Operation and installation manual

PC 400

Particle counter for compressed air and gases



1 Preamble

Dear customer,

Thank you for deciding in favor of PC 400. Please read these operating and installation instructions carefully before mounting and starting up the device and follow our directions. Perfect functioning and thus safe operation of PC 400 can only be guaranteed when the provisions and notes stipulated here are strictly adhered to.

CS INSTRUMENTS GmbH & Co. KG

OneTemp supplies and supports CS Instruments products in Australia and New Zealand. For help with selection, setup, calibration or service, contact our team.

OneTemp pty ltd
measure | control | record
1300 768 887
onetemp.com.au

2 Contents

1 Preamble 2
2 Contents 3
3 Safety advice 4
4 General product information 6
5 Intended use 6
5.1 Important notes 6
6 Service 6
7 Principles of functioning 7
8 Technical data 7
9 Identification 7
9.1 Name plate 7
10 Scope of delivery 8
11 Initiation 8
11.1 Voltage supply 8
11.2 Connection to the compressed air system (gas supply system) 8
11.2.1 Zero test 8
11.3 Measurement procedure 9
11.4 Status display 10
12 Connection of the RS 485 interface 11
12.1 Connection of the RS 485 interface to a DS 500 11
12.2 Connection of the RS 485 interface to a DS 400 11
12.3 Modbus Interface Standard-Settings (Factory settings) 12
12.4 Registertable Device version 0,1µm 12
12.5 Registertable Device version 0,3µm 13
13 Analogue Output 4...20mA (Optional) 14
14 Operation of the particle counter with the chart recorder DS 500 15
15 Operation of the particle counter with the multifunction measuring instrument DS 400 16
16 Operation of the particle counter PC 400 with a DS 500 mobile in the mobile unit for measurement of compressed air quality according to ISO 8573 – residual oil – particles – moisture 17

3 Safety advice



Please check whether or not these instructions correspond to the device type.

Please adhere to all advice given in these operating instructions. They include basic information which needs to be observed during installation, operation and maintenance. Therefore, it is vital for the technician and the responsible operator/skilled personnel to read these operating instructions prior to installation, start-up and maintenance.

The operating instructions must be accessible at all times at the place of application of PC 400.

In addition to these operating instructions, local and national regulations need to be observed where required.

If you have any queries regarding these instructions, please contact CS Instruments GmbH.



Danger!

Supply voltage!

Contact with non-insulated parts carrying supply voltage involves the risk of an electric shock resulting in injuries and death.

Measures:

- Observe all regulations in effect during electrical installation (e. g. VDE 0100)!
- **Carry out maintenance works only when the device is de-energized!**
- Any electrical works must only be carried out by authorized and skilled personnel.



Danger!

Inadmissible operating parameters!

Under-running or exceeding the limit values involves risks for persons and the material and malfunction and service failures may occur.

Measures:

- Make sure that PC 400 is operated only within the permissible limit values indicated on the type plate.
- Exact compliance with the performance data of PC 400 in connection with the case of application.
- Do not exceed the permissible storage and transport temperature.

Further important safety advice

- During installation and operation, the national regulations and safety instructions in force also need to be observed.
- PC 400 must not be employed in hazardous areas.

Additional advice:

- Do not overheat the device!



Caution!

Malfunction in PC 400

Through incorrect installation and poor maintenance, a malfunction may occur in PC 400, which may affect the measuring results and lead to misinterpretations.

The device may only be opened by authorised, trained service personnel!

Safety advice

The device does not contain any components that can be serviced by the user. All repair and maintenance work must be undertaken by an appropriately qualified service technician, authorised by the manufacturer. All information in this user manual relating to such work is intended for qualified technicians, authorised by the manufacturer.

!!! Laser radiation !!!



Corresponds to IEC 60825-1: 2014

- This air particle counter is a laser class I device
- The user is not exposed to laser radiation during normal operation
- Precautionary measures should nevertheless still be taken to avoid contact with hazardous radiation in the form of intense, concentrated, visible light
- Such exposure may result in blindness
- UNDER NO CIRCUMSTANCES may you remove parts of the particle counter unless you are expressly asked to do so in these operating instructions.



