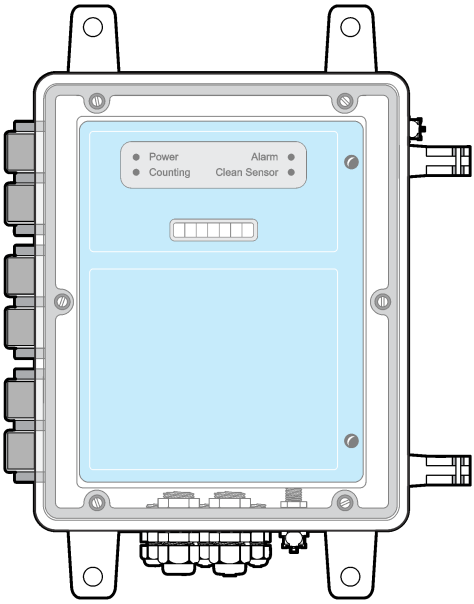
DOC023.53.80464

2200 PCX

04/2018, Edition 2

User Manual



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Specifications

Specifications are subject to change without notice.

Specification	Details
Dimensions (W x D x H)	350 x 211 x 178 mm (13.8 x 8.3 x 7.0 in.)
Weight	4.89 kg (10.78 lbs)
Operating temperature	0 to 50 °C (32 to 122 °F); maximum relative humidity 80% for temperatures with a maximum of 31 ºC (87.8 °F) decreasing linearly to 50% relative humidity at 40 ºC (104 °F)
Storage temperature	0 to 50 °C (32 to 122 °F)
Enclosure	NEMA 4X (indoor use)
Fittings	Quick-connect. Connect to ¼-inch O.D tubing
Power requirements	115-240 VAC, 50/60 Hz, 1A
Maximum solution pressure	65 psig, not more than 1 minute duration; 55 psig continuous
Flow rate	100 mL/minute nominal
Particle size	Smallest size: 2 µm Largest size: 750 µm
Indicators	Power, counting display, cleaning sensor and alarm
Distance from computer to sensor	1219.20 m (4000 ft.) maximum, entire RS485 signal path
Flow control (optional)	Passive control devices available to control water flow through the instrument
Digital communication	Modbus ASCII; WQS Vista data collection software (optional): Monitor filter performance and make reports. Refer to the software documentation for computer requirements.
Hach UDG1000 software (optional)	Organize instrument readings on a SCADA system
Analog input/output card (optional)	Input: accepts input signals from external devices Output: supplies an analog output level proportional to total number of particles counted (raw count)
Pollution degree	2
Installation category	I
Protection class	III (supplied by SELV power source)
Certifications	UL/CSA approved 100 to 115 V, 50/60 Hz external wall-type power supply; wall plug-in power supply is not NEMA rated
Warranty	1 year

General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

Safety information

NOTICE

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol indicates that a risk of electrical shock and/or electrocution exists.
	This symbol indicates a laser device is used in the equipment.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage with the equipment.

Certification

Canadian Radio Interference-Causing Equipment Regulation, IECS-003, Class A:

Supporting test records reside with the manufacturer.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de classe A répond à toutes les exigences de la réglementation canadienne sur les équipements provoquant des interférences.

FCC Part 15, Class "A" Limits

Supporting test records reside with the manufacturer. The device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. The equipment may not cause harmful interference.
2. The equipment must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their expense. The following techniques can be used to reduce interference problems:

1. Disconnect the equipment from its power source to verify that it is or is not the source of the interference.
2. If the equipment is connected to the same outlet as the device experiencing interference, connect the equipment to a different outlet.
3. Move the equipment away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

Class 1 laser

CLASS 1 LASER PRODUCT	This symbol indicates that the instrument is a Class 1 LASER product.

This product complies with IEC/EN 60825-1:2007 and 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007. FDA accession number: 8921784-11.

This product contains a laser that is not user-serviceable.

Product overview

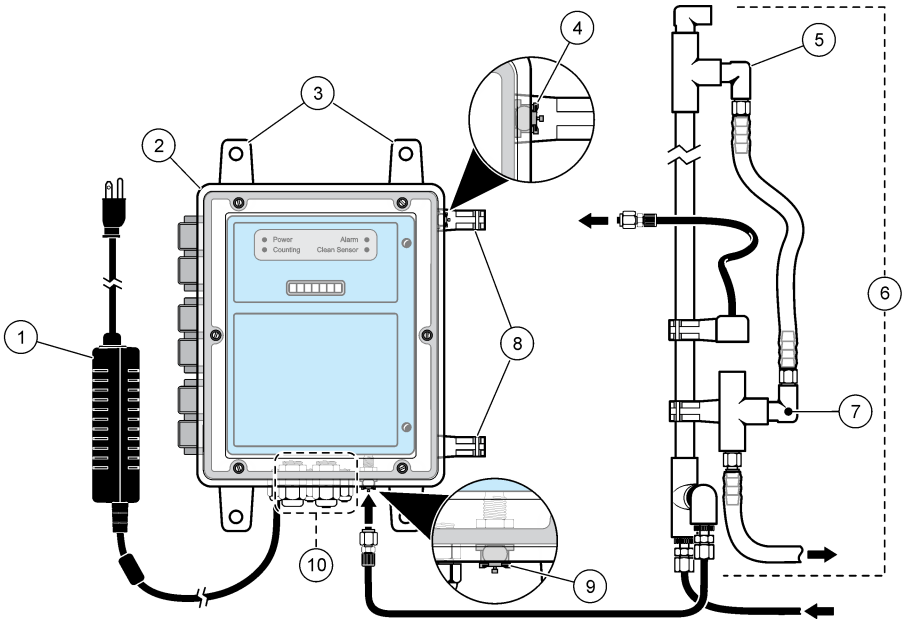
⚠ DANGER	
	Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

⚠ DANGER

Fire hazard. This product is not designed for use with flammable liquids.

The 2200 PCX particle counter is used for drinking water applications. The 2200 PCX does not have data storage capability. The instrument uses a particle counting sensor with a laser-diode. The instrument converts analog signals from other devices and send those output values through Modbus communications. The instrument is used with the Vista software to select the size range, count period and flow rate. Complete data collection with Hach UDG or Vista software. Refer to the software documentation for more information. Refer to Figure 1.

Figure 1 Product overview

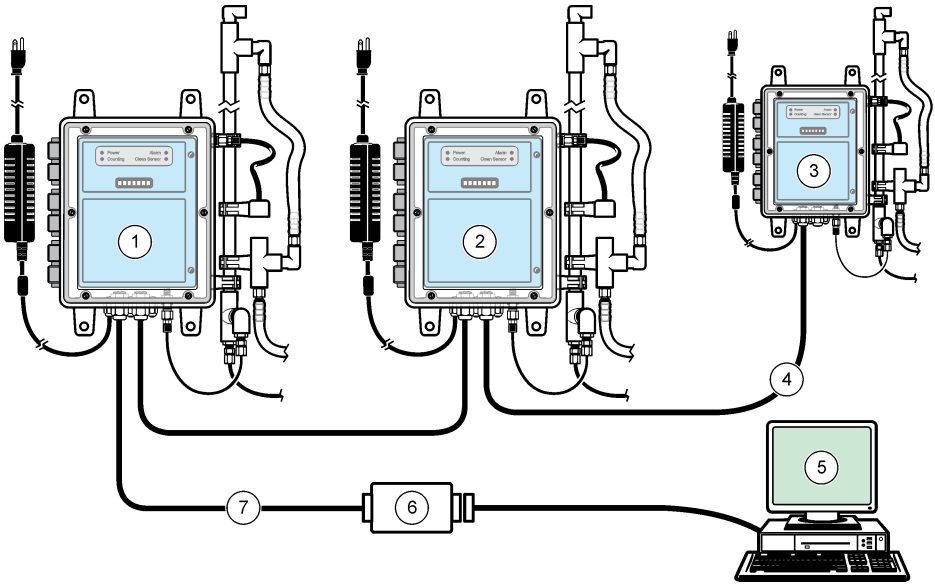


1 AC power supply	**6** Water weir flow controller
2 Particle counter	**7** Water weir drain junction (mounted 1.22 m (4 ft) below the maximum head loss)
3 Wall mounting brackets (4x)	**8** Mounting clips for weir
4 Sensor outlet quick-connect fitting	**9** Sensor inlet quick-connect fitting
5 Water weir overflow	**10** Electrical access ports

System overview

Figure 2 shows an overview of multiple instruments that are installed in one network.

