AEROCET 531S
MANUAL

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AEROCET 531S Manual

Technical Support

This manual is structured by customer feedback to provide the required information for setup, operation, testing, maintaining, and troubleshooting your GT-521S. Should you still require support after consulting your printed documentation, we encourage you to contact one of our expert Technical Service representatives during normal business hours of 7:00 a.m. to 4:00 p.m. Pacific Standard Time, Monday through Friday. In addition, technical information and service bulletins are often posted on our website. Please contact us and obtain a Return Authorization (RA) number before sending any equipment back to the factory. This allows us to track and schedule service work and to expedite customer service. Please have your instrument serial number available when contacting the manufacturer.

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NOTICE

⚠ **CAUTION—Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.**

⚠ **WARNING—This product, when properly installed and operated, is considered a Class I laser product. Class I products are not considered to be hazardous.**

There are no user serviceable parts located inside the cover of this device.

Do not attempt to remove the cover of this product. Failure to comply with this instruction could cause accidental exposure to laser radiation.

Table of Contents

1. Introduction

The AEROCET 531S is a full–featured, battery operated, handheld particle counter or mass monitor.

In count mode, the unit will measure particle counts at four fixed sizes (0.5µm, 1.0µm, 5.0µm, and 10.0µm) when set to low sensitivity and five fixed sizes (0.3µm, 0.5µm, 1.0µm, 5.0µm, and 10.0µm) when set to high sensitivity (See Section 5.3.3 for more detail).

In mass mode the unit will measure PM1, PM2.5, PM4, PM7, PM10 and TSP mass concentration levels.

This instrument can store up to 6,000 sample events including data from the optional ambient temperature (AT) / relative humidity (RH) probe (PN G3120). Sample history events can be viewed on the LCD display, printed on the optional printer (PN G3115) and download to a computer.

2. Setup

The following sections cover unpacking, layout and performing a test run to verify operation.

2.1. Unpacking

Unpack and inspect the contents of the shipping container. Standard items (included) are shown in Figure 1 – Standard Accessories. Optional accessories are shown in **Figure 2 – Optional Accessories**. Contact the supplier if any items are missing. Any damages incurred to the equipment during shipping are the responsibility of the carrier. If any damage to the shipment is noticed before unpacking, a claim must be filed with the commercial carrier immediately. You should follow any special unpacking instructions provided by the carrier as you then carefully remove all items from the containers and inspect each component. It is recommended to document and photograph all damaged packages and items before, during, and after unpacking them. Contact Met One Instruments (see the Technical Support section at the beginning of this manual) to arrange for any replacement items needed.

ATTENTION:

The included USB drivers must be installed before connecting the AEROCET 531S USB port to your computer. If the supplied drivers are not installed first, Windows may install generic drivers that are not compatible with this product.

To install USB drivers:

Insert the Comet CD. The install program should run automatically and display the screen below. If an AutoPlay pop-up window appears, select "Run AutoRun.exe". Finally, select "USB Drivers" to start the install process. You may be prompted to re-boot your computer when the driver installation is complete.
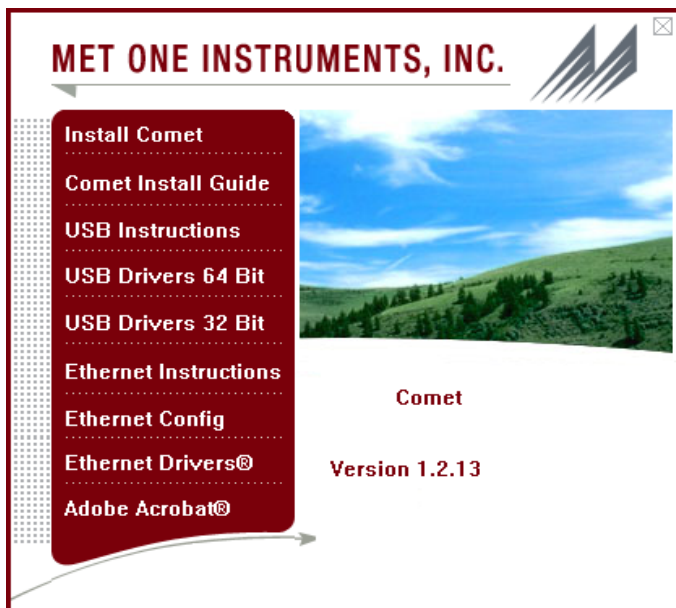
Note:
For proper communication, set the virtual COM port baud rate to 9600

