



Opticstar DS-145M ICE
Opticstar DS-145C ICE

Long Exposure Single Shot Cameras

Set-up Guide



Microsoft Windows
(64-bit & 32-bit)
2000/XP/Vista/7

OPTICSTAR

CAUTION



1. The DS camera is sealed to protect the sensor and electronics, do not open your camera, this will make the camera susceptible to moisture and dust.
2. Do not drop your camera as this can result in serious damage.
3. Only use the supplied power supply unit (3.3VDC 3A regulated).
4. Do not point the camera to a bright light source like the Sun without the appropriate filters.
5. Do not over-tighten adaptors attached to the camera.

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INTRODUCTION

Your Opticstar DS-145M ICE (monochrome model) and DS-145C ICE (colour model) single shot camera will enable you to capture images of deep sky objects, the planets and their satellites as well as images of the Moon and Sun with the use of an appropriate filter.

Your camera incorporates Peltier cooling reducing the levels of noise dramatically during longer exposures.

You will need a PC running Windows 2000/XP/Vista/7 with a USB2.0 port. The camera comes complete with all the software, cables and adapters that you will need to start imaging immediately with a telescope, C type lens or T thread photographic lens.

Please read this manual carefully to get the most out of your Opticstar camera. The following two sections will help you to setup your camera and software.

If you encounter any problems or have any questions please refer to the Troubleshooting section where most common problems have been addressed. Alternatively do not hesitate to contact us or your local dealer.

You can find more information about your Opticstar camera under the Technical Specification section.

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BOX CONTENTS

Once you have received the camera please make certain that you check that no parts are missing. Your camera should include the following:

1. Camera with in-situ USB cable.
2. C-mount ring.
3. T-thread adapter.
4. C-mount to 1.25" telescope nosepiece.
5. Printed camera setup manual.
6. CD with drivers, full manuals and software.
7. Mains PSU for powering the cooling subsystem. A US/UK PSU adaptor is included for US and UK customers.

In the event of a part missing please inform your local supplier immediately.

INSTALLATION

You will first need to install the camera and drivers before installing the Nebulosity software. Please follow the instructions closely for a successful installation. You will require a PC running Windows 2000/XP/Vista/7 with a free USB2.0 port.

If you have any problems during or following installation please refer to the Troubleshooting section in this manual.

Installing the Camera and Software Drivers

If you have installed the camera drivers in the past and you wish to replace the drivers to a different version you must first remove the original drivers. Please refer to the Troubleshooting section on how to remove the currently installed drivers.

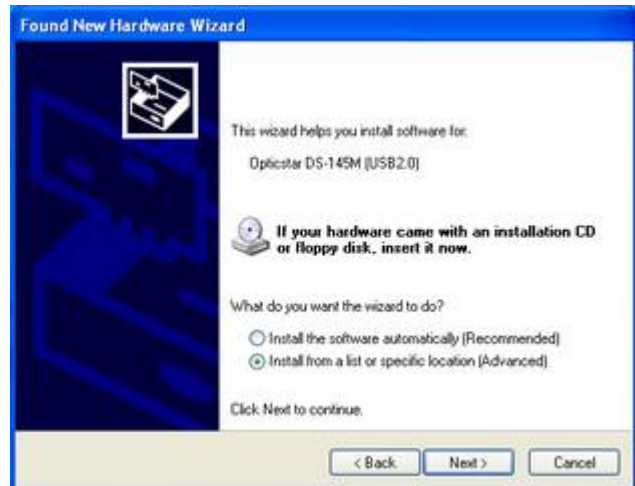
During installation do not allow Windows to automatically select the best drivers. If you allow Windows to automatically select the drivers, installation could fail.

Follow the instructions below closely ensuring that you make the right selections.

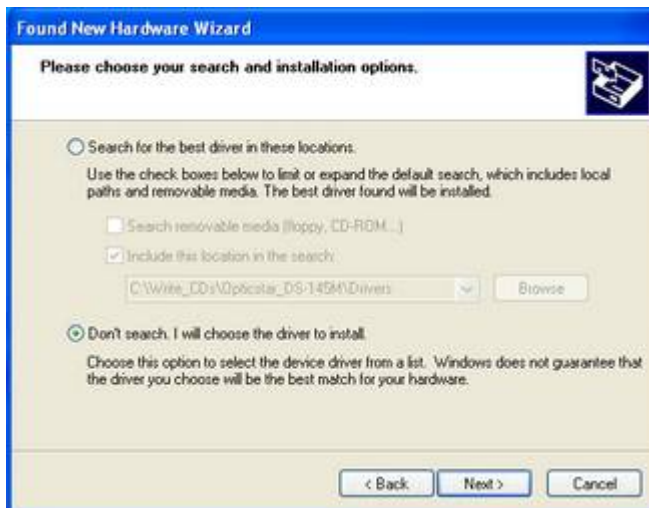
1. Un-install any previous versions of the software.
2. Insert the supplied CD in the CD/DVD drive.
3. Plug the camera to a USB2.0 port (preferably to one on the motherboard).
4. The Windows Found New Hardware Wizard will come into view.



