

**PARTICLES**  
P L U S

# **8000 Series Handheld Particle Counters**

## **User's Manual**

Version 0.4

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#### **Products by Particles Plus, Inc. - 8000 Series**

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MODBUS is a registered trademark of Schneider Automation Inc.

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**NOTICE:** The contents of this manual are subject to change without notice.

**Product Name:** Particles Plus, Inc. 8000 Series Handheld Particle Counter

**Model Numbers:** 8306, 8506. & 8303

The following standards are applied only to the particle counters that are so labeled. EMC is tested using Particles Plus power supplies.

North America: EMI: FCC/ICES-003 Class A

FCC Compliance Statement for American Users

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 own expense.

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## 1-1 Important Safety Information

This section presents important information intended to ensure safe and effective use of this product. Please read this section carefully and store it in an accessible location.

- Do not use near explosive, flammable, or reactive gases.
- Do not attach directly to pressurized gases or liquids.
- Do not improperly discard electronic instruments, only dispose of in accordance with local regulatory requirements or contact Particles Plus for trade-in option.
- Defective or non-working Lithium-Ion batteries must be recycled, do not throw in trash.
- This device contains a Class I laser product that is not accessible during normal operation, do not take this device apart, exposure to harmful laser radiation can occur.
- Taking the device apart will void all warranties
- Do not use this device for any unintended purpose other than measuring of particles in ambient environments.
- Do not operate the instrument with the inlet capped or plugged as this can cause damage to the vacuum pump.
- Do not allow water or any other liquid to enter the inlet of the particle counter, this will damage the unit.
- Any changes or modifications to Particles Plus equipment not expressly approved by Particles Plus could void the user's authorization to operate the equipment, can risk serious injury, and will void all warranties.

### Key to Symbols

The symbols in this manual are identified by their level of importance, as defined below.

Read the following carefully before handling the product.



**WARNING:**

Warnings must be observed carefully to avoid serious bodily injury.



**CAUTION:**

Cautions must be observed to avoid minor injury to yourself or damage to your equipment.

## 1-2 Ergonomic Recommendations



**CAUTION:** In order to prevent or reduce the potential risks of ergonomic injury, follow the recommendations below. Consult with your local Health & Safety Manager to ensure that you are adhering to your company's safety programs to prevent employee injury.

- Reduce or eliminate repetitive motion
- Maintain a natural position while holding the Instrument
- Reduce or eliminate excessive force
- Keep objects that are used frequently within easy reach
- Perform tasks at correct heights
- Utilize a tripod or the built-in stand to use device in a freestanding mode
- Improve work procedures

## 1-3 Warnings for Use of Wireless Devices



Please observe all warning notices with regard to the usage of Particles Plus' particle counters with optional Wi-Fi communications module installed.

### **Safety in Hospitals**

Wireless devices transmit radio frequency energy and may affect medical electrical equipment. Wireless devices should be switched off wherever you are requested to do so in hospitals, clinics, or health care facilities. These requests are designed to prevent possible interference with sensitive medical equipment.

### **Pacemakers**

Pacemaker manufacturers recommend that a minimum of 15cm (6 inches) be maintained between a handheld wireless device and a pacemaker to avoid potential interference with the pacemaker. These recommendations are consistent with independent research and recommendations by Wireless Technology Research.

### **Persons with Pacemakers:**

- Should ALWAYS keep the device more than 6 inches (15cm) from the pacemaker if turned ON.
- Should **not** carry the device on your chest.
- Should use the arm furthest from the pacemaker to minimize the potential for interference
- If you have any reason to suspect that interference is taking place, turn OFF your device.

### **Other Medical Devices**

Please consult your physician or the manufacturer of the medical device to determine if the operation of your wireless product may interfere with the medical device.

## 1-4 Overview

Thank you for purchasing a Particles Plus particle counter, the most advanced handheld instrument available for measuring and monitoring particle counts in clean room and controlled environments for the Aerospace, Life Science, Data Storage, IAQ and Industrial Hygiene Markets.

This user manual will provide the detailed explanation and instructions for the proper use and operation of this feature-rich particle counter.

The Particles Plus 8000 series handheld particle counters provide the largest dynamic range of particle size measurement from 0.3  $\mu\text{m}$  to 25.0  $\mu\text{m}$  of any handheld, providing for true variable binning and allowing for channel size adjustment settings to 0.01  $\mu\text{m}$ . This instrument utilizes 7 or more processors to maintain and manage the various functions of operation. It allows for the fastest, most efficient particle counting with high accuracy and resolution. The advanced processing also allows for many operations to take place simultaneously, even while the unit is sampling. This includes adding annotations to the current sample in progress, or adding annotations to *previously* recorded data while sampling is in progress.

The Real-Time Meter™ function is unique in its ability to fine tune the instrument's sensitivity in order to locate particle contamination sources with visual and audible indications. This versatile particle counter's ability to count higher than typical particle concentrations allows the Real-Time Meter to find point source contamination in cleanrooms as well as locating higher particle concentrations being generated in many industrial environments.

The 8000 series handheld particle counters also have a mass concentration mode, providing for particle mass monitoring of an environment for industrial health and safety regulatory purposes. The unit can measure with all (6) adjustable particle size channels (3 for model 8303) or capture PM levels indicated in  $\mu\text{g}/\text{m}^3$  with values corrected for particle density and refractive index correction.

The Technology designed into these particle counters includes advanced power management functions. Onboard processors in the battery packs manage cell loading and battery life. Advanced power monitoring features allow for >10 hours continuous monitoring use, or the industry's first sleep mode that permits the instrument to take intermittent samples over the course of a few months on one battery charge (dependent on sample settings).

The 8000 Series handheld particle counters also boast the most versatile communication methods and protocols of any particle counter on the market. The instruments allow for Ethernet or Wi-Fi, and USB Host or USB Client connectivity, providing for MODBUS RTU, ASCII, TCP, web-hosted server for remote operation, and USB connection to a PC or to a thumb drive for data uploads or downloads. The remote web server hosting feature allows for monitoring and control of the particle counter from any PC, smartphone or tablet simply by inputting the IP address of the particle counter on the local area network and entering it into any browser. The main processors allow for multiple connections from operators, staff and management, all with simultaneous access to review, monitor and control the operation of the instrument.

Thank you,



## 1-5 Specifications

Size Channels: <b>Model 8306</b>	Factory calibrated at 0.3, 0.5, 1.0, 2.5, 5.0, 10.0 µm variable binning
Size Channels: <b>Model 8506</b>	Factory calibrated at 0.5, 0.7, 1.0, 3.0, 5.0, 10.0 µm variable binning
Size Range	0.3 to 25µm
Size Channels: <b>Model 8303</b>	Factory calibrated at 0.3, 0.5, 5.0 µm variable binning
Size Range	0.3 to 25µm
Flow rates	0.1 CFM (2.83 LPM)
Light Source	Long life laser diode
Counting Efficiency	50% @ 0.3 µm; 100% for particles >0.45 µm per JIS
Zero Count	<1 count / 5 minutes (<2 particles / ft <sup>3</sup> ) (per ISO 21501-4 & JIS)
Count Modes	Automatic, manual, cumulative/differential, mass concentration, count or concentration
Count Alarms	1 to 9,999,999 counts
Calibration	NIST traceable
Display	4.3" (10.9 cm) WQVGA (480×272) color touch screen
Printer (Optional)	External thermal printer
Vacuum Source	Internal pump with automatic flow control
Filtered Exhaust	Internal HEPA filter
Number of Channels	6
Custom Size Channels	Calibration for custom size channels available
Audible Alarm	Adjustable built-in alarm
Battery	Removable Li-ion >10 hours continuous operation and >16 hours normal operation
Battery Recharge Time	<2 hours
Reports	ISO 14644-1, EU GMP Annex 1, FS 209E
Recipes	50 user-configurable recipes
Communication Modes	Ethernet and USB
Optional Communication Modes	Wireless 802.11 b/g, RS485 or RS232
Environmental Sensor	Includes temperature and relative humidity probe 32° to 122°F (0° to 50°C) ±1°F (0.5°C), 15-90% ±2% relative humidity (OPTIONAL FOR 8303)
Alarm	Alarms on counts for all particle sizes, low battery, sensor failure, environmental sensors and flow
Standards	ISO 21501-4 and JIS B9921
Calibration	Recommended minimum once per year
External Surface	High impact injection molded plastic
Dimensions (L x W x H)	10" x 5" x 4.5" (25.4 cm x 12.9 cm x 11.4 cm) includes handle and does not include probes
Weight	2.2 lb. (1.0 kg)

### 1-5 Specifications (continued)

Accessories	Quick start guide, operating manual on USB flash drive, isokinetic probe, temperature relative humidity sensor, purge filter, battery, data download software, USB cable, power supply & cable (8303 Rh/Temp Probe Optional)
Optional Accessories	Printed manual, carrying case, spare battery, external battery charger, external printer and isokinetic probes
Buffer Memory	45,000 sample records (rotating buffer) including particle count data, environmental data, locations and times. Scrollable on screen or printout
Sample Locations	Up to 1,000 locations 20 characters long
Sample Time	1 second to 99 hours
Power	110 to 240 VAC 50/60 Hz universal in-line power supply
Operating Conditions	41° to 104°F (5° to 40°C) / 20% to 95% non-condensing
Storage Conditions	32° to 122°F (0° to 50°C) / Up to 98% non-condensing
Warranty	2 Years. Extended warranties available.

Please note that specifications are subject to change without notice.

## 1-6 Included Accessories

Description	Part Number	Image
Isoprobe Threaded 0.1 CFM Nickel Plated Aluminum	PS-12041	
Purge Filter Assembly 0.1 CFM (2.83 LPM)	AS-99002A	
Rechargeable Battery 55Wh	EE-80003A	
Temperature / RH Probe 32-122°F (0-60°C) ±1°F (0.5°C), 15 - 90% ±2% (NOTE: This probe is optional for Model 8303)	EE-80014A	
Power Supply 15V ~2amp 100-240VAC (Select adapter -US, -EU, -UK or -CN)	EE-80081-XX	
USB Cable 6' (1.8m)	AS-99010	
Handheld User Manual and Instrument Management Software (USB Key)	MN-24001	

## 1-7 Optional Accessories

Description	Part Number	Image
<b>Wireless 802.11 b/g Output with Internal Antenna</b>	<b>EE-80092</b>	
<b>Handheld Carrying Case</b>	<b>AS-99015</b>	
<b>External Battery Charger 55Wh</b>	<b>AS-99005A</b>	
<b>Rechargeable Battery 55Wh</b>	<b>EE-80003A</b>	
<b>External Thermal Printer with 2 rolls of paper</b>	<b>AS-99011</b>	
<b>External Thermal Printer Paper - 1 Roll</b>	<b>AS-99012</b>	
<b>External Thermal Printer Cleanroom Paper - 10 Pack</b>	<b>AS-99013</b>	
<b>External Thermal Printer Spare Battery</b>	<b>AS-99014</b>	

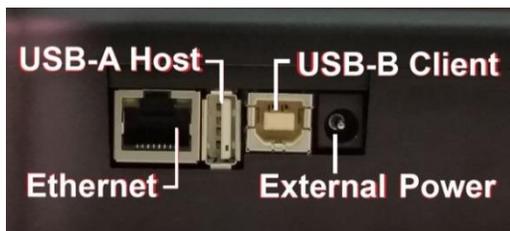
1-7 Optional Accessories (Continued)

Description	Part Number	Image
Isoprobe Threaded 0.1 CFM (2.83 LPM) Stainless Steel	PS-12070	
Isoprobe Barbed 0.1 CFM (2.83 LPM) Stainless Steel	PS-12022	
1/8" Inlet Barbed Fitting Stainless Steel	PS-12005	
Sample Tubing 1/4" OD (1/8" ID) per foot	AS-99018	
CAT5 4 Pair Plenum per foot	AS-99020	
Handheld User Manual (Printed)	MN-24001P	
Handheld Validation Manual	MN-24002	
Certificate of Origin	MN-24000	

# 1-8 Product Views



Left Side View – Input / Output Connections



Connecting Ethernet Cable



Connecting USB - B Client



Connecting USB - A Host



# Unpacking and Preparation for Use

## 2-1 Unpacking and inspecting the Instrument

Careful consideration was given to our packing material to ensure that your Particles Plus Instrument will reach you in perfect condition. If the Instrument has been subject to excessive handling during shipping, there may be visible damage to the shipping carton. In the event of damage, keep the shipping container and packing material for the carrier's inspection. Carefully unpack the Instrument from its shipping container and inspect the contents for damaged or missing items. If the Unit appears damaged or something is missing, contact the carrier and Particles Plus immediately. Please save the container and packing material in case you have to return the Instrument.

## 2-2 Registering Your Product

It is important to register your product with Particles Plus to ensure that your warranty will be activated. To register your product, visit the Particles Plus Website and complete the form provided at the following link:

<http://particlesplus.com/particles-plus-warranty-product-registration/>

## 2-3 Contacting Particles Plus

To order accessories, receive technical assistance, report damaged or missing items from your shipment, or get contact information for your nearest Particles Plus authorized reseller, call **+1-781-341-6898**

## 2-4 Storing and Shipping the Instrument

This instrument utilizes a high quality advanced Lithium Ion Power Cell. This must be removed from the device prior to shipping the unit. If the unit needs to be packed and shipped for annual calibration or service, it is recommended to use the original packing materials. If they are not available please insure that the instrument is packaged in a box that is sturdy and that the unit is well protected with proper packing materials to cushion and protect it from harm during transit.

