

e2V

AVIIVA™ UC2 GE Color Line Scan Camera

MAIN FEATURES

- High Sensitivity and High Dynamic Range Linear CCD
- Monoline 1365 RGB Patterns (total of 4096 Active 10 µm Square Pixels)
- 100 % Aperture, Built-in Anti Blooming, No Lag
- GigE Vision interface standard & GenICam compliant interface
- High data rate up to 62.5 Mpixels/s
- Flexible and easy to operate via GigE Vision with a user-friendly GUI (Graphical User Interface) to control the following functions :
 - Gain Range: 27 dB by Step of 0.035 dB
 - Bit Depth: 8-bit Data
 - Dynamic Range: 58 dB
 - Offset (for Contrast Expansion)
 - Synchronization Modes: Timed, Trigger Width or Trigger Controlled Modes
- Flat-field correction (Lens and light non-uniformity correction)
- Automatic taps balancing
- Single power supply : DC 12 V to 24 V
- Very Compact Design: 56 x 60 x 40.1 mm (w,h,l)
- High reliability, RoHS, CE & FCC compliant
- F (Nikon) mount adapter (lens not supplied)

PRODUCT DESCRIPTION

This new family of Gigabit Ethernet UC2 cameras is designed with our three concepts accuracy, versatility and easy implementation with the same compact housing design: 56 x 60 x 40.1 mm of the AViIVA SC2 family.

- The same compact mechanical design incorporates the sensor of 4096 pixels.
- This camera provides 8 bit data on its output while internal processing works on 12 bit data, thus offering an excellent dynamic range.
- This UC2 GE is fully programmable, offering different integration time, gain and offset. Two external triggers allow to synchronize several cameras.
- For OEMs migrating from AViIVA SC2 to AViIVA UC2, the camera does not require new optic design because the pixel size remains unchanged : 10µm. Also with GigE Vision interface and GenICam compliant interface, you no longer need a frame grabber which means significant system cost savings.

APPLICATIONS

Being an interface standard dedicated to Machine Vision Industry, GigE Vision will gain rapid acceptance by the market. High data rate, standard interface hardware, throughputs of 125MByte/second with cable length up to 100 meters, camera control, are additional criteria for this new attractive interface option. Performance and reliability of this GigE camera make it well suited for the most demanding industrial applications, from web inspection to document scanning, from surface inspection to metrology.

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GigE™
VISION

GENiCAM

CompCam



CE

1. PERFORMANCES

Test conditions :

- maximum data rate (2 x 31MHz)
- light source 3200K with BG38 filter 2mm thickness
- LSB are given for 12-bit depth configuration

Sensor Characteristics at Maximum Pixel Rate			
Resolution	Pixels	1365 RGB patterns or 4096 pixels	
Pixel size (square)	µm	10	
Maximum line rate	kHz	15	
Anti blooming		x 100	
Radiometric Performances at Maximum Pixel Rate and T _{FAV} = 60°C			
Bit depth	Bits	8	
Spectral range	nm	250 to 1100	
Linearity (10% to 90% full scale range)	%	< ±1%	
Gain range	(step of 0.035 dB) dB	Gmin -30	Gmax -3
Peak response	(typical)		
Red	LSB/nJ/cm ²	39	1742
Green	LSB/nJ/cm ²	30	1340
Blue	LSB/nJ/cm ²	21	938
Output RMS noise	(maximum)		
Dynamic range	dB	58	33
Effective bits	Bits	8	5.5
Mechanical and Electrical Interface			
Size (w x h x l)	mm	56 x 60 x 40.1	
Lens mount		C,F	
Sensor alignment (refer to Section 8.4)		Δx,y = ±50 µm Δθ _{x,y} = ±0.2°	Δz = ±150µm Δtilt _z = ±0.35 µm
Power supply	V	DC, single 12 to 24 V	
Power dissipation	W	< 9	
Operating temperature T _{FAV} on housing (Note 1)	°C	0 to 70 (non-condensing)	

Note 1: the temperature is measured on the housing front face. The temperature gradient between the housing front face and the ambient around the camera varies with the cooling system used. In a controlled steam this gradient is less than 15°C. Without a cooling system this gradient might be above 30°C.

2. COLOR PRINCIPLE

2.1 CCD DESCRIPTION

The color CCD sensor is based on a 2 taps, 4096 pixels linear sensor with RGB color filter. It outputs 1365 RGB patterns (+ 1 extra red pixel).

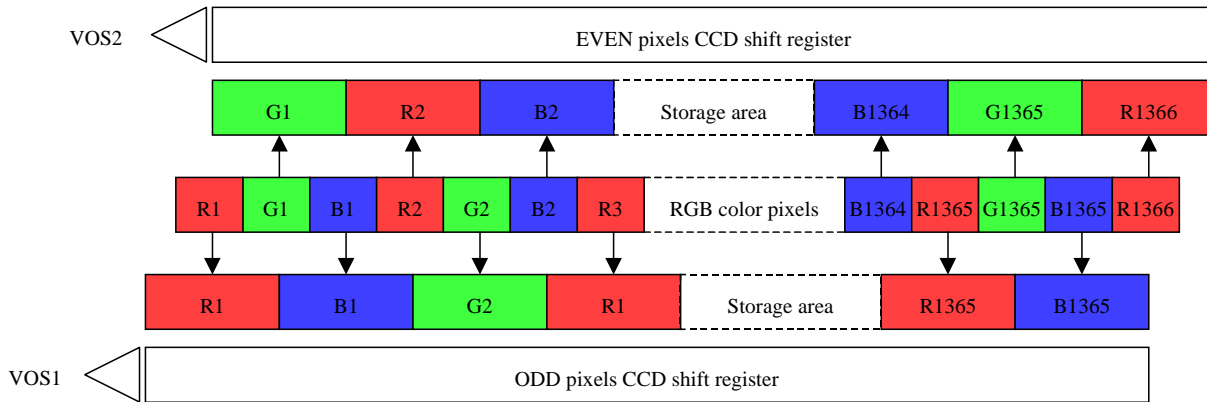


Figure 2 – color CCD sensor synoptic

2.2 IR CUT-OFF FILTER

For calibrated color response, the AVIIVA UC2 sensor should not be exposed to IR wavelengths (>700nm). The AVIIVA UC2 is delivered with a 2mm BG38 cut-off filter in front of the sensor.

2.3 WHITE BALANCE

A white balance function is implemented in the camera. The white balance can be performed automatically (white balance calibration) or manually.

The color filters are balanced for a typical 5500°K light source. For each light source, the white balance should be done. For example, at 3200°K the following typical gains must be applied to white balance the image.

$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} 1 \\ 1.64 \\ 2.89 \end{bmatrix} \times [R \ G \ B]$$

2.4 COLOR SPACE CORRECTION

A color space correction function is implemented in the camera. The nine coefficients can be input manually or chosen in a typical matrix. After white balance, the color space correction should be done to improve the color response. This correction consists in a linear operation to convert the RGB triplet from the camera color space to the RGB triplet of the final color space. The final color space can be a monitor, a printer or others application specific color space. For some specific applications where "absolute" color value is not mandatory the color space correction can be bypassed.

