
Particle Analysis and Display System (PADS):

SPP-100 Module for use with the FSSP Operator Manual

DOC-0199 A; PADS 2.8.2

SPP-100 Module 2.8.2



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1.0 Introduction

The Particle Analysis and Display System (PADS) is a software package that interfaces with 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-100. The module is typically used with the FSSP, which uses SPP-100 electronics.

For an explanation of the basic PADS setup and instructions on how to acquire data using PADS, consult the *PADS Operator Manual, DOC-0116*. Definitions and calculations used in the SPP-100 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 SPP-100

Your SPP-100 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-100” tab.
2. From the **Configure** menu, select **Configure Instrument**. You will see the following window.

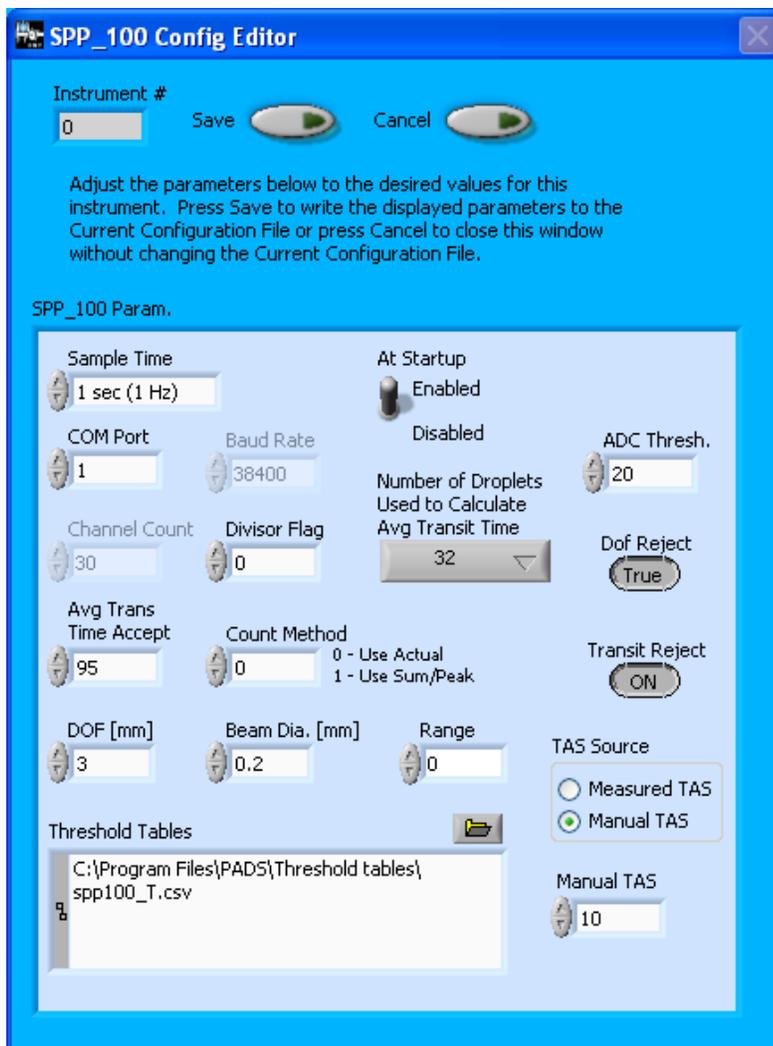


Figure 1: SPP-100 Configuration Editor Window

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 SPP-100 Parameters” and “Rarely Reconfigured SPP-100 Parameters.” If at any time you would like to revert to the previously saved values for the SPP-100 parameters, press **Cancel** to exit the window without saving changes.
4. When you are done configuring the SPP-100 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 SPP-100 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 25 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 25 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.)

At Startup Enabled / Disabled: If you want the SPP-100 to acquire data when PADS begins sampling, make sure this parameter is in the “Enabled” mode. In some cases, such as if the FSSP is inoperative, you may want to use this control to disable the probe. Disabling the FSSP allows data to transmit from other instruments without interference.

COM Port: This is the serial communications port that the SPP-100 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.

TAS Source: These radio buttons allow users to control the source for true air speed. **Measured TAS** uses the global PADS true air speed indicated on the Setup Tab. This can be the TAS measured by one of the instruments or the Manual TAS selected on the Setup tab. **Manual TAS** uses the air speed entered in the field beneath the **TAS Source** radio buttons. (This field is only visible when **Manual TAS** is selected.) When manual TAS is selected, the airspeed (m/sec) will also be displayed on the main SPP-100 display.

