

AVIIVA EM1
Line Scan Monochrome Camera
User Manual



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1 CAMERA OVERVIEW

1.1 Features

- Sensor :
 - 2048 14x14 μm or 4096 10x10 μm pixels for Machine Vision versions (BA0)
 - 2048 10x20 μm or 2048 14x28 μm pixels for OCT/Spectrometer Versions (BA9)
- Interface : Giga Ethernet in respect with GigE Vision® and GenICam® standards
- Data rate : 4x31.25MHz on the sensor level and close to 120Mo/s on GigE interface
- Bit Depth : 12 or 8 bits
- 100% Aperture, Built-in Anti-blooming, No Lag
- Automatic tap balance and FlatField correction
- Contrast expansion
- Look Up Table
- Standby low power mode
- Statistic functions on ROI
- Very compact design : 93 x 56 x 54 mm (w, h, d)
- Delivered and licensed for Pleora PureGeV® SDK/Driver Package
- DemoGeV application delivered as configuration and acquisition tool and development example.

1.2 Key Specifications

Note : All values in LSB are given in 12 bits format

1.2.1 Machine Vision Versions (BA0)

Characteristics	Typical Value		Unit
Sensor Characteristics at Maximum Pixel Rate			
Resolution	2048	4096	Pixels
pixel size (square)	14	10	μm
Max line rate - (in 8 bits)	56	29	KHz
Max line rate - (in 12 bits)	39	19	KHz
Radiometric Performance at Maximum Pixel Rate and minimum camera gain			
Bit depth	8, 12		Bits
Response	145	70	LSB/(nJ/cm ²)
Full Well Capacity	117500		electrons
Response non linearity	+/- 0.3		%
PRNU	1		%
Dynamic range	68		dB

1.2.2 OCT/Spectrometer versions (BA9)

Characteristics	Typical Value		Unit
Sensor Characteristics at Maximum Pixel Rate			
Resolution	2048	2048	Pixels
pixel size (square)	14x28	10x20	μm
Max line rate - (in 8 bits)	56	29	KHz
Max line rate - (in 12 bits)	39	19	KHz
Radiometric Performance at Maximum Pixel Rate and minimum camera gain			
Bit depth	8, 12		Bits
Response (at 840nm)	99	65	LSB/(nJ/cm ²)
Full Well Capacity	312500	238000	electrons
Response non linearity	+/- 0.3		%
PRNU	1		%
Dynamic range	70		dB
Power Spectral Density(*)	< 10		-

(*) Power Spectral Density is a specific test for BA9 version. Contact Hotline for more info.

1.2.3 Common Characteristics

Functionality (Programmable via Control Interface)			
Gain	Up to 32		dB
Offset	-4096 to +4096		LSB
Trigger Mode	Timed (Free run) and triggered (Ext Trig, Ext ITC) modes		
Mechanical and Electrical Interface			
Size (w x h x l)	93 x 56 x 54 with lateral heatsinks 60 x 56 x 54 without lateral heatsinks		mm
Weight	310 (without mount but includes lateral heatsinks)		g
Lens Mount	F, T2, M42x1 compliant with AVIIVA SM2 series		
Sensor alignment (see chapter 4)	±100		μm
Sensor flatness	±35		μm
Power supply	Single 12 DC to 24 DC		V
Power dissipation	< 11		W
Low power mode	< 5		W
General Features			
Operating temperature	0 to 55 (front face) or 70 (Internal)		°C
Storage temperature	-40 to 70		°C
Regulatory	CE, FCC and RoHS compliant		

1.3 Description

The AVIIVA EM1 is designed to set new standards for line scan cameras in term of speed and image quality. With resolutions of up to 4096 pixels, and the design of new CCD image sensors, it delivers state of the art performance, without compromises.

Its rich built-in features, such as automatic FCC, LUT or automatic tap balance, are positioning it as the perfect choice for high demanding Machine Vision Applications (BA0)

A specific rectangular-pixels sensor version (BA9) is dedicated to specific applications as Optical Coherence Tomography (OCT) or Spectrometer.

The EM1 benefits from e2v's long experience in imaging, and the proven qualities of the AviiVA family : performances, reliability, and high precision mechanical design.

1.4 Typical Applications

- Web Inspection : metallurgy, wood, paper, textile ...
- Process control : pick and place, positioning
- Print Inspection
- Sorting : food, postal, parcel, checks, ...
- Surface inspection : wafers, PCB, ...
- Document archiving, data archiving
- OCR and barcode reading
- OCT/Spectrometer for **BA9** versions.

1.5 Models

Part Number	Sensor	Outputs	Max Line Rate
Machine Vision versions			<i>(In 8 bits)</i>
EV71YEM1GE4010-BA0	4k x 10 μ m	4x31.25MHz	29 KHz
EV71YEM1GE2014-BA0	2k x 14 μ m	4x31.25MHz	56 KHz
OCT/Spectrometer versions			
EV71YEM1GE2010-BA9	2k 10 μ m x 20 μ m	4x31.25MHz	56 KHz
EV71YEM1GE2014-BA9	2k 14 μ m x 28 μ m	4x31.25MHz	56 KHz

2 CAMERA PERFORMANCES

2.1 Camera Characterization

2.1.1 Machine Vision Versions (BA0)

	Unit	Min Gain (-24dB)			Av. Gain (-12dB)			Max Gain (0dB)		
		Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max
Dark Noise RMS	LSB	-	1.6	2	6,4			27 -		
Dynamic Range	-	-	2730:1	-	-	635:1	-	-	160:1	-
Light RMS Noise	LSB	=	11,1	=						
SNR	dB	-	48	-	-	42	-	-	35	-
Non Linearity (between 10% and 90%)	%	1			1			-		
Without Flat Field Correction - Half saturation										
FPN rms	LSB	0,3 1			-	1	-	-	4	-
FPN peak-peak	LSB	-	1,2	5	-	7	-	30		
PRNU hf	%	-	0,07	0,5	-	0,1	-	-	0,2	-
PRNU hf peak-peak	%	-	0,4	3	-	1,2	-	-	1,8	-
With Flat Field Correction										
PRNU hf	LSB	-	2.7	10	-	-	-	-	-	-
PRNU hf peak-peak	LSB	-	17	-	-	-	-	-	-	-

2.1.2 OCT/Spectrometer versions (BA9)

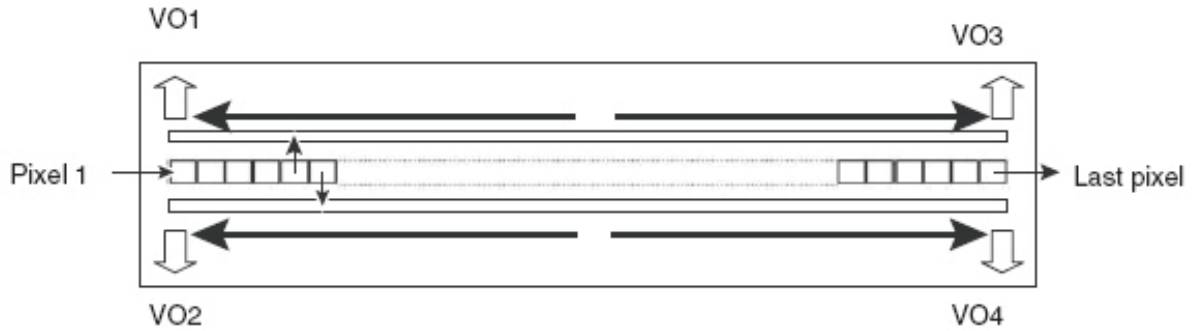
	Unit	Min Gain (-24dB)			Av. Gain (-12dB)			Max Gain (0dB)		
		Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max
Dark Noise RMS	LSB	-	1,25	2	6,4			27 -		
Dynamic Range	-	-	3276:1	-	-	650:1	-	-	165:1	-
Light RMS Noise	LSB	=	7,7	=	=		=	=		=
SNR	dB	-	48	-	-	42	-	-	35	-
Non Linearity (between 10% and 90%)	%	1			3			-		
Without Flat Field Correction - Half saturation										
FPN rms	LSB	0,15 1			-	1	-	-	4	-
FPN peak-peak	LSB	-	0,9	5	-	7	-	30		
PRNU hf	%	-	0,07	0,5	-	0,1	-	-	0,2	-
PRNU hf peak-peak	%	-	0,4	3	-	1,2	-	-	1,8	-
With Flat Field Correction										
PRNU hf	LSB	-	2.7	10	-	-	-	-	-	-
PRNU hf peak-peak	LSB	-	17	-	-	-	-	-	-	-

Test conditions :

- Figures in LSB are for a 12bits format.
- Measured at exposure time = 100µs and line period = 100µs
- Light source 3200K with BG38 filter 2 mm thickness
- Stabilized temperature 30/40/55 °C (Room/Front Face/Internal)
- SNR Calculated at 75% Vsat with minimum Gain.

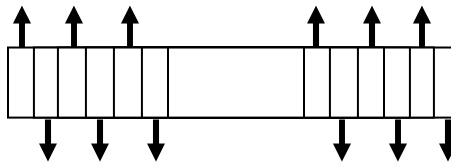
2.2 Image Sensor

The Tap structure of the sensors is the following :



On the BA9 Versions, the pixel is rectangular in order to facilitate the positioning of the Camera in the spectrometer :

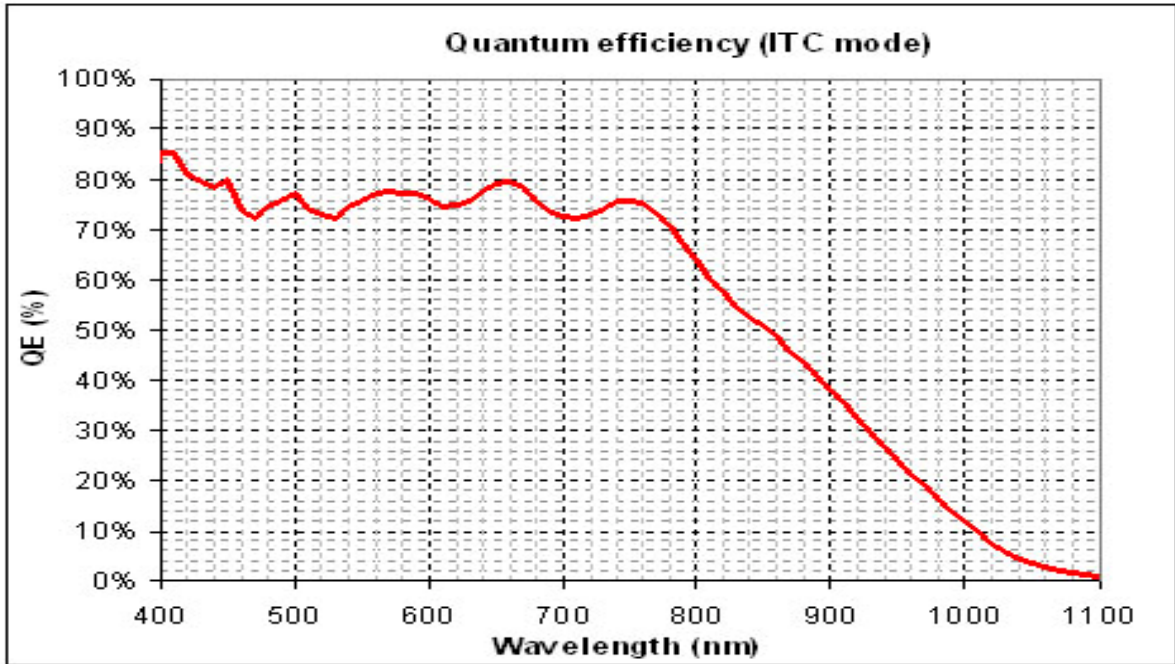
- 20 μm height for the 10 μm pitch.
- 28 μm height for the 14 μm pitch.



