EoSens® CL

User Guide

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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®
- Eo*Sens*®
- GenICam®
- 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.

制造说明：

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® CL 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 or C-mount lens adapter as ordered
- USB storage device with
    - VCAM2 software
    - 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.

Cable

- KKRDCLSRxx: CameraLink cables with lengths from 0.5 to 8 m are available.

INFO   *If the cable length exceeds 8m, high-quality cables are required.*

In order to use Full camera link, two cables for each camera are needed.

Power supply

- NTCAM13xx: The 12V/2.5A power supply is available with 5 or 10 m cable.
- NTCAM13xxSTR with strobe connector: The 12V / 2.5 A power supply with strobe connector is available with 5 or 10 m cable.

Adapter

- F-mount adapter
- C-mount adapter

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 the most recent device driver and software
- A CameraLink cable (one cable for BASE mode or two cables for operating in FULL mode)
- An external power supply providing an output voltage between 8 and 24 V and a current of at least 2 A (e.g. NTCAM13xx or NTCAM13xx10)

3   The camera

3.1   Camera description

The CMOS 1.3 Megapixel CameraLink cameras offer a high photo sensitivity and therefore make inspection in low light conditions possible. Both BASE and FULL mode cameras are available as monochrome and color version.

Mikrotron CameraLink cameras comply with the CameraLink standard. The camera link standard defines the following items:

- Three configuration types BASE, MEDIUM and FULL with different data transfer speeds
- The transfer protocol which is used by the frame grabber to communicate with the camera.

For detailed information about the CameraLink standard, refer to the AIA web page: www.visiononline.org.

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

- Analog and digital gain (digital gain only for color versions)
- Auto exposure
- Decimation mode (subsampling)
- Firmware updates on site possible
- Inversion mode
- Multiple pixel exposure
- ROI move mode
- Threshold mode
- Trigger debouncer
- Programmable via CameraLink interface
- Small, compact housing

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

Despite of its high performance, the fanless 1.3CL camera is compact and works silently. If the camera is mounted on mechanical parts, the heat generated during operation will be dissipated by 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 Additional cooling

INFO *If the camera is e.g. mounted on a sturdy aluminum structure, not only cooling is ensured but also a stable optical path. In addition, vibrations will be minimized within the entire system.*

If the ambient temperature is constantly exceeding 40 °C, additional cooling is recommended. This can be achieved by

- Air- or water-cooling system
- Air-conditioned housings

3.4 Interfaces of the camera

At the rear of the camera, two CL sockets are provided. If only BASE is connected with the frame grabber, a maximal data transfer speed of 255 MB/s can be reached. If the connectors BASE and FULL are connected via two cables with the frame grabber, the data transfer speed amounts to 680 MB/s.
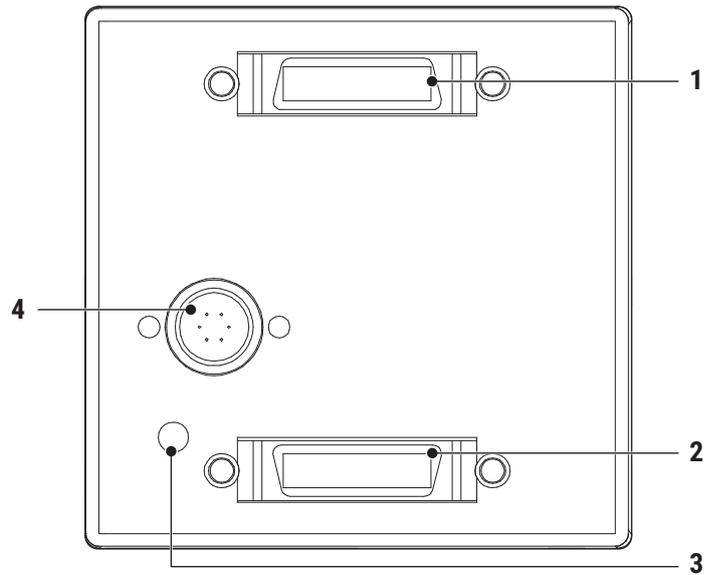
Fig.: 3-1: Interfaces of the camera EoSens® CL

1	FULL interface	2	BASE interface
3	LED	4	6-pin Hirose socket

This connection allows a standardized real-time communication between frame grabber and camera via the standardized CameraLink machine vision protocol.