32 Bit Operating Systems should install the 32 bit USB drivers.

64 Bit Operating Systems should install the 64 bit USB drivers.

AEROCET 531S Standard Equipment

AEROCET 531S
PN AEROCET-531S

Manual
PN AEROCET-531S-9800

Comet Software CD
PN 80248

Calibration Certificate
PN AEROCET-531S-9600

Battery Charger
PN 390031

Power Cord
PN 400113

ISO-Kinetic Probe
PN G3110

Zero Count Filter
PN G3111

Carrying Case
PN 8517

USB Cable
PN 500787

Figure 1 – Standard Accessories

Printer
PN G3115

Flow Meter
PN 9801

Serial Cable
PN 3228

T/RH Probe
PN G3120

Figure 2 – Optional Accessories

2.2. Layout

The following figure shows the layout of the AEROCET 531S and provides a description of each of the components.
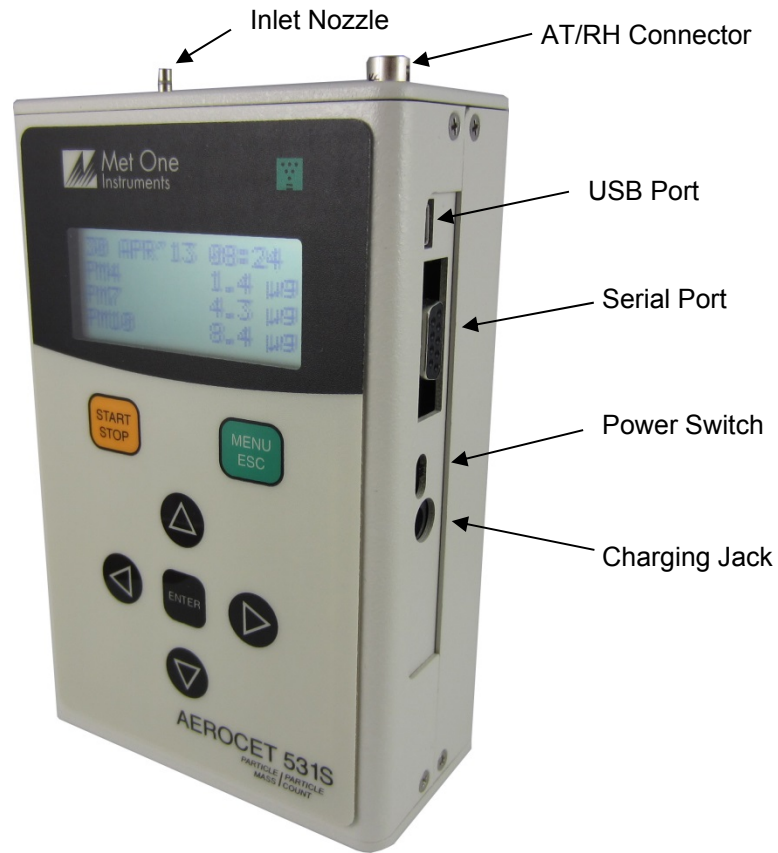
Figure 3 – AEROCET 531S Layout

Component	Description
Power Switch	Switch that turns the AEROCET 531S on or off. Slide up (towards inlet nozzle) to turn on and slide down to turn off.
Charging Jack	Input jack for the battery charger. This connection charges the internal battery pack and provides continuous operating power for the unit.
USB Port	For USB serial communication
Serial Port	For serial communication (RS-232 or RS-485).
AT/RH Connector	Mating connector for the optional external ambient temperature (AT) and relative humidity (RH) sensor. (PN G3120)
Inlet Nozzle	Ambient air inlet nozzle. Connect isokinetic probe to reduce turbulence in the air sample.

2.3.   Default Settings

The AEROCET 531S comes with the user settings configured as follows.

Parameter	Value
Sample Location	1
Sample Type	Mass (µg/m3)
Sensitivity	High
Sample Mode	Manual
Sample Hold Time	0 seconds
Volume (concentration)	CF (particles / ft^3)
Temperature Units	C
Baud Rate	9600
Serial Mode	RS-232

2.4.   Initial Operation

Before operating the AEROCET 531S for the first time, it is recommended that the unit be fully charged. Information regarding charging the battery is found in section 6 of this manual.

Complete the following steps to verify proper operation.
1. Slide the power switch up to turn on the power.
2. Observe the Startup screen for 3 seconds then the Operate screen (Section 4.4)
3. Press **START/STOP** key. The AEROCET 531S will sample for 1 minute and stop.
4. Observe the PM levels on the display
5. Use the up / down arrows to view other PM levels
6. The unit is ready for use

3.   User Interface

The AEROCET 531S user interface is composed of a 7 button keypad and a LCD display. The following table describes keypad functionality. Note some keys have more than one function.

Key	Description
START STOP	• Starts or stops a sample. • Starts the unit printing when in the PRINT DATA screen. • Recalls the selected data when in the RECALL DATA screen.
MENU ESC	• Loads the Menu screen when not in edit mode. • Loads the Operate screen when in the Menu screen. • Cancel edit mode and return the field to the original value.
ENTER	• Loads the screen associated with menu item. • Begins editing of the selected item. • Stops editing a field and saves the changed value.
△▽	• Scroll sizes (Operate screen) • Navigates up/down when not editing (Menu). • Modifies field when editing.
◁▷	• Navigates right / left • Move through history buffer (Operate screen)

4. Operation

The following sections cover the basic operation.

4.1. What's New and Different

You should be aware of key differences between the AEROCET 531S and 531.

Description	531S	531	Comments
Sensitivity	High / Low	0.5µm	0.3µm = High, 0.5µm = Low
Mass Concentration Units	µg/m^3	mg/m^3	
Mass Concentration Precision	0.1 µg /m^3	0.001 mg/m^3	Higher precision
Sample Time	1-minute	2-minutes	Faster sample time
Hold Time Units	Seconds	Minutes	Shorter hold times
Contrast Adjust	Software	Mechanical	No tools required. See Section 5.10
Battery	Lithium-ion	NiMh	Warning: See Section 6

4.2. About the Measurement

The AEROCET 531S counts and sizes particles in 8 different size ranges then uses a proprietary algorithm to convert count data to mass measurements (µg/m3). Fundamentally, the AEROCET 531S calculates a volume for each detected particle then assigns a standard density for the conversion.

The standard density value is augmented by the K-Factor setting to improve measurement accuracy. The AEROCET 531S provides a separate K-Factor setting for each measurement range (PM1, PM2.5, PM4, PM 7, PM10, and TSP). These K-Factors can be modified with Comet software or with the SK serial port command.

K-Factor values should be empirically derived via comparison with a reference unit. If a reference unit is unavailable, the recommended K-Factor setting is 3.0.

4.3. Power Up

AEROCET 531S power is controlled by a slide switch located on the right hand side of the unit. Move the power switch to the on position (towards the top of the case) to power up the unit.

