

# **SENTRONIC<sup>D</sup>**

## **Digital Electronic Pressure Regulator**

### **Series 608/609**

### **with Display and Keypad**

Installation manual



MS-P302-1-GB.R5  
(383 47 48)

**GB**

**ASCO<sup>®</sup>**  
**JOUCOMATIC**

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## CAUTION

OBSERVE PRECAUTIONS  
FOR HANDLING  
ELECTROSTATIC SENSITIVE  
DEVICES

This product contains electronic components sensitive to electrostatic discharge. An electrostatic discharge generated by a person or object coming in contact with the electrical components can damage or destroy the product.

To avoid the risk of electrostatic discharge, please observe the handling precautions and recommendations contained in standard EN 100015-1. Do not connect or disconnect the device while it is energised.



**CAUTION!** Dangerous operating conditions may occur when using the programming interface on the valve as the valve may possibly not react to the analog setpoint any more.

Provide for protection against uncontrolled movement of equipment when putting the valve into operation and before making any modifications to the valve settings.

## DECLARATION OF INCORPORATION

according to Machinery Directive 89/392/EEC, Annex II B

We herewith declare that the version of the product described in this installation manual is intended to be incorporated into or assembled with other machinery and that it must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of Council Directive 89/392/EEC, Annex IIB.

Handling, assembly and putting into service and all settings and adjustments must be done by qualified, authorised personnel only.



This product complies with the essential requirements of the EMC Directive 89/336/EEC and its amendments. It is **CE**-approved. A separate Declaration of Conformity is available on request.

A separate Declaration of Incorporation relating to the EU Directive 89/392/EEC Annex II B is available on request. Please provide ordering code and serial numbers of products concerned.

## NOTICE

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## 1. DESCRIPTION

**SENTRONIC<sup>D</sup>** is a new generation of electronic pressure regulators designed on the basis of an enhanced digital control.

**SENTRONIC<sup>D</sup>** stands for:

Digital communication and control  
Display (incorporated)  
Direct operated valve  
Dynamic behaviour (high speed)

Digital control offers many advantages during installation and start-up of the **SENTRONIC<sup>D</sup>** valve and extended possibilities to adapt it to various applications.

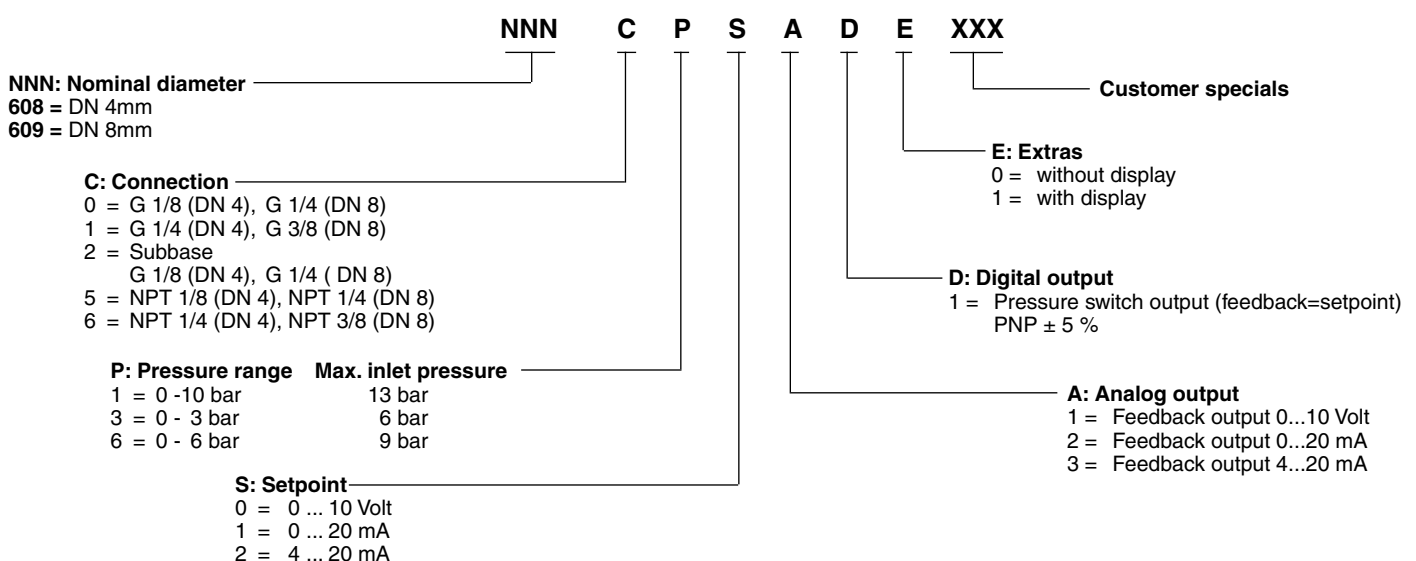
The four following standard versions are available:

- With display and pushbuttons : Pressure display, manual pressure setting and diagnostic LEDs.
- Without display and pushbuttons : The economic solution.
- Nominal diameter DN 4mm : with a flow rate of 470 l/min (SRA).
- Nominal diameter DN 8mm : with a flow rate of 1300 l/min (SRA).

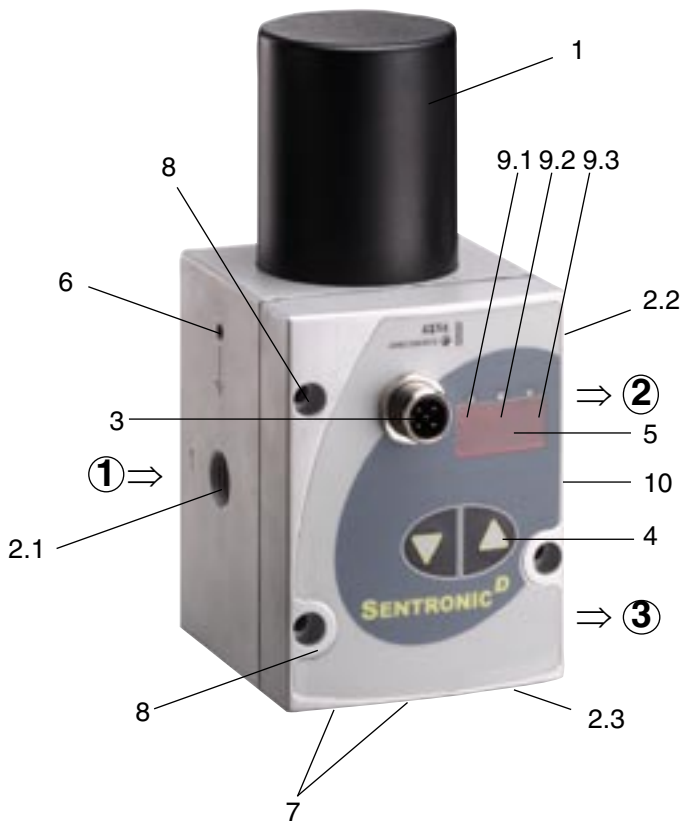
Various pneumatic connections: integral connections, back panel connection and subbase mount.

- All pressure and exhaust ports are the same size, which allows for short response times when the pressure is increased or decreased.
- Digital pressure control in a closed loop: An internal pressure sensor compares the setpoint at the inlet to the outlet pressure. The outlet pressure is adjusted in real time.
- The control parameters can be changed with the additional software called *DaS*. The **DaS program** (Data Acquisition Software) ensures that all parameters used by the valve can be changed. This flexibility allows the valve to be adapted to the most various applications and enables the optimisation of its response time, overshoot and precision.
- After having set the optimum parameters you can save them in a project file for your personal use or send them to our Product Support for future serial production.

### 1.1 CODE



## 1.2 OPERATING ELEMENTS



- 1 Proportional solenoid coil
- 2.1 Pressure supply
- 2.2 Pressure outlet
- 2.3 Exhaust
- 3 Power supply, M12 connector
- 4 Operator buttons
- 5 3-digit display of outlet pressure
- 6 Ground connection, M4
- 7 Threaded mounting holes M4/6 mm
- 8 Mounting holes for M4 screws
- 9.1 Green LED
  - OFF: Setpoint  $\neq$  feedback
  - ON: Setpoint = feedback
  - Flashing: Overtemperature
- 9.2 Yellow LED
  - OFF: Normal
  - ON: Manual operation
  - Flashing: AUTOSAFE enabled
- 9.3 Red LED
  - OFF: Normal
  - ON: Low voltage
  - Flashing: Overvoltage
- 10 Serial communication (PC connection)

## 1.3 MANUAL PRESSURE REGULATION (HAND)

After an interruption in the power supply, press both arrow buttons located beneath the display during power up to switch to the manual mode. The operating mode is indicated by the letters "H n d" in the display.

