

# Hardware Guide

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## Apogee Aspen Series



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**PLEASE READ THIS INFORMATION FIRST**

1. If the equipment is used in a manner not specified by Andor, the protection provided by the equipment may be impaired.
2. Before using the system, please follow and adhere to all warnings, safety, manual handling and operating instructions located either on the product, supplied documentation, or in this guide.
3. Keep this guide in a safe place for future reference.
4. There are no user-serviceable parts inside the product and the enclosure must not be opened. Only authorised service personnel may service this equipment.
5. This equipment has not been designed and manufactured for the medical diagnosis of patients.
6. Only the correctly specified mains supply should be used.
7. Replacement fuse must be of same type and rating.
8. Only the AC/DC external power supply provided with the product should be used.
9. If your camera has a protective earth which is connected through the earth pin of the external power supply, ensure that this is plugged into the buildings earth system via the mains socket. Do not tamper with any earthing measures.
10. Only the power supply cord provided with the product should be used. Should this not be correct for your geographical area, contact your local representative.
11. Make sure the power supply cord is located so that it will not be subject to damage and is accessible in case emergency disconnection is required. If replacement of the detachable power supply cord is required, ensure replacement is of same type and rating.
12. Ensure that the fans are not blocked and that there is clearance (100mm) to enable sufficient airflow for cooling.
13. While running an experiment, try to keep room temperature as stable as possible.
14. Performance of the system may be adversely affected by rapidly changing environmental conditions or operation outside of the operating conditions specified in Technical Specifications (Section 8).
15. This product is not designed to provide protection from ionising radiation. Any customer using this product in such an application should provide their own protection.
16. This is a Class A product. In a domestic environment this product may cause electromagnetic interference, in which case the user may be required to take adequate measures.
17. Shielded I/O cables must be used when operating this equipment.
18. Pollution Degree 2. Normally only non-conductive Pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
19. Your product is a precision scientific instrument containing fragile components. Always handle it with care.
20. Do not wet or spill liquids on the product, and do not store or place liquids on the product.
21. If spillage occurs on the product, switch off power immediately, and wipe off with a dry, lint-free cloth.
22. If any ingress of liquids has occurred or is suspected, unplug the mains cables, do not use, and contact Customer Support.
23. Do not expose the product to extreme hot or cold temperatures.
24. Do not expose the product to open flames.
25. Do not allow objects to fall on the product.
26. Refer to Section 6 for Cleaning information.



This symbol means that the surface it is applied to may become hot. Under normal conditions the surface will not exceed 75°C in an ambient of 25°C. However, in a fault scenario (such as insufficient ventilation clearance), the surface may reach over 120 °C in a maximum ambient of 25°C.

## SECTION 1: INTRODUCTION

Thank you and congratulations for purchasing your Andor Apogee Camera. This Owner's Operating Manual will help you discover, install and use your camera with the Microsoft Windows family of operating systems. USB and Ethernet camera systems are supported by the Windows 7 32 and 64 bit operating systems.

Please refer to your software guide for information on camera control and imaging software.

### 1.1 TECHNICAL SUPPORT

If you have any questions regarding the use of this equipment, please contact the representative\* from whom your system was purchased, or:

#### Europe

Andor Technology Ltd  
7 Millennium Way  
Springvale Business Park  
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Tel. +44 (0) 28 9023 7126  
Fax. +44 (0) 28 9031 0792

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Tel: +86 (0)10 8271 9066  
Fax. +86(0)10-8271 9055

[www.andor.com/contact\\_us/support\\_request](http://www.andor.com/contact_us/support_request)

\* The latest contact details for your local representative can be found on our website.

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## 1.5 ABOUT ANDOR APOGEE CAMERAS


Apogee Imaging Systems started up in 1993 in Tucson, Arizona providing imaging solutions to the astronomy market. The growing company relocated to Northern California in 2001. Apogee was acquired by Andor Technology Ltd., in October 2013 with the Apogee camera range taking full advantage of Andor’s manufacturing facilities and quality systems. Apogee cameras have been used for high-end astronomical applications like capturing the first images of optical counterparts of gamma ray bursts, plus thousands of discoveries of comets, near-Earth asteroids and extra-solar planets. The Apogee range of cameras will always be on the brink of discovery with the latest cutting edge technology.






## 1.6 REVISION HISTORY

Version	Released	Description
1.0	05 Jan 2015	Initial Release.
1.1	02 Sep 2015	Minor updates to document presentation throughout. Updates to show product as Apogee Aspen Section 5.2 enhanced to show greater clarity of power and signal cable connection. Updated office contact details
1.2	19 Aug 2016	Removal of external shutter connection from mechanical drawings and other images. General updates throughout. Removed references to Windows XP and Vista. Updated maximum exposure to 95 minutes.
1.3	23 Sep 2016	Corrected filter wheel mounting instructions to align with revised filter wheel assembly (Section 9.5)
1.4	23 Oct 2017	Mech drawings updated and colour of anodizing changed to that of current product.

## 1.7 SUPPLIED COMPONENTS

### 1.7.1 STANDARD SUPPLIED ITEMS

Description		Quantity
	<p><b>Apogee Aspen Camera</b> (Camera housing and CCD sensor model as ordered)</p>	1

	<p><b>Starter Kit CD</b></p>	1		<p>Ethernet Cable</p>	1
	<p><b>USB Cable (15 ft)</b></p>	1		<p><b>Country specific power cable</b></p>	1
	<p><b>Power Supply</b></p>	1			

### 1.7.2 OPTIONAL ITEMS

There is a wide range of optional accessories for the Apogee Aspen. These may be specified at the time of ordering or purchased at a later date from Andor. Please contact us, or refer to our website [www.andor.com](http://www.andor.com) for further information.

- Flange Adapters
- Lens Adapters
- Telescope Adapter
- USB and Fibre Optic Range extender
- Filter Wheels (inc. range of filters)

**Note:** Only use accessories that are specified or supplied by Andor as performance cannot be guaranteed using other accessories.



## SECTION 2: PRODUCT OVERVIEW

The following section provides a brief overview of the external features and connections of the Aspen series of cameras.

### 2.1 INTRODUCING THE ANDOR APOGEE ASPEN

The Aspen is the latest in design innovation in the Apogee Camera range that follows the successful Alta camera family. Aspen increases cooling performance in a smaller package, improves stray light baffling and adds a Network interface with a built-in web server and sets a new standard in shutter reliability. With a range of high speed sensors running at up to 8 Mhz, low noise and very large format (16 Megapixel) sensor options, it is possible to meet the exacting needs for an exceptional range of applications from astrophotography, sky surveys and radiology as well as demanding life science applications.



Figure 1: The Andor Apogee Aspen

## 2.2 DESCRIPTION OF EXTERNAL FEATURES

Cooling fans with  
thermoelectric coolers  
located below



Figure 2: View of Aspen showing Cooling fans



Figure 3: View of Aspen Shutter and Connection Panel

## 2.2.1 POWER AND SIGNAL CONNECTIONS

### WARNINGS

- **Do not connect the camera to a PC before installing the drivers. If you do and the “Add New Hardware Wizard” appears, please select the Cancel button. Never connect or disconnect the camera from an operating computer.**
- **For connection information refer to Section 5**

### Power

Provides power to the camera from the mains supply via the supplied external power supply unit.

### USB

For the standard connection of the camera to the control PC

### Status LEDs

The two LEDs on the side of the cameras can be programmed to show status of a variety of the camera functions, such as the camera has reached the set temperature, the shutter is open, or the camera is waiting for an external trigger. Alternatively, the LEDs can be turned off if you are concerned about stray light.

### Camera I/O Port

Apogee camera systems provide an 8 pin Mini DIN connector, enabling various hardware signals to be controlled by the device. Five of the eight pins are programmable, and of the remaining pins, pin 6 is for EEPROM Write Protect, pin 8 is ground and pin 7 is a +12 volt line. Each of the five pins may be programmed to be either a specific fixed- function I/O pin, or else a general purpose and user-defined I/O pin.

### I/O Pin-out

The programmable pins of the Apogee I/O port are 3.3V, LVTTTL signals.

The pin out is shown in the following illustration. The numbers correspond to the I/O pin numbers, defined in the table below:

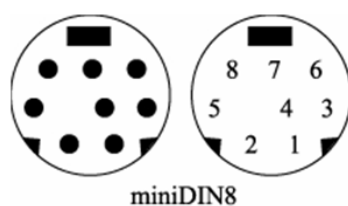


Figure 4: I/O Pin outs

Pin	Description
1	LVTTTL Signal 1
2	LVTTTL Signal 2
3	LVTTTL Signal 3
4	LVTTTL Signal 4
5	LVTTTL Signal 5
6	Reserved
7	+12 volt power from the camera head
8	Ground

Each LVTTTL signal of the I/O Port has two modes of operation. The signal may be used as a general purpose and user-defined I/O pin, or it may be configured to perform a predefined/fixed-function operation. After initialization, the I/O Port defaults to having the signals set as user-defined.

The ICamera2 property, IoPortAssignment, is used to control whether each signal is set to the user-defined or predetermined setting. For user-defined signals, the IoPortDirection property determines whether the signal is an input or output. Please refer to the documentation for these properties for additional details regarding their operation.

The fixed function descriptions of each pin are as follows:

**Pin 1 – Trigger Input** – Used to initiate triggered exposures (both single exposures and sequences). When the CameraMode property is set to Apn\_CameraMode\_ExternalTrigger, the ICamera2 interface object will automatically enable this pin to be used as an input for an external trigger signal. Applications should still call the Expose method to put the camera system into a state where it is waiting for the trigger to arrive. Triggered exposures use the duration parameter that is specified in the Expose method to program the camera's exposure timer. Internally, the Apogee camera will automatically continue flushing the sensor until the triggered exposure begins.

### **Ethernet**

Enables connection and control of camera via an Ethernet connection, for example where the control PC cannot be located close to the camera. The built-in web server supports operation at up to 2 Mhz over longer distances.