The first screen shown on power up is the Startup screen (Figure 4). This screen displays the product type and company website for 2 seconds before loading the Operate Screen.

```
AEROCET 531S

WWW.METONE.COM
```
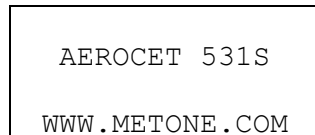
Figure 4 – Startup Screen

4.4. Operate Screen

The Operate screen can display the count or mass measurement. It is determined by the MEASURE setting. The Operate screen displays the date and time, sample status, current sample data and previous sample data. Figure 5 and Figure 6 shows the Mass and Count screens.

When sampling in mass mode, the size selection represents the upper threshold of your sample. For example, when you read the value for PM10 it contains all mass that is size PM10 and lower. Conversely, when sampling in count mode, the size selections represent the lower threshold of your sample. An example would be that the 1.0u size contains all particulate that are 1.0u and larger.

```
22 JAN'13 17:56
PM1         1.1 ug
PM2.5       3.3 ug
PM4         4.6 ug
PM7         5.5 ug
PM10        6.7 ug
TSP        10.6 ug
AT           21 C
RH           45 %
LOCATION   001
```

Figure 5 – Mass Operate Screen with AT and RH

```
22 JAN'13 17:56
0.5u    24,600 TC
1.0u     2,516 TC
5.0u        44 TC
10 u        21 TC
AT          21 C
RH          45 %
LOCATION   001
```

Figure 6 – Count Operate Screen with AT and RH

The top line of the Operate screen is reserved for the normal header (date and time) or status/alarm messages depending upon the machine status. The top line remains stationary while the other 3 lines scroll to display the full list. AT and RH data will precede the location number when the AT/RH probe is attached.

Ambient temperature (AT) can be displayed in units of Celsius (C) or Fahrenheit (F).

4.4.1. Sampling

The Operate screen displays current sample information when the unit is sampling (real time data). Concentration values (ug/m^3) are time dependent so these values may fluctuate early in the sample; however, after several seconds the measurement will stabilize. Figure 7 shows the Operate screen while sampling.

```
█                58
PM1          0.0 ug
PM2.5        0.0 ug
PM4          0.0 ug
```

Figure 7 – Operate Screen Sampling

4.4.2. Sample Status

The top line of the Operate screen displays the status of the AEROCET 531S while the unit is sampling. The following table shows the various status messages:

Status	Description
STARTING...	AEROCET 531S is starting the sample and is waiting for the count system to initialize.
HOLDING...	AEROCET 531S is in auto mode and is waiting for the hold time to finish.
STOPPING...	AEROCET 531S is stopping the sample and is waiting for the count system to stop.
██████10	AEROCET 531S is sampling. The progress bar moves from left to right as the sample progresses. The time remaining is displayed to the far right.

4.4.3. Sample History

Sample history (previous data) can be viewed on the Operate screen when the unit is stopped (not sampling). To view sample history, press the **ENTER** key or ◄ from the Operate screen. The unit will display the last sample event (newest record) and display "←" in the upper right corner of the display (see Figure 8) to indicate history data. Press ◄ or ► to move through sample history one record at a time (◄ displays older events, ► displays newer events). Press the **ENTER** key at any time to return to the Operate screen. Press **START** at any time to start a new sample.

```
03 DEC'12 11:23←
PM1          0.0 ug
PM2.5        0.0 ug
PM4          0.0 ug
```

Figure 8 – History Screen

4.4.4. Warning / Error Messages

The AEROCET 531S displays warning/error messages on the top line of the Operate screen. These messages alternate with the normal date/time header. The following table lists the warning/error messages:

Display Message	Description
LOW BATTERY!	Low battery warning. Less than 15 minutes of normal operation remaining.
SENSOR ERROR!	Particle sensor error.

4.5.   Sample Related Functions

The following sub-sections cover sample related functions.

4.5.1. Starting/Stopping

To start or stop a sample, press the **START/STOP** key. A sample event can be manually started or stopped from either the Operate screen or the menu.

4.5.2. Measurement Type

The measurement type determines if the instrument measure mass (ug/m^3) or particle concentration (particles/volume). Measurement type is discussed in section 5.2.

4.5.3. Sample Mode

The sample mode controls single sample or continuous sampling. The MANUAL setting configures the unit for a single sample. The AUTO setting configures the unit for continuous sampling. Sample modes are discussed in section 5.2.

4.5.4. Hold Time

The hold time is used when the sample mode is set to auto (continuous sample). The hold time represents the time from the completion of the last sample to the start of the next sample. The hold time is user settable from 0 – 999 seconds and is discussed in section 5.2.

4.5.5. Real-Time Serial Report

AEROCET 531S provides real-time report out the serial port at the end of each sample. The format of the report is controlled by the REPORT setting (Section 5.4). Section 7.3 covers the real-time output format.

4.5.6. Sample Timing

The following figures depict the sample timing sequence for both manual and auto sampling modes. The sample time is fixed at 60 seconds. Figure 9 shows the timing for manual sample mode. Figure 10 shows the timing for auto sample mode.

Figure 9 – Manual Mode Sample

Figure 10 – Auto Mode Sample

5.   Menu Selections

The menu is accessible by pressing the **MENU** key on the Operate screen. The table below shows the menu items. Press ▲ or ▼ to navigate to a menu item then press **ENTER** to display a screen where you can view or change item setting(s).

Menu Item	Description	Press ENTER to navigate to…
SAMPLE SETUP	View / change location number, auto / manual mode, sample type and hold time.	Sample Setup screen
SETTINGS	View / change volume, ºC / ºF and Sensitivity	Settings screen
SERIAL	View / change report type, baud rate and serial output mode.	Serial screen
RECALL DATA	Recall sample history based on time.	Recall Data screen
PRINT DATA	Print stored data based on a time range.	Print Data screen
MEMORY	View memory usage and clear memory.	Memory screen
SET FLOW	Adjust the sample flow rate	Flow screen
SET CLOCK	Set the date and time.	Set Clock screen
SET CONTRAST	Adjust the display contrast.	Set Contrast screen
ABOUT	Display firmware version and serial number.	About screen

5.1. Edit Menu Items

To change settings, press **MENU** to display the main menu, press ▲ or ▼ to navigate to the desired item and press **ENTER** to display the item view/edit screen.

