CO_2 concentration transmitter with Ethernet connection

T5540

Programmable transmitter of temperature, relative humidity, CO_2 and other derived humidity values with Ethernet connection

T6540

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.

Content

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

General description

The T55xx and T65xx devices are designed for online measurement of temperature (°C or °F), relative humidity and carbon dioxide concentration of air without aggressive ingredients. Measured temperature and relative humidity are recomputed to following humidity expression: dew point temperature, absolute humidity, specific humidity, mixing ratio and specific enthalpy.

Type	Temp	Humidity	CO_2	Computed quantity
T5540	-	-	✓	-
T6540	✓	✓	✓	✓

Principle of CO_2 concentration measurement is based on Non-Dispersive Infrared Technology (NDIR). It is maintenance free because of the patented autocalibration feature, compensating for the effects of aging and therefore a guarantee for outstanding long-term stability. If the device is in operation permanently, an auto-adjustment will start automatically after 24 hours operation each.

Measured values can be read in „SLOW mode" (filtered, averaged) or in „FAST mode" (current values without averaging). SLOW mode has advantages in applications like climate control because of filtering short time peaks. As an example exhaled air from an employee passing the sensor could affect the climate control negatively with a short response time because the control would trigger a change of the ventilation based on this one-time measurement.

The visual indication of CO_2 concentration is provided by three-color LED.

After power up of the device starts internal test. During this time (about 20s) LCD display shows (----) instead of CO_2 concentration value.

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 and conditions of CO_2 concentration measurement 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.

What is needed to operate instrument

- ac/dc adapter 9-30V, 200mA or PoE splitter
- RJ-45 LAN connection
- free IP address in your network

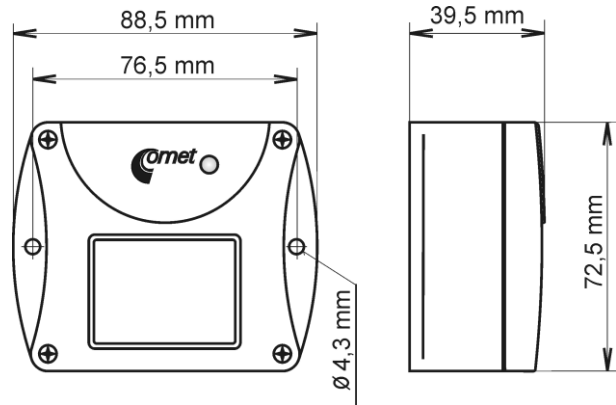**Contact network administrator to get free IP address.**

