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General Information

Note: This manual is for Airborne Particle Sensor technology products including WaferSense APS, APS2, APS3, ReticleSense APSR, APSRQ, and PanelSense APS-FPD. The devices may also be referred to as WaferSense APS in the software section but is applicable to all form factors using APS technology.

WaferSense and ReticleSense Device and Link. PanelSense Device and SENA Link.

Changes or modifications not expressly approved by CyberOptics Corporation, may void your authority to operate the APS device.

The radio contained in the APS meets all the applicable FCC requirements for RF Safety. While in operation, the FCC requires users and nearby persons to maintain a minimum separation distance of 20 cm (8 inches) or farther from the APS.

The APS Device and Link have been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

These devices comply with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Software Note: ParticleSpectrum files are not backwards-compatible with previous versions of ParticleView and ParticleReview. Files that were recorded from ParticleView and ParticleReview will not be compatible with ParticleSpectrum.
The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance instructions in the literature accompanying the device.

**Laser:**
The APS is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.

- **Wavelength:** 405nm
- **Beam Divergence:** 36 milliradians x 178 milliradians
- **Pulse Duration:** Continuous
- **Maximum Power:** 200 milliwatts

**Service:**
Do not remove cover. No user serviceable parts inside. Return to Cyberoptics for service and calibration.

**Power Supply and Charging:**
Use only the power supply provided with this equipment for charging.

- **Input:** 100-240 VAC, 50-60 Hz, 0.6A
- **Output:** 5 VDC, 3.0A

**Lithium Rechargeable Batteries:**
Internal lithium batteries, if handled incorrectly, could cause injury or death. Refer to local regulations for handling and disposal of batteries. Battery should only be serviced by CyberOptics.

**Static Sensitive Components:**
Observe precautions for static sensitive components.

**Disposal:**
The product must not be disposed of with normal waste. Instead, it is your responsibility to dispose of your waste equipment by arranging to return it to CyberOptics for recycling. By separating and recycling your waste equipment at the time of disposal you will help to conserve natural resources and ensure that the equipment is recycled in a manner that protects human health and the environment. For more information about how to recycle your CyberOptics supplied waste equipment please contact our customer services department at 1-763-542-5000.

**Large Particle Detection:**
APS2, APS3, APSR, APSRQ, and APS-FPD units have large particle detection capability. This is in addition to the normal small particle detection. Large particle operation is very similar to small particle detection so that all of the sections in this manual describing settings and operation are still valid for large particle detection. How to operate large particle detection and the differences between the two modes are described in Appendix A – Large Particle Detection.
Labels on Devices
Laser and hazard labels as they appear on the APS devices.

WaferSense APS

WaferSense APS2

WaferSense APS3

ReticleSense APSR

ReticleSense APSRQ

PanelSense APS-FPD
WaferSense, ReticleSense, and PanelSense Technical Support

Technical support is available from CyberOptics Corporation.

E-mail: CSsupport@cyberoptics.com
Phone: +1 763-542-5000
       +1 800-366-9131 (US and Canada only)

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5900 Golden Hills Drive, Minneapolis, Minnesota, 55416
Part # 8025869 Rev B
Chapter 1

Introduction

The CyberOptics WaferSense® and ReticleSense® Airborne Particle Sensors (APS, APS2, APS3, APSR, APSRQ) measures airborne particles inside semiconductor process equipment, and PanelSense™ Airborne Particle Sensor - Flat Panel Display (APS-FPD) measures airborne particles for flat panel display manufacturing. Throughout this document, all devices in this family will be referred to as “APS.”

The ParticleSpectrum™ software application makes it easy to view particle measurements in realtime. The large display and wireless link let you place the computer at a convenient distance from the APS device. The APS wafer and reticle are vacuum compatible, with an operating pressure of 0.4 (300 Torr) to 1.6 atmosphere.

APS consists of the following components:

- **APS device.** The APS is designed with a wafer-like and reticle-like form factor, so it can fit in most handling equipment or tools. The device is vacuum compatible, with an operating pressure of 0.4 (300 Torr) to 1.6 atmosphere.

- **ParticleSpectrum™ software.** The ParticleSpectrum software application monitors the particle measurements and other status information in real time. Review functionality lets you view and compare log files recorded. ParticleSpectrum runs on most personal computers that use the Microsoft Windows operating system. See Chapter 6, “Specifications,” for platform requirements.

- **Wireless link.** The software communicates with the APS wafer by using a Bluetooth wireless link that attaches to a USB port on a personal computer.

- **Charging case.** The APS device is powered by an internal rechargeable battery, which you recharge by placing the APS device into the charging case.

- **Carrying case.** The carrying case makes it easy to take your complete APS system with you in the plant or on the road.

The following chapter provides you with instructions for installing your APS system.

See Appendix B – APS-FPD for additional information regarding PanelSense APS-FPD.
Chapter 1. Introduction

Carrying Case Contents:

![APS Components Image]

- APS Device (APS, APS2, APS3, APSR, or APSRQ)
- Wireless Link
- Charging Case
- Software

Figure 1.1 APS Components

See Appendix B – APS-FPD for additional information regarding PanelSense APS-FPD and its components.
Chapter 1. Introduction

The APS Controls and indicators are visible on the outside of the device as shown below. Note: APS2, APS3, APSR, APSRQ have the same control and indicator layout. APS3 and APS-FPD are the only models that have a Micro USB power connector.

Figure 1.2 APS3 and APS-FPD unit. Controls and indicators shown on APS3 300mm and APS-FPD.
Chapter 1. Introduction

Figure 1.3 APS unit.
Chapter 2

Installing Your APS

This chapter describes the procedures you need to perform to install your APS system and get it ready for use. For best results, perform the procedures in the order they are presented in this chapter:

- Installing the ParticleSpectrum software
- Installing the wireless link on the USB port
- Checking communications between the link and the APS wafer
- Registering your APS device
- Running the ParticleSpectrum application

Caution
Dropping the APS or hitting it against a hard object can bend, break, or chip the housing; damage the internal components; or knock the APS out of calibration. While it is not as fragile as an actual silicon wafer, handle the APS with care, as you would any precision instrument. If the APS is damaged or in need of calibration, see Chapter 5, “Maintaining Your APS”.

Caution
The APS is thicker than a standard silicon wafer so use extreme care to assure that the wafer has proper clearances when being transported through the tool. For example, when you use the device in a tool for the first time, move the APS through the tool in manual mode, visually verifying all clearances. Even when clearances are sufficient for safe APS pass-through, if the robot end-effector is taught too high, you risk crashing and damaging the APS device.

The Intake blower and exhaust filter are fragile. Do not direct compressed air or gas into either the intake or the exhaust of the APS. Damage to the unit may result.
Chapter 2. Installing Your APS

Installing the ParticleSpectrum APS Software

To install and run the APS software ParticleSpectrum, your computer must have the following:

- Windows 7 (32-bit or 64-bit), Windows 8, Windows 10 operating systems
- One free high-power USB 1.1 or USB 2.0 port

To install the APS software, do not plug in the link before you start. The software must be installed first using the following steps:

1. Log on using an account with Administrator privileges.
2. Insert the WaferSense APS Installation Disk into the CD drive.
   The InstallShield Wizard starts automatically, as shown in Figure 2.1. If the wizard doesn't start automatically, use Windows Explorer to view the contents of the CD and double-click the WaferSenseInstaller.exe program.

3. Follow the instructions provided by the wizard to install the software.
Chapter 2. Installing Your APS

4. After you complete the instructions for all of the wizard screens, click Close.

![Figure 2.2: Final Software InstallShield Screen](image)

By default, the Setup program installs the ParticleSpectrum applications in a new program group called CyberOptics. Setup also installs an online copy of this user’s guide, which is available from the ParticleSpectrum Info menu and in the CyberOptics program group in the Windows Start menu.

Note:

The WaferSenseInstaller.exe will install device drivers for the Link Device.
Chapter 2. Installing Your APS

**Link Device Drivers**

If the Link Device drivers do not install correctly, you can manually install them by navigating to the Drivers folder when the `WaferSenseInstaller.exe` completes installation. Navigate to your local disk and follow (C:\Program Files (x86)\CyberOptics\WaferSense\Drivers\FTDI) and click `DPInst_x64.exe` to run the Link Device Installer.

**Figure 2.3: Link Device Install Wizard**

1. Click **Next >** and the wizard automatically completes the link installation.

**Figure 2.4: Final Link InstallShield Screen**

2. Click **Finish** to close the Link Device Install Wizard
Chapter 2. Installing Your APS

Installing the Wireless Link

Before starting the wireless link installation, complete “Installing the WaferSense APS Software,” on page 2.2.

To install the wireless link:

1. Turn on your computer.
2. Locate an unused, high-power USB port on your computer. The APS wireless link module requires a high-power USB port, such as the built-in ports on your computer and ports on USB hubs that have power cords. Unpowered USB hubs won’t work.
3. The USB cable provided with your APS system has a different plug on each end. Locate the end with the plug that matches the USB port on your computer and plug the cable into the port.
4. Plug the other end of the cable into the link module.
   
   Windows automatically finds the drivers installed during the Link Device Installer in Figure 2.3 and Figure 2.4 on page 2.4.

   The Power light on the module turns on indicating that the module is getting power from the USB port. Ignore the Pair Status and Connection Status lights for now.