To edit pick list items (e.g. SAMPLE SETUP MODE: AUTO or MANUAL), press ▲ or ▼ to navigate to the item. Press **ENTER** to select the item. Press ▲ or ▼ to change the setting. Press **ENTER** to save the setting or **ESC** to cancel and return to the main value.

To edit numeric values (e.g. LOCATION), press ▲ or ▼ to navigate to the item. Press **ENTER** to select the item. Press ▲ or ▼ to increment or decrement a value. Press ◄ or ► to select the next digit. Press **ENTER** to save the value or **ESC** to cancel and return to the main value.

5.2. Sample Setup Screen

Figure 11 shows the SAMPLE SETUP Screen. The 4 parameters are covered in the following sections.

```
LOCATION: 001
 MEASURE: COUNTS
    MODE: MANUAL
    HOLD: 000
```

Figure 11 – SAMPLE SETUP Screen

5.2.1. Location Number

The LOCATION number is used to assign a unique number to a location or area. This important field is included in sample data records (display, printer and csv output).

5.2.2. Measure

The MEASURE is either MASS or COUNTS concentration.

Selection	Description
MASS	When MASS is selected the unit will measure PM levels PM1, PM2.5, PM4, PM7, PM10 and TSP in ug/m³.
COUNTS	When COUNTS is selected the unit will measure fixed particles sizes. 0.5u, 1.0u, 5.0u, and 10.0u when using low sensitivity 0.3u, 0.5u, 1.0u, 5.0u, and 10.0u when using high sensitivity.

5.2.3. Sample Mode

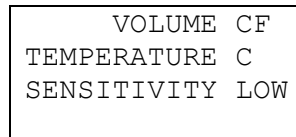The sample MODE controls single sample or continuous sampling as illustrated below.

Selection	Description
MANUAL	The MANUAL setting configures the unit for a single sample.
AUTO	The AUTO setting configures the unit for continuous sampling.

5.2.4. Hold Time

The HOLD time is the time between samples when sampling in AUTO mode (continuous). The HOLD time is user settable from 0 – 999 seconds. The pump will remain on during the hold period if the HOLD time is 60 seconds or less. The pump will stop after each sample, and start a few seconds before the next sample, if the HOLD time is greater than 60 seconds. HOLD times greater than 60 seconds will increase pump life.

5.3.   Settings Screen

Figure 12 shows the SETTINGS screen.

```
          VOLUME CF
    TEMPERATURE C
    SENSITIVITY LOW
```

Figure 12 – SETTINGS Screen

5.3.1. Volume

The AEROCET 531S supports total counts (TC), particles per liter (/L), particles per cubic foot (CF), and particles per cubic meter (M3). Particle count information updates while the unit is sampling. Concentration values (/L, CF, M3) are time dependent so these values may fluctuate early in the sample; however, after several seconds the measurement will stabilize.

5.3.2. Temperature

The AEROCET 531S displays ambient temperature (AT) in Celsius (C) or Fahrenheit (F).

5.3.3. Sensitivity

Select HIGH (0.3µm) or LOW (0.5µm) sensitivity. The default setting is HIGH. Use this setting for normal operation. Use the Low setting for high concentrations (for example, above 100µg) or when comparing measurements with older AEROCETS.

5.4. Serial Screen

Figure 12 shows the `SERIAL` screen.

```
REPORT: NONE
  BAUD: 38400
SERIAL: RS-232
```

Figure 13 – `SERIAL` Screen

5.4.1. Report

The `REPORT` setting determines the behavior of the AEROCET 531S serial output and report format. The settings are `NONE`, `CSV` or `PRINTER`. The following table lists the `REPORT` settings and describes their meanings. See section 7 for report examples.

Selection	Description
NONE	No report is sent to the serial port at the end of the sample event. Reports initiated from the user interface or a serial command will be in a CSV style report.
CSV	A CVS style report is sent to the serial port at the end of the sample event or when initiated from the user interface or a serial command.
PRINTER	A printer style report is sent to the serial port at the end of the sample event or when initiated from the user interface. Reports initiated by a serial command will be in a CSV style report.

5.4.2. Baud Rate

Use the `BAUD` rate selection to set the serial communications baud rate. AEROCET 531S communicates at baud rates from 300 – 38400.

5.4.3. Serial

The `SERIAL` setting controls the behavior of the AEROCET 531S serial output hardware. The modes are `RS-232` or `RS-485`. The following table lists the `SERIAL` settings and describes their meanings.

Serial Setting	Description
RS-232	Set to `RS-232` when communicating with RS-232/USB hardware.
RS-485	Set to `RS-485` when communicating with RS-485 hardware.

5.5. Recall Data Screen

Stored sample events can be viewed from the Operate screen but this requires navigating one record at a time to reach a desired record. The RECALL DATA screen provides a way to quickly navigate to a record based on time. Figure 14 shows the RECALL DATA screen.

```
RECALL DATA
 01 JAN'00 00:00
```

Figure 14 – Recall Data Screen

To recall data, enter the desired date/time string and select the **START/STOP** button. The unit will recall the data from the date/time entered (if an exact match is found) or the next most recent data available. The screen shown when the data is recalled is the Operate screen. The unit will display "←" on the upper right corner of the display to indicate history data.