## SECTION 3: INSTALLING YOUR ASPEN CAMERA SOFTWARE








Before attempting to connect or operate your camera, make sure you have the correct software installed on your computer. Once the software is installed as outlined in this section, proceed with installation of the hardware.

### 3.1 INSTALL/UPDATE APOGEE CAMERA DRIVER

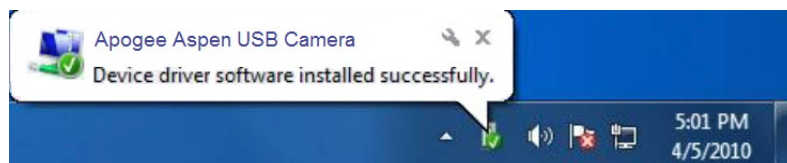
#### 3.1.1 INSTALLATION EXAMPLE FOR WINDOWS VISTA/WINDOWS 7 ONWARDS

**WARNING: Do not connect your camera to a PC before installing the drivers. If you do and the “Add New Hardware Wizard” appears, please select the Cancel button.**

1. Make sure your Windows user account has administrator privileges.
2. Double click on the **setupApogeeSoftware**.

 AIS-69x32	01/06/2012 20:30	Icon	7 KB
 appSwInstall_x86	25/07/2014 08:09	Windows Installer ...	5,629 KB
 appSwInstall_x861	25/07/2014 08:09	Cabinet File	5,388 KB
 ApogeeUsb.32bit	25/07/2014 08:09	Windows Installer ...	2,674 KB
 ApogeeUsb.64bit	25/07/2014 08:09	Windows Installer ...	3,440 KB
 autorun	01/06/2012 20:30	Setup Information	1 KB
 <b>setupApogeeSoftware</b>	25/07/2014 08:09	Application	370 KB

3. If you see an error dialog indicating that another Apogee application has been detected, then please refer to section 3.4. After removing v3 software, execute the file setupApogeeSoftware.exe again.
4. Follow the installation wizard instructions.
5. Upon successful driver installation connect your camera to the PC. Watch the message balloon in the lower right corner state the OS, search for, and successfully install the drivers for the Apogee USB camera.



6. The drivers for your Apogee camera are now installed on your PC.

## 3.2 INSTALL THE CAMERA CONTROL SOFTWARE

The following sections outline the steps for installation of MaxIm DL software. For other software such as Windows SDK for Apogee, refer to the information supplied for guidelines on installation instructions.

### 3.2.1 INSTALL MAXIM DL

- Your Apogee camera will run at its best when you use MaxIm DL image capture and processing software, developed by Diffraction Limited. If you will be using the MaxIm DL software, we recommend you install it prior to setting up your Apogee camera. Please see the MaxIm documentation for specific instructions related to installation of this software.
- Apogee cameras are supported by MaxIm DL version 3.21 and beyond.
- MaxIm DL and other 32-bit applications require the 32-bit installer.
- For other software, please refer to the accompanying installation and user documentation.

## 3.3 UNINSTALLING APOGEE SOFTWARE

We recommend use of the Windows control panel to ensure that the Apogee software has been completely removed.

## 3.4 USING YOUR ASPEN CAMERA ON A NETWORK

Apogee Aspen cameras can be connected to a PC via a network connection. Camera network settings can be configured through any common web browser.

### 3.4.1 SETTING UP YOUR ASPEN CAMERA FOR USE ON A NETWORK

If you do not already know the camera IP address, you can use the ApogeeCameraInfo utility to help locate the camera.

1. Aspen cameras ship with DHCP turned on by default, so in order for the PC to recognise the camera via Ethernet, the camera must be on a network with a router to assign it an IP address.
2. Once you have obtained the IP address, enter it into the Address bar of your internet browser.
3. The camera will reply with its own web page, as shown below.



#### The Home page

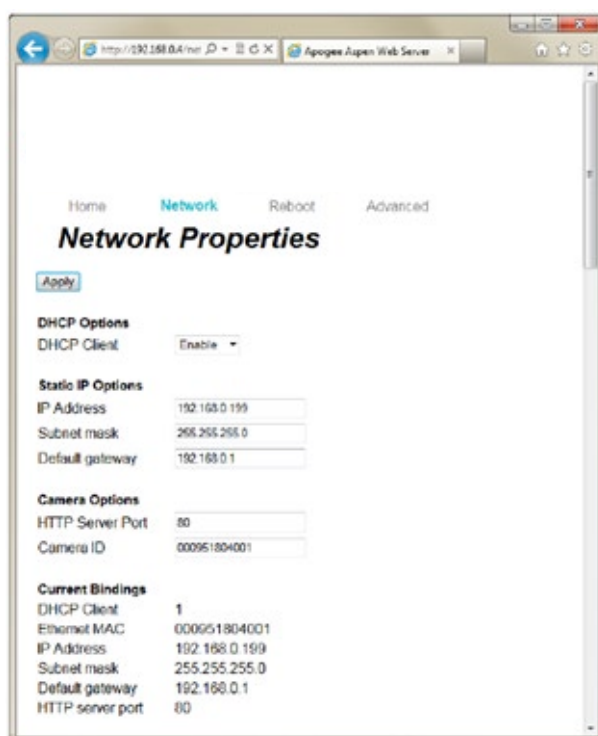
4. The Home page shows the network settings and picture count of the camera. There are also links to adjust the network settings, reboot the interface, and adjust advanced settings. When you click one of these links, the camera will present you with an authentication dialog box:



- The default user name is **admin**.
- The default password is **password**.
- Enter these into their respective fields and press the OK button.

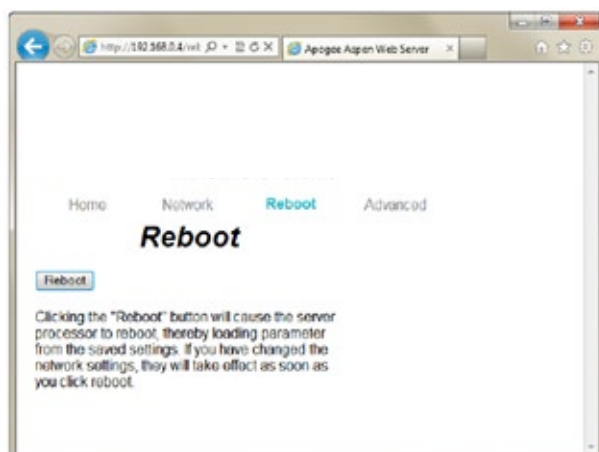
### The Network page

5. The Network page contains the network settings for the camera. From this page, the camera can be configured with a static IP address. For the camera to be discoverable with a static IP address, the camera must be on the same network subnet as the computer that is looking for the camera. After applying changes, either go to the reboot page and reboot the web server on the camera, or power cycle the camera.



### The Reboot page

6. The Reboot page has a button to reboot the web server on the camera. When rebooting, the web server loads the parameters from the saved settings. If you have changed network settings, they will take effect as soon as you click reboot.





## The Advanced page

7. The Advanced page is used for setting a new password on the camera system. This page also contains a network timeout number. The timeout can be used to control how long a session can remain inactive before it is automatically closed. This is useful when the camera is in a remote location, and being controlled by multiple users. By setting an appropriate timeout value, a user will not inadvertently retain control of the camera system because the session was never closed.

Home Network Reboot **Advanced**

### Advanced Options

**Password**  
New Password   
Retype New Password

**Session Timeout**  
Timeout (minutes)

**Password** : This section allows you to change the administrator password. Most of the camera configuration web pages require a username and password for authentication. The username is always "admin". The password can be changed here. You must enter the password twice, just to make sure you type it correctly. This change takes effect as soon as you click Apply.

**Session Timeout** : This section allows you to change the inactivity timeout period for session keys. If a key is not used within the number of minutes specified, the key will be discarded so that other users will no longer be locked out. This change takes effect as soon as you click Apply.

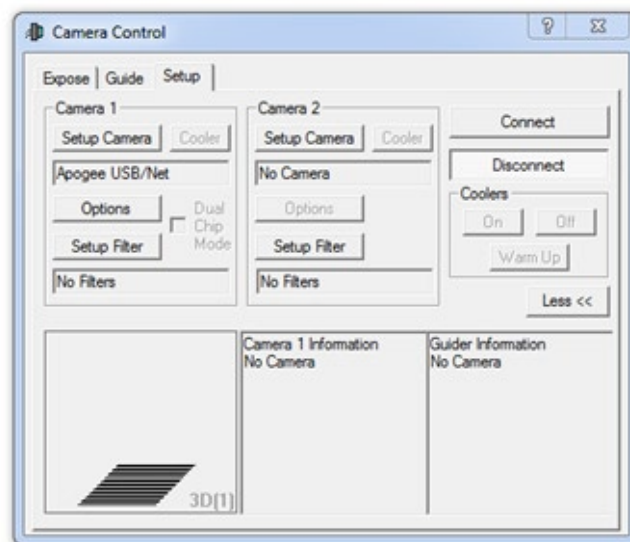
## SECTION 4: SETTING UP MAXIM DL SOFTWARE TO CONTROL YOUR ASPEN CAMERA

MaxIm DL, a product from Diffraction Limited, is a powerful camera control and image processing package. The MaxIm DL software package has an extensive user's guide, which provides details into setting up the software and getting started. The section in this guide covers a quick reference of the specific functionality in MaxIm DL. The camera must be configured as outlined below before it is ready to use.

The information in this section contains specific MaxIm DL screenshots. These screenshots were correct and accurate as of MaxIm v5.06. It is possible that users with other versions of MaxIm DL may notice slight layout changes from what is described here for a more recent release. Refer to the MaxIm DL User guide for further information.

Remember to register your software so that if there are any updates, the latest version of the software will be made available.

