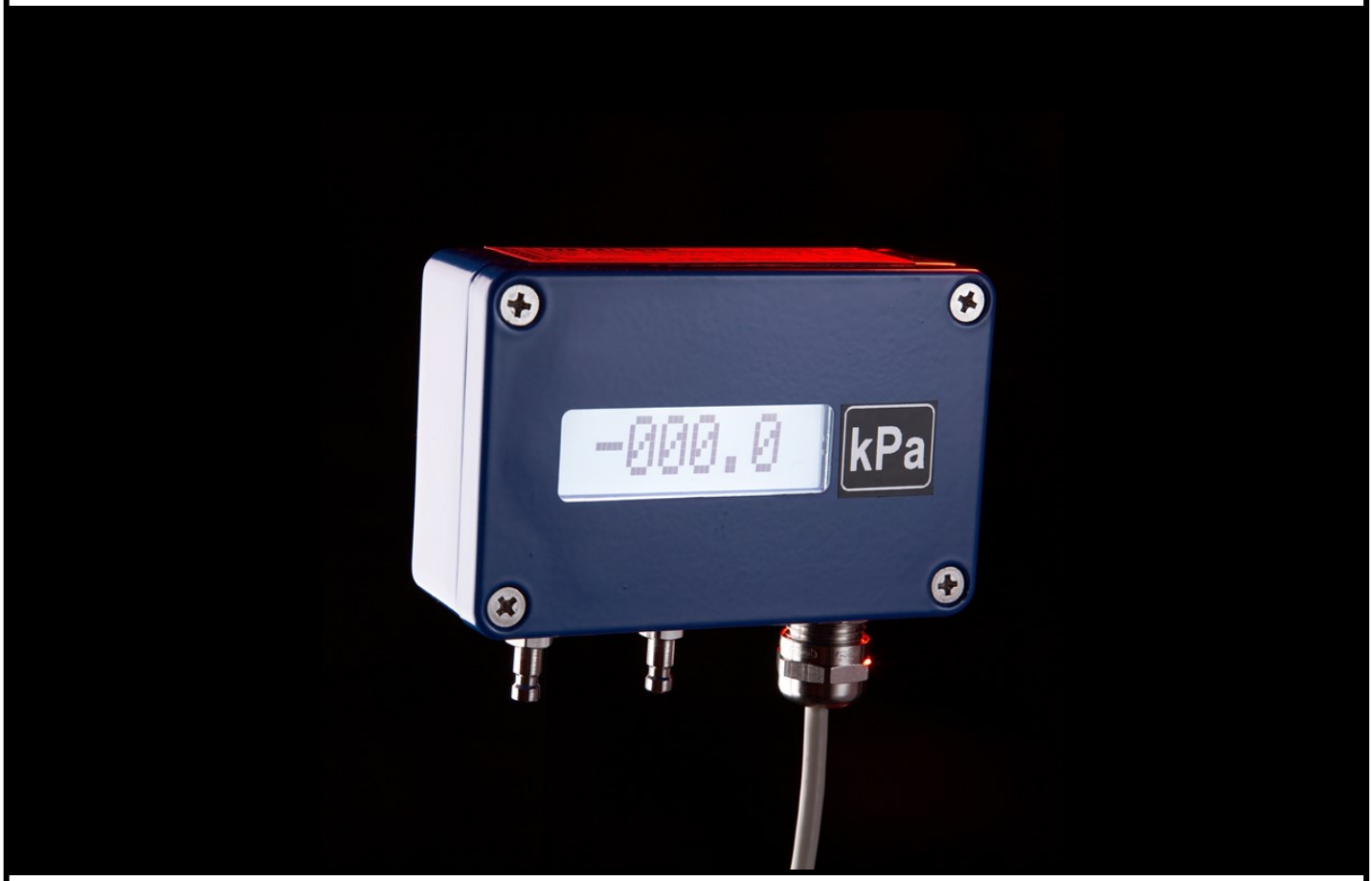
INSTRUCTIONS FOR USE OF PRODUCTS

S series



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PRESSURE MEASUREMENTS

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Instructions for use of products S series

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2. Description

The Cressto product series with the common designation S has several common characteristics:

- Fully microcomputer signal control and processing
- Digital, analog and two-state outputs
- Possibility to configure parameters via PC
- Robust and durable mechanical design
- High degree of protection IP 65
- Optional 4-digit LCD display with backlight
- Great variability

Each subtype has its own datasheet, which contains a detailed description and technical parameters.

2.1. Subtype List

This range of products is not closed and new subtypes of devices are gradually being added. For each subtype, a separate catalogue sheet is issued, in which you can find basic technical specifications.

SP is low and very low-pressure transmitter designed especially air conditioning, ventilation, control of combustion processes, monitoring of clean rooms, etc. It can also be supplied in a version for measuring absolute pressure, or barometric pressure.

SV is a pressure transmitter with automatic offset zeroing. It is a variant of the pressure transmitter of the SP series, which is supplemented with a program-controlled valve, which is used to perform periodic or non-periodic offset measurement and correction transmitter output. The zeroing phase lasts about 300ms and the period can be set in the range of 10 minutes to 256 hours. Thanks to this technical solution, excellent long-term stability can be achieved even at the lowest pressure ranges.

SR is a relative or absolute pressure transmitter for universal use. A silicon sensor with a stainless-steel separating membrane is used to measure the pressure. These transmitters are supplied with a G1/2" thread as standard and are custom-mounted.

SH is differential pressure transmitter for liquid media. Two separate sensors with a stainless-steel separating membrane are used. It is designed especially for hot water heating systems with a static pressure of up to 16 bar. It is connected to the pressure circuit using an impulse pipe.

SD is multifunctional device designed to connect any sensor with an electrical analog output. When powered from a 4-20mA two-wire loop, it can be used as a programmable digital LCD display. With a three-wire power supply additional display backlight can be used. Device can also be used as an A/D converter with serial communication or as a digital comparator with an open collector or relay contact output

ST is being prepared variant of the signal converter from resistance thermometers with a resistance of 1÷5 kΩ. This device uses the same basic software, configuration and communication options as the pressure transmitters in this series.

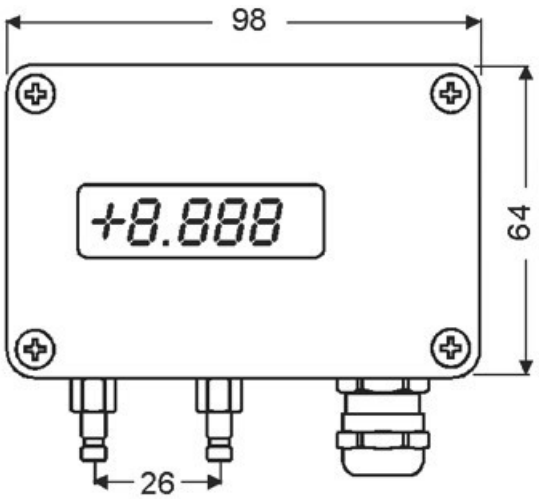
3. Mechanical construction

The S-series devices are mounted in aluminum enclosure with a blue paint finish. The enclosure dimensions are 98 x 64 x 34 mm. The enclosure is rated IP 65. LCD display is an optional accessory mounted at an additional cost. It can be supplied with two types of electrical connection:

- Metal bushing with internal terminal block. This design is preferred.
- Sealed locking connector for connecting analog outputs only. Delivered only by prior order.

The devices are attached using two screws accessible after removing the cap. These screws are outside the sealed space.

3.1. Main dimensions



3.2. Pressure connections

SP and SV transmitter series have variable fittings for the connection of the pressure medium.



For barometric pressure measurement – code designation **B** – the inlet hole is protected by a metal cover made of nickel-plated brass. Obviously, the barometric pressure transmitter can also be equipped with any of the above fittings.

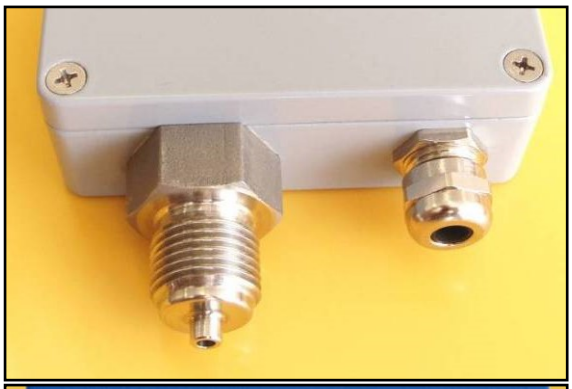


Classic outlets with an outer diameter of 6 mm from nickel plated brass. Code designation **V**.

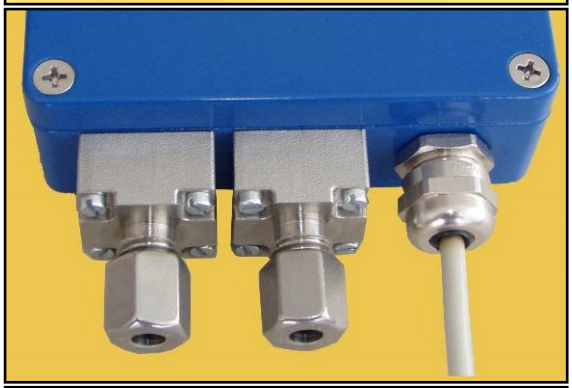


Push-in connection for hose. Precise with guaranteed tightness and pressure resistance up to 1 MPa. Code designation **N** for hose with an outer diameter of 4 mm, **M** for hose with an outer diameter of 6 mm. The material is nickel-plated brass and plastic, O-ring sealing NBR.

Other connection fittings:



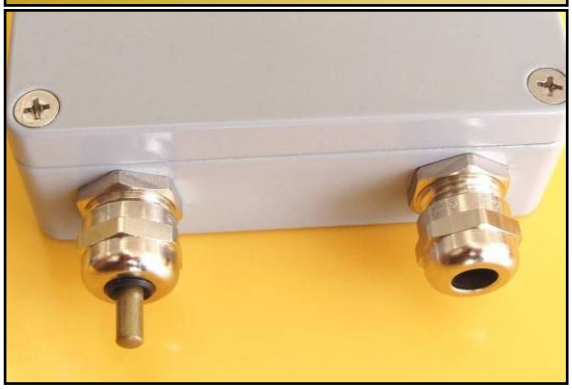
The standard connection of the SR series transmitter is stainless steel with a G1/2" thread. Can also be supplied with other types of threads, etc.



Connection of the SH series differential pressure transmitter using an impulse piping with an outer diameter of 6mm. Code designation P.



Connection of the SH series differential pressure transmitter using G1/8" female thread. The connection has a vent screw. Code designation **Q.**



The converter for temperature sensors is equipped with a second cable gland, into which the resistance thermometer can be fixed directly (see picture) or connect a resistance sensor with a cable. Coverage remains unchanged.

The selected connection type must be specified in the order. Since these are sealed with glue, their additional replacement is very problematic. If necessary, another type of connection can be arranged.

4. Electrical connection

The described series of devices also has very variable signal outputs or inputs. There are classic analog outputs two-wire 4÷20 mA, three-wire 0÷20 mA, 0÷10 V, 0÷3 V. These outputs can be switched by the user software and the range of measured pressures can be assigned to them within a certain range. In addition, for analog outputs, the linear conversion characteristic can be switched to a two-state switching. For example, the voltage output can be used as a logic level output with adjustable logic level 1. Unless otherwise specified, these analog outputs are always available in the transmitters. If the s transmitter operates in a two-wire loop of 4÷20 mA, it is not possible to use any other outputs and functions at the same time, except for display without backlight.

TIP: If there is a requirement for a combination of functions and accessories with a current output of 4÷20mA, it can be solved by setting a three-wire current output in this range. In case of doubt, contact the manufacturer.

CAUTION: *Most electrical circuits are always present in the transmitter and their inappropriate activation using the configuration software could cause interference current spikes to appear in the two-wire current signal, caused by the consumption of these circuits.*

In other cases, analog, digital and two-state outputs and additional circuits can be combined.

There are also serial digital outputs available, the type of which cannot be changed later and must be specified in the order. RS485 is fitted as standard. Only some communication parameters can be configured in software.

CAUTION: *If any of the leads on the terminal block or connector is not used, it must not be connected anywhere, because it is electrically connected to the transmitter circuits and an incorrect connection could cause error, malfunction or complete destruction of the transmitter! A description of each signal is always given on the label.*

All of the above facts also apply to the SD series digital display, only instead of an analog output, pin No. 3 is an analog input. The type of electrical input cannot be switched here by software and must be specified in the order.