Note: Installing the SENA Link instructions for APS-FPD can be located in Appendix B.
Chapter 2. Installing Your APS

Checking Communications Between the Link and the APS Device

To complete the installation, verify that the APS device and link can communicate:

1. The APS operates from an internal rechargeable battery. Before using the APS for the first time, charge it for two hours. For information on checking the charge on the battery and the procedure for recharging, see “Using the Rechargeable Battery,” on page 3.24.

2. On the APS, there are reset buttons as described in Chapter 1. These buttons are rarely used, and require the use of a paper clip, or other small device to activate. These buttons are usually for “pairing.” Placing the unit in the charging case and connecting the charger power supply will start the APS device. See page 3.3.

3. Verify that the Pair Status lights on both the APS and link module are on. The APS and link module in your kit were paired at the factory and will operate with only that particular link module. If either light is not on, your APS device and link might not be paired with each other. To reset the pairing, see “Changing the Pairing Between the APS Device and Link,” on page 3.30.

4. Immediately after turning on the APS, the Connection Status lights on the APS and link will blink slowly. After a few seconds the APS and link will connect and both lights will be on and no longer blinking. If the lights continue to blink, see “Monitoring the Wireless Connection to the APS device” on page 3.26.

5. After starting the ParticleSpectrum application (see “Running the ParticleSpectrum Application,” on page 2.8), you can verify the connection to the APS by comparing the serial number printed on the APS device to the serial number shown in the About your APS dialog, which is available in the ParticleSpectrum application by choosing the Info menu item.

That completes the installation of your APS system.

Note: Pairing instructions for APS-FPD can be located in Appendix B.
Registering Your APS for Calibration Service

To maintain optimum performance, every twelve months you should have your APS calibrated and the battery replaced. These services can be performed only at the factory.

To help you keep track of the next service date so you can schedule this service when it is convenient, register your APS device with the factory. When you start the ParticleSpectrum application (see “Running the ParticleSpectrum Application,” on page 2.8), it prompts you to register your APS device for calibration. You can also register your APS device in any of the following ways:

- By sending an e-mail message containing the model, serial number, and contact information to wsregister@cyberoptics.com

Large Particle Detection: APS2, APSR, APSRQ, APS3, and APS-FPD units are capable of measuring large particles. This is in addition to the normal small particle detection. Large particle operation is very similar to small particle detection so that all of the sections in this manual describing settings and operation are still valid for large particle detection. How to operate large particle detection and the differences between the two modes are described in Appendix A – Large Particle Detection.
Running the ParticleSpectrum Application

To start the ParticleSpectrum application:

1. From the Windows **Start > Programs** menu, choose **CyberOptics > ParticleSpectrum**. The ParticleSpectrum application starts, as shown in Figure 2.5. Initializing communications usually takes less than a second. For information on using ParticleSpectrum, see Chapter 3 “Using Your APS.” If the APS device has not been registered, ParticleSpectrum will display the Calibration Registration dialog. To complete the registration, proceed to the next step.

![Default View](image1)

**Default View**

![Default View with Device List](image2)

**Default View with Device List on the Left side. The device list can be enable and minimized by selecting the arrow icon above Device List**
Chapter 2. Installing Your APS

2. If ParticleSpectrum displays the APS Calibration Registration dialog, as shown in Figure 2.6, you haven’t registered your APS device. Follow the instructions in the dialog to complete the registration.

![Figure 2.6: Calibration Registration Dialog](image-url)
Technical Support

CyberOptics offers free technical support to customers. If the APS hardware or software appear to be malfunctioning, please contact us, and we’ll be happy to assist you.

When you contact us, please make sure that you have the following information available:

- A detailed description of the problem you are having, including the exact text of any error messages and a list of steps to reproduce the problem.
- Information about your computer, including manufacturer, CPU type, version of Windows, and memory size.
- The version of the ParticleSpectrum application. The software version is available in the ParticleSpectrum application by choosing the **Info** icon in the upper right side of the screen.

![Figure 2.7: The About ParticleSpectrum Dialog](image)

- The serial number of your APS device. The serial number of the APS device is printed on a label on the top of the APS device. The serial number is also available in the ParticleSpectrum application by choosing the **Info** icon menu item.

![Figure 2.8: The About your APS Device Dialog](image)
Chapter 2. Installing Your APS

Technical support:

• Toll free: +1 800-366-9131 (US and Canada only)
• E-mail: CSsupport@cyberoptics.com
• Internet: www.Cyberoptics.com
Chapter 3

Using Your APS

This chapter gives you instructions for performing the following tasks with the Airborne Particle Sensor (APS) device:

- Opening and closing the charging case
- Using the APS device buttons and status lights
- Making a simple particle measurement run
- Setting the purge and measurement times
- Monitoring for excessive particle levels
- Recording the particle measurements
- Configuring the display
- Monitoring the operating temperature
- Using the rechargeable battery
- Monitoring the wireless connection to the APS device
- Monitoring the pressure, laser, and fan
- Reporting asynchronous events
- Changing the pairing between the APS device and link
- Saving your settings
- Additional Display Features
Opening and Closing the Charging Case

The APS device comes in a plastic charging case that is used for storing it when not in use and for charging the rechargeable battery in the APS device (see “Using the Rechargeable Battery” on page 3.25). The APS device should be stored in the sealed charging case when not in use.

The charging case is air-tight. After air transport it may be necessary to relieve the pressure differential in order to open the case. To do so, loosen the pressure relief vent screen until air enters the case. Then re-tighten the screw.

To open the charging case:

1. Loosen the captive screws on the top of the case (see Figure 3.1).

![Loosen the captive screws](image)

Figure 3.1: Opening the Charging Case

2. Lift the lid of the charging case using the captive screws.

To close the charging case:

1. Lower the lid.

2. Tighten the captive screws until the top of the case is secured. (see Figure 3.1)
Using the APS Controls

APS devices are designed to operate “hands free” in normal use.

- The unit is turned on by inserting the unit in the charging case and applying power to the charging case.
- The unit is completely turned off by activating the “shutdown” button in the ParticleSpectrum software.
- A “shutdown” turns off all internal electronics in the APS. After a shutdown the unit must be restarted in the charging case. Therefore, if the intent is to put the unit into standby mode, where the fan and laser are turned off but the electronics are still active, the “stop” button in the ParticleSpectrum should be used instead of the “shutdown” button.
- In abnormal situations, the reset switches on the front panel can be used to activate a shutdown or to turn the unit on from a shutdown. See page 1.2 for a view of the reset switches. The button indicated by “1” turns the unit on. The button indicated by “0” turns the unit off.

Using the APS Indicators

APS devices have the following status LED (see illustration on page 1.2)

- **Charger On.** Glows green when power is applied to the charging case.
- **Charging.** Glows red when the unit is being charged. Goes dark when the battery has reached 100% charge. Glows red if the charger is connected and the battery discharges below 95%. Goes dark when the inductive charger is no longer powered.
- **Unit On.** Indicates when the device is on.
- **Connect/Pair. Note:** Glows green when the unit is successfully paired with a link box. Blinks red/green slowly when it is searching for a link. This usually occurs just after turn on or before the link box is powered by the host computer. Blinks red/green rapidly when the pairing function is activated by the “C” reset switch. This rapid blinking indicates it is receptive to a new pairing.
- When the APS device is on and has been removed from its charger and is ready for in-tool use, the “Unit on” and the “Connect/Pair” LEDs should both be glowing steady green. The APS device can be operated inside the charging case. However, do not connect the charger while operating the APS inside the case.
Making a Simple Particle Measurement Run

The APS device detects particles by size, sending the data to the ParticleSpectrum application in nearly real time. ParticleSpectrum displays the readings graphically and numerically, showing particle measurements by particle size. You can place the APS device in a piece of equipment, run the equipment through its paces, and watch the ParticleSpectrum display for particle measurements that might indicate a problem with the equipment.

To use the APS device with ParticleSpectrum:

1. Make sure the computer running the ParticleSpectrum application is within the range of the link module, up to 30 ft (10 m).

2. Normally, you would place the APS device on the equipment you want to check and then start the equipment in motion, monitoring the ParticleSpectrum display. To get an idea of how the APS system works, for now just set the device on a desk or table and turn it on.

3. Start the ParticleSpectrum application. The ParticleSpectrum window appears, as shown in Figure 3.3 on page 3.5.

4. Click START to start the measurement run in the Device Controls (see Figure 3.2).

The particle run begins by purging the APS device’s particle sensor before starting to detect particles (for more information, see “Setting the Purge and Measurement Times” on page 3.7).
**Figure 3.3: Reading the ParticleSpectrum Display**

**Numerical and graphical displays.** The top-left quadrant of the ParticleSpectrum display shows the particle measurements in numerical form. As the APS device detects particles, it assigns them to “bins” based on particle size. The displayed numbers are particle measurements averaged over a time interval (see “Changing the Averaging Interval,” on page 3.19). The grid area of the display on the right shows a graph of the particle measurements. You can select one bin at a time to display on the graph (see “Selecting the Particle Size to Graph,” on page 3.17). The graph shows a dotted line for the average particle measurement over time, as shown in the numerical displays, and a solid line that is the real-time particle measurement received from the wafer. You can adjust the horizontal and vertical scales of the graph (see “Changing the Vertical Scale,” on page 3.18 and “Changing the Horizontal Scale,” on page 3.19). The most recent measurement always appears at the right edge of the graph. When the APS device is purging, the measurement display boxes and the graph are blank. A Purging Countdown Timer will appear in the lower left portion of the graph window.
Chapter 3. Using Your APS

- **Particle frequency and particle density.** ParticleSpectrum displays particle measurements as either particle frequency (number of particles per unit time) or as particle density (number of particles per volume). For more information, see “Displaying Particle Density or Frequency,” on page 3.17.

