
**Particle Analysis and Display
System (PADS):
SPP-200 Module
for use with the
PCASP-100X**

Operator Manual

DOC-0198 A-2; PADS 2.5.6

SPP-200 Module 2.6.5



5710 Flatiron Parkway, Unit B
Boulder, CO 80301 USA

Copyright © 2009 Droplet Measurement Technologies, Inc.

**5710 FLATIRON PARKWAY, SUITE B
BOULDER, COLORADO, USA 80301
TEL: +1 (303) 440-5576
FAX: +1 (303) 440-1965
WWW.DROPLETMEASUREMENT.COM**

All rights reserved. DMT licenses PADS software only upon the condition that you accept all of the terms contained in this license agreement. Each PADS license you purchase allows you to acquire data on one computer only. Data can be viewed in playback mode on an unlimited number of computers.

This software is provided by DMT “as is” and any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. Under no circumstances and under no legal theory, whether in tort, contract, or otherwise, shall DMT or its developers be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including damages for work stoppage; computer failure or malfunction; loss of goodwill; loss of use, data or profits; or for any and all other damages and losses).

Some states do not allow the limitation or exclusion of implied warranties and you may be entitled to additional rights in those states.

Trademark Information

All Droplet Measurement Technologies, Inc. product names and the Droplet Measurement Technologies, Inc. logo are trademarks of Droplet Measurement Technologies, Inc.

All other brands and product names are trademarks or registered trademarks of their respective owners.

CONTENTS

1.0 Introduction	4
2.0 Configuration	4
Configuring the Instrument.....	4
Configuring the Instrument Display	8
3.0 The SPP-200 Window.....	10
Channel Tabs	10
Chart Displays	11
Histogram Data Window	13
Appendix A: SPP-200 Channels.....	15

List of Figures

Figure 1: SPP-200 Configuration Editor Window.....	5
Figure 2: SPP-200 Display Editor Window	8
Figure 3: SPP-200 Particle Size Display Options	9
Figure 4: SPP-200 Data Window.....	11
Figure 5: SPP-200 Histogram Display with Scaling Buttons	14
Figure 6: SPP-200 Selectable Time-Series Charts	12

1.0 Introduction

The Particle Analysis and Display System (PADS) is a software package that interfaces with all the instruments produced by Droplet Measurement Technologies (DMT) and other leading instruments used in the atmospheric sciences. This manual describes the PADS module for the SPP-200.

Note: The PADS SPP-200 tab displays data acquired by the Passive Cavity Aerosol Spectrometer Probe 100X (PCASP-100X). The PCASP-100X has historically been built with SPP-200 electronics, so PADS uses SPP-200 to refer to PCASP-100X systems. In order to maintain consistency, this manual uses the term “SPP-200” to refer to the PADS instrument tab features. Future versions of PADS will rename the SPP-200 tab to PCASP-100X.

For an explanation of the basic PADS setup and instructions on how to acquire data using PADS, consult the *PADS Operator Manual*. Definitions and calculations used in the SPP-200 module are also described in the *PADS Operator Manual*.

2.0 Configuration

Using PADS, you can configure both the software for the instrument and the instrument’s data display in PADS. The following two sections explain how to do this.

Configuring the Instrument

Your instrument and data system should arrive preconfigured from DMT. In some cases, however, you may want to change the software configuration for the instrument. To do this, follow the steps below. *Note: Droplet Measurement Technologies STRONGLY recommends that customers contact our office prior to changing any of the parameters in the instrument configuration. Improper changes can result in communication failure and/or changes in PADS computation algorithms, which can compromise data validity.*

1. Click on the “SPP-200” tab.
2. From the **Configure** menu, select **Configure Instrument**. You will see the following window.

