



MyoCam-S

# ***MyoCam-S***

***Hardware Manual***

# MyoCam-S Hardware Manual

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# 1 Introduction



MyoCam-S Camera



MyoCam-S Power Supply

The MyoCam-S™ is an all-digital, variable frame rate camera that utilizes the USB 2.0 standard to remove the restrictions of analog video formats and frame grabbers. Its maximum pixel clock rate has been increased 70% above the original video-based MyoCam so that our “standard” ¼ height frame rate jumped from 240Hz to 380Hz; sufficient to capture/characterize the fastest cardiac myocyte contractile transient. The MyoCam-S gives you complete control over all aspects of video acquisition to deliver the optimum combination of temporal and spatial resolution needed for your experimental requirements. All analog processing and digitization is done inside the camera to minimize image noise. The digital data are then transferred to the computer using a standard high-speed USB 2.0 port, eliminating the cost of a frame grabber.

## Features

- CCD sensor: 774 pixels wide by 245 lines (progressive) or 490 lines (interlaced)
- Variable frame rates (lines): 97Hz (245 lines), 250Hz (87 lines), 500Hz (36 lines), 1000Hz (10 lines)
- Complete control of camera acquisition window (start pixel & width and height)
- Selectable pixel clocks: standard, 2x high-speed, and low-noise
- 12-bit A/D converter with 8-bit or 12 bit readout
- Programmable CCD image gain and offset
- Programmable integration time to capture fast movement or increase camera sensitivity
- Programmable frame interval and external trigger to synchronize with other recording devices
- Synchronization of multiple cameras
- Compatible driver for use with any standard Windows video application
- Single cable to camera Power Supply

## Manual Convention

The following conventions are used in IonOptix manuals:

- Underlined text refers to the names of interface elements shown in the illustrations included in most sections.
- *Italicized* text refers to names given to specific parts of the IonWizard interface. These names can be either IonOptix names, for example *trace bar* or names of Windows controls, like *scroll bar* and are described in various sections of the manual.
- **Bold** text refers to mouse buttons or keystrokes that must be used in order to operate some function.
- The symbol § indicates the following name is a section in the manual.



*A note icon indicates an important point that you should know.*



*An idea icon shows some ideas on how you can use a device or function.*



**A stop icon indicates a potential for personal injury, equipment damage or data loss.**

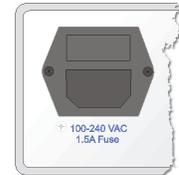
## 2 Connections

Three electrical connections and one optical connection are required to operate the MyoCam-S: AC to the Power Supply, Power Supply to the camera, camera to the computer and camera to the optical image source. There are also optional Auxiliary input and outputs and Synchronization connections.

### Power

The AC power entry and associated fuse holder are accessible on the back panel of the MyoCam-S power supply. It is a NEMA standard power entry that can be used with any compatible power cord.

Note - The Power Supply will automatically adjust to any main voltage between 100 and 240 volts AC.



Power entry

### Camera Connections

The following connections are made to the camera:

1. The "CONTROLLER" plug connects to the the Power Supply using the supplied DVI-I dual-link cable.
2. The "USB2" plug connects to the computer using a standard USB 2.0 cable.
3. A standard c-mount microscope adapter connects the camera to the microscope.



Camera connections

### Auxiliary Connections

The following optional connections are available on the front of the MyoCam-S Power Supply:

#### CLK OUT

50% duty cycle programmable TTL clock output for providing a common time base to other devices. The specific frequency of this clock is set in the [Trigger/Outputs Properties](#) page of the [Camera Properties](#) dialog.

#### REP OUT

1 $\mu$ s positive-going TTL pulse that indicates start of each image frame.

#### PRE OUT

Programmable duration, positive-going TTL pulse that occurs a programmable time after the the start of image acquisition. The width and delay are set in the [Output Sync Pulse section](#) of the [Image Format/Timing Properties - Advanced](#) tab of the [Camera Properties](#) dialog.

#### TRIG IN

#### (FUTURE USE - CURRENTLY DISABLED)

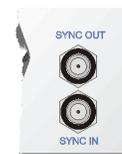
TTL Input that synchronizes start of image frame acquisition to the rising edge of the input signal. The trigger input must be enabled in the [Trigger section](#) of the [Image Format/Timing Properties - Advanced](#) tab of the [Camera Properties](#) dialog.



