epipole

Digital Retinal Camera

EpiCam V

CE	Please ensure you keep this manual in a safe place. Read before operating the device. epiCam V Manual H14 Version 8 24th April 2019

Contents

Notes

1. Please contact your sales representative or local epiCam dealer if you require installation for your instrument.
2. The user is responsible for the use and maintenance of the product. We suggest that a dedicated individual is assigned responsibility for maintenance to ensure that the product is kept in good condition and can be used safely.
3. It is unlikely but possible that this product may malfunction due to electromagnetic waves caused by mobile phones or other radio wave generating devices. Be sure to avoid having objects such as these brought near to the product.
4. Disposal of this product in an unlawful manner may have a negative impact on human health or on the environment. When disposing of this product, therefore, be absolutely sure to follow the procedures which conform with the laws and regulations applicable in your area.
5. Reading of images and storage of data must be performed in accordance with the law of the country where the product is being used. Also, the user is responsible for maintaining the privacy of image data.
6. The cable supplied is designed to be used solely with this camera. Do not use it for any other product.
7. epipole Ltd reserves the right to change the specifications, configuration and appearance of the product without prior notice. Updates may be found on the epipole website at http://www.epipole.com

Warnings and cautions

The manual contains warnings and cautions for the safe usage of epiCam V. Please read these to ensure the safety of both users and patients.

European Union (and EEA*) only

This symbol indicates that this product is not to be disposed of with your household waste, according to the WEEE Directive (2002/96/EC) and your national law. This product should be handed over to a designated collection point, e.g., on an authorized one-for-one basis when you buy a new similar product or to an authorized collection site for recycling waste electrical and electronic equipment (EEE). Improper handling of this type of waste could have a possible negative impact on the environment and human health due to potentially hazardous substances that are generally associated with EEE. At the same time, your cooperation in the correct disposal of this product will contribute to the effective usage of natural resources. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, waste authority, approved WEEE scheme or your household waste disposal service.
*EEA: Norway, Iceland and Liechtenstein

Trademarks

epiCam® and the e logo are trademarked.

1 Overview

The epiCam V is a hand-held retinal fundus camera for veterinary use. It can be used to take colour digital images of the retina by imaging through the pupil.

The epiCam V has the following features:

- Captures real-time video with the option to freeze and store images on demand.
- Hand-held design which connects to a laptop, tablet or PC and has no internal battery to charge.
- Can resolve details down to 10µm, supporting early detection of very small features such as microaneurysms.
- Can correct focus in excess of ± 15 dioptres for pupil sizes above 4 mm.
- May be used for anterior segment imaging without significant adjustment.
- Generates video streams at 14 frames per second
- Images at a wide field angle – the hand-held design allows straightforward panning and tilting to locate areas of interest.
- Safe, low-power illumination which needs no flash.

epiCam V Software

The epiCam V includes simple software to organise patient records, capture and review digital images and videos.

Limitations of use

epiCam V should not be used on human patients.

2 Components

2.1 Contents in the box

EpiCam V

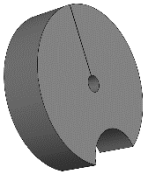
USB drive

Contains the epiCam V software and user manual.

USB cable

USB 3.0 A to micro-B cable for data and power.

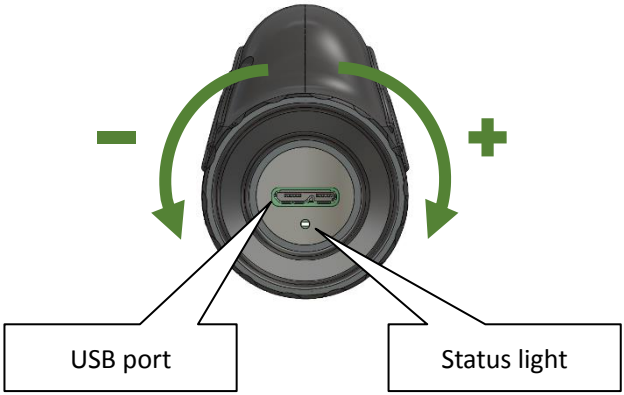
Cable guide



Helps maintain connection if the cable is pulled. Slide it onto the cable and into the Focus Wheel.

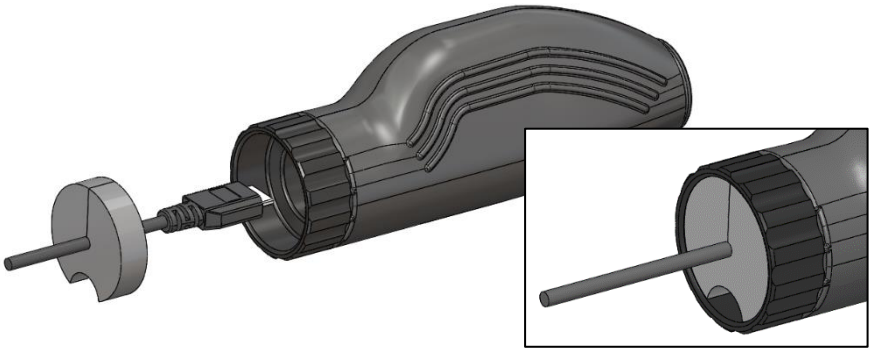
2.2 Overview of epiCam V

To focus epiCam V, rotate the black focus ring anti-clockwise for myopic and clockwise for presbyopic patient prescriptions. One quarter turn is around 3 Dioptres.



The epiCam V emmetropic setting is found by focussing it on an object 3 metres or more from the camera objective lens.

A cable guide is included, which helps maintain connection if the cable is pulled. Slide it onto the cable and into the Focus Wheel.



3 Instructions for use

3.1 Setup

3.1.1 Software setup

System requirements

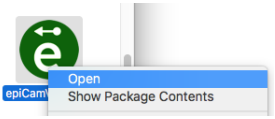
- A desktop, laptop or tablet PC with a quad core CPU (6th generation Intel Core i5 or higher)
- GPU memory of at least 512 MB
- Graphics hardware that supports a hardware-accelerated implementation of OpenGL 2.1 or later.
- Microsoft Windows **(7, 8/8.1 or 10)** or macOS **(High Sierra or Mojave)**
- At least 4 GB of RAM
- A USB 3.0 port is required for full resolution (2592 × 1944) image capture. If connected to USB 2.0 the epiCam V will function at a resolution of 1296 × 972.
- At least 70 MB of free disk space for installation, and as much disk space as necessary for image and video storage. Typical image size is between 4.5 and 6MB and the typical size of a 30 second lossless video is approximately 700 MB.
- A monitor/screen with at least 1920 × 1080 pixel resolution at 24-bit (or greater) colour depth
- An Internet connection to visit the epipole website for future software downloads and support.

