Intelligent pressure meter with Ethernet connection
T2514

Intelligent temperature, relative humidity meter with Ethernet connection
With calculation of dew point temperature, absolute humidity, specific humidity, mixing ratio and specific enthalpy
T3511, T3510

Intelligent temperature transducer with Ethernet connection
T4511

Intelligent temperature transducer with Ethernet connection
T0510

Intelligent temperature, relative humidity, pressure and derivate humidity quantities with Ethernet connection
T7511, T7510

Instruction Manual

General safety rules

The following summary is designed to prevent injury hazards or device damage. Operate the instrument in accordance with this manual to prevent electric trauma.

Service should be performed by a qualified person only.
Precautions against injury or fire
Use a safety ac/dc adapter. Use only an adapter with the power voltage recommended by its manufacturer and which is approved by proper standards. Check that the adapter has undamaged cables and cover.
Connect and disconnect correctly. Do not connect and disconnect a LAN cable or lead-in cables if the device is under electric voltage.
Do not use the instrument without the cover.
Do not use the instrument, if it does not work correctly. If the instrument seems not to work correctly, have it checked by a qualified service person.
Do not use the instrument in an explosive environment.
Before you remove probe of the transmitter TxxxxP, make sure that the pressure in a pressure chamber (duct, pipe …) and the ambient pressure are in equilibrium.

Content

Transmitter version TxxxxP is designed for compressed air measurement up to 25 bars. The removable probe for compressed air measurement is noninterchangeable part of the device. The protection of the connector is IP67.

Models marked TxxxxZ are non-standard versions of the devices. Description is not included in this manual.

General description

The Tx5xx devices are designed for measurement of temperature, relative humidity and pressure of air without aggressive ingredients with computing one of the following values: dew point temperature, absolute humidity, mixing ratio and specific enthalpy. Temperature units are °C or °F. Pressure units are hPa, PSI, inHg, mBar, oz/in^2, mmHg, inH_2O, kPa, it is possible to set pressure correction for altitude (offset). Temperature, relative humidity eventually pressure sensors are non-removable device parts (except of T4511 device), pressure sensor is always placed inside the electronic case. Device T4511 is designed for connection of two-wire Pt1000 temperature probe. For types T3511(P) and T7511 temperature and humidity sensors are placed in external probe connected by a cable.

The meter communicates via Ethernet. Table shows, what quantities are available in concrete type.

Type	Temp	Humidity	Pressure	Computed quantity
T0510	✓			
T3510	✓	✓		✓
T7510	✓	✓	✓	✓
T2514			✓	
T3511(P)	✓	✓		✓
T4511	✓			
T7511	✓	✓	✓	✓

Value can be displayed on the instrument LCD display, or it is possible to read it out by means of an Ethernet interface (to be subsequently processed in a PC). The following formats are supported:

- www pages with user-design possibility
- Modbus protocol
- SNMPv1 protocol
- SOAP

The instrument may send a warning message to several defined points if the measured value gets out of adjusted limits. There are the following possible ways to deliver the warning report:

- to send an e-mail to maximum of three e-mail addresses
- to send a SNMP trap to maximum of three IP addresses
- to display an alarm state on the device www page
- to send a message to syslog server

Alarm limits may be set via Tsensor software, Modbus, telnet or a SNMPv1 protocol. The alarm state may be read via the device www pages, Modbus or the SNMPv1 protocol.

If Power over Ethernet is needed, it is necessary to use some PoE Splitter. Tested is e.f. D-Link DWL-P50. Transmitter itself does NOT support PoE internally!

Preparation to operation

In order to be able to use all the features of the device it is necessary to do some settings by means of a PC. In the case of T4511 transducer it is necessary to connect a temperature probe before use.

What is needed to operate instrument

- ac/dc adapter 9-30V, 200mA
- RJ-45 LAN connection
- free IP address in your network
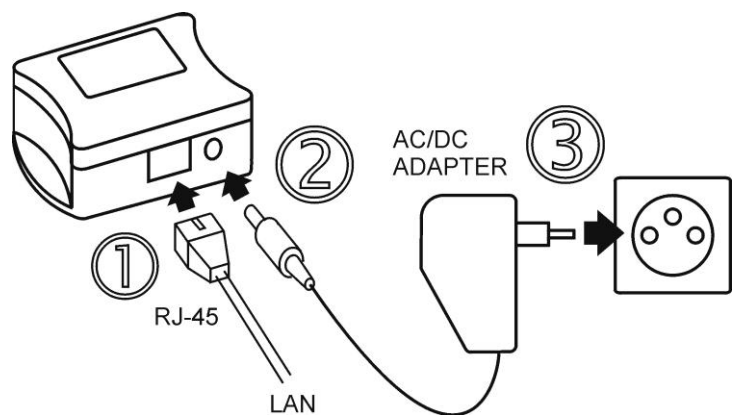- temperature probe with a Pt1000 sensor for the T4511 transducer

Contact network administrator to get free IP address.

Warning! Safety reception of warning messages (e-mail, trap) depends on actual accessibility of required network services. It is recommended to protect device against the unauthorized access to device settings and connection of cables.

Procedure of instrument connection

T0510, T3510,T7510, T2514, T3511(P), T7511

- connect the Ethernet connector
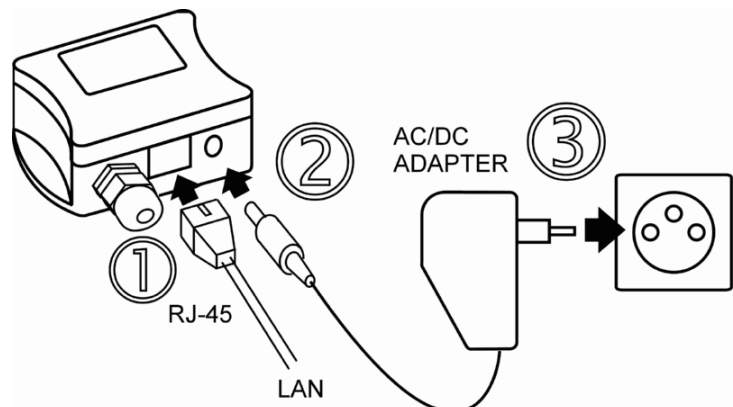- connect the power
- configure the device with Tsensor program

