

Operator Manual

MET ONE 2100C/2200C

PORTABLE AIRBORNE PARTICLE COUNTER



EXCELLENCE IN PROCESS ANALYTICS

Operator Manual

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Manual Part Number 701119

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Safety Considerations	iv
Introduction	1
Unpacking and Initial Inspection	1
Options, Accessories	2
Using the Counter for the First Time	3
Front Panel Overview	4
Display Field Group	4
MODES Group	5
DISPLAY/PROGRAM Group	5
PRINTER Group	7
Setting and Changing Functions	8
Count (Alarm Limits)	8
Location (Number)	8
(Number of Count) Cycles	9
Date/Time	9
Period/Hold (Time)	10
Turning Beeper On or Off (AFb)	10
Volume Units (UOL) for Concentration Mode and ISO 14644 Calculations	11
Baud Rate (bd)	11
Adjusting Airflow (FLO)	11
Using Special Features	12
Concentration (CONCEN) Mode	12
Audible (Beep) Mode	12
Count Cycles Average Calculations	13
Connecting to Clean Dry Air (CDA) Purge Circuit	13
ISO 14644 Calculations	14
Generating a Configuration	15
Using the Printer	17
Loading Printer Paper	17
Selecting Printer Function	18
Printing ISO 14644 Calculations	18
Interpreting the Printout	19
Clearing Data Stored in Rotating Buffer	20
Setting up an External Printer	20
Using Accessories	21
Environmental Probes	21
Setting Temp/RH Probe Alarm Limits	21
Setting Air Velocity Probe Alarm Limits	22
Serial Port Protocol and Commands	23
Serial Cables	23
Communication Protocol	24
Commands	24
Data	27
Technical Data	29
Purge System	29
Component Location	30
Specifications	31
Sensor Cleaning	32
Pump Maintenance	36
Resetting Counter Options	37
Manual Backdating	38
Replacing the Carbon Filter	39
Declaration of Conformity, Warranty Page	(back of manual)

Safety Considerations

Warnings and cautions are used throughout this manual. Familiarize yourself with the meaning of a warning and a caution before operating the particle counter. A warning appears before the procedure or step to which it applies. A caution appears in the narrow column and next to the step to which it applies. Take extreme care when doing any procedures preceded by or containing a warning.

WARNING

A WARNING indicates a hazard for you. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or possibly death. A WARNING appears directly above the step to which it applies. Do not proceed beyond a WARNING until the indicated conditions are fully understood and met.

CAUTION

A CAUTION indicates a hazard for the particle counter. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to the counter. A CAUTION appears in the column to the left or right of the step to which it applies. Do not proceed beyond a CAUTION symbol until the indicated conditions are fully understood and met.

Note

A Note highlights an important operating procedure or other important information not involving safety of equipment or personnel.

Additional safety information is contained in the "Particle Counters For Air" manual.

There are several classifications of Warnings defined as follows:

- Laser — pertaining to exposure to visible or invisible laser radiation
- Electrical/Electrostatic — pertaining to shock/discharge hazards

Laser Safety Information

This product 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. Service procedures on the sensor can result in exposure to invisible radiation. 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

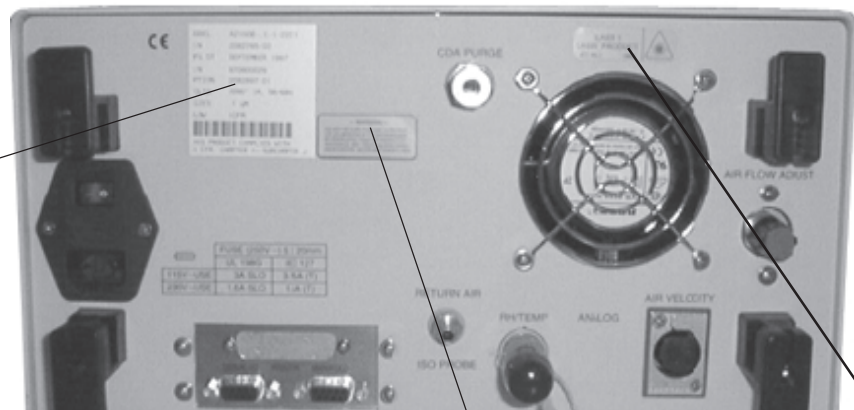
The use of controls, adjustments, or performance of procedures other than those specified within this manual may result in exposure to visible (HeNe) radiation that can quickly cause blindness.

Several labels are attached to the unit for your awareness. Reproductions of the labels are shown below:

MODEL	A2100C-.1-1-115-1
P/N	2082765-21
MFG DT	MAY 2000
S/N	200900573
OPTION	
VOLTS	115V~1A. 50/60HZ
SIZES	0.1 μ m
FLOW	1 CFM

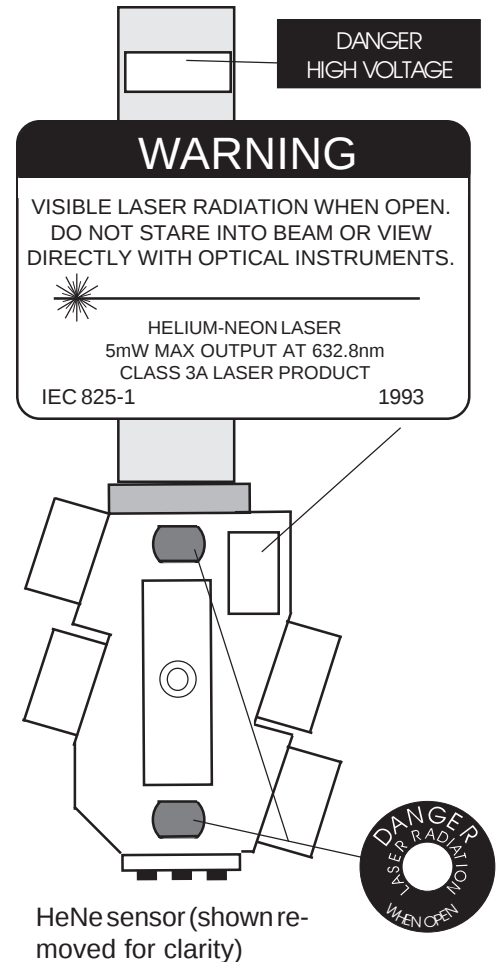


THIS PRODUCT COMPLIES WITH
21 CFR, CHAPTER 1, SUBCHAPTER J



Additional safety information is contained in the "Particle Counters For Air" manual you also received. For further technical assistance, contact our Customer Service Department at the location shown on the back cover of this manual.

Safety



HeNe sensor (shown removed for clarity)

CLASS 1 LASER PRODUCT	
IEC 825-1 1993	

-WARNING-
DO NOT RETURN THIS UNIT FOR REPAIR OR CALIBRATION IF IT CONTAINS ANIMAL BY-PRODUCTS, TOXIC OR RADIOACTIVE MATERIALS. REF: OSHA HAZARD COMMUNICATION STD. 29 CFR SECTION 1910.1200

Safety

Electrical and Electrostatic Safety Information

Potential shock hazard exists as soon as a cover is removed from a particle counter. Extreme care should be used whenever a cover is removed.

WARNING

Failure to disconnect electrical power cord before removing instrument cover can result in severe electrical shock.

Labels pertaining to shock safety are attached to the unit for your awareness. Reproduction of the label is shown below:

**DANGER
HIGH VOLTAGE**

Warning Label

Located inside unit at end of laser sensor tube and on internal power supply

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, all service or maintenance work should be done at a static-safe work station. A static-safe work station 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.

Introduction

This operating guide describes how to use both the Model A2100C and A2200C Particle Counters, both of which operate identically. This operating guide provides complete operating, application, and maintenance information for the particle counter. Any changes of instrument operation due to design changes are covered at the back of this guide in the "Manual Backdating" section.

Both particle counters have six particle-size channels. The Model 2100C counts particles as small as 0.1 micron. The Model 2200C counts particles down to 0.16(special) or 0.2 micron (standard). Specify size at time of order. A built-in printer is standard. A microprocessor controls all instrument functions. Count data is displayed as cumulative count or differential count. Refer to Specifications in this manual for a complete listing of available size channels.

The particle counter uses a helium-neon (HeNe) light source and collection optics for particle detection. Particles scatter light from the light source. The collection optics focus the light onto a photo diode that converts the bursts of light into electrical pulses. The pulse height is proportional to the particle size. Pulses are counted and their amplitude is measured for particle sizing. Results are displayed as particle counts in the specified size channel.



Figure 1. The 2100C Laser Particle Counter

Unpacking and Initial Inspection

The particle counter is thoroughly inspected and tested at the factory and is ready for use upon receipt. When received, inspect the shipping carton for damage. If the carton is damaged, notify the carrier and save the carton for carrier inspection. Inspect the counter for broken

Introduction

parts, scratches, dents, or other damage.

If the carton is not damaged, keep for reshipment. For example, you may want to reuse the carton when you return the counter for the annual factory calibration. If the counter is to be returned to the factory or a field service center for service or calibration, you must obtain a Return Authorization number. Contact Customer Service for a return number. Place the return number on all shipping documentation and purchase orders. After receipt of the number, follow these shipping instructions:

1. Use the original container and packing materials whenever possible.
2. 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.
3. Seal container or carton securely. Mark "Fragile" and enter Return Authorization number in any unmarked corner.
4. Ship the counter to the address shown at left or to the designated Service Center address you are given when you call for an RA number.

Options

Either of the two following firmware options (not both) can be installed when you order your counter or any time thereafter if you return your counter to the factory. See back cover of this manual for address and telephone number.

Firmware: "Manifold" (standard)— Allows the counter to be used as an independent instrument or as part of a multiport manifold sampling system. The location identification of the counter must be set to zero when used with a manifold system. See Manifold accessory for more details. This option and the "configuration" option are not both available simultaneously.

Firmware: "Configuration"—The configuration capabilities option (see Generating a Configuration on following pages) allows the user to program up to 10 sets of count parameters (period, hold time, count alarm limit, etc.) in advance for quick setting of parameters.

Accessories

You can order several accessories to tailor the counter to your needs. These accessories can be ordered from the factory at any time before or after purchase.

Manifold System

The manifold, with controller, allows the counters to sample up

The Model 2432 (32 location) manifold option is available for both Model 2100C and Model 2200C Counters.

to 32 different locations. The manifold routes the sample from each location to the counter for analysis, one location at a time. The location identification of the counter must be set to zero when used with a manifold system.

High Pressure Diffuser—connects to the sensor inlet tubing. Permits direct sampling of pressurized air and inert gases (e.g., argon, helium) at pressures from 30 to 150 psi (2 to 10 Bar).

RH/Temp Probe—plugs into the counter rear panel. The probe monitors relative humidity (10% to 90%) and temperature (0 to 100 °F or -17 to +38°C, specify one). The results are displayed and printed.

Air Velocity Probe—plugs into the counter rear panel. The probe monitors air velocity up to 120 feet/minute (36.5 meters/minute). The results are displayed and printed.

Isokinetic Probe (provided with counter)—for use in unidirectional air flow to maximize correlation between counts and actual particle-size distribution. Can also be hand-held for spot location counting.

Purge Filter—(provided with counter) attaches to sensor inlet; keeps external particles from contaminating sensor while purging sensor of internal particles.

Carrying Case—protects the counter during shipment and storage.

Your particle counter is ready to use directly out of the shipping carton. You may want to take a sample count prior to setting up the programmable functions. To count particles, proceed as follows:

WARNING

Do not attempt to sample reactive gases (such as hydrogen or oxygen) with the particle counter. Reactive gases create an explosion hazard in the counter. Contact the factory for more information.

1. Locate counter in a clean environment.
2. Plug ac power cord into facility power outlet; plug other end of cord into rear panel power connector .
3. Remove the protective tubing from the inlet tube. If using the isokinetic probe provided, install probe by connecting probe tubing to counter inlet tube (on top of counter).
4. Set  on rear panel to 1 (on).
off on
5. To start counting particles, press  key. The number on the display is the number of particles being counted. Check that the indicated flow rate is nominal. The flow is always in cfm unless "Concentration Mode" or "ISO 14644" is selected. If adjustment is required, refer to "Adjusting Airflow" on pages that follow.

Using the Counter for the First Time

CAUTION

Never operate the counter with the inlet tube capped or plugged as damage can occur to the internal pump.

To prevent sensor damage, no liquids of any type should be put into the sensor via the inlet tube.

