

nlvFLUAS



This software is used to control leakvalves from nenion.

It provides a Resolution of 1.000.000 steps per stroke.

It can be controlled [directly via touch screen](#), via [remote](#) or via [script](#)

It has a [status display](#) and can be customized via different [settings](#).

It is possible to connect sensors to the controller (up to 3 0-10V Inputs). It can be defined, which kind of data the sensor provides (e.g. Pressure, Flow), which unit and what mathematical formula is being used.

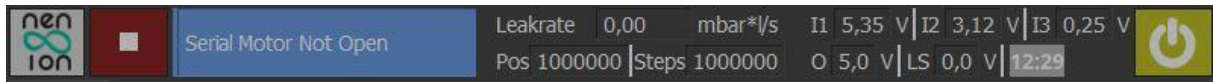
The [sensor](#) is being used to establish a close feedback loop to hold a specific data value automatically.

To do this have to measure a valve position to data correlation via the script control.

This correlation is shown in a [Diagram](#) in all but the [settings control](#).

Status Display

At the top there is an area, where information about the valve is shown.



Picture 1: Status Display

The elements are as follows (from left to right):

nenion Button: Holding and pressing on this button for > 2 seconds shows a context menu, where you can select the What's this mode and show this help.

Stop Button: Clicking this button stops the valve immediately. It also stops any running script.

Status Message: Here the status messages of the valve are displayed.

Position Display: Shows the Position from the internal incremental encoder. It may differ a bit from the steps display because the encoder has a lower resolution than the motor. When clicking on the position Label, a menu is displayed

Steps Display: Shows the position of the motor. It may differ from the position display because the encoder has a lower resolution than the motor.

Data Display: Shows the data of a sensor, that can be connected via the input plug. See sensor.

I1: The voltage of input 1

I2: The voltage of input 2

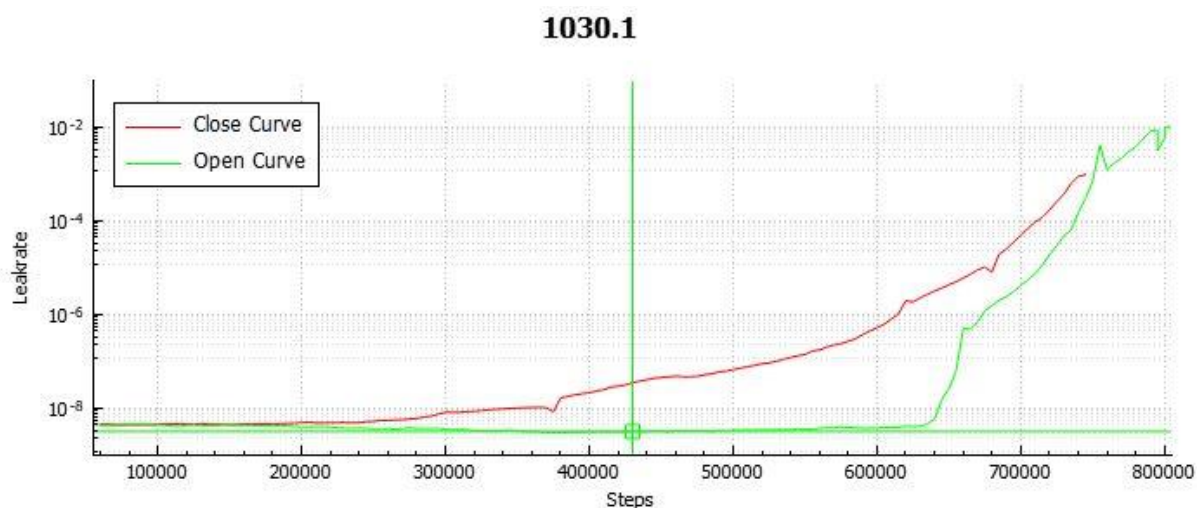
I3: The voltage of input 3

O: Voltage of the Output.

Limit Switch: The voltage of the Limit Switch. If it is 0, the limit switch is pressed or no motor in is connected.

I/O – Software Button: Click to shutdwon the valve. Afterwards you need to physically push the power button to cut off power supply.

The Diagram



Picture 2: The Diagram

The Diagram in the remote, manual and script control show the correlation between the data and the valve position and/or time. The correlation has to be saved first, this can be done with a script.

