Operating and user manual

N-5A100 CoaXPress

rev1.0

Adimec
Excellence in Imaging

CoaXPress

ABOUT ADIMEC

Adimec designs, manufactures, and markets high performance industrial cameras for equipment manufacturers in:

- Machine Vision
- Healthcare
- Global Security

Our high resolution cameras offer a unique combination of excellence in image quality, speed, and reliability. With optimized functionality for the needs of specific applications, Adimec cameras exceed general purpose.

Adimec is a reliable partner with a focus on establishing long term relationships through a worldwide network of highly qualified engineers.

Adimec aligns its roadmap in close cooperation with industry leaders and monitors the market for the latest technology to continuously provide innovative cameras that enhance our customers' competitiveness. With our capabilities, modular designs, process control and commitment to partnership, we can tailor to the exact solution required in a short time to market and with low risk.

Adimec Advanced Image Systems B.V.
PO Box 7909
5605 SH Eindhoven
The Netherlands
Phone: +31 (0)40 235 3900
E-mail: SalesEU@adimec.com

Adimec Japan
2-10-3-103, Narimasu, Itabashi-Ku
175-0094 Tokyo, Japan
Phone: +81 (3) 5968 8377
Fax: +81 (3) 5968 8388
E-mail: SalesJP@adimec.com

Adimec Electronic Imaging, Inc.
130 New Boston Street, Suite 204
Woburn, MA 01801, USA
Phone: +1 (781) 279 0770
Fax: +1 (781) 279 0571
E-mail: SalesUS@adimec.com

Adimec Asia/Pacific
228 Changi Road
#03-07 ICON @ Changi
Singapore 419741
Phone: +65 6334 1236
Fax: +65 6334 1436
E-mail: SalesAP@adimec.com

TABLE OF CONTENTS

1 INTRODUCTION

1.1 About this manual

This manual describes the N-5A100 CoaXPress camera:

Product name	Product code
N-5A100-Gm/CXP-6.1.1	193101

Practical tips or notes are indicated by the "**NOTE:**" sign.

1.2 List of frequently used abbreviations

Abbreviation	Full expression
CMOS	Complementary Metal Oxide Semiconductor
CRC	Cyclic Redundancy Check
CXP	CoaXPress
ESD	Electro-Static Discharge
GenAPI	GenICam Application Programming Interface
GenICam	Generic Interface for Cameras
GUI	Graphical User Interface
LED	Light Emitting Diode
LUT	Look-up Table
PoCXP	Power over CoaXPress
SFNC	Standard Features Naming Convention
WEEE	Waste Electrical and Electronic Equipment
XML	Extensible Markup Language

1.3 Waste Electrical and Electronic Equipment

With regard to waste electrical and electronic equipment (WEEE), Adimec wishes to follow the Directive 2002/96/EC of the European Parliament and of the Council. The purpose of this Directive is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment.

Separate collection for electronic equipment in your area is recommended in order to minimize the disposal of WEEE as unsorted municipal waste and to achieve a high level of separate collection of WEEE.

1.4 Liability

Adimec prepares this manual with the greatest care. Please inform Adimec of any inaccuracies or omissions. Adimec Advanced Image Systems B.V. cannot be held responsible for any technical or typographical errors and reserves the right to make changes to the product and manuals without prior notice. Adimec Advanced Image Systems B.V. makes no warranty of any kind with regard to the material contained within this document, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Adimec Advanced Image Systems B.V. shall not be liable or responsible for incidental or consequential damages in connection with the furnishing, performance or use of this material.

Layout, composing and editorial staff: Adimec Advanced Image Systems B.V.
Illustrations: Adimec Advanced Image Systems B.V.

All correspondence regarding copyrights and translations should be directed to:

Adimec Advanced Image Systems B.V.
PO Box 7909
5605 SH Eindhoven
The Netherlands
Tel: +31 (40) 2353920
E-mail: SalesEU@adimec.com
URL: www.adimec.com

2 SAFETY PRECAUTIONS

NOTE: A CMOS sensor camera is a sensitive device. Please read the following precautions carefully before continuing unpacking or operating the camera.

NOTE: It is advised to unpack and handle the camera in a clean ESD protected working area.

NOTE: It is advised to read the whole manual before using the camera.

NOTE: Always keep the sensor cap in place as long as no lens is attached.

NOTE: Remove the sensor cap just before the lens is screwed on the camera. It is advised to perform this operation in a clean room or clean bench.

NOTE: Never touch the CMOS sensor surface. The cover glass is easily damaged and the CMOS sensor can be damaged by ESD.

NOTE: In case the camera is used as a subsystem, it is advised to include the text of this chapter in the assembly documents of the main system.

2.1 Cleaning of the CMOS sensor

The cleaning of a CMOS sensor is a difficult task with a high risk on permanent damage to the camera.

NOTE: It is advised to prevent cleaning the CMOS sensor as much as possible.

NOTE: Damage of the CMOS sensor due to scratches on the cover glass or ESD is not covered by warranty!

All cameras are checked for cleanliness in our factory before shipment.

Proper handling instructions during system assembly can prevent the CMOS sensor from getting contaminated.

Should cleaning of the CMOS sensor be necessary, please refer to Appendix A: CMOS Sensor cleaning instructions.

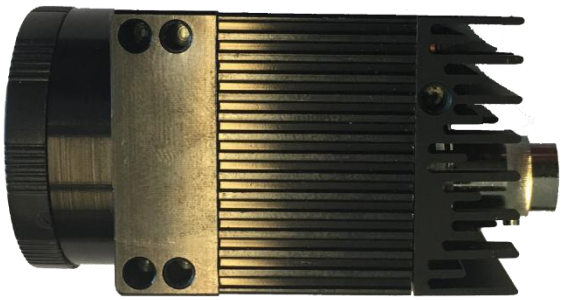
2.2 Camera housing

Thermal interfacing
The act ual housing temperature achieved depends on the thermal configuration of the camera and the system in the end-user application. Provisions as to guarantee maximum housing temperature are therefore a responsibility of the end-user.

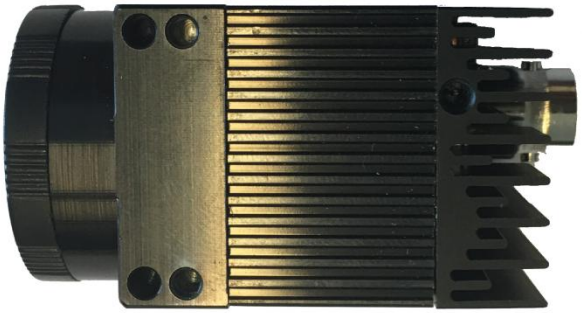
NOTE: The housing temperature should not exceed +55° Celcius.

NOTE: Create airflow over the camera e.g. by using a fan.

NOTE: Mount the thermal interface of the camera on a substantial (preferably metal) body that can act as a heat sink. The thermal interface of the camera is the top and bottom side of the camera housing as shown in the below figure.



Topview



Bottomview

Cleaning

The camera should NEVER be immersed in water or any other fluid. For cleaning, only use a light moist tissue.

Connector

Take care of the connector during handling of the camera. The connector should not be damaged. Prevent the entry of foreign objects or dirt into the connector, as this will result in unreliable operation or damage.

Mounting screws

M3 screws should be used with a maximum screw depth of 5 mm. The recommended tightening torque is 108 cNm. Take notice of the maximum length of the screws that may be used for mounting the camera. Using screws too long can cause damage to the camera.

2.3 Camera repair and Warranty

Repair, modification and replacement of parts shall be done only by Adimec to maintain compliance with the directive 89/336/EEC electromagnetic compatibility, directive 72/23/EEC low voltage directive and the international standards.

For repair and warranty claims contact your local dealer or the business offices in your region. The minimum information we need to know for a repair request or warranty claim are the camera serial number and a detailed failure description.

In case the camera needs to be returned to investigate the repair options or grant your warranty claim you will receive a Return Material Authorization (RMA) number. Please use this RMA-number to ship the camera to Adimec. Cameras without RMA number will be rejected.

Once the camera is arrived at Adimec the camera will be investigated to proof possible repair or grant your warranty claim. In case of repair the repair costs will be quoted. After your approval of the repair cost camera will be repaired and returned.

3 QUICK START GUIDE

The procedure to obtain the first images from the camera depends to some extend on the frame grabber brand or type you use.

A general quick start guide is therefore difficult to provide.

NOTE: The Adimec support department has a couple of frame grabbers available. Inform at support@adimec.com which frame grabber specific quick install guides are available or can be created.

The general steps to collect your first images are:

1. Mount a lens on the camera.
2. Connect the CXP cable to the camera.
3. Connect the CXP cable to the frame grabber.
4. Start the PC.
5. Go through the frame grabber specific procedure to configure your frame grabber. Some frame grabbers will automatically identify the camera while for others the right configuration file has to be loaded.
6. Use the capture software supplied by your frame grabber manufacturer to start acquiring images.

For a correct configuration in step 5, the factory default settings might be required. The relevant parameters are listed in Table 3-1.

Table 3-1: Factory default settings for the N-5A100 CoaXPress camera.

Parameter	Value
Revision	1.1.1
ConnectionConfig	CXP3_X1
ConnectionConfigDefault	CXP3_X1
PixelFormat	Mono8
AcquisitionMode	Continuous
ExposureMode	Timed

NOTE: Discovery always occurs on CXP3_X1. Most frame grabbers will change the ConnectionConfig feature automatically to the ConnectionConfigDefault value after discovery.

4 INTERFACES

In this chapter the mechanical, electrical, and optical interface are described in detail.

4.1 Mechanical interface

For the mechanical interface please refer to the mechanical outline drawing.