The 6-pin Hirose connector is used to connect an external power supply.

3.5   Status LED

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

LED State	Indication
OFF	No power
Solid orange	System is booting
Fast flash alternate green/orange	Connection detection in progress, PoC active
Slow flash alternate red/green	Device incompatible, PoC active
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
Fast flash red	System error

4 First steps

4.1 Connecting power and I/O signals

The power connector of DC power supply must be connected to the 6-pin Hirose plug (HR10A-7P-6S).
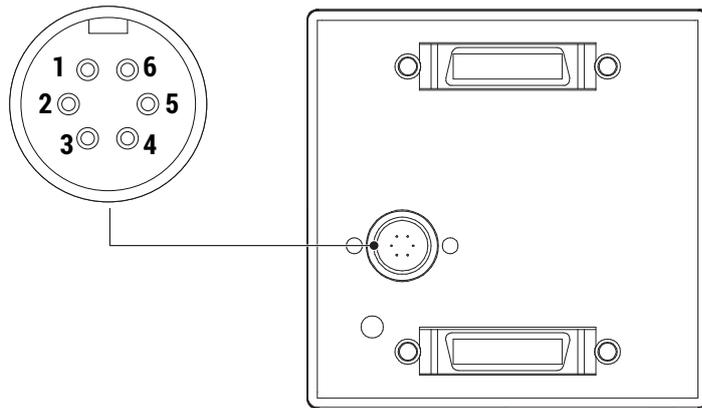
Fig.: 4-1: Power connector pinning

<table>
<tr><td>NOTICE</td><td>If it is connected with another 12 - 24 V/2A power supply, take the pinning of the connector into account.</td></tr>
</table>

Pin	Signal	Pin	Signal
1	V_{CC}	2	V_{CC}
3	$STRB_{OUT}$	4	GND_{STRB}
5	GND	6	GND

INFO *Before applying power, verify the polarity of the leads (+/-) and whether the applied voltage is correct.*

Pin 3 of the 6-pin connector provides a strobe signal ($STRB_{OUT}$) which is high during exposure.

Internally, the STRB signal of pin 3 ($STRB_{OUT}$) is connected with an optocoupler.
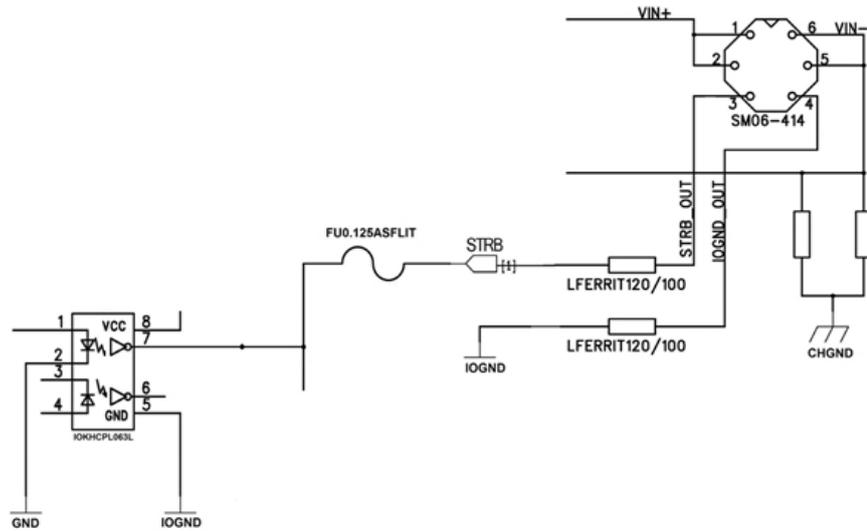
Fig.: 4-2: Optocoupler

NOTICE — The camera must be used with a supply voltage according to the camera specification. Connecting a lower or higher supply voltage, AC voltage, reversal polarity or using wrong pins of the power connector may damage the camera. If doing so, the warranty will expire immediately.