All types of S series devices can be supplemented with a 4-digit display. Activating the display does not change the requirement of a minimum supply voltage of 5V even for transmitter s with an output of 4÷20 mA. The display is equipped with white LED backlight. The current consumption of backlight is about 20 mA. Backlight activation is possible using software configuration.

Transmitters can also be additionally equipped with a switching output module. This module contains a small bistable relay with one switching contact and two separately controlled NPN open-collector transistors. Transistor switching is indicated by red LEDs that are visible outside the case. These LEDs are in operation even without the load of the output transistors connected, so they can be used for just optical signaling of states. Setting of switching and breaking levels of hysteresis, etc. is done by software.

TIP: If you need to indicate that the relay contacts are closed using the built-in LED, also program to switch the open collector transistor with the same levels and do not connect its output.

The devices can be supplied with an internal FLASH memory, into which it is possible to record measured data with a preset period, which can then be read into a computer. The memory capacity is 8000 entries. However, it is not a full-fledged data logger, as the transmitter does not have a battery and a real-time clock. This accessory is more suitable for diagnostic purposes.
The S series is also available with a USB connection. In this case, the USB cable is installed directly at the manufacturer, the device is powered from a USB port (including the display and backlight), communication with the user software takes place via the mapped COM port of the computer. This solution is very practical for implementing mobile workplaces equipped with laptops, or for working in laboratories.

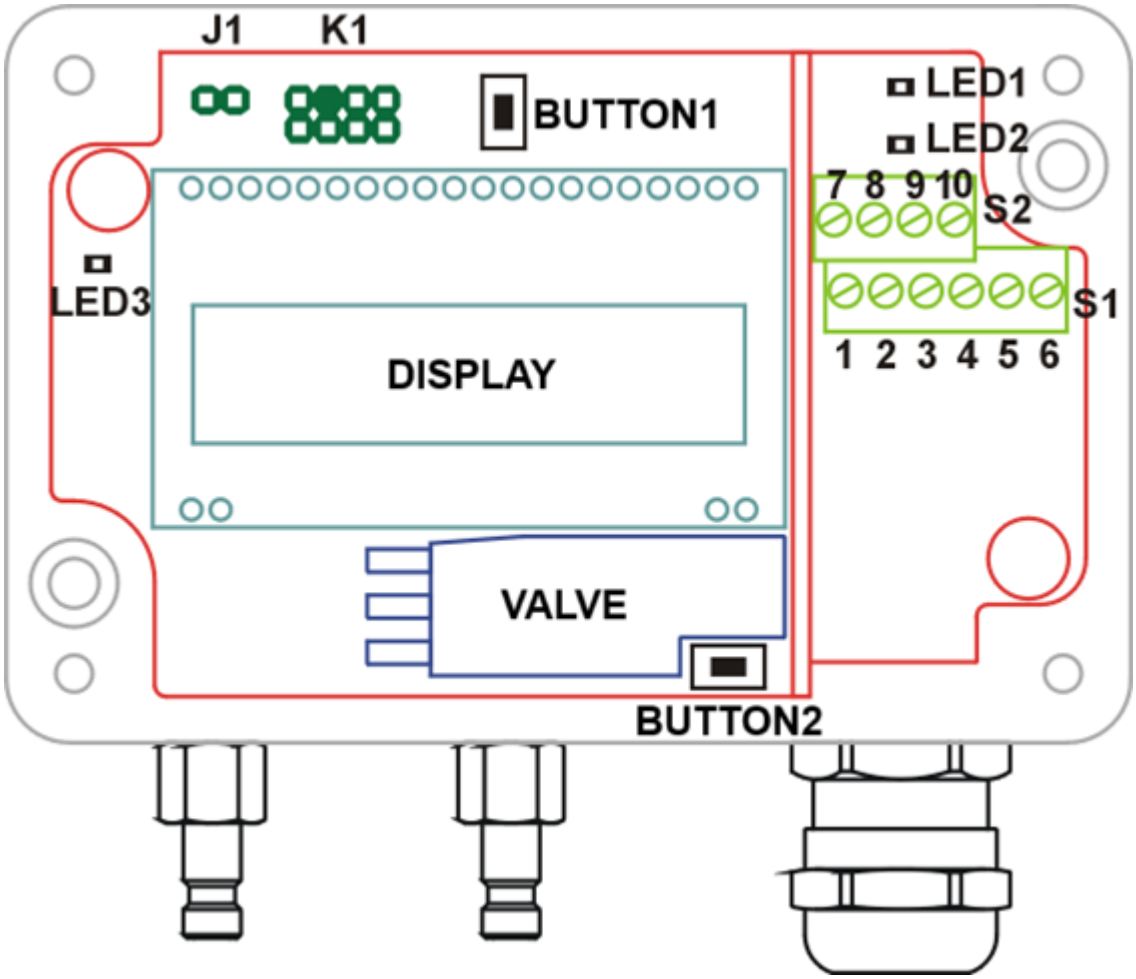
4.1. Table of outputs, assignment of terminal block and connector outputs

Connector	3	2	1			⊆				
Terminal block	1	2	3	4	5	6	7	8	9	10
4 ÷ 20mA	+Ucc	-Ucc				Case				
0 ÷ 20mA	+Ucc	-Ucc	Out			Case				
0 ÷ 10V	+Ucc	-Ucc	Out			Case				
0 ÷ 3V	+Ucc	-Ucc	Out			Case				
RS232	+Ucc	-Ucc		RxD	TxD	Case				
RS485	+Ucc	-Ucc		B	A	Case				
Switching outputs							Re1	Re2	OK1	OK2

Output No. 6 is connected to a metal box and serves as a shield for the entire transmitter. It is galvanically separated from the transmitter electronics itself, electrical isolation at 1000V DC is tested.

4.2. Wiring diagrams

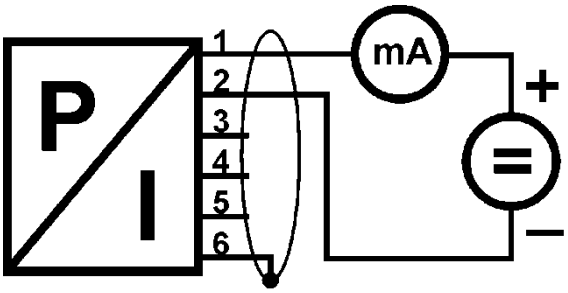
All devices in the S series are connected to the electrical circuit in the usual way. They are always powered by DC voltage in the range of 5 to 36V. Especially in the case of two-wire connections, it must be taken into account that this voltage must be available at the transmitter terminals, not for powering the entire loop. The transmitters are protected against reverse polarity of the power supply by a serial diode. CAUTION when connecting multi-wire connections, e.g. when confusing the output and power wires can cause damage to the transmitter.
All transmitter circuits, analog and digital outputs are galvanically connected and operate with a common ground, –Ucc inlet. This requires careful consideration, especially when combining analog and digital outputs. All leads are separated by 33 uH inductors and protected by varistors against short high-voltage peaks.



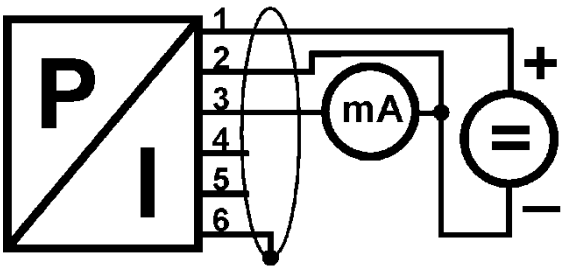
Connection and control elements under the transmitter cover

- **S1** Main terminal block for power connection, analog and digital outputs
- **S2** Terminal block on the switching output module for connecting relays and open collectors
- **LED1, LED2** Red LEDs for open-collector transistor switching indication
- **LED3** LED for indication of INIT mode for setting communication parameters
- **BUTTON1** Button with default zeroing function
- **BUTTON2** Button with default INIT mode activation function
- **K1** Connector for connecting the CresProg communication device
- **J1** Jumper for manual switch to the Cressto communication protocol
- **DISPLAY** 4-digit LCD display with backlight option – optional
- **VALVE** 3-way electromagnetic valve for automatic zeroing – only for SV series

The numbering in the following pictures corresponds to the numbering of the internal terminal block.

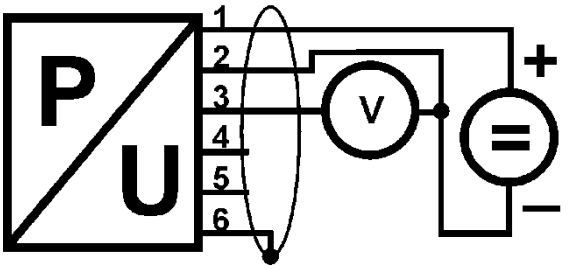


F 4÷20 mA two-wire is the most widely used analog output. For proper operation, it is necessary to ensure a supply voltage of at least 5 V at the transmitter terminals. The transmitter has software and hardware limitations of the maximum loop current.

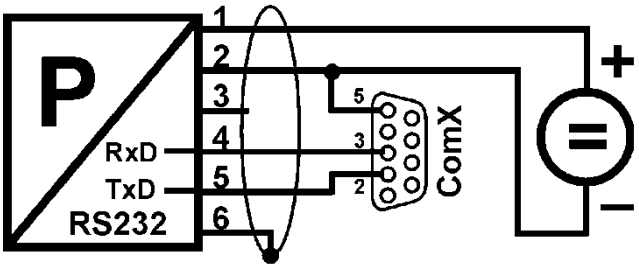


G 0÷20 mA three-wire.
Can be set to a range of 4÷20 mA.
Maximum load impedance

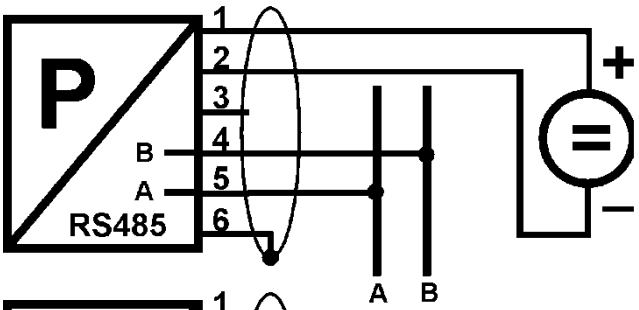
$$R = (U_{cc} - 2) / 20\ mA$$



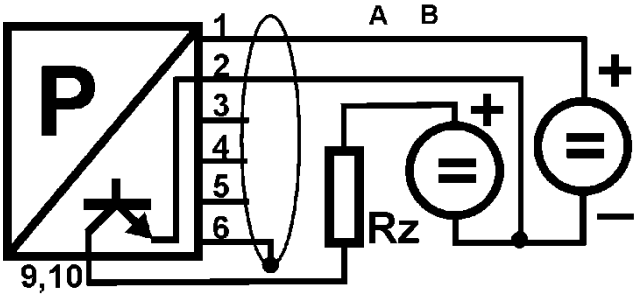
H 0÷10 V, other ranges can be set. For ranges smaller than 3 V, it is preferable to switch the output range of the transmitter to take advantage of the D/A converter resolution. The minimum supply voltage must be at least 2 V higher than the max. output voltage. The maximum load current is 20 mA.



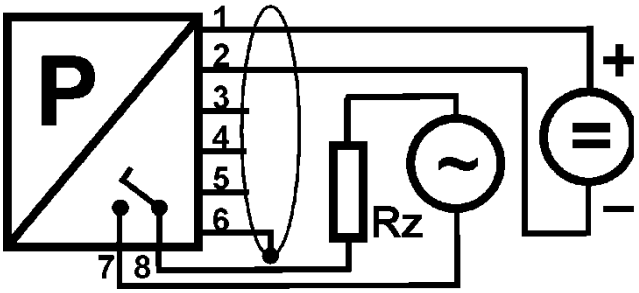
A RS232 digital output. Can be connected directly to the native and mapped (USB, LAN) serial port of the computer. Only Rx and Tx data signals are used for communication. The RS232 line is not galvanically isolated.



B connection to the RS485 bus. The line is not galvanically isolated, when powered from different sources, it is recommended to connect grounds.



L is a double switching output with NPN open-collector transistors. It is possible to switch currents up to 100 mA and DC voltage up to 50 V. The load is always galvanically connected to the transmitter power supply. The power supply for the transmitter and the load can be shared. Switching levels, hysteresis, polarity are set by software. It is also possible to set a switching "window".



