HD402T, HD402ST, HD402AT

HD402T HD402ST HD402AT
PRESSURE TRANSMITTERS

• Sensor with high accuracy and stability
• Measurement of pressures relative to the atmosphere or differential pressures
• Dual analog output, current (active or passive) and voltage, or RS485 Modbus-RTU output
• Versions with or without LCD display

Applications
• Control of air conditioning and ventilation
• Control of filters
• Monitoring of clean rooms
• Pneumatic controls
• Respirators
• Vaporizers

Description

The series of transmitters **HD402xT...** is suitable for measuring relative pressure with respect to atmosphere or differential pressure in the range from as low as 0-50 Pa to 0-200 kPa.

These transmitters use a silicon piezoresistive sensor with high accuracy and temperature compensation, which has excellent linearity, repeatability and stability over the time.

The output signal of the sensor is converted, depending on the model, into a:
• RS485 Modbus–RTU digital output (HD402ST);
• voltage 0...10 V or active current 0...20 mA / 4...20 mA analog output (HD402T);
• 2-wire (current loop) 4...20 mA analog output (HD402AT).

The output signal can be transmitted over long distances with high immunity to interference (in the models with analog output the maximum distance depends on the load and the section of the connection cables, but distances of several hundred meters are commonly reached).

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.

The configuration can be made through a series of dip switches mounted on the circuit board or by connecting the serial port of the transmitter to the PC.

Thanks to the particular sensor used, the transmitters are insensitive to orientation and position. Moreover, the high stability of the sensor over the time and in comparison to the changes in temperature allows to eliminate the operations of maintenance typically required to compensate for the aging and the deviation of the sensor zero.

The option "display" (L) is available, in this case the values of pressure are displayed on a 4 digit display under the unit of measure set by the user.

The transmitters are supplied ready for use and factory calibrated in 3 points.

Power supply: 24Vac or 18...40 Vdc for the models with voltage and active current analog output, 12...30 Vdc for the models with passive current analog output and for the models with RS485 Modbus RTU output.

Technical specifications	
Sensor	Piezoresistive, High stability
Measuring range	from 0…50 Pa to 0…200 kPa both relative and differential (please refer to table 1)
Resolution	Please refer to table 2
Accuracy @ 25 °C	± 1.5% f.s. nominal for HD402xT1 ± 0.75% f.s. nominal for HD402xT2 ± 1% f.s. nominal for HD402xT3, HD402xT4 and HD402xT5
Accuracy @ 0…50 °C	± 3% f.s. nominal for HD402xT1 ± 1% f.s. nominal for HD402xT2, HD402xT3, HD402xT4 and HD402xT5
Long term stability (1000 h) @ 25 °C	± 0.5% f.s. nominal for HD402xT1 and HD402xT2 ± 0.35% f.s. nominal for HD402xT3 ± 0.25% f.s. nominal for HD402xT4 and HD402xT5
Output	• **HD402T**…: Active analog 0…10 Vdc (R_{Lmin} = 10 kΩ)) or 0…20 or 4…20 mA (R_{Lmax} = 500 Ω) • **HD402AT**…: 2-wire (current loop) 4…20 mA (R_{Lmax} = (Vdc-12)/0,022) • **HD402ST**…: Digital RS485 Modbus RTU
Response time	Configurable 0.125, 1, 2 or 4 seconds for the output 0.5 seconds for the display updating
Overpressure limit	50 kPa for the models with f.s. up to 10 kPa 200 kPa for the model with f.s. 100 kPa 400 kPa for the model with f.s. 200 kPa
Compatible media	Only air and non-aggressive dry gases
Power supply	**HD402T**…: 24 Vac ± 10% or 18…40 Vdc **HD402AT**, **HD402ST**…: 12…30 Vdc
Absorption	**HD402T**… and **HD402AT**…: < 1 W @ 24 Vdc **HD402ST**…: < 100 mW @ 12 Vdc
Pressure connection	Ø 6.2 mm for tubes with internal Ø 5...6 mm
Electrical connections	Screw terminal block, max 1.5 mm², PG9 cable gland for the input cable
Operating conditions	-10...+60 °C / 0…95% RH
Storage temperature	-20...+70 °C
Housing dimensions	80 x 84 x 44 mm
Protection degree	IP65

Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402T1	50/100/250	---	0,5/1/2,5	5/10/25	0,2/0,4/1	---	---
HD402T2	250/500/1000	---	2,5/5/10	25/50/100	1/2/4	---	---
HD402T3	---	2,5/5/10	25/50/100	---	---	10/25/50	0,4/0,75/1,5
HD402T4	---	25/50/100	250/500/1000	---	---	100/250/500	4/7,5/15
HD402T5	---	50/100/200	500/1000/2000	---	---	250/500/1000	10/15/30

