User Guide

Axiocam 702 mono

We make it visible.

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1 About this guide 5

1.1 Introduction 5
1.2 Safety notes conventions 6
1.3 Text formats and conventions 6

2 Safety 8

2.1 Safety Notes 8
2.2 Limitation of liability 9
2.3 Warranty 9

3 Technical Data 10

3.1 Axiocam 702 mono 10
3.1.1 Analog signal amplification and typical quality parameters of the image signal 12
3.1.2 High Dynamic Range Mode 13
3.1.3 Frame Rates 13
3.1.4 Spectral Sensitivity 14

4 Shipment 15

5 Connecting the camera 16

5.1 Camera Overview 16
5.2 Building in the interface card 16
5.3 Mounting the camera on the microscope 17
5.4 Connecting the camera to the PC 18
5.5 Connecting the trigger cable 19
5.6 Function indicator 20

6 Installing software and drivers 22

7 Trouble-shooting 23

7.1 Software 23
7.1.1 The camera does not appear in the menu of selectable cameras 23
7.1.2 You don't see a camera image on your screen 23
7.1.3 The color of my image does not correspond to the impression through the ocular 23
7.2 Hardware 24

7.2.1 Vibrations 24

8 Maintenance 25

8.1 Optical System 25
8.2 Cleaning the infrared filter or protective glass 25

9 Disposal and Recycling 26

1 About this guide

1.1 Introduction

Welcome

Welcome to the user documentation.

The camera is a professional digital camera for universal light microscopy with a high resolution sensor and a USB 3.0 interface.
To set up the camera correctly, follow the instructions in this guide step by step.

This monochrome camera offers a very broad range of spectral sensitivity. Due to the very low noise level weakest signals can be detected. The sensor architecture enables frame rates up to 1000 frames per second at short exposure times and sensor sub frames. The broad dynamic range of the sensor resolves a very broad intensity range in one single image. Due to these features, the camera is optimally suited for live cell imaging applications.

Content

Chapter	Content
About this guide	Includes an introduction and overview about this guide.
Safety	Provides important information on a safe handling with the . **Read this chapter, before unpacking the camera and putting it into operation.**
Shipment	Describes the contents of delivery and optional attachments.
Technical data	Includes all technical data to your camera.
Connecting the camera	Provides detailed instructions on connecting and using the camera.
Installing software and drivers	Describes how to install the ZEISS software and camera drivers.
Trouble-shooting	Includes some solutions to various problems. If you can not solve your problem, contact the ZEISS support.
Maintenance	Describes some measures for the maintenance and care of your camera. For greater damage always contact the ZEISS support.
Disposal and Recycling	Includes important instructions for disposal and recycling.

1.2 Safety notes conventions

The safety notes in this document follow a system of risk levels, defined in the following manner:

⚠ CAUTION

Risk of personal injury

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate personal injury.

NOTICE

Risk of property damage

NOTICE indicates a property damage message. In addition, NOTICE is used for data loss or corrupt data.

i INFO

Indicates useful additional information. It helps you to make your daily work easier, but it is optional. There is no risk for personal injury or property damage involved.

1.3 Text formats and conventions

Bold texts

Bold is used for texts within the software like names of GUI elements (e.g. buttons, sections, tools, menus), buttons on a device, and product names (e.g. **MTB 2011**).

Font type "Courier"

`Used for programming code, e.g. macro code as well as for anything that you would type literally when programming, including keywords, data types, constants, method names, variables, class names, and interface names.`

Shortcuts and key commands

Shortcuts are written like *Crtl*+*C*, meaning you should press *Crtl*-Key and *C*-Key simultaneously.

Procedures

The following formats are used for procedures (instructive sequences):

Prerequisites ■ stands for a condition which must be fulfilled before starting with the action.

Procedure **1** stands for a single step the user is asked to perform.

Web-Links

Web links appear in blue text. To open the linked website, simply click on the link. Please make sure you have an internet connection established before opening the web link.

2 Safety

2.1 Safety Notes

The has been manufactured and tested by ZEISS according to the regulations specified in CE and has left the manufacturer's premises in perfect working order. In order to ensure that this condition is maintained and to avoid any risks when operating the system, the user must comply with any notes and warnings contained in this manual. The manufacturer shall be exempt from statutory liability for accidents should the operator fail to observe the safety regulations.

⚠ CAUTION

Personal Injury

To avoid personal injury, read and adhere to the safety notes below.