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.
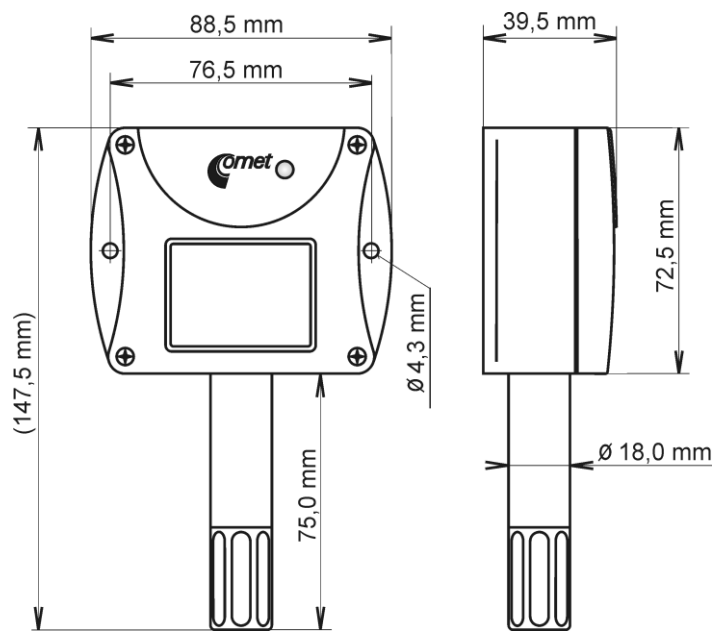
Procedure of instrument connection
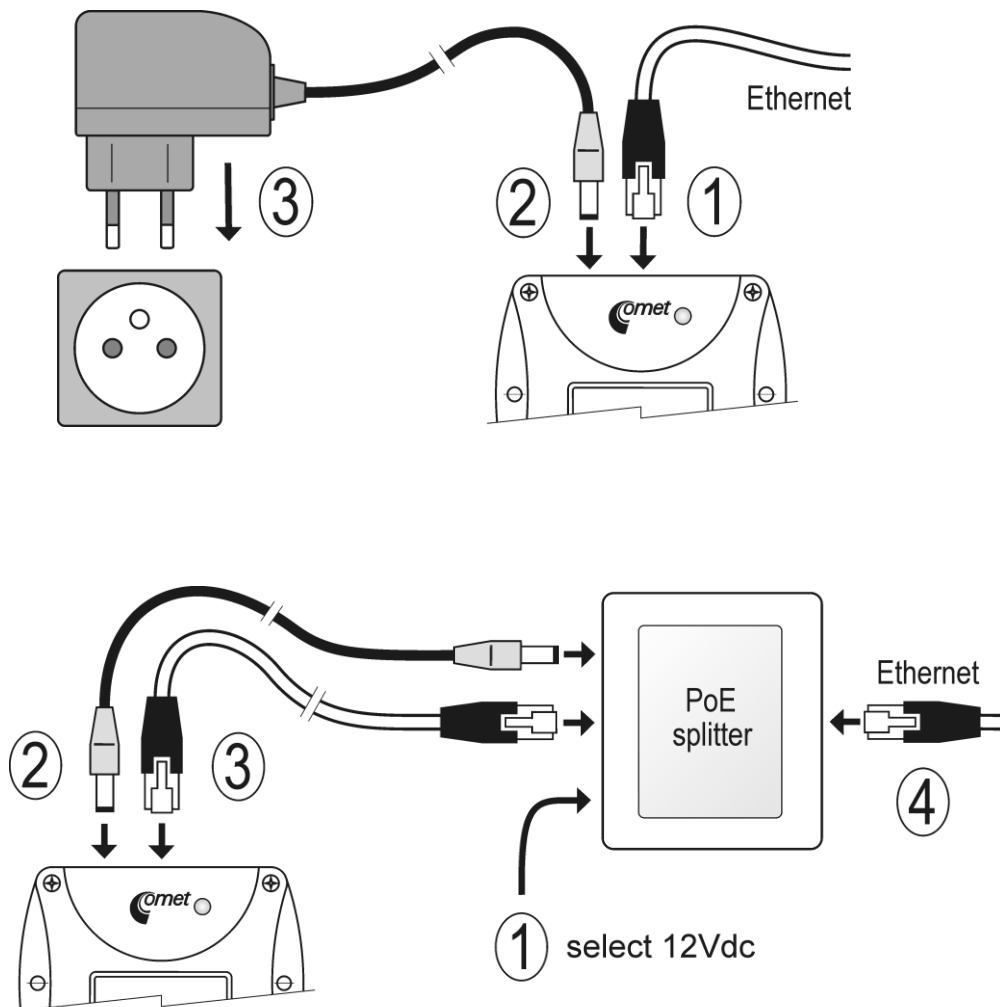
Dimensions

Transmitter T5540

Transmitter T6540

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 alarm settings, sending of e-mail, traps…
- set CO_2 concentration measuring mode and change (as needed) values of two boundary limit of LED indication

Whole measuring range of CO_2 concentration (0 to 2000 ppm) can be divided into three areas. Using three-color LED the transmitter indicates, in which of these areas the measured value is.
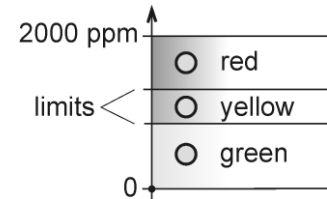
- store the settings