Auxiliary connections

### Sync Connections

To synchronize multiple MyoCam-S cameras in a master/slave relationship, you need to connect the **Sync Out** (located on the rear of the Power Supply) for the "Master" camera to the **Sync In** (located on the rear of the Power Supply) for the slave camera. In addition to making the physical connections, you must enter the correct settings in the [Trigger/Outputs Properties](#) page of the [Camera Properties](#) dialog.

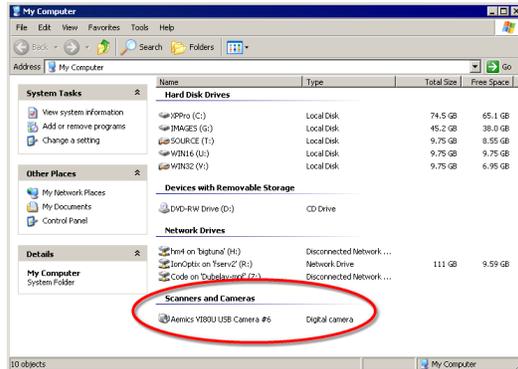


Sync In&Out

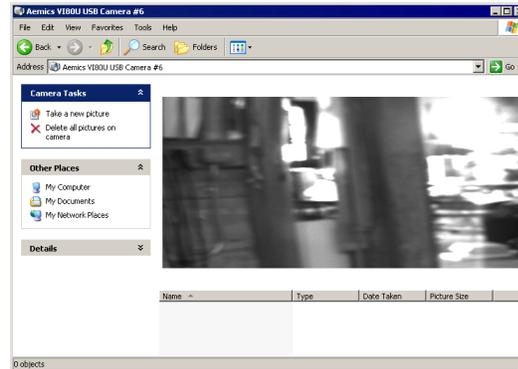
## 3 Required Programs

The MyoCam-S is compatible with any Windows program that uses the Microsoft's DirectX 9 camera API (DirectShow). As there are many available video acquisition programs, including Microsoft's free MovieMaker, IonOptix does not provide a separate video display and acquisition program with the MyoCam-S.

### Displaying Live Video



My Computer - MyoCam-S



My Computer - Live Display

Windows XP provides a simple built-in mechanism for viewing live images from a DirectX camera in the Windows Explorer. Simply double click on the the camera name (Aemics V180U/USB Camera) and then a live video display will appear.

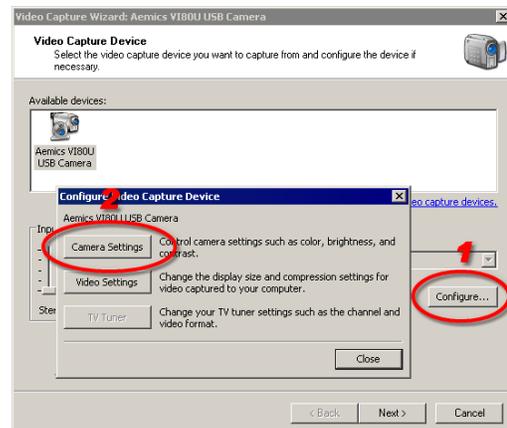


*Camera properties can not be changed from the Windows Explorer. The live display will use the last parameters set by a program that provides access the MyoCam-S camera properties, such as MovieMaker.*

### Accessing Camera Properties in Microsoft MovieMaker

All of the MyoCam-S video settings are set in software using the standard Windows DirectShow camera properties function. The location and instructions for accessing the camera properties vary depending upon the program that you are using. However, once they are open, they generally operate the same way.

For example, if you are using Windows Movie Maker, you access the MyoCam-S properties pages by clicking on the "Capture from video devices" link. Then, select "Aemics VIO80U USB Camera", click the "Configure..." button (1) and finally click the "Camera Settings" button (2). The MyoCam-S [Properties](#) dialog will appear, allowing you to adjust the settings.



Windows Moviemaker Camera Properties

## 4 Camera Properties

The MyoCam-s Properties dialog is accessible through several [programs](#)<sup>3</sup>. The dialog is divided into three separate tabs which control different aspects of the camera.

