

CoaxPress®

EoSens® 21CXP2

User Guide

Content

1	Before you start	4
1.1	About this manual	4
1.1.1	Tips, remarks, and notes	4
1.1.2	Registered trademarks	4
1.1.3	Conformity and use	4
1.1.4	Supplements	5
1.2	Warranty and non-warranty clause	6
1.3	Support	6
2	Introduction	7
2.1	Intended use	7
2.2	Scope of delivery	7
2.3	Optional accessories	7
2.4	System requirements	8
3	The camera	9
3.1	Camera description	9
3.2	Operating temperature	10
3.3	Active cooling	10
3.4	Interfaces of the camera	11
3.5	Status LED	12
4	First steps	13
4.1	Connecting a frame grabber	13
4.2	Connecting an external power supply or I/O signals	14
4.3	Connecting camera and image processing system	16
4.4	The power-up profile	16
4.5	Cleaning sensor and lens	17
4.6	Updating the camera firmware	17
5	Technical data	19
5.1	Camera specifications	19
5.2	Sensor specifications	20
5.3	Resolution and frame rates	21
5.4	Camera dimensions	21

5.5	Spectral response	23
5.5.1	Monochrome	23
6	Appendix	24
	Declaration of Conformity	25

1 Before you start

1.1 About this manual

This manual contains helpful information to install and operate the described camera. It has been produced with care. Nevertheless, information might be erroneous or incomplete. Mikrotron GmbH cannot be held responsible for any problems resulting from incomplete or erroneous information.

In case you detect errors or need further information, please inform us via mail:

service@mikrotron.de or

Call +49- 89-7263-4200

We highly recommend to read this manual carefully.

NOTICE This manual is subject to change without notice.

It is intended for staff with technical qualifications who have been specially trained and have the appropriate knowledge in the field of automation technology, electrical and optical devices.

INFO *Keep this manual for future use.*

1.1.1 Tips, remarks, and notes

This manual contains tips and notes that help to avoid data loss or camera damage. They are emphasized as follows:

INFO *Provides information that may help to improve camera handling or avoid data loss.*

NOTICE *Provides information to avoid damage to the system.*

1.1.2 Registered trademarks

In this manual the following registered trademarks may be used:

- MotionBLITZ®
- ImageBLITZ®
- EoSens®
- GenlCam®
- Microsoft® and Windows®
- Intel®

Throughout the manual, these trademarks are not specifically marked as registered trademarks. This in no way implies that these trademarks can be used in another context without the trademark sign.

1.1.3 Conformity and use

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions given in this guide, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will have to correct the interference at its own expense.

NOTICE

You are herewith cautioned that any changes or modifications not expressly approved in this description could void your authority to operate this equipment.

製造説明:

此设备的生产与测试依照FCC条例第15条条例，符合A类电子设备标准。产品提供在商用使用环境中的合理保护，以防止使用过程中可能涉及到的损害。

此设备会产生、使用并可发射出无线电波，如果未按照本手册中所述安装和使用，可能会对无线通信设备产生干扰。如本设备在居民区操作出现干扰等情况，用户需要自费处理。

备注：请注意，如未按照此使用说明操作而自行更改设备，那么您将无权使用本设备。

規制適合宣言とご使用について(米国FCC)

この機器は、FCC規則のパート15に定められたクラスAデジタル装置に関する規制要件に基づいて所定の試験が実施され、その適合が認証されています。これらの規制要件は、商業環境において機器を使用する際、有害な干渉に対する妥当な保護を提供するために設けられています。この機器は、無線周波数エネルギーを生成かつ利用するとともに、放射することもあります。このリファレンスガイドの指示に従って設置および使用が行われない場合は、無線通信に有害な干渉を引き起こす恐れがあります。この機器を住宅地で利用すると有害な干渉を起こすこともあり、その場合、使用者は自己負担において適切な対策を講じる必要があります。

注意事項：このリファレンスガイドに明示的に承認していない変更や修正を行った場合には、本製品を使用する権利が無効となることがあります。

1.1.4 Supplements

For customers in Canada

This apparatus complies with the Class A limits for radio noise emissions set out in Radio Interference Regulations.

Pour les utilisateurs au Canada

Cet appareil est conforme aux normes Classe A pour bruits radioélectriques, spécifiées dans le Règlement sur le brouillage radioélectrique.

Life support applications

The products described in this manual are not designed for use in life support appliances or devices and systems where malfunction of these products can reasonably be expected to result in personal injury.

NOTICE Mikrotron customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Mikrotron for any damages resulting from such improper use or sale.

