Model 227 Particle Counter

Operator's Manual

Met One

Published by

PACIFIC SCIENTIFIC INSTRUMENTS

FAX (541) 479-3057
Phone (541) 479-1248
Online www.particle.com

Major revisions of this manual will be indicated by a new revision level. Minor corrections or additions may be made at any time without changing the revision level. Changes made to this manual causing the new revision are documented in the Manual Backdating section of this manual.

Note:
Shipping this instrument out of the U.S.A. may require an export license. Contact the factory for more information.

Manual PN: 701094 REV: E

Contents

Safety

Manual Safety Conventions

Warnings and Cautions are used throughout this manual, appearing before the procedure or step to which it applies. A Warning indicates a personnel safety hazard. It calls attention to a procedure, which if not correctly performed or adhered to, could result in injury or possibly death. Do not proceed beyond a warning until the conditions are fully understood and met. A caution indicates an equipment safety hazard and calls attention to a procedure, which if not correctly performed or adhered to, could result in damage to the counter. Do not proceed beyond a caution until the conditions are fully understood and met.

A triangle with exclamation point indicates a general safety and a triangle with lightning bolt indicates an electrical safety

hazard hazard.

Electrical Safety

To reduce the risk of electric shock, do not expose to rain or moisture.

WARNING

Failure to use this instrument in a manner intended by Pacific Scientific Instruments may circumvent the protection provided by this instrument, resulting in personal injury or loss of life.

Laser Safety

This particle counter contains a laser-based sensor that is a Class 1 product (as defined by 21 CFR, Subchapter J, of the Health and Safety Act of 1968) when used under normal operation and maintenance. The manual contains no procedures for service of internal parts within this unit. Service should be performed only by factory-authorized personnel.
The particle counter has been evaluated and tested in accordance with EN 61010-1:1993, "Safety Requirements For Electrical Equipment For Measurement, Control, and Laboratory Use" and IEC 825-1:1993, "Safety of Laser Products".

WARNING

The use of controls, adjustments, or performance of procedures other than those specified within this manual may result in exposure to invisible (infrared) radiation that can quickly cause blindness.

Electrostatic Safety

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work inside the particle counter should be done at a static-safe workstation. A static-safe workstation can be created by doing the following:

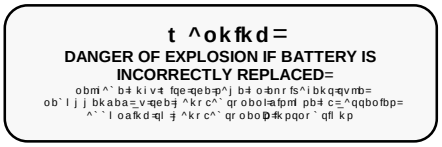
- Use a grounded conductive table mat and resistor-isolated wrist-strap combination
- Earth-ground all test instruments to prevent a buildup of static charge

WARNING

Using a wrist strap without an isolation resistor will increase the severity of an electrical shock.

Battery Safety Information

An explosion can occur if the internal battery is incorrectly replaced. The following label appears on the battery for your safety.



Unpacking and initial inspection

Before opening the shipping container, inspect it and immediately notify the carrier of any signs of damage for possible insurance adjustment purposes. If the container is intact, carefully open and unpack the contents and compare each item with the shipping list to assure receipt of all listed materials. Report any missing or surplus items to a Pacific Scientific Instruments representative.

Technical Support Information

Contact our Technical Support Department by telephone at (800) 866-8854 or you may contact us via the Internet at *www.particle.com*

Return Shipping

Should it become necessary to return the unit to the factory for any reason, you must first **contact your local service representative or Customer Service for return authorization instructions**. After you have received a **Return Authorization** number, follow the shipping instructions below.

U.S.A.:

1. Use the original container or carton and packing materials whenever possible. If the original container and packing materials are not available, wrap the unit in “bubble pack” plastic; surround with shock-absorbent material and place in a double-wall carton.
2. Seal container or carton securely. Mark “Fragile” and enter Return Authorization number in an unmarked corner. All shipments will be returned if the Return Authorization number does not appear on the box.

International:

1. Contact the nearest overseas representative listed below. In Canada you may contact Technical Support at (800) 866-7889 for the phone number of your local agent. Everywhere else, visit our website at *www.particle.com/sales1.htm* and click on your area for contact information.

2. Contact your local service representative (visit "Service and Support" at *www.particle.com*) or Technical Support Department (800) 866-8854 for more information. You may also FAX Customer Service at (541) 474-7414. For further technical assistance you may contact us via the Internet at *www.particle.com*

Pacific Scientific Instruments Service Centers

Central

964 N. 21st Street, Suite H
Newark, OH 43055
TEL 740 366 5068
FAX 740 366 7619

Midwestern

555 Tollgate Road, Suite E
Elgin, IL 60123
TEL 847 888 3600
FAX 847 888 3789

Factory

481 California Avenue
Grants Pass, OR 97526
TEL 541 479 1248
800 866 7889
FAX 541 479 3057

Southeastern

2120 Corporate Square, Suite 19
Jacksonville, FL 32216
TEL 904 721 9706
FAX 904 721 9709

West/Northwest

3375 Scott Blvd, Suite 406,
Santa Clara, CA 95054
TEL 408 588 0884
FAX 408 588 0881

Eastern

127-G Gaither Drive
Mt. Laurel, NJ 08010
TEL 856 235-8224
FAX 856 235-7370

New England

1200 Millbury Street
Heritage Business Park, Suite 6N
Worcester, MA 01607
TEL 508 757 3700
FAX 508 791 4441

Southwestern (2 locations)

459 N. Gilbert Rd., Suite A-135,
Gilbert, AZ 85234
TEL 480 892 2939
FAX 480 892 1861

Albuquerque, NM 87112
TEL 505 893 3876

Southern

TEL 888 894 1655
FAX 817 656 7883

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England

Pegasus House
Haddenham Business Park
Haddenham
Bucks HP178LL
England, United Kingdom
TEL 44 (0) 1844 299 336
FAX 44 (0) 1844 299 379

Germany

Ostwall 30
LÜdinghausen D-59348
Germany
TEL 49 (0) 25 91 3091
FAX 49 (0) 25 91 5014

Pacific Scientific Instruments maintains a complete international distribution network. Please contact the Factory service center for the name of your local representative.

Scotland

CEL Enterprise Centre
58 Cornton Road,
Stirling FK9 5AT
Scotland, United Kingdom
TEL 44 (0) 1786 448 338
FAX 44 (0) 1786 446 711

France

100 rue Blaise Pascal
Zl les Mardelles
93605 Aulnay-sous-Bois
Cedex
France
TEL 33 (0) 1 58 03 0500
FAX 33 (0) 1 48 66 4666

Introduction

Particle Counter

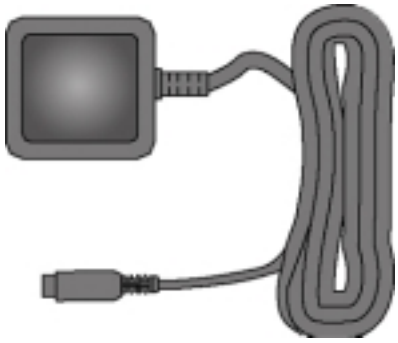
This operating guide describes how to use the Models 227A and 227B hand-held Particle Counters. Operation of the two variants is identical, where the minimum size sensitivity of the 227A is 0.5µm and the minimum size sensitivity of the 227B is 0.3µm. The counter design has been changed in several ways since it's introduction and where it is different from the current product, operation of older versions is covered in the "Technical Data" section of this guide under the "Manual Backdating" heading.

Accessories - included

Several accessories are included with your counter and are shown below.

Isokinetic Probe – P/N 2080613. For use in laminar air flow up to 100 feet per minute. The probe is used by facing the open end into the direction of the air stream.

Purge Filter – P/N 2080442. Attaches to sensor inlet; used for maintenance (purge and zero count) of the counter to keep external particles from contaminating sensor while purging sensor of accumulated internal particles.



AC Adapter – P/N 770007 (115VAC)
P/N 770012 (230VAC)
P/N 770009 (100VAC)
For recharging the internal battery and using the counter with a standard 115 VAC outlet

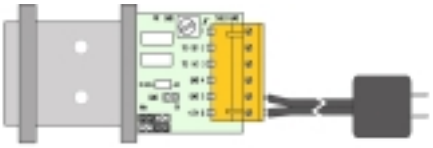
Charging Stand– P/N 2080469. Used to hold the counter during recharging or when sampling from a stationary position.

Accessories – optional

You can order other accessories to tailor the counter to your needs. These accessories can be ordered by calling the factory at 541-472-6500 during the week from 8:00 a.m. to 5:00 p.m. Pacific Time.