Because of the hysteresis of the valve there are two different types of data correlation:

- Open Curve: The correlation while opening the valve. Set in the script by the command Measure Open (MEAS_OPEN).
- Close Curve: The correlation while closing the valve. Set in the script by the command Measure Close (MEAS_CLOSE).

There is also a possibility to set different values of the defined data (e.g. pressure) and display these over time:

- Data Curve: Set in the script by the command Measure (MEAS).

All of these correlations have to be saved with a save command as a teach-in-file to display them in the diagram.

Long Press or doubleclick on the diagram shows a menu. The menu items are:

- Zoom In: zooms in with a factor of 1,5
- Zoom Out: zooms out with a factor of 1,5
- Redraw: Redraws the diagram
- Choose Data: selects another data file to display in the diagram
- Show/Hide Key: Shows or hides the key.
- Show/Hide Sensitivity: Shows or hides the Sensitivity. For information only. Equals change of data / change of steps (first derivative)
- Print Diagram: A picture of the diagram is being saved. You can choose a file to save to.
- Export Diagram: Export the Data to an Excel File

Click on a curve to select the data. For example in the manual control to set the valve to a specific data value.

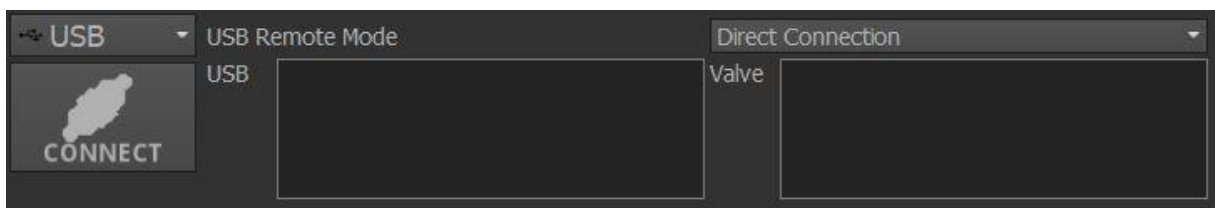
Remote Control

The Remote Control can be used to remotely control the valve.

Options are:

- [USB](#)
- [Analog](#)
- [Ethernet](#)
- [Terminal](#)

USB



Picture 3: Remote Control USB

USB connection is used to remotely control the valve. The settings of the interface are summarized and set in the [Settings Control](#).

The settings are: Baudrate: 19200 Parity: Even DataBits: 8 Stop Bits: 1 Flow Control: None

Connect the controller with a USB Cable to a PC. Important: Use the remote USB – Plug.

You can choose between

- [Direct Connection](#)
- [Nenion 2.7.2](#)
- [Modbus](#)

In the left text field (titled USB) data, that is sent from the remote source is shown.

In the right text field the data sent from the motor driver is shown.

Click the Connect Button to connect to the USB remote host.

When connected the connection can be closed by clicking the Disconnect Button.

Direct Connection

Everything that is received from the remote Source is directly sent to the motor driver.

Nenion 2.7.2

This is used to convert the commands of the old leakvalve.

Modbus

This is used to communicate with a Modbus Master. The Modbus Address is 1. The Modbus data definitions are as follows:

Coils

Adress	Value Range	Description	Read/Write
0	0..1	Motor Stop. 1=Stop. Sets itself automatically back to 0.	w
1	0..1	Plus 4 Step, corresponds to Manual open slow Button with 1 arrow. ¹⁾	w
2	0..1	Minus 4 Step, corresponds to Manual close slow Button with 1 arrow. ¹⁾	w
3	0..1	Plus 4 Step, corresponds to Manual open normal Button with 2 arrows. ^{1) 2)}	w
4	0..1	Minus 4 Step, corresponds to Manual close normal Button with 2 arrows. ^{1) 2)}	w
5	0..1	Plus 4 Step, corresponds to Manual open fast Button with 3 arrows. ^{1) 2)}	w
6	0..1	Plus 4 Step, corresponds to Manual close fast Button with 3 arrows. ^{1) 2)}	w
7	0..1	Start Feedback loop with Holding Register 5 and 6 as the input of the sensor formula. 1=Feedback active; 0=Feedback stopped	w

¹⁾ Sets itself automatically back to 0, so that the Modbus Master can set 1 again directly afterwards.