Front Panel Overview

6. Press **Stop** to stop counting. The total number of particles counted during the “run” time will be displayed.

7. (Optional) You may want to read “Front Panel Overview” to learn about the keys and displays that run your counter.

Each front-panel key has a specific function. The keys are grouped into operating functions such as display field, modes, display/program, and printer. Some keys are used in conjunction with others. Some keys

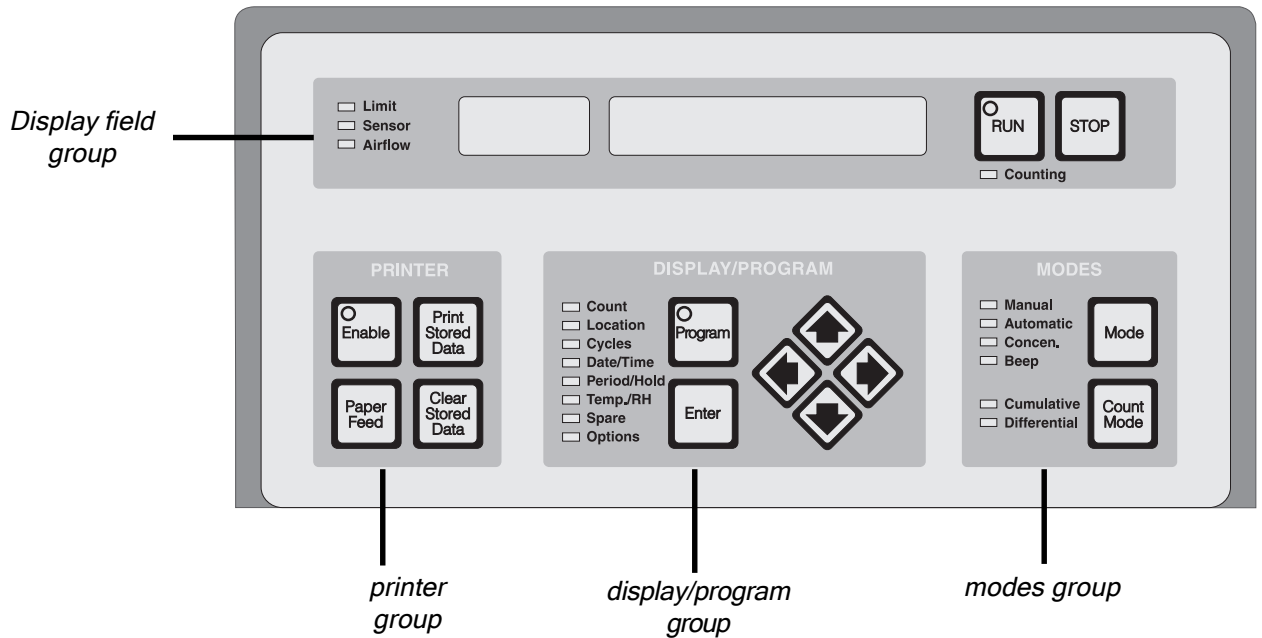


Figure 2. Front Panel Keys and Indicator Lights

select the desired mode while others select functions to be set such as count alarm limits, particle size range, time, date, etc. In this subsection, you will learn the function of front-panel keys and displays of each group.

Display Field Group



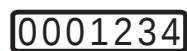
Starts the count cycle.



Stops the count cycle. (Infinite hold time when stopped.)



When on, indicates the counter is counting.



(Seven Digit Display) Displays total particle count, time-of-day, date, etc.



(Three Digit Display) Displays particle size range selected (Model 2100C shown).



When flashing, indicates the programmed count and/or analog alarm limit has been surpassed.

-  **Sensor** When flashing, indicates a degradation of counting efficiency or contamination in the sensor.
-  **Airflow** When flashing, indicates airflow through sensor is high or low.

MODES Group

-  Selects one of four operating modes: Manual, Auto, Concen. (concentration), or Beep.
-  **Manual** When on and  is pressed, the counter will count for one count cycle then turn off.
-  **Automatic** When on and  is pressed, the counter will repeat count and hold cycles for the programmed number of count cycles and then pump will turn off.
-  **Concen.** When on, the counter will calculate particle concentration in counts/ft³ (or counts/1000 liter) of air; display is updated once each second; the counter runs for programmed number of count cycles. The concentration value is saved as stored data and may be printed as "particles /cu.ft.
-  **Beep** When on, the counter will give one beep when count alarm limit is reached, then beep once for every multiple of the limit; the counter runs until  is pressed.
-  Selects differential or cumulative count mode for display.
-  **Cumulative** When on, the count readout being displayed is the total count of all particles of the size channel selected and larger.
-  **Differential** When on, the count readout being displayed is the count of particles only in the size channel selected, up to but not including the next larger size channel.

DISPLAY/PROGRAM Group

-  or  Selects what will be displayed in the seven-digit display: Count, Location, Cycles, Date/Time, Period/Hold, Temp./RH, Spare, or Options. Temp./RH will not come on if probe is not connected. Spare

Front Panel Overview



(containing air velocity probe information) will not come on if probe is not connected.

Steps through or toggles between choices when a program has more than one selection (e.g., Count, Date/Time, and Options). Also changes digit value when in Program status.



For entering the programming mode to set a limit (e.g., alarm limit), change a number (e.g., number of cycles to be taken), change date/time, or change an option; also displays the alarm limits of the selected size. The appropriate indicator light must be on to make a change within the program functions (description of indicators given below).



Saves to memory the new limit set during programming (see description of  above); exits program mode.



When on, indicates the particle size range is being displayed. This light must be on to program the count alarm limit of the displayed size range. When blinking, indicates a count alarm limit has been exceeded.



When on, indicates the location assigned to a test run is being displayed. This light must be on to select a new location.



When on, indicates the programmed number of count cycles to be taken is being displayed. This light must be on to program a new number of count cycles.



When on, indicates date or time of day is being displayed. This light must be on to change either function.



When on, indicates either the sample period or hold time is being displayed. This light must be on to program period or hold time.



When on, indicates current temperature or relative humidity is being displayed. This light must be on to program alarm limits. It will not come on if environmental probe is not connected. When blinking, indicates the probe alarm limit has been exceeded.



When on, indicates air velocity is being displayed.

Front Panel Overview

Options

This light must be on to program air velocity alarm limits. It will not come on if probe is not connected. When blinking, indicates the probe alarm limit has been exceeded.

When on, indicates one of the available options is being displayed: **AFb** - turns audio feedback (beeper) on or off; **CFg** - gives configuration number that was last added or deleted (applies only if "configuration" option was ordered instead of the standard manifold option); **FLO** - gives flowrate through the counter; **bd** - selects baud rate; **UOL** - selectable units of volume between cu. ft. (CF) or liters (L) when in Concen. mode or when printing ISO 14644 calculations; **Prn** - selectable between:

- ALL** - when printer enabled, prints results,
- 14644-1** - calculates and prints stored data as calculations; and
- ALr** - prints results only if a count or analog alarm occurs.

PRINTER Group



Enables printer to print results of the choice selected in Options. The LED is a reminder the printer is enabled.



When printer is enabled, will print all the count cycles stored in the rotating buffer. Contents re-

Setting and Changing Functions

Note

For basic operation of the particle counter, refer to "Using the Counter for the First Time" on earlier pages.

To turn off the alarm, enter a limit value of 0 (zero) for all particle size ranges. To silence the alarm, press any key except  or . To hear one beep when the count limit is reached and at each multiple thereafter, select the beep mode.

Note

For any of the following programming functions, if the counter is in the run mode when it is turned on, press .



main in the buffer.

When momentarily pressed, gives number of count cycles presently stored in the rotating buffer. When held down for more than two seconds, clears rotating buffer of its contents.



When printer is enabled, will advance paper.

Operating functions of the counter (count alarm limits, period and hold times, etc.) are changed using front panel keys. You can also change some set-up functions (environmental probe limits, baud rate, etc.) via the front panel.

Reference is made in the following procedures to digits of the front panel display. Refer to the following example for more digit information:

Procedures below provide step-by-step instructions to change all programmable functions.

Count (Alarm Limits)

An audible count alarm can be set to occur when the count exceeds any number. The range is from zero (turns alarm off) up to 9,999,999. Each particle size range may have a different count alarm limit. The alarm will sound as soon as any count alarm limit is exceeded. Set count alarm limits as follows:

1. Turn counter on; press .
2. Press  or  until Count  is on. Press  or  until size range of the limits to be changed appears.
3. Press  (program LED comes on); the current count alarm limit will be displayed and the smallest digit of alarm limit will blink.
4. Press  or . The smallest digit of alarm limit will blink. Press  until digit requiring change is blinking.
5. Press  (or ) once to increment (or decrement) digit to the next value. To scroll, press and hold either arrow key.
6. To change another digit, press  then repeat step 5 above.
7. Press  to save changes and exit programming mode (Program LED is off).
8. To change count alarm limits for another particle size range, press  until desired size range is displayed then repeat steps 3 through 7 above.

Setting and Changing Functions

Location (Number)

Any number from zero to 999 can be assigned to a location. You can assign a different number each time you change locations. The number will appear on the printout and as part of the stored data.

During remote operation, this number is also used as the device number (from 0 to 63). Refer to “Serial Port Protocol and Commands” for more information. Change location number as follows:

1. Press  or  until Location  is on. Current location number will appear on the readout display.
2. Press  (“ones” digit will blink) then press  once to increment digit to the next value. To scroll, press and hold  key.
3. To change “tens” or “hundreds” digit, press  then press  to increment number. To scroll, press and hold  key.
4. Press  to save changes and exit programming mode (Program LED is off).

Note

Press  to start a new count cycle, display automatically goes to count and displays the last size selected.

(Number of Count) Cycles

The number of count cycles is the number of times the counter will count then hold, count then hold, etc., before stopping. Up to 999 cycles can be made while in the Automatic mode. To repeat count cycles indefinitely, set the number to zero. Change number of count cycles as follows:

1. Press  or  until Cycles  is on. The current number of count cycles programmed will appear on the readout display.
2. Press  (“ones” digit will blink) then press  to increment the number to the next value. To scroll, press and hold either arrow key.
3. To change “tens” or “hundreds” digit, press  then press  to increment number. To scroll, press and hold  key.
4. Press  to save changes and exit programming mode (Program LED is off).

Date/Time

These parameters can be displayed while in either the run or stop mode by pressing  or  until the Date/Time  comes on then by pressing  or  to switch between date and time. To change date or time-of-day, perform the following steps:

1. Turn counter on; press .

Setting and Changing Functions

2. Press  or  until Date/Time  is on. Current date will be displayed. The MMDDYY numerical format is used.
3. Press ; the month digits will blink. To advance to week or day digits, press .
4. To increment digits to the next value, press  once. To scroll, press and hold either arrow key.
5. To change additional digits, press  and repeat step 4 above.
6. Press  to save changes and exit programming mode (Program LED is off).
7. To change time of day, press  then repeat steps 3 through 5 above for hours, minutes, and seconds.

Period/Hold (Time)

The period (sample time) is the length of time you want to sample air. Period can be set to any value from 0 (zero) up to (but not including) 24 hours. Hold time is the length of time between samples and can be set to any value from 1 second up to (but not including) 24 hours. If the period is set to 0 (zero), the counter will count indefinitely or until  is pressed. In the Manual mode the counter counts for the period (sample time) then stops. In the Automatic mode, the sample and hold cycles repeat for the number of times programmed under Cycles. The final count value will be displayed during the hold time. Change period or hold time as follows:

1. Turn counter on; press .
2. Press  or  until Period/Hold  is on. Existing period will be displayed in hours, minutes, and seconds. To change hold time, press  then go to step 3. To change period, go to step 3.
3. Press ; seconds digits will blink. To advance to minutes or hours digits, press .
4. To increment digits to the next value, press  once. To scroll, press and hold either arrow key.
5. To change additional digits, press  and repeat step 4, otherwise press  to save changes and exit programming mode (Program LED is off).

Turning Beeper On or Off (AFb)

The audible feedback system (beeper) can be turned on or off except for an environmental probe alarm. Turn beeper on or off as follows:

1. Press  or  until Options  is on then press  or .

Setting and Changing Functions

until AFB is displayed. The current status (on or off) of the beeper will appear on the readout display.

2. Press  (the status will blink) then press  or  to change to either OFF or ON.
3. Press  to save changes and exit programming mode (Program LED is off).