RH/Temp Probe – P/N 2080825. Plugs into the connector on top of unit. The probe monitors relative humidity (10% to 90%) and temperature (5 to 125°F, or -15 to 50°C). The particle counter displays the reading and includes it in the internal particle count data record.

High-Pressure Diffuser – P/N 2080372-6. Connects to the sensor inlet tubing. Permits direct sampling of pressurized air at pressures from 30 to 150 psi.



RS-485 Converter – P/N 2082383-2. Converts data from RS-232 to RS-485 format, for longer serial networking to a computer. Consult Technical Support for application

External Printer – P/N 2083806. Provides for printout of count and temperature/relative humidity data.

PortAll Software – P/N 2084045. For transferring count data from the counter's buffer and displaying the data on your computer in a spreadsheet format. Performs calculations for Fed Std 209E and ISO 14644. Includes adapter for use with a standard 9 pin serial cable.

Carrying Case – P/N 2080878. Protects the counter during shipment or storage.

Applications

The Model 227 is a battery operated, laser based particle counter intended for use in a walk-around sampling routine and is able to store data records for each sample with a different location label on the record, up to 200 records. The data records may later be printed or downloaded to a computer for analysis. It is intended for use in environments where the particulate contamination does not exceed 2 million particles per cubic foot of air, such as cleanrooms, medical instrument assembly, computer rooms, and downstream of air filter installations in HVAC systems. For areas with unknown particulate levels, the Concentration Mode in the Model 227 is useful for taking a brief sample and estimating the probable cleanliness, based on built-in calculations performed in the counter's microprocessor. Continued long term use in uncontrolled environments such as open air office spaces or outdoor air will make user maintenance actions such as sensor cleaning more frequent.

The Model 227 operates at a flow rate of 0.1 cubic feet per minute (cfm), which must be considered when setting sampling parameters. For instance, it will take 10 minutes to sample one cubic foot of air while the results of a one minute sample must be multiplied by ten to obtain counts per cubic foot. All counts are reported as cumulative counts; that is, all the reported 0.3µm particles are 0.3µm *and larger* in size.

Setup

The Model 227 counter is ready to use when unpacked, but ensure the red sensor inlet cap is removed and the isokinetic probe is attached prior to sampling. If the RH/T probe is used, it should be attached before the counter is turned on.

Factory Default settings

The following default parameters are programmed at the factory. For detailed explanation of terms and instructions for reprogramming parameters, refer to the "Operation" section of this manual.

Location Number..... 000
Count Mode..... Manual (the counter will take one sample and stop counting).
Alarm Limits ..... 0 (no particle count level alarms will be registered).
Channel 2 particle size .... 0.7µm in 227A, 0.5µm in 227B
Volume..... Liters (applies to Concentration Mode only).
Temperature ..... °C (only applies if RH/T probe is attached).
RS232 mode ..... Normal
Baud Rate 9600
Sample Time ..... 1 minute (length of sample period).
Hold Time ..... 1 second (hold time between samples in Automatic Mode).
Program Mode..... Unlocked (allows user programming).

Connections and Adjustments

The power and serial I/O connectors are on the bottom of the counter, as is the Power switch. The brightness of the display may be adjusted for the best performance in various ambient light conditions as shown in Figure 1.

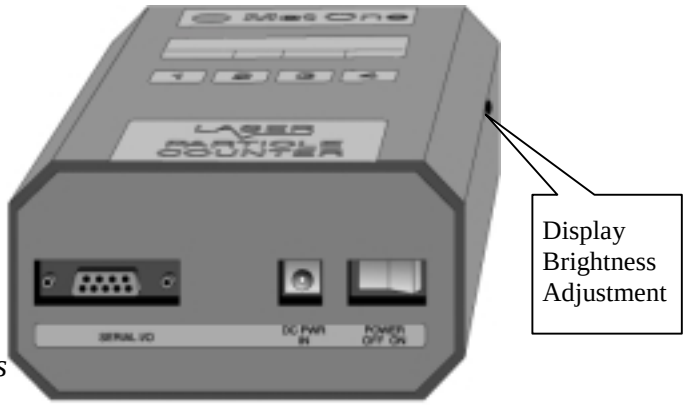


Figure 1. Connections and Adjustments

Operation

Powering Up

Turn on the Model 227 using the switch on the bottom of the counter. When first turned on, the counter will display the screen shown in Figure 2. Take a few minutes to familiarize yourself with the basic display items.

Using Manual Mode

Based on the factory default settings described above, the counter will be in Manual counting mode, which means the counter will take one sample of the programmed length (default is one minute) and stop.

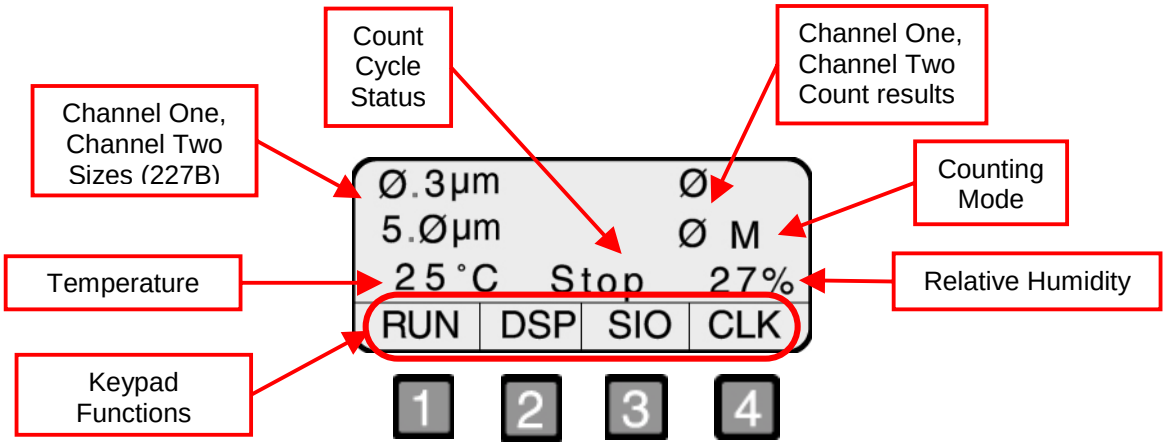


Figure 2. LCD Display

Ensure that the red inlet cap is removed from the sensor inlet tube and either the Isokinetic Probe or the purge filter is attached. At this point, press 1 to initiate a single one minute count cycle based on the factory default settings. The pump will begin operating and the Count Cycle Status will change from "Stop" to "Wait" for two seconds while the pump reaches maximum speed. The Count Cycle Status will change to "Run" during the one minute sample, then return to "Stop" at the end of the count cycle. The counter will have drawn 0.1 cubic feet of air through the instrument, so the displayed results must be multiplied by ten to obtain the counts per cubic foot.

Automatic Mode – Programming Sampling Parameters

The following scenario is an example of how to program a Model 227 counter to verify the cleanliness of a large room, dividing the space into eight sections to ensure a comprehensive measurement. It covers the typical programming requirements for the common functions associated with the 227. Full descriptions of every function can be found in the "Reference Information" section of the Manual. It is not necessary to perform the programming in any particular order, and any parameter may be re-programmed at any time without affecting the others.

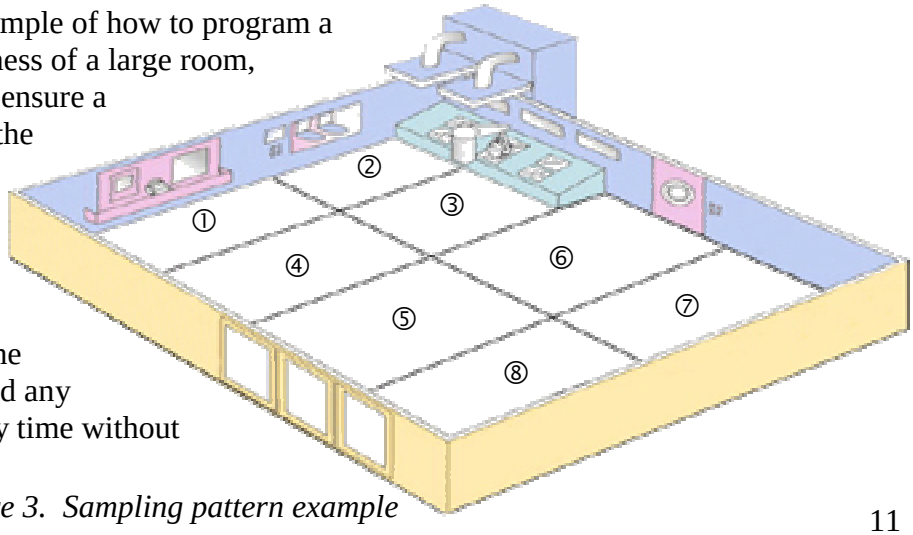
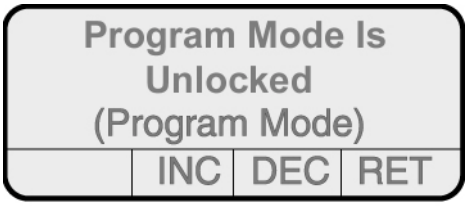


Figure 3. Sampling pattern example

Unlocking the Program Mode

The default settings of the Model 227 leave the Program Mode unlocked, but if it is locked on your counter, the following steps unlock it and allow programming.