TAB. 2: resolution

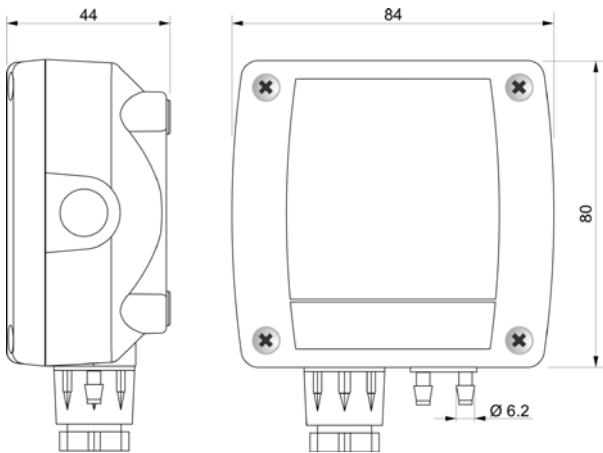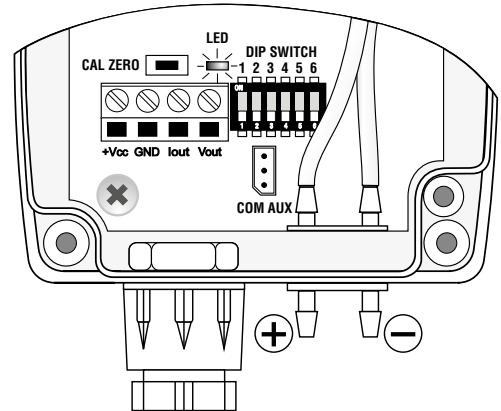| Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402T1	0.1	---	0.001	0.01	0.001	---	---
HD402T2	1	---	0.01	0.1	0.01	---	---
HD402T3	---	0.01	0.1	---	---	0.01	0.001
HD402T4	---	0.1	1	---	---	0.1	0.01
HD402T5	---	0.1	1	---	---	1	0.01

Fig. 1: dimensions (mm)

Installation

In any model the sensor and the electronics are housed in a rugged plastic case with IP65 protection degree. By opening the lid, 3 mm diameter holes are available so to allow securing the base of the transmitter directly to a panel or to the wall.
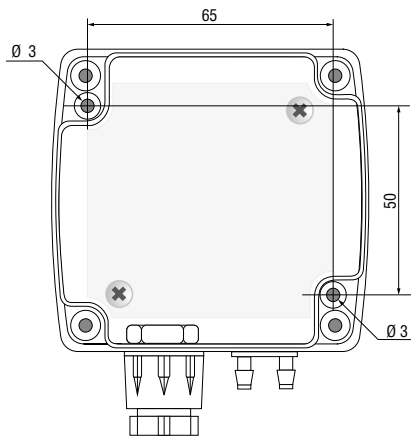

Fig. 2: fixing holes (dimensions in mm)

The transmitter can be mounted in any position, but typically it is secured on a vertical wall with the pressure taps facedown. The deviation of the zero due to the mounting position can be corrected by using CAL ZERO. The procedure for the manual calibration of the zero is the following:

• make sure that the transmitter is powered at least for 1 hour;
• disconnect both the tubes from the pressure + and – inputs;
• press CAL ZERO until the red LED starts flashing;
• when the red LED turns off, the zeroing procedure is completed and you can reconnect the tube to the pressure connections.

It is recommended to follow the auto-zero procedure at least once a year under normal operating conditions.

Models with active analog output
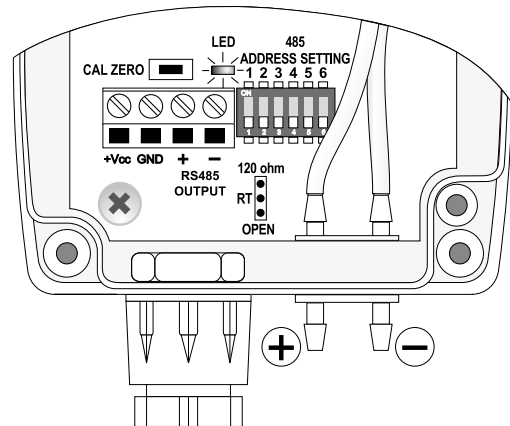
Models with RS485 output
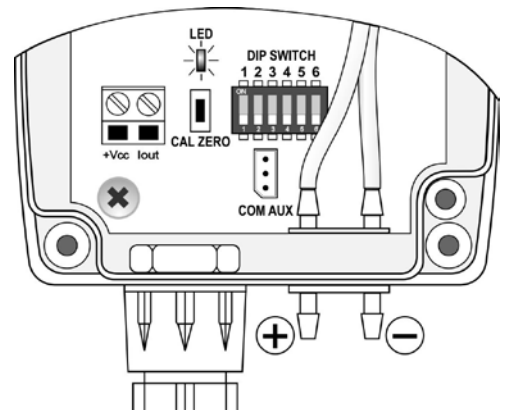
Model with 2-wire current output