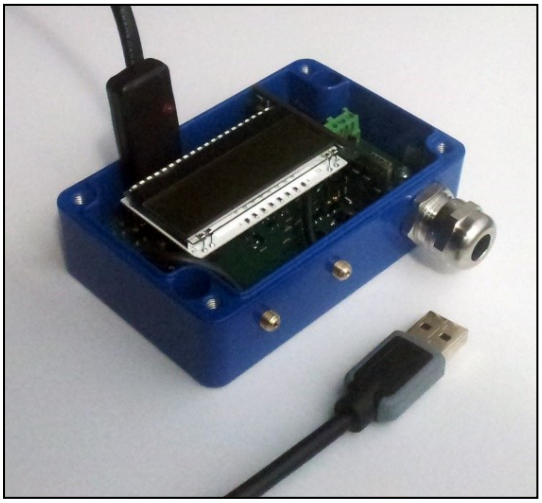
R is a switching output with a galvanically isolated contact of a bistable relay. It is possible to switch DC and AC voltage up to 40 V and current max. 0.5A. Switching levels, hysteresis, polarity are set by software. It is also possible to set a switching "window".

5. Software

The setting of programmable transmitter parameters can be specified in the order and is done by the manufacturer or a company authorized by the manufacturer. A configuration adapter **CresProg** can be purchased for user settings. All software is available on the manufacturer's website in section *Support* for the relevant product family (e.g. for SV series transmitters https://www.cressto.eu/pressure-transmitters/serie-sv-support).

5.1. Configuration adapter CresProg

CresProg is used for custom configuration of the transmitter. It is connected to the USB port of the computer. The big advantage is that the transmitter can also be powered from this port, so the user can perform his configuration "on the table" without the need for additional devices. The power supply is galvanically separated from the transmitter, so it is possible to connect the configuration adapter to a transmitter that is already connected in the application and make changes to its configuration during operation. To connect adapter, it is necessary to remove the transmitter cap and slide it onto the internal keyed connector.
After connecting the adapter to the computer for the first time, computer's operating system (Windows) should search and install driver automatically. Alternatively, the user can download driver from the manufacturer's website and install it manually. For transmitter configuration, the **S Config** service program must be downloaded and installed.



ATTENTION! CresProg cannot be used for transmitters with USB or RS232 connection.

5.2. Service program S Config

For configuring the transmitter, there is a program called **S Config,** which is installed under Windows.

5.2.1. Installation

The installer is available for download on the manufacturer's website. The Cressto tab will appear in the Start menu and you can run the program from there. For program operation, the Microsoft Framework must be installed on the computer. If it is not already installed on your computer it will be downloaded and installed automatically by the operating system.

5.2.2. Function description and settings

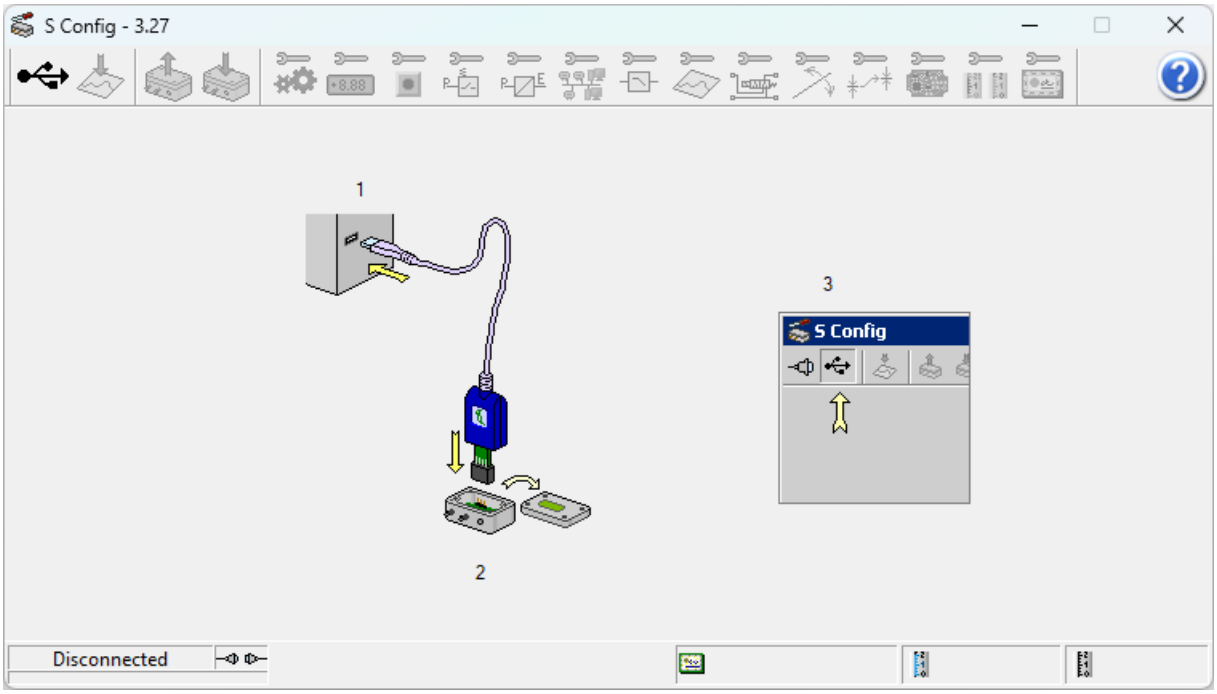
The service program uses the Cressto protocol to communicate with transmitters. If the configuration adapter CresProg is connected, transmitters will automatically switch to the appropriate protocol. For transmitter with USB or RS232 connection, that are not configured to Cressto protocol, it is possible to use the **J1** jumper. Closing J1 jumper switches transmitter communication protocol to Cressto protocol. After configuration, the user must remove the jumper in order to use other communication protocols.

5.2.2.1. Connecting the communication adapter

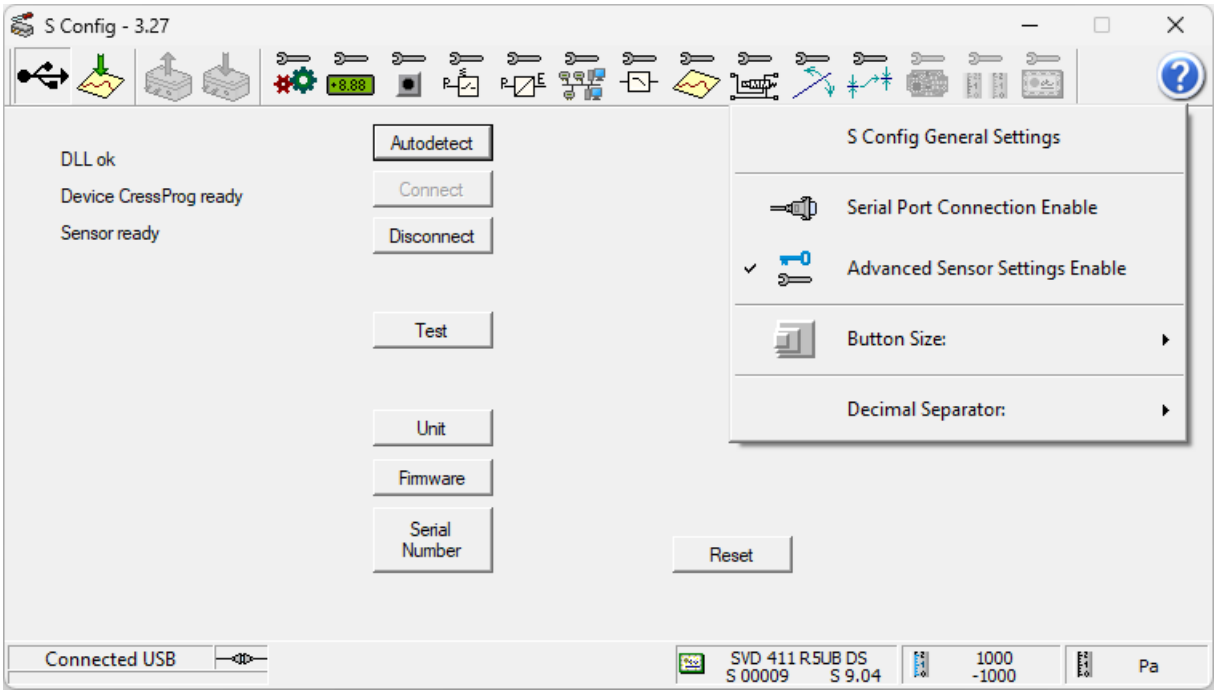
The program is intuitive to use. After connecting the communication adapter, the connected transmitter is automatically detected. If it is not connected, a help window will appear and after connection it is necessary to click on the USB icon.
If the transmitter is equipped with an RS 485 or RS 232 serial communication interface, it can be accessed via **S Config** also join under the following conditions:

- by right-clicking on the toolbar and checking *Serial line connection* option
- only one transmitter will be connected to the communication line at a time

- the native or mapped serial port of the computer must have the default communication parameters set, see chapter 6.3
- clicking on the serial port icon will detect available ports and clicking on the Autodetect button will search for the connected transmitter.



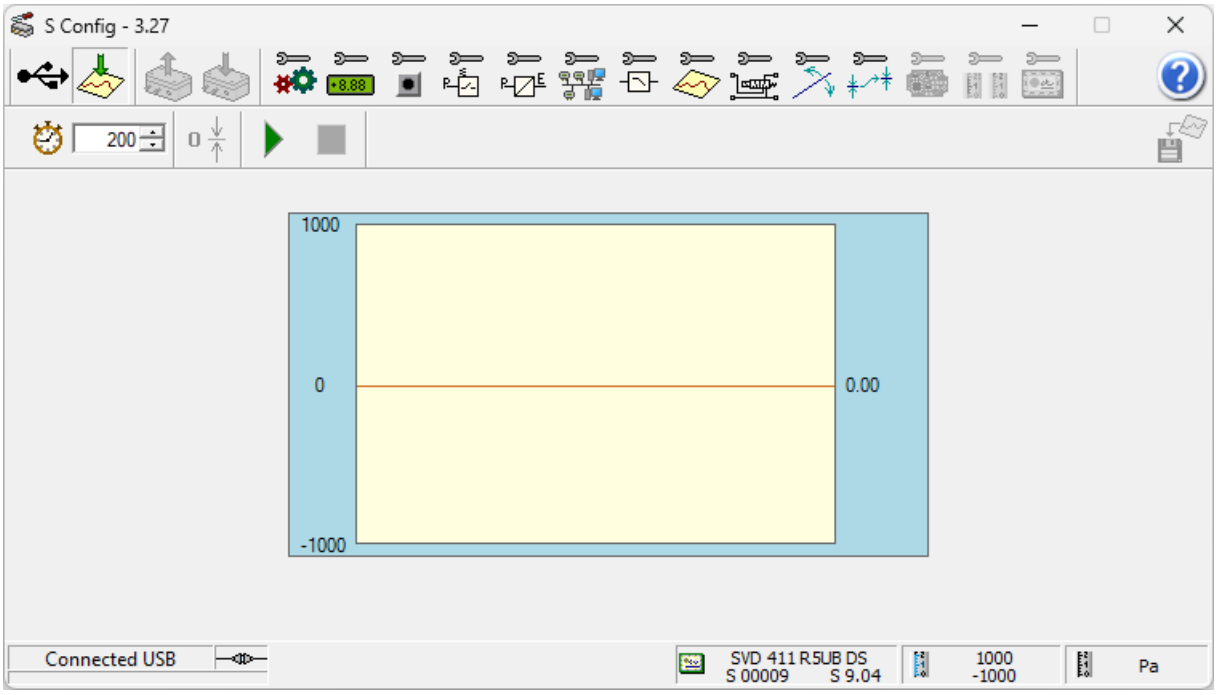
After establishing connection, the basic program window appears. On the bottom bar there is information about the transmitter identification number and the firmware version. Furthermore, the calibrated range of the transmitter in the currently configured unit is displayed. The most important control is the upper toolbar with buttons. The description of button is shown on mouseover. Clicking the individual icons opens the options for setting and checking the transmitter parameters. Right-clicking on this toolbar opens a menu that allows you to modify some settings of the S config program.



If you're not sure, don't change the configuration!