At 3200K with a 2mm BG38 and for a standard PC screen, this typical matrix must be applied to correct the colors.

$$\begin{bmatrix} R'' \\ G'' \\ B'' \end{bmatrix} = \begin{bmatrix} 1.14 & 0.26 & -0.4 \\ -0.19 & 1.71 & -0.52 \\ -0.45 & -0.65 & 2.1 \end{bmatrix} \times \begin{bmatrix} R' \\ G' \\ B' \end{bmatrix}$$

3. CAMERA DESCRIPTION

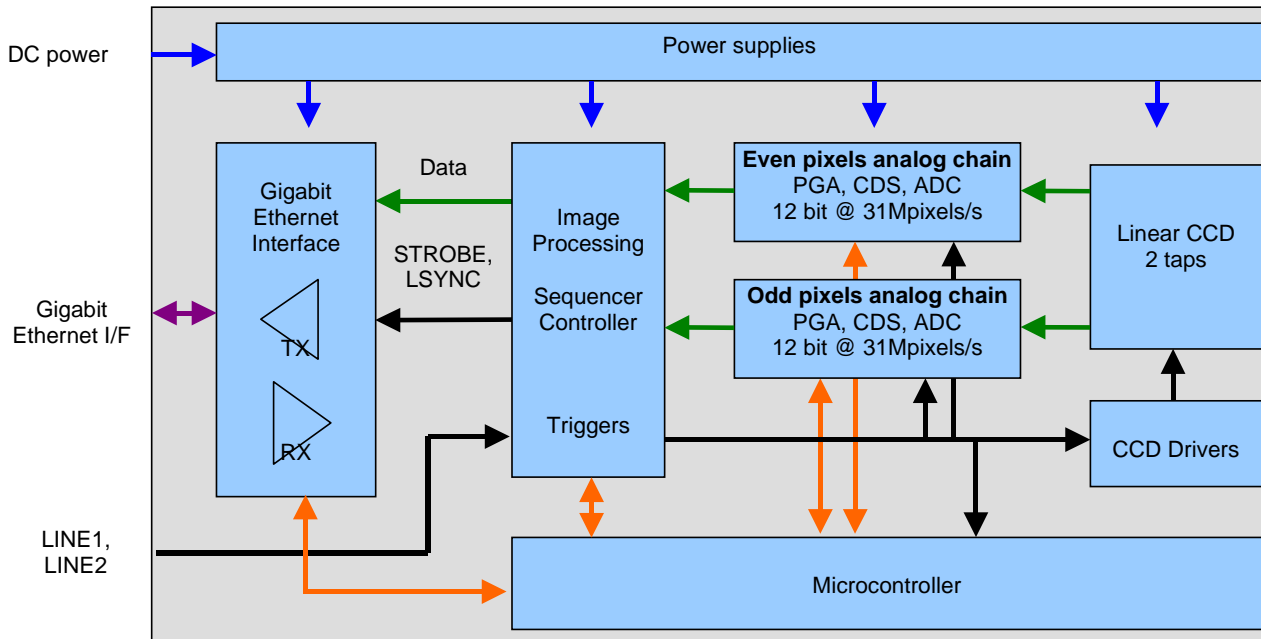


Figure 2 – Camera synoptic

The camera is based on a two-tap linear CCD. Therefore, two analog chains process odd and even pixel outputs of the linear sensor. The CCD signal processing encompasses the correlated double sampling (CDS), the dark level correction (dark pixel clamping), the gain (PGA) and offset correction and finally the analog to digital conversion on 12 bits. Digital datas are then processed into an FPGA (white balance, flat-field correction, color correction, contrast expansion, automatic taps balancing and test pattern generation).

Note : PGA stands for Programmable Gain Array

The camera is powered by a single DC power supply from 12 to 24 V.

The functional interface (data and control) is provided with the GigE Vision interface.

The data is provided on two 8 bits channels.

The camera can be used with external triggers (LINE1 and LINE2 signals) in different synchronization modes.

The camera configuration and settings are performed via the GigE Vision interface. This interface is used for :

- Gain, offset setting
- Dynamic range, data rate setting
- Trigger mode setting : free run or external trigger modes
- Integration time setting : in Timed mode
- Flat-field correction
- White balance
- Color correction

4. STANDARD CONFORMITY

The cameras have been tested in the following conditions :

- Shielded power supply cable
- Shielded and twisted pairs data transfer cable
- Linear AC-DC power supply

E2v recommends using the same configuration to ensure the compliance with the following standards.

4.1 RoHS CONFORMITY

AVIIVA cameras comply with the requirements of the RoHS directive

4.2 CE CONFORMITY

AVIIVA UC2 cameras comply with the requirements of the European EMC directive 89/336/CEE (EN61000-6-4:2001, EN61000-6-2:2001)

4.3 FCC CONFORMITY

AVIIVA UC2 cameras comply with Part 15 of FCC rules. Operation is subject to the following two conditions :

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

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 limits 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 instruction manual, 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 be required to correct the interference at his own expense.

Warning : Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

4.4 GIGE VISION COMPLIANCE

AVIIVA UC2 cameras comply with the GigE Vision V1 standard.

5. CAMERA FEATURES

This chapter describes the GenICam standard features and the additional custom features of the camera. More information about the features is found in the **GenICam Standard Features Naming Convention** document.

This version of document is compliant with the version 2.21 of the Camera firmware.

5.1 GIGE VISION TRANSPORT LAYER

This use case provides access to GigE Vision bootstrap registers and other information related to the GigE Vision transport medium. More information about these features is found in the GigE Vision specification.

5.1.1 PAYLOADSIZE

This feature provides the number of bytes transferred for each image on the stream channel, including any end-of-line, end-of-frame statistics or other stamp data. This is the total size of data payload for a block. UDP and GVSP headers are not considered. Data leader and data trailer are not included. This is mainly used by the application software to determine size of image buffers to allocate.

Name	PayloadSize
DisplayName	PayloadSize
Description	Size of the payload in byte
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	NA

5.1.2 GEVMACADDRESS

The MAC address for E2V AVIIVA UC2 GE cameras is 00:18:28:20:xx:xx

Name	GevMACAddress
DisplayName	GevMACAddress
Description	48-bit MAC address of the selected interface
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	NA

5.1.3 GEVSUPPORTEDIPCONFIGURATION_LLA

Name	GevSupportedIPConfiguration_LLA
DisplayName	GevSupportedIPConfiguration_LLA
Description	Indicate if LLA (Auto-IP) is supported by the selected interface (GevInterfaceSelector)
Visibility	Expert
Type	NA
NameSpace	Standard
Value	NA
OnValue	1

OffValue	0
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5.1.4 GEVSUPPORTEDIPCONFIGURATION_DHCP

Name	GevSupportedIPConfiguration_DHCP
DisplayName	GevSupportedIPConfiguration_DHCP
Description	Indicate if DHCP is supported by the selected interface (GevInterfaceSelector)
Visibility	Expert
Type	NA
NameSpace	Standard
Value	NA
OnValue	1
OffValue	0

5.1.5 GEVSUPPORTEDIPCONFIGURATION_PERSISTENTIP

Name	GevSupportedIPConfiguration_PersistentIP
DisplayName	GevSupportedIPConfiguration_PersistentIP
Description	Indicate if Persistent IP is supported by the selected interface (GevInterfaceSelector)
Visibility	Expert
Type	NA
NameSpace	Standard
Value	NA
OnValue	1
OffValue	0

5.1.6 GEVCURRENTIPCONFIGURATION

Name	GevCurrentIPConfiguration
DisplayName	GevCurrentIPConfiguration
Description	Currently used IP configuration scheme for the selected interface (GevInterfaceSelector)
Visibility	Expert
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	PersistentIP
EnumEntry	DHCP
EnumEntry	LLA
EnumEntry	PersistentIPandDHCP

5.1.7 GEVCURRENTIPADDRESS

Name	GevCurrentIPAddress
DisplayName	GevCurrentIPAddress
Description	NA
Visibility	Beginner
Type	NA

NameSpace	Standard
Sign	Unsigned

5.1.8 GEVCURRENTSUBNETMASK

Name	GevCurrentSubnetMask
DisplayName	GevCurrentSubnetMask
Description	NA
Visibility	Beginner
Type	NA
NameSpace	Standard
Sign	Unsigned

5.1.9 GEVCURRENTDEFAULTGATEWAY

Name	GevCurrentDefaultGateway
DisplayName	GevCurrentDefaultGateway
Description	NA
Visibility	Beginner
Type	NA
NameSpace	Standard
Sign	Unsigned

5.1.10 GEVHEARTBEATTIMEOUT

Name	GevHeartbeatTimeout
DisplayName	GevHeartbeatTimeout
Description	Current heartbeat timeout in milliseconds.
Visibility	Expert
Type	NA
NameSpace	Standard
Min	500
Max	60000
Inc	1

5.1.11 GEVTIMESTAMPICKFREQUENCY

Name	GevTimestampTickFrequency
DisplayName	GevTimestampTickFrequency
Description	Number of timestamp ticks during 1 second. This corresponds to the timestamp frequency in Hertz.
Visibility	Expert
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	NA

5.1.12 GEVTIMESTAMPCONTROL_LATCH

Name	GevTimestampControl_Latch
DisplayName	GevTimestampControl_Latch
Description	Latch current timestamp counter into "Timestamp value" register.
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	2