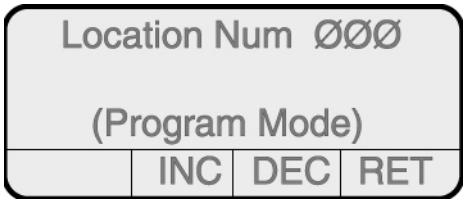
1. At the main screen, press 4 (CLK).
2. Press 3 (BAK) to display the Program Mode status screen.
3. Press 1 (PROG) to enter the Program Mode.
4. Press 2 (INC) to unlock the program mode.
5. Press 4 (RET) to return to the main screen.



Setting Display (DSP) Functions

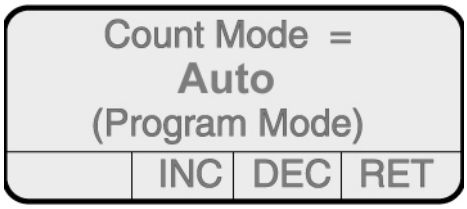
Location Number

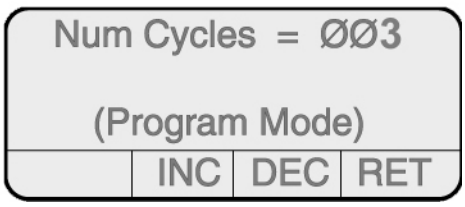
1. At the main screen, press 2 (DSP). The Location Number screen will be displayed.
2. Press 1 (PROG) to enter the Program Mode.
3. Press 2 (INC) to set the Location Number to 001.
4. Press 4 (RET) to return to the main screen.



Count Mode

1. At the main screen, press 2 (DSP) and then press 2 (NXT) to display the Count Mode screen.
2. Press 1 (PROG) to enter the Program Mode.
3. Use 2 (INC) or 3 (DEC) to select the Automatic Count Mode. Auto (A) Repeats count cycles until all the cycles programmed are completed. Press 4 (RET).
4. A Num Cycles screen will be displayed in the Program Mode and use 2 (INC) and 3 (DEC) to select 3 count cycles. If infinity (INF) is selected, the counter will continue count cycles until manually stopped. Press 4 (RET) to save settings and return to the main screen

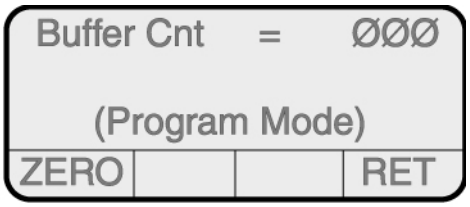




Setting Serial Input/Output (SIO) Functions

Clearing the Memory Buffer

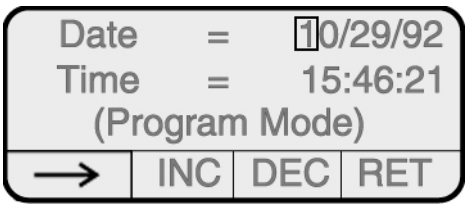
Clearing the memory buffer removes any previously stored data records.



1. At the main screen, press 3 (SIO) and then press 2 (NXT) to display the Buffer Count screen.
2. Press 1 (ZERO) to clear the contents of the Buffer.

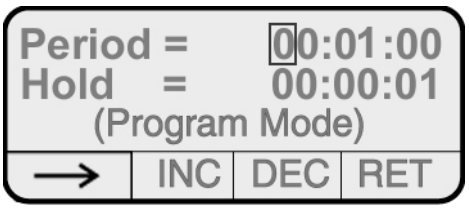
Setting Clock (CLK) Functions

Setting the Date and Time



6. At the main screen, press 4 (CLK). The Date and Time screen will appear.
7. Press 1 (PROG) to enter the Program Mode.
8. Use 1 (→) to move the cursor among the digits, 2 (INC) and 3 (DEC) to set the current date and time, which will appear on the data record for each sample.
9. Press 4 (RET) to save the settings and return to the main screen.

Setting Sample Period and Hold Times



1. At the main screen, press 4 (CLK) and then press 2 (NXT) to display the Period and Hold screen.
2. Press 1 (PROG) to enter the Program Mode.
3. Use 1 (→)to move the cursor among the digits and 2 (INC) and 3 (DEC) to set the Period time to one minute and the Hold time to one second as shown.
4. Press 4 (RET) to save the settings and return to the main screen.

You are now ready to begin sampling your room for which one possible sampling pattern is shown below. Take the counter to the center of the first area to be tested. Place or hold the counter about 4 feet off the floor, ensuring the isokinetic probe opening is facing directly into the laminar flow if present.

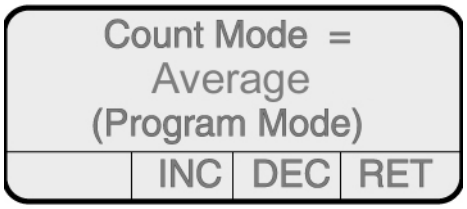
Press 1 (RUN) to initiate counting and observe the display which should show three one minute samples being taken, separated by a one second hold time. When those three samples are complete, the counter will stop. Move to the next location to be tested and, if desired, you may reprogram the Location Number to reflect your movements in the room.

When sampling is complete, the count results may be printed or downloaded to a computer and analyzed to verify the condition of the room. Procedures to print or download data are provided later in this manual. The preceding steps may be modified to create a sampling routine that fits your specific needs.

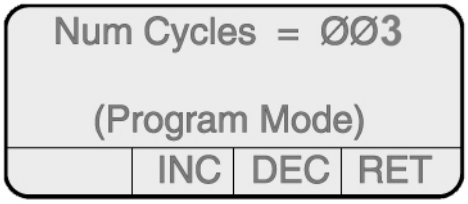
Using Average Mode

In Average Mode the counter counts for the number of sample periods programmed and then stops. The results are displayed for both channels as the average of all cycles; minimum and maximum number of counts that occurred in all cycles is also given. Program the Model 227 for Average Mode as follows:

1. At the main screen, press 2 (DSP) and then press 2 (NXT) to display the Count Mode screen.
2. Press 1 (PROG) to enter the Program Mode.
3. Use 2 (INC) or 3 (DEC) to select the Average Mode. Press 4 (RET).



4. A Num Cycles screen will be displayed in the Program Mode. Use 2 (INC) and 3 (DEC) to select the desired period. Press 4 (RET) to save settings and return to the main screen.

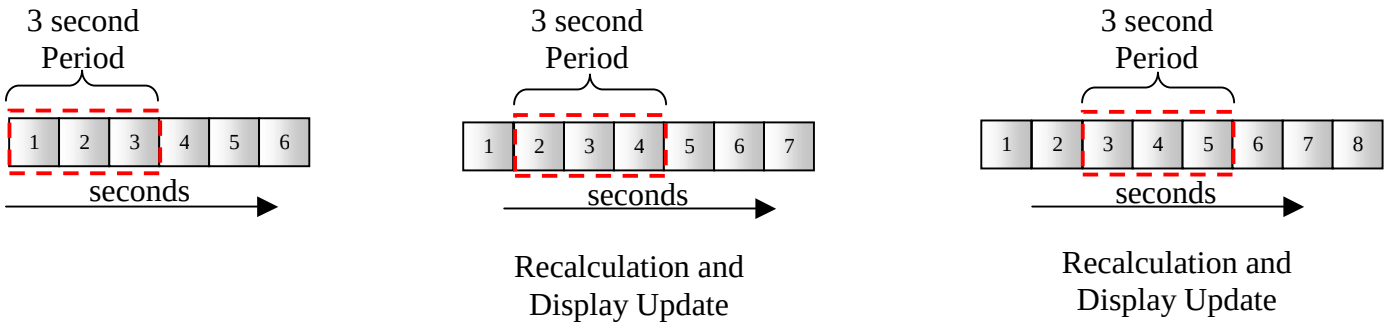


5. Press 1 (RUN) to begin the count cycle. The count status display will momentarily display WAIT while the pump comes up to speed, then display RUN while the counter is taking a sample. It will display HOLD for the programmed hold time between samples and when the programmed number of count cycles are complete it will stop sampling and display the Completed Samples screen. Average, Minimum and Maximum counts may be observed by pressing 1, 2 or 3 respectively. Press 4 (RET) to return to the main screen.