²⁾ Speed can be set in [Settings Control](#)

Discrete Inputs

Adress	Value Range	Description	Read/Write
0	0..1	Limit Switch	r
1	0..1	If feedback loop is started with modbus: 0=feedback target not reached	r

		1=feedback value reached	
--	--	--------------------------	--

Holding Registers

Address	Value Range	Description	Read/Write
0	0..65535	Low – Word Position, can only be written together: Address 0 and 1, high and low word	r+w
1	0..15	High – Word Position, can only be written together: Address 0 and 1, high and low word	r+w
2	0..1023	Analog Input 1	r
3	0..1023	Analog Input 2	r
4	0..1023	Analog Input 3	r
5	0..10000	Val1 used to set the feedback target, calculated with the sensor formula	r+w
6	0..10000	Val2 used to set the feedback target, calculated with the sensor formula	r+w

In the left text field (titled Ethernet) data, that is sent from the remote source is shown.

In the right text field the data sent from the motor driver is shown.

Click the Connect Button to connect to the Ethernet remote host.

When connected the connection can be closed by clicking the Disconnect Button.

Analog Control

Picture 4: Remote Control Analog

An analog input is used to remotely control the valve. The elements to do this are:

Remote Source: Define the Analog Input from which you want to control the valve.

Sampling: Define the time interval in which the analog inputs are read in milliseconds. Cannot be below 500 ms

You can define a linear function to use with the remote signal. It is as follows:

$$steps = lowerSteps + \frac{\Delta steps}{\Delta V} * signal$$

Variable	Description
steps	the steps that the valve moves to
lowerSteps	Value in input field “Lower”
Δsteps	Value in upper steps input field - Value in lower steps input field
ΔV	Value in “Upper” input field - Value in “Lower” input field
signal	The input signal

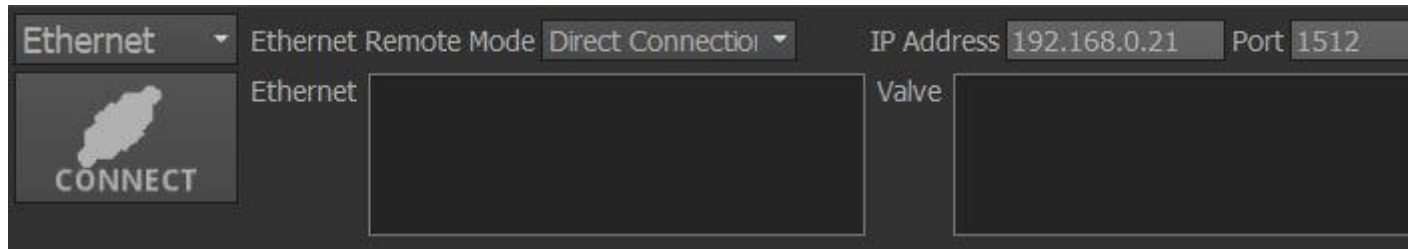
In the left text field (titled Input), the input signal is shown.

In the right text field the resulting steps are shown.

Click the Connect Button to connect to the USB remote host.

When connected the connection can be closed by clicking the Disconnect Button.

Ethernet



Picture 5: Remote Control Ethernet

Ethernet connection is used to remotely control the valve.

Connect the controller with a Ethernet Cable to a network.

You can specify the IP address and the port. If you click on the label "Ip Address" a menu appears. There you can select the show local IP-Addresses item. You are then shown, which IP-Addresses exist on the controller (via DHCP).

You can choose between

- [Direct Connection](#)
- [Nenion 2.7.2](#)
- [Modbus](#)

Modbus

This is used to communicate with a Modbus Master. The Modbus Address is 1. The Modbus data definitions are as follows:

Coils

Address	Value Range	Description	Read/Write
0	0..1	Motor Stop. 1=Stop. Sets itself automatically back to 0.	w
1	0..1	Plus 4 Step, corresponds to Manual open slow Button with 1 arrow. ¹⁾	w
2	0..1	Minus 4 Step, corresponds to Manual close slow Button with 1 arrow. ¹⁾	w
3	0..1	Plus 4 Step, corresponds to Manual open normal Button with 2 arrows. ^{1) 2)}	w
4	0..1	Minus 4 Step, corresponds to Manual close normal Button with 2 arrows. ^{1) 2)}	w
5	0..1	Plus 4 Step, corresponds to Manual open fast Button with 3 arrows. ^{1) 2)}	w
6	0..1	Plus 4 Step, corresponds to Manual close fast Button with 3 arrows. ^{1) 2)}	w
7	0..1	Start Feedback loop with Holding Register 5 and 6 as the input of the sensor formula. 1=Feedback active; 0=Feedback stopped	w

¹⁾ Sets itself automatically back to 0, so that the Modbus Master can set 1 again directly afterwards.

