required	(5) Maintenance Required	Service Management	The Service Reminder has activated the message for a required service. The Service Reminder, Cycle Counter or Travel Sum is above the specified limits. The Partial Stroke test (PST) may have failed.	Follow the rules a service interval. Check the filters, check the pneumatic output by using Menu 7 (Pneumatic Output) and/or by applying setpoint changes by using Menu 8 (Menual setpoint)	1
Power Supply Low (Hist)	(0) OK	(3) Out of Specification	Process	Power Supply below allowed limit. 4-20 mA / HART: Operation below 3.8 mA. Fieldbus / FoxCom: Operation below 9 mA.	Operation below power supply limit (see PSS for details) may cause the positioner to go into failsafe. The communication to the control system might be disturbed. Ensure that the minimum power supply is supplied to the unit.	1

Close Print Stop Update

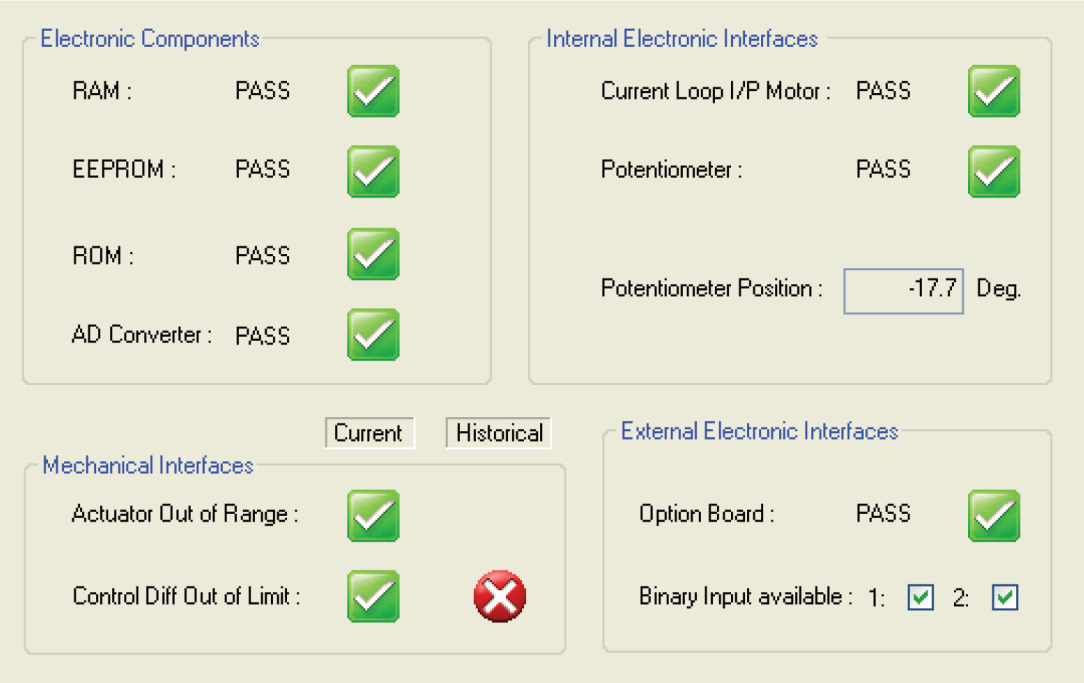
Status indicators are distinguished by messages and color-coding similar to traffic signals:

Red	Failure
Yellow	Maintenance Required
Green	OK
Gray	INFO
Gray	Out of Specification

Green indicates that no status messages are present; grey that a status message is present but no maintenance is required; yellow that maintenance is required but an operation is still possible; red indicates a device failure that requires an immediate service. Comparing the historical and current alarm supports the operator if all messages have been eliminated.

Details can also be retrieved from the ***Diagnostics Status Detail***.

3.2.4 Hardware Status



Electronic Components	Status	Description / Explanation	Recommended Action
RAM	Failure	**This Alarm indicates a critical state for the operation of the device.** Error Writing into positioner memory.	Replace electronic board or complete positioner.
EEPROM	Failure	**This Alarm indicates a critical state for the operation of the device.** Error Writing into positioner EEPROM.	Replace electronic board or complete positioner.
ROM	Failure	**This Alarm indicates a critical state for the operation of the device.** Error Writing into positioner ROM.	Replace electronic board or complete positioner.
AD Converter	Failure	**This Alarm indicates a critical state for the operation of the device.** Converter function not controllable.	Replace electronic board or complete positioner.
Mechanical Interfaces		**Critical Alarm Status**	**Do not continue to operate the unit until the failure has been eliminated.**
Actuator OOR	Failure	**This Alarm indicates a critical state for the operation of the device.** The valve position is not within permissible range of mechanical stops that were determined during the initial start-up. The fingerprint data differ and are outside the allowed range (valve-position: < -5% / > +105%).	Check mechanical connection between the positioner and the actuator / valve. Perform Endpoints Calibration. This can also be a sign of wear on the plug or seat. Check if they are still in tact.

Control Diff OOL	Maintenance Required / Service /	Difference between applied analog or digital setpoint and the corresponding valve position. The values exceed the allowed limit in connection with a specified time limit. The default values are 5% within 60 Seconds.	Check if supply pressure is adequately supplied. Verify the tuning parameters. Check mechanical connection to the actuator and valve. Check configured alarming values under ***Alarms/Control Difference Alarm.*** If pressure sensors are applied and the ***Load Factor*** is available, check if ***Load Factor/High Friction Alarm*** is active. In this case the friction of the packing is too high and causes the stem movement to block. Refer to troubleshooting section of MI.
Internal Electronic Interfaces			
Current Loop I/P Motor	Failure	Connection of I/P converter to electronic board is faulty.	Connect I/P-.converter to the electronic board. Restart the positioner. If the error is still active, replace the positioner.
Potentiometer	Failure	Connection of potentiometer to electronic board is faulty.	Connect potentiometer to the electronic board. Restart the positioner. If the error is still active, replace the positioner.

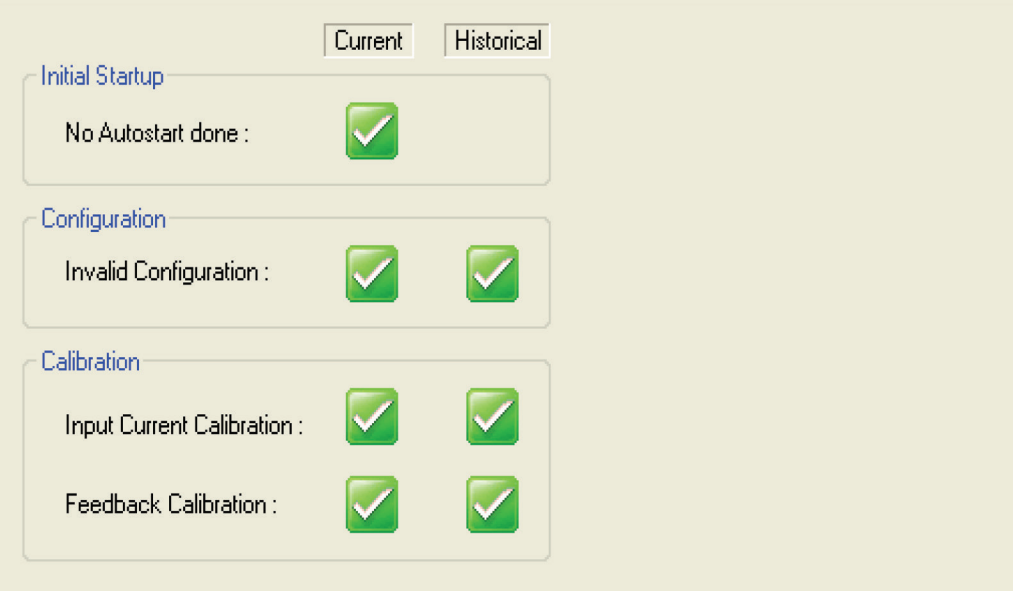
Binary Input indicates which of the binary input channels is active.

3.2.5 Process Status

Message	Status	Description / Explanation	Recommended Action
Temperature High	Out of Specification	Temperature above allowed limit.	Operation outside temperature limit (>80°C/176°F) may damage positioner components and violate electrical safety certification requirements. Stop operating positioner.
Temperature Low	Out of Specification	Temperature below allowed limit.	Operation outside temperature limit (<40°C/40°F) may damage positioner components and violate electrical safety certification requirements. Stop operating positioner.
Power Supply High	Out of Specification	Power Supply above allowed limit. 4-20 mA / HART: Operation above 22 mA Fieldbus / FoxCom: Operation above 12 mA	Operation outside power supply limit (see PSS for details) may damage positioner components and violate electrical safety certification requirements. Stop operating positioner. Ensure that the maximum power allowed supply is supplied to the unit.
Power Supply Low	Out of Specification	Power Supply below allowed limit. 4-20 mA / HART: Operation below 3.8 mA Fieldbus / FoxCom: Operation below 9 mA	Operation below power supply limit (see PSS for details) may cause the positioner to go into failsafe. The communication to the control system might be disturbed. Ensure that the minimum power supply is supplied to the unit.
Air Supply Pressure Alarm	Service / Maintenance Required	The Air Supply Pressure falls below the configured Lower Limit.	Check if the adequate supply pressure is applied.
Output	Service /	The positioner can	Check pneumatics. Check tubing to the

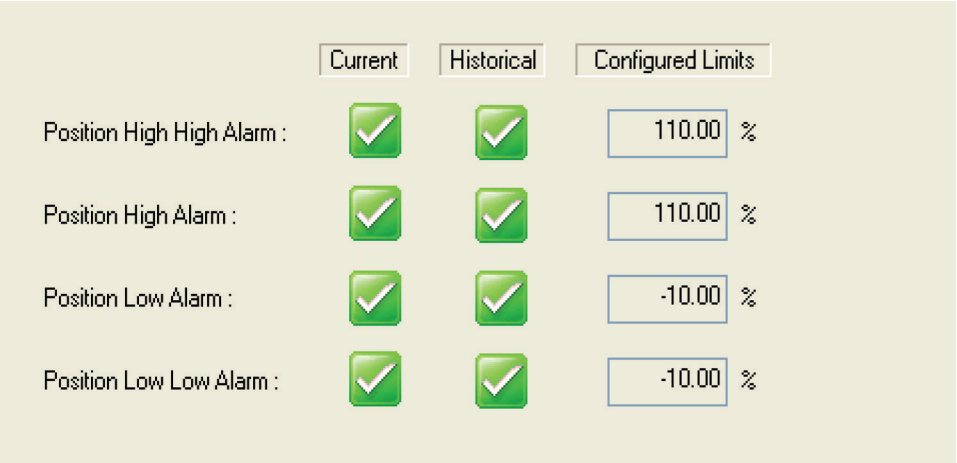
Pressure Alarm	Maintenance Required	not regulate the Output Pressure.	actuator. Check for leakages caused by the diaphragm.
Maximum Temperature	-	Shows the maximum measured temperature during operation.	Shows the exact value of the maximum temperature ever measured to ensure that the ***High Temperature*** limits (>80°C/176°F) are not reached.
Minimum Temperature	-	Shows the minimum measured temperature during operation.	Shows the exact value of the minimum temperature limit ever measured to ensure that the ***Low Temperature*** limits (<40°C/40°F) are not reached.
Maximum Air supply		Shows the maximum measured pressure supply during operation	Shows the exact value of the maximum pressure ever measured to ensure that the ***Maximum Air Supply*** limits (6 bar / 7 bar for spoolvalve) are not reached.
External Sensor	INFO	An external mechanical switch has activated the Binary Input.	Depending on the reason for activating the switches

3.2.6 Calibration Status



Message	Status	Description / Explanation	Recommended Action
No Autostart done		No Autostart was done or Autostart was run and did not complete successfully.	Ensure proper mounting of positioner and adequate supply pressure. Refer to online Help for other potential causes. Rerun Autostart Calibration procedure.
Invalid Configuration	Maintenance Required	Invalid configuration.	Correct configuration, perform Restore Factory Settings, rerun Autostart procedure.
Input Loop Trim	Maintenance Required	Input signal requires calibration.	Perform Analog Setpoint Calibration procedure.
Feedback Trim	Maintenance Required	Feedback unit requires calibration.	Perform Angle Calibration procedure.

3.2.7 Position Alarms



Message	Status	Description / Explanation	Recommended Action
Position High Alarm	INFO	Position above High Alarm Setpoint.	Monitor situation or correct cause.
Position Low Alarm	INFO	Position below Low Alarm Setpoint.	Monitor situation or correct cause.
Position High High Alarm	INFO	Position above High High Alarm Setpoint.	Monitor situation or correct cause.
Position Low Low Alarm	INFO	Position below Low Low Alarm Setpoint.	Monitor situation or correct cause.

3.2.8 Service Management

The ***Service Management*** provides information about the ***Actual Time in Operation***, ***Time Since Last Service*** as well as the ***Cycle Counter*** and ***Travel Sum***. It helps the operator to see how long the unit has been in total operation and when the device had been serviced the last time. Combined with the information of the cycle counter and the travel sum, a full picture of the control valve condition is available.

Actual Time in Operation
This ***Actual Time in Operation*** shows the full time the positioner was in operation. The counter starts as soon as the power is connected to the unit. The value cannot be reset, unless the power supply is switched off.

Time Since Last Service
This ***Time Since Last Service*** shows the time the positioner was in operation since the last time the ***Service Time*** has been reset. To reset this value go to ***Reset Valve Diagnosis***.

Cycle Count
The ***Cycle Counter*** counts the number of changes in direction of the valve movement.

Travel Sum
The ***Travel Sum*** accumulates the movement of the actuator/valve.

Service Reminder
The ***Service Reminder*** [in hours] is used in connection with the value for the ***Actual Time in Operation*** [in hours]. The ***Actual Time in Operation*** provides the information how long the total operation time of this unit is. Once this value exceeds the value configured under ***Service Reminder***, a status bit is set, informing that the device needs to be serviced. In addition the ***Status of Service Interval*** will switch from ***Good*** to ***Service***. The device also shows the ***Time Since Last Service*** [in hours].

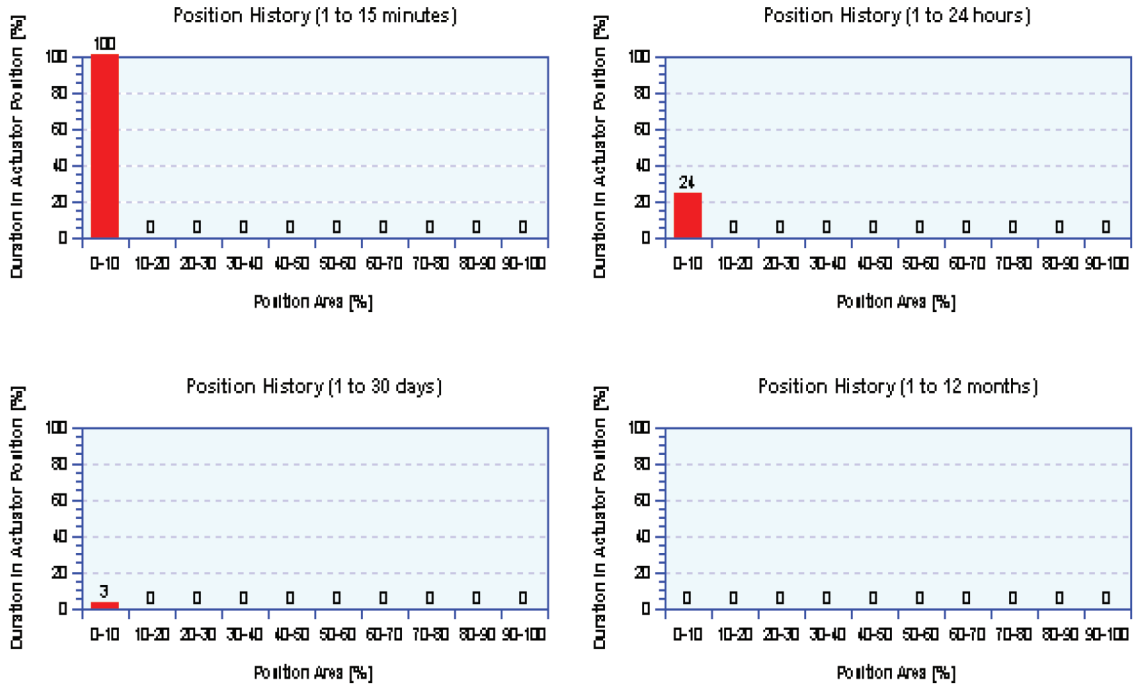
Cycle Count Limit
The ***Cycle Count Limit*** defines the value when an alarm, for reaching a certain ***Cycle Count*** value, shall be activated.

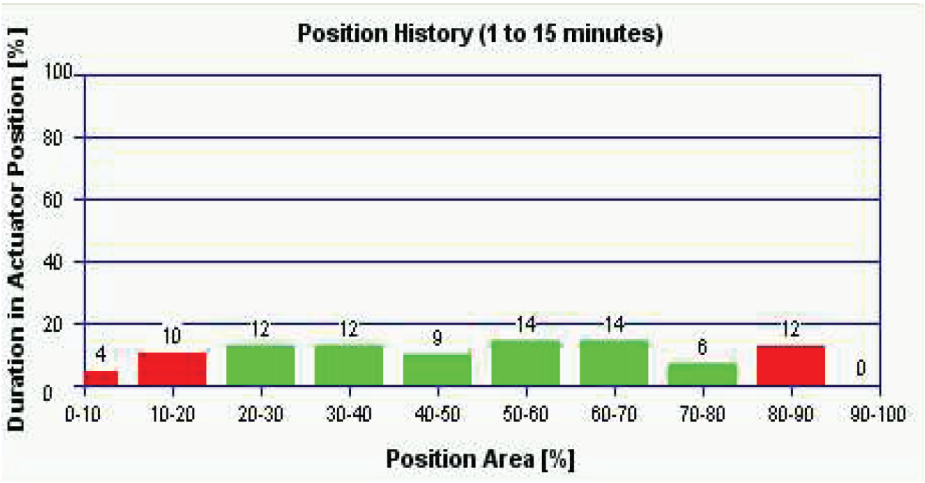
Full Stroke Limit
The ***Full Stroke Limit*** defines the value when an alarm, for reaching a certain ***Travel Sum*** value, shall be activated.

Message	Status	Description / Explanation	Recommended Action
Service Management	Good	The ***Service Reminder***, ***Cycle Counter*** and ***Travel Sum*** is within the specified limits. The ***Partial Stroke test (PST)*** has passed all test cases with Good.	Nothing
Service Management	Service / Maintenance Required	The Service Reminder has activated the message for a required service	Follow the rules a service interval. Check the filters, check the pneumatic output by using Menu 7 (Pneumatic Output) and/or by applying setpoint changes by using Menu 8 (Menual setpoint)

3.2.9 Position History

Position Histograms



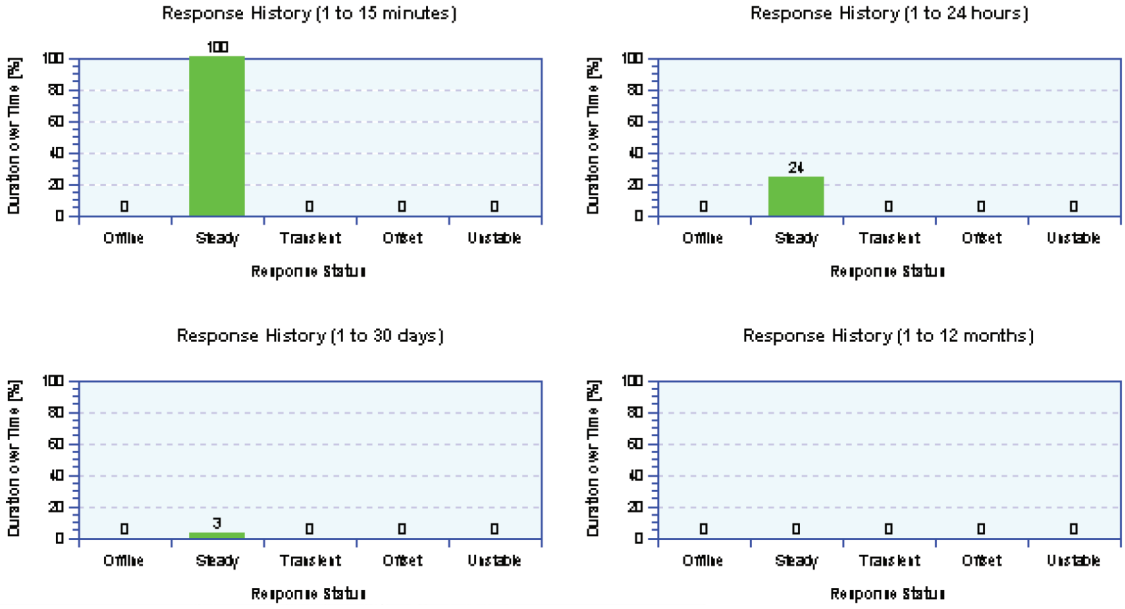


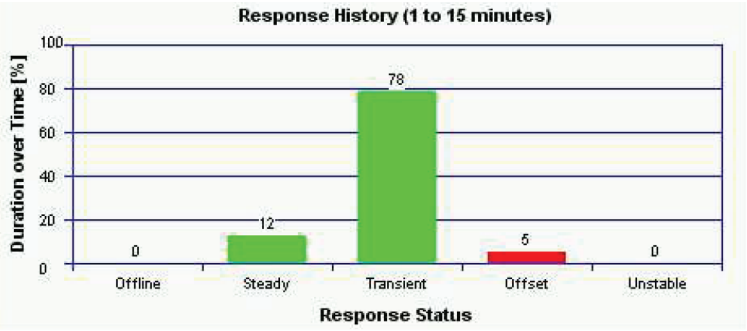
The ***Position History*** is a Histogram that shows the percentage of the actuator/valve duration in a specific valve position. The histogram is divided into 10 segments, each representing a ratio of 10% valve position (0 to 10%, 10-20% etc.). The ***Position History*** can display 4 different ***History Intervals***. These Historians allow seeing the valve positions up to the last 60 months. The 4 Historians can be configured under ***Parameterization/Maintenance/History Interval***.