Figure 2 System overview



1 Particle counter (Location “0” = influent)	**5** System computer with data collection software
2 Particle counter (Location “1”)	**6** RS485 signal converter with cable to computer[1]
3 Particle counter (Location “2”)	**7** RS485 communications cable (Beldon 9841 or equivalent)
4 RS485 cable (total distance 1219.2 m (4000 ft) without repeater	

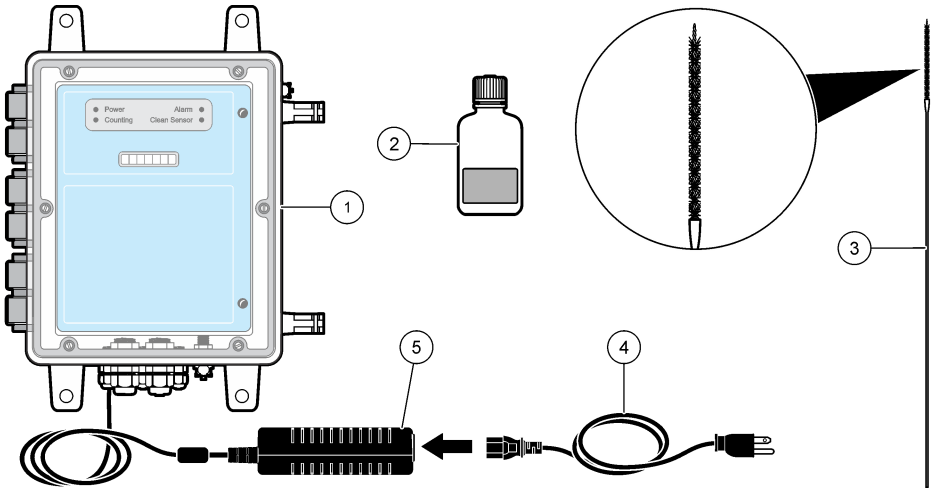
Product components

Make sure that all components have been received. Refer to Figure 3[2]. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

[1] Install the converter directly to the computer.

[2] Refer to Replacement parts and accessories on page 31 for optional items such as the analog input/output kit, water weir and software.

Figure 3 Product components



1 Particle counter with power cord	**4** Power cord
2 Cleaning solution	**5** Power supply
3 Cleaning brush	

Installation

⚠ WARNING

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Installation guidelines

Install the instrument:

- As near the sample source as possible to decrease analysis delay
- In a clean, dry, well ventilated and temperature controlled location
- In a location with minimum vibrations that has no direct exposure to sunlight
- In an environmental enclosure that supplies protection from precipitation and direct sunlight, good ventilation and temperature control if installed outdoors
- In a location where the power switch and power cord are visible and easily accessible
- In a location where there is sufficient clearance around it to make plumbing and electrical connections

Mechanical installation

Attach the instrument to the wall

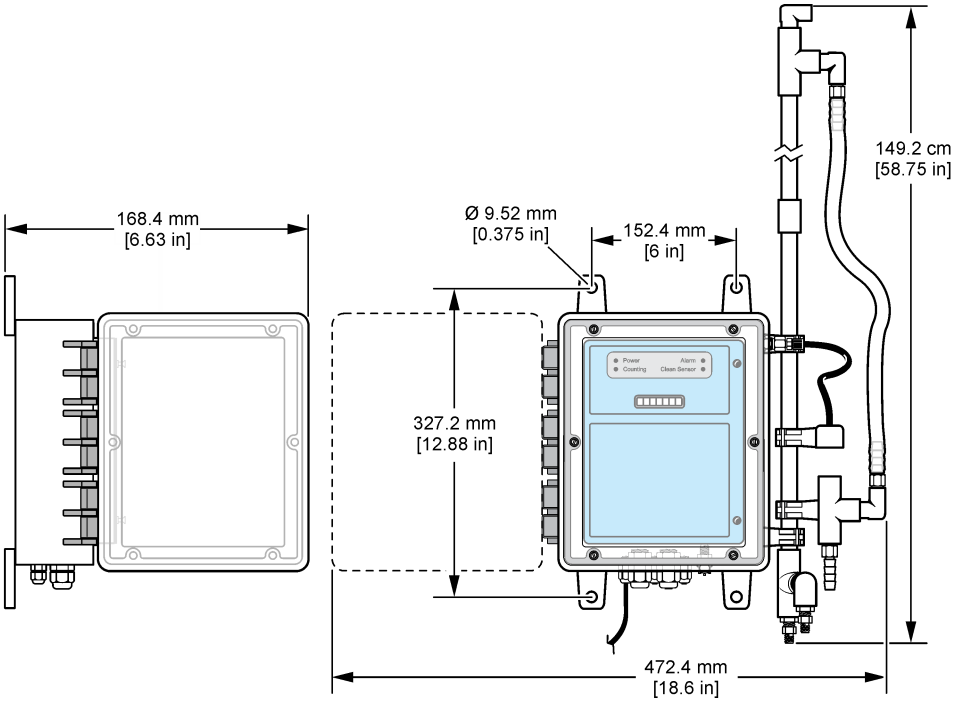
⚠ WARNING

Personal injury hazard. Make sure that the wall mounting is able to hold 4 times the weight of the equipment.

This instrument is rated for an altitude of 2000 m (6562 ft) maximum. Use of this instrument at an altitude higher than 2000 m can slightly increase the potential for the electrical insulation to break down, which can result in an electric shock hazard. The manufacturer recommends that users with concerns contact technical support.

Attach the instrument upright and level on a flat, vertical surface. Refer to Figure 4 for dimensions. Mounting hardware is supplied by the user. Make sure that an electrical outlet is available that is above flood stage areas. If purchased with the instrument, install the standard water weir flow controller so that the sensor outlet of the instrument is lower than the water weir overflow. Refer to Figure 1 on page 6.

Figure 4 Installation dimensions



Plumbing

⚠ DANGER

Fire hazard. This product is not designed for use with flammable liquids.

Sample line guidelines

Select a good, representative sampling point for the best instrument performance. The sample must be representative of the entire system.

To prevent erratic readings:

- Collect samples from locations that are sufficiently distant from points of chemical additions to the process stream.
- Make sure that the samples are sufficiently mixed.
- Make sure that all chemical reactions are complete.

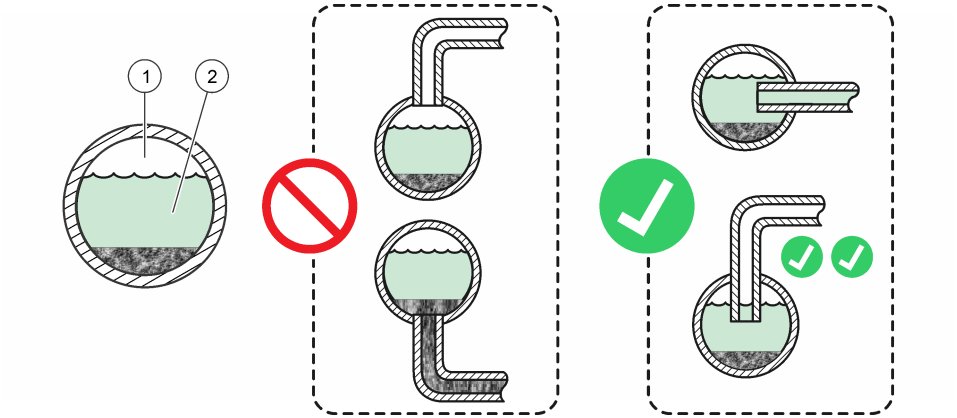
Connect the sample stream

Install the sample line into a larger process pipe to minimize interference from air bubbles or pipeline bottom sediment. A sample line that goes into the center of a process pipe is best.

Figure 5 shows examples of good and bad methods of sample line installation into a process pipe.

Keep the sample line as short as possible to decrease analysis delay. Sediment can collect in long sample lines.