4.2 Electrical interfaces

Only one electrical interface, CoaXPress, is available. The interface connector can be found on the back side of the camera, see Figure 4-1. The type of the connector is explained in Table 4-1.

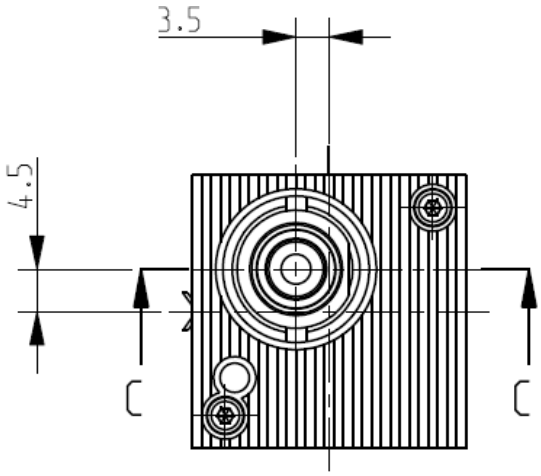


Figure 4-1: Electrical interface, a BNC connector on the back of the camera.

Table 4-1: A description of the connector on the back side of the camera.

Connector	*Description*	*Connector type (camera)*	*Mating connector (cable)*
1	CXP connection 0	BNC	BNC

4.2.1 Power and CoaXPress connector

The CoaXPress interface supports communication in two directions. Power, control data and trigger signals are transferred from the frame grabber to the camera and video data is transferred from the camera to the frame grabber. The function of the connector is listed in Table 4-2. The CXP configurations that are supported by the camera are listed in Table 4-3.

Table 4-2: Functionality per CXP connection

CXP connector	*Interface functions*
0	Video, power, control, triggering (Master connection)

Table 4-3: The supported CXP configurations.

Compliance Labeling	*Max Bit Rate per Coax*	*Nr. connected Cables*
CXP-3 BNC 1	3.125 Gb/s	1
CXP-5 BNC 1	5.000 Gb/s	1
CXP-6 BNC 1	6.250 Gb/s	1

NOTE: The CXP connector 0 supplies the camera with power according to the Power over CoaXPress standard (PoCXP, max 13W).

For a complete description of the CoaXPress interface standard please refer to the CoaXPress specification that can be downloaded from http://jiia.org/en.

4.2.2 CoaXPress status LEDs

Next to the CoaXPress connector a multi-color LED status indicator is present. The meaning for each LED indication is shown in Table 4-4, while Table 4-5 lists the frequencies of the fast and slow flashes.

Table 4-4: The meaning of the LED status indicator explained.

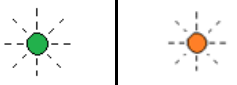
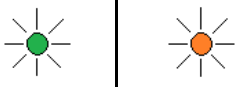
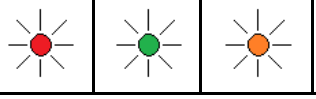
LED indication	*Camera / interface status*
 Off	No power
 Solid orange	System booting
 Slow pulse orange	Device / Host connected, waiting for event (e.g. trigger, exposure pulse)
 500 ms red pulse. In case of multiple errors, there shall be at least two green fast flash pulses before the next error is indicated.	Error during data transfer (e.g. CRC error, single bit error detected)
 Fast flash red	System error (e.g. internal error)
 Solid green	Device / Host connected, but no data being transferred
 Fast flash green	Device / Host connected, data being transferred
 Fast flash alternate green / orange. Shown for a minimum of 1 s even if the connection detection is faster	Connection detection in progress, PoCXP active
 Slow flash alternate green / orange	Connection test packets being sent
 Slow flash alternate red / green / orange	Compliance test mode enabled

Table 4-5: LED indicator flash frequency

Flash indication	*Frequency*
Fast flash	12.5 Hz
Slow flash	0.5 Hz
Slow pulse	1 Hz
Solid	0 Hz (continuous)

4.2.3 Programming over CoaXPress

The CoaXPress interface can be used for firmware uploads to the camera.

The availability of this feature is dependent on the frame grabber manufacturer and the SDK version that is being used. Please inform at support@adimec.com if this feature is available for your system configuration.

4.2.4 Grounding scheme

On all cameras, the mechanical ground is interconnected with the power ground.

4.3 Optical interface

The N-5A100 camera is supplied with a fixed C-mount lens mount.

5 TIMING

5.1 Frame rate

The following camera features could influence the maximum frame rate:

Camera feature	Description	CXP group
ConnectionConfig	The number of CXP links and the CXP link speed	BootstrapCoaXPress
StreamPacketSizeMax	The packet size in bytes	BootstrapCoaXPress
PixelFormat	The pixel format in bit per pixel	ImageFormatControl
Width and Height	The region of interest	ImageFormatControl
BinningHorizontal & BinningVertical	The number of binned pixels in the horizontal and vertical direction	ImageFormatControl
InterfaceUtilization	The interface utilization factor in percent	AcquisitionControl

See the below table for the max frame rate in frequently used configurations.

For custom regions of interest or other settings, please use Adimec's dedicated frame rate calculators which can be made available to you by our business offices or support department.

Table 5-1: Frame rates for frequently occuring configurations. In all configurations the StreamPacketSizeMax=16384, and the InterfaceUtilization=100.

Camera ↓	ConnectionConfig	Width	Height	Frame rate (fps)	Frame rate (fps)
PixelFormat →				Mono8	Mono10
N-5A100	CXP3 X1	2592	2048	56	45
N-5A100	CXP3 X1	2048	2048	71	57
N-5A100	CXP5 X1	2592	2048	90	72
N-5A100	CXP5 X1	2048	2048	114	91
N-5A100	CXP6 X1	2592	2048	105	90
N-5A100	CXP6 X1	2048	2048	133	114

5.2 Operational timing

Table 5-2: An overview of the frame overhead time (FOT). During the light sensitive FOT the camera is still integrating and events happening in this interval might influence the current frame.

Camera type	ReadOutMode	Light sensitive FOT [µs]	Total FOT [µs]
N-5A100	AreaScan	40 (FOT1)	58 (FOT1+FOT2)

NOTE: For externally controlled modes the camera imposes timing restrictions on the externally applied control signals (e.g. maximum frame rate). If these restrictions are violated the camera may skip images. It is the systems responsibility to adhere to the imposed timing restrictions.

5.2.1 Timed mode

In Timed mode, the frame period and integration time are user configurable with the camera features AcquisitionFramePeriod and ExposureTime.

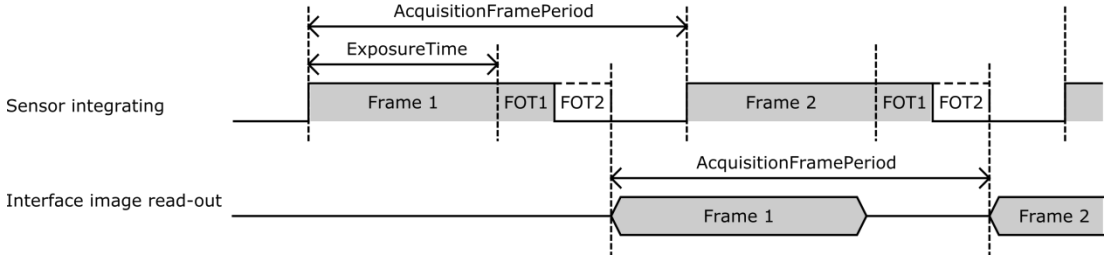


Figure 5-1: Timing diagram for the Timed mode. FOT1 and FOT2 are the light sensitive and light insensitve frame overhead time.

5.2.2 Trigger width mode

In TriggerWidth mode, the start of acquisition and the integration time are determined by an external pulse.

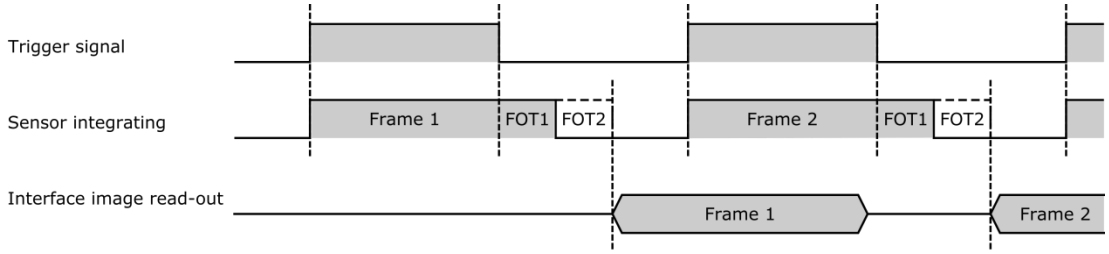


Figure 5-2: Timing diagram for ExposureMode "TriggerWidth". FOT1 and FOT2 are the light sensitive and light insensitve frame overhead time.

5.2.3 Sync Control mode

In SyncControl mode the start of acquisition is determined by an external pulse. The integration time equals the frame period. This means that with each trigger event integration stops and after the FOT time has passed, a new frame integration will start directly.

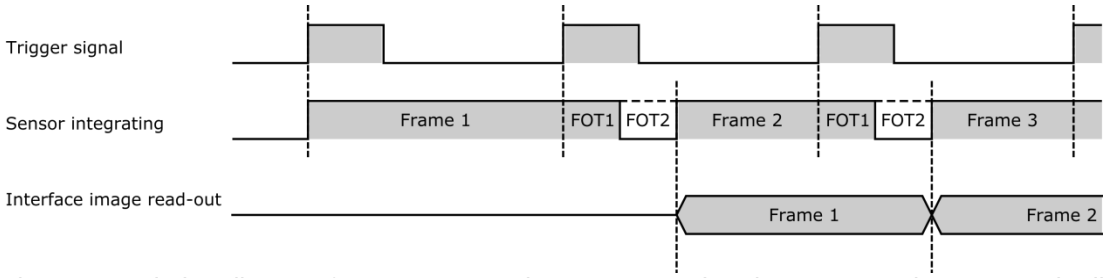


Figure 5-3: Timing diagram for ExposureMode "SyncControlMode". FOT1 and FOT2 are the light sensitive and light insensitive frame overhead time.