To store the instrument, place it in its optional case or in a box, under cover, in an environment as stated in our specifications

## 2-5 Power Considerations and Connecting to AC Mains Power

The Particles Plus Instrument comes with a power adapter line cord for AC mains powered operation and battery charging. The power adapter is designed to operate with line voltage from around the world. The correct plug adapter must be used to match your local AC power adapter standard. If the Instrument power adapter does not have the proper plug configuration, please contact Particles Plus or an authorized reseller for service.

## 2-6 Power Considerations & Connecting to AC Mains Power

To install the country specific plug adapter, simply slide the adapter into the power supply as shown.



## 2-7 Installing Batteries



**CAUTION** - The Particle Plus rechargeable battery model EE-80003A is an intelligent battery pack with onboard processing to ensure proper cell loading and other functions that support the advanced power management features of this instrument. To ensure a long life for the batteries and for adherence to any local regulatory guidelines for the use, storage and disposal of Lithium Ion batteries please follow these instructions carefully.



**WARNING** – Do not plug in, or charge the Particles Plus Lithium-Ion rechargeable battery with any other power source other than the approved Particles Plus Rechargeable Battery External Charger - Model AS-99005A, or using the Particles Plus Power Supply Model EE-80081-XX. Using any other charger can cause fire, shock or serious injury.



**Li-ion**

**Caution: Dispose of Particles Plus lithium-ion batteries only at an approved local battery recycling center.**

## 2-7 Installing Batteries (continued)

Install the Particles Plus Battery pack into the instrument using the following steps:



Step 1 - Remove security screw with Phillips screwdriver.



Step 2 – Pull out kick-stand.



Step 3 – Push down latch while pulling battery compartment cover out and away.



Step 4 – Insert battery connector plug into matching socket on PCB board in battery compartment. NOTE: red and black lead should be on bottom edge of connector.

## 2-7 Installing Batteries (continued)



Step 5 – Carefully push battery into the compartment using an upward motion until bottom of battery clears edge of the compartment and drops in freely.



Step 6 – Seat the battery's compartment cover into bottom slot and push inward until the locking latch clicks. The security screw can be reinstalled with a screw driver or it can be removed for optional battery replacement use.

## 2-8 Turning the Unit On



The External one-touch power and sample button on the handle will power the instrument on and off and will turn sampling on and off.

The one-touch external power button is conveniently located on the particle counter handle to allow for easy one touch operation. Holding the handle, place thumb over the button and press and hold until the particle counter turns on.

Pressing the button momentarily starts the pump and begins sampling.

Pressing the one-touch button again for 1 second stops sampling.

Holding the button for 2.5 seconds turns the instrument off.

The unit can also be turned off from the power management screen.



## 2-9 Power and Charging Status LED (on power button)

Power and charging status is indicated externally on the instrument in the middle of the one-touch power and sample button. The indication provides information on the charging rates and status (shown on right).



### Unit plugged into AC (instrument screen on or off)

Charging: Red LED on

Charging Complete: Green LED on

### Unit not plugged into AC (instrument screen on)

Battery Charge <10%: **Red LED** blinks every 3 seconds

### Unit not plugged into AC (instrument screen off)

All LED's off

## 3-1 Control and Menu Icons

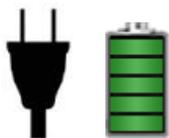


20.2 C  
35% RH

2015/01/15  
12:30:01 PM

Function Name	Location/Screen	Description of Function
<b>P+ logo icon</b>	Home Screen	Press logo and a Product Information Screen will appear displaying your model number, serial number, manufacture date, last calibration date, next calibration due date and number of channels activated on the unit. Press back arrow icon on bottom left corner of the display to return to home screen.
<b>Speaker icon</b>	Home Screen	Speaker Icon allows for volume adjustment using a pop-up slider bar. When pressed the cross bar on slider and move up and down for volume control. Icon will have red prohibited symbol when sound is turned off or muted.
<b>Temperature &amp; RH indication</b>	Home Screen	By pressing the temperature and RH value indication the screen will change to a large indication of the current Temperature, Relative Humidity and the current Barometric Pressure. Press back arrow icon on bottom left corner of the display to return to home screen.
<b>Time and Date Indication</b>	Home Screen	To change time and date, press the date and time in the top right corner of the display and the change time and date screen will appear allowing for changes

### 3-1 Control and Menu Icons (Continued)



Function Name	Location/Screen	Description of Function
<b>Power Management Icon</b>	Home Screen	On the top right of the display is the battery/power adapter indication icon. Pressing this icon displays the battery power management screen as well as the current battery status.
<b>USB Communication Icon</b>	Home Screen	If a USB drive is connected, the USB Icon will appear. When pressed from the home screen the current record displayed will be saved to the USB drive.
<b>Printer Indication</b>	Home Screen	If the Particles Plus Printer is connected to USB Port, the Printer Icon will appear. When pressed from the home screen the current record on screen will be sent to the printer.
<b>System Warning Indication</b>	Home Screen	When the System Warning Indication Icon appears, please contact Particles Plus technical service for assistance. When pressed, the Instrument will display additional information.
<b>Alarm Indication</b>	Home Screen	Visual indication of alarm condition if the particle count exceeds the user defined thresholds. When pressed this will silence the alarm.
<b>Run Icon</b>	Home Screen	The Run Icon starts the instrument sampling. Once pressed the Run Icon will be replaced by the Stop Icon.
<b>Stop Icon</b>	Home Screen	The Stop Icon stops the instrument from sampling.
<b>Real-Time Meter &amp; Environmental TPM Screen Icon</b>	Home Screen	When pressed the Real-Time Icon switches between the Real-Time Meter mode, graphing of pulse/seconds, The environmental PM2.5 indication display and the Main Screen.
<b>Recorded Data Icon</b>	Home Screen	When pressed, the Recorded Data Icon will display the saved data records page. All saved records can be accessed from this screen.

### 3-1 Control and Menu Icons (Continued)

	Function Name	Location/Screen	Description of Function
	<b>Reports Icon</b>	Home Screen	When pressed, the Reports Icon will display the standards options page, where ISO 14644-1, EU-GMP Annex 1, or Federal Standard 209E modes can be selected.
	<b>Particle Data Selection Icon</b>	Home Screen	When pressed, the Particle Data Icon changes the indicated values from particle count, count per cubic meter, or count per cubic foot and particle mass concentration (activated in channel management). These values are displayed simultaneously as differential and cumulative counts.
	<b>Differential Mode Icon</b>	Home Screen	When pressed, the Differential Mode Icon toggles the differential data values off and on the display during or after sampling.
	<b>Cumulative Mode Icon</b>	Home Screen	When pressed, the Cumulative Mode Icon toggles the cumulative data values off and on the display during or after sampling.
	<b>Location Menu Icon</b>	Home Screen	When pressed, the Location Menu Icon displays the Location and Recipe set up pages. This feature allows for the input of up to 1000 locations 20 characters long and up to 50 unique user-defined recipes.
<b>Mode: Automatic</b>	<b>Mode Indication</b>	Home Screen	The Mode Indication displays the current mode of operation the instrument is set to. These modes include automatic, manual, and continuous.
<b>Sample: 00:01:00</b>	<b>Sample Indication</b>	Home Screen	The Sample Time Indication displays the current sample time duration (Hours:Minutes:Seconds). This value will countdown from the set value for the sample time, displaying the amount of time left in the current sample. See Sampling Setup in Settings Menu.
<b>Hold: 00:02:00</b>	<b>Hold Indication</b>	Home Screen	The Hold Time Indication displays the current hold time, as an interval between samples. The maximum hold time is 99 hours, 59 minutes and 59 seconds. See Sampling Setup in Settings Menu.
<b>Cycle: 1 / 3</b>	<b>Cycle Indication</b>	Home Screen	The Cycle Indication displays the number of count samples that will be taken at a location in automatic mode. The maximum number of possible cycles that can be set is 9,999. The value is displayed as the sample number vs. the total number of samples to be completed in this cycle. See Sampling Setup in Settings Menu.

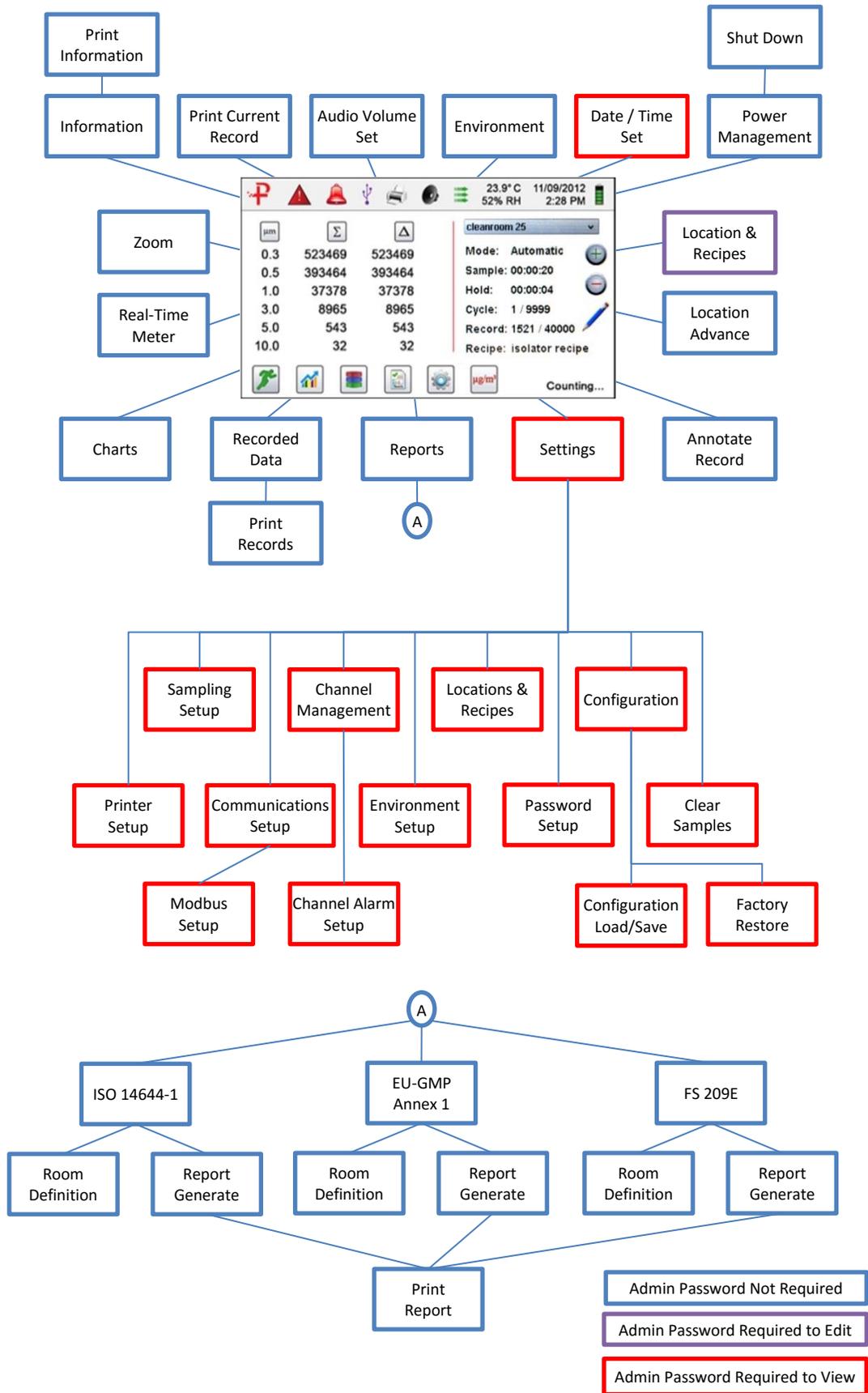
### 3-1 Control and Menu Icons (Continued)

Record: 1 / 40000



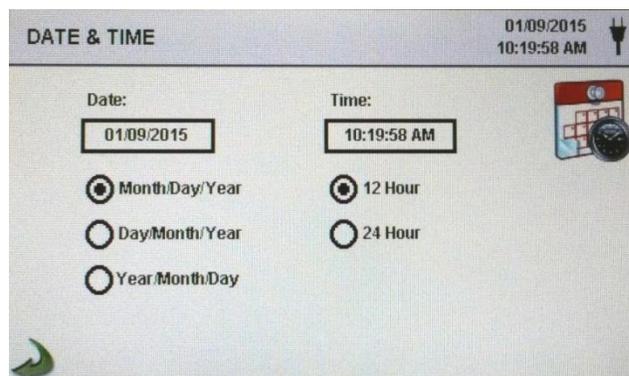
Function Name	Location/Screen	Description of Function
<b>Record Indication</b>	Home Screen	The Records Indication is a display of the total number of sampling records saved in the Instrument out of the total number of records the instrument is capable of storing -- 40,000 possible saved records (rotating buffer) including particle count data, environmental data, locations and times per record.
<b>Settings Menu Icon</b>	Home Screen	When pressed, the Settings Menu Icon brings you to the Settings Screen. All aspects of the Instrument's set-up can be managed from the icon driven sub-menus.
<b>Annotation Icon</b>	Home Screen	<i>The Annotation Icon, displays as a <b>blue</b> pencil. When pressed, written notation (up to 32 letters, can be added to a record during the time of the sampling, or after a sample has been taken. Advanced processing allows for annotations to be inserted while the unit is sampling with no interruption to the operation. The <b>green</b> pencil over a document denotes that an annotation exists on that record. This feature can be disabled from the Configuration screen in Settings.</i>
<b>Plus and Minus Button</b>	Home Screen	When pressed, these icons scroll through 500 possible locations that can be saved and uniquely identified in the Locations set-up screen. Locations can have set recipes assigned to them in advance for ease-of-use during sampling.
<b>Green Flow &amp; No Flow Indication</b>	Home Screen	The three horizontal arrows indicate that the pump is working and that the internal flow sensor is detecting the correct flow rate through the Instrument. If a red line appears diagonally through three green arrows, it is an indication no flow.
<b>Back Arrow Icon</b>	Various Screens throughout program	Press back arrow Icon to return to the previous screen.