5.1.13 GEVTIMESTAMPCONTROL_RESET

Name	GevTimestampControl_Reset
DisplayName	GevTimestampControl_Reset
Description	Reset timestamp 64bit counter to 0.
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	1

5.1.14 GEVTIMESTAMPVALUE

Name	GevTimestampValue
DisplayName	GevTimestampValue
Description	Latched value of the timestamp counter.
Visibility	Expert
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	NA

5.1.15 GEVCCP

Name	GevCCP
DisplayName	GevCCP
Description	Control Channel Privilege register.
Visibility	Expert
Type	NA
NameSpace	Standard

Value	NA
EnumEntry	InvalidCCPValue
EnumEntry	ExclusiveAccess
EnumEntry	ControlAccess

5.1.16 GEVSCPS_FIRETESTPACKET

Name	GevSCPS_FireTestPacket
DisplayName	GevSCPS_FireTestPacket
Description	When this bit is set, the device will fire one test packet of size specified by bit 0-15. The “don't fragment” bit of IP header must be set for this test packet. Applies to the selected stream channel (GevStreamChannelSelector)
Visibility	Expert
Type	NA
NameSpace	Standard
Value	NA
OnValue	1
OffValue	0

5.1.17 GEVSCPS_PACKETSIZE

Name	GevSCPS_PacketSize
DisplayName	GevSCPS_PacketSize
Description	The stream packet size to send on this channel, except for data leader and data trailer; and the last data packet which might be of smaller size (since packet size is not necessarily a multiple of block size for stream channel). The value is in bytes. If a device cannot support the requested packet_size, then it must not fire a test packet when requested to do so. Applies to the selected stream channel (GevStreamChannelSelector)
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	548
Max	16370
Inc	4

5.2 DEVICE INFORMATION

Device Information features provide general information about the camera and its sensor. This is mainly used to identify the camera during the enumeration process and to obtain information about the sensor.

5.2.1 DEVICEVENDORNAME

Name	DeviceVendorName
DisplayName	Device Vendor name
Description	The name of the device vendor.
Visibility	Beginner
Type	NA
NameSpace	Standard

Unit	NA
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5.2.2 DEVICEMODELNAME

Name	DeviceModelName
DisplayName	Device Model name
Description	The name of the device model.
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.3 DEVICEMANUFACTURERINFO

This feature provides the part number of the camera.

Name	DeviceManufacturerInfo
DisplayName	DeviceManufacturerInfo
Description	Additional info from manufacturer about this device.
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.4 DEVICEVERSION

Name	DeviceVersion
DisplayName	DeviceVersion
Description	A string identifying the version of the camera
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.5 DEVICEFIRMWAREVERSION

Name	DeviceFirmwareVersion
DisplayName	DeviceFirmwareVersion
Description	Version of firmware/software
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.6 DEVICEID

Name	DeviceId
DisplayName	Camera ID
Description	Hardware Identifier.
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.7 DEVICEUSERID

This feature stores a user-programmable identifier. For GigE Vision bootstrap registers, this string has a maximum length of 16 bytes (including the NULL-terminating character).

Name	DeviceUserId
DisplayName	User id
Description	A user set ID that is user-programmable.
Visibility	Beginner
Type	NA
NameSpace	Standard
Unit	NA

5.2.8 DEVICEREGISTERSCHECK

This command is used to perform the validation of the current register set for consistency. This will update the **DeviceRegistersValid** flag.

Name	DeviceRegistersCheck
DisplayName	DeviceRegistersCheck
Description	Perform an explicit register set validation for consistency
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	1

5.2.9 DEVICEREGISTERSVALID

This feature is used to read if the current register set is valid and consistent.

Name	DeviceRegistersValid
DisplayName	DeviceRegistersValid
Description	Informs whether the current register set is valid and consistent
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
OnValue	1
OffValue	0

5.3 IMAGE SIZE CONTROL

5.3.1 SENSORWIDTH

The **SensorWidth** feature is used to specify the number of pixels of the sensor.

Name	SensorWidth
DisplayName	SensorWidth
Description	Width of sensor in pixels
Visibility	Beginner
Type	NA
NameSpace	Standard
Sign	Unsigned

5.3.2 SENSORHEIGHT

The **SensorHeight** feature is set to 1 for linear sensor

Name	SensorHeight
DisplayName	SensorHeight
Description	Height of sensor in pixels
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	NA

5.3.3 PIXELFORMAT

The camera operates in one format of data:

- **RGB8Packed**: the pixels are truncated to 8 bits. Three RGB pixels are aligned on three bytes as:
Pixel Red (11..4) | Pixel Green (11..4) | Pixel Blue (11..4)

Name	PixelFormat
DisplayName	PixelFormat
Description	Pixel Format as specified in GigE Vision standard
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	RGB8Packed

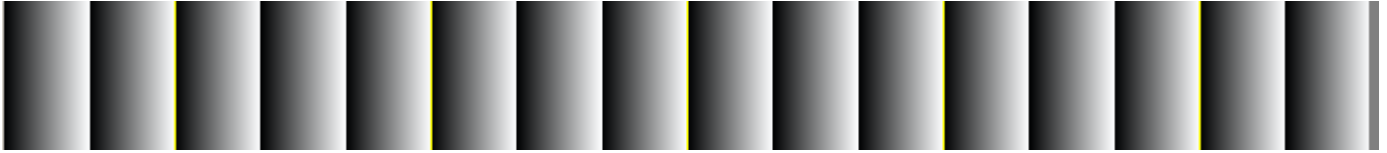
5.3.4 TESTIMAGESELECTOR

In normal mode "OFF", the digital video signal from the sensor is available at the output interface.

For test purpose a digital pattern is generated and can be available instead of video signal at the output interface.

Two different patterns are available:

- "Grey horizontal ramp" is a loop of ramp up from 0 LSB code to 255 LSB code; the same pattern applies for each line :



- "Grey horizontal and vertical ramp moving" is a loop of ramp up from 0 LSB code to 255 LSB code; the pattern is shifted of 1 pixel at each line :



Name	TestImageSelector
DisplayName	TestImageSelector
Description	Selection of the test image to be used.
Visibility	Beginner
Type	NA
Namespace	Custom
Value	NA
EnumEntry	Off
EnumEntry	GreyHorizontalRamp
EnumEntry	GreyHorizontalAndVerticalRampMoving

5.4 ACQUISITION AND TRIGGER CONTROLS

5.4.1 FEATURES DESCRIPTION

The **AcquisitionMode** feature controls the mode of acquisition for the camera. This mainly affects the number of frames captured in the acquisition. The AVIIVA camera operates in continuous mode of acquisition. It is not able to operate in SingleFrame or MultiFrame modes.

Name	AcquisitionMode
DisplayName	AcquisitionMode
Description	Defines the type of acquisition
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	Continuous

The **ExposureMode** feature is used to set the operation mode of the exposure.

ExposureMode can take 3 values : Timed, TriggerControlled and TriggerWidth.

The camera can operate in these 3 modes according to the description in the following paragraphs.

Name	ExposureMode
DisplayName	ExposureMode
Description	Mode of operation for the exposure control
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	Timed
EnumEntry	TriggerControlled
EnumEntry	TriggerWidth

The **ExposureTimeAbs** feature is used in Timed mode to set the exposure duration by programming its value in the range defined in the table below by step of 0.128µs.

Name	ExposureTimeAbs
DisplayName	ExposureTimeAbs
Description	Control the absolute exposure time in us
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	0.128
Max	8388.352
Unit	us

The **AcquisitionLineRateAbs** feature controls the rate (in Hz) at which the lines in a frame are captured. This value can be programmed by writing the period (in μs) in the **LinePeriod** custom feature. It is only used in Timed mode with the **TriggerSource** set to Timer1End.

Name	AcquisitionLineRateAbs
DisplayName	AcquisitionLineRateAbs
Description	Display the imager line rate
Visibility	Beginner
Type	NA
Namespace	Standard
Min	NA
pMin	Note: depends on AcquisitionLineRateAbsMin
Max	NA
pMax	Note: depends on AcquisitionLineRateAbsMax
Unit	Hz

Name	LinePeriod
DisplayName	Line period
Description	Line period
Visibility	Beginner
Type	NA
Namespace	Custom
Min	NA
pMin	Note: depends on ReadOutTime
Max	NA
pMax	Note: depends on LinePeriodMax
Unit	μs

The **TriggerSelector** feature is used to select the type of trigger for acquisition.