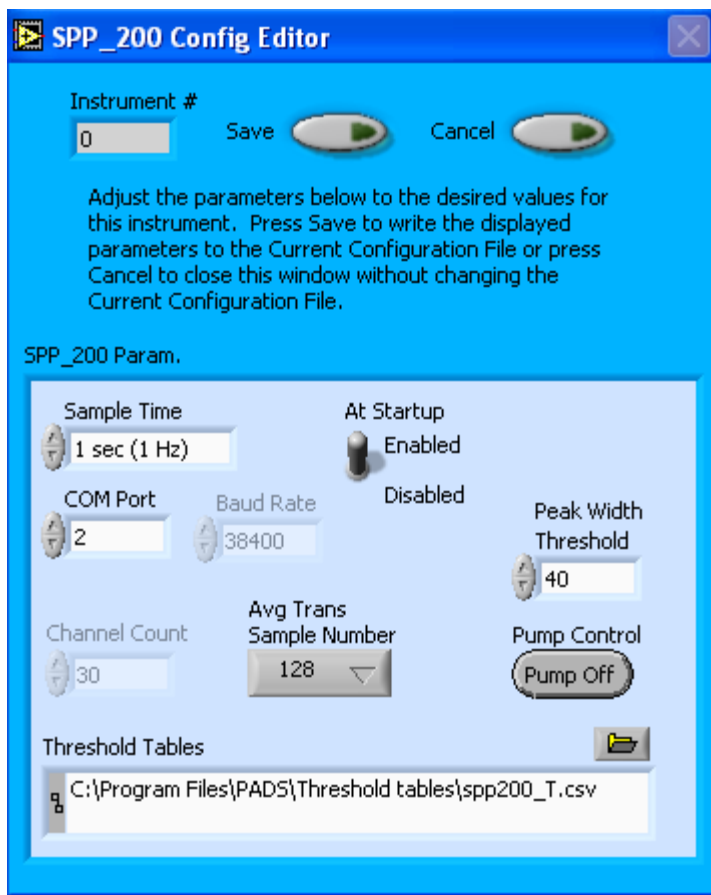


Figure 1: SPP-200 Configuration Editor Window

3. Now you can configure the instrument parameters to your desired specifications. You will find a list of the parameters you may want to reconfigure in the two sections below, “Occasionally Reconfigured Instrument Parameters” and “Rarely Reconfigured Instrument Parameters.” If at any time you would like to revert to the previously saved values for the instrument parameters, press **Cancel** to exit the window without saving changes.
4. When you are done configuring the instrument parameters, press **Save** at the top of the Config editor window. (If you would instead like to revert to the previously saved values, click **Cancel**.) Then press the green **Reset Program** button for the new configuration to take effect. Note that pressing the **Reset Program** button will clear any data currently being displayed.

Occasionally Reconfigured Instrument Parameters

Sample Time: This parameter shows the time interval you'd like between samples. You can have the probe sample at intervals of .1, .2, .5, 1, 2, 5, or 10 seconds (10, 5, 2, 1, 0.5 or 0.1 Hz). A value of one is recommended, as described in the warning below. Note that if you

increase the sample time, you will still collect data for the same number of particles. This is because the probe collects data continuously and relays cumulative data at each sampling interval. For example, say you have the sample time set to .5 seconds. You might see four particles of size 2 μm during the first sample, and five particles of this size during the second sample. If you had set your sample time to one second instead of .5 seconds, you would instead get one sample that showed nine particles of size 2 μm .

WARNING: One hertz sampling is currently recommended, as choosing other values will invalidate time-dependent PADS calculations like number concentration, volume concentration, and LWC on optical probes. (ED and MVD are not affected.) This is a known bug in PADS that will be fixed in an upcoming version of the program.

At Startup Enabled / Disabled: If you want the instrument to acquire data when PADS begins sampling, make sure this parameter is in the “Enabled” mode. In some cases, such as if the instrument is inoperative, you may want to use this control to disable the probe. Disabling the instrument allows data to transmit from other instruments without interference.