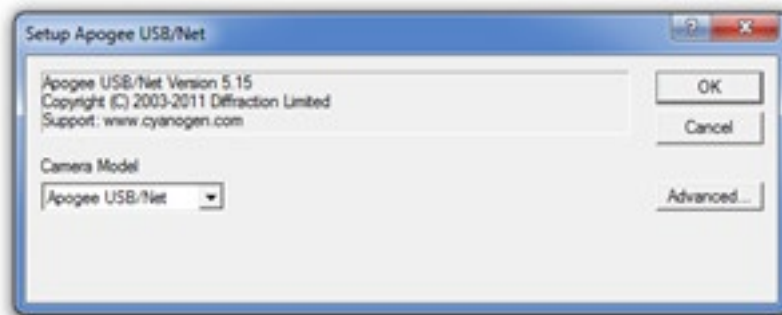
1. To begin, consult your MaxIm DL documentation and launch the MaxIm DL Camera Control window.



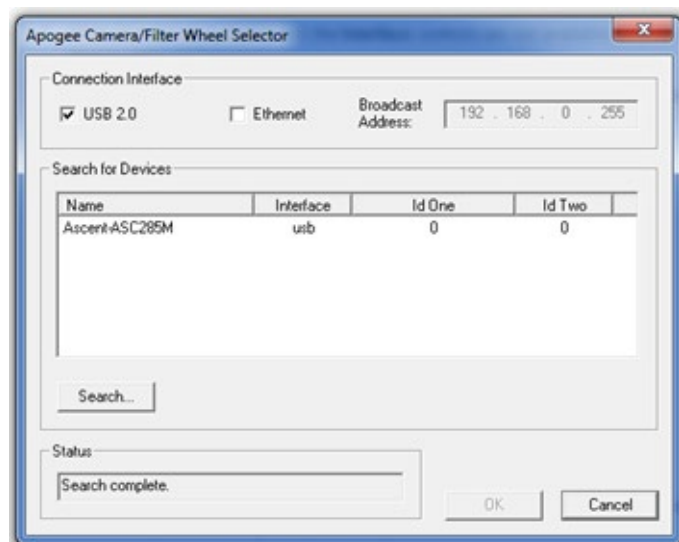
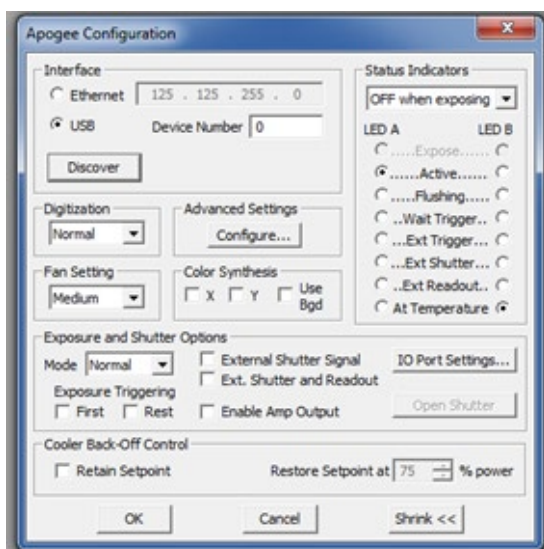
2. This window contains a Setup button. Click the Setup Camera button and then select "Apogee USB/Net" from the list of camera models.
3. For this driver, please select Apogee USB/Net on the Setup tab.



4. All settings for the Apogee camera are in the Apogee Configuration dialog, accessed from the Advanced... button. This dialog is also available while the camera is connected, by clicking the Options button on the Settings Tab and selecting the Camera Settings command.

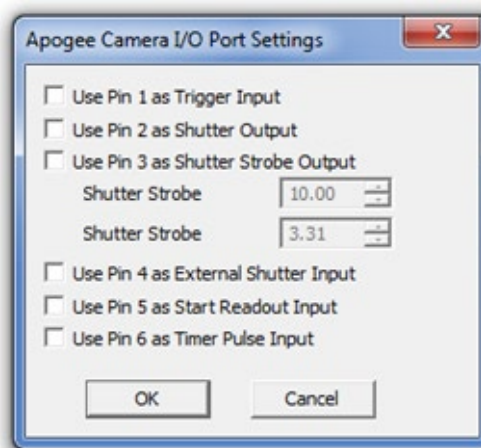


5. The first step is to specify the location of the camera. For cameras with a network interface, select Ethernet, enter the IP address of the camera, and set Device Number to its TCP port number. If the camera is selected as USB, only the Device Number control is available; set it to the camera identifying number, as enumerated by the operating system.
6. While the camera is connected, the Interface controls are not available; they are replaced by a Status area.
7. If you do not know the location of the camera, you can search for it using the Discover button. See below for an explanation of the camera discovery feature.

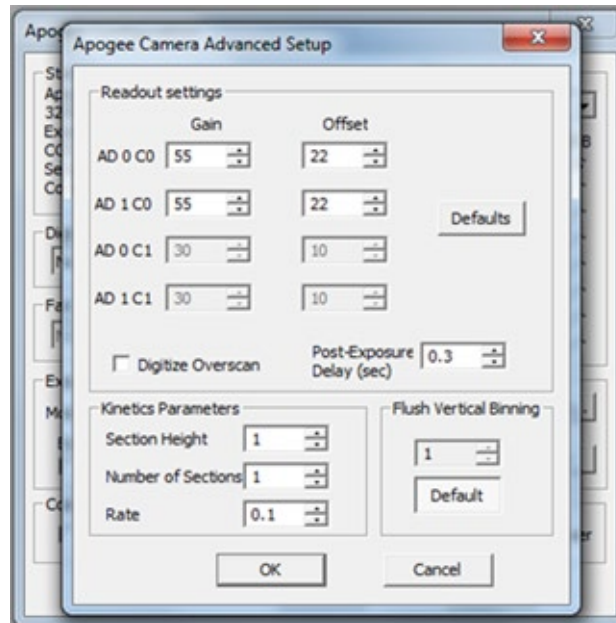


8. **Interface:** the Aspen camera can be connected via USB2 or Ethernet mode.
9. **Fan Setting** controls the camera's fan speed. Higher speeds provide better cooling, but may result in slightly more noise and vibration from the fan.
10. The **Configure...** button in the Advanced Settings group allows you to access some advanced camera control parameters, described below. Note that most of these are intended for laboratory environments, and inappropriate use may adversely affect camera performance and image quality.
11. **Color Synthesis** is used to adjust automatic color generation settings. Some cameras include Bayer matrix color filters, and are capable of "one shot color". If the Bayer matrix is not properly aligned, the color may not be displayed correctly. This can be corrected adjusting the X and Y offset controls. The Use Bgd option automatically tries to adjust the background level to neutral during the conversion process.

12. The **Exposure and Shutter Options** include a camera Mode drop-down whose entries depend on the specific camera in use. In **Normal** mode the software controls both the start time and duration of the exposure. In **Kinetics** mode the sensor must be masked so that a specified number of full-width but reduced-height images known as sections can be rapidly acquired on a single CCD frame. Readout occurs only after all requested sections have been imaged. For further information, consult the documentation for your camera.
13. For cameras with firmware v17 and later, the exposure process can be further modified by the **Exposure Triggering** options. The instrument waits for a TTL signal pulse before starting the exposure if **First** is checked. A separate pulse is required for each subsequent Kinetics section if **Next** is checked. Cameras with earlier firmware do not support Kinetics, but provide a separate Triggered exposure mode equivalent to Normal with First checked.
14. The next two options modify the duration of the exposure. **External Shutter Signal** allows the shutter to be gated open by an external TTL-level signal, with readout occurring at the trailing edge of this pulse. **Ext. Shutter** and **Readout** is similar but readout is controlled by a separate TTL-level signal, allowing the shutter to open and close more than once during the same exposure. In either external shutter mode, the **Enable Amp Output** checkbox disables the CCD voltage while the shutter strobe input is high.
15. **IO Port Settings** displays the Apogee I/O Port Settings dialog box. This allows you to configure each I/O pin for a predefined function. These should be self-explanatory; for advanced use please contact Andor for assistance.



16. **Open Shutter** opens the shutter for inspection or cleaning.
17. The two **Status Indicator** lights can be configured to provide basic status information. To prevent light contamination under very low-light imaging conditions, you can select **OFF** when exposing. You can also select Always **OFF** or Always **ON**.
18. The two Light Emitting Diodes (**LED A** and **LED B**) can be configured individually. They can be set to illuminate when the camera is in **Expose** mode (unless disabled by OFF when exposing), when the camera is **Active**, during **Flushing** to remove charge from the array, at **Wait Trigger** to show when the camera is waiting for a trigger, when an **Ext Trigger** is received, **Ext Shutter** to show the state of the external shutter, **Ext Readout** to show the state of the external readout trigger, and when the camera has stabilized **At Temperature**.
19. The **Shrink <<<** button toggles between the full size dialog box and just the Interface or Status section.
20. NOTE: In earlier versions of this plug-in, a Readout on Stop checkbox specified the disposition of exposures aborted via the Stop button. This capability is now controlled from the Options menu of the Settings tab in the MaxIm DL window.



21. The settings on the Apogee Advanced Camera Setup dialog are intended for advanced users.
22. The **Gain** and **Offset** for Fast digitization mode can be changed from their factory values: you must unclick the **Defaults** button to unlock the edit boxes. The Gain for Normal mode is not adjustable, but its value is displayed. You can also indicate whether to **Digitize Overscan** (the part of the CCD sensor surrounding the imaging area which is covered by an opaque mask). In some applications the overscan region is used as part of the calibration process.
23. Use the **Kinetics Parameters** to specify the **Section Height** in pixels and the **Number of Sections**; these values will be determined by how your CCD chip is masked. Set the **Rate** to the time interval in seconds per section. Note that the timing implied by these controls takes precedence over the exposure time specified elsewhere in MaxIm DL.

24. **Flush Vertical Binning** allows you to override the vertical binning factor used during camera flushing. Ordinarily you should use the **Default** setting.



