VAISALA

USER'S GUIDE

Vaisala BAROCAP® Digital Barometer PTB330

M210855EN-D

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CHAPTER 1
GENERAL INFORMATION

This chapter provides general notes for the manual and the product.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala BAROCAP® Digital Barometer PTB330.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the product.
- Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature of PTB330.
- Chapter 3, Installation, provides you with information about how to install the product.
- Chapter 4, Operation, contains information that is needed to operate the product.
- Chapter 5, Maintenance, contains information that is needed in the basic maintenance of the product.
- Chapter 6, Calibration and Adjustment, contains instructions for performing the calibration and adjustment of the product.
- Chapter 7, Technical Data, provides the technical data of the product.
- Appendix A, Calculation Formulas, contains the calculation formulas used by the product.

- Appendix B, Unit conversion tables, contains the unit conversion tables.

- Appendix C, PA11A Emulation Mode, describes the PA11A emulation mode of the PTB330 series.

Version Information

Table 1   Manual Revisions

Manual Code	Description
M210855EN-D	December 2012. This version. Command descriptions rewritten. Other, more minor changes throughout.
M210855EN -C	January 2008. Previous version.

Documentation Conventions

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.

Safety

The product 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.

WARNING	To avoid electric shock, never open the PTB330 enclosure while the transmitter is connected to mains power.

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.

Trademarks

BAROCAP® is a registered trademark of Vaisala. Windows is a registered trademark of Microsoft Corporation.

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

Visit our Internet pages for standard warranty terms and conditions: www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

CHAPTER 2
PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature of PTB330.

Introduction to PTB330

Vaisala BAROCAP® Digital Barometer PTB330 provides reliable pressure measurement in a wide range of applications. Digital outputs RS-232 (standard) or RS-422/485 (optional) can be selected. Alternatively, analog outputs can be chosen between current and optional voltage signals. A local graphical display is available as well. The quantities measured and calculated by PTB330 are presented in Table 2 on page 15.

The PTB330 barometer is available with one, two, or three barometer modules. The barometer can be used successfully both in accurate pressure measurement applications at room temperature and in demanding automatic weather station applications.

Basic Features and Options

- Applicable in industrial and meteorological areas
- Calculated aviation related output quantities: QFE and QNH
- 1 ... 3 BARO-1 barometer modules (sensors)
- Barometer mounting accessories for multiple installation purposes
- Service port for MI70 Link Interface Software or PC
- Four module slots
- IP 65 housing
- Screw terminal, optional M12 connector or D-9 connector
- Optional graphical display showing the measurement trends of the quantities chosen by the user
- Optional modules: power supply module, RS-485 module, analog output module, and relay module
- Optional USB cable for service use or data transfer

Pressure Measurement

The PTB330 series barometers use a BAROCAP® silicon capacitive absolute pressure sensor developed by Vaisala for barometric pressure measurement applications. The BAROCAP® sensor has excellent hysteresis and repeatability characteristics, low temperature dependence, and a very good long-term stability. The BAROCAP® sensor is very robust and resistant to mechanical and thermal shocks.

The measurement principle of the PTB330 series digital barometers is based on an advanced RC oscillator and reference capacitors against which the capacitive pressure sensor is continuously measured. The microprocessor of the barometer performs compensation for pressure linearity and temperature dependence.

Each barometer module in PTB330 has its own adjustment coefficients for different reference pressures across the entire temperature range. This achieves the best possible accuracy needed in barometric pressure measurements.

Table 2   Quantities Measured by PTB330

Quantity	Abbreviation
Pressure (measures average pressure from P_1, P_2, and P_3)	P
Pressure from barometer module 1 or 2 or 3	P_1, P_2, and P_3
Temperature of barometer module 1 or 2 or 3	T_{P1}, T_{P2}, and T_{P3}
Pressure trend (includes pressure tendency on display)	P_{3h}
Pressure difference (P_1 -P_2)	ΔP_{12}
Pressure difference (P_1 -P_3)	ΔP_{13}
Pressure difference (P_2-P_3)	ΔP_{23} (available on serial port only)
QNH pressure	QNH
QFE pressure	QFE
Height Corrected Pressure	HCP
Pressure tendency (available on serial port only)	A_{3h}

Outer Structure of the Barometer
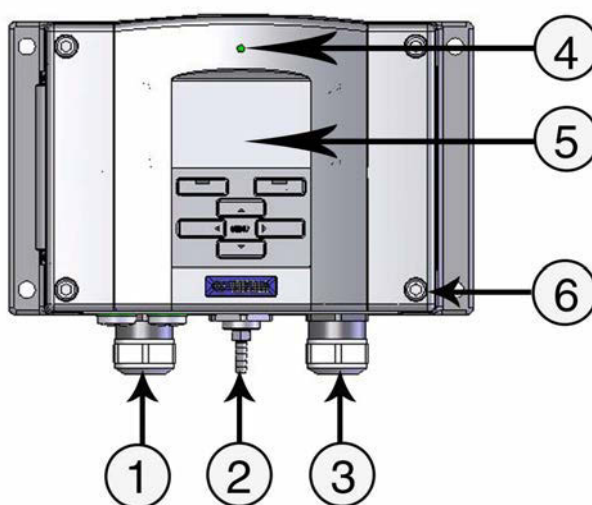
Figure 1   Barometer Body

Numbers refer to Figure 1 above:

1   =   Cable for signal/powering Ø 8 ... 11 mm
2   =   Pressure port
3   =   Cable for optional power supply/relay module Ø 8 ... 11 mm
4   =   Cover LED
5   =   Display with keypad (optional)
6   =   Cover screw (4 pcs)

Inner Structure of the Barometer
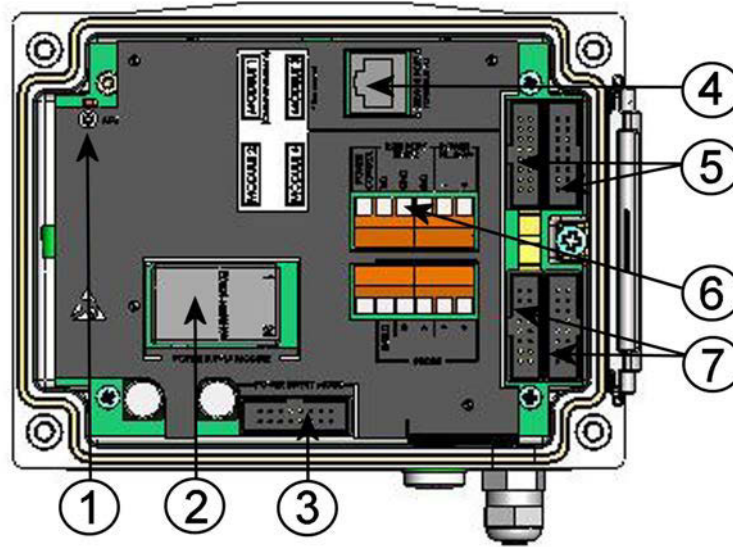
Figure 2   Open Barometer Interior

Numbers refer to Figure 2 above:

1 = Adjustment button with indicator LED
2 = Galvanic isolation module (optional)
3 = Power supply mode selections
    (Do not change the factory settings!)
4 = Service port (RS-232)
5 = Module 1/Module 3 connectors
6 = User port
7 = Module 2/Module 4 connectors

CHAPTER 3
INSTALLATION

This chapter provides you with information about how to 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 barometer to the wall with 4 screws, for example M6 (not provided).
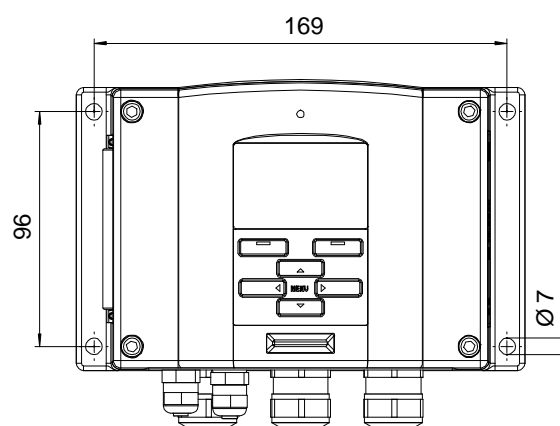
Figure 3   Standard Mounting

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 barometer before mounting.
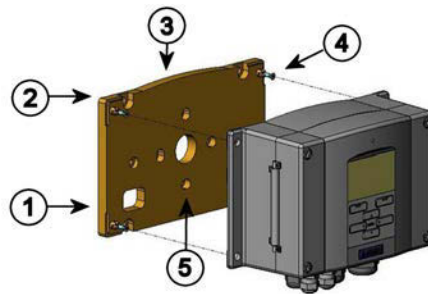
Figure 4   Mounting with Wall Mounting Kit

Numbers refer to Figure 4 above:

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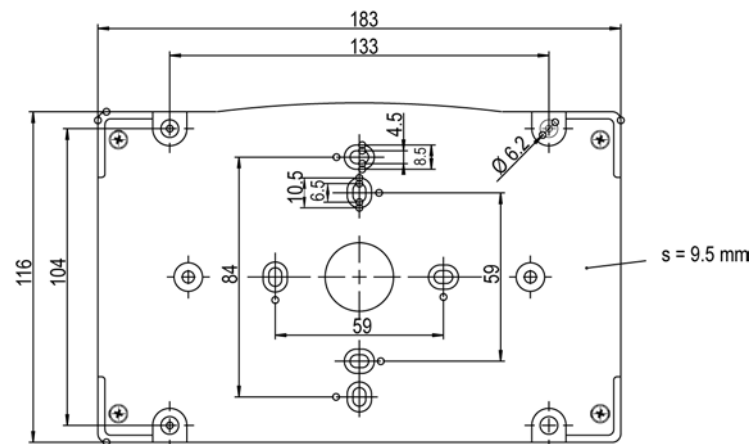
Figure 5   Dimensions of Plastic Mounting Plate

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).

To mount PTB330 using the DIN rail installation kit:

1.   Attach two spring holders to the plastic mounting plate by using the screws provided in the installation kit.

2.   Fasten the barometer to the plastic mounting plate with 4 screws provided for that purpose.

3.   Press the barometer onto the DIN rail so that the clip-fasteners snap into the rail.
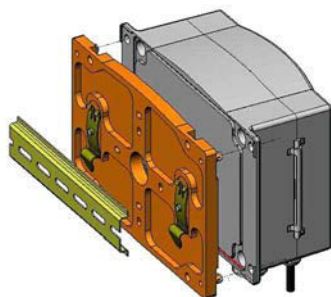
Figure 6   Mounting with DIN Rail Installation Kit

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 21.
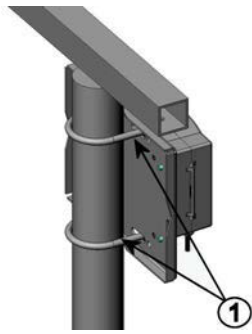
Figure 7   Vertical Pole (Side)
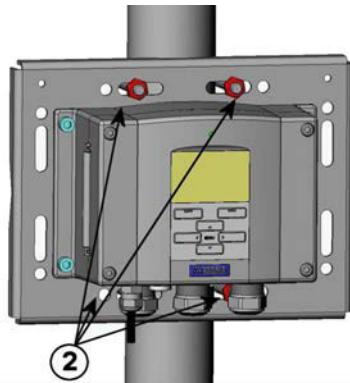
Figure 8   Vertical Pole (Front)

Numbers refer to Figure 8 above:

1   =   Fixing brackets (2 pcs) M8 (provided) for 30 ... 102 mm
          poles.
2   =   Mounting nuts M8 (4 pcs)
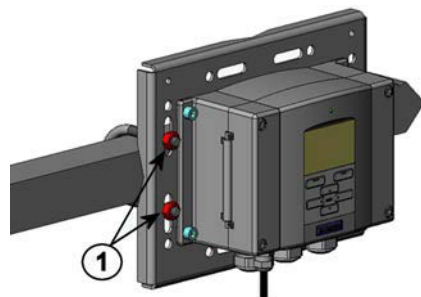
Figure 9   Horizontal Pole

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.
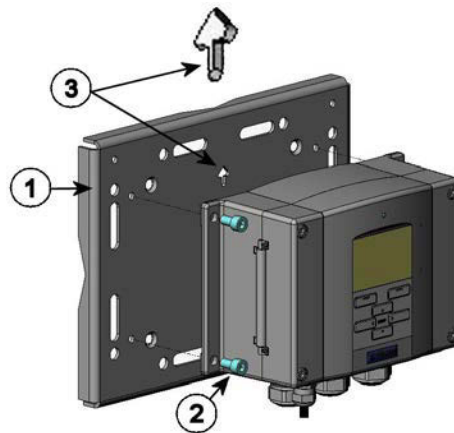
Figure 10   Mounting with Metal Wall Mounting Plate

Numbers refer to Figure 10 above:

1 = Mount the plate to wall with 4 screws M8 (not provided)
2 = Fasten the barometer 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.
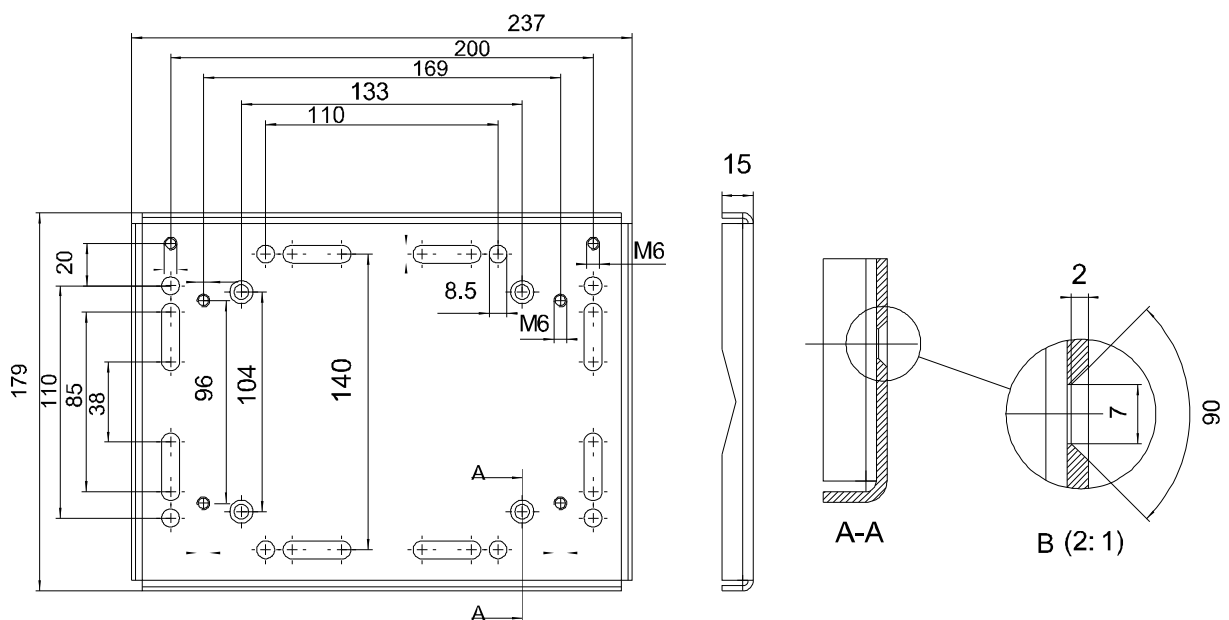
Figure 11   Dimensions of Metal Mounting Plate (mm)

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 the barometer to the mounting plate with 4 fixing screws (provided).

Panel Mounting Frame

To enable a neat and dirt-free embedded installation of the transmitter, a panel mounting frame is available as an option (Vaisala order code: 216038). The frame is a thin, flexible plastic frame for the transmitter, with adhesive tape on one side. The frame is used to hide any rough edges of the installation hole, and provide a more finished look. Note that the panel mounting frame is not intended to bear the weight of the transmitter, and does not include any mounting supports.

To use the panel mounting frame:

1.   Use the frame as a template to mark the required size for the installation hole in the panel.

2.   Cut the hole in the panel.

3.   Mount the transmitter through the panel with suitable supports.

4.   Remove the paper protecting the adhesive tape on the frame, and attach the frame around the transmitter. Refer to Figure 13 on page 23.
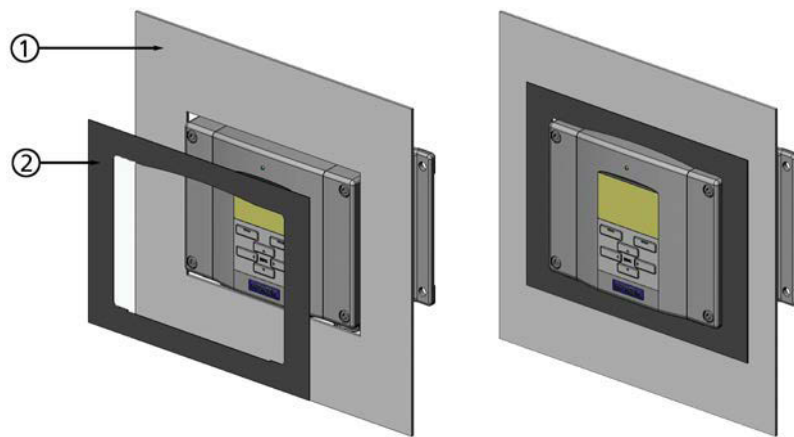
Figure 13   Panel Mounting Frame

Numbers refer to Figure 13 above:

1   =   Panel (not included)
2   =   Panel mounting frame
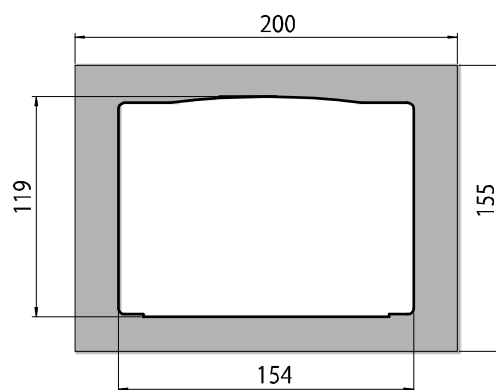
Figure 14   Panel Mounting Dimensions

Pressure connections

The barometer is equipped with a barbed pressure fitting which is ideal for 3-4mm internal diameter tubing. If you require some other pressure fitting, you can replace the standard barbed fitting. The main pressure connector in the barometer housing has a metric M5 internal thread. It is, however, in practice possible to use pressure fittings with a non-metric 10-32 external thread together with this main pressure connector.

