iDS:

USB 3 uEye CP Rev. 2.2

Technical Manual

uEye+
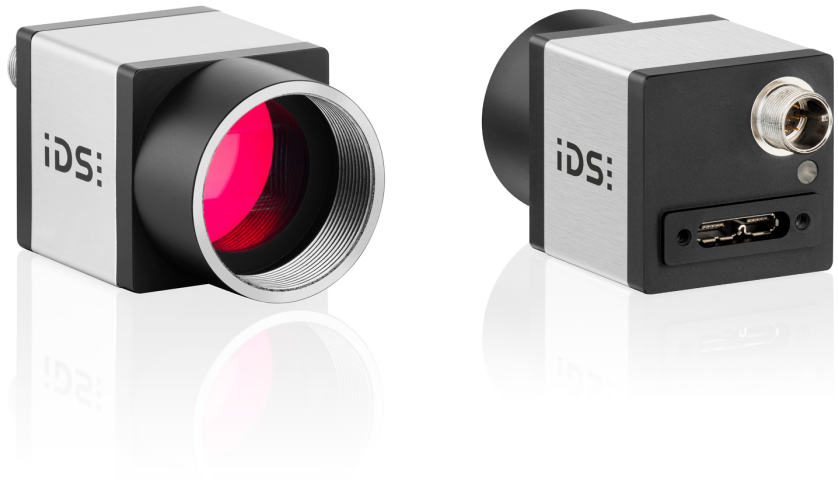
Imprint

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Contents

1 Symbols and hints

This symbol indicates hints with useful information for better understanding and using features and functions.

This symbol indicates important warnings for product safety to prevent damage.

This symbol indicates important warnings for personal safety to prevent injury.

2 Safety instructions

Read carefully these safety instructions before installing and using the product. The producer is not responsible for damages and injury, which can occur due to false handling of the product and ignoring the safety instructions. All warranty will be spoiled in this case.

Intended use

IDS industrial cameras are to be used to capture images for visualization and image processing tasks. They are designed for use in industrial environments. Observe the requirements for the proper use of this product. Failure to do so will render the warranty void.

- The product is not authorized for use in security relevant applications. If it is used in security relevant applications, the customer is responsible for the necessary approvals.

- If the product is modified or changed, all approval becomes invalid. In this case, the customer is responsible for ensuring product conformity.

- The warranty expires if the product is improperly disassembled, reworked or repaired by the customer or a third party and IDS Imaging Development Systems GmbH assumes no liability for defects. If you need service, please contact the support team.

- The product is not a toy. Operate and store out of the reach of children.

Protection against electrostatic discharge (ESD)

Board-level cameras are especially sensitive to electrostatic discharge. Make sure to avoid mechanical or electrical damage of the printed circuit board or its connections. Wear ESD-protective clothing and observe the rules for handling ESD-sensitive components.

- Do not touch the printed circuit board while it is powered.

- Always hold the board by the edges to avoid the risk of electrostatic discharge damage.

- For optimum ESD behavior, a clearance of 4 mm from non-shielded housings must be maintained all the way around. For shielded housings, a smaller clearance is possible.

- Attach the board to a conductive surface using the fixing screws. If this is not possible, ensure an insulating connection.

- Use connecting cable with a low-resistance shield on both sides.

Installation, operation and maintenance

The product must be connected, taken into operation and maintained only by appropriately qualified personnel. The error-free and safe operation of this product can only be ensured if it is properly transported, stored, set up and assembled, and operated and maintained with due care. The installation, inspection, maintenance, extension, and repair may only be done by authorized personnel.

- Observe the specifications in the documentation when installing the product.

- Do not subject the product to direct sunlight, moisture or shock. Ensure that the IP code of the product meets the requirements for the ambient conditions.

- Only operate the product under ambient conditions for which the respective product is approved. The use under other ambient conditions may result in damage.

- To avoid any damage to the connectors, only mount or remove the product with the cables disconnected.

- Lay cables in such a way that no one is endangered.

- Before starting up, check if the electrical wiring corresponds to the specifications in the documentation. Faulty wiring (overvoltage, undervoltage) can result in a damage in the electronics.

Transport

- Only use ESD packaging for storage and transport of ESD-sensitive components.

- Keep packing materials like films away from children. Abuse may result in suffocation.

Operation and power supply

The camera power supply must meet the requirements for SELV (safety extra low voltage)/LPS (limited power source) or ES1/PS2.

WARNING! A USB hub with external power supply may cause painful or dangerous electric shock. Serious injury or death may occur. Use a USB hub that meet the requirements for SELV (safety extra low voltage)/LPS (limited power source) or ES1/PS2.

Avis pour le Canada
Fonctionnement et alimentation électrique

L'alimentation électrique de la caméra doit être conforme aux exigences de sécurité SELV (très basse tension de sécurité)/LPS (source à puissance limitée) ou ES1/PS2.

AVERTISSEMENT ! Sur un concentrateur USB équipé d'une alimentation externe, il existe des risques de décharges électriques douloureuses ou dangereuses. Celles-ci peuvent provoquer des blessures graves, voire mortelles. Utilisez un concentrateur USB conforme aux exigences de sécurité SELV (très basse tension de sécurité)/LPS (source à puissance limitée) ou ES1/PS2.

CAUTION! As the camera housing may get hot depending on the operating conditions there may be risk of burns. Provide sufficient heat dissipation so that the housing temperature does not exceed 55 °C (131 °F).