Select **No, not this time**. Click on **Next**



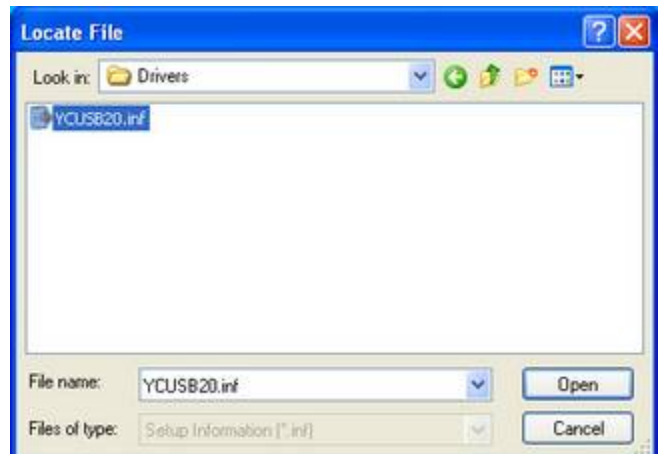
Select **Install from a list...** Click on **Next**



Select **Don't search...** Click on **Next**



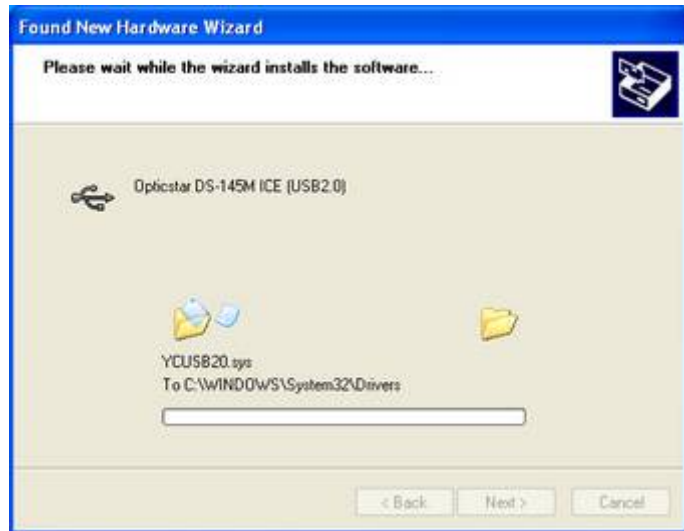
Select **Have Disk**. Click on **Next**



Select **Browse**. Navigate to the **Drivers\32-bit** folder on the supplied CD and select the **YCUSB20** driver for 32-bit Windows or navigate to **Drivers\64-bit** and select **YCUSB2064** for 64-bit Windows. Click on **Open**.



Click on OK.



Windows will commence driver installation.



Click on Continue Anyway.



Click on Finish.



A few seconds later Windows will confirm the installation.

Your camera and drivers are now installed. Note that if later you remove the camera from your computer and re-connect it to a different USB port Windows will ask for the drivers again. Repeat the above procedure to re-install the drivers for the newly selected USB port.

Refer to the Troubleshooting section in this manual if the camera/driver installation fails to complete successfully.

SOFTWARE APPLICATIONS

The Opticstar DS-145M ICE (monochrome model) and DS-145C ICE (colour model) cameras can be controlled by Nebulosity, AstroArt and MaxIm DL.

Nebulosity

The DS-145 ICE camera is bundled with a copy of Nebulosity as standard. Nebulosity is a fully featured application that provides camera control and image processing. Nebulosity needs to be installed as a first step but it will not provide DS-145 ICE camera support by default. The DS-145 ICE plugin for Nebulosity must be copied into the folder where Nebulosity has been installed.

Nebulosity must be registered in order for the software to be fully functional. Please refer to the following pages for detailed instructions. Nebulosity is a Stark Labs product. For the latest software updates please visit Stark Labs at www.stark-labs.com. You may also wish to subscribe to the Stark Labs Yahoo Group at <http://tech.groups.yahoo.com/group/stark-labs-astronomy-software/> where you will receive additional support.

AstroArt

Users of AstroArt v3/v4 will be interested in the DS-145M ICE and DS-145C ICE plugins for AstroArt. These plugins add camera support with binning modes including 1x1, 2x2, and 4x4 in monochrome and colour. Some very fast focus and preview modes are also supported. Please refer to the following pages for detailed instructions.

MaxIm DL

MaxIm DL users will need to install the DS-145M ICE and DS-145C ICE plugins for MaxIm DL. The plugin enables MaxIm DL full camera control with many binning modes including: 1x1, 2x2, 4x4 binning in monochrome and colour. There is also support for fast readout speeds in most modes. Please refer to the following pages for detailed instructions.

Nebulosity

Nebulosity is a fully featured image processing software especially designed for amateur astronomers.

Installation

Follow the instructions below to install the Nebulosity software.

1. Insert the supplied CD in the CD/DVD drive.
2. Navigate to the **Nebulosity** folder on the CD.
3. Double-click (LMB) on the **Setup** icon to start the installation.
4. Follow the on-screen instructions to install Nebulosity.

To add support for the DS-145 ICE cameras to Nebulosity please carry out the following steps.