25. The Apogee Camera Selection Dialog is displayed when the **Discover...** button is clicked. Select **USB 2.0** and/or **Ethernet** (Aspen only). If Ethernet, you must specify a Network Mask, which limits the subnet that is searched.
26. When you click **Search...** the software will generate a list of available cameras detected, if any. You can select the camera by clicking on it in the list and then clicking OK.

## SECTION 5: CONNECTING YOUR CAMERA

### WARNINGS

- Refer to the safety and warning information at the start of this manual and Section 8 before installing and using this product.
- Do not connect your Camera to a PC before installing the drivers. If you do and the “Add New Hardware” wizard appears, please select the cancel button.
- Never connect or disconnect the camera from the PC during operation.
- Take care not to touch the camera window or other optical faces e.g. filters.
- Ensure that the cooling vents are not blocked. Allow 100 mm space for ventilation.

### 5.1 MOUNTING YOUR CAMERA

The Aspen can be connected to a telescope, lens or other equipment using a wide range of plate-lens adapters and other accessories.



Figure 5: Selection of Camera adapters

The general steps are outlined below:

1. Ensure the camera control software and drivers have been installed.
2. Line up the appropriate camera mounting adapter for your application to the camera face plate mounting holes.
3. Insert the supplied mounting screws and lightly tighten into position. If you are using a filter wheel, please refer to Section 9 for further instructions on filter wheel and filter installation.
4. Once all mounting screws are fitted, torque them evenly across the mounting plate, taking care not to overtighten or damage the mounting screwheads.
5. Attach the camera and mounting assembly to your telescope, lens or other equipment.
6. Once the camera is mounted securely, now connect signal and power connections as shown in the following section.

## 5.2 CONNECTING THE POWER AND SIGNAL CABLES

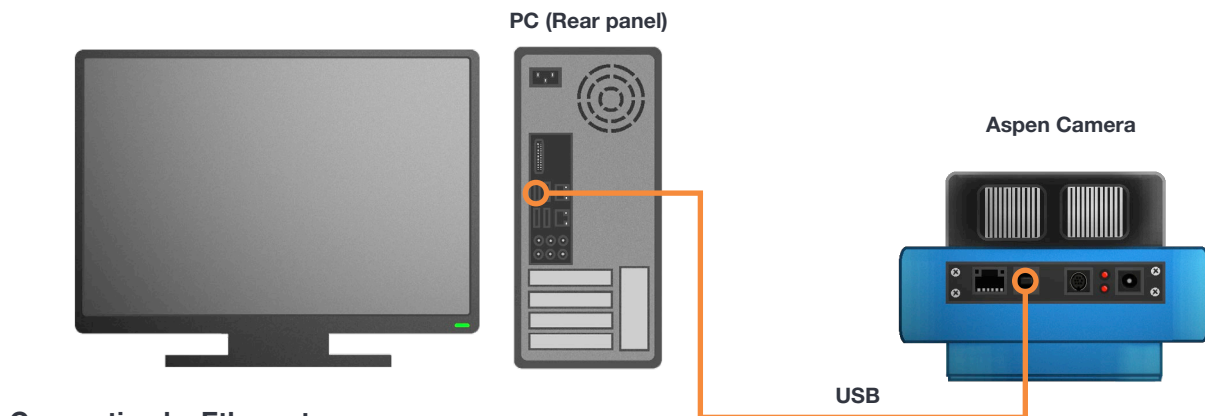
Refer to Section 2.2.1 for a description of power and signal connections.

**Note: Ensure that the mains power cable can be accessed in case that emergency disconnection from the mains power supply is required.**

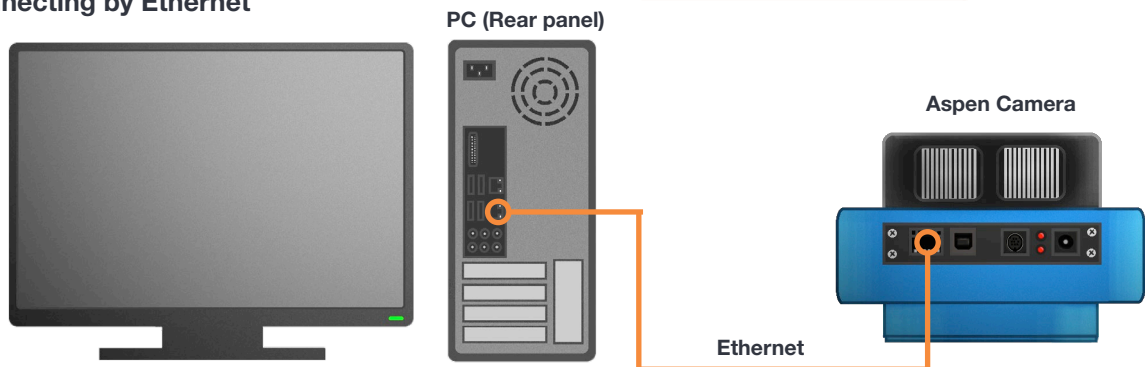
- The Aspen can be connected to a PC via the standard USB connection or Ethernet (Network) connections:

### Connecting by USB

Connect the supplied USB cable between the USB connector on the camera and the corresponding slot on the PC



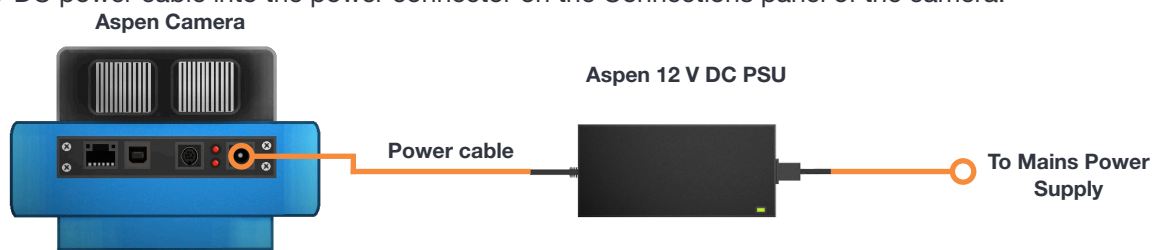
### Connecting by Ethernet



Connect the Ethernet connector between the camera and the PC Ethernet connections

**Optional:** An 8-pin Mini DIN connection enables various hardware signals to be controlled by the device. If this is required, connect the I/O Connection cable to the I/O 8 mini DIN type connector.

- Insert the 12V DC power cable into the power connector on the Connections panel of the camera.



- Connect the power cable for the PSU to the mains supply.
- Turn ON the PC.
- Start your software.
- Start acquiring data.



## SECTION 6: MAINTENANCE

### 6.1 GENERAL CLEANING INFORMATION

- The aluminium camera body can be cleaned with a soft cloth and glass cleaner.
- Never spray liquids directly on the camera; apply cleaning solution to the cloth, then wipe the camera body with the dampened cloth.
- Do not use abrasive or other detergents to clean the camera.
- Dust may also collect on the cooling fans located on the back of the camera head.
- From time to time, it may be necessary to clear away the dust with a small brush. The fans disperse heat as it radiates away from the heat sink. Should the airflow become blocked, the thermoelectric cooler may run warmer than normal and the camera could overheat, causing damage to some of the more sensitive components.

### 6.2 CLEANING THE CAMERA WINDOW

At some point, it may become necessary to clean debris that may have settled on the CCD imaging sensor window. Cleaning the camera window can provide effective results providing you carefully follow these step-by-step directions.

#### WARNINGS

- **Only open the shutter using camera control software.**
- **Do not attempt to manually open the shutter with your fingers or other objects.**



Figure 6: Do not manually attempt to open shutter or touch the Camera Window

- **The glass is located very close to the CCD imaging sensor. Scratching the window may require the window to be replaced.**
- **Cleaning the window is done entirely at the customers risk, window replacement is not covered under the warranty. It's better to under-clean than to over-clean.**

## 6.2.1 TOOLS REQUIRED

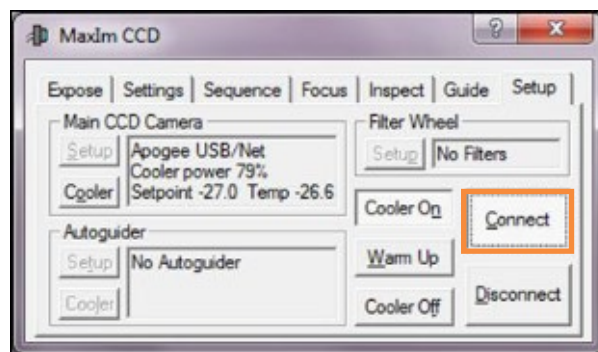
- Compressed Air Can
- Optics Brush

## 6.2.2 WINDOW CLEANING PROCEDURE

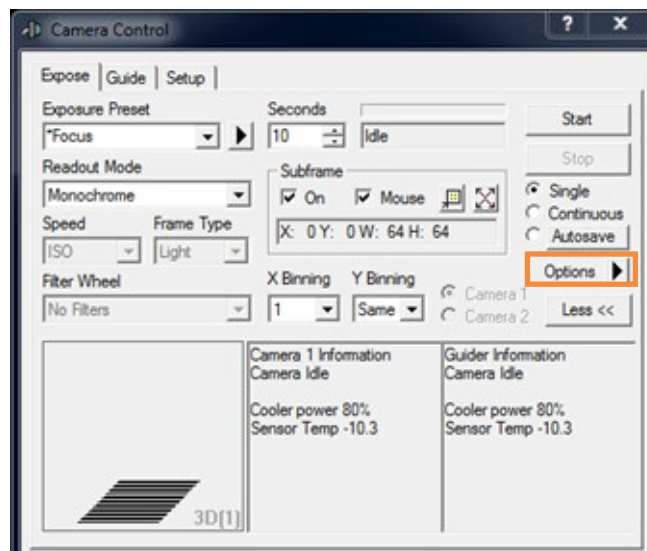
1. Remove the camera from your telescope and place it on a clean dry surface.
2. Use the camera control software to open the shutter.