1.2 Warranty and non-warranty clause

Warranty is described in §8 of our General Terms and Conditions which can be downloaded on the Mikrotron web page (www.mikrotron.de/en/terms.html).

In addition, take the following non-warranty clauses into account.

NOTICE The camera does not contain serviceable parts. Do not open the body of the camera. If the camera has been opened, the warranty will be void.

NOTICE The camera has to be used with a supply voltage according to the camera's specification. Connecting a lower or higher supply voltage, AC voltage, reversal polarity or using wrong pins of the power connector may damage the camera. Doing so will void warranty.

Our warranty does not protect against accidental damage, loss, or acts of nature.

INFO *Mikrotron cannot be held responsible for the loss of data. We recommend a backup plan.*

1.3 Support

1. In case of support or a warranty claim, make a note of the camera type and its serial number (S/N). You find all necessary information on the identification plate of the camera.
2. Contact us in one of the following ways:
 - Contact us via email: support@mikrotron.de. Our support team will guide you through the process.
 - Or visit our support website www.mikrotron.de/en/services/support.html and fill out the form. You will receive an automatic reply from our ticket system.

2 Introduction

2.1 Intended use

The camera EoSens® 21CXP2 belongs to the product class of so-called high-speed machine vision (MV) cameras that are integrated into test or measurement systems.

High-speed MV cameras are designed to capture images with high frame rate for various purposes in an industrial or scientific environment to deliver image data for further analysis. The images are transmitted to a frame grabber on a connected computer where they can be evaluated with the help of a software.

Other uses

Any other use is regarded as unintended use and leads to the loss of guarantee and liabilities. Contact the manufacturer for other uses.

These products are designed for industrial applications only. **The cameras are not designed for life support systems where malfunction of the products might result in any risk of personal harm or injury.**

2.2 Scope of delivery

The following components are part of delivery. Before installing the camera, check if the delivery is complete:

- Camera as ordered
- F-mount lens adapter
- USB storage device with
 - GenICam XML file
 - Product documentation

NOTICE Check if the delivery is complete before installing the camera.

INFO *The firmware can be updated remotely via a special updating software. For firmware updates, inform Mikrotron via email: info@mikrotron.de.*

2.3 Optional accessories

Lenses

Only lenses for industrial purpose are suitable. To find lenses or other accessories, visit www.mikrotron.de/en.

Cables

For connecting the camera, the following cable must be used.

- Cable CXP 12GHz μ BNC RG59 (1x) - 5m

We recommend the following cable:

- KKRDRG59UBNCUBNC05/12GX1 (12GHz μ BNC RG59) - 5m

Power supply

If you do not use power over CXP, you need an external power supply unit, e.g.:

- NTCAM132X (12 V/2.5 A) with 12 pin Hirose connector (HR10A-10P-12S(73) and 5 m cable
- NTCAM132XIO (12 V/2.5 A) with 12 pin Hirose connector (HR10A-10P-12S (73) and 5 m cable plus additional strobe out line

2.4 System requirements

The PC or image processing system that is connected with the camera must be equipped with:

- An image processing system, e.g.: PC and operating system according to the requirements of the frame grabber
- A fully installed frame grabber with device driver and software
- CoaXPress cable with μ BNC connector
- Optional external power supply (NTCAM132X/NTCAM132XIO)

NOTICE To make use of the full performance, all cables, connectors and the frame grabber must be CoaXPress V2.0 compliant.

INFO If a CXP V1.1 frame grabber is used, only speeds up to CXP-6 (6.25 Gb/s) can be achieved.

3 The camera

3.1 Camera description

All cameras of the EoSens CXP family are CoaXPress compliant. The high-speed CMOS cameras come with a 21 Megapixel sensor of 5,120 x 4,096 px (H x V). They are widely configurable and scalable to fit your needs and are available in monochrome and color (Bayer Filter).

The CoaXPress high speed interface technology allows transfer rates of up to 12.5 Gb/s. The CXP camera supports CoaXPress Link Speeds from 3.125 Gb/s to 12.5 Gb/s.

In addition the camera offers a frame rate of over 230 fps at full resolution. By defining a Region of Interest (ROI) the frame rate can be increased to several thousand frames per second. An important feature of CXP cameras is the high photo sensitivity for low-light conditions.

The camera electronic is enclosed in a compact and solid full metal housing robust enough to comply with the requirements in heavy industrial surroundings. Shielded coaxial cables as recommended by the CoaXPress standard will support this.

CXP cameras can be equipped with standard F-mount lenses made for industrial purpose.