5.2.2.2. On-line measurement

 This icon opens the on-line measurement panel and is used for basic control of the correct operation of the instrument. On the sub-toolbar you can set the period of communication with the transmitter. The chart range is set automatically within the range of calibrated values. Clicking on the START icon  starts communication with transmitter and the currently measured values are displayed in time chart. Clicking on the STOP icon  stops the communication.



The measured data are stored in computer memory and can be saved to a PC in csv format by clicking SAVE icon  on the right side of the sub-toolbar.

5.2.2.3. Loading and saving configuration parameters

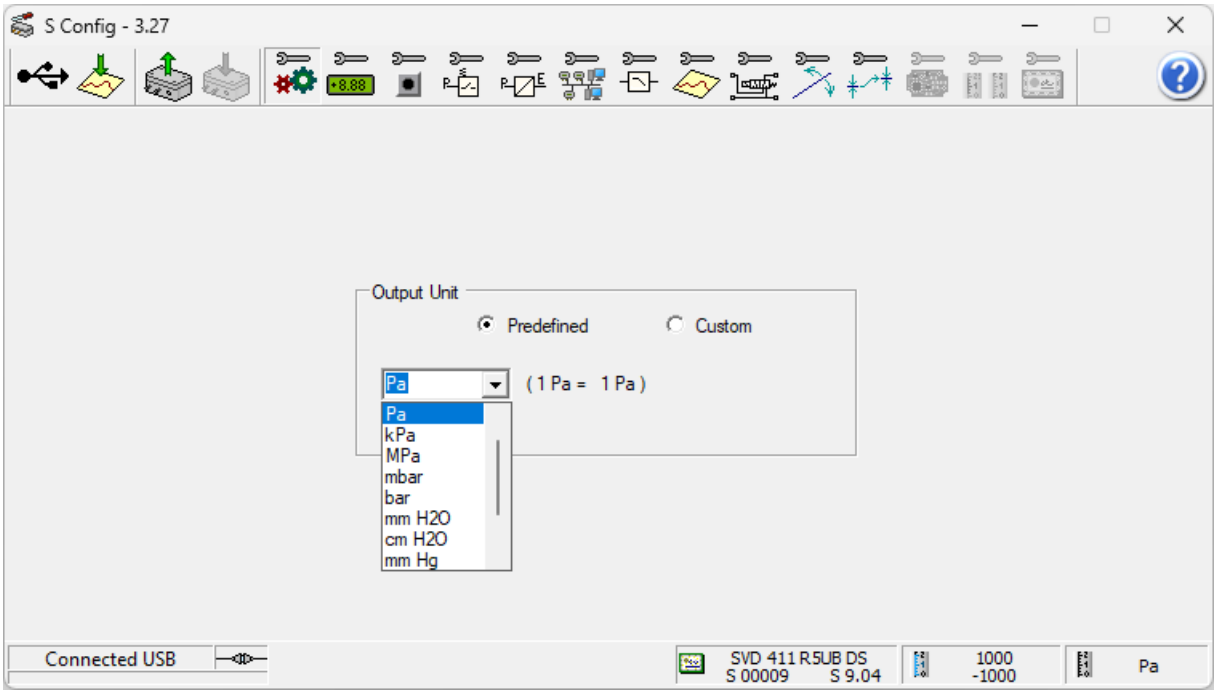
 This icon is used to read the complete configuration from the transmitter Flash memory into the S Config program. Some functions of S Config start loading parameters automatically. After changing settings, you need to save the new settings to the transmitter memory using the icon . The processor will automatically restart with new settings. Configuration parameters are stored in non-volatile memory and are retained even after the power is turned off.

Other icons are used to set the transmitter parameters. Not all of them are always accessible, and the transmitter is not always in maximum configuration, so some settings have no effect.

5.2.2.4. Physical unit settings

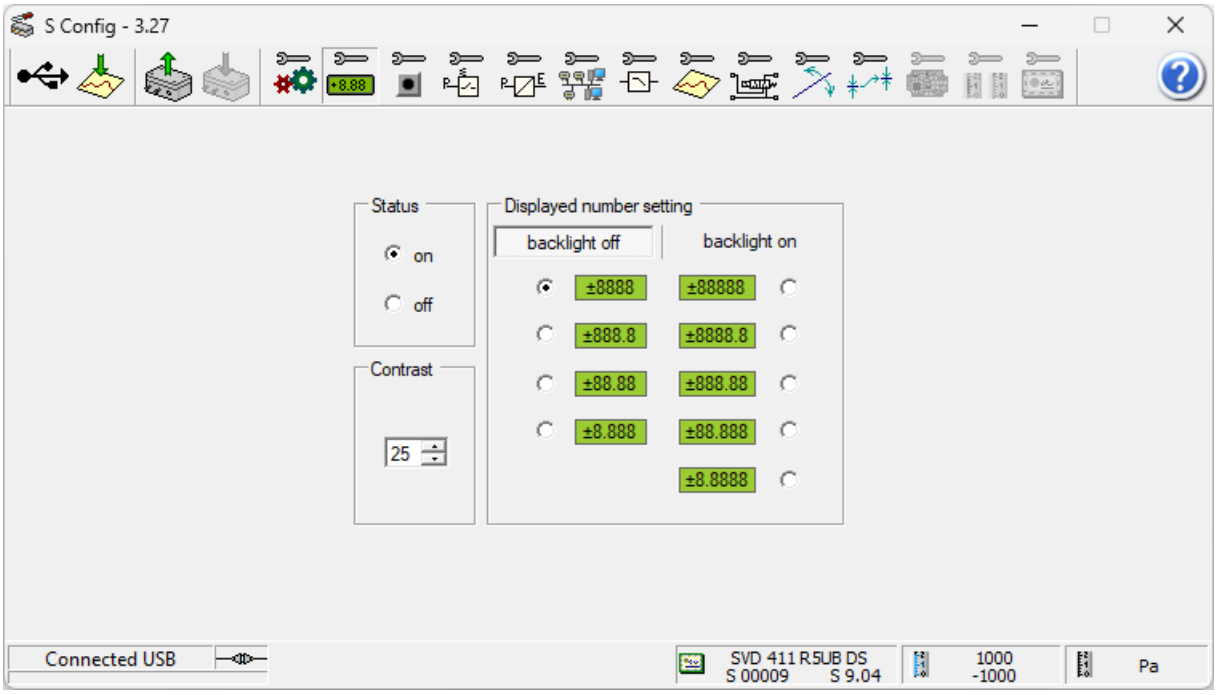
 After activating the panel by this icon, it is possible to set the physical unit that is used by the transmitter and the S Config program. Set unit affects value on the LCD display, value send over serial line and values saved in the internal data memory. If analog outputs are set up using S Config program, the set unit is used too. After setting up the new physical unit, save the configuration to the transmitter to update any other settings.

It is possible to select a preset physical unit from the drop-down menu or to enter your own, where it is also necessary to enter the conversion constant between entered unit and the basic unit 1Pa.



5.2.2.5. Display settings

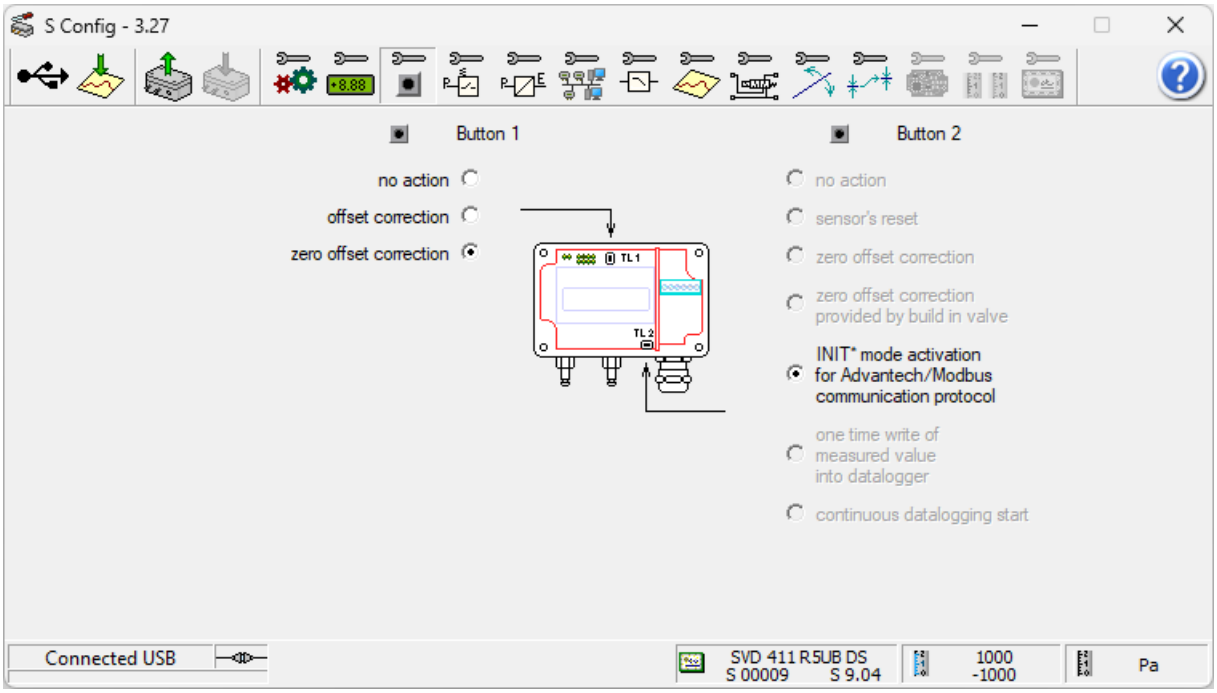
If the transmitter is equipped with a display, some parameters need to be set. On the panel, it is first necessary to enable its function and select the display format with regard to the expected measurement range. The format is fixed and the values are displayed in set physical units. If you change the physical unit, you must change the display format accordingly.
The display is equipped with white LED backlight. The value on the display is easy to read in outdoor lighting without the backlight on. When the backlight is on, it is easy to read even in complete darkness. For the variant of the transmitter with a two-wire output 4÷20 mA, only a display without backlight can be used, because a current of about 20 mA is required to power the LEDs. The solution is to use a three-wire current output set to the range of 4÷20mA.



The display allows software control of LCD contrast. The optimal default value is set during production, but the user has the option to set their own contrast value according to the current lighting conditions.

5.2.2.6. Changing the function settings of internal buttons

For some special transmitter variances, it may be useful to change the default functions of the buttons located inside the transmitter on the printed circuit board.
The basic function of the TL1 button is zeroing. If zero conditions are ensured at the transmitter input – disconnection of measuring hoses, etc. – the offset value is read at the moment of pressing the button, which is then mathematically subtracted from all measured values.



One of the possible functions of the TL2 button is to set the INIT mode for communication over the serial line. When the button is pressed, the red LED on the printed circuit board lights up and the default settings are used according to the selected communication protocol.