4.2 Connecting camera and image processing system

INFO — *Before you start, make sure that all components of the camera-host chain, i.e. camera, connectors, cables, and frame grabber as well as the software are CameraLink-compliant.*
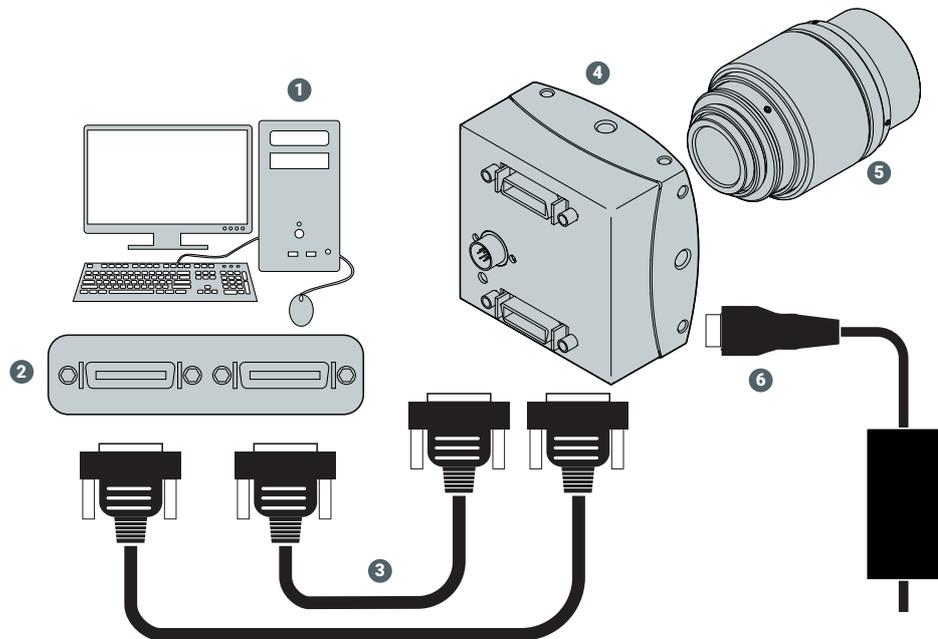
Fig.: 4-3: Connecting camera and image processing system

1. Switch off the image processing system (1).
2. Connect the BASE connector of the camera (4) with the BASE connector of the frame grabber (2).
3. For FULL CL, connect the FULL connector of the camera (4) with the FULL connector of the frame grabber (2).

NOTICE Do not connect a FULL connector with a BASE connector. Otherwise communication between camera and frame grabber cannot be established.

4. Connect the external power supply with the Hirose connector (6) of the camera (4).
5. To connect a STROBE$_{OUT}$ (SYNC), take the pinning into account.
6. Unscrew the dust protection cover of the camera.
7. Mount the lens (5).
8. Connect the power supply (6) with the main supply.
9. Switch on the image processing system (1).
10. Check the LED of the camera to verify that the camera is ready for use.

4.3 Camera settings and profiles

The camera provides several registers. The content of a complete camera register set is called a profile. All values in a register are given in hexadecimal notation (e.g.: 0xff = 255). Depending on the camera type, the non-volatile memory provides space for 9/17 profiles:

- One power-up profile
- Four / eight user profiles
- Four / eight factory profiles

NOTICE The camera does not have to be configured via the serial link to start operation as the power-up profile will deliver all values to bring the camera into a defined operation mode.

In addition, there is one camera profile in the volatile memory. If the camera is powered-up, the power-up profile, which is permanently stored in the non-volatile memory of the camera, will be loaded into the volatile memory.

Any change of a specific register via the serial interface is immediately processed and written into the camera profile. Its content will be lost as soon as power is switched off. If you want to keep your changes, they have to be stored into one of the profiles of the non-volatile memory.