Figure 5 Sampling methods



1 Air	**2** Sample flow

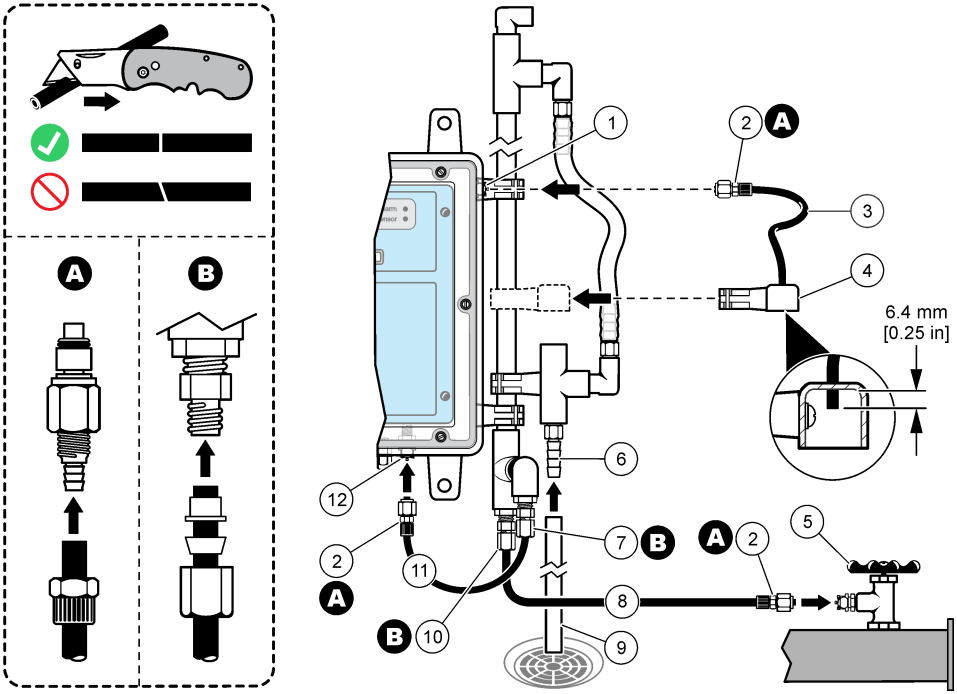
Plumb the instrument

Figure 6 shows the instrument and the water weir controller connection to the water system. Make sure that the tubing length is 3.05 m (10 ft) maximum. Tubing lengths longer than 3.05 m (10 ft) will cause the larger particles to "drop out" of the sample. This will decrease the accuracy of the particle size reading.

1. Install a plumbing tap with a shut-off valve for the instrument. Refer to Figure 6, item 5.
2. Install a quick-connect fitting on the shut-off valve.
3. Install a quick-connect fitting to one end of the 3.05 m (10 ft) length of the 1/4-in. black semi-rigid tubing supplied with water weir. Refer to Figure 6, items 2 and 8.
4. Install the nut and then the compression fitting to the other end of the 3.05 m (10 ft) length of the black tubing. Refer to Figure 6, configuration "B".
5. Attach the fitting to the inlet on the water weir. Refer to Figure 6, item 10.
6. Connect the quick-connect fitting to the plumbing tap (shut-off valve) of the water source. Refer to Figure 6, items 2 and 5.
7. Install a quick-connect fitting to one end of the 18-in. length of 1/4 in. black flexible tubing supplied with water weir. Refer to Figure 6, items 2 and 11.
8. Install the nut and then the compression fitting to the other end of 18-in. length of the black flexible tubing. Refer to Figure 6, configuration "B".
9. Connect the compression fitting to the water weir outlet. Refer to Figure 6, item 7.
10. Connect the quick-connect fitting to the sensor inlet port of the instrument. Refer to Figure 6, items 2 and 12.
11. Attach the quick-connect fitting to a 12-in. length of ¼-in. black flexible tubing. Refer to Figure 6, items 2 and 3.
12. Attach the quick-connect fitting to the sensor outlet port on the instrument. Refer to Figure 6, items 1 and 2.

13. Put the other end of the 12-in. length of ¼-in. black flexible tubing into the hole of the adjustment cap. Make sure that the end of the tubing is 6.4 mm (0.25 in.) inside the cap. Refer to Figure 6, item 4.
14. Install the drain line on the water weir. Install a clear ½-in. I.D. hose over the barbed fitting on the water weir drain. Refer to Figure 6, items 6 and 9.
15. Use the drain hose to measure the distance between the water weir drain and the nearest waste drain. Remove the excess length of the drain hose. Install the other end of the hose on the drain. Refer to Figure 6.
16. Open the shut-off valve on the plumbing tap and examine the tubing for leaks.

Figure 6 Plumbing connections with measurements



1 Sensor outlet port	**7** Water weir outlet
2 Quick-connect fitting[3]	**8** ¼ in. black semi-rigid tubing, 3.05 m (10 ft)
3 ¼ in. black flexible tubing, 308.4 mm (12 in.)	**9** ½ in. I.D. clear drain tubing
4 Adjustment cap	**10** Water weir inlet
5 Shut-off valve in plumbing tap	**11** ¼ in. flexible tubing, 45.72 cm (18 in.)
6 Water weir drain fitting	**12** Sensor inlet port

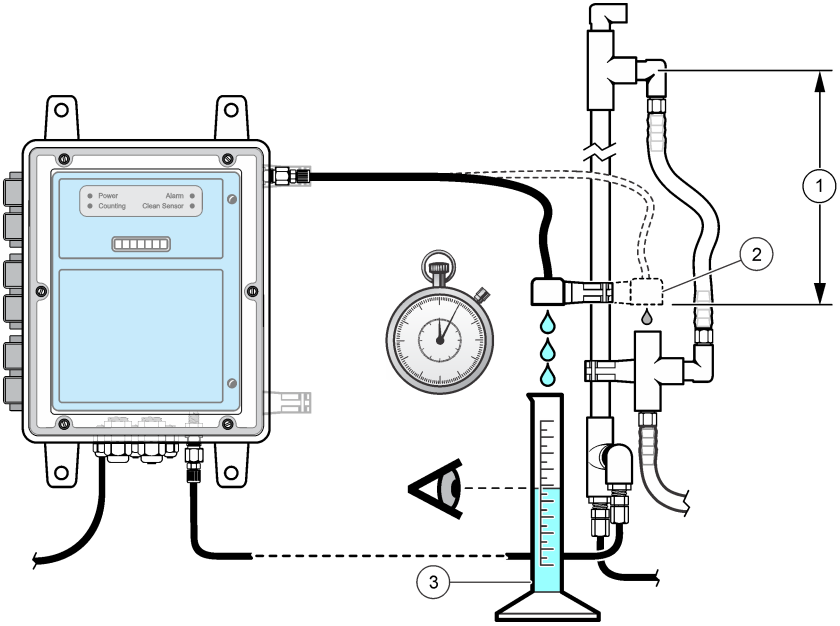
[3] Refer to the installation configurations A and B to correctly install the black tubing on the quick-connect fittings (A) and the water weir inlet and outlet fittings (B).

Measure the flow rate

Set the distance from the overflow to the bottom of the adjustment cap to 832 mm (33 in.) for a flow rate approximately 100-mL/min. Move the adjustment cap up to decrease the flow. Move the adjustment cap down to increase the flow. The flow rate changes about 1 or 2 mL per minute when the adjustment cap is moved 25.4 mm (1 in.) in vertical direction. Do the steps that follow to measure the flow rate. Refer to Figure 7.

1. Turn the adjustment cap and collect sample in a 200-mL graduated cylinder for 1 minute.
2. Record the result as mL/min.
3. To adjust the flow rate by 1 to 2 mL/min, move the adjustment cap 1 in. up or down.
4. If necessary, measure the flow rate again. The results of the count concentration data will be more accurate, the more accurately the flow is set.

Figure 7 Flow rate measurement



1 Adjustment length	**3** Graduated cylinder
2 Adjustment cap	

Electrical installation

Wiring for power

⚠ DANGER

Electrocution hazard. Always remove power to the instrument before making electrical connections.

⚠ DANGER

Electrocution hazard. Protective Earth Ground (PE) connection is required.

⚠ DANGER

Electrical shock and fire hazards. Make sure to identify the local disconnect clearly for the conduit installation.

⚠ DANGER

Electrocution hazard. If this equipment is used outdoors or in potentially wet locations, a Ground Fault Circuit Interrupt (GFCI/GFI) device must be used for connecting the equipment to its main power source.

⚠ WARNING

Electrical shock and fire hazards. Make sure that the user-supplied power cord and non-locking plug meet the applicable country code requirements.

⚠ WARNING

Electrocution hazard. Make sure that there is easy access to the local power disconnect.

⚠ WARNING

Electrical shock hazard. Externally connected equipment must have an applicable country safety standard assessment.

NOTICE

Install the cover after all the connections are made to keep the environmental enclosure rating.

The electrical connections to power the instrument are made at the factory. Make sure to use an electrical outlet that is above flood stage areas. It is necessary to set the power to off and then to on for some programming functions. When all of the connections are made, connect the power cord to an electrical outlet.. Refer to Connect the power cord on page 18.

Electrostatic discharge (ESD) considerations

NOTICE

Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.

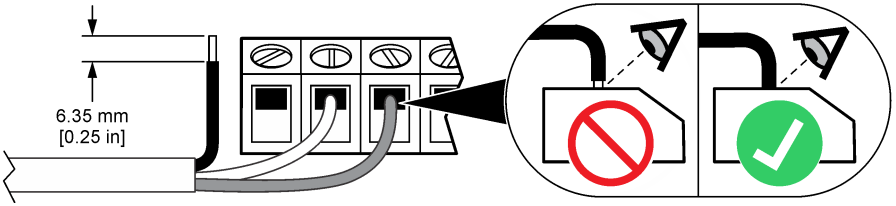
Refer to the steps in this procedure to prevent ESD damage to the instrument:

- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.
- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

Prepare the wiring

Figure 8 shows the wire connection to the terminal blocks. Remove the wire insulation by 6.35 mm (0.25 in.) before the installation. Make sure that the wire is fully installed in the connector so that no bare wire shows.

