

Model 237A/B Particle Counter

Operator's Manual



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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: 701076

REV: D

Contents

Safety.....	5
Manual Safety Conventions	5
Electrical Safety.....	5
Laser Safety	5
Electrostatic Safety.....	5
Battery Safety Information	6
Unpacking and initial inspection	6
Technical Support Information.....	6
Return Shipping.....	6
Introduction	8
Particle Counter.....	8
Accessories - included	8
Accessories – optional	9
Applications	10
Setup	10
Factory Default settings	10
Front Panel Overview	11
Rear Panel Connections	11
Operation	12
Powering Up.....	12
Using Manual Mode	12
Changing The Sample Period.....	12
Enabling The Printer	13
Setting the Date and Time	13
Setting Alarm Limits	13
Automatic Mode	14
Setting Location Numbers.....	14
Setting the Number of Cycles	14
Setting The Sample Period and Hold Time.....	15
Taking the Samples	15
Using Concentration Mode	16
Setting The Sample Period	17
Concentration Mode Sampling.....	17
Using Beep Mode.....	17
Setting Beep Mode Limits	17
Beep Mode Sampling.....	18
Using The Relative Humidity and Temperature Probe	18
Environmental Alarms.....	18
Computer Interface Operations.....	19
Data analysis for ISO 14644	19
Simple Computer Communications	19
Communication Protocol.....	19
Commands.....	19
Data	20
Maintenance and Troubleshooting.....	21
Common Problems.....	21
Resetting the counter	21
Sensor Cleaning.....	22

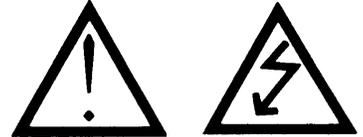
Pump Maintenance.....	23
Disassembly and cleaning.....	23
Pump Optimization.....	24
Battery Replacement.....	24
Printer Maintenance.....	25
Cleaning the Print Head.....	25
Correcting Light Print.....	25
Replacing The Printer.....	25
Reference Information.....	26
Theory of Operation.....	26
Specifications:	27
Manual Backdating	28
Appendix A: Using the Model 237 with PortAll	29
Connections.....	29
Operation.....	29
Appendix B: Using the DPU-414 Printer.....	31
Printer setup.....	31
Counter setup.....	32

Safety

Manual Safety Conventions

Warnings and Cautions are used throughout this manual, appearing before the procedure or step to which they apply. 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 hazard and a triangle with lightning bolt indicates an electrical safety 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

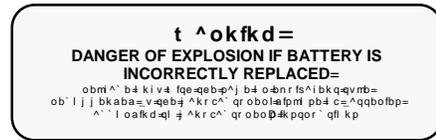


WARNING

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

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Southern

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

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Introduction

Particle Counter

This operating guide describes how to use the Models 237A and 237B portable Particle Counters. Operation of the two variants is identical, while the minimum size sensitivity of the 237A is 0.5µm and the minimum size sensitivity of the 237B 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.



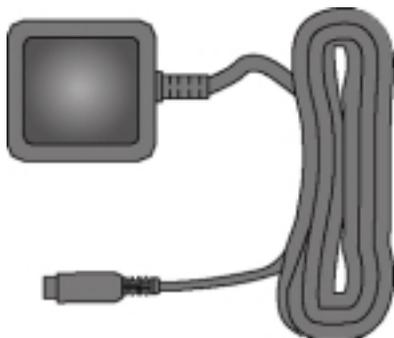
Accessories - included

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



Isokinetic Probes – Wand style P/N 203015-3, Direct mount 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.

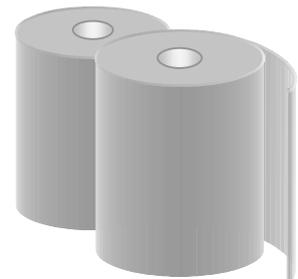
Purge Filter – P/N 2080442. Attaches to sensor inlet; used for maintenance (purge and zero count) of the counter to keep external particles from contaminating sensor while purging sensor of accumulated internal particles.



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

Thermal Printer Paper – P/N 460519. Two rolls, for use with internal printer.



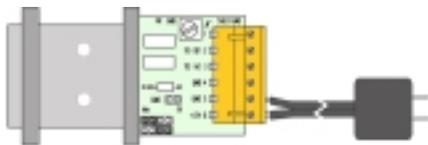
Accessories – optional

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 or 800-866-8854 during the week from 8:00 am - 5:00 pm Pacific Time.



RH/Temp Probe – P/N 2080245-1. Plugs into the connector on rear 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.



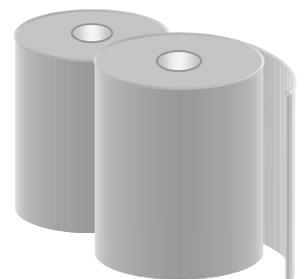
RS-485 Converter – P/N 2082383-2. Converts data from RS-232 to RS-485 format, for longer serial networking to a computer. Consult Technical Support for application.

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 2080879. Protects the counter during shipment or storage.

Cleanroom Printer Paper – P/N 460521. Particle free paper for use in cleanrooms.



Applications

Note:

The Model 237 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.

The Model 237 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 500 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 total count per cubic foot of air, such as cleanrooms, medical instrument assembly and computer rooms. For areas with unknown particulate levels, the Concentration Mode in the Model 237 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.