**TIP:** If your program does not have this feature, try starting a long exposure. Over exposing the CCD to room light will not damage the CCD.

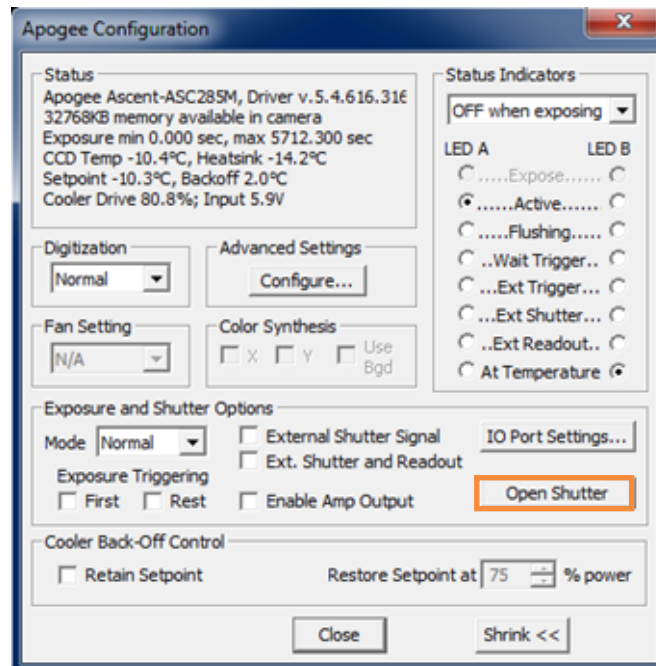
3. Customers using Maxim DL may select the Setup tab and click Connect.



4. Once connected to the camera select the Settings tab and click the Options arrow.



5. A new window will appear, click Open Shutter. The shutter should open immediately.



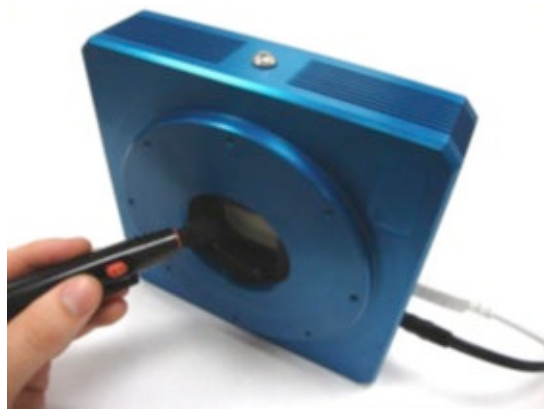
### 6.2.3 GUIDELINES FOR USING COMPRESSED AIR

- **If you are using a compressed air can always test-blast away from window before blowing air on the window. When you test-blast, you'll notice a spray of condensation shoot out from the can.**
  - **If condensation does spray on the window, do not wipe it off. Allow it to fully dry before proceeding.**
  - **Always orient the compressed air can in an upright position before spraying.**
  - **A compressed air can is recommended- do not use a compressor that may spray fine droplets of oil.**
6. With the shutter open, turn the camera on its side making it easier for particles to fall out of the camera head. You might have to remove a button head screw from the tripod mount for the camera to sit flat. Face the window toward you at the edge of a table.



Figure 7: Using Compressed Air to remove dust from the camera window

7. Give the window *short* blasts of compressed air to work dust particles out of the camera head.
8. If there are still particles stuck on the window use an optics brush to very carefully dislodge them from the window surface. Spray the dust particles out of the camera head with compressed air.



9. Make sure to use compressed air to clean your adapter tubes and focal reducers as well so you don't get more dust once everything's assembled.

## 6.3 REGULAR CHECKS

The state of the product should be checked regularly, especially the integrity of the camera enclosure and the mains cable.

### On a Daily Basis:

- Visually inspect the system.
- Perform any maintenance activities suggested by the microscope and camera manufacturer(s).

### On a Weekly Basis:

- Ensure that all power cables are firmly in place.
- Check the optical cables and connections to ensure that the locks are in place and no damage has occurred to the optical fibres connecting the various elements of the system.

## 6.4 ANNUAL ELECTRICAL SAFETY CHECKS

It is advisable to check the integrity of the insulation and protective earth of the product on an annual basis, e.g. U.K. PAT testing.

## 6.5 FUSE REPLACEMENT

In the U.K, Ireland and some other countries, the supplied mains cable of the power supply has a BS 1363 (or Type G) plug that includes an integrated fuse. Only replace with fuse of the same type and rating for continued protection. The characteristics of a replacement fuse are as follows:

- **Rated Current:** 5 A
- **Rated Voltage:** 240 VAC
- **Size:** ¼ × 1" (6.3 × 25.4 mm) cartridge
- **Type:** BS 1362

## SECTION 7: USING YOUR ASPEN CAMERA

Digital imaging and image processing forms the core of modern astronomy. Much of what we know about the structure and behaviour of planets, stars, interstellar clouds, galaxies and the universe that surrounds us has been gleaned from processing pictures exposed through telescopes. This section outlines the basic things you can accomplish with your instruments. In the end, you are only limited mainly by your patience, skill and imagination.

### 7.1 STANDARD CCD IMAGE CALIBRATION PROCEDURES

Today, most astronomical images taken in visible light (also known as white light pictures) are produced using a CCD camera such as your Apogee camera. Although these devices have imaging chips similar to those in many camcorders and personal digital cameras, the CCDs used in astronomical cameras are characterized by their low noise and ability to capture the full visual spectrum of light in a repeatable, linear manner that's easily quantified.

However, raw CCD images of the sky must be corrected for a number of problems produced by the imaging process.

Every pixel value of a raw image taken through the telescope correlates to the number of electrons collected by that pixel during the exposure. Ideally, the number of electrons is exactly proportional to number of photons captured by each pixel for its portion of the sky.

In practice the number of electrons is equal to the number that were freed by photons from the sky impacting on the pixel and by the pixel's thermal agitation or dark current. Furthermore, even before the exposure starts, each pixel value is usually biased higher than zero by some amount.

The number of electrons captured is also dependent on the sensitivity of each pixel- some pixels are more sensitive than others across the face of the imaging sensor. The standard procedures used to produce astronomical images is to correct the raw image for dark current, bias, and sensitivity variations.

### 7.2 DARK CURRENT CORRECTION

Dark current fills each pixel with electrons at a steady rate based on the temperature of the CCD chip. The final number of dark current electrons depends on the temperature of the chip and the length of the exposure.

The standard way to correct for this type of error is to subtract an image that only contains dark current from the sky image. The image to be subtracted is made by taking an exposure of the same length with the chip set to the same temperature as the sky exposure. However, during this exposure, the shutter is closed so no external light is captured. This exposure is known as the dark image.

Because the amount of dark current errors changes very slowly over time, it is possible to produce a dark image and use it over and over for several weeks or even months.

### 7.3 BIAS CORRECTION

CCD cameras typically add a bias value to each image they record. If you know that the same bias value has been added to each pixel, it can be corrected by subtracting a constant from the sky image. However, most CCD cameras add different bias values to their pixels therefore it becomes necessary to produce a bias image and subtract it from the sky image, too.

Because the bias error very slowly, if ever, changes over time, it is possible to re-use the same bias image for several months before a new one is required.

## 7.4 FLAT FIELD CORRECTION

This procedure corrects for the variation in pixel sensitivity across the chip. As an added bonus, this procedure can also remove the shadow of debris that may have fallen into the camera's light path. Therefore, in addition to raw images of celestial objects, dark images, and bias images, the astrophotographer should also collect one or more flat field images while at the telescope.

A flat field image can be produced by pointing the telescope to a location where the sky appears uniform, such as the zenith, during twilight after sunset or before dawn. Another effective method is by pointing the telescope at a uniformly illuminated screen. The exposure time is typically quite short. The purpose of the flat field image is to record the pixel-to-pixel variation in the sensitivity of the imaging system.

Once the raw image of the sky is corrected for dark current (and bias), a flat field correction can be done. The flat field image may also need a dark correction if it required a long exposure but, usually, flat field images do not need this adjustment.

Flat field images should be produced before or after each imaging session. It is also recommended that the flat field image should match the same side of the sky meridian where the corresponding sky image was produced. Further, the most effective flat field images are taken with the camera in the same rotational orientation as the sky image.

Correcting the sky image for dark current, bias and pixel sensitivity errors can be performed with commercially available image processing software such as Maxim DL. These types of applications can automatically perform the dark current and bias subtraction then divide the sky image by the flat field exposure.

## 7.5 FURTHER PROCESSING

Many additional enhancements can be made to an astronomical image once it has been corrected. For example, it is possible to improve the quality of the image by increasing the picture's signal-to-noise ratio. A high signal-to-noise image has very little "snow" (randomly varied noise from one pixel to the next) compared to the actual brightness levels of the picture's subject (a galaxy would be a good example).

The signal-to-noise of deep space astronomical images generally increases as the total length of exposure increases.

## 7.6 COMBINING IMAGES

One way to increase signal-to-noise is to digitally combine a set of images featuring the same subject.

To combine a set of similar images, each picture must be aligned with each other so the subject appears the same size and in an identical rotational orientation.

Image processing software, such as Maxim DL, can automatically align and combine multiple images. This can result in a single picture having the characteristics of an exposure with same length as the cumulative exposure time for all pictures in the set. For example, if there are ten images, each with five minute exposures, combining them can result in an image with similar signal-to-noise as an individual 50 minute exposure.

This is how long exposures are produced- not with a single picture but by digitally combining the photons captured by several, images of the same subject.