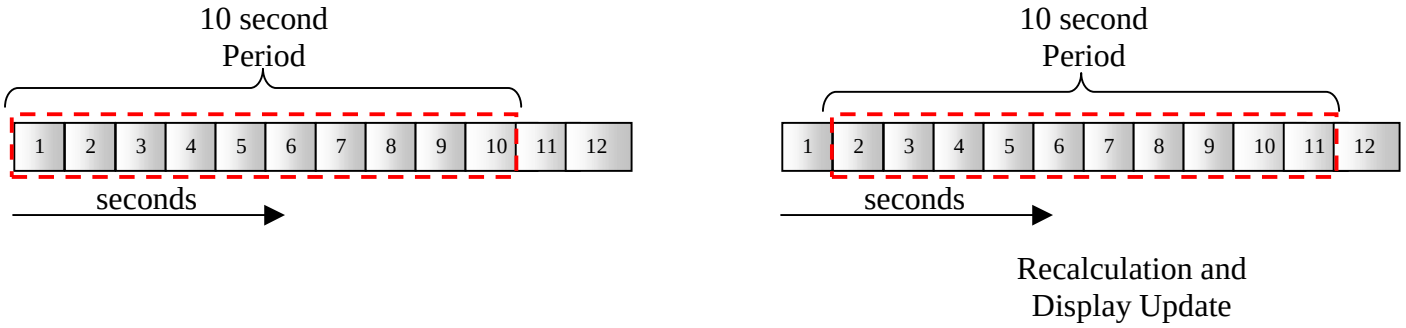
Using Concentration Mode

Concentration Mode in the Model 227 is useful for taking a quick snapshot of airborne particulate contamination levels, but is not a substitute for full sampling. It is appropriate for areas where the particulate levels are unknown and may exceed the operating limits of the counter. When using Concentration Mode, no data records are written into the memory buffer, making later analysis impractical.

In Concentration Mode the counter begins sampling, and estimates the counts per cubic foot or per liter based on a programmable period of time, updating it's calculation results on the display at one second intervals. The programmable period sets the size of a moving calculation "window" which is moved each second to incorporate a new second of sample data and discard the oldest second of sample data in the "window" of calculations as shown below.

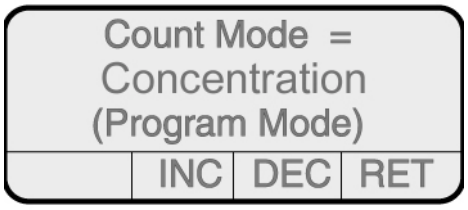


Using a three second period as shown above, the counter calculates the concentration based on a three second window that moves every one second. Using a ten second period as shown below, the counter calculates the concentration based on a ten second window that moves every one second.

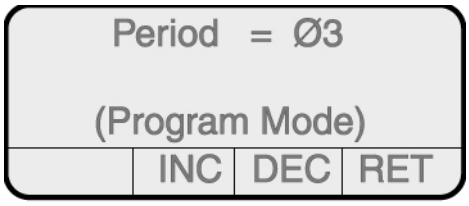


A ten second period is more likely to give a good representation of actual concentration because it covers a longer period, but the longer period also may allow high particulate levels to contaminate the sensor. In an unknown environment it is best to use a shorter period. Program the Model 227 for Concentration Mode operation as follows:

6. At the main screen, press 2 (DSP) and then press 2 (NXT) to display the Count Mode screen.
7. Press 1 (PROG) to enter the Program Mode.
8. Use 2 (INC) or 3 (DEC) to select the Concentration Mode. Press 4 (RET).



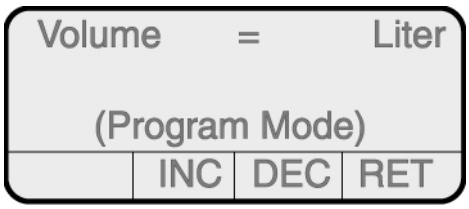
9. A Period screen will be displayed in the Program Mode. Use 2 (INC) and 3 (DEC) to select the desired period. Press 4 (RET) to save settings and return to the main screen



10. Press 2 (DSP) and then press 2 (NXT) four times to display the Volume screen

11. Press 1 (PROG) to enter the Program Mode.

12. Use 2 (INC) and 3 (DEC) to select the unit of volume. Press 4 (RET) to save settings and return to the main screen.

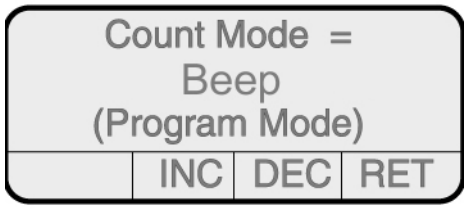


13. Press 1 (RUN) to begin the count cycle. The count status display will momentarily display WAIT while the pump comes up to speed, then display RUN while the counter is taking a sample. In the Concentration mode, counting continues until 1 (STOP) is pressed.

Using Beep Mode

In Beep Mode a single audible sound (beep) once each time a count alarm limit is reached and then once more for every multiple of the count limit. For example, if the limit is set at 1,000 particles, the beep will sound at 1,000, 2,000, 3,000 etc. Since there are two size channels displayed at once and a beep will sound when either particle size range limit is reached, It is suggested you set a limit for only one size range of interest and set the remaining range to zero, which generates no alarm. The beep mode limits and count alarm limits are one and the same. Program the Model 227 for Beep Mode as follows:

1. At the main screen, press 2 (DSP) and then press 2 (NXT) to display the Count Mode screen.

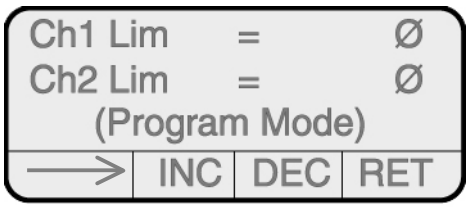


2. Press 1 (PROG) to enter the Program Mode.

3. Use 2 (INC) or 3 (DEC) to select the Beep Mode. Press 4 (RET) to return to the main screen.

4. At the main screen, press 2 (DSP) and then press 2 (NXT) twice to display the Alarm Limits screen.

5. Press 1 (PROG) to enter the Program Mode.



5. Use 1 (→)to move the cursor among the digits and 2 (INC) and 3 (DEC) to set the Alarm limits to the desired settings time to one minute and the Hold time to one second as shown. Press 4 (RET) to save settings and return to the main screen.

6. Press 1 (RUN) to begin the count cycle. The count status display will momentarily display WAIT while the pump comes up to speed, then display RUN while the counter is taking a sample. In the beep mode, counting continues until 1 (STOP) is pressed.

Using the DPU-414 Printer

Printer setup

The Model DPU-414 printer is currently sold as an accessory to the Model 227, while the earlier Model DPU-411 is no longer manufactured. Refer to “Manual Backdating" if you are using a DPU-411 printer.

DIP switch settings for the DPU-414 printer are made in the printer’s internal firmware using the front panel buttons.

1. With the Power switch set to Off, press and hold the Online button, then turn the power switch on.

2. When the printer begins to print the current DIP switch settings, release the Online button. The current settings will be printed and the printer will be in DIP switch setting mode.

3. **If the DIP switch settings match those in figure 4, no changes are necessary.** Press the Feed button to exit the DIP SW setting mode. If changes are necessary, continue to step 4.

4. Press the On-Line button to begin the programming of DIP SW-1 settings. The printer will print “Dip SW-1” and open the first switch position for setting.

5. Press the Feed button to set the first switch position to OFF. The printer will print “1 (OFF) : Input = Serial” and open the next switch position for programming.

6. Press the On-line button to set the second switch position to ON. The printer will print “2 (ON) : Printing speed = High” and open the next switch position for programming.

7. Continue programming the remaining positions as above using the Online button to set ON conditions and the Feed button to set OFF conditions.