The barbed pressure fitting supplied with the barometer is not a static pressure head and cannot be used in turbulent or high-speed wind conditions. The barometric pressure measurement accuracy quoted for the PTB330 series digital barometers does not include any wind or air conditioning system induced measurement errors.

Protect the pressure fitting from the rain. If water gets into the pressure connector it may cause errors in the pressure measurement. The PTB330 barometers are designed to measure the pressure of clean, non-condensing, non-conducting, and non-corrosive gases only.

If you use Static Pressure Head SPH10/20 with PTB330, make sure the SPH10/20 tube is pointing downwards from PTB330. This way the condensed water does not accumulate inside the tube and cause measurement errors.

General about Wiring and Grounding

Cable Bushings

A single electrical cable with screen and three to ten wires is recommended for power and signal connections. The cable diameter should be 8...11 mm. The number of cable bushings depends on the barometer options. See the following recommendations for the cable bushings:
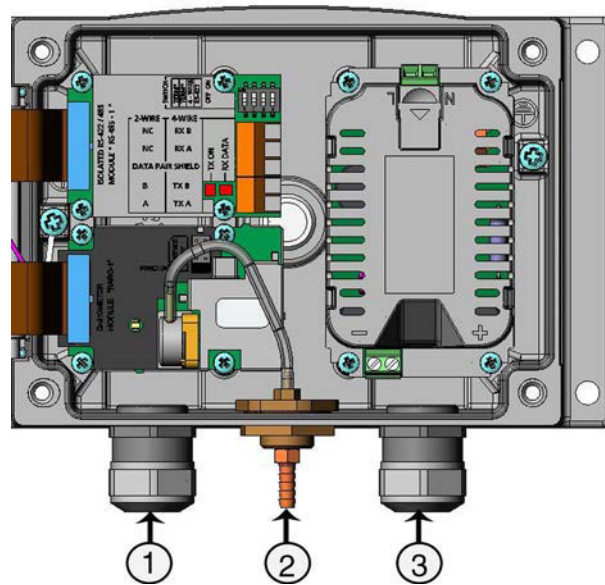
Figure 15   Cable Bushings

Numbers refer to Figure 15 above:

1   =   Cable for signal/powering Ø 8 ... 11 mm
2   =   Pressure port
3   =   Cable for optional power supply/relay module Ø 8 ... 11 mm

NOTE	When there is high electric noise level (for example, near powerful electric motor) in the operating environment, Vaisala recommends using shielded cables or taking care that the signal cables are separated from other cables.

Grounding the Cables

To ensure the best possible EMC performance, you must ground the screen of the electrical cable as shown in
1212-005

Figure 16   below and in the instructions below that.
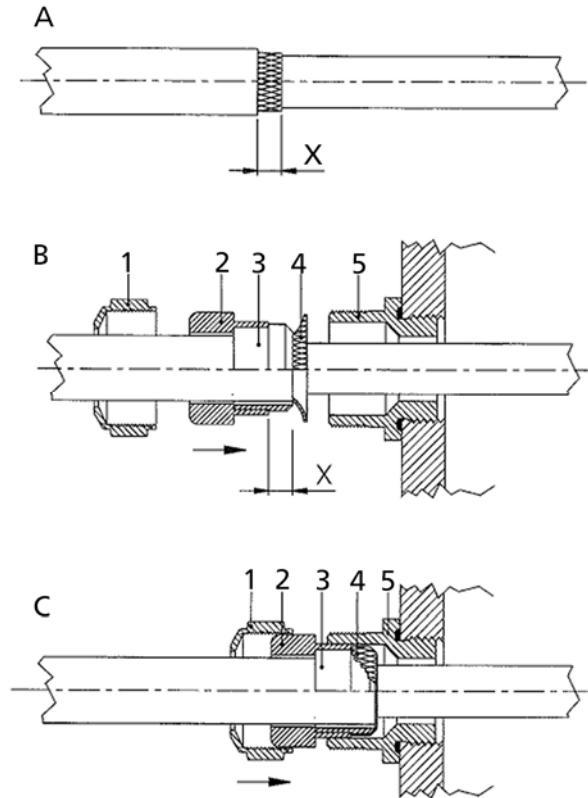
1212-005

Figure 16   Grounding the Screen of Electrical Cable

To ground the electrical cables:

1.   Cut back outer sheath to desired length.

2.   Cut back screen braiding or screen foil to dimension X (see
1212-005

Figure 16   above).

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 90° (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 Barometer Housing

If you need to ground the barometer housing, the grounding connector is found inside the housing. Make sure that different groundings are made to the same potential. Otherwise harmful ground currents may be generated.

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

Alternate Wiring Systems

There are four ways of powering the barometer: using basic wiring, the D-9 connector, the M-12 connector, or the optional external AC-adapter.

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 on page 28.
- When using 8-pin connector, see section M-12 (8-Pin) Connector on page 30.
- When using D-9 connector, see section D-9 Connector on page 31.
- When using an optional external AC-adapter.

Signal and Power Supply Wiring

When wiring the power supply module, see section AC Power Supply Module on page 32.
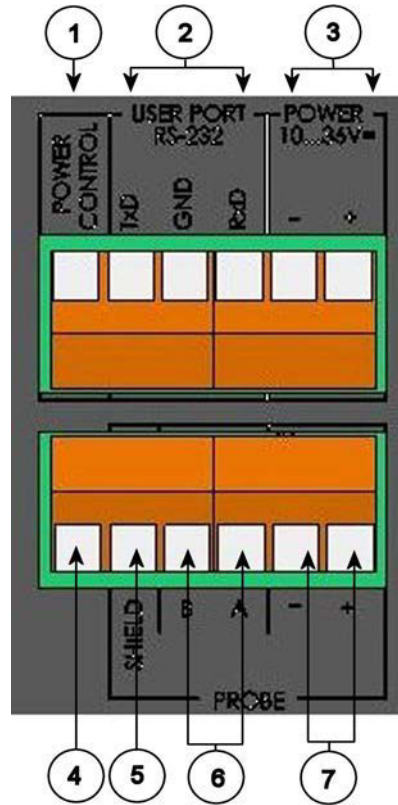
Figure 17   Screw Terminal Block on Motherboard

Numbers refer to Figure 17 above:

1   =   Power control (0VDC = OFF, 5VDC = ON, if feature enabled)
2   =   User port (RS-232 terminals)
3   =   Power supply terminals 10 ... 36 V DC
4   =   Test terminal (not connected, not used in PTB330)
5   =   Probe cable shield (not used in PTB330)
6   =   Probe bus (not used in PTB330)
7   =   Probe power (not used in PTB330)

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

To connect the signal and power supply wires:

1. Open the barometer 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 barometer; see the grounding instructions in the previous sections.

3. Connect the RS-232 user port cables to terminals RxD, GND, and TxD. For more information about the RS-232 connection, see section Serial Line Communication, on page 64.

4. When wiring the RS-485 module, the relay module or the analog output module, see sections RS-422/RS-485 Interface Module on page 42, Relay Module RELAY-1 on page 40, and Analog Output Module on page 38.

5. Connect the power supply wires to the connectors: POWER 10 ... 35V (+) and (-) terminals.

6. Turn on the power. The indicator led on the cover is lit continuously during normal operation.

7. Close the cover and replace the cover screws. The barometer is ready for use.

NOTE	If you have chosen the external power control option, you must remove the wire between the "Power control" and "Power +" - terminals prior to using the power control feature.

M-12 (8-Pin) Connector

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

5 GREY (GND)
6 PINK (+)
7 BLU (RX)
1 WHT (TX)
4 YEL (CH1)
3 GRN (CH2)
2 BRN (-)
8 RED (NC)
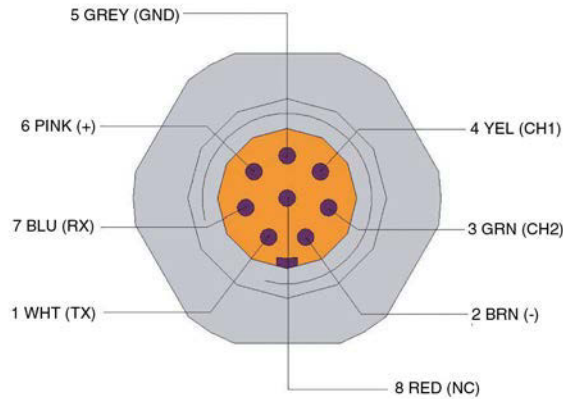
Figure 18   Wiring of Optional M-12 (8-Pin) Connector

Table 3   Pin Assignments to RS-232-/485 Serial Output

Pin/Terminal	Wire	Serial Signal		Analog Signal
		RS-232 (AIE-232)	RS-485 (EIA-485)	
1	White	Data out TX	D1+	-
2	Brown	(serial GND)	-	Signal GND
3	Green	External power control	Ext…	Ext…
4	Yellow	-	-	Analog output
5	Grey	Supply -	Supply -	Supply -
6	Pink	Supply +	Supply +	Supply +
7	Blue	Data in RX	D0 -	-
8	Shield/Red	Cable shield	Cable shield	Cable shield

D-9 Connector
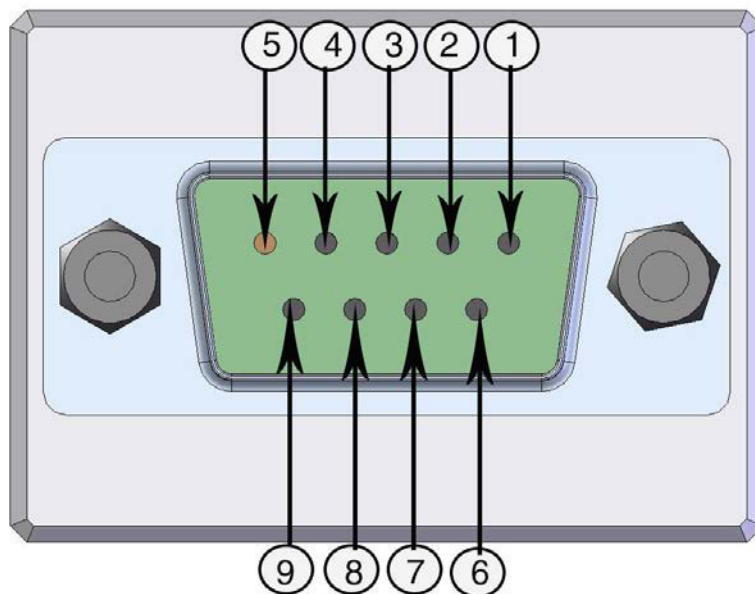
Figure 19   Wiring of Optional D-9 Connector

Table 4   Pin Assignments to RS-232/485 Serial Output

Pin	Wire Color	Serial Signal		Analog Signal
		RS-232 (EIA-232)	RS-485 (EIA-485)	
1	Red			
2	White	TX		TX
3	Black	RX		RX
4 (optional)	Yellow	External power control	External power control	External power control
5	Brown	Ground		Ground
6	Green		D0- (Lo)	Aout
7	Blue	Ground for supply voltage	Ground for supply voltage	Ground for supply voltage
8	Grey		D1+ (Hi)	AGND
9	Orange	Supply voltage (10...30 VDC)	Supply voltage (10...30 VDC)	Supply voltage (10...30 VDC)

NOTE	The D-9 connector cannot be used with relay modules or power supply modules that have AC (mains) power connection.

NOTE	The D-9 connector is not IP65 protection classified.

Optional Modules

AC Power Supply Module

The AC (mains) power connection may be connected to the power supply module only by an authorized electrician, unless you order a unit with a pre-installed power cord. A readily accessible disconnect device must be incorporated in the fixed wiring.
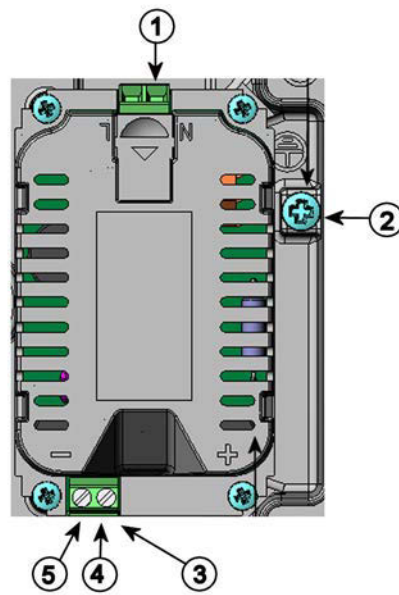
Figure 20   AC Power Supply Module

Numbers refer to Figure 20 above:

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

Installation

To install the AC power supply module:

1. Disconnect the power and open the barometer cover.

2. Remove the protective plug from the cable gland and thread the wires. If 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 of the power supply module in Figure 15 on page 25.

4. Connect the wires from the terminals of the power supply module marked with + and - to the terminals POWER 10 ... 35 V on the motherboard of the barometer.

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 barometer.

7. Connect the power. The LED on the cover of the barometer is lit continuously during normal operation.

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

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

WARNING	Always connect protective ground terminal.

Warnings

Dieses Produkt entspricht der Niederspannungsrichtlinie (73/23 EWG).

- Das Netzmodul darf nur von einem dazu befugten Elektriker angeschlossen werden.
- Trennen Sie das Netzmodul nicht vom Messwertgeber, wenn der Strom eingeschaltet ist.
- Verbinden Sie das Netzmodul nur mit der Spannungsquelle, wenn es im Messwertgeber PTB330 montiert ist.
- Das Erdungskabel muss zum Schutz immer angeschlossen sein.

Ce produit est conforme à la Directive relative à la Basse Tension (73/23 EEC).

- Seul un électricien compétent est habilité à raccorder le module d'alimentation au secteur.
- Ne pas détacher le module d'alimentation du transmetteur lorsqu'il est en service.
- Ne pas raccorder le secteur au module d'alimentation lorsque celui-ci n'est pas installé dans le transmetteur PTB330.
- Toujours raccorder un bornier de protection à la terre.

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 PTB330 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 PTB330-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 PTB330.
- 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 PTB330- 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 PTB330-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 PTB330.
- 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 PTB330-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 PTB330 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 PTB330 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 PTB330 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 PTB330.
- 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 PTB330.
- Vždy zapojte ochrannou zemnící svorku!

Galvanic Isolation for Output

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

NOTE	Output isolation module is not needed when using the AC power supply module.
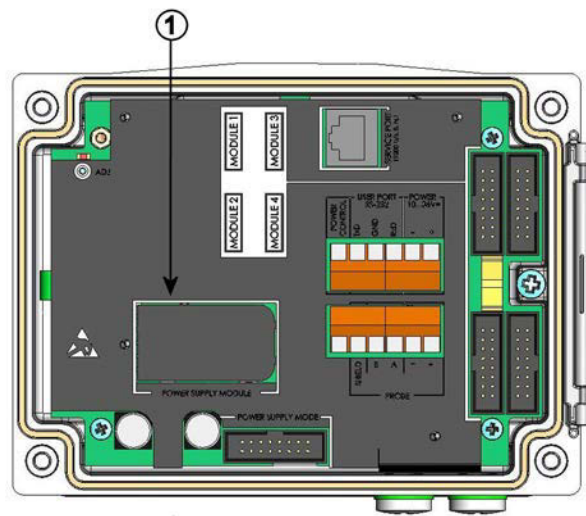
Figure 21   Galvanic Power Isolation

Number refers to Figure 21 above:

1   =   Power Supply module

Analog Output Module AOUT-1T
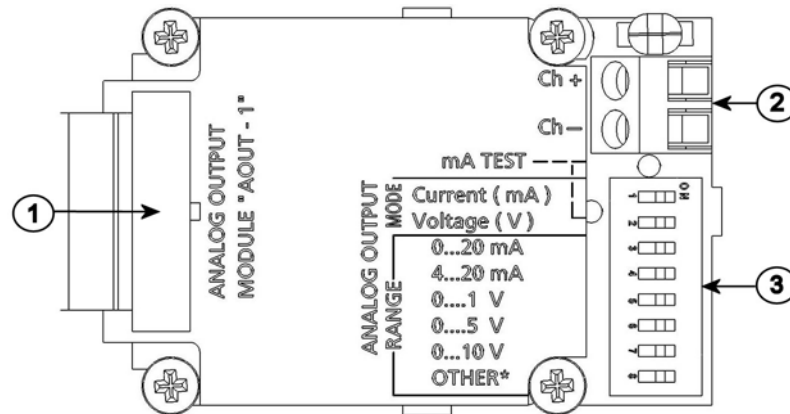
Figure 22   Analog Output 1 Module AOUT-1T

Numbers refer to Figure 22 above:

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

Installation and Wiring

To install analog output module AOUT-1T:

1. Disconnect the power. If the analog output module is installed in
    the factory, continue with the step 4.

2. To attach the module, open the barometer cover and fasten the
    analog output module to the bottom of the housing on the
    module slot 1 with four screws.