The "H n d" display disappears when the arrow buttons are released.

Press the left arrow button or DOWN arrow to reduce the outlet pressure, press the right arrow button or UP arrow to increase the outlet pressure. The yellow LED is on permanently during manual mode.

Exit this operating mode by pressing both arrow buttons simultaneously or by turning off the power supply for a short time.

## 1.4 OPERATING MODES

### Shut-off:

If the setpoint falls below 0.5 %, the coil current is switched off and the valve is fully exhausted.

### Overtemperature:

If the temperature of the internal control electronics exceeds 100°C, the operating mode is switched to AUTOSAFE and the green LED starts to flash.

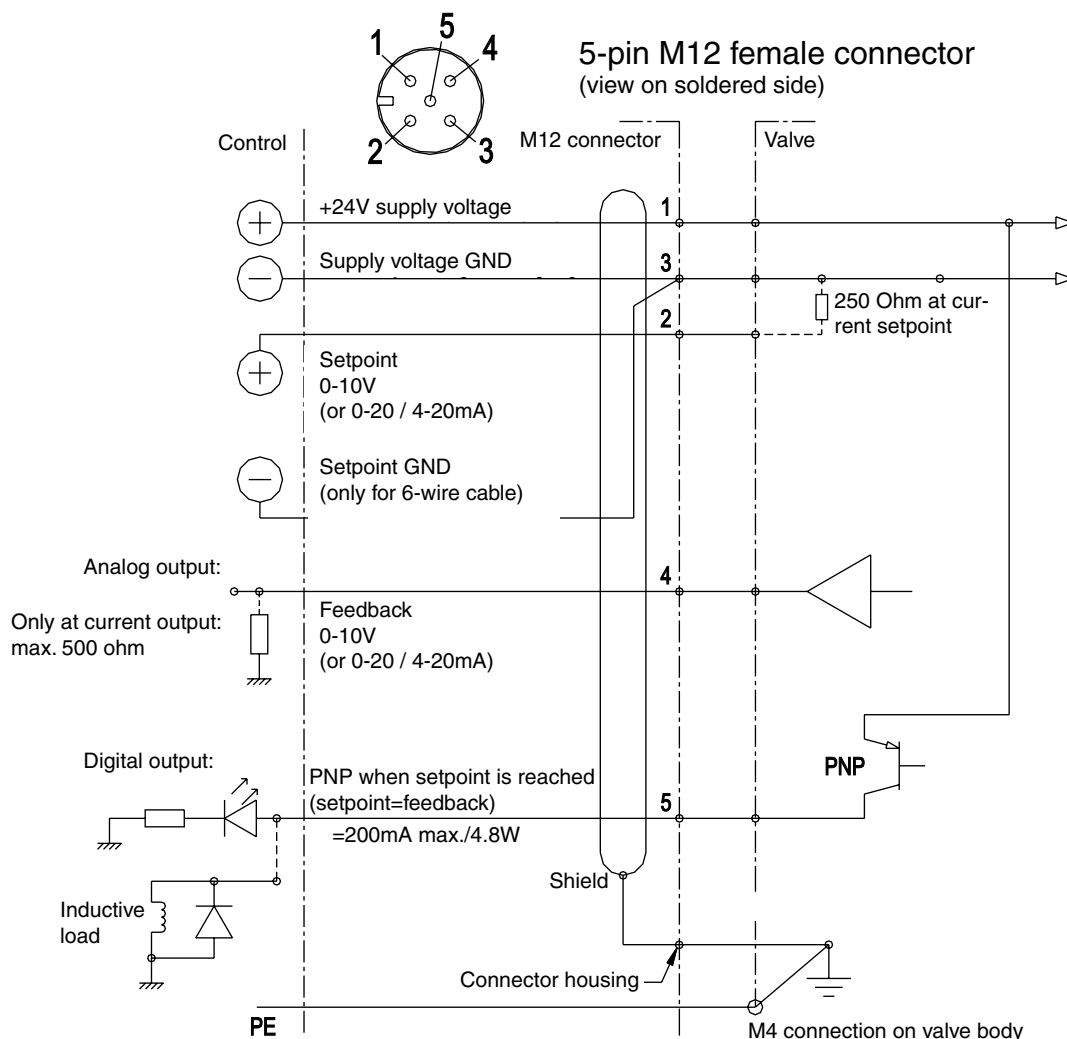
### Undervoltage / overvoltage:

If the supply voltage is less than 20 V or more than 30 V, the coil current is switched off and the valve is fully exhausted. The red LED lights up constantly to indicate undervoltage or flashes to indicate overvoltage.

### Autosafe:

If the coil current exceeds 1000 mA (DN8) or 560 mA (DN4) for more than 20 seconds, the output current is limited to max. 70% every 4 seconds to prevent the valve from overheating. The yellow LED flashes.

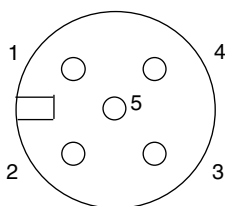
## 2. ELECTRICAL CONNECTION



- 1) The valve must only be supplied with 24V DC at a tolerance of +15%/-10% and a max. ripple of 10% (no supply via diode bridge). Overvoltage or a ripple rate exceeding these tolerances can damage the electronics.
- 2) The max. current at the digital output is 200 mA/4.8W (PNP output). The output is protected against short circuit and overload.
- 3) If a relay (inductive load) is connected to the digital output, a freewheel diode or a varistor must be used.
- 4) A shielded cable must be used for protection against interference and EMC.
- 5) The valve body must be grounded with the earthing terminal PE (dia. M4)

### CONNECTOR PINNING / CABLE WIRING

Analog setpoint: View on soldered side of female connector



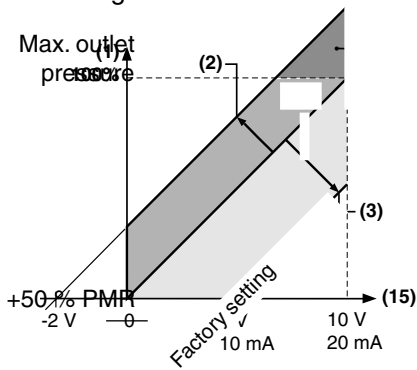
| Pin  | Description                      | 5-wire cable | 6-wire cable |
|------|----------------------------------|--------------|--------------|
| 1    | 24V voltage supply               | brown        | brown        |
| 2    | Analog setpoint input            | white        | white        |
| 3    | Supply ground                    | blue         | green        |
|      | Analog ground *                  |              | yellow       |
| 4    | Analog output (feedback)         | black        | pink         |
| 5    | Digital output (pressure switch) | grey         | grey         |
| Body | EMC shield                       | shield       | shield       |

\* A 6-wire cable with separate analog ground is used for cable lengths over 2 m to set off the voltage drop for the setpoint.

### 3. ANALOG SETPOINT - OUTLET PRESSURE

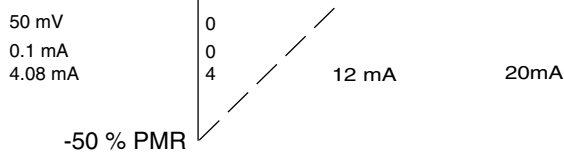
#### Setpoint offset

The pressure setpoint zero can be changed via the *DaS* program. Switch to "Custom" in the "Setpoint setting" section. The zero range is max.  $\pm 50$  %.



| Max. outlet pressure<br>PMR<br>(bar) | Max. inlet pressure<br>MAP<br>(bar) |
|--------------------------------------|-------------------------------------|
| 3 bar                                | 6                                   |
| 6 bar                                | 9                                   |
| 10 bar                               | 13                                  |

#### SHUT-OFF

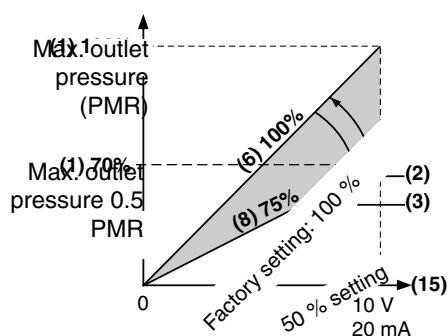


**CAUTION:** Outlet pressures above the maximum outlet pressure (PMR) are not controlled by the valve, i.e. the max. outlet pressure is limited to the PMR.