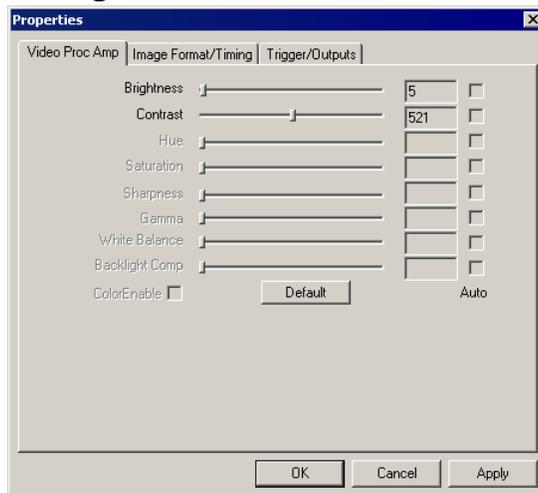


*Camera property settings that are changed using the standard property pages documented below are automatically stored in the registry and become the starting values for any other program that uses the MyoCam-S.*



*IonWizard does not use the standard camera properties pages and does not use or change the values in the registry. Please refer to the IonWizard documentation for more details on how it operates with the MyoCam-S.*

### Video Brightness/Contrast



**Video Properties**

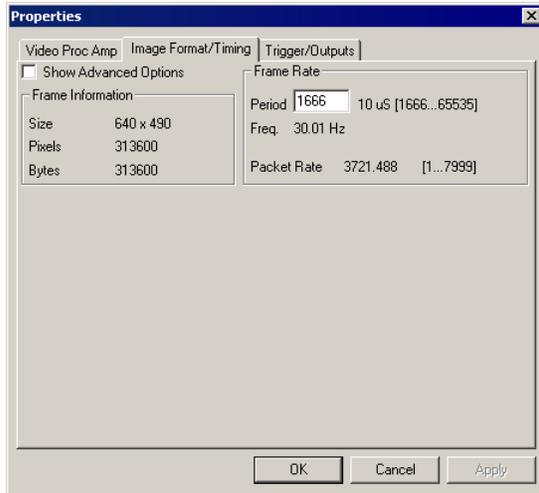
The "Video Proc Amp" page is used to control normal video parameters.

- Brightness** Controls the level that is digitized as black. Decreasing the black level makes the entire image darker. If the black level is too low many dark areas will be solid black, if its too high "black" areas will appear gray.
- Contrast** Controls the overall intensity of the video image. If the contrast is too high bright areas will "wash out" to solid white. If too low the bright areas of the image will be gray.
- Default** Sets brightness and contrast to default values. **NOTE - do NOT use this function as the values that it sets are not the correct 'default values'. The correct default values are Brightness=10 and Contrast=500.**



**If Brightness and Contrast are set incorrectly it will be hard, if not impossible, to see the video image. To set to reasonable default values, set Brightness to 10 and Contrast to 500.**

## Image Format/Timing Properties - Basic



**Basic Image Format/Timing Properties**

When Image Format/Timing is selected as the current property AND the Show Advanced Options *check box* is NOT CHECKED, the basic version of the image Image Format/Timing controls (shown above) will be displayed. In basic mode, you enter the desired frame rate and the system will set the maximum number of lines (y size) and integration time that the camera will support at the given rate.



*Values entered in the advanced version of the Format/Timing properties are used in basic mode. Check Show Advanced Options to see the current values for these 'extra' parameters.*

### Frame Information

The Frame Information group displays information about the image. This information is based on values that can be entered when Show Advanced Options is checked.