Volume Units (UOL) for Concentration Mode and ISO 14644 Calculations

The concentration mode provides an estimation of the counts per cubic foot (CF) or counts per cubic meter (1 cubic meter = 1000 L). Change from one set of units to another as follows:

1. Press  or  until Options  is on then press  or  until **UOL** is displayed. The current units (CF or 1000 L) will appear on the readout display.
2. Press  (existing units will blink) then press  or  to toggle to other choice.
3. Press  to save changes and exit programming mode (Program LED is off).

Baud Rate (bd)

The baud rate may be set to either 300, 1200, 2400, or 9600. Set baud rate as follows:

1. Press  or  until Options  is on then press  or  until **bd** is displayed. The current baud rate will appear on the readout display.
2. Press  (existing baud rate will blink) then press  or  to cycle through selections; stop when your choice is displayed.
3. Press  to save selection and exit programming mode (Program LED is off).

Note

You may want to set a period (sample time) of three minutes to give ample time for airflow adjustment.

Adjusting Airflow (FLO)

Nominal airflow through the sensor is 1 (one) cfm. Airflow is monitored and adjusted during a count cycle only. Adjust airflow as follows:

1. Press  or  until Options  is on then press  or 

Using Special Features

Note

One cfm means one cubic foot of air passes through the sensor in one minute.

After each second, the oldest period's count is deleted from the average and the newest is calculated into the average and the new result is displayed.

Note

The counter will count in this mode until  is pressed.

until **FLO** is displayed.

2. Press  to start a count cycle.
3. After airflow readout has stabilized, turn AIRFLOW ADJUST knob on rear panel for a reading of 1.00. Turning knob clockwise increases airflow.
4. Press  to stop the count cycle.

Your counter offers several special features for sampling air. The following procedures give detailed instructions for using these features.

Concentration (CONCEN) Mode

This mode gives a quick (within seconds) calculation of the particle concentration. The mode averages the number of particles counted in one-second samples to give the calculation of count-per-cubic-foot (or count-per-cubic meter = 1000 L) of air. The displayed count is updated every second. Counting continues for the period and number of samples programmed in "Period/Hold" procedure. If printer is enabled, concentration mode results are printed at the end of each count cycle. Results are also stored in memory and can be printed out at a later time. Particle counter operation by a computer is not possible while in this mode.

1. Turn counter on; press .
2. Press  until Concen.  is on.
3. Select units (ft./min. or meters/min.) required for the concentration reading. Refer to "Volume Units (UOL) for Concentration Mode and ISO 14644 Calculations" procedure in this section to determine units currently programmed or to change units.
4. To start counting, press .

Audible (Beep) Mode

The beep mode changes the count alarm feature to a single audible sound (beep) once each time the count alarm limit is reached and then once again for every count multiple of the count limit. A beep will sound for each particle size range count limit. In order to focus attention on one particle size range, we suggest you set a limit for only the size range of interest and set the remaining ranges to zero (no alarm). The beep mode limits and count alarm limits are one and the same.

1. Press  until Beep  is on.

- The count number that was set in the "Count Alarm Limits" procedure will be the number that applies also for the beep mode. To change when the audible sound occurs, perform "Setting Count (Alarm Limits)" procedure.
- To begin sampling, press . Sampling will continue until  is pressed.

Using Special Features

Count Cycles Average Calculations

Your counter will automatically calculate and print out the results of the average of the counts taken in up to 999 count cycles. To use this averaging feature, perform the following steps:

- Position the counter at the sample location; turn power on.
- Press the  key until Automatic  is on.
- Set the sample Period and Hold functions to the desired duration; set the number of Cycles to be taken (procedures located elsewhere in manual).
- Choose "14644-1" from "Prn" (Options) using "Selecting Printer Function" procedure on following pages.
- From the printer control keys, press  then press . The counter will run for the number of cycles you programmed, print the results of each cycle, and stop.
- Press  key. The counter will print the averages of each particle size range for the number of cycles you programmed in step 3 above. These averages represent particles/cubic foot.
- If more than one location is to be sampled, perform "ISO 14644 Calculations" procedure.

Note

The averages will be calculated and displayed in particles per cubic foot.

The average value includes only the last sample run, not buffer contents from previous runs.

Connecting to Clean Dry Air (CDA) Purge Circuit

Occasionally you may want to connect purge air to your particle counter, especially in high vapor areas. Continual SENSOR LED indications may be a sign of vapors contaminating the sensor optics. Purpose of the CDA purge input circuit is to reduce the contamination on the sensor's Brewster window due to vapors passing through the purge filter.

- Connect purge air source to the Swagelok "CDA Purge" fitting on

Note

All components ahead of the counter, including interconnecting lines, must be pressure rated at >150 psi.

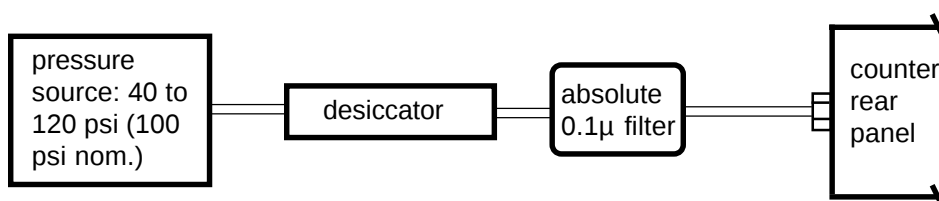


Figure 2a. Components Required for Clean Dry Air Applications

Using Special Features

2. Turn counter on then pressurize counter with the purge air source in step 1.
3. Adjust AIRFLOW knob on counter's rear panel for a reading of 1.00 (refer to "Adjusting Airflow (FLO)" procedure if necessary).

Refer to CDA flow diagrams on page 29 for internal flow path.

ISO 14644 Calculations

Your counter will automatically calculate the statistical data required for compliance with ISO Standard 14644. This selection is made as one of the print modes when setting Options. Calculations are made on the last data stored at each location (up to 400 samples). Sampling must take place at two or more locations for calculations to be made. When all locations have been sampled, the printer prints the mean of averages, standard deviation, standard error, and upper 95% confidence limit. The upper confidence limit is only calculated for nine or fewer locations.

To use ISO 14644 calculations feature, perform the following steps:

1. Position the counter at the first sample location; turn power on.
2. To keep from using previous data in the calculations, clear stored data by pressing and holding .
3. If you are taking temperature, relative humidity, or air velocity readings at location 1, position the probes now.
4. Set "Location" to 1 using "Location (Number)" procedure.
5. Set number of cycles to be taken at each location using "Number of Count Cycles" procedure; set sample time of each cycle to one minute (hold time, your choice) using "Period/Hold (Time)" procedure.
6. Set mode to "Automatic" or "Concentration" (not "Manual") then press . The Counting  will come on while samples are being taken. Verify flow rate is 1 cfm as described on earlier pages. The counter will stop when samples are complete.
7. Turn the counter off then move counter to the next location.
8. Set "Location" to 2 then press . Samples will be taken at location 2.
9. Repeat steps 5 and 6 above for the remaining locations.
10. Decide if calculations are to be in cubic feet (CF) or cubic meters (1000 L) then make selection using Volume Units (UOL) for Concentration Mode and ISO 14644 Calculations.

CAUTION

Make sure you no longer need the stored data before you press and hold down  key.

Note

In the ISO 14644 calculations, a period of 60 seconds must be selected so that at a nominal flow rate of 1 cu. ft./min, a total volume of 1.000 cu. ft will be sampled. The count is calculated on one cubic foot of sampled air.

Note

Number of count cycles must be 1 (one) or greater. If set to 0 (zero) or manual, ISO 14644 calculations will not be made.

Note

If you want to retake the samples at the same location, press  again. The data from the retaken sample will then be used in the calculations.

Using Special Features

ISO 14644-1 STATISTICS			
AVERAGE PARTICLES/CUBIC FOOT			
LOCATION 001, 09:45:39 MAY 7, 93			
CYCLES = 003, VOL = 1.000 CU FT			
TEMP. = 71.3 F RH = 29.5%			
SIZE	CUMULATIVE	DIFFERENTIAL	
0.1μ	3256.3	2634.7	
0.2μ	621.7	361.3	
0.3μ	260.3	58.3	
0.5μ	202.0	31.7	
0.7μ	170.3	22.3	
1.0μ	148.0	148.0	
LOCATION 002, 09:48:41 MAY 7, 93			
CYCLES = 003, VOL = 1.000 CU FT			
TEMP. = 71.3 F RH = 29.5%			
SIZE	CUMULATIVE	DIFFERENTIAL	
0.1μ	4478.7	3954.3	
0.2μ	524.3	435.0	
0.3μ	89.3	43.0	
0.5μ	46.3	18.7	
0.7μ	27.7	9.3	
1.0μ	18.3	18.3	
MEAN OF THE AVERAGES			
SIZE	CUMULATIVE	DIFFERENTIAL	
0.1μ	3867.5	3294.5	
0.2μ	573.0	398.2	
0.3μ	174.8	50.7	
0.5μ	124.2	25.2	
0.7μ	99.0	15.8	
1.0μ	83.2	83.2	
SIZE	STD DEV	STD ERR	95% UCL
0.1μ	864.3	611.2	7724.0
0.2μ	68.8	48.7	880.1
0.3μ	120.9	85.5	714.3
0.5μ	110.1	77.8	615.3
0.7μ	100.9	71.3	549.1
1.0μ	91.7	64.8	492.3

Note

In the ISO 14644 calculations, a period of 60 seconds must be selected so that at a nominal flow rate of 1 cu. ft./min, a total volume of 1.000 cu. ft. will be sampled. The count is calculated on one cubic foot of sampled air.

Figure 3. Typical ISO 14644-1 Printout (Model A2100C shown)

- Choose "14644-1" from "Prn" (Options) using "Selecting Printer Function" procedure on following pages.
- From the printer control keys, press  then press . The average particles per unit volume at each location will be printed out, followed by ISO 14644 calculations of all locations.

Using Special Features

Note

To abort a change, press  again. To save a change, press .

Note

If "Loc" appears in the 3-digit display, presently programmed parameters (count alarm limit, etc.) will be used when  is pressed. If "Loc" appears in the 7-digit display, test parameters have been assigned to this location.

Note

The default configuration (C 1 on the 3-digit display) will be used for all locations during count runs that have not been specifically programmed as described in this procedure.

Generating a Configuration

If you ordered your counter with the "configuration" capabilities option, you can program a "configuration" that stores in memory count cycle information. The information is stored at a location number so that when the location is selected, the period, hold time, count alarm limit, and number of cycles will be automatically performed during a run cycle. Up to 10 different configurations can be generated. Any configuration can be stored in one or more of the 1000 location slots available.

To generate, apply, review, or delete a configuration, perform the following steps:

1. Decide on the "configuration" you want then set the configuration (count alarm limit, period/hold time, number of cycles) using procedures found elsewhere in this section.
2. Press  or  until Options  is on then press  or  until **CFg** (configuration) is displayed.
3. Press  (a configuration number will blink) then press  or  to select the configuration number (any number from 1 to 10) that will be assigned to contain your "configuration" (as set in step 1).
4. Press  to enter into memory the assigned number and to exit the programming mode (Program LED will go off).
5. To apply this configuration (or any other programmed configuration) to a location number, press  or  until Location  is on. The current location number (7-digit display) and the present configuration in this location (3-digit display) will be displayed. If "Loc" appears in 3-digit display, no configurations have yet been assigned.
6. Press  then select the desired location number.
7. Press  until configuration number in the 3-digit display blinks then press  or  to step through the ten configuration numbers until configuration number you want to apply is displayed.
8. Press  to configure the selected location and to exit the programming mode. A configuration must be programmed (using step 3 above) before a location can be programmed (see note to right).
9. To see what configuration is in a location, press  or  until Location  is on, press , then press ,  and ,  to step through locations. The assigned configuration number will be given in the 3-digit display. Press  again when finished.
10. To print out a copy of how many and what configurations have been used, and the parameters of each configuration, repeat step 2 above

then press .

11. To delete a stored configuration, repeat step 2 then press , and with  or , select desired configuration number to be deleted (number will blink); press . Verify deletion by printing the configuration (repeat step 10).

The particle counter can be ordered with or without a printer. If ordered without a printer, a rear-panel connector is installed for use with an external (Centronics parallel-interface) printer. When enabled, the printer will print all count data as well as date, time, location, etc., automatically as a test run is completed. Sample time (period) of each test run must be greater than eleven seconds for the printer to be able to respond. All test run data is stored in a rotating buffer and can be printed out at any time. To print results, you must choose one of the “printer selections” (described below) and “enable” the printer. Operating the printer is described in these subsections:

- Loading Printer Paper
- Selecting Printer Function
- Printing ISO 14644 Calculations
- Clearing Data Stored in Rotating Buffer
- Interpreting the Printout
- Setting up an External Printer

Loading Printer Paper

1. Open paper cover then remove any remaining paper from last roll by snipping paper at spool and pressing  until printer is empty.