Every 24 hours the collected data is stored inside of the positioner-memory. Therefore the information can be retrieved at any later time for diagnostic purposes. This feature allows for instance to identify, if the valve is over- or under-specified. It will show the exact operating range of the positioner over time.

The exact percentage of each position history is identified by the values listed above the histograms.

3.2.10 Response History





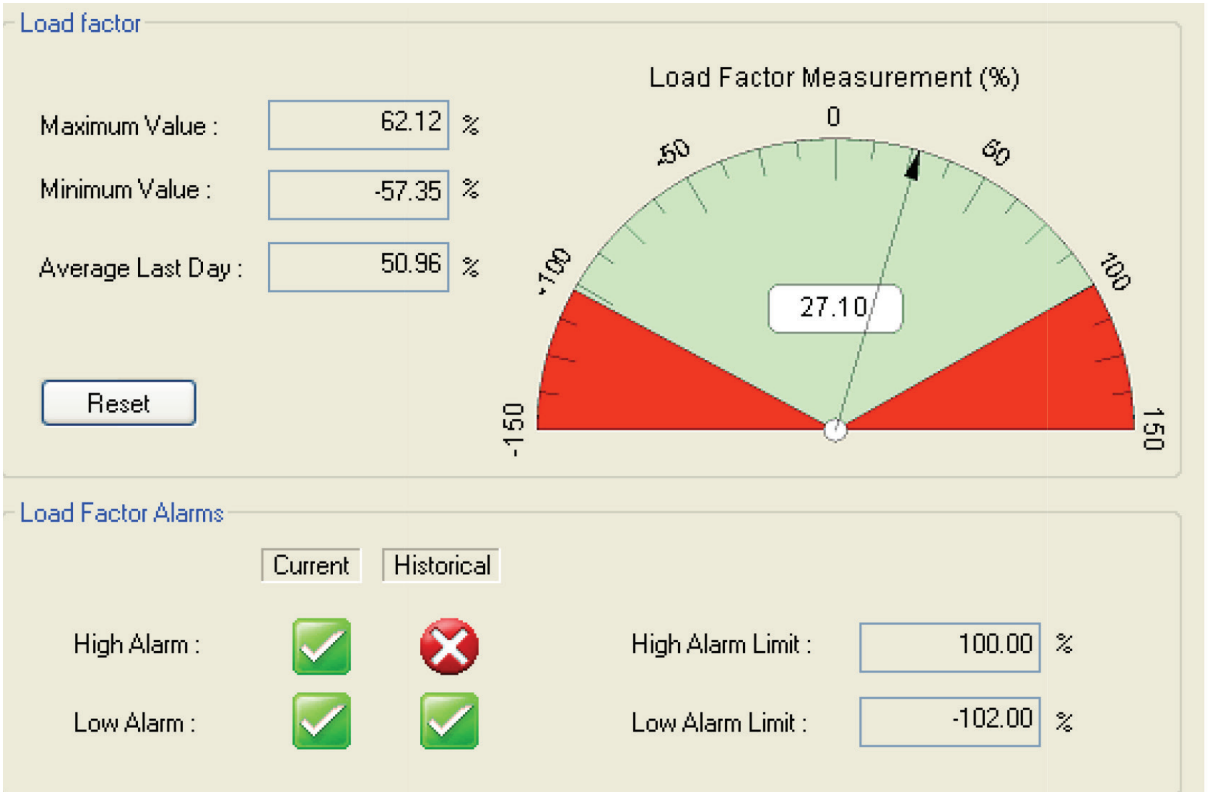
The ***Response History*** is a Histogram that shows the control behavior of the actuator/valve in percentage over time. The histogram is divided into 5 segments, each representing a specific control behavior. This allows identifying if an actuator/valve is predominantly in a steady state, transient, offset for instance if there is a constant control deviation between the setpoint and the valve position or if it's unstable.

The exact percentage of each response behavior is identified by the values listed above the histograms.

- ***Offline***. This value is increased if the positioner is powered up, but the Autostart has not been activated yet, or the positioner has manually been put into the device status Offline.
- ***Steady***. This value is increased if the positioner is in control, but not moving. The setpoint and the valve position are constant at a certain value. See Position History for exact valve position.
- ***Transient***. This value is increased if the positioner is online and constantly moving.
- ***Offset***. This value is increased if the positioner identifies a deviation between the setpoint and the valve position, greater than the specified control deviation configured under alarms.
- ***Unstable***. This value is increased if the positioner is continuously oscillating around a constant setpoint. An Unstable behavior in the control can occur, if there's a leakage in the actuator diaphragm, a leakage in the output-pressure connection between the positioner and the actuator or if the stem-lock or coupling is shifting.

The ***Response History*** can display 4 different ***History Intervals***. These Historians allow seeing the response behavior up to the last 60 months. The 4 Historians can be configured under ***Parameterization/Maintenance/History Interval***.

3.2.11 Load Factor



This page only shows measurements and alarms. The configurations are done on the ***Press / Load Factor*** page under ***Parametrization → Option***.

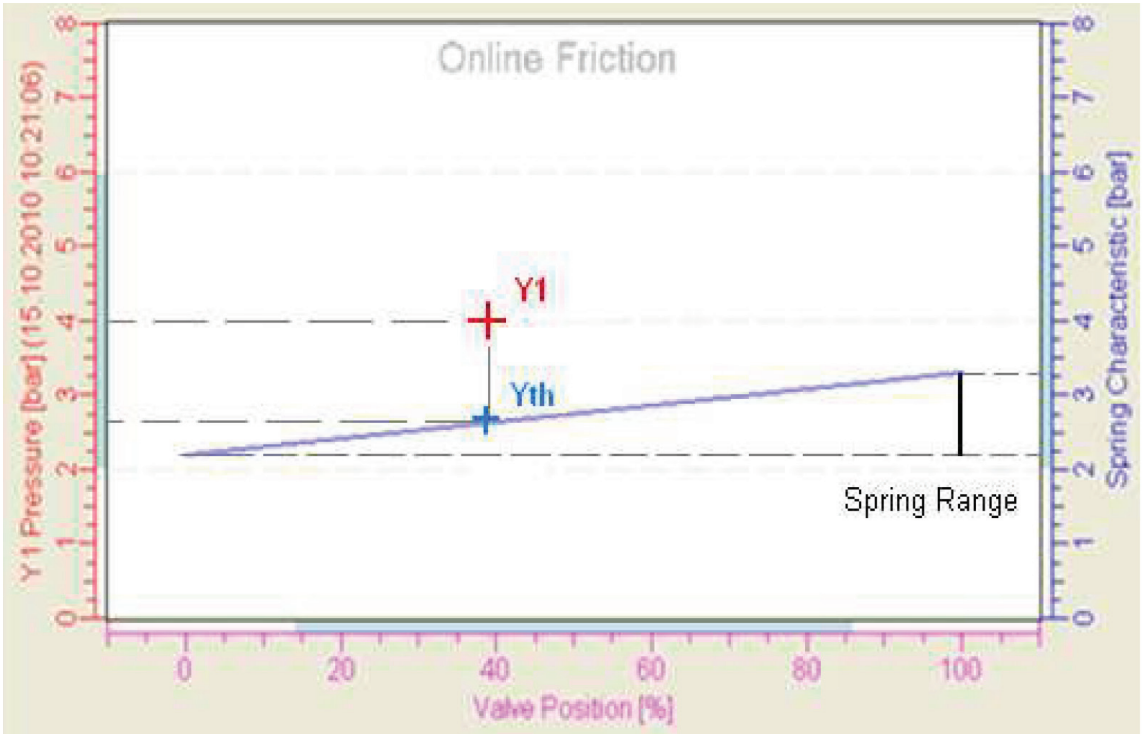
The Load Factor is a representation of the total friction in the valve. Each time the stem or shaft moves, the positioner measures the pressure overshoots caused by the stick-slip effect and calculates every 200ms the values for the friction of the movement displayed as the ***Load Factor Value.***

The Load Factor is the difference between the necessary pressure and the theoretical pressure to reach a given position, compared to the Spring Range.

$$\text{Load Factor (\%)} - \frac{Y_1 - Y_{th}}{\text{Spring Range}}$$

The Spring Range is the difference between the higher value of the Spring Range and the lower value. These values are configured in the ***Press / Load Factor*** page under ***Parametrization → Option***.

The Spring characteristic (in blue) gives the theoretical pressure value for each point of the stroke.



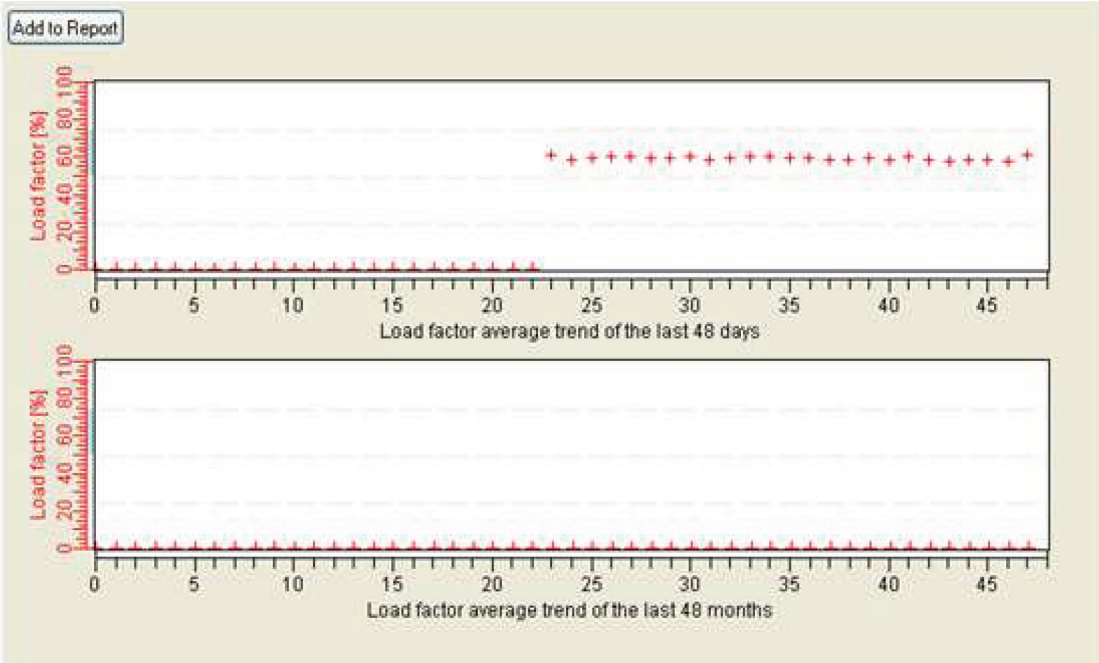
The ***Load Factor*** window shows the numerical values of the Maximum Load Factor and Mimimum Load Factor since the last reset and the Average of Last Day's Load Factor. In the friction dial, the Online Load Factor is shown. The Online Load Factor is calculated every 200ms. Every 24 hours, the Average Load Factor is calculated and saved in the EEPROM. The value is also carried forward in the Average of Last Day textbox and in the ***Load Factor Trend.***

The Load Factor Alarms window shows the Alarms status and the set values.
The Alarms values are configured in the ***Press / Load Factor*** page under ***Parametrization → Option.***

Alarms are activated once the average value of the measurements from the last 24 hours has exceeded the alarm thresholds defined under the upper- and lower limit. The logo for current Alarm turns red and the Alarm activation is registered in the Status List. The activation remains until the average value goes back below the limits. Then, the Historical Alarm turns red, until the next Reset Status

Note:
After initial start-up the ***Load Factor Value*** can be very high, because the ***Spring Range*** originally could have been out of scale. In this case, click on ***"Reset"*** or go to ***Reset Valve Diagnosis*** and check the box for the Load Factor ***Friction History*** and press ***Continue***. The data in the fields for ***Measured Value***, ***Minimum Value***, ***Maximum Value*** will be reset.

3.2.12 Load Factor Trend



The Load Factor is a representation of the total friction in the valve. Each time the stem or shaft moves, the positioner measures the pressure overshoots caused by the stick-slip effect and calculates every 200ms the values for the friction of the movement displayed as the ***Load Factor Value.***

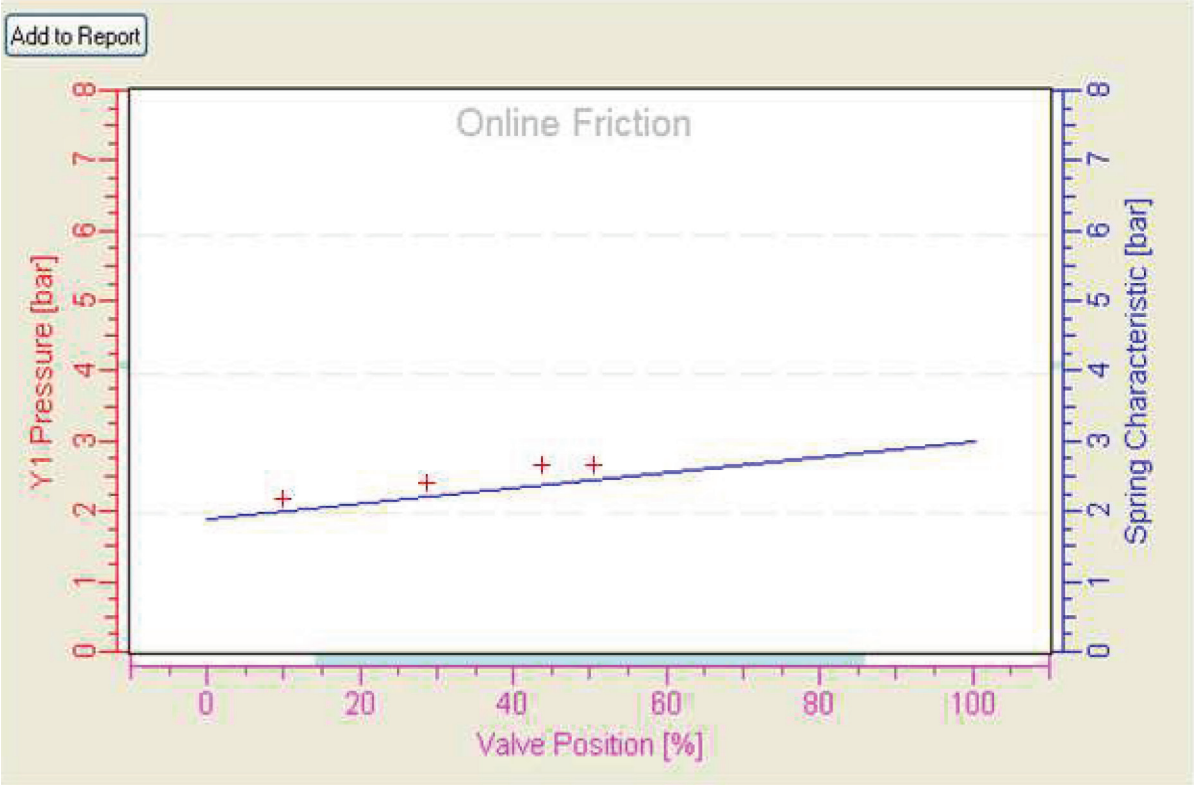
The ***Load Factor Trend*** is important information as regards maintenance. It enables to follow the valve's condition. An increasing trend can warn about valve sticking. On the contrary, a decreasing trend can be a sign of a stem packing's consumption. Therefore, a predictive maintenance is possible. The ***Load Factor Trend*** page shows the average value of friction over the past 48 days and the past 48 months, registered in two graphs.

Every 24 hours, the Average Load Factor is calculated and saved in the EEPROM. The value is also carried forward in the Average of Last Day textbox and in the "*Load Factor Average Trend of the last 48 days"* graph.

Each month, the Monthly Average Load Factor is calculated and carried forward in the EEPROM and the "*Load Factor Average Trend of the last 48 months".* The Monthly value is calculated from the last 30 Average values.

Graphs can be copied in the Report by clicking on "Add to Report" button.

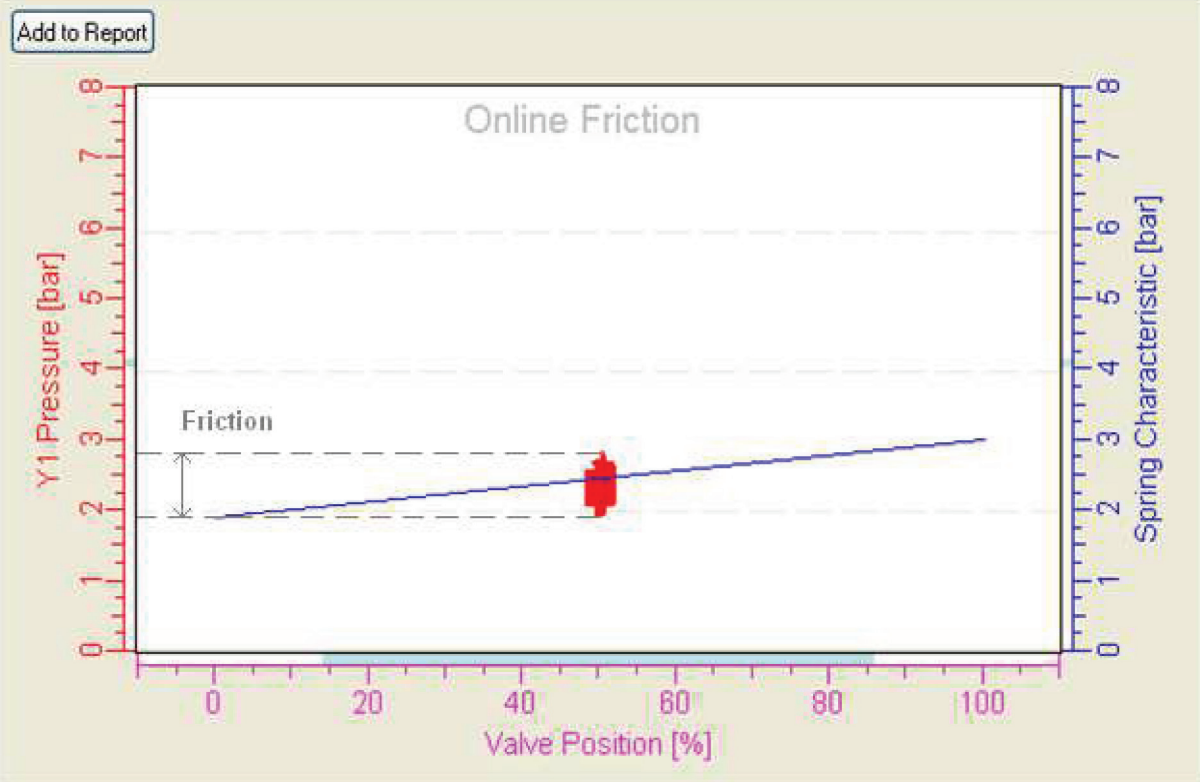
3.2.13 Online Friction



The Online Friction graph provides the measured output pressures for a given position. Every 2 seconds, the positioner signs at its position the value of pressure of the active pressure output (for example Y1). Every 2 second, and when the Online Friction window is open, the registration goes ahead.

In case of single acting actuator, to reach a given position, a certain amount of pressure has to be supplied against spring restoring force (single acting). The blue line is the Spring characteristic of the actuator, that is the theoretical pressure to apply in order to move the actuator. The red crosses are output pressures measured for each position of the valve. The difference for a given position between the theoretical value and the measured pressure is due to the valve friction.
The Online Friction helps to understand how important the friction is.