5.2.4 Timed trigger control mode

In TimedTriggerControl mode, the start of acquisition is determined by an external trigger. The integration time is user configurable with the ExposureTime camera feature.

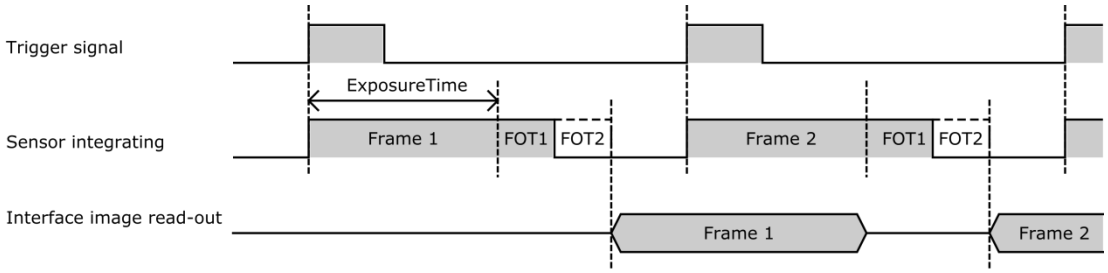


Figure 5-3: Timing diagram for ExposureMode "TimedTriggerControl". FOT1 and FOT2 are the light sensitive and light insensitive frame overhead time.

5.2.5 Over triggering and frame suppress

When external triggers are used to control the camera, it might occur that a new image is ready to be read out while the sensor is still processing the previous image. Such a situation is known as over triggering.

A frame that has to wait before being read out due to a previous frame in the processing line will have a longer integration time then requested. Therefore this frame will be suppressed at the camera interface output. Furthermore while a frame is being suppressed, no new triggers will be accepted. This behavior is described in Figure 5-4.

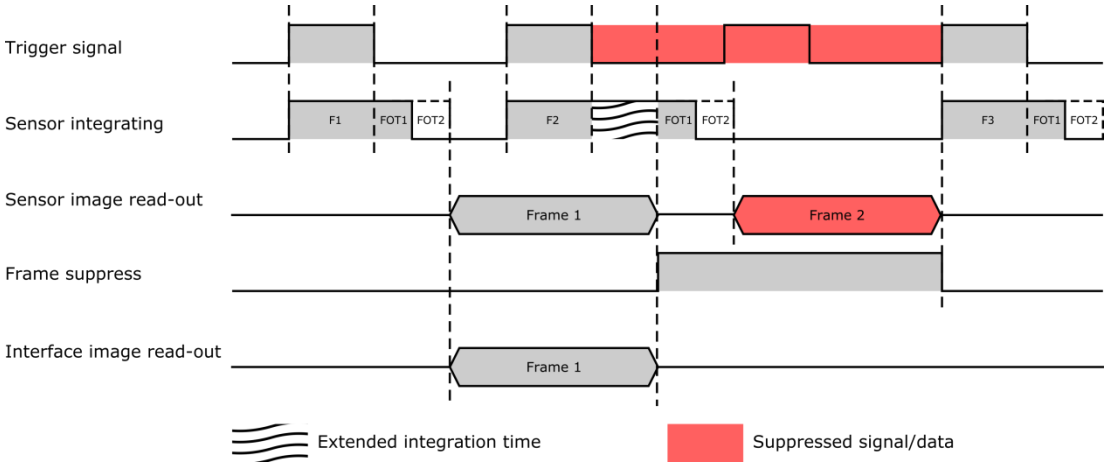


Figure 5-4: Over triggering and frame/trigger suppression. FOT1 and FOT2 are the light sensitive and light insensitive frame overhead time.

6 CONTROL OF THE CAMERA

Access to camera functions and data is provided through the CoaXPress (CXP) protocol. The CoaXPress interface is GenICam compliant.

GenICam compliant means that an XML is stored in the camera that is used to translate the camera internal register addresses to the user friendly feature nomenclature as defined by the Standard Features Naming Convention, SFNC. Basically GenICam is designed to bridge the camera specific register addresses with a camera and manufacturer independent user interface. The SFNC feature names should be used to operate the camera.

How to address the SFNC feature names depends on your frame grabber. With CoaXPress frame grabbers a GenICam Application Programming Interface (GenAPI) is provided. This is a software layer that reads the XML from the camera and builds a graphical user interface (GUI) to control the camera. The GUI is often refered to as the GenICam (feature) Browser.

Next to the GUI often a scripting language will be available in which you can use the SFNC naming to program the camera and frame grabber according to your desired settings.

To illustrate the workflow of CoaXPress we will describe below what will happen if you set the pixel format to 10 bit in a monochrome camera.

When using the GUI:

1. Start the GenICam Browser, The browser will automatically load the XML from the camera and basically builds a user interface.
2. In the GenICam browser search for the feature called PixelFormat.
3. Change this feature to “Mono10”. Often this can be done by selecting “Mono10” from a drop down list.

When using a scripting language

1. Look up the syntax and language used by your frame grabber.
2. By using the frame grabber syntax and language set the feature PixelFormat to Mono10.
3. Execute the script.

In both cases, for the GUI and for the scripting language, on the background the GenAPI uses the XML to link the feature name PixelFormat to the camera register address 0x00008144. Furthermore it links the feature value name “Mono10” to a value of 0x01100003. Using the CoaXPress interface, the API will then write a value of 0x01100003 to the camera register 0x00008144.

Note: The above mentioned register addresses and values are only for illustrational purposes. The exact addresses in your camera might be different.

The above described communication protocol is schematically shown in Figure 6-1.

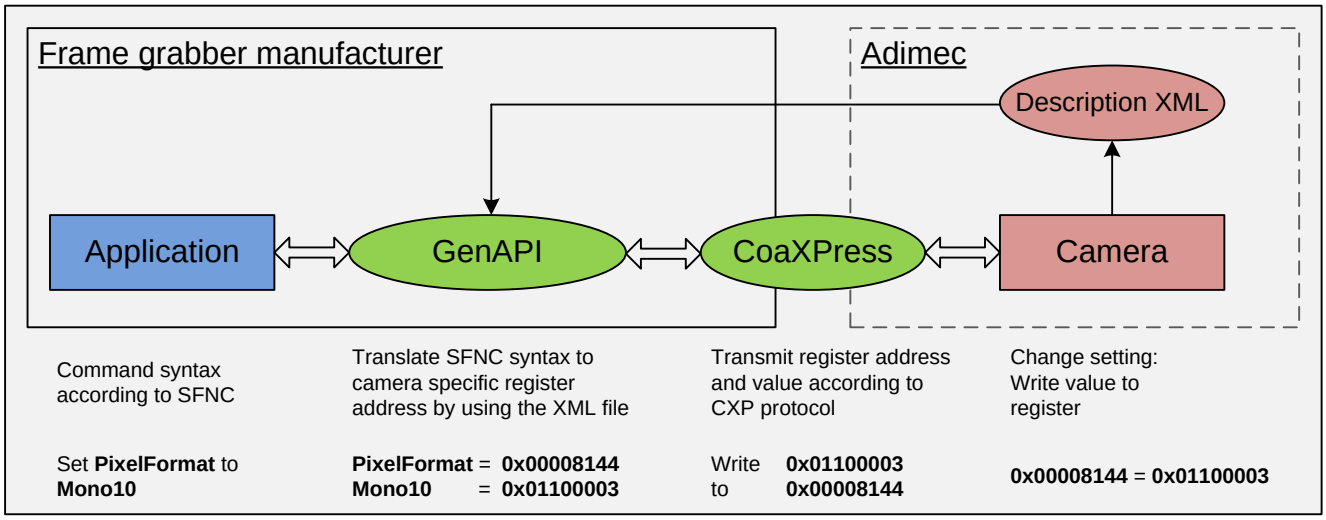


Figure 6-1: Schematic view of the CoaXPress communication protocol.

7 CAMERA FEATURES

In section one of this Chapter, the features within the camera are visualized in a functional diagram and a very brief description is given. In the successive sections each feature is explained more extensively by describing and explaining the available features. The sections are sorted along the groups of features as present in the GenICam interface.

7.1 Functional diagram

The diagram in Figure 7-1 shows the main features of the camera. It gives insight in the order in which the features are executed and thus how features might influence each other. A short description of the features is given in Table 7-1.