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
- T5540   2 years
- T6540   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.
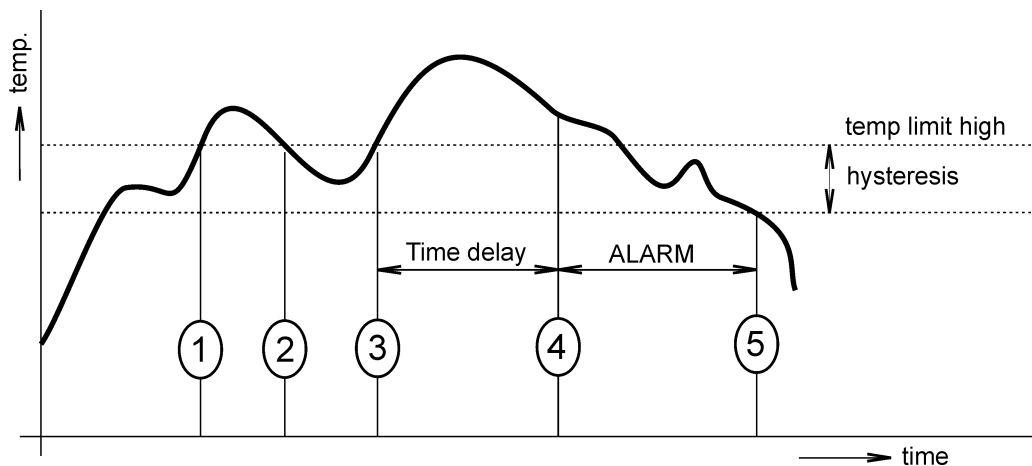
At point 3 the temperature again exceeded the limit, and because it did not drop below the limit value (temp_limit_high) before the time delay ended, the alarm was set at point 4. At this moment the alarm e-mails and traps are sent, if they are enabled, and the alarm flag is set (the flag is set when 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

Variable	Unit	Format	Address [hex]	Address [dec]	Size [bits]	Status
computed value (CV)	CV depend	Int*10	0x0033	51	16	r
CO_2 concentration displayed on LCD (depends on mode setting)	ppm	Int	0x0034	52	16	r
„FAST" mode CO_2 value	ppm	Int	0x0054	84	16	r
„SLOW" mode CO_2 value	ppm	Int	0x0055	85	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
computed value alarm status	[-]	Ascii	0x500F	20495	16	r
lower CO_2 concentration limit	ppm	Int	0x5010	20496	16	r/w
upper CO_2 concentration limit	ppm	Int	0x5011	20497	16	r/w
CO_2 concentration hysteresis	ppm	Int	0x5012	20498	16	r/w
CO_2 concentration limit status	[-]	Ascii	0x5013	20499	16	r
tolerated time of exceeding of CO_2 concentration	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, CO_2 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

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[1] hPa, mBar, mmHg, inH_2O, oz/in^2 are Int*10, inHg, kPa are Int*100, PSI are Int*1000

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.

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 connection 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 or telnet[2]. 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).
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 . . . . .
Sending warning e-mail: Enabling of sending warning e-mails after alarm activation.

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

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 configuration . . . . .

Enabled: enables the display of www pages
WWW refresh: interval for automatic page refresh (update of measured values).
Range 10–65535 s.

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.

Quantities and units . . . . .

Selection of the desired computed quantity (dew point temperature, absolute humidity, specific humidity, mixing ratio or specific enthalpy), selection the units of temperature and atmospheric pressure measurement and choice of the CO_2 concentration measurement mode.

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.

CO_2 *indication card*

Setting conditions of the LED indication.

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 - first line of LCD displays „Err0". Check sum error of stored setting inside device's memory. This error appears if incorrect writing procedure to device's memory occurred or if damage of calibration data appeared. At this state device does not measure and calculate values. It is a serious error, contact distributor of the device to fix.

Error 1 - measured or calculated value (except concentration of CO_2) is over upper limit of allowed full scale range. 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).

  The value of concentration CO_2 9999 ppm is the correct value!