- To avoid the risk of fire or explosion, do not use the camera near inflammable liquids or gases.
- Setup, expansions, re-adjustments, alterations, and repairs must be carried out only by persons who have been authorized by ZEISS.
- Do not allow any cables, particularly power cords, to trail across the floor, where they can be snagged by people walking past.
- Protect the cables from excessive heat (e.g. halogen lamps, microscope fluorescence illumination).

NOTICE

To avoid equipment damage, data loss, or corrupted data, read and adhere to the safety notes below.

- Protect the camera against mechanical impact. External damage may affect the operation of inner components.
- Keep chemicals and fluids away from the camera.
- Make sure there is sufficient ventilation of the camera head. Avoid direct exposure to sunlight and locations near heat sources (radiators, stoves). Overheating can cause noisy images.
- Use the camera in a clean and dry location.
- Attach all connectors firmly and securely.
- Use only the accessories supplied by ZEISS, when applicable.
- Use only normal microscope cleaning material to clean the camera housing.
- Contact your local ZEISS service organization if a repair is necessary.
- Save all your data, such as images, measurement data, archives, reports, forms and documents, at regular intervals on an external storage medium. Otherwise it cannot be avoided that access to this data may be lost as a result of operational errors or hardware defects. ZEISS accepts no liability for consequential damage resulting from insufficient data protection.

2.2 Limitation of liability

No warranty shall be assumed by ZEISS during the warranty period if the equipment is operated without observing the safety regulations. In any such case, ZEISS shall be exempt from statutory liability for accidents resulting from such operation.

2.3 Warranty

ZEISS shall be exempt from any warranty obligations should the user fail to observe the safety regulations. ZEISS only guarantees the safety, reliability, and performance of the system if the safety notes are closely observed.

3 Technical Data

3.1 Axiocam 702 mono

Feature	Value
Sensor Model	Sony IMX 174 , Exmor Pregius Global Shutter Architecture, Active Pixel CMOS, Column ADC, pre-selected sensor quality
Sensor Pixel Count	2.3 Megapixel: 1920 (H) × 1216 (V)
Pixel Size	5.86 µm x 5.86 µm
Sensor Size	Image Diagonal 13,3 mm, equivalent to 1/1.2" Sensor Format 11.3 mm (H) x 7.1 mm (V)
Spectral Sensitivity	app. 350 nm-1000 nm, coated BK7 protective glass plate, Quantum Efficiency at 520 nm 72% (including sensor cover slip)
Max Full Well Capacity (typical)	32.000 e- with amplification 1x
Digitization Bit/Pixel	14 Bit / Pixel (12 Bit ADC, 14 Bit expansion through data processing)
Pixel- Read Out Speed	594 MBit/s, parallel on 8 channels
Dynamic Range (typical)	>5000:1 (single shot) >25000:1 (HDR Mode)
Dark Current (typical)	Typ. < 1.1 e-/p/s at 15 °C sensor temperature
Cooling	Regulated Peltier-Cooling, (power supplied through USB 3.0 and USB 2.0 ports), Delta-T 20° C, sensor temperature 15°C
Dark Current Compensation	Digital Dark Current Compensation for optimum low light performance at long exposure times, automatic Hot Pixel Correction
Exposure Time Range	100 µs to 60 s

Feature	Value
Live Image Repetition Rates	■ Max. frame rate >100 fps (depending on the exposure time) ■ Resolution / Pixel 1920 x 1216
Data-Post Processing (optional)	■ Objective specific shading correction ■ Sharpening, Noise Filter ■ Black Reference, Dark Current Compensation
Special Features	■ Time Stamp from Camera for precise acquisition time point ■ Adjustable intensity of status LED
Special Preset Modes	Eight pre-loadable sets of imaging parameters for speed-optimized multi-modal image acquisition, overlapping exposure and readout for fast time lapse imaging
Binning	Digital Binning from 1x1 up to 5x5 for enhancing signal intensity and further improvement of the signal-to-noise ratio (Analog signal amplification is restricted in Binning Mode to lower levels).
Region of Interest (ROI)	User defined imaging sub area for improvement of readout speed and reduction of amount of data
Hardware Trigger	Galvanic isolated I/O signals, three output signals: exposure time, readout time, trigger ready (i.e. for controlling external mechanical shutters), one trigger input for exposure control, 5V auxiliary voltage, GND
Status LED	Top LED: Camera Status (acquisition, power, cooling, speed) Back LED: Trigger status
Interface	USB 3.0 SuperSpeed (5 Gbit/s), bandwidth max. 300 Mbytes/s USB 2.0 optional, with lower speed