Caution! Laser radiation

The following precautionary measures must be observed:

- UNDER NO CIRCUMSTANCES may you remove parts of the particle counter unless you are expressly asked to do so in these operating instructions
- UNDER NO CIRCUMSTANCES may you remove the housing. There are no components inside the device that can be serviced by the user!

CAUTION – CLASS 3B LASER RADIATION,
WHEN OPENED, DO NOT COME INTO CONTACT WITH LIGHT BEAM



W A R N I N G !



Deviations from the settings specified in these operating instructions or
Procedures can lead to harmful optical radiation exposure.

4 General product information

The device is a particle counter using an embedded laser, which is operated via internal electronics. The laser radiation outside the device is below the radiation limits of a class 1 laser. The device itself is powered by a power supply with external safety extra-low voltage (SELV). It consists of a metal housing. The particle counter forms part of a measuring system for various applications.

5 Intended use

The particle counter PC 400 is used for determination of the particle concentration in gaseous carrier media. It is equipped with a laser diode as a light source. The particle detection is effected sidewise via a 90° optics. The transfer of the measured data is effected via the integrated RS 485 interface (Modbus protocol).

It is designed and constructed exclusively for the intended use described here and may only be used accordingly.
A check whether the device is suitable for the selected application must be carried out by the user. The technical data listed in the data sheet are binding.
Improper handling or operation outside the technical specifications is not permitted. Claims of any kind due to improper use are excluded.

5.1 Important notes

Our particle counters are highly sensitive optoelectronic devices which require a special and careful handling. Therefore, please read through the following annotations and advices carefully. This will help you to save unnecessary problems and costs.

Measuring media:
Suitable measuring media are: Air and all other non-explosive, non-corrosive, non-aggressive gases whose temperature should not exceed 40 °C, as far as the maximum particle concentration (please see technical data) is not exceeded (in case of doubt please use a dilution factor!!!).

Sensor system:
In case of a nonuse of the device the suction nozzle should be closed by means of a zero filter (HEPA CAP) or a closing cap in order to avoid a soiling of the sensor system. This especially applies to the transport and the storage of the instrument.
Please observe the following when putting the device into operation again:
The pump should only be switched on when the closing cap has been removed since this may lead to damages at the pump. Furthermore, the instrument should not be exposed to any mechanical shock since this may lead to a misalignment of the optics.
.
Location:
The instrument should be installed at a vibration-free location with a sufficient heat release, extreme climate conditions (heat, moisture) should be avoided.

6 Service

Our products are thoroughly examined and tested after production. The primary calibration was carried out with latex particles and the compliance of the calibration is confirmed on the calibration label on the back side of the instrument.
The annual recalibration of the instruments with latex particles can be carried out either at the premises of the customer or on our premises.

7 Principles of functioning

The optical particle counters described in this manual use the scattered light effect for determination of the particle size and the concentration of aerosol particles. The particles are illuminated with the laser light. The intensity of the scattered light which is emitted by the particle under different angles is measured and used as a parameter for determination of the particle diameter. As soon as an aerosol particle passes through the measuring cell its scattered light gets to a photo element (photo diode) via a collective lens system. The electronic pulse which is generated is strengthened and allocated to a pre-selected size range in the microprocessor system. The pulses counted in a pre-selected time span are related to the volume flow of air (28.3 l/min., or 2.83 l/min.).
When evaluating the counted particles mainly two terms are used which require a more detailed explanation:

- cumulative (cumul.) = the number of particles which are bigger than the particle diameter given in the respective channel.

- **distributive** (distr.) = the number of particles which are bigger than the particle diameter given in the respective channel but smaller than the (bigger) particle diameter given in the next channel.

According to the factory setting PC 400 gives the measured values distributively.