Setup

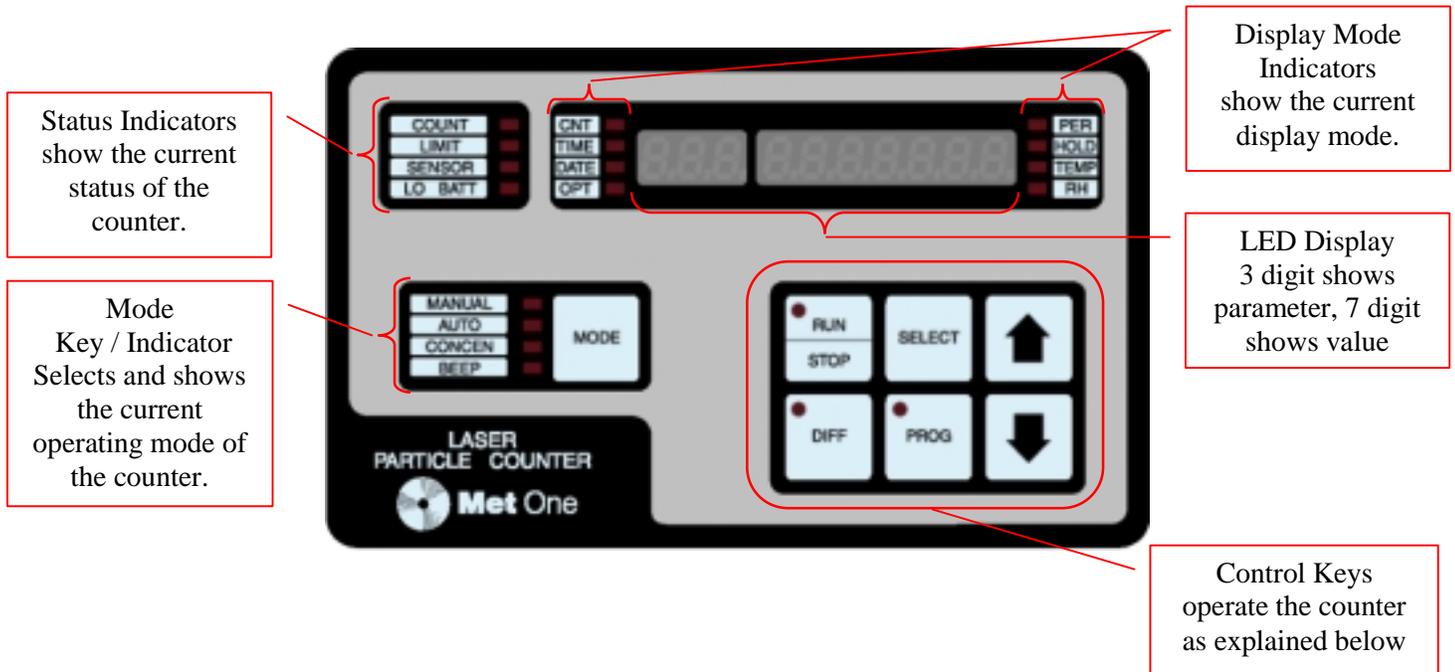
The Model 237 counter is ready to use when unpacked, but ensure the red sensor inlet cap is removed and the isokinetic probe is attached prior to sampling. If the RH/T probe is used, it should be attached before the counter is turned on.

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..... 32
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)
Cycles 0
Printer (PRN)..... Off
Baud Rate 9600
Temperature °C (only applies if RH/T probe is attached)
Sample Time 00:00:06 (HH:MM:SS)
Hold Time 00:00:00 (HH:MM:SS)

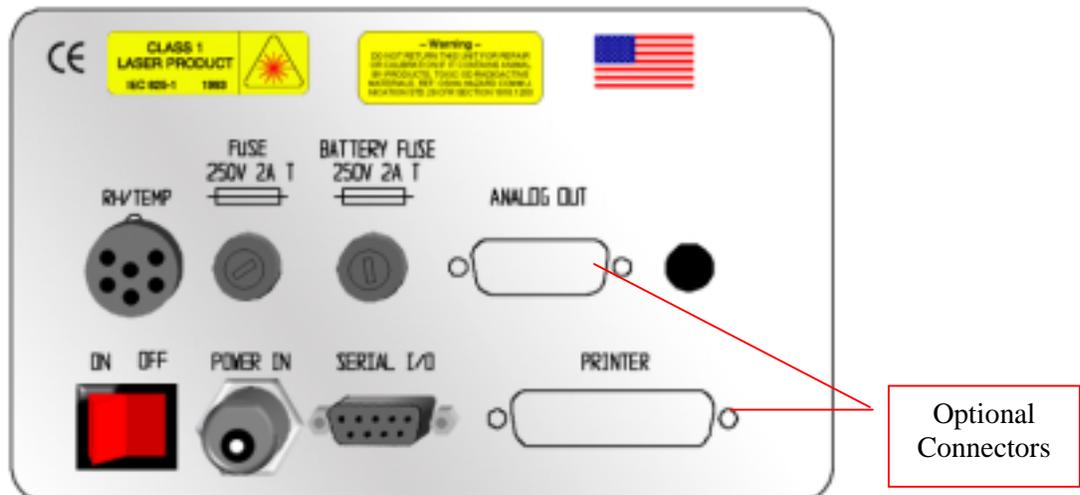
Front Panel Overview



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Rear Panel Connections

The power switch, fuse holders and all connectors are on the rear panel of the counter as shown in Figure 1. Note that the connectors for Analog Out and Printer only appear on models with the Analog Output option, which does not have a built in printer.



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Operation

Powering Up

Turn on the Model 237 using the switch on the rear of the counter. If the LO BATT indicator is lit, plug in the AC adaptor to charge the battery. The counter may be operated during the charging of the battery.

Note:

Use only the AC adapter provided by Pacific Scientific Instruments to charge the battery or operate the counter. Other off the shelf power modules may have different power, current or polarity which could damage the counter.

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 six seconds) and stop. Ensure that the red inlet cap is removed from the sensor inlet tube and the Isokinetic Probe is attached. The CNT light will be lit in the display mode indicators section, one of the particle sizes being monitored will be displayed in the three digit display and the actual cumulative counts will be displayed in the seven digit display. For example: 00.5 0000000. Most model 237 counters are programmed to monitor several sizes, but only one can be displayed at a time.