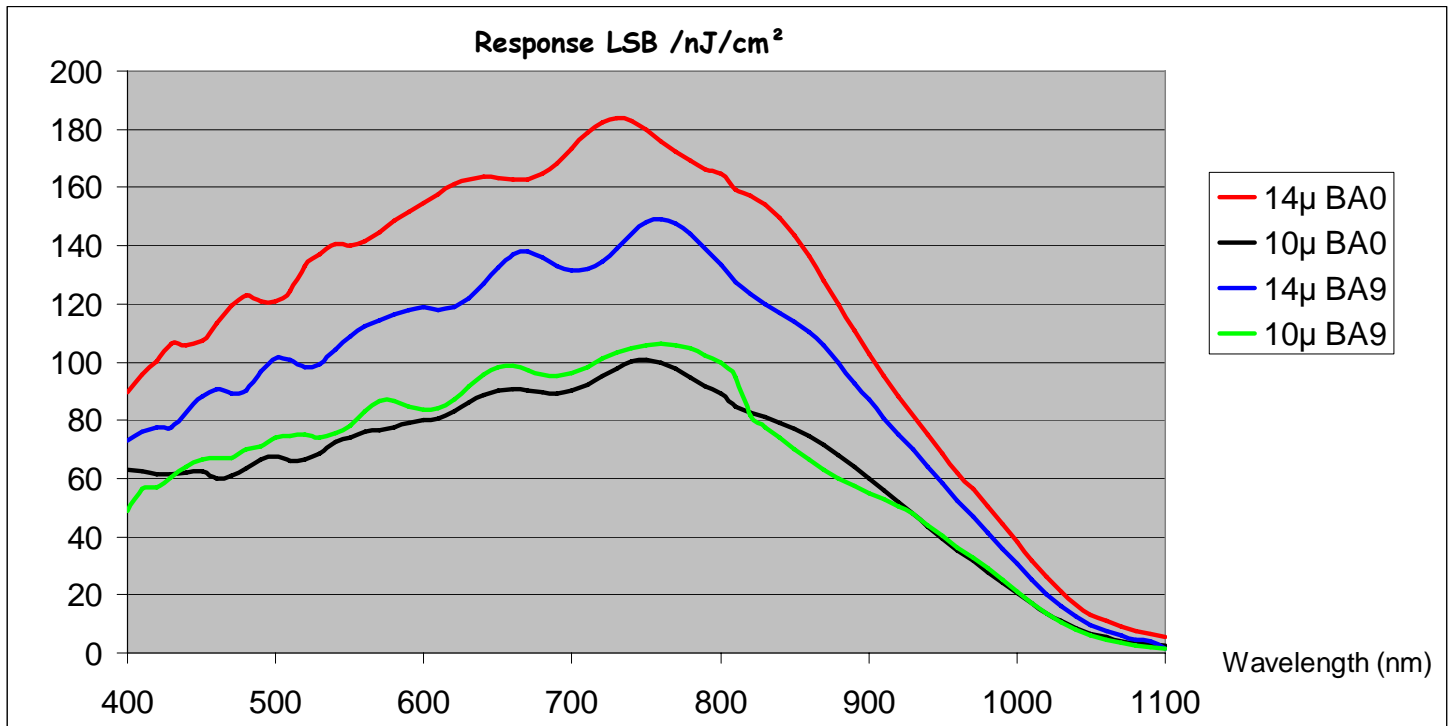
A custom height (up to 100 μm for the 10 μm pitch and 50 μm for the 14 μm are possible on demand :
Contact your sales Office.

2.3 Response & QE curves

2.3.1 Quantum Efficiency

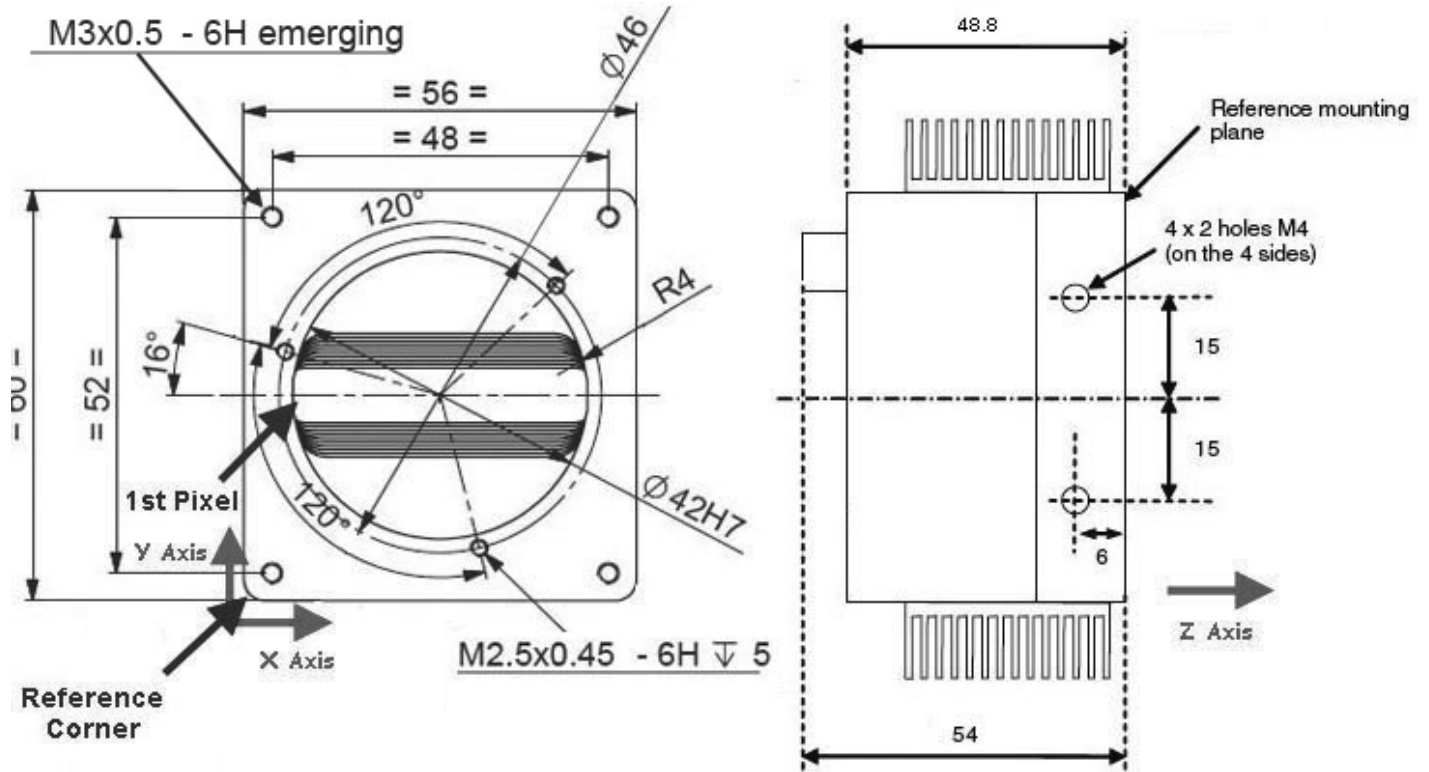


2.3.2 Spectral Response

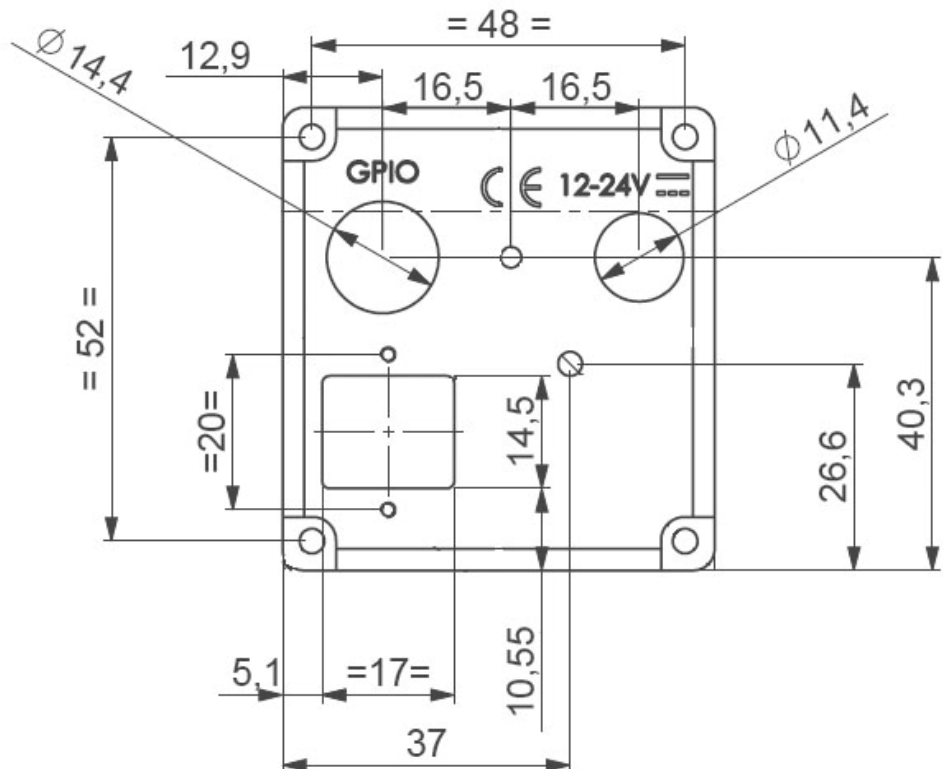


3 CAMERA HARDWARE INTERFACE

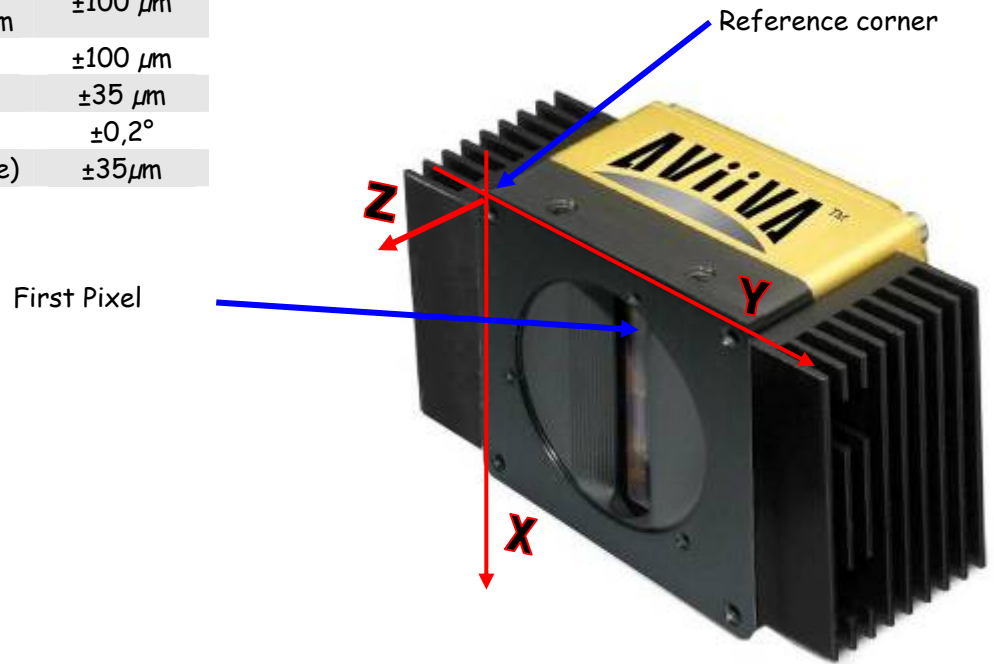
3.1 Mechanical Drawings



Note: All dimensions are in millimeters



Sensor alignment		
Z = -10.3		±150µm
4k 10µm :	X = 7.52mm	±100 µm
2k 14µm :	X = 13.66mm	
Y = 30mm		±100 µm
Planarity		±35 µm
Rotation (X,Y plan)		±0,2°
Tilt (versus lens mounting plane)		±35µm