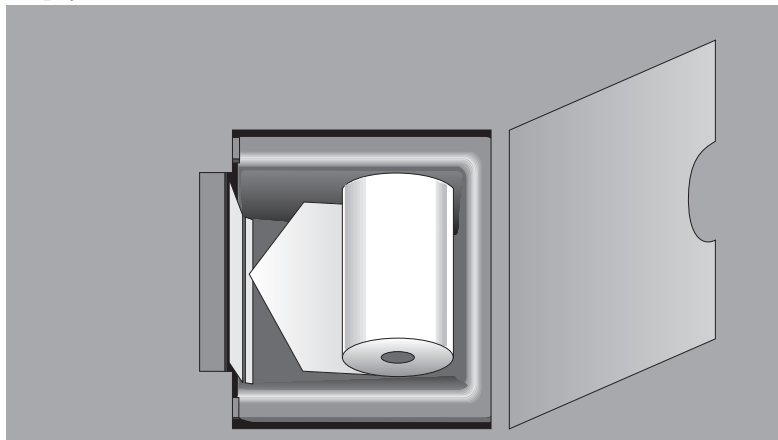


Figure 4. Loading Printer Paper in the Counter

Using the Printer

CAUTION

The printer should not be operated without paper as damage may occur to the print head. If the particle counter must be operated without paper in the printer, be sure printer is not “enabled”.

Do not pull paper from printer in opposite direction of normal feed. This will damage printer.

Paper used in this printer is temperature-sensitive on one side and thus must go into the printer as explained in the instructions.

Note

Leave natural “curl” in paper so that paper tracks properly through mechanism.

Using the Printer

2. Trim end of new roll to a clean, arrow-shaped edge.
3. Place paper roll in paper tray so that paper feeds toward print mechanism from bottom of roll.
4. Insert tip of paper into slot in feed mechanism (above the bottom of the paper tray) so that when  is pressed, paper will be pulled through printer; close paper cover.

Selecting Printer Function

The print function currently selected is displayed when Option is on and Prn appears on the 3-digit display. The three selections available are: 1) print "ALL" - prints results after completion of each count cycle (if cycle is greater than eleven seconds), 2) print "Alr" - prints results only when a count alarm limit has been exceeded, 3) print "14644-1" - prints ISO 14644 calculations. The first two options, when selected, occur during particle counting. The third option, when selected, occurs after count cycles at two or more locations are completed and when  is pressed. For any of the selections to work, the printer Enable LED must be on. Choose desired print selection as follows:

1. Press  or  until Options  is on.
2. Press  or  until Prn is displayed. The current status ("ALL", "14644-1", or "Alr") will appear on the readout display.
3. Press  (current status will blink) then press  or  to step through the three choices ("ALL", "14644-1", or "Alr").
4. Press  to save your choice and exit the programming mode (Program LED is off).

Printing ISO 14644 Calculations

Your counter will automatically calculate the statistical data required for compliance with ISO 14644 after sampling particles at two or more locations. The printer will print the mean of averages, standard deviation, standard error, and upper 95% confidence limit by simply enabling the printer then selecting "14644-1" from the print mode of the Options program. Refer to "ISO 14644 Calculations" for step-by-step instructions for taking samples and printing results.

Using the Printer

Interpreting the Printout

The printer will print the particle size ranges and cumulative and differential counts for each range. It also prints environmental probe values if external probes are connected to the counter. Date, time, location, period and number of cycles 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 printout when  has been pressed will look similar to this:

```

PRINTING002RECORD(S)

***** COUNT ALARM *****
***** ANALOG ALARM *****
LOCATION001,17:45:39 MAY 9,93
CYCLES=002, PERIOD 00:00:30
TEMP. = 75.3 F  RH = 29.0%
SIZE CUMULATIVE DIFFERENTIAL
0.1µ    21205          12150
0.2µ    9055           6398
0.3µ    2657           2263
0.5µ     394            253
0.7µ     141            100
1.0µ      41             41
***** COUNT ALARM *****
LOCATION001,17:46:16 MAY 9,93
CYCLES=002, PERIOD 00:00:30
TEMP. = 71.3 F  RH = 29.5%
SIZE CUMULATIVE DIFFERENTIAL
0.1µ    21934          12578
0.2µ    9356           6625
0.3µ    2731           2301
0.5µ     430            264
0.7µ     166            122
1.0µ      44             44

```

Figure 5. Typical Printer Printout (Model A2100B shown)

In this example, two runs (cycles) were stored in the rotating buffer. The count of 21205 for size .1 micron is the cumulative (total) count. The differential count of 12150 is for the .1 micron range only (.10 through .19 micron) at location 001. The words COUNT ALARM above the count cycle data means the count exceeded the programmed alarm limit for that cycle at one of the six particle sizes. ANALOG ALARM means either the temperature or relative humidity reading exceeded the programmed limits during both count cycles. PRINTING 002 RECORD(S) appears at the top of the printout only when  has been selected.

Using the Printer

CAUTION

Make sure you no longer need the stored data before you press and hold down  key.

CAUTION

Before performing this procedure, load paper into external printer; refer to printer instruction manual. Operating printer without paper may damage the print head.

The counter must be turned off before connecting the external printer. Connecting the printer while the counter is on may damage the counter.

Clearing Data Stored in Rotating Buffer

Count data taken while in the manual and automatic modes are stored in the counter's rotating buffer. Up to 400 data records can be stored in the buffer. At that time the oldest record is removed to make room for the newest record. Printing count data does not remove records from the buffer. To clear all data records from the rotating buffer, perform the following steps:

1. Momentarily press . The number of sample runs currently stored in the buffer will appear on the readout display.
2. Press and hold down  for two seconds or longer; the display will go to 0, meaning no sample runs remain in the rotating buffer.

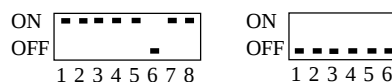
Setting up an External Printer

An external printer is considered an option because output to the external printer requires installation of a Centronics parallel interface connector at the time the counter is built.

Over the years, several external printers have been available as options from the factory. The Model DPU-414 is the latest printer available and supercedes the DPU-411.

If you ordered the external printer option (no built-in printer), connect the printer as follows:

1. Set  to 0 (off).
2. Turn power off to printer.
3. If using a DPU-411 printer, verify switches on bottom of printer are set for parallel format. They should be set as follows:



If using the DPU-414 printer, DIP switch settings are made in software. Set the DIP switch for a parallel format by following the procedure in the printer's Operation Manual.

4. Connect ribbon cable between the printer and the connector marked PRINTER on rear panel of counter.
5. Set  to 1 (on); set printer power switch to on.
6. Make printer selection changes, if desired, as described in "Selecting Printer Function" on earlier pages.

Accessories can be ordered from the factory at any time. Those accessories requiring additional discussion are the two environmental probes currently available.

Using Accessories

Environmental Probes

The particle counter has rear-panel connectors for two environmental probes: RH/temp probe for monitoring relative humidity and temperature and an air velocity probe for monitoring air velocity. When a probe is connected to the counter, the front panel will display the probe reading when the appropriate "DISPLAY" is selected with the arrow keys. (Air velocity can be monitored when .Spare  is on.)

When the printer is enabled, the probe readings present during each count cycle will automatically be printed with the count results. Otherwise, readings can be printed at a later time. Alarm limits can be set for each probe so that if either a high or low limit is exceeded, the Limit light will come on. A light will blink adjacent to the label of the probe in alarm if that probe's reading is being displayed. Refer to the "Probe Alarm Limits" earlier in this manual for setting alarm limits.

The following tips should be noted during use of the RH/temp or air velocity probe:

- Never touch the sensing element of the probe; it is very fragile. Sensing elements should not be exposed to caustic vapors (e.g., acetone, Freon, and RTV).
- Keep the RH/temp probe away from exhaust fans for more accurate measurements of temperature.
- For accurate measurements of relative humidity, allow probe to stabilize several minutes; take samples in still air.
- When taking air velocity measurements, make sure the white sensing element is fully exposed to the direction of airflow.

Setting Temp/RH Probe Alarm Limits

Temperature and relative humidity can be displayed while in either the run or stop mode by pressing  or  until Temp/RH  is on. Program the probe high- and low-alarm limits or change from °F to °C or from °C to °F as follows:

1. Turn counter off. Connect RH/temp probe to the counter rear-panel connector marked RH/TEMP then turn counter on.
2. To read temperature or relative humidity, press  until Temp/RH  is on. Current temperature will be displayed. Press  for relative humidity reading.

Note

Alarm limits for relative humidity and temperature can only be displayed or programmed when the probe is connected to the counter.

To silence the alarm, press any front-panel key *except*  or .

To turn off the alarm, enter both an upper and lower limit value of 0 (zero).

Using Accessories

3. To change the high-alarm limit or to change readout to °F or °C, press  then press  until the digit you want to change is blinking.
4. To increment digit to the next value, press  once. To scroll, press and hold down either  or  key.
5. To change other digits, press  and repeat step 4.
6. To set low-alarm limit, press  until "HI" blinks then press ; "LO" will blink. Press  to select digit to be changed then repeat steps 4 and 5 above.
7. Press  to save changes and exit programming mode (Program LED is off).
8. To set relative humidity alarm limits, while RH/Temp  is on press  (current relative humidity reading will be displayed) then press . Using  select digit to be changed, then repeat steps 4 through 7 above.

Setting Air Velocity Probe Alarm Limits

When air velocity probe is connected, air velocity can be displayed while in either the run or stop mode by pressing  or  until Spare  is on. Program the probe high- and low-alarm limits or change readout units to ft./min. or meters/min. as follows:

1. Turn counter off. Connect air velocity probe to the counter rear-panel connector marked AIR VELOCITY then turn counter on.
2. To read air velocity, press  until Spare  is on. If a decimal point is in the three-digit readout, results are in meters/minute, otherwise results are feet/minute.
3. To change the high-alarm limit or to change readout to ft./min or meters/min, press . "HI" will be blinking. Then press  until the display you want to change is blinking. A blinking "-" means readout is in meters/min; blinking "F" is ft./min.
4. To increment digit to the next value, press  once. To scroll, press and hold down either  or  key.
5. To change other digits, press  and repeat step 4.
6. To set low-alarm limit, press  until "HI" is again blinking, then press ; "LO" will blink. Select digit to be changed using  then repeat steps 4 and 5 above.
7. Press  to save changes and exit programming mode (Program LED is off).

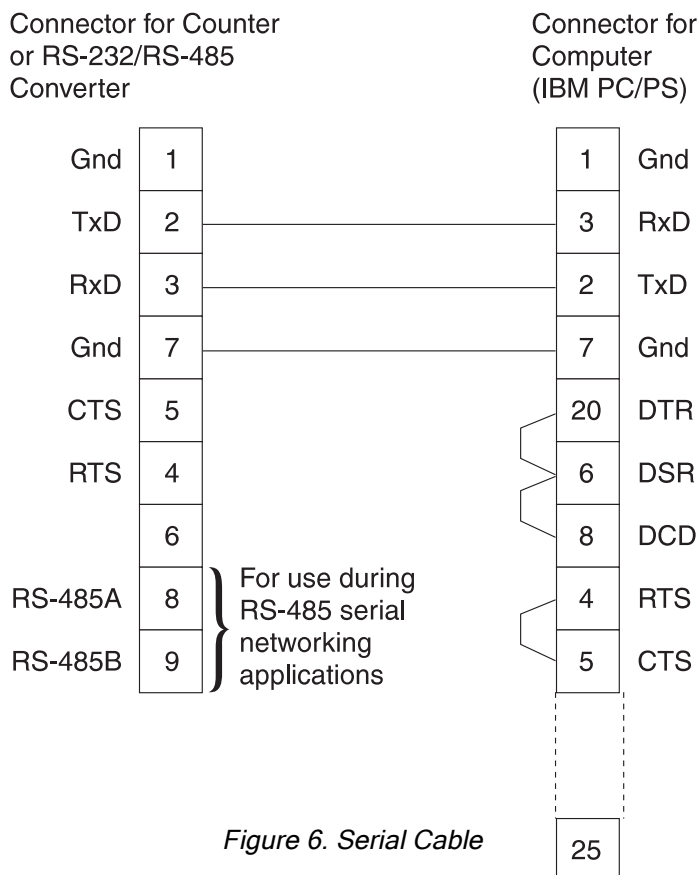
This section describes operating the particle counter with a computer. Your counter provides both RS-232 and RS-485 serial data communications capabilities. RS-232 serial interface circuitry provides asynchronous communications between the counter and computer. RS-485 serial network circuitry provides asynchronous communications between up to 64 counters and a controlling computer.