You will notice that there are other parameters listed on the **SPP-100 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 SPP-100 Parameters” below or consult with a DMT technical representative.

Rarely Reconfigured SPP-100 Parameters

The SPP-100 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, typically the FSSP. If your FSSP 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. This parameter has been grayed out and you should not need to change it. If you reconfigure your hardware, however, the baud rate may change.

Number of Droplets Used to Calculate Average Transit Time 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.

ADC Threshold: The ADC Threshold indicates the smallest peak digital value a particle can have and still be sized by the instrument. Small digital peaks can occasionally occur in the absence of particles, and the ADC Threshold can be used to eliminate such noise.

Channel Count: This number indicates how many sizing bins the SPP-100 uses to categorize particles. This number has been grayed out because it is preconfigured for your instrument and should not change.

Divisor Flag: This selects the PHA divisor of basic clock speed to determine probe sampling speed. 0 = 20 MHz Sample Rate, 1 = 10 MHz Sample Rate. Use 20MHz sampling for airspeed of 40m/s or greater (airborne applications)

DOF Reject: The DOF reject button tells the SPP-100 whether to reject particles that fall outside the SPP-100’s depth of field. The default value is true, and you should not need to change it. During probe calibration and alignment, DMT sets DOF Reject to false, so that the probe will report all particles it detects. (For a definition of Depth of Field, consult *Appendix A: Definitions of the PADS Operator Manual.*)

Avg Trans Time Accept: This value sets the percentage of the transit time average that a particle transit must surpass before accepted.

Count Method: If “0” is selected, the average transit is determined from the number of clock counts that the particle pulse is above the threshold. If “1” is selected, the average transit is determined by dividing the pulse area by the pulse peak. DMT advises using method “0.”

Transit Reject: If this button is ON, particles with transit times shorter than those specified by **Avg Trans Time Accept** will be excluded from average transit time calculations. This feature is designed to reject particles that may be undersized because they pass through the edge of the laser beam. When Transit Reject is enabled, the instrument measures the transit time of all particles that are accepted within the depth of field, maintains an average of their transit times, and then rejects individual particles whose transit times are less than the

accepted percentage of this average. The theory is that if a particle's transit time is too short, the particle must have passed near the beam's edge.

DOF [mm]: The length of the instrument's depth of field in mm. This parameter is set at manufacture and should not need to be changed. It is used in sample volume calculations.

Beam Dia. [mm]: The diameter of the instrument's laser beam in mm. This parameter is set at manufacture and should not need to be changed. It is used in sample volume calculations. $\text{Beam Diameter (mm)} * \text{DOF (mm)} * \text{Beam Acceptance} = \text{Sample Area in mm}^2$.

Range: The FSSP-100X, as built by the original manufacturer, has 4 size ranges. This setting allows the user to select the particle sensing range. Consult your original manual to determine the ranges. There is an "Extended Range" version of the FSSP.

Threshold Tables: This field lists the path to the threshold table files. These files are used in sizing particles, and the SPP-100 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.) `SPP-100_t.csv` tells PADS the correct sizing bin for a particle given the peak digital value converted from the light scattered by the particle. `SPP-100_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 `SPP-100_t.csv` file, and PADS finds the `SPP-100_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 FSSP. The row changes with different Range selections.

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 SPP-100 Display

To configure the SPP-100 display, click on the SPP-100 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.