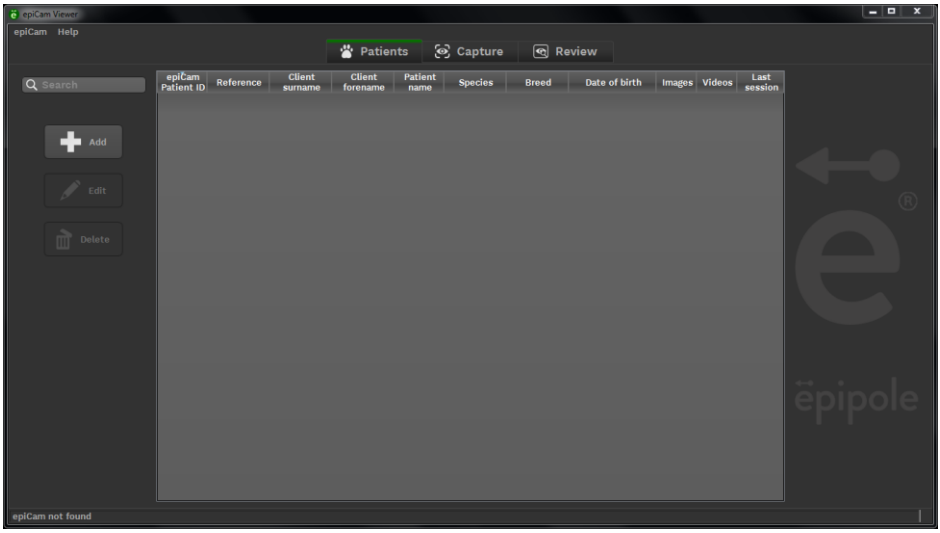
Installing the software

- Make sure that you have the necessary permissions to install software, permission to access a USB drive and a working Internet connection. Contact your IT support if you require help.
- If you are installing from a non-admin user account then you should start the install from your own account and then seek administrator support to complete the install. A password, usually the administrator's, may be required.
- **Anti-virus warnings**: If you encounter warnings from anti-virus software during installation, then please temporarily disable your anti-virus software until the install has been completed. Refer to the instructions for your anti-virus software on how to do this.

- Insert the USB drive supplied with the epiCam V (or download the latest version of the software from http://www.epipole.com).
- Locate the required installer (the .exe file for Windows or the .dmg file for macOS). Run the installer by double-clicking on it and follow the on-screen instructions.
- For Windows users, the **epiCamV Viewer** software will be added to your Windows **Start Menu** and an icon will be added to your **Desktop**. For macOS users the application will be added to your applications folder.

Launching the software

Windows:	macOS:
• Launch the **epiCam V Viewer** software. • The **Patient Management** window will then open with an empty patient record list (see below). This window allows you to add, edit and delete patient records.	• Launch the **epiCam V Viewer** software. • If you receive a message stating that the application "can't be opened because it is from an unidentified developer" then right click the application and select "Open":  Then click "Open" on the message asking if you are sure. You will only need to do this the first time you run the newly installed software. • You will be asked to agree to the License Agreement and to enter your epiCam V serial code the first time the software is run. • The **Patient Management** window will then open with an empty patient record list (see below). This window allows you to add, edit and delete patient records.



Adding patient records

Click on the button with the 'add record' icon ( ) to add a new patient record. This allows you to fill out patient details as required. Each patient record is given a unique **epiCam Patient ID** by the software which cannot be changed and is also used to label the folder where that patient's images and videos are stored on your computer.

The **Species** and **Breed** fields will provide suggestions as you enter text based on any previous entries in the patient database. The **Reference** field is optional for your own use, e.g. a reference number.

Editing patient records

Select the record you wish to change and click on the button with the 'edit record' icon ( ) to change the patient details. This does not make any changes to the folders where the images are stored on your computer.

Deleting a patient record

Click on the button with the 'delete record' icon ( ) to remove a patient record. It is not possible to undo this action or to restore the patient record. Upon deleting a record you will be asked to confirm if you wish to remove the associated images and videos from your computer or not.

Searching patient records

To search for patients enter an appropriate search term in the search box. Use the clear () button to clear the search results and return to the full listing. You can also click on the column headers of the listing if you wish to sort the records into alphabetical or numerical order.

Uninstalling the software

Windows:	macOS:
• Launch the **Uninstall epiCamV Viewer** file from the Start Menu and follow the on-screen instructions. This will remove the epiCam V software from your system.	• Drag the application from the Applications folder to the Trash (located at the end of the dock).

NOTE	Uninstalling the software will not remove any of the patient images and videos which have been stored in your **Documents/epiCamV** folder.

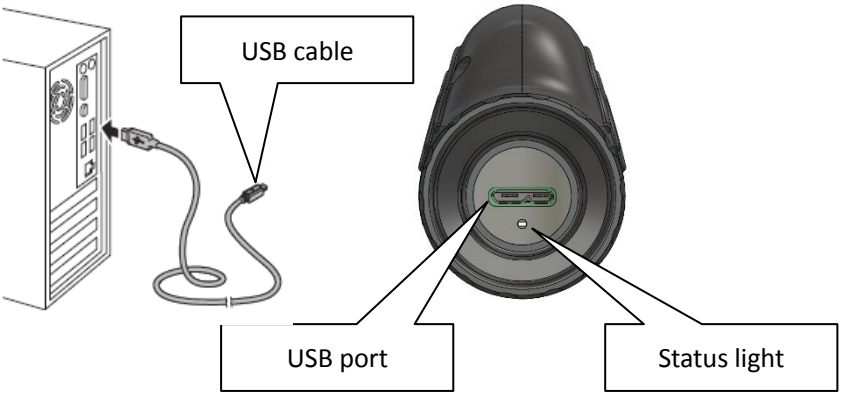
Limitations and restrictions

- The software will only operate a single epiCam V device.
- The software product does not encrypt images or patient data stored on your PC system.
- You, the user, are responsible for safe and secure storage of all data.
- For best viewing it is recommended that the computer screen resolution is at least 1920 × 1080.
- Make sure your system meets the minimum system requirements. Be aware that the software may not display the feed from the camera at full frame-rate, or correctly perform video recording on overloaded or improperly configured PC systems.