The Spring Characteristic has to be entered manually by operator at first use in the ***Press / Load Factor Page (Parameterization -> Options).***

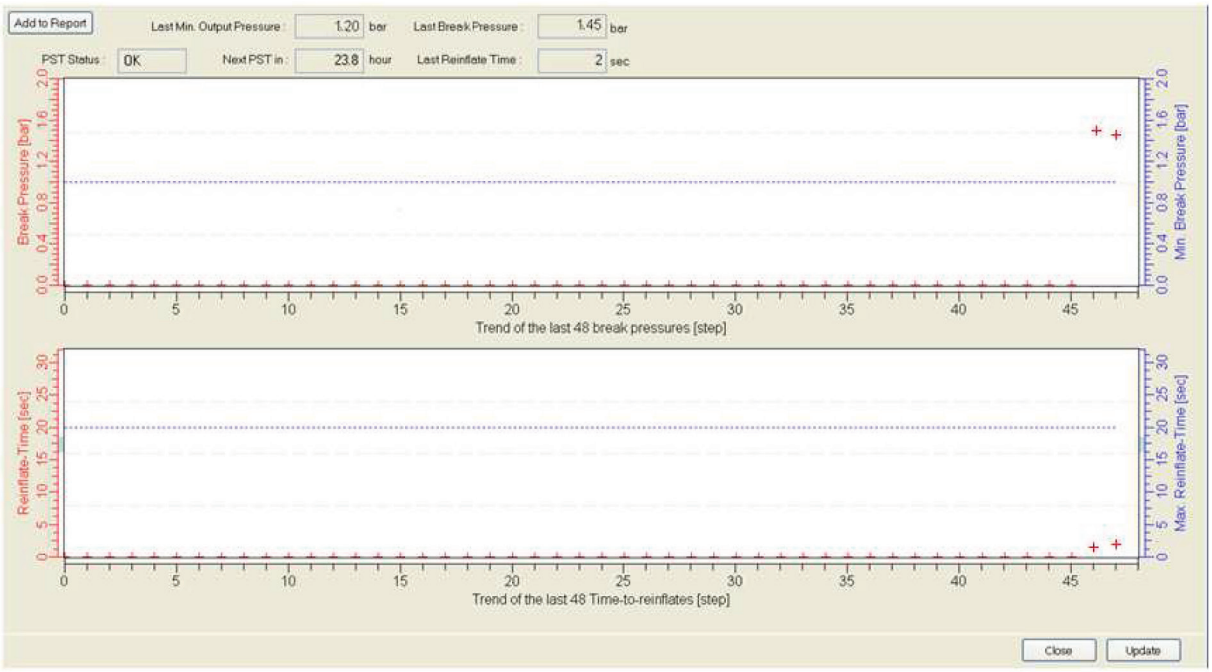


The red stain in the above picture is in fact a scatter plot of red crosses. At a given point, e.g. 50% of the stroke, the output pressure may vary, since the positioner is regulating. This hysteresis gives the amplitude of the friction.
The higher is the hysteresis, the bigger is the friction

In case of double acting, the positioner adjusts pressures Y1 and Y2 in both chambers of the actuator. Usually, there is no spring, as a result no valuable Spring Characteristic. The difference between the output pressure Y1 when the valve is opening and the output pressure Y1 when the valve is closing gives the friction.

Graph can be copied in the Report by clicking on “Add to Report” button.

3.2.13 PST Diagnostic

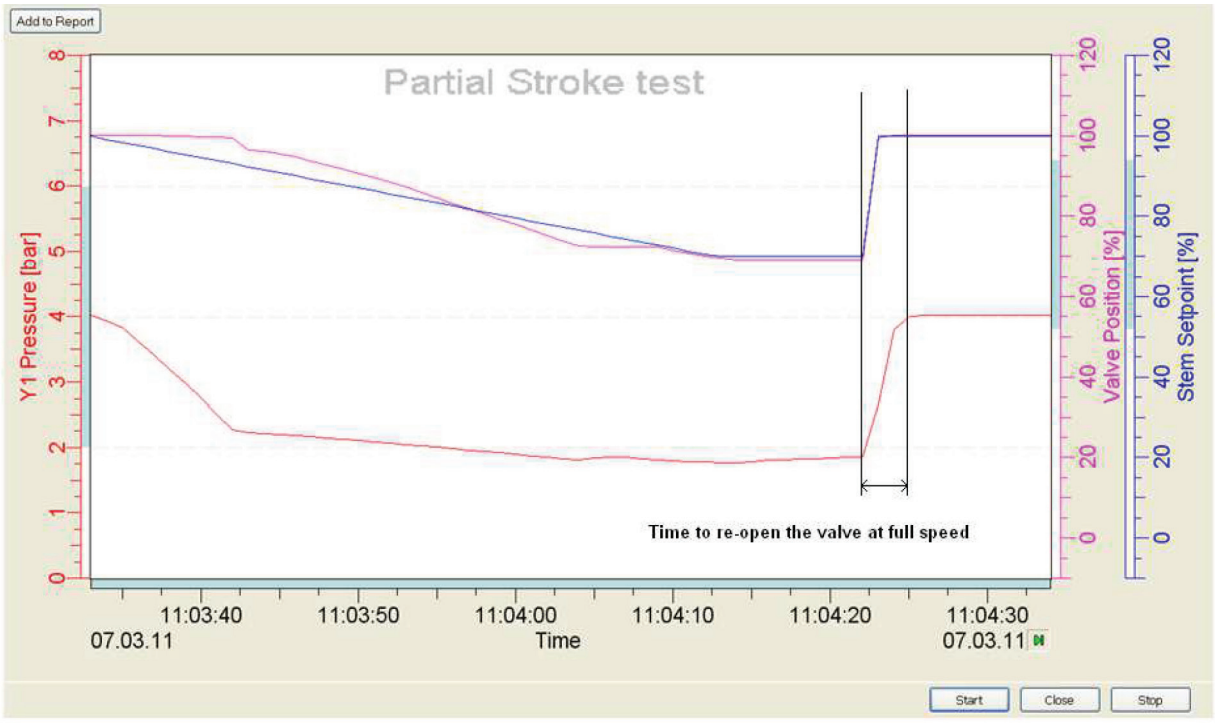


The ***Partial Stroke Test*** (PST) is used for testing of the ESD capabilities of safety shutdown valves. Since the safety related valves are always fully open and do not move within normal operation, it is very important to identify, if a valve would close in case the safety system shuts down the valves. For this purpose the PST is used.

The PST Diagnostic Page gathers the most important data of Partial Stroke Tests. For each PST, break pressure and Time-to-reinflate are registered in two trend graphs when updating.

Break Pressure

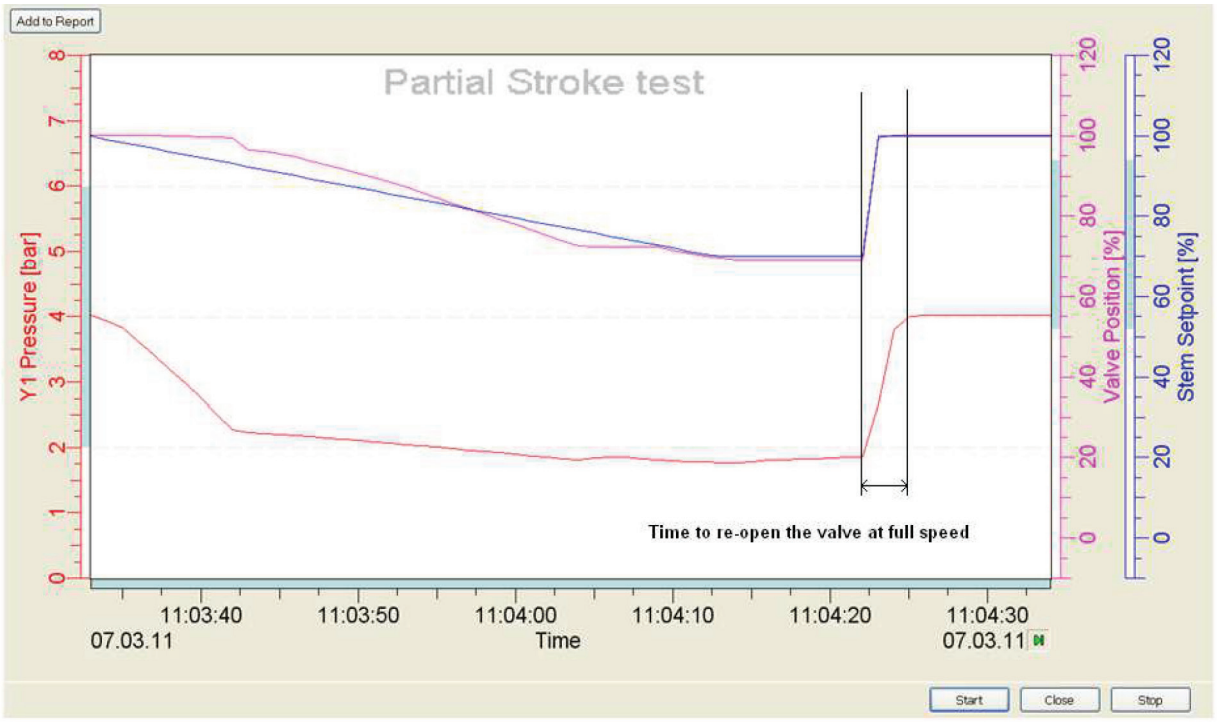
The ***Break Pressure*** is the pressure when the valve starts to move, at the beginning of a PST. To move the valve from the 100% position, the spring force has to be superior to the air pressure and the friction in position.



In blue is the ***Minimum Output Pressure Limit***, which is, as a result, the Minimum Break Pressure (for alarm configuration, see ***Minimum Output Pressure Limit*** in ***Parameterization -> Partial Stroke Test***).
If the ***Break Pressure*** is below this limit, the alarm is activated and the PST status turns in Error. This is to avoid a possible overshoot in case the valve is stuck.
The trend registers the last 48 Break Pressures. After a PST, the ***Break Pressure*** trend can be retrieved by pressing ***Update***.

A decreasing trend can be a sign that the valve starts to jam.

Time-to-Reinflate
The Time-to-Reinflate is the necessary time in second to re-open fully the valve (at 100%) after a Partial Stroke Test.



In blue is the ***Maximum Time-to-Reinflate.*** If the ***Time-to-Reinflate*** is below this limit, the alarm is activated and the PST status turns in Error. For alarm configuration, see ***Minimum Output Pressure Limit*** in ***Parameterization → Partial Stroke Test***.
An increasing trend of the Time-to-Reinflate can come from progressing leakages..
The trend registers the last 48 Break Pressures. After a PST, the ***Time-to-Reinflate*** trend can be retrieved by pressing ***Update***.

PST Status
The ***PST Status*** can be retrieved by pressing ***Update***.
The test will result in displaying a Partial Stroke Test Status showing the different states such as *Not Done, Running, Restricted, OK or Error*. If the PST has failed, the display will show Maintenance, to identify the operator of a failure.

Not Done
A Partial Stroke Test has not been executed yet.

Running
Test has been started and is in progress.

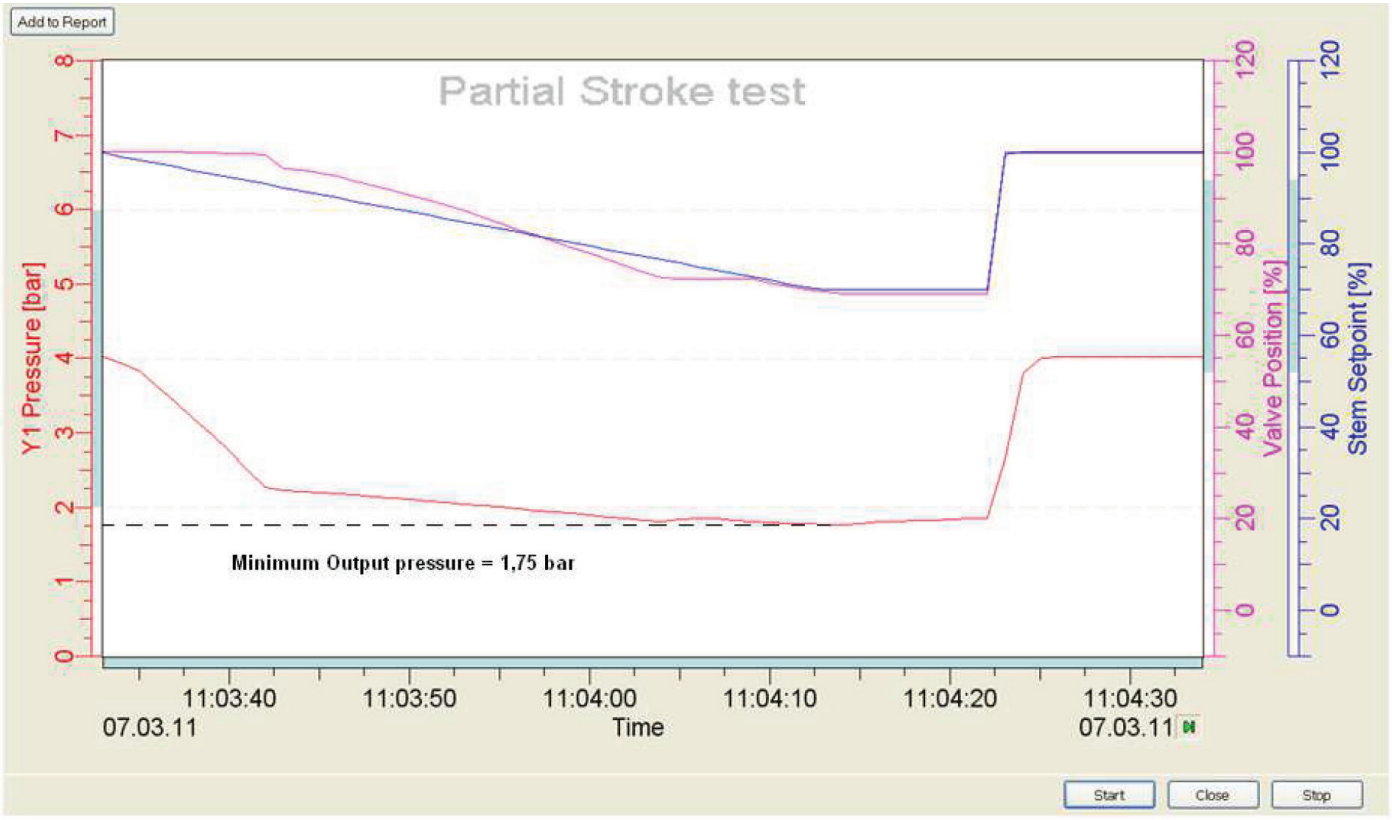
Restricted
Test is restricted. Either the valve is in control or the valve is not fully open (100%).

OK
Test performed OK. The ESD capabilities have been tested and showed that the valve is not stuck. The valve would move if a safety system would close the valve.

Error
Test showed Error. The ESD capabilities cannot be guaranteed. The valve is stuck and cannot move. The valve needs to be inspected immediately!

Message	Status	Description / Explanation	Recommended Action
Partial Stroke Testing		The Partial Stroke Testing enables to evaluate if an Emergency Shutdown Device (ESD) will operate in case of a safety shutdown.	The Partial Stroke Test can be found under the ***Configuration/ Partial Stroke***. This is where the Test can be configured and activated. The ***Testing Status*** shows the evaluation of the test.
		Testing Status	
	Good	Not Done	A Partial Stroke Test has not been executed yet.
	Good	Running	Test has been started and is in progress.
	Local Operation	Restricted	Test is restricted. Either the valve is in control or the valve is not fully open (100%).
	Good	OK	Test performed OK. The ESD capabilities have been tested and showed that the valve is not stuck. The valve would move if a safety system would close the valve.
	Fault / Device Failure	Error	Test showed Error. The ESD capabilities cannot be guaranteed. The valve is stuck and cannot move. The valve needs to be inspected immediately!

Last Minimum Output Pressure



Last Minimum Output Pressure is only information that should help to configure the ***Minimum Output Pressure Limit (Parameterization -> Partial Stroke Test Page).*** After a PST, the ***Last Minimum Output Pressure*** can be retrieved by pressing ***Update***.

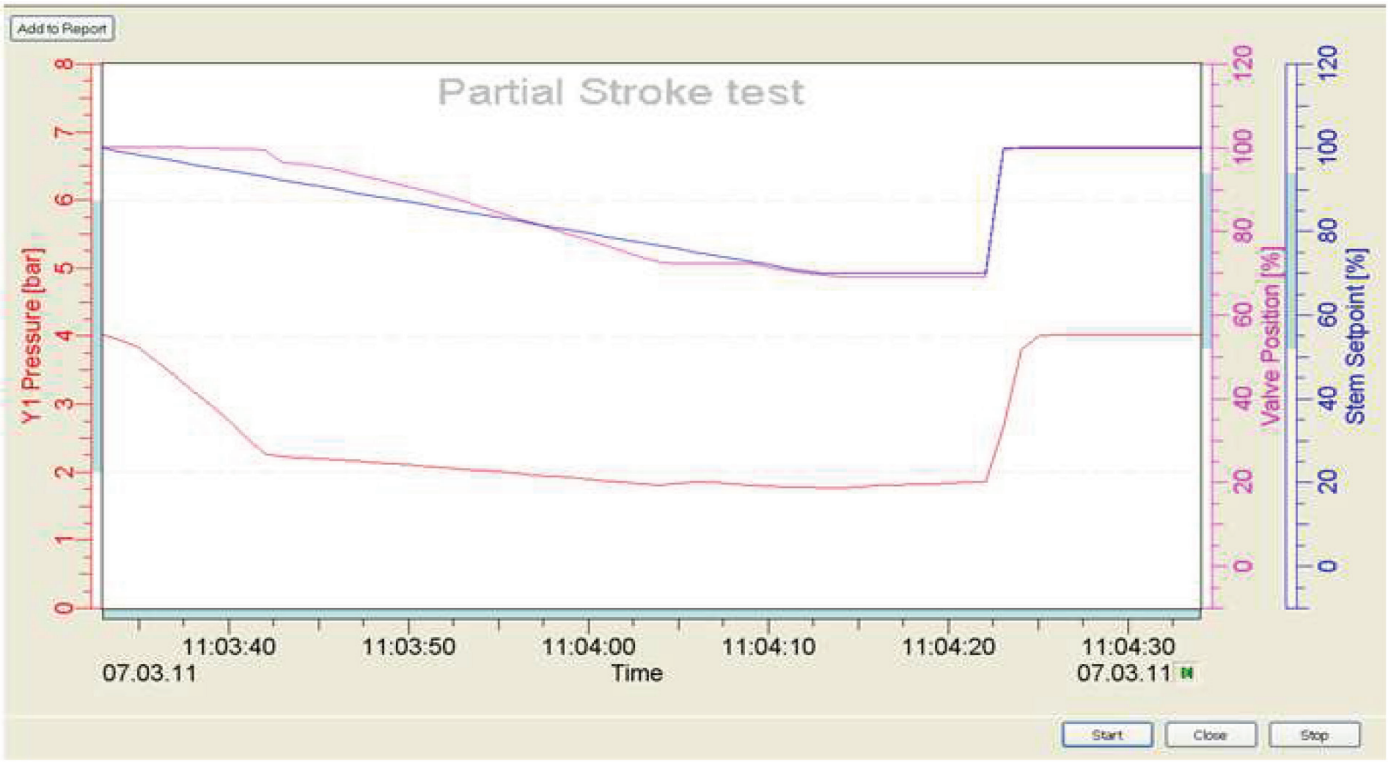
Last Break Pressure
Last Break Pressure is only information that should help to configure the ***Minimum Output Pressure Limit (Parameterization -> Partial Stroke Test Page).*** After a PST, the ***Last Minimum Output Pressure*** can be retrieved by pressing ***Update***.

Last Reinflate Time
Last Reinflate Time is the last measured time in second to re-open fully the valve (at 100%) after a Partial Stroke Test.
Last Reinflate Time is only information that should help to configure the ***Alarm on Reinflate Time (Parameterization -> Partial Stroke Test Page).*** After a PST, the ***Last Reinflate Time*** can be retrieved by pressing ***Update***.

Next PST in
Only for information. When PST is configured in Automatic, the countdown of the next PST, according to the ***Time Interval,*** is visualized in this field.

Graphs can be copied in the Report by clicking on “Add to Report” button.