The other features of the ParticleSpectrum display are described later in this chapter.
Chapter 3. Using Your APS

Setting the Purge and Measurement Times

When you click **START**, the APS device measures particles for the specified measurement time, or until you click **STOP**. Prior to beginning the measurement, to purge the particle sensor, the APS wafer runs its fan for a period of time without measuring particles. You can specify the times for both purging and measurement. Typically a purge time of 60 seconds clears the APS device of residual particles prior to starting a new measurement.

To set the purge time:

- Under **Settings > Measurement Options**, use the **Purge for** controls to choose the time and the units (seconds or minutes).

To set the measurement time:

- Under **Settings > Measurement Options**, use the **Measure for** controls to choose the time and the units (seconds, minutes, or hours).

---

3.7
Chapter 3. Using Your APS

Monitoring for Excessive Particle Levels

You can use the Go/No-Go feature in ParticleSpectrum to monitor particle measurements for sustained excessive levels, to indicate when average measurements exceed your specified thresholds. When a Go/NoGo alarm is active, and a measurement is in progress, the Go/No-Go Alarm area of the display, located in the upper right corner of the screen, indicates the current Go/No-Go condition as shown in Figure 3.5.

Figure 3.5: Go/No-Go Indicators

Green: Measurement below threshold.

Red: Measurement exceeds threshold.

A No-Go marker is added to the graphical display.

Figure 3.5: Go/No-Go Indicators
To set the Go/No-Go threshold:

1. Click **Configure Go/No-Go** (see **Figure 3.6**).

![Figure 3.6: Setting the Go/No-Go Thresholds](image)

The Set Go/No-Go Threshold dialog is displayed, as shown in **Figure 3.7**.

![Figure 3.7: Set Go/No-Go Threshold Dialog](image)

2. Under **Threshold Type**, select either a **Frequency Threshold** alarm or a **Density Threshold** alarm. To disable the alarm, select **None**. Note that choosing a threshold type in the Set Go/No-Go Threshold dialog doesn't affect whether the measurements

3.9
Chapter 3. Using Your APS

displayed in the main ParticleSpectrum window are frequency or density measurements. You need to set that display choice in the main window (see “Displaying Particle Density or Frequency,” on page 3.17).

3. Under Threshold Settings, specify the frequency or density units from the Measurement Units menu, the numerical value of the alarm No-Go Threshold, and the bin to apply the threshold to by selecting an option from the Particle Sizes drop-down menu. Lengthening the averaging interval smooths out the raw data, so the measurement must exceed the threshold for a longer time to trigger the alarm. The averaging interval you specify for the Go/No-Go threshold is independent of the averaging interval for graphing the particle measurements (see “Changing the Averaging Interval,” on page 3.19).

4. Click OK. The Go/No-Go settings take effect immediately. When the next active No-Go event occurs, ParticleSpectrum changes the green Go/No-Go indicator to red (see Figure 3.5 on page 3.8).
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Recording the Particle Measurements

You can record the particle measurement data to a log file and view the file in the Review feature. For information on log files, see “Viewing Log Files,” on page 4.1.

Log files include the particle measurement data and user-specified data (see “Including User-Specified Information in the Log File,” on page 3.13). Particle measurements are recorded at intervals of one second, regardless of the horizontal scale display.

To record particle measurement data during measurement runs:

1. In the Device Controls for the device.

2. To start recording, click START. The START button changes to STOP. ParticleSpectrum starts recording after the purge cycle is complete, or until you click STOP. See Figure 3.8.

3. To stop the recording before the specified recording time has expired, click STOP. When the measurement time expires, or when you click STOP, ParticleSpectrum ends the current log file. To review the log file see “Viewing Log Files,” on page 4.1.

Figure 3.8: Recording Particle Measurement Data
**Placing Marks in a Log File**

At the start of recording and at No-Go and other events, ParticleSpectrum automatically places marks in the log file. In addition to marks created automatically by ParticleSpectrum, you can manually create your own marks in a file while you are recording, and you can add annotations to the marks.

**Adding Marks Manually**

To manually add a mark to a log file:

1. Choose the menu **Settings > Add Marker Options > Show Annotation Dialog**. This menu item toggles the display of the Annotate Mark dialog on and off. The setting is off by default. If you don't display the Annotate Mark dialog, you can still add marks to the file, but you won't be able to add your own comments to be saved with the marks.

2. While you are recording data, click **Add a Mark** (see Figure 3.9).

**Figure 3.9: Adding a Mark**

The Annotate Mark dialog is displayed (see Figure 3.10).

**Figure 3.10: Annotating a Mark**
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3. In the Annotate Mark dialog, type the text you want to record with the mark location in the file and click **OK**. You can't add another mark until you click **OK**.

If you don’t want to be prompted with the Annotate Mark dialog when you click Add a Mark, the next time the dialog appears, check **Don’t show this dialog** and click **OK**. If you have previously checked this box, and you now want to have the dialog displayed again, choose the device menu **Settings > Add Marker Options > Show Annotation Dialog** to toggle on the display of the Annotate Mark dialog.

### Including User-Specified Information in the Log File

**Operator**, **Tool**, **Station**, and **Comment** are text fields you can use to record your own information in each log file. You can fill in any text information you want in these fields.

To include user-specified information for logging:

1. Choose the **Settings > Station Information** menu item.

   ![Set Station Information Dialog](image1.png)

   The Set Station Information dialog is displayed, as shown in **Figure 3.11**.

2. Type your text into the **Operator**, **Tool**, **Station**, and **Comment** text fields.

3. To accept the changes and close the dialog, click **OK**.

---

**Figure 3.11: Set Station Information Dialog**
Chapter 3. Using Your APS

Log File Directory Location

By default, ParticleSpectrum writes log entries to the directory C:\WaferSense\APS Files\. If you prefer, you can specify a different directory (see “Changing the Log File Directory,” on page 3.16).

Log File Names

By default, log file names are automatically assigned by ParticleSpectrum and consist of the serial number for the APS device followed by the date and time (see Figure 3.12).

![Default Log File Names](image)

You can specify a different log file name prefix to replace the APS device serial number, in which case, ParticleSpectrum still adds the date, time, and the appropriate extension.

To specify a different log file prefix:

1. Choose Settings > Output Folder > Output file name

![Specifying a Log File Name Prefix](image)
Chapter 3. Using Your APS

2. In the **Output file name** prefix box, enter the text you want to replace the APS wafer serial number in log file names.
3. Click anywhere off the screen to close the Settings Menu.

**Importing Log Files Into Other Applications**

If you want to be able to import log files into other programs, such as MATLAB or Microsoft Excel, you need to have ParticleSpectrum write log files in comma-delimited format (also called comma-separated-values or CSV files) as well as the `.aps` file format.

The comma-delimited files are named as described in “Log File Names,” on page 3.14, above, but with the `.csv` extension, rather than `.aps`.

To have ParticleSpectrum record comma-delimited files:

1. Choose the menu item **Settings > Output Folder**. The Log File Options dialog is displayed (see **Figure 3.14**).

![Record csv files](image)

**Figure 3.14: Recording Comma-Delimited Files**

2. Select the **Record data to CSV** button so it reads **ON**.
3. Click anywhere off the screen to close the Settings Menu.
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The layout of the data in the comma-delimited file is in columns as displayed in Figure 3.15. Marks are also saved.

![Figure 3.15: Layout of Comma-Delimited File](image)

ParticleSpectrum writes data to the file once per second

**Changing the Log File Directory**

By default, ParticleSpectrum writes log entries to the directory C:\WaferSense\APS Files. If you prefer, you can specify a different directory.

To change the log file directory:

1. Choose the menu item **Settings > Output Folder > Browse Icon**

![Output Folder: c:\WaferSense\APS Files](image)

2. In the Browse for Folder dialog, specify the folder name for the log files, and click **OK**.
Chapter 3. Using Your APS

Configuring the Display

You can change the way particle measurements are displayed by selecting which particle size bin to graph, by choosing to display either particle density or particle frequency, by changing the vertical and horizontal scales, by changing the averaging interval, and other elements in the display.

Selecting the Particle Size to Graph

You can choose which of the cumulative particle measurement bins to graph.

To choose which particle bin to graph:

- In the **Graph Options**, choose the particle size from the **Particle Sizes** list drop down menu (see Figure 3.16).

![Figure 3.16: Selecting the Particle Size for the Graph](image)

Displaying Particle Density or Frequency

ParticleSpectrum displays particle measurements as either particle frequency (number of particles per unit time) or as particle density (number of particles per volume).

To choose particle density or particle frequency:

- In the **Display Options**, under **Measurement Type**, select **Density** or **Frequency** (see Figure 3.17).

![Particle size](image)

Figure 3.16: Selecting the Particle Size for the Graph

Figure 3.17: Displaying Particle Density or Frequency
Chapter 3. Using Your APS

Figure 3.17: Displaying Particle Density or Frequency

Changing the Vertical Scale

You can set the vertical scale for the particle measurement graph. The scale is in particles per unit time when displaying particle frequency, or in particles per unit volume when displaying particle density. Particle measurement values that are too large to display with the current scale setting may appear to be off screen. The Zoom out to extents button will adjust to fit on the screen.