# 4-1 Operational Flow Chart - Menu Map



## 5-1 Operation – Initial Power Up – First Time Use

After the Particle Counter turns on for the first time a window will appear stating “Time of Day Clock Not Set”. Press OK to Set Clock.



**Date Format Select Button** Choose format for - Month/Day/Year, Day/Month/Year, or Year/Month/Day indication by selecting the corresponding button on the touchscreen.

**Numeric Keypad** Touch date window, a numeric keypad will appear to allow for date change. For change or correction of input values navigate using < or > to move cursor. When complete press OK button

**Time Format Select Button** Choose 12 hour or 24 hour clock indication by selecting the corresponding button on the touchscreen.

**Numeric Keypad** Touch time window, a numeric keypad will appear to allow for time change. Use 24 hour clock format for time entry to properly indicate AM or PM. For change or correction of input values navigate using <or> to move cursor. When complete press OK button- Time will display with AM/PM or in 24 hour format based on format selection.



**Back Arrow Icon** Press back arrow Icon to return to the previous screen.

## 5-2 Display

The large color touch screen can zoom in and out on the home page at any time simply by touching any blank space on the screen.



Un-Zoomed View

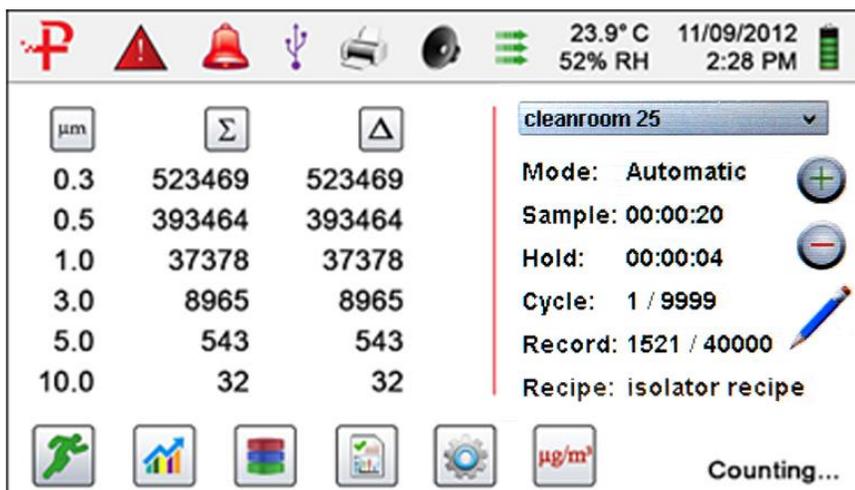


Zoomed View

## 5-3 Taking a Sample

### Main Sampling Home Screen

**Note:**  
Model 8303  
only displays  
(3) channels



#### Taking a Sample

Using the one touch power/sample button on the handle or the start sample icon on the display begins the sample.

To take a sample, select the start sample icon on the display, or momentarily press the one touch button on the particle counter's handle. This will begin the sample according to the sampling set up parameters displayed on the right side of the home display. The sample setting can be changed in the settings sub-menus.



#### Stopping the Sample

Using One Touch Handle button or the Stop Sample Icon on the display

To stop the sampling event press the stop icon on the display or momentarily press the one touch button on the particle counter's handle.



#### Data Unit of Measure Selection

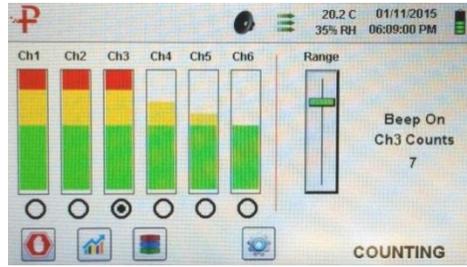
The instrument can display the active sample or any recorded and saved record in count, counter per cubic meter, count per cubic foot, or micrograms per cubic meter (in mass mode, if enabled from the Channel Management Screen). This can be changed on the fly by pressing the icon, rotating through the data output indication options.

## 5-4 Real-Time Meter, & Environmental PM2.5 Display Function

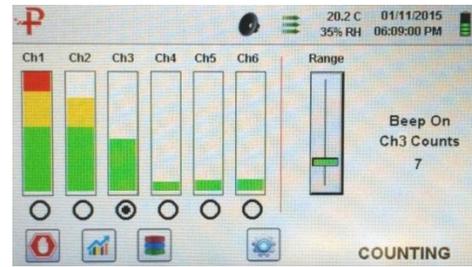


The Instrument will display a bar graph visualization that rises and falls with the increase of pulses counted per second, per channel. This allows for the pinpointing of the cause of the contamination that is being detected in the environment. The closer the instrument is to the source, the higher the indication appears on the bar graph. This feature also graphically displays the pulses per second if the graph function is chosen, making the graph's historical information useful in point source detection.

## 5-4 Real-Time Meter and Graphing Function (continued)



Channel 3 selected & signal at maximum value



Range Slider Lowered to reduce Channel 3 value

While on Real Time Meter Page, the following steps allow for the features operation.



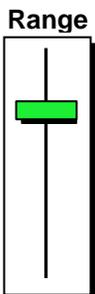
**Start/Stop Sampling while on Real-Time Meter or Pulse Per Second Screen**

The Sampling can be started or stopped from this screen using the Start/Stop icon buttons, or by using the one touch button on the handle.



**Channel Select – Radio Button**

Select the channel size that is the focus of the contamination being investigated by clicking on the radio select button on the bottom of each channel. The channel selected also represents the data being displayed in the pulses per second graph mode.



**Range – Sensitivity Adjustment Slider**

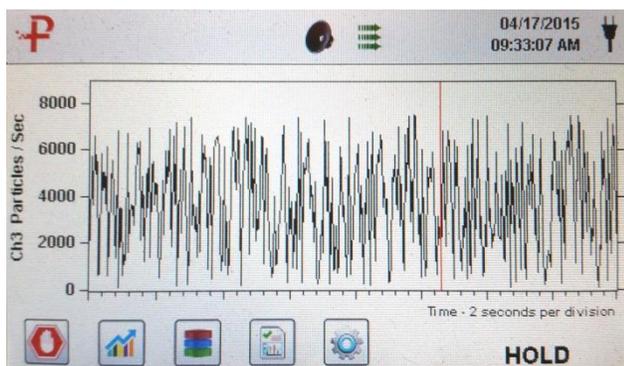
Using the touchscreen, drag the green Range slider bar up towards the top of the slider. This allows for the greatest sensitivity and signal from the contamination within the test area. As the unit gets closer to the concentration source the visual signal can increase and hit 100% of the indicated scale long before the actual source of the contamination is found. By pulling the Range Slider down, the sensitivity is reduced and the indication scaled down. This allows for more precise detection when getting closer to the contamination source. This procedure can be repeated until the source is identified.



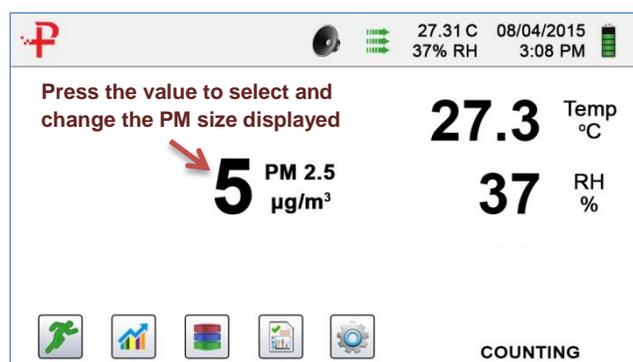
**Switch to Particles Per Second Screen, or to Environmental PM2.5 Display**

Pressing the Real-Time Meter Icon again, switches to the Particles per second graphical display page. Pressing it one more time displays the Environmental PM2.5 Air Quality Display. Pressing the Icon one more time returns the display to the home screen.

Real-Time Meter Particles/Second Graph



PM 2.5 Environmental Conditions Display



## 5-5 Recorded Data



The Particle counter will save up to 45,000 records. These records can be accessed by selecting the recorded data icon. The Recorded data page uses a horizontal slider bar that allows scrolling left and right through all records. Click on the white arrows for fine control in locating a specific record. Press the slider button with the stylus and drag left or right to navigate through large amounts of records quickly.

**IMPORTANT NOTE:** After the 45,000th sample is recorded the software must delete one block of flash memory to make room for the next record. Each block contains 28 records. After 28 records are deleted the next record number will become 44,972. The instrument will then count back up to 45,000 again. Each block removed is from the oldest records (first in, first out method).



### Recorded Data Screen

RECORDED DATA			01/14/2015 11:59:24 AM	
$\mu\text{m}$	$\Delta\text{m}^3$	$\Sigma\text{m}^3$	Location 1	
0.30	0	0	Date:	01/07/2015
0.50	0	0	Time:	05:59:46 PM
1.00	0	0	Sample:	00:01:00.191
3.00	0	0	Volume:	0.100000 ft <sup>3</sup>
5.00	0	0	Laser:	OK
10.00	0	0	Flow:	OK
			Temp:	75° F
			RH:	46%
RECORD: 1 / 28				



### Print or Save the Current Record being displayed

If a Printer or USB thumb drive is attached to the instrument, the current record on the Recorded Data Screen can be downloaded or printed by pressing the corresponding Printer or USB Icon.



### Turn off Indicated Cumulative or Differential value Columns

All displayed channel values can be turned off or back on from the recorded sample record by toggling the mode icons.



### Change Indicated Data Units

The Recorded data indication can be changed to the corresponding calculated values by pressing the Particle Data Selection Icon. Press the icon to change view between particle count, count per cubic meter, count per cubic foot, or micrograms per cubic meter (if enabled for mass concentration mode in Channel Management).



### Adding Annotation To Recorded Data

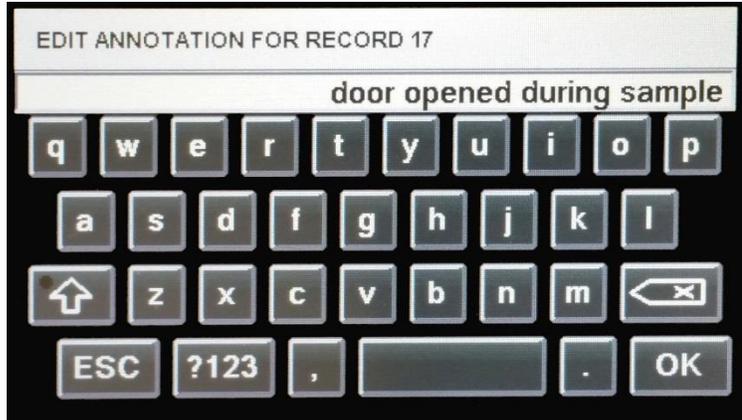
To add an annotation to an existing record, click on the **Blue** Pencil Annotation Icon. This allows for the inclusion of a written notation for the current sample record selected. The Annotation Keyboard will be displayed and the note can be entered. The **Green** pencil denotes that an annotation exists on that record. This feature can be disabled from the Configuration screen in Settings.

RECORDED DATA			01/14/2015 12:00:01 PM	
$\mu\text{m}$	$\Delta\text{m}^3$	$\Sigma\text{m}^3$	Location 2	
0.30	891,809	179,855,856	Date:	01/14/2015
0.50	9,322,324	178,964,032	Time:	11:47:31 AM
1.00	93,325,336	169,641,712	Sample:	00:00:10.169
3.00	48,980,752	76,316,368	Volume:	0.016667 ft <sup>3</sup>
5.00	21,153,382	27,335,622	Laser:	OK
10.00	6,182,239	6,182,239	Flow:	OK
			Temp:	75° F
			RH:	46%
RECORD: 17 / 28				

## 5-5 Recorded Data (continued)



### Annotation Keyboard



### Saved Annotation Indication and Icon

The green pencil over a document denotes that an annotation exists on that record. The annotation can be accessed or edited at a later time.

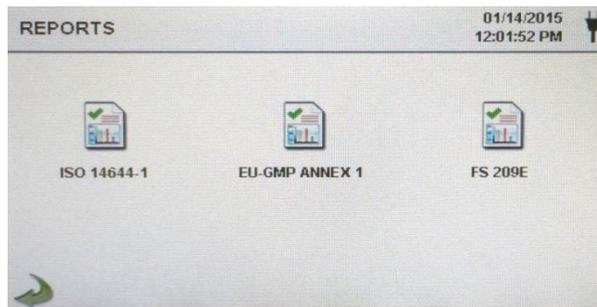
### Special Notes – Cap Locks and Delete

Holding down the Shift button will activate or de-activate the cap locks functions. Holding down the backspace key will delete all text entered on the text line.