In order to avoid damaging the sensor, **the supply pressure must always be less than the maximum inlet pressure (MAP) defined above** (see table).

#### Setpoint span

The pressure span of the setpoint can be changed via the *DaS* program. Switch to "Custom" in the "Setpoint setting" section. The span is between 10 and 100%.



#### SHUT-OFF



The span can be set to max. 100% of the maximum outlet pressure (PMR). It can only be decreased.

## 4. PNEUMATIC CONNECTION

The air flow is from port 1 to port 2.



Inch screw connections (pipe threads) must be used.

Each screw connections must be lined with a fitting synthetic sealing disc.

Do not use Teflon sealing tape or hemp as they may get inside the valve and damage it.

Use an appropriate silencer at port (3). The exhaust time may vary depending on the type of silencer used.

The diameter of the pneumatic lines must be adjusted to the nominal diameter of the valve. The diameter of outlet line (2) must be larger or equal to that of inlet line (1).

The supply pressure must always be less than the value given in the table in section 3 and must always be above the desired outlet pressure.

## 5. FACTORY SETTINGS FOR A STANDARD VALVE

- 0 bar outlet pressure at a setpoint of 0 V / 0 mA / 4 mA.
- Span: 3 bar device: = 3 bar at 10 V / 20 mA  
6 bar device: = 6 bar at 10 V / 20 mA  
10 bar device: = 10 bar at 10 V / 20 mA
- Minimum hysteresis.
- The control parameters, setpoint offset, setpoint span and window size of the digital output (pressure switch) are factory-programmed.

### Parameter set: factory settings

Setpoint offset: 0 %

Setpoint span: 100 %

Setpoint ramp: no ramp

Shut-off: ON; the valve is exhausted at a setpoint below 0.5%

Controller structure: PID

Proportional gain: 4,0

Integration time: 0.1 sec

Derivation time: 8 msec

## 6. FIELD-PROGRAMMABLE SETTINGS

### DISPLAY/PRESSURE READINGS

The actual outlet pressure is displayed during normal operation. See „Parameters/Display“ section.

Other displays:

Hnd indicates that the Manual mode has been selected.

SOF Internal error of pressure control. Replace valve or contact our Product Support.

Err Internal overflow.

AEr Autozero overflow. Contact our Product Support.

### PUSHBUTTONS

To enter the Manual mode, press and hold both pushbuttons simultaneously during power up. "Hnd" appears in the display.

Use the UP button to increase the outlet pressure and the DOWN button to decrease it. The actual outlet pressure is displayed.

Quick presses on the buttons allow you to make slight changes in the pressure rating.

Longer presses allow you to make quick pressure changes.

Press both pushbuttons simultaneously to exit the manual mode.

## 7. TECHNICAL CHARACTERISTICS

### CONSTRUCTION

Directly operated valve

Body: Aluminium

Internal parts: POM

Seals: Perbunan (NBR), Fluorelastomer (FKM)

Degree of protection: IP65

### INSTALLATION

Assembly position: any; for optimum performance vertically with solenoid at the top.

Air: filtered at 50 µm, free of condensate

Connections: Hemp or Teflon tape must not be used.

Electrical connection: Select a wire section that will give a voltage drop of less than 2 volts at 2A.

### 7.1 FLUID CHARACTERISTICS

|                         |                                                                                |
|-------------------------|--------------------------------------------------------------------------------|
| FLUIDS                  | : Air or neutral gas, filtered at 50 µm, free of condensate, lubricated or not |
| PORTS                   | : G1/8-G1/4-G3/8, see section 3                                                |
| MAX. INLET PRESSURE     | : see section 3                                                                |
| TEMPERATURE / FLUID     | : 0...60 °C                                                                    |
| TEMPERATURE / AMBIENT   | : 0...50 °C                                                                    |
| HYSTERESIS              | : <1% of span                                                                  |
| LINEARITY               | : <0.5% of span                                                                |
| REPEATABILITY           | : <0.5% of span                                                                |
| MINIMUM SETPOINT        | : 100mV (0.2 mA/4.2mA) with shut-off function                                  |
| MINIMUM OUTLET PRESSURE | : <1% of span                                                                  |

### 7.2 SPECIFICATIONS

| Nominal diameter DN (mm) | Supply voltage (stabilised) * | Max. power (W) | Max. current (mA) | Isolation class | Degree of protection | Flow     |             | Electrical connection      |
|--------------------------|-------------------------------|----------------|-------------------|-----------------|----------------------|----------|-------------|----------------------------|
|                          |                               |                |                   |                 |                      | Kv Nm³/h | l/min (SRA) |                            |
| 4                        | 24 V = + 15%/-                | 21             | 850               | H               | IP 65                | 0.25     | 470         | 5-pin female M12 connector |
| 8                        |                               | 40             | 1650              |                 |                      | 0.7      | 1300        |                            |

\* Residual ripple: 10 %

Test conditions according to ISO 8778: temperature: 20 °C, relative inlet pressure: 6 bar, relative outlet pressure: 5 bar

|                 |                                                                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Setpoint input  | : 0 ... 10 V (100 kOhm input resistance)<br>0 ... 20 mA / 4 ... 20 mA (250 Ohm input resistance)                                          |
| Feedback output | : 0 ... 10 V (max. 10 mA), short-circuit protected<br>0 ... 20 mA / 4 ... 20 mA (max. 24 VDC)                                             |
| Digital output  | : pnp; open collector; max. 200 mA/4.8W, short-circuit protected<br>HIGH (24 VDC) if feedback=setpoint<br>LOW (open) if feedback≠setpoint |
| Overvoltage     | : Shut-off at a voltage level higher than 30 volts (+10%).                                                                                |
| Low voltage     | : Shut-off at a voltage level lower than 19,5 volts (-10 %).                                                                              |

## 8. ACCESSORIES

| DESCRIPTION                                                                                         | CODES      |
|-----------------------------------------------------------------------------------------------------|------------|
| Straight M12 female connector, 5 pins, with screw terminals                                         | 881 00 256 |
| Right-angle M12 female connector, 5 pins, with screw terminals                                      | 881 00 725 |
| Supply cable 2m; 5x 0.25 mm <sup>2</sup> ; straight connector                                       | 881 00 726 |
| Supply cable 2m; 5x 0.25 mm <sup>2</sup> ; right-angle connector                                    | 881 00 727 |
| Supply cable 5m; 6x 0.50 mm <sup>2</sup> ; straight connector                                       | 881 00 728 |
| Supply cable 5m; 6x 0.50 mm <sup>2</sup> ; right-angle connector                                    | 881 00 729 |
| Supply cable 10m; 6x 0.50 mm <sup>2</sup> ; straight connector                                      | 881 00 730 |
| Supply cable 10m; 6x 0.50 mm <sup>2</sup> ; right-angle connector                                   | 881 00 731 |
| RS 232 cable converter; 2m cable with 9-pin Sub-D for connection to PC                              | 881 00 732 |
| Joinable subbase for 608 (DN 4mm) with G3/8"; common supply and exhaust                             | 335 00 558 |
| Joinable subbase for 609 (DN 8mm) with G1/2"; common supply and exhaust                             | 335 00 559 |
| DaS Light: Data Acquisition Software for <b>SENTRONIC<sup>D</sup></b> - basic parameters - diskette | 991 00 108 |
| DaS Expert: Data Acquisition Software for <b>SENTRONIC<sup>D</sup></b> - full parameters - diskette | 991 00 109 |
| DaS Light: Data Acquisition Software for <b>SENTRONIC<sup>D</sup></b> - basic parameters - CD-ROM   | 991 00 110 |
| DaS Expert: Data Acquisition Software for <b>SENTRONIC<sup>D</sup></b> - full parameters - CD-ROM   | 991 00 111 |