Error 2 - there is a reading „Err2" on LCD display. Measured or calculated value is below lower limit of allowed full scale range or CO_2 concentration measurement error occurred. Value read from the device is -999.9. This state appears in case of:

- Measured temperature is lower than approximately -210°C (i.e. low resistance of temperature sensor, probably short circuit).
- Relative humidity is lower than 0%, i.e. damaged sensor for measurement of relative humidity, or calculation of humidity is not possible (due to error during temperature measurement).
- Computed value – calculation of computed value is not possible (error during measurement of temperature or relative humidity).

Error 3 - there is a reading „Err3" on LCD display upper line. Error of internal A/D converter appeared (converter does not respond, probably damage of A/D converter). This error does NOT affect concentration of CO_2 measurement. Rest values are NOT measured. It is a serious error, contact distributor of the device.

Error 4 - there is a reading „Err4" on LCD display. It is internal device error during initialization of CO_2 sensor. Under this condition device does not measure concentration of CO_2. Value read from device is -9999. CO_2 sensor is probably damaged. It is a serious error, contact distributor of the device.
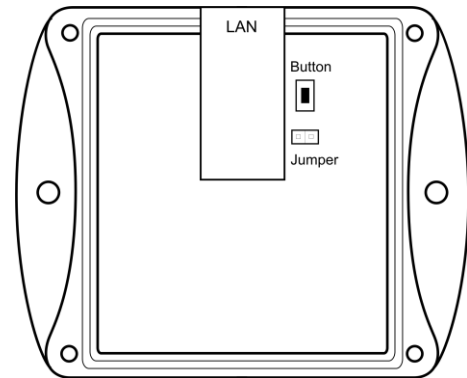
Forgotten password to the setup

- disconnect the power and 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: temperature, relative humidity 2s
                    concentration of CO_2 . . . . 15s
Display switching interval: 4 s (when more than two values are displayed)
Communication with computer: Ethernet connection (RJ-45 connector)
Protection: **T5540** IP30
                 T6540 . . . . IP30, sensors are located in cover with IP40 protection
EMC: EN 61326-1, EN 55011

T5540 - CO$_2$ transmitter

Concentration of CO$_2$:
    Accuracy:: $\pm$ (50 ppm + 2 % of measuring value) at 25°C (77°F) and 1013 hPa
    Range: 0 to 2000 ppm
    Temp. dependence: typ. 2 ppm CO_2 / ºC in the range 0 to 50 ºC (32 to 122°F)
    Long term stability: 20 ppm / year
    Resolution: 1 ppm
Response time: t90 < 195 s in „SLOW" measurement mode
                    t90 < 75 s in „FAST" measurement mode

T6540 - temperature, relative humidity and CO₂ transmitter

Temperature:
Accuracy:	± 0,4 °C (±0,7 °F)
Range:	-30 to +80 °C (-22 to 176 °F)
Resolution:	0,1 °C (0,2 °F)

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

Concentration of CO_2:
Accuracy::	± (50 ppm + 2 % of measuring value) at 25°C (77°F) and 1013 hPa
Range:	0 to 2000 ppm
Temp. dependence:	typ. 2 ppm CO_2 / °C in the range 0 to 50 °C (32 to 122°F)
Long term stability:	20 ppm / year
Resolution:	1 ppm

Measuring temperature and humidity range is limited in accordance with graph below!

Response time measurement of temperature and relative humidity with stainless steel mesh sensor cover (F5200B) and bronze sensor cover (F0000 - selectable option), air flow approximately 1 m/s:

temperature:	t90 < 6 min (temperature step 20 °C (36 °F))
relative humidity:	t90 < 30 s (humidity step 65 %RH, constant temperature)