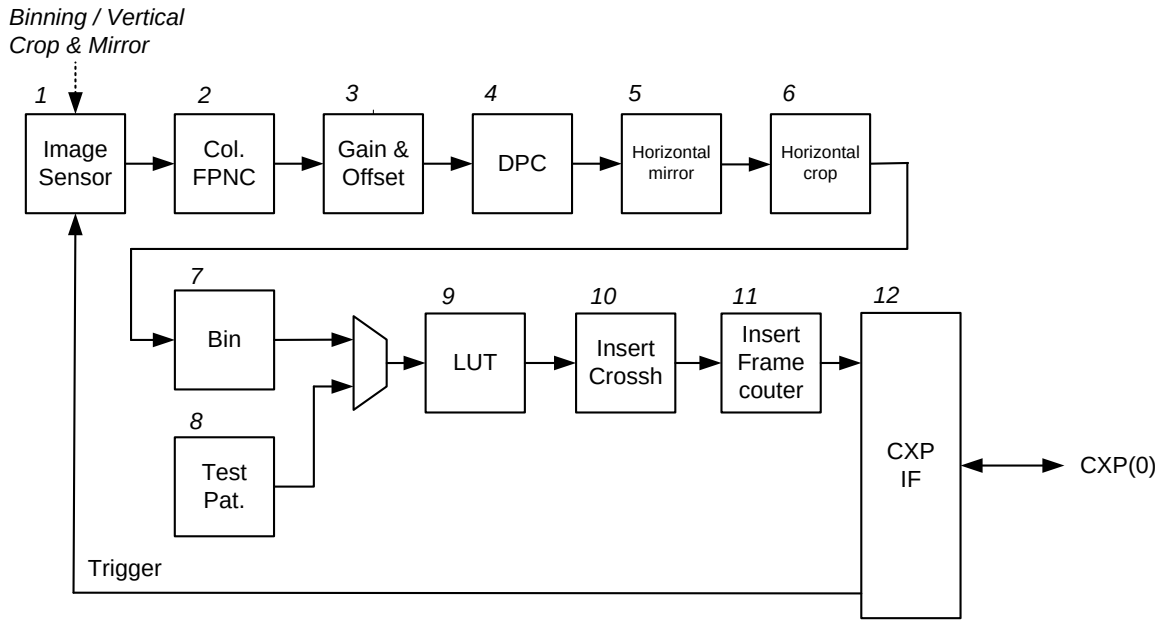


Figure 7-1: Block diagram of the camera describing the variety of available functions.

Table 7-1: Description of the different camera building blocks shown in Figure 7-1.

Block	Name	Description
1	Image Sensor	Python5k Mono. The sensor has build-in functions to realize 2x2 binning and vertical crop & mirror.
2	Column Fixed Pattern Noise Correction	Column-wise correction. Applies a per column gain and offset correction to reduce column-wise Fixed Pattern Noise.
3	Gain & Offset	The applied offset is not amplified by the gain.
4	Defect Pixel Correction	Defect Pixel Correction replaces pixels at programmed locations by a value interpolated from non-defect neighboring pixels.
5	Horizontal mirror	With this feature the image can be reversed in the horizontal direction. Together with the vertical mirror feature of the sensor it is thus possible to reverse the image in the X and Y direction.
6	Horizontal crop	With this feature pixels can be removed per row. Together with the vertical crop feature in the image sensor this feature is part of the region of interest functionality.
7	Binning	Small groups of pixels can be summed or averaged. Together with the sensor binning function 4x4 binning can be applied.
8	Test Pattern	When enabled, the test pattern image replaces the sensor image.
9	Look Up Table (LUT)	Programmable look-up table. The image grey levels are corrected according to the LUT.
10	Insert Crosshair	A configurable crosshair structure can be enabled. When enabled, the pixels of the crosshair structure will be set to maximum pixel value.
11	Insert Frame counter	Insert frame counter as overlay in the image.
12	CoaXPress Interface	Configurable to operate with 1 connection only and a bit rate of 3.125 Gbps, 5.000 Gbps, or 6.250 Gbps.

7.2 Feature description structure

To clearly explain the camera features the structure as described below is used throughout this chapter.

Section headings indicate the group to which the features belong.
Subsection headings indicate the **feature name** in bold and the **accessibility** and **visibility** in normal font.

For example: **7.5.2 Width** | RW | B |

The possible accessibility and visibility values are given in respectively Table 7-2 and Table 7-3.

Table 7-2: Possible values for the accessibility level of a feature.

Accessibility level	Abbreviation	Description
Read Only	RO	Features that only present values to the user
Write Only	WO	Features that can only be written and do not give any feedback to the user
Read and Write	RW	Features that both, provide information as well as that they can be used to control the camera.

Table 7-3: Possible values for the visibility level of a feature.

Visibility level	Abbreviation	Description
Beginner	B	Features that should be visible for all users via the GUI and API. The number of features with “beginner” visibility is limited to all basic features of the devices so the GUI display is well-arranged and is easy to use.
Expert	E	Features that require a more in-depth knowledge of the camera functionality. This is the visibility level for all advanced features in the cameras.
Guru	G	Advanced features that might bring the cameras into a state where it will not work properly anymore if it is set incorrectly for the cameras current mode of operation. The guru parameters mainly have use in debugging.

The features will mostly be described in a two column table in which the left column gives the possible input/output values and the right column a short description of the feature or specific feature value. This general presentation structure is visualized in below table.

Feature input/output value	Feature or feature value description

In some exceptional cases, to improve the readability of the manual a deviation from this lay-out might be used. For example, multiple read only features are sometimes listed in a single table.

7.3 Bootstrap CoaXPress

The Bootstrap CoaXPress group contains features that are required for device discovery and basic configuration.

7.3.1 User Read Only Bootstrap features

Name	Visibility	Description
Standard	B	A Unique Identification of the CoaXPress Standard.
Revision	B	Revision of the CoaXPress specification implemented.
XmlManifestSize	G	The number of XML manifests available.
XmlManifestSelector	G	Selects the XML manifest entry.
XmlVersion	G	Indicates the version of the XML file referenced by the XmlManifestSelector.
XmlSchemeVersion	G	Indicates the scheme version of the XML file referenced by the XmlManifestSelector.
XmlUrlAddress	G	Indicates the start of the URL string referenced by the XmlManifestSelector.
Iidc2Address	G	If the Device supports the IIDC2 protocol, then this feature shall provide the address of the start of the IIDC2 register space.
DeviceConnectionID	G	Provides the ID of the Device connection via which this register is read.
ControlPacketSizeMax	G	Provides the maximum control packet data size. The size is defined in bytes, and shall be a multiple of 4 bytes.
ConnectionConfigDefault	B	Holds a valid default mode combination of Device connection speed and number of active connections.
HsUpconnection	G	Indicates the Device support of the optional high speed upconnection.
TestErrorCount	G	Current connection error count selected by TestErrorCountSelector.
TestPacketCountTx	G	Current connection test transmit packet count selected by TestErrorCountSelector.
TestPacketCountRx	G	Current connection test receive packet count selected by TestErrorCountSelector.

Name	Visibility	Description
WidthAddress	G	This feature provides the address in the manufacturer-specific register space of the feature with the corresponding name.
HeightAddress	G	
AcquisitionModeAddress	G	
AcquisitionStartAddress	G	
AcquisitionStopAddress	G	
PixelFormatAddress	G	
DeviceTapGeometryAddress	G	
Image1StreamIDAddress	G	

7.3.2 Beginner writable Bootstrap features

7.3.2.1 **ConnectionConfig** | RW | B |

With ConnectionConfig the connection speed and number of active connections is configured.

NOTE: Acquisition must be stopped before changing the ConnectionConfig feature.

CXP3_X1	1 connection at 3.125 Gb/s
CXP5_X1	1 connection at 5.000 Gb/s
CXP6_X1	1 connection at 6.250 Gb/s

7.3.3 Guru writable Bootstrap features

Features with a “Guru” visibility level control advanced camera settings. If these features are used incorrectly the camera might not work properly anymore. Most of the time guru parameters mainly have use in debugging.

Name	Access	Description
ConnectionReset	RW	Write “1” to reset all connections of the Device.
MasterHostConnectionID	RW	Holds the Host Connection ID of the Host connection connected to the Device Master connection.
StreamPacketSizeMax	RW	Provide the maximum stream packet data size the Host can accept. The size is defined in bytes, and shall be a multiple of 4 bytes. The default value is always “0”. This value is set by the Host and not the Device.
TestMode	RW	Enables test packet transmission from Device to Host.
TestErrorCountSelector	RW	Selects the TestErrorCount register. Selection shall be a valid Device Connection ID.
ElectricalCompliancyTest	RW	Supports the formal electrical compliancy testing of the Device.

7.4 Device Control

The device control features give basic information about the device. It contains features related with the identification and status of the device.

7.4.1 User Read Only Device Control features

Name	Visibility	Description
DeviceVendorName	B	Name of the manufacturer of the device.
DeviceModelName	B	Model of the device.
DeviceManufacturerInfo	B	Manufacturer information about the device.
DeviceVersion	B	Version of the device
DeviceFirmwareVersion	B	Version of the firmware in the device.
DeviceSerialNumber	E	Device serial number
DeviceTemperature	E	Returns the temperature of the FPGA.

7.4.2 **BuiltInTest** | RO | E |

BuiltInTest can give multiple error messages at the same time. The error values are then added together. To decode which error has occurred start with the largest value that fits into the returned BuiltInTest value and then subtract it. After subtracting again search for the largest number that fits into the remaining value. Continue until after subtracting the value equals zero.

Example:

BuiltInTest 2084
2048 – Camera configuration corrupt

Remainder 0036
0032 – User defect pixel data corrupt

Remainder 0004
0004 – Factory settings corrupt

Value	Failure condition	When tested
1	Primary FPGA not booted	At start-up
2	Flash not recognized	At start-up
4	Factory settings corrupt	When data is read from flash
8	User settings corrupt	When data is read from flash
16	Factory defect pixel data corrupt	When data is read from flash
32	User defect pixel data corrupt	When data is read from flash
64	Calibration corrupt	When data is read from flash

Value	Failure condition	When tested
2048	Camera configuration corrupt	At start-up
4096	Look-Up Table corrupt	When data is read from flash
8192	Device Names corrupt	At start-up
16384	Sensor data alignment failed	Continuous; actual status is updated on a 1 sec. interval
32768	Band table corrupt	When data is read from flash
262144	XML Corrupt	When data is read from flash

7.4.3 **DeviceUserID** | RW | B |

String	User-programmable device identifier. Up to 16 Characters can be used. To save the string to Non-volatile memory, use the DeviceInfoSave command.