Profile	Video data width [MB/s]	Resolution [Pixel]	Image frequency [fps]	Mode	Pixel clock [MHz]
c	144	1280 x 1024	110	2 x 8	80

The eight **user profiles** are predefined with the following values:

Profile no.	Video data width [MB/s]	Resolution [pixel]	Image frequency [fps]	Mode	CL config.	Pixel clock [MHz]
0	155	640 x 480		2 x 10	Base	80
1	180	1280 x 1024		2 x 10	Base	80
2	124	640 x 480		2 x 8	Base	80
3	144	1280 x 1024		2 x 8	Base	80
4	311	640 x 480		4 x 10	Medium	80
5	370	1280 x 1024		4 x 10	Medium	80
6	490	640 x 480	1594	8 x 8	Full	80
7	570	1280 x 1024		8 x 8	Full	80

INFO   *The user profiles 4 to 7 are available in FULL mode with the cameras CAMMC1362 and CAMMC1363 only. All values can be changed by using a load / write command.*

In contrary to the user profiles, the eight **factory profiles** cannot be changed. They offer the presettings described below and can be loaded with a read command.

Profile no.	Video data width [MB/s]	Resolution [pixel]	Image frequency [fps]	Mode	CL config.	Pixel clock [MHz]
0	155	640 x 480			Base	80
1	180	1280 x 1024			Base	80
2	124	640 x 480		2 x 8	Base	80
3	144	1280 x 1024		2 x 8	Base	80
4	311	640 x 480			Medium	80
5	370	1280 x 1024			Medium	80
6	490	640 x 480	1594	8 x 8	Full	80
7	570	1280 x 1024		8 x 8	Full	80

INFO   *The factory profiles 4 to 7 are only available in FULL mode with the cameras CAMMC1362 and CAMMC1363.*

4.4   Changing the pixel clock

If for example fiber repeaters are used, the cameras pixel clock will have to be decreased or set to a specific value. Otherwise it might not work properly. In order to change the pixel clock, the camera's power-up profile has to be adjusted.

Preparation

1. Download and install the 64 bit version of the MC Control Tool from the website https://mikrotron.de/en/services/downloads.html
2. Close the Director2 application if running and make sure the camera is correctly connected.
3. Changing the pixel clock with the software
4. Start the MC Control Tool and connect the camera (software).
5. Click the MISC tab and select "factory profile 7" from the "Load profile" selection.
6. Click "Load".
7. After the profile is loaded, click the Image Control tab.

Changing the pixel clock

NOTICE   After loading the factory profile, do not change other settings than the ones described below.

1. Switch the tab mode to 10 x 8.
2. Select the pixel clock.
3. Click the MISC tab.
4. Select the "power up profile" from the "Save actual profile" selection.
5. Click "Save". The camera will now start with the selected pixel clock.
6. Close the MC Control Tool.

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.

5 Technical data

5.1 Camera specifications

Resolution	1.3 Megapixel
Frame rate (8 bit)	max. 506 fps
Shutter speed	$2\,\mu s - 1$ s
Shutter time (steps)	$2\,\mu s$
Max. Jitter via CXP Trigger	± 4 ns
Max. Trigger frequency	300 kHz
Quantum efficiency	35% @ 550 nm
Interfaces	CameraLink Base mode: 2 x 8 / 2 x 10 Medium mode: 4 x 10 Full mode: 8 x 8 Extended mode: 10 x 8 Frequency: 80 MHz Data rate max: 625 MByte/s Cable length max: 8 m
Adapter	C- / F-mount
Dimensions [mm] (W x H x L)	63 x 63 x 38 (without lens adapter) 63 x 63 x 41.3 (C-mount) 80 x 80 x 69.8 (F-mount)
Weight [kg]	0.30
Cooling	Fanless
Power supply	8 - 24 V DC @ 5 W (Power adapter supplied)
Operating temperature (camera body)	$+5\,°C ... +50\,°C$
Shock resistance	70 g
Vibration resistance	7 grms
Compliance	CameraLink 2.0

5.2   Sensor specifications

Sensor type	CMOS, monochrome or RGB (Bayer filter)
Image sensor size	17.92 x 14.34 mm
Resolution	1280 x 1024 px
Pixel depth	Cube6, mini1, EoSens GE: 8 bit EoSens CL: 10 bit
Pixel size	14 x 14 µm
Active area	17,92 x 14,34 mm
ROI min.	128 x 2 px
Fill factor	40 %
Light sensitivity	10,16 V/lux-sec @ 550 nm
Full well charge	$30000\ e^-$
Bayer filter pattern	BayerGB8 / BayerGB10 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 Connector pinning