COM Port: This is the serial communications port that the instrument uses to connect with the computer. This number should match the computer hardware configuration for the particular computer you are using. If you are not using multiple computers, this number should not be changed.

Pump Control: This control specifies whether the instrument’s pump should turn on when PADS starts acquiring data. The default setting is on. In some cases, such as if the instrument is being calibrated, the technician may want to use this control to turn off the pump.

You will notice that there are other parameters listed on the **SPP-200 Config Editor** window. You should not need to change these, and changing them may compromise your data. If you are curious about these parameters or think you do need to modify them, see the section titled “Rarely Reconfigured Instrument Parameters” below or consult with a DMT technical representative.

Rarely Reconfigured Instrument Parameters

The instrument configuration editor displays several parameters that you will rarely need to modify. The following is a list of these parameters and an explanation of what they do.

Instrument #: This lists the number corresponding to the instrument you are viewing. If your instrument has been assigned instrument number one, you will see “1” in this field. You should not need to modify the instrument number, and in fact you are unable to do so from within PADS.

Baud Rate: The Baud rate for the probe is defined at manufacture, and you should not need to change it. PADS lists this parameter because some probes can run at different baud rates. So if you reconfigure your hardware, the baud rate may change. In general, a higher baud rate means that the probe can transmit data more quickly to the computer. However, higher baud rates may not work with some computers and can result in unreliable data transmission.

Channel Count: This number indicates how many sizing bins the instrument uses to categorize particles. This number has been grayed out because it is preconfigured for your instrument and should not change.

Threshold Tables: This field lists the path to the threshold table files. These files are used in sizing particles, and the instrument has two threshold tables associated with it. (PADS only lists one of these tables in the Threshold Tables field, but both are in the directory.) `SPP200_t.csv` tells PADS the correct sizing bin for a particle given the peak digital value converted from the light scattered by the particle. `SPP200_p.csv` tells PADS the upper size boundary in microns for each sizing bin. Note that the Thresholds Tables field should always be set to the `SPP200_t.csv` file, and PADS finds the `SPP200_p.csv` file automatically using the same path.

While threshold tables have multiple rows, PADS only uses one row from each table. This data row has been chosen to work with your specific SPP-200.

Peak Width Threshold: This control sets the minimum length of time that a particle must be illuminated in order for it to be sized by the instrument. Peak Width Threshold is measured in clock ticks, and a value of 20 is recommended. (20 clock ticks = 1 μ s.) The Peak Width Threshold parameter helps insure data accuracy by rejecting signals that most likely have been generated by electronic noise or particles that pass through the edge of the beam and should not be counted.

Avg Transit Sample Number This control allows you to specify the number of particle readings that are used to calculate Avg_Transit, which is the average time it takes for particles to pass through the beam.

After making changes in the instrument configuration window, you will need to press the **Save** button and then click the green **Reset Program** to activate these changes. Clicking **Reset Program** will clear any data PADS is currently displaying.

Configuring the Instrument Display

To configure the instrument display, click on the instrument tab if you have not already done so. Then select **Configure** from the menu bar and click on **Configure Display**. This will bring up the following window.