3.2 Input/output Connectors and LED



Status LED Behaviour

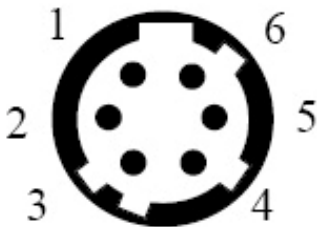
After less than 2 seconds of power establishment, the LED first lights up in ORANGE. Then after a Maximum of 30 seconds, the LED must turn in a following colour :

Colour and state	Meaning
Green and continuous	OK
Green and blinking slowly	Waiting for Ext Trig (Trig1 and/or Trig2)
Red and continuous	Camera out of order : Internal firmware error
Orange and continuous	Initialisation phase

3.2.1 Power Connector

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

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



Camera side description

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

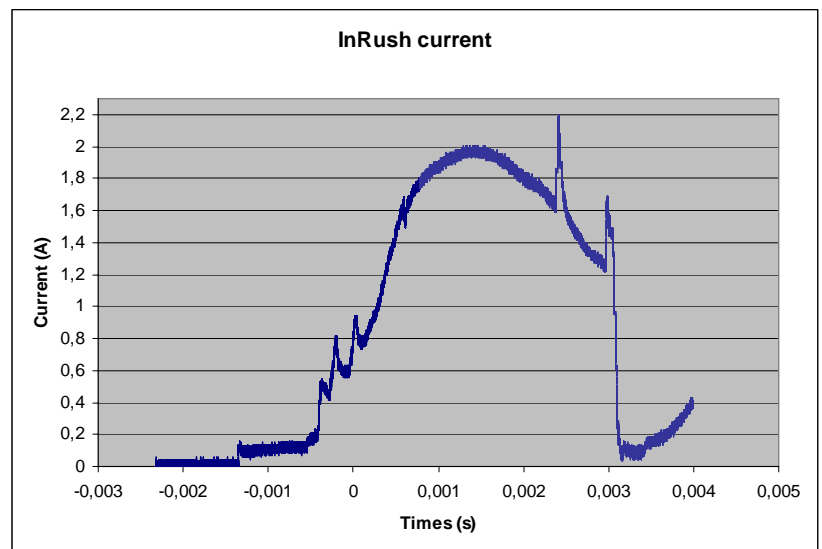
Power supply from 12 to 24v
 Power 11W max with an typical inrush current peak of 2,2A during power up

Typical values	Current consumption	
	12V	24V
Camera		
EM1 2kx10µm	0,73A	0,39A
EM1 2kx14µm	0,79A	0,42A
EM1 4kx10µm	0,81A	0,43A

In standby mode at 24V :

- Power = 5W
- Current = 0,208A

Power up Time : Around 40s

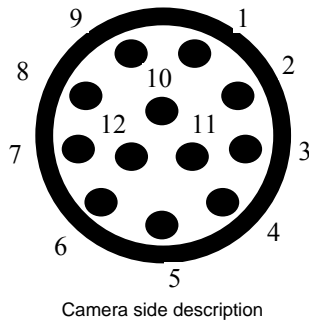


3.2.2 GPIO Connector

Camera Connector type: Hirose HR10A-10R-12SB

Cable Connector type: Hirose HR10A-10R-12P

Cable type: cable immune from interference and with twisted pairs



Signal	Pin	Signal	Pin
Line0-	1	Line3+	7
Line0+	2	Line1-	8
Line2-	3	Line1+	9
Line2+	4	GND	10
GND	5	Line4-	11
Line3-	6	Line4+	12

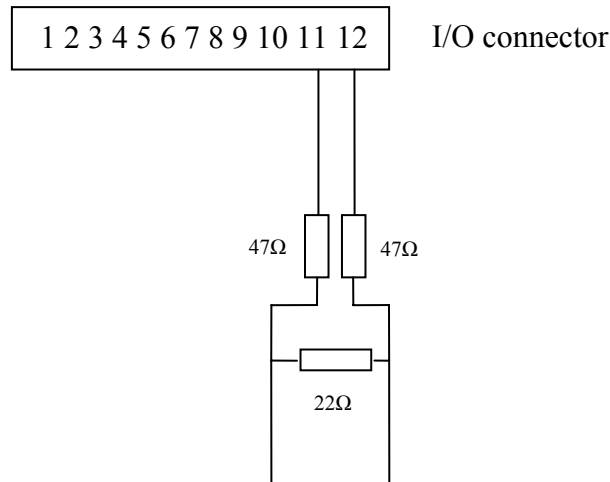
EM1 camera has a flexible I/O block :

- Signals from Input or Output can be inverted with **LineInverter** feature
- Signals from Input can be debounced with **LineDebouncer** feature. The debounce filter allows holding signal transitions for 0.7 μ s period. During this period further transitions will be ignored.
- Input and Output can be driven by TTL, LVDS or RS422 signal type and switched just with a selection on **LineFormat** feature.

For Input in TTLmode, connects on positive pin (Line0+, Line1+ or Line2+) and Ground.

For Output in TTL mode, connects on positive pin (Line3+ or Line4+) and Ground.

For Output in LVDS mode, add three resistors as shown on the schema below at the end of the output line:



- **Absolute maximum rating of I/O block** : pas à jour (voir mail à Nathalie)

	Minimum voltage	Maximum voltage	Peak current
Outputs	-12V	+15V	180mA
Input	-7V	+12V	?

3.2.3 Giga Ethernet Output

Camera connector type: RJ45 8pin female

Cable connector type: RJ45 8pin male

Cable type: cable immune from interference of Cat.6 with a maximum length of 100 meters in order to have best performances. (For short distance, a cat.5E cable can be used.)

- **Ethernet connection :**

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-

EM1 camera works only with a transfer rate of 1Gbit/s in full duplex mode.

4 STANDARD CONFORMITY

The AVIIVA EM1 cameras have been tested using the following equipment:

- A shielded power supply cable
- An Ethernet Cable cat6

e2v recommends using the same configuration to ensure the compliance with the following standards.

4.1 CE Conformity

The AVIIVA EM1 cameras comply with the requirements of the EMC (European) directive 2004/108/CE (EN50081-2, EN 61000-6-2).

This device is a class A device. Operation of this equipment in a residential area is likely to cause harmful interference. In this case the user will be required to correct the interference at his own expense.

4.2 FCC Conformity

The AVIIVA EM1 cameras further comply with Part 15 of the FCC rules, which states that:

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 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.

4.3 RoHS Conformity

AVIIVA EM1 cameras comply with the requirements of the RoHS directive 2002/95/EC.

5 GETTING STARTED

5.1.1 Out of the box

The contents of the Camera box is the following :



There is no CDROM delivered with the Camera : This User Manual , but also the Pleora PureGeV Package, DemoGeV and all documentation associated to the GigE Vision, GenICam standards can be downloaded from the web site : This ensure you to have an up-to-date version.

Main Camera page : www.e2v.com/cameras

On the appropriate Camera Page (EM1) you'll find a download link first version of CommCam compliant is indicated in the last Chapter

PureGeV package and its documentation requires a login/password :

- *Login : [pleora](#)*
- *Password : [vercors](#)*

5.2 Setting up in the system

Vocabulary :

w = size of the sensor line (40,96mm for the 4k 10 μ m)

FOV = Field Of View (width of the web inspected by the sensor line) in mm.

L = Working distance (from the Lens to the Web) in mm.

f = focal distance of the lens in mm.

S = Speed of the web in mm/s

We have : $w/FOV = f/L$

The ratio $M = w/FOV$ is called Magnification.

The FOV is grabbed by 4096 or 2048 pixels in the width.

In order to get a ratio of 1 :1 in your image, at the web speed of S , your line rate has to be set :

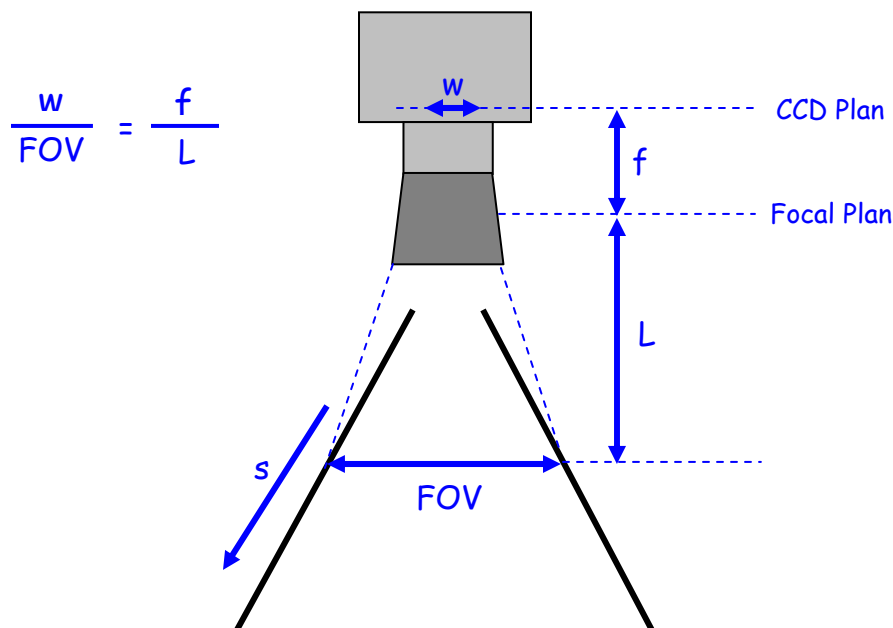
Line Rate = $(S/FOV) \times 4096$ (or 2048)

Ex : if the FOV = 11 cm (110mm) and the speed of the web is $S= 0,3$ m/s (300mm/s) the line rate will be :

Line Rate = $(300 /110) \times 4096 = 11170$ Lines/s.

If you use a 60mm lens, the working distance will be : $L = (60 \times 110) / 40,96 = 161$ mm.

This will certainly require a macro lens.



6 CAMERA SOFTWARE INTERFACE

6.1 *GigE Vision concepts*

Camera interface is compliant with "Gigabit Ethernet Vision" (GigE Vision) or (GEV). GEV normalizes image transport and camera control communications over usual IP networks. Physical GEV carrier has a bandwidth of one gigabit per second (1Gbit/s). GEV is widely used by camera manufacturers and imaging software suppliers.

6.1.1 GenICam

Camera interface is compliant with "Generic Interface for Cameras" (GenICam).

GenICam normalizes the camera control interface with software application. The target is to have a single application controlling cameras from any model and brand the same way.

It introduces the concept of user manual, not for humans but to software application. Application reads this user manual to control cameras.

GenICam has 2 parts, "GenICam Standard" and "GenICam Standard Features Naming Convention" (SFNC)

6.1.2 GenICam Standard

It normalizes the camera control rules. It can be considered as the grammar of the user manual.

From programmer's point of view, all cameras are controlled with the same way by a single Software Developer's Kit (SDK).

6.1.3 SFNC

From vision point of view, camera feature names are standardized by SFNC. It can be considered as the vocabulary of the user manual. The SFNC 1.3 is available in the documentation pack of this Camera : You'll find all the complementary details which could miss you in this manual.

6.2 Getting started with GigE Vision interface

This chapter shows how to connect a GEV camera for the first time.

6.2.1 Network setup

The following is the simplest example of a Gigabit IP network.