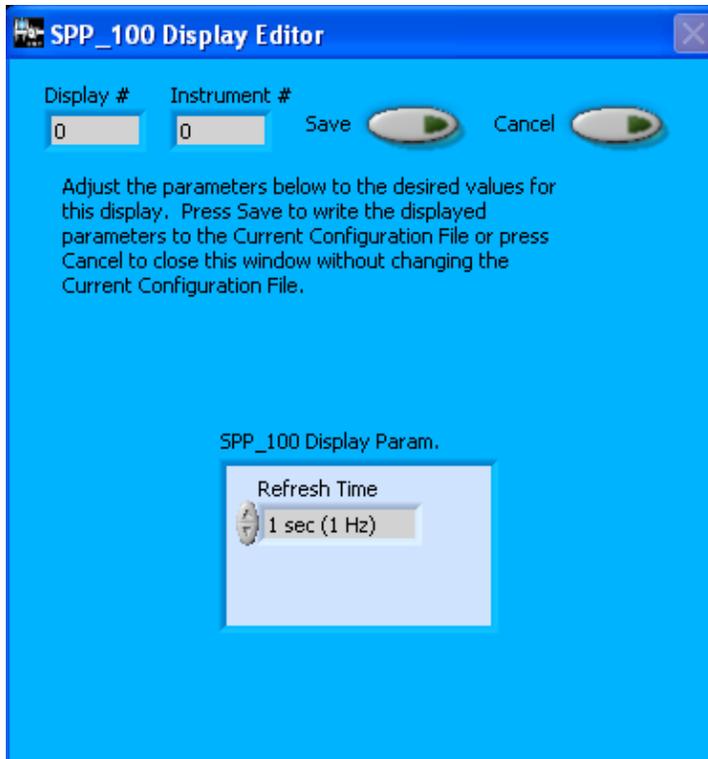


Figure 2: SPP-100 Display Editor Window

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.)

When you are done, click on **Save** to update the configurations or **Cancel** to revert to the previous configuration. After you reset PADS, you will be able to see any changes you have made to Refresh Time. Note that clicking **Reset Program** will clear out any data currently being displayed.

3.0 The SPP-100 Window

Figure 3 displays the SPP-100 window.