The color and monochrome cameras are supplied with the following features:

- Analog/digital gain
- Black level adjustment
- FPN correction
- Image information field
- Lookup table (LUT)
- Test images
- User profiles

Bayer filter

The sensor of the EoSens color cameras is supplied with a Bayer color filter. In order to get the color information, the imaging software has to decode the information of each pixel into red, green, and blue (RGB) by using the values of its neighboring pixels. Each red, green and blue filter element covers exactly one pixel on the sensor. A matrix of 2 x 2 filter elements builds a filter element matrix. A Bayer pattern image therefore must have an even number of pixels and an even number of lines. The ordering of the RGB pixels for each sensor is provided in the section on technical data.

UV / IR cut filter

In addition, color cameras are equipped with an UV / IR cut filter. Light with wavelengths between 370 nm and 670 nm will be transmitted. As CMOS sensors are susceptible to UV and IR rays outside the visible spectrum, UV / IR filter avoid blurred images and therefore improve color images.

3.2 Operating temperature

If the camera is mounted on mechanical parts, the heat generated during operation will be dissipated by the attached fan, the cooling fins at the rear of the camera, and the mechanical parts.

NOTICE The camera body temperature must not exceed the values specified in the technical data (see "Technical data" on page 19).

In case of overheating, the camera will automatically be switched off and the communication between camera and PC will be interrupted.

INFO *Durability of the camera will be reduced when being operated in an environment that is constantly exceeding the maximum permissible operating temperature. In this case, take additional cooling measures as described below.*

NOTICE The camera is not intended for use on an isolated mounting plate or in a closed housing because the temperature of the camera will rise continuously.

3.3 Active cooling

The camera is equipped with active cooling. This can be deactivated if the camera temperature can be stabilized by other methods such as mounting on a heat-dissipating construction.

If the ambient temperature is constantly exceeding 40 °C, additional cooling is recommended.

3.4 Interfaces of the camera

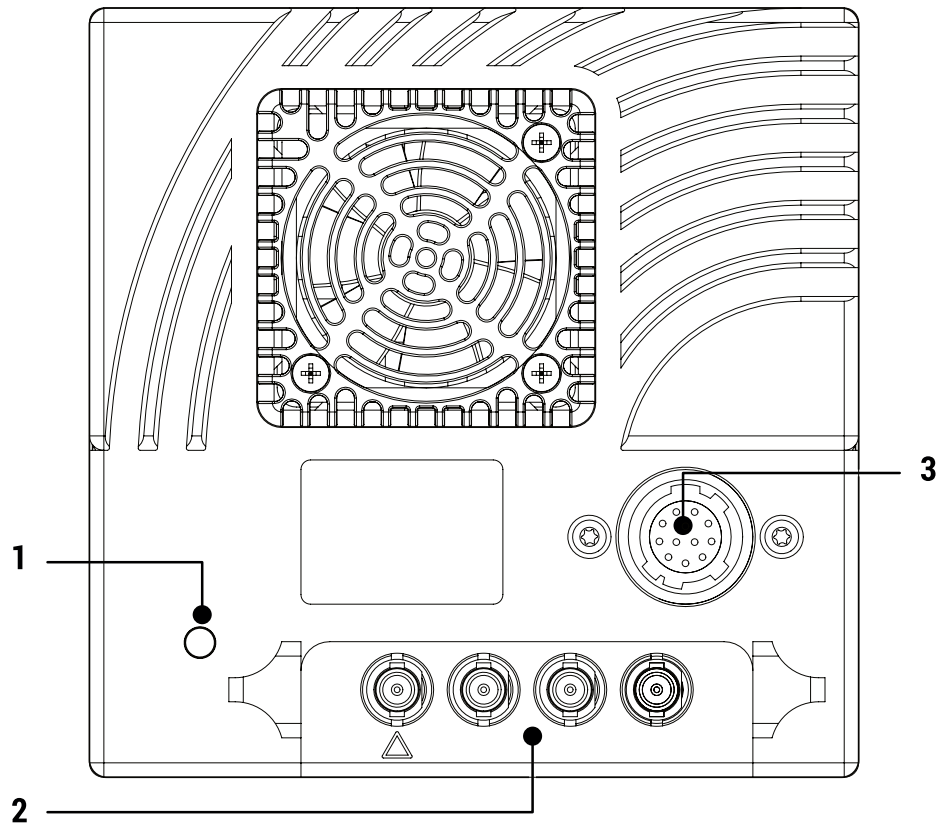


Fig.: 3-1: Interfaces of the camera EoSens® 21CXP2

1	Status LED to verify the operating status of the camera
2	Four CoaXPress μ BNC connectors to connect the camera with a CoaXPress compliant frame grabber. The Δ -marked line can supply the camera with power via power over coax (PoC).
3	12-pin Hirose power connector used when an external power supply (12 ... 24 V) has to be connected, an external trigger is connected and / or an output signal is used.