## 5-6 Reports



### Accessing ISO, GMP, or Federal Standard Report Functions



#### ISO 14644-1

Selecting this report icon allows for the generation of a report based on the parameters and guidelines of the ISO standard.

#### EU-GMP Annex-1

Selecting this report icon allows for the generation of a report based on the parameters and guidelines of the European GMP Annex-1 standard.

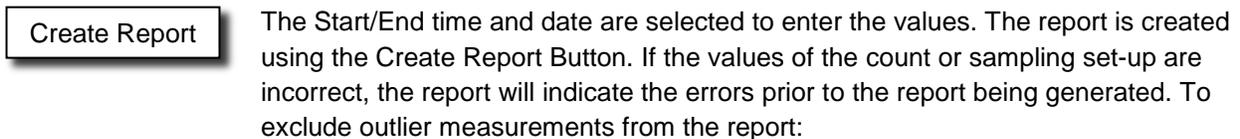
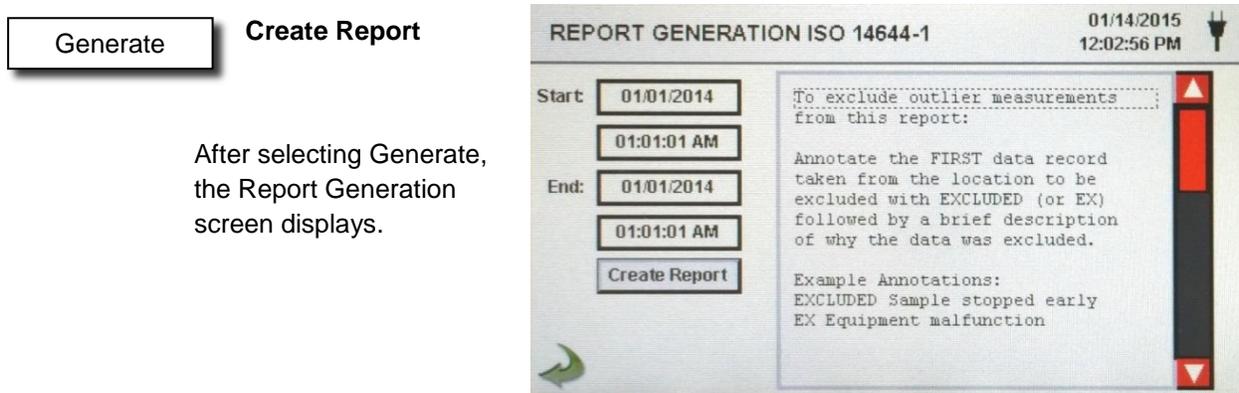
#### FS 209E

Selecting this report icon allows for the generation of a report based on the parameters and guidelines of the US Federal Standard 209E.

## 5-6 Reports (continued)

Selecting the specific report icon from the Reports Screen displays information for the chosen standard. The room parameters can be defined by pressing the Room Definition Button. To generate a report, select the Generate Report button. This creates a report document that can be saved to an external thumb drive, or printed to a connected printer.

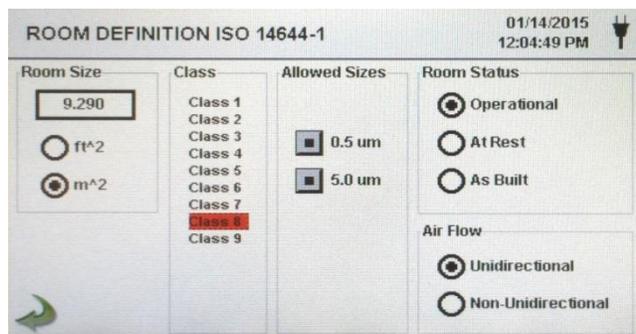
By holding down the Create Report Button for 5 seconds, a sample report will be displayed with the current test records. These records will be added to the system's recorded data so that the values and information can be reviewed prior to actually completing the report and saving to an external source.



Annotate the FIRST data record taken from the location to be excluded with EXCLUDED (or EX) followed by a brief description of why the data was excluded.

Example Annotations: EXCLUDED Sample stopped early or EX Equipment failure.

### Room Definition



Each report standard has a Room Definition page that allows for information to be input defining the output of the generated report. Room size is input in square feet or square meters. The ISO class of the cleanroom being tested is selected, and the allowable sizes may be included or excluded in the report. The Room Status is selected as being Operation, At Rest, or As Built per the standard specification requirements. Airflow is recorded as being Unidirectional or Non-Unidirectional.

## 5-6 Reports (continued)

### Sample of Report Output

01/14/2015  
12:06:22 PM

**REPORT GENERATION ISO 14644-1**

Start:	01/14/2014	ISO 14644-1 Report 01/14/2015 12:05:57 PM  Target Class: Class 8 Room Area: 9.290 m <sup>2</sup> Room Status: Operational Air Flow: Unidirectional Locations: 2 Samples: 4 Start: 01/14/2014 01:01:01 AM End: 01/14/2014 11:59:01 AM
	01:01:01 AM	
End:	01/14/2014	
	11:59:01 AM	
	Create Report	

### Printed Report Sample

```

ISO 14644-1 Report
01/16/2015 06:54:08 AM

Target Class: Class 5
Room Area: 80.000 m^2
Room Status: Operational
Air Flow: Unidirectional
Locations: 9
Samples: 11
Start: 01/16/2015 06:53:01 AM
End: 01/16/2015 06:53:09 AM
-----
Class Class 5 (at 0.3) PASS

Class Limit: 10,200.00 P/m^3
Min Sample Vol: 0.00283 m^3

Grand Mean: 6,349.21
Std Dev: 2,154.42
Std Error: 718.14
95% UCL: 7,684.94

Location Avg P/m^3
14644 Test Loc 1 8,750.0
14644 Test Loc 2 6,607.1
14644 Test Loc 3 2,107.1
14644 Test Loc 4 3,785.7
14644 Test Loc 5 5.857.1
-----
Class Class 5 (at 0.5) PASS

Class Limit: 3,520.00 P/m^3
Min Sample Vol: 0.00568 m^3

Grand Mean: 706.35
Std Dev: 381.65
Std Error: 127.22
95% UCL: 942.97

Location Avg P/m^3
14644 Test Loc 1 750.0
14644 Test Loc 2 857.1
14644 Test Loc 3 0.0
14644 Test Loc 4 250.0
14644 Test Loc 5 785.7
-----
Unit Serial #: 1000
Last Cal: 05/15/2014
----- End of Report -----
    
```



### Printing or Saving a Report

To Print a report on screen, or save it to an installed thumb drive, press the corresponding icon on the.

Note: a thumb drive or printer must be connected to the instrument to display these icons.

## 6-1 Settings



### Settings Screen

Select the Settings Icon to enter the main configuration menu. All settings for the instrument are accessed through this Settings screen. When the administrator password is in use, this screen is not available to regular users and may only be accessed and settings modified by the administrator.

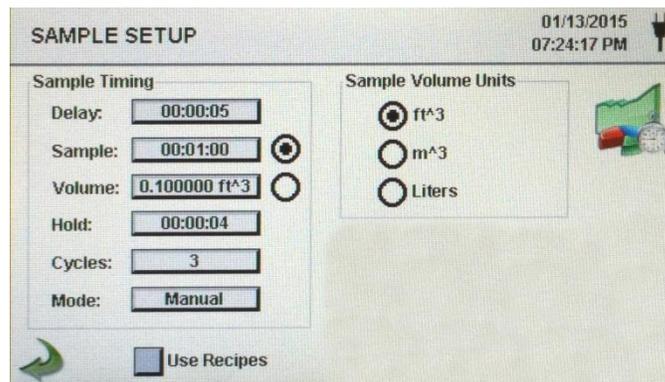


## 6-2 Sampling Setup



### Settings Screen

The Sampling Setup Icon displays the Sample Timing, Sample Volume Units and Pump Start Timing selection windows. The option to utilize recipes instead of the general Sample Timing setup values is also accessed on this page with a selection box.



### Delay

Pressing the Delay time box opens the Enter Time screen. The numeric touchpad is used to enter the amount of time the counter will wait before starting a sample in automatic mode.

The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum delay time is 99 hours, 59 minutes and 59 seconds. This feature is ideal to allow the operator to leave the area before the sampling begins.

## 5-6 Reports (continued)

<b>Sample</b>	Pressing the Sample Button opens the Enter Time screen with numeric touchpad for the entry of the amount of time the counter will sample in automatic mode. The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum sample time is 99 hours, 59 minutes and 59 seconds.
<b>Volume</b>	Pressing Volume displays the numeric touchpad for the entry of the desired volume to be sampled. The volume will correspond to the units selected in the Sample Volume Units Selection on the Sample Setup Screen. The volume value entered will control the length of time per sample to achieve the desired sample volume.
<b>Hold</b>	Pressing the Hold Button opens the Enter Time screen with numeric touchpad for the entry of the amount of time the counter will hold between samples in automatic mode. The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum Hold delay time is 99 hours, 59 minutes and 59 seconds.
<b>Cycles</b>	Pressing Cycles displays the Enter Cycles Screen with numeric touchpad for entry of the number of sampling cycles to be taken at a specific location when the unit is in automatic mode. <b>Enter ZERO (0000) to activate Continuous Sampling Mode.</b>
<b>Mode</b>	The Mode icon opens the Select Sample Mode page. Select Automatic mode or Manual Mode. After making a selection, press OK to accept and return to the previous page, or select cancel.
<b>Sample Volume Units selection</b>	Choose from three different sample volume units: Cubic Feet (ft <sup>3</sup> ), Cubic Meters (m <sup>3</sup> ) or Liters.
<b>Use Recipes Button</b>	The Use Recipes button activates the Recipe Setup Page. Recipes associated with locations will be utilized in place of the general settings from the Sample Timing Setup screen.
 <b>Back Arrow Icon</b>	Press back to last screen arrow on bottom left corner of the display to return to main settings screen.

## 6-3 Channel Management



This screen allows for many rich features to be controlled, including enabling or disabling channels, setting custom channel sizes, enabling or disabling alarms by channel and the setting of the alarm thresholds. The mass concentration mode may also be activated to allow entry of particle density and refractive index values by channel.

### Channel Management Screen

Enable Channel:	Size $\mu\text{m}$ :	Enable Alarm:	Alarm Threshold:	Density g/ml:	Refractive Index:
<input type="checkbox"/> Ch 1	0.30	<input type="checkbox"/>	5000000		
<input type="checkbox"/> Ch 2	0.50	<input type="checkbox"/>	3520000		
<input type="checkbox"/> Ch 3	1.00	<input type="checkbox"/>	832000		
<input type="checkbox"/> Ch 4	3.00	<input type="checkbox"/>	3000		
<input type="checkbox"/> Ch 5	5.00	<input type="checkbox"/>	29300		
<input type="checkbox"/> Ch 6	10.00	<input type="checkbox"/>	350		

Use Recipes  Alarm On   $\Sigma\text{ft}^3$   Mass Mode

**Enable Channel:** Each channel can be turned on or off by pressing the corresponding radio button. When the channel is turned off all values related to that channel are ignored and will not be displayed or recorded.

**Size (micron -  $\mu\text{m}$ )** The individual channels (2 - 6) can have their target size adjusted, by pressing the corresponding Size  $\mu\text{m}$  field and entering the desired value with the numeric keypad. This feature is also known as variable binning, and is ideal for focusing on specific, known particle sizes.

**Enable Alarms** Each channel can have an alarm enabled or disabled by pressing the selection button for the channel. The Alarm Threshold can be entered by pressing this field and entering a numerical value on the Enter Alarm Threshold Screen. This displays a numeric touchpad in order to enter the desired value. Once the value is entered, click ok, or cancel to return to the Channel Management screen.



**Alarm On** By selecting the Cumulative Mode Icon the Channel Alarm Setup Screen is displayed. The Alarm On Threshold values will correspond to the eight (8) options listed on the Channel Alarm Setup page.

**Channel Alarm Setup Page**  $\Delta$  - Differential count,  $\Delta\text{ft}^3$  - Differential cubic feet,  $\Delta\text{m}^3$  - Differential cubic meter,  $\Sigma$  - Cumulative count,  $\Sigma\text{ft}^3$  - Cumulative cubic feet,  $\Sigma\text{m}^3$  - Cumulative cubic meter,  $\mu\text{g}/\text{m}^3$  - micrograms per cubic meter, or PM - Particle Mass

## 6-3 Channel Management (continued)

### Mass Mode Settings

CHANNEL MANAGEMENT						01/15/2015 01:53:24 PM
Enable Channel:	Size $\mu\text{m}$ :	Enable Alarm:	Alarm Threshold:	Density g/ml:	Refractive Index:	
<input checked="" type="checkbox"/> Ch 1	0.30	<input type="checkbox"/>	5000000	2.50	1.000	
<input checked="" type="checkbox"/> Ch 2	0.50	<input type="checkbox"/>	3520000	2.50	1.000	
<input checked="" type="checkbox"/> Ch 3	1.00	<input type="checkbox"/>	832000	2.50	1.000	
<input checked="" type="checkbox"/> Ch 4	3.00	<input type="checkbox"/>	3000	2.50	1.000	
<input checked="" type="checkbox"/> Ch 5	5.00	<input type="checkbox"/>	29300	2.50	1.000	
<input checked="" type="checkbox"/> Ch 6	10.00	<input type="checkbox"/>	350	2.50	1.000	

Use Recipes  Alarm On  $\Sigma \text{ft}^3$   Mass Mode



Mass Mode

### Mass Mode Enable

The Mass Mode button allows the instrument to display particle count data as calculated particle mass concentration in weight/volume units. The international SI unit for mass is ( $\text{kg}/\text{m}^3$ ), which can be translated to micro grams per milliliter ( $\mu\text{g}/\text{ml}$ ). This is indicated as an accepted value for particle mass monitoring for environmental as well as health & safety applications.