5.6. Print Data Screen

Stored sample events can be printed through the serial port within a user selected range. To print selected data, select PRINT DATA from the menu. Figure 15 shows the PRINT DATA screen.

```
 MEASURE: COUNTS
LOCATION: 001
 01 JAN'00 00:00
 18 AUG'06 13:23
```

Figure 15 – Print Data Screen

Edit the location and time range to select which sample events to print. The following table describes settings.

Setting	Description
MEASURE	Print MASS or COUNTS data type events.
LOCATION	The location ID of the sample events to print. Setting location to 000 prints all locations. Settable from 0 – 999.
01 JAN'00 00:00	The date/time to begin printing sample events from.
18 AUG'06 13:23	The date/time to stop print samples at.

After the print settings have been selected, the `PRINTING STATUS` screen is displayed. Figure 16 shows the `PRINTING STATUS` screen as it would look when finished.

```
PRINTING STATUS
SCANNING...15
PRINTING...10
FINISHED!
```

Figure 16 – Printing Status Screen

Pressing the **ESC** button cancels the data printing and loads the menu. The format of the print is dependent upon the `SERIAL` setting (Section 5.4).

5.7. Memory Screen

The AEROCET 531S memory is composed of a single file which contains the data from sample events. Every time a sample is completed, the AEROCET 531S stores that data into the memory. The AEROCET 531S memory is circular, meaning when the memory is full, the unit will start overwriting the oldest saved samples with new samples. AEROCET 531S provides the user the ability to view the memory usage as well as clear the memory.

5.7.1. View Available Memory

`MEMORY` screen is used to view available memory or to clear the memory. The `MEMORY` screen is accessed by selecting `MEMORY` from the menu. Figure 17 shows the `MEMORY` screen.

```
FREE:      100%
SAMPLES: 6257
PRESS ENTER TO
   CLEAR MEMORY!
```

Figure 17 – Memory Screen

`FREE` shows the percent of space available for data storage. When 0% is displayed, memory is full and the oldest data will be overwritten by new data. `SAMPLES` shows the number of samples which can be store in memory before the memory is full. When 0% is displayed, memory is full and the oldest data will be overwritten by new data.

5.7.2. Clearing Memory

To clear memory, press the **ENTER** key while viewing the `MEMORY` screen. This will delete all the sample events in memory. A warning screen will be displayed to prevent accidental erasure.

5.8. Set Flow Screen

The AEROCET 531S has a factory calibrated flow rate of 0.1 CFM (2.83 LPM). Use the following procedure to adjust the flow rate when a periodic flow rate check (Section 8.3) indicates a flow rate error greater than +/- 5%.

```
    SET FLOW
  < > TO ADJUST
  ENTER TO SAVE
   ███████
```
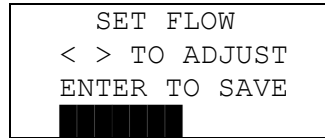
Figure 18 – Set Flow Screen

1. Connect a reference flow meter to the inlet fitting on the top of the unit (PN 9801).

2. Access the SET FLOW screen (Figure 18) by pressing **MENU** then select SET FLOW. The pump will start automatically when you enter the SET FLOW screen and stop when you leave the screen.

3. Press ◄ or ► to obtain a reading of 0.1 CFM (2.83 LPM) +/- 5% on the reference flow meter.

4. Press **ENTER** to save the setting or **ESC** to cancel the change.

5.9. Set Clock Screen

To set the date and time select SET CLOCK from the menu. Figure 19 shows the SET CLOCK screen and the following table describes the date / time formats.

```
  SET CLOCK
  DATE: 18 AUG'06
  TIME: 11:25:36
```
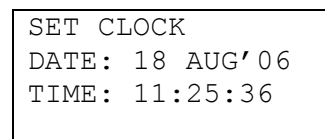
Figure 19 – Set Clock Screen

Date / Time Formats		
DATE	dd MMM'yy	dd – day, MMM' – month, yy – year
TIME	HH:mm:ss	HH – hours, mm – minutes, ss – seconds

5.10. Set Contrast Screen

Press ◄ or ► to improve display quality. Press **ENTER** to save the setting or **ESC** to cancel the change. Figure 20 shows the SET CONTRAST screen.
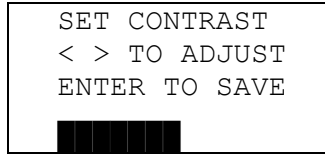
```
SET CONTRAST
< > TO ADJUST
ENTER TO SAVE

██████
```

Figure 20 – Set Contrast Screen

5.11. About Screen

Figure 21 shows the ABOUT screen. The ABOUT screen shows the firmware version and programmable logic versions on the second line. The third line shows the manufacturer's serial number. Press ▲ or ▼ to toggle between the two version numbers.

```
AEROCET-531S
99999-1 R9.9.9
   N12345
WWW.METONE.COM
```
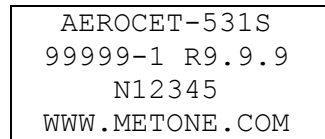
Figure 21 – About Screen

6.   Charging the Battery

> **Caution:**
> **The provided battery charger is designed to work safely with this device. Do not attempt to connect any other charger or adapter to this device. Doing so may result in equipment damage.**

To charge the battery, connect the battery charger to an AC power outlet and the DC barrel connector to the socket on the right side of the AEROCET 531S. The battery charger is universal and will work with power line voltages of 100 to 240 volts, 50 to 60 Hz. A discharged battery pack will take approximately 2.5 hours to fully charge.

When fully charged the battery inside the AEROCET 531S will power the unit for about 10 hours of continuous sampling. Under normal operation, the battery will power the unit for about 24 hours. For continuous operation, operate the unit with the battery charger attached. Charge the battery before storing the AEROCET 531S. Storing a discharged battery will degrade its performance.

7.   Serial Communications

AEROCET 531S provides serial communications via the USB and DB9 connectors located on the right hand side of the unit. The following sections discuss the various serial communications available with AEROCET 531S.