The device T3511P is designed to measure pressured air. It is good to mount probe directly into high pressure area (i.e. air pressured pipe) if it is possible. There is other possibility to use flow chamber SH-PP, see Appendix A.
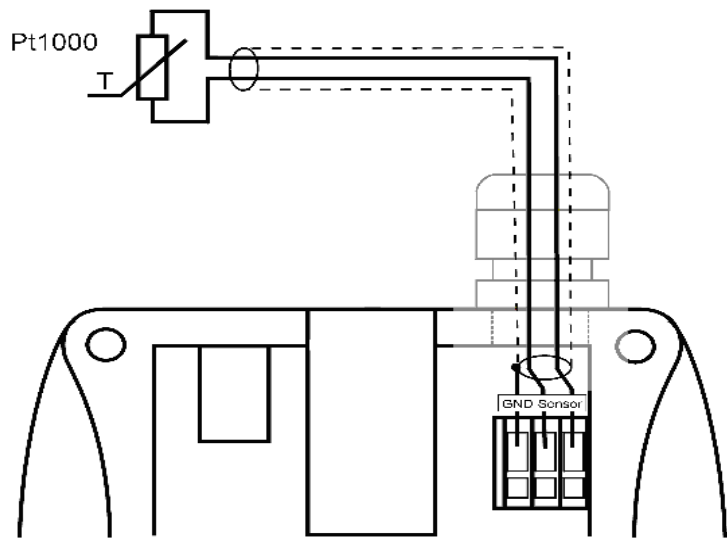
Before you remove probe of the transmitter TxxxxP, make sure that the pressure in a pressure chamber (duct, pipe …) and the ambient pressure are in equilibrium.

T4511

- unscrew four screws from the front side of the transducer case and remove the lid
- get the cable through a sleeve on the case wall
- connect the Ethernet connector
- connect the power supply
- configure the device by means of a PC

Connection of a Pt1000 probe to the T4511 transducer

Dimensions

Intelligent meter T2514

Transducer T4511

Transducer T0510

88,5 mm
76,5 mm
(125,5 mm)
Ø 4,3 mm
53,0 mm
39,5 mm
72,5 mm
ø 15 mm

Intelligent meter T3511(P), T7511

probe for compressed air measurement

1(2;4) m
150
19
12
60
HEX 19
Ø 28
O-ring
G1/2
Ø 18

88,5 mm
76,5 mm
(93,0 mm)
Ø 4,3 mm
1(2;4) m
69,0 mm
(88,0 mm)

39,5 mm
72,5 mm
Ø18,0 mm

Intelligent meter T3510, T7510

Installation

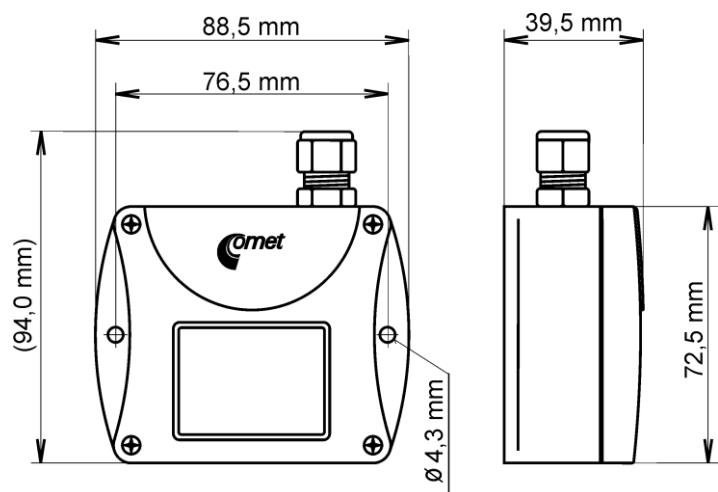It is necessary to assign a new suitable IP address to the device at the first connection to it in order to prevent collisions with already existing network IP addresses, and make the address conform with the local habits. If installing several new devices, connect them to the network one after another! If a suitable IP address is not known, contact your network administrator and ask him for the following:

Meter IP address	_____._____._____._____
Gate IP	_____._____._____._____
Mask	_____._____._____._____

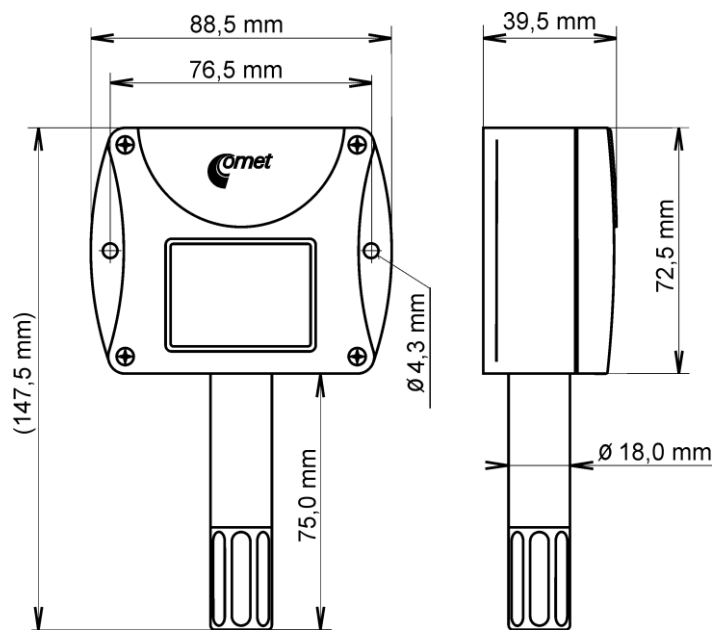The IP gate address and the net work mask need not be specified if the device will be operated only in a local network. If you set the IP address to one which is already used in the network the device will not work correctly and collisions in the network will appear. It is possible to set the IP address by DHCP server.

The IP address of each device is set by the manufacturer to **192.168.1.213.**

Installation procedure

- run a `TSensor` program
- set a new IP address of the device (default IP address is 192.168.1.213)
- configure the device in accordance with your requirements (alarm settings, sending of e-mail, traps…)
- store the settings

Checking operation

Visual check

After connecting the power supply the LCD displays a currently measured value (if the LCD has not been switched off).

Communication check via a LAN

Open a browser of www pages and enter the device IP address.

Example: http://192.168.1.213

The device displays its name, serial number, measured values, alarm states and alarm settings. If „Access denied" appears instead, the display of www pages is not allowed.