3.2.15 PST View



From this PST view, a Partial Stroke Test can be launched. This is one of the five ways to launch a PST.
It can also be activated manually on board via the push buttons, automatically, through a separate Binary Input for SIS Logic Solver or from a LCP960 for local monitoring of PST

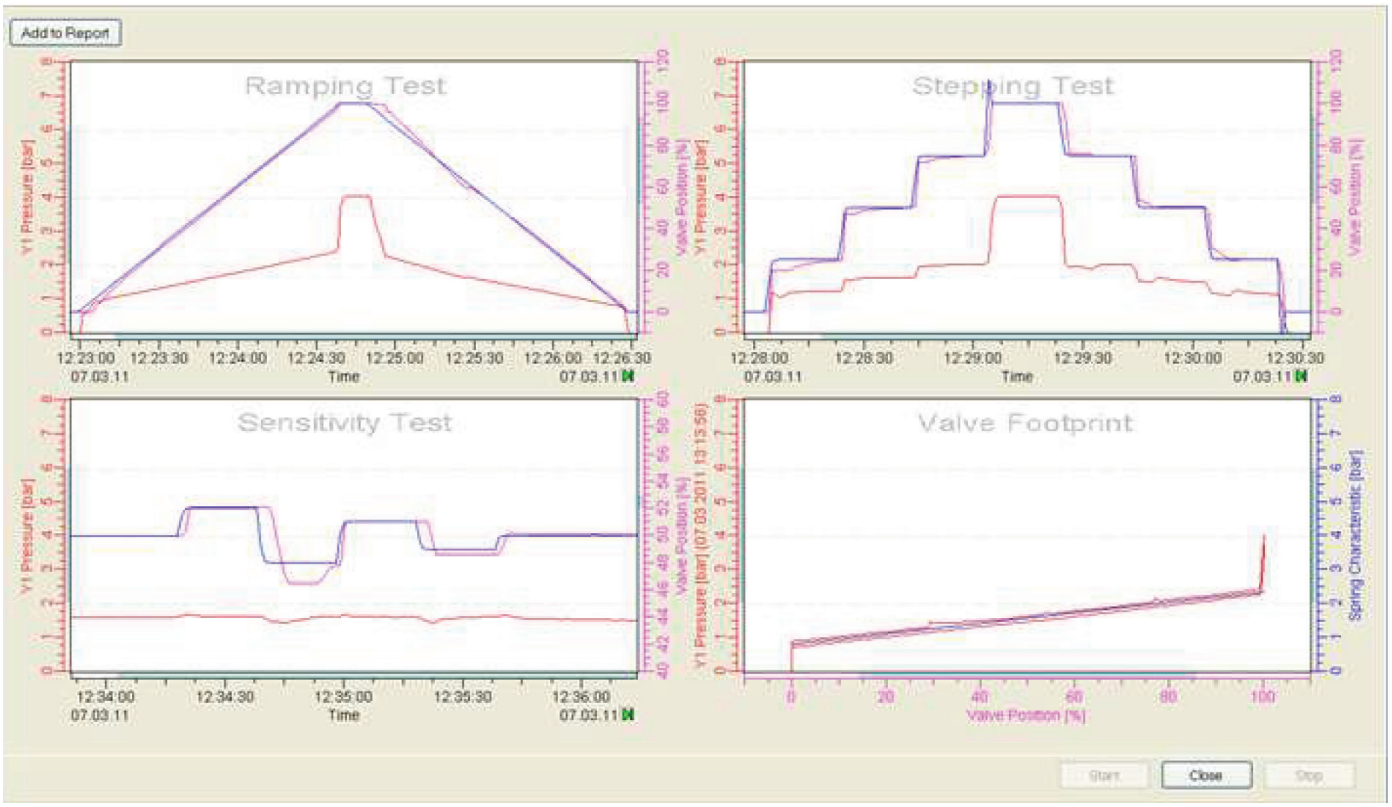
Click on “Start” button to launch PST. Click on “Stop” to stop the test registration. Click on “Close” to leave the page.
The time scale, position scales and pressure scale can be modified by slipping the scale.

The characteristic of the PST step is defined in Partial Stroke Test Page (Parameterization). The graph shows the evolution of Stem Setpoint, Valve position and Output Pressure during the Partial Stroke Testing.

During the Partial Stroke Test, activation of the Minimum Output Pressure Alarm or the Maximum Waiting Time Alarm stops the test and the PST status turns in “Error”.

Graphs can be copied in the Report by clicking on “Add to Report” button.

3.3 OFFLINE DIAGNOSTICS



“Offline Diagnostics” is an off-line function that defines a reference behavior of the valve/actuator/positioner entity. Several types of signatures are available to define precisely the overall characteristic of the final control element such as:

- Ramping Test
- Stepping Test
- Sensitivity Test
- Valve Footprint

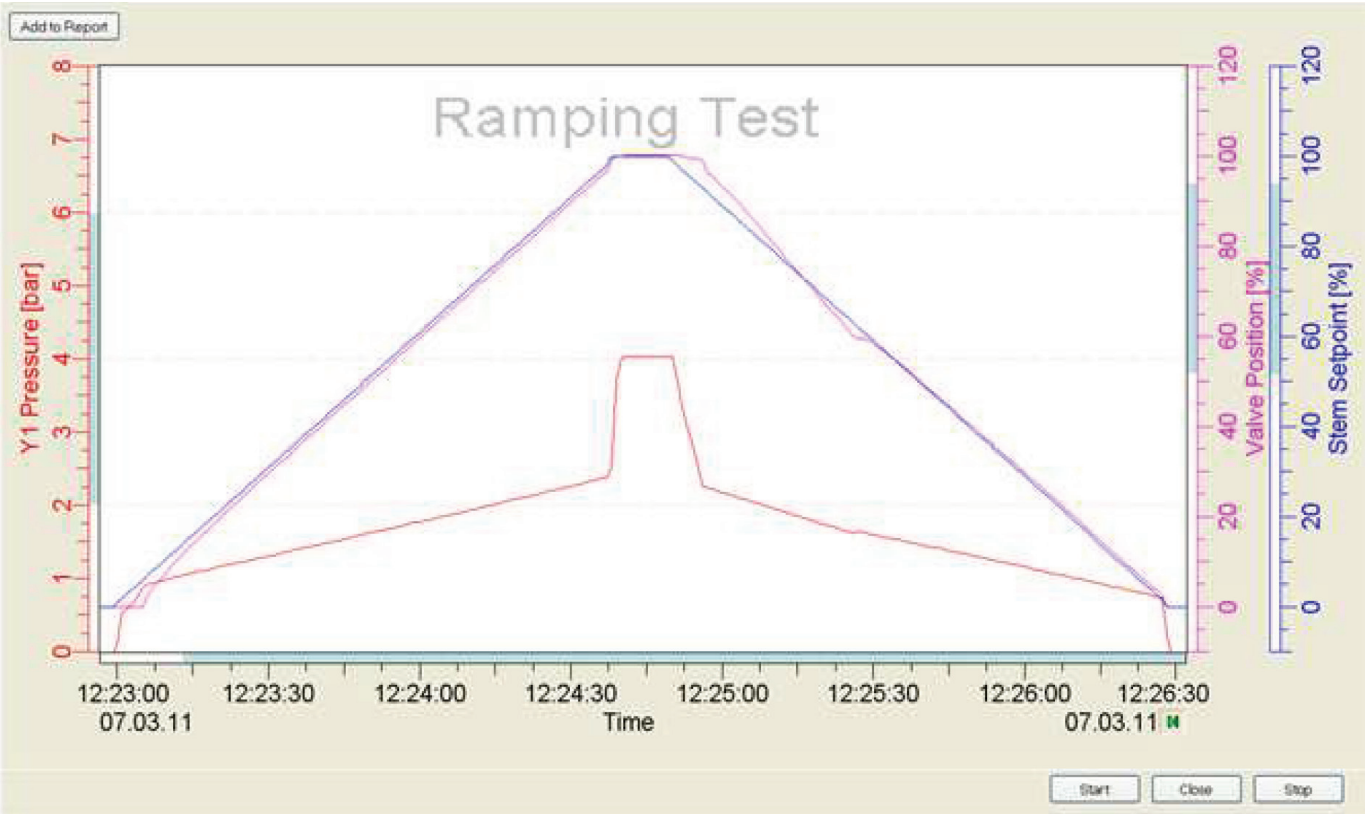
These four tests are displayed in the Test Overview. Each test and the Test Overview can be copied in the Report by clicking on “Add to Report” button.

To reach one of these tests’ page, double-click on the dedicated picture. To go outside of the test page and come back to the Test Overview, double-click on the graph.

For additional information, see:

Ramping Test

During the Ramping test, the positioner follows the increasing and decreasing setpoint changes from 0 to 100%. This test highlights the valve's behavior on a constant ramp. The ramp can be configured in ***Offline Diagnostics → Ramping Config***
Warning: Test will open and close the valve fully and should be launched only when the valve is out of process and free to move without affecting the process.



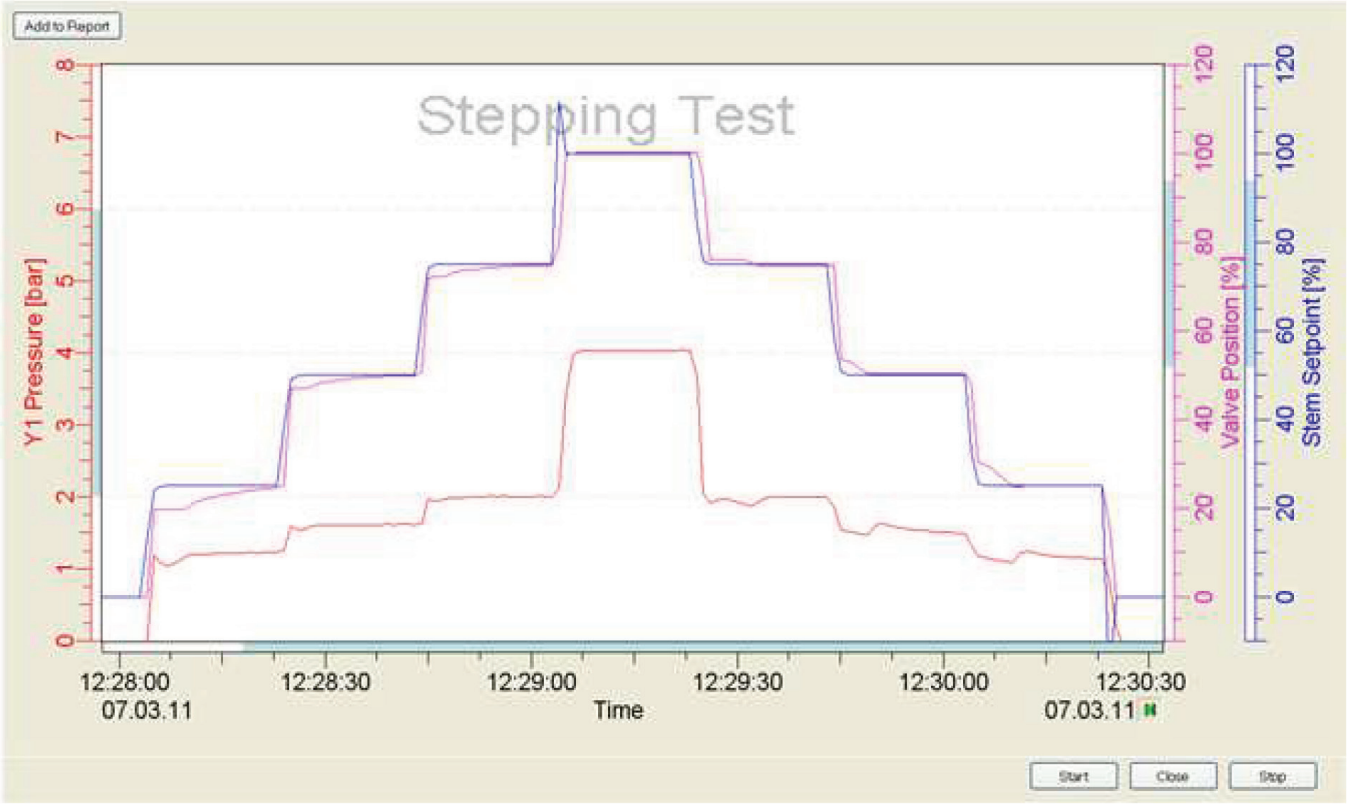
The X-axis is the Time axis. By clicking and sliding the axis, you can adjust the scale.
In blue is the Stem Setpoint, in pink is the Valve position and in red the output pressure Y1.
The pressure scale is from 0 to 8 bars. It can be adjusted by sliding the axis. The unit can be selected (bar, kPa, psi) in ***Parameterization→Press/Load Factor***

The test begins when the Start button is pressed. The test does not stop automatically when it is finished. To stop recording, click on Stop. The Close button will close the DTM window. The triangle at the bottom on the right is a pause/start button during the test.

Stepping Test

During the Stepping test, the positioner follows the setpoint change (0-25-50-75-100-75-50-25-0%). This test highlights the control parameters and valve's behavior on a step. The steps can be configured in ***Offline Diagnostics → Stepping Config***

Warning: Test will open and close the valve fully and should be launched only when the valve is out of process and free to move without affecting the process.



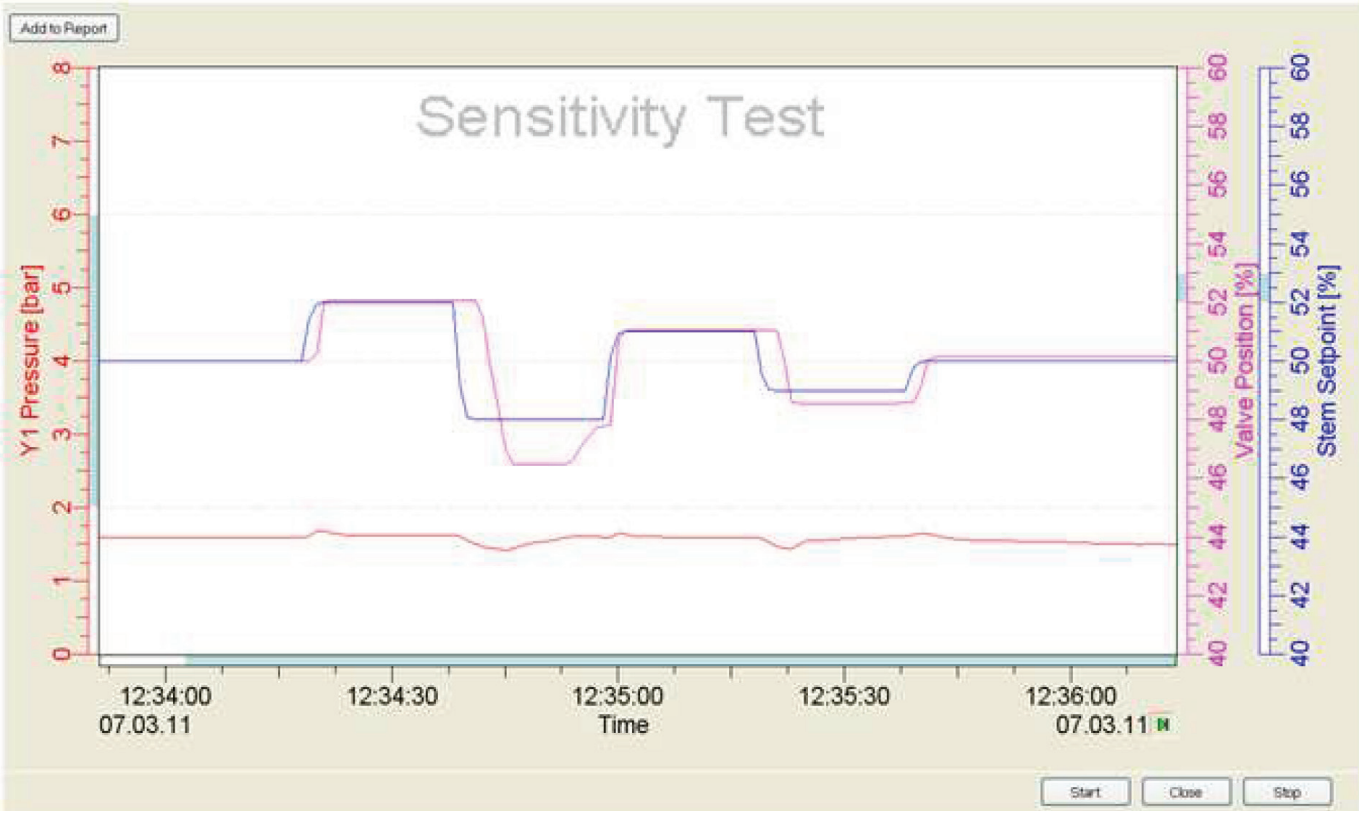
The X-axis is the Time axis. By clicking and sliding the axis, you can adjust the scale.
In blue is the Stem Setpoint, in pink is the Valve position and in red the output pressure Y1.
The pressure scale is from 0 to 8 bars. It can be adjusted by sliding the axis. The unit can be selected (bar, kPa, psi) in ***Parameterization → Press/Load Factor***

The test begins when the Start button is pressed. The test does not stop automatically when it is finished. To stop recording, click on Stop. The Close button will close the DTM window. The triangle at the bottom on the right is a pause/start button during the test.

Sensitivity Test

During the Sensitivity test, the positioner follows the setpoint change of about few percents around 50% (50-52-48-51-49-50%). This test highlights the valve's sensitivity and its behavior on small steps. The steps can be configured in ***Offline Diagnostics→ Sensitivity Config***

Warning: Test will open and close the valve fully and should be launched only when the valve is out of process and free to move without affecting the process.



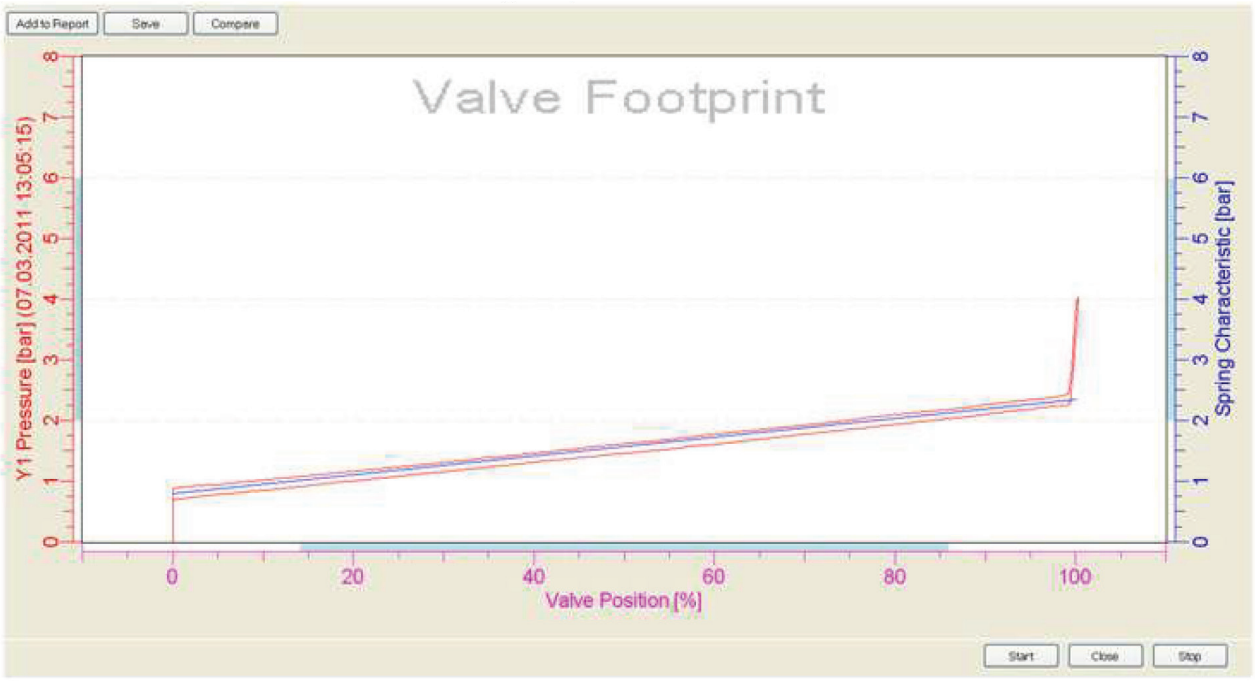
The X-axis is the Time axis. By clicking and sliding the axis, you can adjust the scale.
In blue is the Stem Setpoint, in pink is the Valve position and in red the output pressure Y1.
The pressure scale is from 0 to 8 bars. It can be adjusted by sliding the axis. The unit can be selected (bar, kPa, psi) in ***Parameterization → Press/Load Factor***

The test begins when the Start button is pressed. The test does not stop automatically when it is finished. To stop recording, click on Stop. The Close button will close the DTM window. The triangle at the bottom on the right is a pause/start button during the test.

Signature Test

During the Valve Footprint test, the positioner increases the air output pressure and registers the position for each level of pressure. Then, the positioner decreases the pressure and registers the related position. This test highlights the hysteresis of the valve due to friction.