3.1.2 Connecting epiCam V

You must connect the epiCam V to your computer using the **USB cable supplied**. Do not touch the **objective lens** (see Section 2.2) whilst connecting or disconnecting the epiCam V as any dirt, fingerprints, dust, or other foreign objects on the **objective lens** could appear as artefacts in captured images.

- Insert the **USB cable** into the **USB port** on the **epiCam V**.
- Insert the USB cable connector into a USB 2.0 or USB 3.0 port on your PC. **Note**: epiCam V will operate in full resolution only when connected via USB 3.0
- Windows may automatically install a driver at this point, which may take a few minutes.
- The **Status light** will blink when the epiCam V is connected.



Sudden changes in temperature may cause condensation to form on the objective lens or on optical parts inside the instrument. In this case, wait until condensation disappears before using the device.

⚠	**CAUTION**	Before connecting or disconnecting the cables, be sure to hold the epiCam V firmly to ensure safety. Otherwise the main unit may fall over, causing possible injury.
NOTE		To ensure epiCam V can be detected by your PC, you must only use cables with a type A to micro-B connector plug supporting USB 3.0, maximum length of 3 meters.

3.1.3 Imaging set up

To capture images and videos you must first add a patient record.

To start an imaging session for a patient:

- Open the **epiCamV Viewer** software.
- Select an existing patient record in the list or add a new record.
- Click on the **Capture** () tab to go to the capture window. The camera live view will be shown.

NOTE	Before you begin image capture, please ensure that you have selected the correct patient record and the correct eye. Otherwise a retinal image may become associated with the wrong record or wrong eye.

3.2 Imaging

3.2.1 Imaging steps

Imaging can be performed alone or with support from an assistant.

1. **Choose a dimly lit environment**
   Taking images in a darkened room enlarges the patient's pupils and reduces extraneous light, making imaging easier.

2. **Reset Focus**
   At the start of an imaging session you should **reset the epiCam V's focus** by pointing the device at a distant object then bring it into focus by **turning the focus wheel** clockwise or anticlockwise.

3. **Reset image settings**
   Set the illumination to a mid-range level and leave the other controls at their default values *(Once you are imaging, further adjustments can be made to the Illumination, Exposure, Gain and Gamma if required.)*

4. **Centre the epiCam on the eye**
   Point the epiCam V at the patient's eye from a distance of approximately 15 cm and centre it on the pupil. You should be able to see some retina or the optic disc through the pupil.

5. **Move the epiCam in towards the eye.**
   Slowly move the epiCam V towards the patient while keeping it centred on the pupil until retinal tissue fills the screen. The correct **working distance** between the objective lens and the corneal surface is 13 mm.

6. **Fine-tune the focus**
   Correct focus by turning the black focus wheel until the fine vessels on the retina you see look sharp. You shouldn't need to adjust focus for that eye again. One quarter turn is approximately 3 dioptres. For myopic patients rotate the focus ring **clockwise**. For presbyopic patients rotate it **anticlockwise**.

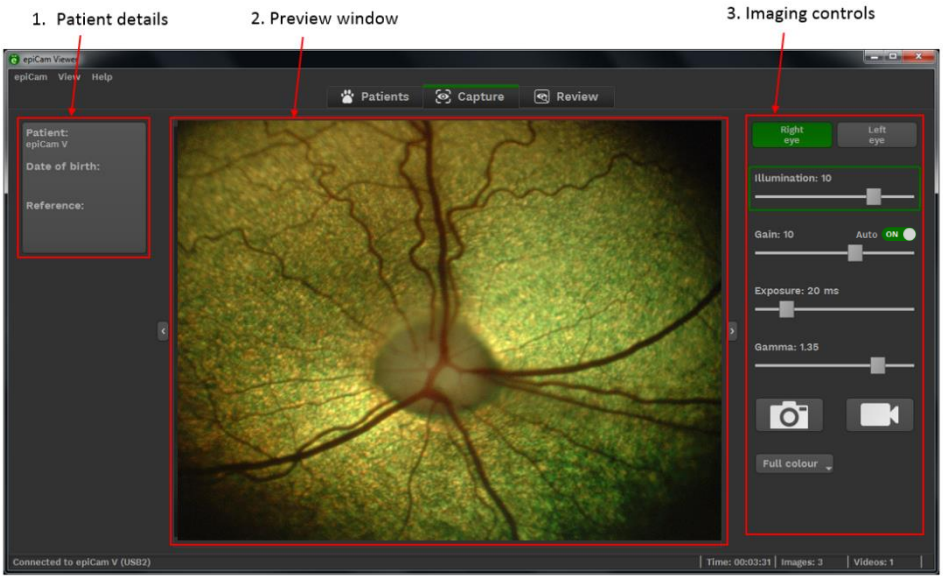
7. **Fine tune the image brightness**
   First adjust the **illumination** setting. The camera **gain** will be adjusted automatically if **auto** gain is ON. If necessary, you can turn **auto** gain OFF and manually adjust the **gain** to set the overall image brightness to suit the RPE reflectance *(when moving from imaging the low reflectance macula to the higher reflectance optic disc, the gain may need to be reduced.)*

3.2.2 The capture window

The capture window can be accessed from the **Patient Management** window by selecting a patient record and clicking on the **Capture** tab ( )

An overview of the **Capture** window is shown below. It consists of three panels:

1. A patient details panel containing the patient information
2. A preview window which shows the camera live view
3. An imaging control panel which is used to control camera settings, capture images and record video.



The software provides the option to scale the camera live view to fit the preview window or zoom in and out. Zoom can be performed by rotating the mouse wheel (many mouse tracker pads are also configured to imitate mouse wheel rotations by performing a two-finger pinch or spread gesture). Alternatively, the zoom level can be set at 100%, 150% or 200% using the options in the View menu.

The live view can also be viewed in full screen mode. To access full screen mode, select "full screen" from the View menu or press the 'f' key. To exit full screen mode, press the 'Esc' or 'f' key, or click the button with the 'exit full screen' icon ().

A reticule can be displayed over the camera live view to aid with centralising the image. The reticule can be shown or hidden using the option in the View menu or pressing the 'r' key.