At this point, press  to initiate a single six second count cycle based on the factory default settings. The red light in the RUN portion of the key will light, the pump will begin operating and after a short delay the COUNT light will light. When the six second sample is finished the pump will stop, the COUNT light will extinguish and the red light in the RUN portion of the key will extinguish. You may press the  and  keys to scroll through the different sizes your counter is programmed to monitor and view the cumulative count in each size channel.

If the manual mode (one sample and stop) is your desired mode of operation, the steps below may be used to set your desired sample time. The 237 counter operates at a sample flow rate of 0.1 cubic feet per minute (cfm), so the results of a one minute sample must be multiplied by ten to estimate the actual counts in a cubic foot of sample. A ten minute sample will draw an actual cubic foot of air through the counter.

Note:

Parameters such as the sample time and printer enabling may be programmed in any order, at any time the counter is not running, as long as the steps for setting each parameter are followed.

Changing The Sample Period

1. To change the sample period, press  until the PER light is lit and the seven digit display shows the current period setting in HH:MM:SS format, for example: 00:00:06.
2. Press the  key and note that the light in the key turns red and the HH digits begin flashing.
3. Press  until the desired digits are flashing, then use the  and  keys to change the selected digits to the desired value.
4. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

Enabling The Printer

1. Press  until the OPT light is lit.
2. Press  or  until the three digit display shows **Prn** and the seven digit display shows the status of the printer.
3. Press  so the light in the key lights red and the printer status flashes.
4. Press  or  until the word **All** is displayed.
5. Press  to save the settings. The light in the key will go out and the printer status will quit flashing. When a sample is complete, the printer will print the results.

Other printer options are:

Alr – print only if an alarm condition exists (setting alarm limits described below).

ALL buF – prints the entire contents of the memory buffer.

Alr buF – prints those records in the memory buffer in which an alarm condition was recorded.

OFF – no printing activity.

Setting the Date and Time

The date and time are a part of each sample record stored in memory, and may be programmed as follows:

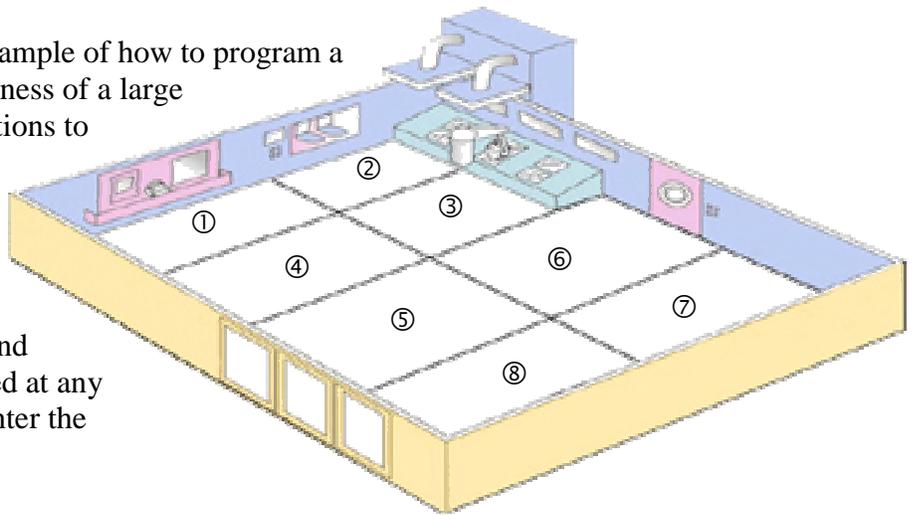
1. To change the time setting, press  until the TIME light is lit and the seven digit display shows the current time setting in HH:MM:SS format, for example: **08:26:47**. The seconds field should be visibly counting.
2. Press the  key and note that the light in the key turns red and the HH digits begin flashing.
3. Press  until the desired digits are flashing, then use the  and  keys to change the selected digits to the desired value.
4. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.
5. To set the date, press  until the DATE light is lit and repeat steps 2 through 4 .

Setting Alarm Limits

1. To change the alarm limits, press  until the CNT light is lit. The three digit display will show the particle size channel and the seven digit display will show the count for that size.
2. Press the  key and note that the light in the key turns red and the seven digit display shows the current alarm limit, with the left digit flashing.
3. Press  until the desired digit is flashing.
4. Use the  and  keys to change the digit to the desired value.
5. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

Automatic Mode

The following scenario is an example of how to program a Model 237 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 237. It is not necessary to perform the programming in any particular order, and most parameters may be re-programmed at any time without affecting the others. To enter the Automatic Mode,



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Press  until the AUTO light is lit.

Setting Location Numbers

1. Press  until the OPT light is lit.
2. Press  or  until the 3 digit display shows **Loc**. The seven digit display will show a number, 32 is the default .
3. Press  . The light in the key will turn red and the digits in the seven digit display will begin to flash.
4. Press  to change the location number to 1.
5. Press  . The red light in the key will go out and the digits in the seven digit display will stop flashing.

Setting the Number of Cycles

The number of cycles indicates the number of times the counter will repeat the sampling cycle determined by the programmed Period time and Hold time; three cycles is typical for a routine verification check. Programming a number of cycles greater than one automatically causes the 237 counter to enter “Average” mode, an internal function the counter uses to generate a report to the printer and memory buffer showing the average of the count cycles just completed. For example, if the number of cycles is set to three, the counter will take three samples of the programmed Period length, with hold times between them of the programmed Hold length. During this activity, the printer will print the results of each of the three sample Periods as they are completed, then print a fourth report, indicating the average count in each size range over the three samples. If the records are printed from the Memory Buffer at a later time, the printout will be identical.