## 9. MAINTENANCE AND CARE

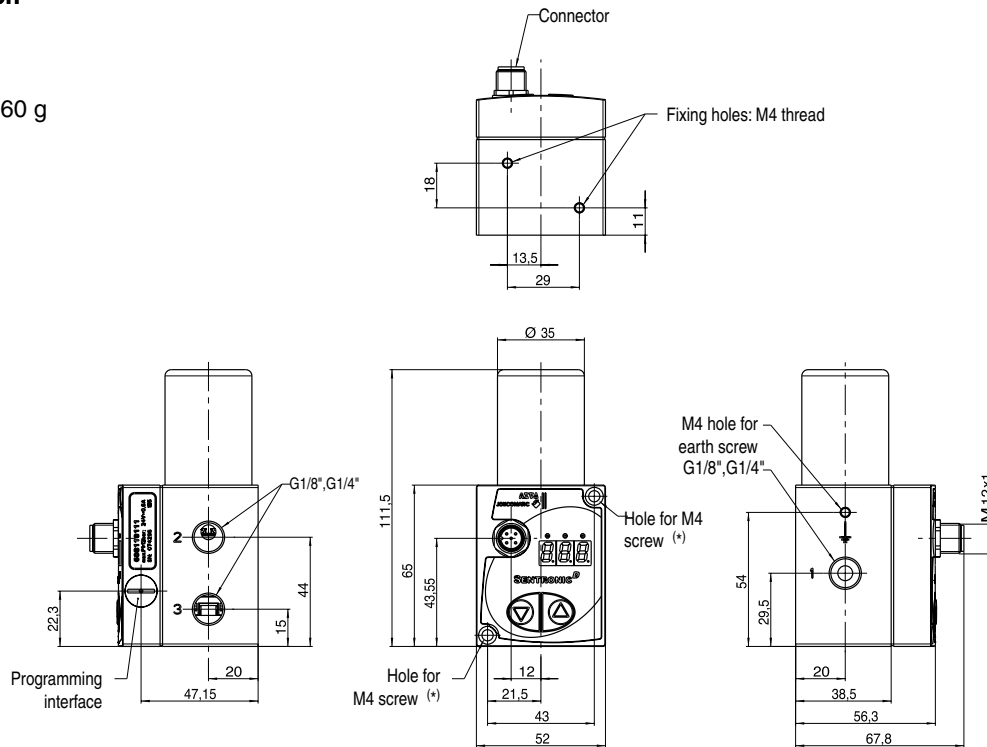
No special maintenance or care required.

## 10. DIMENSIONS AND WEIGHTS

### Inline version

**DN 4**

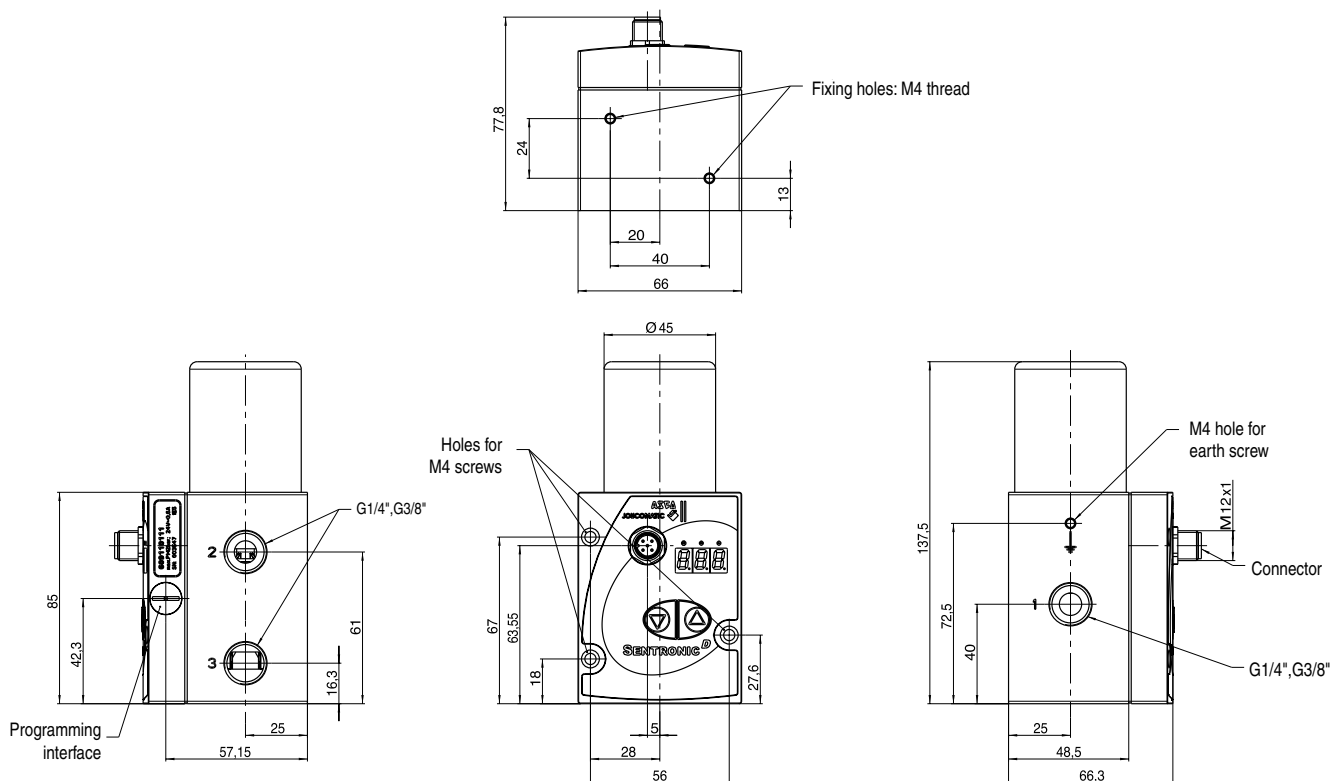
Weight: 560 g



(\*) Remove the pre-installed screws to use the through holes to mount the valve.

**DN 8**

Weight: 1,130 g





## 11. *DaS* PROGRAM (PARAMETERS / SCOPE FUNCTION)

Minimum system requirements:

Pentium II; 800 MHz; 32 MByte RAM; Windows 9x/Windows 2000/Windows NT 4.0

**NOTE:** Option features are only available in the **EXPERT** version of the *DaS* program and not in the **LIGHT** version.

### 11.1 INSTALLATION PROCEDURE

Insert the installation disk into your floppy drive A:

From the Windows® Start menu, click Run... In the Open field type:

- "A:\instal-E" to install the English version.
- "A:\instal-G" to install the German version.
- "A:\instal-F" to install the French version.

Follow the instructions on the screen.

A "C:\Sentronic" directory is created on your hard-drive C:\ and all needed files are copied to this directory. The program will be installed in the language you have selected.

If a "C:\Sentronic" directory already exists, an error message is returned. The installation procedure will, however, still work correctly. The directory will not be completely overwritten, your project files will be preserved. Only the program and language files are updated.

#### 11.1.1 GETTING STARTED

Double-click the *DaS.exe* file now located on your hard drive.

Alternatively, drag and drop the "*DaS-Xp*" or "*DaS-Lt*" icon from the "C:\Sentronic" directory to your desktop and double-click this icon.

#### 11.1.2 HOW TO CONNECT THE SENTRONIC<sup>D</sup>

Unscrew the cover on the side of the valve and connect the RS232 adapter (part no: 881 00 732) into the valve's communication port. Connect the 9-pin Sub-D connector into the serial port of your PC (COM1 or COM2 must be used).

Select the appropriate serial port from the Project/Serial Port menu.

This selection is stored inside your PC.

#### 11.1.3 GENERAL RECOMMENDATIONS

Do not open the *DaS* program more than once. Only one application (.exe) can control the serial port!

Do not start the *DaS* program from the floppy disk drive. Use the installation procedure to have a full installation of the software. Only the hard drive will provide sufficient speed.

If you use the Scope function, it may be helpful to close other time-consuming applications so the necessary resources are available.

#### 11.1.4 HOW TO OPERATE THE SENTRONIC<sup>D</sup>

##### DISPLAY/PRESSURE READINGS

The actual outlet pressure is displayed during normal operation. See „Parameters/Display“ section.

Other displays:

Hnd indicates that the Manual mode has been selected.

SOF Internal error of pressure control. Replace valve or contact our Product Support.

Err Internal overflow.

AEr Autozero overflow. Contact our Product Support.

##### PUSHBUTTONS

To enter the Manual mode, press and hold both pushbuttons simultaneously during power up. "Hnd" appears in the display.

Use the UP button to increase the outlet pressure and the DOWN button to decrease it. The actual outlet pressure is displayed.

Quick presses on the buttons allow you to make slight changes in the pressure rating.

Longer presses allow you to make quick pressure changes.

Press both pushbuttons simultaneously to exit the manual mode.