Response time measurement of CO_2 concentration:

t90 < 195 s in „SLOW" measurement mode

t90 < 75 s in „FAST" measurement mode

Relative humidity and temperature restriction
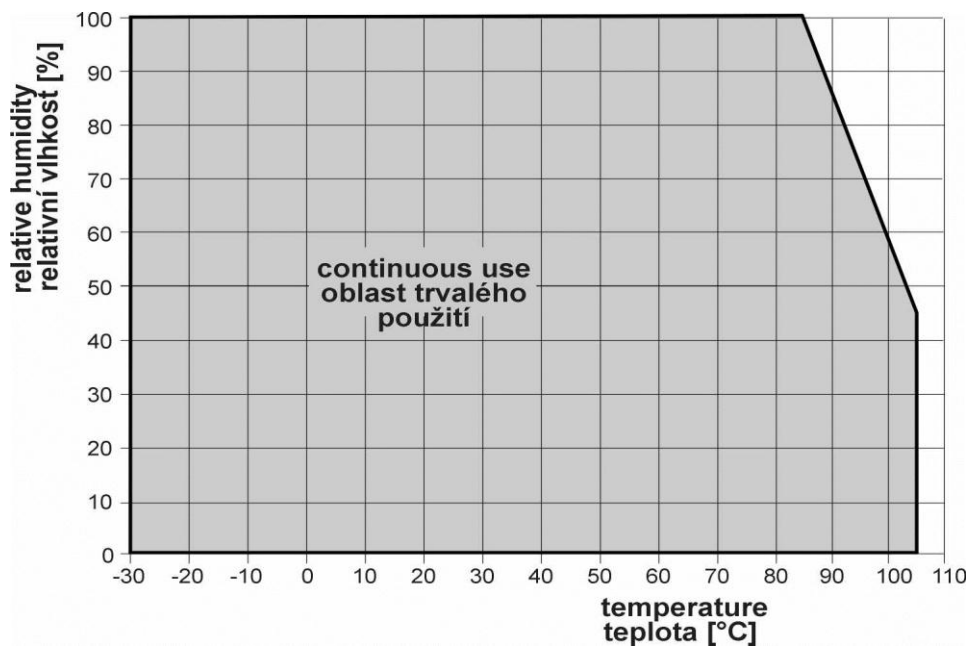
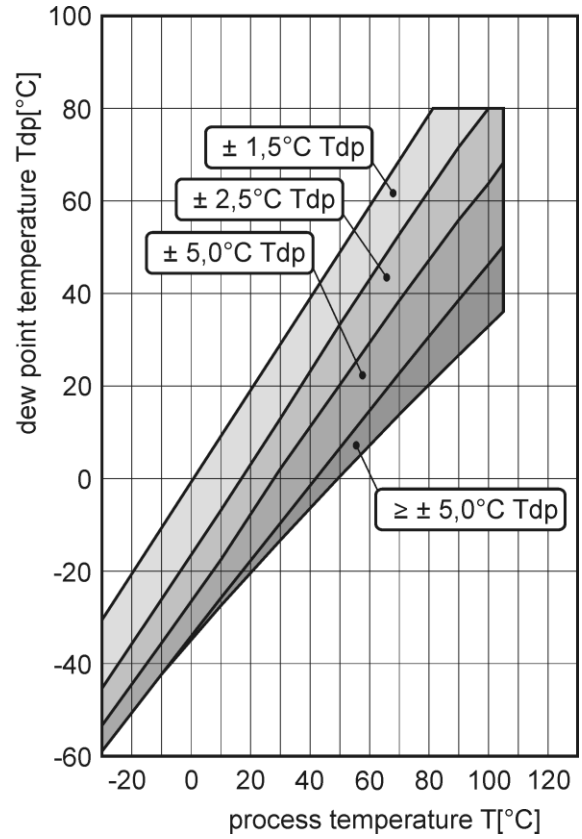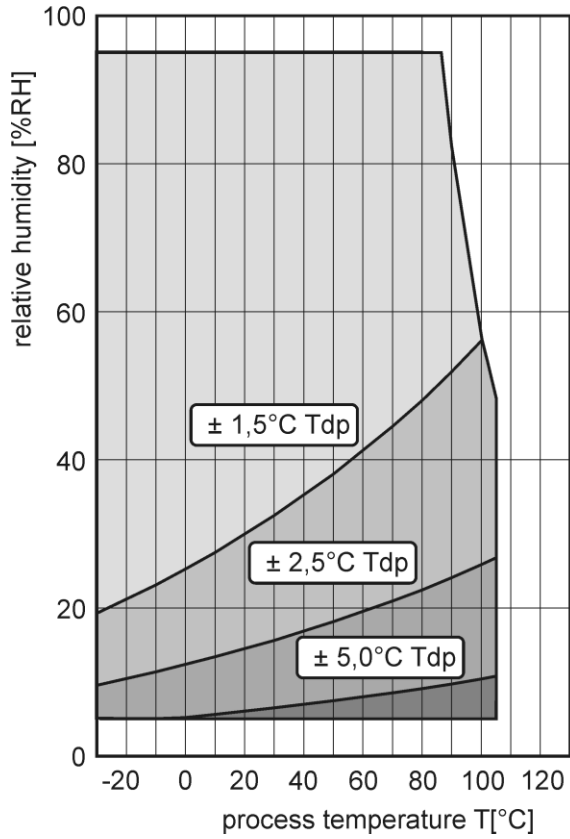**The value computed from ambient temperature and relative humidity:**

