ROTRONIC MANUAL

# PCD DIGITAL

# Differential pressure probe



rotronic
MEASUREMENT SOLUTIONS

# Contents

### Scope:

This manual is applicable to the PCD probe series with firmware version V1.0. The low-order digit of the firmware version stands for minor changes, e.g. correction of errors that do not influence the main functionality of the device.

# 1 Overview

The PCD probe series is developed for use with all RMS data loggers. Compatible from firmware version RMS-LOG-868 (≥V1.5) and RMS-LOG-L (≥V1.4).

The PCD can be operated independently using the RTU-Modbus protocol, for example for integration into OEM applications. The following functions are available via the digital interface:

- Read out serial number
- Read out measurement value

## 1.1 *Hardware and software compatibility*

The PCD is compatible only with RMS-generation devices. To change the PCD device configuration, the RMS-CONFIG software (≥V1.1.0) is required.

# 2 Variants

The PCD comes in two variants.

**Variant 1:** Thermal mass flow measurement principle (order code: PCD-S-Fxx)

In this measurement technique, a heating element is placed between two temperature sensitive resistors. Due to a gas flow, the temperature profile is moved towards one of the resistors, which can be measured and evaluated.

Sensor features:

- Zero point compensation integrated (every measurement interval).
- Temperature compensation integrated.
- Ambient pressure compensation (pressure sensor within the probe).

**Variant 2:** Membrane measurement principle (order code: PCD-S-Mxx)

In this measurement technique, the pressure is converted into a force, which stretches a diaphragm and is measured by a piezo-resistive MEMS membrane sensor.

Sensor features:

- A zero point compensation is necessary after the installation and initial operation. (See chapter 5 - the Installation and initial operation)
- Temperature compensation integrated.
- Ambient pressure compensation not necessary for this measurement principle.

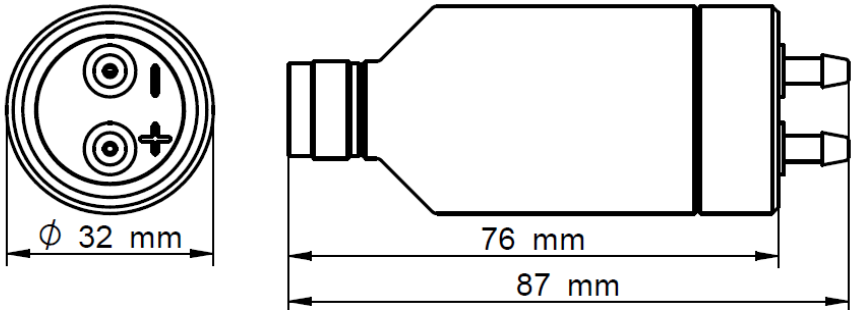
The PCD can be connected also directly to a PC using an AC3001 / AC3001-XD cable.

Further accessories can be found in the **E-M-HC2-accessories** manual.

| **More details** | | |
| --- | --- | --- |
| PCD-S-Fxx | Sensor: | Thermal mass flow |
| | Leak rate: | <180 µl/min |
| | Accuracy[1]: | ±1% full scale |
| | Long term stability: | 0.1% full scale /year |
| | Zero point compensation[2]: | Automatic (1 x per measurement interval) |
| | Temperature compensation: | Yes |
| | Ambient pressure compensation: | Automatic |
| | Pressure resistance: | 5 bar (Burst pressure) |

[1] Incl. reproducibility, hysteresis error, non-linearity and position sensitivity; at 23°C ±3K ambient temperature

[2] For detailed considerations, please see chapter 4.1 Function overview.

| | | |
| --- | --- | --- |
| PCD-S-Mxx | Sensor: | Membrane |
| | Leak rate: | 0 µl/min |
| | Accuracy[3]: | ±1% full scale |
| | Long term stability[4]: | ±2% FSS/year for ±25Pa probe |
| | | ±1% FSS/year for ±50Pa probe |
| | | ±0.5% FSS/year for ±100Pa probe |
| | | ±0.25% FSS/year for ±250Pa and ±500Pa probes |
| | Zero point compensation[5]: | Manual |
| | Temperature compensation: | Yes |
| | Ambient pressure compensation: | Not necessary |
| | Pressure resistance: | 0.7 bar (Burst pressure) |
| All | Range of application pressure: | ±25/50/100/250/500Pa |
| | Range of application temperature: | -20…80°C |
| | Range of application humidity: | 0…95%rh (non condensing) |
| | Diameter: | 32 mm |
| | Length: | 87 mm |
| | Housing material: | Polycarbonate, anthracite |
| | Weight: | 60g |
| Dimension |  | |

[3] Incl. reproducibility, hysteresis error, non-linearity and position sensitivity; at 23°C ±3K ambient temperature and directly after a zero point compensation

[4] Highly reducible by a zero point compensation

[5] For detailed considerations, please see chapter 4.1 Function overview.