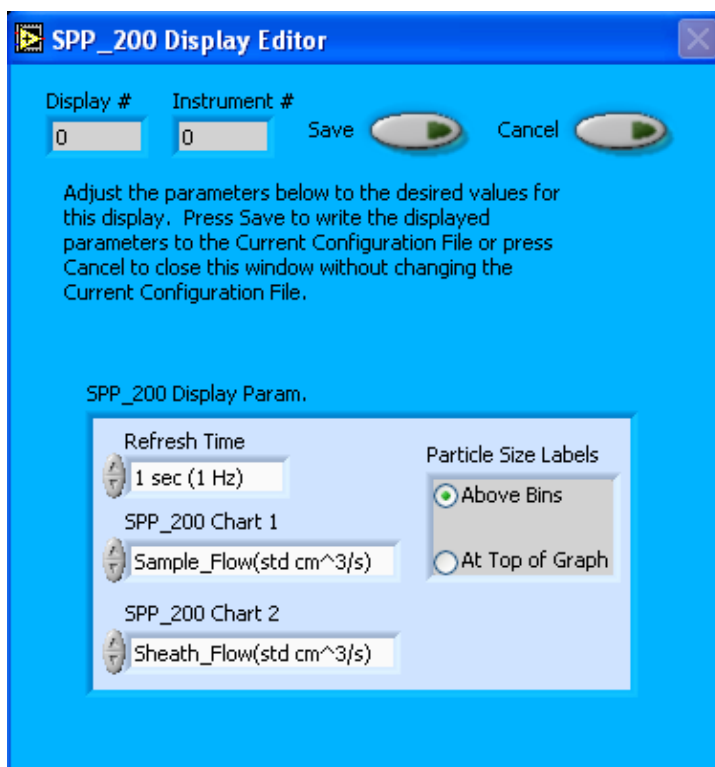


Figure 2: SPP-200 Display Editor Window

You do not need to modify the **Display #** or **Instrument #**. Changing the **Refresh Time** allows you to set the time intervals for data display during acquisition mode; you can choose any time that is equal to or greater than the sample time. (Choosing a time less than the sample time is not useful, since the same data will be displayed multiple times.)

The SPP-200 Chart 1 and Chart 2 controls allow you to configure the channels on the instrument's two selectable graphs, which are located in the "Selectable Charts" tab. For information on specific channels and their definitions, consult *Appendix A: SPP-200 Channels* and the *PADS Operator Manual's Appendix A: Definitions*.

In the SPP-200 Display Parameter box, you can click on the arrow buttons to scroll between available options for the channels. You can also click on the white fields to bring up a list of all the available options, from which you can then choose the channel you want.

The gray box on the right allows you to specify whether particle size labels should appear above each bin or in a straight row at the top of the graph (see Figure 3). The `SPP200_p.csv` table gives upper size limits for each bin. The lower bin boundary for each bin equals the upper boundary of the previous bin, except for bin 1's lower boundary, which is $0.09\ \mu\text{m}$.

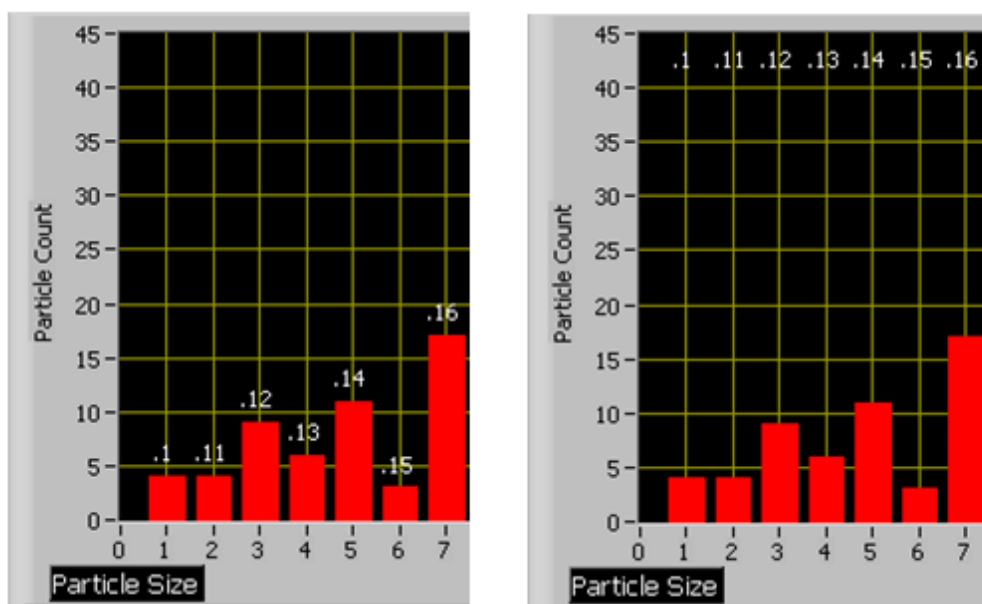


Figure 3: SPP-200 Particle Size Display Options: Labels above Bins (Left Image) or above Graph (Right Image)

When you are done setting parameters in the **SPP-200 Display Editor**, click on **Save** to update the configurations or **Cancel** to revert to the previous configurations. After you reset PADS, you will be able to see any changes. Note that clicking **Reset Program** will clear out any data currently being displayed.