### Density g/ml:

The density of the particles to be measured can be entered to allow for higher accuracy and correlation to the actual mass concentration values. To do so, select the numeric field corresponding to the particle size channel and enter the desired density value in g/ml with the numeric touch pad. Press OK or cancel to return to the Channel Management Screen.

### Refractive Index

The refractive index of the particles to be measured can be entered in mass concentration mode. To do so, select the numeric field corresponding to the particle size channel and enter the desired density refractive index value with the numeric touch pad. Press OK or cancel to return to the Channel Management Screen.

### Calculation of displayed Values on Main Screen for Mass Concentration Mode

#### $\mu\text{g}/\text{m}^3$ Indicated Values Explained

When Mass Concentration Mode is selected,  $\mu\text{g}/\text{m}^3$  is the measured value in the first column. The mass value for a channel size is the particle count between that channel and the next larger channel, calculated using the average particle size of the two channels. For example, the value in the 0.50  $\mu\text{m}$  data field represents the mass of all particles counted between this channel and the next highest channel, calculated as the mass of a particle that is 0.75  $\mu\text{m}$ .

#### Particle Mass Indicated Valued Explained

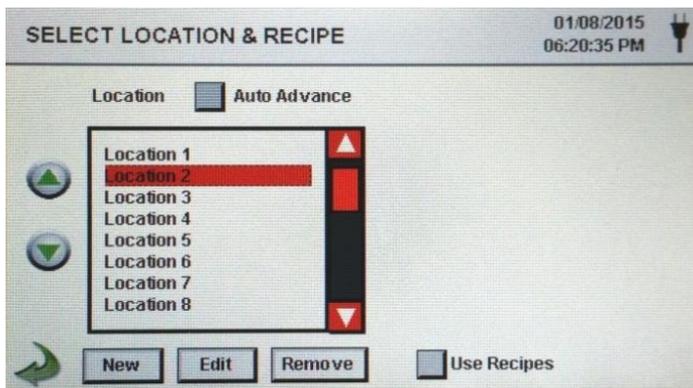
The column labeled PM shows the total particle mass of particles that are less than the displayed channel size. For example, the value displayed in the PM column for the 2.5 $\mu\text{m}$  channel is the particle mass ( $\mu\text{g}/\text{m}^3$  column) of all particles with a size less than 2.5 $\mu\text{m}$ , generally referred to as PM2.5.

## 6-4 Locations & Recipes



Pressing the Locations Icon opens the Select Location & Recipes screen. Up to 1000 unique location names can be created. This screen also provides for Location-specific recipes which utilize preset sample times, delays, hold times, cycles, etc. Over 50 unique recipes can be created to correspond to any number of locations.

### Select Location & Recipe Screen



#### Auto Advance

#### Location Auto Advance

When a sample is completed and the instrument is set to automatic mode, Pressing this button auto advances to the next location.



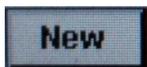
#### Navigate up or down through location list

Navigate with the up and down white arrows on the right side of the list. The red slider button can also be pressed and dragged up or down with a stylus or finger to navigate quickly up and down the list.



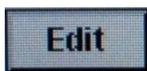
#### Move Selected Location Up / Down through List Order

Move the selected location up or down using the Silver and Green up and down arrow buttons on the left side of the locations list. Locations can be moved in order to group common areas to be tested for more convenient selection during setup, prior to a sampling event.



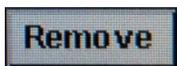
#### New Location Entry

Press the New button to create a new location on the Location list. Selecting this button will display the Enter Name For New Location screen. Use the touchscreen keyboard to enter the name of the new location. Press OK to return to the previous screen.



#### Edit Location

Press the Edit button to modify the location highlighted on the Location list. Selecting this button will display the Enter New Name For Location screen. Use the touchscreen keyboard to modify the name of the existing location. Press OK to return to the previous screen.



#### Remove Location

Press the Remove button to delete the currently highlighted location.

## 6-4 Locations & Recipes (continued)



**Use Recipes**

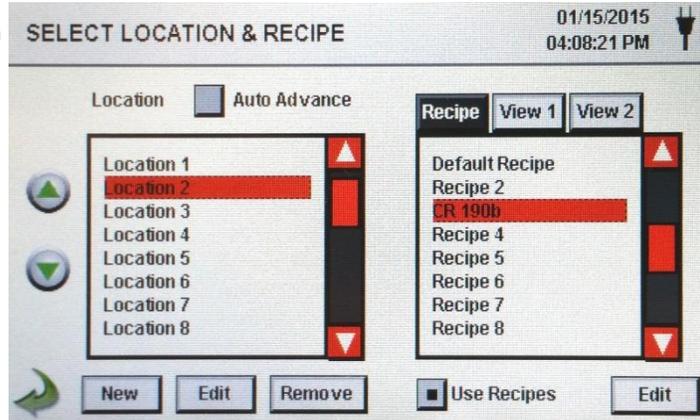
**Use Recipes**

Pressing this button displays the Recipes settings portion of the page. By selecting the Location on the left box, then setting the recipes from the right box, the location is configured with one of 50 possible user defined sampling setups.

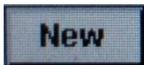
**Edit Recipe for Selected Location**

Press the Edit button on lower right hand side of screen under recipe setup window, to enter the Recipe setup.

**Recipe Information Appears on Right Side of Screen**

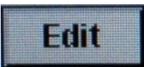


*The instructions that follow are related to the illustration on the top of page 36*



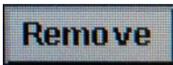
**New Recipe Entry**

Press the New button to create a new recipe. The Enter Name For New Recipe screen will appear. Use the touchscreen keyboard to enter the name of the new recipe. Press OK to return to the previous screen.



**Edit Recipe**

Press the Edit button to modify the existing recipe highlighted on the Location list. Pressing this button will display the Enter New Name For Recipe screen. Use the touchscreen keyboard to modify the name of the existing recipe. Press OK to return to the previous screen.



**Remove Recipe**

Press the **Remove** button to delete the recipe that is highlighted on the Location list.

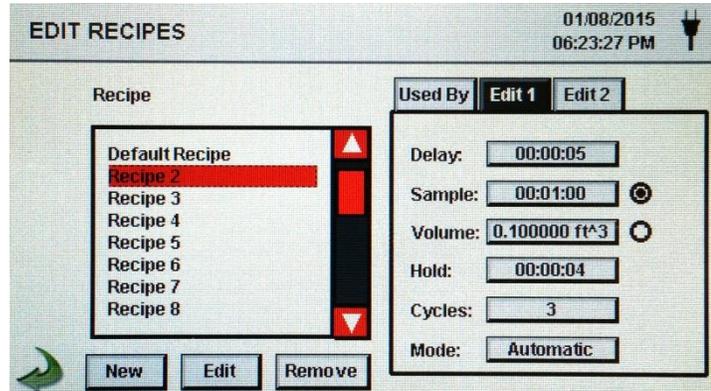
**Used By Tab**

The Used By window displays all locations currently set to use the current recipe when sampling.

## 6-4 Locations & Recipes (continued)

### Edit 1 Tab

The Edit 1 tab allows for the sampling settings, including the delay time, sampling time, cycles and mode that can be set for that recipe.



### Edit Recipe Tab 1 - Delay

Pressing the Delay time box opens the Enter Time screen. The numeric touchpad is used to enter the amount of time the counter will wait before starting a sample in automatic mode.

The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum delay time is 99 hours, 59 minutes and 59 seconds.

### Edit Recipe Tab 1 - Sample

Pressing the Sample Button opens the Enter Time screen with numeric touchpad for the entry of the amount of time the counter will sample in automatic mode.

The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum sample time is 99 hours, 59 minutes and 59 seconds.

### Edit Recipe Tab 1 - Volume

Pressing Volume displays the numeric touchpad for the entry of the desired volume to be sampled. The volume will correspond to the units selected in the Sample Volume Units Selection on the Sample Setup Screen. The volume value entered will control the length of time per sample to achieve the desired sample volume.

### Edit Recipe Tab 1 - Sample or Volume selection buttons

Selecting Sample will cause the sample to be time based on the Sample time value entered. Selecting Volume will cause the sample to be based on the actual volume of air sampled to be measured and achieved before finishing the event.

### Edit Recipe Tab 1 - Hold

Pressing the Hold Button opens the Enter Time screen with numeric touchpad for the entry of the amount of time the counter will hold between samples in automatic mode.

The entry is made in Hours:Minutes:Seconds (HH:MM:SS). The maximum Hold delay time is 99 hours, 59 minutes and 59 seconds.

## 6-4 Locations & Recipes (continued)

### Edit Recipe Tab 1 - Cycles

Pressing Cycles displays the Enter Cycles Screen with numeric touchpad for entry of the number of sampling cycles to be taken at a specific location when the unit is in automatic mode.

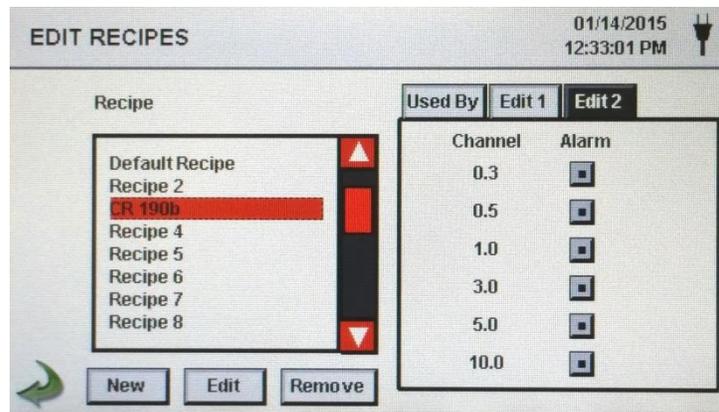
**Enter ZERO (0000) to activate Continuous Sampling Mode.**

### Edit Recipe Tab 1 - Mode

The Mode icon opens the Select Sample Mode page. Select Automatic mode or Manual Mode. After making a selection, press OK to accept and return to the previous page, or select cancel.

### Edit Recipe Tab 2 - Select Channel Alarm

Select the channels to activate the alarm threshold values set in the **Channel Management Screen**.



### Back Arrow Icon

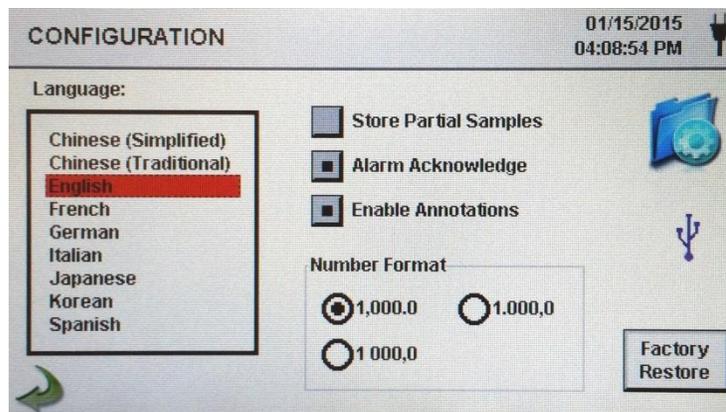
Press back to last screen arrow on bottom left corner of the display to return to the last screen, repeat this action to return to the settings screen or twice to return to the main home screen.

## 6-5 Configuration



Pressing this Icon opens the Configuration screen. Various parameters can be set from this page including language settings, USB configuration save options, and factory restore to default parameters.

### Configuration Screen



#### Language

Select and highlight the language to be used with your device. English is the Default.

#### Store Partial Samples

Select this option to save values from a prematurely ended sampling. If this option is left unchecked, the Instrument will ignore partial sampling events.

#### Alarm Acknowledge

During an alarm, the visual alarm bell and the audible sounder will continue to sound until the alarm bell icon is pressed when this option selected. If this option is not selected, then the alarm sounder and visual alarm indicator will function normally. Once the next sampling cycle starts (in automatic mode) the alarm indications will reset themselves.

#### Enable Annotations

Selecting this option to allow annotations (notes) to be entered on to the sample record while it is taking place, or after the fact in the records history. These notes will be included in downloaded record data. If this is unchecked, the feature is disabled.

#### Number Format

This selection box allows for setting the number formats: 1,000.0 - 1.000,0 - 1 000,0

#### Factory Restore

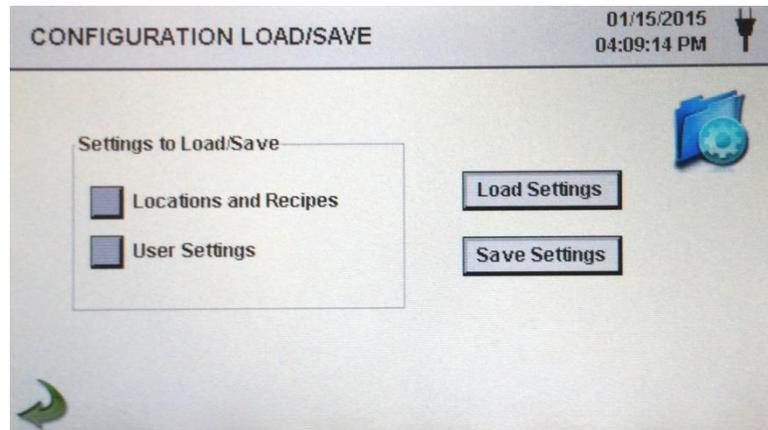
This option will display the Factory Restore screen. Use this screen to restore Locations and Recipes, User Settings, and Retain Language Settings. You must hit the Confirm button to enact this feature.