3.5 Status LED

The multi-color status LED indicates camera and connection states.

LED State	Indication
OFF	No power
Solid orange	System is booting
Slow pulse red	Powered, but nothing connected (not applicable if PoC is used)
Fast flash alternate green/orange	Connection detection in progress, PoC active
Fast flash orange	Connection detection in progress, PoC not in use
Slow flash alternate red/green	Device incompatible, PoC active
Slow flash alternate red/orange	Device incompatible, PoC not in use
Solid green	Device connected but no data being transferred
Slow pulse orange	Device connected, waiting for event (e.g. trigger)
Fast flash green	Device connected, data being transferred
Slow flash alternate green/orange	Connection test packets being sent
Red - 500 ms pulse	Error during data transfer
Slow flash alternate red/green/orange	Compliance test mode enabled
Fast flash red	System error

4 First steps

4.1 Connecting a frame grabber

The transmission speed of the camera can either be set to 3.125, 5, 6.25, 10, or 12.5 Gb/s. The possible cable length depends on the cable type used, its quality, and the selected transmission speed. The following table provides examples. These values will only be reached if the signal quality meets the requirements of the CXP2.0 specification.

INFO To use PoCXP, lane 1 (Master) and lane 2 (Extension 1) must be connected with the frame grabber.

CXP-Type	Transmission speed [Gb/s]	Max. cable length RG59 style [m]
CXP-3	3.125	up to 100
CXP-6	6.25	up to 40
CXP-10	10	up to 40
CXP-12	12.5	up to 30

NOTICE All lines have to be of the same length.

μ BNC connector

Mikrotron offers cables with the following connectors:

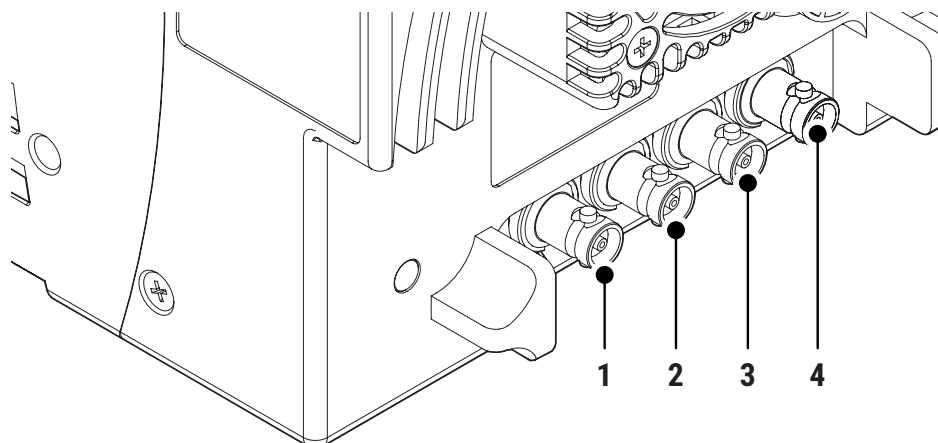
- μ BNC \leftrightarrow μ BNC (cable KKRDxxx)

NOTICE Carefully connect and release the socket with the connector. Connect them precisely to avoid deformation of the connectors or other damages!

If connecting individual cables, keep the order on camera side starting at from Δ -marked link one to channel one on the frame grabber.

INFO Pin 1 always has to be connected.

The master connector (1) is marked by a triangle. Connect it with channel one of the frame grabber (refer to the frame grabber documentation).



The possible connector combinations are shown in the table below.

No. of connections	Connector combination
1	1
2	1+2 (link)
4	1+2+3+4 (link)

INFO All connections are hot-pluggable.

4.2 Connecting an external power supply or I/O signals

If you prefer an external 12 - 24V DC power supply (min. 18 W), connect it with the 12-pin connector at the rear of the camera.

NOTICE The power connector of the camera has to be connected with a DC power supply providing 12 to 24 V DC. Connecting a lower or higher supply voltage, an AC voltage, reversal polarity or using wrong pins of the power connector may damage the camera and will void warranty!

Mikrotron offers the power supply unit NTCAM132xx with cables of 5 or 10 meters.

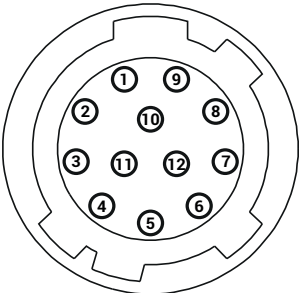
INFO If you assemble your own cable, pay attention to the pinning described below.

