Operating manual

Pressure transmitters
Pressure ON/OFF relay switches
HD402… series

www.deltaohm.com

Keep for future reference.

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1 INTRODUCTION

The **HD402...** series is composed of pressure transmitters and pressure ON/OFF relay switches. The instruments measure relative pressure with respect to atmosphere or differential pressure in the range from 50 Pa to 200 kPa (depending on model) by using a silicon piezoresistive sensor with high accuracy and temperature compensation, which allows excellent linearity, repeatability and stability over the time.

Thanks to the particular sensor used, the instruments are insensitive to the mounting orientation and position. Moreover, the high stability of the sensor over the time and in comparison to the changes in temperature allows eliminating the operations of maintenance typically required to compensate for the aging and the deviation of the sensor zero. The auto-zeroing feature in the HD402TR1L low range model allows stable measurements over the time without the need to recalibrate.

Available outputs, depending on the model:

- RS485 Modbus–RTU digital output (HD402ST...);
- 0...10 V voltage analog output (HD402T...);
- 0...20 mA / 4...20 mA active current analog output (HD402T...);
- 2-wire (current loop) 4...20 mA analog output (HD402AT...);
- ON/OFF relay switch (HD402TR...L).

Different units of measurement can be chosen for each model and, in the models with analog output, it is possible to choose the full scale (f.s.) value for the output (high, intermediate or low range) and set the unipolar (0...+f.s.) or bipolar (-f.s....+f.s.) measuring range.

Versions with optional 4-digit LCD display (option **L**) are available, which allow the measured parameters to be displayed. The pressure relay switches always include the display.

The configuration can be made by connecting the serial port of the instrument to the PC or by means of the quick configuration dip switches on the circuit board. The versions with relay switch output are equipped with two internal buttons for the configuration via display.

The instruments are factory calibrated and ready for use.

Models

HD402

”” = without LCD (except HD402TR...)
L = with LCD

1 = range ± 250 Pa / 25 mmH$_2$O / 1 inchH$_2$O / 2,5 mbar
2 = range ± 1000 Pa / 100 mmH$_2$O / 4 inchH$_2$O / 10 mbar
3 = range ± 10 kPa / 50 mmHg / 1,5 PSI / 100 mbar
4 = range ± 100 kPa / 500 mmHg / 15 PSI / 1000 mbar
5 = range ± 200 kPa / 1000 mmHg / 30 PSI / 2000 mbar

T = 0...10 V and 0/4...20 mA active analog output
AT = 2-wire 4...20 mA analog output
ST = RS485 Modbus-RTU digital output
TR = ON/OFF relay switch output

2   TECHNICAL CHARACTERISTICS

Sensor	Piezoresistive, High stability
Measuring range	See table 2.1
Resolution	See table 2.2
Accuracy (*)	• HD402**TR1**...: ±(0.8% measure + 0.5 Pa) @ 0...50 °C • HD402...**T1**...: ±1.5% FSS @ 25 °C / ± 3% FSS @ 0...50 °C • HD402...**2**...: ±0.75% FSS @ 25 °C / ± 1% FSS @ 0...50 °C • HD402...**3**... / HD402...**4**... / HD402...**5**...: ±1% FSS @ 0...50 °C
Long term stability (1000 h) @ 25 °C	• HD402**TR1**...: ±0,2 Pa with auto-zero • HD402...**T1**... / HD402...**2**...: ±0.5% FSS • HD402...**3**...: ±0.35% FSS • HD402...**4**.../ HD402...**5**...: ±0.25% FSS
Output	• HD402T...: Active analog 0...10 Vdc (R_{Lmin} = 10 kΩ) or 0/4...20 mA (R_{Lmax} = 500 Ω) • HD402AT...: 2-wire (current loop) 4...20 mA (R_{Lmax} = (Vcc-12)/0,022) • HD402ST...: Digital RS485 Modbus-RTU • HD402TR...: SPDT Relay switch, 3 A/250 Vac, 3 A/30 Vdc resistive load
Alarm (only HD402TR)	Front LED, internal buzzer, relay switch
Response time	0.5 seconds for the display updating For transmitters: configurable 0.125, 1, 2 or 4 seconds for the output
Overpressure limit	• HD402...**1**... / HD402...**2**... / HD402...**3**...: 50 kPa • HD402...**4**...: 200 kPa • HD402...**5**...: 400 kPa

Connection to PC	• HD402T... / HD402AT... / HD402TR...:
	  RS232 serial port
	  Can be connect to a USB port by using the optional CP27 adapter
	• HD402ST...:
	  Can be connect to a USB port by using the optional RS48 adapter

Zero calibration	Automatic for HD402TR1L, manual for the other models
Compatible media	Only air and non-aggressive dry gases
Power supply	• HD402T...: 24 Vac ± 10% o 18...40 Vdc • HD402AT... and HD402ST...: 12...30 Vdc • HD402TR...: 24 Vac ± 10% o 15...36 Vdc
Absorption	• HD402T..., HD402AT... and HD402TR...: < 1 W @ 24 Vdc • HD402ST...: < 100 mW @ 12 Vdc
Pressure connection	Nickel-plated brass, Ø 6 mm
Electrical connections	Screw terminal block, max 1.5 mm^2 , PG9 cable gland
Operating conditions	-10...+60 °C / 0...95% RH
Storage temperature	-20...+70 °C
Housing dimensions	80 x 84 x 44 mm
Protection degree	IP65

(*) FSS = nominal range (= 2 x f.s. high range).

TAB. 2.1: full scale (f.s.) values and units of measurement

Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402...1...	50/100/250	---	0.5/1/2.5	5/10/25	0.2/0.4/1	---	---
HD402...2...	250/500/1000	---	2.5/5/10	25/50/100	1/2/4	---	---
HD402...3...	---	2.5/5/10	25/50/100	---	---	10/25/50	0.4/0.75/1.5
HD402...4...	---	25/50/100	250/500/1000	---	---	100/250/500	4/7.5/15
HD402...5...	---	50/100/200	500/1000/2000	---	---	250/500/1000	10/15/30

The instrument range is ±f.s.; the low and intermediate ranges are only for the models with analog output, the models with RS485 and relay output always have the high range. The range 0...+f.s. for the output can be set in the models with analog output (the range on display is always –f.s....+f.s. high range).

TAB. 2.2: resolution

Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402...1...	0.1	---	0.001	0.01	0.001	---	---
HD402...2...	1	---	0.01	0.1	0.01	---	---
HD402...3...	---	0.01	0.1	---	---	0.01	0.001
HD402...4...	---	0.1	1	---	---	0.1	0.01
HD402...5...	---	0.1	1	---	---	1	0.01

