VAISALA

USER'S GUIDE

Vaisala Combined Pressure, Humidity and Temperature Transmitter PTU300

M210796EN-A

PUBLISHED BY

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CHAPTER 1

GENERAL INFORMATION

About This Manual

This manual provides information for installing, operating, and maintaining PTU300.

Related Manuals

Table 1 Related Manuals

Manual Code	Manual Name
M210195EN-A	PTU200 Series Transmitters User´s Guide

General Safety Considerations

Throughout the manual, important safety considerations are highlighted as follows:

WARNING Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

Feedback

Vaisala Customer Documentation Team welcomes your comments and suggestions on the quality and usefulness of this publication. If you find errors or have other suggestions for improvement, please indicate the chapter, section, and page number. You can send comments to us by e-mail: manuals@vaisala.com

Product Related Safety Precautions

The PTU300 delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING	Ground the product, and verify outdoor installation grounding periodically to minimize shock hazard.

CAUTION	Do not modify the unit. Improper modification can damage the product or lead to malfunction.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself to the equipment chassis before touching the boards.

Ground yourself with a wrist strap and a resistive connection cord. When neither of the above is possible, touch a conductive part of the equipment chassis with your other hand before touching the boards.

- Always hold the boards by the edges and avoid touching the component contacts.

Recycling

Recycle all applicable material.

Dispose of batteries and the unit according to statutory regulations. Do not dispose of with regular household refuse.

Regulatory Compliances

The PTU300 complies with the following performance and environmental test standards:

Trademarks

Microsoft®, Windows®, Windows NT®, and Windows®2000 are registered trademarks of Microsoft Corporation in the United States and/or other countries.

License Agreement

All rights to any software are held by Vaisala or third parties. The customer is allowed to use the software only to the extent that is provided by the applicable supply contract or Software License Agreement.

Warranty

Vaisala hereby represents and warrants all Products manufactured by Vaisala and sold hereunder to be free from defects in workmanship or material during a period of twelve (12) months from the date of delivery save for products for which a special warranty is given. If any Product proves however to be defective in workmanship or material within the period herein provided Vaisala undertakes to the exclusion of any other remedy to repair or at its own option replace the defective Product or part thereof free of charge and otherwise on the same conditions as for the original Product or part without extension to original warranty time. Defective parts replaced in accordance with this clause shall be placed at the disposal of Vaisala.

Vaisala also warrants the quality of all repair and service works performed by its employees to products sold by it. In case the repair or service works should appear inadequate or faulty and should this cause malfunction or nonfunction of the product to which the service was performed Vaisala shall at its free option either repair or have repaired or replace the product in question. The working hours used by employees of Vaisala for such repair or replacement shall be free of charge to the client. This service warranty shall be valid for a period of six (6) months from the date the service measures were completed.

This warranty is however subject to following conditions:

a) A substantiated written claim as to any alleged defects shall have been received by Vaisala within thirty (30) days after the defect or fault became known or occurred, and
b) the allegedly defective Product or part shall, should Vaisala so require, be sent to the works of Vaisala or to such other place as Vaisala may indicate in writing, freight and insurance prepaid and properly packed and labelled, unless Vaisala agrees to inspect and repair the Product or replace it on site.

This warranty does not however apply when the defect has been caused through

a) normal wear and tear or accident;
b) misuse or other unsuitable or unauthorized use of the Product or negligence or error in storing, maintaining or in handling the Product or any equipment thereof;
c) wrong installation or assembly or failure to service the Product or otherwise follow Vaisala's service instructions including any repairs or installation or assembly or service made by unauthorized personnel not approved by Vaisala or replacements with parts not manufactured or supplied by Vaisala;
d) modifications or changes of the Product as well as any adding to it without Vaisala's prior authorization;
e) other factors depending on the Customer or a third party.

Notwithstanding the aforesaid Vaisala's liability under this clause shall not apply to any defects arising out of materials, designs or instructions provided by the Customer.

This warranty is expressly in lieu of and excludes all other conditions, warranties and liabilities, express or implied, whether under law, statute or otherwise, including without limitation ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE and all other obligations and liabilities of Vaisala or its representatives with respect to any defect or deficiency applicable to or resulting directly or indirectly from the Products supplied hereunder, which obligations and liabilities are hereby expressly cancelled and waived. Vaisala's liability shall under no circumstances exceed the invoice price of any Product for which a warranty claim is made, nor shall Vaisala in any circumstances be liable for lost profits or other consequential loss whether direct or indirect or for special damages.

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature of PTU300.

Introduction to PTU300

Vaisala combined pressure, humidity and temperature transmitter PTU300 provides reliable pressure measurement in wide range of applications. Analog outputs can be chosen between current and voltage signals. Alternatively, digital outputs RS-232 (standard) or RS-422/485 (optional) can be selected. A local display is also available. The quantities measured and calculated by PTU300 are presented in Table 2 on page 15. The quantities available as an option are presented in Table 3 on page 15 below.

The PTU300 transmitter combines three measurement parameters: pressure, temperature and humidity. The applications of the PTU300 range from calibration laboratory environmental condition monitoring to laser interferometer active wavelength compensation and GPS meterorological measurements.

The PTU300 transmitter is available with one or two pressure transducers. The PTU301, PTU303 and PTU307 probes are available for the PTU300 transmitter.

In outdoor applications it is recommended to use the PTU300MIK mounting kit with the PTU300 transmitters. In addition, a mounting tripod is available to support the PTU300MIK in temporary field installations.

Basic Features and Options

- Several probes for various applications
- User friendly display
- Two pressure transducer
- A 3 h trend and tendency available in pressure measurement
- Calculated output quantities available
- Different probe mounting kits, sensor protection options and probe cable lengths
- Transmitter mounting kits for multiple installation purposes
- Chemical purge for applications where interfering chemicals in the measuring environment pose a risk
- Warmed probe and sensor heating for high humidity conditions (PTU307)
- Optional modules: isolated power supply, power supply module, RS-422/485-module, additional analog output module and relay module
- Additional temperature sensor

New / improved features:

- Better %RH accuracy
- Graphical display (trend of any parameter)
- Operating voltage range 10...35 VDC, 24 VAC, 100...240 VAC
- Analog outputs for all parameters PTU (2 standard, 3rd optional)
- 0...5 V, 0...10 V, 0...20 mA, 4...20 mA
- 3rd analog output
- Service port for MI70 or PC
- Isolated RS485 module (with one barometer module)
- Relay module (with one barometer module)
- IP65 housing
- Use same accessories as HMT330 -series

Key features:

- Pressure redundancy option: 2 sensors in one unit
- Two accuracy classes, calculated RH quantities

Pressure Measurement

The PTU300 series transmitters use a BAROCAP® silicon capacitive absolute sensor developed by Vaisala for barometric pressure measurement applications. The measurement principle of the PTU300 series digital transmitters is based on an advanced RC oscillator and three reference capacitors against which the capacitive pressure sensor and capacitive temperature compensation sensor are continuosly measured. The microprocessor of the transmitter performs compensation for pressure linearity and temperature dependence.

Table 2 Basic Quantities Measured by PTU300

Quantity	Abbreviation	Metric Unit	Non Metric Unit
Pressure	P	See Table 4 below.	
Relative Humidity	RH	%RH	%RH
Temperature	T	ºC	ºF

Table 3 Optional Quantities Measured by PTU300

Quantity	Abbreviation	Metric Unit	Non Metric Unit
Dewpoint /Frostpoint Temperature ($T_{d/f}$)	TDF	ºC	ºF
Dewpoint Temperature (T_d)	TD	ºC	ºF
Absolute humidity (a)	A	g/m^3	gr/ft^3
Mixing ratio (x)	X	g/kg	gr/lb
Wetbulb temperature (T_w)	TW	ºC	ºF
Humid air volume/ dry air volume (by volume or by weight) (H_2O)	H2O	$ppmv/ppm_w$	ppm_v/ppm_w
Water vapor pressure (P_w)	PW	hPa	lb/in^2
Water vapor saturation pressure (P_{ws})	PWS	hPa	lb/in^2
Enthalpy (h)	H	kJ/kg	Btu/lb
Difference of T and $T_{d/f}$ (ΔT)	DT	ºC	ºF

Table 4 Optional Pressure Quantities Measured by PTU300

Quantity	Abbreviation	Units Available
Pressure trend and tendency	P_{3h}	hPa, psia, inHg, torr, bara, barg, psig, mbar, mmHg, kPa, Pa, mmH_2O, inH_2O
Pressure (measures average pressure from P_1 and P_2 if both are connected)	P	
Pressure from transducer 1 or 2	P_1 and P_2	
QNH pressure	QNH	
QFE pressure	QFE	
Height Corrected Pressure	HCP	

Outer Structure of the Transmitter

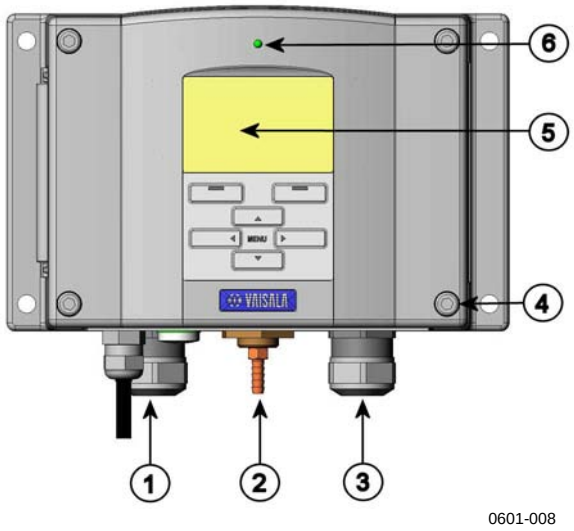

Figure 1 Transmitter Body

Numbers refer to Figure 1 above:

1 = Signal + powering cable gland
2 = Pressure port
3 = Cable gland for optional module
4 = Cover screw (4 pcs)
5 = Display with keypad (optional)
6 = Cover LED

Inner Structure of the Transmitter

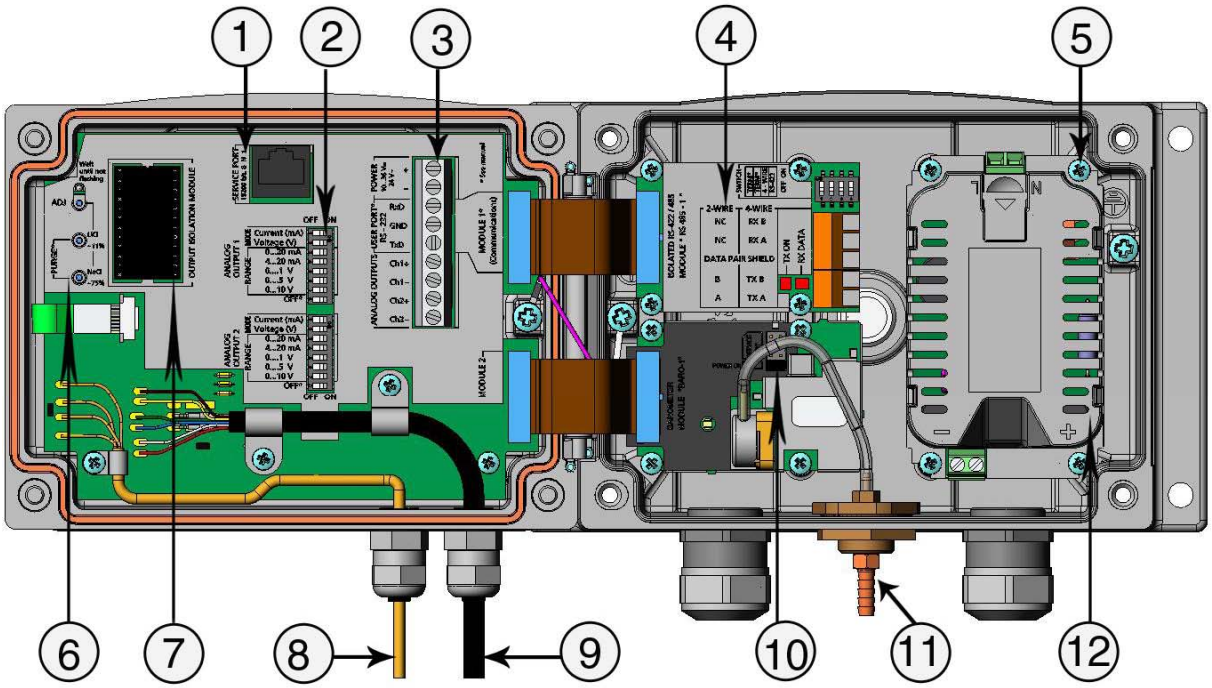

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Figure 2 Inside of Open Transmitter

Numbers refer to Figure 2 above:

1 = Service port (RS-232)
2 = DIP switches for analog output settings
3 = Power supply and signal wiring screw terminals
4 = Relay/RS-422/485 module (optional)
5 = Grounding connector for power supply module
6 = Adjustment buttons (chemical purge buttons) with indicator led
7 = Output isolation module (optional)
8 = Temperature probe cable
9 = Humidity probe cable
10 = BARO1 module
11 = Pressure port
12 = Power supply module.

Probe Options

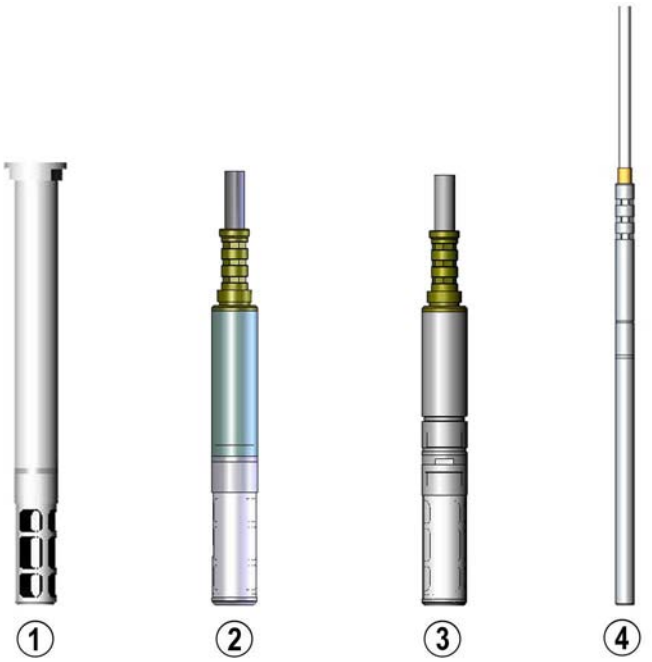

Figure 3 Probe Options

Numbers refer to Figure 3 above:

1 = PTU301 Probe for wall mounting.
2 = PTU303 Probe for general use.
3 = PTU307 for demanding processes (optionally warmed and vapor tight probe head).
4 = Temperature probe.

Probe cable lengths are 2 m, 5 m and 10 m.

Warmed Probe PTU307

Temperature difference between the probe head and external environment can cause a risk of condensation on the sensor. A wet probe cannot observe the actual humidity in the ambient air. If the condensed water is contaminated, the life span of the probe may shorten and calibration may change.

PTU307 probe shall be used in applications where condensation can occur due to high humidity and rapid humidity changes. The warmed probe head is heated continuously so that its temperature is always higher than that of the environment. This prevents condensation on the probe. The power consumption of the warmed probe is slightly higher than that of the other probes.

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CHAPTER 3

INSTALLATION

This chapter provides you with information that is intended to help you install the product.

Mounting the Housing

The housing can be mounted either without the mounting plate or with optional mounting plates.

Standard Mounting without Mounting Plate

Mount the housing by fastening the transmitter to the wall with 4 screws, for example M6 (not provided).

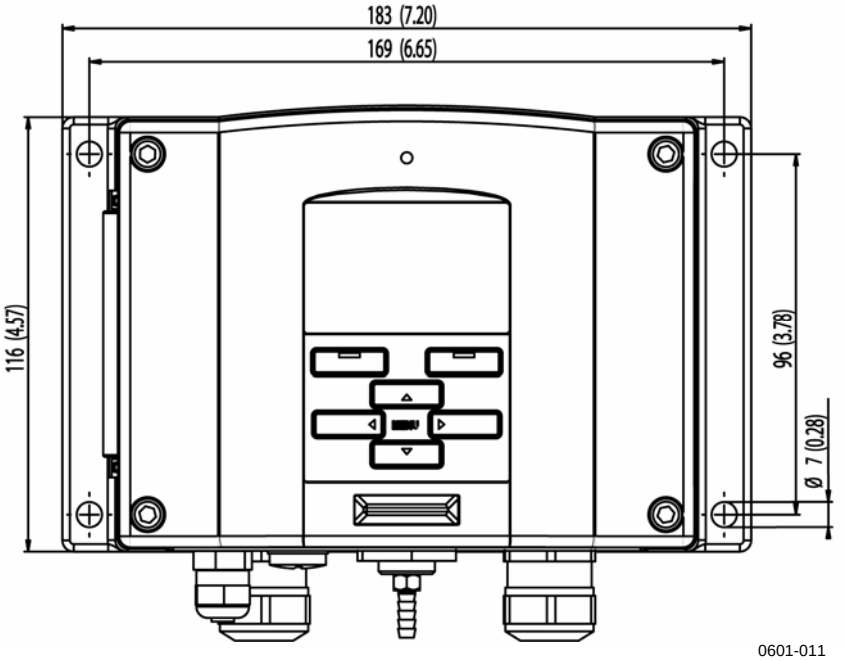

Figure 4 Standard Mounting

Wall Mounting with Wall Mounting Kit

When mounting with wall mounting kit the mounting plate (Vaisala order code 214829) can be installed directly on wall or onto a standard wall box (also US junction box). When wiring through back wall, remove the plastic plug from the wiring hole in the transmitter before mounting.

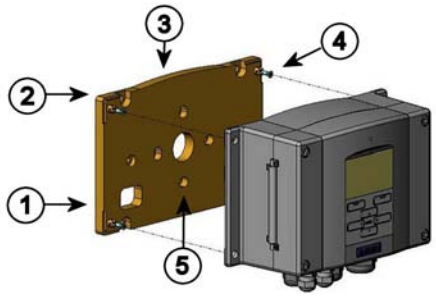

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Figure 5 Mounting with Wall Mounting Kit

Numbers refer to Figure 5 above:

1 = Plastic mounting plate
2 = Mount the plate to wall with 4 screws M6 (not provided)
3 = The arched side up
4 = Fasten PTU300 to the mounting plate with 4 fixing screws M3 (provided)
5 = Holes for wall/junction box mounting

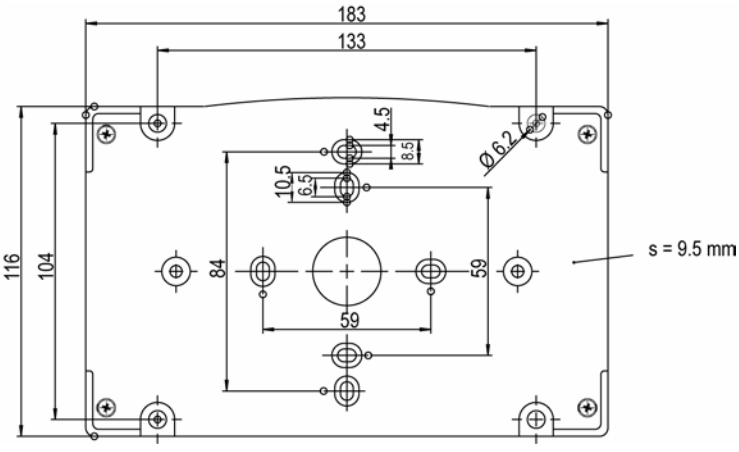

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Figure 6 Dimensions of Plastic Mounting Plate

Mounting with DIN Rail Installation Kit

DIN rail installation kit includes a wall mounting kit, 2 clip-fasteners and 2 screws M4 x 10 DIN 7985 (Vaisala order code 215094).

1. Attach two spring holders to the plastic mounting plate by using the screws provided in the installation kit.
2. Fasten PTU300 to the plastic mounting plate with 4 screws provided for that purpose.
3. Press the transmitter onto the DIN rail so that the clip-fasteners snap into the rail.

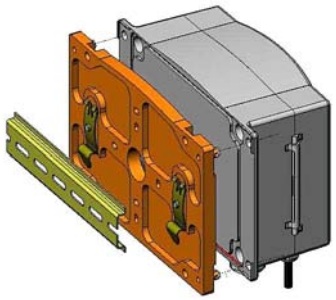

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Figure 7 Mounting with DIN Rail Installation Kit

Pole Installation with Installation Kit for Pole or Pipeline

Installation kit for pole or pipeline (Vaisala order code: 215108) includes the metal mounting plate and 4 mounting nuts for pole mounting. When mounting, the arrow in the metal mounting plate must point upwards**,** see Figure 10 on page 26.

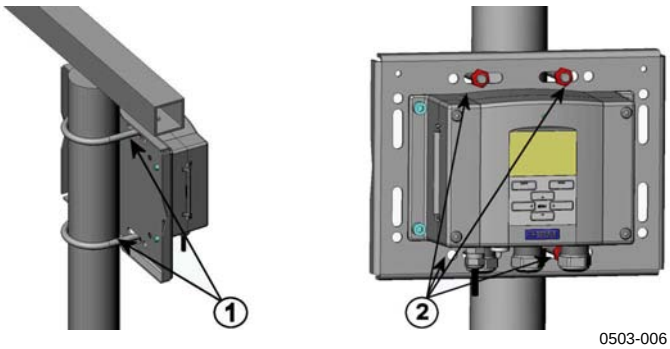


Figure 8 Vertical Pole

Numbers refer to Figure 8 above:

1 = Fixing brackets (2 pcs) M8 (provided) for 30 ... 102 mm poles.
2 = Mounting nuts M8 (4 pcs)

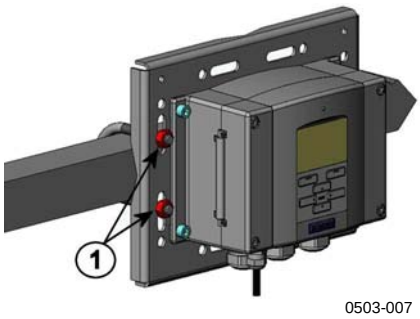


Figure 9 Horizontal Pole

Number refers to Figure 9 above:

1 = Mounting nuts M8 (4 pcs)

Metal mounting plate is included in rain shield with installation kit and installation kit for pole or pipeline.

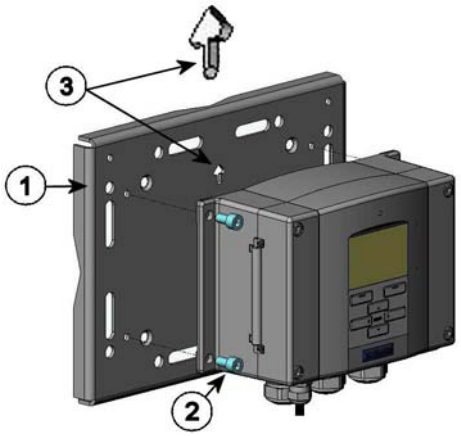


Figure 10 Mounting with Metal Wall Mounting Plate

Numbers refer to Figure 10 above:

1 = Mount the plate to wall with 4 screws M8 (not provided)
2 = Fasten PTU300 to the mounting plate with 4 fixing screws M6 (provided)
3 = Note the position of the arrow when mounting. This side must be up when mounting.

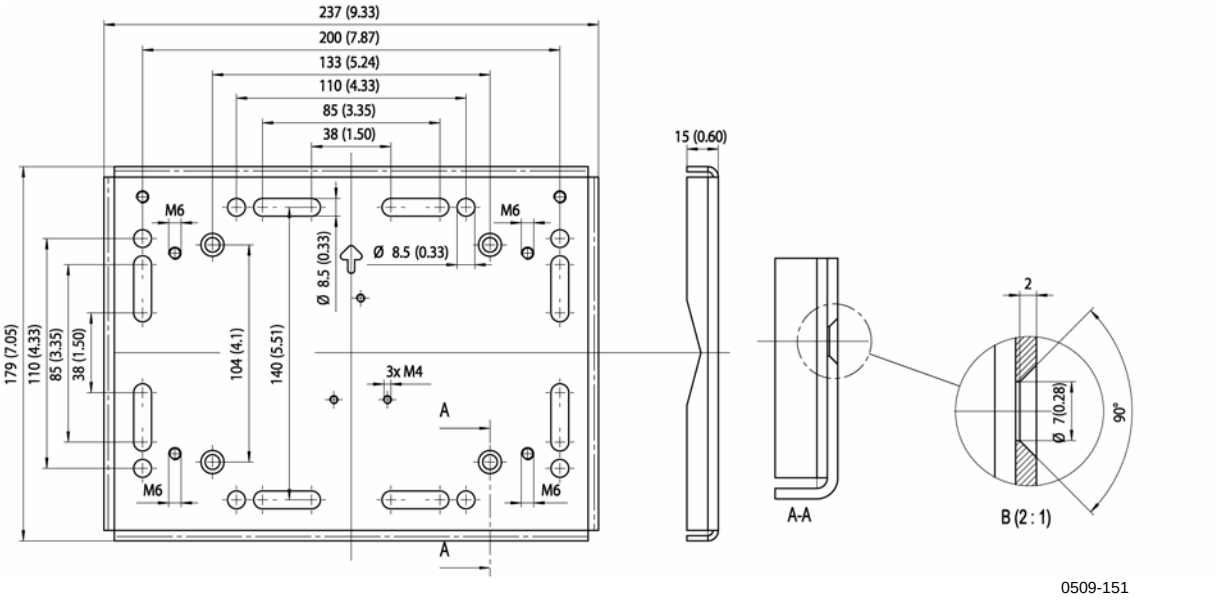


Figure 11 Dimensions of Metal Mounting Plate (mm/inch)

Mounting Rain Shield with Installation Kit

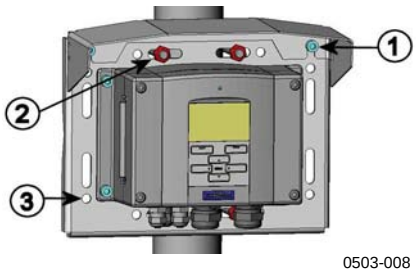


Figure 12 Mounting Rain Shield with Installation Kit

Numbers refer to Figure 12 above:

1 = Fasten the rain shield with installation kit (Vaisala order code: 215109) to the metal mounting plate with 2 (M6) mounting screws (provided).
2 = Fasten the mounting plate with rain shield with installation kit to the wall or to the pole (see pole installation).
3 = Fasten PTU300 to the mounting plate with 4 fixing screws (provided).