Correct disposal

Dispose the camera and accessories properly and separately from other types of waste to encourage recycling of reusable materials and to protect the environment.

According to the EC Directive 2012/19/EU (WEEE) we are obliged to take back this product, distributed by us after August 13, 2005, free of charge at the end of its useful life and to ensure it correct disposal. As this product is exclusively for commercial use (B2B), it must not be handed over to a public disposal facility. The product can be disposed of by specifying the date of purchase and the serial number at the following address:

IDS Imaging Development Systems GmbH
Dimbacher Str. 10
D-74182 Obersulm, Germany

3 USB 3 uEye CP Rev. 2.2

Housing/board-level	+/-
Dimensions height x width x length	29 x 29 x 29 mm
Mechanical specifications	Mechanical specifications
IP code	**IP 30** • Protection against the ingression of small particles (diameter ≥ 2.5 mm) • No protection against water
Ambient conditions	Ambient conditions
Lens mount	C-mount, see Optical specifications
Mounting holes bottom/top/side/front	4/0/0/0
Thread diameter	M3
Status LED	Status LED
Interface connector	USB 3.0 micro B, screwable
Power supply	USB
I/O connector	8-pin Hirose HR25, screwable
Electrical specifications	Electrical specifications
Special features	Integrated image memory Internal pixel preprocessing

> USB 3/USB 3.1 uEye+ cameras are limited usable under USB 2.0. Depending on the camera model, not all camera functions are available in USB 2.0 mode. USB 3/USB 3.1 uEye+ cameras are optimized for USB 3.0 ports and are not tested by IDS Imaging Development Systems GmbH under USB 2.0.
>
> Please note that due to the high performance of modern sensors, some USB 3/USB 3.1 uEye+ models are not supported in USB 2.0 mode anymore, as the USB 2.0 interface does not provide enough power.

3.1 Standards and directives

IDS Imaging Development Systems GmbH hereby confirms that this product has been developed, designed and manufactured in compliance with the following European directives

• 2014/30/EU: EMC - Electromagnetic compatibility

• 2011/65/EU: RoHS - Restriction of the use of certain hazardous substances in electrical and electronic equipment

• Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

• The CE declaration of conformity is available on the IDS website.

If the product is modified or changed all approval becomes invalid. In this case the customer is responsible for ensuring product conformity.

Product type	U3-31N0CP, U3-31R0CP, U3-3990CP	Further models USB 3 uEye CP Rev. 2.2
Information for CE EMC specifications	EN 61000-6-2 EN 61000-6-3* EN 55032 (Class B)	EN 61000-6-2 EN 61000-6-3* EN 55032 (Class B)
Information for USA This equipment has been tested and found to comply with part 15 of the FCC Rules.	Class B	Class B
Information for Canada **Renseignements pour le Canada**	CAN ICES-3 (B)/NMB-3(B)	CAN ICES-3 (B)/NMB-3(B)
Information for UL	-	UL Listed UL 62368-1 CAN/CSA C22.2 No. 62368-1-14
Information for UK EMC specifications	UKCA EN 61000-6-2 EN 61000-6-3* EN 55032 (Class B)	UKCA EN 61000-6-2 EN 61000-6-3* EN 55032 (Class B)
Further information	RCM KC (R-R-img-USB3CPR2) ChinaRoHS EFUP 25	RCM KC (R-R-img-USB3CPR2) ChinaRoHS EFUP 25

* Cameras are intended for use in industrial, residential, commercial and light industrial environments.

For customers in the USA

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and Receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Name of Responsible Party
IDS Imaging Development Systems Inc.
92 Montvale Ave, Suite 4750
02180 Stoneham, MA | U.S.A
 +1 781 787-0048

3.2 Ambient conditions

The temperature values given below refer to the outer device temperature of the camera housing. The temperature inside of the camera housing is generally higher than the outer temperature and may be up to 70 °C (158 °F).

Allowed device temperature during operation	0 °C … 55 °C 32 °F … 131 °F
Allowed device temperature during storage	-20 °C … 60 °C -4 °F … 140 °F
Humidity	20 % … 80 %, relative, non-condensing

Non-condensing means that the relative air humidity must be below 100 %. Otherwise, moisture will form on the camera surface. If, for example, air has a relative humidity of 40 % at 35 °C (95 °F), the relative humidity will increase to over 100 % if the air cools down to 19.5 °C (67 °F); condensation begins to form.

CAUTION! As the camera housing may get hot depending on the operating conditions there may be risk of burns. Provide sufficient heat dissipation so that the housing temperature does not exceed 55 °C (131 °F).

Notes on ambient conditions

- Avoid high air humidity levels and rapid temperature changes when using IDS cameras.

- Temperatures below +4 °C (39 °F) combined with excessive relative air humidity levels can cause icing.

- Note that with increasing device temperatures, the image quality may decrease due to thermal noise, even if the camera is operated below the maximum specified temperature.

Provide sufficient heat dissipation to keep temperatures within the specified ranges. The exact temperature conditions depend on the mounting situation. In general, the following recommendations apply:

- Use a thermally-conductive surface, like a metal plate or a heat sink, for a passive heat dissipation.

- If necessary, provide an active cooling for example by means of a fan.

Vibration and shock resistance

Vibration and shock resistance of the cameras were tested as specified in EN 60068-2-6 and EN 60068-2-27.