5.3.1 CameraLink connector
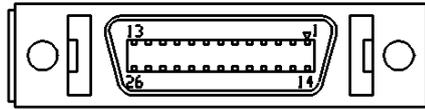
Fig.: 5-1: CameraLink connector, MDR-26

Pin	Signal	Pin	Signal
1	GND	14	GND
2	X0-	15	X0+
3	X1-	16	X1+
4	X2-	17	X2+
5	XCLK-	18	XCLK+
6	X3-	19	X3+
7	SERTC+	20	SERTC-
8	SERTFG-	21	SERTFG+
9	CC1-	22	CC1+
10	CC2+	23	CC2-
11	CC3-	24	CC3+
12	CC4+	25	CC4-
13	GND	26	GND

Table: 5-1: Base CameraLink pinning

Pin	Signal	Pin	Signal
1	GND	14	GND
2	Y0-	15	Y0+
3	Y1-	16	Y1+
4	Y2-	17	Y2+
5	YCLK-	18	YCLK+
6	Y3-	19	Y3+
7	100 Ω Term.	20	100 Ω Term
8	Z0-	21	Z0+
9	Z1-	22	Z1+
10	Z2-	23	Z2+
11	ZCLK-	24	ZCLK+
12	Z3-	25	Z3+
13	GND	26	GND

Table: 5-2: Full CameraLink pinning

5.3.2 Power connector

Before applying power to the camera we strongly recommend to verify the used pins of the power connector, the polarity (+/-) of the leads and the supply voltage.

NOTICE The camera must be used with a supply voltage according to the camera specification. Connecting a lower or higher supply voltage, AC voltage, reversal polarity or using wrong pins of the power connector may damage the camera. If doing so, the warranty will expire immediately.
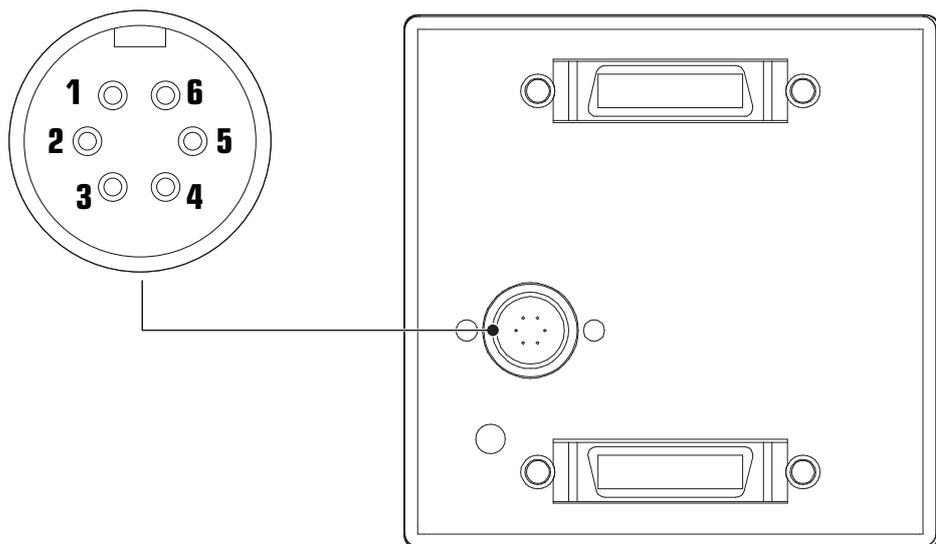

Fig.: 5-2: Power connector

Pin	Signal	Voltage level
1	V_{CC}	8 - 24 V DC
2	V_{CC}	8 - 24 V DC
3	$STROBE_{OUT}$	LVTTL 3.3 V
4	D_{GND}[1]	
5	GND	
6	GND	

Table: 5-3: Power connector pinning

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[1]D_{GND}... digital GND for STRB signal