Fig. 3: CAL ZERO button and configuration dip-switches

TAB. 3: measuring ranges for outputs of the models HD402T1 and HD402AT1

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 Pa		0…5.00 mmH$_2$O		0…0.200 inchH$_2$O		0…0.500 mbar	
	ON	OFF	0…100.0 Pa		0…10.00 mmH$_2$O		0…0.400 inchH$_2$O		0…1.000 mbar	
	OFF	OFF	0…250.0 Pa		0…25.00 mmH$_2$O		0…1.000 inchH$_2$O		0…2.500 mbar	
	ON	ON								
ON	OFF	ON	-50.0…+50.0 Pa		-5.00…+5.00 mmH$_2$O		-0.200…+0.200 inchH$_2$O		-0.500…+0.500 mbar	
	ON	OFF	-100.0…+100.0 Pa		-10.00…+10.00 mmH$_2$O		-0.400…+0.400 inchH$_2$O		-1.000…+1.000 mbar	
	OFF	OFF	-250.0…+250.0 Pa		-25.00…+25.00 mmH$_2$O		-1.000…+1.000 inchH$_2$O		-2.500…+2.500 mbar	
	ON	ON								

TAB. 4: measuring ranges for outputs of the models HD402T2 and HD402AT2

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 Pa		0…25.0 mmH$_2$O		0…1.00 inchH$_2$O		0…2.50 mbar	
	ON	OFF	0…500 Pa		0…50.0 mmH$_2$O		0…2.00 inchH$_2$O		0…5.00 mbar	
	OFF	OFF	0…1000 Pa		0…100.0 mmH$_2$O		0…4.00 inchH$_2$O		0…10.00 mbar	
	ON	ON								
ON	OFF	ON	-250…+250 Pa		-25.0…+25.0 mmH$_2$O		-1.00…+1.00 inchH$_2$O		-2.50…+2.50 mbar	
	ON	OFF	-500…+500 Pa		-50.0…+50.0 mmH$_2$O		-2.00…+2.00 inchH$_2$O		-5.00…+5.00 mbar	
	OFF	OFF	-1000…+1000 Pa		-100.0…+100.0 mmH$_2$O		-4.00…+4.00 inchH$_2$O		-10.00…+10.00 mbar	
	ON	ON								
	ON	ON								

TAB. 5: measuring ranges for outputs of the models HD402T3 and HD402AT3

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…2.50 kPa		0…10.00 mmHg		0…0.400 PSI		0…25.0 mbar	
	ON	OFF	0…5.00 kPa		0…25.00 mmHg		0…0.750 PSI		0…50.0 mbar	
	OFF	OFF	0…10.00 kPa		0…50.00 mmHg		0…1.500 PSI		0…100.0 mbar	
	ON	ON								
ON	OFF	ON	-2.50…+2.50 kPa		-10.00…+10.00 mmHg		-0.400…+0.400 PSI		-25.0…+25.0 mbar	
	ON	OFF	-5.00…+5.00 kPa		-25.00…+25.00 mmHg		-0.750…+0.750 PSI		-50.0…+50.0 mbar	
	OFF	OFF	-10.00…+10.00 kPa		-50.00…+50.00 mmHg		-1.500…+1.500 PSI		-100.0…+100.0 mbar	
	ON	ON								
	ON	ON								

TAB. 6: measuring ranges for outputs of the models HD402T4 and HD402AT4

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 kPa		0…100.0 mmHg		0…4.00 PSI		0…250 mbar	
	ON	OFF	0…50.0 kPa		0…250.0 mmHg		0…7.50 PSI		0…500 mbar	
	OFF	OFF	0…100.0 kPa		0…500.0 mmHg		0…15.00 PSI		0…1000 mbar	
	ON	ON								
ON	OFF	ON	-25.0…+25.0 kPa		-100.0…+100.0 mmHg		-4.00…+4.00 PSI		-250…+250 mbar	
	ON	OFF	-50.0…+50.0 kPa		-250.0…+250.0 mmHg		-7.50…+7.50 PSI		-500…+500 mbar	
	OFF	OFF	-100.0…+100.0 kPa		-500.0…+500.0 mmHg		-15.00…+15.00 PSI		-1000…+1000 mbar	
	ON	ON								
	ON	ON								

TAB. 7: measuring ranges for outputs of the models HD402T5 and HD402AT5

| 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 kPa		0…250 mmHg		0…10.00 PSI		0…500 mbar	
	ON	OFF	0…100.0 kPa		0…500 mmHg		0…15.00 PSI		0…1000 mbar	
	OFF	OFF	0…200.0 kPa		0…1000 mmHg		0…30.00 PSI		0…2000 mbar	
	ON	ON								
ON	OFF	ON	-50.0…+50.0 kPa		-250…+250 mmHg		-10.00…+10.00 PSI		-500…+500 mbar	
	ON	OFF	-100.0…+100.0 kPa		-500…+500 mmHg		-15.00…+15.00 PSI		-1000…+1000 mbar	
	OFF	OFF	-200.0…+200.0 kPa		-1000…+1000 mmHg		-30.00…+30.00 PSI		-2000…+2000 mbar	
	ON	ON								
	ON	ON								