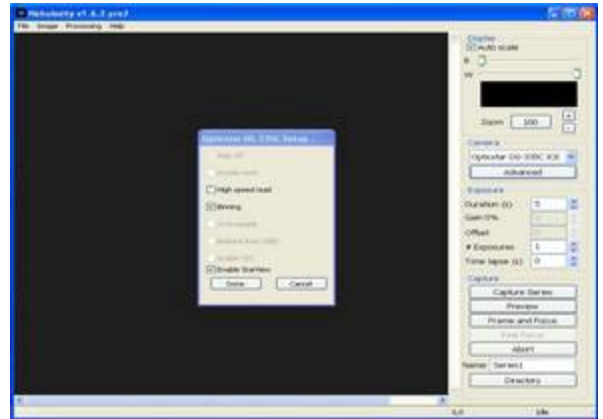
5. Navigate to the **\Plugins\Nebulosity** folder on the CD.
6. Copy all the files from that folder into the folder where Nebulosity has been installed on the hard disk e.g. **C:\Program Files\Nebulosity**.
7. To run Nebulosity double-click (LMB) on the icon.



Please refer to the Nebulosity manual found on the supplied CD in the **Nebulosity** folder for the complete Nebulosity manual. The Serial Number can be found on the inside of the camera manual.

Overview: Plug-in for Nebulosity v1.7 or Later

In order to add support to Nebulosity for the DS-145M ICE camera you will need to copy the **OSDS145MRT.DLL** file from the following folder on the supplied CD **\Plugins\Nebulosity** into the folder where Nebulosity has been installed on the hard disk. For example: **C:\Program Files\Nebulosity**.



For the DS-145C ICE camera please copy the **OSDS145CRT.DLL** file from the **\Plugins\Nebulosity** folder on the supplied CD into the folder where Nebulosity has been installed on the hard disk.

DS-145M ICE Binning Modes

Nebulosity supports four binning modes. The fast read-out modes are best suited for fast frame rates during focusing or preview. The standard speed modes are best suited for image acquisition.

Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	Monochrome	1	x1
2x2	680 x 512	Monochrome	1.5	x4
4x4	340 x 256	Monochrome	2	X16
1x1 fast	1360 x 1024	Monochrome	2	x1
2x2 fast	680 x 512	Monochrome	3	x4
4x4 fast	340 x 256	Monochrome	4	X16

DS-145C ICE Binning Modes

The DS-145C ICE supports five binning modes.

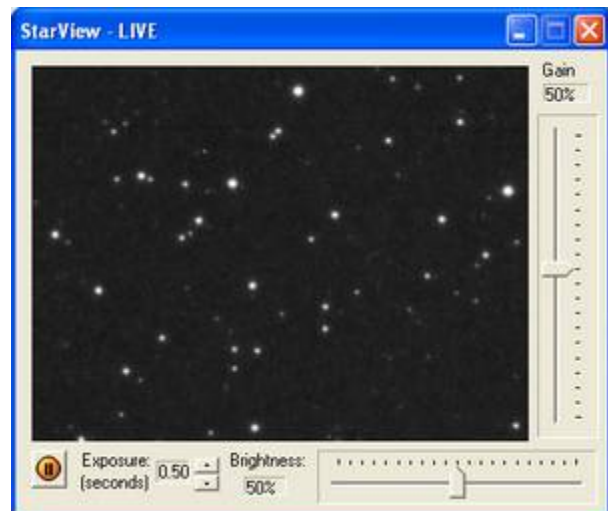
Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	colour	1	x1
2x2	680 x 512	colour	1	x4
4x4	320 x 256	colour	1	X16
1x1 fast	1360 x 1024	colour	3	x1
2x2 fast	680 x 512	colour	3	x4
4x4 fast	340 x 256	colour	3	X16

The fast read-out modes give priority to speed over data integrity and they are useful when the camera operates in semi video mode. The 2x2 and 4x4 colour binning modes are available by performing the colour synthesis manually.

Once a binned image has been captured, it will always appear in monochrome. To add the colour information select **File > Preferences > Acquisition Mode**. If **RAW Acquisition** is selected then the image will be in monochrome. Otherwise it will be in colour. The two high speed binning modes are suitable for focusing and preview.

StarView Mode

The StarView window displays a real time, high sensitivity view. This mode is only to be used for focusing or preview. Images cannot be captured in this mode. The exposure time can be adjusted to up to 10 seconds. There are two slider bars that control the Gain and the Brightness. These controls are for the StarView window only. When Nebulosity captures images, the StarView window must be paused.



The StarView mode can be disabled in the **Advanced** menu. The Advanced menu can be accessed by clicking the **Advanced** button on the right hand side panel.

Hardware Settings

The camera supports Gain and Black Level in hardware. By default, the Gain is set to 1. The maximum value for Gain is 1023. The Black Level cannot be set by the user in Nebulosity. The Black Level is equivalent to Offset but it takes place in hardware.

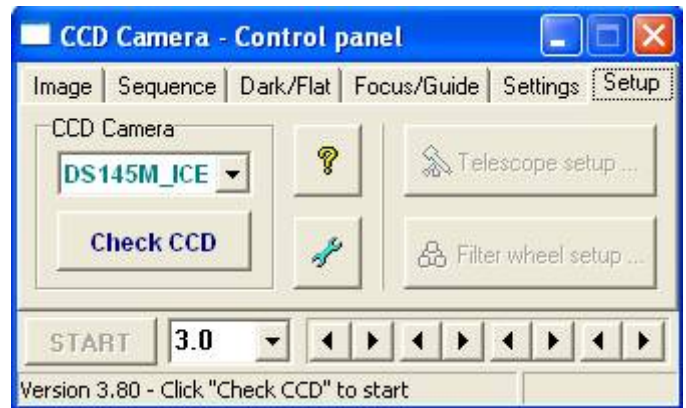
Escaping an Exposure

Please note that when escaping an exposure it will take a certain amount of time for the camera to escape. This delay can become apparent when changing between binning modes.