Test parameter EN 60068-2-6 "Environmental testing - Tests: Vibration"
• Vibration mode: Sinus • Lower frequency: 30 Hz • Upper frequency: 500 Hz • Acceleration: 10 g • Throughput speed: 1 octave/minute, logarithmic • Number of frequency cycles: 10 per axis

Test parameter EN 60068-2-27 "Environmental testing - Tests: Shock"	
• Shock form: half sine • Pulse duration: 1,9 ms • Peak acceleration: 80 g • Number of shocks per direction: 3 (± X, ±Y, ±Z)	• Shock form: half sine • Pulse duration: 6 ms • Peak acceleration: 25 g • Number of shocks per direction: 100 (± X, ±Y, ±Z)

3.3 System requirements

For operating the cameras, the following system requirements must be met:

- Interface: USB 3.0 port (Super Speed)

- CPU/Memory: The requirements regarding CPU/memory depend on the software used for image acquisition.

Depending on the sensor model, the camera performance may be limited with the minimum system requirements.

USB interface

For best performance and stability, all USB drivers and the firmware must be updated to the latest version. Current generation CPUs with energy saving technologies can cause bandwidth problems on the USB bus.

3.4 Electrical specifications

Pin assignment I/O connector

Digital input wiring

Digital output wiring

General Purpose I/O wiring

3.4.1 Pin assignment I/O connector

> **NOTICE!** The General Purpose I/Os are not potential-free and have no protective circuit. Faulty wiring (overvoltage, undervoltage) can result in a damage in the electronics.

8-pin Hirose connector (HR25-7TR-8PA(73))

Pin	Description
1	Ground (GND)
2	Flash output, with optocoupler (-)
3	General Purpose I/O (GPIO) 1, 3.3 V
4	Trigger input, with optocoupler (-)
5	Flash output, with optocoupler (+)
6	General Purpose I/O (GPIO) 2, 3.3 V
7	Trigger input, with optocoupler (+)
8	Output supply voltage, 5 V (100 mA)

Fig. 1: Hirose connector male, camera rear view

The color assignment of the used I/O cable is specified in the data sheet of the cable. For I/O cables from IDS Imaging Development Systems GmbH, you can find the data sheet on the website. Select the specific I/O cable in the download area and view the associated data sheet.

> The maximum length of the I/O cable is 30 m. The cable must be shielded.

Power supply

The camera is supplied with power via the USB 3.0 interface. Information on the power consumption of individual camera models can be found in the model data sheet.

3.4.2 Digital input wiring

	Symbol	Min.	Typ.	Max.	Unit
Input high range	V_{IH}	5	-	-	V
Input low range	V_{IL}	0	0	1	V
Input leakage current	I_I	-	-	-	µA
Trigger pulse width (edge)		10	-	-	µs
Trigger edge steepness		35	-	-	V/ms

For interpreting the trigger signal, either the rising or the falling edge can be used. The digital input is galvanically isolated using an optocoupler to protect the camera and the PC against surges. Only DC voltages may be applied to the digital input.

The signal source of the trigger must be able to carry a load of at least 20 mA.
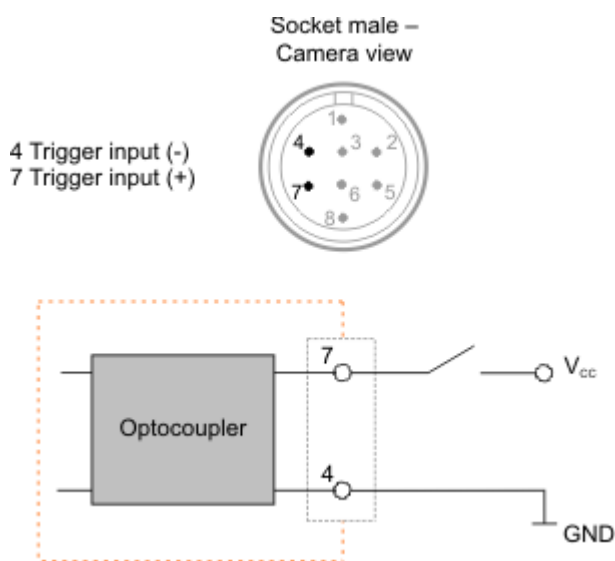
Digital input wiring

Fig. 2: Wiring of the digital input

Absolute maximum rating

	Symbol	Max.	Unit
Voltage range	V_{CC}	30	V

3.4.3 Digital output wiring

	Symbol	Min.	Typ.	Max.	Unit
Recommended supply voltage	V_{CC}	-	-	30	V
Collector-emitter saturation voltage	$V_{CE(SAT)}$	0.03	-	0.15	V
Collector-emitter breakdown voltage	$V_{(BR)CE}$	50	-	-	V
Collector current continuous	I_C	-	-	150	mA

The digital output is galvanically isolated using an optocoupler to protect the camera and the PC against surges. Only DC voltages may be applied to the digital output.

The output of the optocoupler can be used as an open collector or open emitter output. This means that the output signal can be connected to ground or to the supply voltage. The output signal is active if the collector-emitter switch is closed.

Further information on flash configuration can be found in the IDS peak manual in the "Flash configuration" topic.