#### USB Icon

When a USB Thumb drive or mass storage device is plugged into the USB host port on the particle counter, the USB Configuration Save/Load Icon appears on the right side of the main Configuration screen. The Configuration Load/Save feature allows for saving the current configuration, including Recipes, locations and settings, from the instrument to the thumb drive. The feature can be used to restore the saved configuration back to any other Particles Plus handheld Particle Counter.

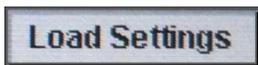
## 6-5 Configuration (continued)

### Configuration Load/Save Screen



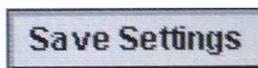
#### Settings to Load/Save

Use the two check boxes to select Locations and Recipes or User Settings for loading or saving with the USB thumb drive.



#### Load Settings

This button initiates the loading of a previously saved settings configuration into the current instrument.



#### Save Settings

This button will save the current configuration settings to the attached thumb drive or mass storage device.



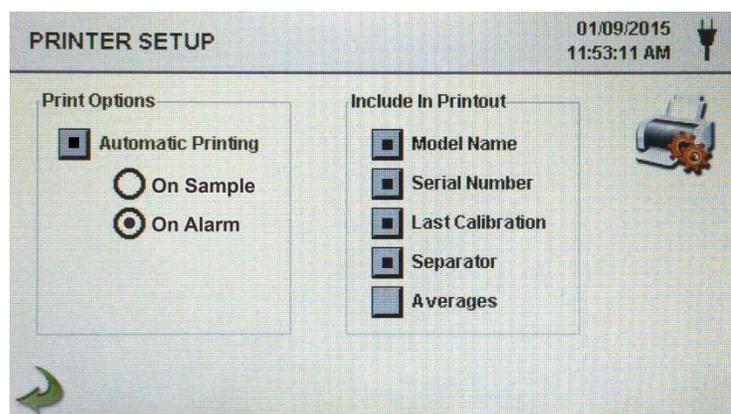
#### back arrow Icon

Press the back to last screen arrow on bottom left corner of the display to return to the previous screen

## 6-6 Printer Setup



This screen allows for the configuration of your printing options.



#### Automatic Printing

Selecting this option gives additional options to choose if the particle counter will print automatically 'On Sample' or 'On Alarm'

#### Include in Printout

Select each item of information to include with printed values and reports - Model Name; Serial Number; Last Calibration (date), Separator; and Averages

## 6-7 Communication



The instrument has multiple modes of communication for uploading or downloading data or configurations for operation. The modes of communication are Ethernet, RS485, RS232, USB Host or Client, and Optional Wi-fi Communications.

### Communications Screen

The screenshot shows the 'COMMUNICATIONS' screen with the date and time '01/09/2015 11:48:59 AM'. It is divided into two main sections: 'Wi-Fi' and 'Ethernet'. The 'Wi-Fi' section has fields for IP Address, Subnet Mask, Gateway, SSID (with a text input 'Your SSI'), and Password (with a text input 'Your Password'). The 'Ethernet' section has fields for IP Address (169.254.089.088), Subnet Mask (255.255.000.000), and Gateway (000.000.000.000). Below these is a 'Connection' section with radio buttons for 'Wi-Fi', 'None', and 'Ethernet' (which is selected). There is also a checkbox for 'Use DHCP'. At the bottom are 'Apply Settings' and 'Modbus Setup' buttons.

### Ethernet Communication IP Address, Subnet Mask, & Gateway

The particle counter can support Ethernet RJ-45 connection to a network for communications. Enter in the IP address for the device for your network, the Subnet mask and gateway for your router. A numeric keypad will be displayed for entering these values.

### USE DHCP

Specifying this will allow the device to obtain an IP address, subnet mask and gateway information from the router automatically

### Wi-fi Settings Screen

The screenshot shows the 'COMMUNICATIONS' screen with the date and time '01/08/2015 06:27:47 PM'. It is divided into two main sections: 'Wi-Fi' and 'Ethernet'. The 'Wi-Fi' section has fields for IP Address (000.000.000.000), Subnet Mask (255.000.000.000), Gateway (000.000.000.000), SSID (with a text input 'Your SSI'), and Password (with a text input 'Your Password'). The 'Ethernet' section has fields for IP Address, Subnet Mask, and Gateway. Below these is a 'Connection' section with radio buttons for 'Wi-Fi' (which is selected), 'None', and 'Ethernet'. There is also a checkbox for 'Use DHCP'. At the bottom are 'Apply Settings' and 'Modbus Setup' buttons.

### Wi-Fi

The particle counter can support an optional Wi-Fi communications module. If this is to be used select this radio button, and input the IP address, Subnet Mask, and Gateway. A numeric keypad will be displayed for entering these values.

### Wi-Fi SSID

Selecting this button allows for the entry of the name of the wireless router or network ID in order to connect to that router wirelessly. A keyboard will be displayed to allow for entry of these characters

### Wi-Fi Password

Selecting this button allows for the entry of the password needed to access the wireless router on the network to be used. A keyboard will be displayed to allow for entry of these characters

## 6-7 Communication (continued)

### Modbus Settings Screen

The screenshot shows the MODBUS SETUP screen with the following fields and values:

Field	Value
Modbus Address	247
TCP Port	00502
TCP Config Port	05000
Mode	RTU
Baud	19200
Parity	Even
Register Set	PPI

An "Apply Settings" button is located at the bottom left of the screen.

- Modbus Address** Enter in the Modbus address for the device for your network, A numeric keypad will be displayed for entering these values.
- TCP Port** Enter in the TCP Port for the device for your network, A numeric keypad will be displayed for entering these values.
- TCP Configuration Port** Enter in the TCP Configuration Port address for the device for your network, A numeric keypad will be displayed for entering these values.
- Mode** Choose either ASCII, RTU or TCP
- Baud** Select baud rate - 9600 / 19,200 / 38,400 / 57,600 / 115,200
- Parity** Select Parity - Odd / Even / None
- Register Set** Choose which register set to be communicated to your network or monitoring system.
- IMPORTANT NOTE:** The Particles Plus MODBUS register map can be found in the Appendix at the back of this manual. Other Register Maps to match your current system configuration are available on request.

## 6-8 Environment



The Environment screen allows for the setting of the temperature, humidity and barometric pressure units, and to allow the instrument to activate an alarm associated with the sensors.

### Environment Setting Screen

#### Enable Alarms

Selecting the enable alarm function for Temperature or Relative Humidity will allow the instrument to indicate if a low or high threshold for either environmental parameter is exceeded or dropped below the minimum set threshold.

#### Low Threshold

The low threshold value fields allow for the low threshold to be entered for either temperature, relative humidity, or both. When the field is selected a numeric keypad appears allowing for the values to be entered and saved.

#### High Threshold

The High Threshold value fields allow for the high threshold to be entered for either temperature, relative humidity, or both. When the field is selected a numeric keypad appears allowing for the values to be entered and saved.

#### Units

This section allows for selection of metric or standard values for temperature and barometric pressure.

## 6-9 Passwords



The Password Setup Screen allows for the secure operation of the instrument by authorized users, and configuration and setup changes by administrators in accordance with 21 CFR 11.

### Password Setup Screen

## 6-9 Passwords (continued)

**Admin Password** Selecting this radio button activates the administrative password function for 21 CFR 1 compliance preventing any settings, time/date, or configurations to be changed by lower level users.

**Admin Password - New Password / Confirm New Password** The two password entry fields allow for the password to be entered and saved. By selecting these fields it will bring up an alpha-numeric keyboard allowing for the user to enter a new administrator password. The default administrator password from the factory is **4321**

**User Password** Selecting this radio button activates the user password function preventing any unauthorized use of the particle counter. User level access allows for using the instrument in its current configuration, and saving samples.

**User Password - New Password / Confirm New Password** The two password entry fields allow for the password to be entered and saved. By selecting these fields it will bring up an alpha-numeric keyboard allowing for the user to enter a new user level password. The default user password from the factory is **1234**

**Password Timeout** Password timeout is the length of time in minutes there is no activity on the particle counter. If the unit is operating and inactive for more than the amount of time entered, the next operation will require a User or Administrator password to continue. The default is 5 minutes.



**Lock Now** The lock now icon puts the instrument immediately to the password enter screen. No activity is possible without entering the password to unlock the particle counter.

### **IMPORTANT NOTES**

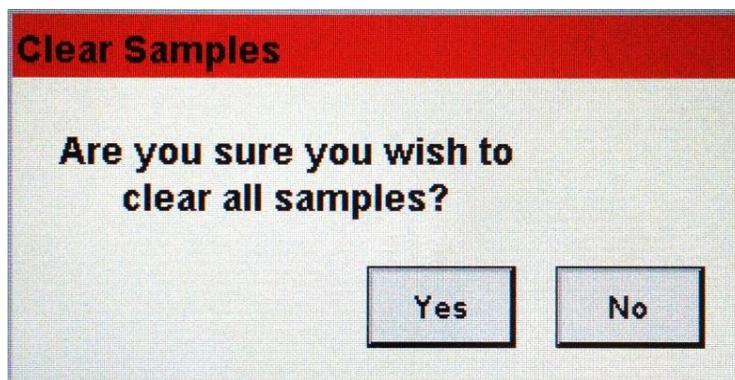
At any time during the operation of the particle counter, while passwords are active, the administrative password can be entered even if the user password is being requested. This will cause the unit to allow all administrative access to features, settings and configuration changes screens.

**If at any time the administrative password is lost or forgotten, you can call or email Particles Plus for a temporary password that will be valid only for that day the password is requested. This is a unique password that will automatically expire at the end of the day it is issued. Due to 21 CFR 11 requirements, proof of ownership and administrative rights will need to be established.**

## 6-10 Clear All Samples



All records on the instrument can be cleared with this function. CAUTION – This is not reversible and all data will be lost. Back up all data to a PC or USB Memory device before using this function.



### Confirmation Screen

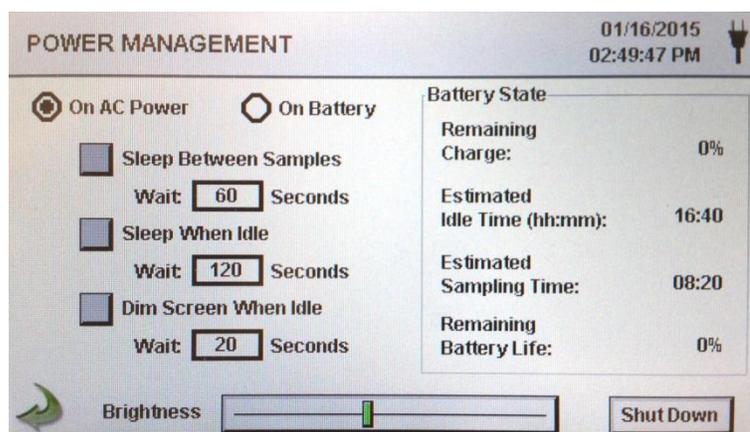
By selecting the Clear Samples Icon in the Settings Screen, the confirmation screen will appear asking if the request should be completed. Selecting Yes will delete all recorded samples. Selecting No returns the display to the settings screen.

## 7-1 Power Management



The instrument utilizes advanced power management function that are unique to Particles Plus. Please be certain to read the battery and power safety instructions at the beginning of this manual.

### Power Management Screen



### AC Adapter Icon

This Icon is visible when the instrument is plugged into AC mains power and pressing this icon brings you to the Power management screen.

## 7-1 Power Management (continued)

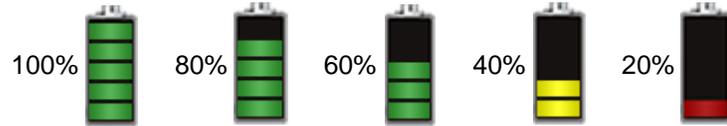
### Battery Level Indicator/Icon

This icon also allows for access to the Power Management screen, and also serves as a visual indication of the battery's power level

### Icon

The battery power level icon will display differently depending on the amount of battery power that is left in a percentage (20% to 100%)

The Power Level Indication is displayed as follows:



### Remaining Charge

(0 to 100%) - this is the percent of battery life left for this current charge displayed as a percent

### Estimated Idle Time

(hours:minutes) - this is the amount of time in hours and minutes left for this current battery charge if the unit remains in the on power state, and without sampling.

### Estimated Sampling Time

(hours:minutes) - this is the amount of time in hours and minutes left for this current battery charge if the unit is on, the pump is running and the unit is sampling.

### Remaining Battery Life

This is a percent indication of the total life left on this battery pack during the life of the battery. This is useful for monitoring when to replace your power cells.

### On AC Power Option

When Selected, all dimming timers, sleep mode timers and screen brightness bar settings will be valid when the unit is plugged into mains power using the AC adapter.

### On Battery Option

When Selected, all dimming timers, sleep mode timers and screen brightness bar settings will be valid when the unit is not attached to mains power and operating on the removable internal batteries.