Configuring channels in the Configuration Display Editor will change the display upon start-up. Once PADS has started, you can select any channels to be displayed. See the "Selectable Charts" heading under the "Chart Displays" section for more information.

3.0 The SPP-200 Window

The different parts of the SPP-200 Window are discussed below. For explanations of the **Enable** button, **COM Port** indicator, and **Fault/No Fault** button, see the “Instrument Tabs” section of the *PADS Operator Manual*.

The **Pump Control On/Off** buttons at the top left of the screen allow you to turn the instrument’s pump on and off. You can change the default on-off setting for the pump by going to the **Configure** menu, selecting **Configure Instrument**, and setting the **Pump Control** as desired.

Channel Tabs

The SPP-200 channels are displayed in the data window in the left of the SPP-200 tab. These data are specific to the time listed in the upper-right of the PADS window.

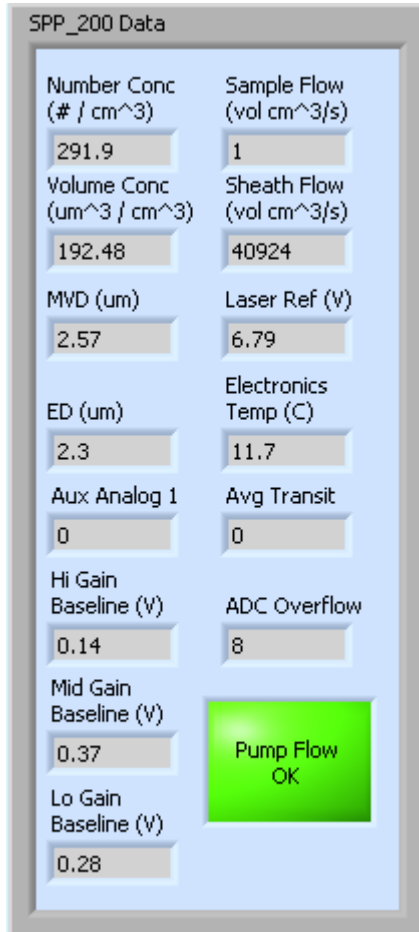


Figure 4: SPP-200 Data Window

The SPP-200 channels are described in Appendices A and B of the *PADS Operator Manual*.

When air is flowing properly through the SPP-200 pump, the indicator at the bottom right of the data window should be green and read “Pump Flow OK,” as shown. When there is a problem with pump flow, this indicator will turn yellow and display “Pump Flow Below Threshold Level.” *Note that PADS only updates the flow status indicator when data are being acquired or when you are in playback mode. If you are in acquisition mode but not sampling data, the flow status indicator will display an outdated and possibly incorrect value.*

Chart Displays

The SPP-200 chart displays consist of a tab with two standard charts and a tab with two selectable charts. You can access any of these charts by selecting the tabs in the upper

part of the chart display window. Figure 6 shows these tabs and the selectable time-series charts.