<b>Size</b>	Number of pixels and number of lines in each image (frame) acquired
<b>Pixels</b>	Total number of pixels in each image
<b>Bytes</b>	Total number of bytes in each image

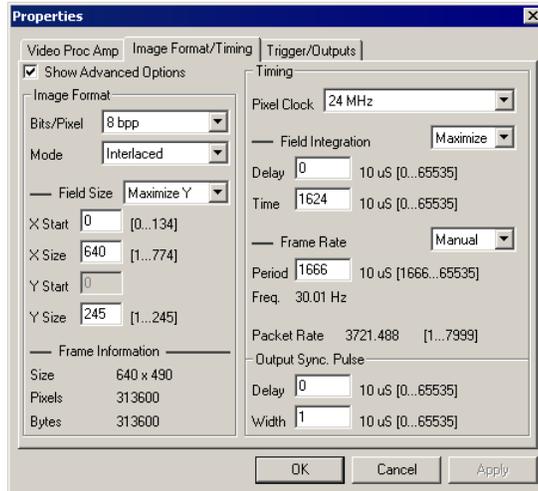
### Frame Rate

<b>Period</b>	Enter the number 10 $\mu$ s clock periods per frame (i.e. frame period in milliseconds times 100).
<b>Freq.</b>	Displays the resulting frame frequency for the entered <u>Period</u> given the current mode (set when <u>Show Advanced Options</u> is checked).
<b>Packet Rate</b>	Displays the USB packet rate. This information is useful for debugging purposes.



*Here are some sample values for Period with resulting Frequencies for progressive mode: 3333=30Hz, 1666=60Hz, 1000=100Hz, 500=200Hz, 100=1kHz*

## Image Format/Timing Properties - Advanced



Advanced Image Format/Timing Properties

When Image Format/Timing is selected as the current property AND Show Advanced Options *checkbox* IS CHECKED, the advanced version of the image Image Format/Timing controls (shown above) will be displayed. The advanced controls give you control of all software-adjustable MyoCam-S parameters.

### Image Format

The main *controls* in the Image Format group determine the major characteristics of the image that will be acquired:

#### Bits/Pixel

Select number of bits to store for each pixel

**8 bpp** - 8 bits/pixel, smallest pixel size, needed to achieve maximum frame-rates and smallest images

**12 bpp** - 12 bits/pixel, more detail for slower frame-rates, doubles size of resulting images

#### Mode

Selects camera acquisition mode

**Progressive** - Only even lines of the CCD are acquired which doubles the available frame rate and halves the number of lines per frame.

**Interlaced** - Each image is acquired in two halves, even lines then odd lines, and then combined into a single image. This results in all lines being acquired but a decrease in the maximum frame-rate.



*When acquiring interlaced images, the odd and even lines are acquired at different points in time which can result in "comb" effects if the image moves between odd and even frames. This may make interlaced mode inappropriate in some situations.*

### Image Format - Field Size

The Field Size section of the Image Format group allows you to specify the dimensions of the image given the constraints of the main Image Format options entered above:

#### drop down

Control how field size parameters are adjusted when values in OTHER *controls* are changed:

**Maximize Y** - As values are changed in other areas, the Y Size value will be recalculated to the maximum possible value given other parameters.

**Manual** - The Y Size value will not be changed which may limit the maximum values of other parameters.

#### X Start

First pixel to acquire in line. To center the acquired image on the sensor chip, enter half of maximum value.

<b>X Size</b>	Number of pixels to acquire in a line. The primary reason to decrease X Size is to reduce the size of the resulting image files which is only significant if the images are saved.
<b>Y Start</b>	Starting line to acquire. The value is fixed at zero for the MyoCam-S.
<b>Y Size</b>	Total number of lines to acquire. The maximum value automatically accounts for <u>Mode</u> selection in <u>Image Format group</u> as well as requested <u>Frame Rate</u> if Frame Rate is set to "Manual".



*Decreasing Y Size will result higher maximum frame rates while changes in X Size do not have a significant effect in the maximum frame rate.*

### **Image Format - Frame Information**

The Frame Information section of the Image Format group displays information about the resulting image given the values that you have selected.

<b>Size</b>	Number of pixels and number of lines in each image (frame) acquired
<b>Pixels</b>	Total number of pixels in each image
<b>Bytes</b>	Total number of bytes in each image

### **Timing**

The main *controls* in the Timing group allows you to select the clock used to read the image data from the CCD sensor.