DIMENSIONS
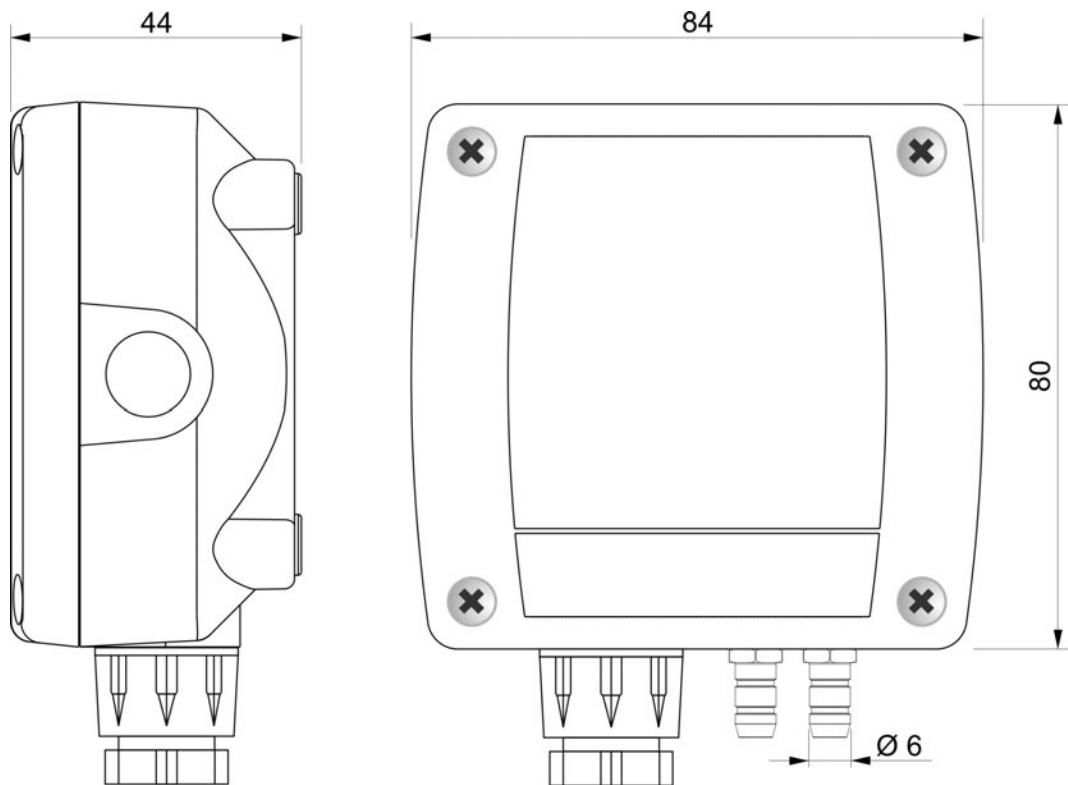
3 INSTALLATION

By opening the lid, 3 mm diameter holes are available so to allow securing the base of the instrument directly to a panel or to the wall.
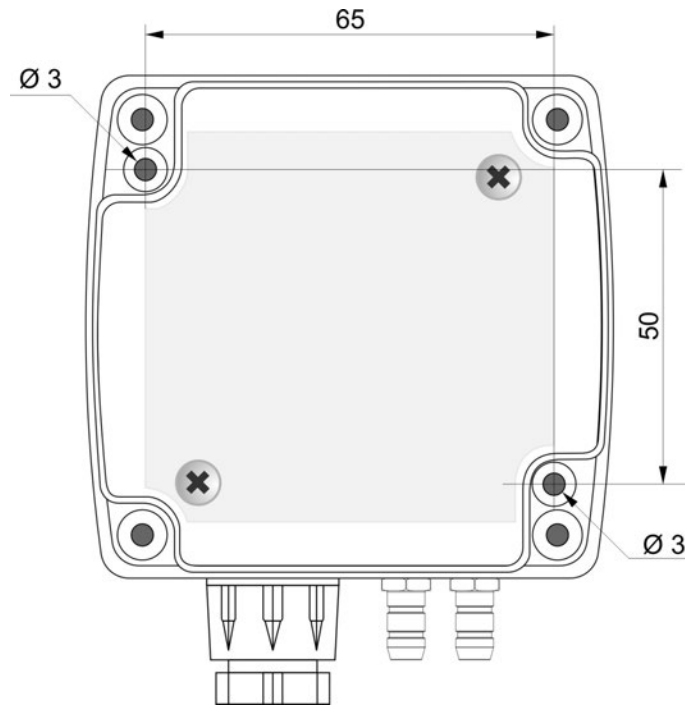
Internally there are:

- the terminal header for connecting the power supply and the output;
- the RS232 serial connector (COM AUX, except HD402ST...);
- the dip switches for quick configuration.
- The CAL ZERO button (except HD402TR...) or the B1 and B2 buttons for the configuration via display (only HD402TR...).
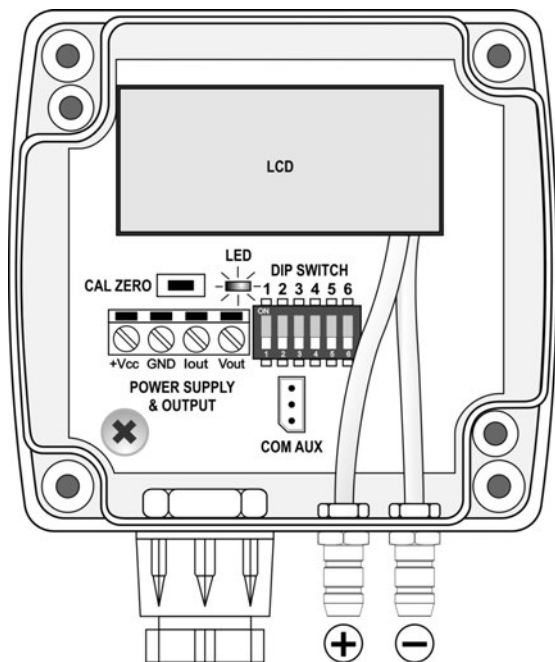
Models with active analog output (HD402T...)
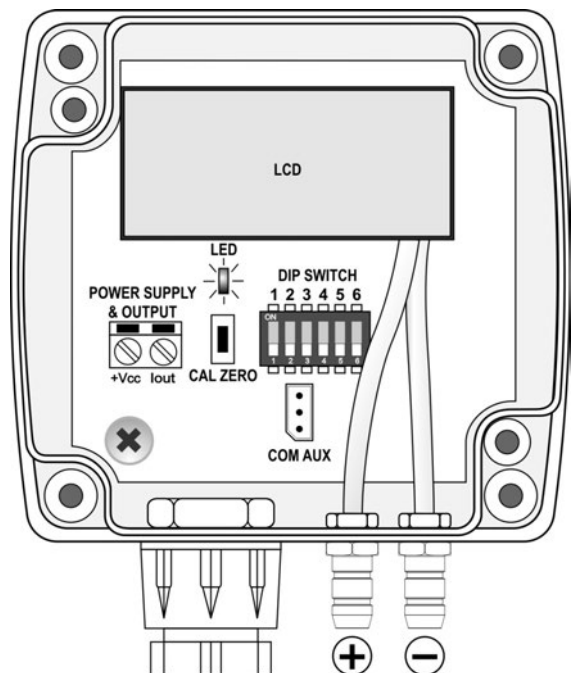
Models with 2-wire current output (HD402AT...)
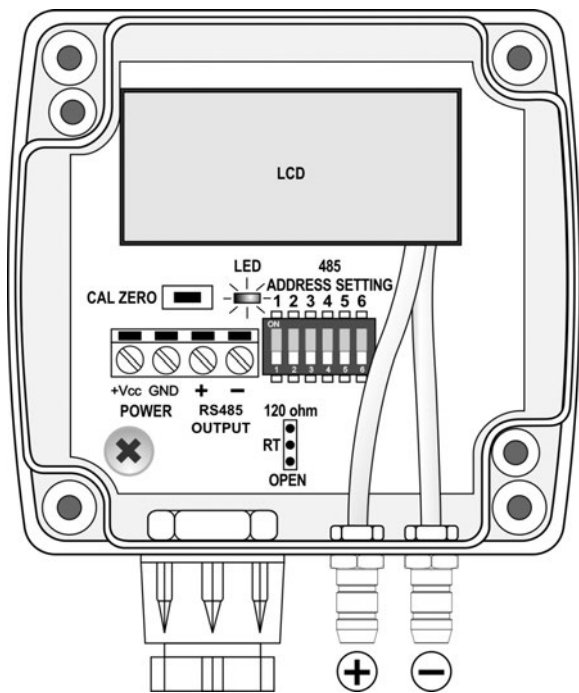
**Models with digital RS485 output
(HD402ST...)**
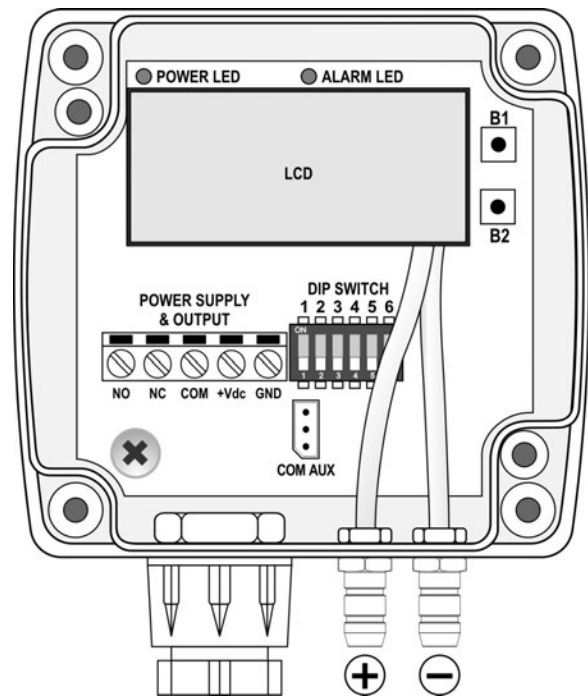
**Models with relay switch output
(HD402TR...)**

The instruments can be mounted in any position, but typically they are fixed on a vertical wall with the pressure inputs facing down.