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)

Absolute humidity
Accuracy: ±3g/m^3 at ambient temperature T < 40°C (104 °F), for more details see graph
Range: 0 to 400 g/m^3
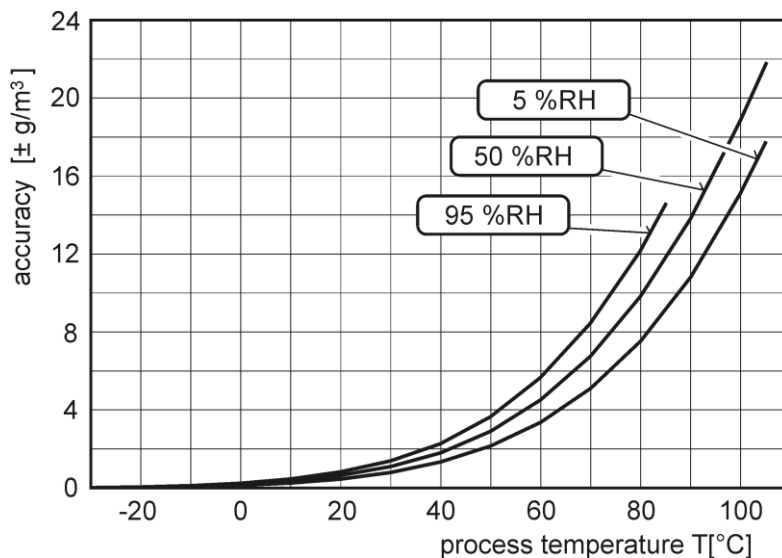
Specific humidity[3]
Accuracy: ±2,1 g/kg at ambient temperature T < 35°C (95 °F)
Range: 0 to 550 g/kg

Mixing ratio[3]
Accuracy: ±2,2 g/kg at ambient temperature T < 35°C (95 °F)
Range: 0 to 995 g/kg

Specific enthalpy[3]
Accuracy: ± 4 kJ/kg at ambient temperature T < 25°C (77 °F)
Range: 0 to 995 kJ/kg [4]

The values computed from ambient temperature and relative humidity including their accuracy you can exactly determine by the program **Conversions**. It is free to download at http://www.cometsystem.cz .

Operating conditions

Operating temperature and humidity range:
electronics **T5540, T6540**: -30 to +60 °C (-22 to 140 °F), 5 to 95 % RH (no condensation)
measuring tip with sensors **T6540**: -30 to +80 °C (-22 to 176 °F)

It is recommended to switch off the LCD display over +70°C!

Operating barometric pressure range: 850 to 1100 hPa

Working position:
T5540: with cable glands upwards
T6540: 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: temperature -40 to +80 °C, humidity 0 to 100 %RH no condensation
Storage conditions: -30 to +60 °C (-22 to 140 °F), 5 to 95 % RH (no condensation), barometric pressure 700 až 1100 hPa
Mechanical dimensions: see dimensional drawings
Weight: approximately
T5540   140 g,
T6540   160 g
Material of the case: ABS
Liquidation: Device itself (after its life) is necessary to liquidate ecologically!

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[3] 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.

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