Calibration

Recommended calibration interval is
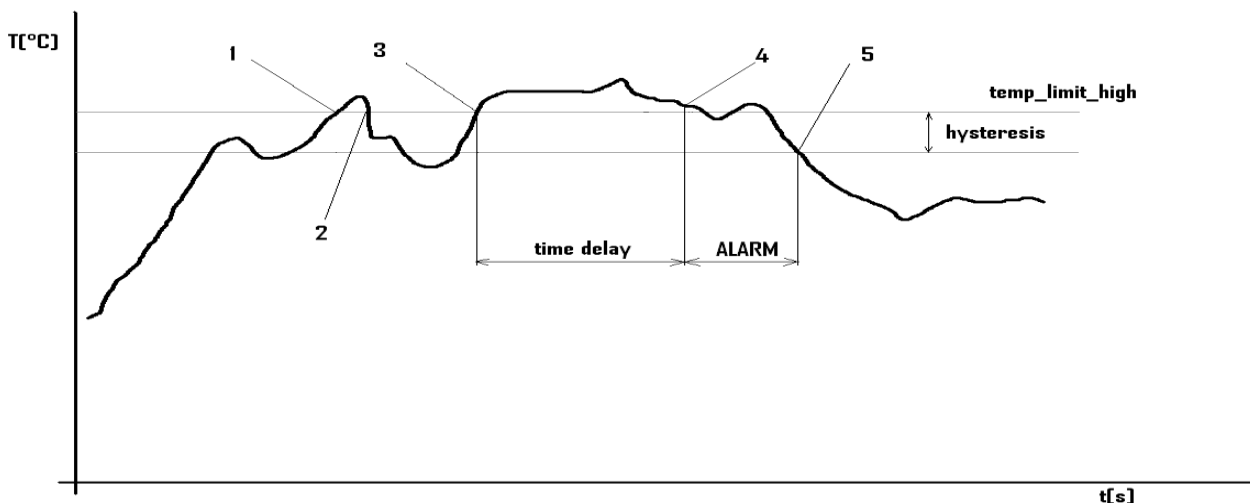- T2514   1 year
- T3511(P)   1 year
- T4511   2 years
- T7511   1 year
- T0510   1 year
- T3510   1 year
- T7510   1 year

Description of device functions

Information provided by the device can be read on its LCD display or by means of the following protocols. Device allows sending SOAP messages to selected web server. To communicate via SNMPv1 and Modbus and SOAP protocols it is necessary to have appropriate software installed on the computer. Such software is not included in the delivery.

Alarms

It is possible to set an upper limit, lower limit, hysteresis and time delay to each measured value. Figure shows a temperature curve with some specified upper limit (temp_limit_high) and hysteresis. At point 1 temperature exceeds the limit. From that moment a time delay is counted (time_delay) after which an alarm is set. Because at point 2 the temperature dropped below the limit value (temp_limit_limit) before the time delay expired, alarm was not set.

Temperature curve

At point 3 the temperature again exceeded the limit, and because it did not drop below the limit value (temp_limit_high) before the time delay ended, the alarm was set at point 4. At this moment the alarm e-mails and traps are sent, if they are enabled, and the alarm flag is set (the flag is set when the alarm is active and reset when inactive). The state of the flag can be found on the www

pages or via Modbus or the information console. The alarm lasted to point 5, where the temperature dropped below the limit value given by the adjusted hysteresis (temp_limit_high– hysteresis).

For other measured values the principle of alarm activity is analogical.

An alarm report is always sent right after an alarm appears. The device memorizes sent alarm reports of current alarms while the power is connected. In case of power disconnection or a reset of the device (e.g. by modification of configuration) a new alarm evaluation is performed and new alarm reports are sent again, if any.

It is possible to set the alarm parameters via telnet, Modbus protocol or a SNMPv1 protocol, Tsensor program. Detailed description of setting via these protocols can be found in chapters informing about particular services.

Modbus

The device contains support for the Modbus protocol to communicate with control systems. The device uses Modbus TCP protocol. The port is set to 502. The Modbus address of the device is always set to 1. Port 502 enables full access, i.e. both read and write operations are supported. Access to port can be disabled in the Setup. Maximal number of client transaction is set to 1.

Supported Modbus commands:

Command	Code	Description
Read multiple register(s)	0x03	Reads 16 bit register(s)
Write multiple register(s)	0x10	Writes 16 bit register(s)

Modbus registers of the device:

Variable	Unit	Format	Address [hex]	Address [dec]	Size [bits]	Status
measured temperature	[°C]	Int*10	0x0031	49	16	r
measured relative humidity	[%]	Int*10	0x0032	50	16	r
computed value (CV)	CV depend	Int*10	0x0033	51	16	r
measured barometric pressure[1]	CV depend	Int*X	0x0034	52	16	r
Device serial number Hi	[-]	BCD	0x1035	4149	16	r
Device serial number Lo	[-]	BCD	0x1036	5150	16	r
lower limit for temperature	[°C]	Int*10	0x5001	20481	16	r/w
upper limit for temperature	[°C]	Int*10	0x5002	20482	16	r/w
lower limit for humidity	[%]	Int*10	0x5003	20483	16	r/w
upper limit for humidity	[%]	Int*10	0x5004	20484	16	r/w
lower limit for computed value	CV depend	Int*10	0x5005	20485	16	r/w
upper limit for computed value	CV depend	Int*10	0x5006	20486	16	r/w
temperature hysteresis	[°C]	Int*10	0x5007	20487	16	r/w
tolerated time of exceeding of temperature	[s]	uInt	0x5008	20488	16	r/w
RH hysteresis	[%]	Int*10	0x5009	20489	16	r/w
tolerated time of exceeding of RH	[s]	uInt	0x500A	20490	16	r/w
computed value hysteresis	CV depend	Int*10	0x500B	20491	16	r/w
tolerated time of exceeding of CV	[s]	uInt	0x500C	20492	16	r/w
Temperature alarm status	[-]	Ascii	0x500D	20493	16	r
RH alarm status	[-]	Ascii	0x500E	20494	16	r

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[1] hPa, mBar, mmHg, inH$_2$O, oz/in^2 jsou Int*10, inHg, kPa jsou Int*100, PSI jsou Int*1000

computed value alarm status	[-]	Ascii	0x500F	20495	16	r
lower pressure limit	CV depend	Int*X	0x5010	20496	16	r/w
upper pressure limit	CV depend	Int*X	0x5011	20497	16	r/w
pressure hysteresis	CV depend	Int*X	0x5012	20498	16	r/w
pressure limit status	[-]	Ascii	0x5013	20499	16	r
tolerated time of exceeding of pressure	s	uInt	0x5014	20500	16	r/w

Legend:
- r   register is designed for read
- w   register is designed for write
- Int*10   register is in format of integer*10.
- Int*X   register is in format of integer*10, int*100, int*1000 depend on type[1]
- BCD   register is in format of BCD
- uInt   register is at range of 0-65535
- Ascii   character

Temperature, RH, pressure and computed value alarm states can have the following values:
- no   there is no alarm
- lo   value is lower than adjusted limit
- hi   value is higher than adjusted limit

SMTP

In case of exceeding adjusted limits of measured values the device can send e-mails to maximum of three addresses. Maximum length of an e-mail address is 55 characters. It is necessary to set your SMTP server address for correct function of e-mail sending.