Feature	Value
Optical Interface	C-Mount (17.5 mm)
Max. File Size per image	app. 4.7 MB per image with 1920 x 1216 Pixels
Operating Systems	Microsoft® Windows 7 Enterprise and higher
Size / Weight	10.8 cm x 7.8 cm x 4.3 cm / 500 g
Housing	Blue anodized aluminum, ¼" thread for camera equipment, zero vibration by convection-cooling with optimized cooling fins, teflon coated C-mount thread, coated protective glass plates
Certificates	CE
Power Supply	7W power supply by USB 2.0 and USB 3.0-Bus from PC for maximum performance connection to USB 3.0 and USB 2.0 required, dual connection cabling provided with camera
Ambient Conditions (Operation)	+5° ... +35° Celsius max. 80% relative humidity, non-condensing, free air circulation required,
Ambient Conditions (Storage)	-15° ... +60° Celsius 90% relative humidity at +40° Celsius, 80% relative at +20° Celsius, non-condensing

3.1.1 Analog signal amplification and typical quality parameters of the image signal

Amplification	Readout Noise	Saturation Charge	Dynamic Range
1x	6,0 e-	32.000 e-	> 5.000 : 1
2x	4,4 e-	16.000 e-	3.600 : 1
4x Opt. Gain	3,9 e-	8.000 e-	2.000 : 1
8x	3,79 e-	4.000 e-	1.000 : 1
16x	3,75 e-	2.000 e-	500 : 1

3.1.2 High Dynamic Range Mode

Optimized combination of two exposures based on photon shot noise theory, automatic acquisition with special parameters:

- 0,2x exposure time at gain 1x
- 0,8x exposure time at gain 4x

Readout Noise	Saturation Charge	Dynamic Range
≙ 5 e-	≙ 160.000 e-	> 25.000 : 1

3.1.3 Frame Rates

H x V	Mode	FPS @ 0.1ms
1920 x 1216	mono	128
1920 x 720	mono	210
1920 x 512	mono	288
1920 X 256	mono	534
1920 X 128	mono	881
1024 X 112	mono	1003

i INFO

Exposure time and sensor sub area (ROI) influence the maximum frame rate.

3.1.4 Spectral Sensitivity

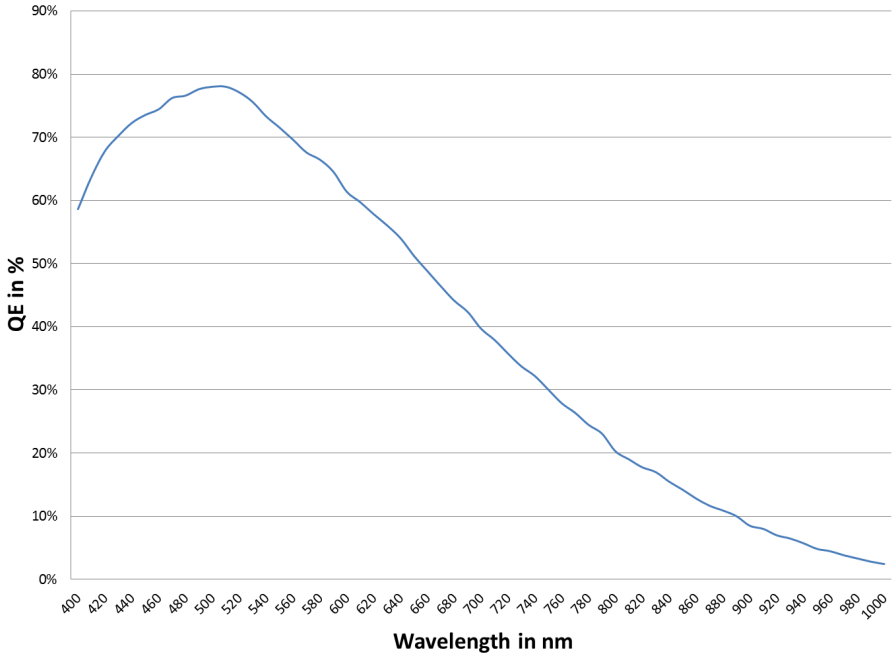

Fig. 3.1: with Sony IMX 174 sensor (maximum QE reduced by appr. 6% due to sensor cover slip)

4 Shipment

Content	Order Number
1 x camera	426560-9010-000
1 x USB cable (2 in one) for power supply (USB 2.0 = black cable) and data transfer (USB 3.0 = blue cable)	
1 x PCI express interface card (4 x USB 3.0)	
1 x 15 Pin SATA power connector cable	
1 x DVD with device driver for ZEISS software as well as this guide as a PDF file.	