## 11.2 HOW TO OPERATE THE *DaS* PROGRAM

### 11.2.1 HOT KEYS

|        |                                                                           |
|--------|---------------------------------------------------------------------------|
| F1     | Displays the Help window on the screen.                                   |
| F2     | Displays the Status window on the screen.                                 |
| F3     | Displays the Scope Function Settings dialogue box (data acquisition).     |
| F4     | Starts data acquisition and updates the on-screen scope graph.            |
| F5     | Stops data acquisition and freezes the scope graph for detailed analysis. |
| F10    | Resets the zoom factor to the default.                                    |
| Alt+F4 | Exits the <i>DaS</i> program                                              |

### 11.2.2 MAIN MENU

Project - Parameters - Diagnosis - Scope - ?

### 11.2.3 PROJECT MENU

You can save your current valve parameters and the current scope graph in a project file.

### 11.2.4 NEW PROJECT... (*unknown.das*)

Creates a new project. Please enter the file name without extension. The file name extension is forced to \*.das. All other field entries (version, address etc.) are optional.

Note:

Use Save Project to save your own "Scope/Setup" in the file "*unknown.das*".

After restarting the *DaS* program, select Open Project to open the "*unknown.das*" file and restore your scope settings.

### 11.2.5 OPEN PROJECT... (\*.das)

Opens an existing project from the directory in which you last saved it.

You can switch to a different directory by using the standard Windows dialogue.

### 11.2.6 SAVE PROJECT (current project, current path)

Saves the current project together with its parameters, status information, current graphs and scope settings in the current path.

### 11.2.7 SAVE PROJECT AS... (\*.das)

Saves the project with a new file name in the directory of your choice.

Enter the file name without extension. The file name extension is forced to \*.das.

### 11.2.8 PROJECT INFO

Allows you to edit the project information such as Project name; Project version, Name; Address; City; Phone/Fax; Email

### 11.2.9 PRINT PROJECT...

Prints the project to the default Windows printer.

|             |                                                                     |
|-------------|---------------------------------------------------------------------|
| All:        | Prints project info, parameters and scope graphs.                   |
| Parameters: | Prints project info and factory or customer parameters as selected. |
| Scope view: | Prints project info, scope graphs and scope setup.                  |

### 11.2.10 SERIAL PORT

Allows you to select the serial port to which your valve is connected.  
The baudrate is automatically set at first start-up of communication with the valve.  
Baudrates of 19200 and 57600 are available.

### 11.2.11 EXIT

Quits the *DaS* program. If you have not saved your changes you will be prompted whether or not to save before exiting.

## 11.3 PARAMETER MENU

Control - Setpoint - Analog IN/OUT - Autosafe - Digital Input - Display/Keys - Digital Out - ERROR

### 11.3.1 PARAMETER SETTINGS

|         |                                                                                                                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FACTORY | Reads the factory parameters from the valve. Factory parameters cannot be changed.<br>These parameters are displayed in the grey parameter fields.<br>If no parameters were read, the value "—" is displayed. |
| CUSTOM  | Reads the custom parameters from the valve.<br>These parameters are displayed in the grey parameter fields.<br>If no parameters were read, the value "—" is displayed.                                        |

Note: Only Custom Parameters can be projected and written into the file. Factory parameters are fixed values that cannot be changed.

### 11.3.2 PROJECTED PARAMETERS / VALVE PARAMETERS

Clicking "Open Project..." will load the projected parameters from the project file and display them in the white parameter fields. If no project is opened, the default parameters are displayed.  
You can also modify the projected parameters in the white fields and save them offline.

#### PARAMETER SETTINGS

|         |                                                                                                                                                                                              |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FACTORY | Reads the Factory Parameters from the valve and displays them in the grey fields.                                                                                                            |
| CUSTOM  | Reads the Custom Parameters from the valve and displays them in the grey fields.                                                                                                             |
| READ    | Reads the Factory/Custom Parameters from the valve.                                                                                                                                          |
| WRITE   | Writes the Custom Parameters to the valve. When modifying parameters, keep to the order of read – copy – write.                                                                              |
| COPY    | Copies the Factory/Custom Parameters from the grey (valve) field into the white (project) field. Differences in the radio buttons between valve and project settings are highlighted in red. |

Reading and writing can take up to 10 seconds.  
If communication with the valve is interrupted or faulty, a "Communication Error" message appears.

CLOSE Returns you to the Main Menu.

For a detailed description of the parameters, see "PARAMETERS" section.

Note:

Modifying custom parameters:

First "read" the Custom Parameters from the valve, then "copy" them into the project file (white fields) before you modify and "write" them. This prevents you from unintentionally changing parameters set for other groups.

Restoring custom parameters:

The initial Custom Parameters are identical to the Factory Parameters. If you wish to restore the initial Custom Parameters, copy the Factory Parameters into the project and write them as Custom Parameters to the valve.

Proceed as follows:

- Click "Factory Parameter Settings" to read the factory parameters.
- Click "Copy" to copy them into the project.
- Click "Custom Parameter Settings" to switch to Custom Parameters.
- Click "Save Project" or "Save Project As..." to temporarily store the factory parameters in the project.
- Click "Open Project" to load the temporary project.
- Click "Parameters/Write" to write the initial parameters as Custom Parameters to the valve.

It is good practice to always save your Custom Parameters in a project file (.das) before changing parameter settings.

## 11.4 DIAGNOSIS MENU

Valve Info - Status - Serial Setpoint - Test Function

### 11.4.1 VALVE INFO

|                         |                                                                                                                                                          |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| READ VALVE INFO         | Reads the actual valve information from the valve.<br>If communication with the valve is interrupted or faulty, a "Communication Error" message appears. |
| OK                      | Returns you to the Main Menu.                                                                                                                            |
| CONTROLLER FIRMWARE     | Shows the version of the valve firmware.<br>Please indicate this version number when contacting our Product Support.                                     |
| PART NUMBER             | Shows the part number of the valve.<br>Please indicate this part number when contacting our Product Support.                                             |
| SERIAL NO.              | Shows the serial number of the valve.<br>Please indicate this serial number when contacting our Product Support.                                         |
| PRODUCTION DATE         | Shows week and year of production of the valve.<br>This is important for warranty claims.                                                                |
| OPERATION COUNTER       | Shows how many days/hours/minutes the valve has been used (under electrical power).                                                                      |
| CALIBRATION DATE        | Shows when the valve was last calibrated (production, service etc.).                                                                                     |
| CALIBRATION STATUS      | On successful completion of calibration, a value of 255 is displayed.                                                                                    |
| CALIBRATION COUNTER     | On completion of calibration sequence, a value of 255 is displayed.                                                                                      |
| TEMPERATURE CALIBRATION | Shows the ambient temperature during the calibration process.                                                                                            |
| TEMPERATURE VALVE       | Shows the actual inside temperature of the valve electronics.<br>In the event of an overtemperature alarm, this value is very high!                      |

### 11.4.2 STATUS

|                 |                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | Displays the actual internal valve conditions.                                                                                                                                                                                                                                                                                                                                           |
| OVERVOLTAGE     | If the supply voltage is more than 30 volts, "YES" is displayed. Control is turned off and the valve is exhausted! Please check your power supply.                                                                                                                                                                                                                                       |
| UNDERVOLTAGE    | If the supply voltage is less than 19,5 volts, "YES" is displayed. Control is turned off! Please check your power supply and the wiring of the valve.                                                                                                                                                                                                                                    |
| JUMPER          | This is an optional hardware jumper currently not used.                                                                                                                                                                                                                                                                                                                                  |
| KEY LOCK        | Shows whether the keypad is locked (Enabled) or not (Disabled), see <Display/Keys – key lock>.                                                                                                                                                                                                                                                                                           |
| OVERTEMPERATURE | Shows that the valve electronics have detected overtemperature >100 °C ("Yes" is displayed). In this case, the operating mode is switched to Autosafe. Please check the inlet pressure which may have been below the outlet pressure for a longer period of time. This results in excess heating of the valve. To see the actual temperature, click Valve Info.                          |
| MANUAL SETPOINT | Shows whether the valve is in Manual mode (Enabled) or not (Disabled).<br>To enter the Manual mode, turn off the power supply, press and hold both pushbuttons simultaneously and turn on the power supply again. "Hnd" appears in the display. Use the UP and DOWN buttons to increase and decrease the outlet pressure. Press both pushbuttons simultaneously to exit the manual mode. |
| DIGITAL OUT     | Shows whether the digital output is in ON (HIGH) or OFF (LOW) state.<br>The state is influenced by the parameter settings in "Output Source" and "Output Mode".                                                                                                                                                                                                                          |
| RESERVE         | Is reserved for future purposes. Currently not used.                                                                                                                                                                                                                                                                                                                                     |

LEDs Display the actual state at the front of the valve.