The deviation of the zero due to the mounting position can be corrected by using the CAL ZERO button (except HD402TR...) or the B1 and B2 buttons (only HD402TR...). In the model HD402TR1L, an auto-zero circuit periodically automatically equalizes the differential pressure at the input of the sensor and corrects the offset due to the mounting position or sensor aging.

To manually calibrate the zero, disconnect both the tubes from the + and − pressure inputs, then proceed as follows:

Zero manual calibration in the models with CAL ZERO button:

- press CAL ZERO until the red LED starts flashing;

- when the red LED turns off, the zeroing procedure is completed: reconnect the tubes to the pressure inputs.

Zero manual calibration in the models HD402TR...:

- Press B1 and B2 buttons at the same time until the ALARM red LED lights up (if it was not already on because of an alarm condition) and the instrument displays the model information and the UP and DOWN arrows on the left of the LCD.

- When the instrument returns to the measurement mode displaying zero reading, reconnect the tubes to the pressure inputs.

If necessary, the manual auto-zero procedure can be performed also in HD402TR1L (in this case it is not necessary to disconnect the tubes from the pressure inputs).

Except for HD402TR1L (in which the auto-zero procedure is periodic and automatic), it is recommended to follow the auto zero procedure at least once a year under normal operating conditions.

3.1 ELECTRICAL CONNECTIONS
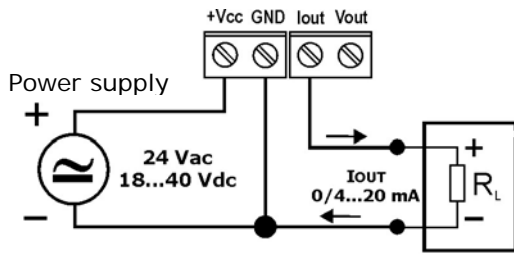
Active current analog output
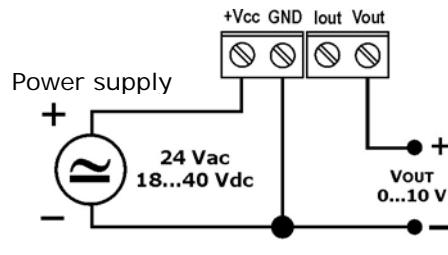
Voltage analog output
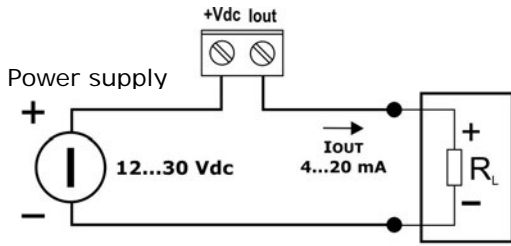
2-wire current analog output
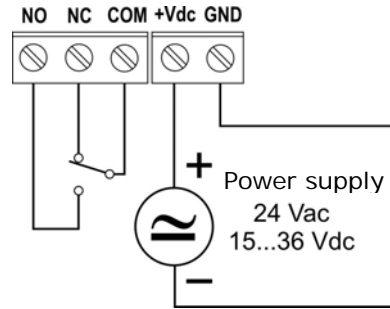
Relay output

In the models with relay output, at power on, the alarm LED blinks quickly while the instrument information is displayed.
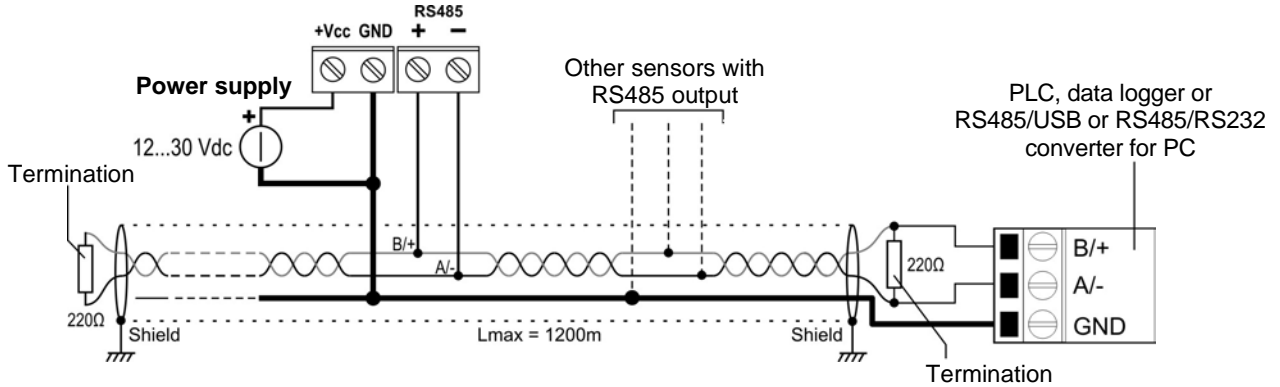
RS485 connection

In the RS485 connection, the instruments are connected in a sequence through a shielded cable with twisted pair for signals and a third wire for the common. Line termination must be set at the two network ends.

The maximum number of devices that can be connected to the RS485 line (Bus) depends on the load characteristics of the devices to be connected. The RS485 standard requires that the total load does not exceed 32 unit loads. The load of an HD402ST… transmitter is equal to ¼ of unit load. If the total load is greater than 32 unit loads, divide the network into segments and add a signal repeater between a segment and the successive one. Line termination should be applied at both ends of each segment.

The instrument has a built-in line termination that can be connected or removed through a short jumper placed next to the terminal block. If the instrument is the last or the first device of a network group, connect the termination placing the short jumper between the "RT" and "120 ohm" indications. If the instrument is not at the

end of a network group, remove the termination placing the short jumper between the "RT" and "OPEN" indications.

The cable shield must be connected to both line ends. The cable should have the following features:

- Characteristic impedance: 120 ohm
- Capacity: less than 50pF/m
- Resistance: less than 100 ohm/km
- Gauge: 0,22 mm^2 (AWG24) at least

The cable maximum length depends on baud rate and cable characteristics. Typically, the maximum length is 1200 m. The data line must be kept separated from any power lines in order to prevent interferences on the transmitted signal.