General about Wiring and Grounding

Cable Bushings

A single electrical cable with a screen and three to ten wires is recommended for power and analog/serial connections. The cable diameter should be 8...11 mm. The number of cable bushings depends on the transmitter options. See the following recommendations for the cable bushings:

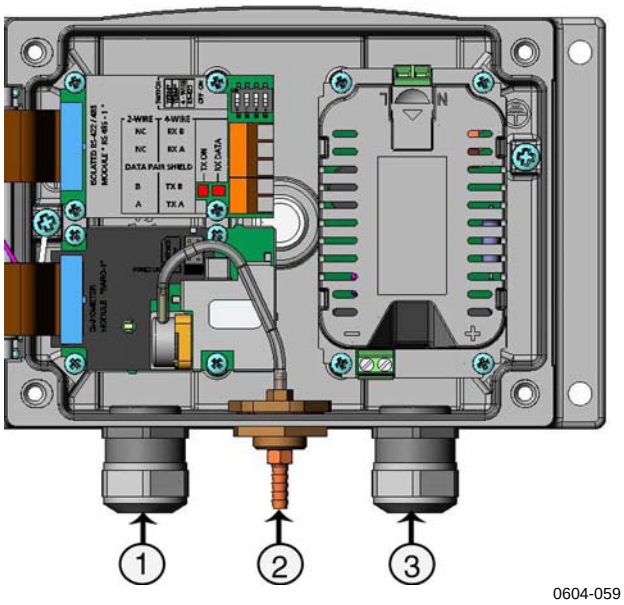


Figure 13 Cable Bushings

Numbers refer to Figure 13 above:

1 = Cable for signal/powering Ø8 ... 11 mm
2 = Pressure port
3 = Cable for optional power supply module Ø8 ... 11 mm

NOTE	When there is high electric noise level (for example, near powerful electric motor) in the operating environment it is recommended to use shielded cable or take care that the signal cables are separated from other cables.

Grounding the Cables

Ground the screen of the electrical cable properly to achieve the best possible EMC performance.

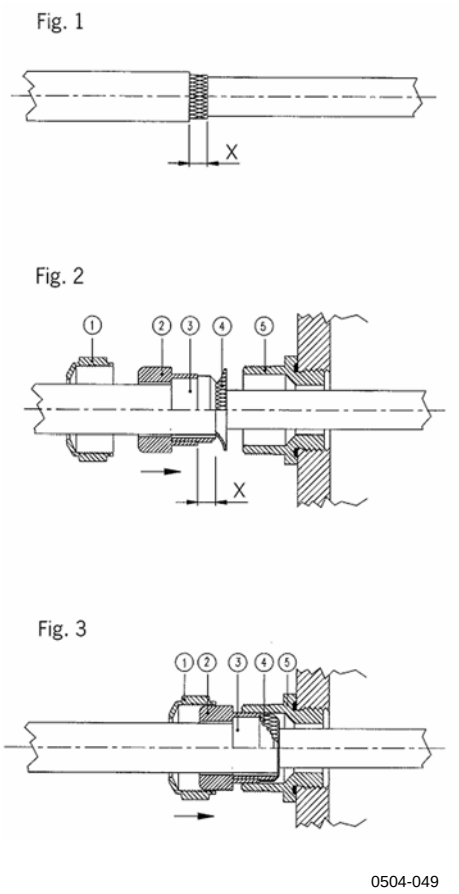


Figure 14 Grounding the Screen of Electrical Cable

1. Cut back outer sheath to desired length.
2. Cut back screen braiding or screen foil to dimension X (see figure 3).
3. Push the domed cap nut (item 1) and the seal insert with contact socket of the gland (item 2+3) onto the cable as shown in the diagram.
4. Bend over the screen braiding or screen foil by about 90º (item 4).
5. Push the seal insert with the contact socket of the gland (item 2+3) up to the screen braiding or screen foil.
6. Mount lower part (item 5) on the housing.
7. Push the seal with the contact socket of the gland and (item 2+3) flush into the lower part (item 5).
8. Screw the domed cap nut (item 1) onto the lower part (item 5).

Grounding the Transmitter Housing

In case you need to ground the transmitter housing, the grounding connector is found inside the housing, see Figure 2 on page 17 above. Note anyhow that the probe head is connected to the same potential as the housing. Make sure that different groundings are made to the same potential. Otherwise harmful ground currents may be generated.

If it is needed to have galvanic isolation of the power supply line from the output signals, PTU300 can be ordered with optional output isolation module. This module prevents harmful grounding loops.

Alternate Wiring Systems

There are three optional ways to connect the transmitter: using basic wiring, using 8-Pin connector, or using D-9 connector.

The wiring system is selected when ordering the device. If a connector is needed for wiring, it is set at the factory.

- When using basic wiring, see section Signal and Power Supply Wiring below.
- When using 8-Pin connector, see section 8-Pin Connector on page 33.
- When using D-9 connector, see section D-9 Connector on page 34.

Signal and Power Supply Wiring

When wiring the power supply module, see section Power Supply Module on page 41.

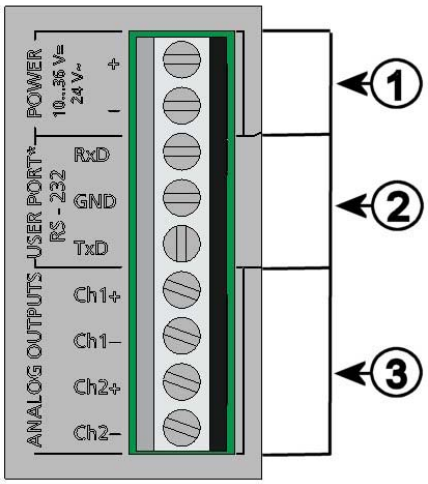


Figure 15 Screw Terminal Block on Motherboard

Numbers refer to Figure 15 above:

1 = Power supply terminals 10 ... 35 VDC, 24 VAC
2 = User port (RS-232 terminals)
3 = Analog signal terminals

WARNING Make sure that you connect only de-energized wires.

1. Open the transmitter cover by taking out the four cover screws.
2. Insert the power supply wires and signal wires through the cable bushing in the bottom of the transmitter; see the grounding instructions in the previous sections.
3. Connect the analog output cables to terminals: **Ch1 +, Ch1-, Ch2+, Ch2-**. Connect the RS-232 user port cables to terminals RxD, GND and TxD. For more information about the RS-232 connection refer to section Serial Line Communication on page 64.
4. When wiring RS-485 module, relay module or additional analog output module, see section RS-422/485 Interface on page 49. section Relays on page 47, and section Third Analog Output on page 46.
5. Connect the power supply wires to the connectors: **POWER 10...35V+ 24V~ (+)** and (-) terminals. If you are using 24 VAC power supply, see the note below before connecting the supply wires.
6. Turn on the power. The indicator led on the cover lit continuously during normal operation.
7. Close the cover and replace the cover screws. The transmitter is ready for use.

8-Pin Connector

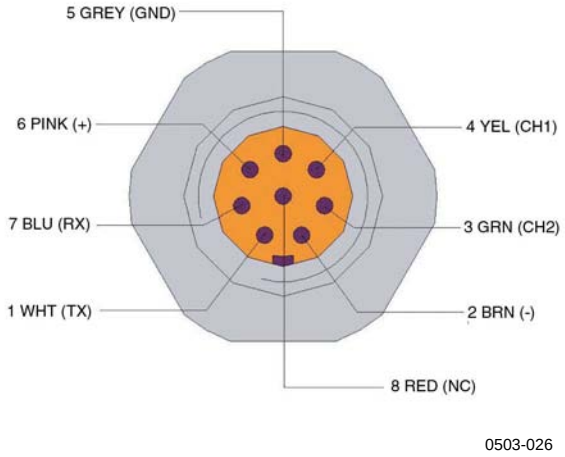


Figure 16 Wiring of Optional 8-Pin Connector

Table 5 Pin Assignments to RS-232/485 Serial Output

PIN/Terminal	Wire	Serial Signal		Analog Signal
		RS-232 (EIA-232)	RS-485 (EIA-485)	
1	White	Data out TX	A -	-
2	Brown	(serial GND)	(serial GND)	Signal GND (for both channels)
3	Green	-	-	Ch 2+
4	Yellow	-	-	Ch 1 +
5	Grey	Supply -	Supply -	Supply -
6	Pink	Supply +	Supply +	Supply +
7	Blue	Data in RX	B -	-
8	Shield/Red	Cable shield	Cable shield	Cable shield

NOTE The 8-pin connector cannot be used with relay modules or power supply module that have AC (mains) power connection.

D-9 Connector

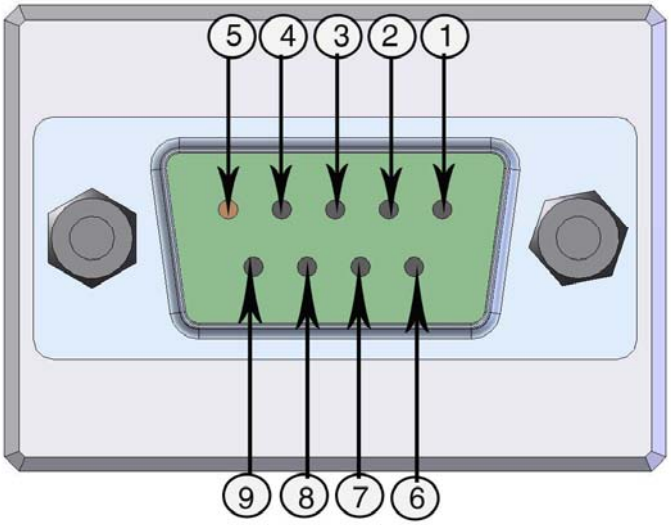


Figure 17 Wiring of Optional D-9 Connector

Table 6 Pin Assignments to RS-232/485 Serial Output

Pin	Wire Color	Serial Signal	
		RS-232 C	RS-485
1	Red		
2	White	TX	
3	Black	RX	
4	Yellow		
5	Brown	Ground	
6	Green		LO
7	Blue	Ground for supply voltage	Ground for supply voltage
8	Grey		HI
9	Orange	Supply voltage (10...30 VDC)	Supply voltage (10...30 VDC)

Connections to 24 VAC Power Supply

Separate floating supply for each transmitter is recommended (see upper Figure 18 on page 35.) If you have to connect several transmitters to one AC supply, the phase (~) must always be connected to (+) connector of each transmitter (see lower Figure 18 on page 35).

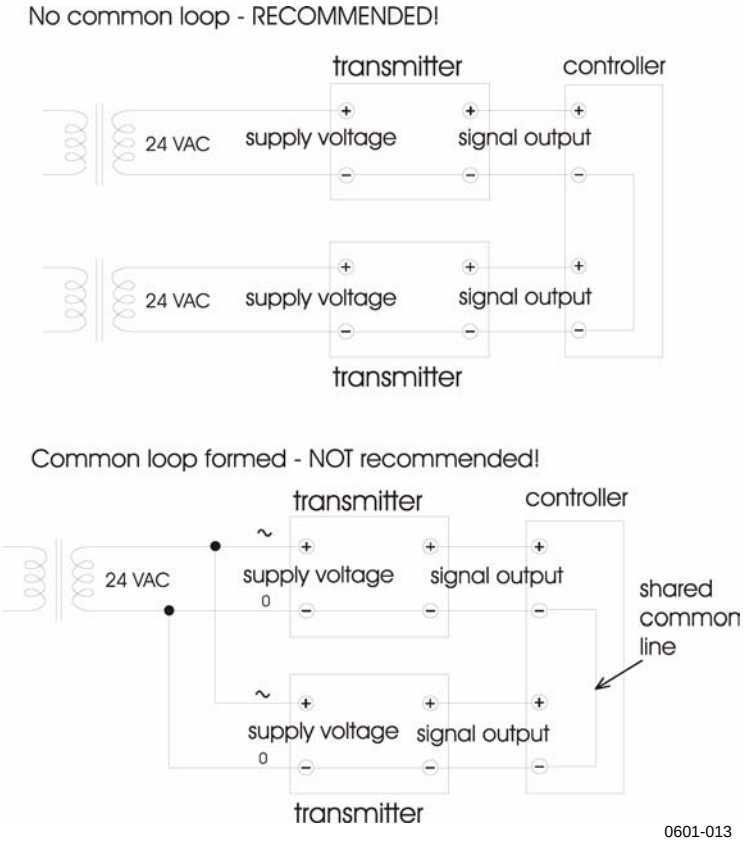


Figure 18 Connections to 24 VAC Power Supply

CAUTION	In case you have only one AC supply, never connect same wire to the + connector of the transmitter and - connector of another one. This kind of connection will cause short-circuit.

Probe Mounting

In humidity measurement and especially in calibration it is essential that temperature of the probe and measuring environment is the same. Even a small difference in temperature between the environment and the probe causes an error. As the curve below shows, if the temperature is +20 °C and the relative humidity 100 %RH, a difference of ±1 °C between the environment and the probe causes an error of ±6 %RH.

The graph below illustrates the measurement error at 100 %RH when the difference between the ambient and sensor temperature is 1 °C.

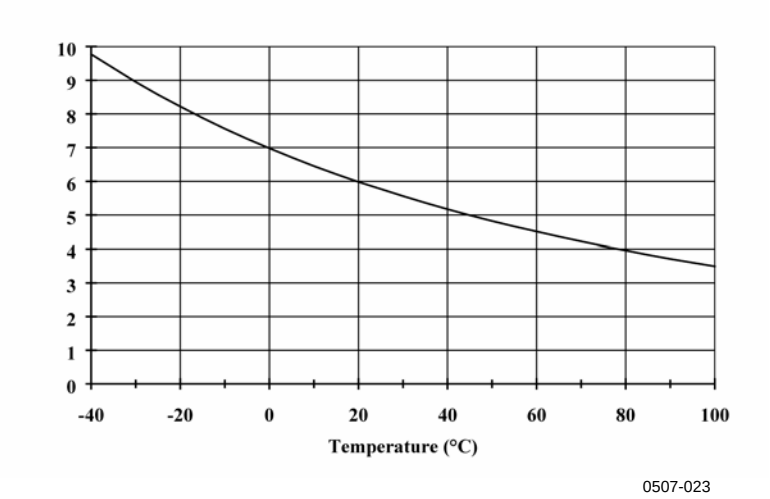


Figure 19 Measurement Error at 100 %RH

General Instructions for Probes with Cable

Mount the probes with a cable with the sensor head **horizontally**; this way, any water condensing on the tube cannot flow onto the sensor.

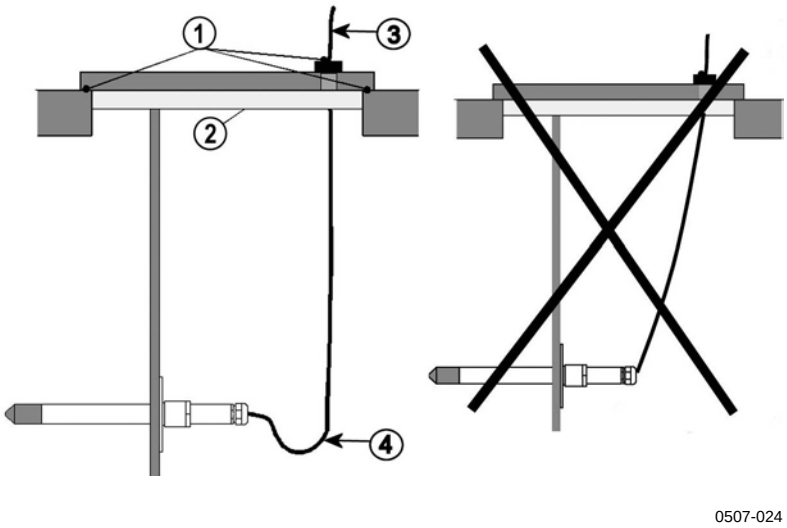


Figure 20 Horizontal Mounting of Probe

Numbers refer to Figure 20 above:

1 = To be sealed.
2 = To be insulated.
3 = Insulate the cable.
4 = Let the cable hang loosely. This prevents condensed water running to the sensor along the cable.

When there is no alternative but to install the sensor head in the process **vertically,** the point of entry must be carefully insulated. The cable must also be allowed to hang loosely as this prevents any condensed water from running onto the sensor head along the cable.

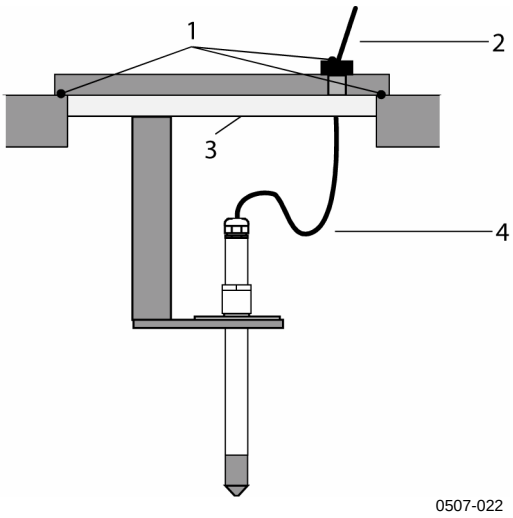


Figure 21 Vertical Mounting of Probe

Numbers refer to Figure 21 above:

1 = To be sealed.
2 = Insulate the cable.
3 = To be insulated.
4 = Let the cable hang loosely. This prevents condensed water running to the sensor along the cable.

NOTE Please do not attach a heated probe (PTU307) to metal structures to avoid condensation problems caused by heat conduction along the metal.

If the process temperature is much higher than that of the environment, the whole sensor head and preferably plenty of cable must be inside the process. This prevents measuring inaccuracy caused by heat conduction along the cable.

When mounted on the side of a duct or channel, the sensor head must be inserted from the side of the duct. If this is not possible and the sensor head must be inserted from the top, the point of entry must be carefully insulated.

For Vaisala probe installation kits and some installation examples see Appendix A below on page 157.

PTU303 for General Use

The PTU303 is a small size (d=12mm) probe for general use, up to +80°C (+176°F). The probe is suitable for weather stations, environmental compensations, laser interferometers and test benches. It is suitable for ducts and channels with the installation kit available from Vaisala.

The PTU303 provides for two measuring range options. The first probe version is equipped with a flexible cable and can be used when measuring in environments up to 80 ºC. The second version is suitable for measuring in environments up to 120 ºC.

See Appendix A on page 157 for the following probe installation kits for PTU303 and installation examples.

- Duct mounting kit
- Cable gland.

PTU307 for High Humidities

The PTU307 is for environment where relative humidity is very high, near saturation. It is suitabale for temperatures up to +180°C (+356°F). The warmed probe head prevents the saturation of the sensor. An additional temperature probe is also available.

See Appendix A on page 157 for a presentation of the following probe installation kits for PTU307 with installation examples:

- Duct mounting kit
- Cable gland
- Pressure tight Swagelok connector
- Vaisala's Meteorological Installation kit

The installation kits are available for both humidity and temperature probe.

Temperature Probe (Optional)

An external temperature probe for PTU307 is needed for the measurement of the ambient temperature in case you have a transmitter with a warmed probe. This allows you to measure other humidity quantities apart from dewpoint and mixing ratio.

The temperature probe is connected always in factory.

The temperature probe can be used as such. A warmed RH probe also enables the calculation of additional quantities.

Optional Modules

Power Supply Module

The AC (mains) power connection may be connected to the power supply module only by an authorized electrician. A readily accessible disconnect device shall be incorporated in the fixed wiring.

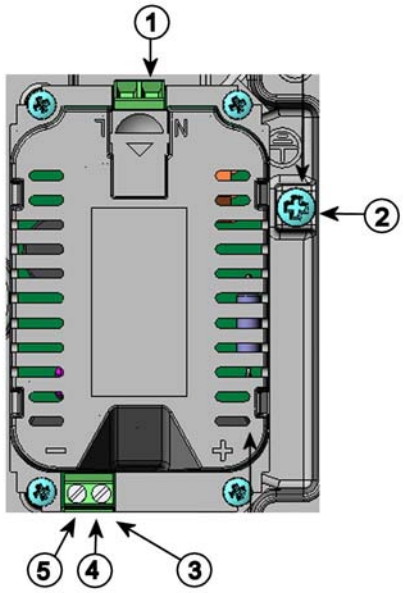


Figure 22 Power Supply Module

Numbers refer to Figure 22 above

1 = Connect AC (mains) voltage wires to these terminals
2 = Grounding terminal
3 = In case the module is not installed in the factory: Connect wires from these terminals to the POWER 10...36V 24V terminals of the mother board.
4 = +
5 = -

Installation

1. Disconnect the power and open the transmitter cover.
2. Remove the protective plug from the cable gland and thread the wires. In case the power supply module is installed in the factory, continue with the step 5.
3. To attach the module fasten the power module to the bottom of the housing with four screws. See the position Figure 2 on page 17.
4. Connect the wires from the terminals of the power supply module marked with + and - to the terminals **POWER 10 ... 35 V** 24V on the motherboard of the transmitter.
5. Connect the AC mains voltage wires to the power supply module terminals marked with **N** and **L**.
6. Attach the grounding wire to the grounding terminal on the right-hand side of the transmitter.
7. Connect the power. The LED on the cover of the transmitter is lit continuously during normal operation.

WARNING	Do not detach the power supply module from the transmitter when the power is on.

WARNING	Do not connect the mains power to power supply module when it is not installed in the transmitter.

WARNING	Always connect protective ground terminal.

Warnings

Tämä tuote on pienjännitedirektiivin (73/23 EEC) mukainen.

- Vaihtovirtaliitännän saa kytkeä tehonsyöttömoduuliin ainoastaan valtuutettu sähköasentaja
- Älä irrota tehonsyöttömoduulia lähettimestä, kun virta on kytkettynä.

- Älä kytke verkkovirtaa tehonsyöttömoduuliin, jos kyseistä moduulia ei ole asennettu PTU300 lähettimeen.
- Kytke aina maadoitusliittimet.

Denna produkt uppfyller kraven i direktivet om lågspänning (73/23 EEC).

- Nätanslutningen (växelströmsanslutningen) får bara anslutas till strömförsörjningsmodulen av en behörig elektriker.
- Ta inte loss strömförsörjningsmodulen från mätaren när strömmen är på.
- Anslut inte strömförsörjningsmodulen till nätet när den inte är installerad i PTU300-mätaren
- Anslut alltid en skyddande jordningsplint.

Questo prodotto é conforme alla Direttiva sul basso voltaggio (73/23 CEE).

- La conduttura elettrica puó essere collegata al modulo di alimentazione elettrica soltanto da un elettricista autorizzato.
- Non staccare l´alimentazione elettrica dal trasmettitore quando é acceso.
- Non collegare la corrente elettrica al modulo di alimentazione elettrica se non é installato nel trasmettitore PTU300.
- Collegare sempre il morsetto protettivo a terra!

Dette produkt er i overensstemmelse med direktivet om lavspænding (73/23 EØS).

- Netstrømskoblingen til må kun tilsluttes strømforsyningsmodulet af en autoriseret elinstallatør
- Strømforsyningsmodulet må ikke løsgøres fra senderen, mens spændingen er sluttet til.
- Slut ikke netspændingen til strømforsyningsmodulet, når det ikke er installeret i PTU300-senderen
- Forbind altid den beskyttende jordklemme!

Dit product voldoet aan de eisen van de richtlijn 73/23 EEG (Laagspanningsrichtlijn).

- De stroom kan aan de stroomtoevoer module aangesloten worden alleen door een bevoegde monteur.
- Het is niet toegestaan de stroomtoevoer module van de transmitter los te koppelen wanneer de stroom aan is.
- Het is niet toegestaan de stroom aan de stroomtoevoer module aan te sluiten als deze niet in een PTU300-transmitter is gemonteerd.
- Altijd beschermend aardcontact aansluiten!

Este producto cumple con la directiva de bajo voltaje (73/23 EEC).

- La conexión de la alimentación principal al módulo de alimentación sólo puede realizarla un electricista autorizado.
- No desenchufe el módulo de alimentación del transmisor cuando esté encendido.
- No conecte la alimentación principal al módulo de alimentación cuando no esté instalado en el transmisor PTU300.
- Conecte siempre el terminal de protección de conexión a tierra.

See toode vastab madalpinge direktiivile (73/23 EEC).

- Voolukaabli võib vooluallika mooduli külge ühendada ainult volitatud elektrik.
- Ärge ühendage vooluallika moodulit saatja küljest lahti, kui vool on sisse lülitatud.
- Ärge ühendage voolukaablit vooluallika mooduli külge, kui seda pole PTU300-tüüpi saatjasse paigaldatud.
- Ühendage alati kaitsev maandusklemm!

Ez a termék megfelel a Kisfeszültségű villamos termékek irányelvnek (73/23/EGK).

- A hálózati feszültséget csak feljogosított elektrotechnikus csatlakoztathatja a tápegységmodulra.
- A bekapcsolt távadóról ne csatolja le a tápegységmodult.
- Ne csatlakoztassa a hálózati feszültséget a tápegységmodulhoz, ha az nincs beépítve a PTU300 távadóba.
- Feltétlenül csatlakoztasson földelő védőkapcsot!

Šis produktas atitinka direktyvą dėl žemos įtampos prietaisų (73/23/EB).

- Elektros tinklą su energijos tiekimo moduliu sujungti gali tik įgaliotas elektrikas.
- Niekada neišimkite energijos tiekimo modulio iš siųstuvo, kai maitinimas yra įjungtas.
- Jei energijos tiekimo modulis nėra įmontuotas PTU300 siųstuve, nejunkite jo į elektros tinklą.
- Visada prijunkite prie apsauginės įžeminimo jungties!

Šis produkts atbilst Zemsprieguma direktīvai (73/23 EEC).

- Strāvas pieslēgumu var pieslēgt pie barošanas avota moduļa tikai autorizēts elektriķis.
- Neatvienot barošanas avota moduli no raidītāja, kad pieslēgta strāva.
- Nepievienot strāvu barošanas avota modulim, ja tas nav uzstādēts PTU300 raidītājā
- Vienmēr pievienot aizsargājošu iezemētu terminālu !

Ten produkt spełnia wymogi Dyrektywy niskonapięciowej (73/23 EEC).

- Napięcie zasilające powinno zostać podłączone do modułu zasilacza tylko przez wykwalifikowanego elektryka.
- Nie wolno odłączać modułu zasilacza od nadajnika, kiedy zasilanie jest włączone.
- Nie wolno podłączać napięcia zasilającego do modułu zasilacza, kiedy nie jest on zamontowany w nadajniku PTU300.
- Zawsze należy podłączać zabezpieczający zacisk uziemiający!

Tento výrobek vyhovuje Směrnici pro nízké napětí (73/23 EEC).

- Připojení síťového napájení k napájecímu modulu smí provádět pouze oprávněný elektrikář.
- Neodpojujte napájecí modul od snímače při zapnutém napájení.
- Nepřipojujte síťové napájení k napájecímu modulu, pokud není instalován ve snímači PTU300.
- Vždy zapojte ochrannou zemnící svorku!

Galvanic Isolation for Output

If galvanic isolation of the power supply line from the output signals is needed, PTU300 can be ordered with optional output isolation module. This module prevents harmful grounding loops.

NOTE	Output isolation module is not needed when using the power supply module.