A full list of keyboard shortcuts for the software can be found in Section 8

3.2.3 Camera settings

The epiCam V has a colour digital image sensor which is sensitive to light and transforms this information into an image. The capture software provides three controls which affect the appearance of the image.

Illumination is the brightness of the epiCam V light source. This setting can be used to adjust the brightness to suit RPE reflectance. If your images appear overly bright, reducing the illumination will help to reduce image saturation. Once a suitable illumination level is found you can then fine tune the image brightness using the Gain control.

Gain is a control to amplify the image information (signal) from the sensor. If your images are very dark, then by increasing gain, you can amplify the signal from the sensor and increase the contrast across the image. However, gain settings which are too high will cause saturation, meaning that the image becomes overly bright. Using Gain and Illumination in combination provides a wide range of image brightness levels. Gain can be set to adjust automatically (the default setting) or manually adjusted.

Exposure is the amount of time (in milliseconds) used to capture a single frame. This is the equivalent of shutter speed on traditional cameras. As you increase exposure, the sensor is allowed more time to gather light and form the image. However, longer

exposure times are more susceptible to motion artefacts from patient and/or operator movement.

Gamma allows adjustment of the image intensities such that dark parts of the image can be made lighter. A value of 1.0 does not apply any gamma adjustment and a higher gamma value will lighten the darker areas of the image more.

The colour mode of the live imaging can be changed between:

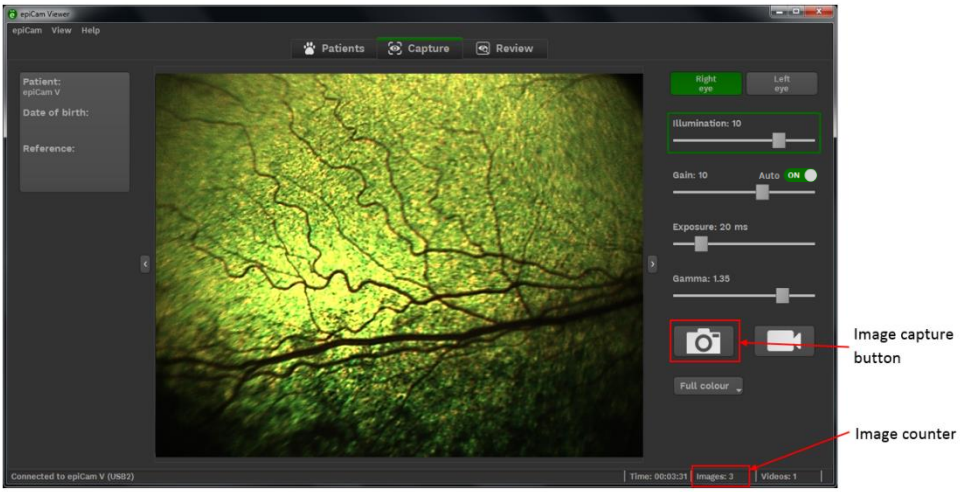
- Full colour
- Green only
- Red only

The green and red colour modes are displayed as monochrome in the live feed. Any images or videos captured in these colour modes will always be stored in 'full colour'.

3.2.4 Image capture

To capture an image:

- First select **left eye** or **right eye**
- Click the button with the camera icon to save the image currently displayed on screen.
- You may also press the space-bar or the letter 'c' on your keyboard. A foot pedal configured to simulate the space-bar can also be used to capture an image by performing a quick press and release on the pedal.
- The image counter will update to reflect the number of saved images for the session.



You may switch between **Left eye** and **Right eye** by clicking on the buttons at the top of the imaging control panel or by pressing the letter ‘e’ on your keyboard. Note that you may have to repeat the focusing procedure for each eye by following the steps in section 3.2.1 .

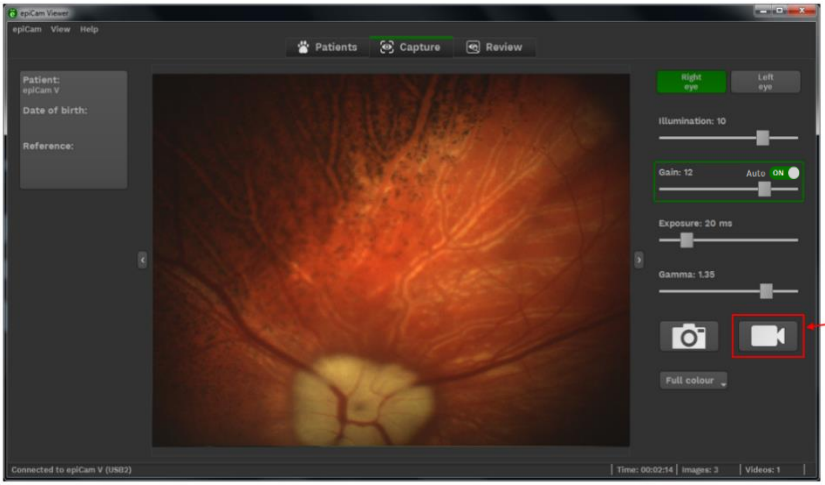
Images are saved in Portable Network Graphics (PNG) format – a standard image format using lossless compression (ISO/IEC 15948:2004). PNG images are completely free from compression artefacts. The image size depends on the image content and is typically between 4.5 and 6 MB when using epiCam V in full resolution USB 3.0 mode. Images can be exported to alternative file formats in Review (see section 3.3.6

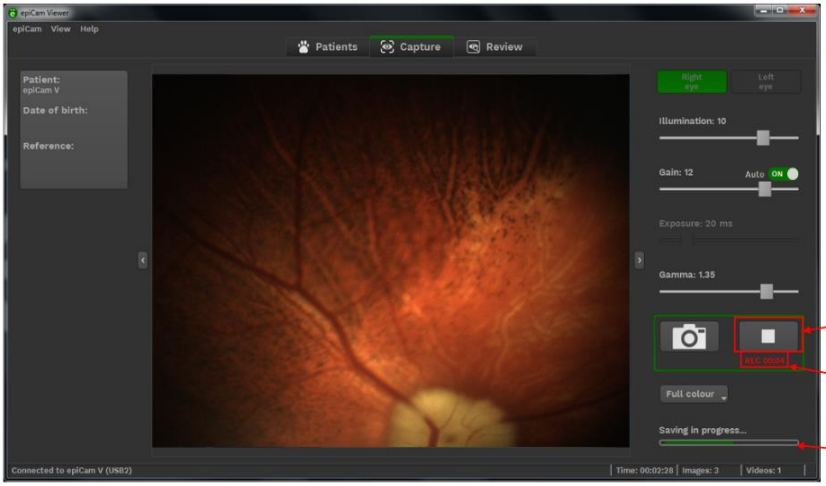
3.2.5 Video recording

To record a video:

- Click the button with the video icon to start recording. The button icon will change and a timer indicating the length of the recording will be displayed.
- To stop the recording press the same button again.
- You may also press the letter 'v' on your keyboard to start, and again to stop, video recording.
- A foot pedal configured to simulate the space-bar can also be used to start and stop video capture. To do this, press and hold down the foot pedal to start recording, and release the foot pedal to stop recording.