Figure 8 Wiring preparation



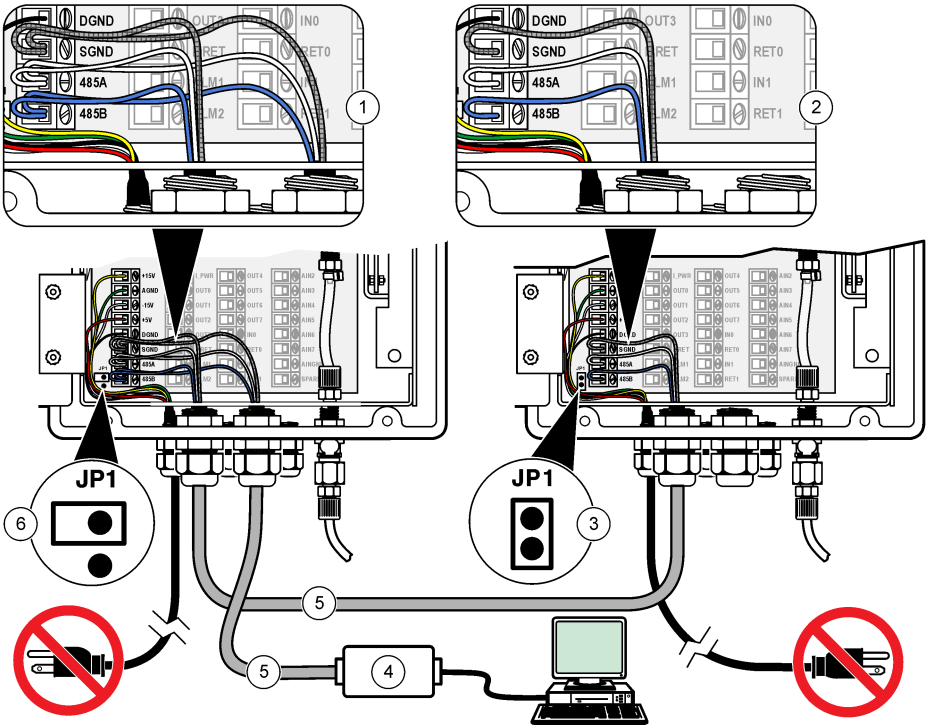
Connect RS485 communications

Set up an RS485 serial network to connect multiple instruments and a controlling computer. The total distance from the RS485 signal converter to the farthest instrument can be a maximum of 1219.20 m (4000 ft) without an amplifier/repeater. Refer to the steps that follow and to Figure 9 to connect two instruments. Refer to Prepare the wiring on page 13 for the wire preparation.

Items to collect: RS485-type shielded and a low capacitance twisted-pair cable (Belden 9841 or equivalent), signal converter (RS485 to RS232 or RS485 to USB)

1. Install a RS485 cable between the signal converter and the first instrument. Refer to the signal converter documentation for wiring instructions.
2. At the first instrument, put the cable through one electrical access port and then connect the blue wire to the terminal lug with the "485B" label.
3. Connect the white wire to the terminal lug with the "485A" label.
4. Connect the shield cable to "SGND". Refer to Connect a junction box on page 18 for an optional junction box installation.
5. To connect another instrument to the system, put the cable through a second instrument to the electrical access port of the second instrument.
6. Connect the blue wire to the terminal lug with the "485B" label at both ends of the cable.
7. Connect the white wire to the terminal lug with the "485A" label.
8. Shield to "SGND" at both ends of the cable.
9. Do steps 2 to 7 again to connect other instruments.
10. Set the jumper JP1 on the last instrument in the chain so that two pins are shorted together (terminated). Refer to Figure 9, item 3.
    Note: *Keep the jumper JP1 open (not terminated) on all other instruments.*
11. Close the covers and apply power to the instruments.

Figure 9 Particle counters wiring



1 Wiring for multiple instrument systems	**4** RS485 signal converter with cable to computer
2 Wiring for last instrument in multiple instrument system	**5** RS485 shielded cable (Beldon 9841 or equivalent)
3 Terminated JP1 jumper configuration for last instrument	**6** Open JP1 jumper configuration

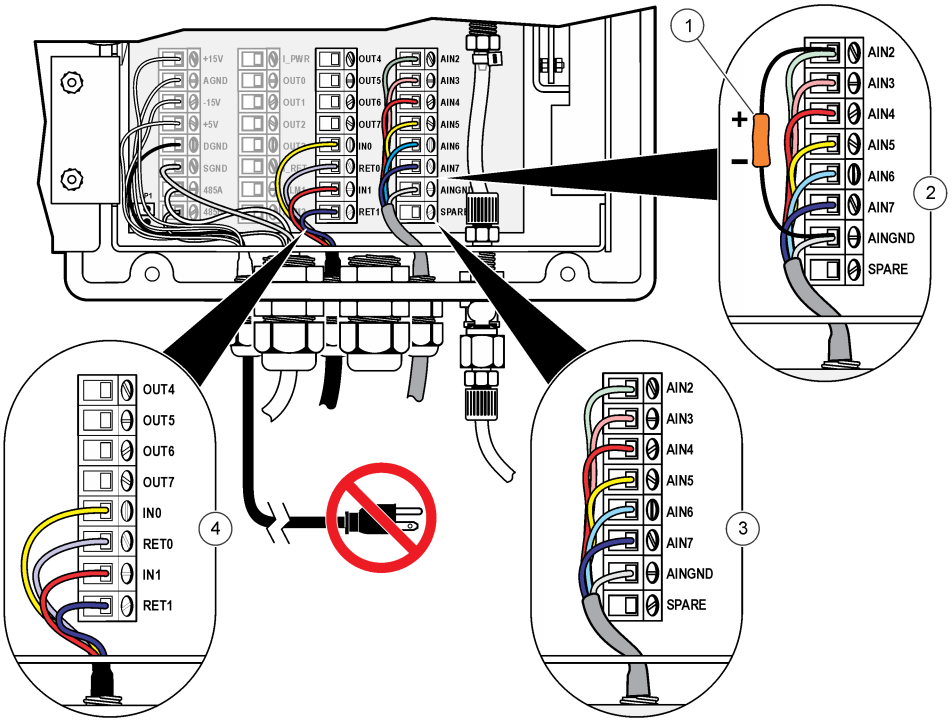
Select the voltage inputs

1. Select +5 V full scale and remove jumpers JP2 through JP7 that are the same as the inputs used (AIN2 through AIN7).
2. Select +10 V full scale and install jumpers JP2 through JP7 that are the same as the inputs used (AIN2 through AIN7).
3. Configure the voltage inputs to accept 4–20 mA inputs when connected to a 250 ohm or a 1% (or better) shunt resistor in parallel with the analog signal cable. Set the applicable jumper for a 5 V operation.

4–20 mA current inputs: Use IN0 (RET0 is ground) and IN1 (RET1 is ground) on the instrument interconnect card. The incoming data is sent along with the particle count data via serial communications to the computer. With the installed online software, the data is shown and recorded. Connect analog inputs from external devices to the instrument interconnect card as shown in Figure 10.

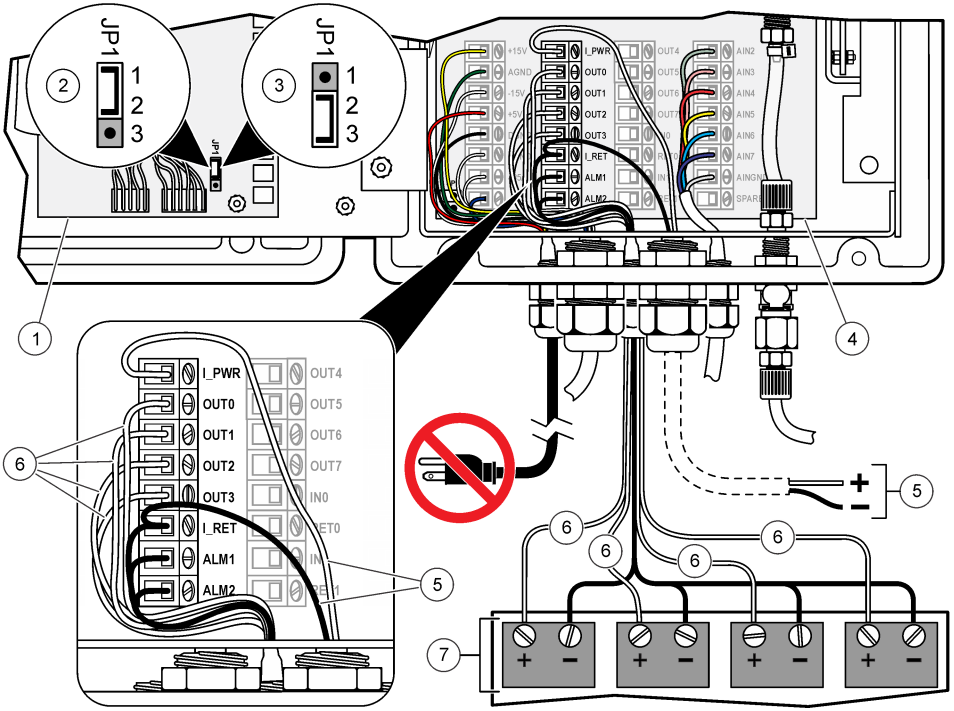
4–20 mA current outputs: If the optional I/O kit is installed, each sensor has eight 4–20 mA analog outputs of particle count data that the user can configure to output raw particle counts. The 4–20 mA output levels are in relation to the total number of particles counted during the sample period. The data is shown and recorded in the installed PC software. Each size category will have a unique analog output signal and will connect to an individual analog input on the data acquisition system input terminals. Analog outputs are connected to the instrument interconnect card. Refer to Figure 11.