Electrical connections
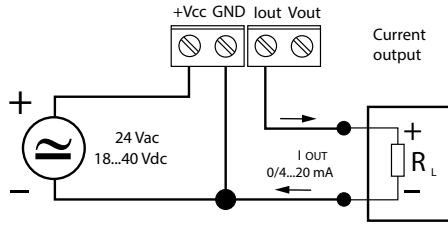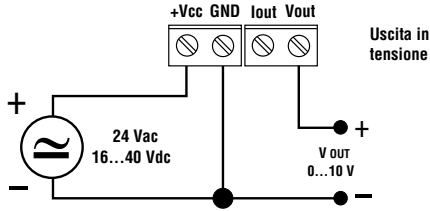

Fig. 4: active current analog output
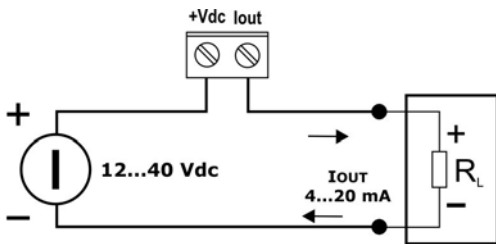

Fig. 5: voltage analog output

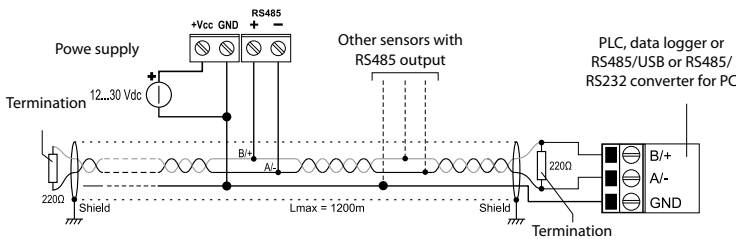Fig. 6: 2-wire current analog output

Fig. 7: 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 mm² (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.

CONFIGURATION OF THE MODELS WITH ANALOG OUTPUT (HD402T… / HD402AT…)

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 1:
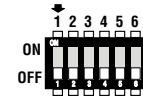
Dip switch 1 = ON → the configuration set through the dip switches 2…6 is used

Dip switch 1 = OFF → the configuration set via serial port is used

Configuration by dip switch (models with analog output)

The configuration of the dip switches is used by the transmitter only if the dip switch 1 is ON.

The dip switches 2 and 3 select the low, intermediate or high measuring range for the analog output.

The dip switches 4 and 5 select one of the four available units in the model.

The dip switch 6 sets the unipolar (0 … + f.s.) or bipolar (-f.s.…..+ f.s.) measuring range for the analog output.

A dip switch is OFF when placed down, towards the serial connector. Instead, it is ON if placed up, towards the DIP SW sign.

The tables 3 to 7 at the following pages report….. report the measuring range, for each model, corresponding to the analog outputs according to dip switch positions.

Configuration via the serial port COM AUX (models with analog output)

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, launch a program for serial communication (e.g. Hyperterminal), set the baud rate to 115200 and the communication parameters to 8N1.
- Send the commands given in table 8 to set the measurement range corresponding to the analog outputs.

TAB. 8: 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 → Pa — n=0 → kPa n=1→ mmH$_2$O — n=1 → mmHg n=2 → inchH$_2$O — n=2 → PSI n=3 → mbar — n=3 → mbar
Rn	&	Set the measuring range of index n n=0 → high range (e.g. 250 Pa / 25 mmH$_2$O / 1 "H$_2$O / 2,5 mbar in HD402T1) n=1 → intermediate range (e.g. 100 Pa / 10 mmH$_2$O / 0,4"H$_2$O / 1 mbar in HD402T1) n=2 → low range (e.g. 50 Pa / 5 mmH$_2$O / 0,2"H$_2$O / 0,5 mbar 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 ⇒ 0.125 s n=1 ⇒ 1 s n=2 ⇒ 2 s n=4 ⇒ 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 9.

TAB. 9: 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.

CONFIGURATION OF THE MODELS WITH RS485 MODBUS-RTU 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 (models HD402ST…)
The transmitters are preset 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.
- In the PC, run a serial communication software (e.g. Hyperterminal), set the baud rate to 57600 and the communication parameters to 8N1.
- Send the CAL START command (the command is required to change the configuratrion; to read the value of the parameters, the command is not required).
- Send the commands given in table 10 to set or read the configuration parameters of the transmitter.

TAB. 10: 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 $\Rightarrow$ 0.125 s, n=1 $\Rightarrow$ 1 s, n=2 $\Rightarrow$ 2 s, n=4 $\Rightarrow$ 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
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 parameters	
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).