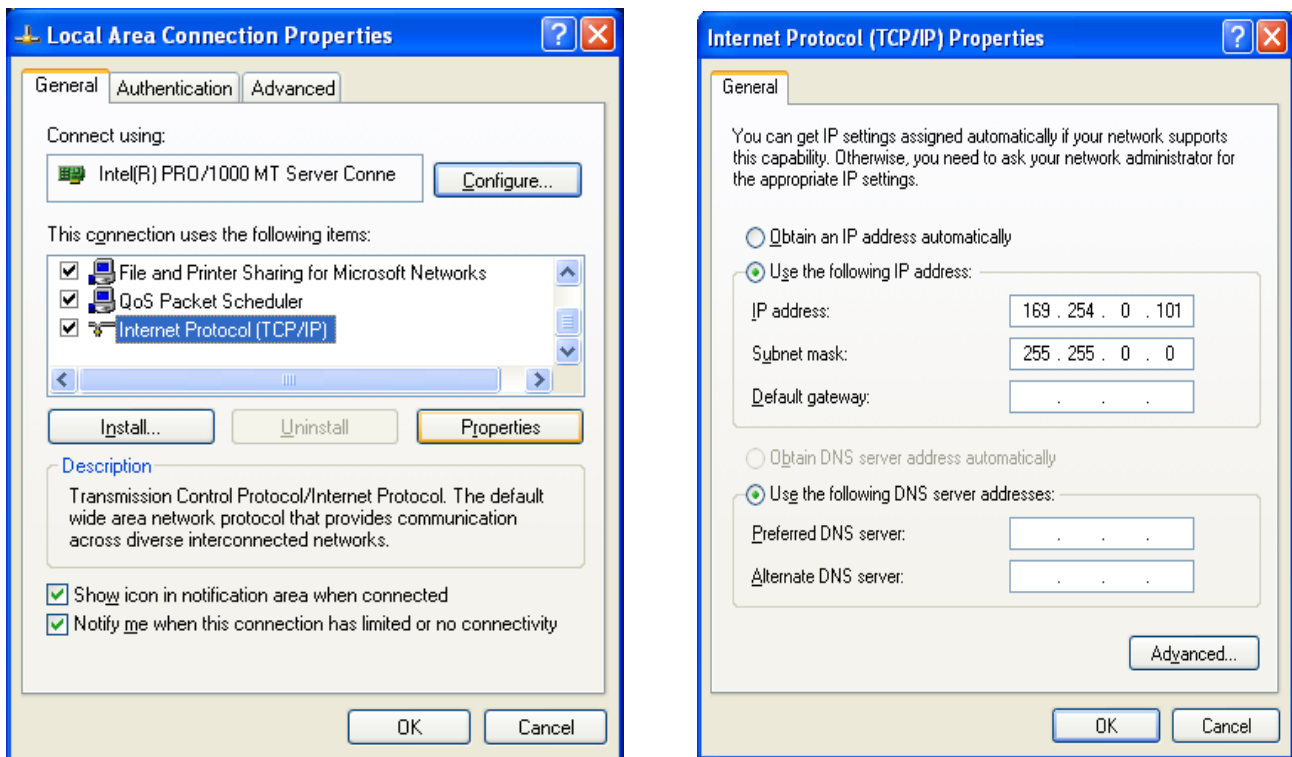
A single Ethernet cable is connected in RJ45 receptacles of GEV camera and PC. Select a "CAT6" shielded twisted pair quality to get a reliable 1Gbit/s. This cable is available at any computer shop.

Recent PC have a gigabit RJG45 plug on the motherboard.

Factory setup has set the camera to the default IP subnet 169.254.X.X. The PC interface is set to this default IP subnet as follows:

Open the Network interface properties. Settings are shown on Windows XP.

Set TCP-IP v4 interface properties to IP address 169.254.0.101 and subnet mask to 255.255.0.0



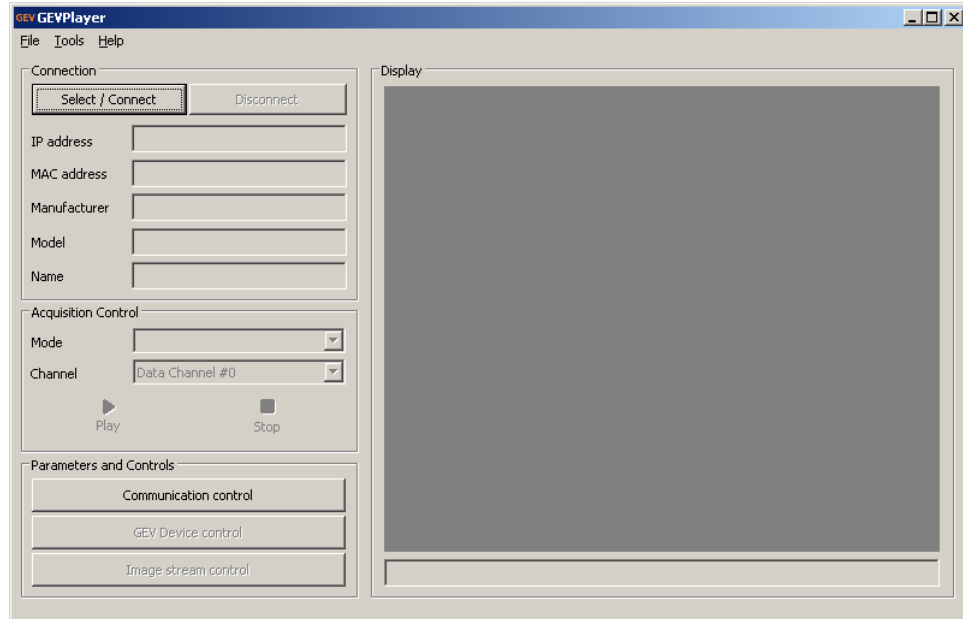
6.2.2 Software installation

A GigE Vision software is required. Use your own or install PureGEV, downloadable from www.e2v.com/cameras site. A PureGEV license is included in camera package. Refer to PureGEV installation manual for instructions. The following assumes Pleora's PureGEV is installed.

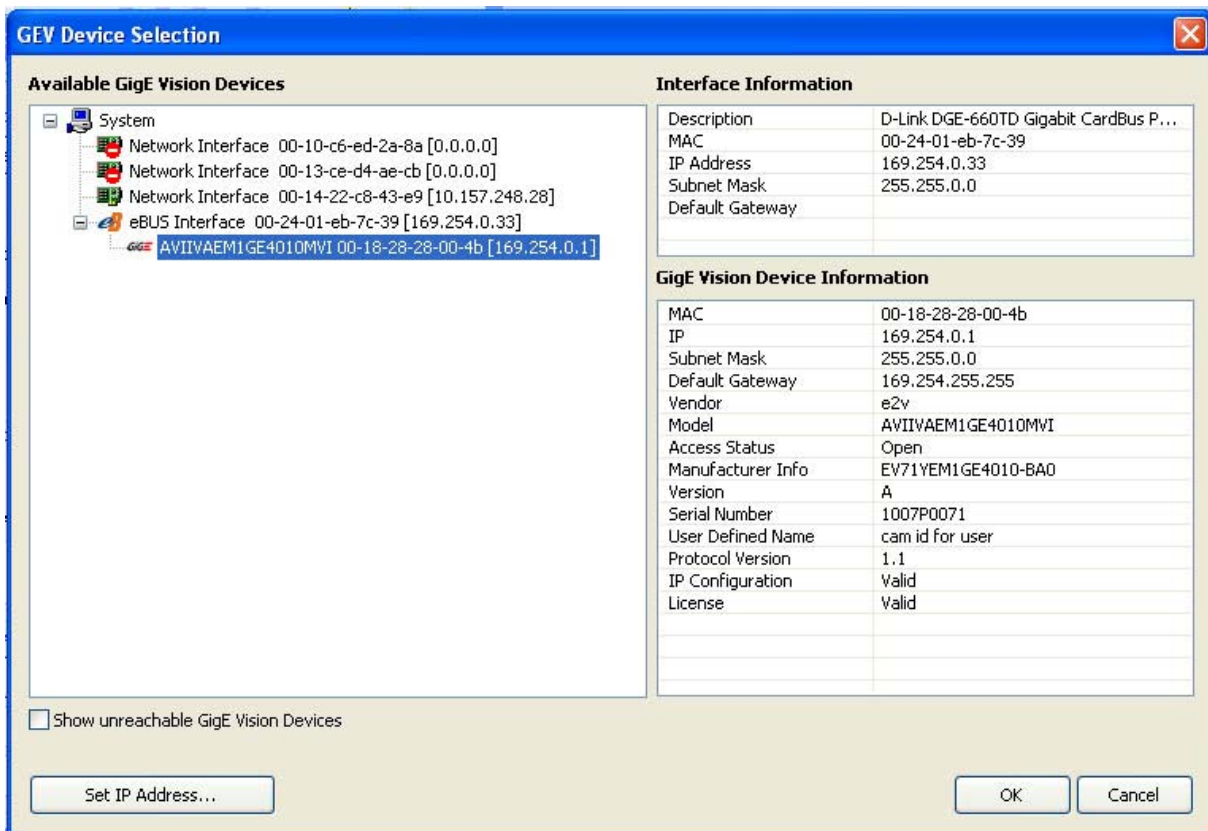
To keep things simple, the firewall should be temporary turned off.

6.2.3 Interactive camera control

PureGEV Player is used to control camera interactively and display images :



"Select / Connect" button opens the GEV Device Selection window. GigE cameras appears.

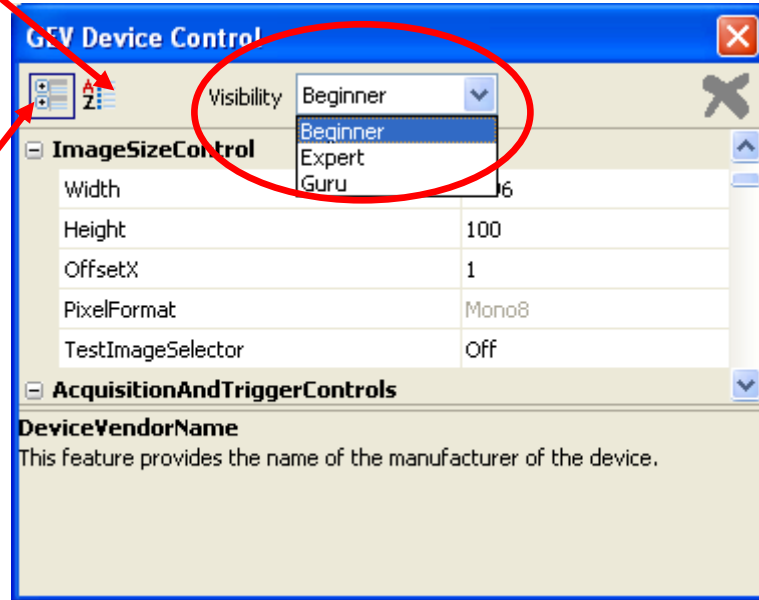


Click on camera and check "License" value is "Valid" and click OK. In GEV Player window, "Gev Device control" and "Play" are now active.

Once connected to the Camera you have an easy access to all its features when you click on "GEV DeviceControl". The visibility of these features can be associated to three types of users: Beginner, Expert or Guru. Then you can make life easy for simple users.

Set Features alphabetically

Set Features inside several items

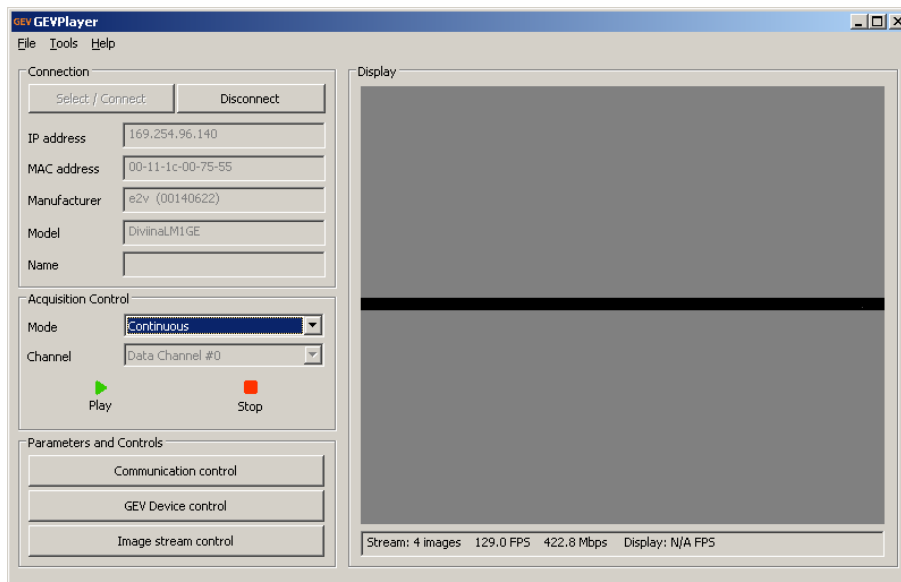


Beginner : The number of features with "Beginner " visibility should be limited to all basics features of the device, and easy to use.