### Sleep Between Samples

Selecting this button activates the feature for power down operation to conserve battery life. A timer window will appear, allowing for the input value of the amount of time, after completing a sample, before the system will go to sleep. This value is input by selecting the time input window box. This will bring up the numeric keypad allowing for the input, in seconds from 30 to 65,535 seconds. after entering value press ok to return to last screen. (Please note that the minimum time possible for the sleep mode will be 30 seconds, and if sampling delay time is also selected, that time is automatically added to this value.)

## 7-1 Power Management (continued)

### Sleep When Idle Option

Selecting this button activates the timer box for this option to count the number of seconds after the unit is idle, with no activity, to go into sleep mode conserving battery power. The amount of time to wait before going to sleep is entered by selecting the time input window box. This will bring up the numeric keypad allowing for the input of the idle time value, in seconds from 1 to 65,535 seconds. After entering the value press ok to return to last screen. (Please note that the default value is 120 seconds.)

### Dim Screen When Idle

Selecting this button allows the instrument to save power by dimming the display brightness after the touch screen is not pressed for the selected time. The amount of time to wait before dimming the screen is entered by selecting the time input window box for this option. This will bring up the numeric keypad allowing for the input of the wait to dim screen when idle time value, in seconds, from 20 to 65535 seconds. After entering the value press ok to return to last screen. (Please note that the default value is 20 seconds.)

### Brightness Select Slider

Selecting the slider green vertical cross bar, move the slider to the left to decrease and to the right to increase the screen brightness.

### Shutdown Icon

Power down the instrument through the interface immediately with this icon. The instrument can also be turned off from the power switch on the handle.



### Back Arrow Icon

Press back to last screen arrow on bottom left corner of the display to return to main home screen.

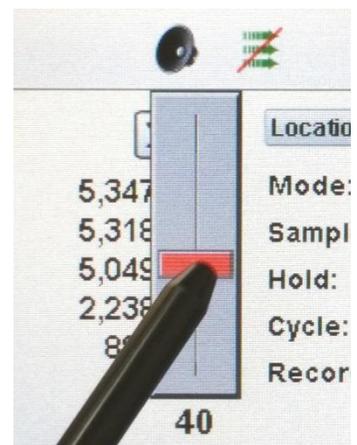
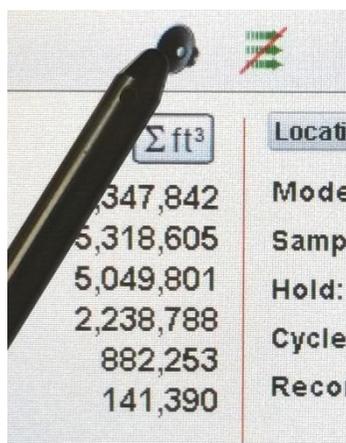
## 8-1 Volume Controls



### Volume Control Icon

By selecting the icon a volume slider control appears. Select the bar on the slider and increase or decrease the volume.

Decreasing the slider to zero, mutes the speaker. A numerical value of the volume level appears at the bottom of the slider.



## 9-1 PC Communication Software



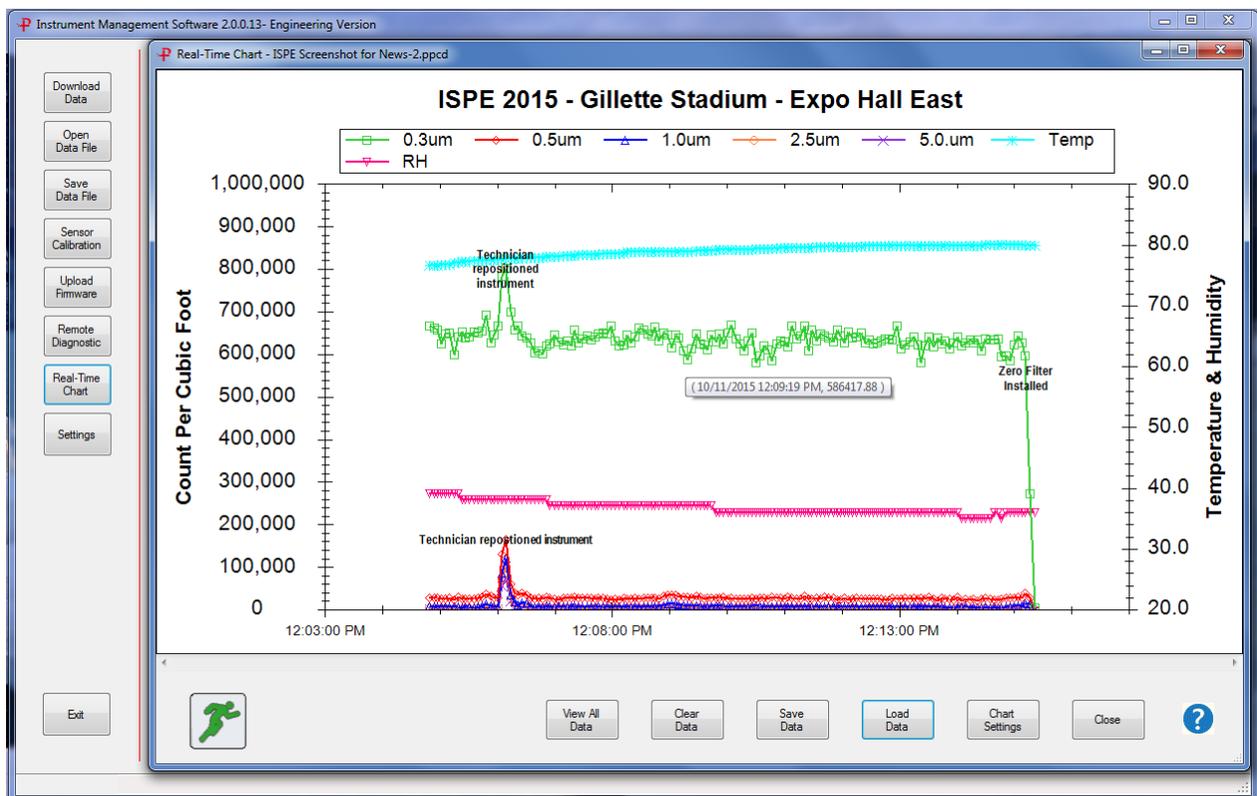
The Particle Counter also includes a PC based software utility that allows for the remote access to download data, or upload firmware updates to the device. This is done when the Instrument is connected to the PC through the USB Client USB-B connector using the provided cable that is included with the standard accessory package.

### Load/Install to PC

To load the Particles Plus Communication Software, install the provided thumb drive in to your PC with the Windows (7™, and 8™) operating system. Open the thumb drive folder and select the setup application file. Follow the installation prompts.

### Start Software

Use the Particles Plus Logo Icon in the program folder or from the desktop to start the program.



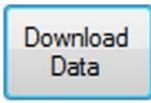
(Communication Real-Time Graph Screen Window Shown Above)

No Connection

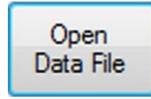
### Connection Indication

USB Connection

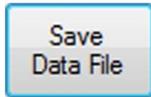
When the instrument is connected to the PC by the provided USB cable, and the software has successfully linked with the device, a Green USB Connection indication will appear on the bottom left side of the program window. A No Connection indication will be displayed when no device is connected or detected.

**Download Data**

Select the Download Data button in order to initiate a download from the instrument to PC. This can be done while the instrument is plugged in directly to the PC using the provided USB Cable.

**Open Data File**

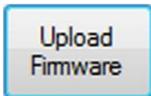
Select the Open Data File Button to access and view values from a previously saved data file. The windows open file screen will display, after selecting the proper file, click Open.

**Save Data File**

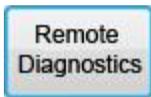
Select the Save Data File Button to save the current open data file. The windows save file screen will display, after selecting the proper file, click Open.

**Sensor Calibration**

The software allows for user capable sensor calibrations offsets. The calibration offset can be utilized for any attached environmental sensor like the Temperature and Relative Humidity sensor. This feature facilitates single point or 2 point offset adjustment to the attached sensors. The calibration correction is saved in the smart sensor's processor.

**Upload Firmware**

The Firmware can be updated based upon the instruction to do so from Particles Plus Technical Support Department. A file will be provided that will be saved to the hard drive, then the Upload Firmware button is selected, and a dialogue window to select the file is displayed. Follow the prompts and confirm the upload operation. **IMPORTANT NOTE:** Do not interrupt or disconnect the instrument from the PC while this operation is taking place. Doing so can cause errors for your device.

**Remote Diagnostics**

Remote access to your instrument from a qualified Particles Plus technical engineer is facilitated through the IMS software and allows for full investigation in to the performance and health of the instrument. The Particles Plus Engineer can also provide remote corrections or fixes to issues that may be identified. This feature saves having to send your instrument in for unnecessary service.

**Settings**

The Settings menu allows for changing how temperature units are displayed in exported data, and to allow for the most recent saved data file to be displayed on startup.

**Export to Clipboard**

The Copy to Clipboard button allows for the current record to be saved to the clipboard and pasted in most any compatible Windows based spreadsheet or text based document.

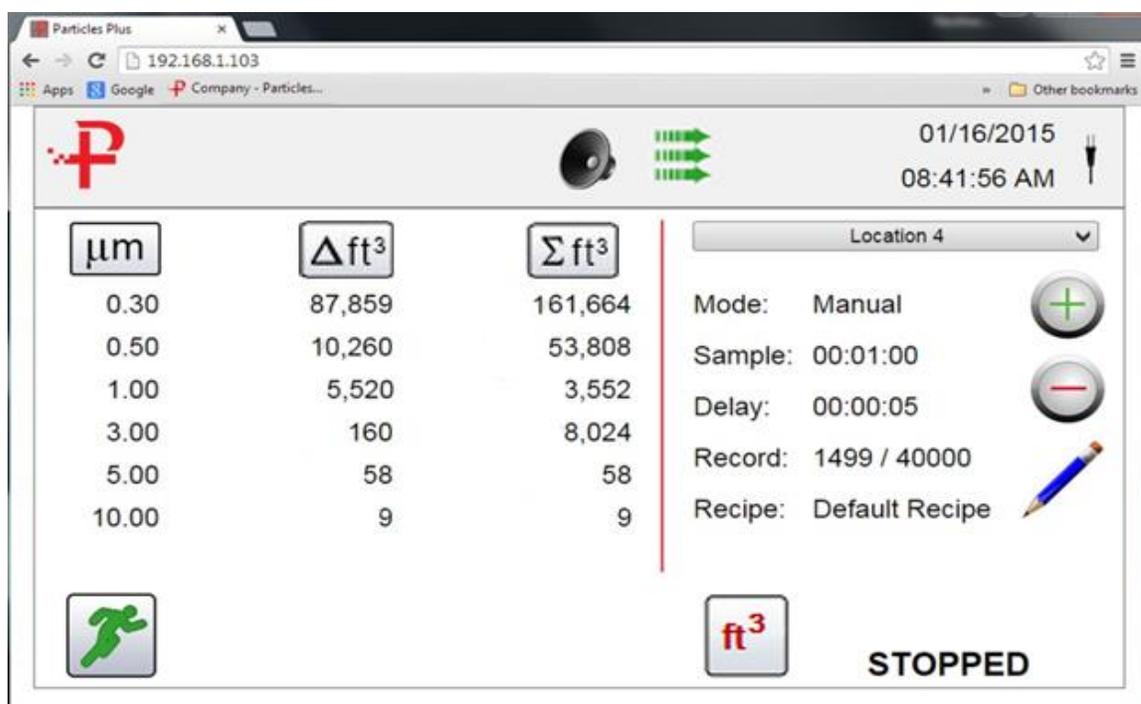
**Column Settings**

This setting allows the user to determine which columns of data will be displayed or omitted from exported data files.

## 10-1 Particle Counter Host Mode – Remote Monitor and Operation

**Access your particle counter from a web browser from any PC, Tablet or smartphone**

The Particles Plus particle counters can host and provide a browser based remote operation interface session. With advanced processing there can be many remote access sessions taking place concurrently with the unit still operating and recording samples. This is achieved through a built in web server software. This allows for direct communication through a local intranet (connected by Ethernet or Wi-Fi), using the instrument's IP address found in the communications setup screen



### 10-1 PC Communication Software (continued)

**The Functions of Remote Web Based Operation.**

The Instrument can have the sampling started, and stopped, It provides a full visual indication of the home page display, the + & - keys can allow the remote user to scroll through and select different locations to utilize; The Units can be changed from Count, to CNT/M3, CNT/F3, or  $\mu\text{g}/\text{m}^3$ . The value columns for cumulative or differential can be turned on and off using the corresponding icons.

**Connecting using Ethernet or Wi-Fi**

The Instrument must be placed in Ethernet or optional Wi-Fi mode to allow for this feature, and the unit must also be connected to a working router on the same network as the PC. In the Communications Setup page, select apply settings with the use DHCP button selected, and the unit will automatically display the router issued settings to allow connection. Use that IP address that is saved on the Communication page, and enter that into any device browser to access the remote screen.

**Note:** the URL address is the IP address that the DHCP Router assigned to the Particle Counter. You can also provide a static IP address for the device through the communications setup screen and with access to your router's administrative functions to set a static IP in the client tables.

This document describes the Modbus registers that are used to communicate with Particles Plus particle counters. These registers are applicable to units with RS485/232 serial and TCP/IP interfaces.