12-pin connector and I/O signals

1. Connect the external power supply with the 12-pin connector of the camera.

NOTICE The DC power supply must deliver 12-24 V DC (18.4 W). It must be equipped with a HR-10A-10P-12S plug.

The 12-pin connector provides two inputs for an external trigger and two output signals. The output signal can be controlled.

	Pin	Signal	Pin	Signal
	1 + 12	GND	6	IN0
	2 + 11	VCC (12 - 24 V)	7	IO _{GND}
	3	IO _{GND}	8	OUT1
	4	OUT0	9	IO _{GND}
	5	IO _{GND}	10	IN1

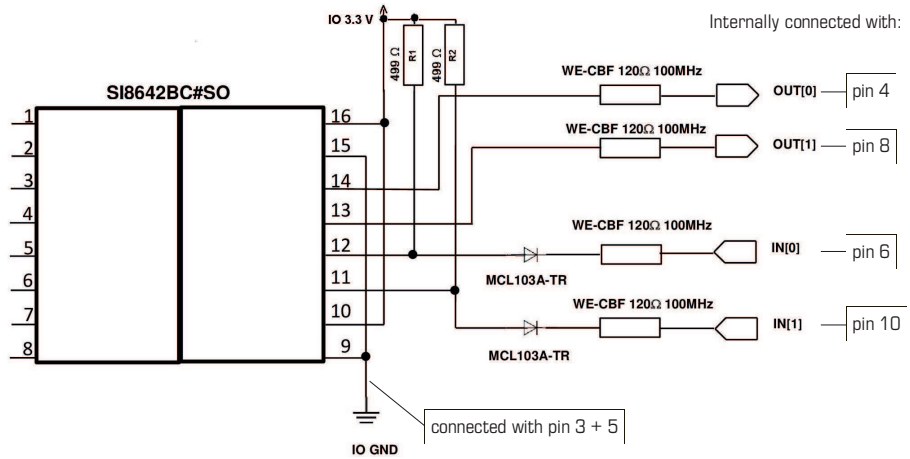


Fig.: 4-1: Connecting input and output signals with the internal circuit

All inputs accept 3.3 V LVTTTL signals. They are also 5 V TTL compatible.

All inputs can also accept signals with 12 V and 24 V.

NOTICE An open (not connected) input will be interpreted as high level from the camera. For low level an input voltage of 0 - 0.3V must be connected.

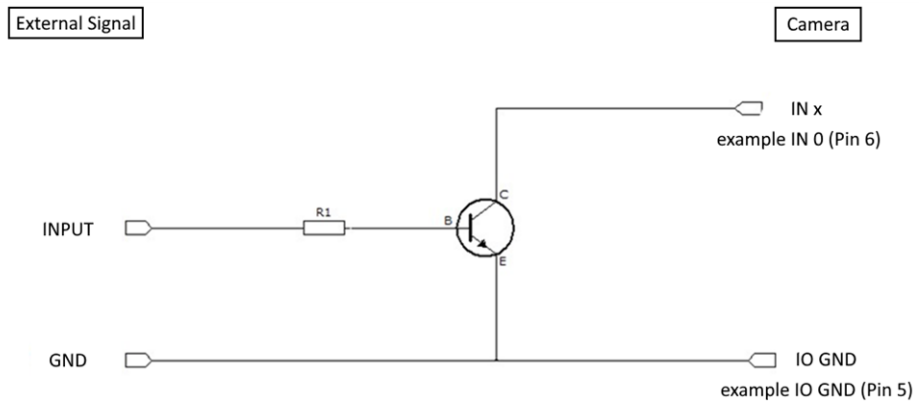


Fig.: 4-2: IO signals

If the available external signal cannot deliver a low level voltage $< 0.3 \text{ V}$ or the input signal is $> 24 \text{ V}$, the following transistor circuit can be used. A suitable transistor is for example BC547, or 2N2222.

NOTICE This circuit will invert the signal. (A high level at the input will be seen as low level at the camera.)

Examples for R1

Input voltage	Resistor
3.3 V	2.7 kOhm
5 V	4.7 kOhm
12 V	12 kOhm
24 V	22 kOhm

4.3 Connecting camera and image processing system

NOTICE To make use of the full performance, all cables, connectors and the frame grabber must be CoaXPress V2.0 compliant.

INFO If a CXP V1.1 frame grabber is used, only speeds up to CXP-6 (6.25 Gb/s) can be achieved.