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.

8. Connect the power.

9. If you are replacing an existing module, the installation is complete. If you are adding a new module, continue to the next step.

10. Connect to the service port, and execute the MODS command to register the changes.

11. Switch the power off and back on again to clear related errors and to activate the changes.

	OFF	ON	Selection
1			Current output selection, ON=Current output selected
2			Voltage output selection, ON=Voltage output selected
3			0...20 mA selection, ON= 0...20 mA selected
4			4... 20 mA selection, ON= 4... 20 mA selected
5			0...1 V selection, ON=0...1 V selected
6			0...5 V selection, ON=0...5 V selected
7			0...10 V selection, ON= 0...10 V selected.
8			For service use only, keep always in OFF position.

Figure 23   Analog Output Dip Switch Positions

NOTE	For instructions on how to operate the analog output, see section Operating Analog Output on page 102.

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.

Relay Module RELAY-1L

The barometer can be equipped with one configurable relay module. The module contains two configurable relays.

NOTE	The relay module is only intended for DC use.

Installation and Wiring

To install relay module RELAY-1L:

1. Disconnect the power and open the barometer cover. If the relay-module is installed in the factory, continue with step 5.

2. To attach the module, first place a protective plate to the bottom of the housing at module slot 3, then fasten the relay module to the top of the plate with four screws. See the position in Figure 2, on page 16.

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 3 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. See section Selecting the Activation State of the Relay on page 41.

7. Connect the power and close the cover.

8. If you are replacing an existing module, the installation is complete. If you are adding a new module, continue to the next step.

9. Connect to the service port, and execute the **MODS** command to register the changes.

10. Switch the power off and back on again to clear related errors and to activate the changes.

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 contact
NC	Normally closed

Relay NOT activated: C and NC outputs are closed, NO is open
Relay IS activated: C and NO outputs are closed, C and NC are open.

NOTE	For instructions on how to operate the relay (for example, select quantity for the relay output and set the relay setpoints) see section Operating Relays on page 93.
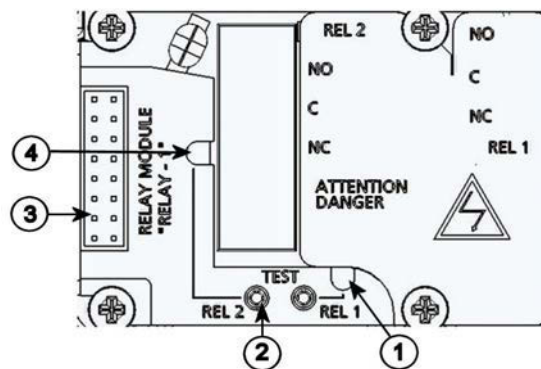
Figure 24   Relay Module

Numbers refer to Figure 24 above:

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

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

WARNING	Do not connect the mains power to the relay unit.

RS-422/RS-485 Interface Module (RS485-1)
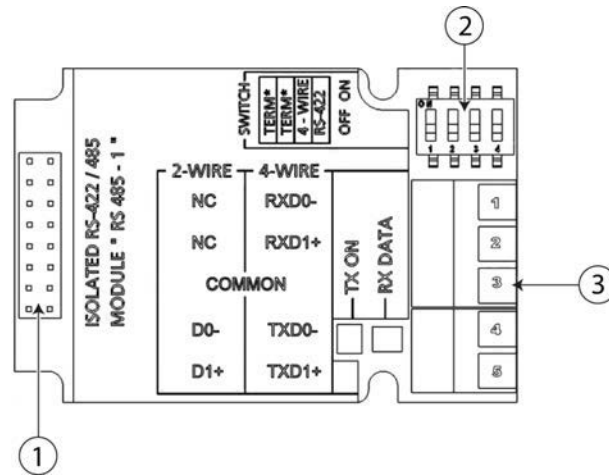
1102-023

Figure 25   RS485-1 Module

Numbers refer to Figure 25 above:

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

Installation and Wiring

1. Disconnect the power. If the RS-485-module is installed in the factory, continue with the item 4.

2. To attach the module, open the barometer cover and fasten the RS-485 module to the bottom of the housing with four screws on the module slot 1.

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 5 on page 44.

6. Connect the RS-422/RS-485 common wire/shield to screw terminal COMMON.

7. If you use RS-485 (or RS-422) to connect just one barometer to a master computer, enable the internal termination of the barometer 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).

8. If you are connecting several barometers 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 barometer without blocking the bus operation.

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

10. In 4-wire mode RS-485 master sends data to the PTB330 barometer through terminals RxD1+ and RxD0- and receives data from PTB330 barometer through terminals TxD1+ and TxD0-.

11. 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).

12. Connect the power and close the cover.

13. If you are replacing an existing module, the installation is complete. If you are adding a new module, continue to the next step.

14. Connect to the service port, and execute the **MODS** command to register the changes.

15. Switch the power off and back on again to clear related errors and to activate the changes.

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

Table 5   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)	RxD0-
2	(not connected)	RxD1+
3	Shield/Common Wire	Shield/Common Wire
4	D0-	TxD0-
5	D1+	TxD1+
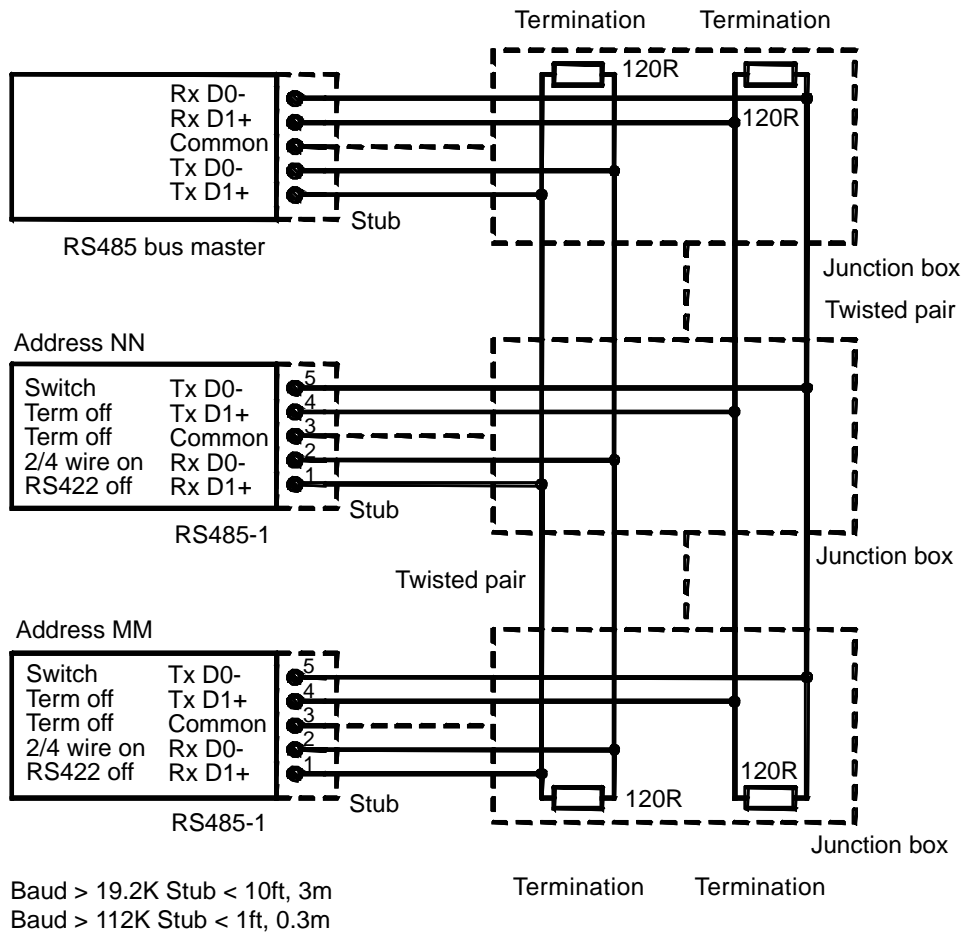
Figure 26   4-Wire RS-485 Bus

Table 6   4-Wire (Switch 3: On)

RS-485 master	Data	PTB330
TxD+	->	RxD1+
TxD-	->	RxD0-
RxD+	< -	TxD1+
RxD-	< -	TxD0-
Common	N/A	Common
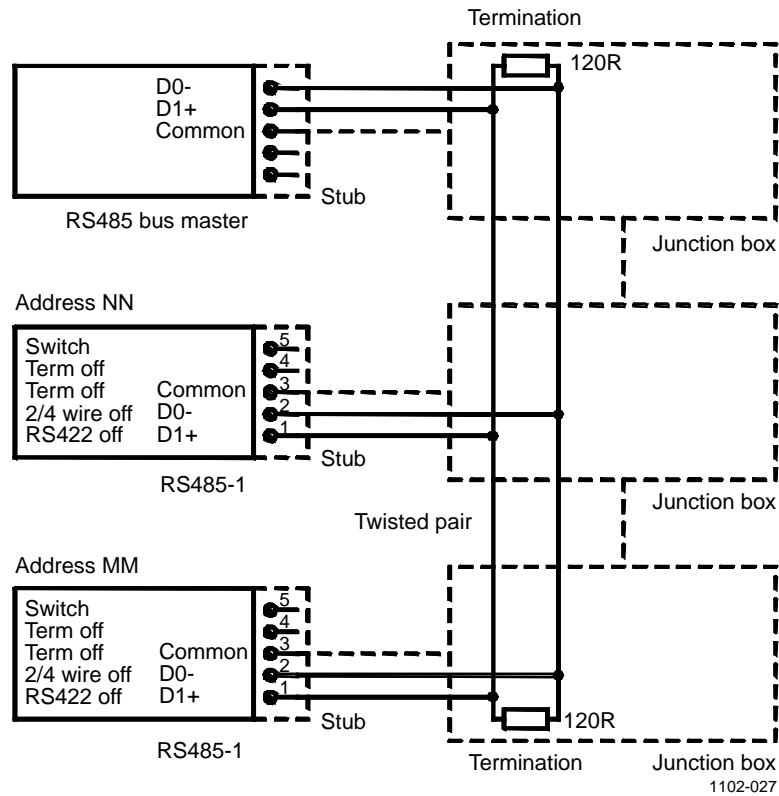
Figure 27   2-Wire RS-485 Bus

Table 7   2-Wire (Switch 3: Off)

RS-485 master	Data	PTB330
A	<->	A
B	<->	B
Common	N/A	Common

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CHAPTER 4
OPERATION

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

Getting Started

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

Display/Keypad (Optional)

Basic Display

Display shows you the measurement values of the selected quantities in the selected units. You can select 1... 4 quantities for the basic display. The basic display shows two quantities (P and P_1) by default.
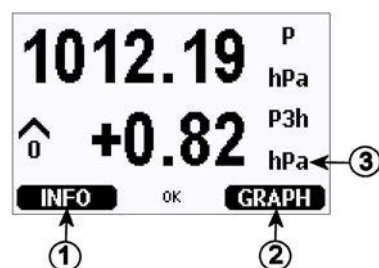
Figure 28   Basic Display

Numbers refer to Figure 28 on page 47:

1 = The Info shortcut key/left function button with guiding text
2 = The Graph shortcut button/right function button with guiding text
3 = Quantities selected for display. Note that units displayed (for example P) depend on the type of measurements.

NOTE	To return directly to the basic display from any view, press and hold down the top right button on the front panel for two seconds.

Menus and Navigation

To change settings and select functions in the menus, do the following:

1. Open the **MAIN MENU** by pressing any of the arrow buttons in the basic display.

2. Move in the menus vertically with the up/down arrow buttons and enter/exit submenus with the left/right arrow buttons.

3. Select an option from a list this way: move to the desired option by pressing the down arrow button as many times as needed. The option is selected once it is highlighted.

4. Submenu is indicated with an arrow pointing right. Open a submenu by pressing the right arrow button.

5. Set value by pressing the left function button.

6. Press the left arrow button to return to the previous menu level.

7. Press the **EXIT** button to return directly to the basic display.

Figure 29   Main Menu (Main Level)

Pressure 3h Trend and Tendency Reading

NOTE	The pressure tendency and trend readings are not available until PTB330 has been powered up for at least three hours.

Using Basic Display

Figure 30 **P₃ₕ Tendency**

Numbers refer to Figure 30 above:

1 = Tendency: Increasing/decreasing graph symbol with the code number (for more information, see Figure 31 on page 50).

2 = P3h symbol

3 = Trend (middlemost numeric value in the example),

that is, pressure change during last 3 hours

Pressure Tendency Graphics and Codes

The characteristic symbols of pressure tendency during the 3 hours preceding the time of observation are described in Figure 31 on page 50.