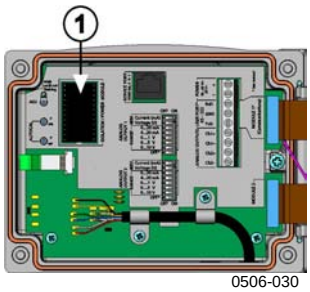


Figure 23 Galvanic Output Isolation Module

Number refers to Figure 23:

1 = Output isolation module

Third Analog Output

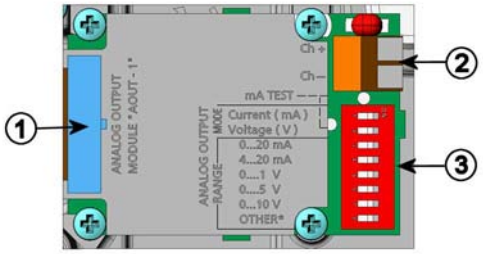


Figure 24 Third Analog Output

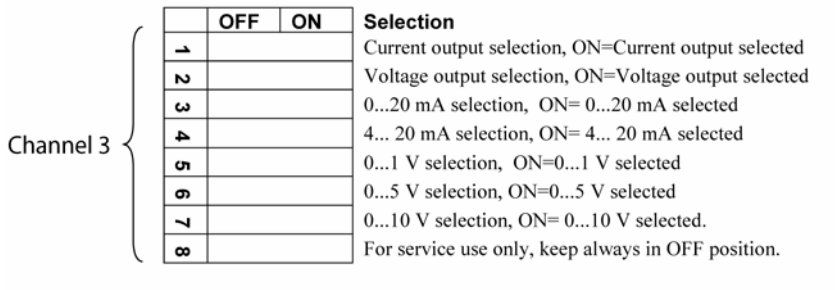
Numbers refer to Figure 24 above:

1 = Flat cable pins
2 = Screw terminals for signal line
3 = DIP switches to select the output mode and range

Installation and Wiring

1. Disconnect the power. In case the analog output module is installed in the factory, continue with the step 4.
2. To attach the module, open the transmitter cover and fasten the analog output module to the bottom of the housing with four screws. See the position from the picture on page 11.
3. Connect the flat cable between the analog output module and the motherboard's pins MODULE 1.
4. Take out the protective plug from the cable gland and thread the wires.
5. Connect the wires to the screw terminals marked with **Ch+** and **Ch-** .
6. Select the current/voltage output by setting ON either of the switches 1 or 2.
7. Select the range by setting ON one of the switches 3...7.

NOTE	Only one of the switches 1 and 2 can be ON at a time. Only one of the switches 3...7 can be ON at a time.



8. Connect the power.
9. Select the quantity and scale the channel via the serial line or display/keypad, see section Analog Output Quantities on page 96. For testing the analog output, see section Analog Output Tests on page 98. For fault indication setting, see section Analog Output Fault Indication Setting on page 99.

Relays

PTU300 can be equipped with one or two configurable relay modules. Each module contains two configurable relays. See the contact ratings in section Technical Specifications of Optional Modules on page 148.

Installation and Wiring

1. Disconnect the power and open the transmitter cover. In case the relay-module is installed in the factory, continue with step 5.
2. To attach the module fasten the relay module to the bottom of the housing with four screws. See the position in Figure 2 on page 17.
3. When the mains power is in use attach the grounding wire to the grounding terminal.
4. Connect the flat cable between the relay module and the **MODULE 1** pins of the motherboard.
5. Take out the protective plug from the cable gland and thread the relay wires.
6. Connect the wires to the screw terminals: NO, C, NC.

Selecting the Activation State of the Relay

The middlemost C terminal and either one of the terminals NO/NC must be connected. The polarity can be freely selected.

NO Normally open
C Common relay
NC Normally closed

Relay NOT activated: C and NC outputs are closed, NO is open
Relay IS activated: C and NO outputs are closed, NC is open.
Connect the power and close the cover.

NOTE For instructions on how to operate the relay (for example, select quantity for the relay output and set the relay setpoints) see section Operation of Relays on page 100.

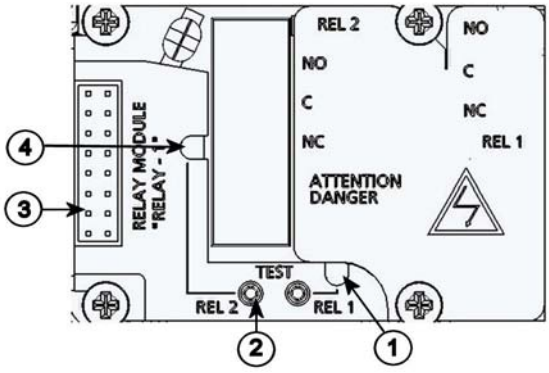


Figure 25 Relay Module

Numbers refer to Figure 25 above:

1 = Indication led for the relay 1 or 3
2 = Relay test buttons
3 = Flat cable pins
4 = Indication led for relay 2 or 4

WARNING The relay module may contain dangerous voltages even if the transmitter power has been disconnected. Before opening the transmitter you must switch off **both** the transmitter **and** the voltage connected to the relay terminals.

WARNING Do not connect the mains power to relay unit without grounding the transmitter.

RS-422/485 Interface

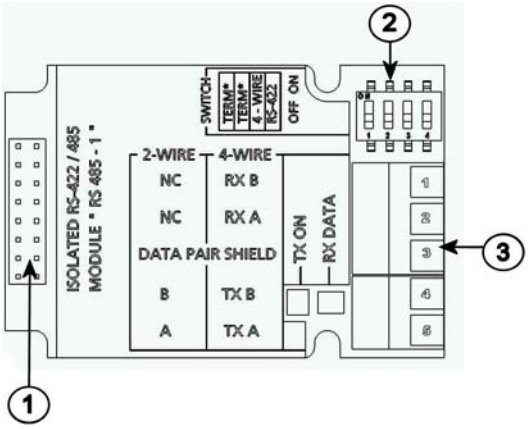


Figure 26 RS-485 Module

Numbers refer to Figure 26 above:

1 = Flat cable pins
2 = Selection switches
3 = Screw terminals for wiring

Installation and Wiring

1. Disconnect the power. In case the RS-485-module is installed in the factory, continue with the item 4.
2. To attach the module, open the transmitter cover and fasten the RS-485 module to the bottom of the housing with four screws.
3. Connect the flat cable between the RS-485 module and the motherboard's pins **MODULE1 (Communications)**.
4. Pull the network wirings through the cable gland.
5. Connect the twisted pair wires (1 or 2 pairs) to the screw terminals as presented in Table 7 on page 50:

Table 7 Connecting the Twisted Pair Wires to the Screw Terminals

Screw terminal	Data line (2-wire RS-485)	Data line (4-wire RS-485/422)
1	(not connected)	RxB
2	(not connected)	RxA
3	Data pair shield	Data pair shield
4	B	TxB
5	A	TxA

6. If you use RS-485 (or RS-422) to connect just one PTU300 to a master computer, enable the internal termination of PTU300 by switching switches 1 and 2 ON. Make sure that the master's end of the line is also terminated (by using master's internal termination or with a separate terminator).

   If you are connecting many transmitters to the same RS-485 bus, make sure that switches 1 and 2 are OFF and terminate the bus with separate terminators at both ends. This allows removing any transmitter without blocking the bus operation.

NOTE If you use the internal termination of the transmitter at the end of the RS-485 bus (instead of using separate terminators) removing that transmitter will block the bus operation.

7. Use the bus type (4-wire/2-wire) to select the selection switch 3.

   In 4-wire mode RS-485 master sends data to the PTU300 through terminals RxA and RxB and receives data from PTU300 through terminals TxA and TxB.

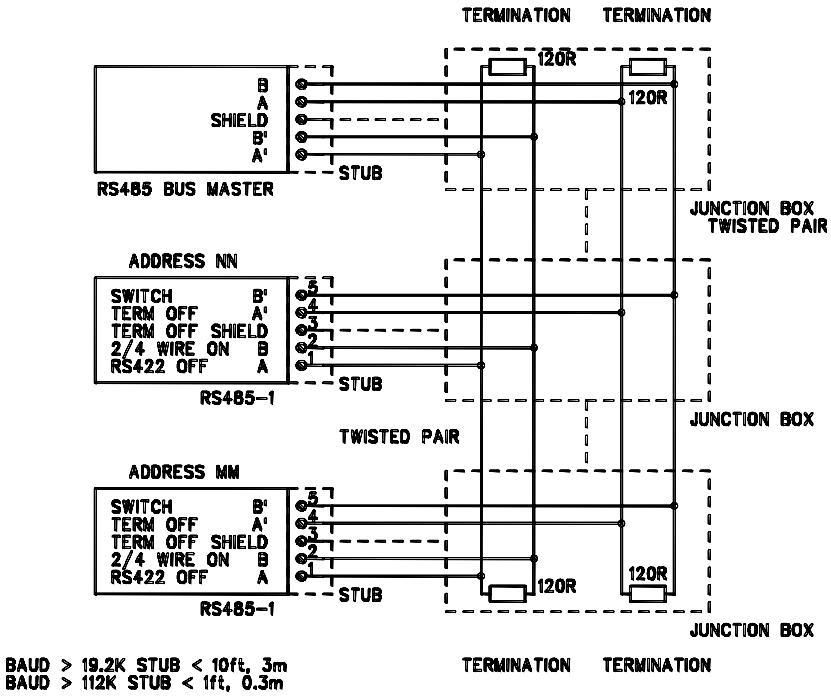


Figure 27 4-Wire RS-485 Bus

Table 8 4-Wire (Switch 3:On)

RS-485 master	Data	PTU300
TxA	→	RxA
TxB	→	RxB
RxA	←	TxA
RxB	←	TxB

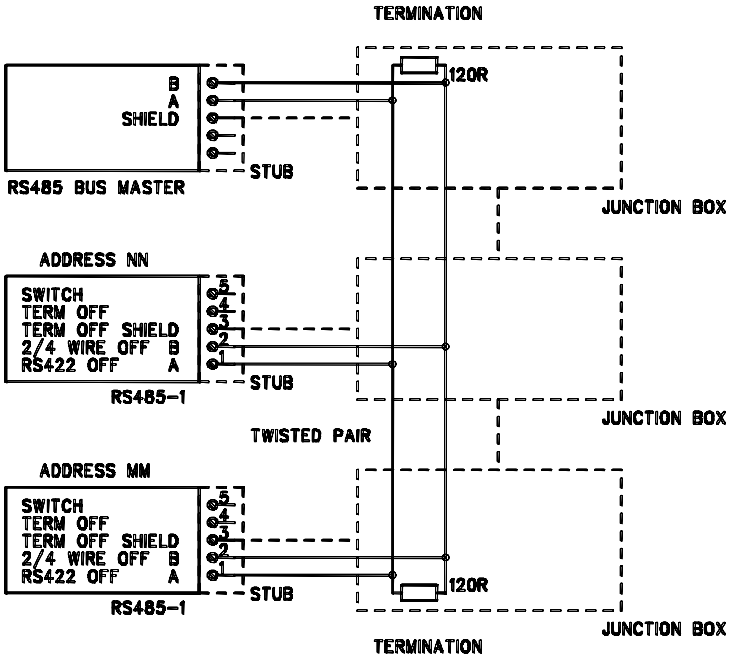


Figure 28 2-Wire RS-485 Bus

Table 9 2-Wire (Switch 3:Off)

RS-485 master	Data	PTU300
A	↔	A
B	↔	B

8. When operating in communication mode RS-422, set both switches 3 and 4 to ON position (4-wire wiring is required for RS-422 mode).
9. Connect the power and close the cover.

CHAPTER 4

OPERATION

This chapter contains information that is needed to operate this product.

Getting Started

Within a few seconds after power-up the led on the cover of the transmitter is lit continuously indicating normal operation. When using the optional display and turning the transmitter on the first time, the language selection menu window opens. Select the language with the up/down arrow keys and press the left function key **SELECT**.

The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the ambient pressure is taken into consideration. PTU300 uses measured pressure for compensation by default.

See section Pressure Compensation Setting on page 80 for instructions on how to set the pressure.

Display/Keypad (Optional)

The optional display and keypad combination enables shortcuts for viewing current settings and status of the device, current measurement values, and graph of the recent measurement history. Additionally the device has user friendly, visible menu system for adjusting settings and turning functions on or off.

Basic Display

Display shows you the measurement values of the selected quantities in the selected units. You can select 1... 3 quantities for the basic display (see section Changing Quantities and Units on page 73).

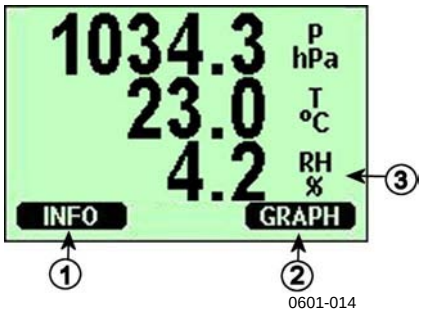


Figure 29 Basic Display

Numbers refer to Figure 29 above:

1 = The Info shortcut key, see section Information on page 59
2 = The Graphic shortcut key, see section Graphic Historyon page 58.
3 = Quantities selected for display

NOTE	You can return directly to the basic display from any view by pressing the right function key **EXIT** for four seconds.

Pressure 3h Trend and Tendency Reading

Using Basic Display

Figure 30 P_{3H} Tendency

Display indicators for pressure 3h trend and tendency above, where:

1 = Tendency: Increasing/decreasing graph symbol with the code number (for more information, see Figure 31, on page 56)
2 = P3h symbol
3 = Trend (middlemost numeric value)

Pressure tendency graphics and codes:

The characteristic symbols of pressure tendency during the 3 hours preceding the time of observation are described as follows:

Pressure tendency	Code
	0
	1
	2
	3
	0
	4
	5
	5
	6
	7
	8

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Figure 31 Pressure Tendency Description

where:

0 = Increasing, then decreasing; atmospheric pressure the same or higher than three hours ago

1 = Increasing, then steady; or increasing, then increasing more slowly; atmospheric pressure now higher than three hours ago

2 = Increasing (steadily or unsteadily); atmospheric pressure now higher than three hours ago

3 = Decreasing or steady, then increasing; or increasing then increasing more rapidly; atmospheric pressure now higher than three hours ago

4 = Steady; atmospheric pressure the same as three hours ago

5 = Decreasing, then increasing; atmospheric pressure the same or lower than three hours ago

6 = Decreasing, then steady; or decreasing, then decreasing more slowly; atmospheric pressure now lower than three hours ago

where:

7 = Decreasing (steadily or unsteadily); atmospheric pressure now lower than three hours ago

8 = Steady or increasing, then decreasing; or decreasing then decreasing more rapidly; atmospheric pressure now lower than three hours ago

Source: The World Meteorological Organization (WMO) publication Manual on Codes Vol. I.1, International Codes, Part A - Alphanumerical Codes, 1995 Edition, WMO - No. 306. Section C, Code Table 0200: a.

Using Serial Line

Pressure 3h trend and tendency reading is also available through serial line. Key in the lines below:

```
>form "P=" p "trend=" p3h "tend=" a3h #r#n
OK

>send <cr>
P=  1024.7trend=     0.8tend=1
```

The last line shows the values.

For more information on the Form command, see the section Changing Quantities and Units, starting on page 73.

Missing trend

In addition to this the PTU300 series barometers output a code "*" when the pressure tendency has not yet been calculated that is, less than three hours have elapsed since the power-up of the barometer. The absence of the pressure trend is indicated in a similar manner, too.

NOTE When the P_{3H} tendency is chosen as a display quantity, the PTU300 logs actual measured pressure, instead of trend or tendency value.

Graphic History

The graphical display shows the data trend of the selected quantities, one at a time. The graph is updated automatically while measuring. Use the following functions in the graphical display:

- Press the left function key **NEXT** to have the trend graph and max/min graph in turns and browse through the quantities selected for display.
- Press the right function key **EXIT** to return to the basic display.

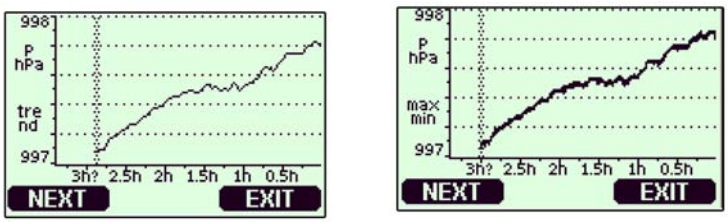

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Figure 32 Graphical Display

Trend graph: Shows you a curve of average values. Each value is a calculated average over a period. See Table 10 below.

Max/min graph: Shows you the minimum and maximum values in a form of curve. Each value is max/min over a time period. See Table 10 below.

Table 10 Periods for Trend and Max/Min Calculations

Observation Period	Period for Trend/Max/Min Calculations (Resolution)
20 minutes	10 seconds
3 hours	90 seconds
1 day	12 minutes
10 days	2 hours
2 months	12 hours
1 year	3 days

- Press the up/down arrow keys ▲▼ to zoom in and out the time in the graph view.
- Press the left/right arrow keys ◄► to switch to the cursor mode where you can observe individual measuring points. Press an arrow key to move the cursor (vertical bar) along the time axis. The numerical value at the cursor position is shown at the upper

left corner. Time from the present to the chosen moment is shown at the upper right corner.

Table 11 Graph Information Messages in Cursor Mode

Message	Interpretation
Power outage	Power failure (marked also with dashed vertical line)
No data	Quantity has not been selected for the display
Device failure	General device failure
T meas. failure	Temperature measurement/sensor failure
RH meas. failure	Humidity measurement/sensor failure
P meas. failure	Pressure measurement/sensor failure
Adj. mode active	Adjustment mode active (data recorded in the adjustment mode is not displayed)

A question mark after time indicates that at least one power failure (dashed vertical line) has occurred after the chosen moment. In this case, the exact time difference between the present and the cursor position is not exactly known.

Information Display

The information display contains current settings and status of the device. You can open the display by pressing the left function key **INFO** in the basic display. The following information will be shown:

- current sensor operation (for example, chemical purge), if any, in progress
- present or past unacknowledged errors, if any
- device identification; product name, version and serial number
- adjustment information (the latest date, user made adjustments)
- measuring settings
- information on chemical purge settings (when applicable)
- serial interface information
- analog output information
- relay output information (when applicable)

Figure 33 Device Information on Display

To access all this information, press the left function key **MORE** as many times as needed. You can also press the left/right arrow keys to browse through the information.

To exit the display, press the right function key **OK**.

Menus and Navigation

You can change settings and select functions in the menus.

1. Open the **MAIN MENU** by pressing any of the arrow keys ▲▼◄► in the basic display mode.
2. Scroll the list upwards or downwards by pressing the up/down arrow keys ▲▼.You can select an option by highlighting it.
3. To open a submenu, press the right arrow key ► .
4. To return to the previous menu level, press the left arrow key ◄.
5. To return to the basic display directly, press the right function key **EXIT**.

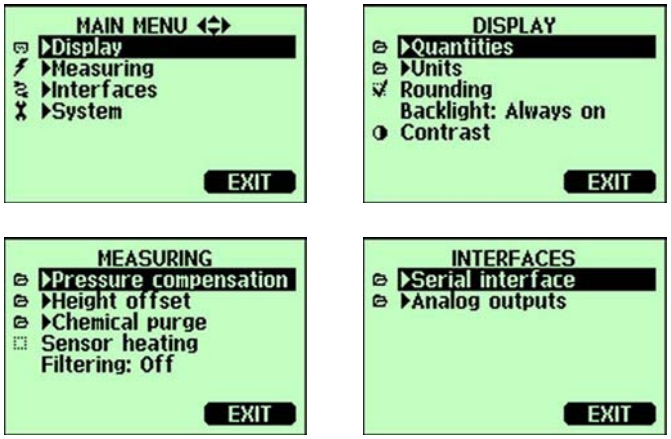

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Figure 34 Main Menu

Language Setting

1. First return to the basic display by pressing the **EXIT** key.
2. Open the **MAIN MENU** by pressing any of the arrow keys.
3. Select **System** (the lowest row), press the right arrow key.
4. Select **Language** (the third row marked with a flag icon), and press the **CHANGE** key.
5. Highlight the desired menu language with the up/down arrow keys and press the **SELECT** key.
6. Press the **EXIT** key to return to the basic display.

Rounding Setting

Round off one decimal by using the Rounding function . The default setting is rounding on. Rounding has no effect on quantities without decimals.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **Display** and press the right arrow key.
3. Select **Rounding** and press the **ON/OFF** key.
4. Press the **EXIT** key to return to the basic display.

Display Backlight Setting

As a default the display backlight is always on. In the automatic mode the backlight stays on for 30 seconds from the last press of any key. When pressing any key, the light turns on again.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **Display**, press the right arrow key.
3. Select **Backlight**, press the **CHANGE** key.

4. Select **On/Off/Automatic**, press the **SELECT** key.
5. Press the **EXIT** key to return to the basic display.

Display Contrast Setting

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **Display**, press the right arrow key.
3. Select **Contrast**, press the **ADJUST** key.
4. Adjust the contrast by pressing the left/right arrow keys.
5. Press the **OK** key and then **EXIT** to return to the basic display

Keypad Lock (Keyguard)

This function locks the keypad and prevents unintentional key presses.

1. Press and hold down the left function key for 4 seconds to lock the keypad (at any display).
2. To unlock the keypad, press and hold down the same key for 4 seconds.

Menu PIN Lock

You can prevent unauthorized changes of the device settings by activating the menu PIN lock. When this function is activated, the basic display and graphical views are available but access elsewhere in the menu is locked. The key symbol indicates the activation of this feature.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **System**, press the right arrow key.
3. Select **Menu PIN**, press the **ON** key.
4. Enter a PIN code by using the up/down arrow keys. Move to the next digit by pressing the left/right arrow keys. Press the **OK** key to confirm the setting. Now the PIN lock is on and a key symbol is shown in a display.
5. Press the **EXIT** key to return to the basic display. Returning to the menu is possible only by entering the correct PIN code.

When you want to turn off the PIN lock, open the menu by entering the PIN code and select **System, Menu PIN,** press the **OFF** key.

In case you have forgotten the PIN code, open the transmitter cover and press the **ADJ** button once. Wait for a few seconds and the **Adjustment menu** opens. Select **Clear menu PIN**, press the **CLEAR** key**.**

Factory Settings

Use the display/keypad to restore the factory settings. This operation does not affect the adjustments. Only settings available in the menus are restored.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **System**, press the right arrow key.
3. Select **Factory settings** and press the **REVERT** key to confirm your selection. Press the **YES** key to reset all settings to the factory defaults.

In case you change your mind and want to exit the menu without making any changes, press the **NO** key.

See section General Settings on page 73 for a description of the other menu options.

MI70 Link Program for Data Handling

The recorded data can be transferred to a PC by using MI70 Link program. You can examine the recorded data easily in Windows environment and transfer it further to a spreadsheet program (such as Microsoft Excel) or virtually to any Windows program in numeric or graphical format. MI70 Link program allows you also to monitor transmitter readings directly with a PC (real-time window function).

MI70 Link program is available from Vaisala, see list of accessories in section Options and Accessories on page 149.

1. Connect the connection cable between the serial port of your PC and the Service Port of PTU300, see Figure 35 on page 64.
2. Check that the PTU300 is powered and start using the MI70 Link program.

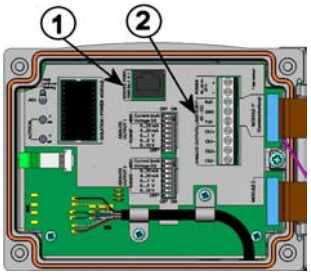
Use a MI70 Link version 1.07, or a newer one, to be able to utilize all the functions of PTU300.

Serial Line Communication

Connect the serial interface by using either the user port or the service port.

For permanent interfacing to host system, use the user port. You can change the serial settings and operate in RUN, STOP, POLL and SEND modes.

For temporary RS-232 connections use the service port. Service port is always available with fixed serial settings.



0507-026

Figure 35 Service Port Connector and User Port Terminal on Mother Board

Numbers refer to Figure 35 above:

1 = Service port connector
2 = User port terminals

User Port Connection

Use suitable serial cable between the user port RxD, GND and TxD screw terminals and the PC serial port, see Figure 36 on page 65.

Table 12 Default Serial Communication Settings for the User Port

Parameter	Value
Bits per second	4800
Parity	Even
Data bits	7
Stop bits	1
Flow control	None

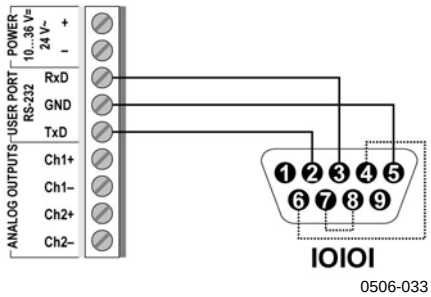


Figure 36 Connection Example Between PC Serial Port and User Port

Connections to pins 4,6,7 and 8 on PC serial port are required only if you are using software requiring hardware handshaking.

NOTE	User port cannot be used when RS-485 module is connected.

Service Port Connection

Table 13 Fixed Communication Settings for Service Port

Parameter	Value
Bauds	19200
Parity	No
Data bits	8
Stop bits	1
Flow control	None

1. Connect the serial interface cable (optional accessory, order code: 19446ZZ) between the serial port of your PC and the service port connector on the motherboard, see Figure 39 on page 67.
2. Open a terminal program and set the communication settings (see the following section for more detailed instructions).
3. Power-up the PTU300.

After power-up the transmitter (in STOP-mode) outputs the software version and the command prompt.

```
PTU300 / 3.01
>
```

In RUN mode a measurement output starts immediately after power-up.

Terminal Program Settings

The following instructions show a connection example with HyperTerminal program (included in the Microsoft Windows).

Follow the instructions below to open a HyperTerminal program:

1. Start HyperTerminal. To get help for starting HyperTerminal, click "Start", select "Help" to open Windows help, and search for "HyperTerminal".

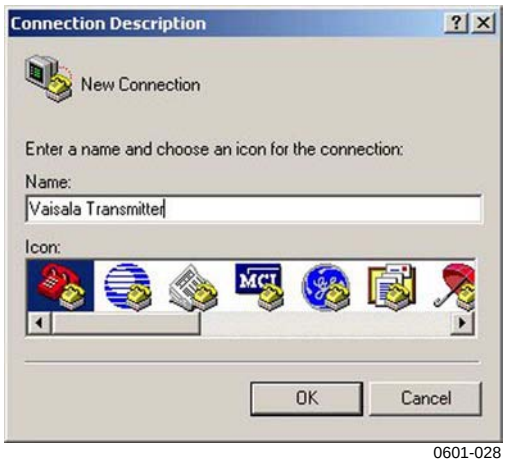


Figure 37 Starting Hyper Terminal Connection

2. In the "New Connection"window of the HyperTerminal, define a name for PTU300 serial connection, for example "PTU300". Click OK.
3. In "Connect using" box, select the PC communications port where the serial cable is connected. (If your computer has only one COM port, it is called "COM1"). Click OK.

Figure 38 Connecting to Hyper Terminal

4. Set the port settings in the "Properties" window to match the settings of your PTU300 *user port*/*service port*. For PTU300, "Flow control" must always be set to "None". Finally click OK to start using the serial connection.