The length of test can be configured in ***Offline Diagnostics→Signature Config***
Warning: Test will open and close the valve fully and should be launched only when the valve is out of process and free to move without affecting the process.

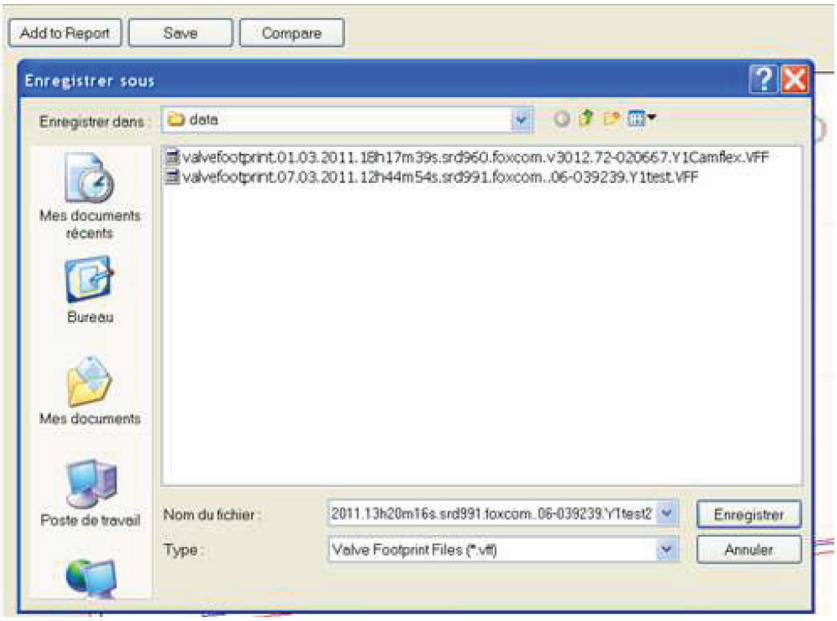


In blue is the Spring characteristic of the actuator. This characteristic must be entered manually at first time in ***Parameterization →Press/Load Factor***. In pink is the Valve position and in red the output pressure Y1.

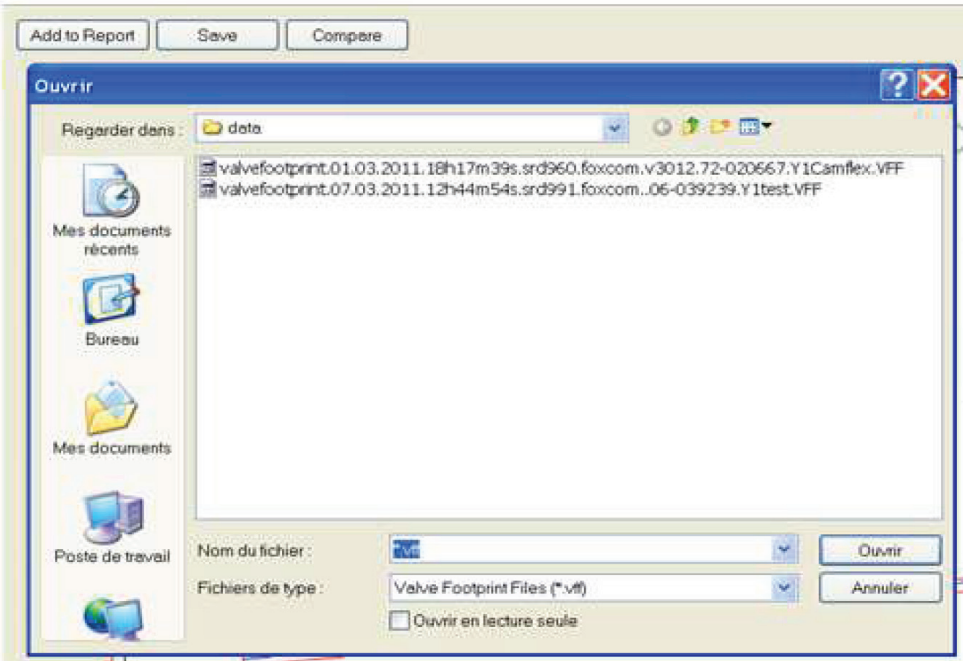
The pressure scale is from 0 to 8 bars. It can be adjusted by sliding the axis. The unit can be selected (bar, kPa, psi) in ***Parameterization →Press/Load Factor***

The test begins when the Start button is pressed. The test stops automatically when it is finished. However, to stop recording, click on Stop. The Close button will close the DTM window. The Valve Footprint can be copied in the Report by clicking on "Add to Report" button. It can also be saved in your files in order to compare two Valve Footprints.

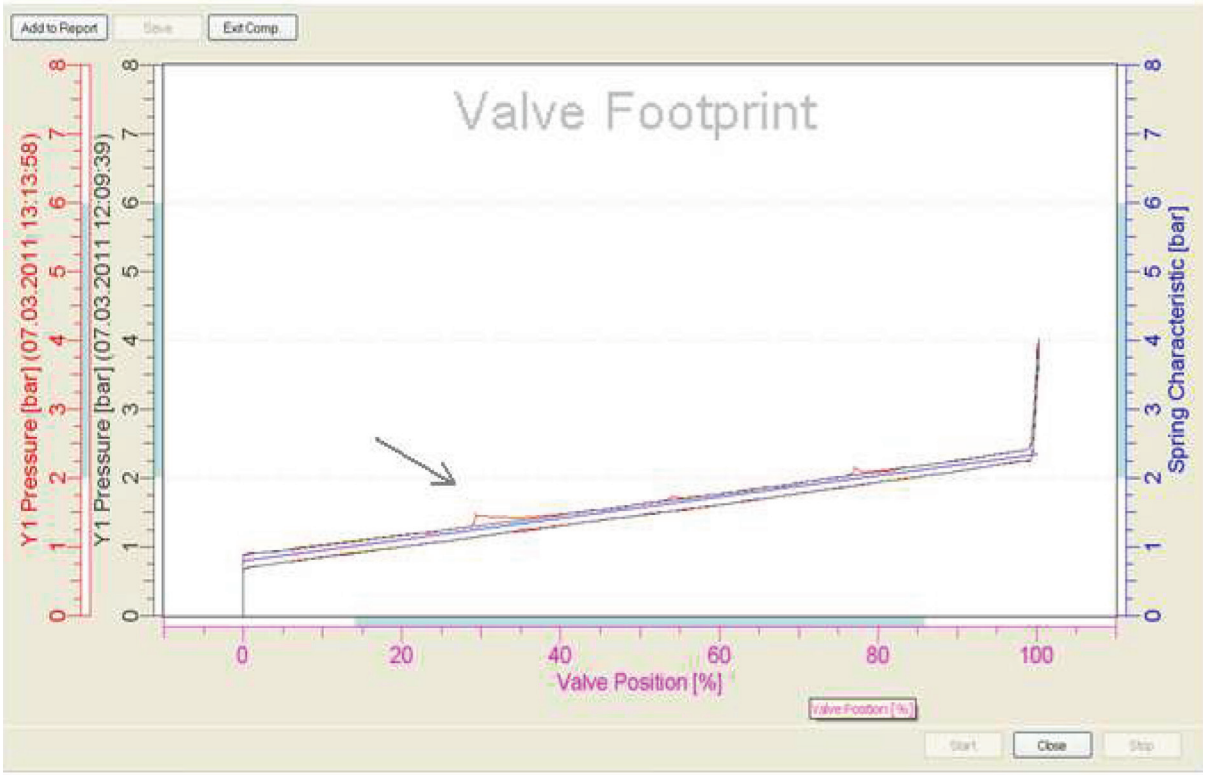
To save the Valve Footprint, click on "Save".



To compare the Valve Footprint with a former one, click on “Compare” in order to load the former Valve footprint.



The comparison enables to highlight a drift of the friction over time. For example, the graph below shows the creation of a hardpoint in the valve.



3.3.1 Ramping Configuration

The length of Ramping test can be configured. Enter in the box the new values of ramping time and remaining time in seconds, and send it to the positioner by pressing Save button.
It is also possible to know the configured value. Press Load button to get this value from the positioner.

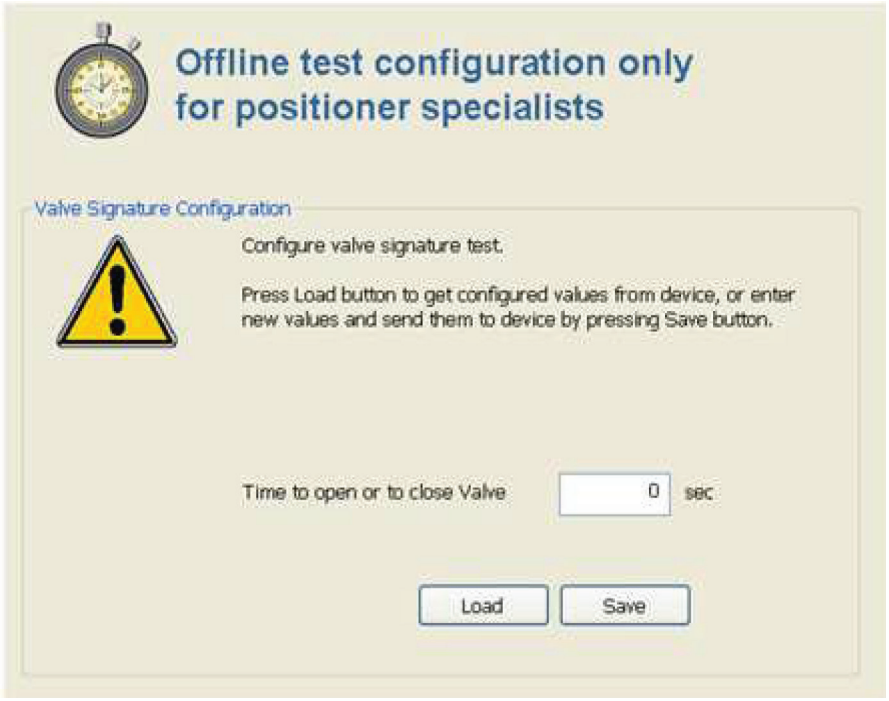
3.3.2 Stepping Configuration

The steps of the Sensitivity test can be configured. Enter the new values of position in % and the remaining time in seconds, and send it to the positioner by pressing Save button. It is possible to configure up to 30 steps.
It is also possible to know the configured values. Press Load button to get these values from the positioner.

3.3.3 Sensitivity Configuration

The steps of the Sensitivity test can be configured. Enter the new values of position in % and the remaining time in seconds, and send it to the positioner by pressing Save button. It is possible to configure up to 30 steps.
It is also possible to know the configured values. Press Load button to get these values from the positioner.

3.3.4 Signature Configuration



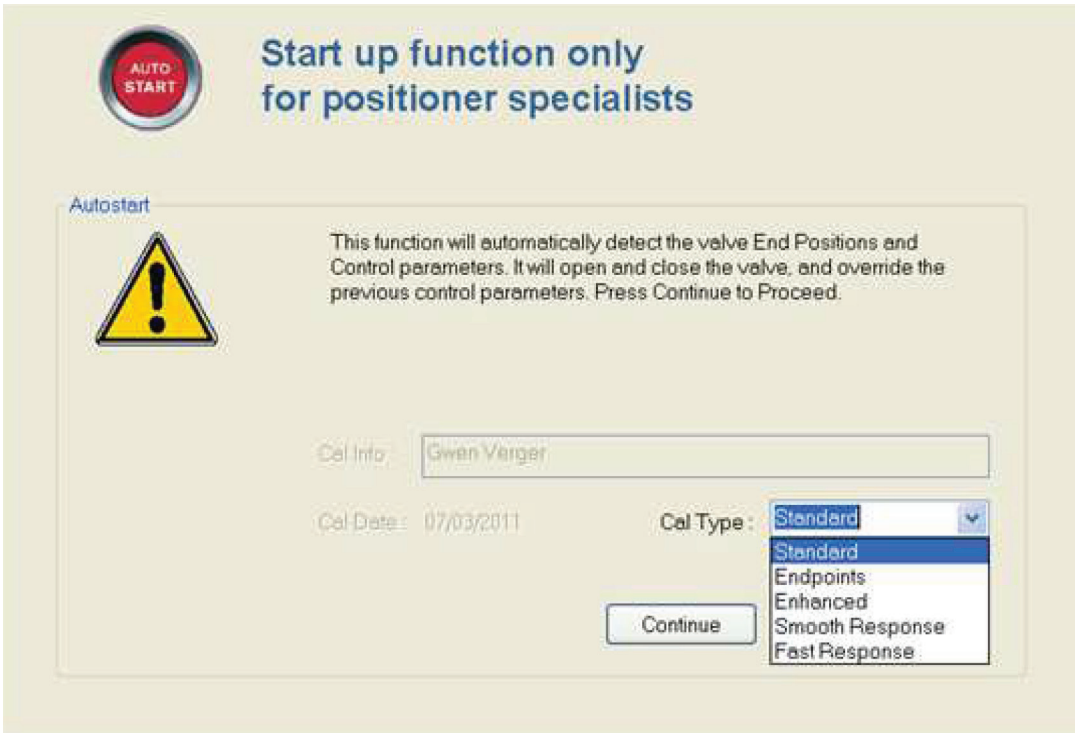
The length of Valve Signature Test can be configured. Enter in the box the new value in seconds and send it to the positioner by pressing Save button. The maximum length is 1310 secondes
It is also possible to know the configured value. Press Load button to get this value from the positioner.

3.4 Start up

3.3.1 Autostart

The **Start Up** directories allows applying setpoint changes or launching Autostart, even if the current (analog) or the digital setpoint is fixed.
Since these operations will move the valve, they should only be used when it is safe to do so.

Note: The SRD991 has to be in Online or Offline Mode to do any start up function. If the user calls a start up function when the SRD991 is in Local Mode by using the local keys, the SRD991 will return an error and the start up function will be cancelled.



The ***Autostart*** function allows a full adaptation of the positioner to the actuator, whereas the ***Endpoints*** only do a determination of the mechanical stops and the IP parameters.

Autostart includes five Autostart methods

	SRD-DTM	Local	
• Endpoints	✓	2.1	
• Standard Autostart	✓	2.2	[recommended!]
• Enhanced Autostart	✓	2.3	
• Smooth Response	✓	2.4	
• Fast Response	✓		2.5

All methods can be selected via software.

This ***Autostart*** process will determine valve travel limits (zero, span) and tuning parameters. This procedure is executed in four stages:

- 1st Determining the mechanical travel stops of the actuator.
- 2nd A series of ramps is applied to determine the control system parameters for the IP-Module
- 3rd A series of step-response tests is applied to determine the control parameters
- 4th Determination of stroke-time (T_{63}-time).

By performing these steps, the valve will be stroked several times and ramps will be applied to the input signal.

Warning!
If the Autostart is executed, it will open and close the valve and in result disturb the process.

Details about the different Autostart routines:

Endpoints
It determines only the mechanical stops of actuator/valve.

This function will automatically detect the valve end points. It accomplishes this by using only the first of the four autostart steps. This process determines the valve mechanical travel stops, zero and span but not the tuning parameters. Accordingly, it requires much less time than a full ***Autostart***. If the tuning parameters are available for the control valve from previous testing or existing data, then ***Endpoints calibration*** and manually entering tuning parameters (previous section) will shorten the positioner setup time significantly.

Executed steps during Autostart:

- 1st Determining the mechanical travel stops of the actuator.
- 2nd A series of ramps is applied to determine the control system parameters for the IP-Module.

Standard Autostart
Autostart recommended for standard application. Executed steps during Autostart:

- 1st Determining the mechanical travel stops of the actuator.
- 2nd A series of ramps is applied to determine the control system parameters for the IP-Module
- 3rd A series of step-response tests is applied to determine the control parameters
- 4th Determination of stroke-time (T_{63}-time).

Enhanced Autostart
Enhanced Autostart. Optimized control behavior compared to Standard Autostart. Execution of same Autostart steps as with Standard Autostart, but with additional iterations.

Smooth Response
Extended Autostart. Dampened control behavior for e.g. smaller actuators.
Execution of same Autostart steps as with Standard Autostart, but with different settings of the P-gain and I-time.

Fast Response
Extended Autostart. Control behavior without damping for e.g. larger actuators. Execution of same Autostart steps as with Standard Autostart, but with different settings of the P-gain and I-time.

General comments for Autostart:
The duration of ***Autostart*** depends on the actuator size (volume) and hysteresis of the actuator. For small actuators, it may only take a few minutes, whereas actuators with large volumes may require significantly longer times. This can be reduced in some cases by using the spool valve version or by applying a volume booster. Each of the stages in the ***Autostart*** process will be identified by the LCD and/or red+green LEDs.

If ***Autostart*** is not successful, it may terminate before reaching the last step which means that the positioner is not properly calibrated. To check whether ***Autostart*** is successfully completed or not, select **Valve Status** from the **Test** option in the main menu.

Potential reasons for an Autostart not being successful are:

- Positioner mounting problem. Feedback lever or coupling in wrong orientation. Refer to section 1 on “getting started”
- Inadequate supply pressure
- Large actuator. Use Endpoint calibration and tune manually. Employ boosters to increase output capacity.
- Hardware problem

If ***Autostart*** cannot be successfully executed, refer to the section for ***Endpoint Calibration***.

The ***Autostart*** feature can also be manually accomplished at the positioner by push buttons.

3.4.2 Set Setpoint

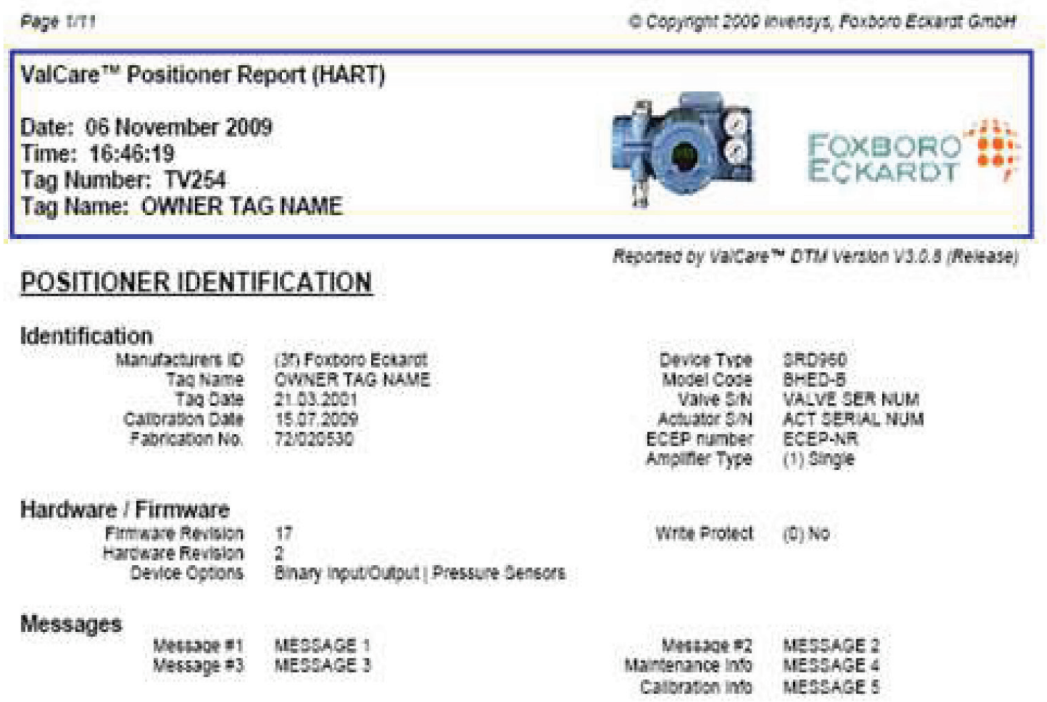
The ***Set Setpoint*** test can be activated from ***Start up*** under the ***Autostart*** page. It allows applying setpoint changes, even if the current (analog) or the digital setpoint is fixed.

To exit press ***Cancel***, to apply a ***Setpoint*** press ***Continue***. After pressing Continue, the ***Setpoint*** field will then turn from gray to white. Enter your ***Setpoint*** and press ***Apply***.
Exit the ***Set Setpoint*** window by pressing on ***Continue***; this might take a few seconds.

Warning!
If the Apply button is executed, the valve will move and in result disturb the process.