To set the number of cycles:

1. Press  until the OPT light is lit.
2. Press  or  until the 3 digit display shows **CYC**. The seven digit display will show a number in the right hand places.
3. Press . The light in the key will turn red and the digits in the seven digit display will begin to flash.
4. Press  until the desired digits are flashing, then use the  and  keys to change the selected digits to the desired value.
5. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

Setting The Sample Period and Hold Time

Using the following steps, set the sample PERIOD to one minute and the HOLD time to ten seconds.

Note:

The HOLD time must be set to a minimum of 10 seconds when the printer is enabled, or a sample record will be overlooked when calculating the average counts, because of printer operation during the calculations. All the samples will be stored in the Memory Buffer and will print the proper average report if printed at a later time.

1. To change the sample period, press  until the PER light is lit and the seven digit display shows the current period setting in HH:MM:SS format, for example: **00:00:06**.
2. Press the  key and note that the light in the key turns red and the HH digits begin flashing.
3. Press  until the desired digits are flashing, then use the  and  keys to change the selected digits to the desired value.
4. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.
5. to set the HOLD time, press  until the HOLD light is lit and repeat steps 2 through 4 .

Taking the Samples

You are now ready to begin sampling your room for which one possible sampling pattern was shown in Figure 3 above. 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  to initiate counting and observe the display which should show three one minute samples being taken, separated by a ten second hold time. At the conclusion of each count period, the printer will print the results (if enabled) When all three cycles are complete, the counter will print an additional record showing the average of all three samples. Move to the next location to be tested and reprogram the Location Number as described above to reflect your movements in the room.

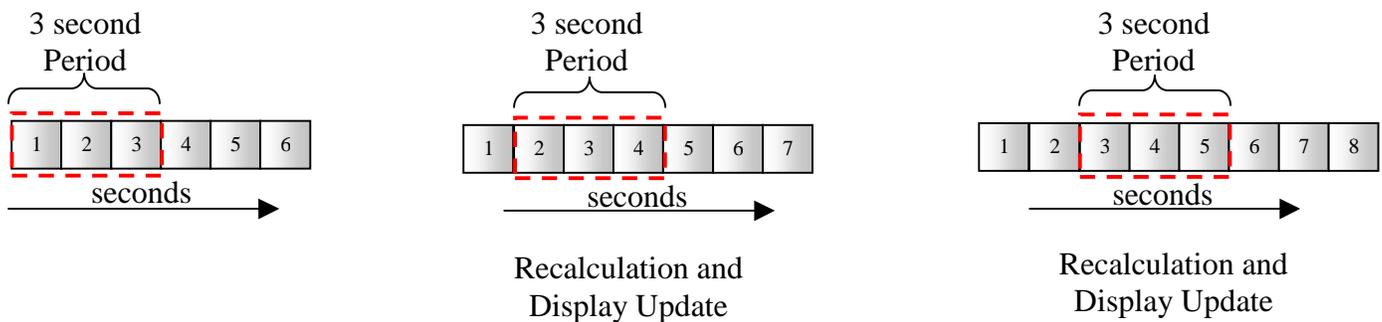
When sampling is complete, the count results may be downloaded to a computer and analyzed to verify the condition of the room. Download procedures and data string description are provided later in this manual.

The preceding steps may be modified to create any sampling routine that fits your specific needs.

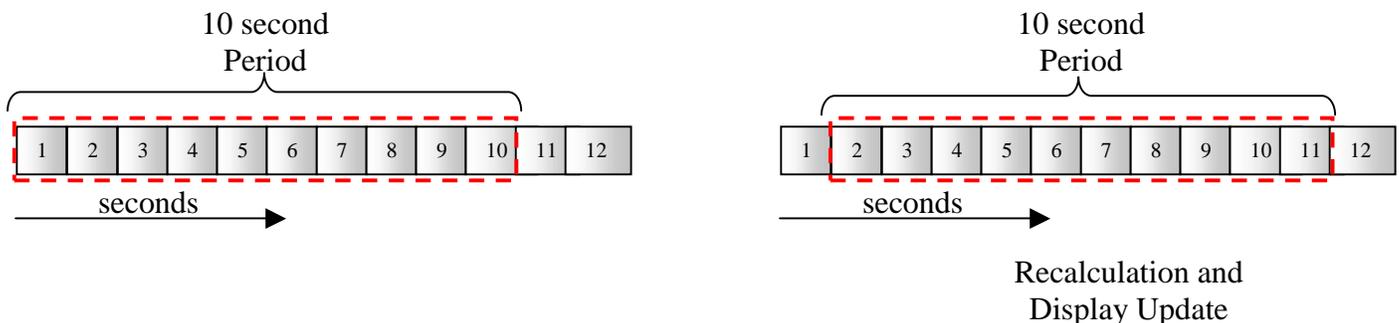
Using Concentration Mode

Concentration Mode in the Model 237 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 its 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 237 for Concentration Mode operation as follows:

1. Press  until CONCEN is lit.
2. Press  until OPT is displayed.

3. Press  or  until the 3 digit display shows **VOL** (volume). The seven digit display will show either **L** (liter), **1000 L** or **CF** (cubic foot) right hand places. **L** is the default setting from the factory and the concentration estimates will be expressed as counts per liter. Use the following steps to change the Volume setting if desired.
4. Press  so the light in the key lights red and the volume units in the seven digit display flash.
5. Press  or  until the desired setting is displayed.
6. Press  to save the settings. The light in the key will go out and the display will quit flashing.

Setting The Sample Period

Using the following steps, set the sample PERIOD to the desired length, but note that the period will not accept settings exceeding ten seconds.

6. To change the sample period, press  until the PER light is lit and the seven digit display shows the current period setting in HH:MM:SS format, for example: **00:00:06**.
7. Press the  key and note that the light in the key turns red and all the digits begin flashing.
8. Use the  and  keys to change the digits to the desired value, but note that the period will not accept settings exceeding ten seconds.
9. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

The HOLD time is not used in concentration mode.