- When the video recording is stopped there may be a short period while the file is being saved during which a new video cannot be recorded. Whenever file saving is in progress a message is displayed at the bottom of the imaging control panel.
- The video counter will update to reflect the number of saved videos for the session.





You may switch between **Left eye** and **Right eye** by clicking on the buttons at the top of the imaging control panel or by pressing the letter ‘e’ on your keyboard. Note that you may have to repeat the focusing procedure for each eye by following the steps in section 3.2.1 .

3.2.6 Telemetry sensors

EpiCam V is fitted with on-board telemetry sensors which allow the position of the device to be determined. This data is recorded along with each captured image and video and will allow useful functionality in Epipole's future review software.

A visual representation of the epiCam V's orientation can displayed in the top right corner of the live view. This can be shown or hidden by checking or un-checking 'Show telemetry graphic' in the view menu, or by pressing 't' on your keyboard.

3.2.7 Anterior segment imaging

The epiCam V may also be used for anterior segment imaging to make a photographic record of the cornea and front of the eye. This may be performed in the same imaging session as retinal imaging.

Guidance for anterior segment imaging:

- You may require a low level of directional light to illuminate the cornea.
- Position the objective lens approximately 2-3 cm from the cornea.
- Adjust the focus wheel to obtain the desired focus – approximately 2 full turns clockwise (as seen from behind the epiCam V).
- Stabilise the epiCam V to hold it in focus.
- You may need to adjust **Illumination** or **Gain** settings if on-screen images appear overly bright until a high contrast image is obtained.
- Perform image or video capture as described in Section 3.2.4 and 3.2.5 .

3.2.8 Patient comfort

Use of epiCam V will introduce a level of visual retention in the patient’s eye. This is not harmful, and will clear within a few minutes.

To minimise this retention, **it is recommended not to image one eye continuously for**

more than two minutes at a time.

The illuminant in epiCam V is safe in use and is classified as a Group 1 device under ISO 15004, the international standard for light hazard protection in ophthalmic devices.

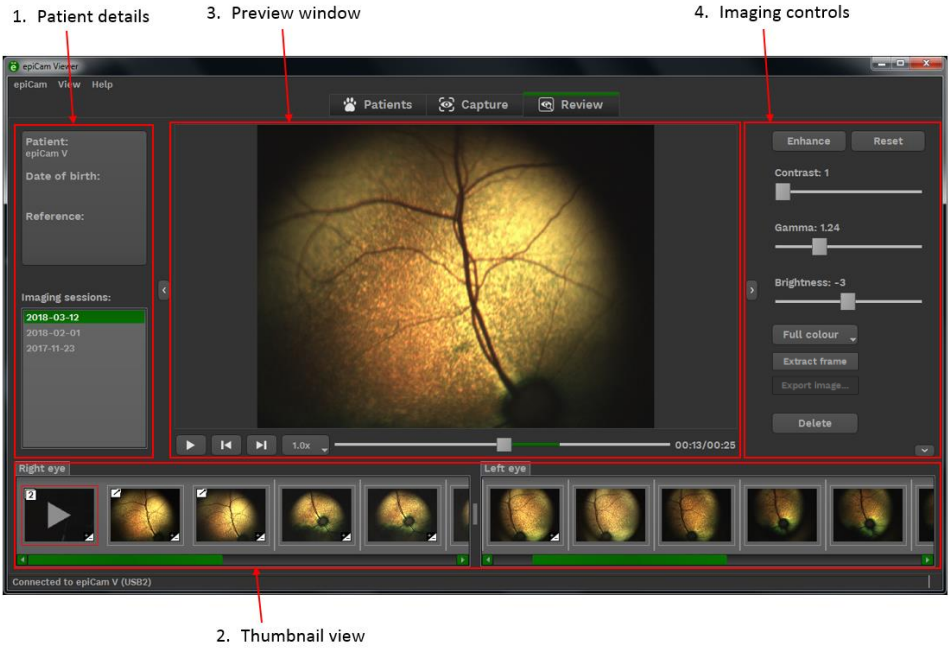
3.3 Reviewing images and videos

3.3.1 Overview of the review window

The epiCam V software provides the ability to review captured images and videos, extract still frames from videos, adjust image settings and export images. The **Review** window can be accessed from the **Patient Management** window by selecting a patient record and clicking on the **Review** ( ) tab. The review window can also be accessed directly from a capture session in the same manner.

An overview of the **Review** window is shown below. It consists of four panels:

1. A patient details panel containing the patient details and a list of selectable imaging session dates for the patient
2. A panel which shows selectable thumbnail previews of the imaging from a selected session
3. A preview window which shows the currently selected image or video
4. An imaging control panel which is used to perform image adjustments, extract frames from video and export enhanced images.



3.3.2 Previewing images and videos

To view captured images and videos for an imaging session:

- Click on a session date in the “Imaging sessions” list.
- The lower frame will update to show thumbnail previews of all the images and videos captured for the selected session. There are two thumbnail panels, one each for the left and right eye.
- Select an image or video thumbnail to show it in the preview window.

The software provides the option to scale the image to fit the preview window or zoom in on the image. Zoom can be made by using a mouse wheel or can be set at 100%, 150% or 200% using the options in the View menu.

Imaging can also be viewed in full screen mode. To access full screen mode, select “full screen” from the View menu or press the ‘f’ key. To exit full screen mode press the ‘Esc’ or ‘f’ key, or click the button with the ‘exit full screen’ icon ( ). A full list of keyboard shortcuts for the software can be found in Section 8

3.3.3 Video playback

When a video is selected for preview the **video player controls** will be shown and the video will begin loading.