To change the vertical scale:

- In the Display Options, under Measurement Units choose the type of measurement for your application. If you have chosen to display particle density, the units will be those of volume. If you have chosen to display particle frequency, the units will be those of time.
- The graph window will adjust to the units that have been selected. The vertical scale bar can be adjusted to accommodate the larger values, and the Zoom out to extents button in the upper right of the graph window will also adjust to the new values if you’ve already recorded data.
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Changing the Horizontal Scale

You can set the horizontal scale for the particle measurement graph. The scale will list time in seconds, or can list **Absolute Time Labels**.

The horizontal scale setting affects only the display of the particle measurements. The APS device always sends measurements once per second to ParticleSpectrum, and log files always record measurements at increments of one second.

To change the horizontal scale to list **Absolute Time Labels**:

- In the **Graph Options**, under **Absolute Time Labels**, select the button to read **ON**. The new setting takes effect immediately.
- The graph window will adjust to the units that have been selected. The **horizontal scale bar** can be adjusted to accommodate the larger values, and the **Zoom out to extents** button in the upper right of the graph window will also adjust to the new values if you’ve already recorded data.

![Absolute Time Labels](image1)

![Horizontal scale bar](image2)

Figure 3.19: Horizontal Scale

Changing the Averaging Interval

The values displayed in the numerical readouts are moving averages of the particle measurements. ParticleSpectrum averages the raw data over an interval that you specify. ParticleSpectrum displays both the raw data and the averaged data in the graph.

The averaging interval you specify affects only the display of the particle measurements. The APS wafer provides the following:

- Measurements are always sent once per second to ParticleSpectrum and log files always record the raw measurements at increments of one second.
- The APS airflow is always 0.1 cubic feet per minute.
Chapter 3. Using Your APS

To change the averaging interval:

- In the Display Controls, under Averaging Interval, choose the interval in seconds, minutes, or hours for averaging the particle measurements. The new setting takes effect immediately.

![Averaging Interval](image)

**Figure 3.20: Horizontal Scale**

For example, you know the airflow through the APS device is 0.1 cubic feet per minute but you want to average the particle count over one cubic foot of air. You can determine the length of time the APS device needs to run using the following formula:

\[
\frac{1 \text{ cu ft.}}{0.1 \text{ cu ft. per minute}} = 10 \text{ minutes}
\]

Using the formula you know the APS device needs to run for 10 minutes to process one cubic foot of air.

**Measurement Accuracy**

The APS device’s accuracy is based on particle density measurements using an averaging interval of ten minutes. The shorter the averaging interval, the accuracy of numeric measurements is degraded while longer averaging intervals will have increased accuracy of the numeric measurements.
Device Status Icons ParticleSpectrum

ParticleSpectrum lists a Device Status Bar for connected devices in two different locations; the Device List, and the Graph Window for the device. The Device Status Bar has icons showing Battery Level, Operating Temperature, Pressure, Fan, and Laser.
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Additional Icons in Device List

There are additional icons for the connected device in the Device List.

- **Visibility**, hide and unhide the device. When the device is hidden, the graph window for the device is also hidden.
- **Menu**, remove the device from the device list. If the device is removed, you will need to restart the ParticleSpectrum software.
- **Select Review File**, accesses log files to be imported into ParticleSpectrum for review.
- **Manage Device List**, manages and links list of connected devices.
- **Display All and Hide All Devices**, displays and hides all devices in the device list.
- **Start All and Stop All Devices**, starts and stops all devices in the device list.

Additional information can be found in Appendix B

![Device Status Bar in Device List](image)

**Figure 3.22: Device Status Bar in Device List**
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Monitoring the Operating Temperature

The operating range for the APS devices to achieve the specified accuracy for readings is 15°C to 45°C. The APS can withstand exposure to 60 °C for brief periods. The Temperature monitor in the APS device status bar of the ParticleSpectrum window (see Figure 3.23) shows the current operating temperature of the APS device with a numeric readout and a color graphic.

![Temperature Monitoring Gauge](image)

**Figure 3.23: Temperature Monitoring Gauge**

The temperature bar changes color to indicate where the current temperature is relative to the accurate operating range:

- **Blue.** Less than 15 °C; the APS device is operating below the range where it produces accurate readings.
- **Green.** 15 °C to 45 °C; the APS device is operating in its optimum temperature range, where it produces readings meeting the specified accuracy.
- **Red.** 45 °C to 80 °C and Greater than 80 °C; the APS device is operating at a temperature so high that it might be damaged.
Chapter 3. Using Your APS

Using the Rechargeable Battery

The APS device operates from an internal rechargeable battery. From a full charge, the battery provides about four hours of continuous use. Before using your APS device for the first time, charge it for two hours.

The battery can be recharged about 400 times before the charge life starts to degrade significantly. The battery is not user replaceable. For information on replacing the battery, see “Annual Factory Calibration and Battery Replacement,” on page 5.3.

Battery performance degrades at temperatures outside the temperature range: 15 °C - 45 °C.

Monitoring the Battery Level

ParticleSpectrum receives frequent updates from the APS device on the status of the APS device’s battery. The Battery indicator in the APS device status bar of the ParticleSpectrum window shows the approximate percentage of operating time remaining before you must charge the battery.

Charging the Battery

To charge the APS device’s battery:

1. Use only the battery charger supplied with your APS device. Using a different battery charger might damage your APS device or create a safety hazard.

2. Do not charge the APS device if the temperature is higher than 45°C. Charging the APS device at a temperature higher than 45 °C might damage the APS device housing or create a safety hazard.

3. Place the APS device in the charging case (see “Opening and Closing the Charging Case,” on page 3.2). Close the lid.
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Figure 3.25: Contact Case Connection and Pressure Relief Vent

4. Plug the charger line adapter into a 100 VAC to 240 VAC mains and plug the other end into the charging case connection on the right side of the charging case. (See figure 3.25)

The charging case is air-tight. After air transport it may be necessary to relieve the pressure differential in order to open the case. To do so, loosen the Pressure Relief Vent screw until air enters the case. Then re-tighten the screw.

5. When power is applied to the charging case, the “Charger on” LED will light and the “Charging” LED will also light unless the unit is already fully charged. In addition the “Unit on” LED will light. If the unit is still paired to a powered link box the “Connect/Pair” LED will light.

6. Charge the unit until the “Charging” LED goes dark. The unit is now fully charged and ready for data collection. However, the unit can be used if not fully charged.

7. The APS can remain in the charging case with power applied to the case even when fully charged. The battery will not be damaged. The APS should be stored in the sealed charging case when not in use.

Micro USB Charging

The APS3 and APS-FPD contains a micro USB connector to allow charging and operation from a standard USB power source. (see page 3.25). CyberOptics offers an optional Power Bank and cable that can connect and extend the normal APS3 and APS-FPD battery life. Alternatively, the customer can connect any standard USB power source to this connector. However, this connector is only a power connector and does not transmit any data to or from the unit. Also, because of the extreme thinness of the APS3 and APS-FPD, only a very thin micro USB connector can attach without interfering with the carbon fiber substrate. Contact CyberOptics for more information.
Chapter 3. Using Your APS

Monitoring the Wireless Connection to the APS Device

The ParticleSpectrum application communicates with the APS device by using a Bluetooth wireless link. The wireless link has a range of up to 30 ft (10 m).

The Connection indicator in the APS device status bar area of the ParticleSpectrum window shows the wireless connection between the APS device and the link module. The connection quality is indicated by the color of the bar and the wording below the bar (see Figure 3.26):

- **Blue - Connected.** The connection between the link and APS device is good. With a good connection, the APS device is sending the maximum number of readings per second to the link module (at least 200 readings per second).
- **Grey - No connection.** Indicates that there is no connection between the APS device and link module. The entire device status bar will be greyed out.

![Connected](image1.png) ![No Connection](image2.png)

**Figure 3.26: Wireless Connection Monitor**

The Bluetooth wireless link technology used in the APS device is a low-power technology that operates in the 2.4 GHz radio frequency band. This unlicensed band is also used by many other types of devices, such as cordless phones and microwave ovens. Another 2.4 GHz device operating in close proximity could interfere with the APS system. When this happens, separating the devices by at least 6 ft (2 m) usually solves the problem.

Other factors can also affect the wireless link, such as the distance between the APS device and link, and obstacles between the device and link that block the signal. If ParticleSpectrum indicates that the connection isn't good, try moving the wireless link module a few feet closer to the APS device.

After turning off the APS device, the Connection indicator might not change to grey for a few seconds.
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Monitoring the Pressure, Laser, Fan

In addition to connection, battery, and temperature, ParticleSpectrum includes indicators for the status of the atmospheric pressure, the laser, and the fan:

- **Fan.** The APS device uses a fan to flow gases in the local atmosphere through the particle detector. When the fan is operating, this indicator is green; otherwise the indicator is grey. If the fan fails:

- **Pressure.** For the fan to work, local atmosphere must be at a minimum pressure of 0.4 atmosphere. When the pressure is high enough for good readings, the Pressure indicator is green; otherwise the indicator is red. If the APS device detects pressure dropping below 0.4 atmosphere, the fan and laser will automatically turn off to prevent damage.