5.4 Sensor defect specifications

Parameter	Description	Limit
BrightPix	Number of bright pixels allowed in the full window size of 1696 x 1710 pixels. A bright pixel is defined as a pixel that has a 25% higher response than the median response of the dark image.	max. 25 bright pixels allowed; bright pixel defects are stored in a global defect map
Mid Defect Pixel	Number of mid pixels defects allowed in the full window size of 1696 x 1710 pixels. A mid defect pixel is defined as a pixel that has a +/- 25% response from the median response of the gray image.	mid pixel defects are stored in a global defect map
Dark Defects	Number of dark defects allowed in the full window size of 1696 x 1710 pixels. A dark defect pixel is defined as a pixel that has a 25% response lower than the median response of the saturated image.	dark defects are stored in a global defect map
Total Defects	The total number of defect count from the global defect map.	Less than 50 total defect pixels allowed in the full active window
Defective Column	Number of bad columns in the full window size of 1696 x 1710 pixels derived from a half scale image. A bad column is defined as a column that has a response of more than 5% deviation from the median of the surrounding 20 columns.	Zero defective columns allowed
Defective Row	Number of bad rows in the full window size of 1696 x 1710 pixels derived from a half scale image. A bad row is defined as a row that has a response of more than 5% deviation from the median of the surrounding 20 rows.	Zero defective rows allowed
Cluster	Number of clusters allowed in the full window size of 1696 x 1710 pixels. A cluster is defined as a group of pixels greater than 4 neighboring defect pixels (top, bottom or side; not diagonal). Clusters that exceed a maximum of 4 defect pixels are not allowed.	Zero clusters allowed
Test conditions:		
All calculations are performed on the full pixel array of the chip. The Illumination source is a RGB light source and F number=5.4 Integration time for all types of images: 7.8 ms.		

5.5 Camera dimensions

All dimensions in Millimeters.
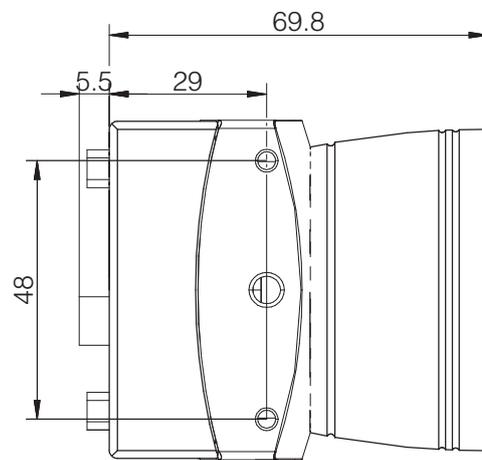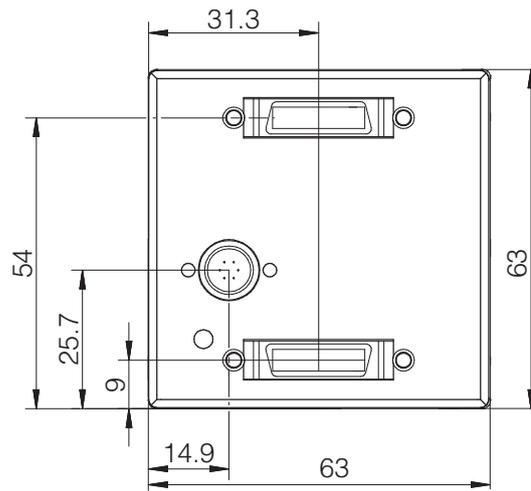
F-mount
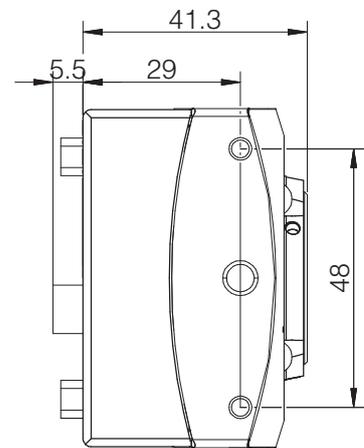
**C-mount**

5.6 Timing diagrams

5.6.1 Free run with electronic shutter

In this mode, the frame rate and exposure time are controlled by the camera. At the strobe output (power connector) is a high signal while the camera exposes a picture.
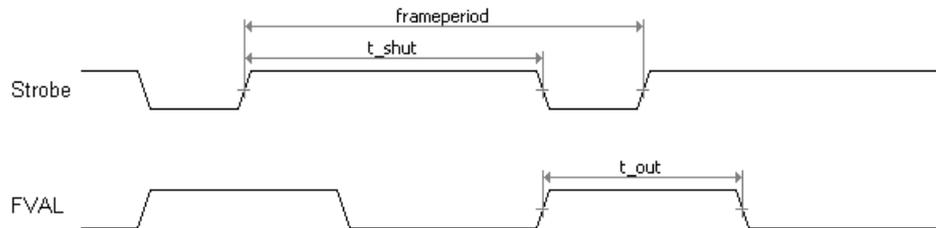