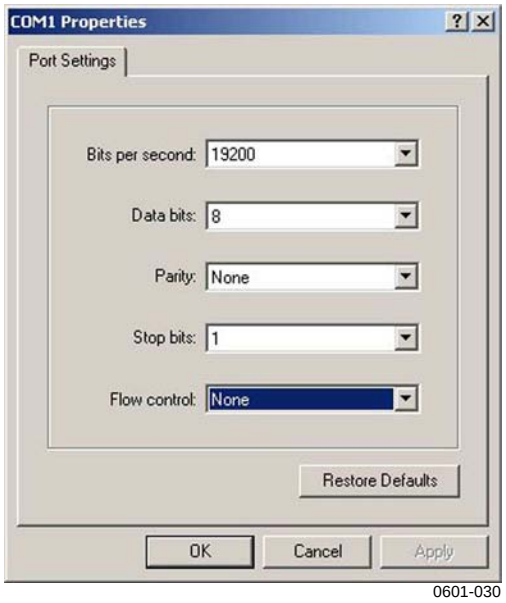


Figure 39 Hyper Terminal Serial Port Settings

5. Select "File" → "Save" in the HyperTerminal main window to save the serial port settings. To use the saved settings later, start HyperTerminal, click cancel in the "New Connection" window, and select "File" → "Open".

List of Serial Commands

The bold text in the brackets is the default setting. Enter commands by typing them on your computer and pressing the Enter key <cr>.

General commands

?	Output the information about the device
??	Output the information about the device in POLL-state
ECHO [**ON**/OFF]	Turn the serial interface echo ON/OFF
FIND	All devices in POLL mode are sent their addresses
HELP	List the most common commands
ERRS	List present transmitter errors
SERI [baud p d s]	User port settings (default: 4800 E 7 1) baud: 300…115200
LOCK	Lock the menu/disable keypad
XHEAT	Sensor heating

Measurement commands

R	Start the continuous outputting
S	Stop the continuous outputting
INTV [**0**…255 **S**/MIN/H]	Set the continuous output interval (for RUN mode)
SEND [0…99]	Output the reading once
SEND D	Outputting the reading with the raw data
SCOM	Define a user-specific SEND command for one message output
SMODE [**STOP**/RUN/ POLL/SEND]	Set the serial interface (change operating mode)
SDELAY	View or set user port (RS232 or RS485) answer minimum delay.
ADDR [**0**…99]	Set the transmitter address (for POLL mode)
OPEN [0…99]	Open temporarily connection to the POLL-mode device
CLOSE	Close the connection (back to POLL mode)

Formatting commands	
FORM	Set the output format of SEND and R commands
TIME	Set the time
DATE	Set the date
UNIT	Select the metric or non-metric output units
Data recording commands	
DSEL	Select data recording and display quantities.
PLAY [0...17]	Output recorded data file
DIR	Display recorded files
DELETE	Delete the graph files
UNDELETE	Recovers the deleted files
Chemical purge commands	
PUR	Set the automatic chemical purge
PURGE	Start the manual chemical purge
Calibration and adjustment commands	
CRH	Relative humidity calibration
CT	Temperature calibration
CTA	Additional temperature probe calibration
FCRH	Relative humidity calibration after sensor change
CTEXT	Give the text to calibration information field
CDATE	Set the calibration date
ACAL	Analog output calibration
LC	Output the linear corrections in use
LCI x<cr>	Activate or deactivate the linear offset or offset/gain pressure corrections.
LCI n <cr>	Enter new linear offset and offset/gain pressure corrections to the transmitter
MPC	Output the corrections in use
MPCI x <cr>	Activate or deactivate the multipoint corrections.
MPCI n<cr>	Enter new multipoint corrections to the transmitter
OFFSET	Pressure one-point offset correction

Setting and testing the analog outputs

AMODE	View the analog output modes
ASEL	Select the parameters for the analog outputs
ITEST	Test the analog outputs
AERR	Change the analog error output values

Setting and testing the relays

RSEL	Set and view the relays
RTEST	Test the relays

Pressure commands

PRES [hPa]	Set the value for pressure compensations
XPRES [hPa]	Set the value for pressure compensations, temporarily
FILT	Set the result filtering
PFIX	Select pressure compensation using either fixed value or using measured value
AVRG x <cr>	Set pressure average period
VERS	Display the software version information
HHCP	Set height offset for HCP calculation
HQNH	Set height offset for QNH calculation
HQFE	Set height offset for QFE calculation
PSTAB	Set the pressure stability indicator
PDMAX	Set the pressure difference limit

GPS commands

0100P9	Data output query
0200P9	Data output query
9900P9	Data output query
9900SN	Serial number query

Getting Measurement Message from Serial Line

Enter the **R** command to start output of measurements. Enter the **S** command, press the Esc key or reset the transmitter to stop outputting. See command **SMODE** to change the default (power-up) operation mode.

Format the output by using the following commands:

- outputting interval can be changed with the **INTV** command.
- output message format can be changed with a command **FORM.**

Example:

```
>r
P=  1021.6 hPa   T= 23.2 'C RH=  5.8 %RH
>
```

Stopping Continuous Outputting

S

Use the **S** command to end the **RUN** mode. After this command all other commands can be used.

Outputting Reading Once

SEND

Use the **SEND** command to output the reading once in **STOP** mode:

The output format depends on which parameters the transmitter can output.

Examples:

```
P=  1021.6 hPa   T= 23.3 'C RH=  5.7 %RH
>
```

If value is too long to fit to the allocated space or if there is an error in outputting the quantity, value is displayed with stars ‘*’.

Example:

```
RH=***.* %RH T= 31.0 'C
```

The output mode can be changed with the command **FORM**.

Outputting Reading With Raw Data

SEND D

Example:

```
>send d
 24.1720  15.0399  -3.5743 189.2324  15.0709  15.0399
23.9765
```

Where the readings (from the left) are:

24.1720 = Temperature of the humidity probe (ºC)
15.0399 = RH (%RH)
-3.5743 = Tdf (C)
189.2324 = Capasitance (pF)
15.0709 = RH raw: calculated from scaled capasitance (%RH)
15.0399 = Enchancement factor corrected RH (%RH)
23.9765 = Temperature of the additional temperature probe (optional) (ºC)

SCOM

The **SCOM** command is used to define a user specific **SEND** command for one message output. The standard **SEND** command of the transmitter will always function normally whatever the **SCOM** definition may be.

Example of setting a P command for one message output:

```
>scom
Send command   :  ? p <cr>
>
```

Any previous SCOM definition may be removed with the following command:

```
>scom
Send command   : p ? <esc>
```

Setting time and date

TIME and DATE

To set time enter the **TIME** command. To set date enter the **DATE** command.

TIME

DATE

These time and date settings are shown on the timestamps of **PLAY** command. When you want to include time and date in the **R** and **SEND** commands, use the **FTIME** and **FDATE** commands.

Example:

```
>TIME
Current time is 04:12:39
Enter new time (hh:mm:ss) ? 12:24:00
>DATE
Current date is 2000-01-01
Enter new date (yyyy-mm-dd) ? 2004-07-05
>
```

NOTE	Time and date are cleared to 2000-01-01 00:00:00 at reset or at power failure.

General Settings

Changing Quantities and Units

Use serial commands or the optional display/keypad to change quantities and units. For more information on available quantities and units, see Table 2 on page 15. For more information on optional quantities, see Table 3 on page 15 .

NOTE	Only the quantities selected when ordering the device can be selected as a display output quantity.

Using Display/Keypad

To select the display output quantities.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Display**, press the right arrow key.
3. Select **Quantities**, press the right arrow key.
4. Select quantities by pressing the up/down arrow keys. Confirm the selection by pressing the **SELECT** key. You can select 1 ... 3 display quantities at a time.
5. Press the **EXIT** key to return to the basic display.

To select the display unit:

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Display,** press the right arrow key.
3. Select **Units** and press the right arrow key.
4. Select the display unit by pressing the up/down arrow keys. Confirm the selection by pressing the **CHANGE** key. The unit changes from metric to non-metric or the other way round.
5. Press the **EXIT** key to return to the basic display.

NOTE	Changing the display quantities/units (by using the display/keypad) has no effect on the serial output data.

Using Serial Line

FORM

Use the serial line command **FORM** to change the format or select a certain quantities for the output commands **SEND** and **R**.

FORM [*x*]

where

x = Formatter string

Formatter string consists of quantities and modifiers.

When entering the command, use the abbreviations of the quantities. For more information on quantities, see Table 2 on page 15.

The modifiers are presented in Table 14 below.

Table 14 The modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
“”	String constant
#xxx	Special character, code "xxx" (decimal), for example #027 for ESC
U5	Unit field and length
ADDR	Transmitter address with two characters [00...99]
ERR	Error flags for P, T, Ta, RH [0000 ... 1111], 0 = no error
STAT	Transmitter status in 7 character field, for example: N 0 no heating h 115 probe heating active, power 115/255 H 159.0 purge heating active, temperature 159ºC S 115.0 purge cooling active, temperature 115ºC X 95.0 sensor heating active, temperature 95ºC
SN	Transmitter serial number
TIME	Time [hh:mm:ss]
DATE	Date [yyyy-mm-dd]
OK	Pressure stability indicator, two characters [OK or " "]
CS2	Modulus-256 checksum of message sent so far, ascii encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ascii encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ascii encoded hexadecimal notation
A3H	Pressure tendency [* or 0...8]

To output reading including pressure, temperature and relative humidity

```
>form <cr>
6.1 "P=" P " " U6 3.1 "T=" T " " U3 3.1 "RH=" RH " " U4
\r \n

>send
P=  1033.7 hPa   T= 22.2 'C RH= 38.3 %RH
```

Other examples:

```
>form "RH=" 4.2 rh U5 #t "T=" t U3 #r #n
OK
>RH=  14.98%RH   T=  74.68'F

>form "Tfrost=" tdf U3 #t "Temp=" t U3 #r#n
OK
>Tfrost=   36.0'C        Temp=   31.0'C
```

Command '**FORM** ' will return the default output format. The default output format depends on the device configuration.

```
>form /
>send
RH= 98.4 %RH T= 31.1 'C
>
```

UNIT

Use this command to select metric or non-metric output units. With the command you can also set P units.

UNIT [*x*] [*y*]

where

x = M or N or P
y = Pressure Units (see Table 4 on page 15)

where

M = Metric units
N = Non-metric units
P = Pressure

Examples of changing the units:

```
>unit n
Output units   : non metric
>unit m
Output units   : metric
>unit p torr
P units        : torr
>unit p hpa
P units        : hPa
```

NOTE	This command changes both the serial output and display units to either metric or non-metric units. When you want to output both metric and non-metric units simultaneously on the display, select the display units later by using the display/keypad.

NMEA Data Format

The PTU300 transmitter can be used in connection with a GPS receiver. It responds to a GPS input command by outputting a single predefined NMEA format message or the transmitter serial number.

NOTE	The pressure unit has to be set as **bar** when the NMEA data output format is used. The maximum length of FORM is 128 characters.

NOTE	Check that the serial bus settings of the transmitter and those of the GPS receiver are the same. A baud rate less than 9600 is recommended.

Example:

"$PASHS,XDR,P,"1.5_P_",B,"_SN_",C,"_3.2_T_",C,"_SN_",H,"_RH_",P,"_SN_#r #n

where,

"$PASHS,XDR,P," text field $PASHS,XDR,P, (P transducer type = pressure)

1.5 number field

P pressure

",B," text field (B transmitter unit = Bar)

SN transmitter ID (serial number)

",C," text field (C transducer type = temperature)

3.2 number field

T	temperature
",C,"	text field (C temperature unit = degrees Celcius)
SN	transmitter ID (serial number)
",H,"	text field (H transducer type = humidity)
RH	humidity
",P,"	text field (P humidity = % relative humidity)
SN	transmitter ID (serial number)
#r #n	CR LF
_	space

Output format:

```
>send<cr>
$PASHS,XDR,P,0.99710,B,S1630001,C,22.47,C.S1630001,H,20.
84,P,S1660001
>
```

Example 2:

"$PASHS,XDR,P," 1.5_P_",B,,C,"_3.2_T_",C,,H,"_RH_",P,"_#r_#n_

Output format:

```
>send<cr>
$PASHS,XDR,P,1.01148,B,,C, 27.11,C,,H, 54.29,P,
>
```

GPS Commands

The PTU300 transmitter responds to following GPS specific application commands.

*0100P9

Example:

```
>*0100P9 <cr>
$PASHS,XDR,P,1.03384,B,A2100012,C,22.28,C,A2100012,H,39.
65,P,A2100012
>
```

*0200P9

Example:

```
>*0200P9 <cr>
$PASHS,XDR,P,1.01496,B,T5030004,C,24.42,C,T5030004,H,41.
18,P,T5030004
>
```

*9900P9

Example:

```
>*9900P9
$PASHS,XDR,P,1.01496,B,T5030004,C,24.42,C,T5030004,H,41.
18,P,T5030004
>
```

*9900SN

Example:

```
>*9900sn <cr>
A2100012
>
```

Pressure Compensation Settings

The pressure has an effect on humidity calculations and accuracy. Therefore, accurate calculations can be achieved only when the process pressure is taken into consideration.

Note that conversions from mmHg and inHg are defined at 0°C and for mmH_2O and inH_2O at 4°C.

NOTE	Pressure compensation is intended to be used in normal air only. When measuring in other gases, please contact Vaisala for further information.

Using Display/Keypad

Use display/keypad to set the pressure compensation. To select the pressure unit using display/keypad see section Changing Quantities and Units on page 73.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Measuring** and press the right arrow key.
3. Select **Pressure compensation** and press the right arrow key.
4. Use the up/down arrow keys to select either **Fixed: 1013.25hPa** or **Measured P** for pressure compensation.
5. Selecting **Measured P**: Press the **SELECT** key and then exit the menu**.**
6. Selecting **Fixed: 1013.25hPa**: Press the **SELECT** key, and then **SET**. You can move from a digit to another one by pressing the left/right arrow keys. To change the unit, press the up/down arrow keys.
7. Press the **OK** key and then exit the menu.

Using Serial Line

PRES and XPRES

Command **XPRES** should be used if the value is changed frequently. Its value is not retained at reset, and when set to 0, last value set with **PRES** is used instead. Use the serial line and do the following:

PRES [*aaaa.a*]

XPRES [*aaaa.a*]

where

aaaa.a =Absolute process pressure (hPa)

Example:

```
>pres
Pressure       : 1013.00 hPa ?
>pres 1010
Pressure       : 1010.00 hPa
>
```

Table 15 Multiplication Factors

From	To: hPa
mbar	1
Pa N/m2	0.01
mmHg torr	1.333224
inHg	33.86388
mmH_2O	0.09806650
inH_2O	2.490889
atm	1013.25
at	980.665
bar	1000
psia [1)]	68.94757

1) psia = psi absolute.

Example:

29.9213 inHg = 29.9213 x 33.86388 = 1013.25 hPa

PFIX

Use the PFIX command to select either P inputted or P measured.

- When PFIX is On, fixed PRES value is used
- When PFIX is Off, measured PRES value is used

PSTAB

Use the PSTAB command to define the pressure stability indicator reflecting maximum allowed pressure difference between two successive averaged measurements. The user also has to define the FORM command to include the "OK" stability indicator field. The factory setting for the stability indicator level is 0.5 hPa.

Example:

```
>pstab <cr>
Stab. indicator: OFF ? on
Max P change   : 0.5 ? 1.0
```

PDMAX [*x*] <cr>

where

x = Pressure reading

The **PDMAX** [*x*] command is used to define the maximum pressure difference between the pressure readings from two pressure transducers (P1 and P2). If the defined value is exceeded, the relevant digit in the ERR field will change from 0 to 1.

Crucial conditions for an acceptable measurement are:

- two transducers: P high - P low = Pd max limit/less than Pd max limit

The factory setting for Pdmax is 1.0 hPa.

Example of setting the limit to 0.5 hPa:

```
>pdmax <cr>
Max P diff.    : 1.00 ? 0.5
```

Pdmax limit works as follows:

```
>form 4.1 p1 " " p2 " " p " " u3 " " ERR #r#n
OK
```

Example1: Maximum pressure difference is within the limit

```
>send
1034.2 1034.4 1034.3 hPa 0000
>
```

Example2: Maximum pressure difference exceeds the limit

```
>send
1034.2 1035.4 ****** hPa 1000
>
```

Use the **ERRS** command to analyze problems.

User Port Serial Settings

Using Display/Keypad

The communication settings for the user port can be changed via the serial line or by using the optional display/keypad. The communication settings for the service port are fixed and not changeable.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Interfaces** and press the right arrow key.
3. Select **Serial interface** and press the right arrow key.
4. Select **Bit rate/Serial format/Comm. mode** and press the **CHANGE** key. Next specify some details (speed, format or mode) for the options just selected. Use the up/down arrow keys and press the **SELECT** key**.**
5. If you set RUN for communication mode, specify the interval for RUN mode, as well. First press the **SET** key, adjust numbers and change the unit with the arrow keys and finally press the **OK** key.
6. Select POLL address and press **SET** to confirm your selection. By using poll address, the device can be identified from other devices connected to the same network system. Use the arrow keys to set the poll address and finally press the **OK** key.
7. Press the arrow keys to select **ECHO**. Press **ON** to turn to it on. Press **OFF** to turn it off.
8. Press the **EXIT** key to return to the basic display.

The new user port settings set using the display/keypad are effective immediately.

Using Serial Line

SERI

Use the serial line command **SERI** [*b p d s*] to set communication settings for the user port.

SERI [*b p d s*]

where

b = Bit rate (110, 150, 300, 600, 1200, 2400, 4800, 9600,19200, 38400, 57600, 115200)
p = Parity (n = none, e = even, o = odd)
d = Data bits (7 or 8)
s = Stop bits (1 or 2)

Example:

```
>SERI 600 N 8 1
600 N 8 1
>
```

You need to reset the transmitter to activate the new communication settings set with command SERI.

The settings can be changed one parameter at a time or all parameters at once:

```
>SERI O              changing parity only
4800 O 7 1
>SERI 600 N 8 1      changing all parameters
600 N 8 1
>
```

You can use the SERI command to change/view the user port settings even if you are currently connected to the service port.

SMODE

Use the command **SMODE** to set the user port start-up operating mode.

SMODE [*xxxx*]

where

where

xxx = STOP, RUN, POLL or SEND

Table 16 Selection of Output Modes

Mode	Output	Available Commands
STOP	Only with the **SEND** command	All (default mode)
RUN	Automatic output	Only command S
POLL	Only with the **SEND** [*addr*] command	Use with RS-485 buses, see Operation of RS-485 Module on page 107.
SEND	One message at power-up.	

Selected output mode will be activated after power outages.

INTV

Use the command **INTV** to set the outputting interval for the RUN mode.

INTV [*xxx yyy*]

where

xxx = Output inverval (0 ... 255). 0: the fastest possible output rate.
yyy = Unit (s, min or h)

Example:

```
>INTV 10 min
Output intrv. :  10 min
>
```

ECHO

Use the command **ECHO** to set the user port echo. The command either enables or disables echo of characters received.

ECHO [*x*]

where

x = ON (default) or
= OFF

NOTE	You can use the SERI, SMODE, INTV and ECHO commands to change/view the user port settings even if you are currently connected to the service port.

Pressure Average Calculation

Pressure

The averaging data filter calculates an average pressure over a certain period of time. The lowest measurement noise is achieved with the extended filtering. There are three filtering levels available.

AVRG [*x*] <cr>

where

X = 1 ... 60 s (default: 1 s)

.

The **AVRG** command is used to set and inspect the averaging time during which the individual measurement samples are integrated to get an averaged reading. The averaging time is the total averaging time of the transmitter.

Note that if the averaging time is defined to be long, the settling time at power-up will be long, too.

A minimum of one-second averaging time is recommended per each pressure transducer. These selections are used as the factory setting averaging times.

Example of setting the averaging time to 60 seconds (WMO averaging time for barometric pressure measurement):

```
>avrg <cr>
P1 average     : 1 s ? 60 <cr>

>avrg <cr>
P1 average     : 60 s ? <cr>
```

Relative Humidity (RH) and Temperature (T) Filtering

Table 17 Filtering Levels for Relative Humidity (RH) and Temperature (T)

Setting	Filtering level
OFF	No filtering
ON (default)	Standard = short filtering (approximately 15 s moving average)
EXTENDED	Extended filtering (default: approximately 1 min average)

Use display/keypad to set the filtering level.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Measuring** and press the right arrow key.
3. Select **Filtering** and press the **CHANGE** key.
4. Select **Off/Standard/Extended** and press the **SELECT** key.
5. Press the **EXIT** key to return to the basic display.

FILT

Use the serial line command **FILT** [*xxx*] to set the filtering level.

FILT [*xxx*]

where

xxx = OFF, ON or EXT (default = ON)

Device Information

The device information contains current configuration; status and settings of the device. The information is available through the display/menu, as well. For more information, see Information Display on page 59.

When requesting the device information, the following information will be shown:

- current sensor operation (for example, chemical purge), if any, in progress
- present or past unacknowledged errors, if any

- device identification; product name, version and serial number
- adjustment information (the latest date, user made adjustments)
- measuring settings
- information on chemical purge settings (when applicable)
- serial interface information
- analog output information
- relay output information (when applicable).

Using Serial Line

?

Use the serial line command **?** to check the current transmitter configuration. Command **??** is similar but can also be used if the transmitter is in POLL mode.

Example:

```
>?
PTU300 / 3.01
Serial number  : A2150004
Batch number   : A1450004
Adjust. date   : 2006-01-22
Adjust. info   : (not set)
Date           : 2006-02-27
Time           : 14:00:57
Serial mode    : RUN
Baud P D S     : 4800 E 7 1
Output interval: 150 s
Address        : 0
Echo           : OFF
Pressure       : 1013.25 hPa
Filter         : ON
Ch1 output     : 4...20mA
Ch2 output     : 4...20mA
Ch1 P     low  : 500.00 hPa
Ch1 P     high : 1100.00 hPa
Ch2 T     low  : -40.00 'C
Ch2 T     high : 60.00 'C
Module 1       : RELAY-1
Module 2       : BARO-1
>
```

HELP

Use the command **HELP** to list the commands.

Example:

```
>help
?          ACAL       ADDR       AERR       ASCL
ASEL       CDATE      CLOSE      CODE       CRH
CT         CTA        CTEXT      DATE       DELETE
DIR        DSEL       DSEND      ECHO       ERRS
FCRH       FDATE      FILT       FORM       FST
FTIME      HELP       INTV       ITEST      MODS
OPEN       PLAY       PRES       R          RESET
SEND       SERI       SMODE      TEST       TIME
UNDELETE   UNIT       VERS       XPRES
>
```

ERRS

Use the command **ERRS** to display transmitter error messages, see Error States on page 121 and Table 18 on page 122.

Example:

```
>errs
No errors
>
```

Example:

```
>ERRS
FAIL
Error: Temperature measurement malfunction
Error: Humidity sensor open circuit
>
```

VERS

Use the command **VERS** to display software version information.

Example:

```
>vers
PTU300 / 3.01
>
```

Resetting Transmitter By Using Serial Line

RESET

Resets the device. The user port switches to start-up output mode selected with command SMODE.

Locking Menu/Keypad by Using Serial Line

LOCK

Use the **LOCK** command to turn on the menu lock with 4-digit PIN code, for example 4444.

LOCK [*x yyyy*]

where

x = 1 (Menu locked)
yyyy = 4-digit PIN code

Example:

```
>lock 1 4444
Keyboard lock  : 1 [4444]
>
```

Use the **LOCK** command to turn on the menu lock without PIN code access possibility.

LOCK [*x*]

where

x = 1 (Menu locked)

Example:

```
>lock 1
Keyboard lock  : 1
>
```

Use the **LOCK** command to disable the keypad completely.

LOCK [*x*]

where

x = 2 (Keypad disabled)

Example:

```
>lock 2
Keyboard lock  : 2
>
```

NOTE	Open the locks with the serial command **LOCK 0**. You can open the menu lock also by using the keypad, if a PIN code has been set.

Data Recording

Data recording function is always on and collects data automatically into the memory of the device. Recorded data do not disappear from the memory when the power is switched off. Collected data can be observed in a form of a graph in the graphical view of the display or it can be listed out by using the serial line or MI70 Link program.

Selecting Data Recording Quantities

If the device is provided with the optional display, the recorded quantities are always those selected for the display. Up to three quantities can be recorded at a time. For instructions on how to select the display quantities with the keypad, see section Changing Quantities and Units on page 73.

DSEL

Use the serial line command **DSEL** to select the quantities to be recorded if the transmitter is not equipped with display/keypad.

DSEL [*xxx*]

where

xxx = Data recording quantity. For more information on available quantities and units, see Table 2 on page 15. For more information on optional quantities, see Table 3 on page 15 .

Example:

```
>dsel rh t tdf
 RH T Tdf
>
```

Enter the command without parameters and press **ENTER** to display current recording parameters.

View Recorded Data

If the device is provided with the optional display, the graphical display shows the data of the selected quantities, one at a time. For details about graphical display, see section Graphic History on page 58.

You may also dump the logged data to the serial line in numeric form with the following commands.

DIR

Use the serial line and enter the **DIR** command to check the available files.

The device records six files (six observation periods) for each selected quantity. Thus, total amount of the files depends on the amount of the selected quantities being at minimum 6 and at maximum 18. See Table 10 on page 58.

Select, for example, two quantities (P and T). The last two columns illustrate software information that is not essential for the user.

Example:

```
>dir
0  P   latest 20 minutes    00-01-01 01:55:29  135  020A
1  P   latest 3 hours       99-12-31 22:55:29  135  025A
2  P   latest 1 day         99-12-30 23:17:59  135  040C
3  P   latest 10 days       99-12-20 20:17:59  135  0802
4  P   latest 2 months      99-10-25 14:17:59  135  080C
5  P   latest 1 year        98-11-22 02:17:59  135  1003
6  T   latest 20 minutes    00-01-01 01:55:29  135  020A
7  T   latest 3 hours       99-12-31 22:55:29  135  025A
```

```
8  T   latest 1 day          99-12-30 23:17:59  135  040C
9  T   latest 10 days        99-12-20 20:17:59  135  0802
10 T   latest 2 months       99-10-25 14:17:59  135  080C
11 T   latest 1 year         98-11-22 02:17:59  135  1003
>
```

PLAY

Use the **PLAY** command to output the selected file to the serial line. Data in the output is <TAB> limited. This is compatible with most spreadsheet programs. Before giving the command, set the correct date and time with **TIME** and **DATE** commands, if needed.

PLAY [*x*]

where

x = 0 ... 17

Example:

```
>play 2
RH  latest 1 day         99-12-30 22:33:13
Date     Time            trend   min     max
yy-mm-dd hh:mm:ss        %RH     %RH     %RH
99-12-30 22:33:13        19.16   18.99   19.33
99-12-30 22:45:13        19.30   19.09   19.55
99-12-30 22:57:13        20.01   19.28   21.17
99-12-30 23:09:13        21.21   20.98   21.44
99-12-30 23:21:13        19.57   17.72   21.11
99-12-30 23:33:13        19.09   18.62   19.84
```

The <**ESC**> key can be used to interrupt the output listing.

The **PLAY** -1 command can be used to output all files.

NOTE	Output of large amounts of recorded data can take a long time. If you are using the user port, select the highest serial baud supported to reduce the time required for output.

Deleting the Recorded Files

Use the keypad/display to delete the recorded data files. Note that the transmitter automatically overwrites the old data when the memory gets full, so manual deletion of the recorded files is not necessary.

1. Press any of the arrow keys to open the **MAIN MENU.**
2. Select **System** and press the right arrow key.
3. Select **Clear graph memories** by using the down arrow key. Press the **CLEAR** key. Confirm by pressing the **YES** key.