AstroArt

AstroArt is powerful image processing software especially designed for amateur astronomers. Before installing the plugin, please ensure that the camera's software drivers and AstroArt have already been installed on the computer. Follow the instructions below to add support for the DS-145 ICE cameras to AstroArt.

1. Insert the supplied CD in the CD/DVD drive.
2. Navigate to the **\Plugins\AstroArt** folder.
3. Copy all the files in that folder into the folder where AstroArt has been installed on the hard disk e.g. **C:\Program Files\AstroArt**.
4. Run AstroArt and from the **Plug-in** menu select **CCD Camera**.



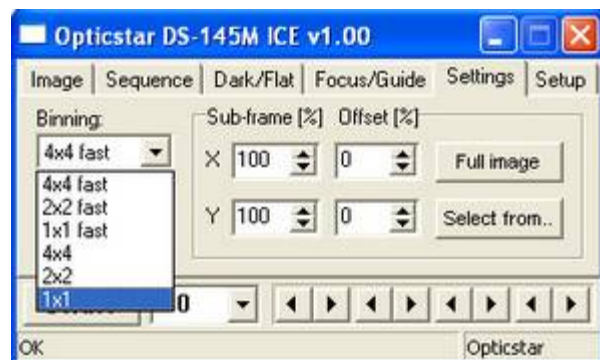
5. Select the appropriate camera model: **DS145M_ICE** or **DS145C_ICE**.

Overview: Plug-in for AstroArt v3/v4 or Later

In order to add support to AstroArt v3/v4 for the DS-145M ICE camera you will need to copy the **D_DS145M_ICE.DLL** and **OSDS145MRT.DLL** files into the folder where AstroArt has been installed on the hard disk. For example: **C:\Program Files\Astroart**. Likewise, to add support to AstroArt for the DS-145C ICE camera you will need to copy the **D_DS145C_ICE.DLL** and **OSDS145CRT.DLL** files into the folder where AstroArt has been installed on the hard disk.

DS-145M ICE Binning Modes

The DS-145M ICE supports six binning modes. The fast read-out modes are best suited for fast frame rates during focusing or preview. The standard speed modes are best suited for image acquisition.



Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	Monochrome	1	x1
2x2	680 x 512	Monochrome	2	x4
4x4	340 x 256	Monochrome	2	x16
1x1 fast	1360 x 1024	Monochrome	2	x1
2x2 fast	680 x 512	Monochrome	4	x4
4x4 fast	340 x 256	Monochrome	4	x16

DS-145C ICE Binning Modes

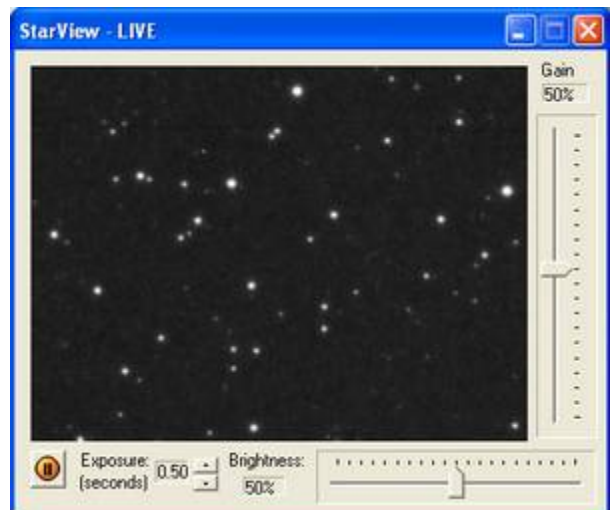
The DS-145C ICE supports six binning modes.

Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	colour	1	x1
2x2	680 x 512	colour	1	x4
4x4	340 x 256	colour	1	x16
1x1 fast	1360 x 1024	colour	3	x1
2x2 fast	680 x 512	colour	3	x4
4x4 fast	340 x 256	colour	3	x16

The fast read-out modes give priority to speed over data integrity and they are useful when the camera operates in semi video mode.

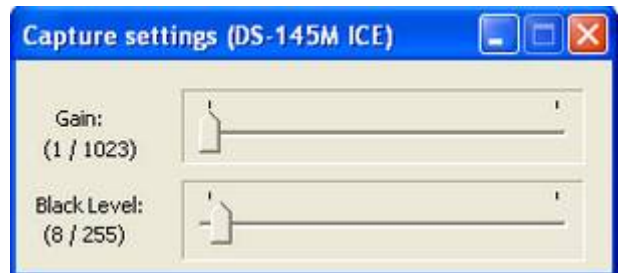
StarView Mode

The StarView window displays a real time, high sensitivity view. This mode is only to be used for focusing or preview. Images cannot be captured in this mode. The exposure time can be adjusted to up to 10 seconds. There are two slider bars that control the Gain and the Brightness. These controls are for the StarView window only. When AstroArt captures images, the StarView window must be paused.



Hardware Settings

The camera supports Gain and Black Level in hardware. By default, the Gain is set to 1. The maximum value for Gain is 1023. The Black Level default value is 8. The maximum Black Level value is 255. The Black Level is equivalent to Offset but it takes place in hardware. Typically, the Black Level should be set at the default value of 8.