- Green LED: ON indicates that the digital output is HIGH.  
OFF indicates that the digital output is LOW.  
FLASHES indicate an overtemperature alarm.
- Yellow LED: ON indicates that the valve is in Manual mode.  
OFF during normal operation.  
FLASHES in Autosafe mode, see "Autosafe".
- Red LED: ON indicates an undervoltage alarm.  
OFF during normal operation.  
FLASHES indicate an overvoltage alarm.

If communication with the valve is interrupted or faulty, a "Communication Error" message appears.

#### 11.4.3 SERIAL SETPOINT

You can use this menu item to set an outlet pressure for start-up and maintenance.

- SERIAL SETPOINT Enter the desired outlet pressure in percent (%).
- TRANSMIT Click the "Transmit" button to send the setpoint you have selected to the valve.  
If communication with the valve is interrupted or faulty, a "Communication Error" message appears.
- OFF Click the "Off" button to disable the function. The valve switches back to the analog setpoint.
- CLOSE Returns you to the Main Menu. For security, this is only possible if the Serial Setpoint is "Off".

#### 11.4.4 TEST FUNCTION

The test function is used for auto-testing during start-up and maintenance (continuous duty function).  
Once the test function is activated, it is executed until it is disabled (OFF) or until the valve is powered off.

- WRITE Writes the Test Function and the Ramp/Step Time to the valve.
- READ Reads the Test Function and the actual Ramp/Step Time from the valve and displays the values on the screen.  
If communication with the valve is interrupted or faulty, a "Communication Error" message appears.
- CANCEL Returns you to the Main Menu.  
CAUTION: The test function remains active!

#### TEST MODE SELECTION

- OFF Test Function disabled.
- RAMP Continuous up and down ramping from 0 to 100% and back in a triangular wave.
- STEP Continuous up and down stepping between 0 and 100% and back in a square wave.
- MULTISTEP Outlet pressure is continuously increased in 10% steps from 0 to 100% and then decreased in 10% steps back to 0%.
- RAMP/STEP TIME Defines the time for increasing the ramp/step from 0 to 100% and decreasing the ramp/step from 100 to 0%.  
Defines the time in multistep mode for each 10% step.

## 11.5 SCOPE MENU

Setup – Start Acquisition – Stop Acquisition – Show Grid – Reset Zoom

### 11.5.1 SCOPE SETUP

#### MODES:

|                  |                                                                                                                                                                                                        |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STEP MODE        | Performs one step from "Setpoint Begin" to "Setpoint End" and displays the result in a graph.<br>Note: The outlet pressure is controlled by the <i>DaS</i> program.                                    |
| RAMP MODE        | Performs one linear pressure ramp from "Setpoint Begin" to "Setpoint End" in the "Ramp Time" and displays the result in a graph.<br>Note: The outlet pressure is controlled by the <i>DaS</i> program. |
| TRIGGER MODE     | Performs like a digital oscilloscope.<br>For details, see "Trigger" section.                                                                                                                           |
| ACQUISITION TIME | Note: The outlet pressure is controlled by the analog setpoint.<br>Sets the size of the time scale.                                                                                                    |

#### TRIGGER:

|                    |                                                                                                                                                                                                                     |                                                                                             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| CHANNEL            | NONE (Roll mode)                                                                                                                                                                                                    | No trigger condition. Continuous display of selected analog channels and 4 binary channels. |
|                    | ANALOG CHANNELS                                                                                                                                                                                                     | Channel 1 to 4                                                                              |
|                    | BINARY CHANNELS                                                                                                                                                                                                     | Channel 1 to 4                                                                              |
| SLOPE              | Trigger on "rising" or on "falling" slope of the selected trigger channel.                                                                                                                                          |                                                                                             |
| VALUE              | Trigger value of the selected trigger channel (in percent).                                                                                                                                                         |                                                                                             |
| SAMPLE RATE        | Sets the number of data sets to be transmitted per second.<br>Maximum: 4 msec = 250 data sets per second.<br>Minimum: 200 msec = 5 data sets per second.<br>For Step/Ramp mode, the Sample Rate is fixed at 4 msec. |                                                                                             |
| ANALOG CHANNEL     | Sets the transmitted and displayed channels.                                                                                                                                                                        |                                                                                             |
| Analogue Channel 1 | Setpoint                                                                                                                                                                                                            | (Standard)                                                                                  |
|                    | Analog In 2                                                                                                                                                                                                         | (Option)                                                                                    |
| Analogue Channel 2 | Internal Sensor                                                                                                                                                                                                     | (Standard)                                                                                  |
|                    | Analog In 2                                                                                                                                                                                                         | (Option)                                                                                    |
|                    | PWM Out                                                                                                                                                                                                             | Percentage of output current (coil)                                                         |
|                    | PWM Out 2                                                                                                                                                                                                           | (Option) Reserved for future use (currently not used)                                       |
| Analogue Channel 3 | Control Deviation                                                                                                                                                                                                   | Difference between setpoint and feedback value                                              |
|                    | PID Out                                                                                                                                                                                                             | Sum of proportional+derivative+integral value                                               |
|                    | Control Out                                                                                                                                                                                                         | Sum of PID+forward control                                                                  |
|                    | None                                                                                                                                                                                                                | No signal is displayed for this channel                                                     |
| Analogue Channel 4 | P Value                                                                                                                                                                                                             | Proportional value                                                                          |
|                    | I Value                                                                                                                                                                                                             | Integral value                                                                              |
|                    | D Value                                                                                                                                                                                                             | Derivative value                                                                            |
|                    | Forward Control                                                                                                                                                                                                     | Sum of forward offset + forward gain                                                        |
|                    | None                                                                                                                                                                                                                | No signal is displayed for this channel                                                     |

|                       |                 |                                                                                                                                                                                            |
|-----------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BINARY CHANNEL</b> |                 |                                                                                                                                                                                            |
| Binary Channel 1      | Digital Output  | sets the transmitted and displayed channels.<br>see below                                                                                                                                  |
| Binary Channel 2/3    | Digital Output  | Level of digital output (pressure switch window = default)<br>The state is influenced by the Output Mode and the Output Source (see PARAMETERS)                                            |
|                       | Shut Off        | HIGH = Output current (coil) is set to zero. The valve exhausts.<br>LOW = Normal condition.                                                                                                |
|                       | Autosafe        | HIGH = Autosafe alarm is enabled.<br>Coil current is switched on and off to prevent overheating; see Parameters/Autosafe.<br>LOW = Normal condition                                        |
|                       | Limit Threshold | (Option)<br>HIGH = Outlet pressure is above the limiting threshold + limit hysteresis.<br>LOW = Outlet pressure is below the limiting threshold; see Parameters/Digital Output/Limit Size. |
|                       | Digital Input   | (Option)<br>HIGH = Input level above 11 volts<br>LOW = Input level below 5 volts                                                                                                           |
|                       | Range           | HIGH = Setpoint is outside the 4...20 mA window; see Parameters/Error/Setpoint Range Detection<br>LOW = Setpoint is inside the 4...20 mA window, or Out-Of-Range Detection is disabled.    |
|                       | Error           | HIGH = Error message according to error parameter setting; see Parameters/Error.<br>LOW = No error or Error Select is disabled.                                                            |
|                       | Inlet Pressure  | (Option) Not used.<br>HIGH = Inlet pressure is below the Inlet Pressure Limit.<br>LOW = Inlet pressure is above the Inlet Pressure Limit, or Inlet Pressure Limit is disabled.             |
|                       |                 |                                                                                                                                                                                            |
|                       |                 |                                                                                                                                                                                            |
| Binary Channel 4      | Digital Input   | see above                                                                                                                                                                                  |

### 11.5.2 START ACQUISITION

Starts data acquisition.

If data acquisition is started in Step/Ramp mode, it is automatically stopped after the data acquisition time has expired.

In Roll mode, data acquisition has to be stopped manually by pressing the "Stop Acquisition" button.

In Trigger mode, data acquisition is started after the trigger condition is true and the graph is completed. Data acquisition is automatically stopped after the screen is filled (trigger is at 10% of the data acquisition time).

### 11.5.3 STOP ACQUISITION

Stops data acquisition manually in Roll mode and Trigger mode. You can stop data acquisition at any time. The readings are plotted in a scope graph and displayed on the screen.

### 11.5.4 SHOW GRID

Displays a time and amplitude grid on the screen.

To remove the grid, click "Show Grid" once again.

### 11.5.5 RESET ZOOM

Resets the zoom factor to the default set in Scope/Setup.