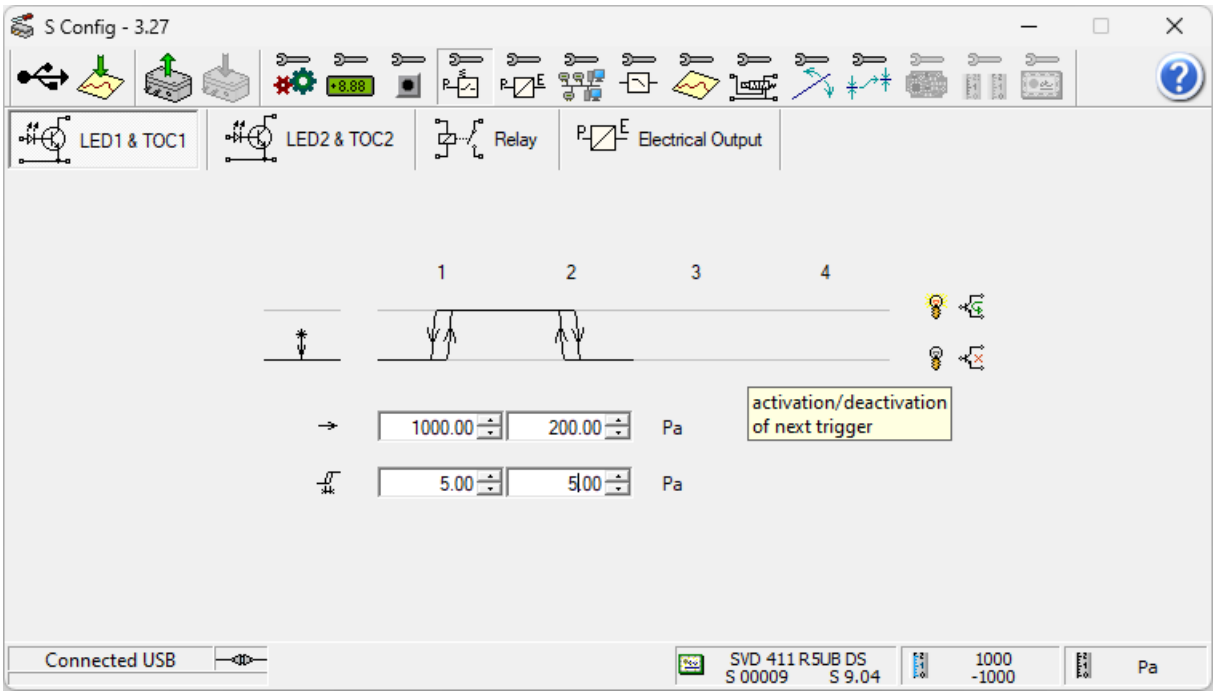
5.2.2.7. Two-state outputs

The S-series devices can be supplemented with a switching module that allows switching functions to be realized. The following outputs are available:

- Two independent open collector outputs with NPN transistor for currents up to 100 mA and voltage 50V. This output can be used to directly switch small loads – relays, LEDs, sirens, bulbs, etc. Transistor switching is indicated by red LEDs that are visible outside the case. These LEDs are in operation even without the load of the output transistors connected, so they can be used for just optical signaling of states.
- Bistable single contact relay for controlling electrical circuits that require galvanic isolation. The allowed voltage is 40 V DC or AC, max. current up to 0.5 A.
- Linear analog outputs can be switched to two-state output mode in the analog output settings panel and e.g. logic level function can be realized. The switching levels are set on this panel. This function can be implemented without an additional switching module.

Normally, these outputs cannot be operated in a two-wire transmitter connection. Again, a three-wire connection with the appropriate setting can be recommended as a solution. The setting of the switching characteristics of the individual two-stage outputs is completely independent.

After selecting the desired switching output on the sub-toolbar, it is possible to set the initial state after reset by clicking between the two lines on the far left. By clicking between the lines under the numbers 1 to 4, it is possible to select up to 4 comparison levels. By repeated clicking, you can cyclically change the direction of switching at a given point, or disable it. The level of flipping is entered into the controls in the top row, and the hysteresis in the bottom row, all in set physical unit. By specifying only one comparison level, a simple comparator is realized, and by two levels, a window comparator. By entering 4 levels, two switching windows can be defined. It is up to the user to set meaningful values, especially with regard to hysteresis.

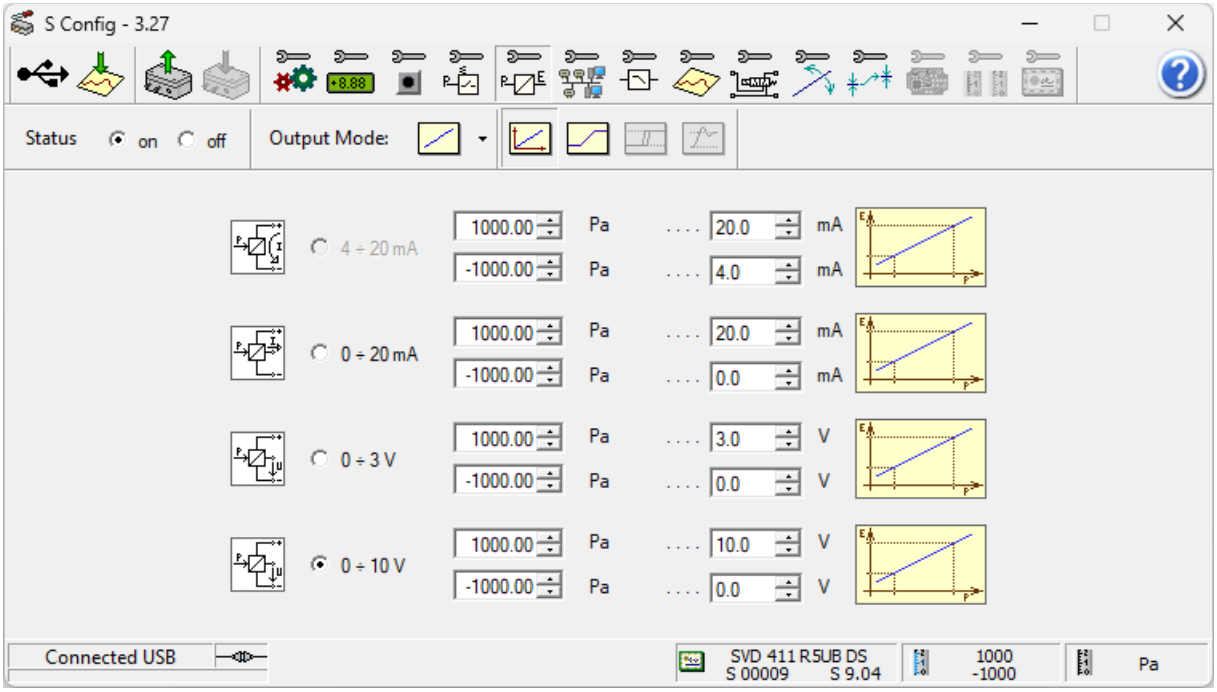


5.2.2.8. Analog outputs

The S-series transmitters are equipped with a unique circuit solution that allows software switch between different types of analog outputs and adjusting their range within a certain range. To maintain guaranteed accuracy, *we do not recommend changing the pressure range beyond 1:3*, even if it is technically possible.

The user has 4 types of analog outputs at their disposal:

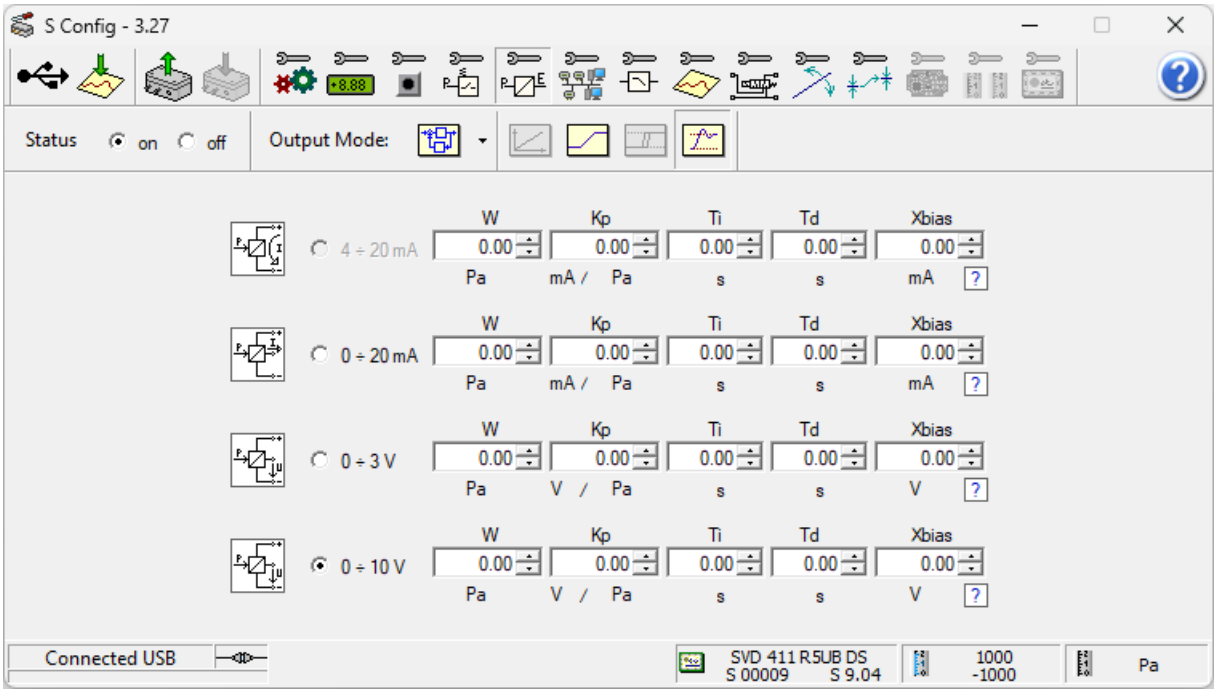
- current two-wire 4÷20 mA
- current three-wire 0÷20 mA
- voltage 0÷10 V
- voltage 0÷3 V



Keep in mind that software range change does not change the native range of the pressure transmitter itself, especially its pressure overload capacity!!!

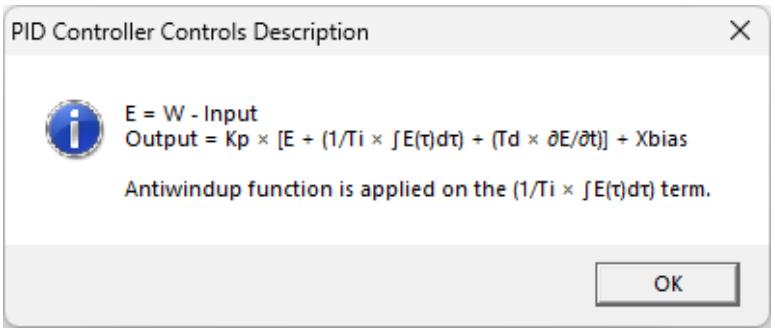
Conversion to analog value is realized by a 12-bit D/A converter, its function is switched on the sub-toolbar by selecting ON. If one of the outputs is not available, e.g. by selecting additional functions that are not technically compatible with this output, its selection is made inaccessible in the panel. By entering two points of the transmitter transfer function, almost any output range can be set within the range of the calibrated range of the transmitter. A three-wire current output can beset in the range of 4÷20 mA for example, in case the transmitter cannot be powered directly from a two-wire loop due to accessories. The 3 V output is recommended for voltage outputs lower than 3 V in order to make better use of the D/A converter resolution.

After clicking on the icon  on the sub-toolbar, it is possible to set software restrictions on the range of individual outputs, especially to protect the inputs of related devices. If, for example, we have set the output range of 5 V in accordance with the input range of the connected meter, at a supply voltage higher than 12 V during pressure overload of the transmitter, a voltage higher than 10 V may appear at the output, which can damage the electrical input of the follow-up device. Seting the limit value slightly higher than the desired maximal output value is recommended.
It is possible to switch to two-state mode using the Output mode option and specify the levels for logic 0 and logic 1 for any analog output.



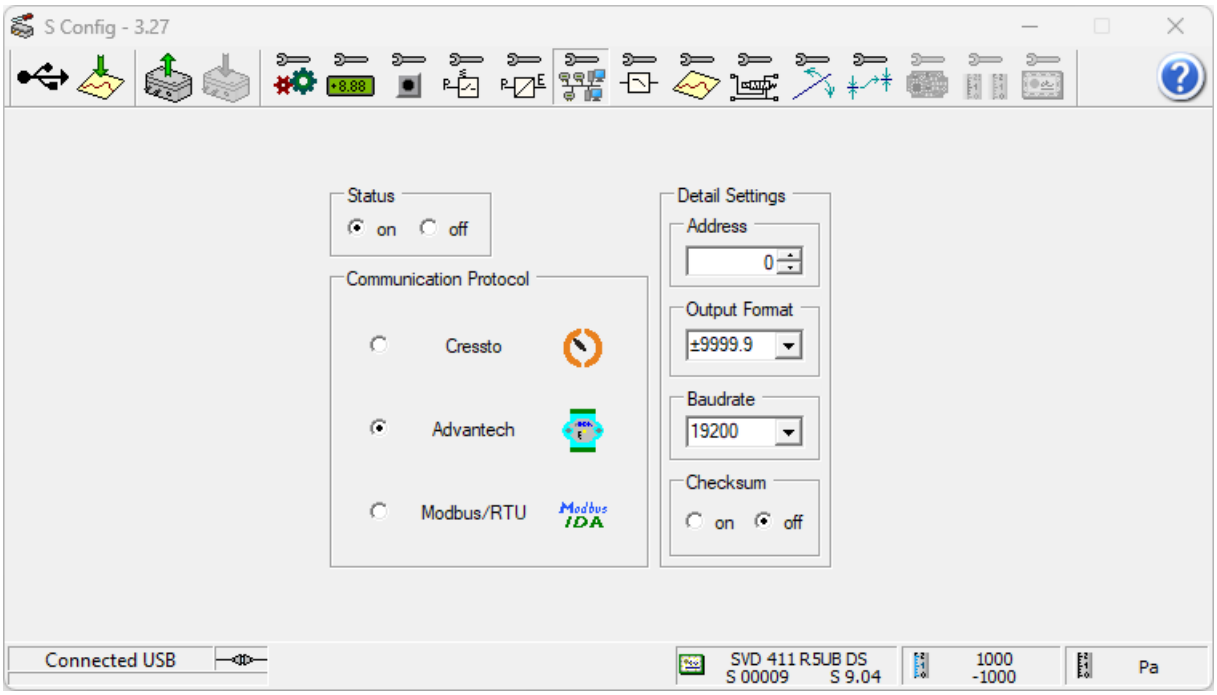
From firmware version 9.01 onwards, the analog output mode can also be switched to the PID controller mode and a feedback control circuit can be implemented directly after connecting actuator. The serial digital output and the display always show the currently measured pressure value at the transmitter input.
In order to avoid confusion of the dynamic parameters of the controller, it is necessary to turn off the damping function, see Damping adjustment. The limiting function can be used to limit the output signal. Control constants are set separately for each type of analog output. The integral term in the controller equation is treated with an anti-windup function to prevent the output signal from being "overloaded".