²⁾ Speed can be set in [Settings Control](#)

Discrete Inputs

Address	Value Range	Description	Read/Write
0	0..1	Limit Switch	r
1	0..1	If feedback loop is started with modbus: 0=feedback target not reached 1=feedback value reached	r

Holding Registers

Address	Value Range	Description	Read/Write
0	0..65535	Low – Word Position, can only be written together: Address 0 and 1, high and low word	r+w
1	0..15	High – Word Position, can only be written together: Address 0 and 1, high and low word	r+w
2	0..1023	Analog Input 1	r
3	0..1023	Analog Input 2	r
4	0..1023	Analog Input 3	r
5	0..10000	Val1 used to set the feedback target, calculated with the sensor formula	r+w
6	0..10000	Val2 used to set the feedback target, calculated with the sensor formula	r+w

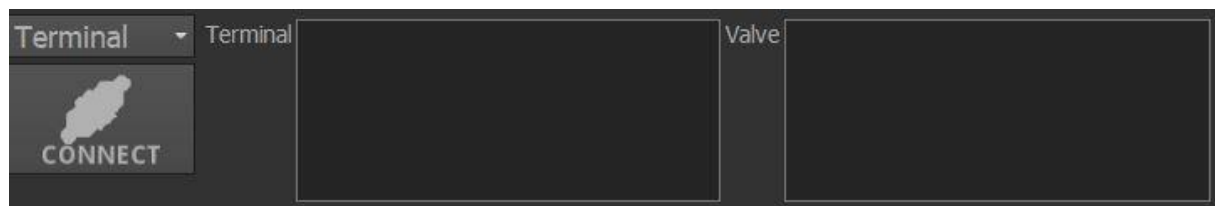
In the left text field (titled Ethernet) data, that is sent from the remote source is shown.

In the right text field the data sent from the motor driver is shown.

Click the Connect Button to connect to the Ethernet remote host.

When connected the connection can be closed by clicking the Disconnect Button.

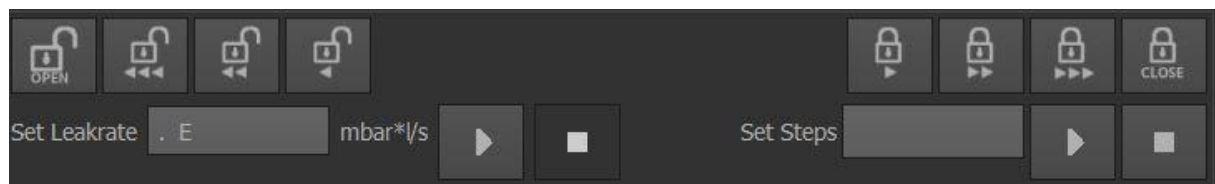
Terminal



Picture 6: Remote Control Terminal

In Terminal Mode you can send Motor Commands directly to the motor controller.

Manual Control



Picture 7: Manual Control

Open Button: Opens the valve completely.

Open Fast Button (with 3 arrows): When clicked, the valve opens a few steps. You can hold it and the valve will keep opening relatively fast. 10 times faster than slow speed. The speed can be set in the [Settings Control](#).

Open Normal Button (with 2 arrows): When clicked, the valve opens fewer steps. You can hold it and the valve will keep opening in normal speed. 5 times faster than slow speed. The speed can be set in the [Settings Control](#).

Open Slow Button (with 1 arrows): When clicked, the valve opens 4 steps. The speed can be set in the [Settings Control](#).

Close Slow Button (with 1 arrows): When clicked, the valve closes 4 steps. The speed can be set in the [Settings Control](#).

Close Normal Button (with 2 arrows): When clicked, the valve closes fewer steps. You can hold it and the valve will keep closing in normal speed. 5 times faster than slow speed. The speed can be set in the [Settings Control](#).

Close Fast Button (with 3 arrows): When clicked, the valve closes a few steps. You can hold it and the valve will keep closing relatively fast. 10 times faster than slow speed. The speed can be set in the [Settings Control](#).