Concentration Mode Sampling

In Concentration mode, pressing  will start the sampling, which will be continuous until  is pressed again.

Using Beep Mode

Beep Mode is similar to Concentration mode in that sampling is continuous, regardless of Period and Hold settings and printing is disabled. 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 is only one size channel displayed at a time and a beep will sound when any particle size range limit is reached, it is suggested you set a limit for only one size range of interest and set the remaining size ranges to zero, which generates no alarm. The beep mode limits and count alarm limits are one and the same.

Setting Beep Mode Limits

1. To change the alarm limits, press  until the CNT light is lit. The three digit display will show the particle size channel and the seven digit display will show the count for that size.
2. Press the  key and note that the light in the key turns red and the seven digit display shows the current alarm limit, with the left digit flashing.

3. Press  until the desired digit is flashing.
4. Use the  and  keys to change the digit to the desired value.
5. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

Beep Mode Sampling

In Beep mode, pressing  will start the sampling, which will be continuous until  is pressed again.

Using The Relative Humidity and Temperature Probe

The optional environmental probe may be plugged in to the keyed RH/TEMP connector on the rear panel (refer to figure 2), and the Model 237 will display the relative humidity as a percent and display the temperature in degrees Celsius or Fahrenheit. Upper and Lower alarm limits may be programmed for both readings, as well as choosing which temperature scale to use. The probe must be plugged in to enable the humidity and temperature programming functions, then turn on the counter and follow these steps:

1. To change the alarm limits, press  until the TEMP light is lit. The seven digit display will show the temperature reading and the scale being used.
2. Press the  key and note that the light in the key turns red. The three digit display will show **HI**, indicating the upper alarm limit is now being programmed. The seven digit display shows the current alarm limit, with the left digit flashing, and the scale being used.
3. Press  until the desired digit or the scale label is flashing.
4. Use the  and  keys to change the flashing digit to the desired value.
5. Press  until the Three digit display shows **LO**, indicating the low temperature alarm level is being programmed. The seven digit display shows the current alarm limit, with the left digit flashing, and the scale being used.
6. Press  until the desired digit. The temperature scale is only programmable with the HI temperature alarm limit.
7. Use the  and  keys to change the digit to the desired value.
8. Press the  key to save the new settings and exit the programming function. The digits will quit flashing and the red light in the key will go out.

Programming the HI and LO Relative Humidity alarm limits is similar, with the absence of a measurement scale.

Environmental Alarms

When a programmed environmental alarm limit is exceeded, an audible alarm will sound and the LIMIT light will light red. The audible alarm may be silenced by pressing any front panel key. If the alarm occurs when the RH or TEMP reading is not being displayed, The appropriate TEMP or RH light will flash.

Computer Interface Operations

Data analysis for ISO 14644

The primary reason for computer interface with the Model 237 is to download the count data for analysis. ISO 14644 is the governing standard for cleanrooms, and while the Model 237 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 237, 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 237 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 and a special serial cable is available from Pacific Scientific. A standard serial cable may be used with the PortAll adapter as shown in Appendix A.

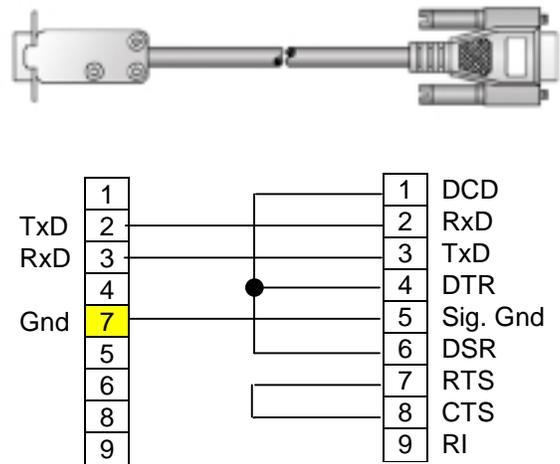


Figure 7. Serial Interface Pinout
(cable p/n 2082197-1)

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. 237A).

"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.

"I" Local Mode:

(for factory test purposes) The counter will be set to off-line.

"U" Universal Select:

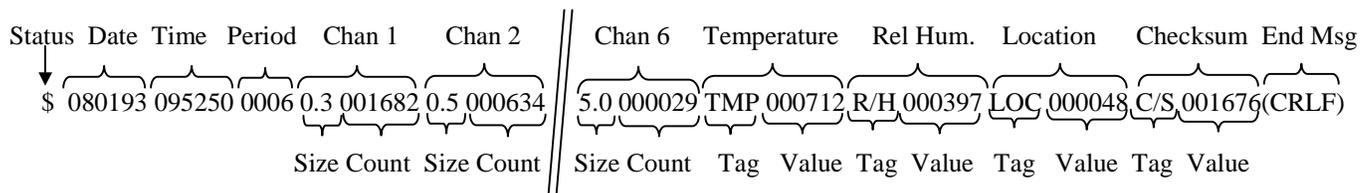
(functions only when one counter is connected at a time) The counter will respond to all commands after receiving this command, regardless of which select code is programmed into the counter until a counter select command is received. Any counter select command (128 through 191) will disable the Universal 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 of a model 237B:



Maintenance and Troubleshooting

Common Problems

Two of the Status Indicators in the upper left corner of the front panel (refer to Figure 1) indicate conditions which may require user maintenance.

LO BATT 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 on any stable surface and allow it to charge for 10 – 12 hours.

SENSOR 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.

LIMIT 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

Resetting the counter may be necessary to correct intermittent fault conditions in the microprocessor controlled functions, and is similar to re-booting a computer that is not operating correctly. All programmable settings will return to factory defaults and the memory buffer will be cleared.

1. Turn the Power switch off 
2. Press and Hold the  key
3. Turn the Power switch on 
4. When a beep is heard, release the  key.
5. The three digit display should show **dEF**, and the 7digit display should show **270 – ic**, which is the number and revision level of the internal EEPROM. Your revision level may vary from the example shown.
6. Press  to restore normal operation, and reprogram the counter's operating parameters as desired.