Escaping an Exposure

Please note that when escaping an exposure it will take a certain amount of time for the camera to escape. This delay can become apparent when changing between binning modes.

MaxIm DL

MaxIm DL is a powerful image capture and processing software especially designed for amateur astronomers. Before installing the plug-in, please ensure that the camera's software drivers and MaxIm DL have already been installed on the computer. Follow the instructions below to add support for the DS-145 ICE cameras to MaxIm DL.

1. Insert the supplied CD in the CD/DVD drive.
2. Navigate to the **\Plugins\MaxImDL** folder.
3. Copy all the files in that folder into the folder where MaxIm DL has been installed on the hard disk e.g.

C:\Program Files\Diffraction Limited\MaxIm DL V4.

4. Run MaxIm DL by click the application's icon or from the Start menu.



5. Click the **Toggle CCD Control** icon and select **Opt DS145M ICE** (monochrome model) or **Opt DS145C ICE** (colour model).



Overview: Plug-in for MaxIm DL v4 or Later

In order to add support to MaxIm DL for the DS-145M ICE monochrome camera you will need to copy the **CCDPlugOSDS145M.DLL** and **OSDS145MRT.DLL** files into the folder where MaxIm DL has been installed on the hard disk. For example: **C:\Program Files\Diffraction Limited\MaxIm DL V4**. Likewise, to add support to MaxIm DL for the DS-145C ICE colour camera you will need to copy the **CCDPlugOSDS145C.DLL** and **OSDS145CRT.DLL** files into the folder where MaxIm DL has been installed on the hard disk.

DS-145M ICE Binning Modes

The DS-145M ICE supports six binning modes. The fast read-out modes are best suited for fast frame rates during focusing or preview. The standard speed modes are best suited for image acquisition.

Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	Monochrome	1	x1
2x2	680 x 512	Monochrome	2	x4
4x4	340 x 256	Monochrome	2	x16
1x1 fast	1360 x 1024	Monochrome	2	x1
2x2 fast	680 x 512	Monochrome	4	x4
4x4 fast	340 x 256	Monochrome	4	x16

DS-145C ICE Binning Modes

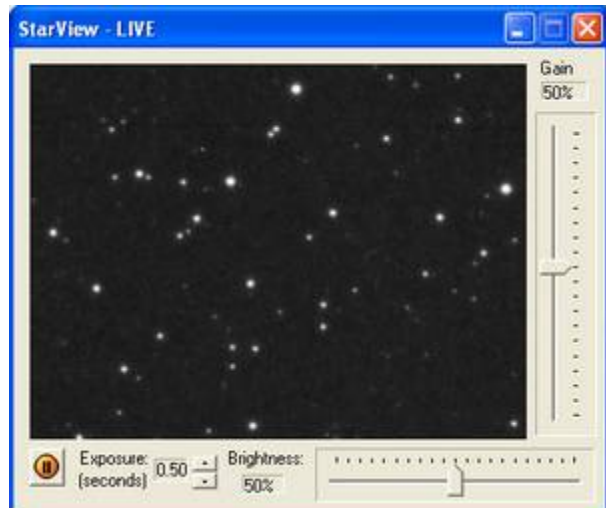
The DS-145C ICE supports six binning modes.

Mode	Resolution	Data	Frame Rate (max)	Sensitivity
1x1	1360 x 1024	colour	1	x1
2x2	680 x 512	colour	1	x4
4x4	340 x 256	colour	1	x16
1x1 fast	1360 x 1024	colour	3	x1
2x2 fast	680 x 512	colour	3	x4
4x4 fast	340 x 256	colour	3	x16

The fast read-out modes give priority to speed over data integrity and they are useful when the camera operates in semi video mode.

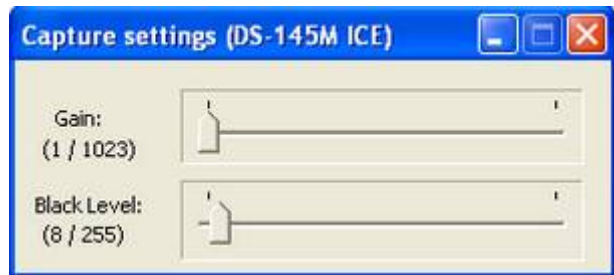
StarView Mode

The StarView window displays a real time, high sensitivity view. This mode is only to be used for focusing or preview. Images cannot be captured in this mode. The exposure time can be adjusted to up to 10 seconds. There are two slider bars that control the Gain and the Brightness. These controls are for the StarView window only. When MaxIm DL captures images, the StarView window must be paused.



Hardware Settings

The camera supports Gain and Black Level in hardware. By default, the Gain is set to 1. The maximum value for Gain is 1023. The Black Level default value is 8. The maximum Black Level value is 255. The Black Level is equivalent to Offset but it takes place in hardware. Typically, the Black Level should be set at the default value of 8.



Escaping an Exposure

Please note that when escaping an exposure it will take a certain amount of time for the camera to escape. This delay can become apparent when changing between binning modes.

TROUBLESHOOTING

This section is divided into smaller sections covering various topics including information on system requirements, installation, drivers, USB issues, USB cable lengths, camera performance etc. Also refer to the **Articles** folder on the CD.