5.6.2 External sync with internal timer

In this mode, the frame rate is controlled by the frame grabber while the exposure time is controlled by the camera.
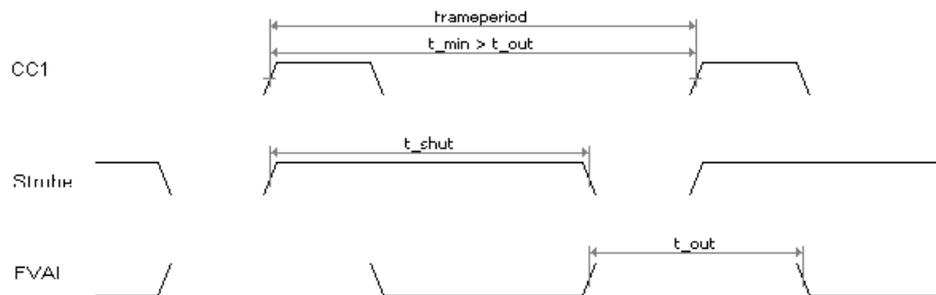
5.6.3 Pulse width mode

In this mode, the frame rate and exposure time are controlled by the frame grabber with the CC1 (CameraLink) camera input. The time t_min (defines the frame rate) must not be smaller than t_out (output time for one frame).
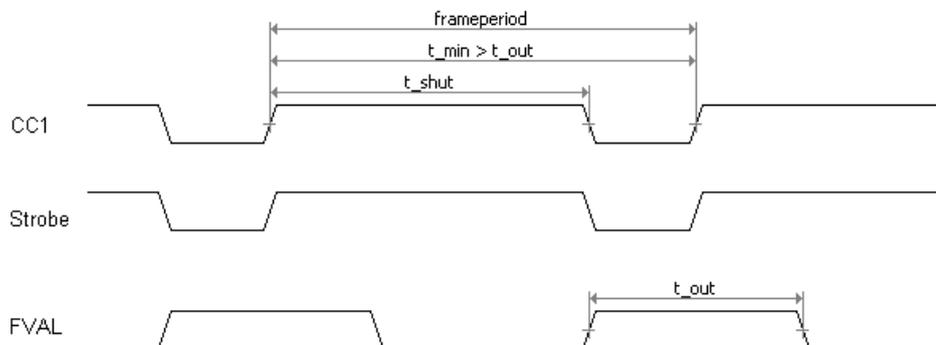
5.7 Spectral response

### 5.7.1 Monochrome and color with UV/IR Cut Filter
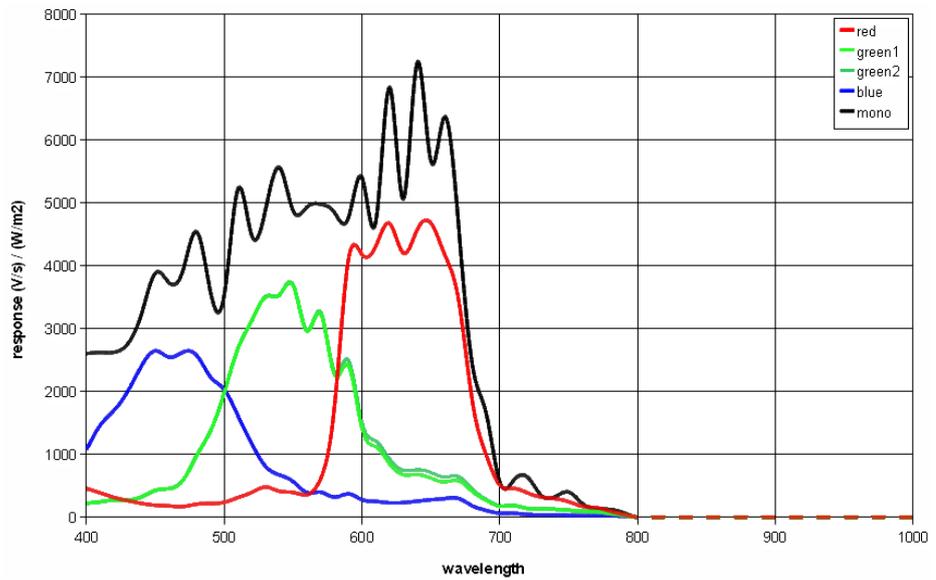
Fig.: 5-3: Quantum Efficiency mono and color with UV/IR Cut Filter