3.2 EXAMPLE OF CONNECTION WITH THE INDICATOR CONTROLLER HD9022

0...20 or 4...20 mA active current output

0...10 Vdc Voltage output
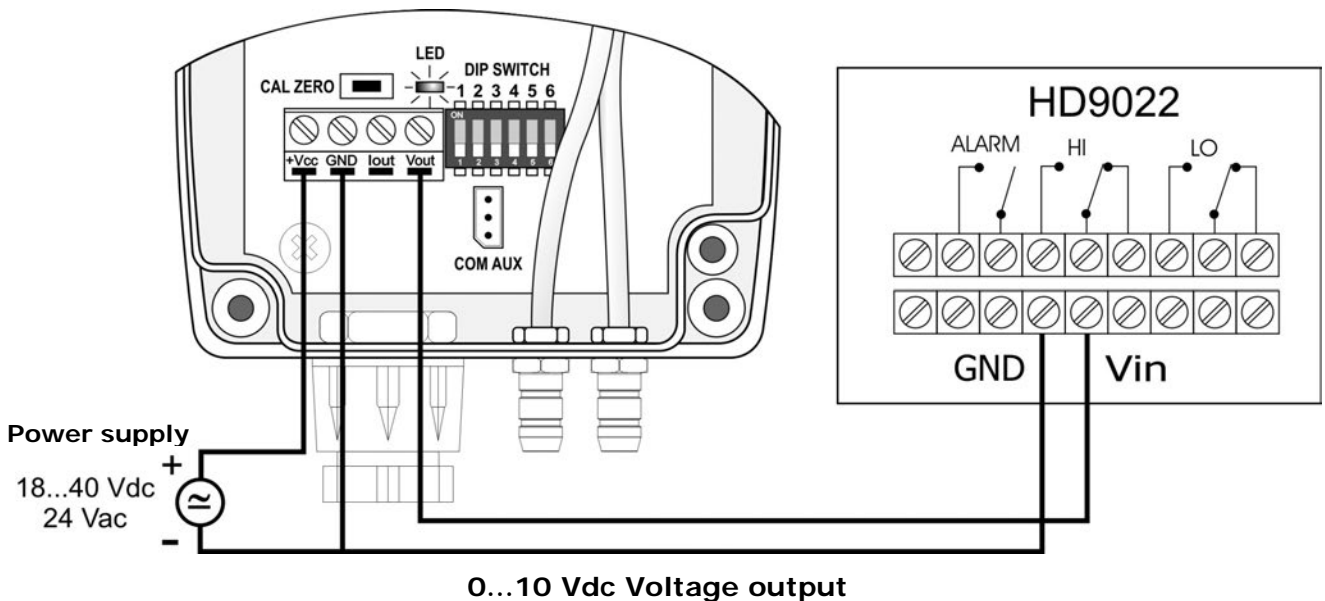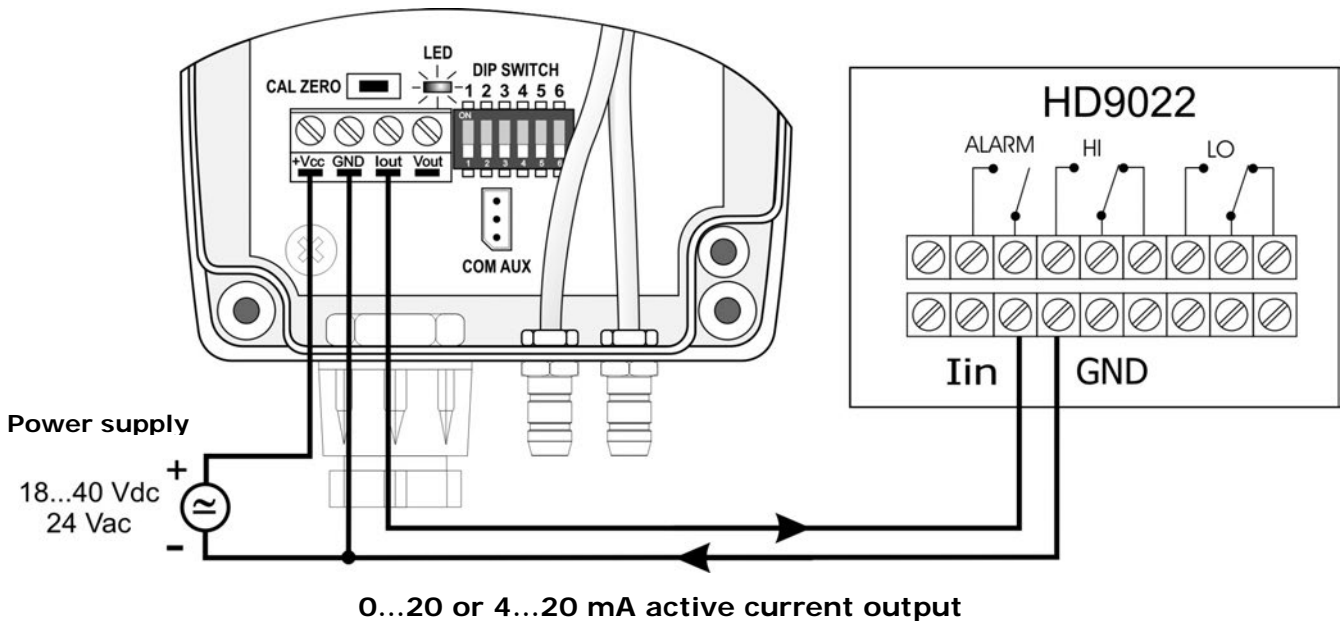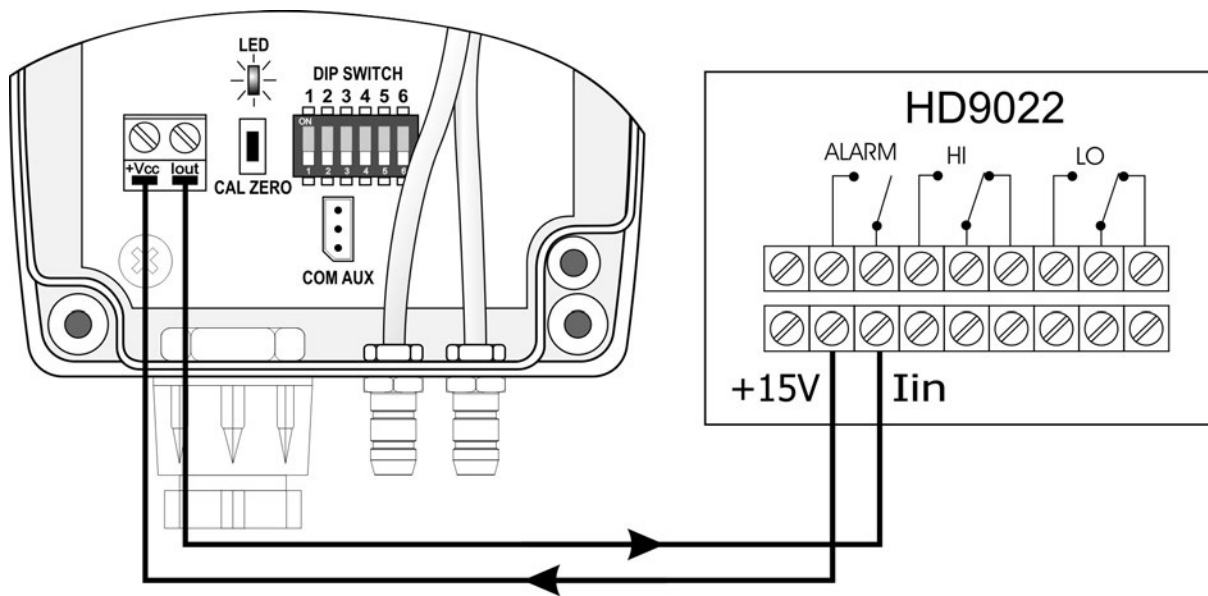
2-wire (current loop) 4...20 mA output

4 CONFIGURATION

4.1 CONFIGURATION OF THE MODELS WITH ANALOG OUTPUT (HD402[A]T...)

Setting the configuration mode: the transmitter can be configured by using the dip switches on the circuit board or via the serial communication port COM AUX. The choice of the configuration mode is done with the dip switch dip switch 1:
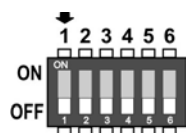
- Dip switch 1 = ON ⇒ the configuration set through the dip switches 2…6 is used
- Dip switch 1 = OFF ⇒ the configuration set via serial port is used

Configuration via dip switches:

The configuration of the dip switches is used by the transmitter only if the dip switch 1 is ON. A dip switch is ON if placed up, towards the DIP SW sign.

Dip switches 2, 3: selection of the low/intermediate/high range for the analog output.

Dip switches 4, 5: selection of the unit of measurement.

Dip switch 6: setting of the unipolar (0…+f.s.) or bipolar (-f.s…+ f.s.) measuring range for the analog output.

The following tables report, for each model, the measuring range corresponding to the analog outputs according to dip switches position.

TAB. 4.1: measuring ranges for the analog output in the models HD402[A]T1

Dip switch number										
6	2	3	4	5	4	5	4	5	4	5
			OFF	OFF	ON	OFF	OFF	ON	ON	ON
			Pa		mmH$_2$O		inchH$_2$O		mbar	
OFF	OFF	ON	0…50		0…5		0…0.2		0…0.5	
	ON	OFF	0…100		0…10		0…0.4		0…1	
	OFF	OFF	0…250		0…25		0…1		0…2.5	
	ON	ON								
ON	OFF	ON	-50…+50		-5…+5		-0.2…+0.2		-0.5…+0.5	
	ON	OFF	-100…+100		-10…+10		-0.4…+0.4		-1…+1	
	OFF	OFF	-250…+250		-25…+25		-1…+1		-2.5…+2.5	
	ON	ON								

TAB. 4.2: measuring ranges for the analog output in the models HD402[A]T2

Dip switch number										
6	2	3	4	5	4	5	4	5	4	5
			OFF	OFF	ON	OFF	OFF	ON	ON	ON
			Pa		mmH$_2$O		inchH$_2$O		mbar	
OFF	OFF	ON	0…250		0…25		0…1		0…2.5	
	ON	OFF	0…500		0…50		0…2		0…5	
	OFF	OFF	0…1000		0…100		0…4		0…10	
	ON	ON								
ON	OFF	ON	-250…+250		-25…+25		-1…+1		-2.5…+2.5	
	ON	OFF	-500…+500		-50…+50		-2…+2		-5…+5	
	OFF	OFF	-1000…+1000		-100…+100		-4…+4		-10…+10	
	ON	ON								