CAUTION	This function clears all the data history from the memory, all graphs included.

DELETE/UNDELETE

Use the serial line to delete or undelete data files.

Use the **DELETE** command to delete all data files. Use the **UNDELETE** command to recover the deleted files.

NOTE	The **UNDELETE** command will only recover the part of the deleted data that has not been recorded over yet.

Analog Output Settings

The analog outputs are set in the factory according to the order form. In case you want to change the settings, follow these instructions. See section Third Analog Output on page 46.

Changing Output Mode and Range

Both output channels have their own DIP switch module with 8 switches, see the position in Figure 2 on page 17. (DIP switches for analog output settings.)

1. Select the current/voltage output, switch ON either of the switches, 1 or 2.
2. Select the range, switch ON one of the switches from 3 to 7.

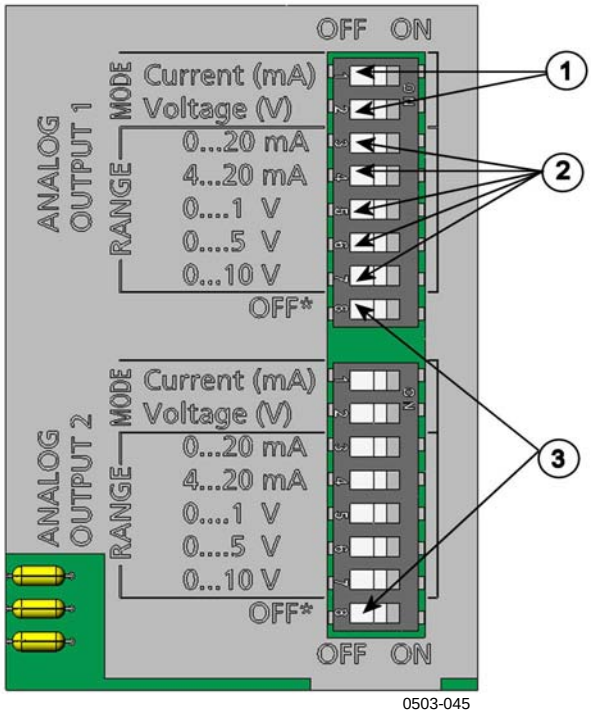


Figure 40 Current/Voltage Switches of Output Modules

Numbers refer to Figure 40 above:

1 = Current/voltage selection output switches (from 1 to 2)
2 = Current/voltage range selection switches (from 3 to 7) in analog output 1 and 2.
3 = Switches for service use only. Keep in OFF position always.

NOTE	Only one of the switches 1 or 2, must be ON at a time. Only one of the switches 3 to 7, must be ON at a time.

Example: 0 ... 5 V voltage output selected for channel 1 and 4...20 mA selected for channel 2.

	OFF	ON	Selection
1			
2			Voltage output selected
3			
4			
5			
6			0...5 V selected
7			
8			

1			Current output selected
2			
3			
4			4... 20 mA selected
5			
6			
7			
8			

NOTE If you have customized the error output setting (**AERR**), check that the set error values are still valid after changing the output mode/range, see section Analog Output Fault Indication Setting on page 99.

Analog Output Quantities

NOTE For best accuracy, pressure must always be output using Ch3, if available.

Use the display/keypad to change and scale the analog output quantities.

1. Press any of the arrow keys to open the **MAIN MENU.**
2. Select **Interfaces** and press the right arrow key.
3. Select **Analog outputs** and press the right arrow key.
4. Select **Output 1/2/3** and press the right arrow key.

5. Select **Quantity** and press the **CHANGE** key.
6. Select the quantity by using the up/down arrow keys. Press the **SELECT** key to confirm your selection.
7. Select **Scale,** lower limit, by pressing the up/down arrow keys. Press the **SET** key. Adjust the lower limit value by pressing the arrow keys up/down/left/right. Press the **OK** key to confirm your setting.
8. Select **Scale,** upper limit by pressing the up/down arrow keys. Press the **SET** key. Adjust the upper limit value by pressing the arrow keys up/down/left/right. Press the **OK** key to confirm your setting.
9. Press the **EXIT** key to return to the basic display.

AMODE/ASEL

Use the serial line to select and scale the analog output quantities. Connect the transmitter to the PC. Open the terminal connection between your PC and the transmitter.

1. Check the analog output modes with the **AMODE** command.

Example:

```
>amode
Ch1 output      : 0...1V
Ch2 output      : 0...1V
>
```

2. Select and scale the quantities for the analog outputs with the command **ASEL**. Note that the optional quantities can be selected only if they have been selected when ordering the device.

ASEL [*xxx yyy zzz*]

where

xxx = Quantity of channel 1
yyy = Quantity of channel 2
zzz = Quantity of the optional analog output channel 3

Enter always all the quantities for all outputs. For quantities and their abbreviations see Table 2, Table 3 and Table 4 on page 15.

Use the command **ASEL** [*xxx yyy*] as shown in the example below when using a device with two analog outputs.

Example:

```
>asel rh t p <cr>
Ch1 RH    low  : 0.00 %RH ?
Ch1 RH    high : 100.00 %RH ?
Ch2 T     low  : -40.00 'C ?
Ch2 T     high : 60.00 'C ?
Ch3 P     low  : 500.00 hPa ?
Ch3 P     high : 1100.00 hPa ?
>
```

Analog Output Tests

Use the display/keypad for testing the operation of the analog outputs by forcing the outputs to known values. Measure then the outputs with a current/voltage meter.

1. Press any of the arrow keys to open the **MAIN MENU.**
2. Select **System** and press the right arrow key.
3. Select **Diagnostics** and press the right arrow key.
4. Select **Analog output tests** and press the right arrow key.
5. Select one of the testing options **Force 0%/50%/100% of scale.** Press the **TEST** key. All outputs are tested simultaneously. The actual output value depends on the selected range.
6. Press the **OK** key to stop testing. Then press the **EXIT** key to return to the basic display.

ITEST

Use the serial line to test the operation of the analog outputs. Use the command **ITEST** to force the analog outputs to entered values. The set values remain valid until you enter the command ITEST without parameters or RESET the transmitter.

ITEST [*aa.aaa bb.bbb*]

where

aa.aaa = Current or voltage value to be set for channel 1 (mA or V)
bb.bbb = Current or voltage value to be set for channel 2 (mA or V)

Example:

```
>itest 20 5
Ch1 (Td )      :          *        20.000 mA   H'672A
Ch2 (T  )      :          *         5.000 mA   H'34F9
>itest
Ch1 (Td )      :    -23.204 'C     16.238 mA   H'FFFE
Ch2 (T  )      :     22.889 'C      8.573 mA   H'5950
>
```

Analog Output Fault Indication Setting

Factory default state for analog outputs during error condition is 0 V/ 0 mA. Please be careful when selecting the new error value. The error state of the transmitter should not cause unexpected problems in process monitoring.

Use the display/keypad to set the analog output fault indication.

1. Press any of the arrow keys to open the **MAIN MENU.**
2. Select **Interfaces** and press the right arrow key.
3. Select **Analog Outputs** and press the right arrow key.
4. Select **Output 1/2/3** and press the right arrow key.
5. Select **Fault indication**. Press the **SET** key. Enter the fault indication value by using the arrow keys. Press the **OK** key to confirm your setting. This value is outputted if a transmitter error occurs.
6. Press the **EXIT** key to return to the basic display.

AERR

Use the serial line **AERR** command to change the error output.

AERR

Example:

```
>aerr
Ch1 error out  : 0.000V ? 5.0
Ch2 error out  : 0.000V ? 5.0
>
```

NOTE	The error output value must be within a valid range of the output mode.

NOTE	The error output value is displayed only when there are minor electrical faults such as a humidity sensor damage. When there is a severe device malfunction, the error output value is not necessarily shown.

Operation of Relays

Quantity For Relay Output

A relay monitors the quantity chosen for the relay output. Any of the quantities available can be chosen.

Measurement-Based Relay Output Modes

Relay Setpoints

When the measured value is in between the "above" and "below" values, the relay is passive. When choosing lower value as "above" value and higher value as "below" value, the relay is passive when the measured value is not between the setpoints. You can also set only one setpoint.

See Figure 41 below for illustrative examples of the different measurement-based relay output modes.

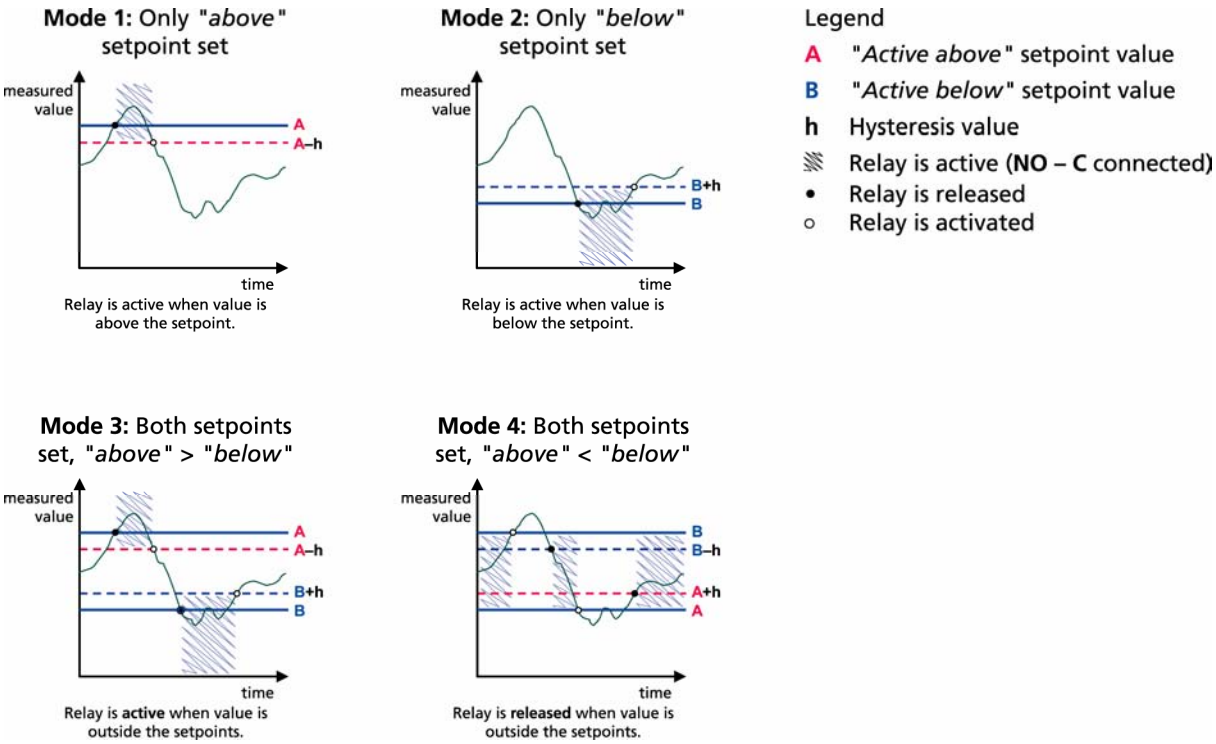


Figure 41 Relay Output Modes

Mode 4 is usually used if an alarm needs to be triggered when the measured value exceeds a safe range. The relay is active when measurement is in range, and is released if the value goes out of range or the measurement fails.

NOTE	If the measurement of the selected quantity fails or the transmitter loses its power, the relay is released.

Hysteresis

Hysteresis function is to prevent the relay switching back and forth when the measured value is near to the setpoint values.

Relay is activated when the measured value passes the exact value of the setpoint. When returning and passing the setpoint again relay is not released before the value reaches the setpoint increased/decreased by the hysteresis value.

Hysteresis should be smaller than difference of the setpoints.

Example:

When the 'active above' value is 60 %RH and the hysteresis value is 5 %RH, relay activates when the relative humidity reaches 60 %RH. As the humidity decreases, relay releases at 55 %RH.

NOTE If both setpoints are specified and "above" setpoint is lower than "below" setpoint, the hysteresis works in the opposite direction, that is, relay is **released** when the measured value passes the exact value of the setpoint.

Relay Indicating Transmitter Error Status

You can set a relay to follow the operation status of the device. By selecting FAULT/ONLINE STATUS for output quantity a relay changes state on the basis of the operation status as follows:

FAULT STATUS
Normal operation: relay active (C and NO outputs are closed)
Not measuring state (error state or power off): relay released (C and NC outputs are closed).

ONLINE STATUS
Live measurement (data available): relay active (C and NO outputs are closed)
No live data (for example: error state, chemical purge or adjustment mode): relay released (C and NC outputs are closed).

See Figure 42 below for illustrative examples of the FAULT/ONLINE STATUS relay output modes.

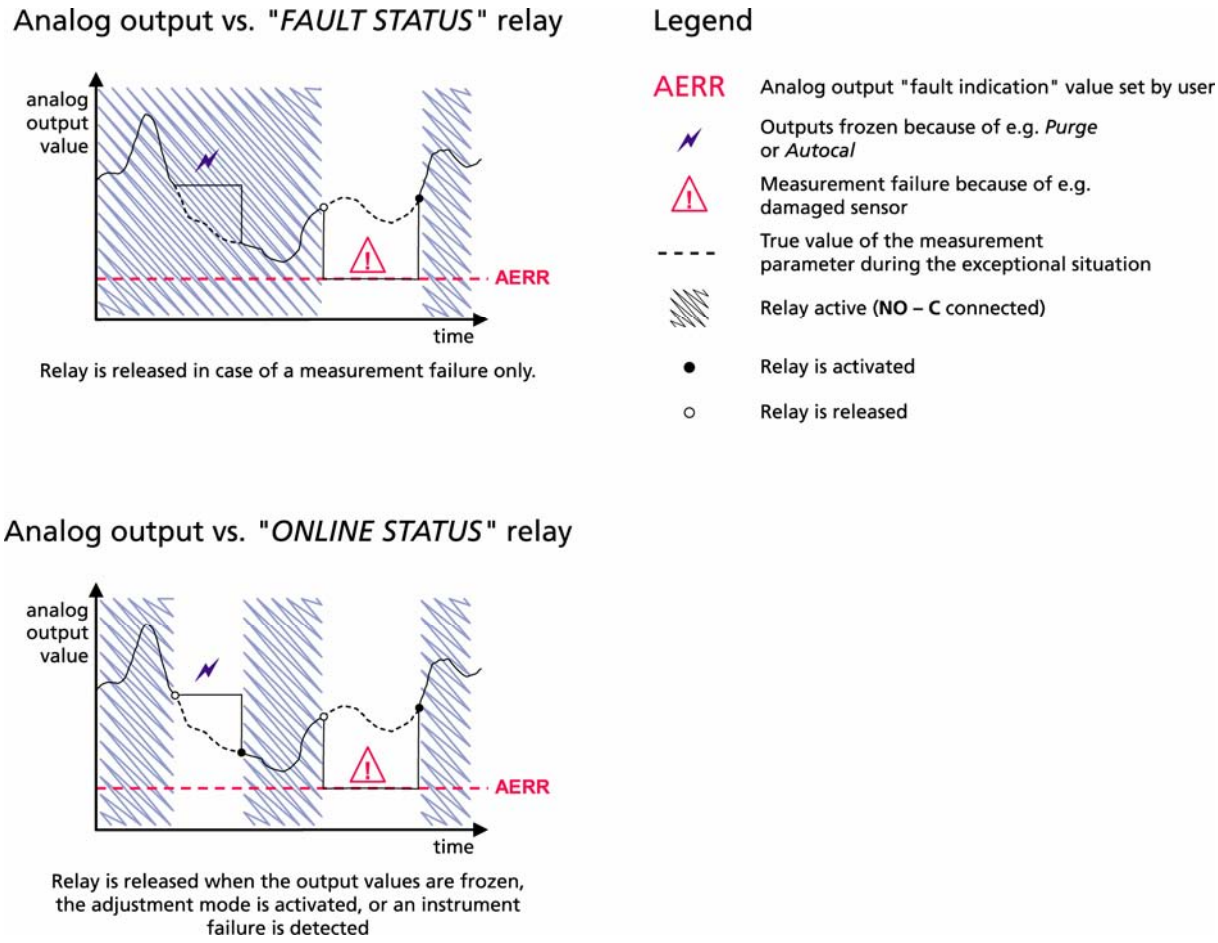


Figure 42 FAULT/ONLINE STATUS Relay Output Modes

FAULT/ONLINE STATUS relays are usually used in conjunction with an analog output to obtain validity information for the output value.

NOTE	If transmitter loses its power, all status-based relays are released similarly to the case of an instrument failure.

Enabling/Disabling Relays

You can deactivate the relay outputs for example for service purposes of your system.¨

Setting Relay Outputs

NOTE	When having only one relay module installed, its relays are called 'relay 1' and 'relay 2'. When having two relay modules, the relays of the module connected to slot **MODULE 1** are called 'relay 1' and relay 2'.

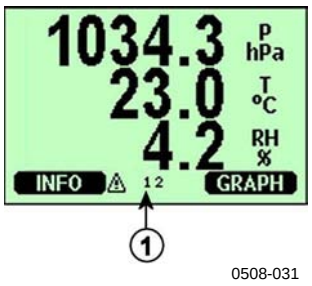


Figure 43 Relay Indicators on Display

Number refers to Figure 43 above:

1 = Lists enabled relays. Activation state shown in black. Disabled relays are not shown.

Use the display/keypad to set the relay outputs.

1. Press any of the arrow keys to open the **MAIN MENU**.
2. Select **Interfaces** and press the right arrow key.
3. Select **Relay outputs** and press the right arrow key.
4. Select **Relay 1/2/3/4**, press the right arrow key.
5. Select **Quantity**, press the **CHANGE** key. Select quantity by using the up/down arrow keys. Confirm your selection by pressing the **SELECT** key.
6. Select **Act. above/Act**. **below**. Press the **SET** key. You may be asked, whether you want to modify the value or remove the setpoint. In this case, select **MODIFY** to adjust the value or **REMOVE** to clear the setpoint. Adjust numeric values by pressing the up/down/left/right arrow keys. Confirm your selection by pressing the **OK** key.
7. Select **Hysteresis**. Press the **SET** key and adjust the value. Finally press the **OK** key.

8. Select **Relay enable**. Press the **ON/OFF** key to enable/disable the relay.

RSEL

Use the serial line to select the quantity, setpoints and hysteresis or enable/disable the relay outputs. Enter the **RSEL** command.

RSEL [*q1 q2*]

where

q1 = quantity for the relay 1 or Fault/Online
q2 = quantity for the relay 2 or Fault/Online

Factory setting: all relays disabled.

Use the quantity abbreviations presented above. For quantities and their abbreviations and pressure units, see Table 2, Table 3, and Table 4 on page 15.

Example of window limit switch:

Selecting relay 1 to follow dewpoint/frost point temperature measurement and relay 2 to follow temperature measurement. Two relay setpoints are set for both relays.

```
>rsel rh t
Rel1 RH   above: 0.00 %RH ? 30
Rel1 RH   below: 0.00 %RH ? 40
Rel1 RH   hyst : 0.00 %RH ? 2
Rel1 RH   enabl: OFF ? ON
Rel2 T    above: 0.00 'C ? 30
Rel2 T    below: 0.00 'C ? 40
Rel2 T    hyst : 0.00 'C ? 3
Rel2 T    enabl: OFF ? ON
>
```

Example of normal limit switch:

Selecting relay 1 to follow relative humidity, relay 2 to follow temperature, relay 3 to follow dewpoint and relay 4 to follow dewpoint. One setpoint is chosen for all the outputs.

```
>rsel rh t td td
Rel1 RH   above: 60.00 %RH ? 70
Rel1 RH   below: 70.00 %RH ? -
Rel1 RH   hyst : 2.00 %RH ? 2
Rel1 RH   enabl: ON ? on
```

```
Rel2 T    above: 50.00 'C ? 60
Rel2 T    below: 40.00 'C ? -
Rel2 T    hyst : 2.00 'C ? 2
Rel2 T    enabl: ON ? on
Rel3 Td   above: 5.00 'C ? 10
Rel3 Td   below: 0.00 'C ? -
Rel3 Td   hyst : 1.00 'C ? 1
Rel3 Td   enabl: OFF ? on
Rel4 Td   above: 0.00 'C ? 20
Rel4 Td   below: 0.00 'C ? -
Rel4 Td   hyst : 0.00 'C ? 2
Rel4 Td   enabl: OFF ? on
>
```

Example of using relay 1 as fault alarm: selecting relay 1 to follow the fault status and relay 2 to follow the temperature measurement.

```
>rsel fault t
Rel1 FAUL above: -
Rel1 FAUL below: -
Rel1 FAUL hyst : -
Rel1 FAUL enabl: ON ?
Rel2 T    above: 0.00 'C ? 30
Rel2 T    below: 0.00 'C ? -
Rel2 T    hyst : 0.00 'C ? 2
Rel2 T    enabl: OFF ? ON
>
```

Testing Operation Of Relays

Testing activates relays even if they are disabled.

Use the module push keys to activate the relays. Press the **REL 1** or **REL 2** key to activate the corresponding relay.

Relay is activated:	led is lit
Relay is not activated:	led is not lit

Use the display/keypad to test the operation of relays.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **System**, press the right arrow key.
3. Select **Diagnostics**, press the right arrow key.
4. Select **Relay tests**, press the right arrow key.

5. Select **Invert relay 1...** , press the **TEST** key. Now the selected relay output is forced to opposite state. Press the **OK** key to return to normal operation.
6. Press the **EXIT** key to return to the basic display.

RTEST

Use the serial line command **RTEST** to test the operation of the relays.

RTEST [*x1 x2 x3 x4*]

where

x = ON/OFF

Example: Activate and then release all four relays.

```
>rtest on on on on
 ON ON ON ON
>
>rtest off off off off
 OFF OFF OFF OFF
>
```

Enter the command **RTEST** without parameters to stop testing.

Operation of RS-485 Module

RS-485 interface enables communication between RS-485 network and PTU300 transmitter. The RS-485 interface is isolated and offers a maximum communications rate of 115 200 bits/s. (For maximum bus length of 1 km, use bit rate 19200 b/s or less.)

When selecting an RS-232-RS-485 converters for the network, avoid self powered converters as they don't necessarily support the needed power consumption.

Echo function shall be always disabled (OFF) when using the 2-wire connection. When using the 4-wire connection you can disable/enable the echo setting.

NOTE	User port on PTU300 main board cannot be used and connected when RS-485 module is connected. Service port is operating normally.

Networking Commands

Set the RS-422/485 interface by using the following commands. The other serial line commands are presented in section List of Serial Commands on page 68.

RS-485 configuration commands **SERI; ECHO; SMODE; INTV** and **ADDR** may be entered by using either the service port or RS-422/485 port. Also the optional display/keypad can be used, see section User Port Serial Settings on page 83.

SDELAY

With the sdelay command you can set delay (response time) for user port (RS232 or RS485), or view currently set delay value. Value corresponds to tens of milliseconds (eg. 5 = 0.050s minimum answer delay). The value can be set between 0...254.

Example:

```
>sdelay
Serial delay   : 0 ? 10

>sdelay
Serial delay   : 10 ?
```

SERI

Use the **SERI** command to input RS-485 bus settings.

SERI [*b p d s*]

where

b = bit rate (300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
p = parity (n = none, e = even, o = odd)
d = data bits (7 or 8)
s = stop bits (1 or 2)

ECHO

Use the **ECHO** command to enable/disable echo of characters received over the serial line.

ECHO [*x*]

where

x = ON/OFF (default = OFF)
When using 2-wire connection, echo must be always disabled.

SMODE

Use the **SMODE** command to set the default serial interface mode.

SMODE [*xxxx*]

where

xxxx = STOP, RUN, POLL or SEND

In STOP mode:	measurements output only by command SEND, all commands can be used
In RUN mode:	outputting automatically, only command S can be used to stop
In POLL mode:	measurements output only with command SEND [*addr*]
In SEND mode:	no commands are needed, a message is automatically outputted after power-up

When several transmitters are connected to the same line, each transmitter must be entered an own address in the initial configuration, and POLL mode must be used.

INTV

Use the **INTV** command to set the RUN mode output interval.

INTV [*n xxx*]

where

n = 1 - 255
xxx = S, MIN or H

Sets the RUN mode output interval. The time interval is used only when the RUN mode is active. For example, the output interval is set to 10 minutes.

```
>INTV 10 min
Output intrv. :    10 min
>
```

Setting RUN output interval to zero enables the fastest possible output rate.

ADDR

Addresses are required only for POLL mode (see serial line command SMODE on page 84). Use the **ADDR** command to input the RS-485 transmitter address.

OPEN [*aa*]

where

aa = address (0 ... 99) (default = 0)

Example: the transmitter is configured to address 99.

```
>ADDR
Address : 2 ?  99
>
```

SEND

Use the SEND command to output the reading once in POLL mode:

SEND [*aa*]

where

aa = address of the transmitter

OPEN

When all transmitters on the RS-485 bus are in POLL mode the **OPEN** command sets one transmitter temporarily to STOP mode so that other commands can be entered.

OPEN [*aa*]

where

aa = address of the transmitter (0 ... 99)

CLOSE

The **CLOSE** command switches the transmitter back to the POLL mode.

Example:

```
>OPEN 2   (opens the line to transmitter 2, other
          transmitters stay in POLL mode)
>CRH      (for example, calibration performed)
...
>CLOSE    (line closed)
```

Sensor Functions

Chemical Purge (Optional)

In some specific applications the sensor gain may decrease gradually due to an interference caused by a particular chemical present in the measured gas, for example. The decrease of sensor gain due to an interfering chemical and the effect of the chemical purge process are illustrated below, see Figure 44 on page 112. The sensor polymer absorbs the interfering chemical; and this reduces the ability of the polymer to absorb water molecules and consequently the sensor gain decreases. In chemical purge, heating the humidity sensor to a temperature level of approximately +160 °C for several minutes evaporates the interfering chemical.

The purge function starts with heating stage, continues with settling and when the temperature of the sensor is decreased the transmitter returns to normal mode. The whole cycle takes about 6 minutes.

NOTE	Chemical purge function locks the output values for about 6 minutes.

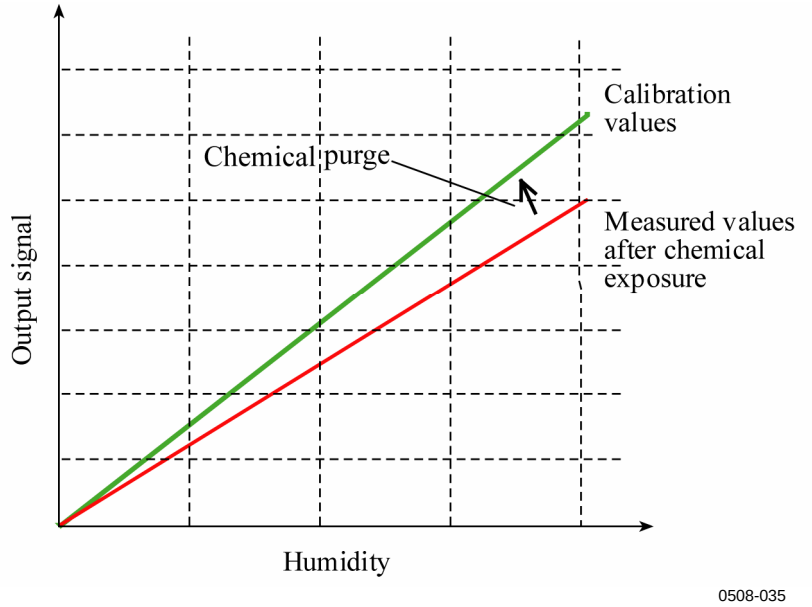


Figure 44 Decrease of Sensor Gain

Before starting the chemical purge note the following:

- the sensor is protected with a PPS grid with stainless steel netting, a stainless steel sintered filter or with membrane SST filter
- the sensor temperature must be below 100 °C. At higher temperatures the chemicals evaporate spontaneously from the sensor and the chemical purge is not necessary.