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

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

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. 1.1, International Codes, Part A - Alphanumerical Codes, 1995 Edition, WMO - No. 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 "trend=" P3H " " "tend" A3H #RN
>
```

For more information on the Form command, see section Changing Quantities and Units on page 70.

Missing Trend

When the pressure tendency has not yet been calculated, that is, the device has been powered-up less than three hours ago, the PTB330 barometer outputs a code "*" when viewing via serial connection. The absence of the pressure trend is indicated in a similar manner, too.

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 **NEXT** button to have the trend graph and max/min graph in turns and browse through the quantities selected for display.

- Press the **EXIT** button to return to the basic display.
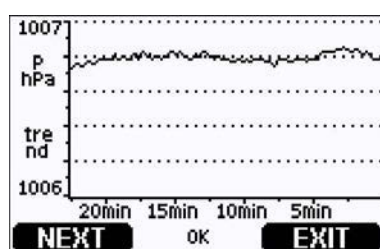
Figure 32   Graphical Display

Trend graph: Displays a curve of average values. Each value is a calculated average over a period.

Max/min graph: Displays the minimum and maximum values in a form of curve. Each value is max/min over a time period. See Table 8 on page 52.

Table 8   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 buttons to zoom in and out the time in the graph window.

- Press the left/right arrow buttons to monitor the cursor mode where you can observe individual measuring points. Press an arrow button to move the cursor (vertical bar) along the time axis. The numerical value at the cursor position is shown at the left upper corner. Time from the present to the chosen moment is shown at the upper right corner.

Table 9   Graph Information Messages in Cursor Mode

Message	Interpretation
Power outage	Power failure (marked also with dashed vertical line)
No data	No data was recorded at pointed time.
Main unit failure	Generic failure detected at pointed time.
Meas. failure	Pressure measurement failure detected at pointed time.
Adj. mode active	The device was in the adjustment mode at pointed time.

A question mark after time tells you 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.

NOTE	The 3h trend (P_{3h}) is not shown on the graphical display. Instead, the history readings of P (pressure) are displayed.

Information Display

The information display contains the current settings and status of the device. Access the display by pressing the left **INFO** function button in the basic display. The following information is shown:

- present or past unacknowledged errors, if any

- device identification; product name, version, and serial number

- information on barometer modules

- adjustment information

- measuring settings

- diagnostic settings

- serial interface information

- analog output information (when applicable)

- relay output information (when applicable).

Figure 33   Device Information on Display

Proceed through the information views by pressing the **MORE** button as many times as you need to get the desired information. You can browse through the information displays also with the arrow buttons. Press the **OK** button to return to the basic display.

Display Settings

Changing Quantities

1. Open the **MAIN MENU** by pressing any of the arrow buttons.

2. Select **Display** and press the right arrow button.

3. Select **Quantities** and press the right arrow button.

4. Select a quantity by using the up/down arrow buttons. Confirm your choice by pressing the **SELECT** button. You can select 1 ... 4 display quantities at a time. Undo selection by selecting it and pressing the **HIDE** button.

5. Press **EXIT** to return to the basic display.

See Table 2 on page 15 for available quantities.

NOTE	Only the quantities selected for the display are stored in the graphical history. If a quantity is hidden, it is not stored in the memory of the barometer for the time being.

NOTE	In order to output P_{3h} or A_{3h} readings through the serial line, either P or P_{3h} must be selected for display.

Changing Units

1. Open the **MAIN MENU** by pressing any of the arrow buttons.

2. Select **Display** and press the right arrow button.

3. Use the up/down arrow buttons to select **Units**. Press the right arrow button.

4. Use the up/down arrow buttons to select display units. Confirm the selection by pressing **CHANGE**.

5. Press **EXIT** 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.

Rounding

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

1.   Open the **MAIN MENU** by pressing any of the arrow buttons.

2.   Select **Display** and then press the right arrow button.

3.   Select **Rounding** and press the **ON/OFF** button.

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

Backlight

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 button. When pressing any button, the light turns on again. To change backlight preferences:

1.   Open the **MAIN MENU** by pressing any of the arrow buttons.

2.   Select **Display** and then press the right arrow button.

3.   Select **Backlight**, press the **CHANGE** button.

4.   Select **On/Off/Automatic**, then press the **SELECT** button.

5.   Press **EXIT** to return to the basic display.

Contrast

1.   Open the **MAIN MENU** by pressing any of the arrow buttons.

2.   Select **Display**, press the right arrow button.

3.   Select **Contrast**, press the **ADJUST** button.

4.   Adjust the contrast by pressing the left/right arrow buttons.

5.   Press **OK** and **EXIT** to return to the basic display.

Keypad Lock

This function locks the keypad and prevents unintentional button strokes. To use keypad lock:

1.   To lock the keypad, press and hold down the left function button for 4 seconds (at any display).

2.   To unlock the keypad, press and hold down the **OPEN** button for 4 seconds.

Measuring Settings

See the calculation formulas for pressure values in Appendix A, Calculation Formulas, on page 133. To change the measuring settings:

1. Open the **MAIN MENU** by pressing any of the arrow buttons.

2. Select **Measuring** and press the right arrow button.

3. Select **Measuring settings**. Press the right arrow button.

4. Select an option with up/down arrow buttons. Press the **SET** button.

5. First press the left/right arrow buttons to move from a digit to another. Then press the up/down arrow buttons to enter desired numeric value for the digit. Repeat the procedure until all the desired digits are set. Press the **OK** button.

6. Press **EXIT** to return to the basic display.

Diagnostic Settings

Use the display/keypad or the serial line commands PSTAB on page 82, and DPMAX on page 78 to set the diagnostic settings:

1. Press any of the arrow buttons to open the **MAIN MENU**.

2. Select **System** and press the right arrow button to confirm your selection.

3. Select **Diagnostics** and press the right arrow button to confirm your selection.

4. Select **Diagnostic Settings.**

5. Use the up/down arrow buttons to select **Stability.** Press **SET** to input the value. Use the left/right arrow buttons to move between the value and the unit. Set the value and the unit using the up/down arrow buttons. Press **OK** to confirm your choice.

6. Proceed as instructed in point 5 to set **Max. diff.**

7. Press **SET** to confirm your selection.

8. Press **EXIT t**o return to the basic display.

Use the display/keypad to check the stability of the pressure measurement. If concurrent pressure measurements differ less than the set value, the display outputs a small "OK" text.
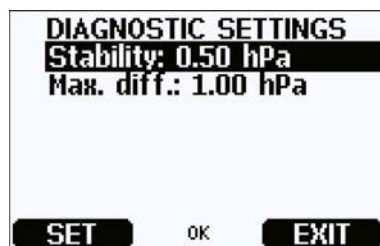
Figure 34   Checking Stability of the Measurement

Use the variable "OK" with the **FORM** command to show stability info in the serial output.

Serial Interface Settings

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

1.   Press any of the arrow buttons to open the **MAIN MENU**.

2.   Select **Interfaces** and press the right arrow button to confirm your selection.

3.   Select **Serial interface** and press the right arrow button to confirm your selection.

4.   Select **Bit rate**/**Serial format**/**Comm. mode** by pressing the **CHANGE** button. Use the up/down arrow buttons to select and press **SELECT** to confirm your selection.

5.   If you selected RUN for communication mode, select **RUN interval** and press **SET** to confirm your selection.

6.   Use the arrow buttons to set the measuring interval and the unit. Press **OK** to confirm your settings.

7.   If you selected POLL for communication mode, select **POLL address** and press **SET** to confirm your selection.

8.   Use the arrow buttons to set the barometer address. Press **OK** to confirm the setting.

9.   Use the arrow buttons to select **ECHO**. Press **ON** to turn to it on. Press **OFF** to turn it off.

10.   Press **EXIT** to return to the basic display.

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

System Settings

Language

1.   Open the **MAIN MENU** by pressing any of the arrow buttons.

2.   Select **System**, press the right arrow button.

3.   Select **Language** (marked with a flag symbol), press the **SELECT** button.

4.   Select the menu language with up/down arrow buttons and press the **SELECT** button.

5.   Press the **EXIT** button to return to the basic display.

Menu PIN Lock

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

1.   Open the **MAIN MENU** by pressing any of the arrow buttons.

2.   Select **System**, press the right arrow button.

3.   Select **Menu PIN**, press the **ON** button.

4.   Enter a PIN code by using the up/down arrow buttons. Press **OK** to confirm the setting. Now the PIN lock is on and a key symbol is shown in a display.

5.   Press **EXIT** 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, go to the menu by entering the PIN code and select **System**, **Menu PIN**, press **OFF** button.

If you have forgotten the PIN code, open the barometer cover and press the **ADJ** button once. Wait for a few seconds until the adjustment menu opens. Select **Clear menu PIN**, press **CLEAR**.

NOTE	You can also disable the keypad completely with the serial command **LOCK**. For more information, see section LOCK on page 89.

Factory Settings

Use the display/keypad to restore the factory settings. This operation does not affect the adjustments. To restore factory settings:

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

If you change your mind and want to exit the menu without making any changes, press the **NO** button.

NOTE	Factory Settings only resets the settings available in the menus. Advanced settings that are only available via serial line commands are not reset to defaults.

Clearing Graph Displays

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

1.   Press any of the arrow buttons to open the **MAIN MENU**
2.   Select **System** by pressing the right arrow button.
3.   Select **Clear graph memories** by pressing the **CLEAR** button. Press the **YES** button to confirm the selection.

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

For more information on how to handle recorded measurement data, see section Data Recording on page 90.

Relay Settings

Relay Outputs
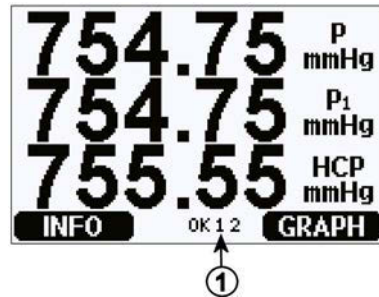
Figure 35   Relay Indicators on Display

The number refers to Figure 35 above:

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

Use the display/keypad to set the relay outputs:

1.   Press any of the arrow buttons to open the **MAIN MENU**.

2.   Select **Interfaces** and press the right arrow button to confirm
      your selection.

3.   Select **Relay Outputs** and press the right arrow button to
      confirm your selection.

4.   Select **Relay 1/Relay 2** by pressing the right arrow button. Use
      the up/down arrow buttons to select the quantity and press
      SELECT to confirm your selection.

5.   Select **Quantity**, press the **CHANGE** button. Select quantity by
      using the up/down arrow buttons. Confirm your selection by
      pressing the **SELECT** button.

6.   Select **Act. above/Act. below**. Press the **SET** button. 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 buttons. Confirm your
      selection by pressing the **OK** key.

7.   Select **Hysteresis**. Press the **SET** button and adjust the value.
      Finally press the **OK** button.

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

9. Press **EXIT** to return to the basic display.

See section Relay Setpoints on page 93 for more information on the relay setpoints.

Testing the Operation of Relays

NOTE	Testing activates relays even if they are disabled.

Use the module push buttons to activate the relays. Press the REL 1 or REL 2 button 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 buttons.

2. Select **System**, press the right arrow button.

3. Select **Diagnostics**, press the right arrow button.

4. Select **Relay tests**, press the right arrow button.

5. Select **Relay Output Status**, press **SHOW** to see the active relay or relays. Press **OK** to return to the previous level.

6. Select **Test relay 1** to test the output of relay 1. Press **ON/OFF** to activate/deactivate the output. Press **OK** to go back to normal operation.

7. Select **Test relay 2** to test the output of relay 2. Press **ON/OFF** to activate/deactivate the output. Press **OK** to go back to normal operation.

8. Press **EXIT** to return to the basic display.

Analog Output Settings

Analog Output Quantities

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

1. Press any of the arrow buttons to open the **MAIN MENU**.

2. Select **Interfaces** and press the right arrow button.

3. Select **Analog outputs** and press the right arrow button.

4. Select **Output 1** and press the right arrow button.

5. Select **Quantity** and press the **CHANGE** button.

6. Select the quantity by using the up/down arrow buttons. Press the **SELECT** button to confirm your selection.

7. Select **Scale**, lower limit, by pressing the up/down arrow buttons. Press the **SET** button. Adjust the lower limit value by pressing the arrow buttons up/down/left/right. Press the **OK** button to confirm your setting.

8. Select **Scale**, upper limit by pressing the up/down arrow buttons. Press the **SET** button. Adjust the upper limit value by pressing the arrow buttons up/down/left/right. Press the **OK** button to confirm your setting. Press the **EXIT** button to return to the basic display.

9. Press the **EXIT** button to return to the basic display.

Testing the Operation of Analog Outputs

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. To test the analog outputs:

1. Press any of the arrow buttons to open the **MAIN MENU**.

2. Select **System** and press the right arrow button.

3. Select **Diagnostic**s and press the right arrow button.

4. Select **Analog output tests** and press the right arrow button.

5. Select **Analog output status**. Press the **SHOW** button to check the status and **OK** to finish.

6. Select **Test analog output 1**. Press **TEST**. Select one of the testing options by pressing the **0%/50% or 100%** button.

7.   Press the **OK** button to stop testing and go back to the Analog output tests menu. Then press the **EXIT** button to return to the basic display.

Analog Output Fault Indication

The factory default state for the analog outputs during error condition is 0 V/ 0 mA. Please be careful when selecting the new error value. The user must not input an error value that can cause unexpected problems in process monitoring.

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

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

MI70 Link Interface Software for Data Handling

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

The MI70 Link Interface Software is available from Vaisala. To start using the MI70 Link Interface Software:

1.   Connect the connection cable between the serial port of your PC and the Service Port of the barometer.
2.   Check that the barometer is powered up and start using the MI70 Link program.

Use a MI70 Link version 1.10, or a newer one, to be able to utilize all the functions of the barometer.

Serial Line Communication

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

For setting up a permanent interface to the host system, use the user port. You can change the serial settings and operate in RUN, STOP and POLL modes.

For temporary RS-232 connections, use the service port. Service port is always available with fixed serial settings and, after power-up, it always starts in the STOP mode.
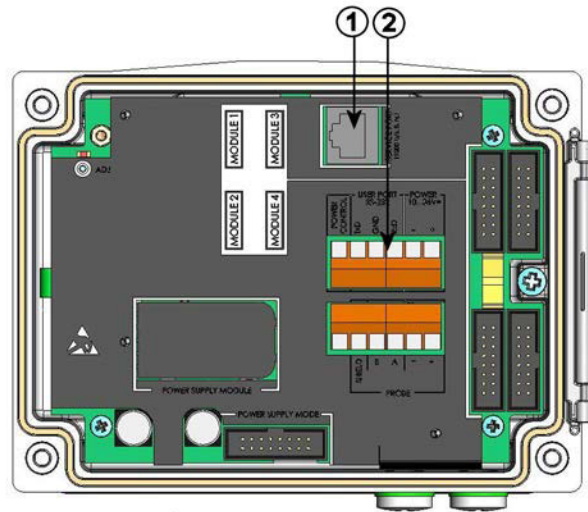
Figure 36   Service Port Connector and User Port Terminal on Motherboard

Numbers refer to Figure 36 above:

1   =   Service port connector
2   =   User port terminals

User Port Connection

Use a suitable serial cable between the user port's RxD, GND, and
TxD screw terminals and the PC serial port.

NOTE	Do not use the user port when RS-485 module is connected.

**Table 10   Default Serial Communication Settings for the User
Port**

Parameter	Value
Bit rate	4800
Parity	Even
Data bits	7
Stop bits	1
Flow control	None
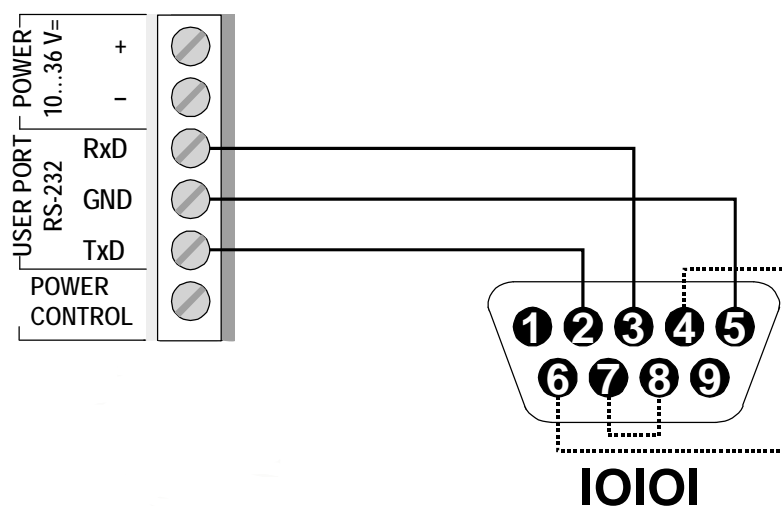
**Figure 37   Connection Example Between PC Serial Port and
User Port**

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

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

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

Service Port Connection

Table 11   Fixed Communication Settings for Service Port

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

To create a service port connection:

1.   Connect the serial interface cable (optional accessory) between the serial port of your PC and the service port connector on the motherboard.

2.   Open a terminal program and set the communication settings (see the following section for detailed instructions).

3.   Power-up the barometer.

Terminal Program Settings

The instructions below describe how to connect to PTB330 using the PuTTY terminal application for Windows. Perform the necessary cabling and configuration of the transmitter before following the instructions.

PuTTY is available for download at www.vaisala.com.

NOTE	PuTTY cannot be used to access the transmitter through the User Port if PTB330 is configured to use the MODBUS protocol. However, you can always use PuTTY to access PTB330 through the Service Port.

Opening a Serial/USB connection

To open a serial/USB connection:

1. Power up the PTB330 and start the PuTTY application.

2. Select the Serial & USB settings category, and check that the correct COM port is selected in the **Serial or USB line to connect to** field. Change the port if necessary.

    If you are using a Vaisala USB cable, you can check the port that it uses by clicking the **USB Finder...** button. This opens the *Vaisala USB Instrument Finder* program that has been installed along with the USB drivers.

3. Check that the other serial/USB line settings are correct for your connection, and change if necessary. The default settings (shown in Table 11 on page 66) are used by the PTB330 Service Port.
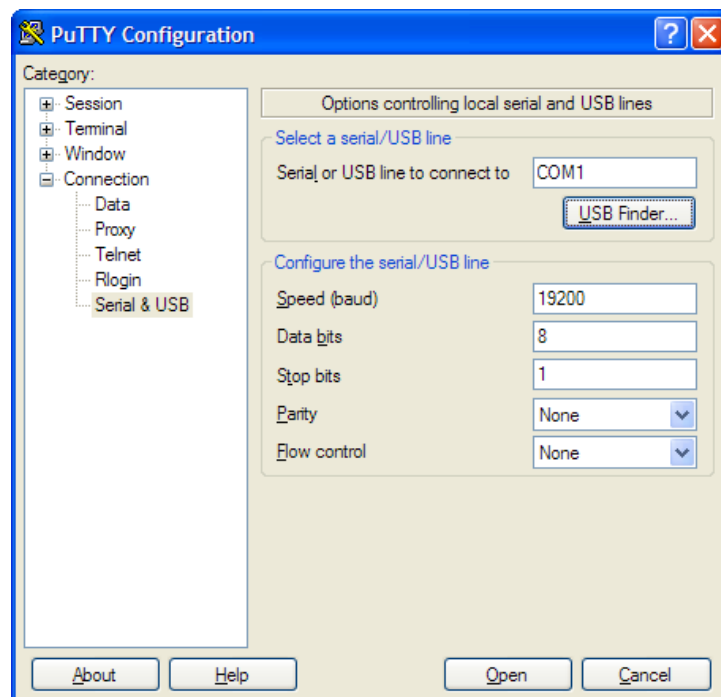
0810-070

Figure 38 Opening a Serial Connection

4. Click the **Open** button to open the connection window and start using the serial line.

    If PuTTY is unable to open the serial port you selected, it will show you an error message instead. If this happens, restart PuTTY and check the settings.

List of Serial Commands

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

General commands

BNUM		Shows the device and module batch numbers.
SERI		Shows or sets the serial port settings for the user port.
SNUM		Shows the device and module serial numbers.
ERRS		Shows all unacknowledged errors (and clears them).
HELP		Shows the available commands.
LOCK		Shows or sets the keyboard lock.
?		Outputs information on the device.
ECHO	[**ON**/OFF]	Shows or sets the serial interface echoing.
RESET		Resets the device.
VERS		Displays the product name and software version number.
SNUM		Shows the device and module serial numbers.
MODS		Acknowledges added or removed modules.
CON		Adjusts display contrast.

Measurement commands

R		Changes the serial mode to RUN and starts outputting measurement results according to the **FORM** string (with interval defined by **INTV**).
INTV	[**0**...255 s/min/h/d]	Shows or sets the continuous output interval (for RUN mode).
SEND	[0...255]	Shows the measurement results according to the configured form.
SMODE	[**STOP**/POLL/RUN /SEND/PA11A]	Shows or sets the start mode.
SDELAY	[0...254] (0... 2540 ms)	Shows or sets the answer delay for the serial line in tens of milliseconds.
ADDR	[**0**...255]	Sets the barometer address.
OPEN	[0...255]	Opens communications after having entered the **CLOSE** command.
CLOSE		Closes communications until the **OPEN** command is entered.
SCOM		Shows or sets an alias (a user-specific form) for the **SEND** command. The given alias cannot be a command already in use.

Measurement setting commands

TQFE	[-80...+200° C]	Shows or sets the temperature for QFE corrected pressure.
DPMAX	[0…9999.99 hPa]	Shows or sets the maximum permissible difference pressure between barometer modules.
HHCP	[-30...+30 m]	Shows or sets the altitude for height corrected pressure.
HQFE	[-30...+30 m]	Shows or sets the altitude for the QFE corrected pressure.
HQNH	[-30...+3000 m]	Shows or sets the altitude for the QNH corrected pressure.
PSTAB	[0…9999.99 hPa]	Shows or sets the pressure stability limits.
AVRG	[0…600 s]	Sets the barometer measurement averaging time (in seconds).

Formatting commands

FORM	Sets the custom output for the **SEND** command and for RUN mode.
TIME	Shows or changes the current time.
DATE	Shows or changes the current date.
UNIT	Shows or sets unit for a quantities.

Data recording commands

DSEL	Selects the quantities that are displayed on the graphical user interface as well as quantities for data recording.
DELETE	Erases the log memory.
UNDELETE	Restores the erased log memory.
DIR	Lists the available logs in the logging memory.
PLAY	Shows the trend, min, and max values of the given log.

Calibration and adjustment commands

CDATE	Shows or sets the calibration date.
LCP1/	Performs a linear adjustment for the
LCP2/	barometer module/module.
LCP3	
MPCP1/M	Performs a multipoint adjustment for the
PCP2/MP	barometer module/module.
CP3	
CTEXT	Shows or sets the calibration info text.

NOTE	The calibration and adjustment commands are available in adjustment mode only. Press the adjustment button before inputting these commands.

Setting and testing the analog outputs

AMODE	Displays the analog output mode (if an AOUT-1 module is connected).
ASEL	Sets the analog output quantity and scaling (low/high).
ACAL	Adjusts the analog output.
AERR	Sets the analog output error value.
ATEST	Starts/ends an analog output test.

Setting and testing the relays

RSEL	Sets the relay scaling (if a RELAY-1 module is connected).
RTEST	Starts/ends a relay output test.

General Settings

Changing Quantities and Units

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

FORM

Use the serial line command **FORM** to change the format or define quantities for the output command **SEND** and for **RUN** mode.

FORM [x]

where:

x   =   Formatter string

Formatter string consists of quantities and modifiers. When selecting the quantity, use the abbreviations of the quantities presented in Table 2 on page 15. The modifiers are presented in Table 12 on page 71.

Table 12   FORM Modifiers

Modifier	Description
/	Restores the default output message (depends on the device configuration). Used alone.
??	Displays list of supported parameters. Used alone.
0.0	Revert back to the default number format per each quantity.
x.y	Length modifier (number of digits and decimal places).
quantity	Quantity value or * characters if not available.
U	Unit symbol as it is (width depends).
U1…U9	Unit symbol in the specified number of characters (truncated or space filled as necessary).
"xxx"	String constant (free text).
#N \N	Line feed character <0x0A>.
#R \R	Carriage return character. <0x0D>.
#RN \RN	Carriage return and line feed characters. <0x0D><0x0A>.
#T \T	Horizontal tabulator character <0x09>.
#0…#255 \0…\255	Data byte with the specified decimal value.
ADDR	Device address (left-filled with spaces).
CS2	Modulus-256 checksum of message sent so far, hexadecimal format.
CS4	Modulus-65536 checksum of message sent so far, hexadecimal format.
CSX	NMEA XOR checksum of message sent so far, hexadecimal format.
DATE	Date in format *yyyy-mm-dd.*
ERR	Error flags for P_1, P_2, and P_3 (if installed, right-filled with spaces); 0 = no error, 1 = error.
MCTR	Running counter for pressure measurement.
PSTAB	Pressure stability indicator (OK or two spaces), see PSTAB on page 82.
RDTIME	Time in format *hh:mm:ss.ss.*
SN	Device serial number.
TIME	Time in format *hh:mm:ss.*

Checksums are calculated as described in the equations below.

$$cs_2 = \sum_{i=1}^{n} b_i \bmod 256$$

$$cs_4 = \sum_{i=1}^{n} b_i \bmod 65536$$

$$cs_x = b'_1 \oplus b'_2 \oplus \ldots \oplus b'_n$$

$$b'_i = b_i \ \ if \ b_i \neq 36 \ and \ b_i \neq 42$$

$$b'_i = 0 \ \ if \ b_i = 36 \ or \ b_i = 42$$

Table 13   Symbols Used in FORM Checksum Equations

Symbol	Description
cs$_2$	Value of CS2 checksum in the output message.
cs$_4$	Value of CS4 checksum in the output message.
cs$_x$	Value of CSX checksum in the output message.
b$_i$	Value of the byte at position *i* (1-based) in the output message.
n	Number of bytes in the output message before the CS2, CS4, or CSX field (including earlier checksum fields, if any).
$\oplus$	Bit-wise exclusive-or operator.
36	Byte value of ASCII $ character.
42	Byte value of ASCII * character.

Table 14   Quantity Symbols

Product	Quantity symbols
PTB330 with 1×BARO-1	P P3H P1 HCP QFE QNH TP1 A3H
PTB330 with 2×BARO-1	P P3H P1 P2 DP12 HCP QFE QNH TP1 TP2 A3H
PTB330 with 3×BARO-1	P P3H P1 P2 P3 DP12 DP13 DP23 HCP QFE QNH TP1 TP2 TP3 A3H

Command '**FORM /**' returns the default output format. The default output format depends on the device configuration.

Query syntax and output example:

```
>FORM ?
Output format  : P \RN
>SEND
 999.92
>
```

Prompt syntax and output example:

```
>FORM
Output format  : P \RN
? 4.0 P " " U \T 0.0 P1 \T P2 \T P3 \RN
Output format  : 4.0 P " " U \T 0.0 P1 \T P2 \T P3 \RN
>SEND
1000 hPa  999.93   999.81   999.86
>
```

Command line syntax and output example:

```
>FORM DATE \T TIME \T P \T ERR \RN
Output format  : DATE \T TIME \T P \T ERR \RN
>SEND
2000-01-01    00:01:54  999.88   000
>
```

Restoring the default output message (depends on the device
configuration) and output example:

```
>FORM /
Output format  : QNH \T QFE \R \N
>SEND
 999.88    999.88
>
```

Displaying information on supported parameters (depends on the
device configuration, see Table 14 on page 72):

```
>FORM ??
P P3H P1 P2 P3 DP12 DP13 DP23 HCP QFE QNH TP1 TP2 TP3 A3H
Additional parameters
#T, #R, #N, #RN, Un, n.n, CS2, CS4, CSX, SN, ERR, PSTAB, ADDR, DATE, TIME
>
```

UNIT

Use the **UNIT** command to display or set the output quantities and
their units.

Table 15   Output Quantities and Units

Quantity	Output Quantity	Available Output Units
Pressure (measures average pressure from P_1, P_2, and P_3)	P	hPa, psi, inHg, torr, bar, mbar, mmHg, kPa, Pa, mmH_2O, inH_2O
Pressure from barometer module 1 or 2 or 3	P_1, P_2, and P_3	
Pressure trend	P_{3h}	
Pressure difference (P_1 -P_2)	ΔP_{12}	
Pressure difference (P_1 -P_3)	ΔP_{13}	
Pressure difference (P_2 -P_3)	ΔP_{23}	
QNH pressure	QNH	
QFE pressure	QFE	
Height Corrected Pressure	HCP	
Temperature of barometer module 1 or 2 or 3	T_{P1}, T_{P2}, and T_{P3}	°C, °F, K

UNIT [x] [y]

where:

x   =   Output quantity
y   =   Output unit

Use the **UNIT** command to change the measurement unit for the quantities. The output consists of all the measured quantities of the unit you enter as variable **[y]**.

Example:

```
>unit Pa
P               : Pa
P3h             : Pa
P1              : Pa
P2              : Pa
DP12            : Pa
HCP             : Pa
QFE             : Pa
QNH             : Pa
>
```

Use the **UNIT** command with a quantity symbol to change the measurement unit for a specific quantity. Specify the quantity and the desired unit for it.

Example:

```
>unit P mmhg
P               : mmHg
P3h             : Pa
P1              : Pa
P2              : Pa
DP12            : Pa
HCP             : Pa
QFE             : Pa
QNH             : Pa
>
```

NOTE	This command changes both the serial output and display units.

Use the **UNIT ??** command to list the available measurement units for the quantities.

DATE and TIME

The system date is always reset to 2000-01-01 when you switch the power on to the device.

NOTE	The accuracy of **DATE** and **TIME** is limited. The system date/time is only intended for short-duration timekeeping.

DATE [?] [x]

where:

? = Displays the current date set to the device.
x = Date (format: yyyy-mm-dd)

Query syntax:

```
>DATE ?
Date            : 2000-01-01
>
```

Prompt syntax:

```
>DATE
Date            : 2000-01-01 ? 2012-08-27
Date            : 2012-08-27
>
```

Command line syntax:

```
>DATE 2012-08-28
Date            : 2012-08-28
>
```

The system time is always reset to 0:00:00 when you switch the power on to the device. The system uses a 24 hour clock.

TIME [?] [x]

where:

? = Displays the current time set to the device.
x = Time (format: *hh:mm:ss*)

Query syntax:

```
>TIME ?
Time            : 00:01:51
>
```

Prompt syntax:

```
>TIME
Time            : 00:01:55 ? 9:22:45
Time            : 09:22:45
>
```

Command line syntax:

```
>TIME 9:23:09
Time            : 09:23:09
>
```

Measurement Related Commands

TQFE

Use the **TQFE** command to show or set the temperature for QFE corrected pressure. The valid range of QFE temperature is -80...+200 °C.

TQFE [?] [x] [y]

where:

? = Displays the current QFE temperature. You cannot use this modifier with the other modifiers.
x = Numeric value (temperature).
  Ranges:
  -80 … 200 °C
  -110…390 °F
  190…470 K
y = Temperature scale used.
  Values:
  'C
  'F
  K

Examples:

Query syntax:

```
>TQFE ?
QFE temp.      : 20.00 'C
>
```

Prompt syntax:

```
>TQFE
QFE temp.      : 20.00 'C ? 70 'F
>
```

Command line syntax:

```
>TQFE 300 K
QFE temp.      : 300.00 K
>
```

DPMAX

The serial line command **DPMAX** shows or sets the maximum permissible difference pressure allowed between barometer modules. The command is only available if more than one barometer module has been installed.

DPMAX [x] [y] [?]

where:

x = Pressure
y = Unit

Example:

```
>dpmax 0.2
Max. diff.     : 0.20 hPa
>
```

If the defined value is exceeded, the relevant digits in the ERR field (see FORM command) change from 0 to 1, and the corresponding pressure measurement(s) are no longer included in the average pressure reading.

Vaisala recommends using the ERR field as part of the **FORM** command definition if there are two or three pressure transducers in a PTB330 series digital barometer.

The following basic cases may occur for barometers with two or three pressure transducers (only the differences found between the readings from the pressure transducers are important):

	P high			P high
	≤ DPMAX ?			≤ DPMAX ?
Two transducers:	P low	Three transducers:		P middle
				≤ DPMAX ?
				P low

For an acceptable measurement crucial conditions are:

- two transducers: P high - P low ≤ DPMAX

- three transducers:

  P high - P middle ≤ DPMAX and P middle - P low ≤ DPMAX.

The factory setting for DPMAX is 1 hPa.

Example of setting the limit to 0.5 hPa:

```
>dpmax <cr>
Pd max         :     1.000 ? 0.5 <cr>
>
```

```
Use the ERRS command to analyze problems
```

AVRG

Use the **AVRG** command to set barometer measurement averaging time (in seconds). Valid range of averaging time is 1...600 seconds or 0, which disables the measurement averaging function.

AVRG [x] [?]

where:

x   =   Average time

Example:

```
>avrg
Average filter : 1 s ?
>
```

HHCP

The **HHCP** command shows or sets the altitude for height corrected pressure. The valid range of HCP height is -30... 30 m.

HHCP [?] [x] [y]

where:

? = Displays the current altitude offset for HCP calculation. You cannot use this modifier with the other modifiers.
x = Numeric value (altitude).
    Ranges:
    -30 … 30 m
    -99… 99 ft.
y = Distance scale used.
    Values:
    m
    ft

HQFE

The **HQFE** command displays or sets altitude for QFE corrected pressure. The valid range of QFE height is -30...+30 m.

For calculation formulas, see Appendix A, Calculation Formulas, on page 133.

HQFE [?] [x] [y]

where:

?	=	Displays the current altitude offset for QFE calculation. You cannot use this modifier with the other modifiers.
x	=	Numeric value (altitude). Ranges: -30 … 30 m -99… 99 ft.
y	=	Distance scale used. Values: m ft

HQNH

The **HQNH** command displays or sets altitude for QNH corrected pressure. The valid range of QNH height is -30...+3000 m.

For calculation formulas, see Appendix A, Calculation Formulas, on page 133.

HQNH [?] [x] [y]

where:

?	=	Displays the current altitude offset for QNH calculation. You cannot use this modifier with the other modifiers.
X	=	Numeric value (altitude). Ranges: -30 … 3000 m -99… 9900 ft.
Y	=	Distance scale used. Values: m ft

ICAOQNH

The **ICAOQNH** command selects the calculation formula and rounding method used for QNH and QFE calculations.

For calculation formulas, see Appendix A, Calculation Formulas, on page 133.

ICAOQNH [?] [ON/OFF]

where:

?   = Displays the current ICAOQNH status.
ON = ICAO QNH calculation formula, QNH and QFE values rounded down to nearest integer. Only units [hPa] and [mmHg] are available for QNH and QFE.
OFF= Default QNH calculation formula, no rounding other than specified with FORM command on page 70. All pressure units for QNH and QFE are available.

NOTE	Although ICAOQNH is ON, you can use the FORM command (on page 70) to force the display of decimal places on QNH and QFE values. Because of ICAOQNH rounding, these decimal places are always filled with zeros.

Query syntax:

```
>ICAOQNH ?
ICAO QNH        : OFF
>
```

Prompt syntax:

```
>ICAOQNH
ICAO QNH        : OFF ? ON
>
```

Command line syntax:

```
>ICAOQNH OFF
ICAO QNH        : OFF
>
```

PSTAB

Use the **PSTAB command** to define the pressure stability indicator reflecting maximum allowed pressure difference between two successive averaged pressure measurements.

In addition to defining the pressure stability indicator, you must also define the FORM command to include the "OK" stability indicator field.

Adding a PSTAB element to the FORM string enables checking the stability using the serial port. The factory setting for the stability indicator level is 0.5 hPa.

PSTAB [?] [x] [y]

where:

?	=	Displays the current pressure stability indicator. You cannot use this modifier with the other modifiers.
x	=	Numeric value (pressure).
		Ranges:
		0…9999.99 (hPa)
		0…99.9999 (psi)
		0…999.999 (inHg)
		0…9999.99 (torr)
		0…9.99999 (bar)
		0…9999.99 (mbar)
		0…9999.99 (mmHg)
		0…999.999 (kPa)
		0…999999 (Pa)
		0…99999.9 (mmH_2O)
		0…9999.99 (inH_2O)
y	=	Pressure scale used.
		Values:
		hPa
		psi
		inHg
		torr
		bar
		mbar
		mmHg
		kPa
		Pa
		mmH_2O
		inH_2O

Examples:

Query syntax:

```
>PSTAB ?
P stab.          : 1.00 hPa
>
```

Prompt syntax:

```
>PSTAB
P stab.          : 0.5 psi ? 1.5 HPA
>
```

Command line syntax:

```
>PSTAB 0.5 PSI
P stab.          : 0.5 psi
>
```

The pressure stability indicator is useful as it indicates instability in the pressure measurement. The pressure instability may result from different reasons depending on the application:

- In outdoor barometric pressure measurement, high wind speeds can induce notable pressure instability.
- Building automation systems may also introduce pressure fluctuations, and for example opening the door of a room can often result in temporary pressure instability.

User Port Serial Settings

Use the commands described in this section to configure the user port serial settings.

SDELAY

With the **SDELAY** command you can set delay (response time) for the user port (RS232 or RS485), or view currently set delay value. Value corresponds to tens of milliseconds (for example, 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 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, 230400)
p = Parity (n = none, e = even, o = odd)
d = Data bits (7 or 8)
s = Stop bits (1 or 2)

Example:

```
>seri
Baud P D S     : 9600 N 8 1
>
```

You must reset the barometer to activate the new communication settings set with the **SERI** command.

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

```
>seri
Baud P D S    : 9600 N 8 1
>seri o
Baud P D S    : 9600 O 8 1
>
```

SMODE

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

SMODE [x]

where:

x   =   STOP, RUN, POLL, SEND, or PA11A

Table 16   Selection of Output Modes

Value	Description
STOP	Use STOP protocol on the User Port by default.
RUN	Use RUN protocol on the User Port by default.
POLL	Use POLL protocol on the User Port by default.
SEND	Use SEND protocol on the User Port by default.
PA11A	Use STOP protocol with fixed PA11A output message on the User Port by default (see PA11A Emulation Mode on page 139).

Selected output mode is activated after power outages.

INTV

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

INTV [xxx yyy]

where:

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

Example:

```
>intv 10 min
Output interval :  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] [y]

where:

x = ON (default) or
y = OFF

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

Example:

```
>echo off
Echo     : OFF
send
pressure = 1013.00 hPa
echo on
Echo     : ON
>
```

System Information Commands

?