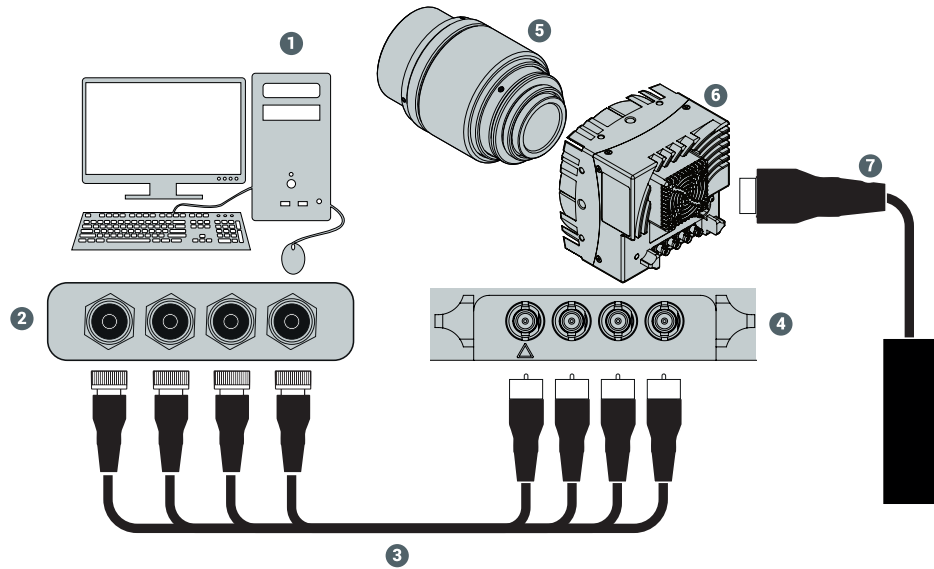


Fig.: 4-3: Connecting the camera and image processing system

1. Install the frame grabber software on the image processing system (see documentation of frame grabber board).
2. Switch off the image processing system (1).
3. Unscrew the dust protection cover of the camera (6).
4. Mount the lens (5).
5. Connect the μ BNC cables (3) with the camera connectors (4).
6. Connect the other end of the cable with the frame grabber board (2).
7. If required, connect the power supply NTCAM132x via the 12-pin connector with the camera (6).

INFO If connecting an external trigger, take the pinning into account.

8. If an external power supply (7) is used, connect the power supply with the main supply.
9. Switch on the image processing system (1).
10. Check the status LED of the camera to verify that the camera is ready for use.

4.4 The power-up profile

If the camera is powered-up, the power-up profile permanently stored in the non-volatile memory of the camera will be loaded. This profile consists of a number of camera settings such as sensor resolution and frame rate. It is used to set the camera into a defined operation mode.

INFO

The camera has NOT to be configured by the host to start operation. The power-up profile will deliver all necessary values.

Serial number and firmware version are provided in the non-volatile memory of the camera. Use the GenICam feature "DeviceSerialNumber" to read the serial number and the firmware revision.

INFO

Read the chapter on Bootstrap Registers in the Reference Guide for more information. For the serial number, see the identification plate at the side of the camera.

4.5 Cleaning sensor and lens

Unplug the camera before you clean any parts!

Never open the housing when cleaning the window of the sensor. If the camera has been opened, the warranty will be void.

1. If there are coarse particles on the lens or the window of the sensor, use a vacuum cleaner to remove them before cleaning to prevent scratches.
2. Clean the window of the sensor and the lens with a dry and soft lens-cleaning tissue.

NOTICE

Do not use tools that may harm the sensor or lens.

4.6 Updating the camera firmware

This section describes how to carry out a firmware update for a camera from Mikrotron GmbH using the software "CXPUdater".

Prerequisites

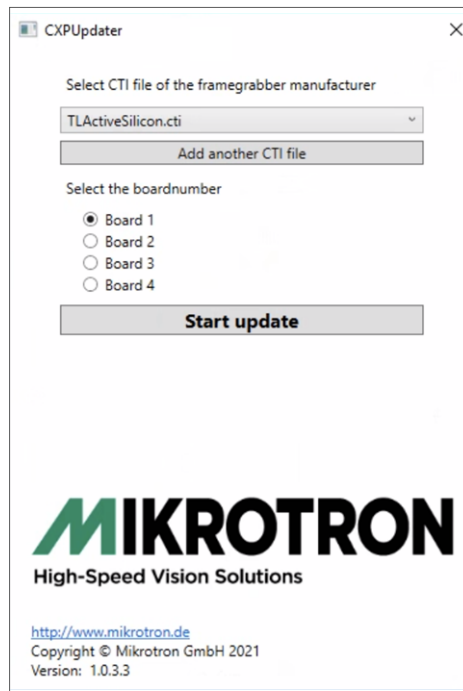
INFO

The updater software requires the Microsoft Redistributables for Visual Studio 2015-2019 (vcredist_x64.exe) that can be downloaded from Microsoft for free.