<b>Pixel Clock</b>	Selects the CCD pixel (read-out) clock frequency: <b>24 MHz</b> - high speed clock which results in the maximum frame rate for a given y-size. <b>12 MHz</b> - medium speed clock decreases CCD read-out noise, which increases image quality, while decreasing the maximum frame rate for a given y-size by 1/2. <b>1 MHz</b> - low speed clock provides lowest CCD read-out noise to allow for the maximum image quality when acquiring images with long integration times. This option dramatically reduces the maximum frame-rate.
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*The qualitative difference between read-out clocks may not be noticeable and/or measurable unless you are in a low light (high gain) situation.*

### **Timing - Field Integration**

The Field Integration section of the Timing group allows precise control over when the CCD is sensitive to light.

<b>drop down</b>	Control how field size parameters are adjusted when values in OTHER <i>controls</i> are changed: <b>Maximize</b> - As values are changed in other areas, the <u>Time field</u> will be recalculated to the maximum possible value given other parameters. <b>Manual</b> - The <u>Time field</u> value will not be changed which may limit the maximum values of other parameters.
<b>Delay</b>	Number of 10 $\mu$ s clock periods to delay from frame "start" before "exposing" CCD.
<b>Time</b>	Number of 10 $\mu$ s clock periods to "expose" CCD.



*Changing the Field Integration Time (either manually or via Maximize) effects the brightness of the acquired image in the same way that changing the shutter speed does on a 35mm camera.*



If you set the Field Integration Time to a fixed value (drop down=manual), the overall brightness of the image will not change as you pick different frame-rates.



If you have enough light, a shorter Field Integration Time can be used to decrease the amount of motion blur caused by the image moving while the CCD is exposed. Again, this is similar to using fast shutter settings on a 35mm camera.

### Timing - Frame Rate

The Frame Rate section of the Timing group allows you to specify specific camera frame rates.

<b>Period</b>	Enter the number of 10 $\mu$ s clock periods per frame (i.e. frame period in milliseconds times 100).
<b>Freq.</b>	Displays the resulting frame frequency for the entered <u>Period</u> .
<b>Packet Rate</b>	Displays the USB packet rate. This information is useful for debugging purposes.



Here are some sample values for Period with resulting frequencies for progressive mode: 3333=30Hz, 1666=60Hz, 1000=100Hz, 500=200Hz, 100=1kHz

### Output Sync Pulse

The Output Sync Pulse group allows control of the timing of the TTL output pulse that is output on the **PRE OUT** BNC on the [front panel](#) <sup>[24]</sup> of the [Power Supply](#) <sup>[14]</sup>. The output sync pulse occurs for every frame acquired.

<b>Delay</b>	Number of 10 $\mu$ s clock periods from frame "start" to setting output pulse to active.
<b>Width</b>	Number of 10 $\mu$ s clock periods before pulse is set to inactive. Set to zero to disable.

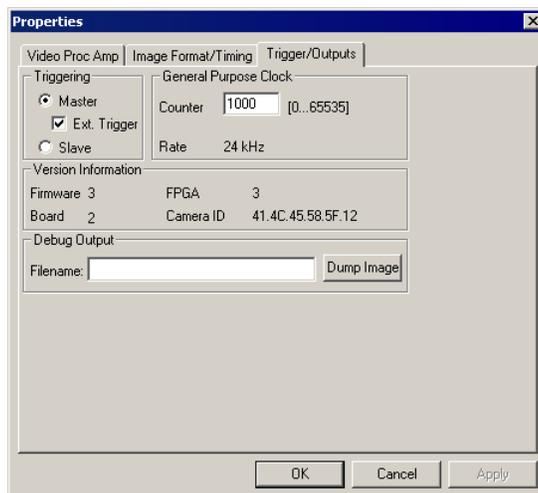


Delay happens BEFORE the CCD is sampled and increases the amount of time required to sample each frame which decreases the maximum frame-rate



Here are some sample values for Delay/Width and the resulting delays: 1=10 $\mu$ s, 25=250 $\mu$ s, 100=1ms, 500=5ms, 1000=10ms

### Trigger/Outputs Properties



MyoCam-S Trigger/Output Properties

When Trigger/Outputs tab is selected, the following *controls* will be displayed:

## Triggering

The Triggering group allows you to configure multiple MyoCam-S cameras to operate in a master/slave relationship so that images acquired between the two cameras are phase-locked.