7.4.4 **DeviceInfoSave** | WO | B |

Command	Save the DeviceUserID string to the non-volatile memory of the device.

7.4.5 **DeviceIndicatorMode** | RW | E |

Inactive	Turn off the status indicator LEDs
Active	Turn on the status indicator LEDs
ErrorStatus	Let the LEDs show the error status of the camera

7.5 Image Format Control

The features in the image format control group influence the image format. You can set here a region of interest (ROI) and the pixel format for example.

7.5.1 User Read Only Image Format Control features

Name	Visibility	Description
SensorWidth	E	Effective width of the sensor in pixels.
SensorHeight	E	Effective height of the sensor in pixels.
WidthMax	E	Maximum width (in pixels) of the image. This feature takes into account if binning is active or not.
HeightMax	E	Maximum height (in pixels) of the image. This feature takes into account if binning is active or not.
DeviceTapGeometry	E	Tap geometry to be used by streams of the Device.
Image1StreamID	G	Identification of stream 1.

7.5.2 **Width** | RW | B |

32 to 2592, Increment 16:	Set the width of the image in pixels

This feature is automatically updated if any of the following features is changed:
BinningHorizontal

7.5.3 **Height** | RW | B |

2 to 2048, Increment: 2	Set the height of the image in pixels

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandEnable, BandRemove, BandLoad, BandSelector, BinningVertical

7.5.4 **OffsetX** | RW | B |

0 to 2584, Increment: 8	Set the horizontal offset from the origin to the region of interest in pixels.

This feature is automatically updated if any of the following features is changed:
BinningHorizontal

7.5.5 **OffsetY** | RW | B |

0 to 2046, Increment: 2	Set the horizontal offset from the origin to the region of interest in pixels.

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandEnable, BandRemove, BandLoad, BinningVertical

7.5.6 **ReverseX** | RW | B |

True	The output image is flipped horizontally.
False	The output image is not flipped.

7.5.7 **ReverseY** | RW | B |

True	The output image is flipped vertically.
False	The output image is not flipped.

7.5.8 **BinningHorizontal |** RW **|** E |

1, 2 or 4,	Set the number of horizontal pixels to combine together. This reduces the horizontal width of the image. A value of 1 indicates that no horizontal binning is performed by the camera.

The maximum frame rate of the camera will increase if horizontal binning is activated and the CXP-interface is the limiting factor.

The maximum frame rate of the camera will also increase if horizontal sensor binning is activated and the sensor interface is the limiting factor.

NOTE: For 2x binning, the binning is performed on the sensor. For 4x binning , the binning is a combination of 2x on sensor and 2x digital binning.

7.5.9 BinningVertical | RW | E |

1, 2 or 4,	Set the number of vertical pixels to combine together. This reduces the vertical height of the image. A value of 1 indicates that no vertical binning is performed by the camera.

NOTE: For 2x binning, the binning is performed on the sensor. For 4x binning , the binning is a combination of 2x on sensor and 2x digital binning.

NOTE: When vertical sensor binning is enabled, the integration time and readout time should not overlap. The sensor integration cannot start before the frame readout is completed. If the integration time starts within the frame readout, the sensor will stop working until the camera is rebooted.

7.5.10 BinningMode | RW | E |

Sum	Set the binned pixel signal level to the sum of the signal levels of the individual pixels of which it is composed.
Average	Set the binned pixel signal level to the average of the signal levels of the individual pixels of which it is composed.

By using binning you can reduce the noise due to averaging. It is also possible to increase the frame rate.

Table 7-4: Frame rates for frequently occuring configurations. In all configurations the ConnectionConfig=CXP6_X1, PixelFormat=Mono8, StreamPacketSizeMax=16384, and the InterfaceUtilization=100. Width and height refer to the width and height without binning.

Camera ↓	**Width**	**Height**	**Frame rate (fps)**	**Frame rate (fps)**	**Frame rate (fps)**
Binning →			1x1	2x2	4x4
N-5A100	2592	2048	105	211	211
N-5A100	2048	2048	133	235	235

7.5.11 PixelFormat | RW | B |

Mono8	Set the pixel format for acquisition to 8 bit mono.
Mono10	Set the pixel format for acquisition to 10 bit mono.

NOTE: PixelFormat can only be changed if there is no acquisition active.

7.5.12 TestImageSelector | RW | B |

Off	No test pattern is shown
AdimecTestPattern	Specific Adimec test pattern with grey bars and contour lines, see Figure 7-2.
UniformVideoLevel	Uniform test pattern to verify corrections
DiagonalPattern	The diagonal test pattern is defined by $\mathbf{V_{x,y} = (x + y)\ modulo\ 2^N}$ where N represents the bit depth and $V_{x,y}$ the digital pixel value at pixel (x,y). See Figure 7-3 for the resulting pattern.
DiagonalPatternRunning	This running test pattern is different from the diagonal test pattern by the addition of the frame counter in the defining formula: $\mathbf{V_{x,y} = (x + y + frame\ counter)\ modulo\ 2^N}$.

The camera can generate test patterns in the mode the camera is currently working. The camera will continue to work in the selected mode, but instead of the usual image an artificial image is displayed.

NOTE: The test patterns are amplified with the set gain.

NOTE: The test image is resized when a different width and/or height is set.

7.5.13 TestImageVideoLevel | RW | B |

0 to 1023, increment: 1	Set the video level for the UniformVideoLevel test image. The video level is always in 10 bit.

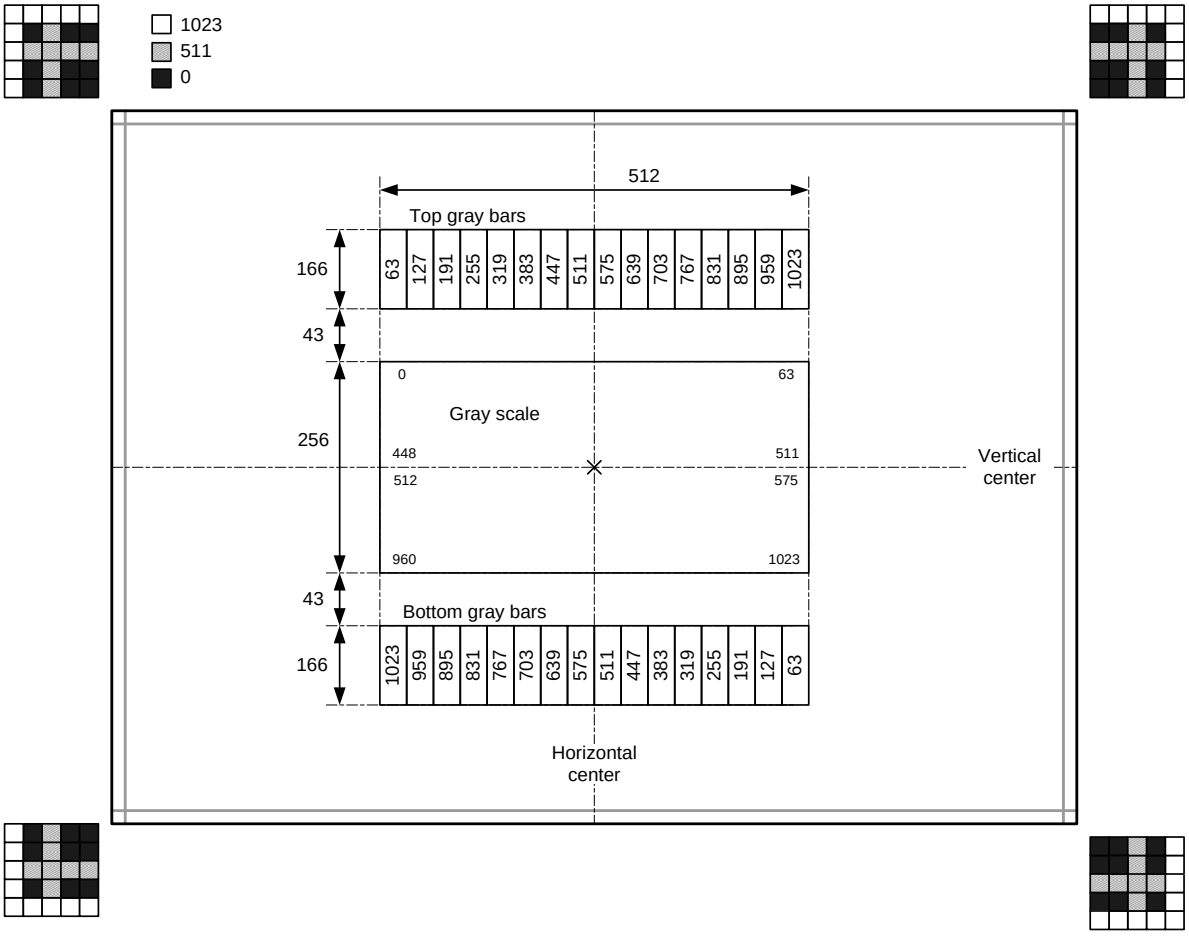


Figure 7-2: The Adimec Test Pattern in a 10 bit pixel resolution, black is 0 and white is 1023. The test image is defined in 10 bit. When an 8 bit pixel format is selected the lowest 2 bits are discarded. When the region of interest gets too small parts of the test pattern will disappear. The border of the test pattern will always be visible.