Automatic Chemical Purge (Interval Purge)

When PTU300 leaves the factory the automatic chemical purge (if chosen) takes place repeatedly with the time intervals set in the factory. User can change the interval in which the purge takes place by using serial commands or with the optional display/keypad. This can be needed if the measuring environment contains high concentrations of interfering chemicals. The automatic chemical purge can also be turned off if necessary.

Manual Chemical Purge

The chemical purge should be performed always before calibration (see section Calibration and adjustment on page 125) or when there is a reason to believe that a sensor has become exposed to an interfering chemical. Make sure that the temperature of the sensor has come down to normal temperature before starting a calibration.

Chemical Purge in Power Up

Chemical purge (start-up purge) can be set to start within 10 seconds from the power-up of the device.

Starting and Configuring Chemical Purge

Using Buttons On Motherboard

Start manual chemical purge by pressing simultaneously two **PURGE** buttons on the motherboard inside the transmitter for a few seconds. Indicator led flashes until purge is complete (up to 6 minutes).

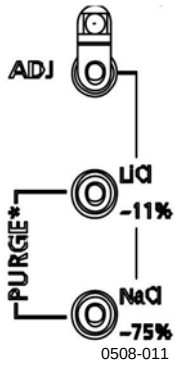


Figure 45 Purge Buttons on Motherboard

Using Display/Keypad (Optional)

Set the automatic and manual chemical purge by using the display/keypad.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **Measuring**, press the right arrow key.
3. Select **Chemical purge,** press the right arrow key.

Figure 46 Chemical Purge Settings

- Select **Automatic purge** and turn it on or off by pressing the **ON/OFF** key.
- Select **Interval** and press the **SET** key. Set the purge interval and the unit (hour/day) by using the arrow keys. The interval must be set between 1 hour...10 days. Press the **OK** key.
- Select **Start-up purge** and press the **ON/OFF** key.
- Start manual purge by selecting **Manual purge** and pressing the **START** key.

4. Press the **EXIT** key to return to the basic display.

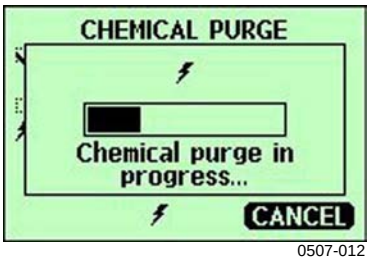


Figure 47 Performing Chemical Purge

Using Serial Line

PURGE

Enter the **PURGE** command to start chemical purge immediately.

```
>purge
Purge started, press any key to abort.
>
```

The prompt '>' appears when the heating period is over. However, the transmitter outputs are locked to the values measured before performing chemical purge until the settling time is over.

With **PUR** command you can enable or disable automatic and power-up chemical purge and set the interval for automatic purge. If the sensor is exposed to chemicals it is recommended to have the chemical purge done at least once in 720 min (=12 hours). In applications where the chemical exposure is not likely, the interval can be longer.

It is not recommended to change duration, settling, temperature or temp. difference.

PUR

Type **PUR** and press ENTER to proceed. The maximum interval is 14400 minutes (=10 days).

Example:

```
>pur
Interval Purge : ON ?
Interval       : 600 min ?
Power-up Purge : OFF ?
Duration       : 60 s ?
Settling       : 240 s ?
Temperature    : 180 'C ?
Temp. diff.    : 0.5 'C ?
>
```

NOTE	To activate the new interval settings immediately, reset the transmitter.

NOTE	When chemical purge in power-up is enabled, wait about 6 min after power-up before taking measurements. The output channels are locked for the first operation minutes to the initial measured values

Setting Sensor Heating

This function is optionally available only in transmitters with HUMICAP®180 C sensor. It should be used only with the warmed probe head.

The sensor heating is recommended for the high humidity environments where even a small temperature differences can cause water to condense on the sensor. The sensor heating speeds up the recovery of the humidity sensor from condensation.

Sensor heating starts-up when the relative humidity of the measuring environment reaches the RH-value set by a user (RH-limit). The user can define the RH-sensor heating temperature as well as the duration of the heating.

After the heating cycle the humidity conditions are checked and new sensor heating is performed if the predefined conditions are reached again.

NOTE	During the sensor heating the outputs are locked to the values measured before the heating cycle.

Setting Humidity Sensor Heating Using Display/Keypad

When the PTU300 leaves the factory the sensor heating follows the factory default values. You can enable/disable the function, change the RH-limit and define the heating temperature and duration of this function.

1. Open the **MAIN MENU** by pressing any of the arrow keys.
2. Select **Measuring**, press the right arrow key.
3. Select **Sensor heating,** press the **ON** key.

Using Serial Line

XHEAT

Enables/disables the sensor heating.

XHEAT [*xx*]

where:

xx = ON / OFF

```
>xheat on
Extra heat     : ON
>xheat off
Extra heat     : OFF
>
```

To configure the sensor heating use the XHEAT command without parameters. Enter the values after question mark. The available ranges include the following:

Extra heat RH -limit (heating function starts-up above the setpoint)	0...100 %RH (default: 95 %RH)
Extra heating temperature	0...200 ºC (default: 100 ºC)
Extra heating time	0...255 s (default: 30 s)

Example:

```
>xheat
Extra heat     : OFF
Extra heat RH  : 95 ? 90
Extra heat temp: 100 ? 85
Extra heat time: 30 ? 10
>xheat on
Extra heat     : ON
>
```

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CHAPTER 5

MAINTENANCE

This chapter contains information that is needed in basic maintenance of the product

Periodic Maintenance

Cleaning

Clean the transmitter enclosure with a soft, lint-free cloth moistened with mild detergent.

Changing the Probe Filter

1. Unscrew the filter from the probe head.
2. Screw a new filter on the probe head. When using the stainless steel filter (for oil and fuel cell), take care to tighten the filter properly (recommended force 130 Ncm).

New filters can be ordered from Vaisala, see section Options and Accessories on page 149.

Changing the Sensor

The user can change the HUMICAP180 and HUMICAP180L sensors

1. Unscrew the filter from the probe head. See the instructions in section Changing the Probe Filter on page 119.
2. Remove the damaged sensor and insert a new one. Handle the new sensor by the plastic socket. DO NOT TOUCH THE SENSOR PLATE.
3. After sensor change the humidity calibration must be made according to the instructions, see section Relative Humidity Adjustment After Sensor Change on page 134.
4. Screw a new filter on the probe head. When using the stainless steel filter, take care to tighten the filter properly (recommended force 130 Ncm).

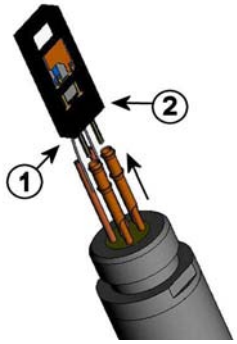

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Figure 48 Changing the Sensor

Numbers refer to Figure 48 above:

1 = Pull out the sensor
2 = Plastic socket

Error States

In error state the quantity is not measured and the output is shown as follows:

- analog channel outputs 0 mA or 0 V (you can use the serial line command **AERR** or display/keypad to change this fault indication value, see section Analog Output Fault Indication Setting on page 99.)
- the serial port outputs stars (***)
- the cover LED is blinking
- optional display: error indicator is lit.

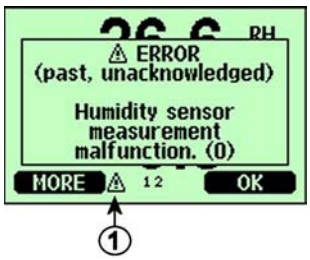

Figure 49 Error Indicator and Error Message

Number refers to Figure 49 above:

1 = Error Indicator

- The error indicator disappears when the error state is over and you have checked the error message. Press the **INFO** key to display the error message.

You can also check the error message via the serial interface by using the command **ERRS**. In case of constant error, please contact Vaisala, see Vaisala Service Centers on page 155.

Table 18 Error Messages

Error Message	Action
Humidity sensor measurement malfunction.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
Humidity sensor short circuit	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt, water, ice or other contaminants.
Humidity sensor open circuit	Check the integrity of the humidity probe and the probe cable.
Temperature sensor open circuit.	Check the integrity of the humidity probe and the probe cable.
Temperature sensor short circuit.	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
Temperature measurement malfunction	Check the integrity of the humidity probe and the probe cable. Clean the probe from dirt water, ice or other contaminants.
Temperature sensor current leak.	Check the integrity of the humidity probe and the probe cables. Clean the probes from dirt, water, ice or other contaminants.
Internal ADC read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal EEPROM read error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal EEPROM write error	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Add-on module 1 (or 2) connection failure	Turn off the power and check the module connection. Turn on the power.
Device internal temperature out of range	Ensure that the operating temperature is within the valid range.
Operating voltage out of range	Ensure that the operating voltage is within the valid range.
Internal analog voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal system voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal ADC reference voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Internal analog output reference voltage out of range	Internal transmitter failure. Remove the transmitter and return the faulty unit to Vaisala Service.
Configuration switches for analog output 1/2/3 set incorrectly	Check and re-set the switches, see page 55.
EEPROM failure on add-on module 1 (or 2)	Disconnect the power and check the analog output module connection.
Communication module installed in incorrect add-on module slot	Disconnect the power and change the communication module to another module slot.
Unknown/incompatible module installed in add-on module slot 1(or 2)	Ensure that the module is compatible with the PTU300.
Pressure measurement	Disconnect power and check pressure module connection.

Error Message	Action
failure in add-on module slot 1or 2	
Pressure out of valid range	Check that assumed pressure is within measurement range for the transmitter.

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CHAPTER 6

CALIBRATION AND ADJUSTMENT

The PTU300 is fully calibrated and adjusted as shipped from factory. Typical calibration interval is two years. Depending on the application it may be good to make more frequent checks. Calibration must be done always when there is a reason to believe that the device is not within the accuracy specifications.

When defining the calibration interval the long term specifications and the requirements of the customer must be taken into consideration. Contact Vaisala Service Centers for details.

It is recommended that calibration and adjustment should be carried out by Vaisala. See section Vaisala Service Centers on page 155.

Calibration and adjustment is carried out either by using the push-keys on the motherboard, through the serial port or with the optional display/keypad.

(Vaisala portable instruments HM70 and HMI41 can also be used).

Pressure

The user can select a simple offset or a two-point offset and gain adjustment and use the LCI command for adjustment of pressure transducer. The MPCI command is used for the more sophisticated multipoint correction capability at up to eight pressure levels.

Check first what linear corrections the transmitter is currently using before attempt to readjust the transducer. As the previous linear corrections will disappear when new linear corrections are input, the user has to take into account the previous linear corrections when deciding about the new ones.

NOTE	Entering new linear or multipoint corrections will always cancel the previous corrections. It is advisable to write down the previous linear and multipoint corrections so that they will not be lost by mistake.

Table 19 Adjustment and Calibration Commands

Function	Command
linear corrections on/off	LCI ON/OFF
entering linear corrections	LCI
multipoint corrections on/off	MPCI ON/OFF
entering multipoint corrections	MPCI
calibration date	CDATE

Opening And Closing the Adjustment Mode

1. Open the transmitter cover. The buttons needed in adjustment are on the left-hand side of the motherboard.
2. If the chemical purge option is available, it should be carried out always before RH calibration. To start chemical purge press simultaneously two **PURGE** push-buttons (on the motherboard) for a few seconds. Red indicator led flashes with short pulses until purge is complete (up to 6 minutes).
3. Press the **ADJ** button to open the adjustment mode.
4. Press the **ADJ** button again to close the adjustment mode.

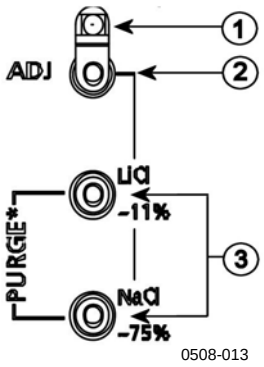

Figure 50 Adjustment and Purge Buttons

Numbers refer to Figure 50 above:

1 = Indicator led
2 = Adjustment button
3 = Press the purge buttons simultaneously to start chemical purge (if available)

Adjustment menu is displayed only when **ADJ** button (on the motherboard inside the transmitter) is pressed.

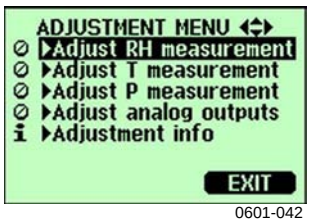

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Figure 51 Adjustment Menu

Table 20 Indicator Led Functions

Indicator Led Function	Description
LED off	adjustment locked
LED on	adjustment available
LED blinking evenly	measurement not stabilized
LED blinking with short pulses	performing chemical purge

NOTE If using a warmed probe (**PTU307 option**), probe heating will be interrupted when **ADJ** key is pressed. Allow sufficient time for the probe to reach ambient temperature before starting the adjustment procedure.

NOTE Fixed pressure compensation value of 1013.25 hPa is used when in adjustment mode

Pressure Adjustment

1-point Adjustment Using Display/Keypad

1. Carry out the chemical purge (if available).
2. Press the **ADJ** button to open the **ADJUSTMENT MENU**.
3. Select **Adjust P measurement**, press the right arrow key.
4. Select **P_1 adjustment**. Press the **START** key.

5. Let the readings stabilize. Press the **READY** key when stabilized.
6. Enter the actual pressure of the reference used using the up/down arrow keys. Press the **OK** key.
7. Press the **YES** key to perform the adjustment. Press the **OK** to return to the adjustment menu.

1-point Adjustment Using Serial Line

NOTE	Making adjustments is possible only after adjustments are unlocked. To unlock the adjustment menu, press the ADJ button on the motherboard of the transmitter.

LCI

Use the command LCI

- to activate or deactivate the linear adjustment function
- to enter new linear offset and offset/gain pressure corrections to the transmitter
- to edit existing linear offset and offset/gain pressure corrections.

Key in the linear corrections for each pressure transducer separately.

NOTE	The new linear corrections will always cancel the previous corrections as well as the valid date of calibration of the transmitter.

Example:

```
>lci
P1 linear adj. : OFF ? on
P1 1.reading   : 0.000 ? 950
P1 1.correction: 0.000 ? 0.22
P1 2.reading   : 0.000 ? 1120
P1 2.correction: 0.000 ? 0.15
```

LC

Use the command LC to view current status of the linear offset and offset/gain pressure corrections.

Example:

```
>lc
P1 linear adj. : ON
P1 1.reading   : 950.000
P1 1.correction: 0.220
P1 2.reading   : 1120.000
P1 2.correction: 0.150
```

MPCI

Use the command MPCI

- to activate or deactivate multipoint adjustment function
- to enter new multipoint corrections to the transmitter
- to edit existing multipoint corrections.

First deactivate the previous corrections by using the LCI OFF and/or MPC1 OFF commands. Precalibration of the transmitter then gives the required corrections.

When entering new multipoint corrections, always start at the low-pressure end and then go up the pressure range. Key in the multipoint corrections for each pressure transducer separately.

NOTE	The new multipoint corrections will always cancel the previous corrections as well as the valid date of calibration of the transmitter.

Example:

```
>mpci
P1 multi adj.  : OFF   ? on
P1 1.reading   : 0.000 ? 900
P1 1.correction: 0.000 ? 0.2
P1 2.reading   : 0.000 ? 950
P1 2.correction: 0.000 ? 0.22
P1 3.reading   : 0.000 ? 1000
P1 3.correction: 0.000 ? 0.27
P1 4.reading   : 0.000 ? 1050
P1 4.correction: 0.000 ? 0.31
P1 5.reading   : 0.000 ? 1100
P1 5.correction: 0.000 ? 0.32
```

```
P1 6.reading   : 0.000 ? 1150
P1 6.correction: 0.000 ? 0.33
P1 7.reading   : 0.000 ? 1200
P1 7.correction: 0.000 ? 0.34
P1 8.reading   : 0.000 ?
P1 8.correction: 0.000 ?
```

MPC

Use the command MPC to view current status of the multipoint corrections.

Example:

```
>mpc
P1 multi adj.  : ON
P1 1.reading   : 900.000
P1 1.correction: 0.200
P1 2.reading   : 950.000
P1 2.correction: 0.220
P1 3.reading   : 1000.000
P1 3.correction: 0.270
P1 4.reading   : 1050.000
P1 4.correction: 0.310
P1 5.reading   : 1100.000
P1 5.correction: 0.320
P1 6.reading   : 1150.000
P1 6.correction: 0.330
P1 7.reading   : 1200.000
P1 7.correction: 0.340
P1 8.reading   : 0.000
P1 8.correction: 0.000
>
```

Relative Humidity Adjustment

Using Push-Buttons

A simple push-button adjustment is carried out by using two relative humidity references: 11 % RH (LiCl) and 75 % RH (NaCl). The three buttons needed for the adjustment are located on the motherboard, at the upper left corner of the transmitter.

1. Carry out the chemical purge (if available).

LiCl reference

2. Press the **ADJ** button (see Figure 50 on page 126) to open the adjustment mode. The indicator led starts flashing.

3. Remove the filter from the probe and insert the probe head into a measurement hole of the 11 % RH (LiCl) in the humidity calibrator HMK15. Use the adapter fitting for the PTU307 probe.
4. Wait at least 30 minutes for the sensor to stabilize (the indicator led is lit continuously). Adjustment cannot be done if the conditions are not stabilized (indicator led is flashing).
5. When the indicator led is lit continuously press the LiCl~11% button to adjust the 11 % RH condition. After adjustment transmitter returns to normal operation mode (indicator led is unlit).

NaCl reference

6. When adjusting in the second reference 75 % RH, press the **ADJ** button to open the adjustment mode. The indicator led starts flashing.
7. Insert the probe head into a measurement hole of the 75 % RH (NaCl) reference chamber of the humidity calibrator HMK15. Use the adapter fitting for the PTU307 probe.
8. Wait at least 30 minutes for the sensor to stabilize (the indicator led is lit continuously). Adjustment cannot be done if the conditions are not stabilized (indicator led is flashing).
9. Press the NaCl~75% button to adjust the 75 % RH condition. After adjustment transmitter returns to normal operation mode (indicator led is unlit).

Using Display/Keypad

Note that the difference between the two humidity references must be at least 50% RH.

1. Carry out the chemical purge (if available).
2. Press the **ADJ** button (opens the **ADJUSTMENT MENU**).
3. Select **Adjust RH measurement**, press the right arrow key.
4. Select **1-point/ 2-point adjustment**. Press the **START key.**
5. Select the reference as guided by the display, press the **SELECT** key.

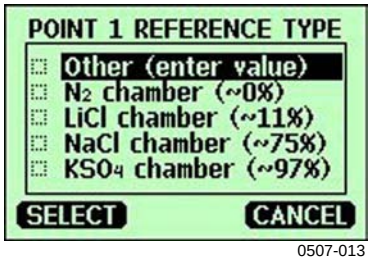

Figure 52 Selecting Point 1 Reference Type

6. Remove the filter from the probe and insert the probe head into a measurement hole of the dry end reference chamber (for example, LiCl: 11 % RH in the humidity calibrator HMK15.) Use the adapter fitting for the PTU307 probe.
7. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.
8. Press the **READY** key when stabilized. If you have chosen the **Other** reference value, enter now the reference value by using the arrow keys.

   When carrying out the 2-point adjustment proceed to the next adjustment point and carry out the procedure as described in the previous items.
9. Answer **YES** to confirm the adjustment. Press the **OK** key to return to the adjustment menu.
10. Press the **EXIT** key to close the adjustment mode and return to the basic display. Before closing the adjustment mode, feed the adjustment information into the device, see section Feeding Adjustment Information on page 138.

Using Serial Line

Note that the difference between the two humidity references must be at least 50% RH.

1. Connect the PTU300 to a PC. See section Serial Line Communication on page 64. Open a terminal program.
2. Carry out the chemical purge (if available).
3. Press the **ADJ** button.
4. Remove the filter from the probe and insert the probe head into a measurement hole of the dry end reference chamber (for example, LiCl: 11 % RH in the humidity calibrator HMK15).

Use the adapter fitting for the probes of HMT334, HMT335, PTU307 and HMT338.

5. Enter the **CRH** command and press **ENTER.**

CRH

6. Wait at least 30 minutes for the sensor to stabilize.
7. Type **C** and press **ENTER** a few times to check if the reading is stabilized.
8. When the reading is stabilized, give the reference humidity after the question mark and press **ENTER.**

```
>crh

RH  :    11.25  Ref1 ? c
RH  :    11.25  Ref1 ? c
RH  :    11.25  Ref1 ? c
RH  :    11.24  Ref1 ? c
RH  :    11.24  Ref1 ? 11.3
Press any key when ready ...
```

9. Now the device is waiting for the high end reference. Insert the probe head into a measurement hole of the high end reference chamber (for example,. NaCl: 75 % RH chamber in the humidity calibrator HMK15). Use the adapter fitting for the HMT334, HMT335, PTU307 and HMT338 probes. Press any key when ready.
10. Let the probe stabilize for about 30 minutes. You can follow the stabilization by typing C and pressing **ENTER**.
11. When stabilized, type the high end reference value after the question mark and press **ENTER**.

```
>crh

RH  :    11.25  Ref1 ? c
RH  :    11.24  Ref1 ? c
RH  :    11.24  Ref1 ? 11.3
Press any key when ready ...

RH  :    75.45  Ref2 ? c
RH  :    75.57  Ref2 ? c
RH  :    75.55  Ref2 ? c
RH  :    75.59  Ref2 ? 75.5
OK
>
```

12. **OK** indicates that the adjustment has succeeded and the new calibration coefficients are calculated and stored.Enter the

adjustment information (date and text) to the memory of the transmitter, see the commands **CTEXT** and **CDATE**.

13. Press the **ADJ** button on the motherboard to close the adjustment mode.
14. Take the probe out of the reference conditions and replace the filter.

Relative Humidity Adjustment After Sensor Change

Using Display/Keypad

When using the optional display/keypad, follow the instructions on Using Display/Keypad on page 131 on page but select **Adj. for new RH sensor (**instead of **1-point**/ **2-point adjustment)**.

Using Serial Line

After sensor change, carry out the procedure as described in previous sections. Just replace the **CRH** command with the **FCRH** command.

FCRH

Example:

```
>FCRH
RH   :    1.82 1. ref    ?    0
Press any key when ready...
RH   :    74.22     2. ref    ? 75
OK
>
```

The OK indicates that the calibration has succeeded.

Temperature Adjustment

Using Display/Keypad

1. Press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**. If using a warmed probe for measuring, probe heating will be interrupted when **ADJ** button is pressed. Wait some time for the probe to reach ambient temperature.
2. Select **Adjust T measurement** (or **TA measurement** for additional probe) press the right arrow key.
3. Select **1-point/ 2-point adjustment**. Press the **START** key.
4. Remove the filter from the probe and insert the probe head into the reference temperature.
5. Wait at least 30 minutes for the sensor to stabilize. Follow the stabilization from the **GRAPH** display.
6. Press the **READY** key when stabilized. Give the reference temperature by using the arrow keys.

When carrying out the 2-point adjustment, proceed to the next adjustment point and carry out the procedure as described in the previous items. Please note that the difference between the two temperature references must be at least 30 ºC.

7. Press the **OK** key. Then press **YES** to confirm the adjustment.
8. Press the **OK** key to return to the adjustment menu.
9. Press the **EXIT** key to close the adjustment mode and return to the basic display

Using Serial Line

1. Press the **ADJ** button on the motherboard to open the adjustment mode. If using a warmed probe for measuring, probe heating will be interrupted when **ADJ** button is pressed. Wait some time for the probe to reach ambient temperature.
2. Remove the probe filter and insert the probe head into the reference temperature.
3. Enter the command **CT** or (**CTA** for additional T probe) and press **ENTER**.

CT

or for additional T probe:

CTA

4. Type **C** and press **ENTER** a few times to check if the reading is stabilized. Let the reading stabilize, give the reference temperature after the question mark and press **ENTER** three times**.**

When having another reference temperature (2-point calibration) press **ENTER** only twice and insert the probe to the second reference. When the reading is stabilized, give the second reference temperature after the question mark and press **ENTER**. Please, note that the difference between the two temperature references must be at least 30 ºC.

Example (1-point adjustment):

```
>ct
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? c
T   :    16.06  Ref1 ? 16.0
Press any key when ready ...
T   :    16.06  Ref2 ?
OK
>
```

5. **OK** indicates that the calibration has succeeded.Give the calibration information (date and text) to the transmitter's memory, see the serial commands **CTEXT** and **CDATE**.
6. Press the **ADJ** button on the motherboard to close the adjustment mode.
7. Take the probe out of the reference conditions and replace the filter.

Analog Output Adjustment (Ch1 and Ch2)

In the analog output calibration the analog output is forced to the following values:

- current output: 2 mA and 18 mA

- voltage output: 10 % and 90 % of the range

Connect PTU300 to a calibrated current/voltage meter in order to measure either current or voltage depending on the selected output type.

NOTE	Normally, analog output Ch3 does not need to be adjusted once it has left from the factory. However, if accuracy of the unit is suspected, it is advisable to return the unit to Vaisala for re-adjustment/calibration.

Using Display/Keypad

1. Press the **ADJ** button to open the **ADJUSTMENT MENU**.
2. Select **Adjust analog outputs**, press the right arrow key.
3. Select the output to be adjusted **Adjust analog output 1/2**, press the **START** key.
4. Measure the first analog output value with a multimeter. Give the measured value by using the arrow keys. Press the **OK** key.
5. Measure the second analog output value with a multimeter. Give the measured value by using the arrow keys. Press the **OK** key**.**
6. Press the **OK** key to return to the adjustment menu.
7. Press the **EXIT** key to close the adjustment mode and to return to the basic display.

Using Serial Line

Enter the **ACAL** command and type the multimeter reading for each case. Continue by pressing **ENTER**.

ACAL

Example (current outputs):

```
>ACAL
Ch1  I1   (mA) ?    2.046
Ch1  I2   (mA) ?    18.087
Ch2  I1   (mA) ?    2.036
Ch2  I2   (mA) ?    18.071
>
```

Feeding Adjustment Information

This information is shown on the device information fields (see sections Information Display on page 59 and Device Information on page 87).

Using Display/Keypad

1. If you are not in the adjustment menu, press the **ADJ** button on the motherboard (opens the **ADJUSTMENT MENU**).
2. Select **Adjustment info,** press the right arrow key.
3. Select **Date**, press the **SET** key. Enter date by using the arrow keys. Press the **OK** key.
4. Select **i,** press the **SET** key. Enter information text including 17 characters at maximum. Use the arrow keys. Press the **OK** key.
5. Press the **EXIT** key to return to the basic display.