Name	TriggerSelector
DisplayName	TriggerSelector
Description	Select the type of trigger to control
Visibility	Beginner
Type	NA
Namespace	Standard
Value	NA
EnumEntry	LineStart
EnumEntry	ExposureStart
EnumEntry	ExposureActive
EnumEntry	ExposureEnd

The **TriggerMode** feature defines the selected trigger operation mode. It must be always set to Hardware.

Name	TriggerMode
DisplayName	TriggerMode
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Value	0
EnumEntry	Hardware

The **TriggerSource** feature specifies the physical input Line or internal signal to use for the selected trigger. For the AVIIVA camera the trigger source can be either the end of Timer1 or the LINE1 input signal or the LINE2 input signal.

Name	TriggerSource
DisplayName	TriggerSource
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Value	NA
EnumEntry	Timer1End
EnumEntry	Line1
EnumEntry	Line2

The **TriggerActivation** feature specifies the activation mode of the trigger.

Name	TriggerActivation
DisplayName	TriggerActivation
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Value	NA
EnumEntry	RisingEdge
EnumEntry	FallingEdge
EnumEntry	LevelLow

The **AcquisitionStart** feature starts the Acquisition of the camera. Note that the AcquisitionStart command must validate all the current features for consistency before starting the acquisition. This validation will not be repeated for the subsequent acquisitions unless a feature is changed in the camera.

Name	AcquisitionStart
DisplayName	AcquisitionStart
Description	NA
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	0

The **AcquisitionStop** feature stops the acquisition of the camera at the end of the current frame. If no acquisition is in progress, the command is ignored.

Name	AcquisitionStop
DisplayName	AcquisitionStop
Description	NA
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	1

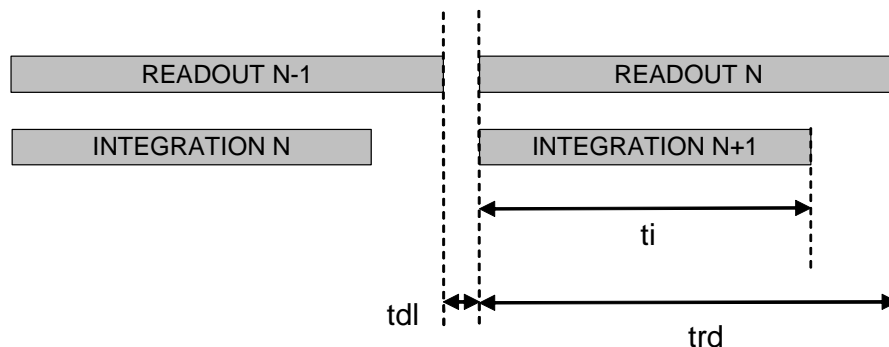
5.4.2 TIMING SPECIFICATIONS

Label	Description	Min	Typ	Max
ti	Integration time duration	0.128 μs	-	-
trd	Readout time duration	-	65.536 μs	-
tdl	Minimum delay between two consecutive readout phases	-	2 μs	-
td	LINE1 rising to integration period start delay		2.4 μs	
ts	Integration period stop to LINE1 rising set-up time	0 μs		
th	LINE1 hold time (pulse high duration)	2 μs		
td1	LINE1 falling to integration period start delay		3.2 μs	
td2	LINE1 rising to integration period stop delay		3.8 μs	

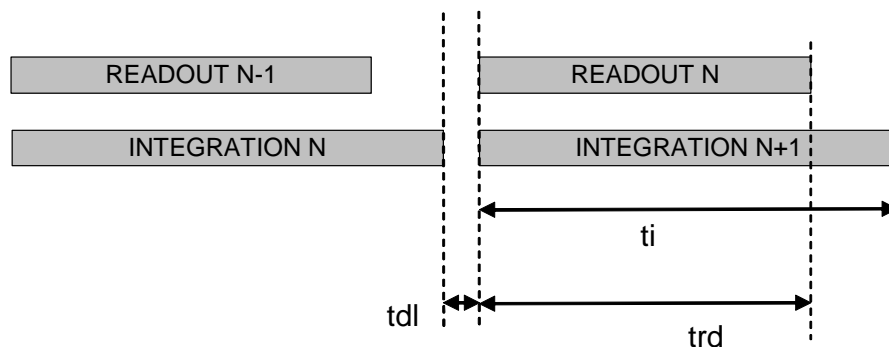
5.4.3 EXPOSURE MODE TIMED

The **ExposureMode** is set to Timed and the **ExposureTimeAbs** is set to the desired exposure duration by step of 0.128μs. The integration period starts automatically and immediately after the rising edge of the trigger source. The read-out time depends on the pixel number.

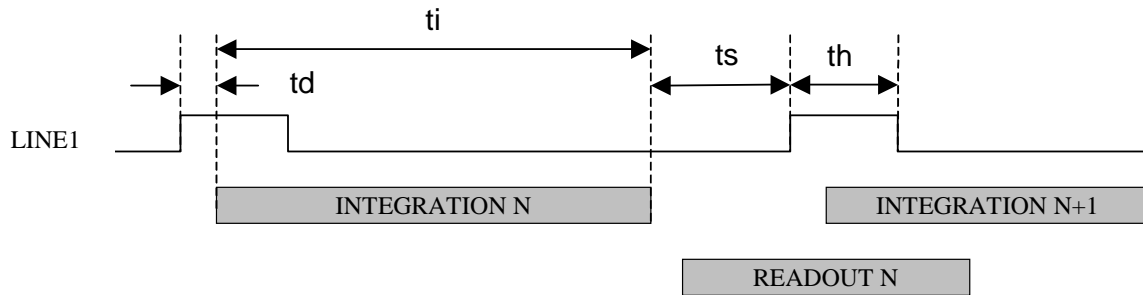
- If the Timer1 is selected as the trigger source, the integration and readout periods start automatically after the previous period. The line acquisition is periodic and is defined by the **AcquisitionLineRateAbs** or by the **LinePeriod** custom feature. The **TriggerSelector** is set to LineStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to Timer1End. The **TriggerActivation** is set to RisingEdge. There are two cases to define the **LinePeriod** depending on the integration time duration:
 - If the integration time is lower than the readout time then the **LinePeriod** is calculated by the addition of the readout time plus the readout delay : $65.536 + 2 = 67.536 \mu s$



- If the integration time is greater than the readout time then the **LinePeriod** is calculated by the addition of the integration time plus the readout delay.



- If the LINE1 is selected as the trigger source, the integration period starts automatically after the rising edge of LINE1 signal. The integration period is immediately followed by a readout period. The read-out time depends on the pixel number. The **TriggerSelector** is set to LineStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to RisingEdge.



5.4.4 EXPOSUREMODE TRIGGERWIDTH

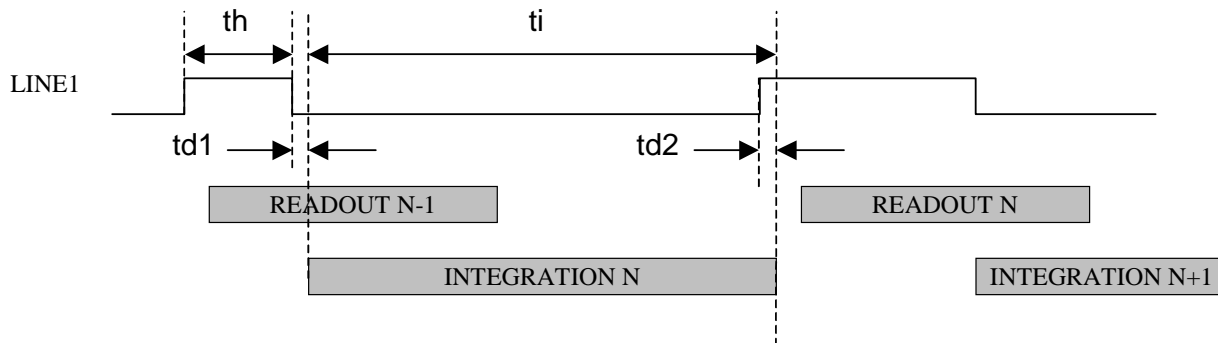
The width of the current line trigger signal pulse is used to control the exposure duration. The integration period starts immediately after the falling edge of LINE1 signal. The integration period stops immediately after the rising edge of LINE1 signal. This integration period is immediately followed by a readout period. The read-out time depends on pixel number. The **ExposureMode** is set to TriggerWidth.