The time taken to load a video will depend mainly on the computer's processing speed. The slower the processing speed, the more of the video may need to be loaded before playback can begin without interruption. As soon as the first video frame is shown, the video can be played. However, to ensure the smoothest possible playback it is advisable to wait until the video has finished loading.

The video player controls provide the following functionality:

1. Play/Pause
2. Step back one frame
3. Step forward one frame
4. Change the playback speed ('1.0x' or 'Normal' is full frame rate, '0.75x' is 75% of full frame rate, 0.5x is half speed, 0.25x is 25% of full frame rate)
5. Slider to navigate to a new playback position
6. Video playback position time and video duration

3.3.4 Adjusting image settings

Manual image adjustments

The sliders within the imaging control panel provide three options for adjusting the image settings for the displayed image or video:

- **Contrast**: Allows fine control in amplifying or reducing the intensity range across the image, which may help to visualise the detail in the image.
- **Gamma**: Allows adjustment of the image intensities such that dark parts of the image can be made lighter. A value of 1.0 does not apply any gamma adjustment and a higher gamma value will lighten the darker areas of the image more.
- **Brightness**: Adjustment of the overall intensity of the image. A higher value will brighten the overall image more.

Automatic image enhancement

Click "Enhance" to apply automatic image enhancement. This provides a useful

starting point for applying imaging settings by automatically optimising the **contrast**, **gamma** and **brightness** based on the image or video frame content.

Applying the automatic enhancement on images will also reduce any noise present in the image by applying a median filter.

Automatic enhancement can be performed on images and paused video frames. However, the noise removal filter is not applied when paused video frames are enhanced. Video frames must be extracted first and then enhanced in order to apply the noise removal.

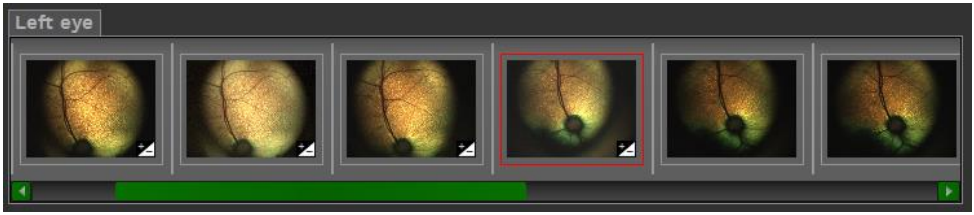
NOTE	When applying automatic enhancement to a paused video frame, the settings will persist when a different frame is next displayed until the imaging settings are changed again.
NOTE	The image enhancement function uses the entire image content to try and optimise the image. To optimise the viewing of areas within an image you may need to manually adjust the settings.

Reset image settings

Any adjustments made using the manual sliders or the “Enhance” button can be undone by pressing the “Reset” button. This will reset the imaging settings to the default contrast and brightness, and will reset the gamma to the value used when capturing the image. For video, the gamma will be set to the value used at the start of the video.

The “Reset” button will also undo any noise removal filtering previously applied to an image.

Images and videos that have had their settings adjusted from their default values will have this indicated in the thumbnail with an ‘adjusted’ icon () in the lower right corner:



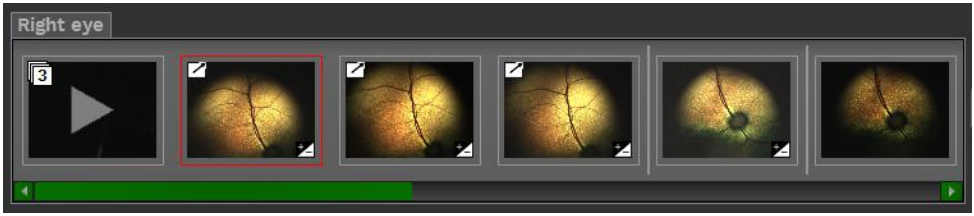
3.3.5 Extracting video frames

Video frames can be extracted from video to create new images that can then be previewed and exported as required. To extract a frame from a video:

1. Move to the desired frame within the video. This can be easily achieved by pausing the video and stepping forward or backward to select the most appropriate frame. It may be beneficial to perform video playback at a slower rate to make it easier to pause at an appropriate section of video.
2. Adjust image settings on the frame if required.
3. Click the “Extract frame” button.
4. Saving progress will be shown at the bottom of the imaging controls frame.
5. A new image thumbnail will appear grouped next to the video thumbnail (and any other images extracted from that video).

Videos that have had frames extracted will indicate this in the thumbnail view with an icon displaying the number of extracted frames in the top left corner of the video thumbnail.

Similarly, images that have been extracted from a video will also indicate this in the thumbnail view with the ’extracted’ icon () displayed in the top left corner of the image thumbnail.



3.3.6 Exporting adjusted images

Captured images and videos are stored locally on the computer's hard drive **without any image adjustments applied**. Adjusting the image settings in the software changes the preview of the image or video shown in the review window but does **not** change the original image or video file. To save an image with the image adjustments applied, it must be **exported**.

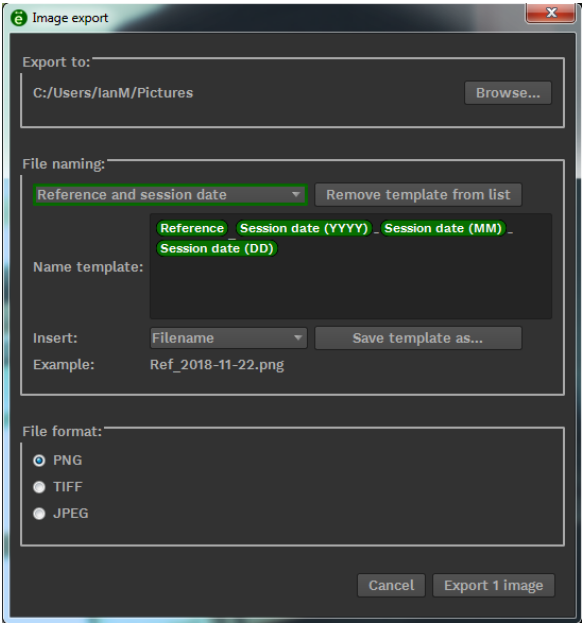
Images can be exported individually, or multiple images can be batch exported. To export a single image, select the image and click the "**Export image…**" button.