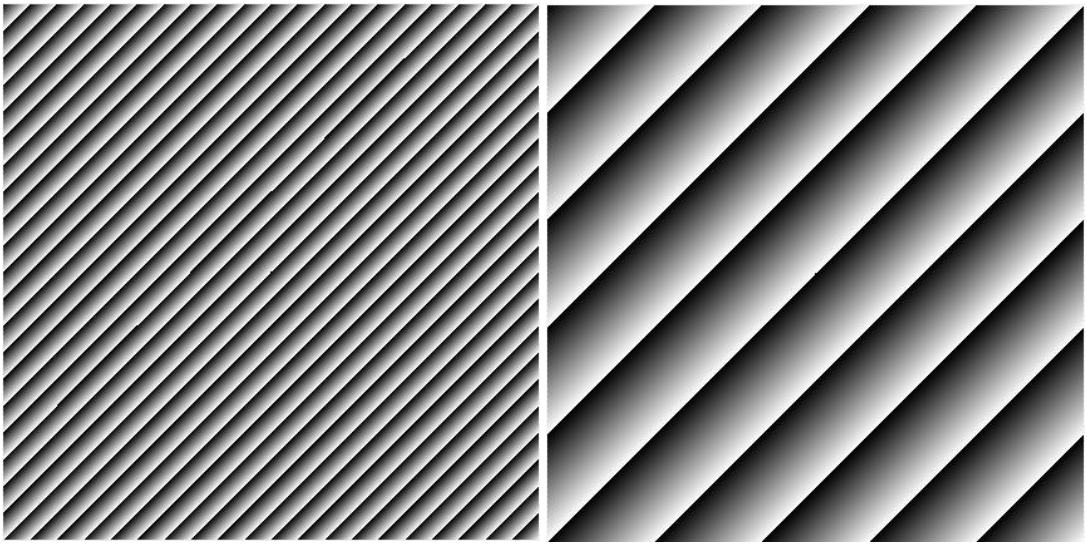


Figure 7-3: Diagonal test pattern in 8 bit (left image) and 10 bit (right image).

7.5.14 **FrameCounter** | RO | B |

Integer	Provides the current frame count

This feature is automatically updated if any of the following features is changed:
FrameCounterReset

7.5.15 **FrameCounterReset** | WO | B |

Command	Reset the frame counter

7.5.16 **FrameCounterOverlay** | RW | E |

True	Add a frame counter overlay to the image sent by the device. The frame counter is displayed in the first 4 bytes of the image, mapped in the 8 most significant bits.
False	No frame counter will be added to the images.

7.5.17 **CrosshairOverlay** | RW | E |

True	Add a crosshair overlay to the image sent by the device. The crosshair is applied to the center of the image and is 2 pixels wide. The gray level of the crosshair pattern equals the maximum output level.
False	No crosshair will be added to the camera image.

7.6 Acquisition Control

In this group you find all features related to basic camera operation.

7.6.1 **AcquisitionMode** | RW | B |

Continuous	Set the acquisition mode of the device.

NOTE: AcquisitionMode is related to how data is transferred over the interface. ExposureMode is related to the sensor operation.

7.6.2 **AcquisitionStart** | RW | B |

Command	Start the Acquisition of the device.

7.6.3 **AcquisitionStop** | RW | B |

Command	Stop the Acquisition of the device at the end of the current frame.

7.6.4 **AcquisitionFrameRate** | RW | B |

Min 10 Hz Increment: undefined	Control the acquisition rate (in Hertz) at which the frames are captured. The maximum depends on the camera configuration. The frame rate is rounded such that AcquisitionFramePeriod is a multiple of 1 µs.

This feature is automatically updated if any of the following features is changed:
AcquisitionFrameRate, AcquisitionFramePeriod, AcquisitionMaxFrameRate, BinningHorizontal, ConnectionConfig, InterfaceUtilization, PixelFormat, ReadOutMode, StreamPacketSizeMax, Width, Height

7.6.5 AcquisitionFramePeriod | RW | B |

Max 100000 µs Increment: 1 µs	Control the acquisition rate (in 1 µs steps) at which the frames are captured. The minimum depends on the camera configuration.

This feature is automatically updated if any of the following features is changed: AcquisitionFrameRate, AcquisitionFramePeriod, AcquisitionMaxFrameRate, BinningHorizontal, ConnectionConfig, InterfaceUtilization, PixelFormat, ReadOutMode, StreamPacketSizeMax, Width, Height

7.6.6 AcquisitionFramePeriodRaw | RW | B |

Max 100000 µs Increment: 1 µs	Control the acquisition rate (in 1 µs steps) at which the frames are captured. The minimum depends on the camera configuration.

This feature is automatically updated if any of the following features is changed: AcquisitionFrameRate, AcquisitionFramePeriod, AcquisitionMaxFrameRate, BinningHorizontal, ConnectionConfig, InterfaceUtilization, PixelFormat, ReadOutMode, StreamPacketSizeMax, Width, Height

7.6.7 AcquisitionMaxFrameRate | WO | B |

Command	Set the camera to the maximum frame rate as is possible with the current settings.

7.6.8 TriggerSource | RW | B |

Trigger	Use trigger over CXP.

Not applicable in ExposureMode Timed.

7.6.9 TriggerActivation | RW | B |

FallingEdge	Use the falling edge as the trigger activation event.
RisingEdge	Use the rising edge as the trigger activation event.

Not applicable in ExposureMode Timed.

7.6.10 TriggerDelayTime | RW | B |

1 to 65535 µs	Set the trigger delay time

Not applicable in ExposureMode Timed.

This feature is automatically updated if any of the following features is changed: TriggerDelayTimeRaw

7.6.11 TriggerDelayTimeRaw | RW | B |

1 to 65535 µs	Set the trigger delay time in 1 µs steps.

Not applicable in ExposureMode Timed.

This feature is automatically updated if any of the following features is changed: TriggerDelayTime

7.6.12 ExposureMode | RW | B |

Timed	Free run mode. The camera is master: frame period and integration time are both fixed and controllable via the AcquisitionFramePeriod feature and ExposureTime feature respectively.
TriggerWidth	Camera is slave; In this mode an external trigger starts integration. The integration time is determined by the duration of the trigger pulse.
SyncControlMode	Camera is slave: Start and stop of integration time are determined by the start of the trigger. The frame period equals the integration time.
TimedTriggerControl	Camera is slave: Start of integration time is determined by the start of the trigger, the integration time is fixed and can be controlled via the ExposureTime feature. When TimedTriggerControl mode is used the ExposureTime is clipped against the configured AcquisitionFramePeriod used for the Timed mode. The user is responsible to change AcquisitionFramePeriod such that the desired ExposureTime can be configured.

Acquisition must be stopped when changing the ExposureMode.

For more details about the timing of the various modes, see section 5.2.

7.6.13 ExposureTime | RW | B |

Min: 1µs Max: AquisitionFramePeriod Increment: 1 µs	Set the exposure time (in 1µs steps). The exposure time is not corrected for the light sensitive FOT of the sensor. To obtain the actual integration time the light sensitive FOT has to be added to the exposure time set with this feature. See section 5.2 for the FOT times.

This feature is automatically updated if any of the following features is changed:
ExposureTimeRaw

7.6.14 ExposureTimeRaw | RW | B |

Min: 1µs Max: AquisitionFramePeriod Increment: 1 µs	Set the exposure time (in 1µs steps). The exposure time is not corrected for the light sensitive FOT of the sensor. To obtain the actual integration time the light sensitive FOT has to be added to the exposure time set with this feature. See section 5.2 for the FOT times.

This feature is automatically updated if any of the following features is changed:
ExposureTime, AcquisitionFramePeriodRaw

7.6.15 InterfaceUtilization | RW | B |

50% to 100%, increment 1%	Decrease the data rate of the interface in order to prevent the frame grabber from being overrun. Example: a utilization factor of 50 halves the available interface bandwidth.

7.7 Analog Control

Analog control functions like gain can be found in this group.

7.7.1 **GainSelector** | RW | B |

All	Gain features will influence all pixels

NOTE: Only digital gain is available.

NOTE: Gain is applied before BlackLevel.

7.7.2 **Gain** | RW | B |

GainSelector value	**Gain range (increment 0.001)**
All	1 to 32

This feature is automatically updated if any of the following features is changed:
GainRaw, GainSelector

7.7.3 **GainRaw** | RW | B |

GainSelector value	**Gain range (increment 1)**
All	1000 to 32000

This feature is automatically updated if any of the following features is changed:
Gain, GainSelector

7.7.4 **BlackLevel** | RW | B |

0 to 511 Increment 1	Control the analog black level as an absolute physical value.

This feature is automatically updated if any of the following features is changed:
BlackLevelRaw

For the 8-bit pixel formats, the configured value is presented at the video output as BlackLevel/4.
For example a BlackLevel setting of 20 wil give a black level of 5 when the bit depth is set to 8.

NOTE: BlackLevel is applied after gain.

7.7.5 **BlackLevelRaw** | RW | B |

0 to 511 Increment: 1	Control the analog black level as an absolute physical value.

This feature is automatically updated if any of the following features is changed:
BlackLevel

For the 8-bit pixel formats, the configured value is presented at the video output as BlackLevelRaw/4.

NOTE: BlackLevelRaw is applied after gain.

7.8 Factory

The factory settings are not user accessible, this mode is only required to adjust factory settings.

7.9 LUT Control

This group describes the Look Up Table features.

7.9.1 **LUTEnable** | RW | E |

True	Activate the Look Up Table (LUT). The LUT transforms the video signal from the image processing to the output.
False	Deactivate the Look Up Table.

7.9.2 **LUTStart** | WO | E |

Command	Start the creation of a LUT. The exact amount of 1024 entries should be written using the LUTValue feature to successfully create a LUT.

7.9.3 **LUTValue** | RW | E |

0 to 1023, Increment 1	After executing LUTStart, use this feature to consecutively write each index of the LUT. This feature also returns the value that is written at the LUT index selected with the LUTIndex feature.

This feature is automatically updated if any of the following features is changed:
LUTIndex

7.9.4 **LUTEnd**| WO | E |

Command	Finish the creation of a LUT. Make sure you wrote a value to all 1024 LUT entries.