## 7.7 FIELD OF VIEW AND SCALE

When visually observing, larger telescopes are better than smaller because big apertures collect and focus more light at the eyepiece. For CCD imaging, however, focal ratio has a greater impact because the telescope's focal ratio determines how much light is accumulated by the CCD chip during the exposure. For example, telescopes with shorter focal ratios will capture faint extended subjects, like nebulae and galaxies, faster than longer focal ratio instruments. Incredibly, a camera with a typical 200mm lens, and an f-ratio of 2.3, will capture more of the Andromeda galaxy than the 200-inch Hale Telescope, operating at f3.3, during the same exposure time.

However, even though a modest 200mm lens out speeds one of the world's most famous telescopes, the scale of the two images will be vastly different- the Hale image will be about 85 times greater than the picture produced with a simple camera lens because the Hale focal length is approximately 17,000mm.

So, image scale is a function of focal length while imaging speed is predicated on focal ratio. The focal length of a 4-inch f/8 refractor is the same as an 8-inch reflector operating at f/4 thus they will both produce images at the same scale. However, the larger instrument will be faster than the smaller by a factor of 4.

Since the image scale of a longer focal length telescope is greater, it will capture a smaller area of the sky than a scope with a smaller focal length when using the same CCD sensor size. As a result, long focal length telescopes are typically better for imaging small scale subjects such as planetary nebulae, galaxies and planets. Small focal length telescopes, particularly if they also have a short focal ratio, tend to excel at capturing distended object such as nebulae.

Of course, the field of view for any telescope can be expanded if a CCD imaging sensor with a larger physical surface area is used.

## 7.8 FURTHER READING

There is a wealth of information and technical notes covering all aspects of CCD, imaging and spectroscopy technology at [Andor.com](http://Andor.com).

## SECTION 8: SPECIFICATIONS

Refer to the specification sheet specific to your camera model as technical specifications will vary with sensor type and camera configuration. Depending on the sensor, the housing may be either a G01, G07 or G09 (Section 8.3).

### 8.1 ASPEN- GENERAL SPECIFICATIONS

PC Interface	USB 2.0; Network interface with built-in web server, up to 2MHz throughput
Digital Resolution	16-bit
Exposure Time	100 milliseconds to 95 minutes (2.56 microsecond increments)
Image Sequencing	1 to 65535 image sequences under software control
Frame Sizes	Full frame, subframe (ROI)
Max. Cooling (typical)	Thermoelectric cooler with forced air. Maximum cooling up to 60°C below ambient temperature*
Temperature Stability	+/- 0.1°C
Usage	Indoor use only
Operating Conditions	0 to 40°C. Relative humidity: <70% non-condensing. Altitude up to 2000 m
Recommended Storage Conditions	-25 to 50°C. Relative humidity: <70% non-condensing
Power Input	External AC/DC power supply: 100-240VAC, 50-60Hz. Alternate 12V DC input from user's source
Power Consumption (max)	75W (with shutter open and maximum cooling)
Overvoltage Category	CAT II. An overvoltage category of CAT II means that the equipment is designed to cope with transient voltages above the rated supply that would be experienced by any product connected to a mains socket in a building.
Rated Pollution	Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Remote Triggering	LVTTL trigger input, expose strobe output
Camera Head Size & Mounting	Refer to Sections 8.2 and 8.3
OS Support	Windows, Linux

\* Ambient temperature 25°C

### 8.2 MODEL SPECIFIC SPECIFICATIONS

Please refer to product Specifications Sheet for model specific sensor and performance specifications.

### 8.3 CAMERA MODELS AND CAMERA HOUSINGS

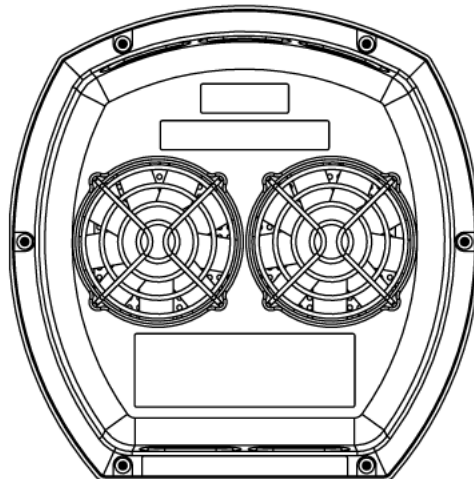
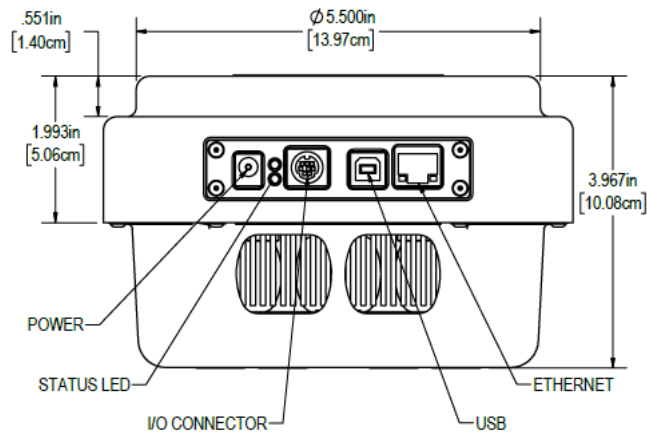
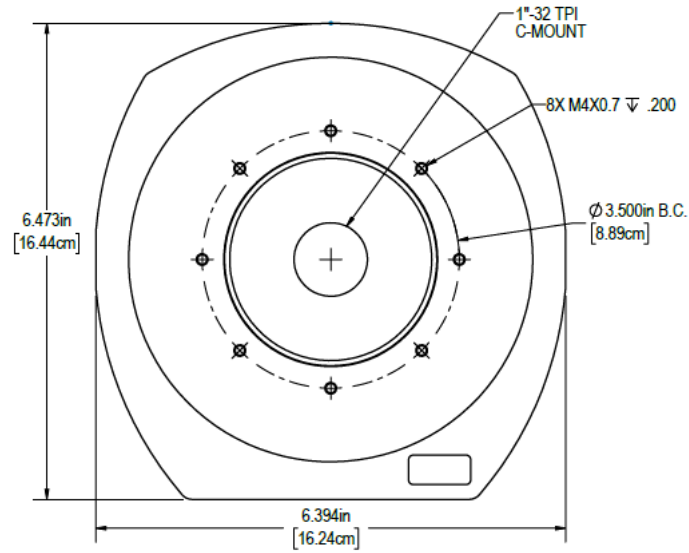
The following table outlines the camera housings that are used for each model of the Aspen Series. Refer to Section 8.4 for Mechanical Drawings. If your model is not listed and you need further information, refer to the specification sheet or contact us for further information.

Camera Housing	Models
G01	CG47, CG8300, CG8050
G07	CG6, CG9, CG16M, CG16070
G09	CG42, CG230

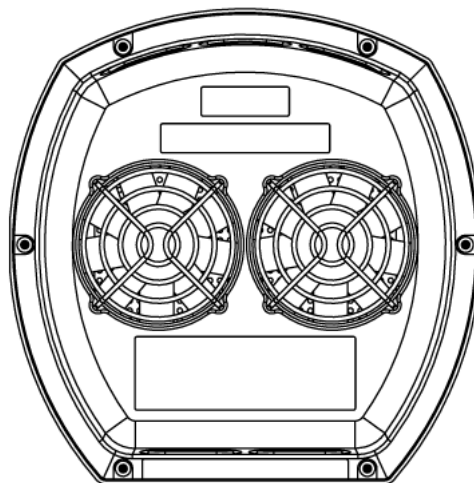
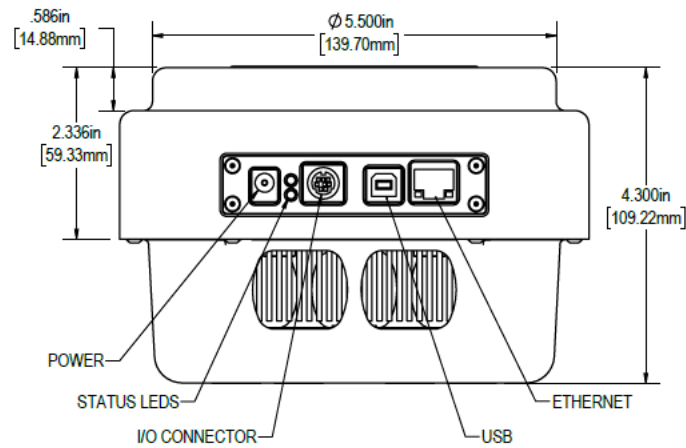
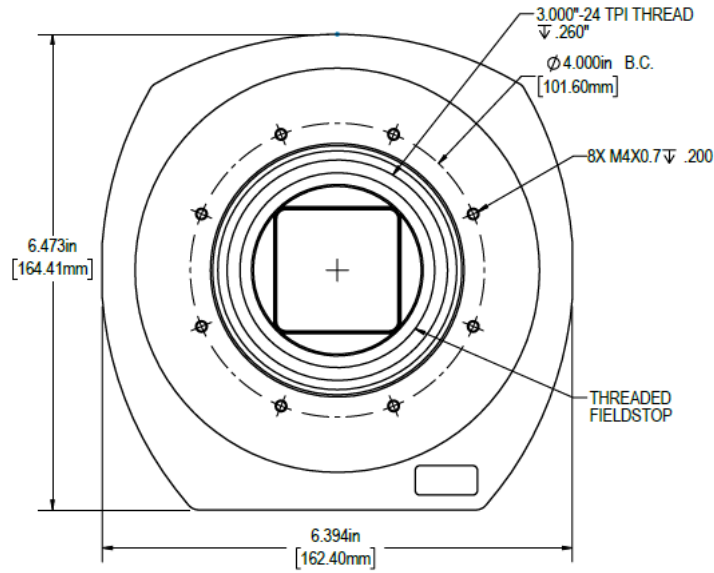