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

Example:

```
>?
PTB330 / 1.01
Serial number  : A1234567
Batch number   : B8901234
Output format  : P #T P1 #T P2 #T DP12 #T QFE #RN
Adjust. date   : 2007-05-03
Adjust. info   : VAISALA
Date           : 2007-05-08
Time           : 13:42:01
Start mode     : STOP
Baud P D S     : 4800 E 7 1
Output interval: 1 s
Address        : 0
Echo           : ON
Module 1       : BARO-1
Module 2       : BARO-1
Module 3       : BARO-1
Module 4       : EMPTY
>
```

ERRS

Use the command **ERRS** to display all current device errors, unacknowledged errors, and error log contents.

An error is active if the cause for the error is still present when you execute the ERRS command. If the cause disappears, the error message changes to the unacknowledged state. An unacknowledged error is an error message that has not yet been displayed to the user.

Unacknowledged errors are automatically cleared when they are displayed with **ERRS** command or with the optional display and keypad.

NOTE	Because **ERRS** command does not display any difference between present and past errors, execute **ERRS** twice in a row to see which ones are still present (past errors are not displayed anymore on the second **ERRS** response).

Table 17   ERRS command line parameters

Value	Description
	Display currently active and past, unviewed (unacknowledged) errors.
LOG	Show error log contents.
BARO	Show detailed error information for pressure transducer errors.

Example:

```
>errs
PASS
No errors
>errs
FAIL
Error: Operating voltage out of range.
>
```

VERS

Use the command **VERS** to display software version of PTB330:

```
>VERS
MT300 / 1.13
>
```

Resetting Barometer 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 display or turn on the menu lock with a 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 while retaining access to INFO and GRAPH buttons.

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 in the device memory. 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 connection or MI70 Link Interface Software.

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 four quantities can be recorded at a time. See section Changing Quantities on page 54 for instructions on how to select the display quantities with the keypad.

DSEL

Use the serial line command **DSEL** to select the quantities to be recorded if the barometer is not equipped with display/keypad. The maximum number of recorded quantities is four (4).

DSEL [xxx]

where:

xxx =   Data recording quantities, see Table 2 on page 15.

Example:

```
>dsel p HCP
P HCP
>
```

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

NOTE	If P$_{3h}$ is selected, P is recorded instead.

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. See section Graphic History on page 51 for details about graphical display.

You can also dump the logged data to the serial line in numeric form with the commands presented below.

DIR

Use the serial line and enter the **DIR** command to list the logged data 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 24. See Table 8 on page 52.

NOTE	The timestamps provided by the DIR command are based on the **current** system date and time. In order to see correct timestamps, you must ensure that the system date and time is set to correct values with **DATE** and **TIME** commands (see section DATE and TIME on page 75) before using the **DIR** command.

Select, for example, two quantities (P and P$_1$).

Example:

```
>dir
File description          Oldest data available   No. of points
1  P latest 20 minutes         2000-01-08 03:44:30    135
2  P latest 3 hours            2000-01-08 00:44:30    135
3  P latest 1 day              2000-01-07 01:07:00    135
4  P latest 10 days            1999-12-27 22:07:00    135
5  P latest 2 months           1999-11-01 16:07:00    135
6  P latest 1 year             1998-11-29 04:07:01    135
7  P1 latest 20 minutes        2000-01-08 03:44:31    135
8  P1 latest 3 hours           2000-01-08 00:44:31    135
9  P1 latest 1 day             2000-01-07 01:07:01    135
10 P1 latest 10 days           1999-12-27 22:07:01    135
11 P1 latest 2 months          1999-11-01 16:07:01    135
12 P1 latest 1 year            1998-11-29 04:07:01    135
>
```

PLAY

Use the **PLAY** command to output the selected file to the serial line.
The command outputs trend, min, and max values from the given log.
Use the DIR command to find out what log index number corresponds
to a particular log. Data in the output is delimited with TAB
characters. 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   =   1 ... 24

Example:

```
>play 4
P latest 10 days                2000-12-20 18:31:17    135
Date        Time        trend    min      max
yyyy-mm-dd  hh:mm:ss    mbar     mbar     mbar
2000-12-21 20:31:17     974.22   972.83   975.21
2000-12-21 22:31:17     976.45   975.21   977.73
2000-12-22 00:31:17     979.29   977.69   980.94
.
.
>
```

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

You can use the **PLAY 0** command to output all files one after
another.

_____

DELETE/UNDELETE

Use the serial line to clear or restore the data files.

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

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

Operating 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 39 on page 94 for illustrative examples of the different measurement-based relay output modes.

Figure 39   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 a power outage occurs.

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

Hysteresis

The hysteresis function prevents the relay switching back and forth when the measured value is near to the setpoint values. The relay is activated when the measured value passes the exact value of the setpoint. When returning to and passing through the setpoint again, the relay is not released before the value reaches the setpoint increased/decreased by the hysteresis value, see Figure 39 on page 94. The hysteresis should be smaller than the difference of the setpoints.

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

Relay Indicating Barometer Error Status

You can set a relay to follow the operation status of the device. By selecting FAULT 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): relay released (C and NC outputs are closed).

See Figure 40 below for an illustrative example of the FAULT STATUS relay output mode.
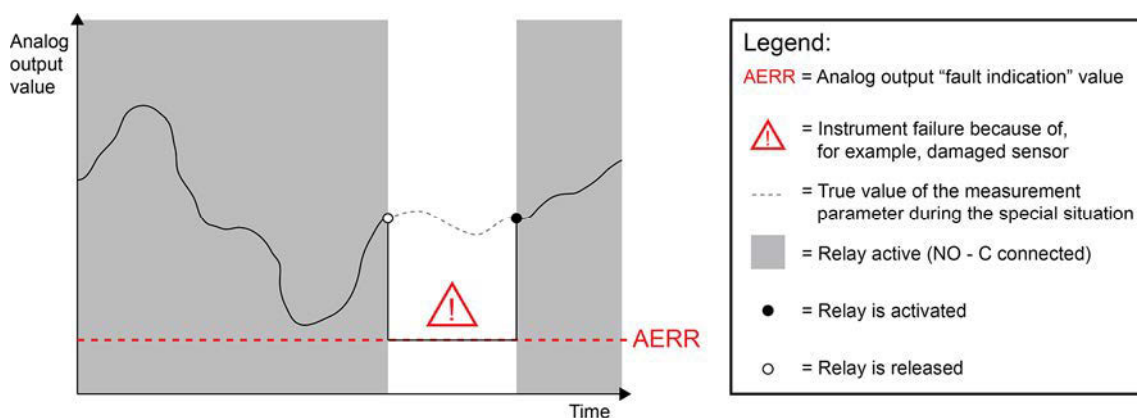
1212-004

Figure 40   FAULT STATUS Relay Output Mode

FAULT STATUS relay is usually used in conjunction with an analog output to obtain validity information for the output value.

NOTE	If a barometer 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

RSEL

Use the serial line to select the quantity, setpoints, and hysteresis or enable/disable the relay outputs. The factory setting is that all the relays are disabled. Enter the **RSEL** command.

RSEL [q1 q2...]

where:
q1   =   quantity for the relay 1 or Fault
q2   =   quantity for the relay 2 or Fault

and so on

Use the quantity abbreviations presented in Table 2 on page 15.

Example of window limit switch:

Selecting relay 1 to follow pressure measurement and relay 2 to follow measurement of pressure from barometer module 1. Two relay setpoints are set for both relays.

```
>rsel P P1
Rel1 P    below: 980.00 hPa ?
Rel1 P    above: 995.00 hPa ?
Rel1 P    hyst : 0.10 hPa ?
Rel1 P    enabl: ON ? ?
Rel1 P1   below: 1001.00 hPa ?
Rel1 P1   above: 1005.00 hPa ?
Rel1 P1   hyst : 0.10 hPa ?
Rel1 P1   enabl: ON ?
>
```

Example of normal limit switch: Selecting relay 1 to follow pressure
measurement and relay 2 to follow measurement of pressure from
barometer module 1. One setpoint is chosen for both outputs.

```
>rsel P P1
Rel1 P    below: 980.00 hPa ? -
Rel1 P    above: 995.00 hPa ? 1020
Rel1 P    hyst : 0.10 hPa ? 1
Rel1 P    enabl: ON ? ON
Rel1 P1   below: 1001.00 hPa ? -
Rel1 P1   above: 1005.00 hPa ? 1010
Rel1 P1   hyst : 0.10 hPa ? 2
Rel1 P1   enabl: ON ? ON
>
```

Example of using relay 1 as fault alarm:

Selecting relay 1 to follow the fault status and relay 2 to follow the
pressure measurement.

```
>rsel fault p
Rel1 FAUL below: -
Rel1 FAUL above: -
Rel1 FAUL hyst : -
Rel1 FAUL enabl: ON ?
Rel2 P    below: - ? -
Rel2 P    above: 1050.00 hPa ? 1050
Rel2 P    hyst : 12.00 hPa ? 10
Rel2 P    enabl: ON ? ON
>
```

Testing the Operation of Relays

If a relay module is installed on PTB330, you can use either the optional display and menus or the serial line command **RTEST** to test the operation of relays. For testing via menus see section Testing the Operation of Relays on page 61.

Testing activates relays even if they are disabled.

Use the module push buttons to activate the relays. Press the REL 1 or REL 2 button to activate the corresponding relay.

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

RTEST

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

RTEST [x1 x2]

where:

x   =   ON/OFF

Example: use the command to activate and then release the relays.

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

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

Operating RS-485 Module

RS-485 interface enables communication between RS-485 network and the barometer. 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.

NOTE	User port on the barometer 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.

You can enter the RS-485 configuration commands SERI, SMODE POLL, ADDR, SDELAY, and SCOM by using either the service port or the RS-422/485 port. You can also use the optional display/keypad. See sections Serial Interface Settings on page 57 and User Port Serial Settings on page 84.

After the network setup, you can open and close the connection to a barometer using the **OPEN** and **CLOSE** commands, respectively. You can also use the **SEND** command to output the reading once in POLL mode.

ADDR

Addresses are required only for POLL mode (see serial line command SMODE on page 85). Use the **ADDR** command to input the RS-485 barometer address.

ADDR [*aa*]

where:

aa = address (0 ... 255) (default = 0)

Example: the barometer is configured to address 99.

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

SDELAY

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

```
>sdelay
Serial delay   : 0 ? 10
>sdelay
Serial delay   : 10 ?
```

SMODE POLL

Use the **SMODE POLL** command to set the default serial interface mode to POLL. See section SMODE on page 85 for detailed information.

SCOM

Use the **SCOM** command to show or set an alias for the **SEND** command. The given alias cannot be a command already in use.

NOTE	When you use a **SCOM** alias in POLL mode, you must add the barometer address number as with a regular **SEND** command.

Example:

```
>scom meas
Send command   : meas
>send
pressure = 1013.02 hPa
>measpressure = 1013.02 hPa
>
```

OPEN

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

OPEN [*aa*]

where:

aa = address of the barometer (0 ... 255)

Example:

```
open 1
PTB330: 1 line opened for operator commands
>
```

CLOSE

Use the **CLOSE** command to switch the barometer back to the POLL mode.

Example:

```
>close
line closed
```

SEND

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

SEND [*aa*]

where:

aa = address of the barometer

Operating Analog Output

The analog outputs are set in the factory according to the order form. If you want to change the settings, follow these instructions. See section Analog Output Module on page 38.

Changing Output Mode and Range

The output channel has its own DIP switch module with 8 switches, see the position in Figure 22 on page 38 (DIP switches to select the output mode and range). To change output mode and range:

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.
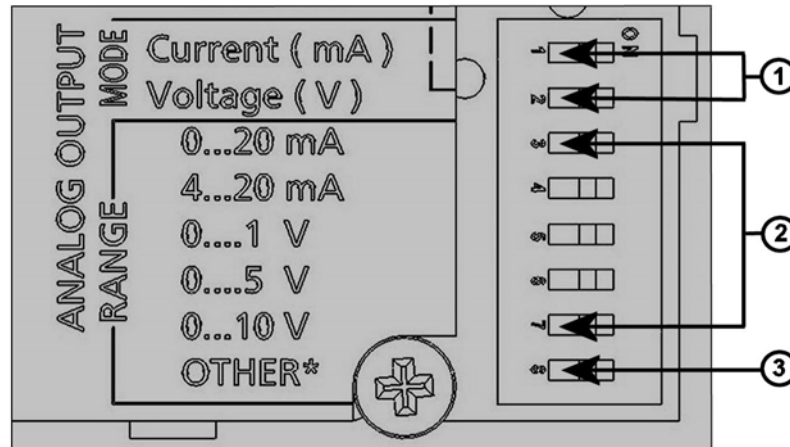
Figure 41   Current/Voltage Switches of Output Module

The number refers to Figure 41 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 = Switch 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.

The example below illustrates how to select a 0 ... 5 V voltage output.

Figure 42   Dip Switch Selection Example

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 105.

Analog Output Quantities

AMODE/ASEL

Use the serial line to select and scale the analog output quantities:

1.   Connect the barometer to the PC.

2.   Open the terminal connection between your PC and the barometer.

3.   Check the analog output modes with the AMODE command.

        Example:

```
>amode
Ch1 output      : 0...1 V
Ch1 slot        : 4
Ch1 type        : T compensated
>
```

4.   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*]

where:

xxx =   Quantity of channel 1

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

Example:

```
>asel P
Ch1 P      low  : 900.00 hPa
Ch1 P      high : 1100.00 hPa
>
```

Analog Output Tests

ATEST

Use the serial line to set the analog output test value. The output value is forced to the inputted value and held until the command is fed without parameters. The valid range of test voltage/current is the same as the analog output range.

ATEST [*x*] [*y*]

where:

x   =   volts
y   =   milliamperes

Example:

```
>atest 1.0
Ch1             :  1.000 (mA/V)   H'6644
>
```

Analog Output Fault Indication Setting

AERR

Use the serial line command **AERR** to set the analog output error value, when an error condition is active, in V or mA). The valid range (output range) for error value depends on the mode of the AOUT-1.

Example:

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

This page intentionally left blank.

CHAPTER 5
MAINTENANCE

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

Periodic Maintenance

Cleaning

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

Error States

In error state pressure 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 105.
- The serial port outputs stars (***).
- The cover LED is blinking.
- Optional display: error indicator is lit.
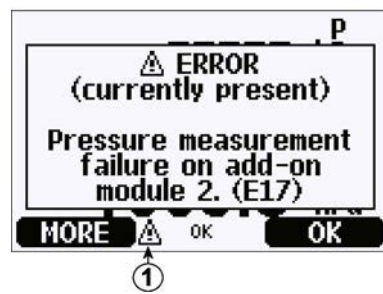
Figure 43   Error Indicator and Error Message

The number refers to Figure 43 above:

1   =   Error Indicator

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

You can also check the error message through the serial interface by using the command **ERRS**. In case of constant error, please contact Vaisala; see Technical Support and Product Returns on page 110.

Table 18   Error Messages

Error Code	Error Message	Action
E10	Internal EEPROM read error.	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E11	Internal EEPROM write error.	Internal barometer failure. Remove the barometer and return the faulty unit to Vaisala Service.
E12...E15	Add-on module 1/2/3/4 connection failure	Turn off the power and check the module connection. Turn on the power. If the module is intentionally missing, enter the **MODS** command to register the change.
E8	Device internal temperature out of range	Ensure that the operating temperature is within the valid range
E6	Operating voltage out of range	Ensure that the operating voltage is within the valid range.
E7	Internal system voltage out of range	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E20	Configuration switches for analog output set incorrectly	Check and re-set the switches of the analog output module, see section Changing Output Mode and Range on page 102.
E5	Communication module installed in incorrect add-on module slot	Disconnect the power, change the RS485-1 module to module slot 1, and enter the **MODS** command to register the change.
E28...E31	Unknown/incompatible module installed in add-on module slot 1/2/3/4)	Ensure that the module is compatible with the PTB330. When a new unregistered module is installed in the module slot, enter the **MODS** command to register the change.
E4	Pressure out of valid range	Check that the assumed pressure is within the measurement range for the barometer.
E3	Difference between pressure transducers too large	1) Check that the barometer modules are measuring the same pressure or 2) Check if one of the barometer modules is out of the valid range or 3) Check if the DPMAX value is set too low.
E16...E19	Pressure measurement failure on add-on module 1/2/3/4	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E9	Checksum error in the internal configuration memory	Internal barometer failure. Return the barometer to the Vaisala Service Center.
E24...E27	EEPROM failure on add-on module 1/2/3/4	Internal barometer failure. Return the barometer to the Vaisala Service Center.

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question

- Serial number of the product

- Name and location of the installation site

- Name and contact information of a technically competent person who can provide further information on the problem.

Product Returns

If the product must be returned for service, see www.vaisala.com/returns.

For contact information of Vaisala Service Centers, see www.vaisala.com/servicecenters.

CHAPTER 6
CALIBRATION AND ADJUSTMENT

This chapter contains instructions for performing the calibration and adjustment of the product.

The PTB330 is fully calibrated and adjusted as shipped from the factory. Calibration must be done always when there is reason to believe that the device is not within the accuracy specifications.