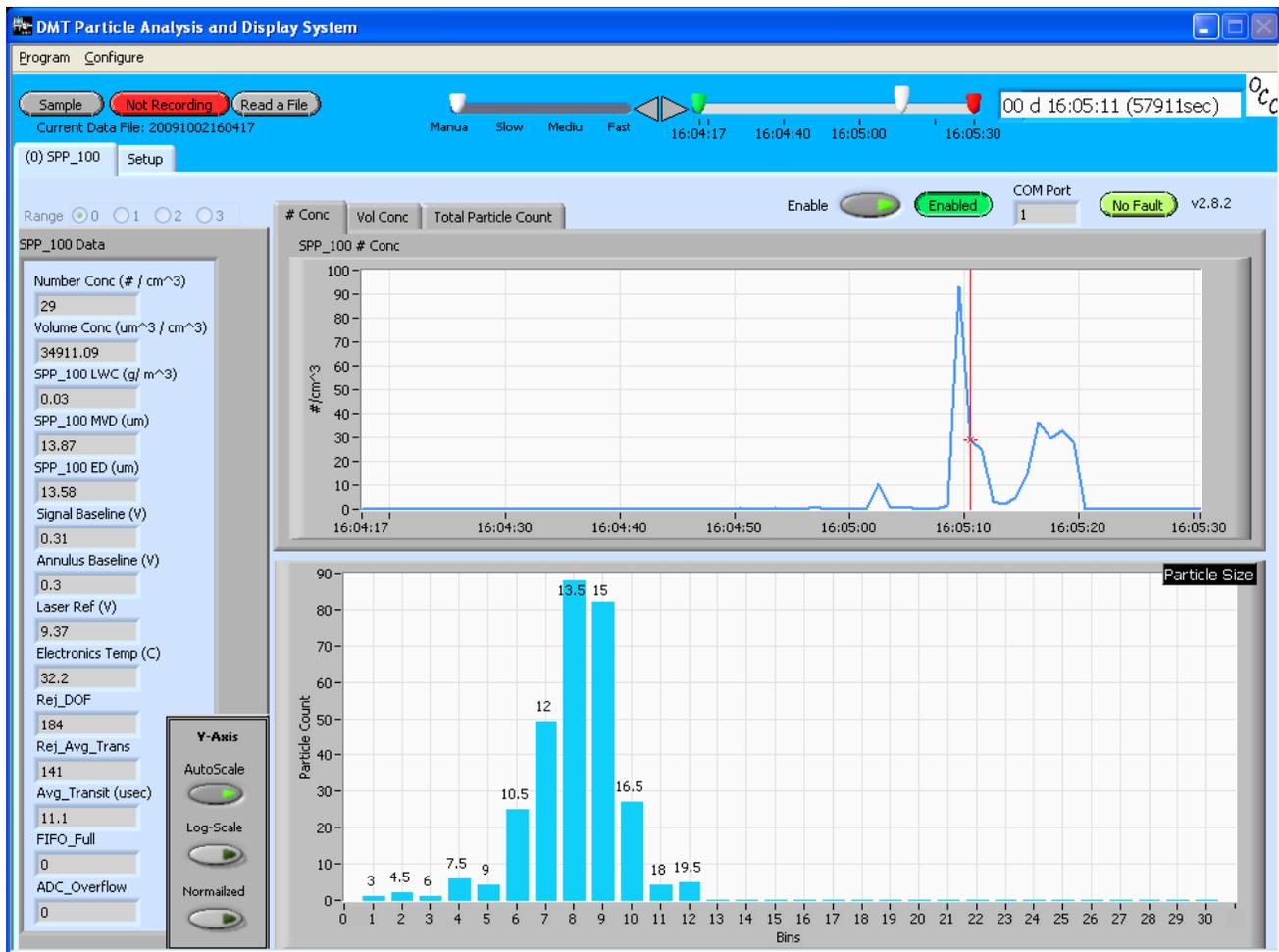


Figure 3: SPP-100 Window

The different parts of the SPP-100 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 **Range** buttons at the top left of the SPP_100 tab indicate which row in the thresholds table the program is using to bin particles. Clicking on another button allows you to change the range.

Channel Data

The SPP-100 channels are displayed in the data window in the left of the SPP-100 tab. These data are specific to the time listed in the upper-right of the PADS window.

The SPP-100 channels are described in Appendices A and B of the *PADS Operator Manual*.

Time-Series Chart Displays

The SPP-100 chart displays are located on the top right of the window. Three tabs display number concentration ($\#/cm^3$), volume concentration ($\mu m^3/cm^3$), and total particle count.

Histogram Data Window

Below the SPP-100 chart displays is the histogram display of SPP-100-acquired particle data (Figure 4). Like the channel data display, the histogram shows time-specific data.

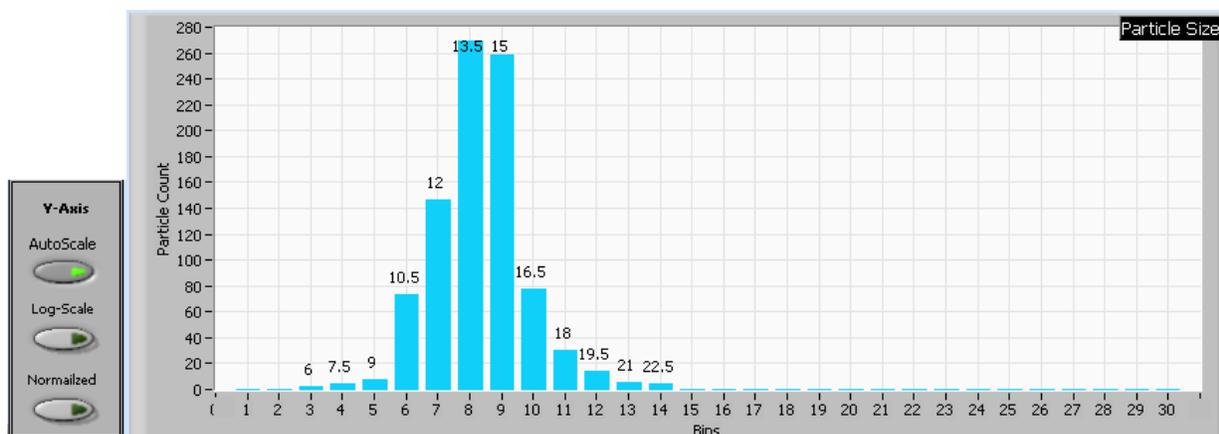


Figure 4: SPP-100 Histogram Display with Scaling Buttons

Note: The SPP-100 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 4.

On instruments with thirty bins, bins have a width ranging from $0.01 \mu m$ 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 4 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. 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 **Autoscale** button can be used to autoscale the y-axis.

Appendix A: SPP-100 Channels

A list of channels for a 30-bin instrument appears below. The SPP-100 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-100 Selectable Charts tab.

For definitions of the channels, consult *Appendix A: Definitions* in the *PADS Operator Manual*. For SPP100_MVD, see the “MVD” entry. For SPP100_ED, see the “ED” entry.