3.5 REPORT

3.5.1 Positioner Report



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ValCare™ Positioner Report (HART)

Date: 06 November 2009
Time: 16:46:19
Tag Number: TV254
Tag Name: OWNER TAG NAME

FOXBORO ECKARDT

Reported by ValCare™ DTM Version V3.0.8 (Release)

POSITIONER IDENTIFICATION

Identification

Manufacturers ID	(37) Foxboro Eckardt	Device Type	SRD960
Tag Name	OWNER TAG NAME	Model Code	8HED-B
Tag Date	21.03.2001	Valve S/N	VALVE SER NUM
Calibration Date	15.07.2009	Actuator S/N	ACT SERIAL NUM
Fabrication No.	72/020530	ECEP number	ECEP-NR
		Amplifier Type	(1) Single

Hardware / Firmware

Firmware Revision	17	Write Protect	(0) No
Hardware Revision	2		
Device Options	Binary Input/Output | Pressure Sensors		

Messages

Message #1	MESSAGE 1	Message #2	MESSAGE 2
Message #3	MESSAGE 3	Maintenance Info	MESSAGE 4
		Calibration Info	MESSAGE 5

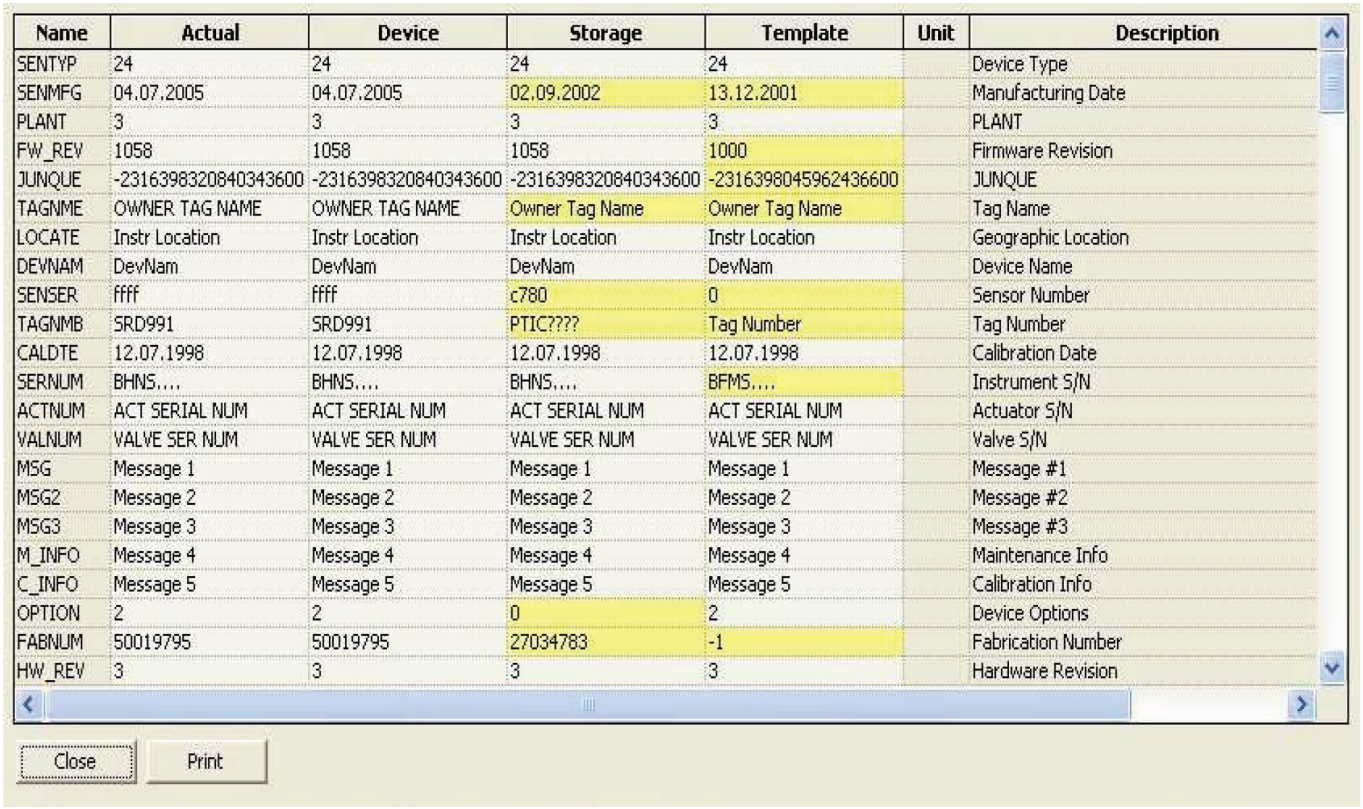
The ***Report*** is a powerful function to enable getting a complete report about the state of the device and its parameter, either currently or historically.
In the **Positioner Report,** all information about device configuration, device status, diagnostics as well as device diagnostic statistics will be collected and shown in a compact form.

Normally the current state of the device will be reported. However, additional tests and diagrams, such as Valve Footprint or Online Friction, can also be reported if you have clicked on “Add to Report” in the relevant pages.
To print it as a paper report or as a PDF document, click on the printer on the toolbar.

3.5.2 Parameter List

In the **Parameter List**, all the parameters are collected in a list with their status and location.

This table shows all parameters saved in the positioner memory. This list can be printed out by clicking onto "***Print***".

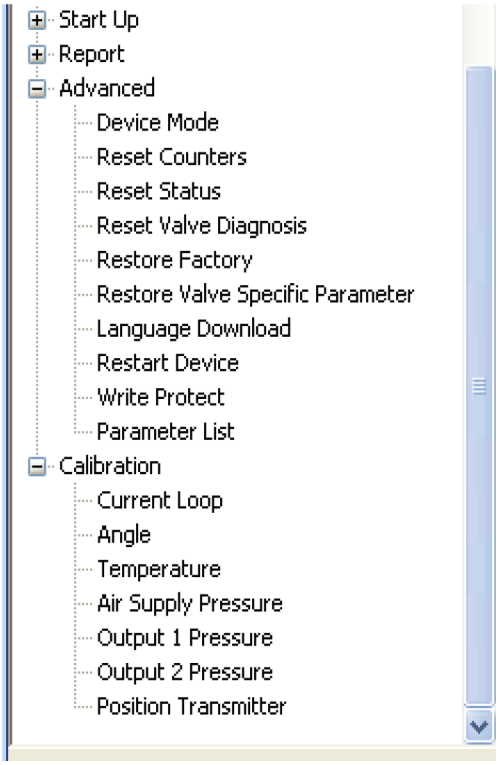


Name	Actual	Device	Storage	Template	Unit	Description
SENTYP	24	24	24	24		Device Type
SENMFG	04.07.2005	04.07.2005	02.09.2002	13.12.2001		Manufacturing Date
PLANT	3	3	3	3		PLANT
FW_REV	1058	1058	1058	1000		Firmware Revision
JUNQUE	-2316398320840343600	-2316398320840343600	-2316398320840343600	-2316398045962436600		JUNQUE
TAGNME	OWNER TAG NAME	OWNER TAG NAME	Owner Tag Name	Owner Tag Name		Tag Name
LOCATE	Instr Location	Instr Location	Instr Location	Instr Location		Geographic Location
DEVNAM	DevNam	DevNam	DevNam	DevNam		Device Name
SENSER	ffff	ffff	c780	0		Sensor Number
TAGNMB	SRD991	SRD991	PTIC????	Tag Number		Tag Number
CALDTE	12.07.1998	12.07.1998	12.07.1998	12.07.1998		Calibration Date
SERNUM	BHNS....	BHNS....	BHNS....	BFMS....		Instrument S/N
ACTNUM	ACT SERIAL NUM	ACT SERIAL NUM	ACT SERIAL NUM	ACT SERIAL NUM		Actuator S/N
VALNUM	VALVE SER NUM	VALVE SER NUM	VALVE SER NUM	VALVE SER NUM		Valve S/N
MSG	Message 1	Message 1	Message 1	Message 1		Message #1
MSG2	Message 2	Message 2	Message 2	Message 2		Message #2
MSG3	Message 3	Message 3	Message 3	Message 3		Message #3
M_INFO	Message 4	Message 4	Message 4	Message 4		Maintenance Info
C_INFO	Message 5	Message 5	Message 5	Message 5		Calibration Info
OPTION	2	2	0	2		Device Options
FABNUM	50019795	50019795	27034783	-1		Fabrication Number
HW_REV	3	3	3	3		Hardware Revision

Close Print

3.6 Advanced

The **Advanced** group contains possible reset and restore operations that the user can perform for the SRD991. Most of these will require special tools or equipment. Since many of these operations will move the valve, they should only be done by positioner specialists.



Note: The SRD991 has to be in Online or Offline Mode to do any calibration function. If the user calls a calibration function when the SRD991 is in Local Mode by using the local keys, the SRD991 will return an error and the calibration function will be cancelled.

3.6.1 Device Mode

The ***Device Mode*** enables to change the internal running mode of the device. Available modes are Online, Offline and Local. After pressing a button, the selected mode is sent to device immediately.

3.6.2 Reset Counters

The Cycle Count and Travel Sum parameters will be reset by this procedure. The device will be taken off-line for a short period, which may cause a process upset. The user should press Continue to reset the counters, or Cancel to abort.

Cycle Count - This is a 4 byte integer measurement. It is used to tally the number of changes in direction (open/close) that the valve has encountered. One step toward open position and one toward close position count as one cycle. The steps have to be larger than positioner deadband. This function writes a zero to this parameter to reset the count.

Travel Sum - This is a 4 byte integer measurement. It contains the actual summarized travel value in full strokes for the valve travel. All movement is added. Once the movement totals a full stroke (four quarter strokes open/close, a single stroke from 0% to 100%, or many small movements in both directions whose total adds up to a full stroke), this field is incremented. The steps have to be larger than positioner deadband. This function writes a zero to this parameter to reset the sum.

3.6.3 Reset Status

All status fields are intended to be reset. This includes the diagnostics, the primary and secondary status, and the additional status. Naturally, if the underlying problem has not been cured, then the failure bit(s) will be reasserted almost immediately.

3.6.4 Restart Device

The positioner will reboot during this procedure. The device behaves as if the power supply will be switched off and on. This may cause a process upset. The user should press Continue to reboot the positioner, or Cancel to abort.

Warning!
If Reboot Device is executed, it will open and close the valve and in result disturb the process.

3.6.5 Restore Factory Defaults

Set all parameters back to factory defaults. This means the Calibration and Configuration data will be restored to factory settings. The valve's current database will be overwritten. The user should press ***Continue*** to proceed, or ***Cancel*** to abort. Restoring Factory Settings**,** to retrieve configuration parameters set at the factory, is an available feature in the file menu. This feature can be tried as a way to back out if positioner ceases to operate/respond due to improper calibration or tuning.

This function is also useful e.g. when a positioner was taken from one valve and mounted to another valve.

Warning!
If Restore Factory Defaults is executed, it will turn the device offline. In this case only a new Autostart or Endpoint calibration will turn the device back online; and in result disturb the process.

3.6.6 Restore Valve Specific Parameter

This function is required if a positioner is replaced w/o the option to perform a new Autostart.

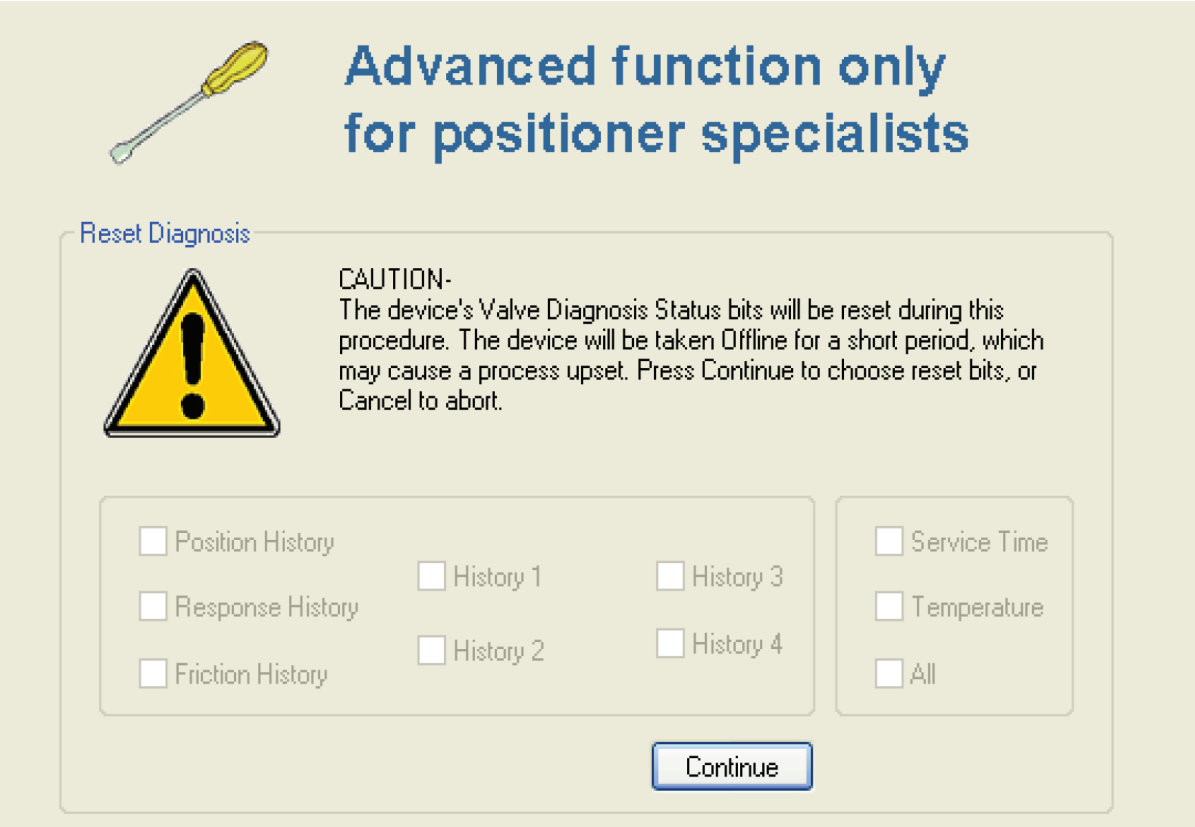
In this case the function allows writing valve specific parameters into the new positioner that have been copied from the replaced positioner. This is done by reading the data file of one positioner mounted to a valve and writing these values into a new positioner. This new positioner can then be adapted to that valve without performing an Autostart.

The parameters for ***Lower End Position, Upper End Position, Motor Parameter*** and ***ADC Gain*** have to be written into the unit. The values of these parameters can be retrieved by means of the ***Parameter List***. However, if the parameters need to be edited, this can be done before pressing ***Continue***.

Due to mechanical tolerances in mounting the adoption can't be optimal so performing a new Autostart Calibration or Endpoint Calibration is required as soon as possible.

NOTE: This function is only allowed at workshop security level.

3.6.7 Reset Valve Diagnosis



The ***Reset Valve Diagnosis*** is used to reset specific data stored inside of the positioner memory. E.g., the individual valve diagnosis status is deleted if the designated status bits are selected and executed with ***Continue***.

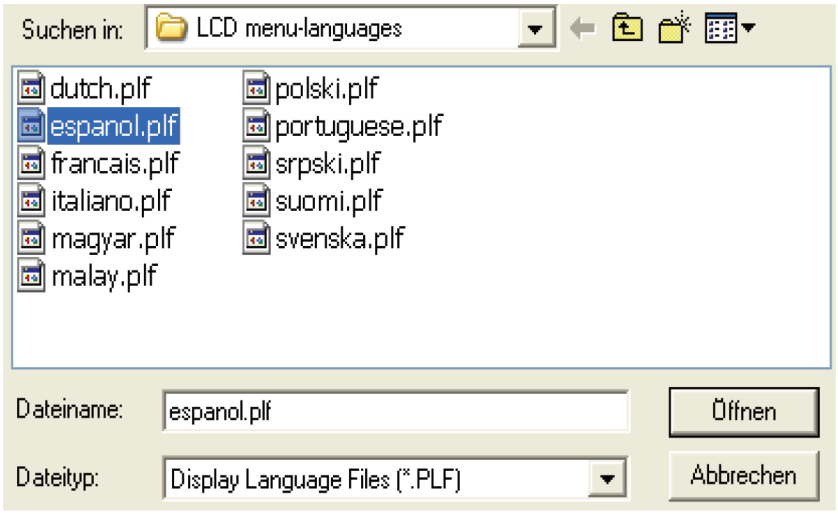
The ***Reset Valve Diagnosis*** can be used for:

- Reset of the Historians 1 to 4 of the ***Position History*** or the ***Response History***. E.g., ***History 2*** of the ***Position History*** will be deleted if the status bits are selected for Position History and History 2 and executed with ***Continue***.
- Reset the ***Service Time*** that is displayed as ***Time Since Last Service*** under ***Service Management***. This value shows how many hours ago the service has taken place on the unit.
- Reset the ***Temperature*** that is displayed as ***Measured Temperature Values*** under ***Process***
- Diagnosis, listed as ***Max. Temperature*** and ***Min. Temperature***.
- Reset the ***Load Factor*** that is displayed as Load Factor Values under ***Load Factor/Load Factor Trend***.
- Reset ***All*** will delete all above listed Historians and status- and diagnostic-messages.

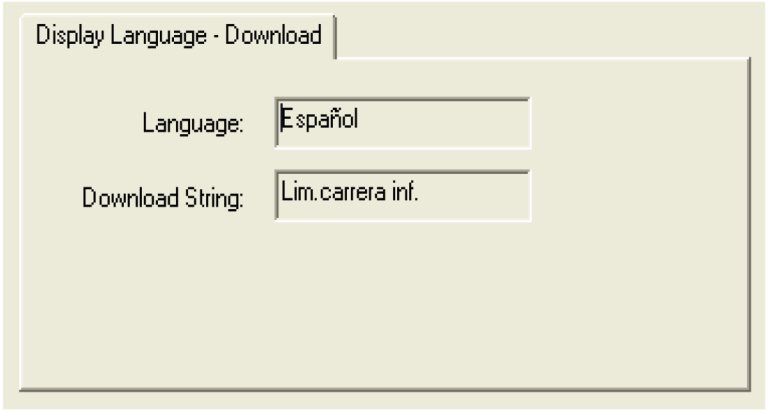
3.6.8 Language Download

To download another language than pre-configured into the device, the following steps have to be executed. First expand the tree node ***Advanced*** and select the item ***Language Download***.

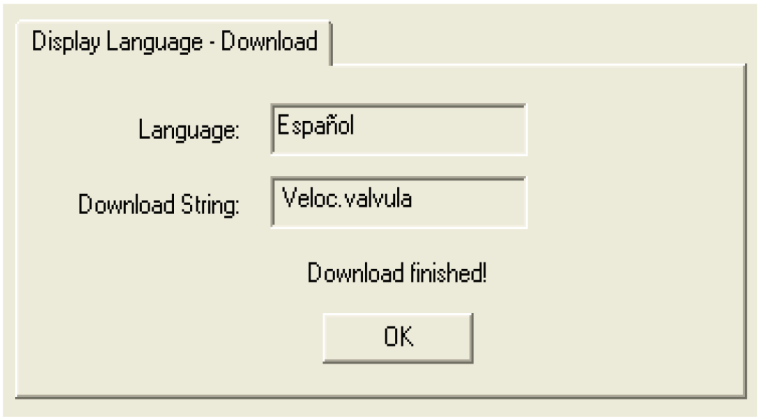
A window will open and the path of where the language files are stored on your computer needs to be opened. In this case the file is called: ***LCD menu-language***.



The download status is shown during the procedure.



The Display Language – Download then needs to be confirmed with OK after it is finished.



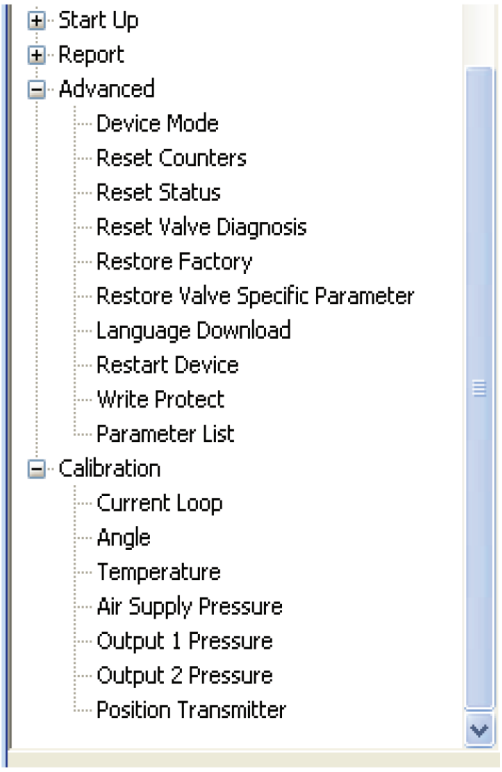
3.6.9 Write Protect

Enable/Disable Write Protection for valve parameters

If this variable is set to “1”, the intelligent positioner is Write-protected. This bit should be only set and reset by a special program pick with password protection. The FBM, PC10 and HHT are normally not allowed to write to this variable. Inadvertent changing of positioner configuration data may be avoided by turning **Write Protect On** from **File** menu.