TAB. 4.3: measuring ranges for the analog output in the models HD402[A]T3

Dip switch number										
6	2	3	4	5	4	5	4	5	4	5
			OFF	OFF	ON	OFF	OFF	ON	ON	ON
			kPa		mmHg		PSI		mbar	
OFF	OFF	ON	0...2.5		0...10		0...0.4		0...25	
	ON	OFF	0...5		0...25		0...0.75		0...50	
	OFF	OFF	0...10		0...50		0...1.5		0...100	
	ON	ON								
ON	OFF	ON	-2.5...+2.5		-10...+10		-0.4...+0.4		-25...+25	
	ON	OFF	-5...+5		-25...+25		-0.75...+0.75		-50...+50	
	OFF	OFF	-10...+10		-50...+50		-1.5...+1.5		-100...+100	
	ON	ON								

TAB. 4.4: measuring ranges for the analog output in the models HD402[A]T4

Dip switch number										
6	2	3	4	5	4	5	4	5	4	5
			OFF	OFF	ON	OFF	OFF	ON	ON	ON
			kPa		mmHg		PSI		mbar	
OFF	OFF	ON	0...25		0...100		0...4		0...250	
	ON	OFF	0...50		0...250		0...7.5		0...500	
	OFF	OFF	0...100		0...500		0...15		0...1000	
	ON	ON								
ON	OFF	ON	-25...+25		-100...+100		-4...+4		-250...+250	
	ON	OFF	-50...+50		-250...+250		-7.5...+7.5		-500...+500	
	OFF	OFF	-100...+100		-500...+500		-15...+15		-1000...+1000	
	ON	ON								

TAB. 4.5: measuring ranges for the analog output in the models HD402[A]T5

Dip switch number										
6	2	3	4	5	4	5	4	5	4	5
			OFF	OFF	ON	OFF	OFF	ON	ON	ON
			kPa		mmHg		PSI		mbar	
OFF	OFF	ON	0...50		0...250		0...10		0...500	
	ON	OFF	0...100		0...500		0...15		0...1000	
	OFF	OFF	0...200		0...1000		0...30		0...2000	
	ON	ON								
ON	OFF	ON	-50...+50		-250...+250		-10...+10		-500...+500	
	ON	OFF	-100...+100		-500...+500		-15...+15		-1000...+1000	
	OFF	OFF	-200...+200		-1000...+1000		-30...+30		-2000...+2000	
	ON	ON								

Configuration via the serial port COM AUX:

The configuration set with the serial communication is used by the transmitter only if the dip switch 1 is OFF.

In order to modify the settings, please proceed as follows:

- Connect the serial COM AUX output of the transmitter to the RS232 port (via the

RS27 cable) or USB (via the cable CP27) of the PC. If you use the CP27 cable, install the USB drivers on your PC.

- On the PC, run a serial communication software, set the baud rate to 115200 and the communication parameters to 8N2.
- Send the commands given in table 4.6 to set the measurement range corresponding to the analog outputs.

TAB. 4.6: configuration serial commands (models with analog output)

Command	Response	Description
Kn	&	Set the unit of measurement of index n HD402T1 & HD402T2 HD402T3 & HD402T4 & HD402T5 $n=0 \Rightarrow$ Pa $n=0 \Rightarrow$ kPa $n=1 \Rightarrow$ mmH$_2$O $n=1 \Rightarrow$ mmHg $n=2 \Rightarrow$ inchH$_2$O $n=2 \Rightarrow$ PSI $n=3 \Rightarrow$ mbar $n=3 \Rightarrow$ mbar
Rn	&	Set the measuring range of index n $n=0 \Rightarrow$ high range (e.g. 250 Pa /... in HD402T1) $n=1 \Rightarrow$ intermediate range (e.g. 100 Pa /... in HD402T1) $n=2 \Rightarrow$ low range (e.g. 50 Pa /... in HD402T1)
PU	&	Set the unipolar measuring range (0...+f.s.)
PB	&	Set the bipolar measuring range (-f.s....+f.s.)
Sn	&	Set the response time of index n for the analog outputs $n=0 \Rightarrow$ 0.125 s $n=1 \Rightarrow$ 1 s $n=2 \Rightarrow$ 2 s $n=4 \Rightarrow$ 4 s
U0	&	Set the interval 0...20 mA for the analog active current output
U1	&	Set the interval 4...20 mA for the analog active current output

In order to read the settings of the transmitter, send the commands described in Table 4.7.

TAB. 4.7: serial commands to read the configuration (models with analog output)

Command	Response	Description
G0	See the example below	It reads the current configuration of the transmitter. If the dip switch 1 is OFF, it returns the configuration set via the serial port. If the dip switch 1 is set to ON, it returns the configuration set by dip switch
GF	See the example below	It reads the configuration set by the serial port
GS	See the example below	It reads the configuration set by the dip switch
S?	Response time	It reads the response time set for the analog outputs

The commands G0, GF and GS for reading the configuration return a string consisting of:

- model
- full scale value set for the analog outputs
- polarity of the measuring range (U=unipolar, B=bipolar)
- range of the analog output current (0=0...20mA, 4=4...20 mA)

for example: the string "HD402T2 5.00mbar B40" indicates that the transmitter model is HD402T2, the full scale set for the analog outputs is 5.00 mbar, the measuring range is bipolar (-5.00...+5.00 mbar) and the analog current output type is 4...20 mA. The last character of the string (0 in the example) is a confidential code.

4.2 CONFIGURATION OF THE MODELS WITH RS485 OUTPUT (HD402ST…)

RS485 Modbus address: each transmitter of the network is univocally identified by an address between 1 and **247**. **Transmitters having the same address shall not be present in the network**. The transmitter Modbus address is equal to the sum of the value set with the dip-switches 2…6 (value settable from 0 to 31) and the value set with the serial command WA (value settable from 1 to 216, default = 1). By setting a dip-switch to ON (upwards), the following values are added to the address:

	Dip-switch 2	Dip-switch 3	Dip-switch 4	Dip-switch 5	Dip-switch 6
ON	16	8	4	2	1
OFF	0	0	0	0	0

Example: if the dip-switches 2 and 4 are set to ON, and the dip-switches 3,5 and 6 are set to OFF, the value set with the dip-switches is 16+4=20. If the value set with the serial command WA is 1 (default value), the transmitter Modbus address is 20+1=**21**.

The dip-switches can be set even if the transmitter is powered, and the change is effective immediately.

Configuration via the RS485 serial port:

The transmitters are pre-set by the factory. To change the settings, proceed as follows:

- Connect the transmitter RS485 output to the PC RS232 (through a RS485/RS232 converter) or USB (through a RS485/USB converter, for example the **RS48** cable) port. If a RS485/USB converter is used, install in the PC the related USB drivers.

- To enable the configuration mode, set the **dip-switch 1** (the one closest to the terminal block) to **ON** (upwards), then power the transmitter.

  Note: the dip-switch 1 can be changed from OFF to ON even when the instrument is powered; in this case it is however necessary, after setting the dip-switch to ON, to press briefly (less than 0.5 seconds) the CAL ZERO button to enable the configuration mode (the transmitter model information appears on display, if present). Alternatively, power cycle the transmitter.

- On the PC, run a serial communication software, set the baud rate to 57600 and the communication parameters to 8N1.

- Send the **CAL START** command (the command is required to change the configuration; to read the value of the parameters, the command is not required).

- Send the commands given in table 4.8 to set or read the configuration parameters of the transmitter.

TAB. 4.8: serial commands (models with RS485 Modbus-RTU output)

| Command	Description
Response time	
AVGn	Set the response time of index n for the measurement n=0 ⇒ 0.125 s n=1 ⇒ 1 s n=2 ⇒ 2 s n=4 ⇒ 4 s
AVG?	Reads the response time set for the measurement
Unit of measurement	
DU0	Shows pressure in Pa (HD402ST1 and HD402ST2) or kPa (HD402ST3, HD402ST4 and HD402ST5) on display

Command	Description
DU1	Shows pressure in mmH$_2$O (HD402ST1 and HD402ST2) or mmHg (HD402ST3, HD402ST4 and HD402ST5) on display
DU2	Shows pressure in inchH$_2$O (HD402ST1 and HD402ST2) or PSI (HD402ST3, HD402ST4 and HD402ST5) on display
DU3	Shows pressure in mbar on display
Modbus parameter	
WA n…n	Sets the Modbus base address to the value n…n The value must be between 1 and 216 (default = 1) **Warning: the actual Modbus address of the transmitter is equal to the base address set with this command plus the value set with the dip-switches.** Note: in the reply to the command, the previous actual address appears; the new address will appear in the replies to the next commands.
BAUD r…r	Sets the Modbus Baud Rate to the value r…r The acceptable values are 9600 and 19200 (default = 19200) If the command is sent without the parameter r…r, the current setting is obtained
PAR p	Sets the Modbus communication parameters of index p p=O $\Rightarrow$ 8O1 p=N $\Rightarrow$ 8N2 p=E $\Rightarrow$ 8E1 If the command is sent without the index p, the current setting is obtained (default = 8E1).