## 8.4 ASPEN MECHANICAL DRAWINGS

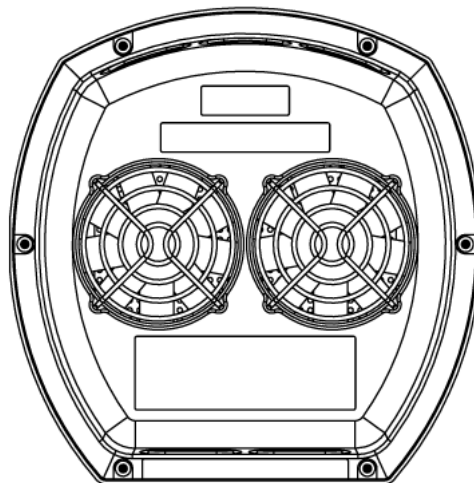
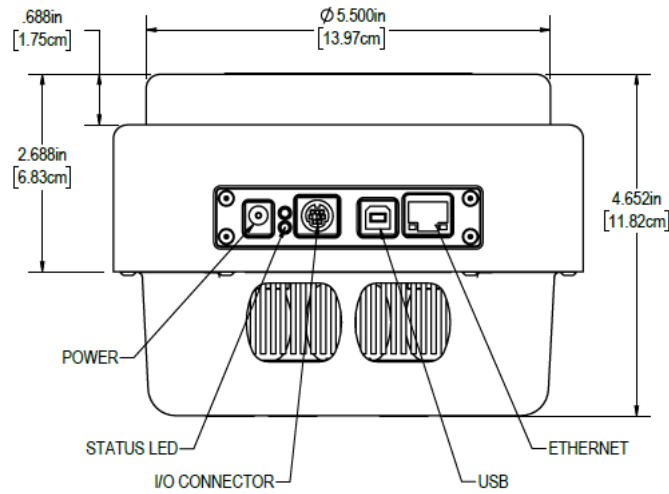
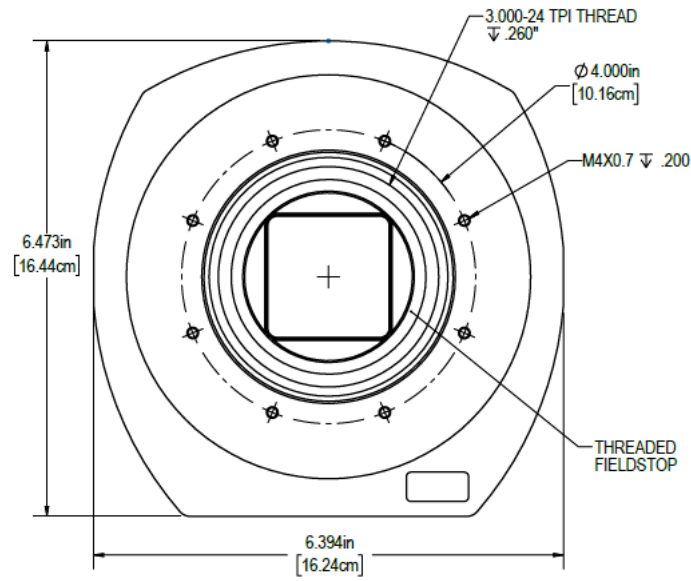
### 8.4.1 G01



8.4.2 G07



8.4.3 G09



## SECTION 9: FILTER WHEEL INSTALLATION

### 9.1 INTRODUCTION AND SETUP

Apogee USB Filter Wheels are optimized for the USB 2.0 interface, while also supporting backward compatibility with older USB 1.1 connections.

We recommend the following steps for getting your new Filter Wheel up and running as quickly as possible:

- 1) Install the latest Apogee Drivers
- 2) Install the MaxIm DL application software
- 3) Connect to the Filter Wheel using MaxIm DL
- 4) Integrate filters into the Filter Wheel and integrate into your system
- 5) Begin using your new Apogee Filter Wheel!

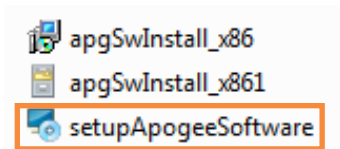
### 9.2 UPDATE APOGEE DRIVER (APOGEE.DLL)

If you already have Apogee drivers installed on your system, be sure to update to the latest version before proceeding. The disk included with your Filter Wheel has the latest driver at the time of shipping. For the most up-to-date version of the Apogee.DLL you can visit our website, <http://www.andor.com/downloads>. This manual provides detailed instructions for driver installation.

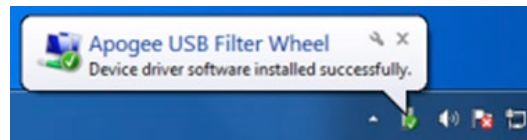
## 9.2.1 DRIVER INSTALLATION

**WARNING: Do not connect your camera to a PC before installing the drivers. If you do and the “Add New Hardware Wizard” appears, please select the Cancel button.**

Make sure your Windows user account has administrator privileges. Double click on the setupApogeeDriver for your operating system type, 32 or 64 bit. The following example shows Windows 7:



1. Follow the installation wizard instructions for your version of Windows and click Finish once complete.
2. Upon successful driver installation connect your Filter Wheel to the PC. Watch the message balloon in the lower right corner state the OS, search for and successfully install the drivers for the Apogee USB camera and the filter wheel.



3. The drivers for your USB Filter Wheel are now installed on your PC.

## 9.3 INSTALL MAXIM DL

The Apogee Filter Wheel is easily used with the MaxIm DL image capture and processing software, developed by Diffraction Limited. If you will be using the MaxIm DL software, we recommend that you install it prior to setting up your Filter Wheel. If you already have MaxIm DL installed make sure that it is the latest update. Please see the MaxIm DL documentation for specific instructions related to installation of this software.

Apogee Filter Wheels are supported by MaxIm DL Ver. 4.61 and higher.

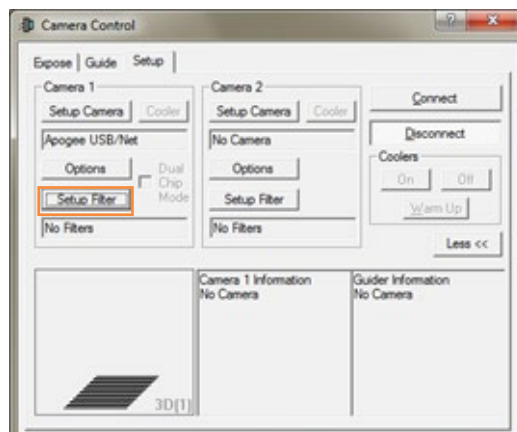
## 9.4 USING MAXIM DL

MaxIm DL is a powerful camera control and image processing package. The MaxIm DL software package has an extensive user's guide, which provides detailed instructions for setting up the software and getting started. This section covers a quick reference of how to connect to your Filter Wheel using MaxIm DL.

The information in this section contains specific MaxIm DL screenshots. These screenshots were accurate as of MaxIm v5.06, appearance of other versions may vary.

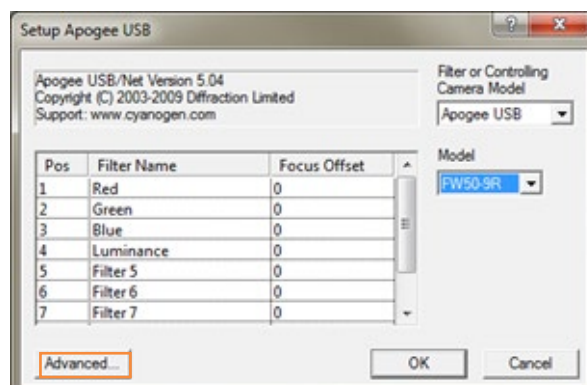
To begin, launch the MaxIm DL camera control window. Under “Camera 1” click the **Setup Filter** button.

A dialog box will appear for setting up the filter positions. Select Apogee USB/Net from the “Filter or Controlling Camera Model” pull down list. This driver works with all Apogee Filter Wheels controlled via USB or Ethernet, as well as wheels controlled through the camera. The user can assign names for each of the color filter slots, under Filter Name. If your

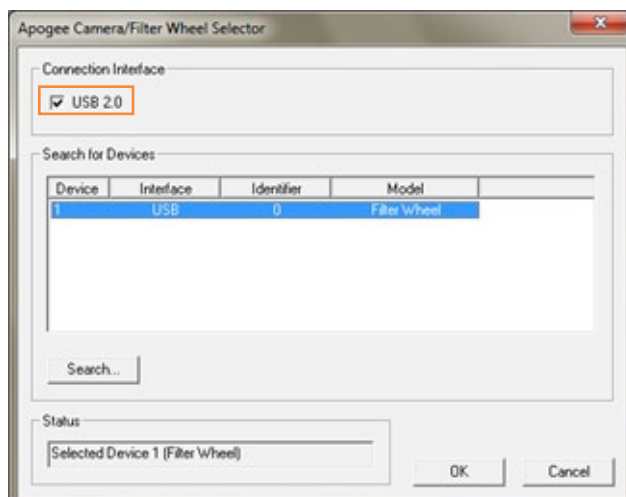


Filter Wheel has fewer slots than available, simply leave the Filter Name in the extra slots blank; they will not appear in the drop-list filter selectors.

If your filters vary in thickness a Focus Offset can be entered for each filter. Consult the MaxIm DL user's guide for details on this feature. The Model should be set to the type of Filter Wheel you are controlling. Click the **Advanced** button and press Search to find the device.



Choose the Filter Wheel from the list and verify that the “Connection Interface” is set to USB 2.0 and click OK.



Press OK in the “Setup Apogee USB/Net” window and then click **Connect** in the “Camera Control” window. The Aspen Filter Wheel is now setup in MaxIm DL.

## 9.5 FILTER WHEEL INSTALLATION

This section outlines the filter wheel installation process (the images are shown for an Alta camera with a AFW50-9R) . For dual filter wheel installations please contact your Andor representative for further information.