Figure 10 Analog input wiring



1 Connect shunt resistor between voltage input and analog ground (AINGND)	**3** 0 to 5 VDC or 0 to 10 VDC from other devices. Connect wires to AIN2-AIN7 and braided shield to AINGND.
2 Voltage inputs configured to accept 4-20 mA inputs	**4** 4-20 mA wires from other devices. Connect wires to IN0, IN1, RET0 and RET1.

Figure 11 Analog output wiring

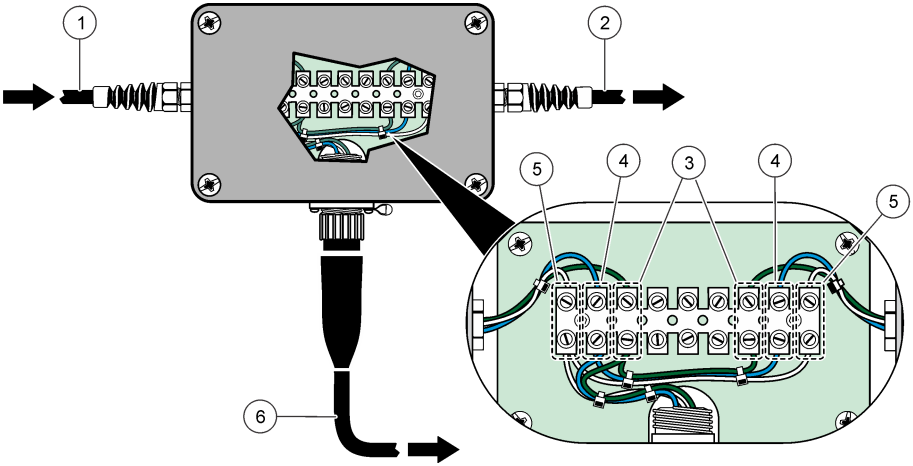


1 Analog input card	**5** Optional external loop power, 15-24 VDC (150 mA)
2 Jumper position (internal loop power)	**6** Wires from analog output terminals (OUT0-OUT7)
3 Jumper position (external loop power)	**7** Analog connections on PLC, SCADA
4 Interconnect card	

Connect a junction box

Use junction boxes to connect instruments in a RS485 network. With an installed junction box, remove or install the instrument from or to the network without network integrity interruption. Connect wires from the RS485 cables (Belden 9841 or equivalent) as shown in Figure 12.

Figure 12 Junction box wiring



1 RS485 cable from the previous junction box	**4** Terminals for 485B (blue wires)
2 RS485 cable to next junction box	**5** Terminals for 485A (white wires)
3 Terminals for SGND (green wires)[4]	**6** Pigtail connector to particle counter

Startup

Connect the power cord

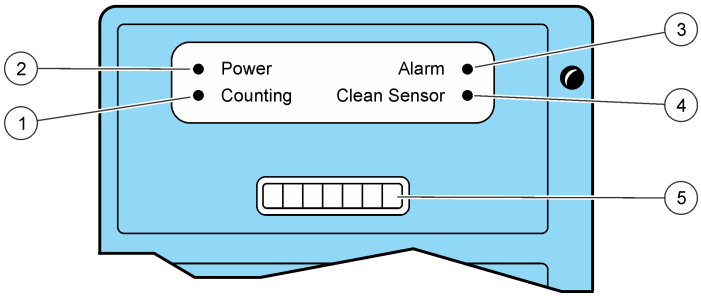
Connect the power cord to an electrical outlet with protective earth ground.

Status indicator light and count display window

When the instrument is set to on, the status indicator lights on the front panel show. In operation, the count display window shows the particle count. Refer to Figure 13 and to Table 1.

[4] The green drain wire must go through a 100 ohm ½ W resistor before it is connected to the SGND terminal.

Figure 13 Front panel description



1 Counting LED	**4** Clean sensor LED
2 Power LED	**5** Count display window
3 Alarm LED	

Table 1 Status indicators

Indicator	Description
Counting LED	Comes on during the count cycle.
Power LED	Comes on when the instrument power is set to on.
Alarm LED	Comes on when the alarm limit is exceeded.
Clean sensor LED	Comes on if a sensor defect is identified. Refer to Clean the cell on page 28 and/or Troubleshooting on page 30.
Count display window	Shows the "normalized" particle count (counts/mL) in the size range limits for the count period. If the flow rate is set to 0 in the configuration menu, the display shows the raw counts of the selected sizes (count/count period). The raw count is configured with the WQS Vista Software.

Operation

Configuration

⚠ DANGER

Electrocution hazard. Always remove power to the instrument before making electrical connections.

Most applications can use the factory configuration. Refer to Configure the RS485 connection on page 19 or Configure the RS232 connection on page 21 for a custom configuration for an RS485 or RS232 operation.

Configure the RS485 connection

Make sure that all connections are made to the instrument before the RS485 configuration.

1. Find the file "Advanced CRTS" on the manufacturer's website to download. Save the file from the website to the computer.
2. Make sure that the instrument power is set to on and is connected to the computer.
3. Unzip the advanced "CRTS_2200 PCX" configuration file. Push **Run** to start the "AdvancedCRTS.exe" file to install CRTS.
4. Open "CRTS".
5. Go to "Setup PCX" to make sure that the communications operate correctly.

6. Close the setup screen and go to the terminal.
   Note: *Make sure that only one instrument is connected during the setup.*
7. Make sure that the correct COM port is selected.
8. Click on "Send Lead Command". Do not confirm with **OK**.
9. Set the instrument power to off. Wait 2 seconds and set the instrument to on again.
10. Confirm "Load Delay: 2 Sec." within 30 seconds.
11. When the "load" command was sent successfully, the menu that follows shows: **---MAIN MENU--- RMCA [2082375-1E]**
12. Type the number 1 to 9 and do the prompts at the command line that follow to select a specific operating parameter. Refer to Table 2.

    1. UNIT ID32 [0...32[5]]
    2. COUNT PERIOD00:10 [MIN,SEC]
    3. CAL LIMITS0800–1200 [LOWER, UPPER mV]
    4. COUNT MODEMANUAL [AUTO, MANUAL]
    5. PANEL DISPLAY2.0 [CUMULATIVE 9U0]
    6. FLOW RATE 100 mL/min]
    7. CALIBRATE
    8. DEFAULT MEMORY
    9. SETUP ANALOG I/OQ = QUIT
13. Select "9" to configure the analog inputs and outputs. Select "1" to set the analog inputs to on or off. Push "2" to go out of the output configuration menu.
14. Select "1" for analog inputs or "2" for analog outputs, then enter the command number but do not push the <Enter> key.

    - ENTER ANALOG OUTPUT CHANNEL [0 to 7]
    - ENTER LOWER SIZE
    - ENTER UPPER SIZE (0=cumulative)
    - ENTER FULL SCALE COUNT (0=disable channel)

    Note: *Enter the lowest particle size and 0 for no upper limit. The upper size specifies the count value shown by 20 mA.*
15. Complete the sequence with “Q <Enter>”. All of the configuration information is saved in the instrument memory.
    Note: *To go out of the configuration menu at the very end, stop the sequence with “P <Enter>”.*
16. Do steps 11 to 15 again for more channels.
17. Do steps 2 to 11 again for more instruments.

Table 2 Operating parameter selection

Menu number	Command line message	Description
1	ENTER ID	Enter the Modbus address.
2	ENTER MIN:SEC	Set count period when in "AUTO" mode.
3	ENTER LOWER THRESHOLD (mV)	Calibration check threshold. Do not change the value.
	ENTER UPPER THRESHOLD (mV)	Calibration check threshold. Do not change the value.
4	ENTER COUNT MODE (A OR M)	Auto = locally self-timed; Manual = count period is controlled by data collection software.