Note: the replies of the transmitters with RS485 Modbus-RTU output always start with the address of the connected transmitter. For example, sending the AVG2 command to a transmitter with Modbus address 1, the reply is "001: averaging = 2 sec".

To exit the configuration mode after sending the CAL START command, send the CAL END command (the transmitter automatically exits the configuration mode after 5 minutes from the last command sent).

4.3 CONFIGURATION OF THE MODELS WITH RELAY OUTPUT (HD402TR...)

The instrument can be configured by using the dip switches (for the unit of measurement) and the buttons (for alarm settings) on the circuit board or via the COM AUX serial port. The choice of the configuration mode is done with the dip switch 1:
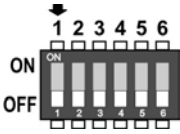
- Dip switch 1 = ON $\Rightarrow$ the configuration set through the dip switches 4/5 and the buttons is used
- Dip switch 1 = OFF $\Rightarrow$ the configuration set via serial port is used

Configuration via dip switches:

The configuration of the dip switches is used by the instrument only if the dip switch 1 is ON. A dip switch is ON if placed up, towards the DIP SW sign.

The following tables report the unit of measurement corresponding to the dip switches setting.

TAB. 4.9: selection of the unit of measurement via dip switches

Models TR1 e TR2			Models TR3, TR4 e TR5		
Dip switch number		Unit of measurement	Dip switch number		Unit of measurement
4	5		4	5	
OFF	ON	inchH$_2$O	OFF	ON	PSI
ON	OFF	mmH$_2$O	ON	OFF	mmHg
OFF	OFF	Pa	OFF	OFF	kPa
ON	ON	mbar	ON	ON	mbar

The dip switches 2, 3 and 6 are not used.

CONFIGURATION VIA THE COM AUX SERIAL PORT:

The configuration set with serial communication is used by the instrument only if the dip switch 1 is OFF.

In order to modify the settings, proceed as follows:

- Connect the COM AUX serial port of the instrument to the RS232 port (via the RS27 cable) or USB (via the cable CP27) of the PC. If you use the CP27 cable, install the USB drivers on your PC.

- On the PC, run a serial communication software, set the baud rate to 115200 and the communication parameters to 8N2.

- Send the **CAL START** command (the command is required to change the configuration; to read the value of the parameters, the command is not required).

- Send the commands given in the table below to set or read the instrument parameters

TAB. 4.10: serial commands (models with relay output)

Command	Description
G0	Reads the instrument model and range Example of reply: HD402TR2 1000Pa If the model has the Auto-zero feature, AZ will appear after the range
G2	Reads the instrument serial number
G3	Reads the instrument firmware version
G4	Reads the instrument firmware date
GD	Reads the instrument calibration date
GM	Reads the current measurement
Kn	Sets the unit of measurement HD402TR1 and HD402TR2: $n=0 \Rightarrow$ Pa; $n=1 \Rightarrow$ mmH$_2$O; $n=2 \Rightarrow$ inchH$_2$O; $n=3 \Rightarrow$ mbar HD402TR3, HD402TR4 and HD402TR5: $n=0 \Rightarrow$ kPa; $n=1 \Rightarrow$ mmHg; $n=2 \Rightarrow$ PSI; $n=4 \Rightarrow$ mbar Default: Pa (HD402TR1 / HD402TR2), kPa (HD402TR3 / HD402TR4 / HD402TR5)
AWSn	Sets the relay operating mode $n=0 \Rightarrow$ Negative (NC contact is closed if no alarm, NO contact is closed if in alarm) $n=1 \Rightarrow$ Positive (NO contact is closed if no alarm, NC contact is closed if in alarm) Default: Negative
ARS	Reads the relay operating mode
AWBn	Sets the buzzer activation status: $n=0 \Rightarrow$ OFF; $n=1 \Rightarrow$ ON Default: OFF
ARB	Reads the buzzer activation status
AWAn	Sets the alarm activation status: $n=0 \Rightarrow$ OFF; $n=1 \Rightarrow$ ON Default: OFF
ARA	Reads the alarm activation status
AWEn	Sets the alarm operating mode $n=0 \Rightarrow$ Above threshold (alarm is on if measurement is greater than threshold 1) $n=1 \Rightarrow$ Below threshold (alarm is on if measurement is less than threshold 1) $n=2 \Rightarrow$ Outside thresholds (alarm is on if measurement is less than threshold 1 or greater than threshold 2) Default: Above threshold
ARE	Reads the alarm operating mode
AWT1snnnn	Sets the threshold 1 value to snnnn ("s" is the sign of the value) [*] Default: pressure value corresponding to 30% of the full scale
ART1	Reads the threshold 1 value
AWT2snnnn	Sets the threshold 2 value to snnnn ("s" is the sign of the value) [*] Default: pressure value corresponding to 70% of the full scale
ART2	Reads the threshold 2 value
AWHnnnn	Sets the hysteresis value to nnnn [*] Default: pressure value corresponding to 10% of the full scale
ARH	Reads the hysteresis value
AWD1nnn	Sets the alarm activation delay to nnn seconds (0... 600 s) Default: 0

Command	Description
ARD1	Reads the alarm activation delay value
AWD2nnn	Sets the alarm deactivation delay to nnn seconds (0… 600 s) Default: 0
ARD2	Reads the alarm deactivation delay value

(*) The thresholds and hysteresis values are considered in the unit of measurement set in the instrument. The value must be written without the decimal point, even if it is not an integer value (e.g., to set thresholds 1 to +1.500, write AWT1+1500). Leading zeros can be omitted (e.g., to set thresholds 1 to +0.050, write AWT1+50).

To exit the configuration mode after sending the CAL START command, send the CAL END command (the instrument automatically exits the configuration mode after 5 minutes from the last command sent).

CONFIGURATION VIA THE INTERNAL BUTTONS

The configuration set with the internal buttons is used by the instrument only if the dip switch 1 is ON.

The upper button **B1** allows scrolling the available operating parameters, while the lower button **B2** allows changing the setting of the selected parameter.
The function of a button depends on whether it is short or long pressed. To short press a button, hold it down for about 1 second, until the power LED turns off. To long press a button, hold it down for at least 3 seconds, until the power LED turns off and then turns on again.

Long press the upper button **B1** to enter the menu. Inside the menu, long press **B1** to scroll the available parameters. Below is the sequence of the operating parameters (in brackets the indication that appears on the display) with the possible set-tings for non-numerical parameters:

- **Relay operating mode** (SECU):
  - Negative (NEG): NC contact is closed if no alarm, NO contact is closed if in alarm
  - Positive (POS): NO contact is closed if no alarm, NC contact is closed if in alarm

- **Buzzer activation** (BEEP):
  - OFF: buzzer disabled
  - ON: buzzer enabled

- **Alarm activation** (ALAR):
  - OFF: alarm disabled
  - ON: alarm enabled

- **Alarm operating mode** (EDGE):
  - Above threshold (RISE): alarm is on if measurement is greater than threshold 1
  - Below threshold (FALL): alarm is on if measurement is less than threshold 1
  - Outside thresholds (OUTS): alarm is on if measurement is less than threshold 1 or greater than threshold 2

- **Threshold 1** (THR1): Value of the threshold for above (RISE) and below (FALL) alarm operating modes; value of the lower threshold for outside thresholds (OUTS) alarm operating mode (OUTS).

- **Threshold 2** (THR2): Value of the upper threshold for outside thresholds (OUTS) alarm operating mode. The parameter appears only if the alarm operating mode

is set to OUTS.

- **Hysteresis** (HYST): Value of the hysteresis for above (RISE) and below (FALL) threshold alarm operating modes. The parameter does not appear if the alarm operating mode is set to OUTS.