The value of the analog output when the PID controller is switched on is calculated from the following equation:



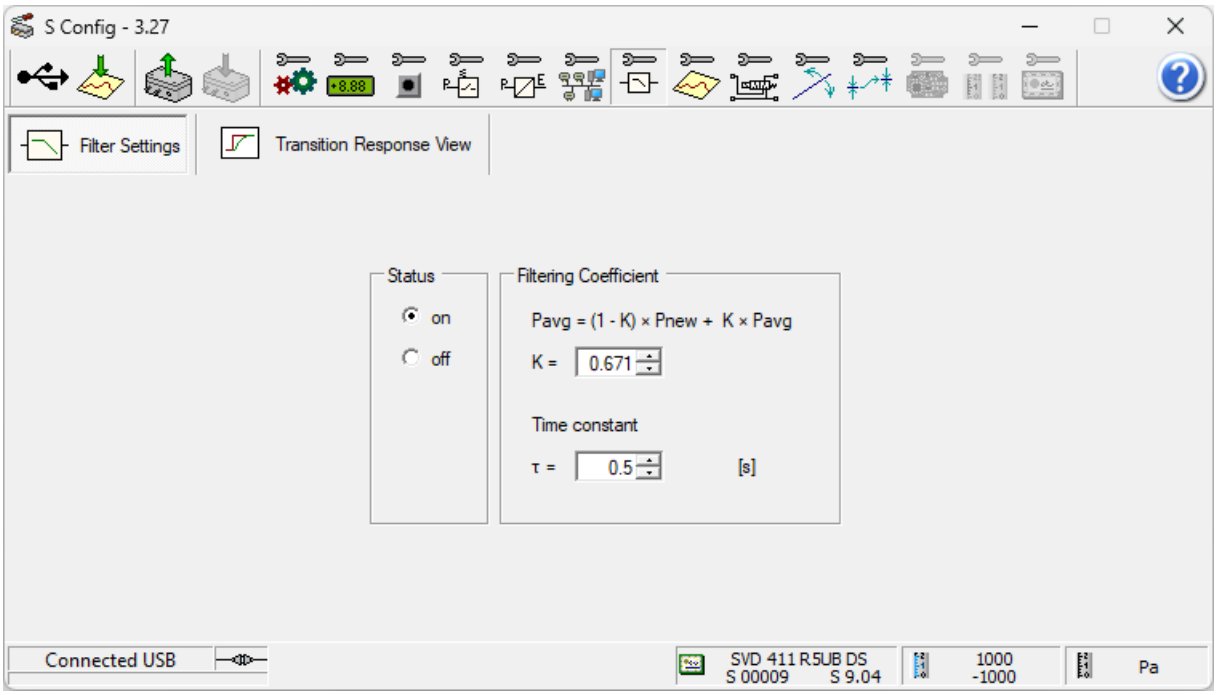
5.2.2.9. Serial digital outputs

The transmitters can communicate digitally over a serial line. The RS485 interface is standard, and it is possible to supply an RS232 or USB interface with a mapped serial port. It is possible to use both analog and digital outputs simultaneously, with the exception of the two-wire current output. Serial communication must first be enabled by selecting ON. If transmitter has RS485 interface, after connecting CresProg adapter communication line is automatically blocked. For other interfaces, the line is shared and it is recommended to disconnect it during the configuration. For normal use Modbus RTU and Adam Advantech protocols are available. It is possible to set basic communication parameters via S config program. Detailed description of protocols is in the chapter Communication protocols.



5.2.2.10. Damping adjustment

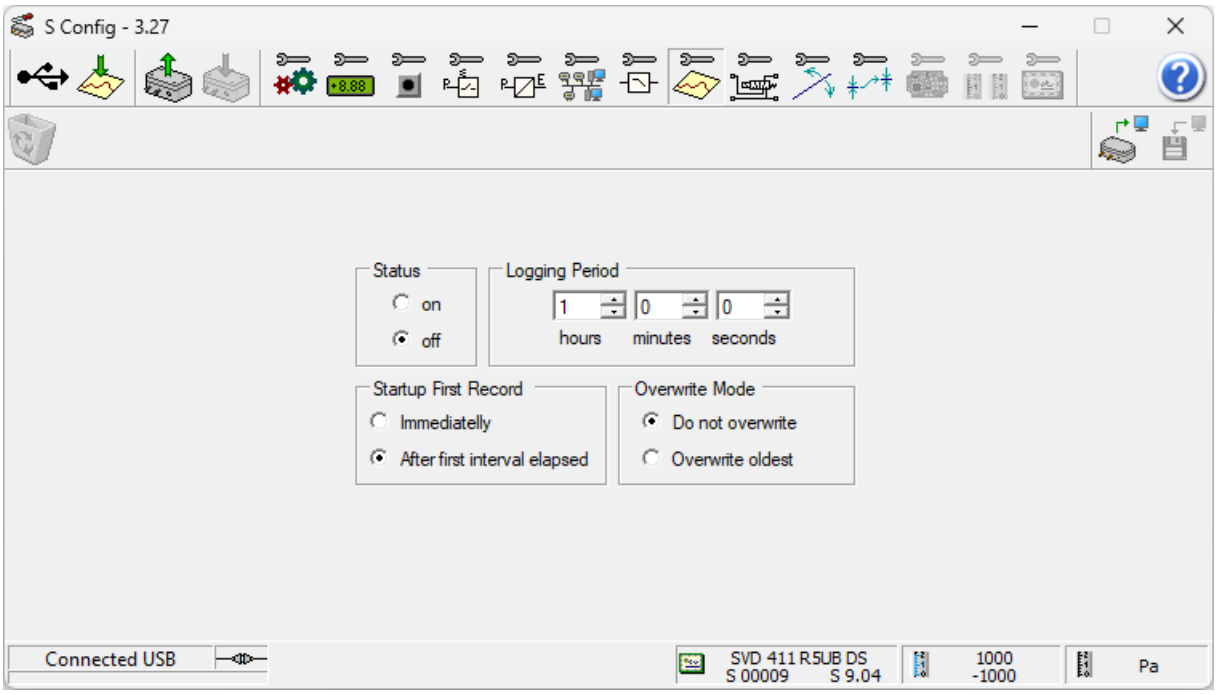
The output value from the transmitter can be damped by a 1st order filter. The damping coefficient can be selected in the range of 0 to 0.99. After switching on, selecting the coefficient and saving it into the transmitter, it is possible to check the expected response on the Transition Response View tab. The choice of the coefficient is rather a matter of experimentation depending on the specific application.



Since the damping coefficient is applied to the centrally calculated pressure value, it affects the analog output value, the display value, the reference value for two-state outputs and the value passed over the serial line in equal measure.

5.2.2.11. Datalogger

The S-series devices can be equipped with Flash memory for data recording. Since the transmitter does not have a real-time clock or battery backup, it is not a true data logger because the records do not have time record. However, you can set the recording period. 8000 values can be stored in the memory. Values are retained after the power is switched off.
The recording function must be activated by selecting ON and setting the recording period. The Do *not overwrite records* option stops writing after the memory is full and the *oldest* records since the start of recording are available. The *Overwrite oldest* option causes new records always written to the memory, so *the latest* records are available. If there is no memory overflow, both types of records are identical. All settings must be saved in the transmitter.



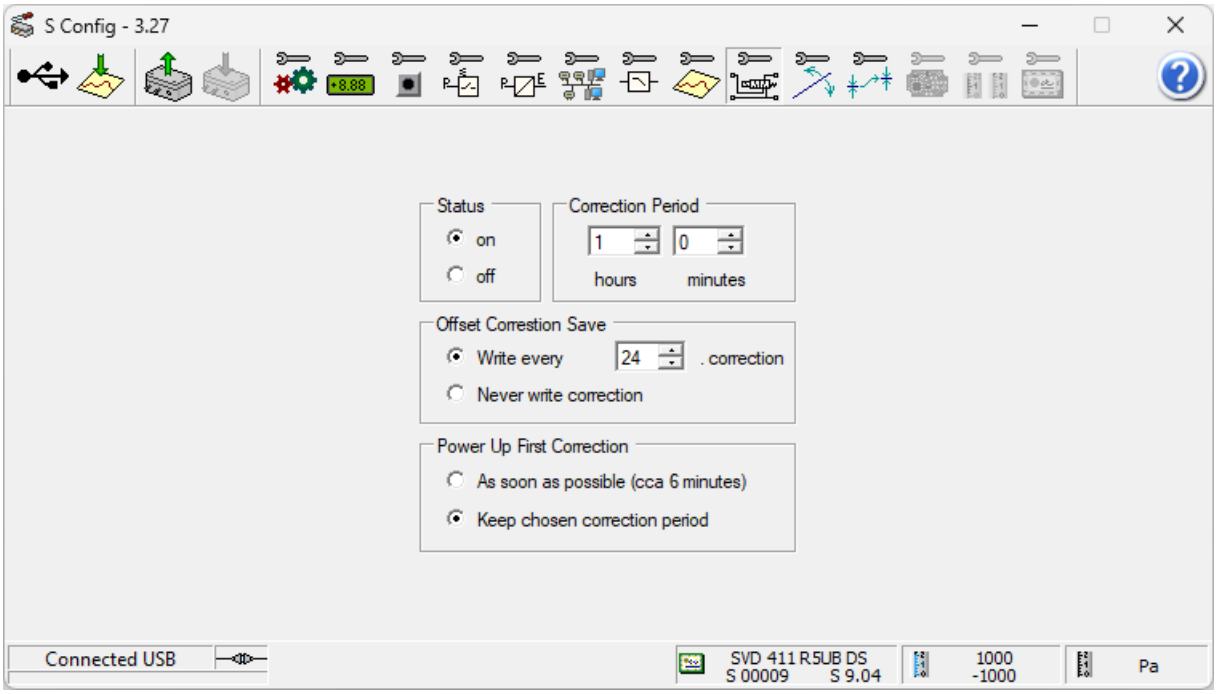
When using a two-wire connection, short current spikes of up to 200uA amplitude may appear in the output signal at levels below 5mA when writing to memory. If this causes a problem, use a three-wire connection.

The data stored in the flash memory can be read into the PC memory using the icon on the sub-toolbar and then saved to the computer disk in CSV format using icon. CSV data can then be processed e.g. by Excel. Using the program settings, see 5.2.2.1, it is possible to set the decimal separator – comma or dot – for the numbers to be passed. The time needed to read the entire memory is about 2 minutes. The data is stored as a series of numbers without time stamps. If the processor is reset or the power is turned off for an unknown period of time during data logging, one blank line appears in the data. Using icon will erase all data stored in the data memory.