Software is available from the factory that will control your counter from an IBM PC and upload count data into the PC. For additional information on Software contact the factory. Also, the "Particle Counters for Air" manual you received with your counter will provide more detail information on particle counter control with a computer.

Serial Cables

All counters are connected to a computer with a serial cable. If you order software, you will receive the correct serial cable for your counter. The cabling diagram below is provided for those who wish to make their own custom-length cable.

Communication Protocol



Serial Port Protocol and Commands

CAUTION

To avoid internal circuit board damage, configure the cable as shown in the figure below. The figure shows wiring for a 25-pin connector on the computer. If your computer is a nine-pin type, use a nine-pin to 25-pin adapter cable. Both cables are available from Met One.

Serial Port Protocol and Commands

The counter has the following fixed parity and protocol:

- Eight (8) data bits
- One (1) stop bit
- No parity

The device number (select code) and baud rate are selected from the front panel of the counter. Make these selections as described in "Location (Number)" and "Baud Rate (bd)", respectively, covered earlier in this manual.

REQUEST FOR DATA Commands:

"A" Send Buffered Record—The next data 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.

A record of the most recent count cycle will always be sent first. If no count cycles have been completed since the counter was turned on, then a "#" will be sent. The record cannot be sent until the current count cycle is complete.

"B" Send Current Record—The data record of the most recent sample period will be sent. Thereafter, if no new sample period has been completed, a "#" character will be sent. The rotating buffer is unaffected.

"C" Clear Buffer—Contents of the rotating buffer will be erased.

"D" Number of Records—The counter will send the number of records in the rotating buffer terminated by a carriage return and line feed. The number of records returned is varying length, no leading zeros, and has no limit. If no data records are available, a "0" will be returned (D0<cr><lf>).

"E" EPROM Revision—The counter will send the EPROM number and latest revision. The format field lengths can vary, and is terminated by a carriage return and line feed.

"H" Hold Time—When an upper case "H" followed by a carriage return and line feed are sent, the counter will display the current Hold Time terminated by a "carriage return" plus "line feed" (<cr><lf>). Hold time will be in a format of HHMMSS (hours, min., sec.).

To program hold time, enter upper case "H" followed by only relevant time information. Use the form of HHMMSS (hours, min., sec.), terminated by (<cr><lf>). Do not enter leading zeros.

"L" Sample Period—When an upper case "L" followed by a carriage return and line feed are sent, the counter will display the current Sample Period terminated by a carriage return line feed (<cr><lf>). Sample period will be in a format of HHMMSS (hours, min., sec.). To program sample period, enter upper case "L" followed by only relevant time information. Use the form of

HHMMSS (hours, min., sec.), terminated by (<cr><lf>). Do not enter leading zeros.

"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.

"R" Retransmit Record—The last record sent will be retransmitted. The buffer will not be cleared. If there is no record to retransmit, a # following the echoed command will be sent.

"T" Identify Model—The counter will send an alphanumeric data string name label terminated by a carriage return and line feed. The "Name Label" field can vary in length.

"U" Universal Device Select—The counter will be placed in the "remote" mode, and will respond to all commands after receiving this command, regardless of which select code is programmed into the counter.

"V" Protocol Version—The counter will send an alpha data string terminated by a carriage return and line feed. The "Protocol Version" field will contain FX (enhanced Standard FIX Protocol).

ACTION Commands:

"128-191" Device Select—The counter will respond to all subsequent commands when a number is sent that matches its select code. The counter is deselected (made unresponsive to computer commands) by selecting another counter, 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. To send a number, press and hold <Alt> key then enter number.

"a" Auto—When the "d" command is used, the counter will count in the auto mode.

"b" Manual—When the "d" command is used, the counter will count in the manual mode.

"c" Start Counting (computer controlled)—The counter will begin counting without waiting for an even second boundary (immediate 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 on an even second boundary (using internal clock; not in the middle of a second) and control the count cycle based on the front-panel setting for the period (sample time).

"e" Stop Counting—The counter will immediately stop counting without waiting for an even second boundary.

"g" Active Mode—This device will enter a mode that prepares it for counting. For example, the air pump will turn on to purge the air path, and the sensor's laser will turn on.

Serial Port Protocol and Commands

CAUTION

Do not use the Universal Select command when more than one counter is on the same serial port because more than one counter will respond at the same time, causing communication problems.

Note

Some software requires the use of a leading zero; e.g. <ALT> 0128.

Valid range for most RS-485 networks and PSI software is from location 00 to 31.

Serial Port Protocol and Commands

Note

Commands preceded by a lower case "u" will affect all active counters on the RS-485 line.

These universal commands are valid only for counters with the "FX" protocol installed.

"h" Standby Mode—The device will enter a mode that will turn off air pumps and shut down laser sensors to conserve power or reduce equipment wear, if applicable. Only this command can turn off the pump and laser.

UNIVERSAL ACTION Commands:

"ua" Universal Auto Sample Mode—Puts the counter(s) in the "Auto" count mode. When the "ud" command is used, the device(s) will count in the auto mode. Auto mode causes the device(s) to continuously cycle through their own Sample and Hold period settings. This command is not echoed.

"ub" Universal Manual Sample Mode—Places the counter(s) in the "Manual" count mode. When the "ud" command is used, the device(s) will count in the manual mode. Manual mode causes the device(s) to cycle through their own Sample period once. This command is not echoed.

"uc" Universal Clear Buffer—The contents of the buffer will be erased. This command is not echoed.

"uc" Universal Auto Sample Mode—The counter(s) will start counting in either pre-selected counting mode (Auto, Manual). This command is not echoed. The device will start counting without waiting for an even second boundary (quick start). Counting will continue until stopped by the computer. The count cycle the computer will control time.

"ud" Universal Start Count—The counter(s) will start counting in either of the two preselected counting modes (Auto or Manual). This command is not echoed.

"ue" Universal Stop Count—The counter(s) will stop counting and will build a data record. This command is not echoed.

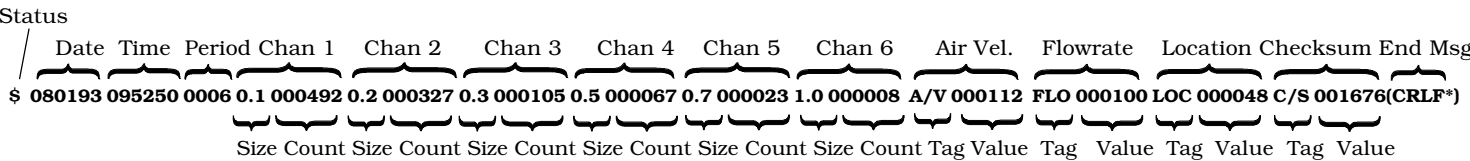
"ug" Universal Active Mode—The counter(s) will enter a mode that prepares it for counting. For example, the air pump will turn on to purge the air path, and sensor's laser will turn on. This command is not echoed.

"uh" Universal Standby Mode—The counter(s) will enter a mode that will turn off air pumps and shut down laser sensors to conserve power or reduce equipment wear, if applicable. Only this command can turn off the pump and laser. This command is not echoed.

Data

Serial Port Protocol and Commands

Each counter, regardless of model version, 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 six-channel counter with an air velocity probe:



*CRLF is the carriage return and line feed command

Figure 7. Typical Data Record of a Model A2100C Counter

Status: When translated to a binary byte, this character will indicate the status of the counter. As shown below, ASCII character "\$" has a decimal value of 36, which when converted to a binary byte, sets the third and sixth (always 1) bits. Bit 0 is considered the first bit (see example below):

Decoding the Status Character			
ASCII Character	Meaning	Decimal Equivalent	Binary Equivalent (bit 76543210)
(blank space)	no alarms	32	00100000
!	Cal Fail	33	00100001
"	WAIT condition	34	00100010
\$	alarm/count alarm	36	00100100
%	Cal Fail and alarm	37	00100101

(always 0) (always 1)

In this example the ASCII character "\$" translates to a status byte that is indicating a "Count Alarm" (see shaded line in table above). **Date:** Date information is carried in the 3rd through 8th characters of the record. The 2nd character is always a space, to separate the status character from the date characters. The date is arranged as MMDDYY (Month Day Year). In the serial communications example on the previous page, the date is August 1, 1999: the day the counter collected the data.

Serial Port Protocol and Commands

Time: Time information is carried in the 10th through the 15th characters of the record. The 9th character is always a space, to separate the date from the time. The time is arranged as HHMMSS (Hours Minutes Seconds) military time. In the example on the previous page the time is 9:52 A.M. and 50 seconds.

Period: The period is the sample time, or the length of counting time. The period information is carried in the 17th through 20th characters. The 16th character is always a space, to separate the time and period. The period is presented in minutes and seconds. In the example on the previous page the period was 0130 or one minute, 30 seconds. When the period is controlled by the computer (c command), the period characters will be zeros. When the period is controlled by the counter (d command), the characters will represent the sample time.

Tags: The tags contain three characters that identify the type of data that will follow. If the data is particle count, the tag will indicate the particle size. If the data is location number, the number programmed during setup as the remote counter's location number (any identifying number from zero to 31 can be assigned) will be indicated.

Chan 1, Chan 2: These characters contain count data from the measurements the counter has made. The size and count are each preceded by a space character for separation.

Size: The size is three characters, preceded by a space, and indicates the particle size range.

Count: The count is six characters, preceded by a space, and indicates the number of particles counted for the particle size range preceding the number. In the data string example on a previous page, the count in the channel 1 size range was 32 particles.

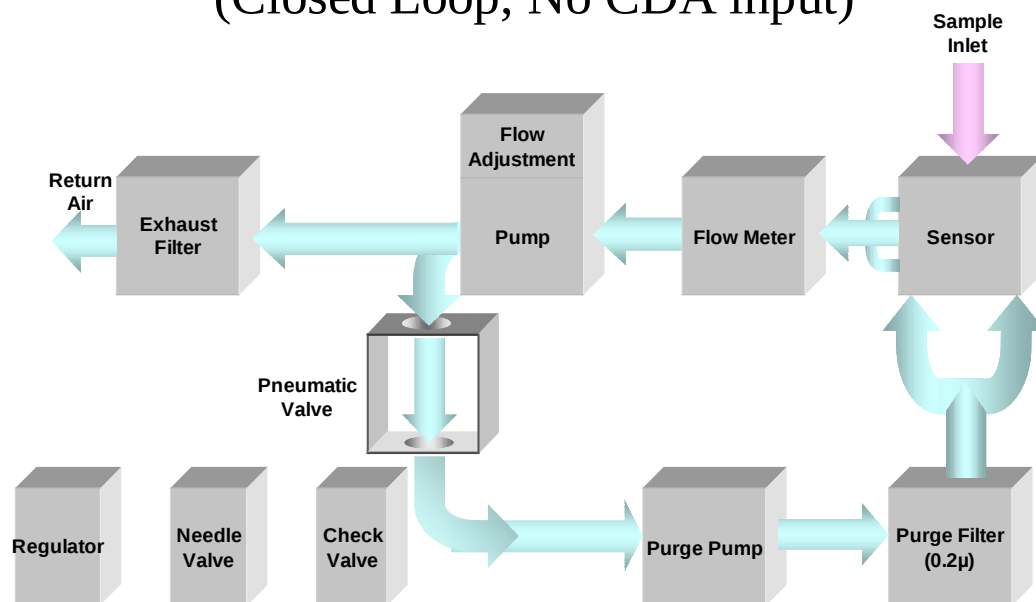
Location: A unique number assigned to each unit in multiple counter installations. The assigned number applies to the "device" select code number and eliminates simultaneous talking on the bus during serial networking of multiple counters.

Checksum: The checksum is a six-character hexadecimal number (with two leading zeros), preceded by a three-character tag and a space. The numerical value of the checksum is equal to the sum of the decimal equivalent of each ASCII character in the record, including spaces. Used for testing accuracy of data transmission.

End of Message: The end-of-message characters will immediately follow the count data and the checksum. There will be no separating space. The end of message characters are a carriage return and line feed.