Then the configuration sequence is as following:

The **TriggerSelector** is first set to LineStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to RisingEdge.

Then the **TriggerSelector** is set to ExposureStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to FallingEdge.

Then the **TriggerSelector** is set to ExposureActive. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to LevelLow.



5.4.5 EXPOSUREMODE TRIGGERCONTROLLED

One or two line trigger signals are used to control the exposure duration. The **ExposureMode** is set to TriggerControlled.

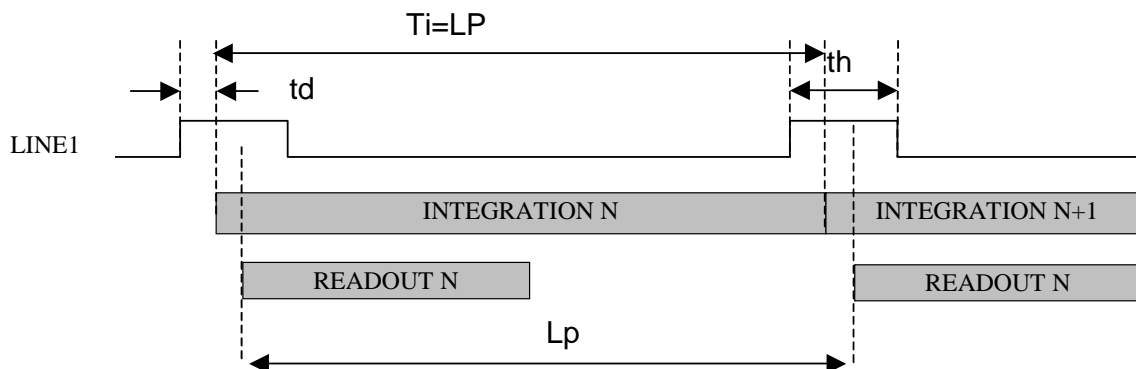
- One external trigger signal is used : the exposure time is maximum

The integration and the readout periods start immediately after the rising edge of LINE1 signal. The read-out time depends on pixel number.

The configuration sequence is as following:

The **TriggerSelector** is first set to ExposureStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to RisingEdge.

Then the **TriggerSelector** is set to ExposureEnd. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to RisingEdge.



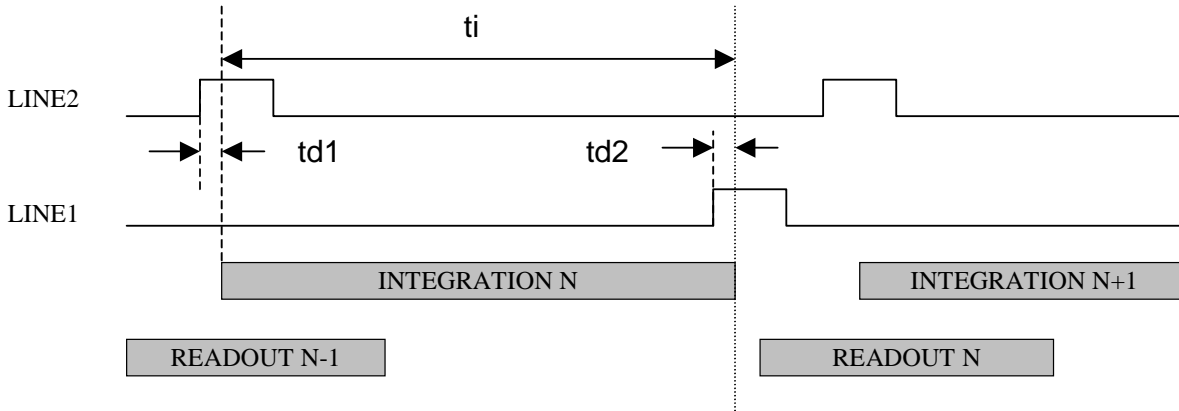
- Two external trigger signals define the exposure time

The integration period starts immediately after the rising edge of LINE2 input signal. The integration period stops immediately after the rising edge of LINE1 signal. This integration period is immediately followed by a readout period. The read-out time depends on pixel number.

The configuration sequence is as following:

The **TriggerSelector** is first set to ExposureStart. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE2. The **TriggerActivation** is set to RisingEdge.

Then the **TriggerSelector** is set to ExposureEnd. The **TriggerMode** is set to Hardware. The **TriggerSource** is set to LINE1. The **TriggerActivation** is set to RisingEdge.



5.5 GAINOFFSET

The AVIIVA UC2 camera is based on a two taps linear sensor.

The Gains & Offsets Menu enables the user to program analog and digital gains as well as offsets. Some apply to both taps and some others apply to each tap separately. This gives to the user the ability to optimize the tap balance.

5.5.1 GAINSELECTOR

The **GainSelector** feature can take two values:

- AnalogAll : this is a coarse analog gain common for both taps. The value is set in the **GainAbs** feature and it can take the values : -30, -27, -24, -21, -18, -15, -12, -9, -6 and -3 (unit dB).
- All : this is a fine gain common for both taps. The value is set in the **GainAbs** feature and it can take the values between -2.24 and 2.21 by step of 0.035 (unit dB).

Name	GainSelector
DisplayName	GainSelector
Description	Select which gain to control
Visibility	Beginner
Type	NA
Namespace	Standard
Value	NA
EnumEntry	AnalogAll
EnumEntry	All

Name	GainAbs
DisplayName	GainAbs
Description	Gain
Visibility	Beginner
Type	NA
Namespace	Standard
Min	NA
pMin	Note: depends on GainAbsMin
Max	NA
pMax	Note: depends on GainAbsMax
Unit	dB

5.5.2 ANALOGGAIN TAP1 ANALOGGAIN TAP2

The user can optimize the tap balance by the mean of these two gains. The values are set in the range of -2.24 to 2.21 by step of 0.035 (unit dB).

Name	AnalogGainTap1
DisplayName	AnalogGainTap1
Description	Analog Gain for tap 1
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	NA
pMin	Note: depends on GainTapMin
Max	NA
pMax	Note: depends on GainTapMax
Unit	dB

Name	AnalogGainTap2
DisplayName	AnalogGainTap2
Description	Analog Gain for tap 2
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	NA
pMin	Note: depends on GainTapMin
Max	NA
pMax	Note: depends on GainTapMax
Unit	dB

5.5.3 BLACKLEVELSELECTOR

The user can optimize the tap balance by adjusting the black level of each tap. This is done by selecting the tap TAP1 or TAP2 in the **BlackLevelSelector** feature and then setting the value in the **BlackLevelRaw** feature in the range of -128 to 127 LSB.

By selecting ALL in the **BlackLevelSelector** feature the user can adjust the black level of both taps for the contrast expansion feature. The value is set in the **BlackLevelRaw** feature in the range of -4096 to 4095 LSB.

Name	BlackLevelSelector
DisplayName	BlackLevelSelector
Description	Select which tap is controlled by BlackLevelAbs
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA

EnumEntry	Tap1
EnumEntry	Tap2
EnumEntry	All

Name	BlackLevelRaw
DisplayName	BlackLevelRaw
Description	Offset in 12bit LSB
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	NA
Max	NA
Inc	1

5.5.4 DIGITALGAINALL

This **DigitalGainAll** custom feature is used for contrast expansion.