[5] The default ID number is "32". This number is set at the factory to a lower number. "32" typically shows that the EPROM was changed. If the instrument shows "32", contact technical support.

Table 2 Operating parameter selection (continued)

Menu number	Command line message	Description
5	ENTER LOWER SIZE	Specify the particle size range (for front panel numerical display units only). Do not set a lower size to less than 2 microns.
	ENTER UPPER SIZE (0 FOR CUMULATIVE)	Specify the largest particle to be included in the count shown on the display (for front panel numerical display units only).
6	ENTER FLOW RATE	If 0 is entered, the display shows particles/count period (raw count). If 100 mL/min is entered, the display shows particles/mL (normalized count).
7	CALIBRATING DISPLAY	Use for the 4-20 mA analog output calibration. Toggles from 4-20 mA when the space bar is pushed on the connected computer.
8	DEFAULT MEMORY	Do not enter a message on this line unless instructed by the manufacturer.
9	SETUP ANALOG I/O	Use only when an analog I/O card is installed.

Configure the RS232 connection

1. Set the power of the instrument to off.
2. Open the instrument cover and disconnect the RS485 "COM" line connector (485A, 485B, SGND) from the instrument interconnect card.
3. Connect the programming cable between connector J1-RS232 on the instrument interconnect card and serial port 1 or 2 of the computer.
4. Use the terminal emulation software (Windows "Terminal", "Procomm", or "Advanced CRTS") to configure the computer for COM 1 or 2 port, 9600, N, 8, 1. 5.
5. Set the instrument power to on.
6. Refer to Configure the RS485 connection on page 19 and do steps 11 to 16.

Configure the analog input connection

When an analog I/O card is installed in the instrument, a maximum of eight analog inputs from other devices are accepted.

- Inputs IN0/RET0 and IN1/RET1 are configured for 4–20 mA inputs
- Analog inputs AIN2 through AIN7 are configured as 0–5 V or 0–10 V inputs
- AIN 2–7 use a common ground connection, AINGND

1. Set the jumpers JP2 through JP7 on the analog board to select 0–5 V or 0–10 V operation. Refer to Figure 10 on page 16.
2. To configure the card for 4–20 mA inputs, set the inputs for a 0–5 V operation.
3. Install a 250 ohm, 1% (or better) shunt resistor, e.g., AIN 2 and AINGND.
4. When the analog input connections are made, set the analog inputs for use. Refer to Figure 10 on page 16 and to Configure the RS485 connection on page 19 and go to the configuration menu.
5. The menu option “Setup Analog I/O” shows when an analog I/O card is installed.
   Note: *If this option does not show, make sure that the analog card is installed correctly. If the analog card installed and the "Setup Analog I/O" menu does not show, contact technical support.*
6. Select “Setup Analog I/O” from the menu. The analog set up menu shows.
   The analog inputs will be set to OFF when the instrument is configured at the factory. If the instrument goes back to the default condition, the analog inputs are set to OFF and it is

necessary to change to ON again. Set the analog connection to ON. Do not continue until it is ON.
Note: *Set all analog inputs to ON, even if they are not in use to prevent operation problems.*

Configure the analog output connection

It is possible to configure a maximum of eight analog output signals of particle count data for the instrument with an analog I/O card installed. The analog output connections are identified as OUT0 through OUT7. Ground connections for all analog outputs are made to I-RET. All of these outputs are configured as 4–20 mA outputs. Refer to Figure 11 on page 17.

1. Determine the correct count period.
   The manufacturer recommends to set a count period between 6 and 15 seconds for raw water or filter influent samples and 24 to 60 seconds for clean filtered water.
2. Set the count period in the main menu. Refer to Configure the RS485 connection on page 19.
   Note: *If the digital RS485 signal is connected to the data collection software, the count period is set in the software. The connection to WQS Vista data collection software automatically overrides the count period set in the main menu during the configuration programming.*
3. Configure the output channels (1 to 8).
   A shielded, twisted-pair cable, wiring for eight channels and the connections to a PLC or other devices are necessary for each channel.
4. Configure the analog outputs for cumulative or differential count formats in all possible combinations. Configure one output for cumulative and another for differential if necessary.
5. Set the lower and upper size for one channel. Refer to Configure the RS485 connection on page 19.
6. Determine the correct setting for the full scale value. Refer to Determine the full scale value on page 22.

Determine the full scale value

Counts/mL must be less than or equal to 17,000 counts/mL (the concentration limit of the instrument). The value used for counts/mL should be as small as is applicable for the sample to be measured. Select the maximum counts/mL with the applicable resolution of the analog output signal. Refer to Table 3 for the sample size references.

The full scale value is calculated as follows: Full Scale (FS) = counts/mL x mL sample; mL sample = 100 mL/min[6] x count period (in minutes) or = 100 mL/60 seconds x count period (in seconds)

Determine the full scale value with the estimate of the maximum cumulative particle counts at the sensitivity of the instrument, >2 µm. When the value is determined, calculate the estimated full scale value for other channels with the applicable divisor. Refer to Table 4.[7]

[6] The necessary flow rate for this instrument is 100 mL/min ± 5%.

[7] To make an estimate for the divisors of the values that are not shown in the table, use the formula that follows: Divisor = $(Size/2)^3$. For example, the divisor for >18 µm is $(18/2)^3$= 729

Table 3 Sample size reference table (flow = 100 mL/min)

Count Period (seconds)	Sample Size (mL)	Count Period (seconds)	Sample Size (mL)
6	10	24	40
12	20	30	50
15	25	48	80
18	30	60	100

Table 4 Divisors for full scale value determination (> 2µm)

Channel	Divisor	Channel	Divisor	Channel	Divisor
>3µ	3.4	>7µ	43	>11µ	166
>4µ	8	>8µ	64	>12µ	216
>5µ	15.6	>9µ	90	>14µ	343
>6µ	27	>10µ	125	>15µ	422

Complete a SCADA calculation

When the values are specified after each analog output for the lower limit, the upper limit and the full scale, the SCADA programmer enters the values for: The channel range, the upper size limit and the full scale value. The lower limit (4 mA) will always be 0 counts. In all cases, the lower limit signal (4 mA) will be 0 (zero) particles, the upper limit signal (20 mA) will be equal to the full scale value. The full scale value must then be divided by the sample volume (mL sample).

For example: If the sample flow rate is 100 mL/min, a count period of 30 seconds, the sample volume result is 50 mL. The maximum expected particle count is 1000 particles/mL. Then, the FS value = 1000 particles/mL x 50 mL = 50,000 CH0 set to cumulative particle counts > 2 µm. Refer to Table 5.

Table 5 SCADA calculation

CH	Lower	Upper	Full scale	Label at SCADA	4 mA =	20 mA =	Divide by[8]
0	2	0	5000	>2 µm	0	5000	50
1	5	0	3200[9]	>5 µm	0	3200	50
2	7	0	1166[2]	>7 µm	0	1166	50
3	10	0	400[2]	>10 µm	0	400	50

Complete a 4–20 mA output test

Do the test that follows to make sure that the analog current scaling of 4–20 mA data acquisition instruments (e.g., SCADA, PLC, etc.) are connected to the instrument with the analog I/O card installed. This procedure will push 4 mA or 20 mA from the instrument and an amp meter in series with the 4–20 mA loop in the line verifies the current flow.

1. Set the instrument power to off.
2. Connect the programming cable between the computer and the connector J1-RS232 on the instrument interconnect card. Use the RS485 connection.
3. Supply power to the instrument.
4. Send the ASCII command "load" to the instrument terminal to change the operating configuration.
   Note: *The word "load" is case sensitive. All letters in the word must be lower or upper case characters.*

[8] Divide by the value that value equals the mL sample used to calculate the full scale value.
[9] Divisor applied from Table 4 on page 23

5. Get access to the change menu within 30 seconds for the instrument configuration. Make sure to send the "load" command within 30 seconds after the unit power is set to on.
6. Type the number “7” to start the calibration mode. Calibration data and two instruction lines show on the monitor.
   - SPACE—toggles analog outputs between 4 mA and 20 mA
   - RETURN—goes back to the main menu
7. Push the space bar once to start the system (current flow).
8. Push the space bar to toggle from 4 mA to 20 mA or from 20 mA to 4 mA current source as read on the ammeter.
   Push the space bar again to toggle back and forth.
9. When done, push <Enter> to return to the main menu.
   Note: *Failure to enter the "quit" command can result in erroneous calibration and address values.*
10. To stop the sequence, type “Q <Enter>”.
11. Set the power of the instrument to off and remove the programming cable and the ammeter.
12. Return all wiring to the original configuration. Refer to Electrical installation on page 12.

PC communications

Install the data collection software on the computer. Refer to the software documentation for more information. The software controls the instrument operation and saves the count data to the computer memory.