When defining the calibration interval, you must the local long term specifications and other requirements into consideration. Contact Vaisala Service Centers for details.

It is recommended that calibration and adjustment should be carried out by Vaisala. See sections Technical Support and Product Returns on page 110. Calibration and adjustment are carried out through the serial port or with the optional display/keypad.

Pressure

You can select a simple offset or a two-point offset and gain adjustment for the barometer module using the **LCP** command. The **MPCP** command is for the more sophisticated multipoint adjustment with up to eight pressure levels.

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

**Table 19   Adjustment and Calibration Commands for
                  Barometer Module P1**

Command	Function
LCP1 ?	Displays current linear adjustment status
LCP1 ON/OFF	Enables/Disables the linear adjustments
LCP1	Enter linear adjustments
MPCP1 ON/OFF	Enables/Disables the multipoint adjustments
MPCP1	Enters multipoint adjustments
CDATE	Shows or sets the calibration date
CTEXT	Shows or sets the calibration info text.

Opening and Closing the Adjustment Mode

Before you can proceed with the adjustment and calibration, you must open the adjustment mode by following the instructions below. The adjustment button with indicator LED is located in the upper corner on the left-hand side of the motherboard. See the position of the adjustment button in Figure 2 on page 16. To open and close the adjustment mode:

1.   Open the barometer cover.

2.   Press the **ADJ** button. The adjustment mode is now available. The red indicator LED is on.

3.   Press the **ADJ** button again to lock the adjustment mode. The red indicator LED is off.

The adjustment menu on the display/keypad is visible only when the **ADJ** button (on the motherboard inside the transmitter) is pressed.
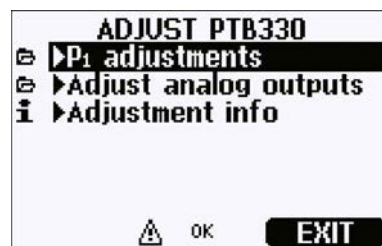
Figure 44   Adjustment Menu

Pressure Adjustment

In PTB330, the raw measured pressure value of each barometer module is first corrected using the corresponding multipoint adjustment values. The additional linear adjustment (if enabled) is applied to the corrected values. This allows you to fine-tune the pressure display using the linear adjustment without performing a complete readjustment for the barometer module, see Figure 45 below.
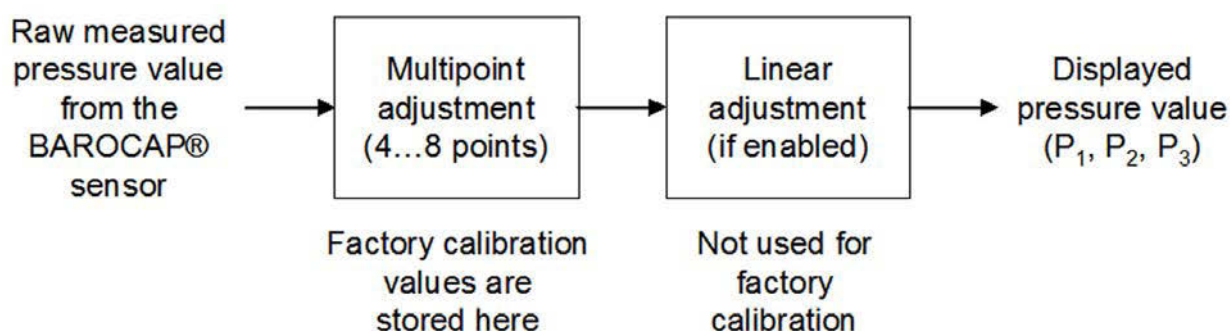
Figure 45   PTB330 Adjustments

For correct adjustment, the existing adjustment must be disabled before measuring the new adjustment data. If you are going to do only offset or linear adjustment (one to two pressure points), leave the multipoint adjustments active. If you want to perform a complete readjustment of your PTB330, disable both the multipoint and the linear adjustments, and calibrate the instrument at 2…8 pressure points. In such a case, the new adjustment values are entered to the multipoint adjustment function and the linear adjustment is not used (that is, it is left disabled).

NOTE	You can set up a 1-point offset adjustment in prevailing ambient pressure using a suitable reference instrument, such as Vaisala Barometric Pressure Transfer Standard PTB330TS.

Adjustments Using Display/Keypad

Use the display/keypad to view the active multipoint/linear adjustments:

1.   Press the **ADJ** button located on the motherboard in the upper corner on the left-hand side to open the **ADJUST PTB330** menu.

2.   Select **P1 adjustments**, press the right arrow button.

3.   Select **Multipoint/Linear adjustment.** If the corresponding adjustment is already enabled, it is marked with a check mark.

4.   If the adjustment is enabled, press the **SHOW** button to see the active adjustment values. Press **OK** to leave the adjustment active or **DISABLE** to disable the adjustment (confirm by pressing **YES**).

5.   Exit the adjustment mode by pressing **EXIT**.

To measure new adjustment values and perform the actual adjustment, first disable the corresponding adjustment on each barometer module you are going to adjust (see the procedure above). If you are going to perform a multipoint adjustment, disable also the linear adjustments. If you are going to do only a linear adjustment, leave the multipoint adjustments untouched.

NOTE	For offset adjustment, enter only one adjustment point in the linear adjustment function.

After disabling the previous adjustments, calibrate the PTB330 against your pressure reference. Make a note of the pressure reading of each PTB330 barometer module separately (quantities P_1, P_2, and P_3). Then use the display/keypad to enter and activate the new multipoint/linear adjustment factors:

1. Press the **ADJ** button located on the motherboard in the upper corner on the left-hand side to open the **ADJUST PTB330** menu.

2. Select **P1 adjustments**, press the right arrow button.

3. Select **Multipoint/Linear adjustment,** press the **SET** button.

4. Select an existing adjustment point or **Add adjustment point** and press the **SET** button to enter your new values. If asked, select **MODIFY** to replace the old values with your new ones.

5. Enter the P_1 value of the PTB330 at the **Reading** prompt using the up/down arrow buttons. Press the **OK** button.

6. Enter the corresponding pressure reference value to the **Reference** prompt using the up/down arrow buttons. Press the **OK** button.

7. Repeat steps 4…6 until you have entered all the pressure points you have.

8. To remove any excess old adjustment points, press **SET** and select **REMOVE** on each of them.

9. Once you have finished, press the **OK** button. Press the **YES** button to activate the adjustment you have configured.

10. Press the left arrow button to go back to the **ADJUST PTB330** menu and repeat steps 2…9 for each barometer module you are adjusting.

11. If necessary, go to the Adjustment Information submenu and set a new calibration date and note.

12. Exit the adjustment mode by pressing **EXIT**.

Linear/Offset Adjustment Using Serial Line

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

LCP1, LCP2, LCP3

The **LCP1** command performs offset adjustment for barometer module/module P1. The **LCP2** and **LCP3** commands do the same for modules P2 and P3. Use the commands:

- to view current linear/offset adjustments

- to activate or deactivate the linear/offset adjustment function

- to enter new offset or linear offset/gain pressure adjustments to the transmitter.

NOTE	Each barometer module has its own adjustment commands. You must enter the linear/offset adjustments for each barometer module separately.

To enter new offset (1-point) or linear (2-point) adjustments:

1. Enter the command **LCP1 ?** (and **LCP2 ?**, **LCP3 ?**, if applicable) to display current pressure adjustments.

2. Write down the current settings if you want to restore the old values later on.

3. Enter the command **LCP1 OFF** (and **LCP2 OFF**, **LCP3 OFF**, if applicable) to deactivate the previous adjustments.

4. Put PTB330 to reference pressure conditions and write down the reference and measured P_1 (P_2, P_3) values for linear offset/gain adjustment.

5.   For linear adjustment, enter the command **LCP1** (**LCP2**, **LCP3**), and enter the new adjustments when prompted. See the first example.

     For 1-point offset adjustment, enter the command **LCP1** (**LCP2**, **LCP3**), and enter the measured and reference values in the first slots, and then enter the same values increased by one in the second slots. See the second example.

6.   Enter the command **LCP1 ON** (and **LCP2 ON**, **LCP3 ON**, if applicable) to activate the new adjustments.

LCP1 [x/y] [z]

where:

x   =   ON
y   =   OFF
z   =   ?

Examples:

Linear adjustment:

```
>lcp1
1. Reading ? 981.2
1. Reference ? 980.0
2. Reading ? 1102.1
2. Reference ? 1100.0
>
```

Offset adjustment:

```
>lcp1
1. Reading ? 981.2
1. Reference ? 980.0
2. Reading ? 982.2
1. Reference ? 981.0
>
```

NOTE	The new linear/offset adjustments cancel the previous linear/offset adjustments as well as the valid date of calibration of the transmitter. A new calibration date and note can be set with the CDATE and CTEXT commands.

Multipoint Adjustment Using Serial Line

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

MPCP1, MPCP2, MPCP3

Use the **MPCP1**, **MPCP2**, and **MPCP3** commands:

- to view current multipoint adjustments for barometer module/modules P1, P2, and P3

- to activate or deactivate the multipoint adjustment function

- to enter new multipoint pressure adjustments to the transmitter.

The commands operate like **LCP1**, **LCP2**, and **LCP3**, but can take up to eight reading/reference pairs. If there are three pressure barometer modules installed, the commands **MPCP1**, **MPCP2**, and **MPCP3** are available. When changing multipoint adjustments, remember to disable all offset/linear adjustments as well.

NOTE	Each barometer module has its own adjustment commands. You must enter the multipoint adjustments for each barometer module separately.

To enter new multipoint adjustments:

1. Enter the command **MPCP1 ?** (and **MPCP2 ?**, **MPCP3 ?**, if applicable) to display current pressure adjustments.

2. Write down the current settings if you want to restore the old values later on.

3. Enter the commands **MPCP1 OFF** (and **MPCP2 OFF**, **MPCP3 OFF**, if applicable) and **LCP1 OFF** (and **LCP2 OFF**, **LCP3 OFF**, if applicable) to deactivate all adjustments.

4. Record the (up to eight points of) measurements in controlled reference pressure conditions. Make note of P_1 P_2, and P_3 separately, if applicable.

5. Enter the command **MPCP1** (and **MPCP2**, **MPCP3**, if applicable), and enter the new adjustments when prompted.

6.   Enter the command **MPCP1 ON** (and **MPCP2 ON**, **MPCP3 ON**, if applicable) to activate the new adjustments.

7.   Leave **LCP1** (and **LCP2**, **LCP3**, if applicable) in the **OFF** state after multipoint adjustment.

NOTE	The new multipoint adjustments cancel the previous adjustments as well as the valid date of calibration of the transmitter. A new calibration date and note can be set with the CDATE and CTEXT commands.

MPCP1 [x/y] [z]

where:

x   =   ON
y   =   OFF
z   =   ?

Examples:

Display current multipoint adjustments:

```
>MPCP1 ?
Multipoint adjustment: OFF
Reading                      Reference                     Correction
        800.21 hPa                  800.10 hPa                  -0.110 hPa
        850.22 hPa                  849.20 hPa                  -1.020 hPa
        901.02 hPa                  899.99 hPa                  -1.030 hPa
        949.98 hPa                  950.01 hPa                   0.030 hPa
       1000.11 hPa                 1000.10 hPa                  -0.010 hPa
       1050.12 hPa                 1050.12 hPa                   0.000 hPa
>
```

Disable MPCP1 and LCP1 adjustments:

```
>MPCP1 OFF
Multipoint adjustment: OFF
>LCP1 OFF
Linear adjustment: OFF
>
```

Enter MPCP1 adjustment data, six points:

```
>MPCP1
1. Reading ? 800.21
1. Reference ? 800.10
2. Reading ? 850.22
2. Reference ? 849.2
3. Reading ? 901.02
3. Reference ? 899.99
4. Reading ? 949.98
4. Reference ? 950.01
5. Reading ? 1000.11
5. Reference ? 1000.10
6. Reading ? 1050.12
6. Reference ? 1050.12
```
7. Reading ? (Leave empty to finish data entry.)
```
Multipoint adjustment: OFF
Reading                   Reference                   Correction
        800.21 hPa              800.10 hPa                  -0.110 hPa
        850.22 hPa              849.20 hPa                  -1.020 hPa
        901.02 hPa              899.99 hPa                  -1.030 hPa
        949.98 hPa              950.01 hPa                   0.030 hPa
       1000.11 hPa             1000.10 hPa                  -0.010 hPa
       1050.12 hPa             1050.12 hPa                   0.000 hPa
          0.00 hPa                0.00 hPa                   0.000 hPa
          0.00 hPa                0.00 hPa                   0.000 hPa
>
```

Activate MPCP1 adjustment:

```
>MPCP1 ON
Multipoint adjustment: ON
>
```

Analog Output Adjustment (Ch1)

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 PTB330 to a calibrated current/voltage meter in order to measure either current or voltage depending on the selected output type.

NOTE	Normally, analog output module 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

To adjust the analog output:

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**, press the **START** button.

4.   Measure the first analog output value with a multimeter. Give the measured value by using the arrow buttons. Press the **OK** button.

5.   Measure the second analog output value with a multimeter. Give the measured value by using the arrow buttons. Press the **OK** button.

6.   Press the **OK** button to return to the adjustment menu.

7.   Press the **EXIT** button to close the adjustment mode and to return to the basic display.

Using Serial Line

ACAL

The **ACAL** command adjusts the analog output (if an AOUT-1 module is present). Connect a multi-meter to the analog output and input measured voltage/current values.

First, press the **ADJ** button inside the motherboard to enable adjustments.

ACAL [x]

where:

x   =   1

Example:

```
>acal 1
1st value ? 0.11
2nd value ? 0.92
>
```

Feeding Adjustment Information

This information is shown on the device information fields, see section Information Display on page 53 and the ? command on page 87.

Using Display/Keypad

To feed in the adjustment information:

1.   If you are not in the adjustment menu, press the **ADJ** button on the motherboard to open the **ADJUSTMENT MENU**.

2.   Select **Adjustment info**, press the right arrow button.

3.   Select **Date**, press the **SET** button. Enter date by using the arrow buttons. Press the **OK** button.

4.   Select **i**, press the **SET** button. Enter information text including 17 characters at maximum. Use the arrow buttons. Press the **OK** button.

5.   Press the **EXIT** button to return to the basic display.

Using Serial Line

CTEXT

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

Example:

```
>ctext Vaisala/MSL
Calibration text : Vaisala/MSL
>
```

CDATE

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

```
>cdate 2006-06-12
Calibration date : 2006-06-12
>
```

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CHAPTER 7
TECHNICAL DATA

This chapter provides the technical data of the product.

Specifications

Performance

Barometric pressure range 500 ... 1100 hPa

Table 20   Barometric Pressure range 500 ... 1100 hPa at 20°C

	Class A	Class B
Linearity*	±0.05 hPa	±0.10 hPa
Hysteresis*	±0.03 hPa	±0.03 hPa
Repeatability*	±0.03 hPa	±0.03 hPa
Calibration uncertainty**	±0.07 hPa	±0.15 hPa
Accuracy at +20 °C (+68 °F)***	±0.10 hPa	±0.20 hPa

Barometric pressure range 50 ... 1100 hPa

Table 21   Barometric pressure range 50 ... 1100 hPa at 20°C

	Class B
Linearity*	±0.20 hPa
Hysteresis*	±0.08 hPa
Repeatability*	±0.08 hPa
Calibration uncertainty**	±0.15 hPa
Accuracy at ±20 °C (+68 °F)***	±0.20 hPa

Table 22   Temperature Dependence****

	Class B
500 ... 1100 hPa	±0.1 hPa
50 ... 1100 hPa	±0.3 hPa

Table 23   Total Accuracy at -40 ... +60°C (-40 ... +140 °F)

	Class A	Class B
500 ... 1100 hPa	±0.15 hPa	±0.25 hPa
50 ... 1100 hPa		±0.45 hPa

Table 24   Long Term Stability

500 ... 1100 hPa		±0.10 hPa/year
50 ... 1100 hPa		±0.20 hPa/year

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

Defined as ±2 standard deviation limits of inaccuracy 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.