MODBUS-RTU MODE
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.
The measured values can be read in Modbus RTU mode by using the 04h function code (Read Input Registers). Table 11 lists the Modbus Input Registers available:

TAB. 11: MODBUS Input Registers

Register number	Register address	Datum	Format
4	3	Pressure in tenths of Pa (only HD402ST1)	16-bit integer
5	4	Pressure in Pa (only HD402ST1, HD402ST2 and HD402ST3)	16-bit integer
6	5	Pressure in daPa (only HD402ST2, HD402ST3 and HD402ST4)	16-bit integer
7	6	Pressure in hPa (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
8	7	Pressure in kPa (only HD402ST4 and HD402ST5)	16-bit integer
9	8	Pressure in hundredths of mmH$_2$O (only HD402ST1 and HD402ST2)	16-bit integer
10	9	Pressure in tenths of mmH$_2$O (only HD402ST1, HD402ST2 and HD402ST3)	16-bit integer
11	10	Pressure in mmH$_2$O (only HD402ST2, HD402ST3 and HD402ST4)	16-bit integer
12	11	Pressure in thousandths of inchH$_2$O (only HD402ST1 and HD402ST2)	16-bit integer
13	12	Pressure in hundredths of inchH$_2$O (only HD402ST2 and HD402ST3)	16-bit integer
14	13	Pressure in tenths of inchH$_2$O (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
15	14	Pressure in inchH$_2$O (only HD402ST4 and HD402ST5)	16-bit integer
16	15	Pressure in thousandths of mmHg (only HD402ST2)	16-bit integer
17	16	Pressure in hundredths of mmHg (only HD402ST2 and HD402ST3)	16-bit integer
18	17	Pressure in tenths of mmHg (only HD402ST3 and HD402ST4)	16-bit integer
19	18	Pressure in mmHg (only HD402ST4 and HD402ST5)	16-bit integer
20	19	Pressure in thousandths of PSI (only HD402ST3)	16-bit integer
21	20	Pressure in hundredths of PSI (only HD402ST3, HD402ST4 and HD402ST5)	16-bit integer
27	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. 12: MODBUS - Holding Registers

Register number	Register address	Datum	Format
101	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
102	101	Modbus Baud Rate Acceptable values: 3 ($\Rightarrow$ 9600) and 4 ($\Rightarrow$ 19200)	16-bit integer
103	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 number 3 (address 2) by using the 05h function code (Write Single Coil).

TAB. 13: MODBUS - Coils

Register number	Register address	Datum
3	2	Activation and permanent storage of the Holding Registers content changes.

Display

Models with suffix **L** are equipped with a 4-digit LCD display. In models with LCD option, the measuring range shown on the display is always bipolar (-f.s.....+f.s.) and related to the maximum full scale available in the model (the setting of the measuring range only affects the behavior of the analog outputs).
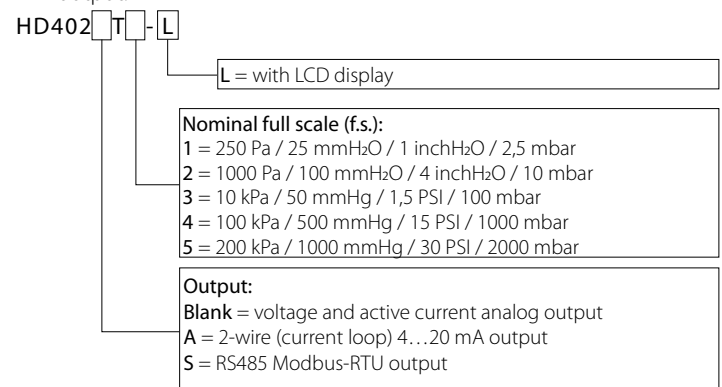The measure on the display is updated twice a second.

Error messages:

Undr → it appears if the measured value is less than the minimum measurable value

OvEr → it appears if 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.

ORDERING CODES

HD402T…: Pressure relative to the atmosphere or differential pressure transmitters. For dry air and non-aggressive gases. Barbed connection. Ø 6.2 mm for tubes with internal Ø 5...6 mm pressure inputs. RS485 Modbus RTU output (HD402ST), voltage 0...10 V or active current 0...20 mA / 4...20 mA analog output (HD402T) or 2-wire (current loop) 4...20 mA analog output (HD402AT). Operating temperature 10...+60 °C. Power supply: 24Vac or 18...40 Vdc for the models with voltage and active current analog output, 12...30 Vdc for the models with passive current analog output and for the models with RS485 Modbus RTU output.

HD402 [T] - [L]

L = with LCD display

Nominal full scale (f.s.):
1 = 250 Pa / 25 mmH$_2$O / 1 inchH$_2$O / 2,5 mbar
2 = 1000 Pa / 100 mmH$_2$O / 4 inchH$_2$O / 10 mbar
3 = 10 kPa / 50 mmHg / 1,5 PSI / 100 mbar
4 = 100 kPa / 500 mmHg / 15 PSI / 1000 mbar
5 = 200 kPa / 1000 mmHg / 30 PSI / 2000 mbar

Output:
Blank = voltage and active current analog output
A = 2-wire (current loop) 4…20 mA output
S = RS485 Modbus-RTU output

Accessories

Included:
- N°1 piece of silicone tubing Ø 5 int./ Ø 8 ext. length 2 m
- N°2 plastic fittings HD434T.5

Upon request:

AP3719: Air inlet for square or cylindrical channel.