<b>Master</b>	Camera generates all timing and clocks required for operation. <b>Ext. Trigger</b> - If selected the MyoCam-S outputs signals needed to provide timing and clock signals to a 2nd, slave, MyoCam-S
<b>Slave</b>	Camera uses timing and clock signals from first, master, MyoCam-S.



**Master/Slave and Ext Trigger options do not currently work, Contact IonOptix for more information.**

## General Purpose Clock

The General Purpose Clock group allows a synchronization clock signal to be output on the **CLK OUT** BNC on the [front panel](#)<sup>[2]</sup> of the [Power Supply](#)<sup>[1]</sup>.

<b>Counter</b>	Divisor value from the 24MHz crystal
<b>Rate</b>	Resulting output clock frequency for the entered <u>Counter</u> value

## Version Information

<b>Firmware</b>	MyoCam-S firmware version
<b>FPGA</b>	MyoCam-S programmable logic code version
<b>Board</b>	MyoCam-S board version
<b>Camera ID</b>	Unique camera ID value

## Debug Output

Dumps a raw image for debugging purposes.

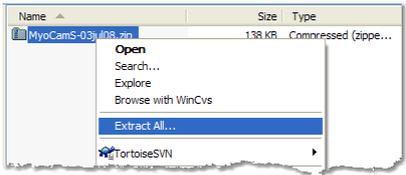
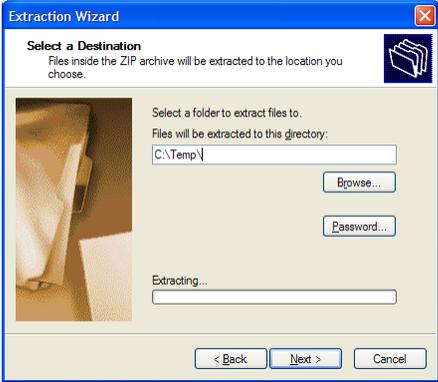
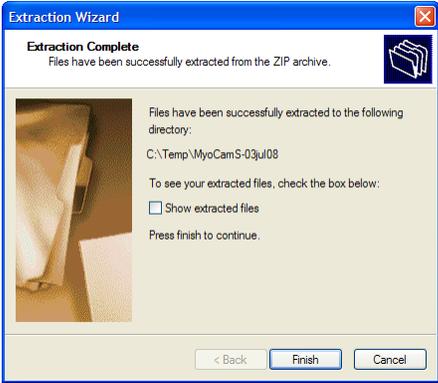
## 5 Driver Installation

The MyoCam-S drivers are distributed as a zip file named "MyoCam-S ddmmmyy.zip" where ddmmmyy is the day, month and year the driver was released as in "03jul08". Contact IonOptix for instructions on receiving the latest version of the MyoCam-S driver file.

Once you have the MyoCam-S driver zip file you will need to unzip the driver files to your computer then select them in the Add Hardware Wizard that runs when the MyoCam-S is attached for the first time.

### Copy and unzip driver files

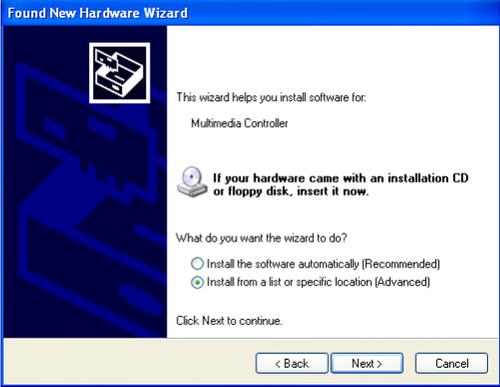
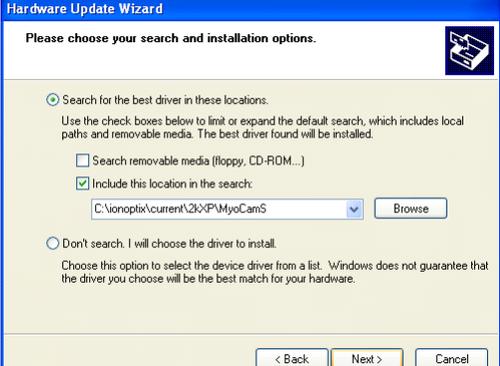
The first step in installing the MyoCam-S drivers is to copy them onto your computer.