- **Alarm activation delay** (T1): Value in seconds of the time delay for generating the alarm. The alarm is generated only if the measurement exceeds the threshold for more than the set time.

- **Alarm deactivation delay** (T2): Value in seconds of the time delay for deactivating the alarm. The alarm is de-activated only after the set time has elapsed from the disappearance of the alarm condition.

Note: the EDGE, THR1, THR2, HYST, T1 and T2 parameters do not appear if the alarm is set to OFF.

Changing non-numerical parameters:

- Select the parameter by using the button **B1**.
- Short press the button **B2** to change the setting.
- Long press the button **B1** to move to the next parameter.

Changing numerical parameters:

- Select the parameter by using the button **B1**.
- Short press the button **B2** to change the sign.
- Long press the button **B2** to select the first digit.
- Short press the button **B2** to change the selected digit.
- Long press the button **B2** to select the next digit.
- Repeat the above two steps until all the digits are set.
- Long press the button **B1** to move to the next parameter.

While a parameter value is displayed, a short press of the button **B1** will briefly show the name of the currently selected parameter.

4.4 ERROR MESSAGES ON DISPLAY

**Undr**: The measured value is less than the minimum measurable value.

OvEr: The measured value exceeds the maximum measurable value.

CAL Error: It appears at the end of the zero calibration if the maximum offset value possible to be corrected is exceeded.
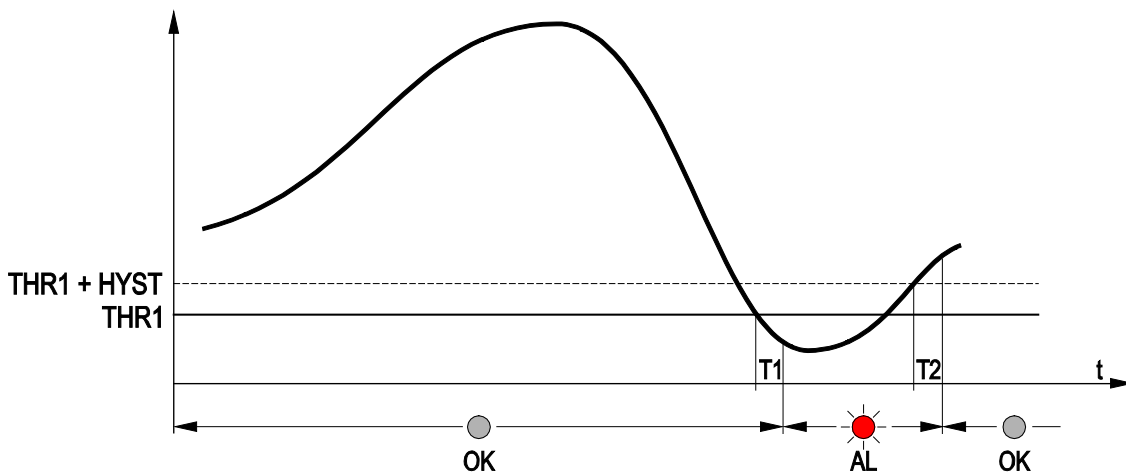
5 ALARM OPERATING MODES (HD402TR…)

Above threshold (RISE): the alarm is turned on if the measurement is greater than threshold 1 for more than T1 seconds. The alarm is turned off when the measurement becomes less then threshold 1 minus the hysteresis for more than T2 seconds.

The up arrow on the left of the display is shown when this mode is selected.
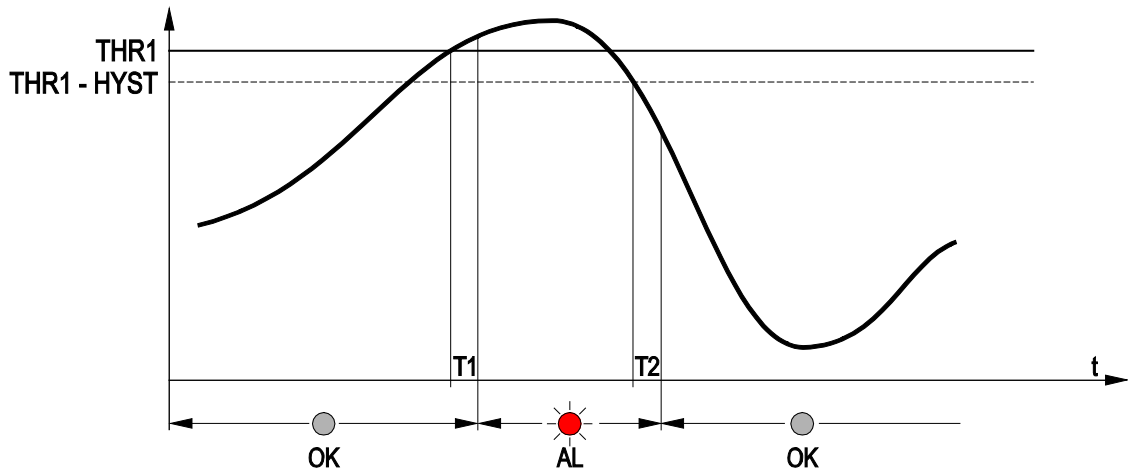
Below threshold (FALL): the alarm is turned on if the measurement is less than threshold 1 for more than T1 seconds. The alarm is turned off when the measurement becomes greater then threshold 1 plus the hysteresis for more than T2 seconds.

The down arrow on the left of the display is shown when this mode is selected.

Outside thresholds (OUTS): the alarm is turned on if the measurement is greater than threshold 2 or less than threshold 1 for more than T1 seconds. The alarm is turned off when the measurement returns between the two thresholds for more than T2 seconds. No hysteresis is applied to the thresholds.

The up and down arrows on the left of the display are shown when this mode is selected.
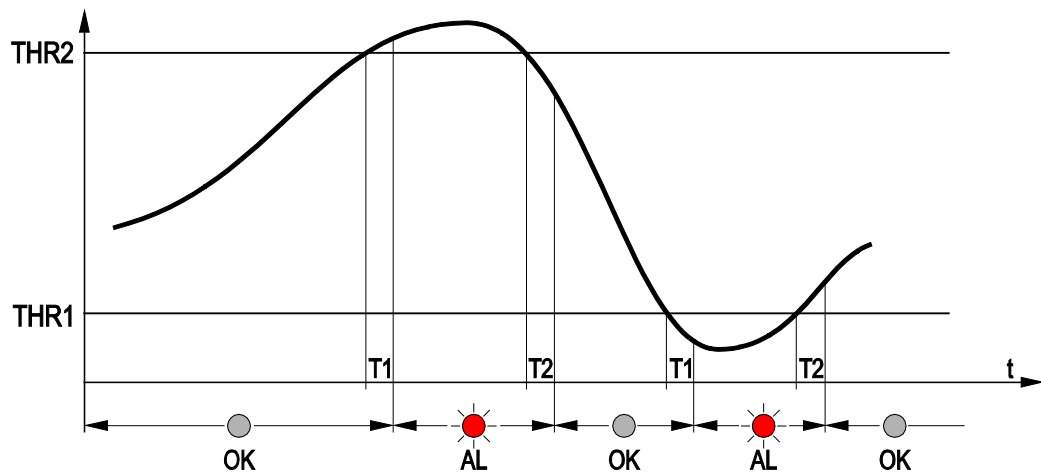
When the measurement is in alarm, the red LED lights up, the buzzer is on (if enabled) and the relay is switched (depending on the chosen relay operating mode).

While in alarm, the buzzer can be stopped (only for the current event) by short pressing the button B1.

The alarm is disabled while in the configuration menu.

6 MODBUS-RTU PROTOCOL (HD402ST…)

To operate with the Modbus-RTU protocol be sure that the **dip-switch 1** (the one closest to the terminal block) is set to **OFF** (downwards). The dip-switch can be set to OFF even if the transmitter is powered, and the change is effective immediately.