- **Laser.** The APS particle detector works by scattering laser light off of the particles. The Laser indicator is green when the laser is operating; otherwise the indicator is grey.

![Device Status bar when not measuring](image1)

![Device Status bar when measuring](image2)

**Figure 3.27: Pressure, Laser, and Fan Status**
Chapter 3. Using Your APS

Reporting APS System Events

Specific APS system events are reported to ParticleSpectrum when they are encountered by the APS device. For example, an event can include a low battery or a laser failure and can stop particle measurement. The events described in this section include the following:

- Low battery
- Laser failure
- Low pressure environment

The following information lists these events and the resulting ParticleSpectrum behavior when the event is reported by the APS device.

**Low Battery**

When the battery charge decreases to the point that there is not enough power to drive the laser and fan, ParticleSpectrum is unable to perform meaningful measurements, resulting in one of the following events depending on the current state of the APS device.

- **Purging.** If a low battery condition arises while the sensor is purging, ParticleSpectrum displays a warning dialog and aborts the measurement.
- **Measuring.** If a low battery condition arises when the sensor is actively measuring, ParticleSpectrum shuts off the fan and laser, inserts a data mark in the log file, saves the log file contents, and stops the measurement.

To correct this problem recharge the sensor battery as described in Charging the Battery.

**Laser Failure**

In the unlikely occurrence of a laser failure, ParticleSpectrum is unable to perform meaningful measurements, resulting in one of the following events depending on the current state of the APS device.

- **Purging.** If a laser failure occurs when the sensor is purging, ParticleSpectrum displays a warning dialog and aborts the measurement.
- **Measuring.** If a laser failure occurs while the sensor is actively measuring, ParticleSpectrum turns off the fan and laser, inserts a data mark in the log file, saves the log file contents, and stops the measurement.

If a laser failure occurs, the APS device needs to be serviced. Do not attempt to operate it again until it is serviced. For information on sending the APS wafer to CyberOptics for servicing, refer to page 5.3 in Chapter 5.
Chapter 3. Using Your APS

Low Pressure Environment

In low pressure environments below 300 Torr (0.4 atmosphere), the APS device responds in order to prevent damage, resulting in the following event:

- **Pressure below 300 Torr.** The APS device’s fan turns off. The laser remains on and ParticleSpectrum continues to record and display data. ParticleSpectrum inserts a data mark into the log file noting that the fan was turned off due to low pressure.

![Figure 3.28: Below Pressure Warning and Fan Off](image)

When the pressure returns above 300 Torr, the fan turns on and ParticleSpectrum inserts a data mark into the log file noting that the fan is functioning.

For operation of the fan to continue running below 300 Torr, select the **Device Settings** icon. Under **Device Options** click **Allow fan to run in vacuum** button to read **ON**. This will allow continued operation of the fan in a vacuum. The **Device Status Bar** icon for the fan will turn green.

Note: The **Allow fan to run in vacuum** is specific to your device hardware. If you power down the device with the setting still **ON**, the fan will turn on the next time you power up the device. If you connect a new APS device that did not have the feature turned on previously, you will need to go into the **Device Options** to turn the **Allow fan to run in vacuum** feature back **ON**.

Note: If your APS device is not vacuum compatible, the **Allow fan to run in vacuum** will not be listed in the **Device Options**.

![Figure 3.29: Fan Operation in Vacuum](image)
Changing the Pairing Between the APS Device and Link

The APS device and link module in your kit were paired at the factory and will operate with only that particular link module. You can change this pairing, so that you can use your APS device with a different APS link module, or vice versa. Link modules for different CyberOptics WaferSense or ReticleSense products, such as Auto Gapping Sensors (AGS), are not interchangeable.

To pair an APS device and link module:

1. If you are changing the pairing of an APS device that is already paired with a link module, first unplug the currently paired link module. You can’t pair an APS device with a new link module while the currently paired link module is powered on.

2. Make sure the “Power” LED is illuminated on the link module you want to pair, and make sure the “Unit On” LED is illuminated on the APS device.

3. On the APS device, press and hold the “C” reset switch button until the “Connect Pair” LED starts to blink rapidly (about four times per second).

4. On the link module, press and hold the “New Pair” button until the “Pair Status” and “Connection Status” LED lights start to blink rapidly (about four times per second).

The LEDs on the link module and the APS device will continue to blink for a few seconds until the link and the APS device have established a new pairing, after which the LEDs will be on and no longer blinking.
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Saving Your Settings

Each time you exit the ParticleSpectrum application, it saves your current settings for Go/No-Go threshold, horizontal scale, vertical scale, and other display settings, and log file directory. The next time you start ParticleSpectrum, it restores those saved settings.

Additional Display Features

ParticleSpectrum has additional display features for APS devices that can be found in the graph window for the device. This includes hiding the graph line, minimizing device information, and adding a name for the device.

To hide the graph line:

1. A color box is assigned to the device, which is located in the upper right corner of the device information.

![Figure 3.30: Hide Graph Line](image)

2. Select the color box to hide and unhide the charted graph for the device. The ‘X’ will indicate that the charted graph is hidden.

To minimize device information:

1. A grey box with an arrow head is assigned to the device, which is located in the upper right corner of the device information.

![Figure 3.31: Minimize/Maximize device information](image)

2. Select the grey arrow box to minimize and maximize the device information.
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To add a device name:

1. A grey box with a pencil icon is assigned to the device, which is located in the upper right corner of the device information.

2. Select the grey pencil icon to enter a name for the device. You can also edit or delete an existing name. The name will be saved to the device, and will also be outputted to the .aps log file, and comma delimited (.csv) file.

![Figure 3.32: Add device name](image)
Chapter 4

Viewing Log Files

The ParticleSpectrum contains Review functionality, letting you replay log files that you previously recorded. This chapter provides instructions for performing the following tasks using Review Features:

- Review Log Files
- Working with marks
- Changing log files
- Configuring the display
- Displaying user-specified information from the log file

This chapter assumes that you are familiar with the information in Chapter 3, “Using Your APS.”

Note: ParticleSpectrum files are not backwards-compatible with previous versions of ParticleView and ParticleReview. Files that were recorded from ParticleView and ParticleReview will not be compatible with ParticleSpectrum.
Chapter 4. Viewing Log Files

Review Log Files

To review a log file:

1. Locate **Device List** or **Device Graph Window**, select the **Select Review File** folder icon.  

   ![Figure 4.1: Running the Review Feature](image)

2. Navigate to the log file you want selected and select ‘OK’ as shown in Figure 4.1 to load the log file into ParticleSpectrum.

   ![Figure 4.1: Running the Review Feature](image)
Chapter 4. Viewing Log Files

3. The **Review** window will appear below the active device as shown in Figure 4.2, displaying the controls and the graphical window used to review log files. The log file will also appear in the **Device List**.

The log file does not contain a status bar, and does not playback functionality.

![Figure 4.2: Opening a Log File](image)

You are able to reorder the **Log File** and **Device** using the **Device List Menu Settings**, by selecting **Move Up** or **Move Down**. The appearance in the graph window will also adjust the order of appearance. You are also able to **Remove** the Log File. The **device list** and **graph window** will adjust accordingly.

![Figure 4.3: Reordering Appearance](image)
Expanding Review Space

This **Review Graph Window** can be expanded to the primary work space. These same steps can also be used to expand the **Device Graph Window**.

To expand the **Review Graph Window**:

1. Locate and select the **Maximize** icon in the upper right of the graph window.
Chapter 4. Viewing Log Files

2. You can also select the *Visibility* icon in the **Device List** to hide any item, and the **Graph Window** will adjust to the maximum size. When you select the *Visibility* icon to **Show Device**, the graph window will appear for that device, and adjust to show the Graph Windows of both visible items.

To minimize the **Review Graph Window** and revert to the previous view of showing both Graph windows:

1. Locate and select the **Minimize** icon in the upper right of the graph window.

![Figure 4.5: Minimize Review Space](image)
Chapter 4. Viewing Log Files

**Working with Marks**

You can add a marker annotation, and edit an existing marker annotation in the log file.

To add/edit a marker:

1. Select the Marker Icon in the Review Graph Window.
2. The Marker Icon will turn orange, indicating you are in the add/edit mode.
3. A pencil cursor will appear when hovering over the graph. Select where you want to place the marker on the graph. To edit an existing marker, select the vertical dotted line.
4. The annotation dialog will pop up. Add/edit the annotation and select OK.
Chapter 4. Viewing Log Files

5. To exit the add/edit marker mode, select the Marker Icon. The icon will return to a grey color.

Changing Log Files

You can open a log file using the Select Review File folder icon, as described in “Running Review” on page 4.2, (see Figure 4.1). If you don’t see the file you want in the list, navigate to the location you’ve chosen for log files to be saved to. See “Changing the Log File Directory,” on page 3.16.

You can open and view multiple log files at the same time, and the main window will adjust to show multiple Graph Windows from what’s in the Device List.

Figure 4.6: Multiple Review Windows
Chapter 4. Viewing Log Files

**Configuring the Display**

You can change the way particle measurements are displayed in the graph display by selecting which particle size bin to graph, by choosing to display either particle density or particle frequency, by changing the vertical and horizontal scales, and by changing the averaging interval.

**Reviewing Measurements**

The left side of the **Review Window** for the log file display allows you to review log files in numeric form for either Density or Frequency mode. Each particle bin displays a differential measurement and a cumulative measurement.