If limits of several measured values are exceeded a special alarm e-mail is sent for each alarm state. Dummy address `sensor@[device IP address]` is displayed as a sender of the e-mail. It is not possible to reply to this address. In the Subject field of the message the sentence `Alarm [Description of the device]` is displayed or `Test message [Description of the device]` in the case of sending a test e-mail.

The description of the device is preset to the string TPRh-Sensor, TRh-Sensor, P-Sensor, or T-Sensor depending on the device model.

SNMPv1

By means of the SNMPv1 protocol it is possible to find currently measured values, read and set parameters concerning alarms. In case of alarm activation, warning message (a trap) can be sent to specified addresses. By means of the SNMPv1 protocol it is also possible to display history of last 100 measured values.

For read and write the device communicates via port 161. Traps are sent via port 162. Sending of traps can be disabled in the Setup.

The following traps sent:

- 0/0   reset of the device
- 1/0   testing trap
- 1/1   communication error with SNTP server
- 1/3   communication error with SOAP server
- 6/3   report on a measured value being outside of the limits or a return of the measured value to the limits

For the correct function of the SNMPv1 server it is necessary to store the MIB table RFC-1213.mib and Tx5xx.mib to the MIB client. The path to the device is then:

iso.org.dod.internet.private.enterprises.comet.products.tx5xx.

MIB tables are available at www pages http://www.cometsystem.cz or on the installation CD in the MIB directory.

Password for a read operation is set by the manufacturer to PUBLIC, password for write is set to PRIVATE. These passwords may be changed in the setup.

History

By means of the SNMPv1 protocol it is possible to display history of the last 100 measured values, stored in adjusted time interval. This interval is set by configuration program. If a value has not been measured yet or an error was detected the value is 9999, or -9999, if pressure is measured. The history is erased after each restart of the device.

WWW

The device supports display of measured values, adjusted limits and alarm states on its www pages. The address of the www pages is identical with its IP address. It is possible to upload self-made web pages to device. More info about user-defined web you can find on http://cometsystem.cz section programs.

Example: The device has an IP address 192.168.1.204. Enter http://192.168.1.204 to the browser address field and confirm it with the Enter key.

Description of the device is displayed on line 1. Description is displayed also in the subject of the e-mail, if sending is enabled. Currently measured values follow: temperature, humidity, computed quantity, alarm states and setting of alarms. In case of the T4511 temperature transducer, only temperature readings are displayed.

WWW pages have adjustable automatic refresh interval. The manufacturer sets it to 60 seconds. The value can be modified in the setup in a range of 10–65535s. If the device has www pages display disabled screen with message "Access denied".

SNTP

The device allows time synchronization with SNTP server. The time synchronization is set to one per day. If the time synchronization failed in next three hours, SNTP trap and e-mail will be sent.

Syslog

Device allows send messages to selected syslog server. Events are described bellow.

event	text
device restart	Device restart
test message	Testing message
alarm occured	Alarm …
SNTP coonection error	NTP connection error
write to device via modbus, SNMP	Settings changed
change firmware	Firmware uploaded
alarm is down	Clearing …
SOAP server communication error	SOAP connection error

SOAP

Device allows sending SOAP messages with measured values to user defined remote web server in preset time intervals 10-65535 s. If the device cannot establish connection with the web server in the whole delay interval, device sends trap 1/3 and tries to send next measured data. The file with XML schema is on `www.cometsystem.cz/schemas/soapTx5xx.xsd`.

How to configure sending SOAP messages example:

There is SOAP service at address http://my.hosting.com/soap/server.php where the transducer shall send SOAP messages each 10s. IP address of the server my.hosting.cz is 123.456.789.123. Then sending SOAP messages needs to be set like this:

SOAP enable: *Yes*

Target web page: my.hosting.cz/soap/server.php
SOAP server IP address: 123.456.789.123
Source port: 80
Destination port: 80 (http servers standardly listens at this port)
Sending interval: 10

Setting of device by Tsensor program

The Setup is designed for managing device settings. Setting is performed by means of `Tsensor` program[2], or telnet. Setting thru the telnet is described in separated document on http://www.cometsystem.cz. Access to the Setup can be protected by a password. The `TSensor` program you can find on http://www.cometsystem.cz or on the installation cd. This program is free for use and supports firmware update too. The newest firmware is available at web pages too.

Run the `TSensor` program and follow the program instructions. Settings options will be described in the next chapter.

Communications setup card

Global settings

> **Contact your network administrator to get the correct values of the IP address, mask, gateway. Entering incorrect values can cause the device be not found in the network or other complications!**

Sensor IP: setting of the IP address of the device.
Get IP from DHCP server: Set the IP address to 0.0.0.0. DHCP server on the network will provide the unit with an IP address, gateway address, and subnet mask when the unit boots up. If you do not change the DHCP name, and you are using an IP of 0.0.0.0, then the DHCP name will default to CXXXXXX (XXXXXX are the last 6 digits of the MAC address shown on the label on the bottom/side of the unit).
For example, if the MAC address is 00-20-4A-12-34-56, then the default DHCP name is C123456. You can change the DHCP name by specifying the last octet of the IP address. When you use this method, the DHCP name will be LTXYY where YY is what you chose for the last octet of the IP address. If the IP address you specify is 0.0.0.12, then the DHCP name will be LTX12. This method will only work with 2 digit numbers (0-99).

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[2] In telnet some settings are not allowed (display settings, computed value selection)

Gateway IP: setting of the internet gateway. The value need not be entered if the device will operate only in a local network.