Name	DigitalGainAll
DisplayName	DigitalGainAll
Description	Common digital gain to all tap, for contrast expansion
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	0
Max	255
Inc	1

5.6 FLAT FIELD CORRECTION

The Flat Field Correction consists in applying $Ax + B$ formula to each pixel value. This allows to correct :

- the CCD sensor Non-Uniformity (DSNU / PRNU) when necessary
- the Lens vignetting
- the light source non-uniformity

5.6.1 CALIBRATION PROCEDURE

- Set the camera in the useful configuration
- Put the camera in darkness and start the FPN calibration setting the **FPNCalibrationCtrl** custom feature → the camera calculates the "B" coefficient for each pixel

Name	FPNCalibrationCtrl
DisplayName	FPN calibration control
Description	FPN calibration control
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
CommandValue	1

- The user can abort the calibration process by setting **FPNCalibrationAbort** custom feature

Name	FPNCalibrationAbort
DisplayName	FPNCalibrationAbort
Description	FPN calibration abort
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
CommandValue	0

- Switch on the light and place a white reference in front of the camera. Be careful, the quality of this reference is important to get a good calibration.
- Set parameters (light level, integration time, gain) to get an output level between half and full dynamic range for better results
- Enable or Disable the FFC filter depending on the reference quality by setting the **CalibrationMediumFilter** custom feature. This filter, when enabled before starting calibration, will mask the reference small defects. The filter can be applied on a window of 3, 5 or 7 pixels width.

Name	CalibrationMediumFilter
DisplayName	Calibration medium filter
Description	Calibration medium filter
Visibility	Expert
Type	NA
Namespace	Custom
Value	NA
EnumEntry	Disable
EnumEntry	Filter3
EnumEntry	Filter5
EnumEntry	Filter7

- Start Flat Field calibration control by setting the **FFCCalibrationCtrl** custom feature → the camera calculates the “A” coefficient for each pixel

Name	FFCCalibrationCtrl
DisplayName	Flat field calibration control
Description	Flat field calibration control
Visibility	Beginner
Type	NA
Namespace	Custom
Value	NA
CommandValue	1

- The user can abort the calibration process by setting **FFCCalibrationAbort** custom feature

Name	FFCCalibrationAbort
DisplayName	FFCCalibrationAbort
Description	FFC calibration abort
Visibility	Beginner
Type	NA
Namespace	Custom
Value	NA
CommandValue	0

- Apply the correction by setting **FFCorrection** custom feature to Disable

Name	FFCorrection
DisplayName	Flat field correction
Description	NA
Visibility	Expert
Type	NA
Namespace	Custom
Value	NA
EnumEntry	Disable

EnumEntry	Enable
-----------	--------

In order to achieve a good result during the calibration process the user must take care that the average level of each tap is in an acceptable range. The two warnings FFC underflow and FFC overflow indicate that a condition of invalid value has been detected during the calibration process. These two warnings are readable in the registers StatusWarningFFCOvf and StatusWarningFFCUdf. Therefore the result could be affected. Nevertheless the correction can be applied.

Name	FPNCalibrationAbort
DisplayName	FPNCalibrationAbort
Description	FPN calibration abort
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
CommandValue	0

5.6.2 SAVE & RESTORE FFC

Up to 4 user FFC configurations can be stored in the camera.

Select the configuration with the **UserFFCSelector** custom feature.

Name	UserFFCSelector
DisplayName	UserFFCSelector
Description	Current FFC bank
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
EnumEntry	Factory
EnumEntry	User1
EnumEntry	User2
EnumEntry	User3
EnumEntry	User4

Save the FFC correction in the selected FFC bank with the **UserFFCSave** custom feature.

Name	UserFFCSave
DisplayName	UserFFCSave
Description	Save user FFC in the selected bank
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
CommandValue	1

Load the FFC correction in the selected FFC bank with the **UserFFCLoad** custom feature.

Name	UserFFCLoad
DisplayName	UserFFCLoad
Description	Load user FFC from the selected bank
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
CommandValue	1

5.6.3 MANUAL FFC

The User has some control over the FFC coefficients.

The FPN, FFC or both coefficients can be reset by programming the **FFCReset** custom feature.

Name	FFCReset
DisplayName	FFC Reset
Description	Reset FPN, FFC or both coefficients
Visibility	Beginner
Type	NA
NameSpace	Custom
Value	NA
EnumEntry	FPN
EnumEntry	FFC
EnumEntry	Both

The FPN coefficients can be accessed by setting the address in the **FPNAddr** custom feature and then reading or writing the value in the **FPNVal** custom feature.

Name	FPNAddr
DisplayName	FPN index
Description	FPN coefficient index
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	0
Max	NA
Inc	1

Name	FPNVal
DisplayName	FPN Value
Description	FPN value of one coefficient
Visibility	Beginner
Type	NA
NameSpace	Custom

Sign	Signed
------	--------

The FFC coefficients can be accessed by setting the address in the **FFCAddr** custom feature and then reading or writing the value in the **FFCVal** custom feature.

Name	FFCAddr
DisplayName	Flat field coefficient index
Description	Flat field coefficient index
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	0
Max	NA
Inc	1

Name	FFCVal
DisplayName	Flat field coefficient Value
Description	One flat field coefficient value
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	0
Max	16383
Inc	1

5.7 WHITE BALANCE

A white balance function is implemented in the camera.

The color filters are balanced for a typical 5500°K light source. For each light source, the white balance should be done. For example, at 3200°K the following typical gains must be applied to white balance the image.

$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} 1 \\ 1.64 \\ 2.89 \end{bmatrix} \times [R \ G \ B]$$

The white balance can be performed automatically by setting the **BalanceWhiteAuto** feature to Once.

Name	BalanceWhiteAuto
DisplayName	Auto white balance
Description	Auto white balance
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	Off
EnumEntry	Once

Alternatively the white balance can be performed manually by setting the gain value for each of the three colors. This is done by setting the **DigitalRed**, **DigitalGreen** and **DigitalBlue** features.

Name	DigitalRed
DisplayName	Digital red
Description	Digital red
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	1
Max	NA
pMax	Note: depends on SWMaxU3_10
Unit	NA

Name	DigitalGreen
DisplayName	Digital green
Description	Digital green
Visibility	Beginner

Type	NA
NameSpace	Standard
Min	1
Max	NA
pMax	Note: depends on SWMaxU3_10
Unit	NA

Name	DigitalBlue
DisplayName	Digital blue
Description	Digital blue
Visibility	Beginner
Type	NA
NameSpace	Standard
Min	1
Max	NA
pMax	Note: depends on SWMaxU3_10
Unit	NA

The average value for each of the three colors is available in the three registers **RedAverageLevelReg**, **GreenAverageLevelReg** and **BlueAverageLevelReg**.

Name	RedAverageLevelReg
DisplayName	RedAverageLevelReg
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Sign	Unsigned

Name	GreenAverageLevelReg
DisplayName	GreenAverageLevelReg
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Sign	Unsigned

Name	BlueAverageLevelReg
DisplayName	BlueAverageLevelReg
Description	NA
Visibility	Beginner
Type	NA
NameSpace	
Sign	Unsigned

The white balance is then enabled by setting the **BalanceWhiteEnabled** feature to On.

Name	BalanceWhiteEnabled
DisplayName	White balance enabled
Description	White balance enabled
Visibility	Guru
Type	NA
NameSpace	Standard
Value	NA
EnumEntry	Off
EnumEntry	On

5.8 COLOR MATRIX

A color space correction function is implemented in the camera.

The nine coefficients can be input manually (**CoefficientCM11**, **CoefficientCM12**, **CoefficientCM13**, **CoefficientCM21**, **CoefficientCM22**, **CoefficientCM23**, **CoefficientCM31**, **CoefficientCM32**, **CoefficientCM33**).

Name	CoefficientCM11
DisplayName	ColourMatrix line Red Column Red
Description	ColourMatrix line Red Column Red
Visibility	Beginner
Type	NA
NameSpace	Custom
Min	NA
pMin	Note: depends on SWMinS3_7
Max	NA
pMax	Note: depends on SWMaxS3_7
Unit	NA

After white balance, the color space correction should be done to improve the color response. This correction consists in a linear operation to convert the RGB triplet from the camera color space to the RGB triplet of the final color space. The final color space can be a monitor, a

printer or others application specific color space. For some specific applications where "absolute" color value is not mandatory the color space correction can be bypassed.

At 3200K with a 2mm BG38 and for a standard PC screen, this typical matrix must be applied to correct the colors.

$$\begin{bmatrix} R'' \\ G'' \\ B'' \end{bmatrix} = \begin{bmatrix} 1.14 & 0.26 & -0.4 \\ -0.19 & 1.71 & -0.52 \\ -0.45 & -0.65 & 2.1 \end{bmatrix} \times \begin{bmatrix} R' \\ G' \\ B' \end{bmatrix}$$

The color space correction is then enabled by setting the **ColorMatrixEnabled** feature to On.