Clicking the "Zoom Back" button does the same.

## 11.5.6 GRAPHIC DISPLAY

Four analog channels and four binary channels are displayed along a time axis.

The time scale is set from Scope/Setup/Acquisition Time.

The time resolution (sampling points) for the Trigger Mode is set from Scope/Setup/Sample Rate.

For the Step/Ramp Mode, the sample rate is fixed at 4msec.

The graphic time resolution depends on the sample rate and the zoom factor.

The amplitude resolution of the analog channels is limited to 256 increments; this corresponds to 0.4% for the left axis and 0.8% for the right axis.

## ZOOM IN

Move the mouse pointer over the analog section of the time graph. The mouse pointer changes to a magnifying glass. Press and hold the left mouse button to slowly draw a "window". The "window" must be located in the analog section. Wait until the pointer cursor changes back into a magnifying glass. Then release the left mouse button to zoom in on the window you have drawn.

Note: To zoom in on the time axis only, just draw a horizontal line.

## ZOOM OUT

Click the "Zoom Back" button or press F10.

## 11.5.7 READOUT

The cursor readouts are displayed on the left side of the screen. The results are continually updated in the Roll mode.

As soon as the acquisition is complete, you can move the readout cursor to obtain a more detailed acquisition. Enter a new value in the Readout Time field and press the Return button. The value you entered is rounded off to a multiple of the sample time.

You can also move the cursor readout graphically: Place the mouse pointer on the arrow symbol. The pointer changes into a double-arrow. Press and hold the left mouse button. Move the cursor in the horizontal direction. Wait until the pointer changes into a double arrow, then release the mouse button. Your cursor readout is now in a new position.

Be sure to move the cursor slowly to allow the readouts to be updated.

## 11.6 INFO BAR

The Info Bar is located at the bottom of the screen.

|               |                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PROJECT       | Displays the Project Name as defined in the Project Info window.                                                                                                                        |
| FILE          | Displays File Name under which the project was saved.                                                                                                                                   |
| SETPPOINT     | Displays the actual setpoint setting (normal or custom).<br>This information will only display if a valve has been connected and a Read Parameter or Read Status command has been used. |
| PARAMETER SET | Displays whether Factory Parameters (unchangeable) or Custom Parameters (changeable) are used.                                                                                          |

## 11.7 PARAMETERS DESCRIPTION

### 11.7.1 CONTROL section

#### FORWARD OFFSET $F_o$ (Option)

Applies a constant offset value to the control output (PWM).

The coil needs a minimum current to increase the outlet pressure.

Forward offset is used to compensate this physical effect [ $Y = \dots + F_o$ ].

#### FORWARD GAIN $F_g$

Increases the control output (PWM) in proportion to the setpoint.

The coil needs more current to increase the outlet pressure [ $Y = \dots + (F_g * X)$ ].

The maximum increase of the control output is " $F_g * 100\%$ ".

#### PROPORTIONAL GAIN $K_p$

Control deviation  $X_d$  is " $X_d = \text{Setpoint } W - \text{Sensor value } X$ ".

The control output changes in proportion to the control deviation:  $Y = \dots + (K_p * X_d)$ .

#### DERIVATION TIME $T_d$

The sensor value (feedback) is derivated, then multiplied with Derivation Time and subtracted from the control output [ $Y = \dots - (T_d * dX/dt)$ ].

If you select  $T_d=0$  msec, derivation is disabled.

**INTEGRATION TIME Ti**

The control deviation  $X_d$  is integrated, then divided by Integration Time and added to the control output  $Y$  [ $Y = \dots + (\text{Time Integral } X_d) / T_i$ ].

**INTEGRATION LIMIT IL (Option)**

The integrator value is limited to avoid saturation.

It is limited to  $\pm IL$  (in %).  $IL=100\%$  gives maximum limitation; integration is disabled with  $IL=0\%$ .

**DEADBAND DB (Option)**

To avoid low frequency oscillation, the integrator is halted inside the deadband. If control deviation  $X_d$  is smaller than  $\pm DB\%$ , the integration is halted.

**CONTROL STRUCTURE (Option)**

Radio buttons are used to enable/disable parts of the control law and to get special control structures.

Control law (calculation of manipulated variable):

Control output  $Y = \text{forward value} + P \text{ value} - D \text{ value} + I \text{ value}$

$Y = F_o + (F_g * W) + K_p * X_d + K_p * T_d * dX_d/dt + (1/T_i) * (\text{Time Integral over } X_d)$ .

**PWM FREQUENCY (Option)**

The proportional coil is controlled by a pulse-width-modulated (PWM) voltage. The PWM frequency can be modified within a range of 20 to 2000Hz. The PWM frequency is adapted to the valve's mechanics and should not be changed!

**CONTROL CYCLE TIME**

The control cycle time indicates the time intervals at which the control output ( $Y$ ) is newly calculated.

Changes within a range of 1 to 100 msec are possible.

The cycle time is adapted to the control and the valve and should not be changed!

**11.7.2 SETPOINT section****SETPOINT SIGNAL**

Select the signal for the setpoint: 0-10 volt; 0-20 mA; 4-20 mA

**SETPOINT DIRECTION**

Select whether the rising setpoint increases the outlet pressure (normal) or decreases the outlet pressure (inverse).

**SHUT OFF**

ON: If the setpoint is below the "shutoff level", the coil current is switched off and the valve is fully exhausted.

OFF: Disables the shutoff function. This function is needed for "Setpoint Adjustment/Custom".

Shutoff level: Select a value between 0 and 10%.

**SETPOINT ADJUSTMENT**

Normal: 0 to 100% setpoint gives 0 to 100% outlet pressure.

Custom: A setpoint between 0 and 100 % results in an outlet pressure between "offset" and "offset + span".

Setpoint Offset: Select between -50% and +50%.

Setpoint Span: Select between 50% and 100%.

**SETPOINT SELECTION (Option)**

You can choose between the standard "Setpoint 1" and an optional "Analog In 2".

**RAMP FUNCTION**

No RAMP: Function disabled.

Rising Ramp: "Ramp Rise Time" is used for increasing setpoints.

Falling Ramp: "Ramp Fall Time" is used for decreasing setpoints.

Rising+Falling Ramp: Combination of both ramp actions.

The ramp time (in seconds) is always related to a 0 to 100% setpoint step. This means the rise of pressure (slope) is constant.

## 11.7.3 ANALOG IN/OUT section

### ANALOG OUT (option)

An analog output can be used to transmit the feedback signal or other internal control signals.

Note: Conversion from voltage output to current output must be made on the electronics (factory only).

Signal: Select the signal (0..10V/0..20mA/4..20mA)

Direction: Normal: 100% outlet pressure gives 100% current/voltage.  
Inverse: 100% outlet pressure gives minimum current/voltage.

### ANALOG IN 2 (option)

Feedback Select: Feedback control is made over the "Internal Sensor" or an optional "Analog In 2".

Signal: Select the signal (0..10V/0..20mA/4..20mA)

Direction: Normal: 100% external sensor value gives 100% outlet pressure.  
Inverse: 100% external sensor value gives 0% outlet pressure.

### AUTO ZERO

Off: Function disabled.

On: The sensor is automatically reset to zero during "power up".  
The last compensation value is displayed in the "Auto Zero Value" field.

Aer is displayed if the Auto Zero value exceeds  $\pm 90$ .

## 11.7.4 AUTOSAFE section

### AUTOSAFE

Off: Function disabled.

On: Autosafe enabled. This function is activated by "Overtemperature", "Overcurrent" or "Outside Window".  
After the "delay time", the coil current is decreased in cycles to prevent overheating.

### OVERTEMPERATURE (option)

Off: Function disabled.

On: If the electronics temperature rises above the "Temperature Limit" setting, Autosafe is activated until the temperature falls below this limit.

Temperature limit: Values between 50 and 150 degrees celsius are allowed.  
Note: Values below 70 degrees celsius can cause Autosafe during normal operation!  
Autosafe is activated right just after the "delay time" has expired.

### AUTOSAFE SOURCE (option)

Outside Window: If the outlet pressure is outside the "Digital Out/Window Size" setting, Autosafe is activated until the outlet pressure is again within this window.

Overcurrent: If the coil current rises above the "Current Limit Level", Autosafe is activated until the current falls below this limit.

Current Limit Level: Select values between 100 mA and 2000 mA.

### AUTOSAFE TIMING (option)

Delay time: Select between 5-10-15-20-25-30-35-40 seconds.