Netmask: setting of the network mask of your network.

Example:

mask	no. of bits
255.255.255.252	2
255.255.255.0	8
255.128.0.0	23

Configuration password: change of the access password for telnet.

Sensor name: The description of the device (it is possible to change it if needed). This description is displayed on WWW pages and in subjects of sent e-mails. Its maximum length is 32 characters.

MTU size: (maximum transmission unit) – maximal packet size. Default setting is 1400, range is from 1400 to 512. If you have some troubles with connection, try reducing the MTU size.

E-mail settings- SMTP configuration

Sending warning e-mail: Enabling of sending warning e-mails after alarm activation.

SMTP IP: setting of an IP address of the SMTP server. Correct setting is required for the device to be able to send e-mails. Contact your network administrator to get the correct address.

recipient 1-3: e-mail addresses of warning e-mail recipients.

Send test email: In case of confirmation a test e-mail is sent to the specified addresses.

Default e-mail sender: allow change the mail from box.

SNMP- Trap Configuration

traps sending enable: enabling/disabling of sending SNMP traps.

Password for read: setting of the password for access to SNMP MIB tables.

Password for write: setting of the password for write to SNMP MIB table of the device.

Trap IP 1-3: the IP address of recipients of SNMP traps.

Send test trap: Sends a test trap of type 1/0 to the specified IP addresses.

WWW- WWW configuration

Enabled: enables the display of www pages

WWW refresh: interval for automatic page refresh (update of measured values). Range 10– 65535 s.

Modbus- Modbus configuration

Setting of Modbus. The device provides access to measured values by means of the Modbus. The port is set to 502. Change the Modbus port through the telnet is possible.

Enabled : enables the access to the device

Port: modbus port

SNTP

SNTP enabled: enable time synchronization with SNTP server

SNTP IP: SNTP server IP address

UTC +: time shift (in minutes) between device place and UTC (GMT) time. Summer time is not supported.

History

Storage time: interval of data storage to table

Factory defaults – setting from the manufacturer

This selection sets the Setup items to the following values:

- sets SMTP server address to 0.0.0.0
- erases addresses of e-mail recipients
- disables sending of e-mails
- erases addresses of SNMP traps recipients
- disables sending of traps
- set modbus port to 502 and enable this port
- enables display of www pages
- sets refresh time of www pages to 60 seconds
- enables access via Modbus
- disable SNTP server
- sets history logging interval to 60 s
- setting of alarms: upper temperature limit: 300 °C, lower temperature limit: -200 °C, temperature hysteresis: 1 °C, time delay for alarm activation after exceeding temperature limit: 30 s, upper humidity limit: 100 %RH, lower humidity limit: 0 %RH, humidity hysteresis: 1 %RH, time delay for humidity alarm activation after exceeding limit: 30 s, upper limit of computed value: 80, lower limit of computed value: -50, hysteresis of computed value:1, time delay for computed value alarm activation after exceeding limit:30 s
- set sensor name to TRh-Sensor, TPRh-Sensor, P-Sensor or T-Sensor in compliance with sensor type

Save settings

Saves modifications to the memory and resets the device.

Communications setup card I

SOAP- sending data to server settings

This function allows sending measured data to remote web server in defined interval

Enabled: SOAP sending enabled
Target SOAP server IP address: remote web server IP address
Get IP From Host Name: getting IP address from DNS server
Target web page: path to web page, where device send the message
Source port: device source port
Destination port: web server port
Sending interval: sending interval to web server

Syslog – sending messages to syslog server

Enabled: sending message to syslog server enabled
SysLog IP address: syslog server IP address
Send syslog message: send test message to syslog server

Configuration card

Alarm configuration

Setting of alarms. This submenu contains settings of upper limits, lower limits, hysteresis and time delays for supported quantities.

Computed quantity

Select of the desired computed quantity- dew point temperature, absolute humidity, specific humidity, mixing ratio or specific enthalpy.

Atmospheric pressure

This value is needed for some of computed humidity quantities.

Pressure compensation for altitude above sea-level

This offset depends on current altitude. This value is add to barometric pressure, final value must be in range 300 hPa to 1350 hPa. If the pressure is over this limit, result is Error 2.

Display settings

Display settings.

What to do when…

I forgot the IP address of the device

Finding the device IP address

IP address is set to the value 192.168.1.213 by the manufacturer. If you changed it and forgot the new IP address, run the `TSensor` program and press the "Find…" button. In a new window all sensors will be show.

It is not possible to connect to the device from a LAN

In the "Find device" window is only IP and MAC address displayed

The next information is displayed as N/A. This problem will be occurred, when the device IP is set to another LAN.

In `TSensor` program choose `Find device/Change IP address`. Follow the program instruction.

The sensor IP address in Find device window is not displayed

In `TSensor` program select `Find device/Help my device Wasn't found!` Follow the program instruction.

Finding the MAC address

The MAC address is a unique address of a device which is necessary to be known e.g. in case when there are several devices connected to the network. MAC address is on device label.

It is not possible to find meter after manual MAC enter

In `TSensor` program select `Find device/Help my device Wasn't found`. In this select "Set IP to ARP only". To "Device MAC address" enter the meter MAC address (e.g. 00-20-4A-84-F0-80) and press the "Set IP" button.

Open telnet to the IP address you assigned to the device MAC address by running a telnet command `telnet [IP_address_assigned_to_MAC_address] 9999` and confirm with the Enter key. Choose 0- Global Settings, set the meters IP address, clear the gate IP, no. of net mask set to 0. Pres the Enter key, until you are not back into a menu. Press 9 Save and Exit. The connection will be closed. Now you can connect to meter by the `TSensor` program.

Display is off:

- check if the power is connected
- disconnect and connect the power - watch the display at the moment of connecting the power. If all LCD segments light for 1 second and go out again, the display is turned off by the software.

Device error states

The device still make self-test. If error occurred, LCD show error code:

Error 0

On the first display line is "Err 0". Internal memory CRC error occurs. This error occurs when incorrect write into device, or write to unspecified memory range. This is critical error, contact device distributor. In this state device doesn't work.

Error 1

Measured or computed quantity is over the upper limit. This state appears in case of:

- Measured temperature is higher than approximately 600 °C (i.e. high non-measurable resistance of temperature sensor, probably opened circuit).
- Relative humidity is higher than 100%, i.e. damaged humidity sensor, or humidity calculation of humidity is not possible (due to error during temperature measurement).
- Computed value – calculation of the value is not possible (error during measurement of temperature or relative humidity or value is over range).