Accessory (optional)

Fig. 4.1: Axiocam trigger cable

Content	Order Number
Trigger cable	426557-0001-000

5 Connecting the camera

5.1 Camera Overview

Camera connections

Fig. 5.1: Camera back

Number	Description
1	Trigger connection
2	USB 2.0 connection for power supply and cooling
3	USB 3.0 connection for image / controller data and power supply
4	¼ " photo thread (tripod connection)

5.2 Building in the interface card

This topic describes how to build in the PCI express interface card (4 x USB 3.0) into your PC.

If the interface card is already built in you can continue with chapter *Mounting the camera on the microscope* [▶ 17].

NOTICE

Static Electricity

Static electricity can damage electronic components. To protect electronic components against static electricity, do not touch them until you have grounded yourself to the casing of the device. Never touch the contacts of the electronic components. We also recommend that you work only on an antistatic mat.

Prerequisites

- You have read the documentation of the interface card and of your computer before you build in the interface card.

Procedure

1. Switch off your PC and all connected peripherals.
2. Disconnect the PC and the peripherals from the mains and open the computer case.
3. Examine your PC's power supply to see if it has Molex type connectors or SATA type connectors. Choose the appropriate power connector cable for the following steps. If your PC's power supply has both connector types, choose only one cable.
4. Connect the appropriate power connector cable to one of the open connectors from your computer's power supply.
5. Connect the other end of the power cable to the PCIe interface card.
6. Insert the PCIe interface card into the appropriate slot on your computer.
7. Close the computer case and reconnect the peripherals.

You can now mount the camera on the microscope and connect it to the PC via the USB 3.0 interface, see *Mounting the camera on the microscope* [▶ 17].

5.3 Mounting the camera on the microscope

To mount the camera onto your microscope's TV port, use a C-mount adapter. The adapter is not included in the shipment. You will find some suitable examples for adapters in the list below:

Port	Name	Order Number
44	Video Adapter 44 C 2/3" 1,0x	452995-0000-000
60	Camera Adapter 60 C 1" 1,0x	456105-9901-000
60	Video Adapter 60 C 2/3" 0,63x	000000-1069-414
60N	Camera Adapter 60N-C 1" 1,0x	426114-0000-000
60N	Camera Adapter 60N-C 2/3" 0,63x	426113-0000-000

Procedure

1. Remove the dust cap from the camera's C-mount port.
2. Screw the adapter in as far as it will go.
3. Mount the camera onto the microscope's TV port. Ensure that no dust enters the opening of the camera or the microscope's TV port.

5.4 Connecting the camera to the PC

Prerequisites

- You have built in the interface card, see *Building in the interface card* [▶ 16].
- You have mounted the camera to the microscope, see *Mounting the camera on the microscope* [▶ 17]

Procedure

1. Switch off the PC.
2. Lay the USB cable carefully between the camera and the PC.
3. Connect the USB 3.0 plug (blue color) to the USB 3.0 port on the interface card.
4. Connect the USB 2.0 plug (black color) to the USB 2.0 port on the interface card.
5. Connect the USB 3.0 plug to the USB 3.0 port on the camera.
6. Connect the USB 2.0 plug to the USB 2.0 port on the camera.
7. Switch on the PC.

   If you switch on the PC, the camera will be also switched on.

Power is supplied via the USB 3.0 cable. The USB 2.0 cable supplies the peletier cooling. By switching off the PC, the camera will be switched of as well. If the camera is assembled correctly, the status LED will light red. If you start the software the LED will turn blue. You`ll find a detailed description of the LED status light in the chapter *Function indicator* [▶ 20]

5.5 Connecting the trigger cable

In this chapter you will learn how to connect the trigger cable (optional) to the camera and the SVB (signal distribution box).