When all the SW-1 settings are done, the printer will prompt you to select Continue by pressing the On-Line button, or Write by pressing the Feed button . If SW-2 and SW-3 settings are correct, select Write to exit the programming routine and save the settings. If SW-2 settings are correct, but SW-3 settings need to be changed, SW-2

Dip SW-1		
1	(OFF)	: Input = Serial
2	(ON)	: Printing Speed = High
3	(ON)	: Auto Loading = On
4	(ON)	: Auto LF = On
5	(ON)	: Setting Command = Enable
6	(ON)	: Printing
7	(ON)	: Density
8	(ON)	: = 72 %
Dip SW-2		
1	(ON)	: Printing Columns = 40
2	(ON)	: User Font Back-up = ON
3	(ON)	: Character Select = Normal
4	(ON)	: Zero = Normal
5	(ON)	: International
6	(ON)	: Character
7	(ON)	: Set
8	(OFF)	: = U.S.A
Dip SW-3		
1	(ON)	: Data Length = 8 bits
2	(ON)	: Parity Setting = No
3	(ON)	: Parity Condition = Odd
4	(ON)	: Busy Control = H/W Busy
5	(OFF)	: Baud
6	(ON)	: Rate
7	(ON)	: Select
8	(ON)	: = 9600

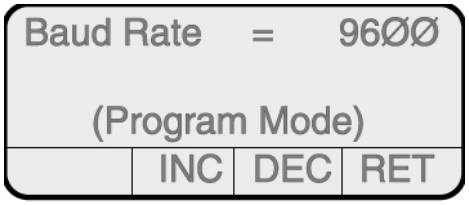
Figure 4. Printer controls and settings

settings must be programmed first in order to access SW-3 settings. If the SW-3 settings are modified, the printer will automatically exit the DIP-SW programming mode after the last position is set and print " DIP SW setting complete!!" Ensure the printer is on line when programming is complete.

Counter setup

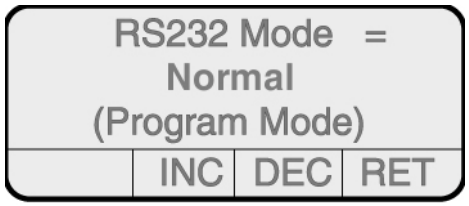
Connect the printer cable between the printer and the counter. Printer interface settings are located under the SIO functions menu on the main screen because the data is transmitted serially from the counter in RS 232 format. The Baud Rate in the Model 227 must be set to 9600 as follows

1. At the main screen, press 3 (SIO) to display the RS232 Mode screen.
2. Press 2 (NXT) twice to display the Baud Rate screen.
3. Press 1 (PROG) to enter the program Mode.
4. Use 2 (INC) or 3 (DEC) to select the desired RS232 Mode.
5. Press 4 (RET) to return to the main screen.



There are three RS232 Modes from which to choose: Normal mode which disables the printer function, Print A Record which prints particle count results after completion of each count cycle and Print The Buffer which prints all the count cycles contained in the rotating buffer. Data is removed from the rotating buffer during printing in Print The Buffer mode. Select the desired RS232 mode as follows: If Print The Buffer is selected, printing will begin as soon as 4 (RET) is pressed.

1. At the main screen, press 3 (SIO) to display the RS232 Mode screen.
2. Press 1 (PROG) to enter the program Mode
3. Use 2 (INC) or 3 (DEC) to select the desired RS232 Mode.
4. Press 4 (RET) to return to the main screen.



Interpreting the Printout

The printer will print the particle size ranges and total counts for both ranges. It also prints environmental probe values if an external probe is connected to the counter. Date, time, period, and location are always added to each printout. If there is an alarm during a sample run, the printout will show what type of alarm occurred. A typical "Print The Buffer" printout will look similar to this:

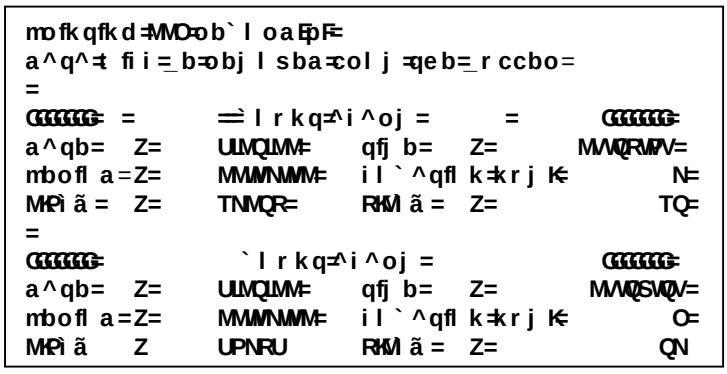
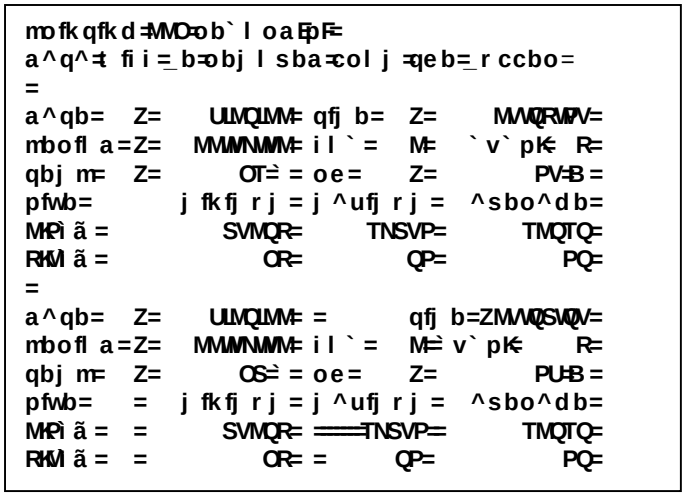


Figure 5. Data Record Printout



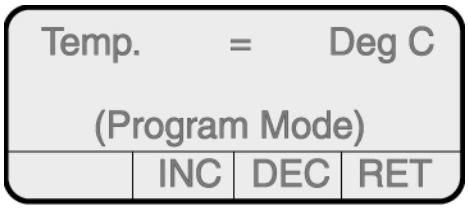
If the count mode had been "Average", the printout might look like this, where the minimum, maximum, and average count for both sizes are given.

Figure 6. Average Mode Data Record Printout

Relative Humidity and Temperature Probe

The Model 227 displays the temperature readings of the optional environmental probe in degrees Celsius or Fahrenheit. To program the temperature display:

1. At the main screen, press 2 (DSP) and then repeatedly press 2 (NXT) to display the Temperature screen.
2. Press 1 (PROG) to enter the Program Mode.
3. Use 2 (INC) or 3 (DEC) to select the Beep Mode.
4. Press 4 (RET) to return to the main screen.



Computer Interface Operations

Data analysis for ISO 14644

The primary reason for computer interface with the Model 227 is to download the count data for analysis. ISO 14644 is the governing standard for cleanrooms, and while the Model 227 counter is a small instrument without the capability to perform the calculations internally, the PortAll software package offered by Pacific Scientific Instruments is able to download the data from the counter and perform all the necessary functions to ensure compliance with the ISO standard. If you purchased PortAll for use with your Model 227, Appendix A provides instructions for setup and operation of the counter and software. If you purchased PortAll software, you will have also received an adapter you can use with a standard 9-pin to 9-pin serial cable instead of the special cable required for simple serial interface.

Simple Computer Communications

The Model 227 counter has been set up for both serial data communications capabilities: RS-232 serial interface circuitry provides asynchronous communications between the counter and computer, or RS-485 serial network circuitry provides asynchronous communications between up to 64 counters and a controlling computer. A terminal program such as Windows HyperTerminal is used to perform the basic communication. Met One counters do not use a standard 9 pin serial cable, but a special pin configuration is required as shown in figure 7. A special serial cable is available from Pacific Scientific (p/n 2082197-1), but the backshell must be modified to fit the recessed connector on the Model 227. A standard serial cable may be used with the PortAll adapter as shown in Appendix A.