System Requirements

The Opticstar DS series cameras require a modern PC running Windows 2000/XP/Vista/7. Please make certain that you have installed the latest windows updates that are available free of charge at www.microsoft.com. A USB2.0 port is also a requirement. This port should be preferably dedicated to the camera and not shared by another bandwidth hungry device like a guide camera.

Installation Issues

In case Windows fails to recognise your camera or successfully install the drivers there are certain actions you can take to solve the problem, these have been outlined below.

Keep in mind that you will not be able to install the drivers unless Windows first recognises your camera when this has been connected for the first time to a working USB2.0 port. Once Windows has recognised the camera it will proceed with driver installation.

Windows does not Recognise the Camera

If you experience camera/driver installation issues please ensure that:

1. Your PC meets the minimum requirements.
2. The drivers are present in the Windows Device Manager.
3. The drivers are working properly.

In case the PC is unable to recognise the camera try connecting the camera to a different USB port that resides on a different USB controller. In other words if installation has failed on a USB port on the front of your PC also try the USB ports on the back of your PC.

Connecting the camera to a USB2.0 port that resides on the computer's motherboard is the best way to resolve such issues. Windows will only need to recognise your camera the first time that this has been connected to a certain UB2.0 port. Once Windows has successfully recognised the camera it will not do this again unless the camera is plugged to a different USB2.0 port.

Camera Driver Check

To check whether the camera drivers are present follow the instructions below.



Right click on My Computer, then click on Properties.



Click on Hardware, then click on Device Manager

Click on Universal Serial Bus Controllers to reveal the Opticstar camera drivers.



Check that the Opticstar driver entry does not show any conflicts. If there is a conflict this will appear as an exclamation mark over the Opticstar driver entry.



You will need to resolve the conflict before proceeding. A conflict may be as a result of another device being present also showing a conflict. If you are unable to resolve the conflict then you may have to remove or momentarily disable the offending driver. For more information on how to Update, Uninstall or momentarily Disable a device driver please refer to the following section in this manual. You can re-enable a disabled driver at any time using the same sub-menu.

Camera Driver Removal

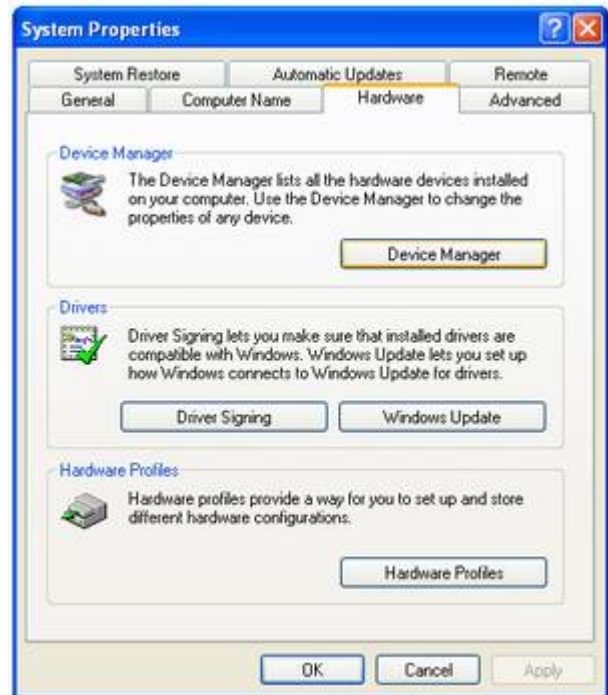
If you encounter any problems with the installation you may need to remove/uninstall the camera drivers. You can uninstall the drivers via the **Windows Device Manager**. To remove the drivers successfully please follow the procedure below.



Right click on My Computer.

Click on Properties. Click on Hardware.

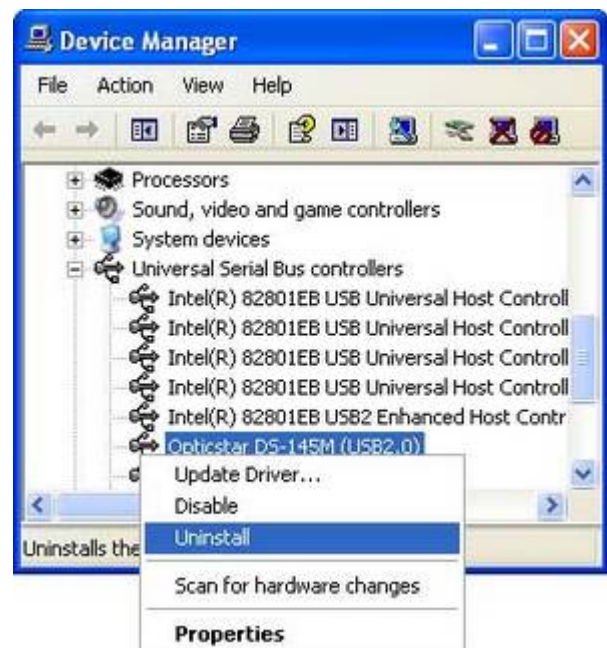
Click on Device Manager.



Click on Universal Serial bus Controllers.

Right-click on the Opticstar driver entry.

Click on Uninstall to uninstall the drivers.



From this sub-menu you can also Update or momentarily Disable a driver if you wish.

Re-installing the Camera and Drivers

If you wish to re-install the camera, its drivers and software for any reason please refer to the instructions below.