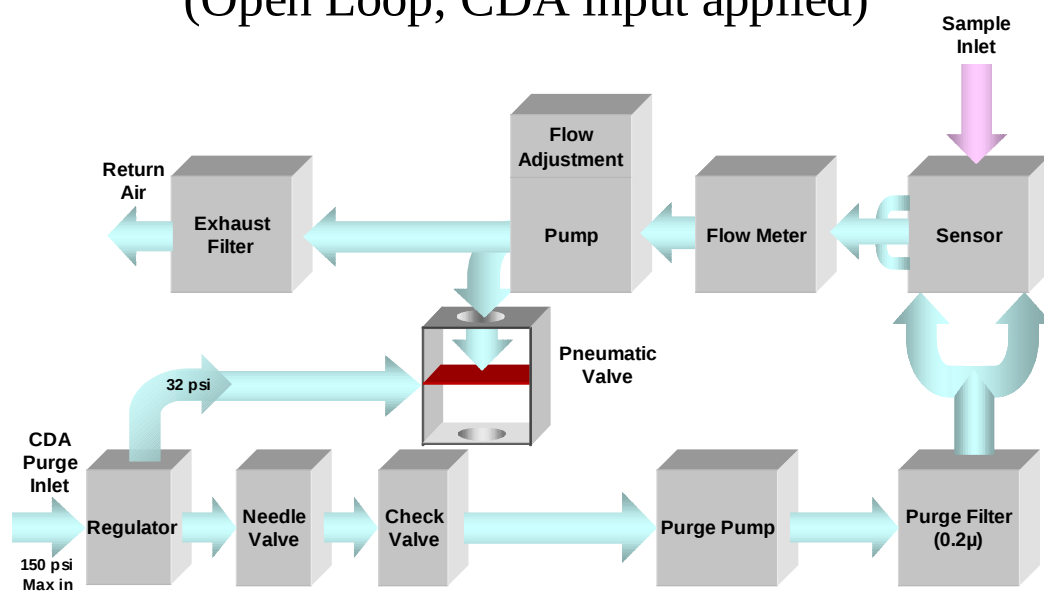
Passive Purge System Flow

(Closed Loop, No CDA input)



Active Purge System Flow

(Open Loop, CDA input applied)



Technical Data

Component Location

The following drawing can be used to help locate and identify components on your counter that are referenced in this operating guide or the "Particle Counters for Air" manual.

Note:

Some interconnecting tubing not shown
to maintain clarity

Front Panel

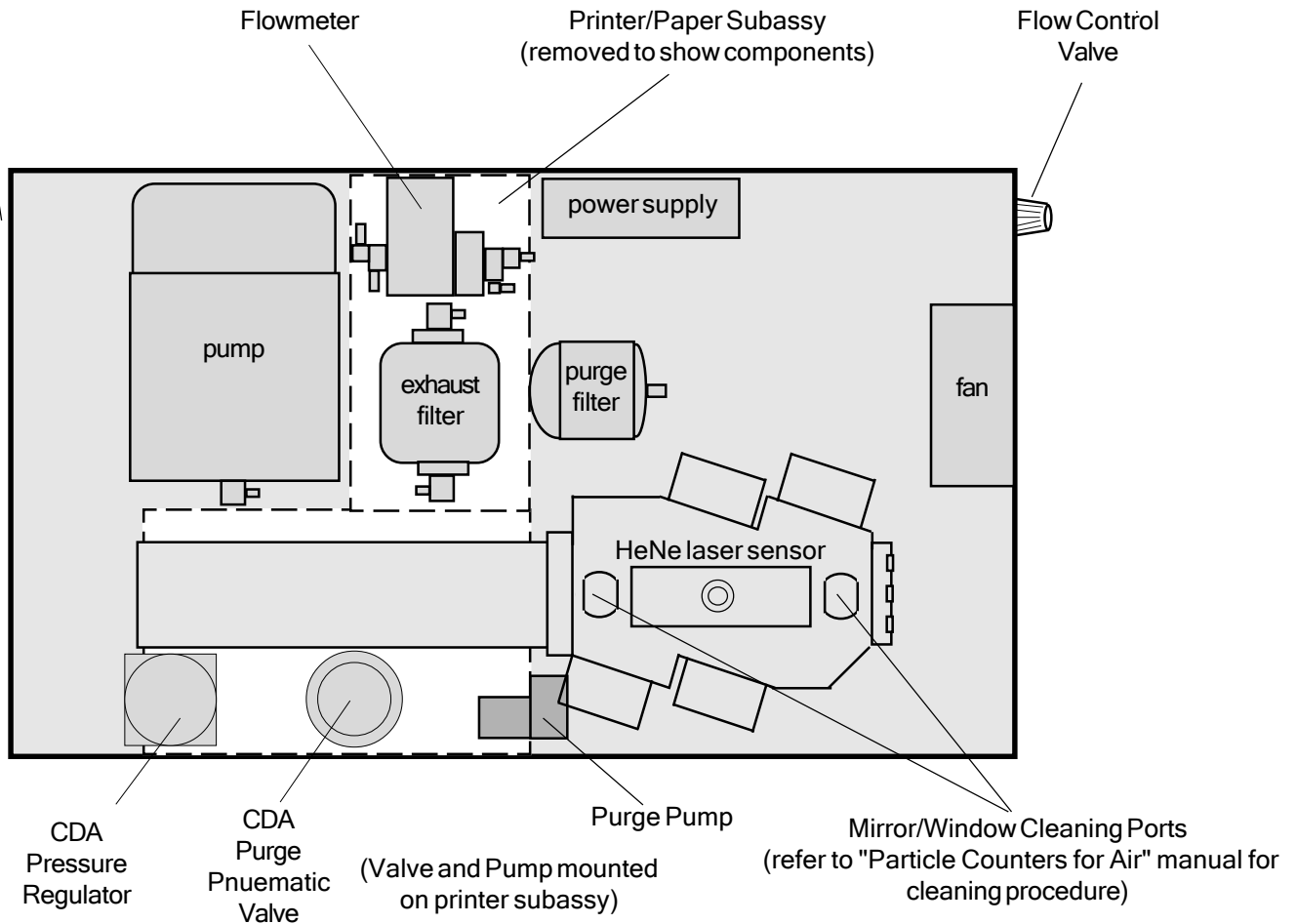


Figure 8. Layout of Major Components (Model A2100C and CE-Conformance shown)

Specifications

Number of Size Ranges	6
Particle Size Ranges	
2100C:	0.1, 0.2, 0.3, 0.5, 0.7, 1.0 micron
2200C:	0.16, 0.2, 0.3, 0.5, 1.0, 5.0 microns <u>OR</u> 0.2, 0.3, 0.5, 1.0, 3.0, 5.0 microns (standard) (select at time of order)
Minimum Threshold Setting	
2100C:	0.1 micron at 50% counting efficiency
2200C (0.16µ option):	0.16 micron at 50% counting efficiency
(0.20µ option):	0.2 micron at 50% counting efficiency
Zero Count	one count or less in 15 minutes
Sample Flow Rate	1 cfm (28.3L/min)
Coincidence Loss	Less than 5% at 40,000 particles/cu. ft.
Light Source	HeNe laser tube
Count Display	7-digit LED
Maximum Count Displayed	9,999,999
Sample/Hold Times	1 second to 24 hours
Count Alarms	1 to 9,999,999 counts
Data Storage	400 samples, rotating buffer
Count Cycles	up to 999 while in Automatic mode
Locations	up to 999, number appears on printout
Output	RS-232C/RS-485 for computer
Sensor Type	
2100C:	4-port HeNe, open cavity
2200C:	2-port HeNe, open cavity
Pump Type	air vacuum (linear), 1 cfm
Size	13.3" wide x 6.8" high x 22.8" deep (33.8 x 17.3 x 57.9 cm)
Weight	42 lbs. (19 kg.)
Power	200 watts, 100, 115, or 230 vac ±10% (specify), 50 - 60 Hz
Environment (Operating):	
Temperature	12 to 29°C (55 to 84°F), typical
Humidity	20 to 95% relative, non-condensing
Environment (Storage):	
Temperature	-40 to 60°C (-40 to 140°F)
Humidity	Up to 98% relative, non-condensing

Technical Data

Note

The sensors in the 2100C and 2200C are designed for use in class 100 or better cleanrooms.

HeNe Sensor Cleaning

CAUTION

Do not remove the “Warranty Void if Broken” stickers that cover the set screws located on several sensor assemblies. Any movement of lenses in the collection lens housing will damage critical focus parameters, ruining sensor calibration. Never put fluids into the sensor inlet fitting. Fluids will damage the sensor.

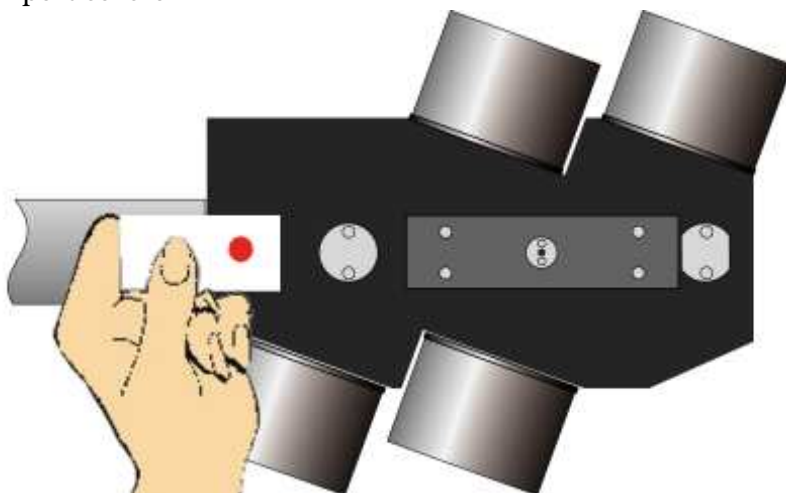
Note

Reagent-grade alcohol (laser diode sensors) and acetone (HeNe sensors) plus medical-grade cotton applicators should be used to minimize lint, dust, and dirt accumulations. If you have access to a laminar-flow hood, clean the sensor in the hood to minimize the possibility of adding further contamination to the sensor.

Warning

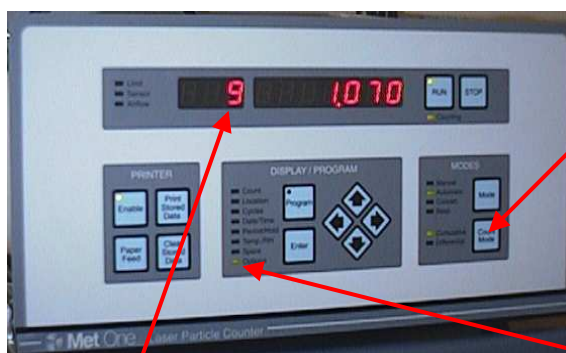
Maintenance procedures on the sensor can result in exposure to either visible or invisible radiation, depending on the type of sensor you have. The use of controls, adjustments, or performance of procedures other than those specified within this manual may result in exposure to visible or invisible (infrared) radiation that can quickly cause blindness.

1. Turn Power off.
2. In a clean room or under a clean hood,
3. Remove top cover from particle counter.
4. Locate sensor Assembly
5. Clean sensor surfaces around cleaning ports, remove cleaning port covers



6. Place a small white paper over the Brewster's window opening and turn on counter. If there is an intense red dot shining through the paper, turn counter off and scrub Brewster's window surface with acetone and a swab. Turn counter on and make sure the red dot is gone. If not, return the counter to the factory.