Digital output wiring

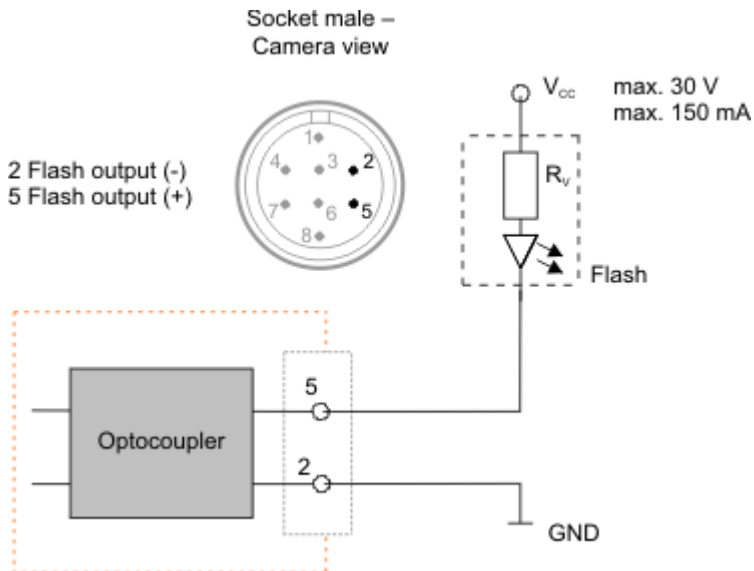The following figures show examples of how the digital output is wired.

Fig. 3: Wiring of the digital output as an open collector output
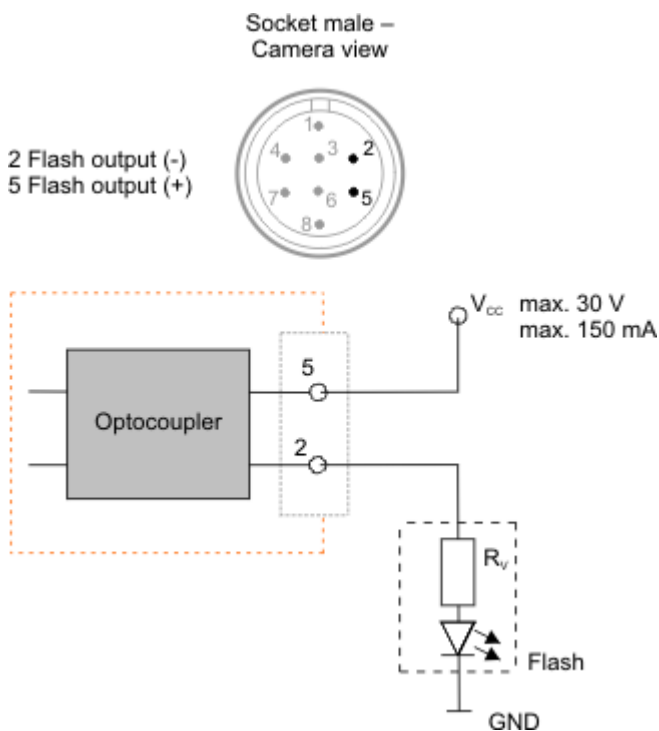

Fig. 4: Wiring of the digital output as an open emitter output

3.4.4 General Purpose I/O wiring

Observe the following criteria when wiring the General Purpose I/Os:

	Symbol	Min.	Typ.	Max.	Unit
IO voltage range	V_{CCIO}	0	-	3.3	V
Input high range	V_{IH}	2.3	-	3.3	V
Input low range	V_{IL}	0	-	1	V
Output high range	V_{OH}	2.4	-	3.3	V
Output low range	V_{OL}	0	-	0.6	V

NOTICE! The General Purpose I/Os are not potential-free and have no protective circuit.

Faulty wiring (overvoltage, undervoltage) can result in a damage in the electronics.

The two GPIOs (general purpose I/O) are initially configured as inputs.

- The initial level is "high" with 10K internal pullup (even if the camera is only powered and no images are captured yet).
- The output cannot drive current, thus it is only suitable for logic inputs without pulldown.
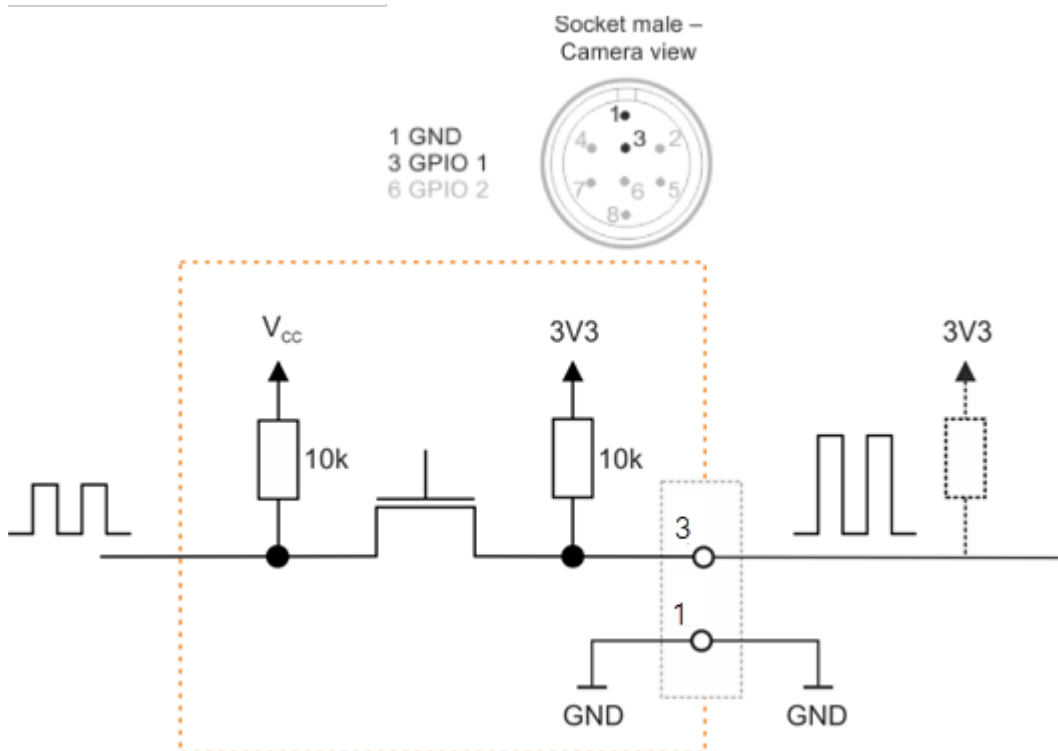
GPIO wiring