Close Button: Closes the valve completely.

Set Data Input Field: Here you can set the data, that a connected sensor represents. Sensor not mandatory.

Goto Data Button (with play symbol): Uses the data file, shown in the diagram, to position the valve to the data defined in Set Data Input Field. The sensor is then used to reach the data point automatically, using the feedback settings.

Stop Data Button (with stop symbol): The automatic feedback to reach the data point defined in Set Data Input Field is turned off.

Set Step Input Field: Here you can set the steps to which the valve positions when clicking the Goto Step Button.

Goto Step Button (with play symbol): The valve positions to the steps defined in Set Step Input Field.

Stop Step Button (with stop symbol): The valve stops.

Script Control



Picture 8: Script Control

Here you can use a script to automatically control the valve.

The Script List

At the left side, the scripts are listed. Each list entry (i.e. each script) has 4 buttons, 2 before the script name and 2 afterwards. A single click on the list selects a script. A double-click or long-press starts the buttons. The functionality is:

Run Script Button (play symbol): Runs the script. Th script starts at the command selected in the commands list (right)

Stop Script Button (stop symbol): Stops the script.

New Script Button (plus symbol): A new empty script is added to the list.

Delete Script Button (minus symbol): The selected script is being deleted.

If you click on the script (or anywhere in the script list) and it has changed, a message will appear to ask you for saving.

To rename a script double-click or long-press on the script name.

The Command List

At the right side the commands of the selected scripts are listed. A command consists of:

- Command Number: Identifier number of the command.
- Command Name: Identifies the command. See [table of commands](#).
- Value: An integer number
- Repetition: An integer number stating the number of Repetitions for certain commands.

Each list entry (i.e. each command) has 4 buttons at the right side. A double-click or long-press starts the buttons. The functionality is:

Up Button (up arrow symbol): The command is moved one command upwards.

Down Button (down arrow symbol): The command is moved one command downwards.

New Command Button (plus symbol): A new empty command is added to the list.

Delete Command Button (minus symbol): The selected command is being deleted.

Table of Commands

Command	Description	Value	Repetition
GotoPos	The valve moves to an absolute position	Absolute Position in steps (1..1.000.000)	Not evaluated
GotoPosRel	The valve moves to a relative position	Relative Position in steps (1..1.000.000)	Number of Repittions
GotoCmd	Move the execution of the script to a specific command identified by the command number.	Command number of the command that should follow	Number of Repittions
GotoData	Automatically moves the valve to a position where the connected sensor reaches using the formula defined in sensor. When it is reached, the next command is executed. If a wait command follows, feedback is left turned on.	Integer Value: Val1 of sensor Formula $Val1 = Value/1000$	Integer Value = Val2 of sensor Formula $Val2 = Repetition/1000$
Wait	Waits a given time	Wait time in ms	Not evaluated
Measure	Sets Measurement of a Data Curve on or off	0...turn off 1...turn on	Not evaluated
MeasClose	Sets Measurement of a Data Curve on or off	0...turn off 1...turn on	Not evaluated
MeasOpen	Sets Measurement of a Data Curve on or off	0...turn off 1...turn on	Not evaluated
Save	Saves the measured data to a teachin – File. The Filename is the name of the script.	Not evaluated	Not evaluated



Important: Repetition only work for one command!

Settings Control

Here you can change settings of the nlvFLUAS Software. There are three different categories of the settings:

- [Valve Settings](#)
- [Diagram Settings](#)
- [Feedback Settings](#)

Valve Settings

Picture 9: Valve Settings

Sampling Rate of Inputs: the sampling rate in ms. Cannot be below 1000 ms.

Continuous Speed: The speed for the continuous movement in the [Manual Control](#). Must be between 1 and 100

Output 1: The output (pin 7 (5V) and 8 (GND)) of the analog input connection can be defined as:

- None
- OK – Signal from the motor driver: Output is 5V, when the Motor driver is ready.
- Moving: Output is 5V, when the Motor is moving.
- Error: Output is 5V in Case of an Error.

Calibration on Start: When checked, the valve calibrates (=moves to the closed position) automatically when the controller is put on. If not checked, the controller saves the position and a message box is being displayed on Start, if the user wants to calibrate or use the saved position (=force).

Version: The Version Number of the Software.