Error 2

Measured or computed quantity is under lower limit, or is error in pressure measuring. This value i s-999.9. This shut be when:

- Measured temperature is lower than approximately -210 °C.
- Relative humidity is lover than 0 %
- Measured pressure with pressure elevation is over range 300 to 1350 hPa, or the probe is damaged. Check the correction in Tsensor program.
- Computed value- result cannot be computed.

Error 3

Internal A/D converter error. Contact the distributor.
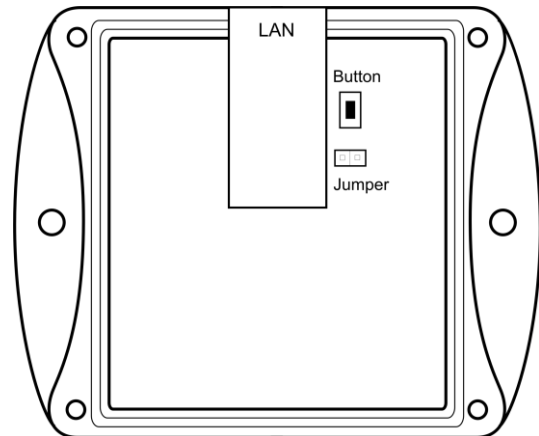
Error 4

Internal pressure probe error. Contact the distributor.

Forgotten password to the setup

- disconnect the power
- unscrew upper lid of the device case
- press the button inside the device and connect the power at the same time. Keep the button pressed
- keep the button pressed for 10 s - then the password will be erased
- close the device

The settings program cannot write to device

Open the device and close jumper.

Preventive maintenance

Pay heed to recommended calibration interval. Do not subject the device to mechanical stress.

Technical specification

Technical parameters:

Common parameters:

Power voltage: 9 to 30 V DC
Power consumption: approximately 1 W
Power connector: coaxial connector, diameter 5,5 x 2,1 mm, (+) internal contact
Measuring interval: 1 s
Display switching interval: 4 s (when more than two values are displayed)
Communication with computer: Ethernet connection (RJ-45 connector)
Protection: IP30 - case with electronics
EMC: Devices conform in accordance with EN 61326-1 these norms:

Radiation:	EN 55022	class B
Immunity:	EN 61000-4-2	levels 4/8 kV, class A
	EN 61000-4-3	intensity of electromagnetic field 3 V/m, class A
	EN 61000-4-4	levels 1/0.5 kV, class A
	EN 61000-4-6	intensity of electromagnetic field 3 V/m, class A

Temperature and relative humidity meter T3511(P)

Temperature

Accuracy:	± 0,4 °C (±0,7 °F)
Range:	-30 to +105 °C (-22 to 221 °F), including probe cable
Resolution:	0,1 °C (0,2 °F)

Relative humidity:

Accuracy:	± 2,5 %RH in range 5 to 95 %RH in 23 °C (73,4 °F)
Range:	0 to 100 %RH, temperature compensated
Resolution:	0,1 %RH

Temperature and humidity measuring range is limited accordingly with graph below.
Probe protection: IP 40

Response time with stainless steel metal sensor cover (F5200B) and bronze sensor cover (F0000 –selectable option), air flow approximately 1 m/s:

temperature: T3511 t90 < 6 min (temperature step 20 °C (68 °F))

T3511P t90 < 16 min (temperature step 20 °C (68 °F))

relative humidity: t90 < 30 s (humidity step 65 %RH, constant temperature)

Temperature, relative humidity and atmospheric pressure meter T7511

Temperature, relative humidity and computed quantity values are same with T3511(P) meter.

Barometric pressure:

unit	hPa, mBar	PSI	mmHg	inHg	inH$_2$O	oz/in^2	kPa
range	600	8,70	450,0	17,72	240,9	139,2	60,00
	1100	15,95	825,1	32,48	441,6	255,3	110,00
accuracy							
T=23 °C	±1,3	±0,02	±1,0	±0,04	±0,5	±0,3	±0,13
0≤T≤40°C	±1,5	±0,02	±1,1	±0,04	±0,6	±0,3	±0,15
else	±2,0	±0,03	±1,5	±0,06	±0,8	±0,5	±0,20

Response time[3]**:** pressure: t90 <44s

Pressure meter T2514

Pressure limits are same as T7511.

Temperature transducer T4511

Probe: Pt1000/3850 ppm, connected by shielded cable of 10m maximum length
Temperature measuring range: -200 to +600 °C (-255 °F to 999 °F)
Temperature resolution: 0,1 °C (0,2 °F)
Accuracy of temperature measurement: ±0.2 °C (0,4 °F)

Temperature meter T0510

Temperature measuring range: -30 to +80 °C (-22 to 176 °F)
Temperature resolution: 0,1 °C (0,2 °F)
Accuracy of temperature measurement: ±0,6 °C (±1,1 °F)

Temperature and relative humidity meter T3510

Temperature

Accuracy: ± 0,6 °C (±1,1 °F)
Range: -30 to +80 °C (-22 to 176 °F)
Resolution: 0,1 °C (0,2 °F)
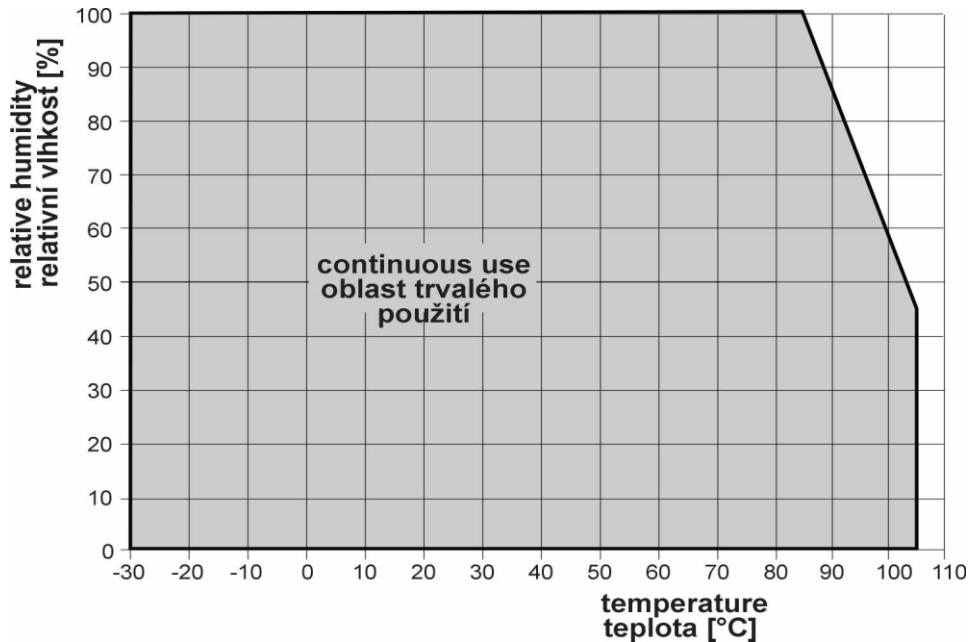
Relative humidity: values are the same with T3511(P).
Temperature and humidity measuring range is limited accordingly with graph below.