Fig. 5: GPIO wiring as input

4 Installing the camera

CAUTION! As the camera housing may get hot depending on the operating conditions there may be risk of burns. Provide sufficient heat dissipation so that the housing temperature does not exceed 55 °C (131 °F).

NOTICE! The camera connectors may be damaged if you install or remove the camera with plugged in cables. Therefore, first unplug the USB and/or I/O cable from the camera.

To install the USB 3 uEye CP Rev. 2.2, proceed as follows:

1. Mount the lens as described in section Mounting the lens.

2. Fasten the camera on its bottom side to the mount, e.g. the tripod plate, using suitable M3 screws with the maximum torque and screw-in depth specified in the technical drawing of your camera model. When doing so, make sure that the mounting threads are undamaged.

3. When mounting the camera in your system, follow the instructions in chapter Position accuracy of the sensor.

4. Install a USB3 Vision compliant software featuring a suitable USB driver on the PC, e.g. IDS peak, which you can find on the IDS website in the Download section after selecting your camera.

5. Connect the camera to the power supply, see Connecting the camera.

⇨ Your camera is ready for use. For information on how to operate the camera, please refer to the Operating the camera.

⇨ For information on using the inputs and outputs, refer to the sections Setting up the I/O interfaces of the camera and Electrical specifications.

4.1 Mounting the lens

Prerequisites:

- The lens has to be suitable for the camera. You can find suitable lenses on our lens finder website.

- Mount lenses in a dust-free environment.

To mount the lens, proceed as follows:

1. Observe the specifications for the maximum immersion depth for lenses during installation.

2. Follow the instructions in the manual for your lens during installation.

3. Hold the camera with the front facing down when removing the protective cap to prevent dust or particles from getting into the camera.

4. Mount the lens while holding the camera with the front facing down.

4.2 Mechanical specifications

The mechanical data for each camera model can be found on our website directly at the respective camera model beneath in the "Downloads" tab.
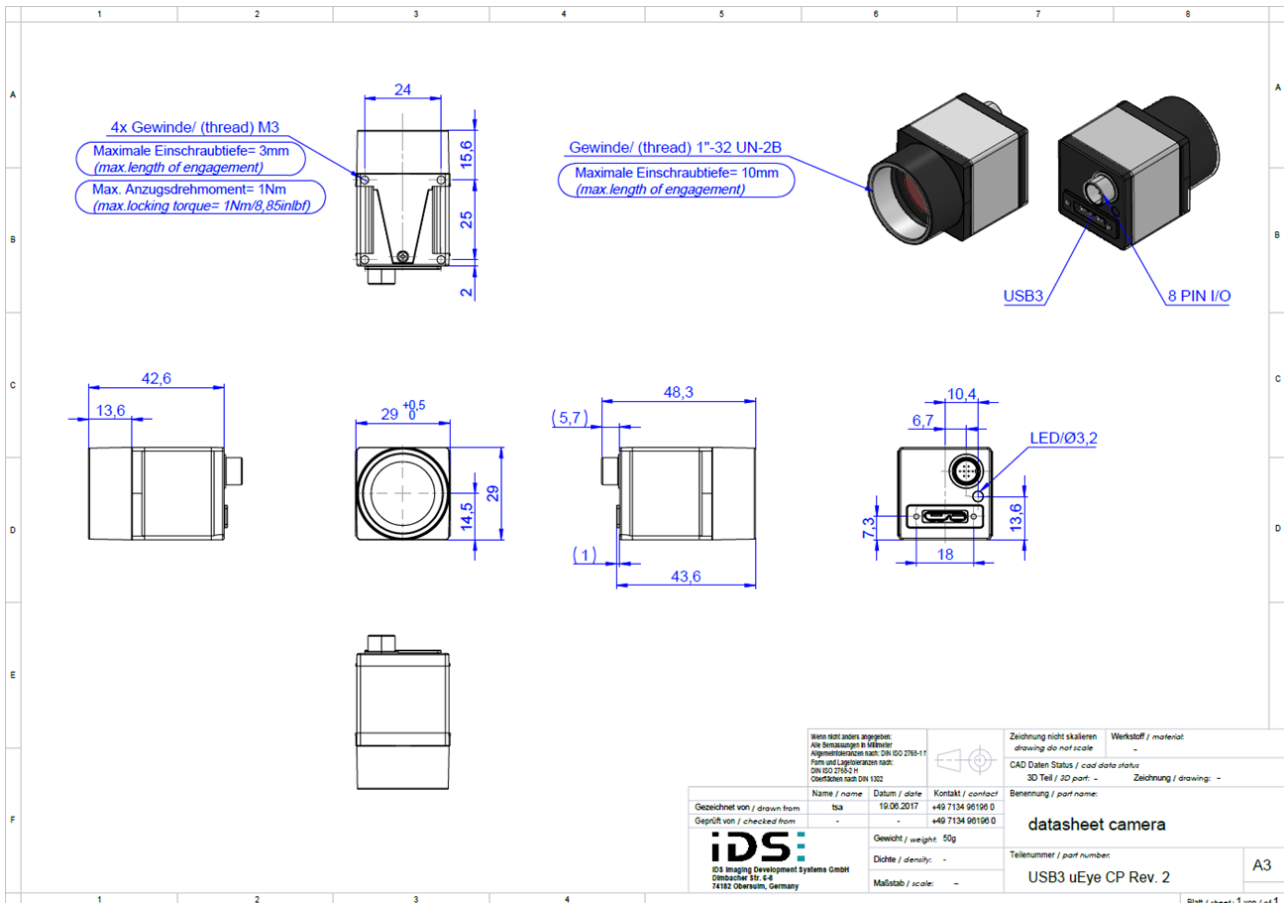
Fig. 6: USB 3 uEye CP Rev. 2.2