Sensor Cleaning



WARNING

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



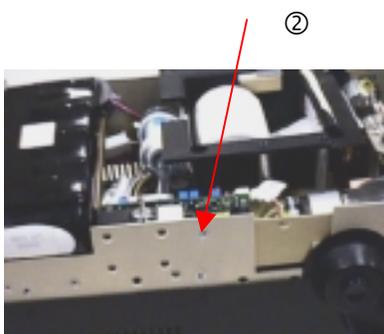
CAUTION

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.

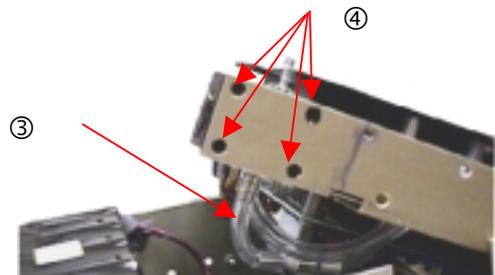
1. Remove six screws that hold the top cover on the counter,



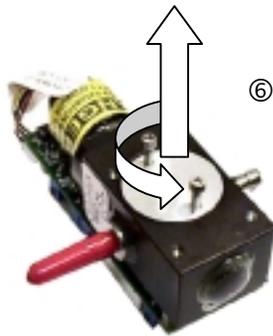
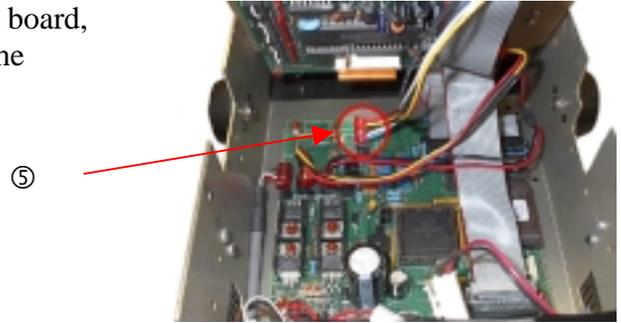
2. Remove two screws, one from each side, which allows the chassis tray to pivot up for sensor access.

3. Disconnect the clear tubing from the sensor outlet fitting

4. Remove the four screws holding the sensor to the chassis tray.



5. Disconnect the sensor cable from the sensor circuit board, taking care to note the position and orientation of the connector, and remove it from the counter.



6. 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.

7. 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.



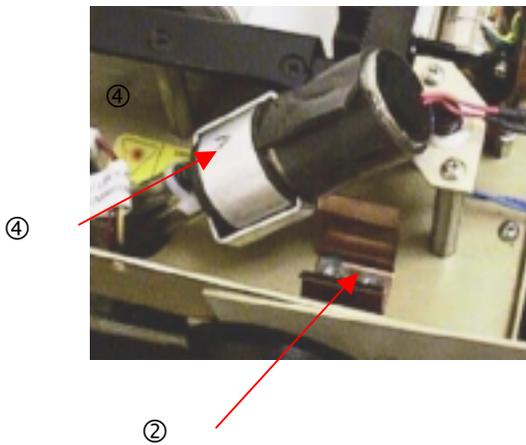
8. Re-assemble the unit in reverse order.

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.

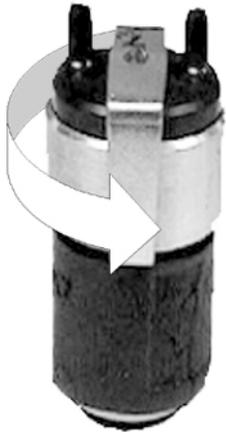
Disassembly and cleaning

1. Open the counter as described in step 1 of the sensor cleaning procedure above.



2. Remove the pump from the chassis clip as shown.
3. Unplug the pump electrical connection from the main circuit board, taking care to note the position and orientation of the connector
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.

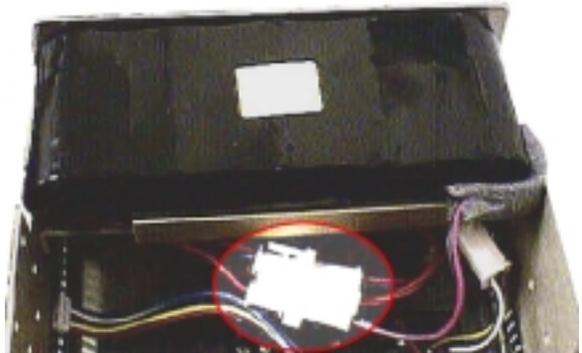


Pump Optimization

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.

Battery Replacement

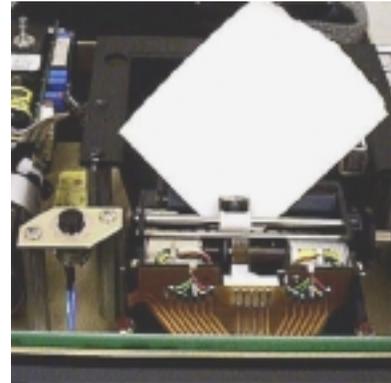
If it becomes necessary to replace the rechargeable battery pack, remove the top cover from the counter and disconnect the battery cable as shown at right.



Printer Maintenance

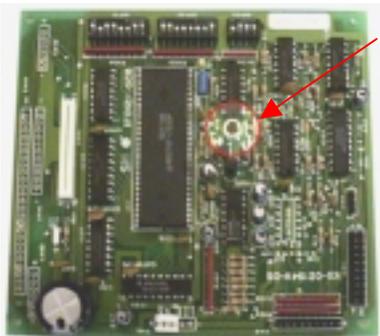
Cleaning the Print Head

1. Run the particle counter with a short sample period and enable the printer.
2. When the print head is about in the middle of the platen turn the power to the counter off.
3. Take a piece of printer paper, folded in half, and wet it with isopropyl alcohol.
4. Wedge the paper between the print head and the platen.
5. Move the paper left and right to clean the print head.