8 Technical data

	PC 400 (0.1µm…5 µm)	PC 400 (0.3 µm…5 µm)
Measuring range	0.1 µm…5 µm	0.3 µm…5 µm
Channels	0.1…0.5 µm 0.5…1 µm 1…5 µm	0.3…0.5 µm 0.5…1 µm 1…5 µm
Counting accuracy acc. to ISO 21501-4	50% at 0.1 µm 100 at > 0.15 µm	50 % at 0.3 µm 100 % at > 0.45 µm
Max. concentration	1 million. / 1 CFM	
Light source	Laser diode	
Zero counting	According to ISO 21501-4: < 1 counting / 5 min.	
Flow rate	1 CFM / 28.3 L/min	
Flow generator	Overpressure in compressed air system / pressure reducer	
Calibration	According to ISO 21501-4: Latex-Aerosol	
Interface	RS 485 (Modbus protocol)	
Dimensions D x W x H [cm]	15 x 20 x 30	
Weight [kg]	8	
Power Supply	24 VDC / 30W	

9 Identification

9.1 Name plate



10 Scope of delivery

1x PC 400
1x Pressure regulator
1x Power supply
1x calibration certificate
1x User manual

11 Initiation

After removing the transportation packaging please place the particle counter PC 400 at first horizontally onto a vibration-free surface near a mains socket. However, please avoid lines at which large electric motors or devices with strong electrical interferences are operated. Please use the instrument in no case near devices with stray radiances or heat radiation (e. g. blowers and heating devices).

11.1 Voltage supply

The voltage supply is effected via the mains unit which is included in the shipment.

In case of any voltage supply via third-party mains units please observe the following requirements: **18…36 VDC / 0,75 A**

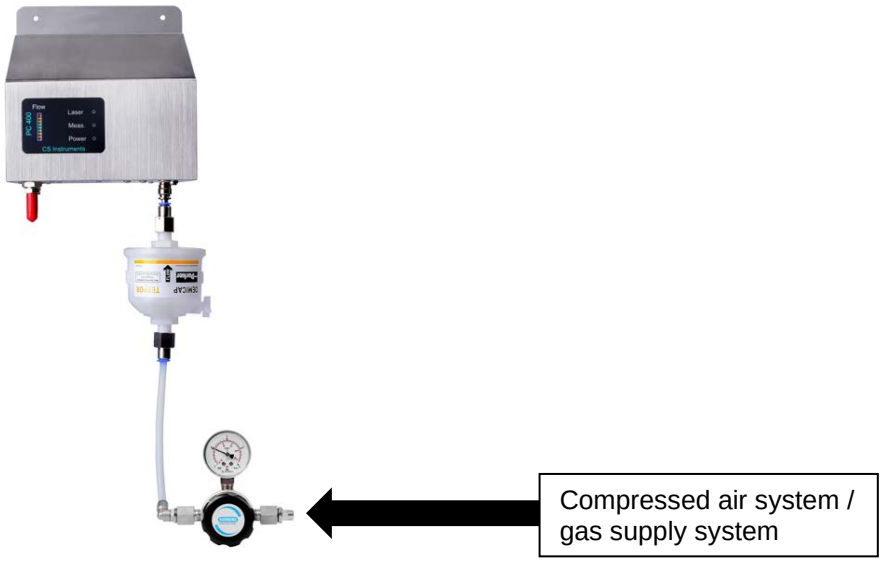
11.2 Connection to the compressed air system (gas supply system)

The particle counter PC 400 is connected to the compressed air system/gas supply system via the supplied pressure controller (please see photo below).

11.2.1 Zero test

If a zero test should be carried out before starting the measurement the zero filter has to be inserted behind the pressure controller before connecting PC 400 to the compressed air system/gas supply system. This serves for a zero test of the sensor and avoids a pollution of the optics.

Important: The pressure at the particle counter PC 400 is not allowed to exceed 1.6 bar over-pressure. The pressure has to be reduced correspondingly by means of the supplied pressure controller.



11.3 Measurement procedure

Before starting the measuring procedure, the zero filter which possibly has been inserted in front of the PC 400 for zero test has to be removed.