5.2.2.12. Automatic zeroing

The SV series transmitters have built-in automatic pressure offset correction via a solenoid valve, achieving excellent long-term offset stability at very low-pressure ranges. With this three-way valve, the negative pressure input of the transmitter is disconnected at a set period and both inputs of the pressure transmitter are connected. After a short stabilization, the offset value is read, which is then used for correction for all further measurements. The entire zeroing phase takes about 300 milliseconds. To open the valve, it is necessary to accumulate energy in electrolytic capacitors. This process takes about 6 minutes, runs completely in the background and does not affect the measurement or other functions of the transmitter in any way. The correction value read during zeroing is stored in the RAM memory, so after power reset, it takes at least 6 minutes for a new correction to be measured. During this time

transmitter may measure with some error. To eliminate this error, correction values are stored in the Flash memory and immediately after the start the last known correction is used. Flesh memories have limited number of write cycles (hundreds of thousands) during their lifetime. Therefore, when setting a short zeroing period, it is recemented to save into Flash memory only every nth correction. Setting correction period less than 1 hour is usually unnecessary. Recommended settings values are: period 1h, write every 24th correction and first correction after power up as soon as possible.



Hidden functions can be used to make some additional functions available to experienced users, but they may affect the accuracy of measurements, etc. If necessary, contact the manufacturer.
The program is undergoing constant improvement and modifications, new versions will be available for download on the manufacturer website.

6. Communication protocols

There are 2 communication protocols available to the user: Adam and Modbus. The transmitter supports communication speeds in the range of 2400bd to 38400bd. When using 19200bd and 38400bd, it is recommended to turn off the analog output of the transmitter to ensure maximum response speed. A simple Cressto service protocol can also be used for communication.

The new transmitters are set to the Adam protocol by the manufacturer. The exception is transmitters with a USB connection, which are set to the Cressto protocol by the manufacturer.

After connecting the service adapter, transmitter automatically switches to the Cressto protocol for communication with the S Config service program. When the service adapter is disconnected, the transmitter switches back to the currently set protocol.

For the Adam and Modbus protocols, the *INIT mode can be called up by pressing the TL2 button if the configuration is unknown. This will invoke the default settings of the protocol, which is valid until the transmitter is reset or a new configuration is written.

6.1. Adam Protocol

The transmitter can communicate via the Adam protocol from Advantech. The basic serial link setup is 8 data bits, one stop bit and no parity bit. The user can set the following parameters:

- **Address** – in the range 0 to 255 (0 is reserved for broadcast)
- **Output format** – ±9.9999, ±99.999, ±999.99 or ±9999.9
- **Baud rate** – 2400, 4800, 9600, 19200 or 38400
- **CRC** – Enabled or Disabled

The default setting is address 0, 9600bd and CRC disabled.

Basic command syntax:

[delimiter][address][command][data][checksum][carriage return]

Each command begins with a delimiter. The following 4 characters are allowed: $, #, %, @. The delimiter is followed by two characters of the address of the target module in hexadecimal format. Other characters specify the command itself. Depending on the type of command, a string of data can follow. This is followed by an optional two-character checksum. Each command is terminated by a CR character (0DH).

ALL COMMANDS MUST BE WRITTEN IN CAPITAL LETTERS!

Command	Name	Description
#AA	Measured value reading	Returns the measured value in the set format
$AA1	Transmitter zeroing	Resets the current measured value
#**	Synchronized sampling	Commands all modules to measure and store the current input value in memory for later reading
%AANNTTCCFF	Configuration settings	Sets the address, format of the measured value, communication speed, checksum
$AA2	Read configuration	Returns current the transmitter configuration
$AA4	Read synchronized value	Returns a stored value
$AA5	Reset status	Outputs whether the transmitter has been restarted since the last query $AA5
$AAF	Read firmware version	Returns the firmware version
$AAM	Read transmitter name	Returns the transmitter type – a string of 24 characters
$AAR	Read transmitter range	Returns the transmitter calibrated range – a string of 28 characters

6.1.1. Description of commands

#AA – Measured value reading

The command returns the current input value in a preset format from the transmitter with an AA address.

Transmitter response:

>(data)(cr) – input value including sign.
No response – syntax error, communication error or unknown address.

$AA1 – Transmitter zeroing

Use this command to perform zeroing routine. The currently measured value is written to the Flash memory and is then subtracted from each measured value. It is imperative that zero conditions are ensured at the transmitter inputs before applying this command. For relative or differential pressure transmitter, this means disconnecting the pressure inputs. Absolute pressure transmitter cannot be zeroed.

Transmitter response:

!**AA(cr)** – the command is valid and is accepted by the transmitter.
?AA(cr) – the command was not accepted by the transmitter.
no response – syntax error, communication error, or unknown address.

#** - Synchronized sampling

This command commands all modules with analog inputs that are connected to the communication line to measure the input value and store it in special register. These values can then be read sequentially using the command $AA4, see below.
The transmitters do not respond to this command in any way.

%AANNTTCCFF - Configuration settings

Sets the address, measured value format, communication speed and checksum.

AA – the address of the transmitter you want to configure, the range is 00-FF.
NN – new address of the configured transmitter, range is 00-FF.
TT – is the format in which the measured value is displayed.

TT [hex]	Output format
01	±9.9999
02	±99.999
03	±999.99
04	±9999.9

CC – is the communication speed of the serial line

CC [hex]	Baud rate [BPS]
03	1200
04	2400
05	4800
06	9600
07	19200
08	38400

FF - allows the message checksum to be passed

FF [hex]	Checksum
00	Disabled
40	Enabled

Transmitter response:

!**AA(cr)** – the command is valid and is accepted by the transmitter.
?AA(cr) – the command contains invalid data.
No response – syntax error, communication error or unknown address.

Default values: AA = 00, TT = 04, CC = 06 (9600 bd), FF = 00

Changing the configuration settings can be done at any time, but it is necessary to know the current address and communication speed of the target transmitter. If these parameters are not known, pressing the TL2 button can put the communication program into INIT* mode, where default parameters are set. This mode is indicated by the red LED on the transmitter PCB. After writing a new configuration to the Flash memory, the transmitter automatically restarts and the INIT* mode is exited.

$AA2 – Read configuration

Use this command to read the current configuration of the transmitter.

Transmitter response:

!AATTCCFF(cr) – the command is valid and is accepted by the transmitter.
See command **%AANNTTCCFF** for configuration meaning.
?AA(cr) – the command was not accepted by the transmitter.
No response – syntax error, communication error or unknown address.

$AA4 – Read synchronized value

This command returns a value stored in a special register after the synchronized sampling command was execution.

Transmitter response:

!**AA(status)(data)(cr)** – the command is valid and is accepted by the transmitter. The status parameter indicates whether the value from last synchronized sampling was read at least once.
Status is 1 – the data is read first time,
Status is 0 – the data has already been read.
WARNING – status 0 can also mean that last synchronized sampling command was not executed!
?AA(cr) – the command was not accepted by the transmitter.
No response – syntax error, communication error or unknown address.

$AA5 – Reset status

This command can be used to determine whether the transmitter has been reset since the last time this command was performed.

Transmitter response:

!AA(Status)(cr) – the command is valid and is accepted by the transmitter.
Status is 1 – transmitter has been reset or connected to power since the last query.
Status is 0 – transmitter has not been reset since the last query.
?AA(cr) – the command was not accepted by the transmitter.
No response – syntax error, communication error or unknown address.

$AAF – Read firmware version

This command can be used to check the current firmware version of the transmitter.

Transmitter response:

!AA(Version)(cr) – the command is valid and is accepted by the transmitter. The Version parameter is a string that contains firmware version code in S 1.00 format.
No response – syntax error, communication error or unknown address.

$AAM – Read transmitter name

This command can be used to determine the type designation of the transmitter.

Transmitter response:

!AA(Name)(cr) – the command is valid and is accepted by the transmitter. The Name parameter is a fixed-length 24-character string that contains transmitter type designation according to the marking system listed in the corresponding datasheet. The string also contains currently set physical unit.
No response – syntax error, communication error or unknown address.

$AAR – Read transmitter range

This command can be used to determine the range of the transmitter within which it is calibrated.

Transmitter response:

!AA(Range)(cr) - the command is valid and is accepted by the transmitter. The Range parameter is a fixed-length 28-characters string that includes the lower and upper limits of the transmitter calibrated range. The string also contains the physical unit in which the transmitter was calibrated.
no response – syntax error, communication error or unknown address.

6.1.2. Checksum

Checksum helps eliminate errors during communication between the server and the transmitter. This parameter adds two characters to both the server command and the transmitter response. These characters are placed after the message itself before the CR terminator. This property is enabled in the configuration settings command, see above. It is essential that all elements of the system must work with the same communication speed and all must have the same set or disabled checksum generation. The checksum is represented by 2 characters in ASCII hexadecimal format. It is calculated as a simple sum of the ASCII values of all message characters before the checksum characters, including the leading separator. This sum is modified by the function module 256 (100H) – the remainder after integer division. If the checksum is missing or incorrect, the transmitter will not respond.

6.2. Modbus RTU protocol

The transmitter allows communication via the standard Modbus RTU protocol. The basic serial link settings are 8 data bits, one parity bit and one stop bit. The user can set the following parameters:

- **Address** – in the range of 1 to 255 (0 is reserved for broadcast)
- **Baud rate** – 2400, 4800, 9600, 19200 or 38400
- **Parity** – even, odd or none (If no parity is selected, 2nd stop bit is transmitted instead of the parity bit)

The default setting is address 1, 19200bd, and no parity. A detailed description of the protocol is available on www.modbus.org.

6.2.1. Supported functions

Code	Function name	Description
03	Read Holding Registers	Reading one or more 16-bit registers
04	Read Input Registers	Reading one or more 16-bit registers
05	Write Single Coil	Write a single bit
06	Write Single Register	Write a single 16-bit register

6.2.2. Registry addresses

Address	Content	Type	Status
COILS			
00001	Zeroing	Bit	W
00002	Valve zeroing (for SV series transmitter s)	Bit	W
INPUT REGISTERS			
30001	Measured value (pressure) – word 1	INT32 * 65536	R
30002	Measured value (pressure) – word 2		R
30003	Measured temperature (of the MCU)	INT16 * 256	R
30004	Firmware version – word 1	ASCII String (8 characters)	R
30005	Firmware version – word 2		R
30006	Firmware version – word 3		R
30007	Firmware version – word 4		R
30008	Transmitter type – word 1	ASCII String (16 characters)	R
30009	Transmitter type – word 2		R
30010	Transmitter type - word 3		R
30011	Transmitter type – word 4		R
30012	Transmitter type – word 5		R
30013	Transmitter type – word 6		R
30014	Transmitter type – word 7		R
30015	Transmitter type – word 8		R
HOLDING REGISTERS			
40001	Modbus configuration settings	UINT16	R/W
40002	Unit (pressure)	UINT16	R/W

6.2.2.1. Configurable registers

Register 40001 – Modbus configuration settings		
Byte 1	**Byte 2**	
	Top nibble	**Lower Nibble**
Transmitter address Ranging from 1 to 255 Address 0 is reserved for broadcast and cannot be set	**Baud rate** 4 - 2400 5 - 4800 6 - 9600 7 - 19200 8 - 38400	**Parity** 0 – None 1 – Even 2 – Odd

Register 40002 – Pressure Unit
1 – Fri 2 – KPa 3 – MPa 4 – mbar 5 – bar 6 – mm H2O 7 – cm H2O 8 – mm Hg 9 – inch H2O 10 – dogs 11 – Torr

6.2.3. Exceptions

Code	Exception Name	Description
01	Illegal Function	Unsupported function number
02	Illegal Data Address	Invalid registry address
03	Illegal Data Value	Invalid data or number of registers read
04	Slave Device Failure	The Transmitter could not complete the function successfully

6.2.4. Error checking

The transmitter checks received message CRC. The CRC calculation algorithm can be found in the Modbus specification. The parity bit is not checked.

6.2.5. Command syntax

The basic syntax of the command looks like this:

Address	Function	Registry address	Data	CRC
1 Byte	1 Byte	2 bytes	2 bytes	2 bytes

- **Address** – Set transmitter address.
- **Function** –The number of one of the supported functions
- **Register address** – Address of the first register minus 1 (address 30000 is sent for reading register 30001).
- **Data** – The meaning of the data is determined by the function number, for functions 3 and 4 it is the number of registers to be read, for functions 5 and 6 it is the data to be written.
- **CRC** – Checksum calculated from the previous 6 Bytes of query.

The Byte ordering in the registers and in communication (register address, data) is big endian. The exception is CRC, which is transmitted in the reverse order during communication – the first lower byte, then the higher byte.

Examples of transmitter r communication with explanations can be found below. In the examples, the pressure transmitter address 1 is always used.