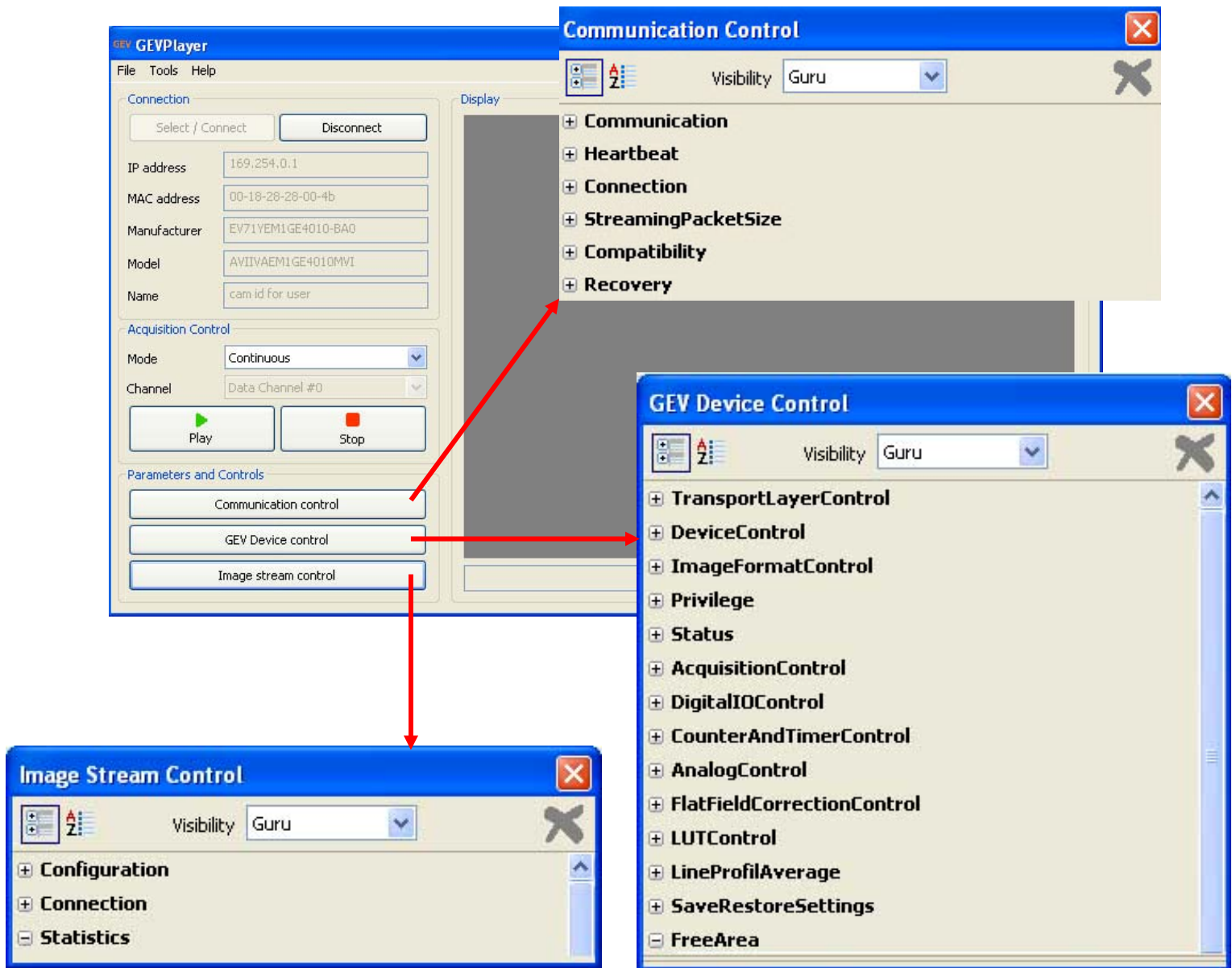
Expert : features that require a more in-depth knowledge of the camera functionality. This is the preferred visibility level for all advance features in the camera.

Guru : Advanced feature that might bring the camera into a state where it will not work properly anymore if it is set incorrectly for the current mode operation.

Click "Play" to start grab. Check camera image on display.



6.3 Camera Commands



In the following Chapters, you will find the details of the **GEV Device Control** Menu, relative to the Camera configuration.

The **Image Stream Control** and **Communication Control** menus are dedicated to *GeVPlayer* configuration and are explained in the corresponding documentation.

6.3.1 TransportLayerControl

This section provides the Transport Layer control features.

This category lists the features necessary to access GigE Vision bootstrap registers and other information related to the GigE Vision transport medium. Note most of these registers are mapped according to GigE Vision specification.

More information about exact meaning of these features is found in the GigE Vision specification. All GigE Vision features start with the "Gev" prefix.

GigE Vision registers are 32-bit. If a GigE Vision register has multiple fields within this 32-bit, then they are separated in multiple features.

The screenshot shows the 'GEV Device Control' window with the 'TransportLayerControl' category expanded. The 'Visibility' dropdown is set to 'Guru'. The table below lists the settings for this category.

GevVersionMajor	1
GevVersionMinor	1
GevDeviceModeIsBigEndian	True
GevDeviceModeCharacterSet	UTF8
GevInterfaceSelector	0
GevMACAddress	00:18:28:28:00:48
GevMACAddressHigh	24
GevMACAddressLow	673710155
GevSupportedOptionSelector	IPConfigurationLLA
GevSupportedOption	True
GevCurrentIPConfigurationLLA	True
GevCurrentIPConfigurationDHCP	True
GevCurrentIPConfigurationPersistentIP	False
GevCurrentIPAddress	169.254.0.1
GevCurrentSubnetMask	255.255.0.0
GevCurrentDefaultGateway	169.254.255.255
GevFirstURL	Local:EmbeddedFile.>
GevSecondURL	File:AVIIVAEM1GE.xn
GevNumberOfInterfaces	1
GevPersistentIPAddress	169.254.1.1
GevPersistentSubnetMask	255.255.0.0
GevPersistentDefaultGateway	0.0.0.0
GevLinkSpeed	1000
GevMessageChannelCount	1

The screenshot shows the 'GEV Device Control' window with various GigE Vision registers listed. The 'Visibility' dropdown is set to 'Guru'. The table below lists the settings for these registers.

GevStreamChannelCount	1
GevHeartbeatTimeout	5000
GevTimestampTickFrequency	31250000
GevTimestampControlReset	{Command}
GevTimestampControlLatch	{Command}
GevTimestampValue	0
GevDiscoveryAckDelay	1000
GevGVCPExtendedStatusCodes	False
GevGVCPhartbeatDisable	False
GevCCP	ControlAccess
GevPrimaryApplicationSocket	1617
GevPrimaryApplicationIPAddress	0xA9FE0021
GevMCPHostPort	1618
GevMCDA	169.254.0.33
GevMCTT	400
GevMCRC	3
GevMCSP	57831
GevStreamChannelSelector	0
GevSCPInterfaceIndex	0
GevSCPHostPort	1625
GevSCPSFireTestPacket	False
GevSCPSDoNotFragment	True
GevSCPSBigEndian	False
GevSCSPPacketSize	1476
EffectiveDataPerPacket	1440
GevSCPD	0
GevSCDA	169.254.0.33
GevSCSP	58200
PayloadSize	409600

Name	Interface	Access	Visibility	Description
<i>GevVersionMajor</i>	IIInteger	R	E	Major version of the specification.
<i>GevVersionMinor</i>	IIInteger	R	E	Minor version of the specification.
<i>GevDeviceModeIsBigEndian</i>	IBoolean	R	G	Endianess of the device registers.
<i>GevDeviceModeCharacterSet</i>	IEnumeration	R	G	Character set used by all the strings of the bootstrap registers.
<i><u>GevInterfaceSelector</u></i>	IIInteger	R	B	Selects which physical network interface to control : Always 0 as only one network is available
<i>GevMACAddress</i>	IIInteger	R	B	MAC address of the network interface.
<i>GevMACAddressHigh</i>	IIInteger	R	B	High part of the MAC address of the network interface.
<i>GevMACAddressLow</i>	IIInteger	R	B	Low part of the MAC address of the network interface.
<i>GevCurrentIPConfigurationLLA</i>	IBoolean	R/W	B	Indicates if Link Local Address IP configuration scheme is activated on the given network interface.
<i>GevCurrentIPConfigurationDHCP</i>	IBoolean	R/W	B	Indicates if DHCP IP configuration scheme is activated on the given network interface.
<i>GevCurrentIPConfigurationPersistentIP</i>	IBoolean	R/W	B	Indicates if PersistentIP configuration scheme is activated on the given network interface.
<i>GevCurrentIPAddress</i>	IIInteger	R	B	Reports the IP address for the given network interface.
<i>GevCurrentSubnetMask</i>	IIInteger	R	B	Provides the subnet mask of the given interface.
<i>GevCurrentDefaultGateway</i>	IIInteger	R	B	Indicates the default gateway IP address to be used on the given network interface.
<i>GevPersistentIPAddress</i>	IIInteger	R/W	B	Indicates the Persistent IP address for this network interface.
<i>GevPersistentSubnetMask</i>	IIInteger	R/W	B	Indicates the Persistent subnet mask associated with the Persistent IP address on this network interface.
<i>GevPersistentDefaultGateway</i>	IIInteger	R/W	B	Indicates the persistent default gateway for this network interface.
<i>GevLinkSpeed</i>	IIInteger	R	E	Indicates the speed of transmission negotiated by the given network Interface in MBytes/s

Name	Interface	Access	Visibility	Description
<i><u>GevSupportedOptionSelector</u></i> IPConfigurationLLA IPConfigurationDHCP IPConfigurationPersistentIP CommandsConcatenation WriteMem PacketResend Event EventData PendingAck Action ExtendedStatusCodes DiscoveryAckDelayWritable DiscoveryAckDelay TestData ManifestTable CCPApplicationSocket LinkSpeed HeartbeatDisable SerialNumber UserDefinedName StreamChannelSourceSocket MessageChannelSourceSocket	IEnumeration	R/W	E	Selects the GEV option to interrogate for existing support. Answer is given in <i>GevSupportedOption</i>
<i><u>GevSupportedOption</u></i>	IBoolean	R	E	Returns if the selected GEV option is supported.
<i><u>GevFirstURL</u></i>	IString	R	G	Indicates the first URL to the XML device description file.
<i><u>GevSecondURL</u></i>	IString	R	G	Indicates the second URL to the XML device description file.
<i><u>GevNumberOfInterfaces</u></i>	IInteger	R	E	Indicates the number of physical network interfaces supported by this device.
<i><u>GevMessageChannelCount</u></i>	IInteger	R	E	Indicates the number of message channels supported by this device.
<i><u>GevStreamChannelCount</u></i>	IInteger	R	E	Indicates the number of stream channels supported by this device.
<i><u>GevHeartbeatTimeout</u></i>	IInteger	R/W	G	Indicates the current heartbeat timeout in milliseconds.
<i><u>GevTimestampTickFrequency</u></i>	IInteger	R	E	Indicates the number of timestamp ticks during 1 second (frequency in Hz).
<i><u>GevTimestampControlReset</u></i>	ICommand	W	E	Resets the Timestamp counter to 0.
<i><u>GevTimestampControlLatch</u></i>	ICommand	W	E	Latches current timestamp counter into <i>GevTimestampValue</i> .
<i><u>GevTimestampValue</u></i>	IInteger	R	E	Returns the latched 64-bit value of the timestamp counter.
<i><u>GevDiscoveryAckDelay</u></i>	IInteger	R/(W)	E	Indicates the maximum randomized delay the device will wait to acknowledge a discovery command in ms
<i><u>GevGVCPExtendedStatusCodes</u></i>	IBoolean	R/W	G	Enables generation of extended status codes.
<i><u>GevGVCPHeartbeatDisable</u></i>	IBoolean	R/W	E	Disables the GVCP heartbeat.