Procedure

The updater process requires frame grabber specific components. The program assumes that there is a "Data" folder containing the following files:

- FlashData.ibf
- fpga_app_firmware.ibf



1. Open the tool “CXP Updater.exe” in the folder “Firmware”.
2. Select the CTI file that corresponds to the frame grabber board. If unsure, consult the Device Manager.
3. To add a CTI file that is not in the list, select **Add another CTI file** and navigate to the file.
4. Select the board for updating.
5. Start the update process. The progress bar displays the current update status.

NOTICE Do not switch off the camera during the update process.

6. When the update is finished, restart the camera.

5 Technical data

5.1 Camera specifications

Frame rate (8 bit)	>230 fps
Shutter speed	4 μ s – 1 s
Shutter time (steps)	1 μ s
Max. Jitter via CXP Trigger	\pm 4 ns
Quantum efficiency	>62% @ 500 nm
Interfaces	<ul style="list-style-type: none"> • CoaXPress 1.x @ 3.125 Gb/s • CoaXPress 1.x @ 6.25 Gb/s • CoaXPress 2.x @ 10 Gb/s • CoaXPress 2.x @ 12.5 Gb/s • CoaXPress lanes switchable to 1, 2, or 4 <p>Frame rates of 12.5 Gb/s can only be reached when the camera is connected to a system that supports CXP2. Otherwise, frame rates of up to 6.25 Gb/s are possible.</p>
Adapter	F-mount
Dimensions (W x H x L)	<ul style="list-style-type: none"> • 80 x 80 x 72.8 mm (without lens adapter) • 80 x 80 x 92.8 mm (F-mount)
Weight	<ul style="list-style-type: none"> • 0.50 kg (without lens adapter) • 0.63 kg (F-mount)
Cooling	Fan
Noise of fan	max. 23 dB(A)
Power supply	12 - 24 V DC
Operating temperature (camera body)	+5 °C ... +50 °C
Shock resistance	70 g
Vibration resistance	7 grms
Compliance	GenICam CoaXPress 1.1 / 2.0

5.2 Sensor specifications

Sensor type	CMOS global shutter
Image sensor size	23.04 x 18.432 mm
Resolution	21 Megapixel
Active pixels	5,120 x 4,096 px
ROI min	128 x 32 px
Pixel depth	8 bit / 10 bit / 12 bit
Pixel size	4.5 x 4.5 μm
Light sensitivity	TBD
Dynamic range up to	68.8 dB (12 bit Gain 2)
Full well charge	28,000 e- (12 bit Gain 0) 16,500 e- (12 bit Gain 2)
Bayer filter pattern	BayerGR8 / BayerGR10 / BayerGR12 Because the pattern must always start at the same field with a color camera only even height and even offset-y is possible. The camera will automatically round down if odd values are entered. Also bear in mind when using the invert readout function the pattern must be inverted too.

5.3 Resolution and frame rates

Resolution	Frame rate (4 x CXP-12 @ 8 bit centered)
5120 x 4096 px	230 fps
4096 x 3072 px	305 fps
1920 x 1088 px	842 fps
1280 x 1024 px	892 fps
1024 x 768 px	1174 fps
832 x 608 px	1463 fps
640 x 480 px	1822 fps
512 x 512 px	1717 fps
320 x 256 px	3189 fps
128 x 128 px	5582 fps
128 x 32 px	12764 fps

INFO

Use our camera compare tool to calculate the frame rate for a certain ROI size.
www.mikrotron.de/cameracompare/

5.4 Camera dimensions

All dimensions in Millimeters.