5.7.2 Monochrome and color without UV/IR Cut Filter
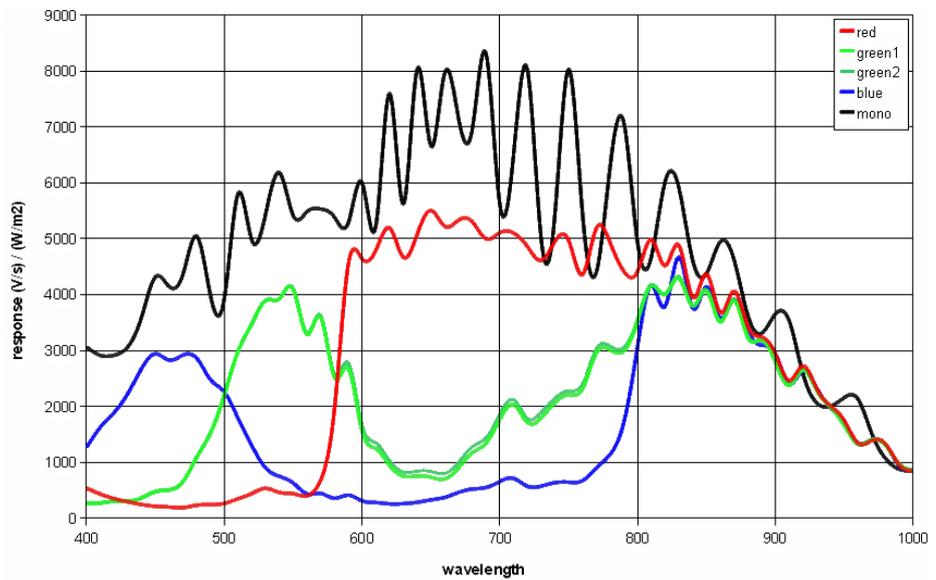
Fig.: 5-4: Quantum Efficiency mono and color without UV/IR Cut Filter

6   Appendix

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

EU Declaration of Conformity
EU-Konformitätserklärung

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We herewith declare under our sole responsibility that the products mentioned below:
Hiermit erklären wir in alleiniger Verantwortung, dass die folgenden Produkte:

Product type: 1.3 Camera Link Camera
Produkt: 1.3 Camera Link Kamera

Models: CAMMC1360, CAMMC1361, CAMMC1362, CAMMC1363, and all variants
Modelle: CAMMC1360, CAMMC1361, CAMMC1362, CAMMC1363 und alle Varianten

are in conformity with the following EU directives: / den folgenden EU-Richtlinien entsprechen:

Title / Titel	EU Directive /-Richtlinie
RoHS Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment RoHS-Richtlinie zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten	2011/65/EU
Approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC Angleichung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit und zur Aufhebung der Richtlinie 89/336/EWG	2014/30/EU

In order to testify the presumption of conformity the following standards were consulted:
Die Konformitätsvermutung wurde nach folgenden Standards überprüft:

Title / Titel	EU Standard / -Norm
Information technology equipment - Immunity characteristics - Limits and methods of measurement Einrichtungen der Informationstechnik – Störfestigkeitseigenschaften - Grenzwerte und Prüfverfahren	EN55024:2011-09
Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test Elektromagnetische Verträglichkeit (EMV) - Teil 4-8: Prüf- und Messverfahren - Prüfung der Störfestigkeit gegen Magnetfelder mit energietechnischen Frequenzen	EN 61000-4-8:2009
Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement Einrichtungen der Informationstechnik – Funkstöreigenschaften - Grenzwerte und Messverfahren	EN55022:2011-12

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