3.7 Calibration

The **Calibration** directories of the navigation tree contain possible calibration operations that the user can perform. Most of these will require special tools or equipment. Since many of these operations will move the valve, they should only be used when it is safe to do so.



Note: The SRD991 has to be in Online or Offline Mode to do any calibration function. If the user calls a calibration function when the SRD991 is in Local Mode by using the local keys, the SRD991 will return an error and the calibration function will be cancelled.

3.7.1 Angle Calibration

Angle calibration is needed whenever the "Printed Circuit Board" or the potentiometer is replaced. This operation is typically done on the bench and may require removal of positioner from the valve as well as special tools. Refer to the positioner MI for more information.

Zero Calibration / Span Calibration
The complete procedure includes:

- The feedback lever is rotated to the lower angle value (typically 45 degree down from horizontal).
- By entering the lower angle value, it is acknowledged by the user (Zero calibration).
- The feedback lever is rotated to the upper angle value (typically 45 degree up from horizontal).
- By entering the upper angle value, it is acknowledged by the user (Span calibration).
- The system informs the user that the angle calibration finished.

3.7.2 Current Loop Calibration

If the positioner is being used in the analog mode, then calibration by **Analog Setpoint** feature is available in the **Management** menu. **Analog Setpoint** is also available manually from the local push buttons of the positioner.
This function calibrates lower and upper limits of the input current (4 mA and 20 mA). A calibrated current source is needed.

Zero Calibration / Span Calibration
To perform this procedure, proceed as follows:
- Take positioner off the process loop and connect a current source.
- Set input current to 4 mA.
- Acknowledge by entering this value (4 mA) in the edit box (Zero Calibration).
- Set input current to 20 mA.
- Acknowledge by entering this value (20 mA) in the edit box (Span Calibration).
- The system will respond with the "Analogue Setpoint Calibration finished" message.

3.7.3 Temperature Calibration

Temperature calibration is needed whenever the "Printed Circuit Board" is replaced. Refer to positioner MI since special tools might be required.

This function calibrates the temperature of the internal electronics module. It is only intended to be performed in a bench environment. A Temperature Probe is required to perform this calibration. After pressing Continue to proceed, measure the electronics temperature with the probe. Enter this value in the Edit Box and then press Continue. Temperature calibration is now completed.

3.7.4 Output Calibration

This function performs calibration of the Output of the Position Feedback option board. This operation is typically done on the bench and may require special tools and special electrical connections. Refer to MI EVE 0105A for more information.

This function is only allowed at workshop security level.

3.7.5 Air Supply Pressure Calibration

Air Supply Pressure (Sensor) calibration is needed whenever the "Printed Circuit Board" is replaced. This operation is typically done on the bench and may require special tools. Refer to positioner MI for more information.

For additional information, see:

Zero Calibration /Span Calibration
This function performs calibration of the Air Supply Pressure sensor. To perform this procedure, proceed as follows:

- Regulate air supply to LOW supply pressure value. Enter this value in the Edit Box and then press Continue.
- Regulate air supply to HIGH supply pressure value. Enter this value in the Edit Box and then press Continue.
- The air supply pressure calibration is now completed.

3.7.6 Output Pressure Calibration

Output Pressure (Sensors) calibration is needed whenever the "Printed Circuit Board" is replaced. This operation is typically done on the bench and may require special tools. Refer to positioner MI for more information.

For SRD991 there are two output pressure sensors, i.e. **Output 1 Pressure** and **Output 2 Pressure** available.

Zero Calibration /Span Calibration
This function performs calibration of the Output Pressure sensor. To perform this procedure, proceed as follows:

- Regulate the Output Pressure to LOW pressure value. Enter this value in the Edit Box and then press Continue.
- Regulate the Output Pressure to HIGH pressure value. Enter this value in the Edit Box and then press Continue.
- The output pressure calibration is now completed.

4 STATUS BITS

4.1 Primary Status Bits

The Primary Status Byte is returned in every response message generated by the positioner. The individual bits of the status byte are defined below and are derived from the reference ED3699 rev C. When the specified condition exists, the status bit will be set to One otherwise, the status bit will be Zero.

7	6	5	4	3	2	1	0
Control	SSTAT Error	Diag Error	Health		Device Busy	Mode	
Operate							

- Bit 7 - Set to 1 if the positioner is running in analog, zero if running digital mode
- Bit 6 - Set to 1 if the Secondary Status Byte is non-zero, it requests FBM action
- Bit 5 - Set to 1 if a Current Diagnostic Error exists
- Bits 4,3 - Setpoint health:
  - 00 = OK, operation of positioner normal
  - 01 = warning condition, alarm is set but positioner still functional
  - 10 = error condition, positioner is non-functional (supersedes all warnings)
  - 11 = not used
- ☐ Bit 2 - Set to 1 only if the positioner is busy writing its EEPROM, or if the positioner is in the incorrect mode for what is requested. That is, the current command is valid but not currently executable (for instance, while calibrating).
- ☐ Bits 1,0 - Mode:
  - 00 = ON-LINE mode (normal)
  - 01 = LOCAL mode (normal, only HHT/PC10 are allowed to write setpoint)
  - 10 = CALIBRATE mode (auto start)

4.2 SECONDARY STATUS BITS

When the specified error condition exists, the status bit will be set to One. Otherwise, the status bit will be Zero. The secondary status is meant to be non-sticky. That is, the error condition is reflected here but only as long as it is true. Clearing the error condition is a matter of correcting the underlying fault.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

- Bit 7 - Control difference out of limit alarm. This means that the positioner exceeded the allowable control difference for the allowed duration. Control is either sluggish or un-optimized.
- Bit 6 - Travel Position low low alarm. The valve position is below the minimum allowed.
- Bit 5 - Travel Position high high alarm. The valve position is above the maximum allowed.
- Bit 4 - Travel Position low alarm. The valve position has gone below the user specified point.
- Bit 3 - Travel Position high alarm. The valve position has gone above the user specified point.
- Bit 1 - More Status is available by reading the additional status bytes
- Bit 0 - Currently in fail safe time out. No setpoint commands have been sent from the controlling system for the entire time out period. The positioner only fail safes when it is on-line. So, communication from the host have ceased. Most probable cause is that the host or FBM has been taken off-line or the connection has been broken.

4.3 DIAGNOSTIC STATUS

In general, an error bit raised here indicates a serious problem in the positioner and probably requires replacement.

Message	Explanation	Recommended Action
RAM	Error Writing positioner memory.	Replace failed item or positioner.
EEPROM	Error Writing positioner EEPROM.	Replace failed item or positioner.
ROM	Error Writing positioner ROM.	Replace failed item or positioner.
AD Converter	Converter function not controllable.	Replace failed item or positioner.
Actuator OOR	Position is not within permissible range (-5% ... +105%).	Check mechanics of actuator and valve. Perform Endpoints Calibration.
Current Loop I/P Motor	Connection of I/P converter to electronic board failed.	Replace failed item or positioner.
Potentiometer	Connection of potentiometer to electronic board failed.	Replace failed item or positioner.
Option Board	Option Board not configured or failed.	Check configuration or replace failed option board.

Detailed technical Information:

15	14	13	12	11	10	9	8
NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
7	6	5	4	3	2	1	0
NOT USED	Pot Fail	Current Loop	Out of range	ADC not finish	RAM Error	EEPROM Error	ROM Error

- Bit 6 - Potentiometer use has failed; the positioner no longer accurately controls the valve. (Fatal).
- Bit 5 - Current loop to I/P-Motor broken. (Fatal).
- Bit 4 - The actuator is out of range. Position is unreliable or not being properly controlled. (Fatal).
- Bit 3 - Analog to Digital conversion won't finish. (Fatal).
- Bit 2 - Access to positioner read addressable memory (RAM) resulted in an error. If all the data in the configuration pages looks correct, the positioner is probably still functional.
- Bit 1 - Access to positioner EEPROM resulted in an error. Positioner is incapable of storing configuration information or saving data. (Non-fatal)
- Bit 0 - Access to positioner ROM resulted in an error. Positioner software is now unreliable. (Fatal).

RAM - Diagnostic Bit 0
Access to positioner read only memory resulted in an error. Positioner must be replaced because the software is no longer reliable.

EEPROM - Diagnostic Bit 1
Access to positioner EEPROM resulted in an error. Positioner is incapable of storing configuration or saving data. It will still run until the next cycling of power, but should be replaced at the earliest opportunity.

ROM - Diagnostic Bit 2
Access to positioner read addressable memory (RAM) resulted in an error. RAM is used to initialize data. If all the data in the configuration pages looks correct, the positioner is probably still functional. It should be replaced at the earliest opportunity, however.

A/D Converter - Diagnostic Bit 3
Analog to Digital conversion cannot be completed. Positioner has become unreliable and should be replaced.

Actuator - Diagnostic Bit 4
The valve actuator is out of calibration. Despite the calibration, the actuator (valve) position is outside the allowable limits. Positioner should be treated as unreliable. Maintenance should be done at once.

Current Loop - Diagnostic Bit 5
Current loop to I/P motor broken. Positioner should be replaced.

Potentiometer - Diagnostic Bit 6
Potentiometer has failed. That means the positioner no longer accurately controls the valve position and the positioner should be replaced immediately.

4.4 ADDITIONAL STATUS

The additional status contains 4 bytes of Status for the SRD991.

These bytes may be reset via a reset status under the test menu. This action will also clear the 'More Status'-Flag within the Secondary Status and the 'SSTAT-Err'-Flag within the Primary Status, if the Secondary Status is empty.

Byte 1 contains system errors. The individual bits of the status byte are defined below. When the specified condition exists, the status bit will be set to One otherwise, the status bit will be Zero. Byte 3 contains the same information but historically - that is the condition existed but has been cleared.

7	6	5	4	3	2	1	0
NOT USED	Feedback	Trim Loop	Cycle Count	Travel Sum	Config invalid	Temp low	Temp high

- Bit 6 - Feedback failed; the feedback lever or coupling is out of range
- Bit 5 - Trimming of Input Loop Current failed; uncertain range in use
- Bit 4 - Cycle Count Limit reached; enough cycles completed to warrant planned maintenance
- Bit 3 - Travel Sum Limit reached; enough cycles accumulated to warrant planned maintenance
- Bit 2 - Configuration not valid
- Bit 0 - Device temperature too high

Byte 2 contains process errors. When the specified condition exists, the status bit will be set to One otherwise, the status bit will be Zero. Byte 4 is again a historical version of byte 2.

7	6	5	4	3	2	1	0
Output Press Alarm	Supply Press Alarm	Auto start fail	Control Diff	LowLow Alarm	HiHi Alarm	Low Alarm	High Alarm

- Bit 7 - Output Pressure Alarm; pressure is out of range
- Bit 6 - Air Supply Pressure Alarm; pressure is out of range
- Bit 5 - Auto start failed; positioner operation will only be correct if fully set up manually.
- Bit 4 - Control difference out of limit; operation sluggish or not possible, may be un-tuned
- Bit 3 - Travel Position low low alarm
- Bit 2 - Travel Position high high alarm
- Bit 1 - Travel Position low alarm
- Bit 0 - Travel Position high alarm

High Alarm

This is a 4-byte real, expressed as percentage of stroke. When the valve position exceeds this parameter, the Hi Alarm status bit in the secondary device status will be set. Default for this parameter is 110%.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	**High Alarm**	NOT USED	More Status	Fail safe time out

High High Alarm

This is a 4-byte real, expressed as percentage of stroke. When the valve position exceeds this parameter, the High High Alarm status bit in the secondary device status will be set. Default for this parameter is 110%.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	**HiHi Alarm**	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

Low Alarm

This is a 4-byte real, expressed as percentage of stroke. When the valve position exceeds this parameter, the Low Alarm status bit in the secondary device status will be set. Default for this parameter is -10%.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	**Low Alarm**	High Alarm	NOT USED	More Status	Fail safe time out

Low Low Alarm

This is a 4-byte real, expressed as percentage of stroke. When the valve position exceeds this parameter, the Low Low Alarm status bit in the secondary device status will be set. Default for this parameter is -10%.

7	6	5	4	3	2	1	0
Control Diff	**LoLo Alarm**	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

Cycle Count Limit

This is a 4 byte integer parameter. Its value contains the number of cycles necessary to trigger an alarm condition. When the cycle count equals or exceeds this number, an alarm bit is raised in the SRD991 additional status. Default value is 90,000,000.

7	6	5	4	3	2	1	0
NOT USED	Trim feedback	Trim Loop	**Cycle Count**	Travel Sum	Config invalid	Temp low	Temp high

Travel Sum Deadband

The default for this 4-byte real is 1%.

Travel Sum Limit

This is a 4-byte integer parameter. The parameter default is 90,000,000.

7	6	5	4	3	2	1	0
NOT USED	Trim feedback	Trim Loop	Cycle Count	**Travel Sum**	Config invalid	Temp low	Temp high

Control Difference Limit

Default for this parameter is 5%. This is a 4-byte real, expressed as a percentage.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

Control Difference Time

Default for this parameter is 60 seconds. This is a 4-byte real.

7	6	5	4	3	2	1	0
Control Diff	LoLo Alarm	HiHi Alarm	Low Alarm	High Alarm	NOT USED	More Status	Fail safe time out

Alarm Deadband

This 4-byte real, expressed as percentage. As an example, if the Low alarm is set to 8%, and this parameter is set to 1%, the default, then if the Low Alarm has occurred, the positioner needs to move back to 9% in order for the alarm to be cleared from the secondary status.

Please note, the alarm is also recorded in the historical status. Thus it is possible to check if an alarm had occurred since the last reset of historical status.

7	6	5	4	3	2	1	0
Control Diff	**LoLo Alarm**	**HiHi Alarm**	**Low Alarm**	**High Alarm**	NOT USED	More Status	Fail safe time out

Internal Electronics Temperature Lower Limit

This is a 4-byte real field that allows the user to set a minimum value for the internal electronics temperature. If the internal temperature of the positioner is outside the **Lower Temperature Limit** displayed in the alarms page, an alarm will be raised. The diagnostic bit remains set as long as the condition is valid.

Default value is -40 degrees Celsius (-40 Fahrenheit). Operating the positioner below this limit may cause damage to the instrument.

7	6	5	4	3	2	1	0
NOT USED	Trim feedback	Trim Loop	Cycle Count	Travel Sum	Config invalid	**Temp low**	Temp high

Internal Electronics Temperature Upper Limit

This is a 4-byte real field that allows the user to set a maximum value for the internal electronics temperature. If the internal temperature of the positioner is outside the **Upper Temperature Limit** displayed in the alarms page, an alarm will be raised. The diagnostic bit remains set as long as the condition is valid.

Default value is +80 degrees Celsius (+176 Fahrenheit). Operating the positioner above this limit may cause damage to the instrument and violate electrical safety conditions.

7	6	5	4	3	2	1	0
NOT USED	Trim feedback	Trim Loop	Cycle Count	Travel Sum	Config invalid	Temp low	**Temp high**

Pressure Sensor Page

Air Supply Pressure Lower Limit

This is a 4-byte real, expressed in the units defined in the **Units** page. It specifies the lower limit of the air supply pressure. If the air supply pressure falls below this limit a status bit will be set.

Air Supply Scaling Low

This is a 4-byte real, expressed in the units defined in the **Units** page. It specifies the minimum value for scaling of the air supply pressure, which is displayed in the Device Data Screen.

Air Supply Scaling High

This is a 4-byte real, expressed in the units defined in the **Units** page. It specifies the maximum value for scaling of the air supply pressure, which is displayed in the Device Data Screen.

Output Pressure Scaling High

This is a 4-byte real, expressed in the units defined in the **Units** page. It specifies the maximum value for scaling of the output pressure, which is displayed in the Device Data Screen .

Output Pressure Scaling Low

This is a 4-byte real, expressed in the units defined in the **Units** page. It specifies the minimum value for scaling of the output pressure, which is displayed in the Device Data Screen

Options Page

This is a single-byte parameter with each bit representing different options that may have been added to this particular SRD991. Currently there are five bits defined as follows:

7	6	5	4	3	2	1	0
NOT USED	NOT USED	NOT USED	Extern Analog Sensor	Extern Binary Output	Extern Binary Input	Intern Press Sensor	Extern Posit Xmit

Check Sum

If the 5 bytes of the Device ID are not correct, an improper CRC will be generated and sent as part of the message. On arrival, the CRC will be detected as invalid and the command will be ignored - that is, no response will be sent at all from the positioner!

Calculation of the CRC for non-secure commands is simply to apply the CRC algorithm to all bytes of the message. For secure (and enhanced mode) transmissions, the 5 bytes of the Device ID are used to seed the CRC calculation. It is as if those bytes were actually sent, but they are not for timing reasons. This second, more elaborate, CRC is labeled the PCRC in the new command definitions.

Presume the current byte being added to the CRC is 0x5A and presume the two byte CRC for the current command is 0x12, 0x34 up to this point. Then the steps taken in the software calculation are as follows:

- the current byte is exclusive or'd with the most significant byte of the CRC (crcmsb)

- crcmsb = 0x12 ^ 0x5A = 0x48
- the most and least significant bytes are swapped
  - crclsb = 0x48
  - crcmsb = 0x34
- four bit permutations are done:
  the crclsb is exclusive or'd with the top 4 crclsb bits shifted down 4 bits crclsb = 0x48 ^ (0x48 >> 4) = 0x48 ^ 0x04 = 0x4C
- the crcmsb is exclusive or'd with the bottom four crclsb bits shifted up 4 bits

- crcmsb = 0x34 ^ (0x4C << 4) = 0x34 ^ 0xC0 = 0xF4
- the crcmsb is exclusive or'd with the top 5 crclsb bits shifted down 3 bits

- crcmsb = 0xF4 ^ (0x4C >> 3) = 0xF4 ^ 0x09 = 0xFD
- the crclsb is exclusive or'd with the bottom three crclsb bits shifted up 5 bits crclsb = 0x4C ^ (0x4C << 5) = 0x4C ^ 0x80 = 0xCC

So the CRC saved for the next byte will be 0xFD, 0xCC.

The reason for all this calculation is to insure detection of all single bit transmission errors. Obviously, the calculation must be done the same way on both ends or a mismatch will occur and no reply will be sent.

Measurement value

The device data display shows the static tag information and data, such as setpoint, position, error,etc which is updated. For additional information, see:

Setpoint

This is a 4-byte real, expressed as percent. Since it is the digital setpoint, Setpoint source should be set to **Digital** in the configuration screen. This parameter provides a read back of the setpoint value that the positioner is currently using. (Default range is: 0.0 to 100.0%).

Position

This is a 4-byte real, expressed as percentage. The normal operating range for the valve **position** is 0 to 100% of the full scale.

Valve Position

This is a 4-byte real, expressed as percentage. The normal operating range for the valve **position** is 0 to 100% of the full scale.

Stem Setpoint

This is a 4-byte real, expressed as percentage. The **Stem setpoint** is the same as **Setpoint** unless an option other than **linear** (default) is chosen in the characterization screen.

Air Supply Pressure Reading

This is a 4-byte real. The measurement reflects the current value on the optional air supply pressure sensor.

Output Pressure Reading

This is a 4-byte real. The measurement reflects the current value on an optional output pressure sensor.

Control Difference

This is a 4-byte real parameter. This measurement indicates the difference between the setpoint and actual position. The calculation is done by the Control Processor.

Travel Position

The travel position is a 4-byte real which shows the valve position in the units selected in the **Units** screen.

Travel Sum

This is a 4 byte integer measurement. It contains the valve travel accumulation in full strokes. All movement, regardless of direction, is added. Once the movement totals a full stroke (four quarter strokes open/close, a single stroke from 0% to 100%, or many small movements in both directions which add up to a full stroke), this field is incremented. The sum may be reset by writing a zero to this parameter (**test->reset**). It is initialized to zero at the factory.

Internal Electronics Temperature

This is a 4-byte real parameter. Its value represents the PCB temperature in degrees Celsius. If the internal temperature of the positioner is outside the **Upper and Lower Temperature Limits** displayed in the alarm page, an alarm will be raised. Warning: Operating the positioner outside these limits may cause permanent damage and violate hazardous safety conditions.

Cycle Count

This is a 4 byte integer measurement. It is used to accumulate the number of changes in direction (open/close) that the valve has encountered. One move toward open and one movement toward close, both exceeding positioner deadband, count as one cycle. The count may be reset by writing a zero to this parameter (**test->reset**). The value is initialized to zero at the factory.

Local Enable

This function allows the device to enter into local mode. If local enable is disabled, a local master like the HHT or PC10 is not allowed to write to the positioner at all as long as the communication to the FBM is not broken. This variable is only written by the FBM.

Analog Setpoint Low

This is a 4-byte real and defines the minimum value of the analog setpoint. It is normally set at the factory to 4.0 mA, but can be adjusted higher for split ranging**.** If the positioner is being used in the analog mode, the calibration by **Analog Setpoint** feature is available in the **Calibrate** menu. The **Analog Setpoint** feature is also available in the push button menu of the positioner's PCB.