Important: The pressure at the particle counter PC 400 is not allowed to exceed 1.6 bar over-pressure. The pressure has to be reduced correspondingly by means of the supplied pressure controller.



Please observe that no rough objects, smoke (also testing tubes from flow meters) or liquids get into the optics. The optical system is the most sensitive part of the instrument and has to be disassembled, cleaned, mounted, adjusted and calibrated completely after the entry of the above mentioned materials. This time expenditure can be avoided by careful handling. Please avoid an impact of the instrument by cigarette smoke. Furthermore, please avoid air resp. gas samples which contain more particles than the specified maximum particle concentration (please see technical data).

The measurement procedure starts immediately after connecting PC 400 to the power supply.

The LED „Power“ (red) and „Laser“ (green) show the proper condition of PC 400.

11.4 Status display



Power: Lightens up if supply voltage is connected

Meas.: Lightens up of the instruments is in measuring mode (counter is active).
If this light expires the particle counter is in the rinsing stage.

Laser: Lightens up if the laser power is within the tolerance.

Flow: The green LED of the three colors luminous row display shows the correctly adjusted flow (sampling) and the following indications:

green	=	OK
yellow	=	within tolerance
red	=	out of tolerance

12 Connection of the RS 485 interface

The particle counter PC 400 disposes of a M12 connector for communication(M12 , 4pole, A-coded)

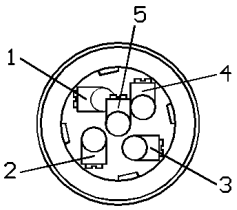


Pin 1	Pin 2	Pin 3	Pin 4
	RS 485 (A) RS 485 (+)	GND	RS 485 (B) RS 485 (-)

RS 485 (A) RS 485 (B)	Modbus RTU A / Modbus RTU (+) Modbus RTU B / Modbus RTU (-)

If no connection cable is ordered the sensor will be supplied with a M12 connector plug. The user can connect the supply and signal cables as indicated in the connection diagram.

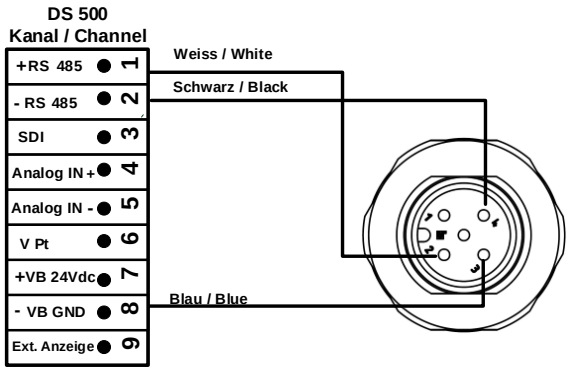




M12 Connector plug

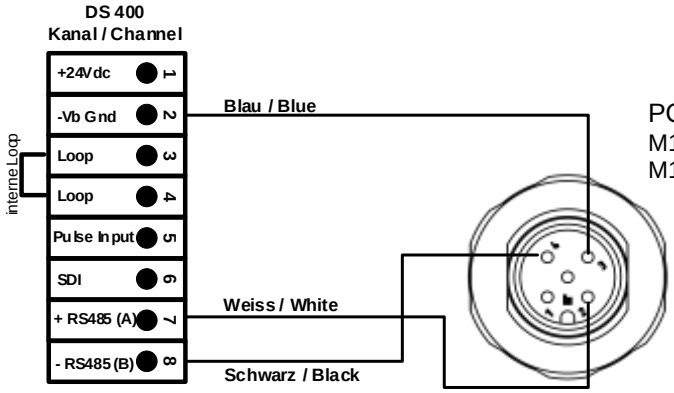
View from back side
(terminal side)