# 3 General information

## 3.1 *Power supply*

The clip is created to be used directly connected to and powered by a RMS LAN or RF Logger.
Alternatively an AC3001 / AC3001-XD (3.3V or 5.5V) can be used to connect the probe to a PC.

## 3.2 *Measured parameters*

The PCD measures differential pressure.

## 3.3 *Digital interface*

The PCD probe has an UART interface for communication using the RTU Modbus protocol. The logic level is 2.5V.

## 3.4 *RMS Config*

This SW tool is used for configuration, customer adjustment and measurement using the probe out of the RMS SW.
The following information and function are available:

- Probe information: serial number, probe address, FW version and FW update
- Read out measurements
- Probe settings: Filter and simulator function
- Adjustment

## 3.5 *Communication protocol*

The probe can be addressed directly using the MODBUS RTU protocol, to request the measured CO2 values.
The parameters highlighted in yellow should be selected according to the table below.
Baud rate: 19’200 8N1

### 3.5.1 Request

| Probe address | Command ID | | Start address of device data | | Number of data | MODBUS-CRC |
| --- | --- | --- | --- | --- | --- | --- |
| 0x01 | 0x04 | 0x00 | 0x00 | 0x00 | 0x00 | 0x0000 |

**Probe address**: 0…255, default at ‘1’

**Device data:**

| Device Data | | Byte |
| --- | --- | --- |
| Start Address | Data Bytes | |
| 0x00<br>Quantity <=3 | Serial No. [3] | [3] |
| | Serial No. [2] | [2] |
| 0x01<br>Quantity <= 2 | Serial No. [1] | [1] |
| | Serial No. [0] | [0] |
| 0x02<br>Quantity 1 | Diff. Pressure [1] | [1] |
| | Diff. Pressure [0] | [0] |

**CRC**: CRC 16bit (MODBUS)

**Example request (hexadecimal)**: 01 04 00 00 00 03 B0 0B
01 → Probe address
04 → Command ID
00 → not used
00 → start address of device data
00 → not used
03 → number of data
B0 → CRC 16bit Modbus (LSB)
0B → CRC 16bit Modbus (MSB)

### 3.5.2 Response

| Probe address | Command ID | Number of data bytes | Data (6 bytes) | CRC 16 bit MODBUS |
| --- | --- | --- | --- | --- |
| 0x01 | 0x04 | 0x00 | 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 | 0x00, 0x00 |

**Serial number:** 4 byte int32

**Differential pressure:** 2 byte int16

| | | |
| --- | --- | --- |
| Range of the probe | +/-25, +/-50, +/-100, +/-250Pa | +/-500Pa |
| Differential pressure value -> positive range | = value / 100 | = value / 50 |
| Differential pressure value -> negative range | = -1 x ((65535 - value + 1) / 100) | = -1 x ((65535 - value + 1) / 50) |

*Indication:*

If the value of the differential pressure data > 0x7FFF → Diff pressure is neg.

If the value of the differential pressure data <= 0x7FFF → Diff pressure is pos.

**Example response (hexadecimal) to the request above**: 01 04 06 00 7A 73 F0 07 D0 A0 42

01 → Probe address

04 → Command ID

06 → number of data [bytes]

00 → serial number [byte 3] (MSB)

7A → serial number [byte 2]

73 → serial number [byte 1]

F0 → serial number [byte 0] (LSB)

07 → differential pressure [byte 1]

D0 → differential pressure [byte 0]

A0 → CRC 16bit Modbus (LSB)

42 → CRC 16bit Modbus (MSB)

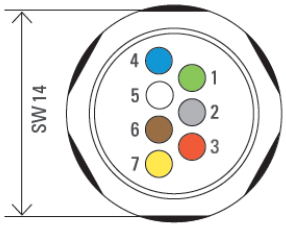
Serial number of the example: 0x00 7A 73 F0 → 8025072

Differential pressure of the example: 0x07 D0 → 2000 → +20Pa (range of probe is e. g. +/-50Pa)

## 3.6 *Connector*

All PCD probes use the same connector (male).