Name	Interface	Access	Visibility	Description
<i>GevCCP</i> OpenAccess ExclusiveAccess ControlAccess	IEnumeration	R/W	G	Controls the device access privilege of an application.
<i>GevPrimaryApplicationSocket</i>	IIInteger	R	G	Returns the UDP source port of the primary application.
<i>GevPrimaryApplicationIPAddress</i>	IIInteger	R	G	Returns the address of the primary application.
<i>GevMCPHostPort</i>	IIInteger	R/W	G	Indicates the port to which the device must send messages.
<i>GevMCDA</i>	IIInteger	R/W	G	Indicates the destination IP address for the message channel.
<i>GevMCTT</i>	IIInteger	R/W	G	Provides the transmission timeout value in milliseconds.
<i>GevMCRC</i>	IIInteger	R/W	G	Indicates the number of retransmissions allowed when a message channel message times out.
<i>GevMCSP</i>	IIInteger	R	G	This feature indicates the source port for the message channel.
<i>GevStreamChannelSelector</i>	IIInteger	R	E	Selects the stream channel to control. Always 0 as only one stream channel available.
<i>GevSCPInterfaceIndex</i>	IIInteger	R	G	Index of network interface to use Always 0 as only one network available.
<i>GevSCPHostPort</i>	IIInteger	R/W	G	Indicates the port to which the device must send data stream.
<i>GevSCPSFireTestPacket</i>	IBoolean	R/W	G	Sends a test packet.
<i>GevSCPSDoNotFragment</i>	IBoolean	R/W	G	The state of this feature is copied into the "do not fragment" bit of IP header of each stream packet.
<i>GevSCPSBigEndian</i>	IBoolean	R/W	G	Endianess of multi-byte pixel data for this stream.
<i>GevSCSPPacketSize</i>	IIInteger	R/W	E	Specifies the stream packet size in bytes to send on this channel.
<i>GevSCPD</i>	IIInteger	R/W	E	Indicates the delay (in timestamp counter unit) to insert between each packet for this stream channel.
<i>GevSCDA</i>	IIInteger	R/W	G	Indicates the destination IP address for this stream channel.
<i>GevSCSP</i>	IIInteger	R	G	Indicates the source port of the stream channel.
<i>PayloadSize</i>	IIInteger	R	E	Provides the number of bytes transferred for each image or chunk on the stream channel in Bytes

Note : If the user has configured the camera front end, he can read from the back end which PayloadSize will be transferred for each image. This number covers all kind of data coming with the image, e.g. stamps etc. If the user allocates PayloadSize for each buffer he is insured that each frame will fit into his target buffers.

6.3.2 DeviceControl

Device control features provides general information and control for the device (camera) and its sensor. This is mainly used to identify the device during the enumeration process and to obtain information about the sensor resolution. Other information and controls pertaining to the general state of the device are also included in this category.



Name	Interface	Access	Visibility	Description
<i>DeviceVendorName</i>	IString	R	B	Name of the manufacturer of the device.
<i>DeviceModelName</i>	IString	R	B	Model of the device.
<i>DeviceManufacturerInfo</i>	IString	R	B	Manufacturer information about the device.
<i>DeviceID</i>	IString	R	E	Device identifier (serial number).
<i>DeviceVersion</i>	IString	R	B	Version of the device.
<i>DeviceFirmwareVersion</i>	IString	R	B	Version of the firmware in the device.
<i>DeviceUserID</i>	IString	R/W	B	User-programmable device identifier.
<i>ElectronicBoardID</i>	IString	R	B	Electronic Board ID (NON SFNC)
<i>DeviceScanType</i> LineScan	IEnumeration	R	E	Scan type of the sensor. LineScan Only
<i>DeviceMaxThroughput</i>	IInteger	R	E	Maximum bandwidth of the data that can be streamed out of the device in Byte/s
<i>DeviceRegistersCheck</i>	ICommand	(R)/W	E	Perform the validation of the current register set for consistency.
<i>DeviceRegistersValid</i>	IBoolean	R	E	Returns if the current register set is valid and consistent.

6.3.3 ImageFormatControl

This section describes how to influence and determine the image size and format. It also provides the necessary information to acquire and to display the image data. The sensor provides *SensorWidth* time *SensorHeight* pixels.

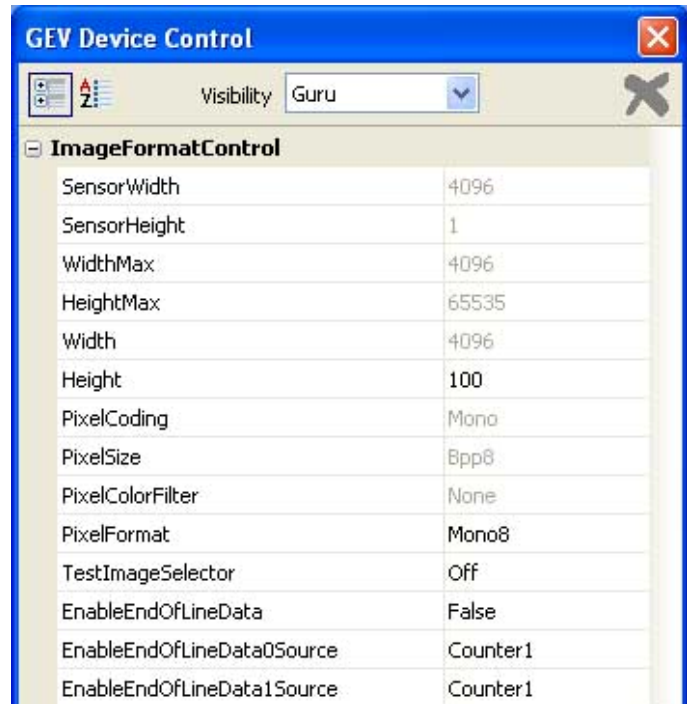
Note : The image outputted is necessary with a *Width* of *SensorWidth* as there is no Region of interest available.

The *Height* parameter will give you the number of lines grabbed for each image.

As some reception buffers are required on the Application side, the size of each of these buffers is defined by :

$$Width \times Height \times PixelFormat$$

Each pixel in the image has a format defined by *PixelFormat* which fix both *PixelSize* and *PixelCoding*



Name	Interface	Access	Visibility	Description
<i>SensorWidth</i>	IInteger	R	E	Effective width of the sensor in pixels.
<i>SensorHeight</i>	IInteger	R	E	Effective height of the sensor in pixels.
<i>WidthMax</i>	IInteger	R	E	Maximum width (in pixels) of the image.
<i>HeightMax</i>	IInteger	R	E	Maximum height (in pixels) of the image.
<i>Width</i>	IInteger	R	B	Width of the Image provided by the device sensor (in pixels).
<i>Height</i>	IInteger	R/W	B	Height of the image provided by the device (in pixels).
<i>PixelCoding</i> Mono MonoPacked	IEnumeration	R/(W)	E	Coding of the pixels in the image. Depends on PixelFormat.
<i>PixelSize</i> Bpp8 Bpp12	IEnumeration	R/(W)	E	Total size in bits of a pixel of the image. Depends on PixelFormat.
<i>PixelColorFilter</i>	IEnumeration	R	E	Type of color filter that is applied to the image. Always None
<i>PixelFormat</i> Mono8 Mono12	IEnumeration	R/W	B	Format of the pixel to use for acquisition.

Name	Interface	Access	Visibility	Description
TestImageSelector Off GrayHorizontalRamp GrayDiagonalRampMoving	IEnumeration	R/W	B	Selects the type of test image that is sent by the camera.
EnableEndOfLineData	IBoolean	R/W	B	Enable the addition of 2 x 32bits data at the end of each line
EnableEndOfLineData0Source Counter1 Counter2 Timer1 Timer2	IEnumeration	R/W	B	Selects the source of first data of 32 to put at the end of each line
EnableEndOfLineData1Source Counter1 Counter2 Timer1 Timer2	IEnumeration	R/W	B	Selects the source of second data of 32 to put at the end of each line

- **TestImageSelector** : The GrayHorizontalRamp (test patterns) are different depending on the *PixelFormat* and the *SensorSize*. They are defined in details Appendix A of this document.
- **EndOfLineData** : The User can put 2 words of 32bits each in addition at the end of each pixel line data. These words can be designed as the output of the two Counters or the two timers.

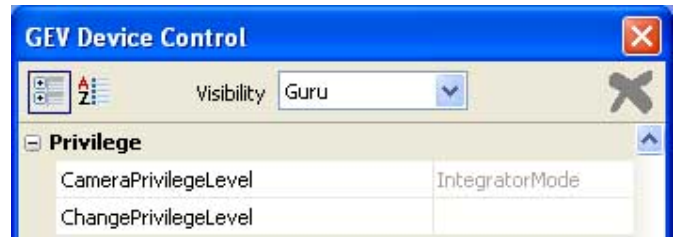
6.3.4 Privilege (Non SFNC)

There are 3 privilege levels for the camera :

- Factory (0) : Reserved for the Factory
- Integrator (1) : Reserved for system integrators
- User (2) : For all Users.

The Cameras are delivered in Integrator mode.

They can be locked in User mode and a specific password is required to switch back the Camera in Integrator mode. This password can be generated with a specific tool available from the hotline (hotline-cam@e2v.com)



None of these parameters and Section are defined with the SFNC.

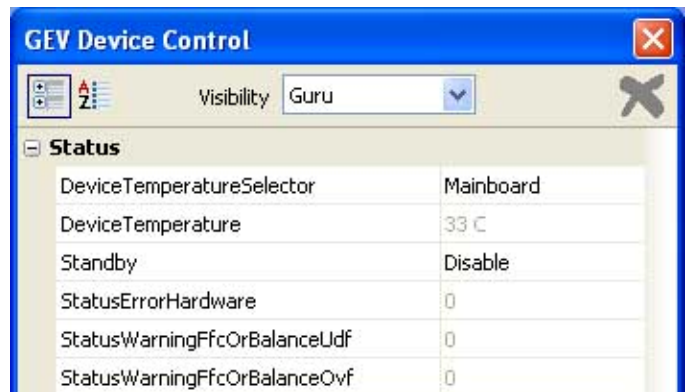
Name	Interface	Access	Visibility	Description
<i>CameraPrivilegeLevel</i> IntegratorMode UserMode	IEnumeration	R	E	Current Privilege Level. NON SFNC
<i>ChangePrivilegeLevel</i>	IIInteger	R/W	E	Input code to change privilege. NON SFNC

6.3.5 Status (Non SFNC)

This section doesn't exist in the SFNC. Except the *DeviceTemperature* features (usually defined in the DeviceControl Section), the other features are not defined also in the SFNC

The *StatusErrorHardware* is global for the Camera

The *StatusWarnings* are common for FFC and Tap Balance Processes.



The StandBy mode is a unique feature from the AVIIVA EMx series.

Name	Interface	Access	Visibility	Description
<i>DeviceTemperatureSelector</i> MainBoard	IEnumeration	R	E	Select the temp sensor location.
<i>DeviceTemperature</i>	IInteger	R	E	Temperature measured
<i>Standby</i>	IBoolean	R/W	E	Enable/Disable the Standby mode NON SFNC
<i>StatusErrorHardware</i>	IInteger	R	E	Status bit for an Hardware error NON SFNC
<i>StatusWarningFfcOrBalanceUdf</i>	IBoolean	R	E	Warning for Underflow after FFC or Balance NON SFNC
<i>StatusWarningFfcOrBalanceOvf</i>	IBoolean	R	E	Warning for Overflow after FFC or Balance NON SFNC

- **DeviceTemperature :**
Return by the camera : Temperature in Q10.2 format (8 bits signed + 2 bits below comma). Value is between -512 to 511 in °C.