![Figure 4.7: Frequency or Density Display](image)

**Figure 4.7: Frequency or Density Display**
To choose which information to display:

1. In the **Settings** icon, **Display Options**, select **Density** or **Frequency** from the **Measurement Type** drop down menu.

   Review displays particle measurements as either particle frequency (number of particles per unit time) or as particle density (number of particles per volume).

2. To change the averaging interval, under **Averaging Interval** select seconds or minutes for averaging the particle measurements. The new setting takes effect immediately.

The measurement values displayed in the measurement boxes are an average of the 1Hz density or frequency sample stream taken over the selected averaging interval.

![Figure 4.8: Review Display Options](image)
Chapter 4. Viewing Log Files

Reviewing Graphs and Resetting Parameters

The graph shows one line for the particle measurement data. The running average trace is blank until the first averaging interval, selected by the Averaging Interval controls, then displaying a second line on the graph.

To choose which particle bin to graph:

1. In the Display Options, choose the particle size from the Graph Particle Sizes (see Figure 4.9).

2. To choose particle density or particle frequency, in the Display Options select Density or Frequency.
   Review displays particle measurements as either particle frequency (number of particles per unit time) or as particle density (number of particles per volume).

3. Adjust the horizontal and vertical scales of the graph:
   - **Vertical Scale.** The scale is in particles per unit time when displaying particle frequency, or in particles per unit volume when displaying particle density. Particle measurement values that are too large to display with the current scale setting are truncated at the top of the graph.
   - **Horizontal Scale.** You can set the horizontal scale for the particle measurement graph. Default is set to scale by time (seconds) between the divisions on the horizontal axis, or showing Absolute Time Labels. The horizontal scale setting affects only the display of the particle measurements. The log files always record measurements at increments of one second.

4. To change the Averaging Interval choose an interval in seconds or minutes for averaging the particle measurements. The new setting takes effect immediately.
4. To change the Result Type choose ‘Average & Instantaneous’, ‘Average Only’, or ‘Instantaneous Only’. The new setting takes effect immediately.

Figure 4.9: Selecting Graph Parameters
Displaying User-Specified Information from the Log File

Operator, Tool, Station, and Comment are user-specified text in ParticleSpectrum from a ‘Record Data’ session that can be recorded in a log file along with the particle data.

To display the user-specified information for a log file in Review:

1. Choose the Settings > Show Station Information menu item.

The Station Information dialog is displayed and is read-only, as shown in Figure 4.10.

Figure 4.10: Station Information Dialog

Select OK to close the dialog.
Chapter 4. Viewing Log Files

Saving a modified Review file

Upon opening a log file for review, the Save Modified Review File icon will be inactive. When any markers are added or edited in a review file, the Save Modified Review File icon will become active.

To save a modified log file in Review:

1. Choose the Save Modified Review File icon.
2. The ‘Save data as’ window dialog will appear.
3. The Directory is set to the default folder location where the log file was recorded to. To change the directory, choose the Browse for Folder icon.
4. For File Name Options, you can choose to use the Use default file name, or Custom file name. Note: Use default file name will have the tag ‘Edited’ at the end of the file.
5. To save as a Custom file name, select Custom file name.
   a. Data Name, can be customized. The Data Name will replace the content before the serial number.
   b. Use Edited tag, by default this is checked on. Unchecking this box will remove the ‘edited’ tag at the end of the file name.
6. Click the OK button to save the log file, and the dialog window will close.

Figure 4.11: Saving a modified Review file
Chapter 5

Maintaining Your APS

This chapter discusses the following:

- Annual factory calibration and battery replacement
- Battery use and disposal

**Warning**

The edges of the APS devices are thin. It may be possible to sustain injury from these edges if the APS device is not handled with proper care.

Protection afforded by compliance EN61010-1 (2010) may be impaired if the equipment is not used as specified.

**Caution**

Use extreme care to assure that the device has proper clearances when being transported through the tool. For example, when you use the device in the tool for the first time, move the device through the tool in manual mode, visually verifying all clearances. Even when clearances are sufficient for safe APS pass-through, if the robot end-effector is taught too high, you risk crashing and damaging the APS device.

Periodic calibration and battery replacement is the only regular maintenance your APS device requires:

**Annual Calibration and Battery Replacement.**

Once a year, you should have your APS device calibrated and the internal rechargeable battery replaced by returning the APS to the CyberOptics factory.

**Cleaning the APS Device.**

If cleaning is required, wipe the outside of the APS device with IPA (isopropyl alcohol). If the APS device is used in a clean environment, follow proper procedures for this environment.
Warning

Do not immerse the APS device or the link module in liquid. Do not spill liquid on the APS device or on the link module.

Warning

The use of controls, adjustments, or procedures other than those specified in this manual may result in exposure to hazardous optical radiation.
Chapter 5. Maintaining Your APS Device

Annual Factory Recalibration and Battery Replacement

Every 12 months, you should return your APS device to the CyberOptics factory, where we will calibrate the APS wafer and replace the internal rechargeable battery. You can find the date when the APS device was last calibrated at the factory by choosing the **Info Icon** in the ParticleSpectrum application.

![Figure 5.1: The About your APS Dialog](image1.jpg)

When the date for calibration approaches, the ParticleSpectrum application will occasionally notify you by displaying the APS device calibration status dialog, as shown in figure 5.2.

![Figure 5.2: APS Calibration Status Dialog](image2.jpg)
Chapter 5. Maintaining Your APS Device

If you drop the APS device or suspect that it is no longer in calibration, contact CyberOptics technical support. (see “Technical Support,” on page 2.11.)

Battery Use and Disposal

Your APS device contains lithium-polymer battery. To avoid damage to the APS device, use the supplied charger only. Do not charge the APS device at temperatures outside the specified range (0 C to 45 C). Do not incinerate or dispose of the APS device into fire. Do not immerse the APS device when cleaning or spill liquids on the APS device.

For proper batter disposal, please return the APS device to CyberOptics.

Contact customer support. (see “Technical Support,” on page 2.11)
Specifications APS

WaferSense APS Features

Wireless, wafer-shaped and battery-powered
Available in 200mm and 300mm.

Easy-to-use software: ParticleSpectrum
ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.
 Highly accurate: Measures particles greater than 0.15μm
 Less than 5 false counts per hour

Durable housing: Carbon fiber substrate coated with Parylene C. SEMI standard notch.
Lightweight: 200 grams (200mm), 270 grams (300mm)
Airflow 0.1CFM (2.8L/min)@ 1 atmosphere
Operating pressure 0.4 to 1.6 atmosphere
Operating internal temperature 15 deg C to 45 deg C non-condensing
Charging operating temperature range: 0 deg C to 45 deg C
Battery-operation >1 hour per charge. Battery performance degrades at temperatures outside the optimum operating temperature range. Inductive wireless charging and hands-free operation. Typical battery recharge cycles: approximately 400

Link Box: Bluetooth, Class 1, 2.4GHz connected via USB.
Chapter 6. Specifications

Systems requirements: Operating Systems - Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Particle measurement device, charging clean case, carrying suitcase, USB communications link module, USB cable, application software CD, calibration certificate and start guide.

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APS is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications

Specifications APS2

WaferSense APS2 Features

Wireless, wafer-shaped and battery-powered
Available in 150mm, 200mm, 300mm. Model #8022291, 8022292, 8022293 respectively.

Easy-to-use software: ParticleSpectrum
ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.

Highly accurate: Measures particles greater than 0.14μm Size channels: Reports particles in 0.1μm and 0.5μm bin sizes. (Consult factory for other bin sizes.)

Less than 5 false counts per hour

Durable housing: Glass filled PEEK with carbon fiber composite substrate coated with Parylene C. SEMI standard notch on 200mm, 300mm. SEMI standard flat on 150mm.

Lightweight: 124 grams (150mm), 170 grams (200mm), 200 grams (300mm)

Airflow 0.07CFM (2L/min)@ 1 atmosphere

Operating pressure 0.4 to 1.6 atmosphere

Operating internal temperature 15 deg C to 45 deg C non-condensing

Charging operating temperature range: 0 deg C to 45 deg C

Battery-operation >1 hour per charge. Battery performance degrades at temperatures outside the optimum operating temperature range. Inductive wireless charging and hands-free operation. Typical battery recharge cycles: approximately 400

Link Box: Bluetooth, Class 1, 2.4GHz connected via USB.

Systems requirements: Operating Systems - Windows XP, Vista, Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Particle measurement device, charging clean case, carrying suitcase, USB communications link module, USB cable, application software CD, calibration certificate and start guide.

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APS2 is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications
Chapter 6. Specifications

Specifications APS3

WaferSense APS3 Features

Wireless, wafer-shaped and battery-powered

Available in 300mm. Model #8025754.

Easy-to-use software: ParticleSpectrum

ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.

Highly accurate: Measures particles greater than 0.14μm Size channels: Reports particles in 0.1μm and 0.5μm bin sizes and larger particles in 2, 5, 10, and 30μm bin sizes.

Less than 5 false counts per hour

Durable housing: 300mm carbon fiber substrate coated with Parylene C. SEMI standard notch.

Lightweight: 185 grams (300mm)

Airflow 0.07CFM (2L/min)@ 1 atmosphere

Operating pressure 0.4 to 1.6 atmosphere

Operating internal temperature 15 deg C to 45 deg C non-condensing

Charging operating temperature range: 0 deg C to 45 deg C

Battery-operation >1 hour per charge. Battery performance degrades at temperatures outside the optimum operating temperature range. Inductive wireless charging and hands-free operation. Typical battery recharge cycles: approximately 400

Link Box: Bluetooth, Class 1, 2.4GHz connected via USB.