**Connection diagram (7-pin connector, male – view: probe side)**

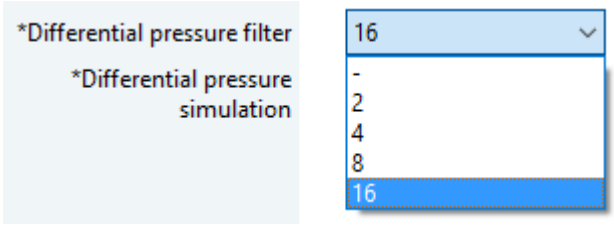



1) V+
2) GND
3) UART RxD (Logic level 2.5V)
4) UART TxD (Logic level 2.5V)
5) UART TxD_EN (Logic level 2.5V)
6) –
7) GND

# 4 User settings

## 4.1 *Function overview*

| Calibration | |
| --- | --- |
| **Functions** | **Description** |
| ► Differential pressure adjustment | **Differential pressure adjustment by the customer**<br><br>A pressure adjustment can be done by the customer. The following options are available:<br>o Acquisition of 1 to 9-point differential pressure reference points<br>o Zero point compensation – see below<br>o Reset to the factory adjustment.<br><br>*Attention*:<br>o A new adjustment or a reset to the factory adjustment cause a loss of any customer adjustment before.<br>o The customer should take care that the differential pressure applied at the probe and the reference is stable before acquisition. Please take into account, that short time variations of the measured differential pressure values of the reference and the probe within standard measurement interval could influence the accuracy of the acquired data and the whole adjustment process. Therefore the data acquisition of the reference and the probe values need to be done in real time to each other. For that reason the RMS Config SW and an AC3001-XD cable (USB adapter to a PC) is recommended for an adjustment setup and process.<br><br>**Zero point compensation (PCD-S-Mxx):**<br>For the probes with membrane sensor (PCD-S-Mxx), the zero point compensation is realized doing a 1-point adjustment with a reference value of 0Pa using a short pipe connected directly between '+' and '-'.<br>It compensates a constant deviation (offset over the complete range) caused by sensor drift or system deviations.<br>For maximum accuracy, Rotronic recommends strongly to perform a zero point compensation after the installation and initial operation and to repeat it annually. For aggressive environments / gas media a more frequent zero point compensation advised.<br>The RMS SW or the RMS Config SW is to be used for the zero point compensation. Please acquire only one reference value (0Pa) and adjust. For more information – see the related SW manuals.<br><br>**Zero point compensation (PCD-S-Fxx):**<br>The probes with the flow-based sensors (PCD-S-Fxx), the zero point compensation is integrated automatically at the sensor, see above - chapter 2. |

| | |
| --- | --- |
| ► Simulator mode | The measured differential pressure value of the probe can be replaced by a fixed value for setup reason of the RMS system. In this case, the value is marked as a “Simulator” as the RMS SW. |
| ► Filter | The differential pressure probe has a low pass filter included to reduce noise on the measured value. Possible values are 0, 2, 4, 8, 16 (default).<br>The value represents the number of measurements, which create the basis for the measurement filter (average calculation).<br>This measurement and its average calculation is done in less than 100 milliseconds and within every measurement interval. Due to the fast measurement, we advise to use the maximum filter of 16 (standard).<br>The settings can only be configured via the RMS-CONFIG SW and the AC3001 cable.<br>  |

## 4.2 *Factory defaults*

| Configurable settings | Factory default |
| --- | --- |
| Unit of measurement (metric/English) | Pa |
| Psychrometric calculation | None |
| Communication protocol | MODBUS RTU |
| MODBUS address | 1 |

| Functions | Factory default |
| --- | --- |
| Differential pressure adjustment | Factory adjustment: 5 points -1x; -0.5x; 0, +0.5x; +1x measurement range). |
| Differential pressure measurement | 1s |
| Differential pressure filter | Filter enabled at 16 |
| Differential pressure simulator | Disabled |

# 5 Installation and initial operation

Zero point compensation PCD-S-Mxx:

- For maximum accuracy, Rotronic recommends strongly to perform a zero point compensation after the installation and initial operation, see above – chapter 4.1

Differential pressure connectors:

- Typically pipes of 4mm internal diameter are used.

# 6 Electrical installation

If necessary, please use Rotronic extension cables. These allow a maximum length of 5 m.

# 7 Maintenance

## 7.1 *Zero point compensation for PCD-S-Mxx*

For maximum accuracy, Rotronic recommends strongly to perform a zero point compensation after the installation and initial operation and to repeat it annually. For aggressive environments / gas media a more frequent zero point compensation is advised. – See chapter 4.1

# 8 Firmware update

Any FW updates are available at the download area of the ROTRONIC website.