Viewing Calibration Voltage



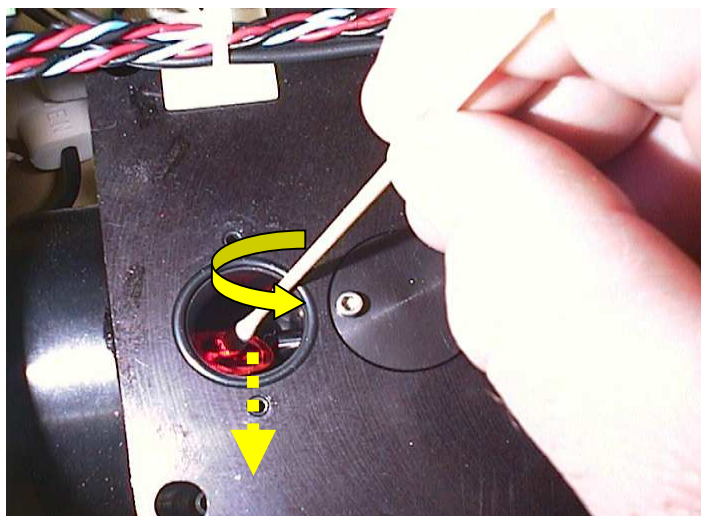
1. With power off, press and hold Count Mode key

2. Turn counter on (Rear panel)

3. Use up or down arrow keys to select Options display

4. Use left or right arrow keys to select Option 9

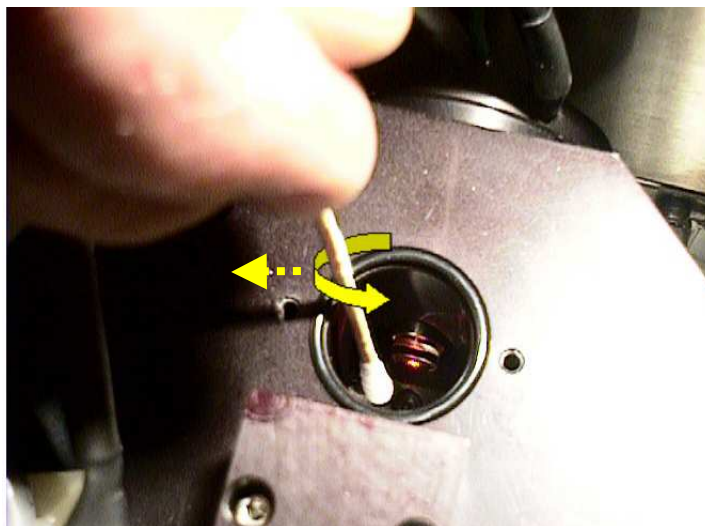
Brewster Window Cleaning Technique



1. Wet a cotton swab with a generous amount of reagent grade acetone and apply to window
2. Wet a fresh swab with a very slight amount of reagent grade acetone and make a single swipe across the window
3. Repeat using a clean swab each time until you achieve the optimum cal voltage.

HeNe Sensor Cleaning

Laser Mirror Cleaning Technique



1. Wet a cotton swab with a generous amount of reagent grade acetone and apply to mirror
2. Wet a fresh swab with a very slight amount of reagent grade acetone and make a single swipe across the mirror
3. Repeat using a clean swab each time until you achieve the optimum cal voltage.

Pump Maintenance

1.0 cfm Pump Filter Inspection and Replacement

If your particle counter is to be used in extremely dusty or dirty environments, clean or replace the intake air filter element periodically. Frequency of cleaning depends on the environment and running time of counter. Clean or replace element as follows:

1. Turn counter off and unplug. Remove cover.
2. Remove screw holding white air filter cover to pump body; pull air filter cover away from pump body in order to access filter.
3. Gently pull filter from filter cover and inspect for dirt or debris.
4. If filter is dirty, replace with a new filter or wash existing filter with detergent and rinse with clean water. Allow filter to air dry.
5. Insert new (or clean) filter in cover.
6. Check that "O" ring is in position on mounting flange of pump then place cover on pump noting orientation of cover. Attach air filter cover to pump then install cover on counter.

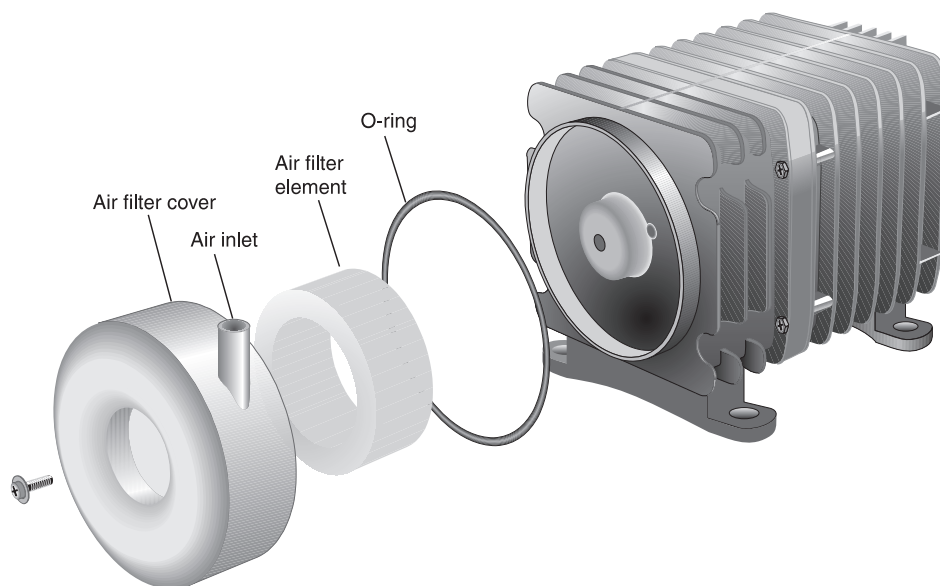


Figure 9. Inspecting Filter and "O" Ring in Air Vacuum Pump

Resetting Counter Options

This procedure clears the counter memory and restarts its micro-processor. Reset the counter as follows:

1. Set  to 0 (off).
off on
2. Press and hold  then turn power on.
3. When an audible beep sounds, release . The front panel displays should be as follows:
Manual : on, Cumulative : on,
dEF 2179 - 1F :shows default values have been reloaded;
gives EPROM part number and revision level (Note: your EEPROM
or revision level letter may not match the letter shown in this
manual).
4. Press  then reenter programmed functions.

Technical Data

CAUTION

All stored sample data will be cleared when the counter is reset. All functions you have programmed (time and date, count alarm limits, etc.) will also be cleared and reset to the factory default settings.

Note

If the results in step 2 do not occur, disconnect any external equipment (RH/temp probe, external printer if applicable) and repeat this procedure. Reconnect one piece of equipment and repeat procedure to determine if external equipment is the source of the problem.

Manual Backdating

Changes to this manual reflecting Revision D include: Inclusion of Clean Dry Air (CDA) purge system documentation, model number change from 2100B and 2200B to 2100C and 2200C, Inclusion of the current communication protocol and sensor cleaning procedures.

Several additions to both the A2100 and A2200 particle counters brought about the revision C level change: 1) a "count cycles average" feature automatically calculates and prints out results of the average of counts taken. Up to 999 count cycles can be programmed; 2) a clean, dry air purge circuit (CDA) now provides capability to apply dry purge air to the sensor optics to minimize vapor contamination in high vapor areas.

Changes to the original Model A2100 Operating Guide warranted its change to revision B level. They are:

Coverage to include the Model A2200 Particle Counter has been added to the operating guide. Operation of the two units is identical, thus basic operating procedures did not change. Changes to include this model were primarily to the Introduction and Specifications pages.

A "configurations" feature has also been added that when programmed into the particle counter and then selected, the period, hold time, count alarm limit, and number of cycles will be automatically performed during a run cycle. Up to 10 different configurations can be generated. Refer to "Generating a Configuration" for a step-by-step procedure. Particle counters with the "configurations" feature will display the EPROM number shown in "Resetting the Counter" when reset. Otherwise, **dEF 1145 - 1b** will be displayed for older units (Note: your revision level letter may not match the letter shown in this manual). All references to data storage in the rotating buffer changed from 500 to 400 samples, as firmware was changed to make room for storage of the "configuration" information.

Requirements to conform to electromagnetic compatibility (European customers) brought about changes to component layout. A layout prior to meeting "Declaration of Conformity" requirements appears on following pages.

Replacing the Carbon Filter

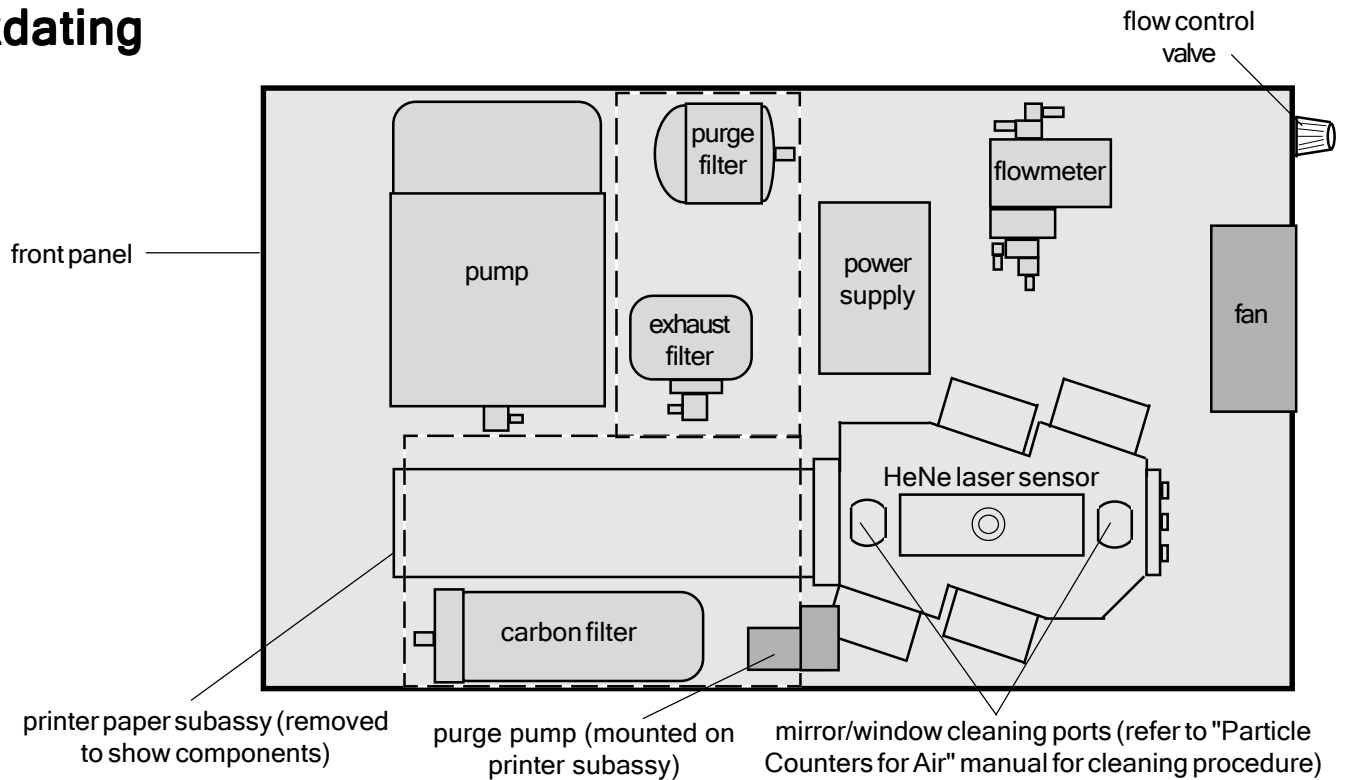
If the counter is used in an environment with high levels of inorganic vapors in the sample, the laser optics may become contaminated more readily than normal. This contamination may begin shortly after initial start-up, depending on concentration levels. The carbon filter installed inside your unit may need replacing more frequently if the following operating problems begin to occur:

- Laser optics become contaminated with vapors within hours after cleaning the optics; the CAL FAIL light will come on.
- A fog will coat the entire surface of the optics, especially the Brewster's window. The entire optics will shine bright red instead of a few bright red specks from particle contamination.

Replace the carbon filter as follows (refer to figure 8 for filter location):

1. Remove top cover.
2. Remove carbon filter from holding clamps.
3. Unscrew carbon filter from fitting; screw on new carbon filter.
4. Snap new carbon filter in place then reinstall top cover.