> **NOTICE!** The camera connectors may be damaged if you install or remove the camera with plugged in cables. Therefore, first unplug the USB and/or I/O cable from the camera.

4.3 Immersion depth for lenses

Some C-mount lenses reach deep into the camera flange. This may cause the lens to push against the back of the filter glass inside the camera or even make it impossible to screw in the lens.

The table below indicates the maximum possible immersion depth. The actual immersion depth of a lens is given in the relevant data sheet. As lens parts with a small diameter are allowed to reach deeper into the camera flange, the immersion depths are specified based on the diameter (named as A, B, and C in the image below).

Beside the immersion depth also the back focal length has to be considered, that means the distance between the last lens and the sensor (named "bfl" in the image below). The back focal length can be calculated for C-mount/TFL-mount with the following formula:

$$bfl = 17{,}526 - x$$

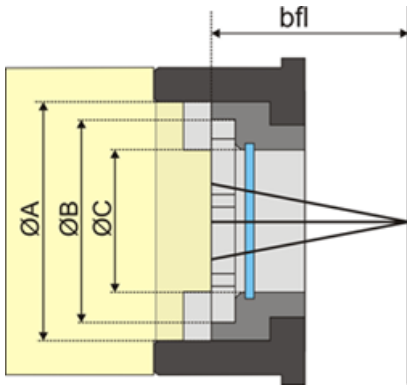x stands for the maximum immersion depth (see table below).

Fig. 7: Camera front (sectional view)

> ℹ️ The data given in the table include the following tolerances as a safety clearance:
> - Immersion depth: 0.2 mm
> - Diameter: 0.2 mm

Type	Thread depth (min.)	for diameter at lens end [mm] Ø A, B	resulting maximum immersion depth [mm]	minimum required back focal length [mm]
C-mount	5 mm	24.0	11.0	5.7
		19.0	11.8	

4.4 Position accuracy of the sensor

The following illustrations show the tolerance margins of the sensor position relative to the outer camera front.
A maximum error in all directions (rotation, translation) cannot occur at the same time.
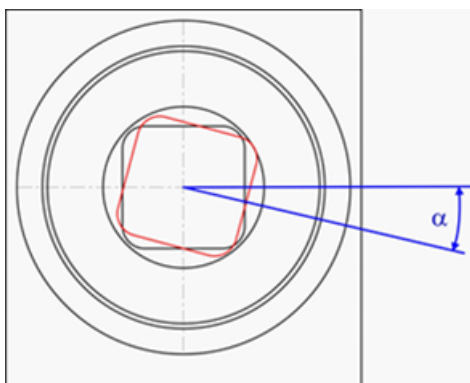
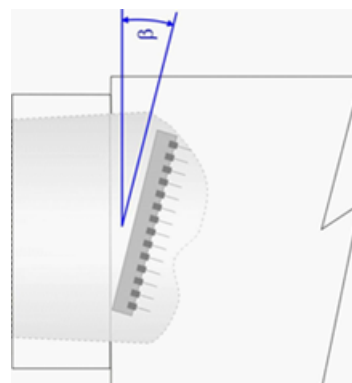**Fig. 8: Position accuracy of the sensor (1)**

Fig. 9: Position accuracy of the sensor (2)

It cannot be guaranteed that the sensor cover glass or filter glass are absolutely parallel to each other.

> ℹ️ C-mount/TFL-mount lenses can also be subject to inaccuracies of the flange back distance. The tolerance usually is ±0.05 mm. In some cases, however, the inaccuracies of camera and lens might add up, resulting in a total error > 0.05 mm.

Position accuracy, in each direction	±0.3 mm
Horizontal/vertical rotation (α)	±1.0°
Translational rotation (β)	±1.0°
Flange back distance	±0.05 mm

4.5 Connecting the camera

When you connect a new USB device with a PC or a new USB port for the first time, Windows update searches automatically online for a suitable driver. This may take some time depending on your system.

1. Connect the camera to a USB3 port on the PC either directly or using USB hubs or repeaters. To get the maximum bandwidth connect the cameras directly to the USB ports on the mainboard.

⇨ The camera will be recognized automatically. When the camera has been correctly installed, the camera LED lights green.
The camera is supplied with power via the USB 3.0 interface. Information on the power consumption of individual camera models can be found in the respective data sheet.

When using a USB hub with external power supply the camera LED still may light green even if the data connection between the PC and the USB hub is interrupted after the camera driver was loaded completely.