To export multiple images, select one image and then hold down the **Ctrl** key (**Command** key on macOS) or the **Shift** key when selecting additional image thumbnails. Using **Ctrl/Command** or **Shift** have differing functionality as follows:

- **Ctrl (Command on macOS)** allows thumbnails, that are anywhere in the thumbnail view, to be selected (or deselected) one at a time.

- **Shift** allows a group of contiguous (i.e. next to each other) thumbnails to be selected (or deselected). To do this, click one thumbnail, then hold shift and click another thumbnail, all the thumbnails in between will be selected.

Once one or more images have been selected, click on the "**Export image…**" button. This will open the "**Image export**" dialog:



The "**Image export**" dialog provides options for:

1. The **export location**: Click "**Browse…**" to change the location where images are to be saved.

2. The **file naming** strategy: A list of file name templates is available to select from. It is also possible to create your own custom name or template by typing in the "Name template" box and also inserting database fields as required.

   To save a custom template, click "**Save template as…**". If you want to delete an existing template, select it in the template name dropdown list and click "**Remove template from list**".

3. The **file format**: Export as PNG, TIFF or JPEG. PNG and TIFF files are compressed with **lossless** compression. JPEG files are compressed using **lossy** compression but will use the highest possible quality factor.

NOTE	The original captured images and videos (that have not been exported) **do not** have any image adjustments made to them. You

	must **export** images in order to save them with the settings applied.
NOTE	The original captured images and videos are stored in individual folders indexed by **epiCam Patient ID**. Each Patient ID folder contains subfolders for the Left/Right eye. Each eye folder contains subfolders for each imaging session. The **epiCam Patient ID** folder location can be opened by selecting the 'Open patient folder' item in the 'epiCam' menu.
NOTE	The **epiCam Patient ID** folders are themselves stored locally on your system within the **Documents/epiCamV** folder. Personal details are not used in the naming of folders or images to ensure that all identifiers are anonymous. **Do not** move or rename folders or images in the **Documents/epiCamV** folder.
NOTE	**Do not** export images to anywhere within the **Documents/epiCamV** folder
NOTE	Exporting using the **JPEG** file format uses lossy compression.

3.4 Monitor setup

Note that the appearance of images on screen depends on the monitor/screen and colour management in use.

For best results, it is recommended that you use a large monitor with a screen resolution of at least 1920 × 1080 and a colour depth of 24-bit (or greater).

Make sure you have contrast, brightness, gamma etc. set appropriately for your screen – refer to instructions from your monitor manufacturer on how to achieve this. It is also recommended that the monitor has an appropriate colour management profile.

3.5 After use

After imaging is finished and the software is closed, the device will enter standby mode. It is recommended that the epiCam V is disconnected from the PC/laptop and stored within the carry case to protect both the device and computer from accidental damage. Do not pull on the USB cable as this can cause damage – remove the cable by

holding onto the USB plug.

3.6 Cleaning

- The front lens should be cleaned with a lens puffer.
- If a lens puffer does not remove dust or marks, use a microfibre lens cleaning cloth. Be careful not to scratch the lens surface when cleaning, particularly when there is dust or other substances present.
- Never wipe the objective lens with disinfecting ethanol, eyeglass lens cleaner, or cleaning paper containing silicon as the lens surface could be damaged.
- The outer casing and cable can be wiped clean with a damp cloth.

4 Technical specifications and performance

4.1 Intended use

The device is intended to be used in veterinary ophthalmology for taking digital images of the retina.

This device is intended to observe and record images of retinal fundus through the pupil without making contact with patient's eye. The purpose of these images is as an aid to diagnosis.

4.2 Main specifications

Operating Systems	Windows 7, 8, 8.1 & 10, macOS High Sierra & Mojave
Diameter of pupil required	ø4 mm or more
Field angle	Min 45° horizontal x 33° vertical
Panning	30° horizontal and 20° vertical
Working distance	13 mm
Resolving power	Around 10µm
Focus adjustment range	Greater than -15D to +15 D
Illuminant wavelength	White light
Camera sensor	CMOS digital sensor 1296 × 972 pixels (using USB 2.0) 2592 × 1944 pixels (using USB 3.0)
Frames per second	14 fps uncompressed video
Rated power supply	USB 2.0/3.0, 5V at 500 mA
Dimensions	64 × 44 × 153 mm
Weight	185 g (not including cable)

NOTE	The International System of Units (SI), the expression 1 D (dioptre) = m^{-1}
NOTE	Technical specification is subject to modification without prior notice

4.3 Environment of use

Use, store, and transport the camera in an environment that satisfies the following requirements. Use the supplied hard case to store or ship it.

Criteria	In use	Storage and transportation
Temperature	10°C to 35°C	–10 °C to 50 °C
Humidity	30% to 90% RH (no condensation)	10% to 95% RH (no condensation)
Atmospheric pressure	700 hPa to 1060 hPa	700 hPa to 1060 hPa

Do not install, store or leave the camera in an adverse environment where the temperature or humidity levels are high. Doing so may result in misuse of the device and/or malfunction. Keep the environment of use free from dust. Dust in the air may attach to the objective lens and to the optical parts inside the instrument. This may affect the quality of images that can be taken.

4.4 Software licenses

The epiCam V software uses:

- the Qt framework version 5.9, licensed under LGPL V2.1 and LGPL V3.
- FFmpeg version 3.0 licensed under LGPL V2.1.
- libpng, the official PNG reference library version 1.6.34, licensed under the libpng license.
- libTIFF version 4.0.8 licensed under the libtiff license.
- libjpeg version 8c licensed under the libjpeg license. The epiCam software is based in part on the work of the Independent JPEG Group.
- The zlib compression library version 1.2.11 licensed under the zlib licence.
- software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/), version 1.0.2m
- A Work Sans typeface licensed under the SIL Open Font License version 1.1.

Third-party licenses can be found in the installation directory or application bundle.

5 Safety information

Follow the safety instructions in this manual and all warnings and cautions printed on the warning labels. Ignoring such cautions or warnings while handling the product may result in injury or accident. Be sure to read and fully understand the manual before using this product. Keep this manual for future reference.

Meaning of caution signs

To protect the safety of users and others and to prevent accidents, this operation manual utilises the symbols and text shown below in warnings and cautions. Read the meanings of these caution signs and the safety precautions and follow the safety instructions.