Correcting Light Print

The printer PCBA is on the underside of the chassis tray. Remove two screws as in step two of the Sensor cleaning procedure above, which allows the chassis tray to tilt up for access to the PCBA.



Varicap



CAUTION

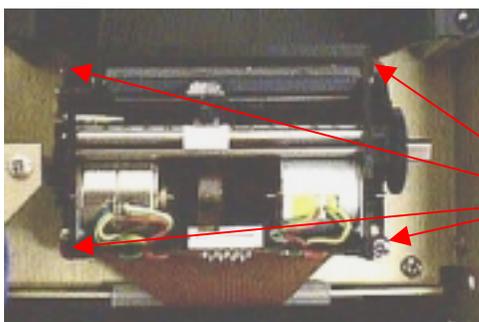
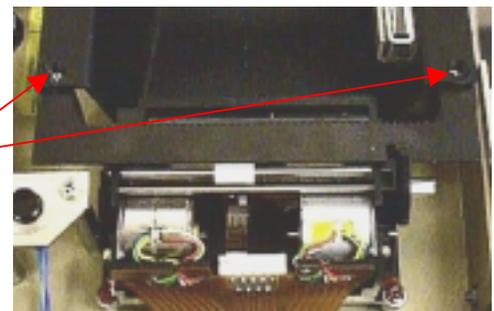
Making the print too dark can cause the print head to be damaged by overheating. Darken it just enough to make the print easily readable.

Make a very small adjustment to the varicap on the printer logic board, about 1/16th turn, counter clockwise to darken the print or clockwise to lighten the print.

Replacing The Printer

1. With the top cover removed, remove the two screws that hold the printer bar on and remove the printer bar.

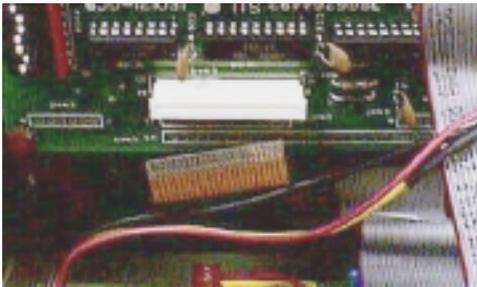
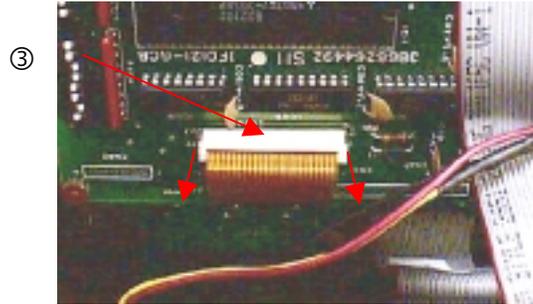
①



2. Remove the four 1/4" nuts that hold the print head assembly on.

②

3. Tilt the chassis tray up as in step two of the sensor cleaning procedure and locate the printer ribbon cable connector. The connector must be unlocked by pulling the edges of the connector away from the PCBA before attempting to remove the cable from the connector



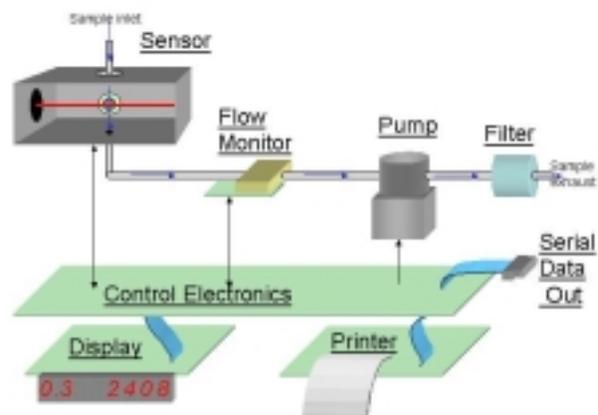
4. Carefully remove the cable from the connector

Reference Information

Theory of Operation

The Model 237A/B counter is a compact full featured particle counter including sensor, pump, electronics and printer that includes. Both variants use the same sensor, pump, CPU and display electronics. The 237A is calibrated with channel one sensitivity of $0.5\mu\text{m}$ and the 237B is calibrated with a channel one sensitivity of $0.3\mu\text{m}$. 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 6.7" wide x 4.5" high x 11.7" deep
Weight 6.8 lbs.(3.0 kg)
Maximum Count Displayed 9,999,999
Sample Flow Rate 0.1 cfm
Number of Size Ranges..... 2, 4, 5 or 6 (specified at time of order)

Particle Size Ranges

237A

(2 channel)..... :0.5 and 5.0 micron
(4 channel)..... 0.5, 0.7, 1.0 and 5.0 micron
(5 channel)..... 0.5, 0.7, 1.0, 2.0 and 5.0 micron
(6 channel)..... 0.5, 0.7, 1.0, 2.0, 3.0 and 5.0 micron

237B:

(2 channel)..... 0.3 and 5.0 micron
(4 channel)..... 0.3, 0.5, 1.0, and 5.0 micron
(5 channel)..... 0.3, 0.5, 0.7, 1.0 and 5.0 micron
(6 channel)..... 0.3, 0.5, 0.7, 1.0, 2.0 and 5.0 micron

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 500 samples, rotating buffer
Count Cycles up to 100 in AUTO Mode
Locations up to 250, number appears on printout
Output..... RS-232C/RS-485 for computer
Pump Type Carbon-vane, 0.1 cfm
Battery Type..... Rechargeable NiCd, 3500 mAH
Operating Time 4 hours printing, 8 hours without

Environment (Operating):