Systems requirements: Operating Systems - Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Particle measurement device, charging clean case, carrying suitcase, USB communications link module, USB cable, application software CD, calibration certificate and start guide.

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APS3 is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications

Specifications APS-FPD

PanelSense APS-FPD Features

Wireless and battery-powered
Available in 135mm x 137mm x 5.0mm (MAX), (L x W x H). Model #8025826.

Easy-to-use software: ParticleSpectrum
ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.

Highly accurate: Measures particles greater than 0.14μm Size channels: Reports particles in 0.1μm and 0.5μm bin sizes and larger particles in 2, 5, 10, and 30μm bin sizes.

Less than 5 false counts per hour

Durable housing: 30% Glass filled PEEK

Lightweight: 121g (± 7%)

Airflow 0.07CFM (2L/min)@ 1 atmosphere

Operating pressure 0.4 to 1.6 atmosphere

Operating internal temperature 15 deg C to 45 deg C non-condensing

Charging operating temperature range: 0 deg C to 45 deg C

Battery-operation >1 hour per charge. Inductive wireless charging and hands free operation. Micro-USB power bank connector, power bank provides >10 hours of additional operation

PanelSense Link: Bluetooth, Class 1, 2.4GHz SENA link

Systems requirements: Operating Systems - Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Two APS-FPD devices, each with charging clean cases and carrying suitcase. Four power banks, SENA communications link module, extended range antenna and application software are also included.

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APS-FPD is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications
Chapter 6. Specifications

Specifications APSR

ReticleSense APSR

Wireless, reticle-shaped and battery-powered
Available in reticle form factor. Model #8022103.

Easy-to-use software: ParticleSpectrum

ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.

Highly accurate: Measures particles greater than 0.14μm Size channels: Reports particles in 0.1μm and 0.5μm bin sizes. (Consult factory for other bin sizes).

Less than 5 false counts per hour

Durable housing: Glass-filled Peek with polycarbonate cover. Dimensions, chamfers, and squareness conform to SEMI standards for 6 inch reticles.

Weight: 312 grams +/-15g

Airflow 0.07CFM (2L/min)@ 1 atmosphere

Operating pressure 0.4 to 1.6 atmosphere

Operating internal temperature 15 deg C to 45 deg C non-condensing

Charging temperature range: 0 deg C to 45 deg C

Battery-operation >1 hour per charge. Battery performance degrades at temperatures outside the optimum operating temperature range. Inductive wireless charging and hands-free operation. Typical battery recharge cycles: approximately 400

Link Box: Bluetooth, Class 1, 2.4GHz connected via USB.

Systems requirements: Operating Systems - Windows XP, Vista, Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Particle measurement device, charging clean case, carrying suitcase, USB communications link module, USB cable, application software CD, calibration certificate and start guide.
Chapter 6. Specifications

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APSR is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications

Specifications APSRQ

ReticleSense APSRQ

Wireless, reticle-shaped and battery-powered
Available in reticle form factor. Model #8022290.

Easy-to-use software: ParticleSpectrum
ParticleSpectrum: Displays real-time numeric and visual feedback, cumulative or differential counting modes and density or frequency modes. Replays log file data for review and analysis.

Highly accurate: Measures particles greater than 0.14μm Size channels: Reports particles in 0.1μm and 0.5μm bin sizes. (Consult factory for other bin sizes.)

Less than 5 false counts per hour

Durable housing: Quartz outer frame. Rear surface of quartz frame is an uninterrupted quartz surface. Glass-filled PEEK inner housing. Dimensions, chamfers, and squareness conform to SEMI standards for 6 inch square reticles.

Bar-codes and alignment marks allow placement in most scanners and steppers.

Weight: 312 grams +/-15g

Airflow 0.07CFM (2L/min)@ 1 atmosphere

Operating pressure 0.4 to 1.6 atmosphere

Operating internal temperature 15 deg C to 45 deg C non-condensing
Charging temperature range: 0 deg C to 45 deg C

Battery-operation >1 hour per charge. Battery performance degrades at temperatures outside the optimum operating temperature range. Inductive wireless charging and hands-free operation. Typical battery recharge cycles: approximately 400

Link Box: Bluetooth, Class 1, 2.4GHz connected via USB.

Systems requirements: Operating Systems - Windows XP, Vista, Windows 7, 8 or 10. One free high-powered USB 1.1 or USB 2.0 port.

Product components: Particle measurement device, charging clean case, carrying suitcase, USB communications link module, USB cable, application software CD, calibration certificate and start guide.

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APS2 is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications

Calibration Factory: recalibration recommended annually. Consult factory for large particle calibration.

Laser - The APSRQ is a Class 1 laser product employing an embedded Class 3B laser whose radiation is fully enclosed and not exposed to the user.
Chapter 6. Specifications

CyberOptics is in compliance testing for listed markings for APS3 and APS-FPD

Compliant to the Following Directives and Standards:

<table>
<thead>
<tr>
<th>CE Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directive</td>
</tr>
<tr>
<td>Low Voltage Directive 2014/35/EU</td>
</tr>
<tr>
<td>EMC Directive 2014/30/EU</td>
</tr>
<tr>
<td>Radio Equipment Directive 2014/53/EU</td>
</tr>
<tr>
<td>RoHS Directive 2011/65/EU</td>
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<table>
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<tr>
<th>North American Compliance</th>
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<tr>
<td>FCC 15.109 Class B</td>
</tr>
<tr>
<td>FCC 15.247 Intentional radiators</td>
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<table>
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<th>Environmental Conditions</th>
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</tr>
<tr>
<td>Altitude 2000M</td>
</tr>
<tr>
<td>Relative Humidity &lt;80%</td>
</tr>
<tr>
<td>Overvoltage Category II</td>
</tr>
<tr>
<td>Pollution degree 2</td>
</tr>
</tbody>
</table>

Directives and Standards for APS2, APSR, APSRQ, APS3, and APS-FPD models

Table 6.1: Compliance with Directives and Standards
### Table 6.2: China RoHS Declaration

<table>
<thead>
<tr>
<th>Part Name</th>
<th>铅 (Pb)</th>
<th>水银 (Hg)</th>
<th>锗 (Cd)</th>
<th>六价铬 (Cr(VI))</th>
<th>多溴化苯 (PBB)</th>
<th>多溴化二苯醚 (PBDE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>电子 (Electronics)</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>电缆及电缆组件 (Cables &amp; Cable Accessories)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>塑料零件 (Plastic parts)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>金属五金 (Metal Hardware)</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

本表格依据 SJ/T 11364 的规定编制
(This form is prepared in accordance with the provisions of SJ/T 11364)

O = 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下 (indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572).

X = 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求 (indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572).
Large Particle Detection

The WaferSense APS2, APS3, ReticleSense APSR, APSRQ, and PanelSense APS-FPD sensor are capable of large particle measurements. WaferSense APS does not have Large Particle Detection capability. Throughout this Appendix, all devices in this family will be referred to as “APS.”

General information about large particle detection: In some circumstances it is desirable to sense only large particles and not detect small particles. This may be the case in certain photolithography tools. The APS, with the large particle, has two detector channels. Each has separate optics and amplifiers. One channel is for small particles and another for large particles.

In the normal small particle mode, the APS uses a high gain detector channel. When the large particle mode is selected, a second detector channel is enabled that has much lower gain and is optimized and calibrated for particles larger than 2 microns. The two different modes cannot be viewed at the same time. Also, since large particles are typically counted at a much lower rate than small particles, the large particle mode only counts particles in frequency mode.

Because the large particle scale covers a wider range of particle sizes, there are 4 bins. The bin sizes are for particles larger than 2, 5, 10 and 30 microns.

The APS large particle mode is calibrated by measuring dry glass micro-spheres dispersed via a venturi aspiration technique. As with all airborne particle detectors, the size is calibrated to an “equivalent” test particle, in this case glass micro-spheres. Real world contamination particles may have non-spherical shapes and may respond differently than glass micro-spheres.
Appendix A. Large Particle Detection Device

Large Particle Mode Selection
Large Particle Mode is selected on the Settings menu using the Large Particle Mode menu button. When the menu button is selected “on” you are in Large Particle Mode and the ParticleSpectrum display will show four bins as shown in Figure A.2. Large Particle Mode selection is in ParticleSpectrum and is used to select the mode for particle measurement. Review conforms to the mode the log file was recorded in.

Note: If your APS device is not Large Particle compatible, the Large Particle Mode will not be listed in the Device Options.

Figure A.1: Large Particle Mode Selection
Reading the ParticleSpectrum Display

In Large Particle mode, you will have the same Settings Menu but the **Graph Particle Sizes** will change to 4 bin sizes. You will also no longer have selection control between Density and Frequency, because all large particle charts display using frequency mode (the number of particles per unit time). All other display controls operate the same in large particle mode.

Large Particle Chart

For large particles mode differential particle measurements are charted, whereas in the small particle mode cumulative particle measurements are charted. Differential particle measurements assign and chart a given particle to one and only one “bin” based on the particles size. Cumulative particle measurements include all particles of a given size or larger. ParticleSpectrum charts only one bin size on the graph.