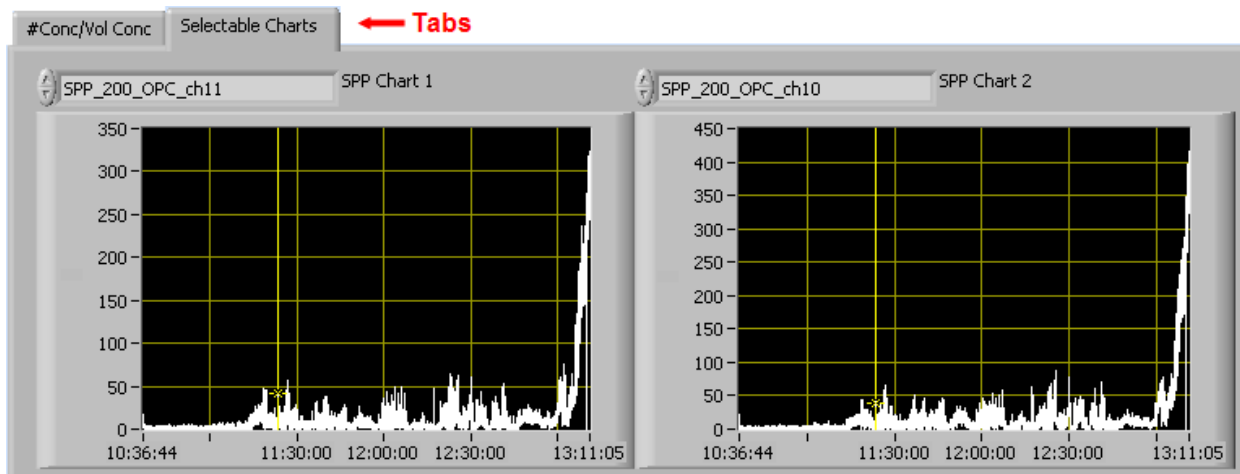


Figure 5: SPP-200 Selectable Time-Series Charts

When you access time-series charts in playback mode, the currently selected moment in time is indicated by a yellow cursor, as shown above. The y-axis value for this time is indicated by cross (+) on this cursor. Note that when you display a large range of time-series data, the chart display does not have sufficient resolution to display each individual time point. To increase resolution, zoom in on the data by changing the time interval to a smaller range.

On all the charts with x and y axes, you can change the scale by typing a different number into the starting and ending values on each axis. For instance, if you want to change the time period in one of the graphs above to end at 11:00:00, you simply select the field that currently says 13:11:05, type in 11:00:00, and hit the <Enter> key. In acquisition mode, you must disable autoscaling (see below) before you modify fields in this way.

Many charts also show you options for scaling and copying the data when you right-click on them, which brings up a drop-down menu. These options are as follows:

Autoscale This autoscales the relevant axis. In autoscaling mode, the minimum and maximum values of the axis are set automatically so that all data points can be seen in the display. Note that on charts that have autoscale buttons, like the large histogram chart on some instrument tabs, the buttons override the Autoscale options in the drop-down menu. To see autoscaling options in the drop-down menu, position the cursor over the relevant axis before right-clicking. Note that you may not always be able to autoscale the x-axis.

Copy Data This copies the chart to the clipboard using a screen capture. This chart can then be pasted into other documents like Word or PowerPoint presentations.

Export Simplified Image This copies a simplified image of the data to the clipboard or an output file. You can choose the format you desire—bitmap (.bmp), encapsulated postscript (.eps), or enhanced metafile (.emf). Note that when you select the .eps option, you must copy the data to a file. Unless you specify otherwise, output files will be saved in the time-and-date-specific output file directory for the current session.

Clear Graph This erases the currently displayed data points from the graph.

More information about each of the tabs on the chart displays section is given below.

1. # / Vol Conc

The two graphs on the first tab display particle number concentration ($\#/cm^3$) and volume concentration ($\mu m^3/cm^3$) with respect to time. In playback mode, you can zoom in or out by using the time controls. In acquisition mode, use the “Display Range” control to zoom in or out.