7.9.5 **LUTIndex** | RW | E |

0 to 1023, Increment 1	Select the LUT index for which you want to know the assigned value. The assigned value will be displayed in the LUTValue feature.

7.9.6 **LUTStatus** | RO | E |

LUT_Idle	LUT programming sequence in idle situation
LUT_Started	LUT programming sequence started
LUT_Restarted	LUT programming sequence restarted
LUT_TooMuchEntries	Too much LUT entries (LUTValue) written before LUTEnd command is written
LUT_NotEnoughEntries	Not enough LUT entries (LUTValue) written before LUTEnd command is written
LUT_Stored	LUT programming sequence finished and stored in memory
LUT_NotStarted	LUT programming sequence has not been started yet

This feature is automatically updated if any of the following features is changed:
LUTStart, LUTEnd

7.10 Transport Layer Control

7.10.1 PayloadSize | RO | E |

Integer	Provides the number of bytes transferred for each image or chunk on the stream channel.

This feature is automatically updated if any of the following features is changed:
Width, Height, PixelFormat

7.11 Defect Pixel

Up to 1000 defect pixels can be stored in the camera. From factory the defect pixel list contains the major defects that are identified during the manufacturing process. The factory list is limited to 700 pixels. The user can always add at least 300 custom defect pixels.

7.11.1 DefectPixelCorrectionEnable | RW | G |

True	Enable the defect pixel correction, the pixels as listed in the volatile memory will be corrected.
False	Disable the defect pixel correction

7.11.2 DefectPixelTestMode | RW | E |

Off	Turn off the defect pixel test mode
MarkDefectsWhiteOnVideo	Mark defects white on video, for use in a dark environment
MarkDefectsBlackOnVideo	Mark defects black on video, for use in a light environment
ShowDefectsAsWhiteOnBlackBackground	Generate a non-video test pattern that indicates the defect pixels.

7.11.3 DefectPixelTotal | RO | E |

Integer	Returns the total amount of pixels that will be corrected.

This feature is automatically updated if any of the following features is changed:
DefectPixelAdd, DefectPixelClearAll, DefectPixelRemove, DefectPixelRestore, DefectPixelRestoreFactory

7.11.4 DefectPixelSelect | RW | E |

0 to 1000, increment 1	Select the defect pixel index from which you want to know the coordinates. The coordinates are displayed in the DefectPixelReadX and DefectPixelReadY feature.

This feature is automatically updated if any of the following features is changed:
DefectPixelAdd, DefectPixelClearAll, DefectPixelRemove, DefectPixelRestoreFactory

7.11.5 DefectPixelReadX | RO | E |

Integer	Returns the horizontal coordinate of the pixel selected by DefectPixelSelect.

This feature is automatically updated if any of the following features is changed:
DefectPixelAdd, DefectPixelClearAll, DefectPixelRemove, DefectPixelRestoreFactory, DefectPixelSelect

7.11.6 DefectPixelReadY | RO | E |

Integer	Returns the vertical coordinate of the pixel selected by DefectPixelSelect.

This feature is automatically updated if any of the following features is changed:
DefectPixelAdd, DefectPixelClearAll, DefectPixelRemove, DefectPixelRestoreFactory, DefectPixelSelect

7.11.7 DefectPixelWriteX | RW | E |

0 to SensorWidth-1, increment: 1	Select the horizontal coordinate of a defect pixel that needs to be corrected. Defect pixel coordinates x, y are referenced to the full sensor image, where (0, 0) is the top-left most image pixel.

7.11.8 DefectPixelWriteY | RW | E |

0 to SensorHeight-1, increment: 1	Select the vertical coordinate of a defect pixel that needs to be corrected. Defect pixel coordinates x, y are referenced to the full sensor image, where (0, 0) is the top-left most image pixel.

7.11.9 DefectPixelAdd | WO | E |

Command	Add the defect pixel determined by DefectPixelWriteX and DefectPixelWriteY to the defect pixel list in volatile memory.

7.11.10 DefectPixelRemove | WO | E |

Command	Remove the defect pixel determined by DefectPixelWriteX and DefectPixelWriteY from the defect pixel list in volatile memory.

7.11.11 DefectPixelClearAll | WO | E |

Command	Clear all defect pixels from the defect pixel list in volatile memory.

7.11.12 DefectPixelSave | WO | E |

Command	Save the defect pixel list from volatile memory as a user list to the non-volatile memory of the camera.

7.11.13 DefectPixelRestore | WO | E |

Command	Load the defect pixel user list from the non-volatile memory to the volatile memory. All existing defect pixel coordinates in the volatile memory will be lost.

7.11.14 DefectPixelRestoreFactory | WO | E |

Command	Load the factory default defect pixel list from the non-volatile memory to the volatile memory. All existing defect pixel coordinates in the volatile memory will be lost.

7.11.15 DefectPixelSaveAsFactoryDefault | WO | G |

Command	Not accessible by the user

The correction method that is applied depends on the local defect distribution. A defect pixel correction is available that replaces a defect pixel by a horizontally interpolated value, a vertically interpolated value, or a horizontal nearest neighbor value. The available correction methods are illustrated in Figure 7-4. The user does not have control about which method is being applied.

The defect correction is currently not band-aware; defects at the vertical border of a band may be corrected with pixel information of the adjacent band, if vertical correction is chosen.

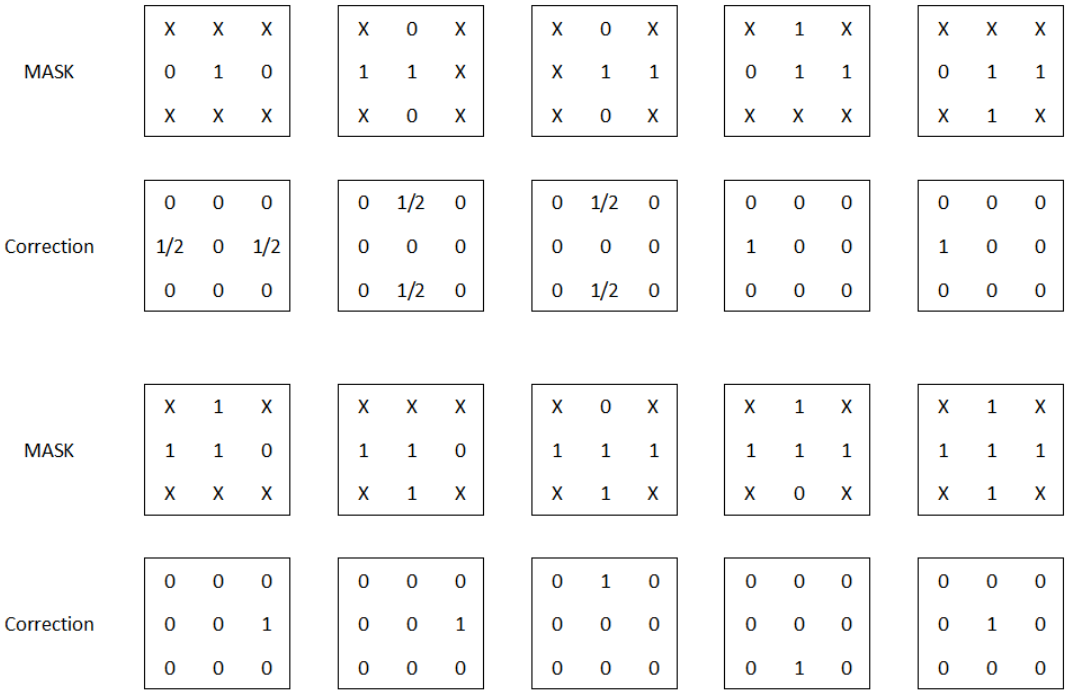


Figure 7-4: An overview of the defect pixel correction methods. In the mask box, 1 indicates a defect pixel, 0 a working pixel and the pixels with an x are not involved in the correction. After correction, the center defect pixel in the mask will be given the value that is obtained by adding the surrounding pixels with the weighting factors as indicated in the correction box.

7.12 Dark Field

This group contains all features related to column based dark field correction, i.e. a compensation for Dark Signal Non-Uniformities (DSNU) in between columns.

7.12.1 DF_ColumnOffsetCorrection | RW | E |

True	Enable the dark field column offset correction.
False	Disable the dark field column offset correction

7.12.2 DF_Calibrate | WO | E |

Command	Start the dark field calibration of the camera. Perform this operation with no illumination on the camera. The calibrated correction will automatically be saved in the non-volatile memory.

NOTE: During calibration the camera uses the internal timing generator to acquire images with an integration time of 1 µs.

7.12.3 DF_Status | RO | E |

DF_CalibrateOK	The calibration is successfully finished and stored in non-volatile memory
DF_CalibrateError	An error occurred during calibration. A new calibration is required
DF_SensorNotDark	The calibration could not be executed as the sensor is not dark.

This feature is automatically updated if any of the following features is changed:
DF_Calibrate

7.12.4 DF_RestoreFactory | WO | E |

Command	Reset to factory dark field correction.

7.12.5 DF_SaveAsFactoryDefault | WO | G |

Command	Not accessible by the user

7.12.6 DF_IsUserCalibration | RO | E |

True	The user calibrated correction is active.
False	The factory calibrated correction is active.

This feature is automatically updated if any of the following features is changed:
BF_Calibrate, BF_RestoreFactory, BF_SaveAsFactoryDefault

7.13 Bright Field

This group contains all features related to column based bright field correction, i.e. a compensation for Photo Response Non-Uniformities (PRNU) in between columns.

7.13.1 BF_ColumnGainCorrection | RW | E |

True	Enable the bright field column gain correction.
False	Disable the bright field column gain correction.