For a FW update,

- the PCD probe need to be connect to a PC using an AC3001-XD cable (see **E-M-HC2-accessories**)
- and the FW update is to be done using the RMS-CONFIG SW.

# 9 Technical specifications

| General | |
| --- | --- |
| Device type | Differential pressure probe |
| Range of application | -20…+80°C / 0…95%RH non condensing<br>(temperature compensation from 0…70°C) |
| IP protection | IP65 |

| Power supply / connection | | |
| --- | --- | --- |
| Sensor | Mass flow | Membrane |
| Power supply (VDD) | 3.3…5.5 VDC | |
| Current consumption | 30mA | 12mA |
| Polarity protection | Mechanical protection | |
| Battery life<br>RMS wireless logger | 60 days with a 10s measurement interval<br>350 days with a 60s measurement interval | 130 days with a 10s measurement interval<br>650 days with a 60s measurement interval |
| Battery life<br>LAN logger | 70 days with a 10 measurement interval<br>395 days with a 60 measurement interval | 180 days with a 10 measurement interval<br>840 days with a 60 measurement interval |

| Differential pressure measurement | | |
| --- | --- | --- |
| Sensor | Mass flow | Membrane |
| Parameter | Differential pressure | |
| Measurement range | ±25, ±50, ±100, ±250, ±500Pa | |
| Resolution | 1 ppm | |
| Accuracy | ±1% Full scale[6] | ±1% Full scale[7] |
| Long term stability[8] | 0.1% full scale /year | ±2% FSS/year for ±25Pa probe<br>±1% FSS/year for ±50Pa probe<br>±0.5% FSS/year for ±100Pa probe<br>±0.25% FSS/year for ±250Pa and ±500Pa |
| Medium | Air | Air and non-aggressive gases |
| Zero point compensation[9] | Automatic (1 x per measurement interval) | Manual |
| Pressure resistance | 5 bar | 0.7 bar |
| Leak rate | <180µl/min | N/A |

[6] Incl. reproducibility, hysteresis error, non-linearity and position sensitivity; at 23°C ±3K ambient temperature

[7] Incl. reproducibility, hysteresis error, non-linearity and position sensitivity; at 23°C ±3K ambient temperature and directly after a zero point compensation

[8] Highly reducible by a zero point compensation of the PCD-S-Mxx (membrane version)

[9] For detailed considerations, please see chapter 4.1 Function overview.

| Start time / measurement interval | |
| --- | --- |
| Startup time | <0.5 s |
| Measurement interval | >10 s |
| Response time T63 | <1 s |

| Digital interface | |
| --- | --- |
| Type | UART |
| Protocol | MODBUS |
| Factory default | Baud rate 19200, tolerance 2 %<br>Parity: none<br>Data bits: 8<br>Stop bits: 1<br>Flow control: none |
| Logic levels | Logic 0: ≤0.4 V<br>Logic 1: ≥2…2.5 V |
| Maximum cable length | 5 m |

| General specifications | |
| --- | --- |
| Housing material | Polycarbonate (housing) |
| Thumb-screw material | Stainless steel, DIN 1.4305 |
| Weight | 60g |
| Dimensions | Ø32mm x 87mm |
| Pressure connections | Tubing connector for tubes with internal Ø4mm |

| Conformity | |
| --- | --- |
| CE / EMC | EMC Directive: 2014/30/EU<br>EN 61000-6-1:2007<br>EN 61000-6-2:2005<br>EN 61000-6-3:2007+A1:2011+AC:2012<br>EN 61000-6-4:2007+A1:2011<br>EN 61326-1: 2013<br>Performance criterion: www.rotronic.com |
| Fire protection class | Corresponds to UL94-V2 |
| Soldering | Lead free (RoHS Directive 2011/65/EU) |
| FDA/GAMP guidance | Compatible |

| Accepted environmental conditions | |
| --- | --- |
| Storage/transportation | -20…80°C / 0…95%RH, non-condensing |
| Range of application electronics | -20…80°C / 0…95%RH, non-condensing |

# 10 Accessories

All accessories for the PCD probe such as extension cables, adapters, calibration material etc. are listed in the manual **E-M-HC2-accessories.**

# 11 Additional documents

| Document name | Contents |
| --- | --- |
| **E-M-HC2-accessories** | Accessory parts for probes and transmitters |

# 12 Document version

| Version | Date | Remarks |
| --- | --- | --- |
| V1_0 | March 2018 | First version |
| V1_1 | August 2018 | Sec. version<br>Add some details about zero point compensation |