Name	ColorMatrixEnabled
DisplayName	Color matrix enabled
Description	Color matrix enabled
Visibility	Beginner
Type	NA
Namespace	Custom
Value	NA
EnumEntry	Off
EnumEntry	On

5.9 SAVE & RESTORE SETTINGS

Up to 4 user settings configurations can be stored in the camera.

Select the current settings with the **UserSetSelector** custom feature.

Name	UserSetSelector
DisplayName	UserSetSelector
Description	Current settings bank
Visibility	Beginner
Type	NA
Namespace	Standard
Value	NA
EnumEntry	Factory
EnumEntry	User1
EnumEntry	User2
EnumEntry	User3
EnumEntry	User4
EnumEntry	Integrator

Save the current settings in the selected bank with the **UserSetSave** custom feature.

Name	UserSetSave
DisplayName	UserSetSave
Description	Save user in the selected bank

Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	1

Load the current settings in the selected bank with the **UserSetLoad** custom feature.

Name	UserSetLoad
DisplayName	UserSetLoad
Description	Load user from the selected bank
Visibility	Beginner
Type	NA
NameSpace	Standard
Value	NA
CommandValue	1

5.10 LED INDICATOR

There are two LEDs on the rear panel.

5.10.1 THE RED-GREEN LED

The red-green LED gives information on the internal state of the camera.

The green LED is used, after internal configuration, during operation of the camera :

- Normal situation : continuous green
- Waiting for external trigger (triggered and ITC modes) : slow blinking green
- Internal hardware error or configuration error : fast blinking green

The red LED is used when upgrading the camera :

- After upgrading, the camera is started with the previous configuration : slow blinking red
- During upgrading : continuous red

5.10.2 THE YELLOW-RED LED

The yellow-red LED gives information on the ethernet connection of the camera.

- After power up, before the connection detection or in case of link down:
 - Yellow LED and red LED are off
- Waiting for a valid IP address after connection (link up):
 - Yellow LED is slow blinking and red LED is off
- Valid IP address, no Master CPP:
 - Yellow LED and red LED are on
- Master CPP is present:
 - Yellow LED is blinking according to the receiving or transmitting traffic and red LED is on

6. UPGRADE

This camera is fully upgradable using the GigE interface. This prevents from returning the camera and ensures fast correction and easy improvement.

7. ELECTRICAL INTERFACE

7.1 POWER SUPPLY

It is recommended to insert a 2A fuse between the power supply and the camera.

Signal name	I/O	Type	Description
PWR	P	-	DC power input : +12V to +24V (+-0.5V)
GND	P	-	Electrical and Mechanical ground

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

7.2 CAMERA CONTROL

The Camera interface provides two TTL/LVDS signals dedicated to camera control

Signal name	I/O	Type	Description
LINE1/TRIG1	I	TTL	Synchronisation input
LINE2/TRIG2	I	TTL	Start Integration period in dual synchro mode

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

7.3 GIGABIT ETHERNET

Signal name	I/O	Type	Description
MDI_ [3-0]+	IO	-	
MDI_ [3-0]-	IO	-	

I = input, O = output, IO = bi-directional signal, P = power/ground, NC = not connected

8. CONNECTOR DESCRIPTION

All connectors are on the rear panel.

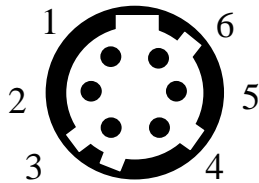
Note : cables for digital signals shall be shielded twisted pairs.

8.1 POWER SUPPLY

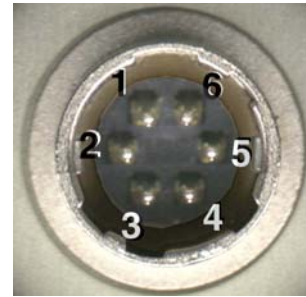
Camera connector type : Hirose HR10A-7R-6PB (male)

Cable connector type : Hirose HR10A-7P-6S (female)

Pin	Signal	Pin	Signal
1	PWR	4	GND
2	NC	5	NC
3	PWR	6	GND



Receptacle viewed from camera back

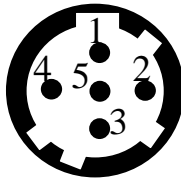


8.2 CAMERA CONTROL CONNECTOR

Camera connector type : Hirose HR10A-7R-5SB (female)

Cable connector type : Hirose HR10A-7P-5P (male)

Signal	Pin	Signal	Pin
TRIG1	1	Output Not Used	4
Input Not Used	2	GND	5
TRIG2	3		



Receptacle viewed from camera back

8.3 GIGABIT ETHERNET CONNECTOR

- Camera connector type : RJ45 9-pin female

Pin	Signal	Pin	Signal
1	MDI_0+	5	MDI_2-
2	MDI_0-	6	MDI_1-
3	MDI_1+	7	MDI_3+
4	MDI_2+	8	MDI_3-

9. MECHANICAL CHARACTERISTICS

9.1 WEIGHT

The camera typical weight (without lens nor lens adapter) is 220 g (typical)