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[3] Response time is selectable. More details you can find in Calibration manual, whitch is included in Tsensor installation directory..

Temperature, relative humidity and atmospheric pressure meter T7510

Temperature, relative humidity and computed quantity values are same with T3510 meter. Pressure values are the same with T7511 meter.

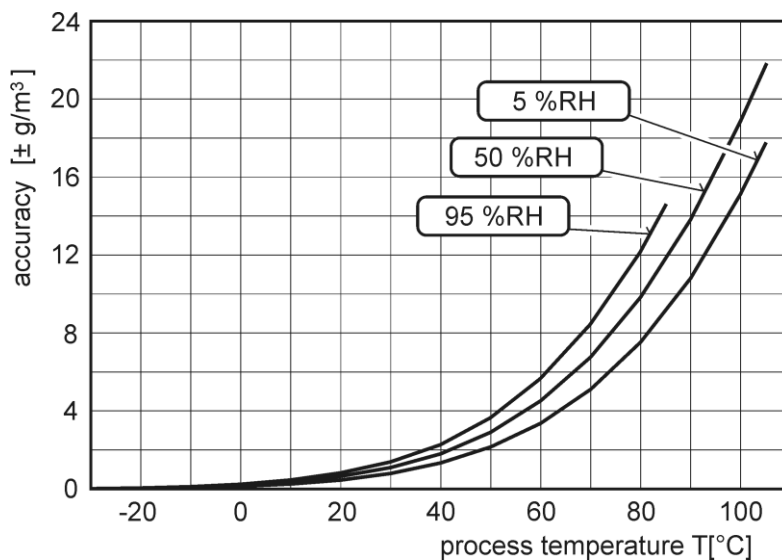## Relative humidity and temperature restriction

The value computed from ambient temperature and relative humidity:

Absolute humidity
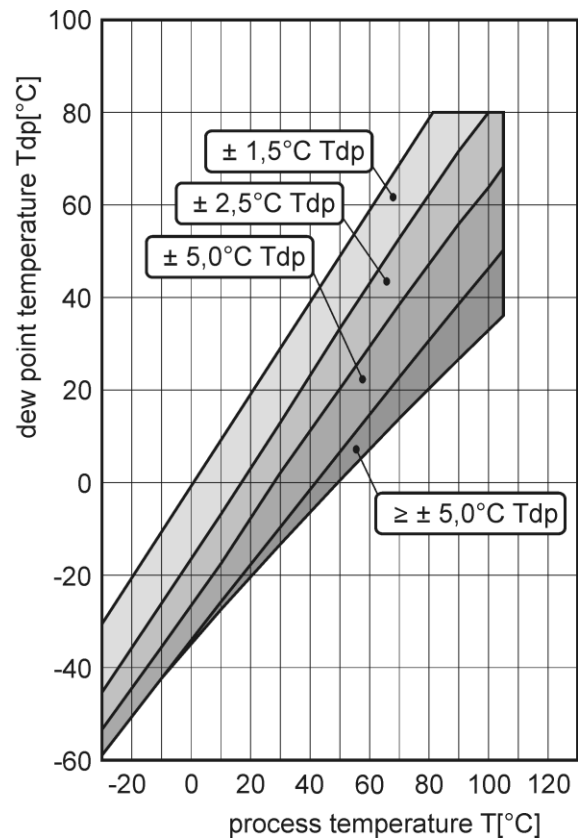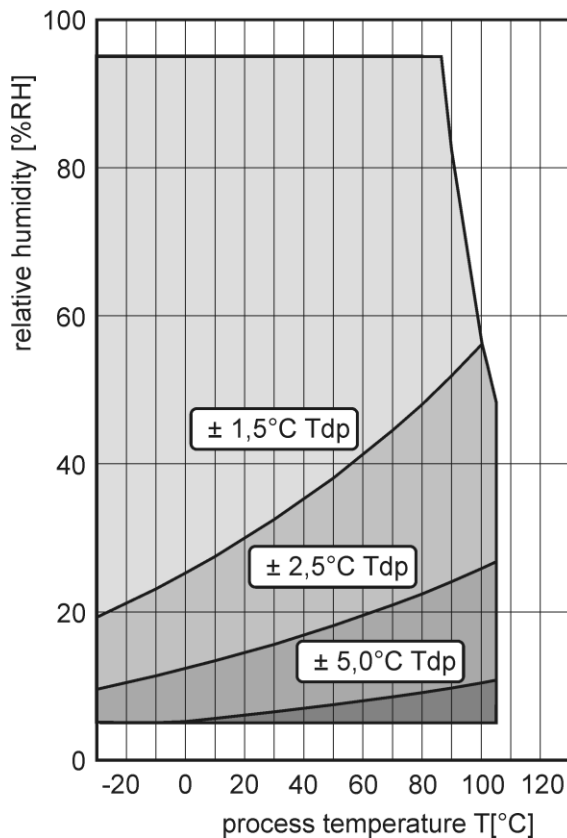Accuracy: $\pm 3 g/m^3$ at ambient temperature $T < 40°C$ (104 °F), for more details see graph
Range: 0 to 400 g/m^3

Dew point temperature

Accuracy: ±1,5 °C (±2,7 °F) at ambient temperature T < 25 °C (77 °F) and RV>30 %, for more details see graphs bellow

Range: -60 to +80 °C (-22 to 176 °F)

Specific humidity[4]

Accuracy: ±2,1 g/kg at ambient temperature T < 35°C (95 °F)

Range: 0 to 550 g/kg

Mixing ratio[4]

Accuracy: ±2,2 g/kg at ambient temperature T < 35°C (95 °F)

Range: 0 to 995 g/kg

Specific enthalpy[4]

Accuracy: ± 4 kJ/kg at ambient temperature T < 25°C (77 °F)

Range: 0 to 995 kJ/kg [5]

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[4] This value depends on the atmospheric pressure. For computing is used constant value stored in device memory. Default value preset by manufacturer is 1013hPa and can be changed by user's software.