Time	SPP_100_OPC_ch12
Signal_Baseline (V)	SPP_100_OPC_ch13
Annulus_Baseline (V)	SPP_100_OPC_ch14
Aux_Analog_3 (V)	SPP_100_OPC_ch15
Aux_Analog_4 (V)	SPP_100_OPC_ch16
Laser_Reference (V)	SPP_100_OPC_ch17
Aux_Analog_1 (V)	SPP_100_OPC_ch18
Aux_Analog_2 (V)	SPP_100_OPC_ch19
Electronics_Temp (C)	SPP_100_OPC_ch20
Rej_DOF	SPP_100_OPC_ch21
Rej_Avg_Trans	SPP_100_OPC_ch22
Avg_Transit_Time (usec)	SPP_100_OPC_ch23
FIFO_Full	SPP_100_OPC_ch24
Reset_Flag	SPP_100_OPC_ch25
ADC_Overflow	SPP_100_OPC_ch26
Total Particle Events	SPP_100_OPC_ch27
SPP_100_OPC_ch0	SPP_100_OPC_ch28
SPP_100_OPC_ch1	SPP_100_OPC_ch29
SPP_100_OPC_ch2	Number_Conc
SPP_100_OPC_ch3	Volume_Conc
SPP_100_OPC_ch4	SSP100_LWC
SPP_100_OPC_ch5	SSP100_MVD
SPP_100_OPC_ch6	SSP100_ED
SPP_100_OPC_ch7	Beam_Acceptance
SPP_100_OPC_ch8	Range
SPP_100_OPC_ch9	Extended Range
SPP_100_OPC_ch10	Status
SPP_100_OPC_ch11	GPS_Time

SPP-100 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-100's housekeeping channels are depicted in italics in the list above. These channels have a 0-10 V scale measured by a 12-bit A/D converter that gives integer values from 0 to 4095.

Bin Channels: Channels labeled SPP_100_OPC_[i] store data on the number of particles of different sizes that the SPP-100 has detected. These data are used in the histogram display.

Channels for Other Statistical Data: Rej_DOF, Rej_Avg_Transit, Avg_Transit, ADC_Overflow, Total Particle Events and Beam_Acceptance store particle statistics collected by the SPP-100. Status stores statistical data the SPP-100 has gathered on the communication between PADS and the probe. FIFO_Full stores data about the probe electronics.

Configuration Channels: Range and Extended Range store information about the thresholds the SPP-100 uses to bin particles.

SPP-100 Calculated Channels: Number_Conc, Volume_Conc, SPP100_LWC, SPP100_MVD, and SPP100_ED store the results of calculations PADS has performed on SPP-100 particle data.

Obsolete, Reserved or Unused Channels: Reset_Flag is reserved for internal use. Aux_Analog channels are unused.

Appendix B: Definitions for Channels

Note: The following definitions are included in Revision H-5 and later of the *PADS Operator Manual, DOC-0116*. They are also listed in this appendix so that users who have an older copy of the PADS manual have access to them.

Signal_Baseline (V): The filtered voltage registered by the sizing detector. This voltage will vary based on whether particles are present at the time of the reading. When no particles are present, the signal baseline should range from .29 - .33 volts.

Annulus_Baseline (V): The filtered voltage registered by the annulus detector. This voltage will vary based on whether particles are present at the time of the reading. When no particles are present, the signal baseline should range from .29 - .33 volts.

Laser_Reference (V): A channel that measures the laser power. The probe does not attempt to control laser power; instead, it uses laser power measurements to compensate for slight declines in power over time. This insures accurate particle measurements. However, if Laser_Reference (V) drops below 6 Volts, it is recommended you replace the laser.

Rej_Avg_Trans: The number of particles that have been rejected for counting because they have passed through the edge of the laser beam and may be undersized. When Transit Reject is enabled, the instrument measures the transit time of all particles that are accepted within the depth of field, maintains an average of their transit times, and then rejects individual particles whose transit times are less than the accepted percentage of this average. The theory is that if a particle's transit time is too short, the particle must have passed near the beam's edge.

Total Particle Events: The sum of bin counts plus **Rej_Avg_Transit**.

Beam_Acceptance: An SPP-100 channel that stores the proportion of binned particles to total detected particles, i.e. the sum of bin counts divided by **Total Particle Events**.

Range: A channel on the SPP-00 that indicates the row in the threshold table that the instrument currently uses for particle-size binning.

Extended Range: A Boolean channel on the SPP-100. Extended Range is 1 if the Threshold Table being used is an extended range table, i.e. if the file name contains the string "ER."