ATTENTION:

The included USB drivers must be installed before connecting the AEROCET 531S USB port to your computer. If the supplied drivers are not installed first, Windows may install generic drivers that are not compatible with this product.

To install USB drivers:

Insert the Comet CD. The install program should run automatically and display the screen below. If an AutoPlay pop-up window appears, select "Run AutoRun.exe". Finally, select "USB Drivers" to start the install process.

Users using a 32 bit system will want to run the USB 32bit drivers. Users using a 64 bit system will want to run the USB 64 bit drivers.
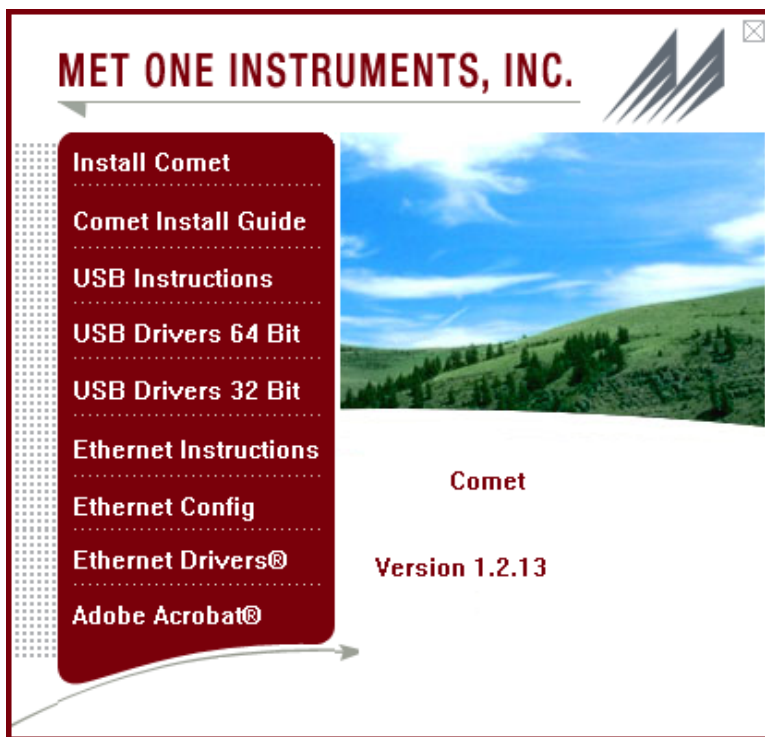
WARNING:
The optional RS-232 serial cable (PN 3228) is specially wired to function with the AEROCET 531S. The use of any other cable can cause damage!

7.1.   Serial Interface

The serial interface to the AEROCET 531S is a standard 9 pin (DB-9) connector. It is located on the right hand side of the instrument as shown below.

Communication with the AEROCET 531S requires a custom serial cable (PN 3228). Standard serial cables will not work and may cause damage to the instrument if connected. Serial Cable PN 3228 is only for RS-232 communication.

Below is a description of the DB-9 connector:

Pin	Function	Communication Type
1	Not Used	
2	TX	RS-232
3	RX	RS-232
4	Not Used	
5	Not Used	RS-232 & RS-484
6	Not Used	DAC
7	Analog Out 2	DAC
8	A+	RS-484
9	B-	RS-484
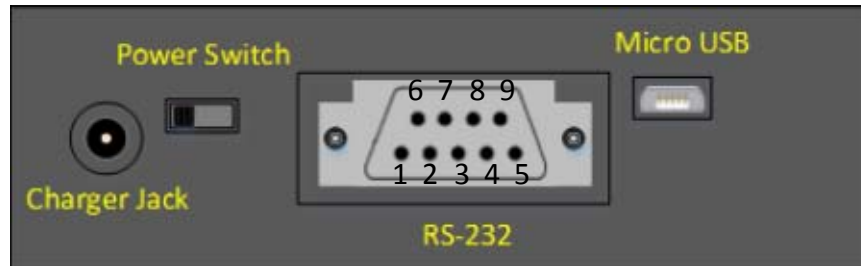
7.2. Commands

AEROCET 531S provides serial commands for accessing stored data and settings. All commands are terminated by a carriage return. Also, these commands are not case sensitive. The following table lists the available commands. These commands are available via USB, RS-232 and RS-485 hardware interfaces. The settings (baud rate, parity and stop bits) must match the computer setting for proper communication regardless of the hardware interface type (USB, RS-232 or RS-485).

The following table lists the available commands:

Command	Description
Settings (must match computer settings): • Baud Rate = Section 5.3, `SETTINGS` screen • Parity = None • Stop Bits = 1	
?,H	Reports the help menu
1	Reports the units settings information
2	Reports all available records from the data file
3	Reports all records since last '2' or '3' command.
4	Reports the last records base on a number of last records or a time stamp.
C	Clear the data file.
D	Set Date with format `yyyy-MM-dd`
T	Set Time with format `HH:mm:ss`
E	End a sample
S	Start a sample
CU	Set the Count Units (`0-CF, 1-/L, 2-TC, 3-M3`)
ID	Set the Location ID from 1 to 999.
MM	Set the measurement concentration (`0-COUNTS, 1-MASS`)
RV	Report the software revision.
SH	Set the Hold Time in seconds
SK pm k	Set PM K-Factors (`pm: 1-PM1, 2-PM2.5, 3-PM4, 4-PM7, 5-PM10, 6-TSP`) (`k: 0.1 to 20.0`) Examples: • `SK1 2.0` changes PM1 K factor to 2.0 • `SK2 1.9` changes PM2.5 K factor to 1.9
SM	Set the Sample Mode (`0-MANUAL, 1-AUTO`)
SR	Set the Report style (`0-NONE, 1-CSV, 2-PRINTER`)
TU	Temperature Units (`0-C, 1-F`)
SS	Report the serial number
RZ	Returns Channel Size information.
DT	Set the Date/Time without user interaction

OP	Operational Status (`S-Stopped, R-Running, H-Holding`)

7.3. Real Time Output

The real time output occurs when the unit finishes a sample. The output format is either off (`NONE`), a comma separated value (`CSV`) or a printer (`PRINTER`) depending on the `REPORT` style settings (see section 5.4.1)

7.4. Comma Separated Value (CSV)

The CSV report will be generated when the REPORT setting is set to CSV. The CSV format for MASS and COUNTS is determined by the MEASURE setting. Both formats are fixed field length.