Below is the list of registers:

TAB. 6.1: Input Registers

Address	Description	Format
3	Pressure in tenths of Pa (only HD402ST1)	16-bit integer
4	Pressure in Pa (only HD402ST1, HD402ST2 and HD402ST3)	16-bit integer
5	Pressure in daPa (only HD402ST2, HD402ST3 and HD402ST4)	16-bit integer
6	Pressure in hPa (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
7	Pressure in kPa (only HD402ST4 and HD402ST5)	16-bit integer
8	Pressure in hundredths of mmH_2O (only HD402ST1 and HD402ST2)	16-bit integer
9	Pressure in tenths of mmH_2O (only HD402ST1, HD402ST2 and HD402ST3)	16-bit integer
10	Pressure in mmH_2O (only HD402ST2, HD402ST3 and HD402ST4)	16-bit integer
11	Pressure in thousandths of $inchH_2O$ (only HD402ST1 and HD402ST2)	16-bit integer
12	Pressure in hundredths of $inchH_2O$ (only HD402ST2 and HD402ST3)	16-bit integer
13	Pressure in tenths of $inchH_2O$ (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
14	Pressure in $inchH_2O$ (only HD402ST4 and HD402ST5)	16-bit integer
15	Pressure in thousandths of mmHg (only HD402ST2)	16-bit integer
16	Pressure in hundredths of mmHg (only HD402ST2 and HD402ST3)	16-bit integer
17	Pressure in tenths of mmHg (only HD402ST3 and HD402ST4)	16-bit integer
18	Pressure in mmHg (only HD402ST4 and HD402ST5)	16-bit integer
19	Pressure in thousandths of PSI (only HD402ST3)	16-bit integer
20	Pressure in hundredths of PSI (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
26	Error register	16-bit integer

Reading a register not available for a particular model returns the value -32768 (0x8000).

Error register

The bits of the error register signal, if set to 1, anomalies in the measurement. The bit 0 (the less significant one) indicates a measurement over-range of the transmitter. The bit 1 indicates whether the measurement is less than the minimum measurable (under-range). The bits 2 and 3 indicate sensor errors.

TAB. 6.2: Holding Registers

Address	Description	Format
100	Modbus base address (from 1 to 216) **Warning: the actual Modbus address of the transmitter is equal to the base address set in this register plus the value set with the dip-switches.**	16-bit integer
101	Modbus Baud Rate Acceptable values: 3 ($\Rightarrow$ 9600) and 4 ($\Rightarrow$ 19200)	16-bit integer
102	Modbus communication parameters Acceptable values: 1 ($\Rightarrow$ 8N2), 2 ($\Rightarrow$ 8E1) and 4 ($\Rightarrow$ 8O1)	16-bit integer

The Modbus Holding Registers allow setting the same Modbus parameters that can be set via the serial commands WA, BAUD and PAR. Use the 06h (Write Single Register) and 03h (Read Holding Registers) function codes to write and read respectively the content of the registers.

To make the changes of the Holding Registers content active and permanent, write the hexadecimal value FF00 in the Coil Register with address 2 by using the 05h function code (Write Single Coil).

TAB. 6.3: Coils

Address	Description
2	Activation and permanent storage of the Holding Registers content changes.

7 INSTRUMENT STORAGE

Instrument storage conditions:

- Temperature: -20…+70 °C.
- Humidity: less than 90 %RH no condensation.
- In storage, avoid places where:
  - humidity is high;
  - the instrument is exposed to direct sun radiation;
  - the instrument is exposed to a high temperature source;
  - high vibration levels are present;
  - the instrument may be exposed to vapor, salt and/or corrosive gas.

8 SAFETY INSTRUCTION

General safety instructions

The instrument has been manufactured and tested in accordance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

The instrument proper operation and operating safety can be ensured only if all standard safety measures as well as the specific measures described in this manual are followed.

The instrument proper operation and operating safety can be ensured only in the climatic conditions specified in this manual.

Do not use the instruments in places where there are:

- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

User obligations

The instrument operator shall follow the directives and regulations below that refer to the treatment of dangerous materials:

- EEC directives on workplace safety.
- National law regulations on workplace safety.
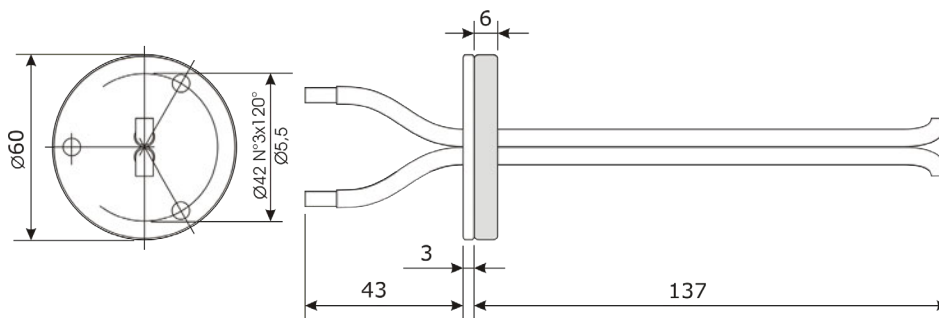- Accident prevention regulations.
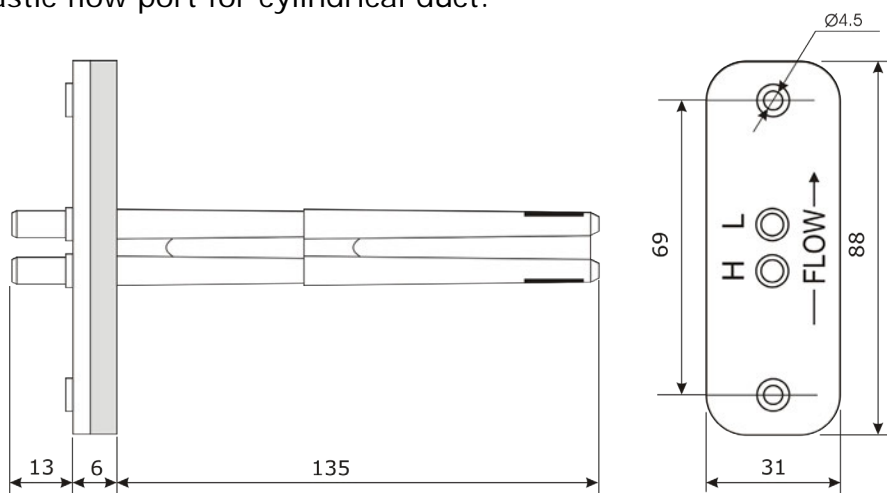
9   ACCESSORIES ORDERING CODES

Accessories included:

- One piece of silicone tubing ⌀ 5 internal/ ⌀ 8 external, length 2 m.
- Two plastic fittings (HD434T.5).

Optional accessories:

AP3719   Flow port for square or cylindrical duct.

AP3721   Plastic flow port for cylindrical duct.

RS27   RS232 null-modem serial connection cable with SubD 9-pin connector on the PC side and 3-pole connector on the instrument side.

CP27   Connection cable with built-in USB/RS232 converter. USB connector on the PC side and 3-pole connector on the instrument side.

RS48   Cable for RS485 connection with built-in USB/RS485 converter. The cable has USB connector for PC and 3 separate wires for the instruments.

Delta OHM metrology laboratories LAT N° 124 are ISO/IEC 17025 accredited by ACCREDIA for Temperature, Humidity, Pressure, Photometry / Radiometry, Acoustics and Air Velocity. They can supply calibration certificates for the accredited quantities.

NOTES

NOTES

WARRANTY

The manufacturer is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased from. During the warranty period (24 months from the date of invoice) any manufacturing defects found will be repaired free of charge. Misuse, wear, neglect, lack or inefficient maintenance as well as theft and damage during transport are excluded. Warranty does not apply if changes, tampering or unauthorized repairs are made on the product. Solutions, probes, electrodes and microphones are not guaranteed as the improper use, even for a few minutes, may cause irreparable damages.

The manufacturer repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales of Goods" apply.

TECHNICAL INFORMATION

The quality level of our instruments is the result of the continuous product development. This may lead to differences between the information reported in the manual and the instrument you have purchased.

We reserves the right to change technical specifications and dimensions to fit the product requirements without prior notice.

DISPOSAL INFORMATION
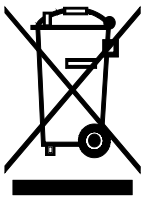
Electrical and electronic equipment marked with specific symbol in compliance with 2012/19/EU Directive must be disposed of separately from household waste. European users can hand them over to the dealer or to the manufacturer when purchasing a new electrical and electronic equipment, or to a WEEE collection point designated by local authorities. Illegal disposal is punished by law.

Disposing of electrical and electronic equipment separately from normal waste helps to preserve natural resources and allows materials to be recycled in an environmentally friendly way without risks to human health.

$C\epsilon$ RoHS

senseca

Please note our new name:
Senseca Italy Srl
Via Marconi 5, 35030 Padua, Italy
Documents are in the process of being changed.