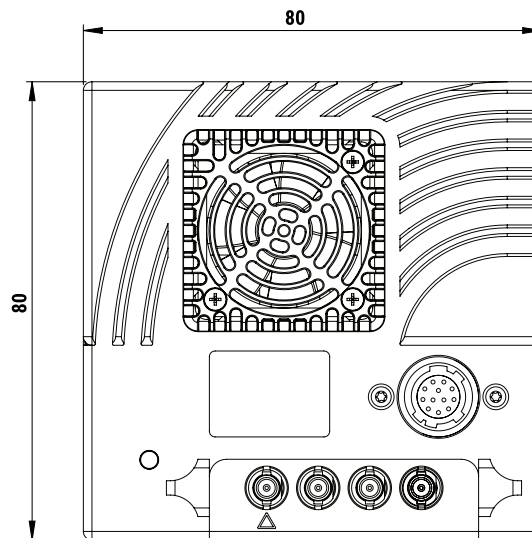


Fig.: 5-1: Rear view

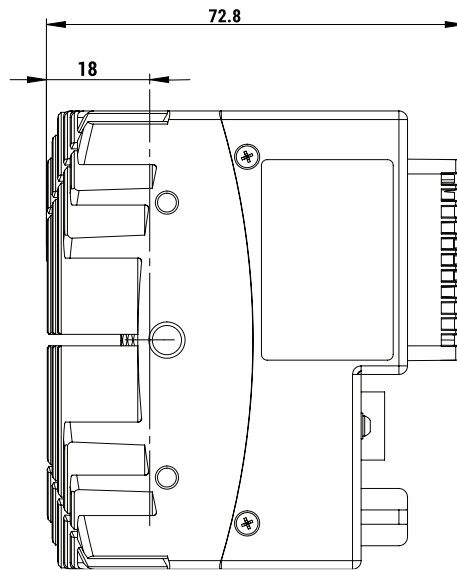


Fig.: 5-2: Side view without adapter

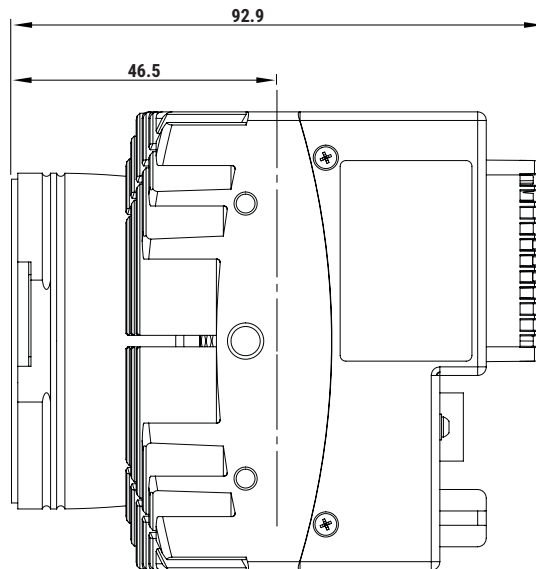


Fig.: 5-3: Side view with F-mount adapter

5.5 Spectral response

5.5.1 Monochrome

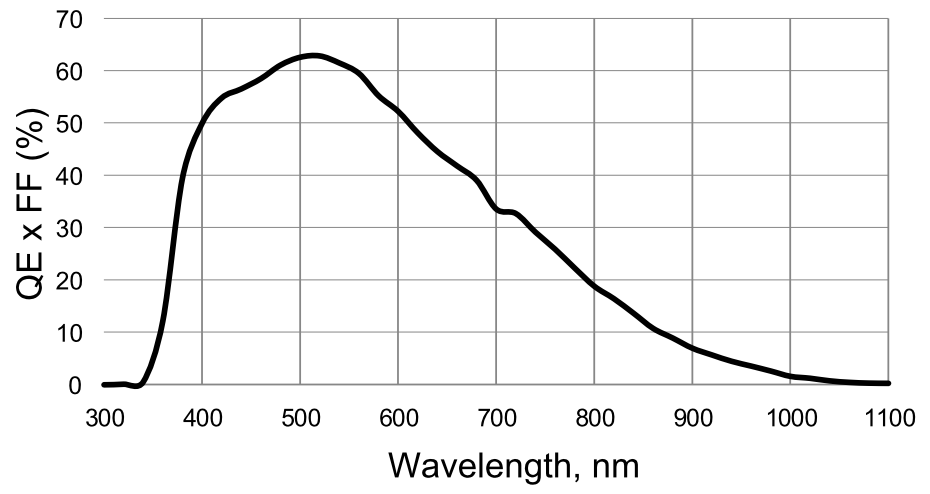


Fig.: 5-4: Spectral response - monochrome

6 Appendix

The following page contains the Declaration(s) of Conformity.



EU DECLARATION OF CONFORMITY

Address: **Mikrotron GmbH**
Landshuter Str. 20-22 ,
85716 Unterschleißheim

Series: EoSens 21CXP2

Model: CAMMC2166, CAMMC2167

The product complies with the requirements of the following European directives:

2014/30/EU	Electromagnetic Compatibility (EMC)
2011/65/EU + (EU) 2017/2102	Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The compliance with the requirements of the European Directives was proved by the application of the following harmonised standards:

EMC:	EN 55032:2016-02
	EN 55035:2018-04

Unterschleißheim, November 15, 2021

Walter Denk, General Manager

i.A. Andreas Ertl, Head of R&D

A BRAND OF SVS-VISTEK

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