9.2 DIMENSIONS

The camera dimension (without lens) is: W = 56 mm, H = 60 mm, L = 40.1 mm

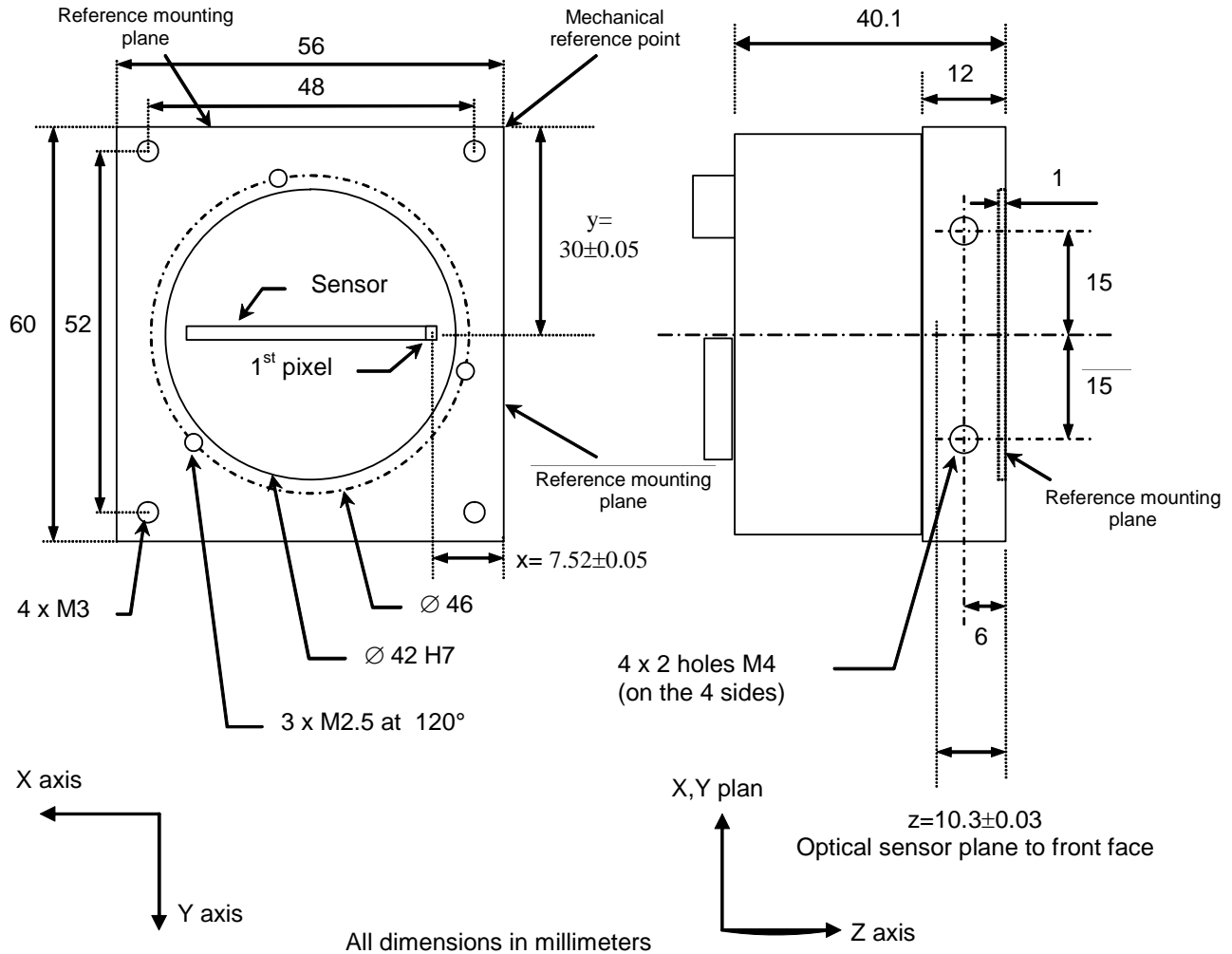
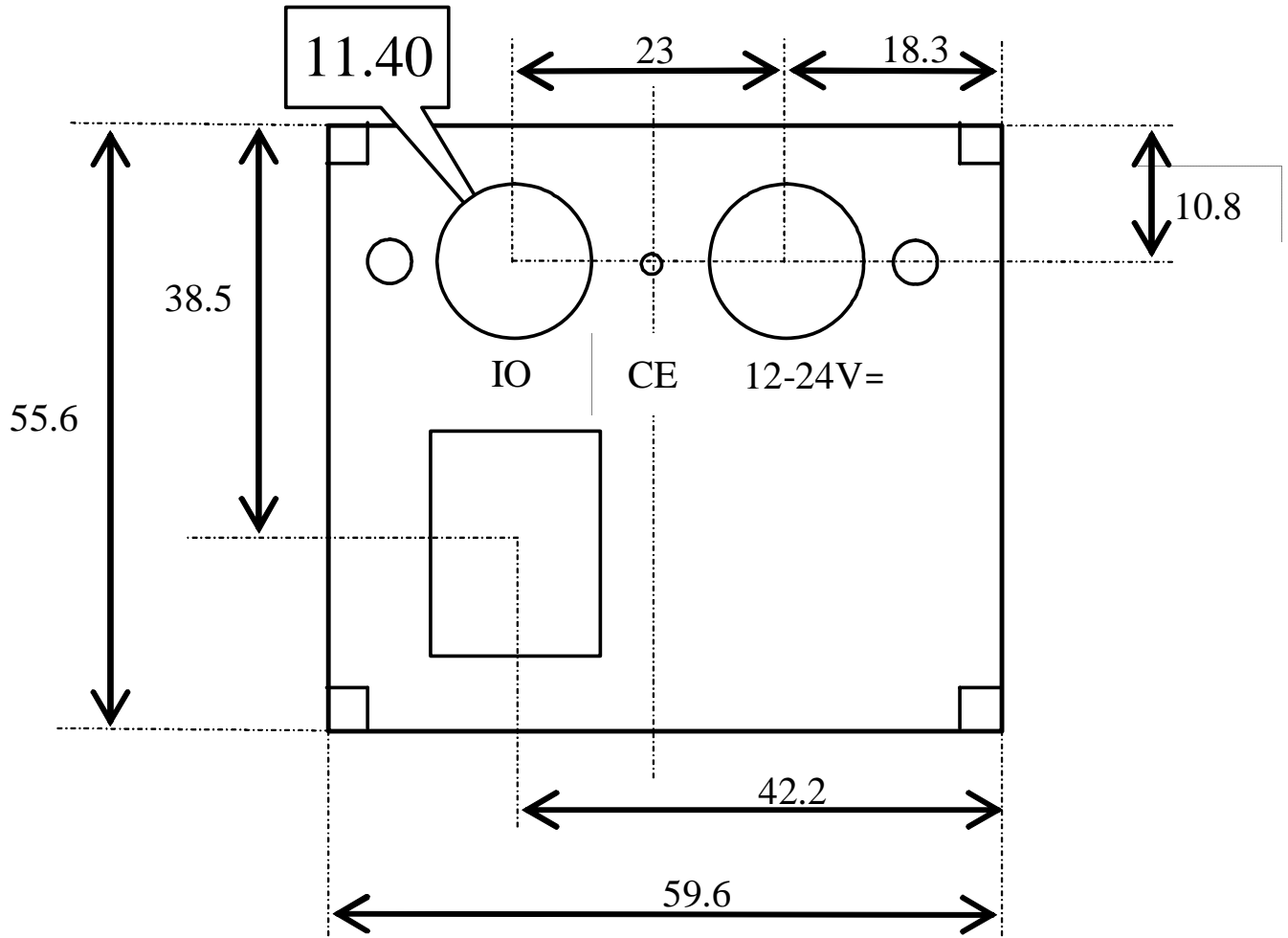


Figure 3 – Mechanical Box drawing and dimensions

9.3 MECHANICAL MOUNTING REFERENCE

The front panel mechanical part is designed to support the mounting of the camera. On this mechanical part, three surfaces are considered as mounting reference surface : i.e. the distance between these surfaces and the first active pixel are known very precisely (better than ±50µm).



9.4 SENSOR ALIGNMENT

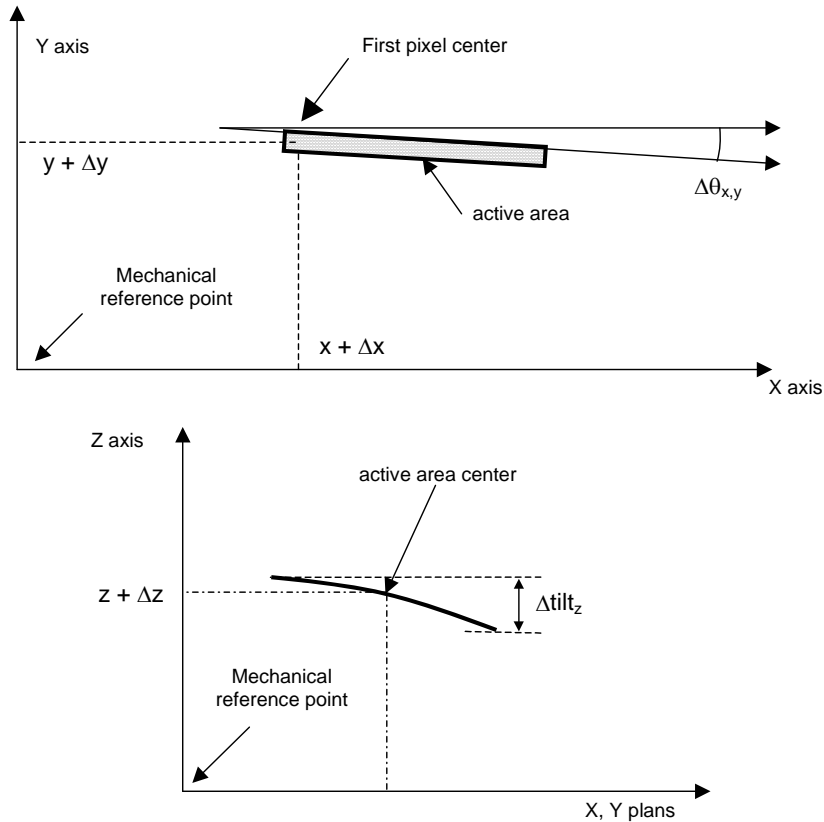


Figure 4 - Sensor alignment diagram

9.5 LENS MOUNTING (LENS NOT SUPPLIED)

The camera can be provided with a Nikon F mount.

9.6 THERMAL MANAGEMENT AND HEAT-SINK MOUNTING

In order to improve the power dissipation, the camera is delivered with a set of 2 heat-sinks to be mounted by the user on the side faces of the camera. The addition of heat-sinks can lower the front face temperature to 5°C.

Moreover, the dynamic range performance of the camera can be improved by using a cooling system. The following table delivers typical darkness noise measurements versus temperature on the mechanical front face:

<i>FAV temperature (°C)</i>	32	42	52	62	68	73	78	83
Dark rms noise (lsb)	2.05	2.09	2.23	2.46	2.66	2.86	3.21	3.71

10. ORDERING CODE

Part Number	Resolution	Pixels size	Description
AT71YUC2GE4010-BA1	4 K	10 µm	AVIIVA UC2 GE 4010
AT71KFPVIVA-ABA			F mount (NIKON)

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