Cables

Use USB compatible data cables that allow for USB Super Speed (5Gbit/s). Be aware of the maximum cable lengths for USB.

5 Setting up the I/O interfaces of the camera

The USB 3 uEye CP Rev. 2.2 has inputs/outputs galvanically decoupled with optocouplers, which can be used for triggering the camera and for flash control. In addition, programmable inputs/outputs (GPIO) are available.

The trigger is here the input signal from the camera that tells the sensor when to capture an image. The flash is the camera's output signal that tells other devices that the camera is currently taking a picture.

You can find further information and the electrical specifications for setting up the I/O interfaces of the camera in the following sections:

- Pin assignment I/O connector

- Digital input wiring

- Digital output wiring

- General Purpose I/O wiring

Regarding the configuration of the I/O interfaces of the camera you can find information in Using digital inputs/outputs in the IDS peak manual.

6 Operating the camera

The USB 3 uEye CP Rev. 2.2 cameras are Vision compliant models. All camera features are described in the Camera feature reference in the IDS peak user manual. An overview of the specific functions of your camera model can be found in the corresponding data sheet.

You can operate your USB 3 uEye CP Rev. 2.2 camera using the software development kit IDS peak. IDS peak contains all libraries and software tools required for operating and programming. With an easy to understand programming interface, it simplifies the use of GenICam without limiting or bypassing its functionality.

For the software and documentation for your camera go to https://en.ids-imaging.com/downloads.html and select your camera model.

For additional information on operating the camera, see the following sections:

Status LED

Filter types

6.1 Status LED

Fig. 10: Status LED

The camera has a two-color LED that indicates information on the current status.

Camera is off/no power								
Camera is booting								
Camera is ready/open								
Camera is open (reduced speed at USB 2.0 port)								
No firmware loaded								
Service firmware is active								
Service firmware: configuration by host								
Camera error: contact support								

The status LED also lights up red if the USB cable is not connected but voltage is applied to the GPIOs.

6.2 Filter types

Every camera has a filter glass in the front flange to prevent the entry of dust particles. Color cameras by default use an IR cut filter (type HQ), which is required to ensure correct color rendering. For monochrome cameras, the standard filter is a glass filter (type GL). The filter type is given at the end of the model name.

The following table shows an overview of the different optical filters used in IDS cameras:

| Filter type	Name	Refractive index (n_{Filter})	Glass type	Thickness (f)	Cut-on wavelength	Cut-off wavelength	Non-reflective
IR cut filter	HQ	1.53	D263	1 mm	-	650 ±10 nm	On one side
Glass	GL	1.53	D263T	1 mm	330 nm	-	On both sides
Daylight cut filter	DL	1.53	RG695	1 mm	695 nm	-	-

You can tell the filter type from the outside by its coloration:

• Reddish glass: HQ filter

• Plain glass: GL filter

• Dark glass: DL filter

All sensors have a cover glass. The transmission of the cover glass is taken into account in the camera data sheet.

Infrared cut filter (type HQ)
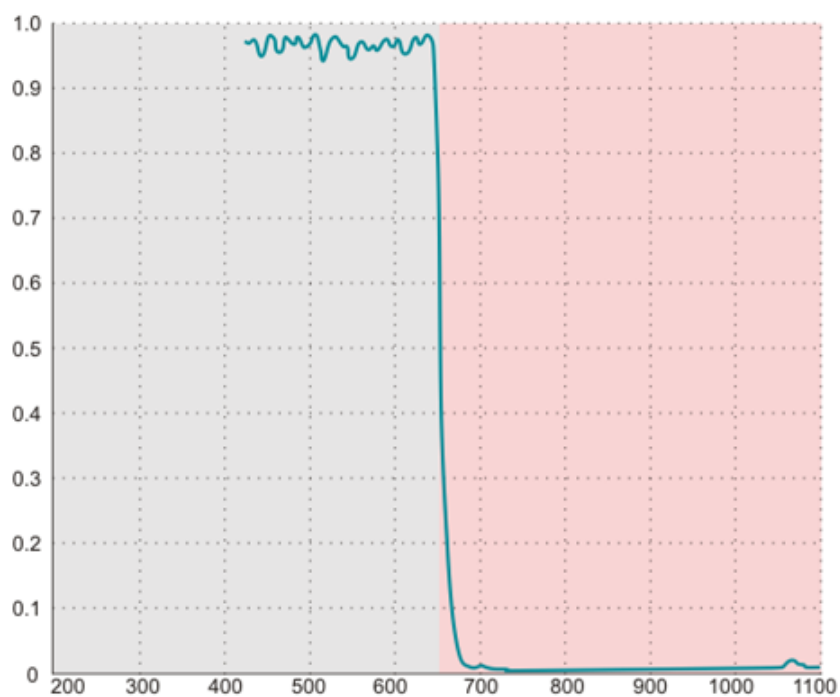
Fig. 11: HQ filter