Communications protocol

The instrument has four serial communications settings:

- Eight data bits
- No parity
- 9600 baud (RS232)
- One stop bit

Use the computer to change the device select mode [= 128 (ID# = 00)]. Refer to Configuration on page 19 to change the value.

Command syntax

The instrument responds to ASCII commands and sends a data record that changes in length related to the content.

The instrument gives results to all commands and selected codes when the command character is sent back to the computer. If the instrument does not identify a command, it sends a “?” character. If the computer asks for a record from an empty buffer, the instrument sends a “#” character. If the computer asks for a record that is already sent the instrument sends a “#” character unless the computer uses the Resend Record command. The instrument does not send any command characters if a parity or framing error occurs.

The command and data syntax is specified in Table 6.
Note: *The ASCII commands that are used by the instrument are case sensitive.*

Table 6 ASCII commands

Command	Description
“c” start counting (computer controlled)	The counter starts to count and does not wait for a second boundary (quick start). The count will continue until it is stopped by the computer. The count cycle must be controlled by the computer.
“d” start counting (counter controlled)	The counter starts to count and control the count cycle based on the front-panel setting for period (sample time).
“e” stop counting	The counter stops counting immediately and does not wait for a second boundary.

Table 6 ASCII commands (continued)

Command	Description
“o” alarm output	The analog multiplexer sets (or resets) a current-sinking output for an external alarm activation or deactivation.
“C” clear buffer	The rotating buffer is erased.
“E” send EPROM revision	The counter sends the EPROM number and revision.
“K” sensor cal curve	The calibration curve is put (or verified) in memory.
“M” mode request	The counter sends the present mode: Counting, a “C” is sent. Holding, an “H” is sent. Stopping, an “S” is sent.
“P” program sizes	The program size labels are put (or validated) in memory.
“T” identify model	The counter sends a four-character model number (e.g., PCX[space]).
“A” send record	The next record of the changing buffer is sent. When the next buffer is empty, a “#” is sent. Each record is erased from the buffer as it is sent. If no count cycles are completed, since the counter was set to on, then a “#” is sent. The record cannot be sent until the current count cycle is complete.
“R” resend record	The last record is sent again. Records that are sent to the last record are permanently erased.
“I” local mode	For technical support only. The counter is set to off-line.
“U” universal select	The counter responds to all commands after this command.
“128 to 191” counter select	The counter responds to all subsequent commands when a number is sent that agrees with the selected code. A number is sent between 128 (related to ID# 00) and 191 (related to ID# 63). The counter is deselected, or made unresponsive to computer commands when another counter is selected.

Data syntax

Each counter can send a stream of the data records. Data records are strings of ASCII characters set apart by end-of-record characters. Each data record starts with 20 characters of Counter Data.

The remainder of the data record has count data for:

- each of the six particle size ranges
- the analog input fields data (up to eight fields: two 4–20 mA and six 0-5 V)
- the calibration number (sensor calibration voltage in mV)
- the counter location number
- a checksum (hexadecimal number) for testing accuracy of the data transmission

The WQS Vista data collection software reads all inputs into the 2200 PCX and from all particle counters on the bus line.

The length of the string can change with the number of data points—count channels and analog inputs—available from the counter. Each data point has a three-character tag that identifies the type of data and six data characters which is set apart by spaces.

Table 8 shows the bold characters that give a data record of the serial communications format of an instrument with six size ranges and two analog inputs. The analog inputs are identified with AN0 (dc current level from flow controller) and AN1 (dc current level from turbidimeter).

When an ASCII character is changed to a binary byte, the character will show the instrument status. For example, the ASCII character “$” has a decimal value of 36, which when converted to a binary byte, sets the 3rd and 6th bits. Refer to Table 9.

Example:

Table 7 shows an example of the change of the ASCII character “$” to a status byte that shows a “Count Alarm”.

Table 7 Example for a count alarm change

Information	Description
Date	The Date information is transmitted in the third through eighth characters of the record. The second character is always a space to set apart the status character from the date characters. The date format is MMDDYY (Month Day Year). Table 8 shows that the instrument collected and stored the data in the record on August 1, 1993.
Time	Time information is transmitted in the tenth through the fifteenth characters of the record. The ninth character is always a space to set apart the date from the time. The time format is HHMMSS (Hours Minutes Seconds) military time. Table 8 shows that the time is 8:13 A.M. and 50 seconds.
Period	The period is the sample time or the length of counting time. The period information is transmitted in the seventeenth through twentieth characters. The sixteenth character is always a space, to set apart the time in the seventeenth through twentieth characters. The period is shown in minutes and seconds. In Table 8 the period was 30 seconds. When the period is controlled by the computer ("e" command), the period characters will be zeros. When the period (sample time) is controlled by the instrument ("d" command), the period characters will show the sample time.
Data 1, 2, 3, 4, 5, and 6	These characters contain data from the different programmed instrument size ranges. Each data value is before a three-character tag that identifies the size range of data that follows. The tags and data are each before a space character for separation. The record contain as many tag/data elements as necessary (a minimum of seven and a maximum of 10).
Tags	The tags contain three characters that identify the type of data that will follow. If the data is a particle count, the tag will show the particle size. In Table 8 the first tag shows that particle count data comes after the 2.0 µ particle size range. The record data will be shown in the units of measure that follow: • Particle Counts....counts • Analog Inputs..... milliamps (mA)
Data	The data are six numeric characters before a space.
Checksum	The sum of the ASCII value of each character in the data string. Used for testing accuracy of data transmission.
End of Message	The end of message characters will immediately follow the last tag/data element. There will be no separation space. The end of message characters are a carriage return and line feed.

Table 8 Serial communications format

Information	Type	Example code	Description
Counter Data	Status	$	—
	Date	080193	
	Time	081350	
	Period	0130	
Count Data	**Range 1**	2.0 002682	The first two numbers identify the particle size and the final six numbers report particle counts.
	Range 2	5.0 000334	
	Range 3	8.0 000136	
	Range 4	10. 000102	
	Range 5	12. 000032	
	Range 6	15. 000009	

Table 8 Serial communications format (continued)

Information	Type	Example code	Description
Analog Input Fields	**Input A**	AN0 001730	The first three characters are the tag and the remaining characters are the value for that tag.
	Input B	AN1 002481	
Service information	Calibration	CAL 001000	
	Location	LOC 000007	
	Checksum	C/S 001676	
	End. msg	CRLF	—

Table 9 Decoding the status character

ASCII character	Importance	Decimal equivalent	Binary equivalent (bit 76543210)
Blank space	no alarms	32	00100000
!	SENSOR fail alarm	33	00100001
$	alarm/count alarm	36	00100100

Maintenance

⚠ WARNING

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

Maintenance schedule

Table 10 shows the recommended schedule of maintenance tasks. Facility requirements and operating conditions may increase the frequency of some tasks[10]

Table 10 Maintenance schedule

Task	Weekly	Monthly	3 months	6 months	Yearly
Clean the cell on page 28 (untreated water or clarifier effluent)	X				
Clean the cell on page 28 (treated water samples (filter effluent))		X			
Replace the tubing on page 30 (untreated water)			X		
Replace the tubing on page 30 (clarifier effluent)				X	
Replace the tubing on page 30 (treated water samples (filter effluent))					X
Factory calibration					X

[10] Excursions of high turbidity, minerals (iron, manganese, calcium, etc.) and algae or other microbiological growths can increase the cleaning frequency.

Clean spills

⚠ CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

1. Obey all facility safety protocols for spill control.
2. Discard the waste according to applicable regulations.

Clean the instrument

Clean the exterior of the instrument with a moist cloth, and then wipe the instrument dry.

Clean the cell

⚠ WARNING

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

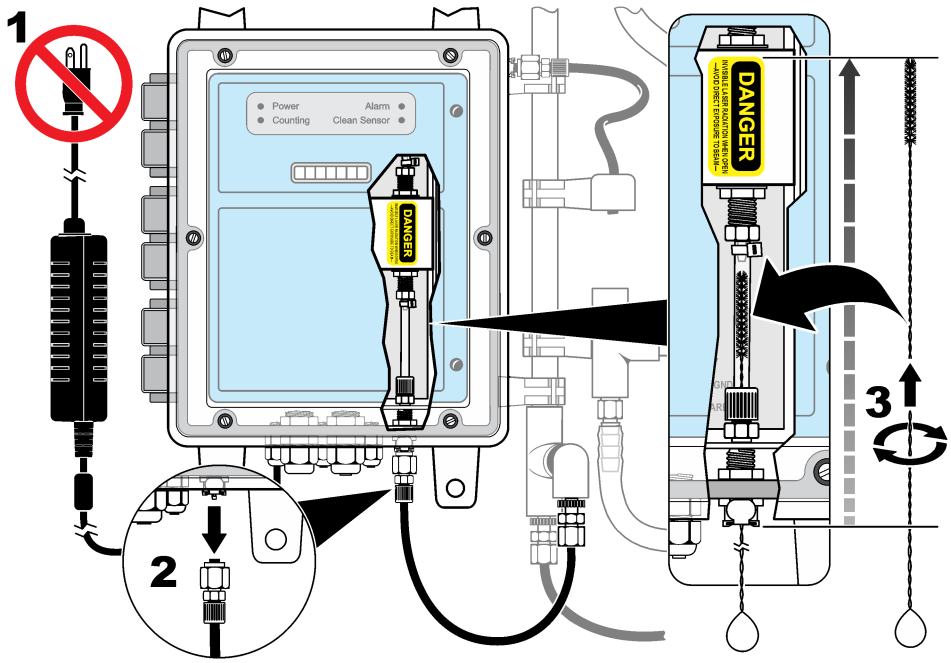
The instrument sensor has a cell assembly that moves the water through the laser beam. A cell becomes dirty when the sample dries out in the flow cell and small quantities of residue stay on the flow cell surface. This can have an effect on the calibration of the instrument and the clean sensor fail indicator LED comes on. Do the procedure that follows and refer to Figure 14.