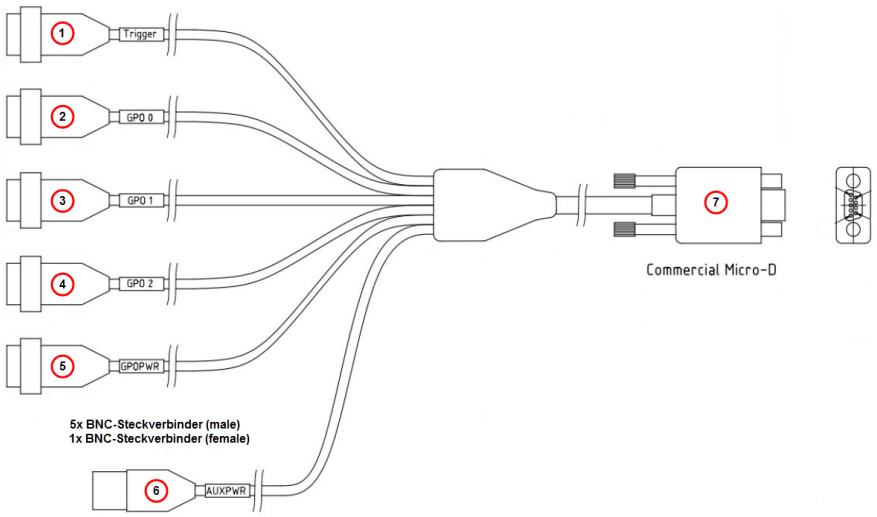

Fig. 5.2: Trigger cable

Number	Description
1	**Trigger** (Trigger-In)
2	**GPO 0** (Trigger Out, for exposure time incl. predelay, coresponding to shutter control
3	**GPO 1** (Trigger Ready, for Readout Time data)
4	**GPO 2**
5	**GPOPWR**
6	**AUXPWR**
7	**Commercial Micro-D**

INFO

The numbers in brackets in the guide below refer to the connectors shown in the illustration "Trigger cable" and described in the table below it.

Procedure

1. Plug the connector **Commercial Micro D (7)** in the trigger connector on the back of the camera, see Camera Overview.
2. Plug the connector **Trigger (1)** in the socket **Trigger Out** of the SVB (Signal distribution box).

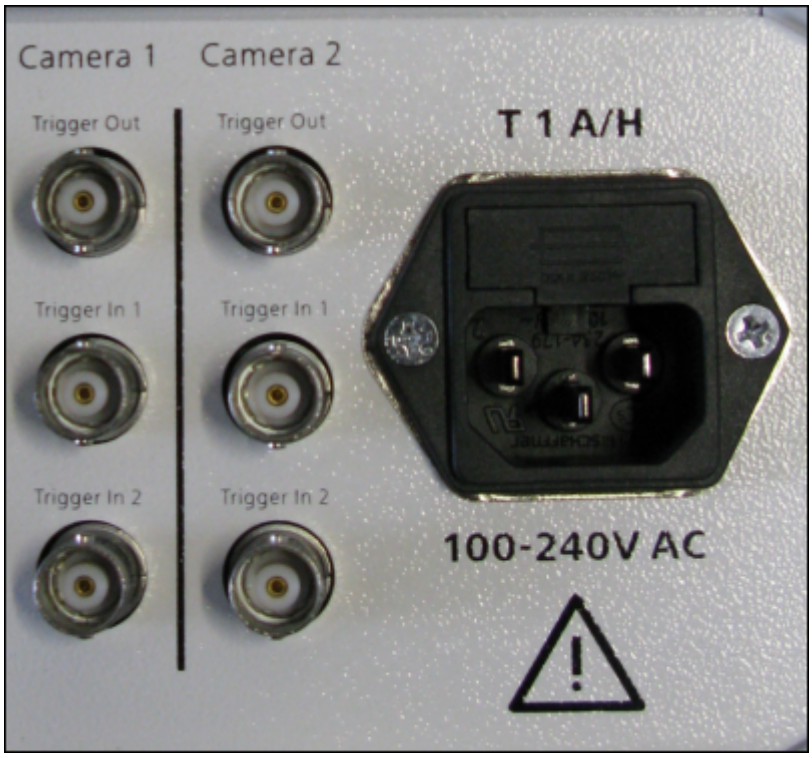

Fig. 5.3: Signal distribution box (SVB) backside

3 Plug the connector **GPO 0 (2)** in the socket **Trigger In 1** of the SVB (Signal distribution box).

4 Plug the connector **GPO 1 (3)** in the socket **Trigger In 2** of the SVB.

5 Connect the connectors **GPOPWR (5)** and **AUXPWR (6)** of the trigger cable together.

GPO 2 (4) is not connected.