Plain glass filter (typ GL)
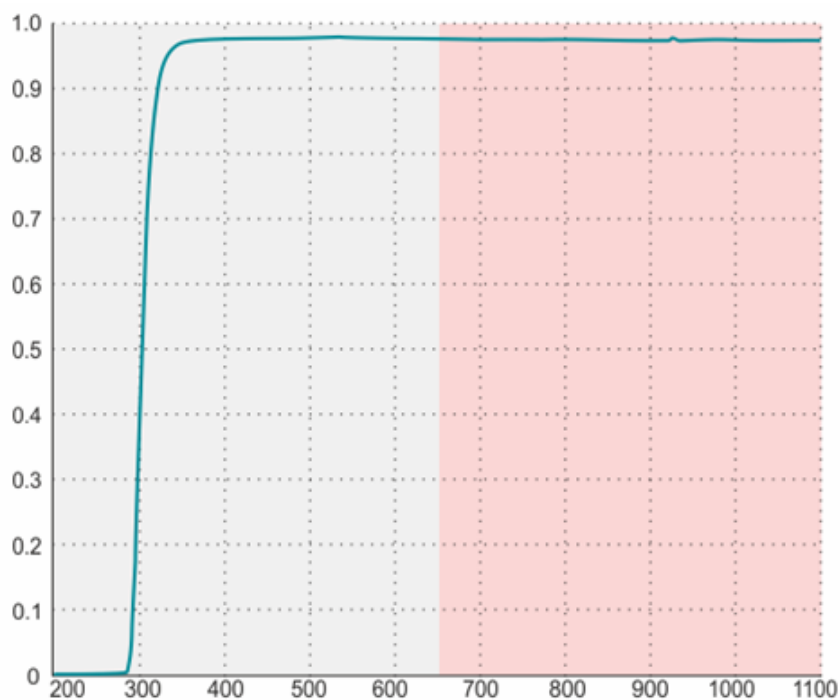
Fig. 12: Glass filter

Daylight cut filter (type DL)
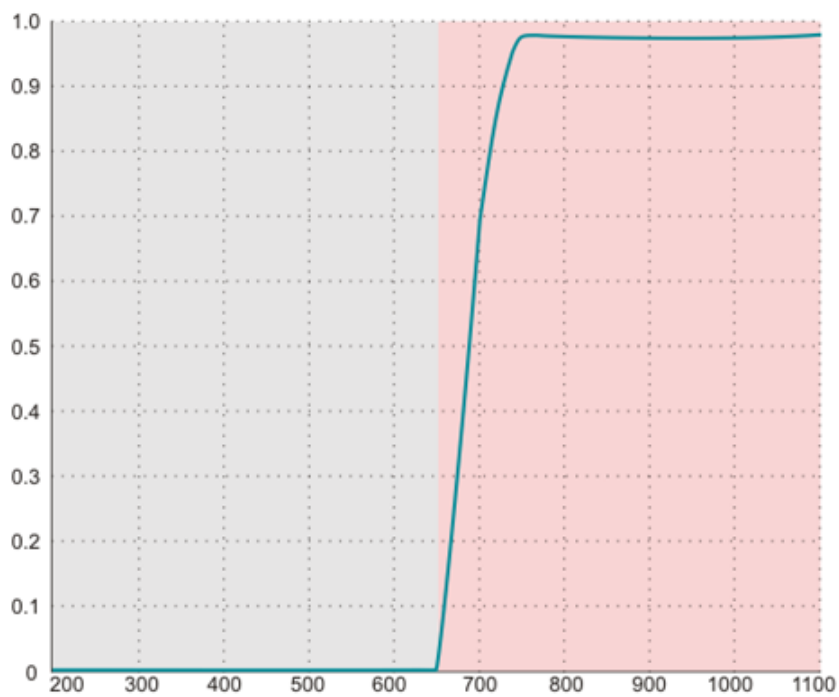
Fig. 13: DL cut filter

7 Maintenance

[Cleaning the filter glasses](#)

[Update camera firmware](#)

Further information on frequently asked questions about the support of our products you can find on our [FAQ website](#).

7.1 Cleaning the filter glasses

When handling the camera with its lens removed, the filter glass can get soiled from the outside. This might be visible in the images that are captured. The filter glass should therefore be cleaned in that case.

> It is strongly recommended to return the cameras to IDS Imaging Development Systems GmbH for professional cleaning.
> IDS Imaging Development Systems GmbH is not liable for any damage resulting from cleaning the filter glasses. This even applies if the following instructions have been observed.

Instructions for cleaning filter glasses

- The filter glasses may only be cleaned from the outside. If you remove the glasses, the sensor might get soiled.IDS Imaging Development Systems GmbH is not liable for any damage to the sensor resulting from removal of the filter glasses.

- First, remove dirt particles on the glass using compressed air. Do not use compressed air from compressors or spray cans since it often contains oil droplets or droplets of other liquids. For best results, use purified nitrogen from nitrogen bottles.

- Only use lint-free wipes or cotton-free swabs for cleaning. Never touch the filter glasses with your bare fingers because often, fingerprints cannot be removed completely afterwards.

- We recommend to use pure alcohol for cleaning. 100% isopropyl alcohol evaporates without leaving any residues. Only add small quantities of alcohol to the wipe. Never pour alcohol directly onto the camera.

> **NOTICE!** Never use cleaning agents containing acetone for cleaning the filter glasses! Acetone may damage the filter glass coating and may deteriorate the optical quality of the glasses.

Cleaning the filter glass

Use a soft wipe to wipe off dirt particles in a single sweep beyond the edge of the filter glass.

Fig. 14: Cleaning the filter glass (example)

7.2 Update camera firmware

The firmware update is transferred to the camera via a GUF file.

You have the following options for updating the camera firmware:

- Use the firmware update tool ids_deviceupdate see <u>Updating the camera firmware</u>.

- Use the IDS peak Cockpit, see <u>Updating the firmware</u> in the IDS peak manual.