Items to collect:

- Supplied cleaning brush
- Supplied cleaning solution

1. Set the instrument to off.
2. Remove the sample line quick-disconnect fitting at the inlet port.
3. Lubricate the brush with the cleaning solution.
4. Move the cleaning brush up through the bottom flow path.
5. Carefully move and twirl the brush 15 to 20 seconds in the bottom fitting.
6. Connect the inlet flow connector again and flush the cell.
7. Set the instrument to on again.
8. Make sure that the clean sensor fail indicator goes off within one sample period, approximately after 30 seconds.
   If the clean sensor fail indicator stays on, complete the stain cleaning procedure. Refer to Complete a stain cleaning on page 29.

Figure 14 Cell cleaning



Complete a stain cleaning

Complete the stain cleaning procedure when the cell cleaning procedure was not successful and the clean sensor fail indicator is still on. The cell is possibly chemically stained.

1. Disconnect the instrument from the normal on-line flow path.
2. Select the applicable contamination and use the applicable solution for the cleaning.

Contaminants	Solution
Microbiological (green) growths	Soak the cell with 30 to 50 mL of 70% or 90% isopropyl alcohol or dilute with solutions of household chlorine bleach (5.25% available chlorine). Dilute the bleach approximately 1:1000 (1 mL bleach to 1 liter of water) to prepare a 50 mg/L cleaning solution. Use stronger bleach solutions to remove severe growths. Soak the cell with 30 to 50 mL of the bleach solution. Rinse with clean water.
Red mineral deposits (iron, etc.)	Soak the cell with an iron-reducing agent then flush the cell with water.
Calcium (white) deposits	Soak the cell with white vinegar or phosphoric acid then flush the cell with water.
Mild manganese stains (purple or black)	Soak the cell with a solution (by volume) of $^1/_3$ water, $^1/_3$ white vinegar, and $^1/_3$ hydrogen peroxide; flush the cell with water.
Strong manganese stains	Soak the cell with a solution by volume of 70% white vinegar and 30% hydrogen peroxide (3% strength).

3. Connect the instrument to the flow path again and set the instrument power to on.
4. If the clean sensor fail indicator is still on, soak the cell for a longer period of time or use a different solution.
   Contact technical support for more information.

Replace the flow cell

The flow cell is not user replaceable. Contact technical support for replacement.

Replace the tubing

If the sample conditions are bad, change the tubing as often as necessary. Refer to Maintenance schedule on page 27 for recommendations for the tubing change.

Prepare the instrument for long-term storage or shipping

NOTICE

Potential instrument damage. Drain all water from the unit before shipment to prevent damage from freezing temperatures.

Fully clean the instrument for long-term storage (more than 2 weeks) or shipment.

1. Clean the sensor with the supplied cleaning solution. Refer to Clean the cell on page 28.
2. Flush approximately 30 mL of isopropyl alcohol through the instrument to remove all water. Make sure that no water is left in the instrument. Water spots can dry on the cell windows and can be difficult to remove.

Troubleshooting

Problem	Possible cause	Solution
Clean sensor indicator light is on.	The flow cell is contaminated or stained.	Complete the cell cleaning procedure. Refer to Clean the cell on page 28.
	Laser became weak.	Contact technical support to replace the laser.
	The flow is stopped. Air bubbles can cause a light beam blockage, which causes a calibration to fail.	Make sure that the flow rate is at 100 mL/min +/-10%.
	Application has too much turbidity.	Install a small or large mesh filter to decrease sample turbidity or find a different sampling location.
	Dangerous electrical incidents can cause the instrument to be set back to the default settings.	Make sure that software item #3 in the "load" menu is set to 800 to 1200.

Problem	Possible cause	Solution
Instrument does not communicate to the computer.	Lightning or a power surge can blow communications chips.	Connect directly to the PCX with RS232 programming kit cable, disconnect from RS485 network, cycle power and scan with advanced CRTS.
	RS485 converter or computer COM port is not connected correctly.	If the instrument is the last one in the network daisy chain, make sure that jp1 on the interconnect card is shorted.
	The instrument is disabled in the vista location setup screen. If the software identifies the instrument as location 32, the instrument is set back to default.	Make sure that the instrument is enabled in the vista location setup screen. Program the instrument completely on the high level and on the low level again.
	The instrument is locked up.	Unplug all instruments on the network, except the defective instrument. Set the power to off and then to on again and scan with the software program again.
	RS485 is not wired correctly in the instrument or connectors are not seated tightly.	Examine all wiring and connectors.
	The drivers for the RS485 adapter are not installed correctly.	Download and install the drivers for the RS485 converter from the converter manufacturer's website.
	For Windows versions of 7 and higher: VISTA is not installed in the correct program files folder.	Uninstall the software and install the software again. Make sure that the software is installed in the folder "Program Files (x86)"

Replacement parts and accessories

⚠ WARNING

Personal injury hazard. Use of non-approved parts may cause personal injury, damage to the instrument or equipment malfunction. The replacement parts in this section are approved by the manufacturer.

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Replacement parts

Description	Item no.
Converter, RS485/232, 120-230 V user selectable, CE	2082383-2
Converter, RS485 to USB	5920400
Desiccant, silica gel	520001
Fitting, quick connect, female, without valve	580186
Fitting, quick connect, female, with valve	580222
Fitting, quick connect, male, with valve	580223
Flow Controller, water weir	5700700
Hinge caps (NEMA cover)	610370
Interconnect Card	2082320
Junction Box, RS485	5700400

Replacement parts (continued)

Description	Item no.
Power supply, PCX standard 120 VAC	770013
Power cord, North America	1801000
Plunger (for cover latch)	590901
Terminal Strip, orange, 3 pos.	5702901
Terminal Strip, orange, 4 pos.	970080
Terminal Strip, orange, 5 pos.	970086
Tubing, Tygon, ¼ in. OD $^{1}/_{8}$ in. ID (per ft)	960024
Tubing, water weir drain, Tygon, ¾ in. OD x ½	5126300
Water weir clamp	510514
Quick connect fittings male with valve	580223
Quick connect fitting female with valve	580222
Water weir	2081335-1
Serial communications cable	2082591-1

Accessories

Description	Item no.
Analog I\O Kit, PCX, 8 channels out, 8 channels in	5700100
Cable, RS485 serial (per ft)	400004
Cable, PCX programming, DB9 to PCX, 6 ft	5700200
Cable Assembly, quick-connect, 25 ft	2083839-01
Cable Assembly, quick-connect, 50 ft	5702450
Cable Assembly, quick-connect, 100 ft	2083839-03
Cleaning Brush—PCX	2081699GP
Cleaning Kit—PCX	204839-6
Connector, quick-connect pigtail, female	2083838-01
Connector, quick-connect pigtail, male	2083837-01
Flow Cell, quartz coating	5701300
Hach UDG1000 software	WS-UDG
Strainer, 40-mesh, small volume	5700800
Strainer, 50-mesh, large volume	860471
Hytrel tubing, ¼ in. OD, black (per ft)	960032
WQS Vista data collection software, version 1.3	5701525
WQS Vista user manual[11]	DOC023.53.90008

[11] The software is available on the manufacturer's website.

HACH COMPANY World Headquarters
P.O. Box 389, Loveland, CO 80539-0389 U.S.A.
Tel. (970) 669-3050
(800) 227-4224 (U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf, Germany
Tel. +49 (0) 2 11 52 88-320
Fax +49 (0) 2 11 52 88-210
info-de@hach.com
www.de.hach.com

HACH LANGE Sàrl
6, route de Compois
1222 Vésenaz
SWITZERLAND
Tel. +41 22 594 6400
Fax +41 22 594 6499