Using Serial Line

CTEXT

Use the CTEXT command to enter text to the adjustment information field.

Example:

```
>ctext
Adjust. info   : (not set) ? HMK15
>
```

CDATE

Use the CDATE command to enter date to adjustment information field. Set the adjustment date in format YYYY-MM-DD.

Example:

```
>cdate
Adjust. date   : (not set) ? 2006-01-22
>
```

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CHAPTER 7

TECHNICAL DATA

This chapter provides the technical data of the product.

Specifications

Performance

Barometric pressure

Pressure range		500 ... 1100 hPa,	50 ... 1100 hPa
Accuracy	500 ... 1100 hPa,	500 ... 1100 hPa	50 ... 1100 hPa
	Class A	**Class B**	
Linearity	±0.05 hPa	±0.10 hPa	±0.20 hPa
Hysteresis*	±0.03 hPa	±0.03 hPa	±0.08 hPa
Repeatability*	±0.03 hPa	±0.03 hPa	±0.08 hPa
Calibration uncertainty**	±0.07 hPa	±0.15 hPa	±0.20 hPa
Accuracy at +20 °C***	±0.10 hPa	±0.20 hPa	±0.30 hPa
Temperature dependence****	±0.1 hPa	±0.1 hPa	±0.3 hPa
Total accuracy (-40 ... +60 °C/ -40 ... +140 °F)	±0.15 hPa	±0.25 hPa	±0.45 hPa
Long-term stability/year	±0.1 hPa	±0.1 hPa	±0.2 hPa
Response time (100 % response) one sensor	2 s•	1 s•	1 s•
Pressure units	hPa, mbar, kPa, Pa, inHg, mmH20, mmHg, torr, psia		

* Defined as ±2 standard deviation limits of endpoint non-linearity, hysteresis error or repeatability error and calibration.

**	Defined as ±2 standard deviation limits of accuracy of the working standard including traceability to NIST.
***	Defined as the root sum of the squares (RSS) of endpoint non-linearity, hysteresis error, repeatability error and calibration uncertainty at room temperature.
****	Defined as ±2 standard deviation limits of temperature dependence over the operating temperature range.

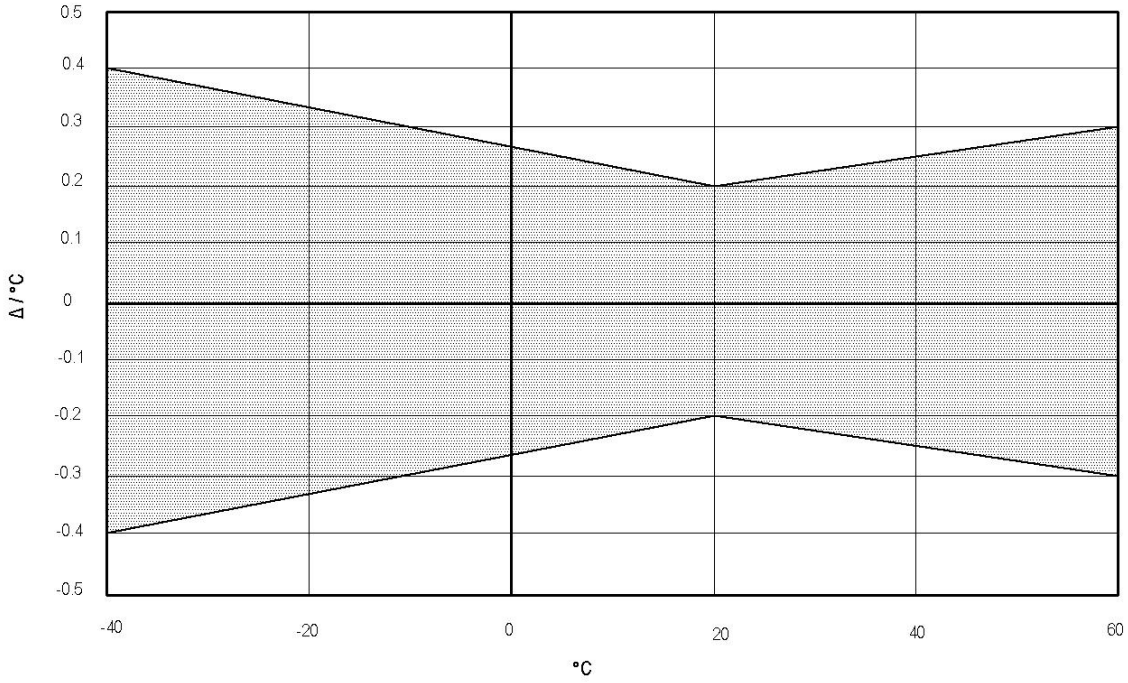
Relative Humidity

Measurement range		0...100 %RH
Accuracy (including non-linearity, hysteresis and repeatability)		
with	HUMICAP®180	for typical applications
	HUMICAP®180C	for applications with chemical purge and/or warmed probe
	at +15... 25 °C	± 1 % RH (0...90 % RH) ± 1.7 % RH (90...100 %RH)
	at -20...+40 °C	± (1.0 + 0.008 x reading) % RH
	at -40...+ 180 °C	± (1.5 + 0.015 x reading) % RH
with	HUMICAP®180L2	for applications with demanding chemical environment
	at -10...+40 °C	± (1.0 + 0.01 x reading) % RH
	at -40...+180 °C	± (1.5 + 0.02 x reading) % RH
Factory calibration uncertainty (+20 °C)		±0.6 % RH (0...40 % RH) ±1.0 % RH (40...97 % RH) (Defined as ± 2 standard deviation limits. Small variations possible, see also calibration certificate.)
Response time (90 %) at 20 °C in still air		8 s with grid filter 20 s with grid + steel netting filter 40 s with sintered filter

Temperature (+ Operating pressure ranges)

PTU301/303/307	-40...+60 °C (-40...+140 °F)
Accuracy at +20 °C (+68 °F)	± 0.2 °C (± 0.2 °F)
Temperature units	°C, °F

Accuracy over temperature range (see graph below):



0605-104

Figure 53 Accuracy over Temperature Range

Temperature sensor	Pt 100 RTD 1/3 Class B IEC 751

Optional Temperature Probe

Temperature measurement range:	-70...+ 180 ºC (-94...+356 ºF)
Typical accuracy:	0.1 ºC (0.18 ºF)
Sensor:	Pt100 PRT DIN IEC 751 class 1/4 B
Cable length:	2 m, 5 m, and 10 m
Pressure tight:	up to 7 bar
Probe material:	stainless steel

Calculated Variables

Table 21 Calculated Variables (Typical Ranges)

Variable	PTU 301	PTU303	PTU 307
Dewpoint temperature	-20...+60 ºC	-20...+80 ºC	-20...+100 ºC
Mixing ratio	0...160 g/kg dry air	0...500 g/kg dry air	0...500 g/kg dry air
Absolute humidity	0...160 g/m^3	0...500 g/m^3	0...500 g/m^3
Wet bulb temperature	0...60 ºC	0...+100 ºC	0...+100 ºC
Enthalpy	-40...+1500 kJ/kg	-40...+1500 kJ/kg	-40...+1500 kJ/kg
Water vapor pressure	0... 1000 hPa	0... 1000 hPa	0... 1000 hPa

Accuracies Of Calculated Variables

Accuracies of the calculated variables depend on the calibration accuracy of the humidity and temperature sensors; here the accuracies are given for ± 2 %RH and ± 0.2 °C.

Accuracy of Dewpoint Temperature °C

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	1.86	1.03	0.76	0.63	0.55	0.50	0.46	0.43	—	—
-20	2.18	1.19	0.88	0.72	0.62	0.56	0.51	0.48	—	—
0	2.51	1.37	1.00	0.81	0.70	0.63	0.57	0.53	0.50	0.48
20	2.87	1.56	1.13	0.92	0.79	0.70	0.64	0.59	0.55	0.53
40	3.24	1.76	1.27	1.03	0.88	0.78	0.71	0.65	0.61	0.58
60	3.60	1.96	1.42	1.14	0.97	0.86	0.78	0.72	0.67	0.64
80	4.01	2.18	1.58	1.27	1.08	0.95	0.86	0.79	0.74	0.70
100	4.42	2.41	1.74	1.40	1.19	1.05	0.95	0.87	0.81	0.76
120	4.86	2.66	1.92	1.54	1.31	1.16	1.04	0.96	0.89	0.84
140	5.31	2.91	2.10	1.69	1.44	1.26	1.14	1.05	0.97	0.91
160	5.80	3.18	2.30	1.85	1.57	1.38	1.24	1.14	1.06	0.99

Accuracy of Mixing Ratio g/kg (Ambient Pressure 1013 mbar)

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	—	—
-20	0.017	0.018	0.019	0.021	0.022	0.023	0.025	0.026	—	—
0	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13
20	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49
40	0.97	1.03	1.10	1.17	1.24	1.31	1.38	1.46	1.54	1.62
60	2.68	2.91	3.16	3.43	3.72	4.04	4.38	4.75	5.15	5.58
80	6.73	7.73	8.92	10.34	12.05	14.14	16.71	19.92	24.01	29.29
100	16.26	21.34	28.89	40.75	60.86	98.85	183.66	438.56	—	—
120	40.83	74.66	172.36	—	—	—	—	—	—	—

Accuracy of Wet Bulb Temperature °C

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	—	—
-20	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.23	—	—
0	0.27	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.31	0.31
20	0.45	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.42	0.42
40	0.84	0.77	0.72	0.67	0.64	0.61	0.58	0.56	0.54	0.52
60	1.45	1.20	1.03	0.91	0.83	0.76	0.71	0.67	0.63	0.60
80	2.23	1.64	1.32	1.13	0.99	0.89	0.82	0.76	0.72	0.68
100	3.06	2.04	1.58	1.31	1.14	1.01	0.92	0.85	0.80	0.75
120	3.85	2.40	1.81	1.48	1.28	1.13	1.03	0.95	0.88	0.83
140	4.57	2.73	2.03	1.65	1.41	1.25	1.13	1.04	0.97	0.91
160	5.25	3.06	2.25	1.82	1.55	1.37	1.24	1.13	1.05	0.99

Accuracy of Absolute Humidity g/m³

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006	—	—
-20	0.023	0.025	0.027	0.029	0.031	0.032	0.034	0.036	—	—
0	0.10	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17
20	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55
40	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.44	1.49	1.54
60	2.73	2.84	2.95	3.07	3.18	3.29	3.40	3.52	3.63	3.74
80	6.08	6.30	6.51	6.73	6.95	7.17	7.39	7.61	7.83	8.05
100	12.2	12.6	13.0	13.4	13.8	14.2	14.6	15.0	15.3	15.7
120	22.6	23.3	23.9	24.6	25.2	25.8	26.5	27.1	27.8	28.4
140	39.1	40.0	41.0	42.0	43.0	44.0	45.0	45.9	46.9	47.9
160	63.5	64.9	66.4	67.8	69.2	70.7	72.1	73.5	74.9	76.4

Dewpoint Temperature (PTU307 Warmed Probe Option)

Find the intersection of the dewpoint temperature curve and the dewpoint difference reading (process temperature-dewpoint temperature) on the x-axis and read the accuracy in dewpoint measurement on the y-axis.

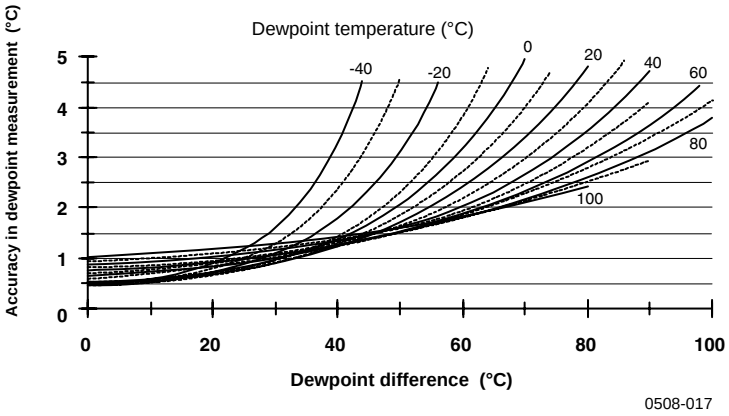


Figure 54 Accuracy in Dewpoint Measurement

Operating Conditions

Operating temperature range	
for humidity measurement	-70...+180 °C (-94...+356 °F) see probe specifications
for transmitter body electronics	-40...+60 °C (40...+140°F)
with display	0...+60 °C (+32...+140°F)
Electromagnetic compatability	EN61326-1:1997+ Am1:1998 + Am2:2001 Industrial environment

Inputs and Outputs

Operating voltage	10...35 VDC, 24 VAC	
with optional power supply module	100...240 VAC, 50/60 Hz	
Start-up time after power-up	3 s	
Power consumption @ 20 °C (Uin 24VDC)		
RS-232	max 28 mA	
Uout 3 x 0...1V / 0...5V / 0...10V	max 33 mA	
Iout 3 x 0...20 mA	max 63 mA	
display and backlight	+ 20 mA	
during chemical purge	+ 110 mA max	
during probe heating (HMT337)	+ 120 mA max	
Settling time at power-up (one sensor)		
class A	4 s	
class B	3 s	
Analog outputs (2 standard, 3rd optional)		
current output	0...20 mA, 4...20 mA	
voltage output	0...1 V, 0...5 V, 0...10 V	
Humidity and temperature		
Accuracy of analog outputs at 20 °C	± 0.05 % full scale	
Temperature dependency of the analog outputs	± 0.005 %/°C full scale	
Pressure		
	500...1100 hPa	50...1100 hPa
Accuracy of analog outputs at 20 °C	0.30 hPa	0.4 hPa
Temperature dependency of the analog outputs	0.6 hPa	0.75 hPa
External loads		
current ouputs	RL < 500 ohm	
0... 1V output	RL > 2 kohm	
0... 5V and 0... 10V outputs	RL > 10 kohm	
Max wire size	0.5 mm2 (AWG 20) stranded wires recommended	
Digital outputs	RS-232, RS-485 (optional)	
Relay outputs (optional)	0.5 A, 250 VAC, SPDT	
Display (optional)	LCD with backlight, graphic trend display	
Menu languages	English, French, Spanish, German, Japanese, Swedish, Finnish	

Mechanics

Cable bushing	M20x1.5 For cable diameter 8...11mm/0.31..0.43"
Conduit fitting	1/2”NPT
User cable connector (optional)	M12 series 8- pin (male)
option 1	with plug (female) with 5 m / 16.4 ft black cable

option 2	with plug (female) with screw terminals
Probe cable diameter	
PTU303 80ºC	6.0 mm
Other probes	5.5 mm
Probe cable lengths	2 m, 5 m or 10 m
Housing material	G-AlSi 10 Mg (DIN 1725)
Housing classification	IP 65 (NEMA 4)

Transmitter Weights

Table 22 Transmitter Weights (in kg/lb)

Probe Type	Probe Cable Length		
	2 m	5 m	10 m
PTU303	1.1/2.4	1.2/2.6	1.5/3.3
PTU307	1.2/2.6	1.3/2.9	1.5/3.3

Technical Specifications of Optional Modules

Power Supply Module

Operating voltage	100...240 VAC 50/60 Hz
Connections	screw terminals for 0.5...2.5 mm^2 wire (AWG 20...14)
Bushing	for 8...11 mm diameter cable
Operating temperature	-40...+60 °C (-40...+140 °F)
Storage temperature	-40...+70°C (-40...+158 °F)

Analog Output Module

Outputs	0...20 mA, 4...20 mA, 0...1 V, 0...5 V, 0...10 V
Operating temperature range	-40...+60 °C (-40...+140 ºF)
Power consumption	
U_{out} 0...1 V	max 30 mA
U_{out} 0...5V/0...10V	max 30 mA
I_{out} 0... 20 mA	max 60 mA
External loads	
current outputs	R_L< 500 ohms
Max load + cable loop resistance	540 ohms
0....1 V	R_L> 2000 ohms
0...5 V and 0... 10 V	R_L> 10 000 ohms

Storage temperature range	-55...+80 °C (-67...+176 ºF)
3-pole screw terminal	
Max wire size	1.5 mm^2 (AWG16)

Relay Module

Operating temperature range	-40...+60 ºC (-40...+140 ºF)
Operating pressure range	500...1300 mHg
Power consumption @24 V	max 30 mA
Contacts SPDT (change over), for example,	
Contact arrangement Form C	
Imax	0.5 A 250 VAC
Imax	0.5 A 30 VDC
Safety standard for the relay component	IEC60950 UL1950
Storage temperature range	-55...+80 ºC (-67...+176 ºF)
3-pole screw terminal / relay	
Max wire size	2.5 mm2 (AWG14)

RS-485 Module

Operating temperature range	-40...+60 ºC (-40...+140 ºF)
Operating modes	2-wire (1-pair) half duplex 4-wire (2-pair) full duplex
Operating speed max	115.2 kbaud
Bus isolation	300VDC
Power consumption	
@ 24V	max 50 mA
External loads	
standard loads	32 RL> 10kohm
Storage temperature range	-55...+80 ºC (-67...+176 ºF)
Max wire size	1.5 mm2 (AWG16)

Options and Accessories

Description	Item code
MODULES	
Relay module	RELAY-1
Analog Output Module	AOUT-1
Isolated RS485 Module	RS485-1
Power Supply Module	POWER-1
Galvanic Isolation Module	DCDC-1
SENSORS	
HUMICAP180	HUMICAP180
HUMICAP180L2	HUMICAP180L2
PT100 Sensor	10429SP
FILTERS	
PPS Plastic Grid with Stainless Steel Netting	DRW010281SP
PPS Plastic Grid Filter	DRW010276SP
Sintered Filter AISI 316L	HM47280SP
Stainless Steel Filter	HM47453SP

Description	Item code
Stainless Steel Filter with Membrane	214848SP
TRANSMITTER MOUNTING ACCESSORIES	
Wall Mounting Plate (plastic)	214829
Installation Kit for Pole or Pipeline	215108
Rain Shield with Installation Kit	215109
DIN Rail Installation Kit	211477
DIN Rail Clips with Installation Plate	215094
Panel Mounting Frame	216038
PROBE MOUNTING ACCESSORIES	
Swagelok for 12mm Probe 3/8" ISO Thread	SWG12ISO38
Swagelok for 12mm Probe 1/2" NPT Thread	SWG12NPT12
Swagelok for 6mm Probe 1/8" ISO Thread	SWG6ISO18
Swagelok for 6mm Probe 1/8" NPT Thread	SWG6NPT18
Cable Gland and AGRO, for PTU303/307	HMP247CG
Duct Installation Kit for PTU303/307	210697
Duct Installation Kit for Temperature Probe	215003
CONNECTION CABLES	
Serial Interface Cable	19446ZZ
Connection Cable for HM70	211339
HMI41 Connection Cable with RJ45 Connector	25917ZZ
OUTPUT CABLES FOR 8-PIN CONNECTOR	
Connection Cable 5m 8-pin M12 Female, Black	212142
Connector 8-pin M12 with Screw Terminals	212416
Male Connector 8-pin M12 with Cable and Adapter	214806SP
CABLE BUSHINGS	
Cable Gland M20x1.5 for 8...11mm Cable	214728SP
Conduit Fitting M20x1.5 for NPT1/2 Conduit	214780SP
Dummy Plug M20x1.5	214672SP
WINDOWS SOFTWARE	
PC Software and cable	215005
OTHER	
Calibration Adapter for HMK15	211302SP
Solar Radiation Shield for PTU303/307/30T	DTR502B
Meteorological Installation Kit	HMT330MIK

Dimensions (in mm and inch)

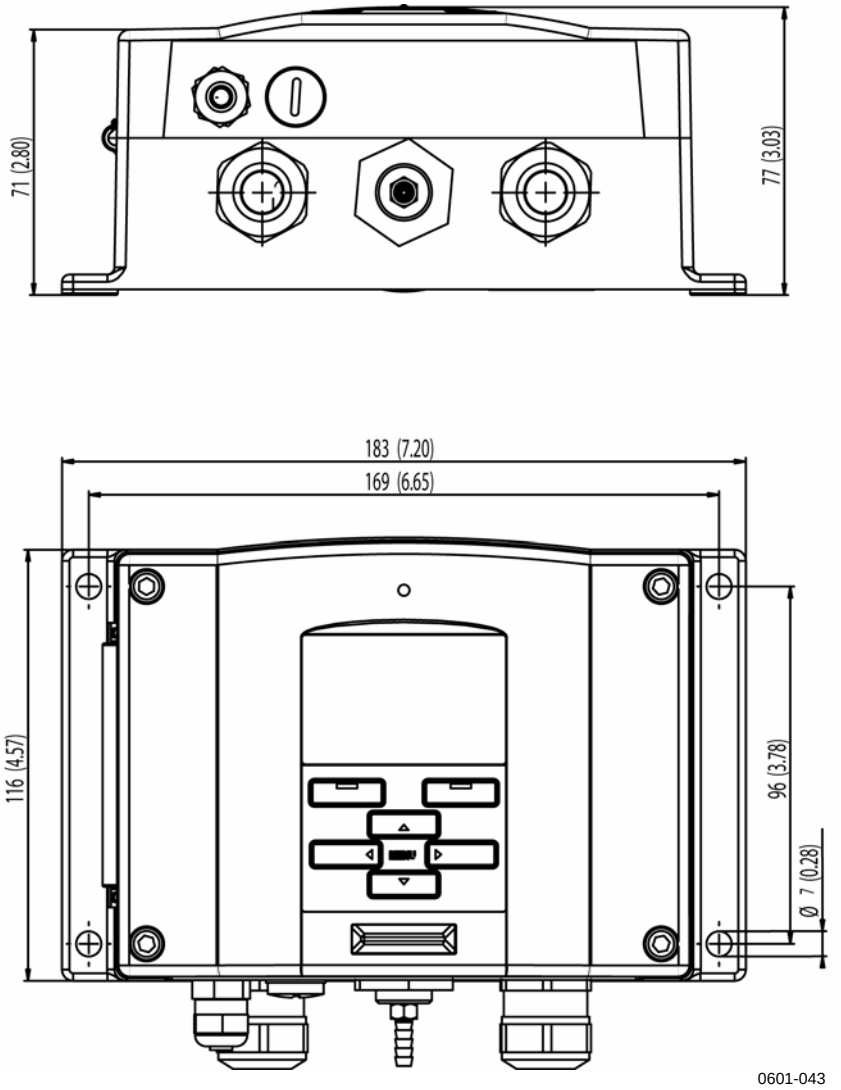


Figure 55 Transmitter Body Dimensions

PTU301

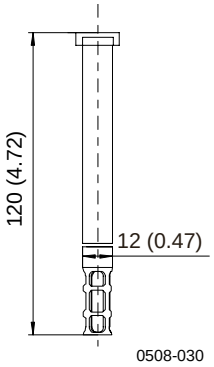


Figure 56 PTU301 Probe Dimensions

PTU303

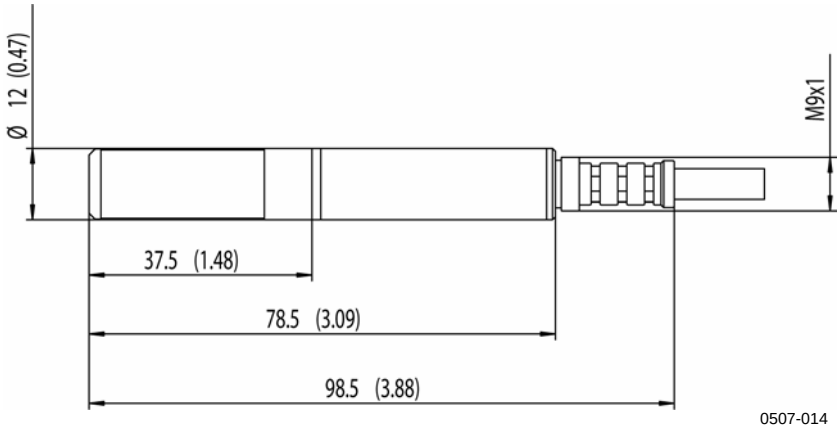


Figure 57 PTU303 Probe Dimensions

PTU307

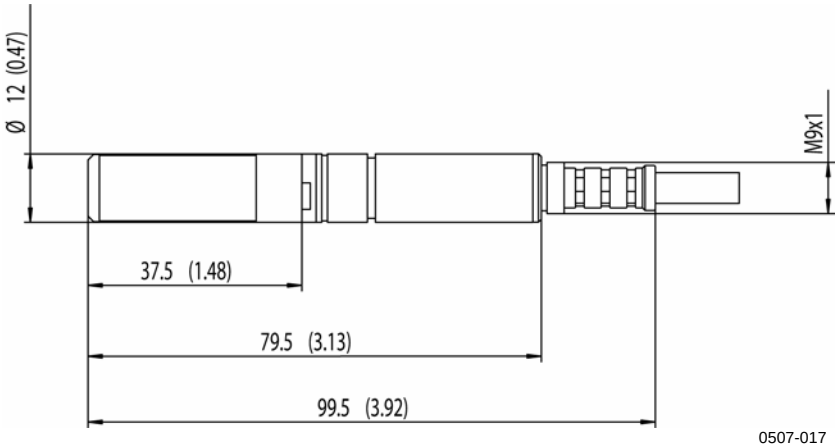


Figure 58 PTU307 Probe Dimensions

Temperature Probe

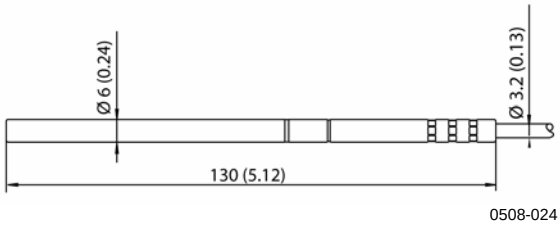


Figure 59 Optional Temperature Probe Dimensions

Technical Support

For technical questions, contact the Vaisala technical support:

E-mail helpdesk@vaisala.com

Fax +358 9 8949 2790

If the product needs repair, please follow the instructions below to speed up the process and to avoid extra costs to you.

Return Instructions

If the product needs repair, please follow the instructions below to speed up the process and avoid extra costs.

1. Read the warranty information.
2. Write a Problem Report with the name and contact information of a technically competent person who can provide further information on the problem.
3. On the Problem Report, please explain:
   - What failed (what worked / did not work)?
   - Where did it fail (location and environment)?
   - When did it fail (date, immediately / after a while / periodically / randomly)?
   - How many failed (only one defect / other same or similar defects / several failures in one unit)?
   - What was connected to the product and to which connectors?
   - Input power source type, voltage and list of other items (lighting, heaters, motors etc.) that were connected to the same power output.
   - What was done when the failure was noticed?
4. Include a detailed return address with your preferred shipping method on the Problem Report.
5. Pack the faulty product using an ESD protection bag of good quality with proper cushioning material in a strong box of adequate size. Please include the Problem Report in the same box.
6. Send the box to:
   Vaisala Oyj
   Contact person / Division
   Vanha Nurmijärventie 21
   FIN-01670 Vantaa
   Finland

Vaisala Service Centers

Vaisala Service Centers perform calibrations and adjustments as well as repair and spare part services, see contact information below.