Temperature 2 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

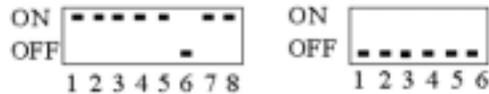
Manual Backdating

Changes, additions, and improvements to the Model 237 brought about several revision level changes to the manual since its initial release. These changes are summarized below:

Changes initiating REV. C:

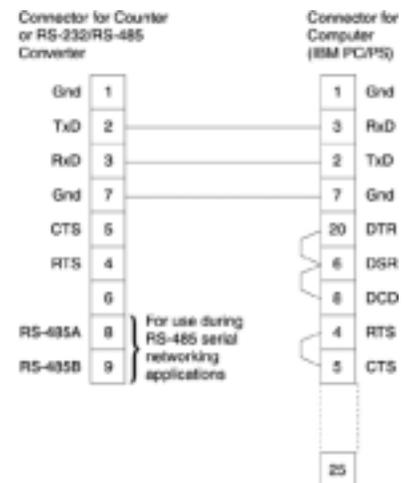
Incorporated enhanced standard protocol ("FX") to replace older version FIX protocol for compatibility with PVO software. Effects to the manual were:

1. The Serial Port Protocol and Commands section of the manual was reworked to reflect the "FX" protocol.
2. Size units on the sample printout were changed from u to um.
3. EPROM changed from 2081507-1E to 2081507-1F to introduce the "FXA" serial protocol, replacing "FIX" protocol.
4. EPROM changed from 2081507-1F to 2084270 to support a new real-time clock that addresses alarm interrupts differently.
5. Removed following reference to the Model DPU-411 printer (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:"



Changes initiating REV. B:

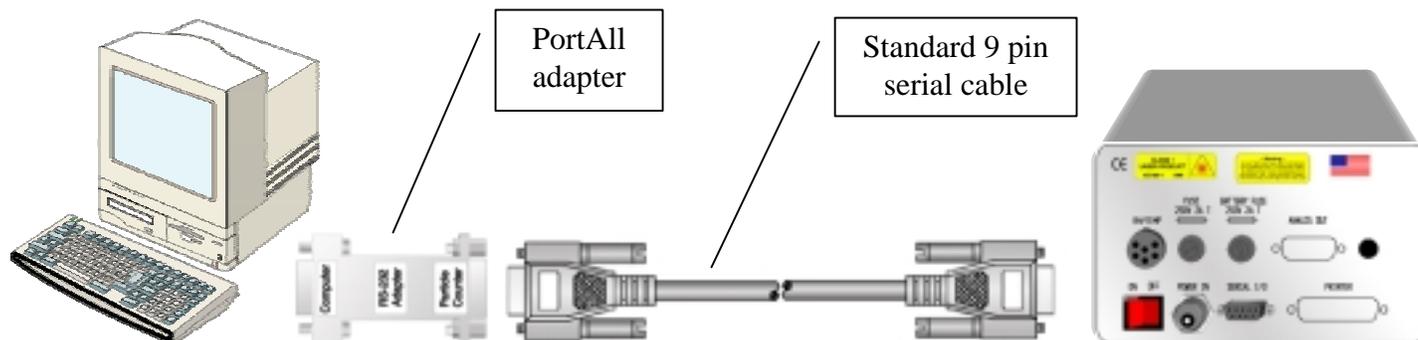
1. Incorporated 4 to 20 mA and 0 to 5 V option (added to "Using Options, Accessories" section).
2. Added counts per cubic meter (1000 L) units for the concentration mode (added to "Changing Volume Units for Concentration Mode (UOL)" procedure).
3. Modified printer selections to print out only results exceeding the alarm limit; print out alarms in buffer.
4. Increased number of runs stored in the rotating buffer from 200 to 500.
5. EPROM changed from 2080570 to 2081507 to update internal operations of the Model 237.
6. The original special serial cable (shown) was for 25-pin PCs.



Appendix A: Using the Model 237 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 237 particle counter, the PortAll software can automatically generate cleanroom verification results.

a. Connections



In order to communicate with a computer, the Model 237 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.

b. 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 237 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.

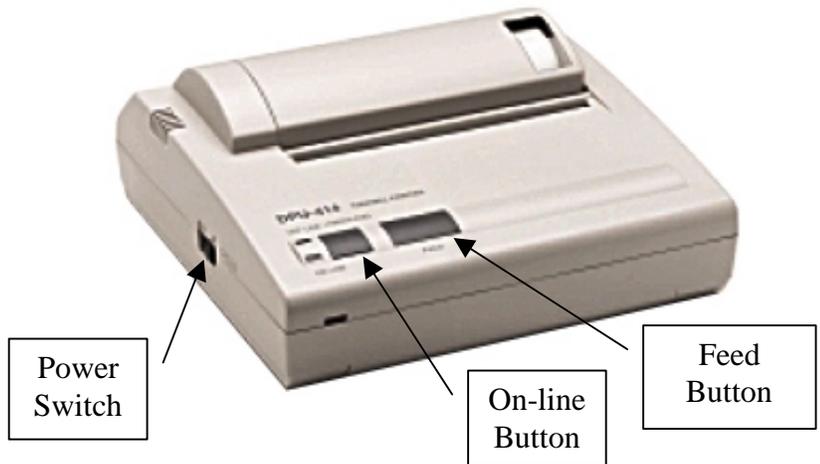
For full PortAll documentation, refer to the PortAll CD.

Appendix B: Using the DPU-414 Printer

Printer setup

The Model 237 counter may be purchased without an internal printer, and the Model DPU-414 printer is currently sold as an accessory to the Model 237. 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.

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

When all the SW-1 settings are done, the printer will prompt you to select Continue by pressing the On-Line

Figure 4. Printer controls and settings

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 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 connector on the counter rear panel (refer to figure 2). The Baud Rate in the Model 237 must be set to 9600

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.