Analog Setpoint High

This is a 4-byte real and defines the maximum value of the analog setpoint. It is normally set at the factory to 4.0 mA, but can be adjusted higher for split ranging**.** If the positioner is being used in the analog mode, the calibration by **Analog Setpoint** feature is available in the **Calibrate** menu. The **Analog Setpoint** feature is also available in the push button menu of the positioner's PCB

Fabrication Number

This is a 4-byte number that is pre-set at the factory.

Hardware Revision

This single byte field is pre-set at the factory to show the revision of the electronics within the positioner.

Simulation Value

If simulation of an SRD991 position is enabled, this simulated value is sent back to the I/A system instead of the actual potentiometer reading.

5 PROFIBUS AND FIELDBUS CONFIGURATION

5.1 Comm-DTM

We recommend using the communication DTM for Profibus distributed by softing. This driver is not included in the modeminstall.exe or the srdinstall.exe.

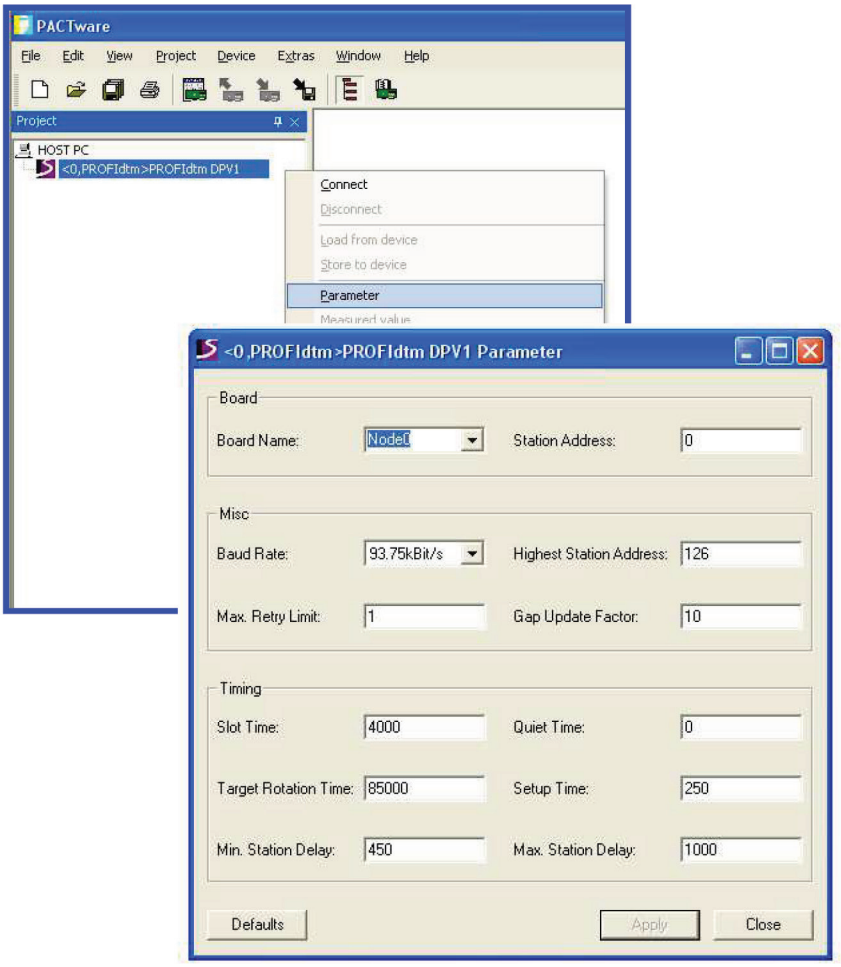
The driver can be downloaded and updated from: http://www.softing.com, but requires a USB-dongle that has to be purchased from Softing directly. In addition an interface (PROFIcard by softing) to connect the PC or workstation to a Profibus DP segment coupler is required.

We recommend to use the following DPV1 parameters for setting up the Comm-DTM.

Settings:

The settings can be found under Parameter for the Comm-DTM

(<0, PROFIdtm>PROFIdtm DPV1).



Misc

Baud Rate:

93.75 kBits/s

Highest Station Address:	126
Max. retry Limit:	1
Gap Update Factor:	10

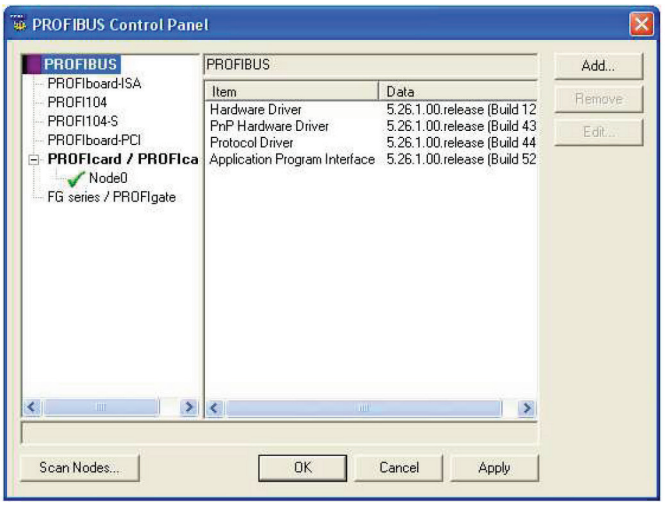
Timing

Slot Time:

4000

Quiet Time:	0
Target Rotation Time:	85000
Setup Time:	250
Min. Station delay:	450
Max. Station delay:	1000

Profibus Configurations



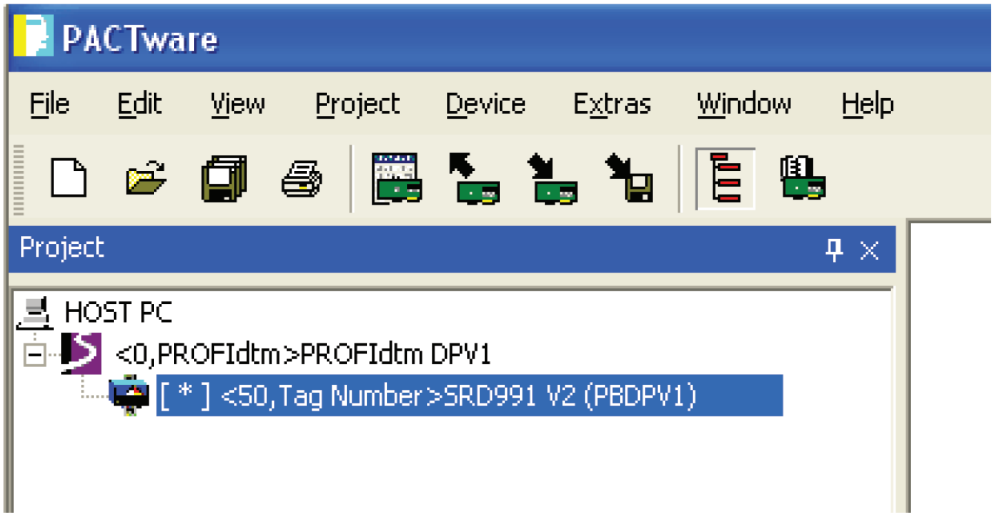
Profibus Control panel

The Profibus Control panel can be found under Start → Control Panel → PROFIBUS.

Ensure that you see a green ✓ in front of the Node. If you do not see other than that, such as a red ✘, the PROFIcard is not active. Contact softing for assistance.

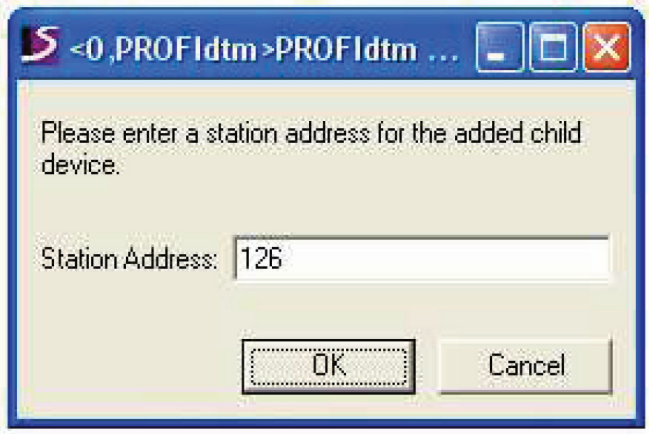
5.1.2 SRD-DTM

Connect the SRD-DTM for Profibus as shown below and described under “Opening a Project”.



After selecting the device driver from the device catalog, a window will automatically open to edit the bus address for this specific unit. The default slave address is 126.

The following addresses are reserved for the Master or default: 0, 1 and 126.



After selecting the bus address, each line will show the address for the Master and Slave first. See the following example:

<0, PROFIdtm>PROFIdtm DPV1 (0: Node 0)
<50, Tag Number> SRD991 V2 (PBDPV1) (50: Bus Address)

5.1.3 Data Screen

For Profibus devices an additional Data Screen may be opened to display additional Profibus specific parameters. For viewing the Profibus Data select **View – Profibus Data**. This function opens a modeless dialog. The displayed information is updated approximately once every two seconds.

Fields	Description
Readback	The actual position of the actuator/valve within the travel span in units of PV-SCALE.
Position D	The current position of the acutator/valve (discrete). Possible values are: NOT INITIALIZED (before an autostart has been performed), CLOSED, OPENED and INTERMEDIATE.
FB-Mode	Actual Mode of the Function Block.
SP	Setpoint SP in units of PV-SCALE. This setpoint is used as desired value , when the function block is in Mode AUTO and the status of SP is ok (e.g. Good (Non Cascade) = 0x80).
RCAS_IN	Setpoint RCAS_IN in units of PV-SCALE. This setpoint is normally transmitted by a DCS- System. This setpoint is used as desired value , when the function block is in Mode RCAS and the status of RCAS_IN is ok (e.g. Good (Cascade) = 0xC0).
RCAS_OUT	Setpoint RCAS_OUT in units of PV-SCALE with status, which is used as input for the function block algorithm. Depending on the mode of the function block contains the setpoint SP or RCAS_IN. RCAS_OUT is offered for the DCS- System or other function blocks.
OUT	Output Setpoint of the function block in units of OUT-SCALE with status. It is valid, when the function block is in mode AUTO or RCAS. In mode MAN, this value can be specified by the operator/engineer.

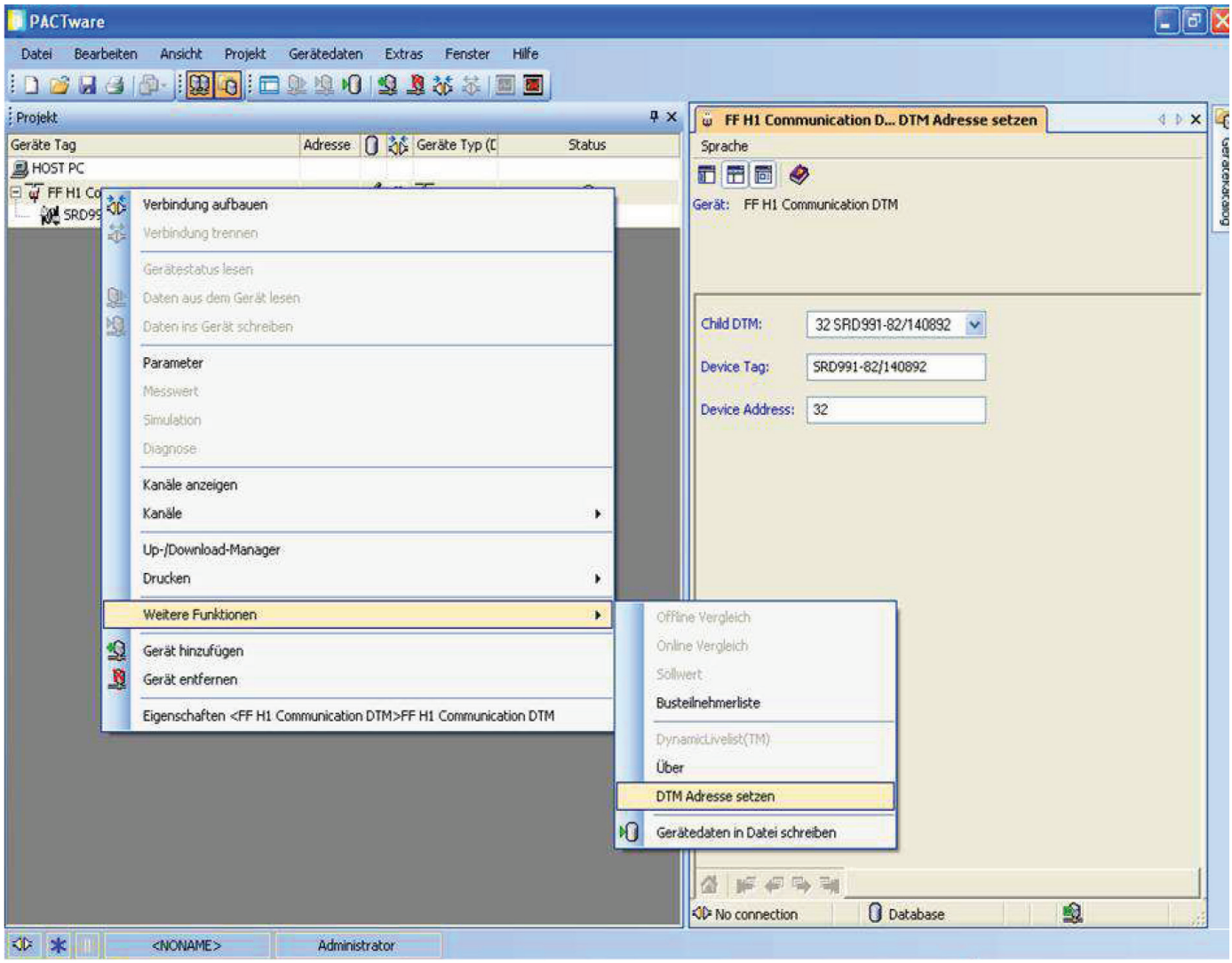
5.1.4 Profibus Function Block Page

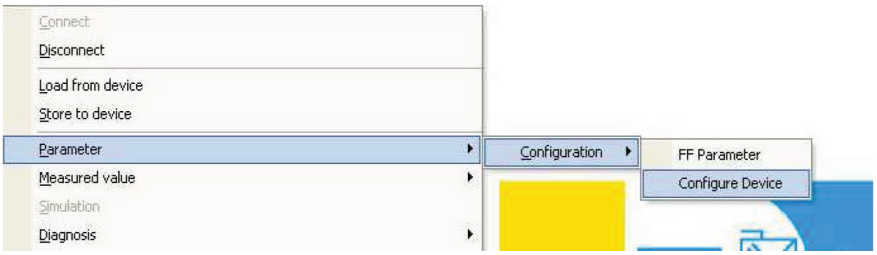
For the detailed configuration of the Profibus Function Block parameters the Profibus Function Block Page is used.

Fields	Entries
Target Mode	Contains the desired mode of the function block.
PV-SCALE:	Conversion of a process value in the defined engineering units to a normalized value in percent as the input value of the function block. It contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point. As default, PV-PSCALE is configured to percent, meaning that the Variables SP, Readback, RCAS_IN und RCAS_OUT, which are depending on PV-SCALE, are displayed in the range 0-100%.
OUT-SCALE:	Conversion of the normalized Output Signal (in percent) of the function block to the OUT parameter in the defined engineering units. It contains the high and low scale values, engineering units code, and number of digits to the right of the decimal point. As default, OUT- SCALE is configured to percent, meaning that the Variable OUT is displayed in the range 0-100%.
Simulation	Allows definition of a value and a status. When Simulation is enabled, this value and status is given in Readback instead of the real position of the actuator/valve. This set of parameters is intended only for commissioning and maintenance reasons.

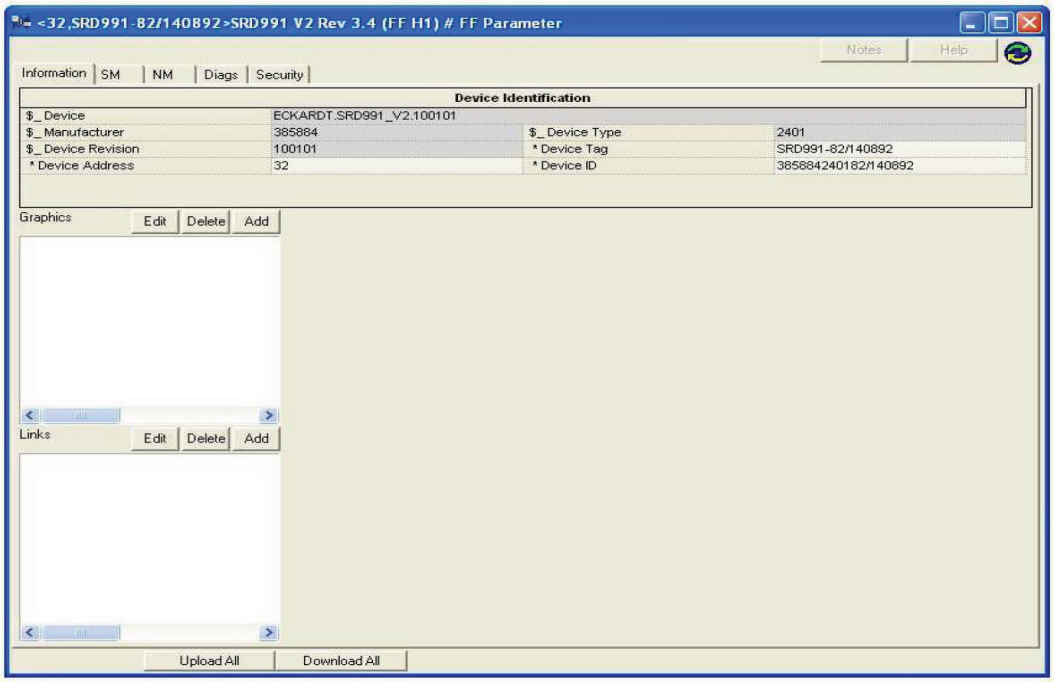
5.2 FOUNDATION Fieldbus Configurations

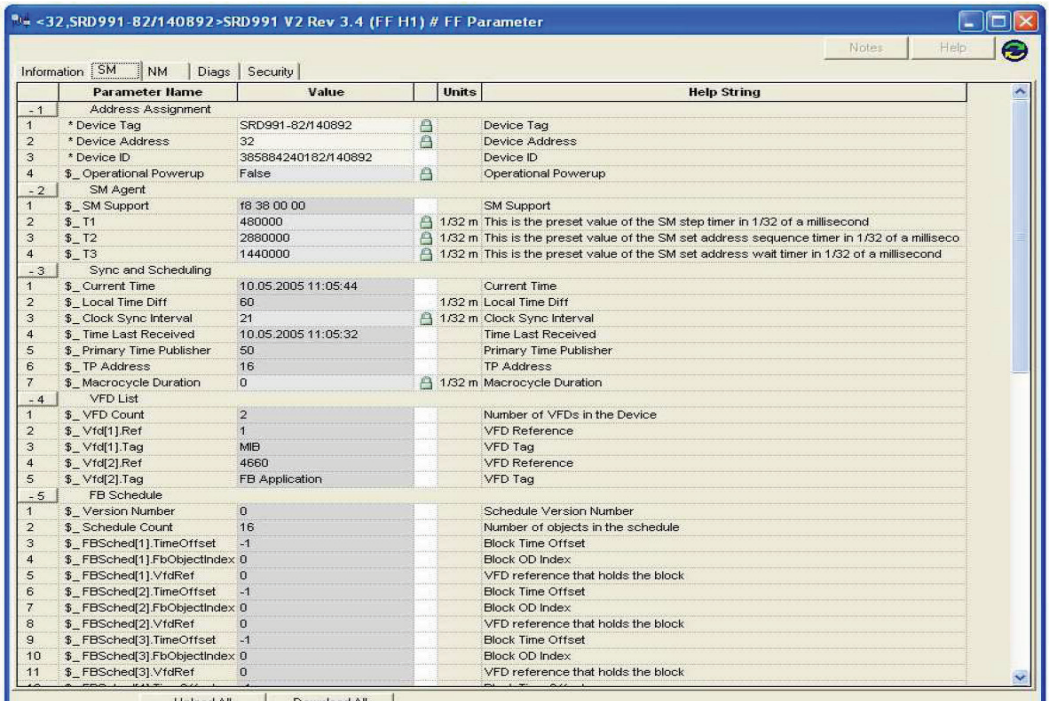
5.2.1 Configuration of address and FF-specific parameters.





5.2.2 Listing of FF parameter





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