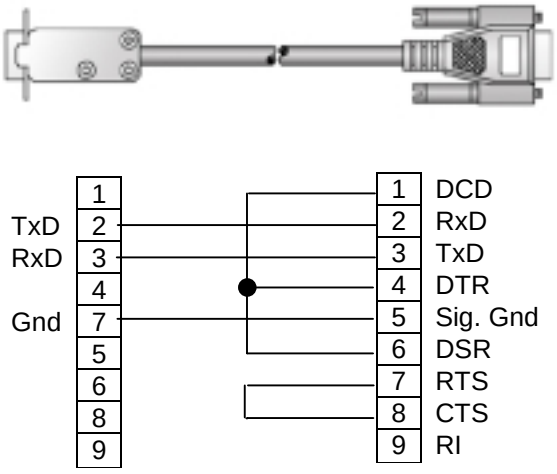


Figure 7. Serial Interface Pinout

Communication Protocol

The counter has the following fixed parity and protocol:
Eight (8) data bits
One (1) stop bit
No parity

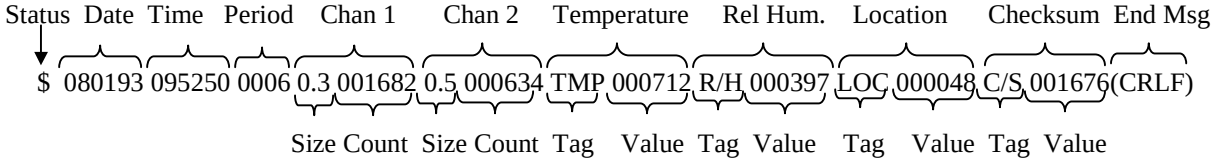
Commands

The following ASCII commands described below are supported by your particle counter:
"a" Auto:
When the “a” command is used, the counter is placed in the auto mode.
"b" Manual:
When the “b” command is used, the counter is placed in the manual mode.
"c" Start Counting (computer controlled):
The counter will begin counting without waiting for an even second boundary (quick start). Counting will continue until stopped by the computer. The count cycle should be controlled by the computer.
"d" Start Counting (counter controlled):
The counter will begin counting and control the count cycle based on the counter’s setting for period.

"e" Stop Counting:
The counter will immediately stop counting without waiting for an even second boundary.
"C" Clear Buffer:
The rotating buffer will be erased.
"D" Send Number of Records:
The counter will send the number of records in the rotating buffer.
"E" Send EPROM Revision:
The counter will send the EPROM number and revision level.
"M" Mode Request:
The counter will send its present mode. If counting, a "C" will be sent. If holding, an "H" will be sent. If stopped, an "S" will be sent.
"T" Identify Model:
The counter will send a four character model number (e.g. 227A).
"A" Send Record:
The next record in the rotating buffer will be sent. When the rotating buffer is empty, a "#" will be sent. Each record is erased from the buffer as it is sent. If no count cycles have been completed since the counter was turned on, then a "#" will be sent. The record can not be sent until the current count cycle is complete.
"R" Resend Record:
The last record sent will be resent. Records sent prior to the last record have been permanently erased.
"h" Standby Mode:
The counter will enter a mode that turns off the air pump and shuts down the sensor to conserve power and reduce equipment wear.
"g" Active Mode:
The counter will enter a mode that prepares it for counting. The air pump will turn on to purge the air path.
"l" Local Mode:
(for factory test purposes) The counter will be set to off-line.
"U" Universal Select:
(functions only when one counter is connected at a time) The counter will respond to all commands after receiving this command, regardless of which select code is programmed into the counter until a counter select command is received. Any counter select command (128 through 191) will disable the Universal Select command. Re-enable this command by turning power to the unit off then on.
"128-191" Counter Select:
The counter will respond to all subsequent commands when a number is sent that matches its select code, i.e. sending a number between 128 (corresponding to LOC 0) and 191 (corresponding to LOC 63) that does not equal the counter's select code. The counter is deselected, or made unresponsive to computer commands, by selecting another counter.

Data

Each counter can send a record of its data. The data record is a string of ASCII characters where the position in the string identifies the character's meaning. The length of the string changes with the amount of data points available from the counter. Each data point is preceded by a three-character tag that identifies the type of data that follows in the next six data characters. The following is an example to show the serial communications format:



Maintenance and Troubleshooting

Common Problems

There are two messages which, when displayed on the LCD, indicate that user maintenance is required.

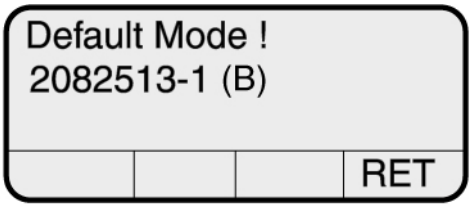
<Low Battery!> indicates that the battery is in need of recharging. Turn off the counter and attach the AC adapter / charger to the power input jack on the bottom of the counter. Place the counter in its stand or on any stable surface and allow it to charge for 10 –12 hours.

<Sensor Fail!> indicates that the internal particle sensor is no longer operating within acceptable limits and any count data taken during this alarm condition should be disregarded as inaccurate. The primary cause of this condition is sensor contamination. When this alarm occurs, the sensor should be purged by attaching the purge filter that was supplied with the counter to the sensor inlet on top of the counter. Place the counter on its stand, and attach the AC adapter/charger to the power connection on the bottom of the counter. Set the counter to Automatic Mode and the number of cycles to infinite (inf). Press run and observe the particle count display. If the count totals are high but descending, allow the counter to operate continuously for an extended period of time until the counts stabilize at or near zero. If the Sensor Fail alarm persists or if the counts do not reach zero after an extended period of time, sensor cleaning is necessary.

<Count Alarm!> indicates that the particle counts have exceeded the programmed limits, but does not indicate a failure in the counter. Ensure that the alarm limits are set to an appropriate level for the environment being monitored.

Resetting the counter

1. If for any reason your particle counter begins to perform out of character (e.g., incorrect date and time), you can clear the counter memory and restart its microprocessor as follows:
2. Disconnect any printer and serial cables and turn power off.
3. Hold down the 1 and 3 keys while turning power on. Release keys when counter beeps once. The following screen will be displayed:
4. Press 4 (RET) to return to the main screen.
5. Reprogram date and time and any other function that may have been set to original default values.



Sensor Cleaning

WARNING

The use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

CAUTION

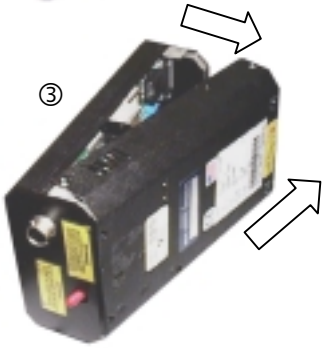
Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all work inside the particle counter should be done at a static-safe workstation. A static-safe workstation can be created by doing the following:

- Use a grounded conductive table mat and resistor-isolated wrist-strap combination
- Earth-ground all test instruments to prevent a buildup of static charge.

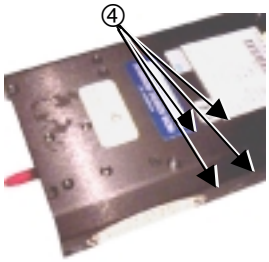
The laser diode in this device is extremely sensitive to static charges and out-of-tolerance voltage variations. NEVER connect or disconnect the sensor cable from the counter when the counter is on. Never make or break electrical connections when equipment power is on.

1. Remove four screws, two from each side of the counter.

2. Remove two screws from the bracket on the top rear of the counter.



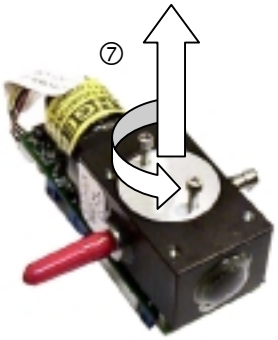
3. Spread the two halves of the unit apart while pulling the back of the unit slightly downward so the sensor inlet clears it's opening at the top of the unit.



4. Remove the four nylon screws holding the sensor to the case.

5. Disconnect the tubing from the sensor.

6. Disconnect the sensor cable from the sensor circuit board



7. Insert 2 #2-56 machine screws into the two threaded holes in the reflector. Use these screws as a handle to remove the reflector with a pulling and twisting motion.

8. Clean the reflector and photo detector with cotton swabs wetted with a small amount of reagent grade acetone. Buff the optical surfaces with a dry swab after cleaning. Blow out the interior surfaces with clean dry air.

9. Re-assemble the unit in reverse order.

Pump Maintenance

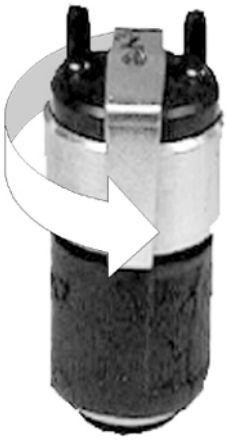
If the vacuum pump does not operate, or exhibits any questionable symptoms such as unusual sound or vibration, it may be removed for maintenance to restore it to optimum operation.