### 9.5.1 INSTALLING FILTERS

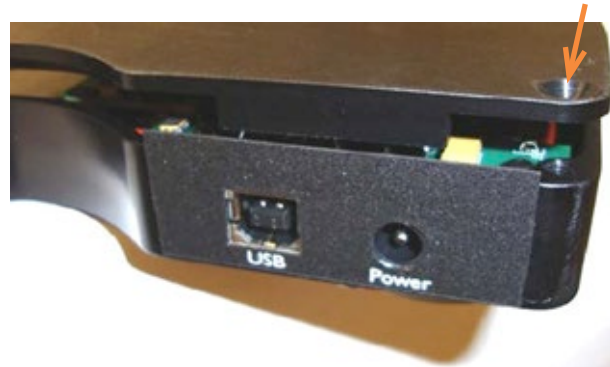
1. Set the Filter Wheel on clean flat surface and remove the two #10-32 x 7/16 buttonhead screws from the mounting flange using the 1/8" Allen wrench provided.
2. Flip the Filter Wheel upside down and remove the two buttonhead screws from the back of the mounting flange. Set aside the mounting flange and the four buttonhead screws for now.



3. Flip the Filter Wheel right side up and set it on the edge of a table. The motor should hang off the side so the housing does not rock back and forth.
4. Remove the ten #6-32 x 5/16 flathead screws from the perimeter of the lid using the 5/64 Allen wrench provided.



5. Remove the lid, making sure not to damage the light guard sticker of the connector face. Set aside the lid and ten flathead screws for now.
6. Inspect for any packing materials or dust inside the wheel, remove using compressed air, optics brush or lens tissue. (see Section 6 for general guidelines on the use of compressed air).



7. Carefully install the filters into openings of carousel. Only touch the filters at the outer edges and never touch the center of a filter. When holding filters always use some kind of protection such as gloves or the glass packing material. It is ok to rotate the carousel by hand to make it easier to install filters. Some filters will be tighter than others when resting in the carousel openings, do not force into place. Center filters in carousel openings (use four tooth picks around the edges of each filter if needed).
8. Fasten the filters using the screw and nylon washer combinations described on the next page.



Install filters using the below screws and nylon washers provided using the 1/16" Allen wrench provided. **DO NOT OVER TIGHTEN**; this may physically distort your filters which will optically distort your image. Make sure filters do not move after tightening. Rotate the carousel by hand to verify clearance under the circuit board.



**3mm Thick Filters:**

- 1X #4-40 x 3/16, Buttonhead Screw
- 1X #4 Nylon Washer

**5mm Thick Filters:**

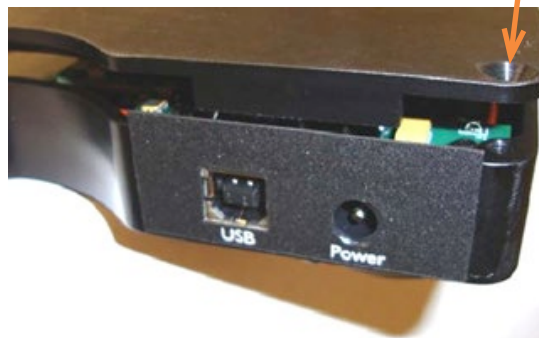
- 1X #4-40 x 1/4, Buttonhead Screw
- 1X #4 Nylon Washer
- 1X #4 Nylon Spacer

**7mm Thick Filters:**

- 1X #4-40 x 5/16, Buttonhead Screw
- 1X #4 Nylon Washer
- 3X #4 Nylon Spacer



9. Now that all the filters have been installed take a moment to blow out the housing in case of any dust or debris. Place the lid back on Filter Wheel housing making sure not to damage the light guard sticker of the connector face.
10. Fasten the lid using ten #6-32 x 5/16 flathead screws.

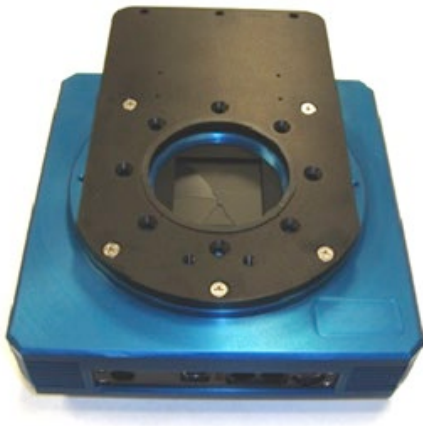


11. Verify that the filter wheel operates correctly before proceeding. If not, refer to the trouble shooting section of this manual.

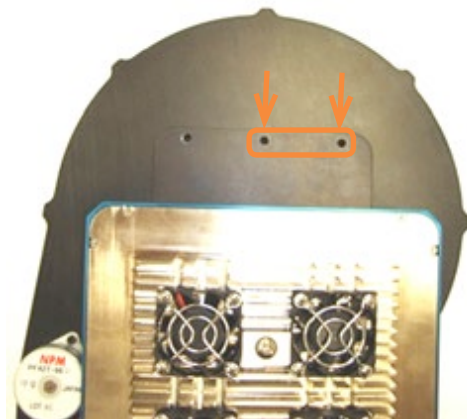
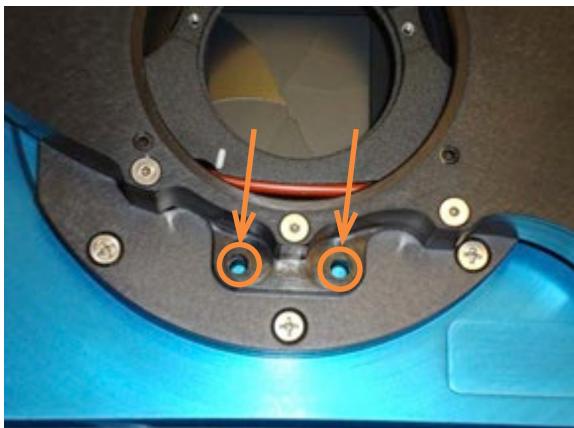
## 9.5.2 MOUNTING THE FILTER WHEEL TO THE CAMERA

1. Mount the adapter flange to the front of your camera using M4 7 x 10mm flathead screws. Make sure counter sunk features are facing up so screws mount flush with adapter surface. There are two hole patterns machined into the flange to accommodate different camera sizes.

**Note:** the following images show the Filter wheel installation for the Alta model. The steps are identical for the Aspen series.



2. Line up the Filter Wheel with the adapter flange in the configuration shown below so the two mounting holes line up with the threaded holes of the flange.
3. Lightly screw in two #10-32 x 7/16 buttonhead screws and flip the assembly upside down to mount the other two buttonhead screws in the rear of the plate. Fasten all four screws using the Allen wrench.



### 9.5.3 ATTACHING THE CAMERA TO OTHER OPTICAL EQUIPMENT

1. Attach your adapter using the center threaded 3-24 TPI center hole or the 4x #10-32 UNF-2B x .250 deep threaded holes.



2. Integrate the Filter Wheel and camera into your system and start imaging!

## 9.6 SETUP SUGGESTIONS

The Filter Wheel and Camera connect to the computer using separate USB cables. It is possible to reduce the number of cables coming off the telescope by connecting multiple USB plugs to a micro USB hub mounted to the telescope so only one USB cable connects to the computer.

USB is unstable if the cable is greater than 16 feet. For longer runs you can purchase a USB powered hub or our Icron USB extender. Icron is the only brand certified to work with our cameras. Each powered USB hub will increase the signal by around 15 feet, the Icron hub will extend the signal by around 165 feet.

A wide variety of telescope adapters for the Filter Wheel can be found at our website: [www.andor.com](http://www.andor.com). Also, if you require a custom adapter please ask your sales representative.

## SECTION 10: TROUBLESHOOTING

Problem	Solution
The motor is turning but the wheel is not.	<ul style="list-style-type: none"> <li>• Check to make sure the belt is on the motor pulley correctly. If the motor is turning but the pulley is not, tighten the motor pulley set screw, being careful not to strip the set screw.</li> <li>• Verify that the screws you used to mount the filters are not too long and colliding with the housing underneath the carousel.</li> </ul>
The wheel turns but does not stop.	<ul style="list-style-type: none"> <li>• Make sure the lid is fastened and the Filter Wheel is not operating in a brightly lit room.</li> </ul>
The Filter Wheel won't connect	<ul style="list-style-type: none"> <li>• Verify that the USB and power connectors are securely plugged in.</li> <li>• Verify the Apogee Driver and Apogee USB 32/64Bit Driver are installed. Open Add or Remove Programs dialog and confirm both appear in the Currently installed programs list.</li> <li>• The USB cable is more than 15 feet long without a powered hub.</li> </ul>
Ethernet: One of the green lights flashes and does not turn off	<ul style="list-style-type: none"> <li>• First make certain that the camera is connected to the network using a network cable.</li> <li>• When a camera is first connected to a network, it requests to be automatically given an IP Address by the local network server or router that assigns addresses. This process is called DHCP (Dynamic Host Configuration Protocol). The blinking green light indicates that the camera is requesting an address. Make sure you have a router or server on your network that is capable of assigning new IP addresses using DHCP.</li> <li>• Ensure under Camera settings that Ethernet is selected.</li> </ul>

## APPENDIX A: OTHER INFORMATION

### TERMS AND CONDITIONS OF SALE AND WARRANTY INFORMATION

The terms and conditions of sale, including warranty conditions, will have been made available during the ordering process. The current version may be viewed at: [www.andor.com/pdfs/literature/Andor\\_Standard\\_Warranty.pdf](http://www.andor.com/pdfs/literature/Andor_Standard_Warranty.pdf)

### WASTE ELECTRONIC AND ELECTRICAL EQUIPMENT REGULATIONS 2006 (WEEE)

The company's statement on the disposal of WEEE can be found in the Terms and Conditions, [WEEE Policy](#).