7.4.1. Counts Format

```
Count Data Report
2013-01-17 16:56:26
Serial Number, N12345


Time,0.3(M3),0.5(M3),1.0(M3),5.0(M3),10 (M3),AT(C),RH(%),Location,Seconds,Status
2013-01-17 15:49:06,04620275,03560226,00399152,00013069,00006358,+020,027,001,060,000
```

CSV Fields			
Field	**Parameter**	**Example Value**	**Notes**
1	Date and Time	2013-01-17 15:49:06	
2	Channel 1 Size 0.3 (TC, /L, CF, M3)	04620275	Note 2
3	Channel 2 Size 0.5 (TC, /L, CF, M3)	00557753	Note 2
4	Channel 3 Size 1.0 (TC, /L, CF, M3)	00074178	Note 2
5	Channel 4 Size 5.0 (TC, /L, CF, M3)	00007417	Note 2
6	Channel 5 Size 10 (TC, /L, CF, M3)	00005298	Note 2
7	AT (C, F)	+020	Note 2 & 3
8	RH (%)	027	Note 3
9	Location	001	
10	Seconds	060	Note 4
11	Status	000	Note 5

Status Bits		
Bit	**Value**	**Condition**
	0	OK (no alarms or errors)
0	1	Not used
1	2	Not used
2	4	Not used
3	8	Not used
4	16	Low battery
5	32	Sensor error

Notes (for table above)
1. CSV header included for multiple record transfers like All Data (2) or New Data (3).
2. Units determined by product setting. 0.3 will be null (,,) if set to low sensitivity.
3. Temperature and RH will be null (,,) if Temp/RH probe is not attached
4. The sample time is fixed at 60 seconds.
5. Status bits combinations are possible. See the Status Bits table.

7.4.2. Mass Format

```
Mass Data Report
2013-01-22 11:59:52
Serial Number, N12345

Time,PM1(ug/m3),PM2.5(ug/m3),PM4(ug/m3),PM7(ug/m3),PM10(ug/m3),TSP(ug/m3),AT(C),RH(%),Location,Seconds,Status
2013-01-22 11:23:27,001.1,003.8,005.2,005.9,006.2,008.2,+020,026,001,060,000
```

CSV Fields			
Field	**Parameter**	**Example Value**	**Notes**
1	Date and Time	2013-01-22 11:23:27	
2	PM1 (ug/m3)	001.1	
3	PM2.5 (ug/m3)	003.8	
4	PM4 (ug/m3)	005.2	
5	PM7 (ug/m3)	005.9	
5	PM10 (ug/m3)	006.2	
6	TSP (ug/m3)	008.2	
7	AT (C, F)	+021	Note 2 & 3
8	RH (%)	40	Note 3
9	Location	001	
10	Seconds	60	Note 4
11	Status	000	Note 5

Status Bits		
Bit	**Value**	**Condition**
	0	OK (no alarms or errors)
0	1	Not used
1	2	Not used
2	4	Not used
3	8	Not used
4	16	Low battery
5	32	Sensor error

Notes (for table above)
1. CSV header included for multiple record transfers like All Data (2) or New Data (3).
2. Units determined by product setting.
3. Temperature and RH will be null (,,) if Temp/RH probe is not attached
4. The sample time is fixed at 60 seconds.
5. Status bits combinations are possible. See the Status Bits table. For example, 48 (00110000B) = Low battery and Sensor error.

7.5. Printer Format

The printer report will be generated when the REPORT setting is set to PRINTER. The printer format for MASS and COUNTS is based on the sample MEASURE setting. AT and RH will be displayed when the AT/RH probe is attached.

7.5.1. Counts Format

```
2013-01-22 11:40:51
Location    001
0.3u  4,620,275 M3
0.5u  3,560,226 M3
1.0u    888,731 M3
5.0u     15,542 M3
10 u      7,417 M3
AT           20 C
RH           26 %
```

7.5.2. Mass Format

```
2013-01-22 11:40:51
Location 001
PM1       1.1 ug/m3
PM2.5     3.3 ug/m3
PM4       4.6 ug/m3
PM7       5.5 ug/m3
PM10      6.7 ug/m3
TSP      10.6 ug/m3
AT         20 C
RH         26 %
```

8.   Maintenance

Due to the nature of the instrument, there are no customer serviceable components in the AEROCET 531S. The case of the AEROCET 531S should never be removed or opened for any reason. ***Opening or removing the case of the AEROCET 531S voids the warranty and may result in exposure to laser radiation, which can cause eye injury.***

8.1.   Service Schedule

Although there are no customer serviceable components in the AEROCET 531S, there are service items which ensure the proper operation of the instrument. Table 1 shows the service schedule for the AEROCET 531S.

Time Period	Item	Manual Section
Weekly	Zero Count Test	8.2
Monthly	Flow Rate Test	8.3
Yearly	Annual Calibration	8.4

Table 1 Service Schedule

8.2. Zero Count Test

Air leaks or debris in the particle sensor can cause false counts which may result in significant count errors when sampling clean environments. Perform the following zero count test weekly to ensure proper operation:

1. Attach zero count filter to the inlet nozzle (PN G3111).
2. Configure the unit as follows: Sample Mode = MANUAL, Volume = Total Count (TC), Measure = COUNTS.
3. Start and complete a sample.
4. The smallest particle size should have a count <= 1.
5. Run this test multiple times to flush out particles in the air stream if the goal is not met.