Disassembly and cleaning

1. Open the counter as described in steps 1-3 of the sensor cleaning procedure above.
2. Remove the pump from the chassis clip as shown.
3. Unplug the pump electrical connection
4. Disconnect the tubing from the pump, taking care to note which is attached to the Vacuum (V) fitting and the Pressure (P) fitting.
5. Using a 1.27mm or 1.5 mm hex key (Allen) wrench, loosen the set screw in the bracket on top of the pump.
6. Push the bracket to one side and remove it from the pump
7. Remove the top of the pump, note locator pin.
8. Remove pump body
9. Remove carbon vanes and ensure the rotor turns freely
10. Reassemble in reverse order.

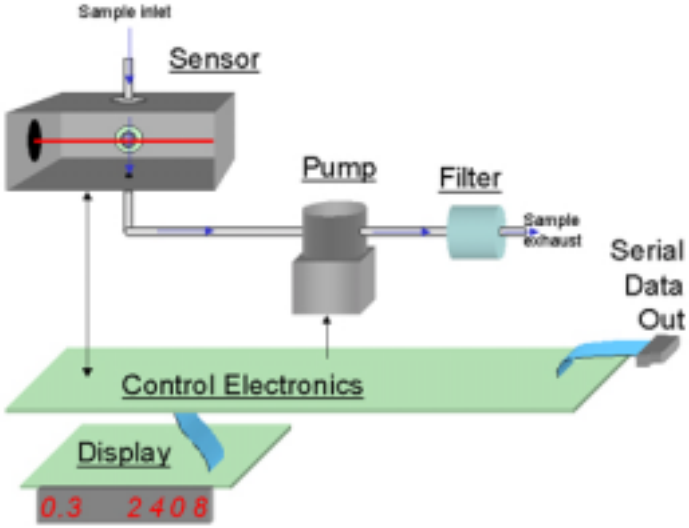
Pump Optimization

1. After reassembling the pump, loosen the setscrew plug in top bracket and make the electrical connection to the 227 counter.
2. Carefully turn on power to the 227 and press 1 (RUN) to initiate a count cycle and turn on the pump.
3. Grasp the pump motor and hold it stationary.
4. Rotate the entire pump head in a 180° arc.
5. As the pump head is rotated listen for the point where the RPM's are the greatest.
6. Keep the pump head at this point and tighten the set screw.



Reference Information

Theory of Operation



The Model 227A/B counter is Met One's simplest combination of sensor, pump and electronics that includes full particle counter features. Both variants use the same sensor, pump, and CPU and display electronics. The 227A is calibrated with channel one sensitivity of 0.5µm and the 227B is calibrated with a channel one sensitivity of 0.3µm. Both operate at a flow rate of 0.1 cfm.

The Sample passes through a laser beam in the sensor, where any particles scatter the laser light, then passes through the pump and a filter to trap particles in the counter rather than return them to the environment. The flashes of scattered light are converted to electronic pulses directly proportional to the amount of scatter, making a correlation to particle size. The electronic pulses are counted and stored in channel "bins" in a data record including date and time from the CPU clock and snapshots of environmental conditions, if the RH/T probe is attached.

Specifications:

Size	4.0" wide x 2.3" high x 6.5" long
Weight	2.13 lbs.
Maximum Count Displayed	9,999,999
Sample Flow Rate	0.1 cfm
Number of Size Ranges	2; second size is front-panel selectable
Particle Size Ranges	
227A:	0.5 micron and larger (channel 1) 0.7, 1, 3, or 5 (channel 2)
227B:	0.3 micron and larger (channel 1) 0.5, 1, 3, or 5 (channel 2)
Coincidence Error	Less than 5% at 2,000,000 particles/cu. ft.
Power	+5 watts, +10 V (approx.) (+6 V with battery pack)
Light Source	Laser diode
Sample/Hold Times	1 second to 24 hours
Count Alarms	1 to 9,999,999 counts

Data Storage	200 samples, rotating buffer
Count Cycles	up to 100 in AUTO or Average mode
Locations	up to 250, number appears on printout
Output	RS-232C/RS-485 for computer
Pump Type	Carbon-vane, 0.1 cfm
Environment (Operating):	
Temperature	12 to 29°C (55 to 84°F)
Humidity	10 to 85% relative, non-condensing
Environment (Storage):	
Temperature	-40 to 71 °C (-40 to 160 °F)
Humidity	Up to 98% relative, non-condensing
Recharging Time	to 90% in 10 hours, 100% in 12 hours
Battery Type	Rechargeable NiMH, 3500 mAH
Operating Time	8 hours, typical

Glossary of terms

Stop ..... Count cycle status when count cycles are complete.
Wait ..... Count cycle status for two-second pause to allow pump to come up to speed before starting first count cycle.
Run..... Count cycle status during a particle count cycle.
Hold ..... Count cycle status during the pause between count cycles.
Location Num ..... Location number (0 to 250) can be set for a sample location as well as an addressing number established for the counter (computer control).
Count Mode= Manual (M) ..... Counts for one count cycle then turns pump off. Counter remains on.
Count Mode= Auto (A) ..... Repeats count cycles until all the cycles programmed are completed.
Count Mode= Average (Av) ..... Gives the average, minimum, and maximum count for a specified number of count cycles.
Count Mode= Concentration (CF or L) ..... Approximates count/ft^3 of air (CF) or count/liter of air (L). Also changes temperature readout from °F to °C.
Period..... Time (1 to 10 seconds) selected for count approximation when in Concentration mode.
Count Mode= Beep (B) ..... One beep occurs after channel 1 and channel 2 count limit is reached and each step multiple thereafter. Counter counts until stopped.
Num Cycles ..... Number of count cycles (1 to 100, or Inf) in Auto (A) and Average (Av) modes. If Inf (infinity) is selected, counter will continue count cycles until stopped.
Ch 1 Lim..... Count limit of channel 1 when an audible alarm begins.
Ch 2 Lim..... Count limit channel 2 when an audible alarm begins.
Ch 2 Size..... Minimum size threshold of particles counted in second size channel. Also, second size channel can be selected while in this function.
Volume = ... Changes particle count readout when in Concentration mode from counts/liter to counts/cubic foot
Temp =..... Changes temperature readout from °F to °C.
RS232 Mode =Print a Record ..... When printer is connected, results are printed at end of each count cycle.
RS232 Mode =Print Buffer..... When printer is connected, prints count data for all count cycles stored in buffer.
RS232 Mode =Normal..... Printer is disabled; RS232 (computer control) is enabled.
Buffer Cnt ..... Number of count cycles presently stored in buffer.
Baud Rate..... Selectable from 300, 1200, 2400, or 9600.
Date..... The present date.
Time..... The present time of day (24 hour clock format).
Period..... Sample time for each count cycle (up to 24 hours).
Hold ..... Time between count cycles (up to 24 hours).
Program Mode Is Unlocked (or **Locked)** ..... Counter can be locked so programming cannot be changed.
<Sensor Fail!>..... When flashing, indicates a sensor problem.
<Count Alarm!> ..... When flashing and beeping, indicates the programmed count alarm limit has been exceeded.

<Low Battery!>..... When flashing, indicates battery needs recharging.
(Program Mode) ..... Means you have entered the mode for changing parameters or limits of the display, serial I/O, or clock functions.

RUN ..... Begins the count cycle.
STOP ..... Stops the count cycle before completion; data is not saved.
DSP ..... Top menu name (Display) for all display parameters.
SIO..... Top menu item (Serial Input/Output) for all serial interface parameters.
CLK ..... Top menu name (Clock) for all clock parameters.
PROG ..... Allows user to change parameters or limits.
NXT ..... Steps to the next function within the top menu.
BAK ..... Steps to the previous function within the top menu.
RET..... Returns to the main screen.
INC..... Either steps to the next mode selection or increments (increases) to the next higher number.
DEC ..... Either steps to the previous mode selection or decrements (decreases) to the next lower number.
→ ..... Advances to the next set of digits to be changed.
ZERO..... Sets buffer count to zero (clears buffer of all count cycle data).

Manual Backdating

Changes, additions, and improvements have been made to the Model 227 Operating Manual to warrant it's updating to revision B through E.

Revision B:

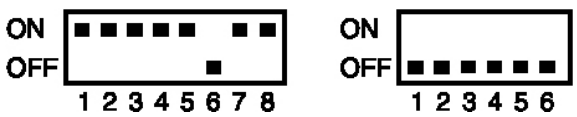
- Made improvements to the firmware to simplify setting the program functions
- Menus were made more user-friendly.
- Added check-sum to end of serial data record.

Revision C:

- Incorporated new EPROM to correct software anomalies.
- Enclosed areas around connectors and switch on bottom plate; added RH/T connectors to all units.
- Provided for external flow rate adjustment through back panel (*for factory use only, do not adjust*).