AP3721: Air inlet for cylindrical channel, made of plastic.

RS27: RS232 null-modem serial connection cable with 9 poles sub-D 9 female and 3-pole connectors for COM AUX port.

CP27: Serial connection cable with USB connector for PC and 3-pole connector for COM AUX port. The cable has a built-in USB/RS232 converter and connects the instrument directly to the USB port of the PC.

Fig. 8:   AP3719
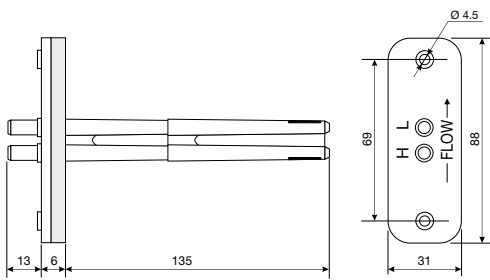duct probe
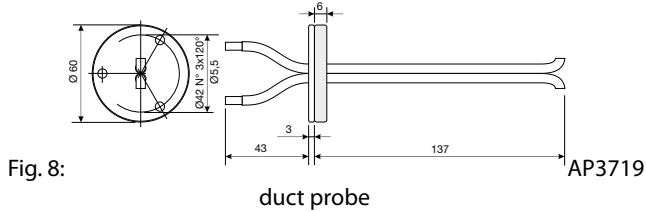
Fig. 9: AP3721 duct probe

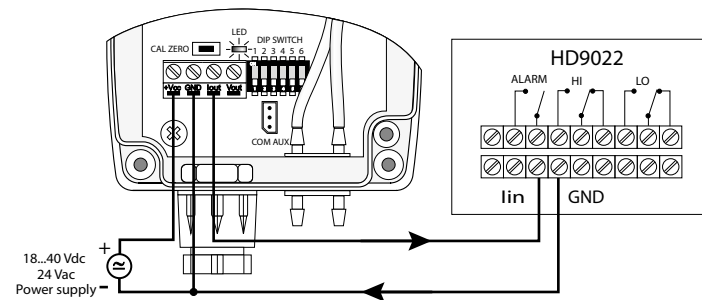### EXAMPLE OF CONNECTION WITH THE INDICATOR CONTROLLER HD9022
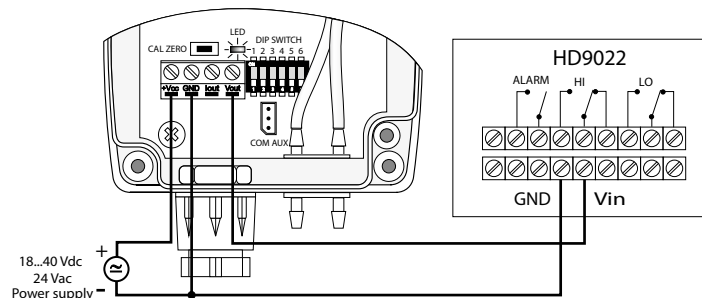
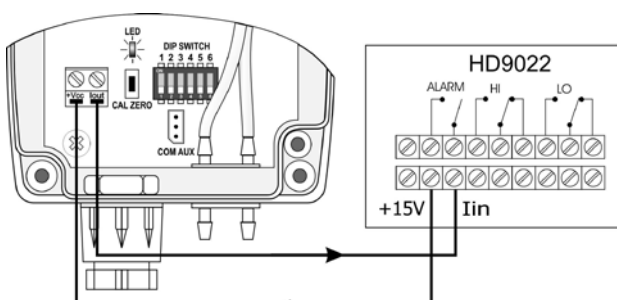Fig. 10: active current output 0…20 or 4…20 mA

Fig. 11: voltage output 0…10 Vdc

Fig. 12: 2-wire (current loop) 4…20 mA output

HD402TR...SERIES

HD402TR…L series
Pressure ON/OFF relay switches

- Sensor with high accuracy and stability
- Measurement of pressures relative to the atmosphere or differential pressures
- Relay switch output
- Front alarm LED and audible alarm
- Settable thresholds, hysteresis and delay
- Auto-zeroing feature in the low range model
- LCD display and 2 configuration keys

The series of pressure ON/OFF relay switches **HD402TR...L** is suitable for controlling the relative pressure with respect to atmosphere or differential pressure in the range from ±250 Pa to ±200 kPa.

If the set threshold value is exceeded, the relay switch output is activated, the front alarm LED lights up and an audible alarm sounds. The alarm can be configured to be activated when the measurement becomes higher or lower than the set threshold. 1 or 2-threshold operating modes are available.

A silicon piezoresistive sensor with high accuracy and temperature compensation is used, which allows excellent linearity, repeatability and stability over the time.

The auto-zeroing feature in the low range model (HD402TR1L) allows stable measurements over the time without the need to recalibrate.