2. Selectable Charts

The **Selectable Charts tab** displays two charts with user-specified channels plotted as a function of time. To change the channels plotted in the selectable charts, you have two options:

- 1.) To change the charts for the current session only, click on the **Selectable Charts tab** and use the control in the upper left of the chart to select the channel you desire. You can either click on the text control to the right, which brings up a selectable list of channels, or you can use the button on the left to scroll between channels.
- 2.) To change the channels shown in the chart’s display when PADS starts, go to the **Configure** menu, select **Configure Display**, and choose the desired channel. Then press the **Reset Changes** button to apply this configuration.

Histogram Data Window

Below the SPP-200 chart displays is the histogram display of SPP-200-acquired particle data. Like the channel data display, the histogram shows time-specific data.

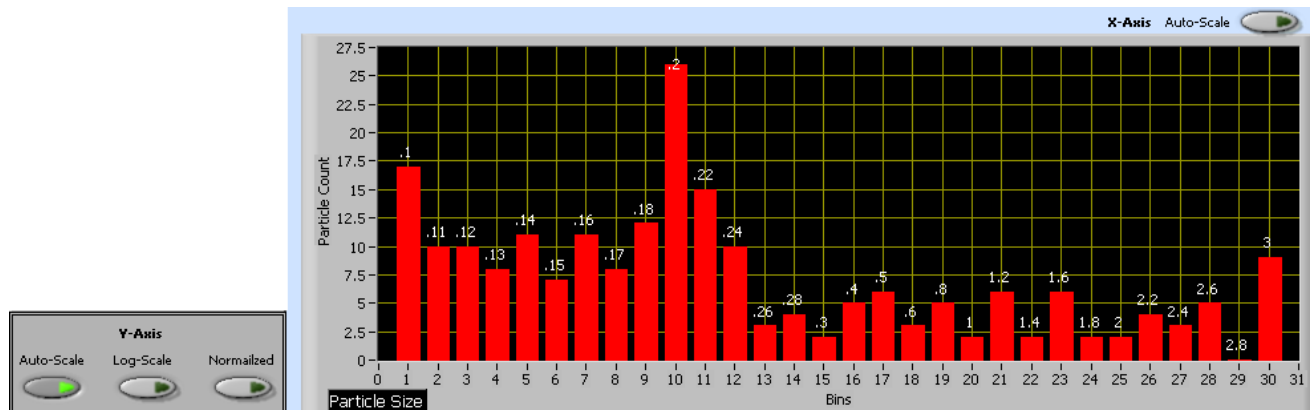


Figure 6: SPP-200 Histogram Display with Scaling Buttons

Note: The SPP-200 histogram does not label the x-axis with particle sizes. Rather, the x-axis labels display bin numbers, and corresponding particle sizes appear either above the data bars (as in Figure 5) or at the top of the graph. You can specify which of these two display options you prefer in the **SPP-200 Display Editor**.

On instruments with thirty bins, bins have a width ranging from 0.01 μm for small bins to 0.2 for large bins. This system enables the instrument to detect a wide size range of particles yet still provide nuanced sizing for smaller particles.

As a result of the instrument's uneven bin sizes, the histogram distribution may not be a smooth curve. When the bin range increases, the bins capture many more particles. Figure 5 above, for instance, shows a jump in detected particles starting with bin 10, which has twice the width of the previous bin.

If you want to see a normalized histogram curve, click on the “Normalized” button to the bottom left of the histogram. When new data are displayed, either by acquiring a new sample or by stepping through data in playback mode, the normalization will take effect and you will see the distribution normalized by bin width. To normalize the data, PADS divides each bin count by the bin width in microns.

If you enable the **Log-Scale** button, PADS will display histogram data logarithmically. The **Y-Axis Autoscale** button can be used to autoscale the y-axis. The **X-Axis Autoscale** button above the histogram is designed to autoscale the X-Axis; currently, however, it does not do this. This is a known bug that will be fixed in an upcoming version of PADS.

Appendix A: SPP-200 Channels

A list of channels for a 30-bin instrument appears below. (Channels will differ for PCASP-100X's with fewer than or more than 30 bins.) The SPP-200 output file will contain data values for each channel for each sampling instance. You can also plot each of these channels against time using the SPP-200 Selectable Charts tab.