8.3. Flow Rate Test

The flow rate test verifies the sample flow rate is within tolerance. The reference flow meter must be non-loading because the vacuum pump can be loaded down by external restrictions. Met One Instruments sells a suitable flow meter (PN 9801). The flow rate test follows:

1. Connect a ±3% reference flow meter to the sample inlet nozzle.
2. Configure the unit as follows: Mode = AUTO.
3. Start sampling.
4. The flow meter reading after ~3 minutes should be 0.1 CFM (2.831 LPM) ±5%.
5. Adjust the flow rate if the error is > ±5% (see section 5.8).

8.4. Annual Calibration

The AEROCET 531S should be sent back to Met One Instruments yearly for calibration and inspection. The annual calibration cannot be performed by the customer because this calibration requires specialized equipment and a skilled technician. Met One Instruments maintains a calibration facility for calibrating particle counters according to industry accepted methods such as ISO, JIS and NIST. The annual calibration also includes inspection and preventative maintenance to improve product reliability.

8.5. Flash Upgrade

AEROCET 531S is firmware upgradeable via the serial connection using a Met One Instruments flash burn program. Binary files and the flash program must be provided by Met One Instruments.

9.   Troubleshooting

The following section covers some common failure symptoms, causes and solutions. It is important to note that there are no customer serviceable components in this product. The AEROCET 531S case should never be removed or opened for any reason. **Opening or removing the case will void the warranty and may result in exposure to laser radiation, which can cause eye injury.**

Symptom	Possible Cause	Solution
Display does not turn on	• Low Battery • Defective Battery	• Charge battery • Send to service center
Pump does not turn on when a sample is started	• Low Battery • Defective pump	• Charge battery • Send to service center
Keypad does not work	• Loose connector • Internal hardware failure	• Send to service center
Sample result is lower than normal	• Flow rate is low • Optics may be contaminated	• Perform flow rate test • Send to service center
Sample result is higher than normal	• Flow rate is high • Air leak in unit • Optics may be contaminated	• Perform flow rate test • Send to service center
Battery does not hold a charge	• Defective or worn out battery • Defective charger	• Send to service center
Low battery	• Low Battery	• Charge battery – the unit can sample while running on the charger

10. Specifications

Performance

Particle Counter Sizes	0.3µm, 0.5µm, 1.0µm, 5.0µm, 10µm
Mass Ranges	PM1, PM2.5, PM4, PM7, PM10, TSP
Concentration Range	0 – 3,000,000 particles per cubic foot (105,900 particles/L)
Accuracy	± 10% to calibration aerosol
Sensitivity	High = 0.3 µm, Low = 0.5 µm
Flow Rate	0.1 cfm (2.83 lpm)
Sample Time	60 seconds
Hold Time	Adjustable: 0 to 999 seconds

Electrical

Light Source	Laser Diode, 90mW, 780 nm
Battery	7.4V Li-ion battery pack.
Battery Life	24 hours Intermittent operation, 10 hours continuous operation
Battery Charge Time	Fully changed in 2.5 hours
AC Adapter/Charger	Li-ion battery charger, 100 – 240 VAC, 50/60Hz, 0.2A
Communications	USB, RS-232 or RS-485

Interface

Display	16 character x 4 line LCD
Keyboard	7 key membrane type

Physical

Height	6.25" (15.9 cm)
Width	4.00" (10.2 cm)
Depth	2.12" (5.4 cm)
Weight	2.00 lbs (0.91 kg)

Environmental

Operating Temperature	0º C to +50º C
Storage Temperature	-20º C to +60º C

Accessories

Supplied	Operation Manual	
	USB Cable	
	Comet Software	
	AC Adapter / Battery Charger	
	Iso-kinetic Sample Probe	
	Carrying Case	
	Zero Particulate Filter	(PN G3111)
Optional	RH & Temperature Probe	(PN G3120)
	Flow Meter	(PN 9801)
	Portable Printer	(PN G3115)
	Custom Serial Cable	(PN 3228)

11.   Warranty / Service

Warranty

Products manufactured by Met One Instruments, Inc. are warranted against defects and workmanship for a period of one (1) year from the ship date.

Any product found to be defective during the warranty period will, at the option of Met One Instruments, Inc., be replaced or repaired. In no case shall the liability of Met One Instruments, Inc. exceed the purchase price of the product.

This warranty may not apply to products that have been subject to misuse, negligence, accident, acts of nature, or that have been altered or modified other than by Met One Instruments, Inc. Consumable items such as filters, bearings pumps and batteries are not covered under this warranty.

Other than the warranty set forth herein, there shall be no other warranties, whether expressed, implied or statutory, including warranties of fitness of merchantability.

Service

Any product being returned to Met One Instruments, Inc. for service, repair or calibration, including items sent for warranty repair, must be assigned a return authorization (RA) number. Please call (541) 471-7111 or send an email to service@metone.com requesting an RA number and shipping instructions.

All returns must be shipped to the factory, freight pre-paid. Met One Instruments, Inc. will pay the shipping charge to return the product to the end user after repair or replacement of an item covered by warranty.

All instruments sent to the factory for repair or calibration must be free of contamination resulting from sampling chemicals, biological matter, or radioactive materials. Any items received with such contamination will be disposed and the customer will be billed a disposal fee.

Replacement parts or service/repair work performed by Met One Instruments, Inc. are warranted against defects in material and workmanship for a period of ninety (90) days from the date of shipment, under the same conditions as stated above.

REV 2013