![Figure A.2: Large Particle - ParticleSpectrum Display](image)
Go/No-Go Threshold dialog
The large particle Go/No-Go threshold dialog (see Figure A.3) functions are almost identical to the small particle dialog. The difference is the Threshold Type selection. For large particle Threshold Type selection the choice is only Frequency.

Figure A.3: Go/No-Go Threshold dialog
Viewing the log file

In Review, the display will switch to the particle mode in which the log file was generated. When a log file is recorded in ParticleSpectrum in large particle mode and opened in Review, the display will configure to large particle mode (see Figure A.4). Also, the Go/No-Go Threshold dialog will open to the appropriate particle mode format.

![Figure A.4: Review Large Particle Display](image-url)
PanelSense™ APS-FPD

The PanelSense APS-FPD sensor is primarily used for particle detection in Flat Panel Display manufacturing processes.

**General information about PanelSense APS-FPD:** The APS-FPD operates the same as an APS, but is in a different form factor and comes with additional components that enable simultaneous measurement using multiple APS-FPD devices.

General operation of the APS-FPD device and reviewing log files are the same as APS. See chapters 3, 4, and 5.

This Appendix explains the installation and operation of multiple APS-FPD devices being used simultaneously.

- APS-FPD components
- Charging the battery and external battery packs
- Installing the ParticleSpectrum software and SENA Link
- Pairing the APS-FPD to the SENA Link in ParticleSpectrum
- Multiple device windows and linking devices
- Using ParticleSpectrum with linked devices
- Log files of linked devices
Appendix B. PanelSense APS-FPD

**APS-FPD Components**

The APS-FPD and its components are as follows:
- Two APS-FPD units
- Two Charging Cases with charging cables
- One SENA link with Extended Range Antenna
- One 3 meter USB cable for PC to SENA Link
- ParticleSpectrum Software installation CD
- Two USB link cables for APS-FPD to External Battery pack
  
  **Note:** The link cable is designed specifically for connection between the APS-FPD device and the External Battery Pack. Using any other cable not specified may cause damage to the APS-FPD device.
- Four External Battery Packs with micro USB charging cables
  - Two USB plug adapters (used with External Battery Pack with micro USB charging cable)
  - Four sets, Universal Plugs for USB Plug adapters

![Image of APS-FPD Components](image)

*Figure B.1: APS-FPD Components*
Appendix B. PanelSense APS-FPD

Charging the Battery and External Battery Packs

The Li-Ion battery in the APS-FPD devices must be fully charged before first use. A discharged battery can take several hours to charge. Connect the battery charger to the charging case. Plug the charger into a 100-240VAC outlet. The “Charger On” and “Charging” status lights will remain on while the unit is charging. When the “Charging” light goes off, the battery is fully charged.

- Charging the External Battery Packs: The battery pack comes partially charged, but should be charged completely before using. Use the included USB charging cable, and connect the micro USB end to the battery pack. Connect the USB end to the USB Plug Adapter with appropriate Universal Plug. Active charging is indicated by a flashing LED. The number of lit LEDs show the current charge level of the battery pack during charging. When fully charged, all LEDs are on.

Installing the ParticleSpectrum Software

To install and run the APS software ParticleSpectrum, your computer must have the following:

- Windows 7 (32-bit or 64-bit), Windows 8, Windows 10 operating systems
- One free high-power USB 1.1 or USB 2.0 port

To install the APS software, do not plug in the SENA link before you start. The software must be installed first using the following steps as listed in Installing the WaferSense APS Software,” on page 2.2.
Installing the SENA Link Hardware

Before starting the wireless link installation, complete the Installing the WaferSense APS Software,” on page 2.2. The ParticleSpectrum Software must be installed prior to connecting and installing the SENA Link. Locate the SENA Link USB module.

Note: If remote positioning of the SENA Link is desired, use the included 3 meter USB cable. If extended radio range is desired, use the extended range antenna on the end of the SENA Link module.

If your computer has an onboard Bluetooth radio, you must disable it in the Device Manager before installing the SENA Link.

To disable/enable onboard Bluetooth:

1. Right click on the Windows Start button and select “Device Manager”
2. Locate the Bluetooth drop down menu and select the Bluetooth Radio for your computer. Note: You can ignore Microsoft Enumerator and Microsoft Support Drivers, if listed.

3. Right click on the Bluetooth Radio, and select “Disable Device”
Appendix B. PanelSense APS-FPD

To install the SENA link:

1. Connect the SENA Link module to a high power USB port directly to your PC

2. Windows will recognize the SENA Link module and the “Found New Hardware” wizard will appear. Select “Install the software automatically (Recommended)”, if prompted.

Note: Use Windows generic Bluetooth Radio Driver only. Other Drives (BlueSoleil, etc.) may not be compatible with ParticleSpectrum.

Pairing APS-FPD to the SENA Link in ParticleSpectrum

To complete the installation, verify that the APS-FPD and SENA Link can communicate and connect/pair.

1. Run the ParticleSpectrum application by navigating to Start Menu > Programs > CyberOptics > ParticleSpectrum

2. To connect/pair the APS-FPD, ensure the device is turned on. Locate the “C” button on the unit and press with a key to initiate pairing mode.

Figure B.5: APS-FPD Pairing
Appendix B. PanelSense APS-FPD

3. Select the “Pair New WaferSense” button in ParticleSpectrum

4. Select the “Yes” in the following menu to continue pairing.

Figure B.6: APS-FPD Pairing in ParticleSpectrum
Appendix B. PanelSense APS-FPD

5. ParticleSpectrum will recognize the APS-FPD unit and will confirm that the sensor is paired successfully. **Note: Ignore any Windows Bluetooth pop up messages about pairing Bluetooth devices or “Configuring Bluetooth Services”**

6. If you are unable to pair the device, repeat the Connect/Pair process (steps 1-4)

7. If the Device List does not refresh after pairing the APS-FPD unit, select the “Search for Devices” button from the main window. The Device List will populate with the newly paired APS-FPD unit.

**Note: You can also restart the ParticleSpectrum application and the Device List will populate with the paired device(s).**

This completes the installation of your APS-FPD system.

*Figure B.7: APS-FPD Pairing in ParticleSpectrum*
Appendix B. PanelSense APS-FPD

Multiple Device Windows and Linking Devices

ParticleSpectrum enables APS-FPD devices to have the ability to run simultaneously. The APS-FPD devices can be shown as individual device windows, or linked together where they can be recorded on the same graph.

To run devices as multiple device windows:

1. Normal operation as listed in Chapter 3 on page 3.4 should be followed if you would like units to be run individually. You can also select the Start All Devices icon in the Device List menu to initiate all active devices.

   Note: Settings for each device will need to be set, as they are independent from each other. Recorded data will be saved as individual log files, and individual CSV files.

![Figure B.8: Multiple Devices Windows](image)
Appendix B. PanelSense APS-FPD

You are able to link sensors by type in ParticleSpectrum. By linking devices, you are able to chart multiple devices on the same graph. Settings and other functions affect both devices.

To link devices:

1. From the Device List window, select Manage Device List.

2. The Select Sensors menu will pop up. You can Refresh List, and Link Sensor Types by Type. The active and connected devices will be listed below. You can select the individual devices you want to link, or check Select All. Once the devices have been selected, click the Link Sensor Type by Type icon, and click OK to close the menu.

Note: You are able to link up to six sensors together. More than six sensors linked may cause performance issues

Figure B.9: Linking Devices in ParticleSpectrum
3. The Graph Window and the Device List Window will update to show the devices are now linked.

The user interface changes when devices are linked together. In the **Graph Window** for the linked devices, each device is automatically assigned a line color that will be charted on the graph. There is also a small menu bar at the top of the devices that provides visibility functions for descriptions and charting.

**Figure B.10: Linking Devices Interface**
Using ParticleSpectrum with Linked Devices

Normal operation as listed in Chapter 3 on page 3.4 should be followed for starting and recording a measurement run. All settings options (Measurement Options, Device Options, Display Options, Graph Options, and Output Folder) affect all devices that are linked together.

To run linked devices:

- Begin a measurement run by selecting the Start icon. The devices will begin to chart on the graph with the assigned color associated with the device. When the measurement run is complete, Average and Instantaneous charting results will be shown for all linked devices.
- The Particle Measurements Menu in the Device Window will give you the same options to review the Averaged Results, Instantaneous Results, and Accumulated Particle Counts. You will also be able to view all devices, or select the specific device.

![Figure B.11: Using Linked Devices](image)
Log Files of Linked Devices

Linked devices follow the same processes and procedures as listed in Chapter 4 on page 4.1. When selecting a log file for review, you have the option to load the linked log file or the individual log files of each device. When you record the data to a CSV, each column is designated by Name (if added), Device Type, and Device Serial Number.

To view Linked Log files for review:

- The initial Select recorded data for review window pops up, there is a link icon located in the bottom left corner that says Files recorded together are linked. The Name is listed and the Device Serial Number(s) are grouped together.
- Select the file, and click OK.

To view Linked Log files for review as individual files:

- Select the Link Icon, to list files individually. You can also select the Link Icon again to view Files recorded together.
- Select the file, and click OK.

Figure B.12: Linked Log files
Appendix B. PanelSense APS-FPD

To view Linked CSV file:

- Navigate to the folder directory the recorded files were saved to
- The top row of the CSV file will list the Device Name with Device Serial Number.

![Figure B.13: Linked CSV files](image-url)
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