For definitions of the channels, consult *Appendix A: Definitions* in the *PADS Operator Manual*. For SPP200_MVD, see the “MVD” entry. For SPP200_ED, see the “ED” entry.

Time	SPP_200_OPC_ch12
Hi_Gain_Baseline(V)	SPP_200_OPC_ch13
Mid_Gain_Baseline(V)	SPP_200_OPC_ch14
Lo_Gain_Baseline(V)	SPP_200_OPC_ch15
Sample_Flow(std cm ³ /s)	SPP_200_OPC_ch16
Laser_Ref_Voltage	SPP_200_OPC_ch17
Aux_Analog_1	SPP_200_OPC_ch18
Sheath_Flow(std cm ³ /s)	SPP_200_OPC_ch19
Electronics_Temp(C)	SPP_200_OPC_ch20
Avg_Transit	SPP_200_OPC_ch21
FIFO_Full	SPP_200_OPC_ch22
Reset_Flag	SPP_200_OPC_ch23
Sync_Err_A	SPP_200_OPC_ch24
Sync_Err_B	SPP_200_OPC_ch25
Sync_Err_C	SPP_200_OPC_ch26
ADC_Overflow(cts)	SPP_200_OPC_ch27
SPP_200_OPC_ch0	SPP_200_OPC_ch28
SPP_200_OPC_ch1	SPP_200_OPC_ch29
SPP_200_OPC_ch2	Number_Conc(cts/cm ³)
SPP_200_OPC_ch3	Volume_Conc(um ³ /cm ³)
SPP_200_OPC_ch4	SSP200_MVD(um)
SPP_200_OPC_ch5	SSP200_ED(um)
SPP_200_OPC_ch6	Sample Flow (vol cm ³ /s)
SPP_200_OPC_ch7	Sheath Flow (vol cm ³ /s)
SPP_200_OPC_ch8	Pressure (mb)
SPP_200_OPC_ch9	Ambient Temp (C)
SPP_200_OPC_ch10	Status
SPP_200_OPC_ch11	GPS Time

SPP-200 channels fall into several broad categories:

Time Channels: The time channels store time data. Time is generated by the PADS computer clock and is the time when the program receives the instrument data. It is given in seconds after midnight on the day the program was started. GPS Time is included in every instrument's list of channels whenever a GPS is included as one of the PADS instruments. GPS Time may be collected from an instrument other than the instrument, even though it appears as a channel in the instrument output file.

Housekeeping Channels: The SPP-200's housekeeping channels are depicted in italics in the list above. These channels have a 0-5 V scale measured by a 12-bit A/D converter that gives integer values from 0 to 4095.

Bin Channels: Channels labeled SPP_200_OPC_[i] store data on the number of particles of different sizes that the SPP-200 has detected. These data are used in the histogram display.

Channels for Other Statistical Data: Avg_Transit and ADC_Overflow(cts) store particle statistics collected by the SPP-200. Status stores statistical data the SPP-200 has gathered on the communication between PADS and the probe. Fifo_Full stores data about the probe electronics.

SPP-200 Calculated Channels: Number_Conc, Vol_Conc, SPP200_MVD, and SPP200_ED store the results of calculations PADS has performed on SPP-200 particle data. PADS calculates Sample Flow (vol cm³/s) and Sheath Flow (vol cm³/s) from their mass flow equivalents, Sample_Flow(std cm³/s) and Sheath_Flow(std cm³/s), as well as from Ambient Temperature and Pressure.

Global Channels: Pressure (mb) and Ambient Temp (C) store data from the master pressure and temperature sources specified on the Set-up screen.

Obsolete, Reserved or Unused Channels: Reset_Flag is reserved for internal use. Sync_Err_A, Sync_Err_B, and Sync_Err_C are obsolete. Aux_Analog_1 is unused.