	**WARNING**	This indicates a potentially hazardous situation which, if not heeded, could result in death or serious injury to you or others.
	**CAUTION**	This indicates a hazardous situation which, if not heeded, may result in minor or moderate injury to you or others, or may result in machine damage.
NOTE		This is used to emphasize essential information. Be sure to read this information to avoid incorrect operation.

Safety precautions

Be sure to follow the safety instructions below to ensure correct operation of the instrument.

Operator precautions

	**CAUTION**	Long periods of use may result in operator or patient fatigue. Fatigue can result in patient visual retention of the illuminant (if imaged for more than two minutes continuously), operator error, slowed responses, incorrect operation etc. Please follow sensible workplace precautions for safe use.

Installation and environment of use

	**WARNING**	Do not use or store the instrument near any flammable chemicals such as alcohol, thinner, or benzine. If chemicals are spilled or evaporate, it may result in fire or electric shock through contact with electric parts inside the instruments. Some disinfectants are flammable. Be sure to exercise caution when using them.
	**CAUTION**	Do not use or store the instrument in a location with the conditions listed below. Otherwise, it may result in failure or malfunction, fall or cause fire or injury. • Close to facilities where water is used. • Where it will be exposed to direct sunlight. • Close to air-conditioner or ventilation equipment. • Close to heat source such as a heater. • Surfaces or areas prone to vibration. • Dusty environment. • Saline or sulphurous environment. • High temperature or humidity. • Freezing or condensation.
	**CAUTION**	Do not cover the instrument or prevent ventilation. Otherwise, the temperature in the instrument may rise and cause fire.

Installation and operation

	**WARNING**	Do not connect the instrument except in the manner specified. Otherwise, fire or electric shock may result.
NOTE		Only install the software system as specified in this manual. Incorrect installation may result in a non-functional system. If a problem occurs, please contact your sales representative or local epiCam V dealer.

Power supply

	**WARNING**	Do not cut or process the cable. Do not place heavy objects on, step on, pull or bend the cable. Otherwise, the cable may be damaged, which may result in fire or electric shock.

Handling

	**WARNING**	Never disassemble or modify the product as it may result in fire or electric shock.
	**WARNING**	Do not place anything on top of the instrument. If metal objects such as a needle are jammed into the instrument, or if liquid is spilled on it, it may result in fire or electric shock.
	**WARNING**	When the instrument is carried, be sure to remove the cable and pack the instrument in its box, bag or cover (as appropriate). Do not hold the device by the cable or eyepiece as it may detach resulting in damage.
	**CAUTION**	To prevent the risk of infection, wipe contact surfaces with disinfectant ethanol for each patient. For details on how to disinfect, consult a specialist.

If a problem occurs

	**WARNING**	Should any of the following occur, immediately unplug the instrument and contact your sales representative or local epiCam V dealer. • When there is smoke, an odd smell or abnormal sound. • When liquid has been spilled into the instrument or a metal object has entered through an opening. • When the instrument has been dropped and it is damaged.
NOTE		If the instrument or software described in this manual becomes inoperable or does not perform as described then please contact your sales representative or local epiCam V dealer.

Maintenance and inspection

	**WARNING**	For safety reasons, be sure to unplug the device when the inspections indicated in this manual are going to be performed. Otherwise, electric shock may result.
	**WARNING**	When the instrument is going to be cleaned, be sure to unplug the instrument. Never use alcohol, benzine, thinner or any other flammable cleaning agents. Otherwise, fire or electric shock may result.
	**WARNING**	Clean the plug of the cable periodically by unplugging it and removing dust or dirt from the plug, its periphery and USB inlet with a dry cloth. If the cable is kept plugged in for a long time in a dusty, humid or dusty environment, dust around the plug will attract moisture, and this could cause insulation failure which could result in a fire.
	**WARNING**	The instrument must be repaired by a qualified engineer only. If it is not repaired properly, it may cause fire, electric shock, or accident.
NOTE		Incorrect maintenance and/or failure of the computer system containing the software may result in loss of access to the software and/or the associated data. Please follow the maintenance and back-up instructions supplied by your computer manufacturer and operating system vendor.

System use

	**CAUTION**	This instrument utilises a CMOS sensor, and pixels may become fully activated or deactivated at all times, over time.

Information security

NOTE	Use password protection for operating system user accounts. Inadequate security may result in theft of or unauthorised access to confidential data.

6 Product failure, repair and return information

Out of box failure or incorrect functioning

If your device is not functioning correctly on receipt or within 3 days of arrival, please contact us either via our website or using the contact information below.

Repair

If a problem occurs during use of the device, please contact your sales representative or local dealer for assistance or repair.

When requesting repair, please provide the following information.

Name of instrument:	epiCam V
Serial code:	Alpha code indicated on the label
Version of the epiCam V software:	Indicated in the About dialog box
Problem:	Please outline the problem in detail.

Limit for supplying performance parts for repair

Parts required to maintain the functioning of this product will be stocked for 5 years after production ceases to allow for repair.

7 Software and manual updates

Updates to this manual and epiCam V software will be available to download at http://www.epipole.com. It is recommended that users check there for the latest updates.

8 Software keyboard shortcuts

Window	Action	Keyboard shortcut
Capture	Switch between right and left eye	E
	Highlight different capture controls (illumination, gain, etc.)	Up/down arrow keys
	Increase Gain	Right arrow key (when Gain control is highlighted)
	Decrease Gain	Left arrow key (when Gain control is highlighted)
	Increase Gamma	Right arrow key (when Gamma control is highlighted)
	Decrease Gamma	Left arrow key (when Gamma control is highlighted)
	Capture image	C Or Left arrow key (when Capture control is highlighted)
	Start/Stop video recording	V Or Right arrow key (when Capture control is highlighted)
	Show/hide reticule	R
	Show/hide telemetry graphic	T
Review	Play/pause video	Space bar
	Step back a frame	Ctrl + comma (Windows) Command + comma (macOS)
	Step forward a frame	Ctrl + period (Windows) Command + period (macOS)
	Enhance image or video frame	Ctrl + E (Windows) Command + E (macOS)
	Reset image settings	Ctrl + R (Windows) Command + R (macOS)
	Extract video frame / export image	Ctrl + X (Windows) Command + X (macOS)
Capture and Review	Enter full screen mode	F
	Exit full screen mode	F or Esc

9 Contact details

On the web:

http://www.epipole.com/contact

Email:

support@epipole.com

Telephone:

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+44 (0) 1383 414 511

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