7.13.2 BF_AutoLevelAdjust | RW | E |

True	Before performing the calibration the camera will adjust the integration time such that the video level will equal the level that is set in the BF_calibrationVideoLevel feature.
False	The integration time will not be adjusted.

This feature is automatically updated if any of the following features is changed:
ExposureMode

NOTE: This feature is only available when ExposureMode is set to Timed.

7.13.3 BF_CalibrationVideoLevel | RW | E |

10 to 90, increment 1	Set the target video level in a percentage of the full scale at which the bright field calibration will take place.

7.13.4 BF_OutputImagesDuringCalibration | RW | E |

True	The camera will output the images that are acquired during calibration. 1 for the Bright field calibration and up to 10 for the auto level adjustment when BF_AutoLevelAdjust is enabled.
False	The camera does not output the images that are acquired during calibration.

7.13.5 BF_Calibrate | WO | E |

Command	Start the bright field calibration of the camera. Perform this operation with uniform constant illumination on the camera. The calibrated correction will automatically be saved in the non-volatile memory.

NOTE: If the camera is running in a triggered mode, the illumination shall be adjusted by the user. The light source may be either constant or flashed synchronously with the applied trigger.

NOTE: Before performing a bright field calibration, first perform a dark field calibration.

7.13.6 BF_Status | RO | E |

BF_CalibrateOK	The calibration is successfully finished and stored in non-volatile memory
BF_UnderExposed	Calibration failed, configured video level cannot be reached with adjusted integration time. Increase exposure level and recalibrate.
BF_OverExposed	Calibration failed, configured video level cannot be reached with adjusted integration time. Decrease exposure level and recalibrate.
BF_UnstableExposure	Calibration failed, adjustment in illumination is required.
BF_CalibrateError	An error occurred during calibration. A new calibration is required
BF_WrongExposureMode	Calibration not executed because wrong exposure mode is selected.
BF_DarkFieldHasToBeCalibrated	Before calibrating the bright field, first calibrate the dark field.

This feature is automatically updated if any of the following features is changed:
BF_Calibrate

7.13.7 BF_RestoreFactory | WO | E |

Command	Reset to factory bright field correction.

7.13.8 BF_SaveAsFactoryDefault | WO | G |

Command	Not accessible by the user

7.13.9 BF_IsUserCalibration | RO | E |

True	The user calibrated correction is active.
False	The factory calibrated correction is active.

This feature is automatically updated if any of the following features is changed:
BF_Calibrate, BF_RestoreFactory, BF_SaveAsFactoryDefault

7.14 Band

With the band function rectangular areas for sensor read out can be selected. By using the band function not every sensor line has to be read out which might increase the frame rate. All created bands will be combined into a single image at the interface output.

NOTE: The maximum number of bands is limited to 16

NOTE: The defect pixel correction is currently not band-aware; defects at the vertical border of a band may be corrected with pixel information of the adjacent band, if vertical correction is chosen.

7.14.1 BandEnable | RW | E |

True	Enable the band functionality
False	Disable the band functionality

7.14.2 BandTotal | RO | E |

Integer	Returns the number of bands created

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandRemove, BandLoad

7.14.3 BandSelector | RW | E |

1 to 32, increment 1	Select a band from which you want to read back the offset and height

7.14.4 BandReadOffsetY | RO | E |

Integer	Returns the y offset of the band selected by BandSelector

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandRemove, BandLoad, BandSelector

7.14.5 BandReadHeight | RO | B |

Integer	Returns the height of the band selected by BandSelector

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandRemove, BandLoad, BandSelector

7.14.6 BandWriteOffsetY | RW | B |

integer	Set the y offset of the band to be added or to be removed

7.14.7 BandWriteHeight | RW | B |

integer	Set the height of the band to be added or to be removed

7.14.8 BandAdd | WO | E |

Command	Add the band determined by BandWriteOffsetY and BandWriteHeight to non-volatile memory

7.14.9 BandRemove | WO | B |

Command	Remove the band determined by BandWriteOffsetY from non-volatile memory

7.14.10 BandClearAll | WO | B |

command	Remove all bands from non-volatile memory

7.14.11 BandLoad | WO | B |

command	Restore the band user list to the device and make it active

7.14.12 BandSave | WO | B |

command	Save the current band list as a user list to the non-volatile memory of the device

7.14.13 BandAvailableOffsetPlusHeight | RO | E |

Integer	Returns the actual height available for bands. BandOffsetY + BandHeight should not exceed BandAvailableHeight

This feature is automatically updated if any of the following features is changed:
OffsetY

7.14.14 BandStatus | RO | B |

BandStatusNoError	No error occurred in programming the bands
BandStatusOutsideAvailableHeight	The band cannot be created as it is outside the available height
BandStatusOverlap	The band overlaps with an already existing band
BandStatusCouldNotAdd	The band could not be added to the band list
BandStatusCouldNotRemove	The band could not be removed from the band list
BandStatusRestoreError	The user band list could not be loaded from non-volatile memory

This feature is automatically updated if any of the following features is changed:
BandAdd, BandClearAll, BandRemove, BandLoad, BandSave, BandSelector

7.15 Sensor

7.15.1 ReadOutMode

AreaScan	In this mode the camera is optimized for area scan mode of operation

7.16 User Set Control

The camera settings can be saved in a user set.

7.16.1 UserSetSelector | RW | B |

Default	This is the factory default set. The user cannot change this set.
UserSet1	This is the set the user can save. This set is automatically loaded at power up.

This feature is automatically updated if any of the following features is changed:
UserSetLoad, UserSetSave

Table 7-5 lists the features and their default values that are stored in the factory default set.

7.16.2 UserSetLoad | WO | B |

command	Activate the set that is selected with UserSetSelector.

NOTE: Loading a set requires acquisition to be stopped.

7.16.3 UserSetSave | WO | B |

Command	If UserSet1 is selected in the UserSetSelector, this feature can be used to save the current camera settings in UserSet1.

Table 7-5: A list of the default values for the features that can be stored with UserSetSave

Group	*Register*	*Default*	*Remark*
DeviceControl	DeviceUserID	<empty>	
	DeviceIndicatorMode	Active	
ImageFormatControl	Width	2592	
	Height	2048	
	OffsetX	0	
	OffsetY	0	
	BinningHorizontal	1	
	BinningVertical	1	
	BinningMode	Sum	
	ReverseX	0	
	ReverseY	0	
	PixelFormat	Mono8	
	TestImageSelector	0	
	TestImageVideoLevel	0	
	CrossHairOverlay	0	
	FrameCounterOverlay	0	
AcquisitionControl	AcquisitionFramePeriodRaw	100000	10 fps
	TriggerSource	Trigger	
	TriggerActivation	RisingEdge	
	ExposureMode	Timed	
	ExposureTimeRaw	5000	
	InterfaceUtilization	100	
AnalogControl	GainSelector	All	
	GainRaw	1000	1x
	BlackLevelRaw	20	
LUTControl	LUTEnable	0	
DefectPixel	DefectPixelCorrectionEnable	1	
	DefectPixelTestMode	Off	
DarkField	DF_ColumnOffsetCorrection	1	
BrightField	BF_ColumnGainCorrection	1	
	BF_AutoLevelAdjust	0	
	BF_CalibrationVideoLevel	40	%
	BF_OutputImagesDuringCalibration	0	
Band	BandEnable	0	

APPENDIX A: CMOS SENSOR CLEANING INSTRUCTIONS

When you would like to clean the CMOS sensor because the sensor got contaminated with dust particles that influence your image quality, this appendix describes the right procedure with the lowest chance on damage. However, due to the high risk of sensor damage it is strongly advised to only perform cleaning when it is really necessary and cannot be avoided.

NOTE: Damage of the CMOS sensor due to scratches on the cover glass or ESD is not covered by warranty!

The correct working environment for cleaning is essential in order to ease cleaning and to prevent damage of the CMOS sensor. Especially take care of the following precautions.

Precautions:

- Take precautions to prevent ESD that can damage the CMOS sensor.
- Never try to clean the CMOS sensor at a relative humidity lower than 30%. A relative humidity of 40% or higher is preferred in order to minimize the chance of damage due to ESD.
- It is advisable to use an ionizer, in order to minimize the built-up of ESD.
- Cleaning of the CMOS sensor and lens assembly is preferably performed in a clean room or clean bench.
- Use non-fluffing Q-tips and Alcohol (or Hexane) for cleaning. De-ionized water may be necessary to remove ionic contaminants like salts.
- Any Q-tip should be used only once - you will otherwise move dirt from one place to another.
- Be sure to clean the lens mount of the lens before assembly.
- Never dry rub the window. This may cause static charges or scratches that can destroy the CMOS sensor.

Cleaning instructions:

1. First try to remove the contamination by using clean, dry air. (Use an ultra-filtered, non-residue dust remover spray). Avoid blowing air into the screw thread of the lens mount, because this may cause contamination on the CMOS sensor due to loose particles and traces of oil or grease.

   If this step does not result in an acceptable result, continue with step 2.

2. Clean the CMOS sensor cover glass using alcohol or hexane and a Q-tip. Gently and carefully rub the window always in the same direction, e.g. top - down.

3. Install a lens, power up the camera, set the lens at a small aperture (F16) and point the lens at a bright source. Adjust gain and integration time if necessary.

4. Check the image on the monitor for dark spots and stripes caused by contamination on the CMOS sensor cover glass. (Note that the image on the monitor should not saturate due to overexposure - if necessary close the iris even further).

If the CMOS sensor is not clean, repeat steps 2 - 4 using a new Q-tip. After three unsuccessful tries, it is advised to wait a few minutes before a new attempt is made. The waiting time allows the electric charge that has been built up during cleaning to neutralize.