1. Uninstall Nebulosity from Start → Control Panel → Add or Remove Programs.
2. Uninstall the camera drivers (please refer to the previous section).
3. Unplug the camera from your PC.
4. Switch off your PC and leave it switched off for at least 30 seconds.
5. Switch on your PC.
6. Refer to the Installation section earlier in this document to re-install the camera, its drivers and software.

Camera Performance

The camera is capable of high transfer rates (1.5 megapixels/second) when taking into account the high resolutions the camera is capable of. The image data sent to the PC by the camera is at high resolution, non-interlaced and uncompressed. This guarantees images of the highest quality possible.

Performance will also greatly depend on the PC that the camera is connected to.

The frame rate will increase if you use a computer with a faster processor or with a faster disk subsystem.

To increase performance on slower computers you may need to disable any anti-virus, spyware and adware software as these may affect the performance of your camera to a degree. Sometimes but not always these can take considerable resources especially when scanning your computer hard disks.

The speed at which images will be transferred to the PC will depend on the speed of the USB2.0 bus. Please refer to the section headed USB Bus Speed later in this manual.

USB Bus Speed

The type of USB2.0 port your camera is connected to will affect the speed at which an image will be transferred to your PC. Typically maximum transfer for the three different types are:

1. USB2.0-PCMCIA/2 card (varies greatly, the latest laptops tend to perform well)

2. USB2.0-PCI type card is 250Mbps (typical)
3. USB2.0 is 480Mbps (USB on motherboard)

If at some point you decide to get a new PC you would need to make certain that the USB subsystem was already on the motherboard as this would offer the maximum bandwidth possible for your system. This is standard with almost all PC motherboards.

It is also worth keeping in mind that normally PCs have two USB controllers, Each USB controller has two or more USB ports that share a controller's bandwidth. If you use two cameras, one for guiding and one for imaging, ensure that the two cameras do not reside on the same USB controller. This is particularly important when using the camera with laptops.

USB Extensions

The camera comes with an in-situ 2.5 metres USB2.0 cable. The in-situ cable can be extended by up to 5 metres total with a standard hi-speed USB.20 cable before a special USB2.0 repeater cable is required to further extend the total length. USB2.0 5 metres repeater cables can be used to extend the total length to an absolute maximum of 25 metres. The DS-145 ICE will function with standard USB2.0 repeater cables to a typical cable length of 12.5 meters depending on the type of USB2.0 repeaters used.

USB2.0 repeater cables tend to vary in the way they work. Various devices including CCD cameras may not function with repeater cables unless the following installation procedure is followed:

1. Disconnect the camera and USB2.0 repeater cable from the PC.
2. Disconnect the USB2.0 repeater cable from the CCD camera.
3. Connect the USB2.0 repeater cable to the PC without the camera.
4. Wait for the USB2.0 repeater cable to be identified by Windows before continuing. Repeat steps 3 & 4 if you use additional repeaters.
5. Connect the CCD camera to the USB2.0 repeater cable.
6. Wait for the CCD camera to be identified by Windows.
7. Install the CCD camera drivers as instructed by Windows.
8. Run the camera application software.

Considerably more expensive USB2.0 amplifiers can also be used that offer better results and considerably longer reach.

USB Port Issues

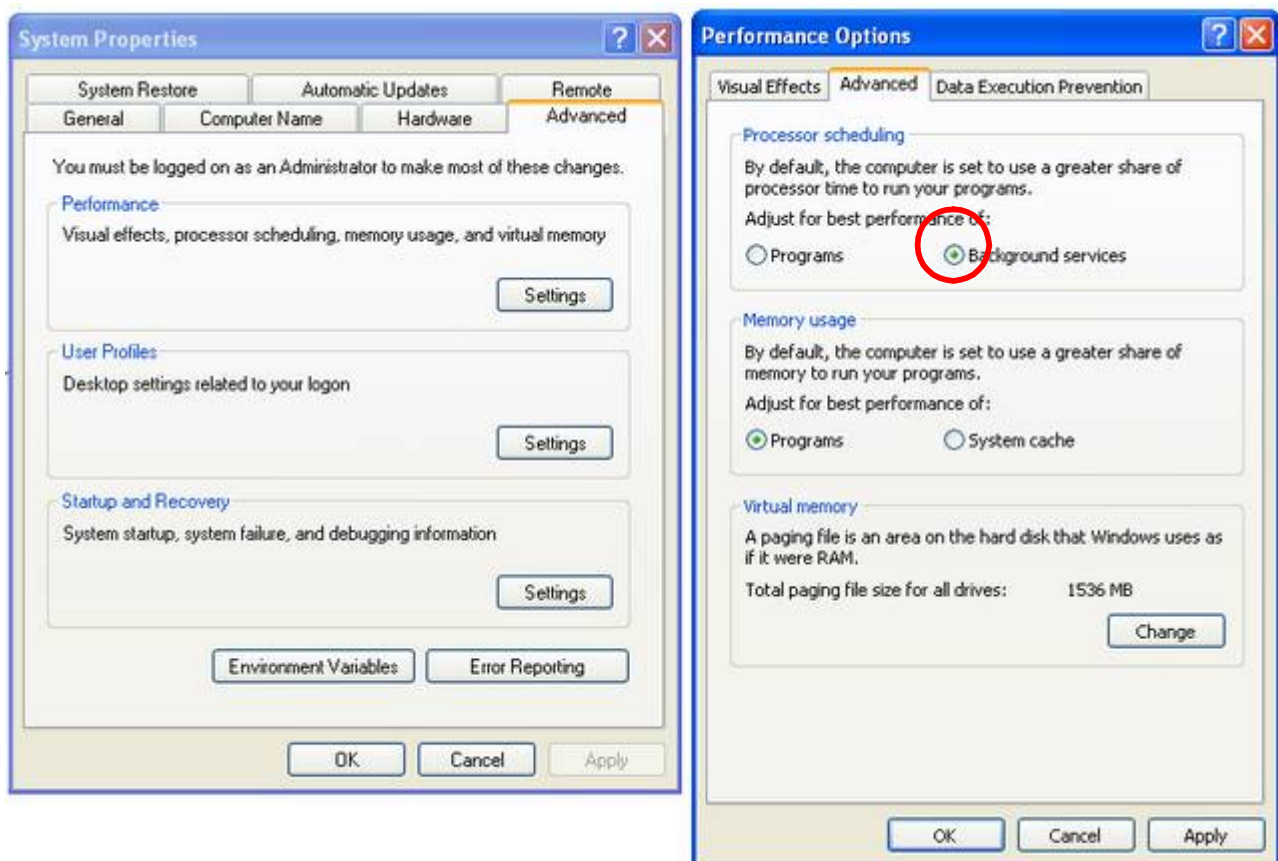
In practice not all USB ports on desktop PCs and laptops are fully featured. As such they may affect the operation of your camera. Experience has shown that USB ports found on the motherboards are the ones closest to the USB standard and as such provide the maximum power and data transfer speeds required.