12.1 Connection of the RS 485 interface to a DS 500



PC 400
M12 Stecker Vorderansicht
M12 Connector Front view

12.2 Connection of the RS 485 interface to a DS 400



PC 400
M12 Stecker Vorderansicht
M12 Connector Front view

12.3 Modbus Interface Standard-Settings (Factory settings)

Baud Rate	9600
Data bits	8
Parity	EVEN
Stop bits	1
Handshake	NONE

12.4 Registertable Device version 0,1µm

Address		Pswd Level			
dec	**Hex**	**R**	**W**	**Data type**	**Count per f^3**
1	0x01	0	-	U_Int32	Last measurement
2	0x02				1. Channel to 3. Channel (0,1 < d ≤ 0,5 µm)
3	0x03	0	-	U_Int32	Last measurement
4	0x04				4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
5	0x05	0	-	U_Int32	Last measurement
6	0x06				6. Channel to 7. Channel (1,0 < d ≤ 5,0 µm)
7	0x07	0	-	U_Int32	Current measurement (counting)
8	0x08				1. Channel to 3. Channel (0,1 < d ≤ 0,5 µm)
9	0x09	0	-	U_Int32	Current measurement (counting)
10	0x0A				4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
11	0x0B	0	-	U_Int32	Current measurement (counting)
12	0x0C				6. Channel to 7. Channel (1,0 < d ≤ 5,0 µm)
13	0x0D	0	-	U_int16	State of laser power (0..100%)
14	0x0E	0	-	U_int16	State of flow rate(80.. 120%)

Address		Pswd Level			
dec	**Hex**	**R**	**W**	**Data type**	**Count per m^3**
40	0x028	0	-	float	Last measurement
41	0x029				1. Channel to 3. Channel (0,1 < d ≤ 0,5 µm)
42	0x02A	0	-	float	Last measurement
43	0x02B				4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
44	0x02C	0	-	float	Last measurement
45	0x02D				6. Channel to 7. Channel (1,0 < d ≤ 5,0 µm)
46	0x02E	0	-	float	Current measurement (counting)
47	0x02F				1. Channel to 3. Channel (0,1 < d ≤ 0,5 µm)
48	0x030	0	-	float	Current measurement (counting)
49	0x031				4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
50	0x032	0	-	float	Current measurement (counting)
51	0x033				6. Channel to 7. Channel (1,0 < d ≤ 5,0 µm)
13	0x0D	0	-	U_int16	State of laser power (0..100%)
14	0x0E	0	-	U_int16	State of flow rate(80.. 120%)

12.5 Registertable Device version 0,3µm

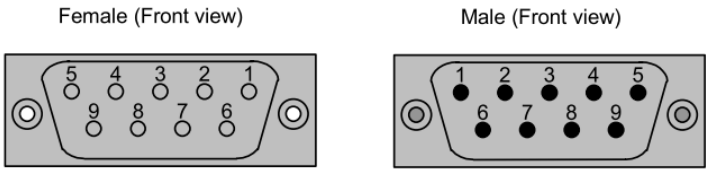
Address		Pswd Level			
dec	Hex	R	W	Data type	Count per f^3
21	0x015	0	-	U_Int32	Last measurement 1. Channel to 3. Channel (0,3 < d ≤ 0,5 µm)
22	0x016				
23	0x017	0	-	U_Int32	Last measurement 4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
24	0x018				
25	0x019	0	-	U_Int32	Last measurement 6. Channel to 7. Channel (1,0 < d ≤ 10,0 µm)
26	0x01A				
27	0x01B	0	-	U_Int32	Current measurement (counting) 1. Channel to 3. Channel (0,3 < d ≤ 0,5 µm)
28	0x01C				
29	0x01D	0	-	U_Int32	Current measurement (counting) 4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
30	0x01E				
31	0x01F	0	-	U_Int32	Current measurement (counting) 6. Channel to 7. Channel (1,0 < d ≤ 1,0 µm)
32	0x020				
13	0x0D	0	-	U_int16	State of laser power (0..100%)
14	0x0E	0	-	U_int16	State of flow rate(80.. 120%)