5.6 Function indicator

Signal color	Description
Blue	USB 3.0 connection (Camera) connected with USB 3.0 connection (PC) Power supply (USB 2.0 cable) attached Recommended configuration for best camera performance
Green	USB 3.0 connection (Camera) connected with USB 2.0 connection (PC) Power supply (USB 2.0 cable) attached
Violet	USB 3.0 connection (Camera) connected with USB 3.0 connection (PC) Power supply (USB 2.0 cable) not attached

Signal color	Description
Yellow	USB 3.0 connection (Camera) connected with USB 2.0 connection (PC) Power supply (USB 2.0 cable) not attached
Red	Power supply attached, no driver loaded, camera not yet initialized
No light	No power supply or software shut down (camera in power down mode)

6 Installing software and drivers

Prerequisites

- To acquire images with the on a PC, you must install ZEISS software (e.g. ZEN or AxioVision). You will find the software installation on the DVD delivered. The camera drivers will be installed automatically during the installation of the software.
- Before starting the installation of the software and drivers, the camera must be connected to the PC, see chapter Connecting the camera to a PC.

Procedure

1. Install the software according to the installation guide delivered with the software.
2. During the installation you will be asked to install the camera drivers. Follow the procedure by confirming the upcoming messages.
3. Restart your PC after the installation.
4. You can check in the device manager if the driver installation was successful.

You have installed the software and the camera drivers. You can now start acquiring images with your camera using ZEISS software. For more information, please read the software documentation.

7 Trouble-shooting

7.1 Software

7.1.1 The camera does not appear in the menu of selectable cameras

- Make sure that you have connected the camera and installed the software and drivers in accordance to the instructions in this manual.
- Make sure that you installed the software and drivers with administrative rights. Install the driver with administrative rights again if necessary.

7.1.2 You don't see a camera image on your screen

- Check the light path setting of the microscope.
- Is the status LED on the camera on? If not, check the cable connections between camera and computer.
- Execute a reset of the camera.
- Execute an automatic exposure measurement.
- Check the display adjustments for the live image.
- Check the aperture diaphragm of the microscope.
- Check the position of the beam splitter between the ocular and the TV port.

7.1.3 The color of my image does not correspond to the impression through the ocular

In case of color cameras:

- Check white balance and, if necessary, repeat white balance.
- Check the monitor’s color temperature setting. If necessary, reduce this to the lowest value that can be set (usually 5200 K).

In case of monochrome cameras:

- Images of monochrome cameras are displayed by using overlay colors to represent the colors of fluorescence dyes on the monitor. If the color is different to the visual impression in the eyepiece, select a different overlay color.

7.2 Hardware

7.2.1 Vibrations

Sudden jolt, vibration or moving objects during the acquisition can detract the image quality. The intensity of light during exposure time can change as well.

- To avoid jolt use damping systems on your microscope.
- Repeat the shot and take care to ensure the conditions remain calm.

8 Maintenance

8.1 Optical System

The internal optical components of the camera should always be protected. If no lens, or TV adapter with optics, is screwed into the camera's C-Mount thread, the camera's sensor and protective glass must be protected by screwing the protective cap onto the camera's C-Mount thread.

8.2 Cleaning the infrared filter or protective glass

Contamination of the IR filter (for color cameras only) or the protective glass has an adverse effect on the quality of the resulting image (dark points, cloudy structures in the image). If there is dry dust on the front side of the infrared filter or protective glass, you can remove it with a soft brush or with cotton (wool). Use cleaning fluid for optics/lenses only to clean the IR filter. Do not use tap water to clean the IR filter.

9 Disposal and Recycling

This product has been developed, tested and manufactured in accordance with the applicable environmental provisions and directives of the European Union:

- The product and its accessories comply with EU directives 2002/95/EC (RoHS) and 2002/96/EC (WEEE), insofar as these apply to this product.
- ZEISS has implemented a take-back and recycling process that ensures that proper recycling is carried out in accordance with the aforementioned EU directives.
- Please contact your ZEISS sales/service organization for details relating to disposal and recycling.
- This product must not be disposed of with domestic waste or using municipal waste disposal services. In the event of resale, the seller must inform the buyer of the need to dispose of the product appropriately.

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