Operating Environment

Table 25   Operating Environment

Pressure range	500 ... 1100 hPa, 50 ... 1100 hPa
Temperature range	
Operating without display	-40 ... +60°C (-40 ... +140 °F)
Operating with display	0 ... +60°C (-32 ... +140 °F)
Storage without display	-55 ... +80 °C (-67 ... +176 °F)
Storage with display	-40 ... +80 °C (-40 ... +176 °F)
Maximum pressure limit	5000 hPa abs.
Electromagnetic compatibility	EMC standard EN61326-1:1997+ Am1:1998 + Am2:2001: Industrial Environment

Inputs and outputs

Table 26   Inputs and outputs

General	
Supply voltage	10 ... 35 VDC
Supply voltage sensitivity	negligible
Serial I/0	RS-232C, RS-485, RS-422
Pressure units	hPa, mbar, kPa, Pa inHg, mmH$_2$O, mmHg, torr, psia
Acceleration sensitivity	negligible
Pressure connector	M5 (10-32) internal thread
Pressure fitting	barbed fitting for 1/8" I.D. tubing, quick connector with shutoff valve for 1/8" hose
Display (optional)	LCD with backlight, graphic trend display of any parameter
Menu languages	English, German, French, Finnish, Spanish, Swedish, Japanese, Russian
Power control	5 VDC to supply voltage
Power consumption @ 20 °C (Uin 24 VDC, one pressure sensor)		
	RS-232	typ 25 mA
	RS-485	typ 40 mA
	Uout	typ 25 mA
	Iout	typ 40 mA
	Display and backlight	+20 mA
Analog output (optional)		
	Current output	0 ... 20 mA, 4 ... 20 mA
	Voltage output	0 ... 1 V, 0 ... 5 V, 0 ... 10 V
Accuracy class differences		
	Class A	**Class B**
Resolution	0.01hPa	0.1 hPa
Settling time at power-up (one sensor)	4 s	3 s
Response time (one sensor)	2 s	1 s 0.2 s (fast measurement mode)
Pressure	500...1100 hPa	50...1100 hPa
Accuracy at +20 °C	±0.30 hPa	±0.40 hPa
Accuracy at -40 ... +60 °C	±0.60 hPa	±0.75 hPa

Mechanics

Table 27   Mechanics

Cable bushing	M20x1.5 For cable diameter 8...11mm/0.31..0.43"		
Conduit fitting	1/2"NPT		
Housing material	G-AlSi 10 Mg (DIN 1725)		
Housing classification	IP 65 (NEMA 4)		
User cable connector (optional)	M12 series 8- pin (male)	Option1 with plug (female) with 5m/16.4ft black cable	
		Option2 with plug (female) with screw terminals	
	D9-connector		

Technical Specifications of Optional Modules

Table 28   AC Power Supply Module

Operating voltage	100...240 VAC 50/60 Hz
Connections	Screw terminals for 0.5...2.5 mm2 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)

Table 29   Analog Output Module AOUT-1

Outputs	0...20 mA, 4...20 mA, 0...1 V, 0...5 V, 0...10 V	
Operating temperature range	-40...+60 °C (-40...+140 °F)	
Power consumption	Uout 0...1 V	max 30 mA
	Uout 0...5V/0...10V	max 30 mA
	Iout 0... 20 mA	max 60 mA
External loads	current outputs	RL< 500 ohms
Max load + cable loop resistance	540 ohms	
	0....1 V	RL> 2000 ohms
	0...5 V and 0... 10 V	RL> 10 000 ohms
Storage temperature range	-55...+80 °C (-67...+176 °F)	
3-pole screw terminal		
Max wire size	1.5 mm^2 (AWG16)	

Table 30   Relay Module

Operating temperature range	-40...+60 °C (-40...+140 °F	
Operating pressure range	500...1300 mmHg	
Power consumption @24 V	max 30 mA	
Contacts SPDT (change over), for example,		
Contact arrangement Form C		
	Imax	0.5 A 30 VDC
Safety standard for the relay component	IEC60950 UL1950	
Storage temperature range	-55...+80 °C (-67...+176 °F)	
3-pole screw terminal / relay		
Max wire size	2.5 mm^2 (AWG14)	

Table 31   RS-422/RS-485 Module RS485-1

Operating temperature range	-40...+60 °C (-40...+140 °F)	
Operating modes	2-wire (1-pair + common) half duplex	
	4-wire (2-pair + common) 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 °C (-67...+176 °F)	
Max wire size	1.5 mm^2 (AWG16)	

Options and Accessories

Table 32   Options and Accessories

Description	Item Code
MODULES	
Relay module	RELAY-1L
T-compensated analog output module	AOUT-1T
Isolated RS485 module	RS485-1
Power Supply module	POWER-1
AC-adapters for devices already equipped with an external AC-adapter connector	
AC-adapter	MI70EUROADAPTER
AC-adapter	MI70USADAPTER
AC-adapter	MI70UKADAPTER
AC-adapter	MI70AUSDAPTER
Static pressure head	SPH10
Static pressure head with heating	SPH20
BAROMETER MOUNTING ACCESSORIES	
Wall Mounting Kit	214829
Installation Kit for Pole or Pipeline	215108
Outdoor installation kit (weather shield)	215109
DIN Rail Clips with Installation Plate	215094
Panel Mounting Frame	216038
CONNECTION CABLES	
Serial Interface Cable	19446ZZ
USB-RJ45 serial connection cable	219685
MI70 connection cable	211339
OUTPUT CABLES FOR 8-PIN CONNECTOR	
Connection Cable 5m with 8-pin M12 Female, Black	212142
Female Connector 8-pin M12 with Screw Terminals	212416
CABLE BUSHINGS	
PTB330/220/PTU200 DC and RS232 cable for PC	213019
PTB330/PTB220/PTU200 DC cable	213026
WINDOWS SOFTWARE	
Software interface kit	215005

Dimensions (in mm)
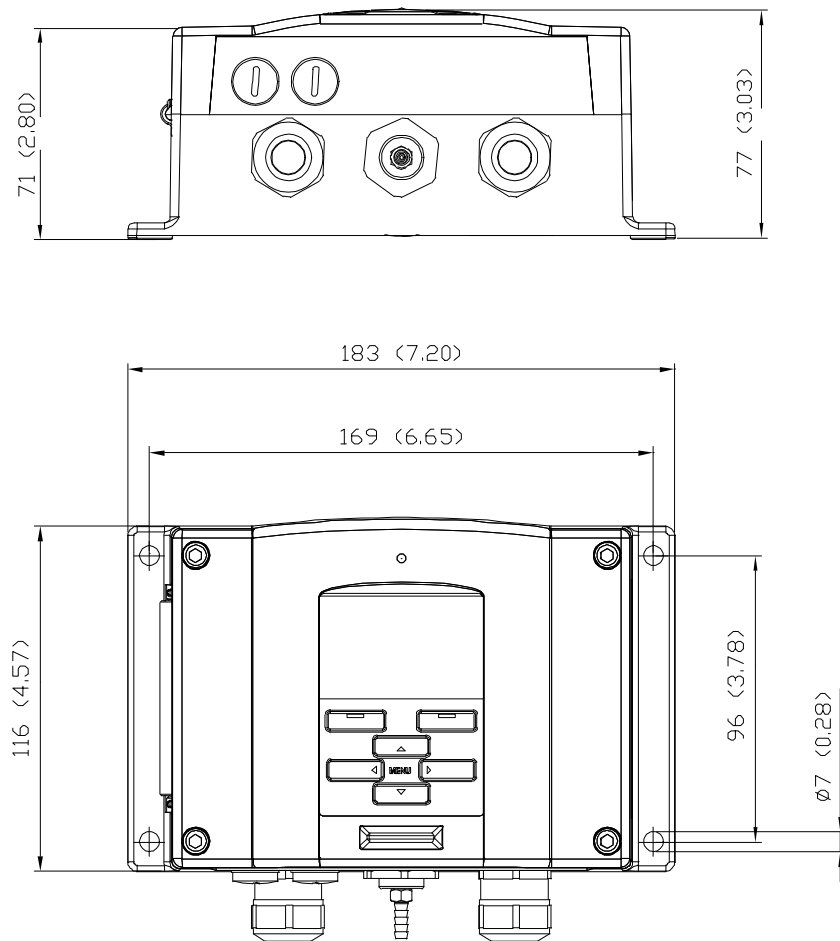
Figure 46   **Barometer Body Dimensions**

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APPENDIX A
CALCULATION FORMULAS

This appendix contains the calculation formulas used by the product.

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

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

where:

p   =   measured air pressure [hPa]
h_{QFE} =   height difference between the barometer and reference level [m]
g   =   9.81 [m/s2]
R   =   287 [J/kg/K]
T   =   temperature [K]

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

where:

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

$$HCP = p + 0.1176 \cdot h_{HCP} \qquad (3)$$

where:

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

ICAOQNH Mode for QNH and QFE

$$H = 44330.77 - 11880.32 \cdot QFE^{0.190263}$$

$$QNH = 1013.25 \cdot \left(1.0 - \frac{0.0065 \cdot (H - h_{QNH})}{288.15} \right)^{5.25588}$$

NOTE	QNH and QFE values are rounded down to the next whole number in ICAOQNH mode.

Table 33   **Symbols used in QNH calculation formulas**

Symbol	Description
QNH	Resulting value of QNH in [hPa] (before any rounding).
QFE	Current value of QFE in [hPa].
h_{QNH}	Value of HQNH setting (on page 80) in meters.

APPENDIX B
UNIT CONVERSION TABLES

This appendix contains the unit conversion tables.

Multiplication factors   Note: conversions for mmHg and inHg are defined at 0°C temperature and for mmH2O and inH2O at 4°C temperature.

	FROM									psia = psi absolute
	hPa mbar	Pa N/m2	mmHg torr	inHg	mmH2O	inH2O*	atm*	at*	bar	psia
TO hPa mbar	1	0.01	1.333224	33.86388	0.09806650	2.490889	1013.25	980.665	1000	68.94757
Pa Nm2	100	1	133.3224	3386.388	9.806650	249.0889	101325	98066.5	100000	6894.757
mmHg torr	0.7500617	0.0075006	1	25.40000	0.07355592	1.8683	760	735.559	750.0617	51.71493
inHg	0.02952999	0.00029530	0.03937008	1	0.002895903	0.073556	29.921	28.959	29.52999	2.036021
mmH2O	10.19716	0.1019716	13.59510	345.3155	1	25.40000	10332.3	10000	10197.16	703.0696
inH2O*	0.40147	0.0040147	0.53525	13.596	0.039372	1	406.79	393.71	401.463	27.6799
atm*	0.00098692	0.000009869	0.00131579	0.033422	0.000096788	0.0024583	1	0.967841	0.98692	0.068046
at*	0.0010197	0.00001020	0.0013595	0.034532	0.0001	0.0025399	1.03323	1	1.01972	0.070307
bar	0.001	0.00001	0.001333224	0.03386388	0.00009807	0.0024909	1.01325	0.980665	1	0.06894757
psia	0.01450377	0.00014504	0.01933678	0.4911541	0.001422334	0.036127	14.6962	14.2233	14.50377	1

Example   1013.25 hPa/mbar = 1013.25 x 0.02952999 inHg = 29.9213 inHg

Figure 47   Pressure Conversion Chart

* A unit not available on PTB330.

The device supports several different units for quantities. The following tables show the gain and offset values used for unit conversions.

Table 34 **Unit Conversion Table for all Pressure Quantities (Excluding ΔP$_{xx}$ and P$_{3h}$)**

Unit	Gain	Offset	Min...Max
hPa	1	0	0 ... 9999
psi	0.01450377	0	0 ... 99.9999
inHg	0.02952999	0	0 ... 99.9999
torr	0.7500617	0	0 ... 999.999
bar	0.001	0	0 ... 9.99999
mbar	1	0	0 ... 9999.99
mmHg	0.7500617	0	0 ... 999.999
kPa	0.1	0	0 ... 999.999
Pa	100	0	0 ... 999999
mmH$_2$O	10.19716	0	0 ... 99999.9
inH$_2$O	0.40147	0	0 ... 999.999

Table 35 **Unit Conversion Table for Difference Pressure ΔP$_{xx}$ and Pressure Trend P$_{3h}$ Quantities**

Unit	Gain	Offset	Min...Max
hPa	1	0	-9999.99 ... 9999.99
psi	0.01450377	0	-99.9999 ... 99.9999
inHg	0.02952999	0	-99.999 ... 99.999
torr	0.7500617	0	-9999.99 ... 9999.99
bar	0.001	0	-9.99999 ... 9.99999
mbar	1	0	-9999.99 ... 9999.99
mmHg	0.7500617	0	-9999.99 ... 9999.99
kPa	0.1	0	-999.999 ... 999.999
Pa	100	0	-999999 ... 999999
mmH$_2$O	10.19716	0	-99999.9 ... 99999.9
inH$_2$O	0.40147	0	-9999.99 ... 9999.99

Table 36 **Unit Conversion Table for Settings Pressure Stability PSTAB and Maximum Pressure Difference ΔPMAX**

Unit	Gain	Offset	Min...Max
hPa	1	0	0 ... 99.99
psi	0.01450377	0	0 ... 9.9999
inHg	0.02952999	0	0 ... 9.9999
torr	0.7500617	0	0 ... 99.999
bar	0.001	0	0 ... 0.09999
mbar	1	0	0 ... 99.99
mmHg	0.7500617	0	0 ... 99.99
kPa	0.1	0	0 ... 9.999
Pa	100	0	0 ... 9999
mmH$_2$O	10.19716	0	0 ... 9999.9
inH$_2$O	0.40147	0	0 ... 99.99

Table 37   Unit Conversion Table for Settings HHCP and HQFE

Unit	Gain	Offset	Min...Max
m	1	0	-30 ... 30
ft.	3.28084	0	-99 ... 99

Table 38   Unit Conversion Table for Settings HQNH

Unit	Gain	Offset	Min...Max
m	1	0	-30 ... 3000
ft.	3.28084	0	-99 ... 9900

Table 39   Unit Conversion Table for Setting TQFE

Unit	Gain	Offset	Min...Max
°C	1	0	-80 ... 200
°F	1.8	32	-110 ... 390
K	1.0	-273.15	190 ... 470

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APPENDIX C
PA11A EMULATION MODE

This appendix describes the PA11A emulation mode of the PTB330 series.

The PTB330 series digital barometers have an emulation mode that allows them to partially emulate the PA11A barometer. In the emulation mode, the PTB330 series can automatically output PA11A type of messages.

The PA11A emulation mode requires a PTB330 that is equipped with three barometer modules.

Activating the PA11A Emulation Mode

To activate the emulation mode, use the command **SMODE PA11A** on the serial line to set the start mode of the transmitter to PA11A. Then reset the transmitter with the **RESET** command:

```
>smode pa11a
Start mode     : PA11A
>reset
```

After start-up, the barometer outputs messages in the PA11A format. You can start the automatic message output with the command **R**, and stop it with the command **S**. Use the **SEND** command to output a single measurement message.

To disable the emulation mode, set a different mode using the SMODE command (for example **SMODE STOP**), and reset the transmitter.

PA11A Message Format

Message type 1 format is as follows:

\<sp\>P1\<sp\>P2\<sp\>P3\<sp\>status\<sp\>average\<sp\>trend\<cr\>\<lf\>

where:

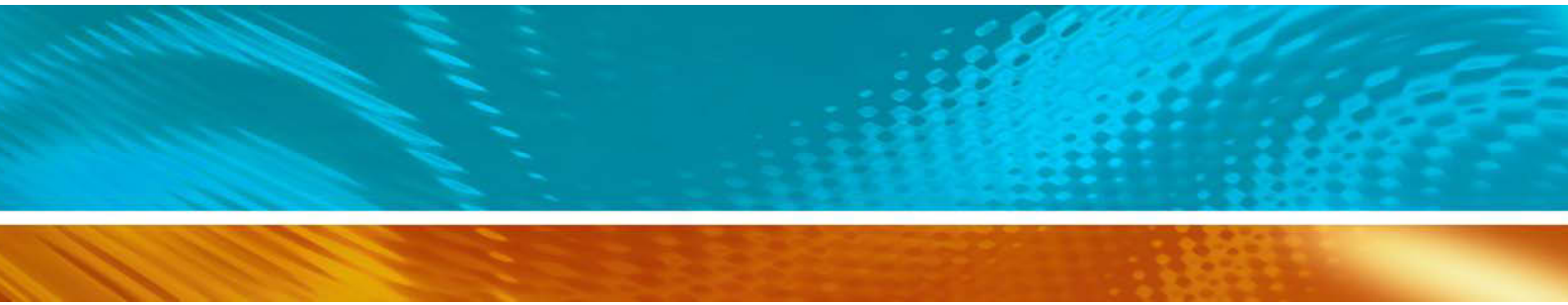|		
\<sp\>	=	Space character
P1	=	Pressure output from transducer 1 (in 0.1 hPa). The reading is written with 5 characters. If the transducer has a fault or has been switched off, the reading is replaced with error status /////.
P2	=	Pressure output from transducer 2, same format as P1
P3	=	Pressure output from transducer 3, same format as P1
status	=	Status of the average pressure measurement (binary, with 8 characters). 10000000 means OK with all three transducers included. Otherwise, the last three bits of the status indicate the transducers that are included when calculating the average. For example, status 00000110 means that transducers 2 and 3 are included and transducer 1 is ignored.
average	=	Average pressure (with 5 characters) based on three consequent measurements of each transducer included, i.e. pressure average over approx. one minute. If the average pressure cannot be calculated, the reading is replaced with error status /////.
trend	=	Three hour pressure trend (with 3 characters). Falling trend is indicated with a minus "-" character before the reading. If the data is not available (when measurement has been running for less than three hours), the reading is replaced with ///.
\<cr\>\<lf\>	=	Carriage return and line feed characters

NOTE	All pressure readings are in 0.1 hPa. The pressure unit selection has no effect. If a reading is shorter than the amount of characters reserved for it, it is left-padded with space characters. See the examples below.

Output examples:

- Pressure is 1014.4 hPa and three-hour trend is +0.8 hPa:

- `10145 10144 10144 10000000 10144    8`

- Pressure is 989.1 hPa, the three-hour trend is not available yet:

- `9891  9890  9892 10000000  9891 ///`

- Pressure is 1008.4 hPa, output from transducer 2 is ignored, and the three-hour trend is not available yet:

- `10084 ///// 10084 00000101 10084 ///`

- Pressure is 1013.4 hPa and the three-hour trend is -0.4 hPa:

- `10134 10134 10134 10000000 10134  -4`

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