The temperature Sensor is placed on the CCD driver Board, close to the Sensor itself.

The Temperature displayed is one of the highest possible in the Camera. Then it can be monitored to activate the standby mode, in case of too high temperature (see insert below)

The limits are always referenced by the internal temperature sensor. (cf APPENDIX B : Thermal Management)



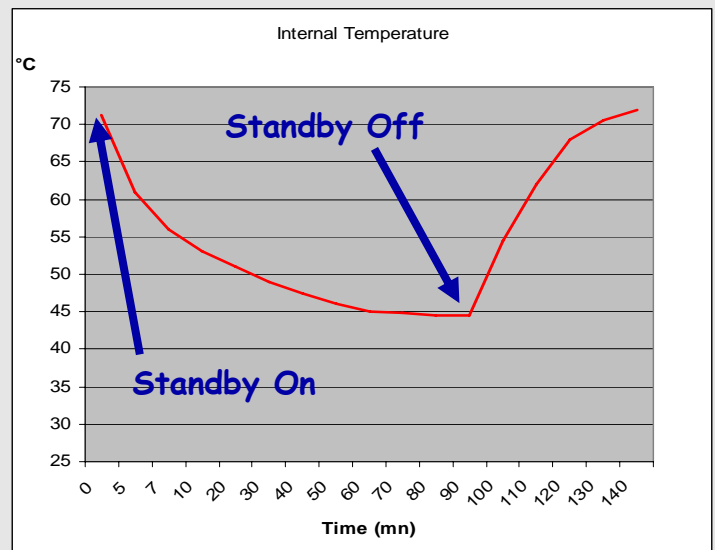
A standby mode, what for ?

The Standby mode stops all activity on the sensor level. The power dissipation drops down to less than 5W. During the standby mode, the Camera carry on sending black images through the CameraLink outputs in order to avoid any disruption in the application system.

Once the Standby mode turned off, the Camera recovers in less than 1ms to send images again from the sensor.



But it's necessary to grab an image of about 100 lines because these first lines after the Sensor Power down don't have a correct level (due to the re-establishment of the black reference level).



6.3.6 AcquisitionControl

The Acquisition Control section describes all features related to image acquisition, including the trigger and exposure control. It describes the basic model for acquisition and the typical behavior of the device.

An **Acquisition** is defined as the capture of a sequence of one or many **Frame(s)**

A **Frame** is defined as the capture of **Width** pixels x **Height** lines.

A **Line** starts with an optional **Exposure** period and ends with the completion of the sensor read out..

The **AcquisitionMode** controls the mode of acquisition for the device. This mainly affects the number of frames captured in the Acquisition (**SingleFrame**, **MultiFrame**, **Continuous**).

The **AcquisitionStart** command is used to start the Acquisition.

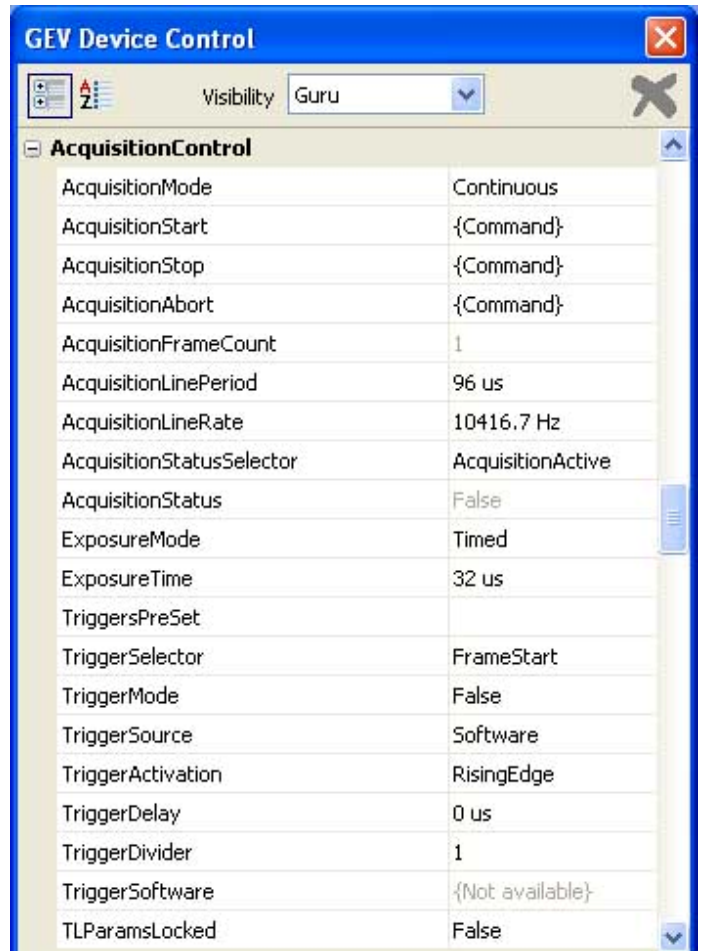
The **AcquisitionStop** command will stop the Acquisition at the end of the current Frame. It can be used in any acquisition mode and if the camera is waiting for a trigger, the pending Frame will be cancelled.

The **AcquisitionAbort** command can be used to abort an Acquisition at any time. This will end the capture immediately without completing the current Frame.

AcquisitionFrameCount controls the number of frames that will be captured when **AcquisitionMode** is **MultiFrame**.

AcquisitionLinePeriod controls the period of each Line. The **AcquisitionLineRate** is calculated from this value.

AcquisitionStatusSelector and **AcquisitionStatus** can be used to read the status of the internal acquisition signals. The standard acquisition signals Status are: **AcquisitionTriggerWait**, **AcquisitionActive**, **FrameTriggerWait**, **FrameActive**,



Name	Interface	Access	Visibility	Description
AcquisitionMode SingleFrame MultiFrame Continuous	IEnumeration	R/W	B	Sets the acquisition mode of the device.
AcquisitionStart	ICommand	(R)/W	B	Starts the Acquisition of the device.
AcquisitionStop	ICommand	(R)/W	B	Stops the Acquisition of the device at the end of the current Frame.
AcquisitionAbort	ICommand	(R)/W	E	Aborts the acquisition immediately.
AcquisitionFrameCount	IInteger	R/W	B	Number of frames to acquire in MultiFrame Acquisition mode.
AcquisitionLinePeriod	IFloat	R/W	B	Controls the line period (in μ s)
AcquisitionLineRate	IFloat	R/W	B	Gives the equivalent line rate (in Hertz)
AcquisitionStatusSelector AcquisitionTriggerWait AcquisitionActive FrameTriggerWait FrameActive	IEnumeration	R/W	E	Selects the internal acquisition signal to read using AcquisitionStatus.
AcquisitionStatus	IBoolean	R	E	Reads the state of the internal acquisition signal selected using AcquisitionStatusSelector.
ExposureMode Timed TriggerWidth TriggerControlled	IEnumeration	R/W	B	Selects the type of trigger to configure.
ExposureTime	IFloat	R/W	B	Sets the internal exposure time of the camera (in μ s)
TriggerPreset ContinuousTimedMode TriggeredTimedMode TriggeredTimedModeWithFrameTrigger TriggeredWidthMode TriggeredWidthModeWithFrameTrigger ITCMaxMode ITCMaxModeWithFrameTrigger ITCMode ITCModeWithFrameTrigger	IEnumeration	R/W	B	NON SFNC Sets automatically the camera in a list of Pre-selected Trigger modes equivalent to the existing CameraLink versions of e2v Cameras. See below for details of each mode.

Name	Interface	Access	Visibility	Description
<i>TriggerSelector</i> AcquisitionStart AcquisitionEnd AcquisitionActive FrameStart FrameEnd FrameActive ExposureStart ExposureEnd ExposureActive	IEnumeration	R/W	B	Selects the type of trigger to configure.
<i>TriggerMode</i> Off On	IEnumeration	R/W	B	Controls if the selected trigger is active.
<i>TriggerSource</i> Line0 Line1 Line2, Timer1End Timer2End Counter1End Counter2End UserOutput0 UserOutput1 UserOutput2 UserOutput3 UserOutput4	IEnumeration	R/W	B	Specifies the internal signal or physical input Line to use as the trigger source.
<i>TriggerActivation</i> RisingEdge FallingEdge AnyEdge LevelHigh LevelLow	IEnumeration	R/W	B	Specifies the activation mode of the trigger.
<i>TriggerDelay</i>	IFloat	R/W	B	Specifies the delay in microseconds (us) to apply after the trigger reception before activating it.
<i>TriggerDivider</i>	IInteger	R/W	B	Specifies a division factor for the incoming trigger pulses.
<i>TriggerSoftware</i>	ICommand	R/W	B	Not available
<i>TLParamsLocked</i>	IBoolean	R/W	B	

6.3.6.1 Trigger Presets

Some synchronization modes are defined as preset in the Camera (*TriggerPreset*, Non SFNC Parameter). When selecting one of these Preset, the Camera sets automatically a list a parameters in the corresponding position to be in accordance with the mode defines as below :

- **ContinuousTimedMode**

- Line Period defined by Acquisition Line Period feature.
- Exposure time defined with Exposure Time feature.

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	Timed
TriggerSelector	"All values"
TriggerMode	Off

- **TriggeredTimedMode**

- Exposure started upon the rising edge of the Line 0 trigger.
- Exposure time defined with Exposure Time feature.

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	Timed
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge

- **TriggeredTimedModeWithFrameTrigger**

- Exposure started upon the rising edge of the Line 0 trigger.
- Exposure time defined with Exposure Time feature.
- Frame started with Line 2 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	Timed
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	FrameActive
TriggerMode	On
TriggerSource	Line2
TriggerActivation	LevelHigh
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge

- **TriggeredWidthMode**
 - Exposure started upon Line 0 trigger.
 - Exposure time defined with Line0 trigger width

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerWidth
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	ExposureActive
TriggerMode	On
TriggerSource	Line0
TriggerActivation	LevelHigh

- **TriggeredWidthModeWithFrameTrigger**
 - Exposure started upon Line 0 trigger.
 - Exposure time defined with Line0 trigger width.
 - The Frame is valid on the high level of the Line 2 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerWidth
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	FrameActive
TriggerMode	On
TriggerSource	Line2
TriggerActivation	LevelHigh
TriggerSelector	ExposureActive
TriggerMode	On
TriggerSource	Line0
TriggerActivation	LevelHigh

- **ITCMaxMode**

- Exposure started upon Timer1End.
- Exposure ended upon Line0 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerControlled
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Timer1End
TriggerActivation	RisingEdge
TriggerSelector	ExposureEnd
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge
TimerSelector	Timer1
TimerTriggerSource	Line0
TimerTriggerActivation	RisingEdge
TimerDelayAbs	0
TimerDurationAbs	1

The Timer1 is set to be equivalent to the readout time

- **ITCMaxModeWithFrameTrigger**

- Exposure started upon Timer1End.
- Exposure ended upon Line0 trigger.
- The Frame is valid on the high level of the Line 2 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerControlled
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	FrameActive
TriggerMode	On
TriggerSource	Line2
TriggerActivation	LevelHigh
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Timer1End
TriggerActivation	RisingEdge
TriggerSelector	ExposureEnd
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge
TimerSelector	Timer1
TimerTriggerSource	Line0
TimerTriggerActivation	RisingEdge
TimerDelayAbs	0
TimerDurationAbs	1

- **ITCMode**

- Exposure started upon Line 0 trigger.
- Exposure ended upon Line1 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerControlled
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge
TriggerSelector	ExposureEnd
TriggerMode	On
TriggerSource	Line1
TriggerActivation	RisingEdge