### Protocol options

Description	Options	Default
Transmission Mode	Modbus RTU, ASCII, TCP	Modbus RTU
Bus Type	RS-232, RS-485 (half-duplex)	RS-232
Baud Rates	9600, 19200, 38400, 57600, 115200	19200
Parity	None, Even, Odd	Even
Modbus Address	0-247 (0=Broadcast)	247

### Register Data Representations

Data Type	Description	Byte Order
I16, U16	Signed and Unsigned 16 bit Integers	Big-Endian
I32, U32	Signed and Unsigned 32 bit Integers	Big-Endian within each register Little-Endian across registers
String	Double-Byte characters zero terminated	First character in high byte of lowest address
Float	IEEE-754 Single Precision (32-bit)	Big-Endian within each register Little-Endian across registers
Date	ISO-8601 YYYY-MM-DD	See String data type
Time	ISO-8601 hh:mm:ss 24-hour notation, local time	See String data type

### Register Access Codes

Code	Description
R	Read Access
W	Write Access
RW	Read and Write Access
PR	Protected Read Access
PW	Protected Write Access
PRW	Protected Read and Write Access

To access protected registers the admin password must be written to register xx. Certain access codes can be combined. For example, an access code of R+PW requires a password to write but may be read without a password.

### References

Modbus: <http://www.modbus.org/>  
 ISO-8601: [http://en.wikipedia.org/wiki/ISO\\_8601](http://en.wikipedia.org/wiki/ISO_8601)  
 IEEE-754 [http://en.wikipedia.org/wiki/IEEE\\_floating\\_point](http://en.wikipedia.org/wiki/IEEE_floating_point)

## System Information

Description	Address	# of Registers	Data Type	Access	Notes
Register Map Version	0	1	U16	R	
Manufacture ID	1	30	String	R	Particles Plus Inc.
System Model Number	31	11	String	R	
System Serial Number	42	13	String	R	
Reserved	55	11			
GUI Model	66	11	String	R	
GUI Serial Number	77	17	String	R	
GUI HW Rev	94	11	String	R	
GUI FW Rev	105	11	String	R	
COM Model	116	11	String	R	
COM Serial Number	127	17	String	R	
COM HW Rev	144	11	String	R	
COM FW Rev	155	11	String	R	
PWR Model	166	11	String	R	
PWR Serial Number	177	17	String	R	
PWR HW Rev	194	11	String	R	
PWR FW Rev	205	11	String	R	
BAT Model	216	11	String	R	
BAT Serial Number	227	17	String	R	
BAT HW Rev	244	11	String	R	
BAT FW Rev	255	11	String	R	
PMP Model	266	11	String	R	
PMP Serial Number	277	17	String	R	
PMP HW Rev	294	11	String	R	
PMP FW Rev	305	11	String	R	
DET Model	316	11	String	R	
DET Serial Number	327	17	String	R	
DET HW Rev	344	11	String	R	
DET FW Rev	355	11	String	R	
LSR Model	366	11	String	R	
LSR Serial Number	377	17	String	R	
LSR HW Rev	394	11	String	R	
LSR FW Rev	405	11	String	R	
EXT Device Count	416	1	U16	R	Number of External Devices
EXT Device Select	417	1	U16	RW	Select External Device to Read
EXT Device Model	418	11	String	R	There may be zero or more External Devices attached to the system. Use EXT Device Select Register to access.
EXT Serial Number	429	17	String	R	
EXT HW Rev	446	11	String	R	
EXT FW Rev	457	11	String	R	

## Configuration

Description	Address	# of Registers	Data Type	Access	Notes
Admin Password	1000	16	String	W	Enter this password to access protected registers
Current Date	1016	11	Date	R+PW	System Date
Current Time	1027	9	Time	R+PW	System Time
Number of Channels	1036	1	U16	R	Maximum # of active channels
Minimum Channel Size	1037	2	Float	R	Smallest channel size in microns
Maximum Channel Size	1039	2	Float	R	Largest channel size in microns
Options	1041	1	U16	R	TBD
Reserved	1042	158			
Calibration Date	1200	11	Date	R	
Calibration Due Date	1211	11	Date	R	
Language		2		R+PW	0 = Not Set 1 = Chinese Simplified 2 = Chinese Traditional 3 = English 4 = French 5 = German 6 = Italian 7 = Japanese 8 = Korean 9 = Spanish
Pump Start Time Use Default					
Pump Start Time in Delay					
Pump Start Time in Hold					
Store Partial Samples					
Alarm Acknowledge					
Enable Annotations					
Temperature Alarm Enable					
Temperature Alarm Low Threshold					
Temperature Alarm High Threshold					
RH Alarm Enable					
RH Alarm Low Threshold					
RH Alarm High Threshold					
Automatic Printing					
Automatic Print on					0 = Sample 1 = Alarm
Print Model Name					
Print Serial Number					
Print Last Calibration					
Print Separator					
Print Averages					

## Communication

Description	Address	# of Registers	Data Type	Access	Notes
Modbus Address	2000	1	U16	R+PW	1 – 247
Modbus Configuration	2001	24	String	R+PW	Format: mmmmm,ttt,bbbbbb,pppp Where (case insensitive): m = Mode t = Type of bus b = Baud Rate p = Parity Example: ASCII,485,9600,None Refer to Protocol Options
Modbus TCP Port		1	U16	R+PW	
Modbus TCP Config Port		1	U16	R+PW	
TCP/IP Interface		1	U16	RW	0 = None 1 = Ethernet 2 = Wi-Fi
Ethernet MAC Address					
Ethernet DCHP Enable					
Ethernet IP Address					
Ethernet Subnet Mask					
Ethernet Gateway					
Wi-Fi MAC Address					
Wi-Fi DCHP Enable					
Wi-Fi IP Address					
Wi-Fi Subnet Mask					
Wi-Fi Gateway					

## Diagnostics

Description	Addresses	# of Registers	Data Type	Access	Notes
Battery Level	3000	1	U16	R	Percentage of remaining battery charge (0-100)
Battery Estimated Idle Minutes	3001	1	U16	R	Estimated number of minutes the instrument can run while Idle (Stopped)
Battery Estimated Sampling Minutes	3002	1	U16	R	Estimated number of minutes the instrument can run while sampling
Battery Remaining Life	3003	1	U16	R	Percentage of remaining battery life (0-100)
On Ac Power	3004	1	U16	R	0 = Running on battery 1 = Running on AC power

## Calibration

Description	Address	# of Registers	Data Type	Access	Notes
	4000				

## Sampling Setup and Control

Description	Address	# of Registers	Data Type	Access	Notes
Start/Stop Sampling	5000	1	U16	W	0 = Stop Sampling 1 = Start Sampling
Sampling State	5001	1	U16	R	0 = Stopped 1 = Delay 2 = Counting 3 = Hold
Cycle Count	5002	1	U16	RW <sup>1</sup>	Number of sample periods (1-9999) 0 = Continuous Sampling
Delay Time	5003	2	U32	RW <sup>1</sup>	Seconds, 0 – 359999 (99h, 59m, 59s)
Sample Time	5005	2	U32	RW <sup>1</sup>	Seconds, 0 – 359999
Hold Time	5007	2	U32	RW <sup>1</sup>	Seconds, 0 – 359999
Sample Mode	5009	2	U16	RW <sup>1</sup>	0 = Automatic 1 = Manual 2 = RT Meter
Alarm On	5011	2			0 = Alarm on Cumulative Counts 1 = Alarm on Cumulative Counts / ft <sup>3</sup> 2 = Alarm on Cumulative Counts / m <sup>3</sup> 3 = Alarm on µg/m <sup>3</sup> 4 = Alarm on Sum Counts 5 = Alarm on Sum Counts / ft <sup>3</sup> 6 = Alarm on Sum Counts / m <sup>3</sup> 7 = Alarm on PM
Mass Mode	5013	1		RW	0 = Disable Mass Mode 1 = Enable Mass Mode
Use Recipes	5014	1	U16	RW <sup>2</sup>	0 = Disabled. Do not use recipes 1 = Enabled. Use Recipes
Recipe Index	5015	1	U16	R	Only applicable when Use Recipes is enabled
Recipe Name	5016	16	String	R	Only applicable when Use Recipes is enabled
Location Index	5032	1	U16	R	

<sup>1</sup> These items may only be written when the Use Recipes register is set to disabled.

<sup>2</sup> This version of the Modbus interface does not provide support for selecting or modifying recipes.

**Channel Setup – To Access Channel n refer to the register address formula found in the next section**

Description	Base Address	# of Registers	Data Type	Access	Notes
Channel Enable	6000	100	U16	RW	
Channel Size	6100	200	Float	RW	
Alarm Enable	6300	100	U16	RW	
Alarm Threshold	6400	200	U32	RW	
Density Factor	6600	200	Float	RW	
Refractive Index	6800	200	Float	RW	

### Data Record Selection

Description	Address	# of Registers	Data Type	Access	Notes
Record Count	8000	2	U32	R	# of records stored
Record Number to Read	8002	2	I32	RW	Record number to access 0 = Read current data 1 – n = Read record n where n is <= to Record Count 65535 = Read last record

To read data that is currently being displayed on the instrument write zero to Record Number (Address 8002) then read the data starting at register 9000. To read the channel data for the selected record use the following formula:

$$\text{Register Address} = \text{Base Address} + (\text{Channel } n - 1) * \frac{\text{\# of Registers}}{100}$$

For example, to read cumulative counts from record #7, channel #5:

1. Set the record number register at address 8002 to 7
2. Read 2 registers (data type float) from address 10308.

**Data Record – Select Record Using Record Number**

Description	Address	# of Registers	Data Type	Access	Notes
Record Number	9000	2	I32	R	-1 = No data 0 = Current data 1 – n = Data record #
Date	9002	11	Date	R	Date data was recorded
Time	9013	9	Time	R	Time data was recorded
Location	9022	21	String	R	Location where data was taken
Annotation	9043	31	String	R	Data annotation
Sample Duration	9074	2	Float	R	Seconds
Sample Flow Rate	9076	2	Float	R	CFM
Sample Status Bits	9078	1	U16	R	Bit Mask (one bit for each status) 0x0001 -> Laser Ok 0x0002 -> Flow Ok 0x0004 -> Temperature Ok 0x0008 -> Relative Humidity Ok 0x0010 -> CO <sub>2</sub> Ok 0x0020 -> TVOC Ok 0x0040 -> Barometric Pressure Ok
Temperature	9079	1	U16	R	Temperature LSB 0.1°C If temperature = 999 No device If temperature = 998 Sensor Error Otherwise temperature at beginning of sample or if a temperature alarm occurred during the sample then the temperature when the alarm was detected.
RH	9080	1	U16	R	Relative Humidity, LSB 1% If RH = 0 No device If RH = 1 Sensor Error Otherwise same logic as temperature
BP	9081	2	Float	R	Absolute Barometric Pressure LSB 1 kPa If BP = 0 Sensor Error
CO <sub>2</sub>	9083	1	U16		CO <sub>2</sub> , LSB 1 ppm If CO <sub>2</sub> = 65535 No Device If CO <sub>2</sub> = 65534 Sensor over range > 2000ppm If CO <sub>2</sub> = 65533 Sensor Over range > 5000ppm
TVOC	9084	1	U16		Total Volatile Organic Compound LSB 1 ppb If TVOC = 65535 No Device If TVOC = 65534 Sensor Error
Sample TPM	9085	2	Float	R	Total Particle Mass in µg/m <sup>3</sup>

**Channel Data – Select Record Using Record Number**  
**Channel Data is offset from base address**

Description	Base Address	# of Registers	Data Type	Access	Notes
Alarm Flag	10000	100	U16	R	0 = Data did not exceed alarm threshold 1 = Data exceeded alarm threshold
Channel Size	10100	200	Float	R	$\mu\text{m}$
Differential Counts	10300	200	Float	R	Count of Particles measured in this channel
Differential Counts/ $\text{ft}^3$	10500	200	Float	R	Particles per cubic foot
Differential Counts/ $\text{m}^3$	10700	200	Float	R	Particles per cubic meter
Differential Mass	10900	200	Float	R	Particle Mass in $\mu\text{g}$ per cubic meter ( $\mu\text{g}/\text{m}^3$ )
Sum Counts	11100	200	Float	R	Sum of Particle counts in this and larger channels
Sum Counts / $\text{ft}^3$	11300	200	Float	R	Sum count per cubic foot
Sum Counts / $\text{m}^3$	11500	200	Float	R	Sum count per cubic meter
PM	11700	200	Float	R	Sum Particle Mass in smaller channels

## Revision History

10/11/14	0.1	mrh	Initial Draft
10/27/14	0.2	mrh	Added register to select sample count units
10/30/14	0.3	DP	Added unit fields for all data, sampled, buffered and logged Clarified status fields for above data (bit fields for any errors)
12/03/14	0.4	mrh	Rewrite to fit better with PPI data structures. Reserve space for 100 channels.
12/05/14	0.5	DP	Reviewed document and added comments
12/16/14	0.6	mrh	Sent out for internal review.
12/23/14	0.8	mrh	Added a register and Renumbered Data Record Addresses. Implemented more registers.
12/29/14	0.9	mrh	Added notes to temp/RH regarding display of errors.
2/9/15	0.10	mrh	Added Co2 and VOC
4/3/15	0.11	mrh	Added Battery Status Registers
4/25/15	0.12	mrh	Added Co2 and VOC status bits to recorded records.
5/3/15	0.13	mrh	Modified definition of register #8002 to include a code that will read the last recorded record.
5/4/15	0.14	Mrh	Modified definition of register #9083 CO2 range errors.



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