Vaisala Service Centers offer also extended services, for example accreditated calibrations, maintenance contracts and calibration reminder program. Do not hesitate to contact them to get further information.

NORTH AMERICAN SERVICE CENTER
Vaisala Inc., 10-D Gill Street, Woburn, MA 01801-1068, USA.
Phone: +1 781 933 4500, Fax: +1 781 933 8029
E-mail: us-customersupport@vaisala.com

EUROPEAN SERVICE CENTER
Vaisala Instruments Service, Vanha Nurmijärventie 21 FIN-01670 Vantaa, FINLAND.
Phone: +358 9 8949 2658, Fax: +358 9 8949 2295
E-mail: instruments.service@vaisala.com

TOKYO SERVICE CENTER
Vaisala KK, 42 Kagurazaka 6-Chome, Shinjuku-Ku, Tokyo 162-0825, JAPAN.
Phone: +81 3 3266 9617, Fax: +81 3 3266 9655
E-mail: aftersales.asia@vaisala.com

BEIJING SERVICE CENTER
Vaisala China Ltd., Floor 2 EAS Building, No. 21 Xiao Yun Road, Dongsanhuan Beilu, Chaoyang District, Beijing, P.R. CHINA 100027.
Phone: +86 10 8526 1199, Fax: +86 10 8526 1155
E-mail: china.service@vaisala.com

www.vaisala.com

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APPENDIX A

PROBE INSTALLATION KITS AND INSTALLATION EXAMPLES

Duct installation kits (for PTU303/307)

Duct installation kit includes a flange, a sealing ring, a supporting bar and probe attaching part for the sensor head and screws for attaching the flange to the duct wall. Vaisala order codes: 210697 (for PTU303 and PTU307), and 215003 for temperature probe.

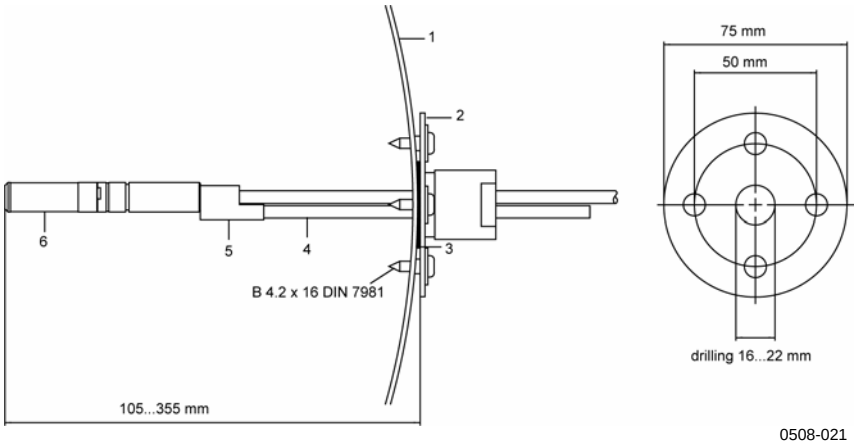

Figure 60 Duct Mounting Installation Kit

Numbers refer to Figure 60 above:

1 = Duct wall
2 = Flange
3 = Sealing ring
4 = Supporting bar (not included in the kit for HMT335)
5 = Probe attaching part (to be fixed with the supporting bar)
6 = Relative humidity probe

NOTE	When the temperature difference between the duct and the air outside the duct is remarkable, the supporting bar must be installed as deep in the duct as possible. This prevents errors caused by the heat conduction in the bar and cable.

Duct Installation Kit for Temperature Probe (for PTU307)

Vaisala duct installation kit for the T-probe includes flange, supporting bar, probe attaching part, sealing ring and the fixing screws (4 pcs). Vaisala order code: 215003.

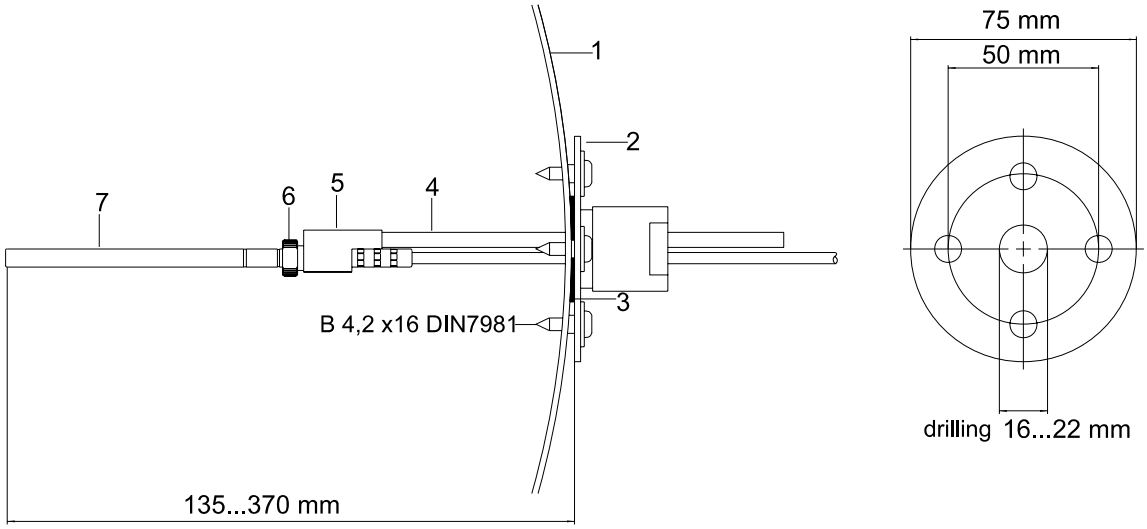

Figure 61 Duct Mounting Installation Kit for T-Probe

Numbers refer to Figure 61 above

1 = Duct wall
2 = Flange
3 = Sealing ring
4 = Supporting bar
5 = Probe support (to be fixed to the supporting bar)
6 = Retainer bushing (to be fixed to the probe support)
7 = Temperature probe (to be fixed to the retainer bushing)

Pressure Tight Swagelok Installation Kits (For PTU307)

RH Probe Installation

Swagelok installation kit for the relative humidity probe includes Swagelok connector with ISO3/8" or NPT1/2" thread. Vaisala order codes: SWG12ISO38 or SWG12NPT12.

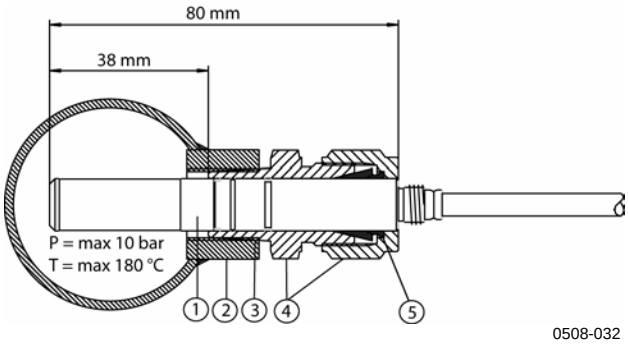

Figure 62 Swagelok Installation Kit for RH-probe

Numbers refer to Figure 62 above:
1 = Relative humidity probe
2 = Duct connector
3 = ISO3/8" or NPT1/2" thread
4 = Swagelok connector
5 = Ferrules

Temperature Probe Installation

Swagelok installation kit for T-probe includes Swagelok connector with either ISO1/8" or NPT1/8" thread. Vaisala order codes: SWG6ISO18 or SWG6NPT18.

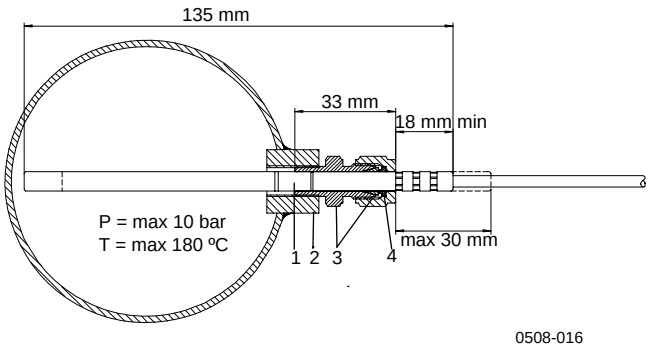

Figure 63 Swagelok Installation Kit for T-Probe

Numbers refer to Figure 63 above

1 = T-probe
2 = Duct connector
3 = Swagelok connector
4 = Ferrules

Examples of Vapor Tight Installations with Cable Gland

RH-Probe Installations (for PTU303/307)

Cable gland AGRO is available from Vaisala (order code: HMP247CG.)

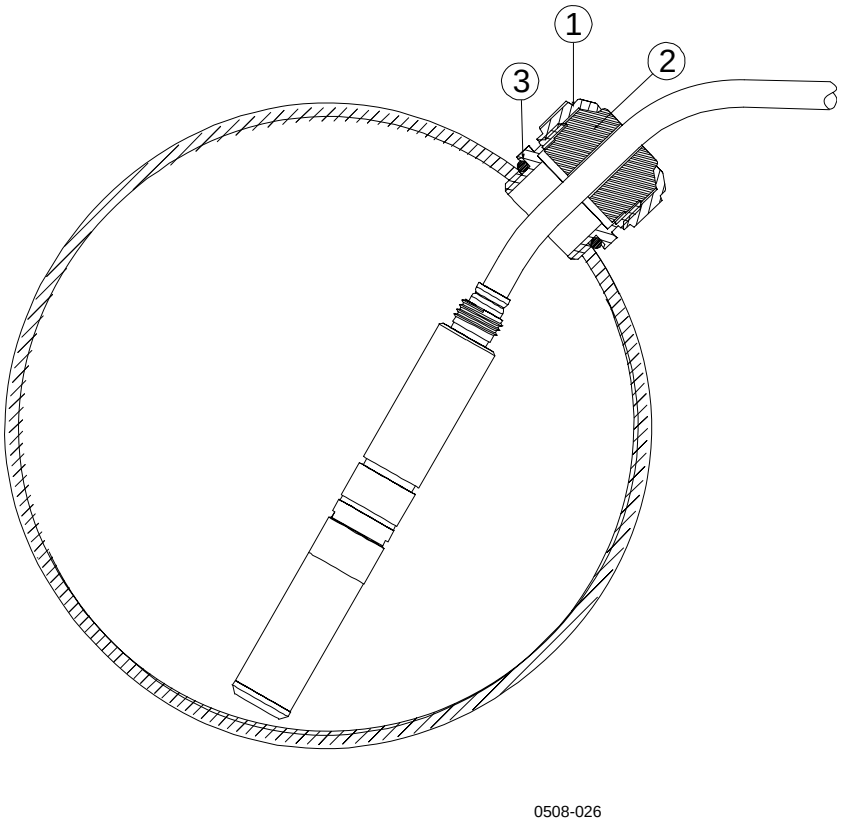

Figure 64 Cable Installation with Cable Gland

Numbers refer to Figure 64 above

1 = Nut (to be tightened to the body)
2 = Seal
3 = Body and O-ring

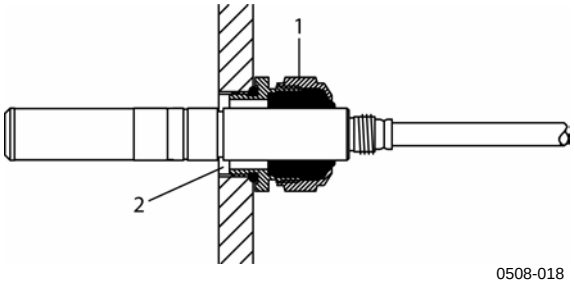

Figure 65 Probe Head Installation with Cable Gland

Probe head installation with cable gland is not available from Vaisala.

Numbers refer to Figure 65 above

1 = AGRO 1160.20.145 (T= -40...+100 ºC) Not available from Vaisala.
2 = In pressurized places, use a locking ring (example: 11x 1 DIN471).

T- Probe Installations (PTU307)

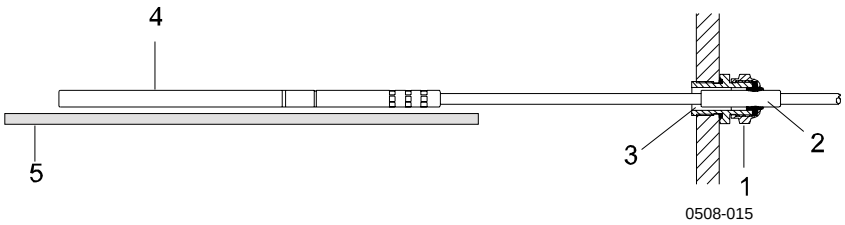

Figure 66 Vapor Tight Installation

Vapor Tight Installation is not available from Vaisala.

Numbers refer to Figure 66 above:

1 = Cable gland. For example AGRO 1100.12.91.065 (T= -25...+200 ºC)
2 = In pressurized processes, use a locking ring (example: 6x 0.7 DIN471)

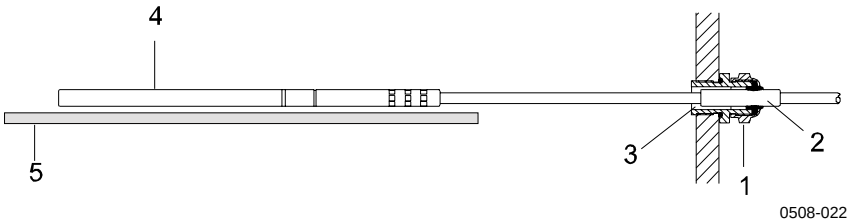

Figure 67 Wall Mounting Installation

Wall Mounting Installation is not available from Vaisala.

Numbers refer to Figure 67 above:

1 = Cable gland. For example AGRO 1100.12.91.065
2 = Compacted PTFE sleeve
3 = Silicon glue between the PTFE sleeve and the cable
4 = Temperature probe
5 = Recommended support to keep the probe in horizontal position

Example Of Climate Chamber Installation

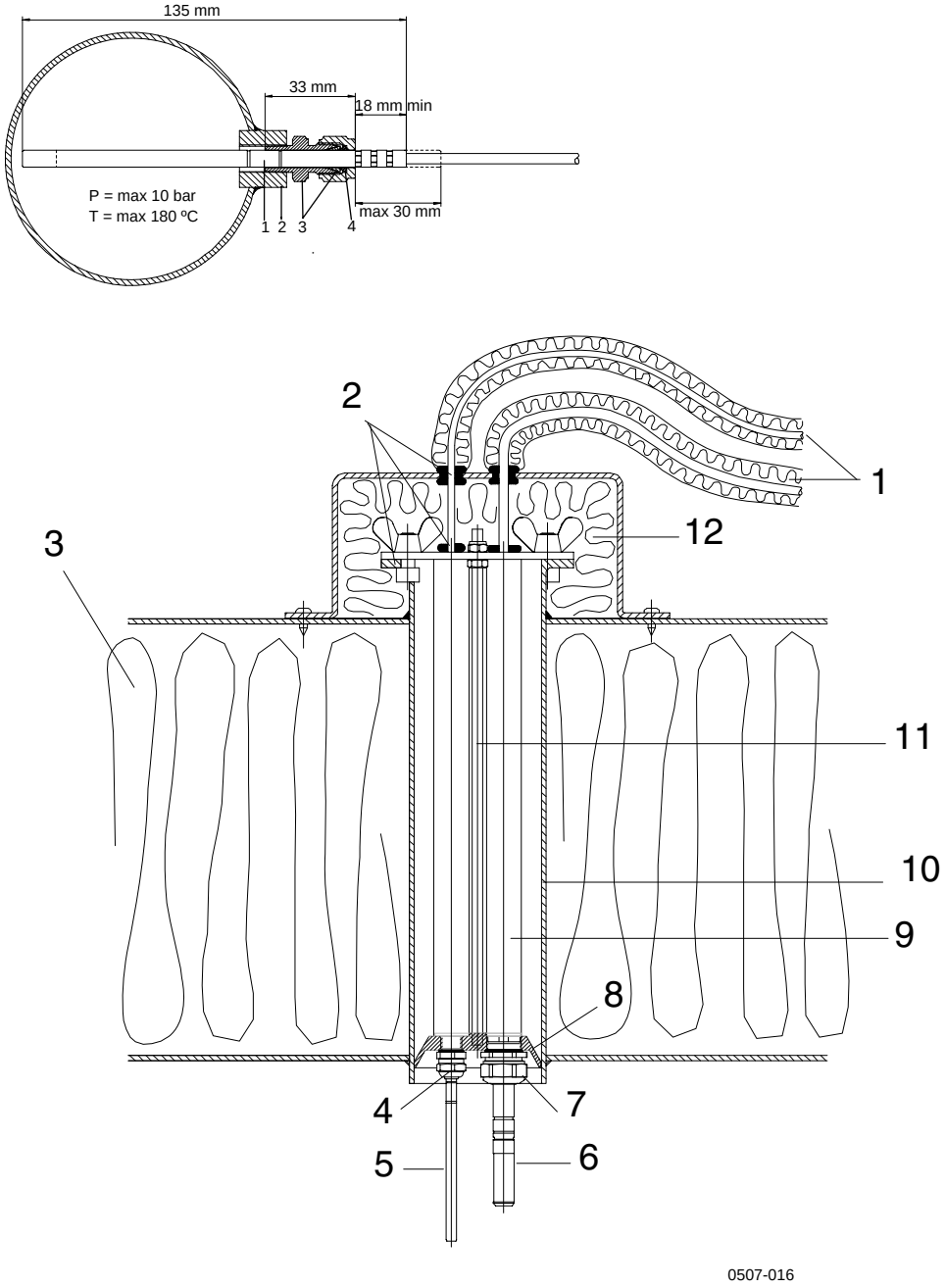

Figure 68 Climate Chamber Installation (not Available from Vaisala)

Numbers refer to Figure 68 above:

1 = PTFE sleeve
2 = Cable gland, for example: AGRO 1100.12.91.065
3 = Stainless steel cable tie or similar fastenerl

Numbers refer to Figure 68 above:

4 = To be sealed (silicone)
5 = Temperature probe
6 = Relative humidity probe
7 = HMP247CG, Cable gland AGRO (available from Vaisala)

NOTE	Let the cables hang loosely to prevent condensed water running to the sensor head.

Example Of Installation Through Roof

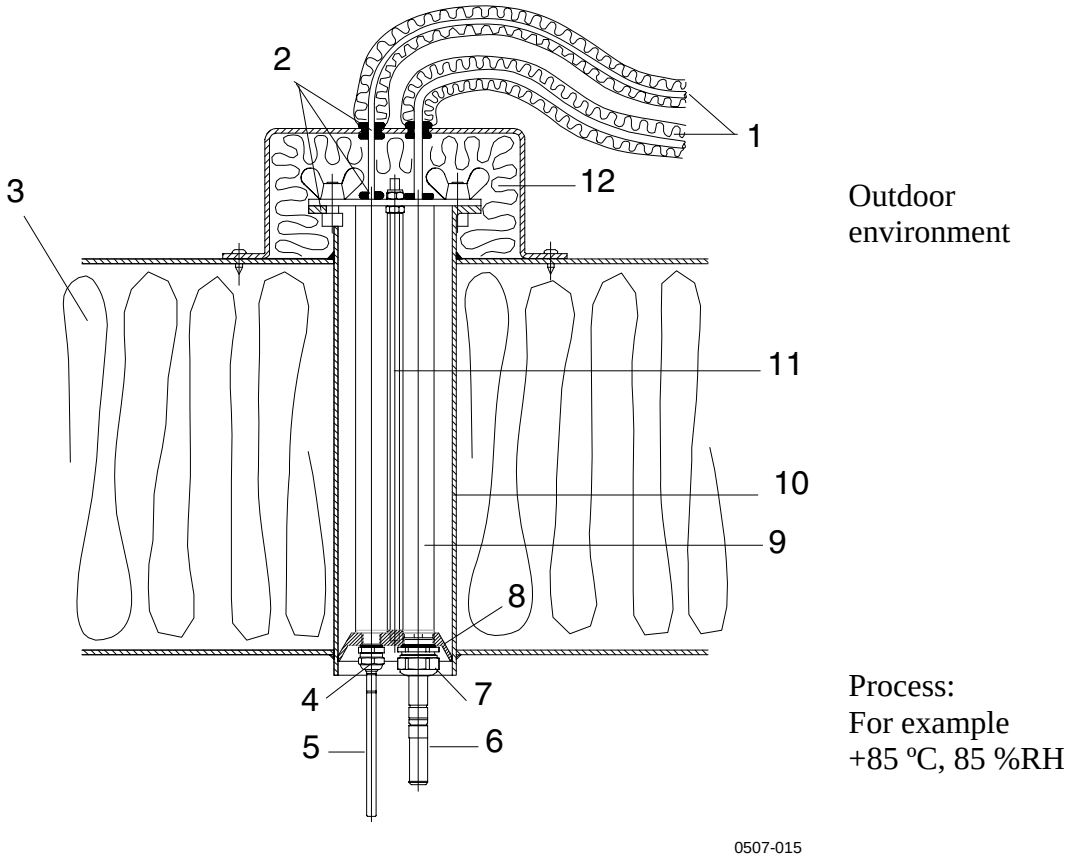

Figure 69 Example of Installation Through Roof

Numbers refer to Figure 69 above:

1 = Insulated probe cables
2 = Sealings
3 = Roof

Numbers refer to Figure 69 above:

4 = Cable gland for temperature probe (for example: AGRO 1100.12.91.065)
5 = Temperature probe
6 = Relative humidity probe
7 = Cable gland for relative humidity probe (for example: AGRO 1160.20.145)
8 = Plastic adapter to protect probes from condensation water coming from the pipe. Diameter slightly smaller than tube diameter.
9 = Plastic tube for probe heads (2 pcs)
10 = Stainless steel tube coming through the roof.
11 = Two thread bars holding the plastic adapter.
12 = Insulated pipe ending.

Meteorological Installation Kit (for PTU307)

The Vaisala meteorological Installation Kit HMT330MIK with a static pressure head enables the PTU307 to be installed outdoors to obtain reliable measurements for meteorological purposes. For more information, see HMT330MIK brochure and order form.

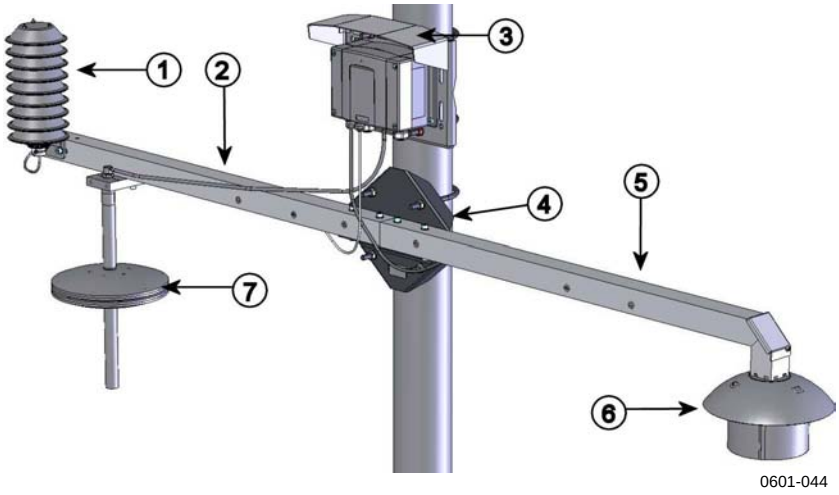

Figure 70 Meteorological Installation Kit for Outdoor Installation

Numbers refer to Figure 70 above:

1 = Radiation shield for the additional T-probe or humidity probe
2 = T support bar
3 = Transmitter mounting plate
4 = Pole mounting plate for support bars
5 = Td support bar
6 = Radiation shield for the warmed humidity probe
7 = Static pressure head

APPENDIX B
CALCULATION FORMULAS

The PTU300 series transmitters measure relative humidity and temperature. From these values dewpoint, mixing ratio, absolute humidity and enthalpy in normal pressure are calculated using the following equations:

Dewpoint:

$$T_d = \frac{T_n}{\frac{m}{\log\left(\frac{Pw}{A}\right)} - 1} \qquad (1)$$

The parameters A, m, and Tn depend on temperature according to the following table (* used for frostpoint calculation if the dewpoint is negative):

t	A	m	Tn
<0 °C *	6.1134	9.7911	273.47
0 ... 50 °C	6.1078	7.5000	237.3
50 ... 100 °C	5.9987	7.3313	229.1
100 ... 150 °C	5.8493	7.2756	225.0
150 ... 180 °C	6.2301	7.3033	230.0

Mixing ratio:

$$x = 621.99 \cdot RH \cdot \frac{P_w}{(p - P_w)} \qquad (2)$$

Absolute humidity:

$$a = 216.68 \cdot \frac{P_w}{T} \quad (3)$$

Enthalpy:

$$h = (T - 273.15) \cdot (1.01 + 0.00189 \cdot x) + 2.5 \cdot x \quad (4)$$

The water vapour saturation pressure P_{ws} is calculated by using the two following equations:

$$\Theta = T - \sum_{i=o}^{3} C_i T^i \quad (5)$$

where:

T = temperature in K
C_i = coefficients
C_0 = 0.4931358
C_1 = $-0.46094296 * 10^{-2}$
C_2 = $0.13746454 * 10^{-4}$
C_3 = $-0.12743214 * 10^{-7}$

$$\ln P_{ws} = \sum_{i=-1}^{3} b_i \Theta^i + b_4 \ln \Theta \quad (6)$$

where:

b_i = coefficients
b_{-1} = $-0.58002206 * 10^4$
b_0 = $0.13914993 * 10^1$
b_1 = $-0.48640239 * 10^{-1}$
b_2 = $0.41764768 * 10^{-4}$
b_3 = $-0.14452093 * 10^{-7}$
b_4 = 6.5459673

The water vapor pressure is calculated using:

$$P_w = RH \cdot \frac{P_{ws}}{100} \quad (7)$$

Parts per million by volume is calculated using:

$$ppm_v = 10^6 \cdot \frac{P_w}{(p - P_w)} \quad (8)$$

Symbols:

Td = dewpoint temperature (°C)
Pw = water vapour pressure (hPa)
Pws = water vapour saturation pressure (hPa)
RH = relative humidity (%)

x = mixing ratio (g/kg)
p = atmospheric pressure (hPa)
a = absolute humidity (g/m3)
T = temperature (K)
h = enthalpy (kJ/kg)

Height compensated pressure values (QFE, QNH, and HCP) are calculated using the following equations:

(9)

$$QFE = p \cdot \left(1 + \frac{h_{QFE} \cdot g}{R \cdot T}\right)$$

where:
p = measured air pressure [hPa]
h_{QFE} = height difference between the barometer and reference level [m]
g = 9.81 [m/s^2]
R = 287 [J/kg/K]
T = temperature [K]

(10)

$$QNH = QFE \cdot e^{\frac{h_{QNH} \cdot g}{R \cdot \left(T_0 + \frac{\alpha \cdot h_{QNH}}{2}\right)}}$$

where:
h_{QNH} = station elevation [m]
g = 9.81 [m/s^2]
R = 287 [J/kg/K]
T_0 = 288.15 [K]
α = -0.0065 [K/m]

(11)

$$HCP = p - 0.1176 \cdot h_{HCP}$$

where:
p = measured air pressure [hPa]
h_{HCP} = height difference between the barometer and reference level [m]

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