Manual Backdating



Layout of Major Components (Model A2100B prior to CE-Conformance)

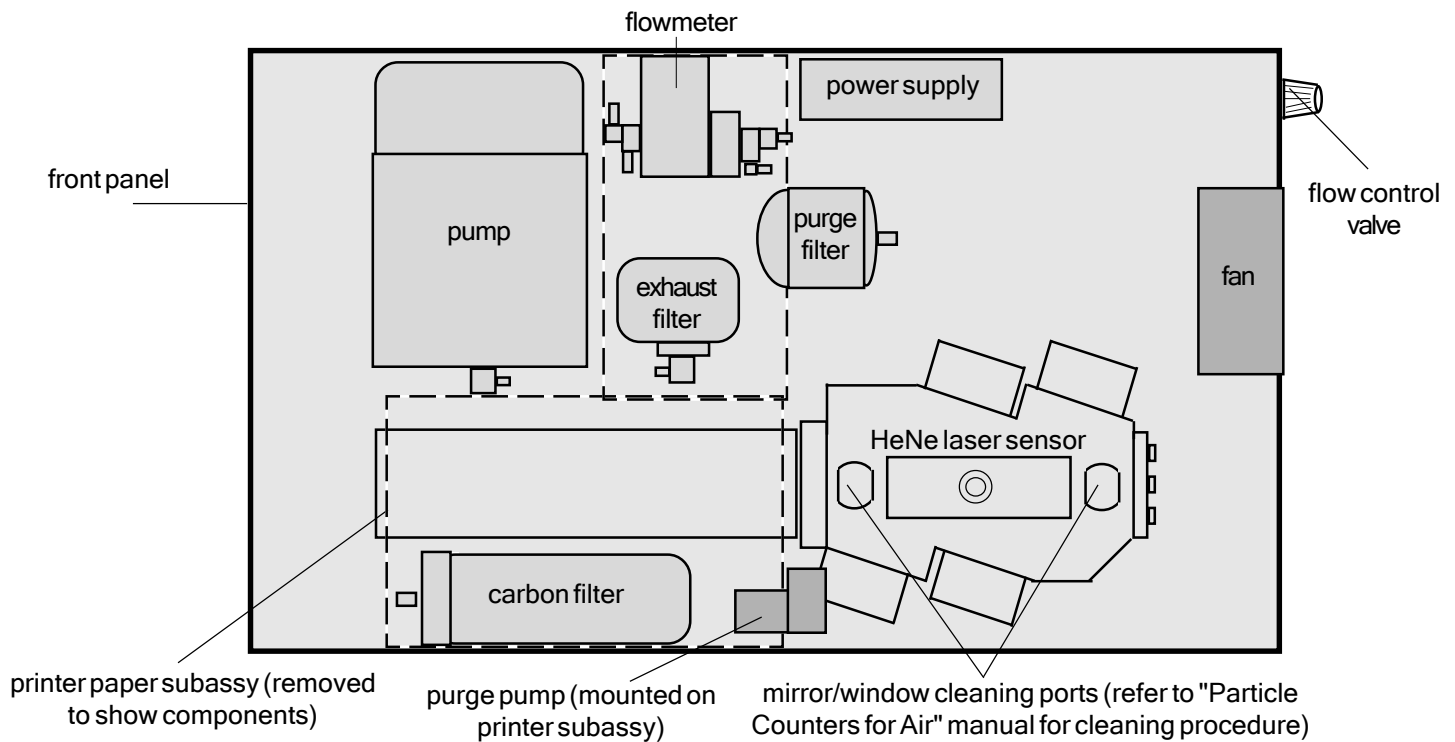


Figure 10. Layout of Major Components (Model A2100B with CE-Conformance)

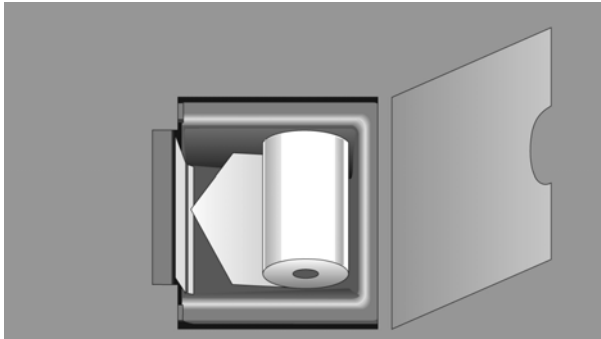
Manual Addendum for 2100, 2200, KM20

1. Added ability to select either Seiko printer or new Fujitsu printer from the Option screen "Pr" menu. Select "F" for Fujitsu or "S" for Seiko.
2. On the new Fujitsu printers there is a gray tab located on the right hand side of the printer. It is visible when the printer door is open. This tab enables the printer and must be in the down position or the printer won't function properly.

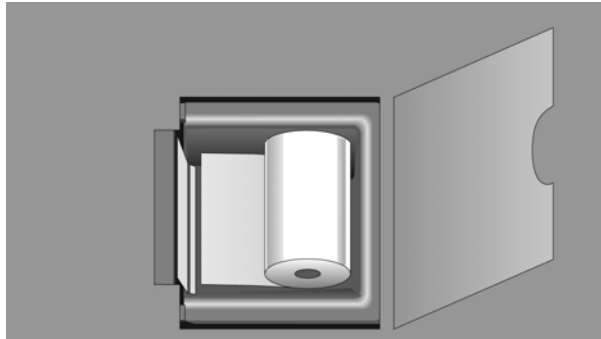
Manual Addendum

Loading Printer Paper

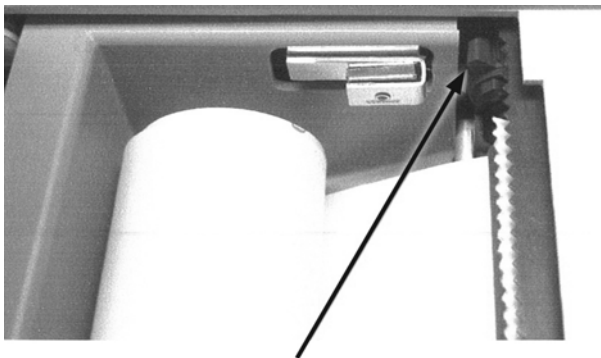
1. Open paper cover then remove any remaining paper from the last roll by snipping paper at the spool and pressing **Paper Feed** until the printer is empty.
2.
 - a. Seiko Printer Only: Trim end of new roll to a clean, arrow-shaped edge.
 - b. Fujitsu Printer Only: Trim end of new roll to a clean straight edge.
3. Place paper roll in paper tray so that paper feeds toward the print mechanism from bottom of the roll.
4. Insert tip of paper into slot in feed mechanism (above the bottom of the paper tray) so that when **Paper Feed** is pressed, paper will be pulled through the printer; close paper cover.



a. Seiko Printer



b. Fujitsu Printer



The Fujitsu printer has a paper tension release lever that must always be in the down position for proper operation.

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. <i>Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment for proper disposal.</i> Important document. Retain with product records.
	GERMAN Elektrogeräte, die mit diesem Symbol gekennzeichnet sind, dürfen in Europa nach dem 12. August 2005 nicht mehr über die öffentliche Abfallentsorgung entsorgt werden. In Übereinstimmung mit lokalen und nationalen europäischen Bestimmungen (EU-Richtlinie 2002/96/EC), müssen Benutzer von Elektrogeräten in Europa ab diesem Zeitpunkt alte bzw. zu verschrottende Geräte zur Entsorgung kostenfrei an den Hersteller zurückgeben. <i>Hinweis: Bitte wenden Sie sich an den Hersteller bzw. an den Händler, von dem Sie das Gerät bezogen haben, um Informationen zur Rückgabe des Altgeräts zur ordnungsgemäßen Entsorgung zu erhalten.</i> Wichtige Informationen. Bitte zusammen mit den Produktinformationen aufbewahren.
	FRENCH A partir du 12 août 2005, il est interdit de mettre au rebut le matériel électrique marqué de ce symbole par les voies habituelles de déchetterie publique. Conformément à la réglementation européenne (directive UE 2002/96/EC), les utilisateurs de matériel électrique en Europe doivent désormais retourner le matériel usé ou périmé au fabricant pour élimination, sans frais pour l'utilisateur. <i>Remarque : Veuillez vous adresser au fabricant ou au fournisseur du matériel pour les instructions de retour du matériel usé ou périmé aux fins d'élimination conforme.</i> Ce document est important. Conservez-le dans le dossier du produit.
	ITALIAN Le apparecchiature elettriche con apposto questo simbolo non possono essere smaltite nelle discariche pubbliche europee successivamente al 12 agosto 2005. In conformità alle normative europee locali e nazionali (Direttiva UE 2002/96/EC), gli utilizzatori europei di apparecchiature elettriche devono restituire al produttore le apparecchiature vecchie o a fine vita per lo smaltimento senza alcun costo a carico dell'utilizzatore. <i>Nota: Per conoscere le modalità di restituzione delle apparecchiature a fine vita da riciclare, contattare il produttore o il fornitore dell'apparecchiatura per un corretto smaltimento.</i> Documento importante. Conservare con la documentazione del prodotto.
	DANISH Elektriske apparater, der er mærket med dette symbol, må ikke bortskaffes i europæiske offentlige affaldssystemer efter den 12. august 2005. I henhold til europæiske lokale og nationale regler (EU-direktiv 2002/96/EF) skal europæiske brugere af elektriske apparater nu returnere gamle eller udtjente apparater til producenten med henblik på bortskaffelse uden omkostninger for brugeren. <i>Bemærk: I forbindelse med returnering til genbrug skal du kontakte producenten eller leverandøren af apparatet for at få instruktioner om, hvordan udtjente apparater bortskaffes korrekt.</i> Vigtigt dokument. Opbevares sammen med produktdokumenterne.

SWEDISH Elektronikutrustning som är märkt med denna symbol kanske inte kan lämnas in på europeiska offentliga sopsstationer efter 2005-08-12. Enligt europeiska lokala och nationella föreskrifter (EU-direktiv 2002/96/EC) måste användare av elektronikutrustning i Europa nu återlämna gammal eller uttrangerad utrustning till tillverkaren för kassering utan kostnad för användaren. *Obs! Om du ska återlämna utrustning för återvinning ska du kontakta tillverkaren av utrustningen eller återförsäljaren för att få anvisningar om hur du återlämnar kasserad utrustning för att den ska bortskaffas på rätt sätt.* Viktigt dokument. Spara tillsammans med dina produktbeskrivningar.

SPANISH A partir del 12 de agosto de 2005, los equipos eléctricos que lleven este símbolo no deberán ser desechados en los puntos limpios europeos. De conformidad con las normativas europeas locales y nacionales (Directiva de la UE 2002/96/EC), a partir de esa fecha, los usuarios europeos de equipos eléctricos deberán devolver los equipos usados u obsoletos al fabricante de los mismos para su reciclado, sin coste alguno para el usuario. *Nota: Sírvase ponerse en contacto con el fabricante o proveedor de los equipos para solicitar instrucciones sobre cómo devolver los equipos obsoletos para su correcto reciclado.* Documento importante. Guardar junto con los registros de los equipos.

DUTCH Elektrische apparatuur die is voorzien van dit symbool mag na 12 augustus 2005 niet meer worden afgevoerd naar Europese openbare afvalsystemen. Conform Europese lokale en nationale wetgeving (EU-richtlijn 2002/96/EC) dienen gebruikers van elektrische apparaten voortaan hun oude of afgedankte apparatuur kosteloos voor recycling of vernietiging naar de producent terug te brengen. *Nota: Als u apparatuur voor recycling terugbrengt, moet u contact opnemen met de producent of leverancier voor instructies voor het terugbrengen van de afgedankte apparatuur voor een juiste verwerking.* Belangrijk document. Bewaar het bij de productpapieren.

POLISH Sprzęt elektryczny oznaczony takim symbolem nie może byćlikwidowany w europejskich systemach utylizacji po dniu 12 sierpnia 2005. Zgodnie z europejskimi, lokalnymi i państwowymi przepisami prawa (Dyrektywa Unii Europejskiej 2002/96/EC), użytkownicy sprzętu elektrycznego w Europie muszą obecnie przekazywać Producentowi stary sprzęt lub sprzęt po okresie użytkowania do bezpłatnej utylizacji. *Uwaga: Aby przekazać sprzęt do recyklingu, należy zwrócić się do producenta lub dostawcy sprzętu w celu uzyskania instrukcji dotyczących procedur przekazywania do utylizacji sprzętu po okresie użytkowania.* Ważny dokument. Zachować z dokumentacją produktu.

PORTUGUESE Qualquer equipamento eléctrico que ostente este símbolo não poderá ser eliminado através dos sistemas públicos europeus de tratamento de resíduos sólidos a partir de 12 de Agosto de 2005. De acordo com as normas locais e europeias (Directiva Europeia 2002/96/EC), os utilizadores europeus de equipamentos eléctricos deverão agora devolver os seus equipamentos velhos ou em fim de vida ao produtor para o respectivo tratamento sem quaisquer custos para o utilizador. *Nota: No que toca à devolução para reciclagem, por favor, contacte o produtor ou fornecedor do equipamento para instruções de devolução de equipamento em fim de vida para a sua correcta eliminação.* Documento importante. Mantenha junto dos registos do produto.

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本手册只包含出口到中华人民共和国的必要信息。

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