6.2.5.1. Pressure reading

Command: 01 04 75 30 00 02 6B C8		**Answer:** 01 04 04 01 46 46 FF 69 8D	
Address:	01	Address:	01
Function:	04	Function:	04
Registry Address H:	75	Number of data bytes:	04
Registry address L:	30	Data byte 1:	01
Number of registers H:	00	Data byte 2:	46
Number of registers L:	02	Data byte 3:	46
CRC L:	6B	Data byte 4:	55
CRC H:	C8	CRC L:	69
		CRC H:	8D

The measured pressure is stored in the memory as a 32-bit integer with a fixed-point between bytes 2 and 3. First, we convert the hexadecimal value to decimal and then we shift the order of comma:

$0x01464655 = 21382741$
$21382741 / 65536 \cong \mathbf{326,27}$

The read pressure value **of 326.27** is in the set transmitter unit.

6.2.5.2. Reading MCU temperature

Command: 01 04 75 32 00 01 8A 09		**Answer:** 01 04 02 18 0F F3 34	
Address:	01	Address:	01
Function:	04	Function:	04
Registry Address H:	75	Number of data bytes:	02
Registry address L:	32	Data byte 1:	18
Number of registers H:	00	Data byte 2:	0F
Number of registers L:	01	CRC L:	F3
CRC L:	8A	CRC H:	34
CRC H:	09		

The MCU temperature is stored in the memory as a 16-bit integer with a fixed-point between bytes 1 and 2. First, we convert the hexadecimal value to decimal and then we shift the order of comma:

$0x180F = 6159$
$6159 / 256 \cong \mathbf{24,06}$

The read value of the MCU temperature is **24.06 °C**.

6.2.5.3. Reading the firmware version

Command: 01 04 75 33 00 04 1B CA		**Answer:** 01 04 08 53 20 39 2E 30 34 20 20 FB 5F	
Address:	01	Address:	01
Function:	04	Function:	04
Registry Address H:	75	Number of data bytes:	08
Registry address L:	33	Data byte 1:	53
Number of registers H:	00	Data byte 2:	20
Number of registers L:	04	Data byte 3:	39
CRC L:	1B	Data byte 4:	2E
CRC H:	CA	Data byte 5:	30
		Data byte 6:	34
		Data byte 7:	20
		Data byte 8:	20
		CRC L:	FB
		CRC H:	5F

The firmware version is stored in memory as an 8-byte ASCII string. Received data bytes can be transferred directly:

$0x5320392E30342020 = S\ 9.04$

The read firmware version is **S 9.04**.

6.2.5.4. Transmitter type reading

Command: 01 04 75 37 00 08 5A 0E		**Answer:** 01 04 10 53 56 44 20 34 31 31 20 52 35 55 42 20 44 20 20 80 52	
Address:	01	Address:	01
Function:	04	Function:	04
Registry Address H:	75	Number of data bytes:	10
Registry address L:	37	Data byte 1:	53
Number of registers H:	00	Data byte 2:	56
Number of registers L:	08	Data byte 3:	44
CRC L:	5A	Data byte 4:	20
CRC H:	0E	Data byte 5:	34
		Data byte 6:	31
		Data byte 7:	31
		Data byte 8:	20
		Data byte 9:	52
		Data byte 10:	35
		Data byte 11:	55
		Data byte 12:	42
		Data byte 13:	20
		Data byte 14:	44
		Data byte 15:	20
		Data byte 16:	20
		CRC L:	80
		CRC H:	52

The transmitter type is stored in memory as a 16-byte ASCII string. Received data bytes can be converted directly:

$0x53564420343131205235554220442020 = SVD\ 411\ R5UB\ D$

The read firmware version is **SVD 411 R5UB D**.

6.2.5.5. Pressure unit reading

Command: 01 03 9C 41 00 01 FA 4E		**Answer:** 01 03 02 00 01 79 84	
Address:	01	Address:	01
Function:	03	Function:	03
Registry Address H:	9C	Number of data bytes:	02
Registry address L:	41	Data byte 1:	00
Number of registers H:	00	Data byte 2:	01
Number of registers L:	01	CRC L:	79
CRC L:	FA	CRC H:	84
CRC H:	4E		

The pressure unit is stored in memory as a 16-bit unsigned integer. The exact meaning is described in the chapter Configurable registers. For this example:

$0x0001 = 1$

The transmitter has a set unit of pressure **Pa**.

6.2.5.6. Changing the Pressure Unit

Command: 01 06 9C 41 00 0A 77 89		**Answer:** 01 06 9C 41 00 0A 77 89	
Address:	01	Address:	01
Function:	06	Function:	06
Registry Address H:	9C	Registry Address H:	9C
Registry address L:	41	Registry address L:	41
Number of registers H:	00	Number of registers H:	00
Number of registers L:	0A	Number of registers L:	0A
CRC L:	77	CRC L:	77
CRC H:	89	CRC H:	89

The value 000A is written to the memory.

$0x000A = 10$

The set transmitter pressure unit is now **psi.**

6.2.5.7. Reading Modbus configuration

Command: 01 03 9C 40 00 01 AB 8E		**Answer:** 01 03 02 01 70 B8 30	
Address:	01	Address:	01
Function:	03	Function:	03
Registry Address H:	9C	Number of data bytes:	02
Registry address L:	40	Data byte 1:	01
Number of registers H:	00	Data byte 2:	70
Number of registers L:	01	CRC L:	B8
CRC L:	AB	CRC H:	30
CRC H:	8E		

From the received data, we can find out the configuration as follows:

- **01**70 → Transmitter address: **1**
- 01**7**0 → Communication Speed: **19200bd**
- 017**0** → Set parity: **None**

6.2.5.8. Modbus configuration change

Inquiry: 01 06 9C 40 A2 61 1E C6		**Answer:** 01 06 9C 40 A2 61 1E C6	
Address:	01	Address:	01
Function:	06	Function:	06
Registry Address H:	9C	Registry Address H:	9C
Registry address L:	40	Registry address L:	40
Number of registers H:	A2	Number of registers H:	A2
Number of registers L:	61	Number of registers L:	61
CRC L:	1E	CRC L:	1E
CRC H:	C6	CRC H:	C6

After receiving the command, the transmitter first sends a response according to the old configuration, and then sets the new configuration:

- **A2**61 → Transmitter address: **162**
- A2**6**1 → Communication Speed: **9600bd**
- A261 → Parity Set: **Even**

6.2.5.9. Zeroing

Command: 01 05 00 00 FF 00 8C 3A		**Answer:** 01 05 00 00 FF 00 8C 3A	
Address:	01	Address:	01
Function:	05	Function:	05
Registry Address H:	00	Registry Address H:	00
Registry address L:	00	Registry address L:	00
Number of registers H:	FF	Number of registers H:	FF
Number of registers L:	00	Number of registers L:	00
CRC L:	8C	CRC L:	8C
CRC H:	3A	CRC H:	3A

For function 05, the data can only have two significant values:

- 0xFF00 – Logical 1 (True)
- 0x0000 – Logical 0 (False)

The transmitter will perform zeroing only when a logical 1 (True) value is received. If for some reason it is not possible to zero (e. g., a barometric transmitter), the transmitter will respond with exception 04.

6.2.5.10. Zeroing with valve

Command: 01 05 00 01 FF 00 DD FA		**Answer:** 01 05 00 01 FF 00 DD FA	
Address:	01	Address:	01
Function:	05	Function:	05
Registry Address H:	00	Registry Address H:	00
Registry address L:	01	Registry address L:	01
Number of registers H:	FF	Number of registers H:	FF
Number of registers L:	00	Number of registers L:	00
CRC L:	DD	CRC L:	DD
CRC H:	FA	CRC H:	FA

This command is only relevant for SV series transmitters that have a zeroing valve. The transmitter will perform zeroing when a logical 1 (True) value is received.

6.3. Cressto Protocol

The transmitters can also communicate via the simple ASCII service protocol Cressto. The protocol can be selected by the Cressto icon in the serial communication settings panel, see chapter Serial digital outputs. For this communication, it is necessary to set the communication speed to 9600 baud, 8 data bits, no parity bit, and 1 stop bit. Communication takes place on a query-response basis.

PRESSURE – query for the main measured quantity, which is the pressure for standard transmitters. For simple displays, it may be a different physical quantity.

Command: **>**M** (3EH 2AH 2AH 4DH)
Reply:

with	with	m	m	m	m	m	m	#
Sign		Number in hexadecimal format with fixed decimal point mmmm,mm						Terminating character (23H)

Sign: 00 (30H 30H) – positive number
01 (30H 31H) – negative number

Example response for a transmitter calibrated in kPa:
0100A45F# = - (0*163 + 0*162 + 10*161 + 4*160 + 5*16^{-1} + 15*16^{-2}) = -164.37 [kPa]

TEMPERATURE – temperature query. This is the approximate temperature of the microcomputer chip inside the transmitter. The measurement accuracy is about ±1°C, and during operation, the chip heats up by its own power consumption, which can cause an additional error of about 1 to 3 °C.

Command: **>**C** (3EH 2AH 2AH 43H)
Reply:

m	m	m	m	#
Raw value from the converter hexadecimal				Terminating character (23H)

Conversion of value from transmitter to temperature

temperature [°C] = (value from converter / 256) – 128

Example Response:
9E20# = (40480)10; (40480/256) – 128 = 30.1°C

ZEROING – performs transmitter zero offset correction routine. The user must ensure zero pressure conditions at the transmitter inputs. By executing this command, the current value is measured, stored in Flash memory, and then subtracted from all measured values. This command is identical to pressing the *zero offset correction* button in the transmitter.

Command: **>**Z** (3EH 2AH 2AH 5AH)
Reply: **!#** (21H 23H)

This command is blocked for absolute pressure transmitters and displays.

OFFSET CORRECTION – the command is similar to the previous one. The user must ensure zero pressure conditions at the transmitter inputs. By executing this command, the current value is measured, stored in Flash memory, and then subtracted from all measured values and at the same time the Correction value is added. The Correction value can be set using the S Config program, by default it is set to 0. The command is used for defined zero offset shift of the transmitter.

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Command: **>**N** (3EH 2AH 2AH 4EH)
Reply: **!#** (21H 23H)

ZEROING WITH VALVE – the command only valid for the SV series of transmitters that are physically equipped with the valve. Zeroing can only be done after charging the internal capacitors, which can take up to about 6 minutes. When using this command, consider that by default, periodic zeroing is turned on by an internal program for these transmitters.

Command: **>**O** (3EH 2AH 2AH 4FH)
Reply: **!#** (21H 23H) in case of zeroing
Reply: **-#** (2DH 23H) in case of rejected zeroing due to insufficient voltage on the capacitors or in the invalid transmitter series (not SV series).

FIRMWARE VERSION – query for the current firmware version

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Command: **>**I** (3EH 2AH 2AH 49H)
Example Response: **S 6.09#**

The transmitter*s themselves, their firmware and the S Config utility software are continuously improving and adding parameters and functions, so some features and procedures may differ slightly from those described here. If you are unsure, always find out the current firmware version of* transmitter *or version of S Config program in advance and then contact the manufacturer for help.*

7. Recommendations for the correct application

- Before connecting the transmitter to the pressure circuit, it must be checked that the measured pressure corresponds to the nominal range of the transmitter. Even short-term overload above the maximum permissible overpressure can cause destruction of the measuring membrane!
- Before connecting to the pressure circuit, it is necessary to check the resistance of the transmitter materials that come into contact with the measured medium.
- Extra care must be taken when sealing into threads (Teflon, tow) for liquid media, because screwing into a closed volume of liquid can cause an uncontrolled increase in pressure and thus destroy the measuring membrane!
- Unless otherwise stated, the S series transmitters are always equipped with a digital serial output, typically RS485, which does not need to be used and does not need to be treated in any hardware or software way. The output type is indicated on the product label.
- Unless otherwise stated, the S-series transmitters are always equipped with a universal analog electrical output. The specific type of output and its range are set by software. If the user does not use any analog output and uses other functions of the transmitter, the analog output must not be set to the 4÷20 mA two-wire mode, otherwise the correct operation of the other circuits is not guaranteed.
- The product label of the transmitter shows the calibrated range of the transmitter, within which the user can set his own measuring range. The product label also shows the measuring range and the type of analog output that has been set at the factory. It is up to the user to record their current values in the accompanying documentation or similarly, e.g. by writing in the free space on the label using Centro fix. The current settings can be checked at any time using the CresProg configuration adapter and the S Config software.
- A maximum conductor cross-section of 1mm2 is allowed for the used terminal blocks. Especially with a larger number of connected outlets, we recommend using wires with a smaller cross-section due to limited space.

Other recommendations are added gradually