Coil OFF Time: If Autosafe is enabled, the coil current is limited to max. 70% for the period set in "Coil OFF Time" to prevent overheating.

Coil ON Time: If Autosafe is enabled, the coil current is regulated for the "Coil ON Time".

### INLET PRESSURE SENSOR (option)

An optional external "Inlet Pressure Sensor" can be used to check the inlet pressure on the valve.

Disabled: Function inactive.

Autosafe: Autosafe is enabled as soon as the inlet pressure falls below the "Inlet Pressure Limit".

Outlet Pressure Decrease: As soon as the inlet pressure falls below the "Inlet Pressure Limit", the outlet pressure is decreased to the inlet pressure minus 10%.

Coil OFF: If the inlet pressure falls below the "Inlet Pressure Limit" the valve is fully exhausted.

Inlet Pressure Limit: Select a value between 0 and 100%.

### 11.7.5 DIGITAL INPUT section (option)

An optional "Digital Input" can be used to perform special outlet pressure functions.

#### SELECT POLARITY (option)

High Active: If digital IN is "high", the function is enabled.  
Low Active: If digital IN is "low", the function is enabled.

#### SELECT FUNCTION (option)

|                 |                             |                                                                  |
|-----------------|-----------------------------|------------------------------------------------------------------|
| Disabled:       | Function inactive.          |                                                                  |
| Setpoint        | Manual/Setpoint1            | Switches between manual operation and setpoint.                  |
|                 | Setpoint1/Analog In 2       | Switches between two analog setpoints.                           |
| Feedback        | Analog In 2/Internal Sensor | Switches between internal and external sensor.                   |
| Outlet pressure | Hold/Setpoint               | Maintain outlet pressure or bring pressure to setpoint.          |
|                 | Zero/Setpoint               | Exhaust valve (0 bar) or bring pressure to setpoint.             |
|                 | Max/Setpoint                | Pressurise valve (inlet pressure) or bring pressure to setpoint. |

### 11.7.6 DISPLAY/KEYS section (option)

#### DISPLAY SELECT (option)

Allows different pressure units and signals to be shown on the "valve display".

#### KEY LOCK (option)

Off: Allows the use of the keypad on the valve.  
On: Locks the use of the keypad on the valve (no function).

#### KEY FUNCTION (option)

|                         |                                                                                                                                                                                                                                             |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Disabled:               | Locks the keypad.                                                                                                                                                                                                                           |
| Manual Setpoint:        | Press both buttons during power up to enter the manual mode (see "How to operate the SENTRONIC <sup>®</sup> ").                                                                                                                             |
| Setpoint offset + span: | Use this button to change the setpoint setting. Press both buttons simultaneously during power up to call setpoint setting. To toggle between offset and span, press both buttons simultaneously (see "Setpoint/Setpoint Setting" section). |
| Reserve:                | Reserved for future use (currently not used).                                                                                                                                                                                               |

#### LED ACTIVATION (option)

Green LED: Controls the ON state of the green LED.  
Yellow LED: Controls the ON state of the yellow LED.  
Red LED: Controls the ON state of the red LED.

### 11.7.7 DIGITAL OUT section

#### OUTPUT SOURCE (option)

|                            |                                                                                                         |
|----------------------------|---------------------------------------------------------------------------------------------------------|
| Inside Window:             | The digital output is enabled when the outlet pressure is inside the window set in "Window Size".       |
| Inside Window+Above Limit: | The digital output is enabled when the outlet pressure is inside the window and above the "Limit Size". |

Note: Above signals are "active good" signals.

|                                   |                                                                                       |
|-----------------------------------|---------------------------------------------------------------------------------------|
| ERROR:                            | An error signal is activated as defined in the "Error" section ("active bad" signal). |
| ERROR+Below Limit+Outside Window: | Combination of all active bad signals.                                                |

#### OUTPUT DELAY

A short-term switch-over into the inactive state is suppressed for the delay time (bounce suppression).  
Select a value between 0 and 10 seconds.  
The signal must stay in the "active" position for the complete delay time until the output changes to the active state. If the signal changes during the delay time, then the delay time is started again.

#### OUTPUT MODE

Normal: The "Digital OUT" is high-active (active = 24 VDC).  
Inverse: The "Digital OUT" is low-active (active = 0 VDC)

## WINDOW SIZE

The window is related to the setpoint and forms a symmetrical limit above and below the actual setpoint.

Example: 5% window and actual setpoint = 80% (8 bar).

To be inside the window, the outlet pressure must be between 75% (7.5 bar) and 85% (8.5 bar).

Select a value between 0 and 20%.

## LIMIT THRESHOLD (option)

Checks whether the outlet pressure is above the limiting threshold (output mode = normal) or below the limiting threshold (output mode = inverse).

Select values between 0 and 100%.

## LIMIT HYSTERESIS (option)

Defines the "Limit Hysteresis" of the limit size. Serves to debounce the limit size. Select values between 0 and 10 %.

### 11.7.8 ERROR section (option)

#### ERROR SELECT (option)

Defines the source of the error signal.

|                                                      |                                                       |
|------------------------------------------------------|-------------------------------------------------------|
| Off:                                                 | Function disabled.                                    |
| Range:                                               | see Error/Setpoint Range Detection.                   |
| Inactive (manual/zero/max):                          | Manual operation, test function or "serial setpoint". |
| Overtemperature:                                     | See Autosafe/Overtemperature                          |
| Low inlet pressure:                                  | See Autosafe/Inlet Pressure Sensor                    |
| Range + inactive:                                    | Combination of error signals.                         |
| Range + inactive + overtemperature:                  | Combination of error signals.                         |
| Range + inactive + overtemperature + inlet pressure: | Combination of error signals.                         |

#### SETPOINT RANGE DETECTION (option)

If the setpoint range is set to 4...20mA (life zero), the input signal is checked to see whether it is inside this range.

|               |                                          |
|---------------|------------------------------------------|
| Off:          | Function disabled                        |
| >20mA:        | Setpoint above 20 mA (control failure)   |
| <4mA:         | Setpoint below 4 mA (cable interruption) |
| >20mA + <4mA: | Checking for both conditions             |

## 12. EXPERIMENTAL DEFINITION OF CONTROL PARAMETERS FOR A SPECIFIC APPLICATION

(How to optimise your control parameters)

### 12.1 PRE-ADJUSTMENT KP

Disable Integration by setting Integration Limit to 0 (zero).

Disable Derivation by setting Derivation Time to 0 (zero).

Set Proportional Gain to:  $K_p=1$ .

Set Deadband to 0.2%.

Disable Forward Gain: Set to 0 (zero).

### 12.2 FORWARD OFFSET

Apply a setpoint of 5% (0.5V) to your valve.

Adjust the Forward Offset so that the outlet pressure is between 3 and 5%.

### 12.3 FORWARD GAIN

Apply a setpoint of 95% (9.5V) to your valve.

Adjust the Forward Gain so that the outlet pressure is between 85 and 95%.

### 12.4 PROPORTIONAL GAIN

Connect the valve to your application (tubing and volume).

Enter the Scope/Step Mode and select a 0 to 50% step.

Watch the step response displayed in the scope graph on the screen.

Starting from 20, adjust down the Proportional Gain until there is no continuous oscillation anymore.

### 12.5 DERIVATION TIME

Enter the Scope/Step Mode and select a 0 to 50% step.

Watch the step response displayed in the scope graph on the screen.

Starting from 0, adjust up the derivation time until the overshoot is acceptable and there is no continuous oscillation anymore.

If the overshoot is still too high, then reduce the Proportional Gain.

**12.6 INTEGRATION TIME**

Set the Integration Limit to 100%.

Set the Integration Time to minimum (0.05 sec.).

Enter the Scope/Step Mode and select a 0 to 50% step.

Watch the step response displayed in the scope graph on the screen.

Set the Acquisition Time to maximum (20 sec.).

If sweeping occurs (low frequency oscillation), then increase the Integration Time step by step.

If sweeping still occurs, you need to increase the Deadband.

Calculation of the integral value is started as soon as the control deviation is smaller than  $\pm (80\%/K_p)$ .

**12.7 DEADBAND**

To improve the precision of control, you can reduce the Deadband.

**12.8 INTEGRATION LIMIT**

Apply a setpoint of 95% (9.5V) to your valve.

Enter the Scope/Trigger/Roll Mode.

Set the Acquisition Time to maximum (20 sec.).

Watch the I value at analog channel 4 for minimum and maximum values.

Add a gap of 20% to the bigger value.

Enter this result in the Integration Limit field.

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