<p>Copy the MyoCam-S driver zip file to any directory on your computer's hard drive. For this example we will copy it to the file "MyoCam-S 03jul08.zip" to "C:\temp"</p>	
<p>Using Windows explorer (My Computer), locate the file that you just copied and extract the zip file contents by right clicking on the zip file and picking "Extract All..."</p> <p>Click "Next &gt;" to skip the opening screen (not shown).</p>	
<p>On the select destination page, edit the directory name so that the name of the base file is no longer included (i.e., If you are extracting "MyoCamS-03jul08.zip" in the "C:\Temp" directory, the default value destination will be "C:\Temp\MyoCamS-03jul08". Delete the "MyoCamS-03jul08" so that it reads "C:\Temp\."). Then, click "Next &gt;"</p>	
<p>On the extraction completed page, uncheck "Show Extracted Files" then click "Finish" to complete extracting the zip file contents.</p>	
<p>When you are done, you should see the zip file and a normal directory named "MyoCamS".</p>	

### Attach MyoCam-S and Select Drivers

After the driver files have been copied and unzipped to your computer, you can attach the MyoCam-S USB connection and turn on the power. When Windows sees the new USB device, it will automatically start the "Found New Hardware" process and let you select the driver.

The MyoCam-S actually has two drivers. The first is a "loader" that is responsible for initializing the loading the MyoCam-S program into the camera and the second is the MyoCam-S driver itself. The loader is found first, immediately followed by the camera driver.

<p>Windows displays the following bubble in the system tray when it detects new hardware.</p>	
<p>Select "no" you don't want to search windows update and click "Next &gt;".</p>	
<p>Select "Install from a list or specific location (Advanced)" and click "Next &gt;".</p>	
<ul style="list-style-type: none"> <li>- Select "search for the best...",</li> <li>- uncheck "search removable media...",</li> <li>- check "include this location..."</li> <li>- enter or browse to the MyoCamS directory that you unzipped in the steps above (in our example, c:\temp\MyoCamS).</li> </ul> <p>Click "Next &gt;".</p>	

Windows will start to install the driver then display this warning. Click "Continue Anyway".



When completed, you will see this message. Click "Finish".

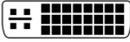


Immediately after you click "Finish", a second "Found New Hardware" popup will be displayed and the "Found New Hardware Wizard" will start again to load the driver for the camera itself. Repeat the process above to load the camera driver.

## 6 Technical Specifications

Here are the specifications for the various parts of the MyoCam-S

### Power Supply

<b>Input Power</b>	100-240VAC, 50-60Hz, 1.5A fuse
<b>Power Entry</b>	NEMA standard for removable power cord
<b>Auxiliary In/Out</b>	Phase-locked programmable output clock, Frame start and programmable frame delay output pulses, Trigger input
<b>Synchronization</b>	Frame-level synchronization between master/slave cameras using Sync In/ Sync Out
<b>Camera connector</b>	Female DVI-I dual-link connector 

### Camera

<b>CCD Sensor</b>	774 pixels wide by 245 lines (progressive) or 490 lines (interlaced)
<b>USB connector</b>	USB "B" connector 
<b>Power supply conn.</b>	Female DVI-I dual-link connector 

### Acquisition Options

<b>Sampling modes</b>	Progressive or Interlaced
<b>Sample resolution</b>	12-bit A/D converter with 8-bit or 12-bit readout
<b>Integration time</b>	Programmable, 10us - 0.6s
<b>Pixel clock</b>	High-speed (24Mhz), medium (12Mhz) and low-noise (1MHz)
<b>Frame Rates (8-bit)</b>	97Hz (245 lines), 250Hz (87 lines), 500Hz (36 lines), 1000Hz (10 lines)
<b>Gain/offset</b>	Programmable, analog

### Software Compatibility

<b>General</b>	Windows DirectShow compatible drivers
<b>Supported versions</b>	Windows XP, Windows 32-Bit Vista only

### Cables (supplied)

<b>Camera to Power sup</b>	Six foot DVI-D dual-link cable
<b>USB</b>	Six foot USB 2.0 cable
<b>Power Cord</b>	Six foot NEMA to U.S. or European plug

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