The instruments are equipped with a 4-digit LCD display and different units of measurement can be chosen for each model.

The configuration can be made through the dip switches mounted on the circuit board (only for the unit of measurement), via the internal buttons or by connecting the serial port of the instrument to the PC.

Thanks to the particular sensor used, the instruments are insensitive to 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 instruments are supplied ready for use and factory calibrated.

Power supply: 24 Vac or 15...36 Vdc.

| Technical specifications	
Sensor	Piezoresistive, High stability
Measuring range	from 0…50 Pa to 0…200 kPa both relative and differential (please refer to table 1)
Resolution	Please refer to table 2
Accuracy @ 25 °C	± 1.5% f.s. nominal for HD402TR1L ± 0.75% f.s. nominal for HD402TR2L ± 1% f.s. nominal for HD402TR3L, HD402TR4L and HD402TR5L
Accuracy @ 0…50 °C	± 3% f.s. nominal for HD402TR1L ± 1% f.s. nominal for HD402TR2L, HD402TR3L, HD402TR4L and HD402TR5L
Long term stability (1000 h) @ 25 °C	± 0.5% f.s. nominal for HD402TR1L and HD402TR2L ± 0.35% f.s. nominal for HD402TR3L ± 0.25% f.s. nominal for HD402TR4L and HD402TR5L
Alarm	Front LED, internal buzzer, relay switch
Output	SPDT Relay switch 3 A/250 Vac 3 A/30 Vdc resistive load
Connection to pc	RS232 serial port Can be connect to a USB port by using the optional CP27 adapter
Configuration	Settable unit of measurement, thresholds, hysteresis, delay and alarm operation mode
Auto-zero	Automatic for HD402TR1L, manual for the other models
Response time	0.5 seconds for the display updating
Overpressure limit	50 kPa for HD402TR1L, HD402TR2L and HD402TR3L 200 kPa for HD402TR4L 400 kPa for HD402TR5L
Compatible media	Only air and non-aggressive dry gases
Power supply	24 Vac ± 10% or 15…36 Vdc
Absorption	< 1 W @ 24 Vdc
Pressure connection	Ø 6.2 mm for tubes with internal Ø 5...6 mm
Electrical connections	Screw terminal block, max 1.5 mm^2, PG9 cable gland for the input cable
Operating conditions	-10...+60 °C / 0…95% RH
Storage temperature	-20...+70 °C
Housing dimensions	80 x 84 x 44 mm
Protection degree	IP65

TAB. 1: full scale values and units of measurement

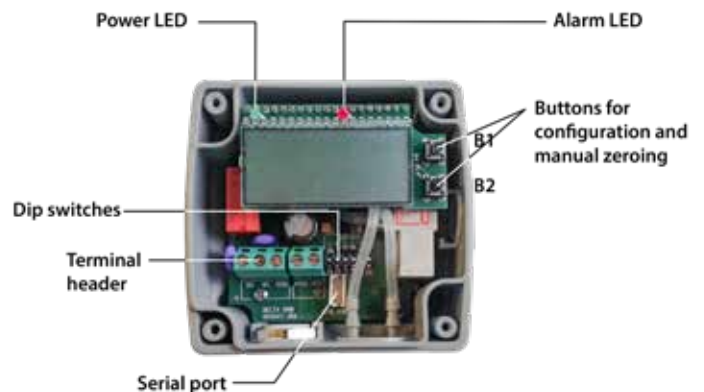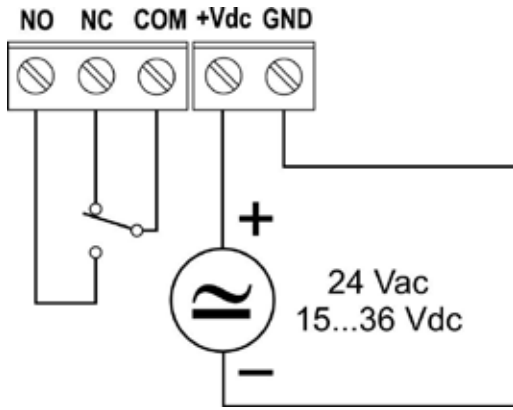| Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402TR1L	250	---	2.5	25	1	---	---
HD402TR2L	1000	---	10	100	4	---	---
HD402TR3L	---	10	100	---	---	50	1.5
HD402TR4L	---	100	1000	---	---	500	15
HD402TR5L	---	200	2000	---	---	1000	30

TAB. 2: resolution

| Model	Pa	kPa	mbar	mmH$_2$O	inchH$_2$O	mmHg	PSI
HD402TR1L	0.1	---	0.001	0.01	0.001	---	---
HD402TR2L	1	---	0.01	0.1	0.01	---	---
HD402TR3L	---	0.01	0.1	---	---	0.01	0.001
HD402TR4L	---	0.1	1	---	---	0.1	0.01
HD402TR5L	---	0.1	1	---	---	1	0.01