Revision D:

- A firmware change added an "m" after the "µ" for particle size units,
- Incorporated NiMH battery for longer operating time; replaced rechargeable Ni-Cd battery.
- Removed reference to the Model DPU-411 printer which is no longer manufactured. If using a DPU-411 printer, verify switches on bottom of printer are set for parallel format. They should be set as follows:



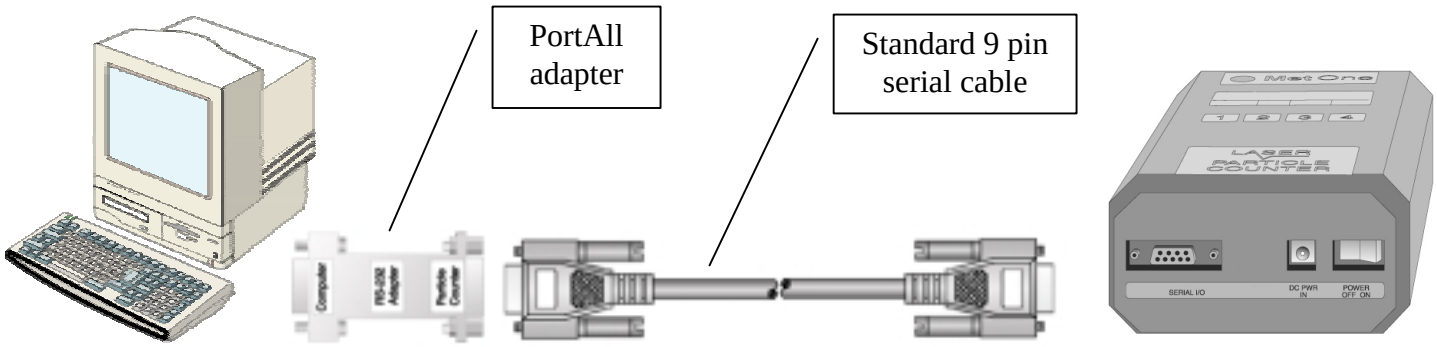
Early Version Counter Resetting

Earlier version particle counters will display different EPROM numbers, depending on time of manufacture, when the "Resetting the Counter" procedure is performed (contact Technical Support for additional historical data information).

Appendix A: Using the Model 227 with PortAll

The cleanroom classification standards FS 209E and ISO 14644-1 require specific particle count measurements and calculations to verify the cleanliness level of a cleanroom or clean area. Using measurement data from the Model 227 particle counter, the PortAll software can automatically generate cleanroom verification results.

Connections



In order to communicate with a computer, the Model 227 RS232 mode, which is found under the SIO menu, must be set to normal (printer disabled). At the time it is connected to the computer, the location number must be set between 0 and 31 to be recognized by PortAll. After any communication under computer control, the keypad will be disabled until the counter's power is cycled off and on.

Operation

The following four rules must be followed to ensure an accurate classification result from PortAll.

1. The data returned from the particle counter contains a location number for each sample. The operator collecting the sample data must change the location number, using the front panel instrument controls, each time the instrument is moved to a new location. PortAll relies on the location number as an accurate indicator of the number of sample locations, and number of samples per location.

2. The sample time must be set to obtain the required sample volume at each location. (Sample Time x Instrument Flow Rate = Sample Volume). PortAll does not have access to the instrument flow rate and has no way to verify that the sample volume complies with standard requirements. Therefore, it is necessary to set up the Model 227 as follows:

    a. Sample period to one minute (0.1 cubic ft.) and select Normalize Data (counts x 10) in PortAll

    OR

    b. Sample period to 10 minutes (1.0 cubic ft) and do not select Normalize Data in PortAll

3. The total count data returned from the particle counter must be normalized to counts per unit volume to obtain a correct classification. PortAll will automatically normalize (counts x 10) the count data, but you must setup this feature (refer to the online User's Guide for instructions). The data normalization settings for a particular instrument are saved based on the instrument address. For most instruments, the sample location (LOC) value is also the serial port address, so be sure to reset the instrument address after

collecting samples in the cleanroom and before connecting the instrument to PortAll. Otherwise, the count values will not be automatically normalized and an erroneous classification could result. Also, the address value cannot exceed 31. PortAll will not recognize an instrument whose address is outside of the range of 0-31.

a. For ISO 14644-1: PortAll stores the ISO classification limits internally in a table as counts per cubic meter. To obtain accurate classifications, the data in the spreadsheet must be normalized to counts per cubic meter.

b. For FS209E: PortAll stores the FS209E classification limits as counts per cubic foot. To obtain accurate classifications, the data in the spreadsheet must be normalized to counts per cubic foot.

4. It is required that you clear the instrument memory before beginning a sampling sequence to classify a cleanroom/area. This ensures that the PortAll spreadsheet of the instrument memory will only contain relevant samples to select for the classification calculations.

For full PortAll documentation, refer to the PortAll CD.

DECLARATION of CONFORMITY

We,

Pacific Scientific Instruments
481 California Avenue
Grants Pass, Oregon 97526

declare under sole responsibility that the

Particle Counter, Model 227, part number 2082611

conforms to Directive 89/336/EEC for Electromagnetic Compatibility and Directive 73/23/EEC for Low Voltage. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:

EN 61326:1998, Class A / EN 500081-1:1992 Emissions:

EN 55011 :1991 Class A Radiated
EN 55011 :1991 Class A Conducted

EN 61326:1998 / EN 50082-1:1997 Immunity:

EN 61000-4-2 Electrostatic Discharge
EN 61000-4-3 Electromagnetic Field
EN 61000-4-4 Electrical Fast Transient
EN 61000-4-5 Surge Test Common and Differential mode
EN 61000-4-6 3 Volt Modulated Interfering Signal
EN 61000-4-8 Susceptible Magnetic Fields
EN 61000-4-11 Voltage Interruption Test

EN 61010-1:1993 Amendment 1 & 2, Safety Requirement for Electrical Equipment for Measurement, Control and Laboratory Use

EN 60825-1:1993 Safety of Laser Products, Equipment Classification, Requirements and User's Guide.

Pacific Scientific Instruments
July 6, 2000
(Place and date of issue)

R. W. Ferguson-Engineering Director
(Name/signature of authorized person)

Warranty

Pacific Scientific Instruments ("Seller") warrants that the Products will operate substantially in conformance with Seller's published specifications, when subjected to normal, proper and intended usage by properly trained personnel, for a period of one (1) year from the date of shipment to Buyer (the "Warranty Period"). Seller agrees during the Warranty, provided it is promptly notified in writing upon the discovery of any defect and further provided that all cost of returning the defective Products to Seller are prepaid by Buyer, to repair or replace, at Seller's option, defective Products so as to cause the same to operate in substantial conformance with said specifications. Replacement parts may be new or refurbished, at the election of Seller. All replaced parts shall become the property of Seller. Lamps, fuses, bulbs and other expendable items are expressly excluded from the warranty under this Section. Seller's sole liability with respect to equipment, materials, parts or software furnished to Seller by third party suppliers shall be limited to the assignment by Seller to Buyer or any such third party supplier's warranty, to the extent the same is assignable. In no event shall Seller have any obligation to make repairs, replacements or corrections required, in whole or in part, as the result of (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the Products in a manner of which they were not designed, (v) causes external to the Products such as, but not limited to, power failure or electrical power surges, (vi) improper storage of the Products or (vii) use of the Products in combination with equipment or software not supplied by Seller. If Seller determines that Products for which Buyer has requested warranty services are not covered by the warranty hereunder, Buyer shall pay or reimburse Seller for all costs of investigating and responding to such request at Seller's then prevailing time and materials rates. If Seller provides repair services or replacement parts that are not covered by the warranty provided in this Section, Buyer shall pay Seller therefore at Seller's then prevailing time and materials rates. ANY INSTALLATION, MAINTENANCE, REPAIR, SERVICE, RELOCATION OR ALTERATION TO OR OF, OR OTHER TAMPERING WITH, THE PRODUCTS PERFORMED BY ANY PERSON OR ENTITY OTHER THAN SELLER WITHOUT SELLER'S PRIOR WRITTEN APPROVAL, OR ANY USE OF REPLACEMENT PARTS NOT SUPPLIED BY SELLER, SHALL IMMEDIATELY VOID AND CANCEL ALL WARRANTIES WITH RESPECT TO THE AFFECTED PRODUCTS. EXCEPT AS EXPRESSLY PROVIDED IN THIS SECTION, SELLER DISCLAIMS ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE PRODUCTS, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE PRODUCTS ARE ERROR-FREE OR WILL ACCOMPLISH ANY PARTICULAR RESULT.