Update: An update-file can be selected from a USB Source (stick or external hard drive). The Software is then updated and the controller restated.

Language: You can select installed language files.

Clear Error: Any Error of the motor driver is being cleared.

Calibrate: The valve is calibrated (=moves to the closed position).

Restart: The software is being restarted.

Change Samba Password: Change the password of the share folder, which can be accessed via IP-Network (Samba Protocol). Default password is nenion2018.

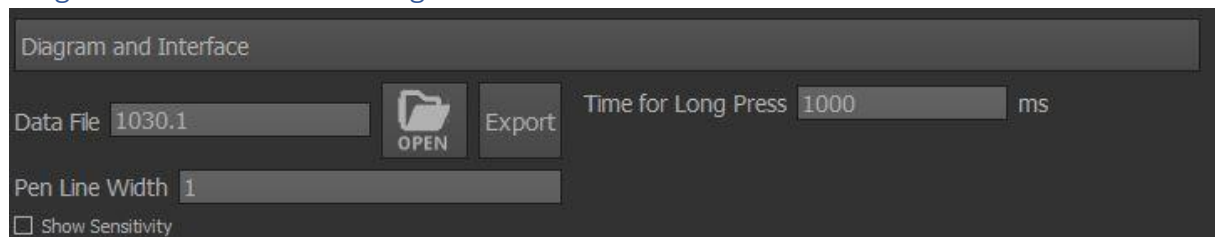
Execute Script: You can select a script, which is then executed. For installing language or data files.

Motor Port: The serial interface for the motor. It is advised not to change it. Disabled when ttyAMA0.

Remote Port: The serial interface for the remote connection. Normally ttyUSB0. Below are the settings of the serial interface for remote connection.

Baudrate: 19200 Parity: Even DataBits: 8 Stop Bits: 1 Flow Control: None

Diagram and Interface Settings



Picture 10: Diagram and Interface Settings

The Data File: Choose the data file. To use feedback features the sensor, that was used to generate it, has to be the same as the connected sensor. The file can be exported, e. g. to a USB – Stick.

Pen Width: The width of the pen used to draw the lines in the diagram

Show Sensitivity: Shows or hides the Sensitivity. For information only. Equals change of data / change of steps (first derivative)

Time for Long Press: time in ms, that is needed to detect a long press (click and hold)

Feedback Settings

Feedback

Recalculation and PID Values

Relative Recalc 0.5 Times 2

TeachIn Curve Use Open Curve Relative Diff 0001

Differential Value 200 Integral Value 200

Proportional Value 50 Integral Quantity 10

Feedback Input 1 Input 1

Upper 10000 mV if above upper, then Stay

Lower 0 mV if below lower, then Close

Feedback Input 2 Input 2

Upper 10000 mV if above upper, then Open

Lower 0 mV if below lower, then Stay

Sensor UL-100 Data Name Leakrate

Sensor Formula val1*Math.pow(10, -Math.round(val2))

Unit: mbar*/s Input Mask ###E##

+

-

...

Picture 11: Feedback Settings

When Feedback is turned on (either by script or by the manual control), a relative deviation (=Difference) is calculated:

$$relative\ difference = abs\left(\frac{measured\ data}{data\ goal} - 1\right)$$

Relative Difference: value of the relative difference where the valve reacts.

The software calculates a difference in steps:

$$steps\ difference = Proportional\ Value * relative\ difference +$$

$$Differential\ Value * relative\ difference * \frac{data_t}{data_{t-1}} +$$

$$integral\ value * \sum_{i=last-integral\ quantity}^{last} relative\ difference$$

Differential Value: The Differential Value in above formula

Integral Value: The Integral Value in above formula

Proportional Value: The Proportional Value in above formula

Integral Quantity: Number of integral values being summed up.

Relative Recalc Value: If the calculated relative Difference is higher than this value, the steps are recalculated according to the teach-in – File. This is meant to deal with the hysteresis.

Times (Reacalc): The number of times recalculation will be done. If too high, it may be toggling between recalculating and feedback control. Generally it should not be higher than 2.

[Sensor](#): Defines the connected sensor (e.g. pressure sensor, flow sensor)

Sensor Formula: The sensor formula

Unit: The unit of the data. (e.g. mbar)

Data Name: The Name of the data being represented by the sensor (e.g. pressure).