Dimensions
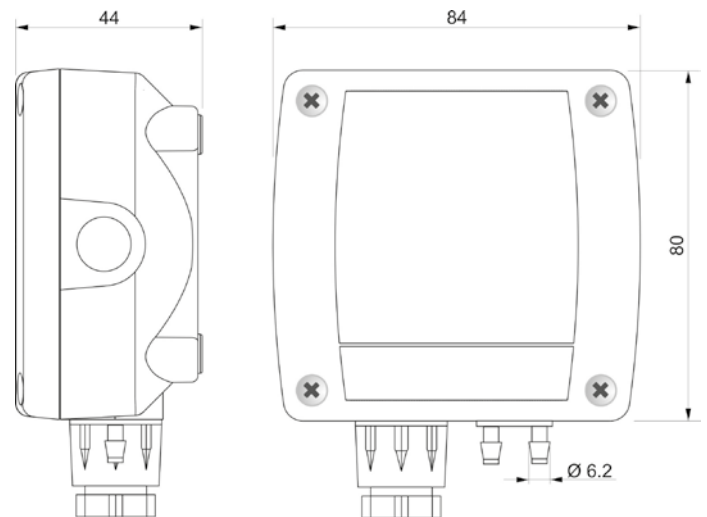
Internal view

CONFIGURATION

The configuration of the instruments can be done via serial commands by connecting the instrument serial port to a PC and using a standard serial communication program, or by using the two internal configuration buttons. Below are the operating parameters that can be configured:

- **Relay operating mode**:

  Negative: NC contact is closed if no alarm, NO contact is closed if in alarm.

  Positive: NO contact is closed if no alarm, NC contact is closed if in alarm.

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

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

- **Alarm operating mode**:

  Above threshold: alarm is on if measurement is greater than the set threshold.

  Below threshold: alarm is on if measurement is less than the set threshold.

  Outside thresholds: alarm is on if measurement is less than lower threshold or greater than upper threshold.

- **Threshold 1**: Value of the threshold for above and below alarm operating modes; value of the lower threshold for outside thresholds alarm operating mode.

- **Threshold 2**: Value of the upper threshold for outside thresholds alarm operating mode.

- **Hysteresis**: Value of the hysteresis for above and below threshold alarm operating modes.

- **Alarm activation delay**: 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**: Value in seconds of the time delay for deactivating the alarm. The alarm is deactivated only after the set time has elapsed from the disappearance of the alarm condition.

AP3719   Flow port for for square or cylindrical duct.
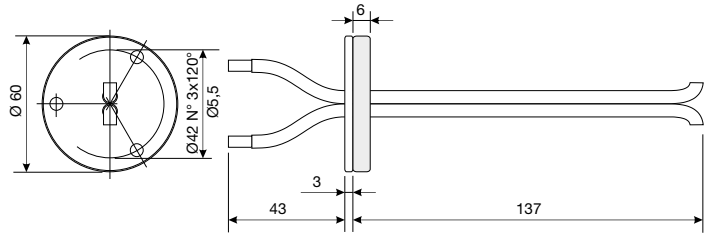
AP3721   Plastic flow port for cylindrical duct.
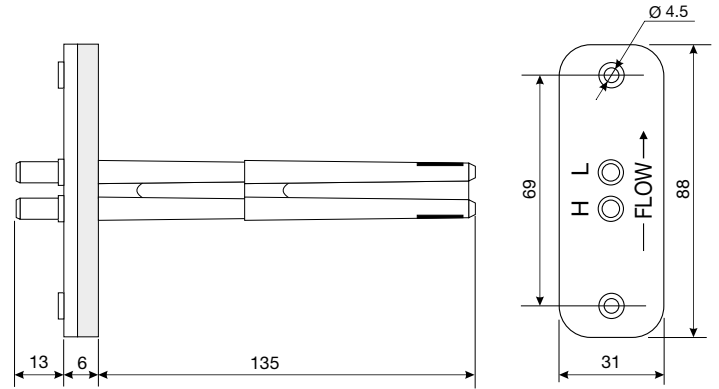
RS27   RS232 null-modem serial connection cable with SubD 9-pin connector on the PC side and 3-pole connector on the instrument side.

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

ORDERING CODES

HD402TR…L   Relative or differential pressure controller with ON/OFF relay switch. Range from ±250 Pa to ±200 kPa depending on model. 4-digit LCD display. User configurable via serial port or internal buttons. Operating temperature 10...+60 °C. Suitable for measuring non-corrosive gases or dry air. Ø 6.2 mm for tubes with internal Ø 5...6 mm pressure inputs. Power supply 24 Vac or 15...36 Vdc.

Range:
1 = ± 250 Pa / 25 mmH₂O / 1 inchH₂O / 2,5 mbar
2 = ± 1000 Pa / 100 mmH₂O / 4 inchH₂O / 10 mbar
3 = ± 10 kPa / 50 mmHg / 1,5 PSI / 100 mbar
4 = ± 100 kPa / 500 mmHg / 15 PSI / 1000 mbar
5 = ± 200 kPa / 1000 mmHg / 30 PSI / 2000 mbar