Address		Pswd Level			
dec	Hex	R	W	Data type	Count per m^3
60	0x03C	0	-	float	Last measurement 1. Channel to 3. Channel (0,3 < d ≤ 0,5 µm)
61	0x03D				
62	0x03E	0	-	float	Last measurement 4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
63	0x03F				
64	0x040	0	-	float	Last measurement 6. Channel to 7. Channel (1,0 < d ≤ 10,0 µm)
65	0x041				
66	0x042	0	-	float	Current measurement (counting) 1. Channel to 3. Channel (0,3 < d ≤ 0,5 µm)
67	0x043				
68	0x044	0	-	float	Current measurement (counting) 4. Channel to 5. Channel (0,5 < d ≤ 1,0 µm)
69	0x045				
70	0x046	0	-	float	Current measurement (counting) 6. Channel to 7. Channel (1,0 < d ≤ 1,0 µm)
71	0x047				
13	0x0D	0	-	U_int16	State of laser power (0..100%)
14	0x0E	0	-	U_int16	State of flow rate(80.. 120%)

13 Analogue Output 4...20mA (Optional)

The particle counter PC 400 can optionally be ordered/delivered with 4x analogue outputs 4...20mA. The particle counter then has a 9-pin Sub-D socket.





Analogue Output:

PIN 1: CH1
PIN 2: CH2
PIN 3: CH3
PIN 4: CH4
PIN 5: GND

Relais:

PIN 6: Common
PIN 7: Measure (Relay switched while measurement is running)
PIN 8: Laser Alarm (Relay switched when laser below 50%)
PIN 9: Flow Alarm (Relay switched if flow outside the measuring range between 80% and 120%)

Remark:

- Channel assignment (value assignment) as well as scaling of the outputs is done at the factory.
- Relays can be configured as normally closed or normally open at the factory.
  The default setting is as follows:
  Measure Relay: Closed when measurement is running
  Laser Alarm Relay: Closed on laser alarm i.e. laser below 50%
  Flow Alarm Relay: Closed on flow alarm i.e. flow out of measuring range
    - Measuring range is 80% - 120%

14 Operation of the particle counter with the chart recorder DS 500



The data transfer of the measured data between particle counter PC 400 and DS 500 is effected via a digital RS 485 interface (Modbus protocol).

The particle counter PC 400 is stored as a sensor in the sensor selection list in DS 500.
For sensor selection in DS 500 please proceed as follows:

Main menu → Settings → Sensor settings → A1



If still no sensor has been configured, the *Type No Sensor* appears.

By pushing the description field *Type No Sensor* the list of sensor types appears (see next step).

Select sensor type **"PC 400"** or **"Particle"** in the selection list, depending on the Version of DS 500.

For detailed information please see instruction manual DS 500.

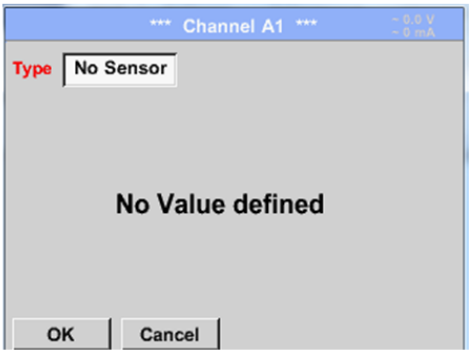
15 Operation of the particle counter with the multifunction measuring instrument DS 400



The data transfer of the measured values between PC 400 particle counter and DS 400 is effected via a digital RS 485 interface (Modbus protocol).

The particle counter PC 400 is stored as a sensor in the sensor selection list in DS 400.
For sensor selection in DS 400 please proceed as follows:

Main menu ➔ Settings ➔ Sensor settings ➔ A1



If still no sensor has been configured, the *Type No Sensor* appears.

By pushing the description field *Type No Sensor* the list of sensor types appears (see next step).

Select sensor type **“PC400“** or **“Particle“** in the selection list, depending on the DS 400 version..

For detailed information please see instruction manual DS 400.

16 Operation of the particle counter PC 400 with a DS 500 mobile in the mobile unit for measurement of compressed air quality according to ISO 8573 – residual oil – particles – moisture



The connection of PC 400 to DS 500 mobile is effected via the 5 meters connection cable (order no. 0553.0501).