Input Mask: An Input Mask can be set. See sensor definition.

Add Sensor Button (plus symbol): Define new sensor.

Delete Sensor Button (minus symbol): The selected Sensor is deleted.

Change sensor definition (... symbol): Change the definition of a sensor.

Feedback Input 1: The Analog Input, which is used to define the sensor (relates to "val1" in the sensor formula)

Upper: Defines an upper boundary in mV. If the Signal is above this boundary, the following actions can be defined:

- Close: closes the valve
- Open: opens the valve
- Stay: The valve stays and it will not move even if feedback is turned on.

Lower: Defines a lower boundary in mV. If the Signal is below this boundary, the actions close, open or stay can be defined.

Feedback Input 2: The Analog Input, which is used to define the sensor (relates to "val2" in the sensor formula)

Upper: Defines an upper boundary in mV. If the Signal is above this boundary, the actions close, open or stay can be defined.

Lower: Defines a lower boundary in mV. If the Signal is below this boundary, the actions close, open or stay can be defined.

[Sensor](#)

A sensor is defined with the following variables:

- Sensor Name: The name of the sensor. This name appears in the Feedback settings and identifies the sensor.
- Sensor Formula: The mathematical Formula, which describes the correlation between the data and the analog input signals. Up to two analog input signals can be defined for one sensor. They are represented in the formula by "val1" und "val2". For example, if the data is defined by a multiplication of the two input signals, the formula is:

$$\text{val1} * \text{val2}$$

The following functions can be used:

- `abs(x)`
- `acos(x)`
- `asin(x)`
- `atan(x)`
- `atan2(y, x)`
- `ceil(x)`

- `cos(x)`
- `exp(x)`
- `floor(x)`
- `log(x)`
- `max([value1 [, value2 [, ...]]])`
- `min([value1 [, value2 [, ...]]])`
- `pow(x, y)`
- `random()`
- `round(x)`
- `sign(x)` // ECMAScript 6: Added in Qt 5.8
- `sin(x)`
- `sqrt(x)`
- `tan(x)`

The following constants can be used:

- `E`
- `LN10`
- `LN2`
- `LOG2E`
- `LOG10E`
- `PI`
- `SQRT1_2`
- `SQRT2`



Important: these expressions are case sensitive.

- **Sensor Unit:** The Unit of the data associated with the sensor. Used only for displaying purposes.
- **Data Name:** The Name of the data associated with the sensor. Used only for displaying purposes.
- **Use Exponential Expression:** Usage of the format `a*10Eb`, where `a` and `b` are decimal numbers. This also results in the diagram being displayed with logarithmic data axis.
- **Input Mask:** An Input Mask can be set, which is used to simplify the user input. The format is:
 # for a digital value
 . decimal point (no comma allowed)
 any other character is displayed in the input field.
 Separated by a semicolon is the placeholder character.
 the Input mask can be seen in the manual control and in the sensor dialog.

License

Qt 5 was used to generate this software.

QCustomplot was used to generate this software.

Release Notes

1.01	Settings Tab structured	
1.01	Closed Loop: New calculation, when deviation too big	only in Settings file

1.02	Better Status Messages	
1.02	PosError Status fixed	
1.03	Samba Password changeable	
1.03	MODBUS: Set Feedback Loop	
1.03	Script: GatoData changed to Sensor Settings	
1.03	Status Message Window fixed width	
1.03	RemoteTab: IP Address Information	Click on the Label Ip Address reveals the available IP-Addresses
1.03	RemoteTab: Keyboard Location for Ethernet	
1.03	Scripttab: Save Script Button added	
1.03	MODBUS: Received via Modbus Messages	
1.03	Settings for continious speed	
1.03	Redraw Diagram added to diagram context menu	
1.03	Print Diagram can choose a file	
1.03	Export Excel file	
1.03	input boundaries are checked when Data is set	
1.03	Closed Loop: Integral - Proportional Value	in Settings Tab
1.03	Closed Loop: calculation, when deviation too big	in Settings Tab
1.03	Remote: Ethernet Connection fix	
1.03	Remote: After Direct Command, Modbus is now working	
1.03	Modbus: added Plus and minus normal, fast. Set back immediately	
1.03	execute Script Button in Settings Tab	
1.03	choosse language file option	
1.03	added Splash screen	
1.03	Remote-Tab: Text Fields are cleared, when options are changed.	