In many cases USB hubs found on the front of desktop PCs or as add-on external units will not supply enough power to devices connected to them starving such devices of power. This problem in most cases can be overcome by external USB hubs that use their own mains power supplies. Keep in mind that powered USB hubs will not extend the reach of a USB cable beyond the 5 metres limit. For that you will need a USB repeater type cable.

CAMERA PERFORMANCE

The camera is capable of high speed data read-outs rates when taking into account the high resolution the cameras are capable of.

To ensure that the operating system allocates the required resources to your camera you could set *Background services* in **Device manager** under **System Properties, Performance Options**. This is not always necessary but it may resolve any operational issues.



Performance will also greatly depend on the PC that the camera is connected to. In order to increase performance on slower computers you may need to disable any anti-virus, spyware and adware software as these may affect the performance of your camera to a degree.

Decreasing the resolution where possible will also increase frame rates.

The performance of your camera will also depend on the bandwidth of the USB bus. Typically maximum transfer for the three different types are:

- PCMCIA/2 card (varies)

- USB-PCI type card is 250Mbps
- USB2.0 is 480Mbps

GOOD PRACTICES

Camera Care

Your DS camera is sealed to protect the sensor and electronics and with the exception of the external fan (if present) the camera is waterproof. Do not open your camera under any circumstances as this will break the seal and make the camera susceptible to moisture and dust. Do not drop your camera as this can result in serious damage to the on-board electronics and sensor.

Camera Cleaning

To clean the camera body use a wet cloth and lukewarm water. Avoid touching the camera window as this may scratch the glass and damage the coatings. Only use special lens cleaning cloths and/or pressurised air, do not rub!

Camera Power Requirements

Only use the supplied power supply unit if your camera came with one. Using the wrong power supply will cause damage to the cooling subsystem and/or camera.

Overexposing the Camera to Strong Light

Never point the camera through a telescope to a bright light source like the Sun without the appropriate filters, doing so will damage the camera sensor!

AVI Tools

A range of AVI tools and converters can be downloaded free of charge at: www.price-media.demon.co.uk (Rostrum Camera) and www.ndrw.co.uk (JPGVideo). Opticstar does not guarantee or endorse these products in any way whatsoever.

DS-145 ICE SERIES SPECIFICATION

Model	Opticstar DS-145 Series
Sensor	Sony CCD: ICX285AL (monochrome) or ICX285AQ (colour)
Sensor type	Progressive scan
Sensor size	10.2mm x 8.3mm (2/3")
Sensor aspect ratio	4:3
Resolution	1.4 Megapixels, 1360 x 1024 pixels (active)
Pixel size	6.45µm x 6.45µm
Readout noise	8e~
Dark current	0.15e~/pix/s (cooled)
Binning modes	1x1, 2x2, 4x4
Preview mode	StarView video mode at 3 frames per second
Analogue to Digital Converter	13-bit
Exposure time	Minimum: 3ms; Maximum: user specified (Nebulosity does not support exposure times under 1 second)
On Board Functions	Black Level; Gain x1024; Noise Reduction;
Data output	16-bit raw
Raw 16-bit image transfer	1 second approximately @ 1340x1024
Cooling	Peltier cooled with fan assist, up to 30°C below ambient
Computer interface	USB 2.0
Housing	Robust all metal case, sealed sensor and electronics
Camera window	AR antireflection, no infra-red IR cut-off
Dimensions	71mm (W) x 95mm (H) x 86.7mm (D) approx.
Weight	730 grams approx.
Bundled Software	Software drivers for Windows (64-bit & 32-bit) 2000/XP/Vista/7; Nebulosity software for camera control and image processing. Software plug-ins for AstroArt and MaxIm DL.
Computer requirements	Microsoft Windows (64-bit & 32-bit) 2000/XP/Vista/7; USB 2.0;

All information correct at the time of writing.



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