[5] This maximum is reached under conditions about 70°C/100%RH or 80°C/70%RH

Operating conditions

Operating temperature and humidity range:
>   electronics T0510,T3510, T7510, T3511(P), T4511, T7511, T2514: -30 to +80 °C, 0 to 100 %RH (not condensing)
>   probe T2514, T7511, T3511(P): -30 to +105 °C include probe cable, 0 to 100 %RH
>   external T4511 probe - depends on probe model.
>   LCD display must be switched off at temperature over +70°C!

Outer characteristics in accordance with Czech National Standard 33-2000-3:
>   Normal environment with the specifications: AE1, AN1, AR1, BE1

Operating pressure range of probe T3511P: up to 25 bar

Air flow velocity (T3511P probe): up to 25 m/s at a pressure of 1bar (1m/s at a pressure of 25 bar)

Working position:
>   T2514, T3511(P), T4511, T7511 . . .arbitrary
>   T0510, T3510, T7510 . . . with sensor cover downwards. When mounting the temperature meter to 19" rack with universal holder MP046 (optional accessory) then sensor cover can be placed horizontally.

Installation of the instrument: by means of two holes at the bottom part

Not allowed manipulations: It is not allowed to operate the device under conditions other than specified in technical parameters. Devices are not designed for locations with chemically aggressive environment. Temperature and humidity sensors must not be exposed to direct contact with water or other liquids. It is not allowed to remove the sensor cover to avoid any mechanical damage of the sensors.

Limits on conditions (the device without a probe): temperature -40 to +80 °C, humidity 0 to 100 %RH not condensing

Mechanical connection of probe T3511P: G1/2 with O-ring

Mechanical dimensions: see dimensional drawings

Weight: approximately:
>   T2514 130 g,
>   T3510 155 g,
>   T3511/1m probe 210 g, T3511/2m probe 250 g , T3511/4m probe 330 g,
>   T3511P/1m probe 260 g, T3511P/2m probe 300 g , T3511P/4m probe 380 g,
>   T4511 145 g,
>   T0510 145 g,
>   T7510 155 g,
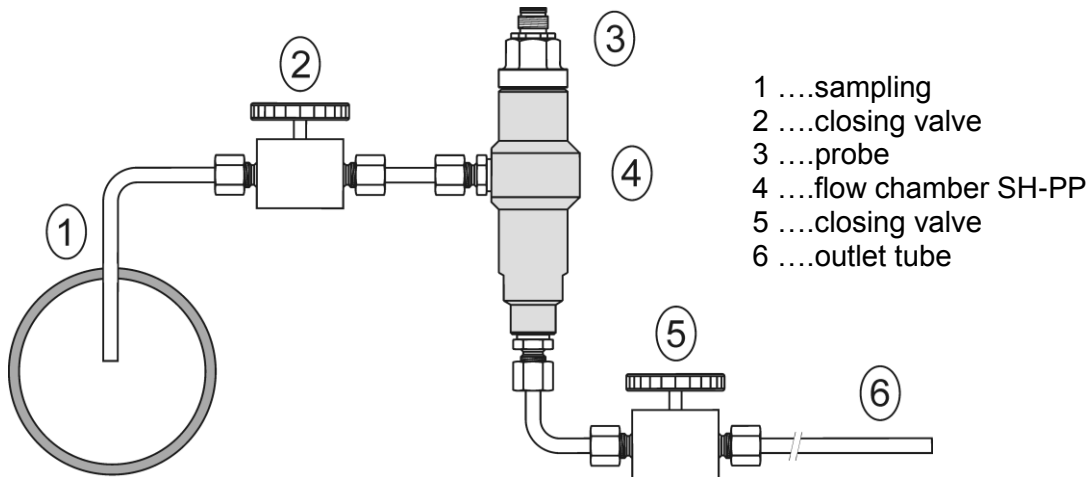>   T7511/1m probe 210 g, T7511/2m probe 250 g, T7511/4m probe 330 g

Material of the case: ABS

Material of the probe T3511P: duralumin with the black eloxal surface finish

Liquidation: Device itself (after its life) is necessary to liquidate ecologically!

Appendix A

The probe for measuring the moisture of compressed air should be placed directly on the pressure pipelines to achieve higher measurement accuracy and fast response times. But they are cases where such placement is not possible. The reason is the high air speed, high temperature, high pollution, small diameter pipes, etc. Such situation can be solved by placing the probe into the flow measuring chamber. The picture shows the basic layout of the sampling system with chamber SH- PP.

1 ....sampling
2 ....closing valve
3 ....probe
4 ....flow chamber SH-PP
5 ....closing valve
6 ....outlet tube

sampling (1) - end of the tube placed in the centre of pressure pipelines (distribution of moisture in the pipe cross-section is not homogeneous). To achieve fast response times to shorten the length of the sample tubes to a minimum (few meters).

closing valve (2) - allows access to the sample system without interrupting the main line

closing valve (5) - the sample flow is regulated by this valve. Measurement accuracy is typically not affected by the sample flow rate, but at low speeds, increasing response time.

outlet tube (6) - if the measured sample of air is released into the atmosphere, select the length of the outlet tube of 1.5 m (recommended for tube diameter 6mm). The reason is to ensure the accuracy of the sample in the flow chamber and avoid back diffusion of moisture from the ambient air..

That basic structure of sampling system can be supplemented with filters, coolers, flow measurement, pressure measurement, etc. For the accurate operation of sampling system is important to ensure perfect tightness of all connections and to use corrosion-resistant materials. Tube inclination is chosen so as to avoid the accumulation of fluid in the system.

Technical specification – flow chamber SH-PP

Material of flow chamber:	stainless steel (DIN 1.4301)
Inlet and outlet connection:	G1/8
Probe connection:	G1/2
Sample flow rate:	0.1 to 3 l/min
Operating pressure:	up to 25 bar
Weight:	580 g

Note: Screw-coupling not included