- **ITCModeWithFrameTrigger**

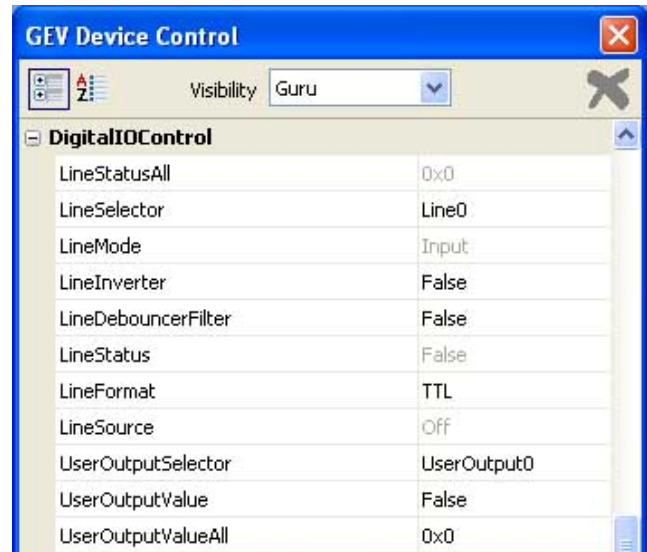
- Exposure started upon Line 0 trigger.
- Exposure ended upon Line1 trigger.
- The Frame is valid on the high level of the Line 2 trigger

Parameter	Value
AcquisitionMode	Continuous
ExposureMode	TriggerControlled
TriggerSelector	"All values"
TriggerMode	Off
TriggerSelector	FrameActive
TriggerMode	On
TriggerSource	Line2
TriggerActivation	LevelHigh
TriggerSelector	ExposureStart
TriggerMode	On
TriggerSource	Line0
TriggerActivation	RisingEdge
TriggerSelector	ExposureEnd
TriggerMode	On
TriggerSource	Line1
TriggerActivation	RisingEdge

6.3.7 DigitalIOControl

Digital I/O covers the features required to control the general Input and Output signals of the camera. This includes Input and output control signals for Triggers Timers, counters and also static signals such as User configurable input or output bits.

The Digital I/O Control section models each I/O **Line** as a physical line that comes from the device connector and that goes into an **I/O Control Block** permitting to condition and to monitor the incoming or outgoing **Signal**.



Name	Interface	Access	Visibility	Description
<i>LineStatusAll</i>	IInteger	R	E	Returns the current status of all available Line signals at time of polling in a single bitfield.
<i>LineSelector</i> Line0 Line1 Line2 Line3 Line4	IEnumeration	R/W	E	Selects the physical line (or pin) of the external device connector to configure.
<i>LineMode</i> Line0 : Input Line1 : Input Line2 : Input Line3 : Output Line4 : Output	IEnumeration	R	E	Indicates if the physical Line is used to Input or Output a signal.
<i>LineInverter</i>	IBoolean	R/W	E	Controls the inversion of the signal of the selected input or output Line.
<i>LineDebounceFilter</i>	IBoolean	R/W	E	Activates the Internal debounce filter of the selected input line. The debounce filtering time is fixed at about 0.7µs.
<i>LineStatus</i>	IBoolean	R	E	Returns the current status of the selected input or output Line.
<i>LineFormat</i> TTL LVDS RS422	IEnumeration	R/W	E	Controls the current electrical format of the selected physical input or output Line.

Name	Interface	Access	Visibility	Description
<i>LineSource</i> Off AcquisitionTriggerWait AcquisitionActive FrameTriggerWait FrameActive ExposureActive Timer1Active Timer2Active Counter1Active, Counter2Active UserOutput0 UserOutput1 UserOutput2 UserOutput3 UserOutput4 MissedTrigger	IEnumeration	R/W	E	Selects which internal acquisition or I/O source signal to output on the selected Line.
<i>UserOutputSelector</i> UserOutput0 UserOutput1 UserOutput2 UserOutput3 UserOutput4	IEnumeration	R/W	E	Selects which bit of the User Output register will be set by UserOutputValue.
<i>UserOutputValue</i>	IBoolean	R/W	E	Sets the value of the bit selected by UserOutputSelector.
<i>UserOutputValueAll</i>	IInteger	R/W	E	Sets the value of all the bits of the User Output register.
<i>UserOutputValueAllMask</i>	IInteger	R/W	E	Sets the write mask to apply to the value specified by UserOutputValueAll before writing it in the User Output register.

6.3.8 CounterAndTimerControl

This section lists all features that relates to control and monitoring of Counters and Timers.

A Counter is used to count internal events (FrameStart, FrameTrigger, ...), I/O external events (Input Line rising edge, ...) and even clock ticks. It can be Reset or Read at anytime. Counters and Timers can also be cascaded to increase their range if necessary.

Timers are readable and can be used to measure the duration of internal or external signals. A Timer can also be used to generate a timed strobe pulse with an optional delay before activation.

In AVIIVA EM1 camera, 2 x Counters and 2 x Timers are available and are used in different applications:

- A Counter is used to count internal events. Ex: number of frame trigger, number of line started...
- A timer is used to measure the duration from an event. Ex: starts the Frame Acquisition 200 μ s after the reception of a Frame Trigger.

- **Counter :**

To start counter there are several possibilities:

- There is no condition to start the counter (**CounterTriggerSource = Off**), the counter increment each time the event occurs.
- There is a condition on the start of the counter: this condition has to be selected in the enumeration of the **CounterTriggerSource** feature and the activation with **CounterTriggerActivation** feature.

The counter stops incrementing if :

- The **CounterDuration** feature is equal to the CounterValue, even if a new event selected occur no new increment of the counter and no reset happened.
- A Reset happened either due to the **CounterReset** command (Enable with **CounterResetSource=Software**) or due to an external event happened on Inputs (Enable with **CounterTriggerSource** and **CounterTriggerActivation** features). If a new event happens the counter starts from 0 to count if condition of start is true.

CounterAndTimerControl	
CounterSelector	Counter1
CounterTriggerSource	Off
CounterTriggerActivation	RisingEdge
CounterEventSource	Off
CounterEventActivation	RisingEdge
CounterDuration	0
CounterResetSource	Off
CounterResetActivation	RisingEdge
CounterReset	{Command}
CounterValue	0
CounterValueAtReset	0
CounterStatus	CounterIdle
TimerSelector	Timer1
TimerTriggerSource	Off
TimerTriggerActivation	RisingEdge
TimerDuration	0 us
TimerDelay	0 us
TimerValue	0 us
TimerStatus	TimerIdle

Name	Interface	Access	Visibility	Description
<i>CounterSelector</i> Counter1 Counter2	IEnumeration	R/W	E	Selects which counter to configure.
<i>CounterTriggerSource</i>	IEnumeration	R/W	E	Selects the source to start the counter.
<i>CounterTriggerActivation</i>	IEnumeration	R/W	E	Selects the activation mode of the trigger to start the counter.
<i>CounterEventSource</i> Off AcquisitionStart AcquisitionEnd AcquisitionTrigger FrameStart FrameEnd FrameTrigger ExposureStart ExposureEnd Line0 Line1 Line2 Counter1End Counter2End Timer1End Timer2End TimeStampTick MissedTrigger	IEnumeration	R/W	E	Select the events that will be the source to increment the counter.
<i>CounterEventActivation</i> RisingEdge FallingEdge AnyEdge LevelHigh LevelLow	IEnumeration	R/W	E	Selects the Activation mode Event Source signal.
<i>CounterDuration</i>	IIInteger	R/W	E	Sets the duration (or number of events) before the CounterEnd event is generated.
<i>CounterResetSource</i> Off Software Line0 Line1 Line2	IEnumeration	R/W	E	Selects the signals that will be the source to reset the counter.
<i>CounterResetActivation</i> RisingEdge FallingEdge AnyEdge LevelHigh LevelLow	IEnumeration	R/W	E	Selects the Activation mode counter Reset Source signal.
<i>CounterReset</i>	ICommand	(R)/W	E	Does a software reset of the selected counter.
<i>CounterValue</i>	IIInteger	R/W	E	Reads or writes the current value of the selected counter.

Name	Interface	Access	Visibility	Description
<i>CounterValueAtReset</i>	IInteger	R	E	Reads the value of the selected counter when it was reset by a trigger or by an explicit CounterReset cmd.
<i>CounterStatus</i> CounterIdle CounterTriggerWait CounterActive CounterCompleted CounterOverflow	IEnumeration	R	E	Returns the current state of the counter.

- **Timer :**

The timer starts with the event occurred on the selected list of **TimerTriggerSource** feature (type of activation selected by **TimerTriggerActivation** feature).

The adjustment of the timer is performed with **TimerDuration** (time before the generation of the event **TimerEnd**) and a **TimerDelay** (Delay before starting the duration value) features.

If it happens a new event (which is selected to start the timer) timer reset before restart the duration.

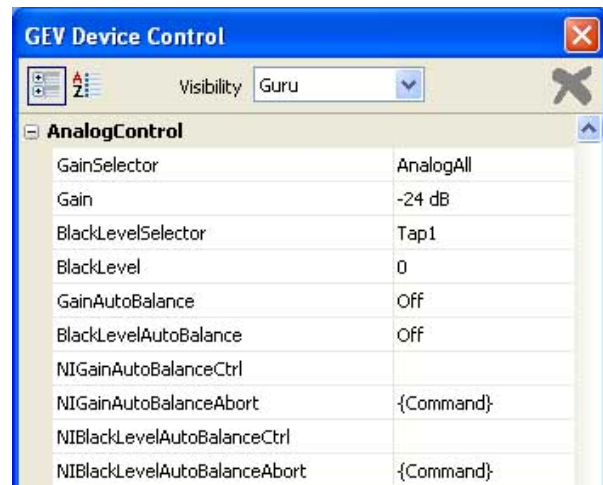
Name	Interface	Access	Visibility	Description
<i>TimerSelector</i> Timer1 Timer2	IEnumeration	R/W	E	Selects which Timer to configure.
<i>TimerTriggerSource</i> Off AcquisitionStart AcquisitionEnd AcquisitionTrigger FrameStart FrameEnd FrameTrigger ExposureStart ExposureEnd Line0 Line1 Line2 Counter1End Counter2End Timer1End Timer2End TimeStampTick MissedTrigger	IEnumeration	R/W	E	Selects the source of the trigger to start the Timer.
<i>TimerTriggerActivation</i> RisingEdge FallingEdge AnyEdge LevelHigh LevelLow	IEnumeration	R/W	E	Selects the activation mode of the trigger to start the Timer.
<i>TimerDuration</i>	IFloat	R/W	E	Sets the duration (in μs) of the Timer pulse.
<i>TimerDelay</i>	IFloat	R/W	E	Sets the duration (in μs) of the delay to apply at the reception of a trigger before to start the Timer.

Name	Interface	Access	Visibility	Description
<i>TimerValue</i>	IFloat	R/W	E	Reads or writes the current value (in μs) of the selected Timer.
<i>TimerStatus</i> TimerIdle TimerTriggerWait TimerActive TimerCompleted	IEnumeration	R	E	Returns the current state of the Timer.

6.3.9 AnalogControl

This section describes the features relative to the camera Gains and Offsets :

- Analog Gain
- Digital Gain and Offset
- Tap Balance (Gains and Offsets)



Name	Interface	Access	Visibility	Description
<u>GainSelector</u> AnalogAll All DigitalTap1 DigitalTap2 DigitalTap3 DigitalTap4 <u>DigitalAll</u>	IEnumeration	R/W	B	Selects which Gain is controlled by the various Gain features.
<u>Gain</u>	IFloat	R/W	B	Controls the selected gain as an absolute physical value.
<u>BlackLevelSelector</u> DigitalTap1 DigitalTap2 DigitalTap3 DigitalTap4 All	IEnumeration	R/W	E	Selects which Black Level is controlled by the various Black Level features.
<u>BlackLevel</u>	IFloat	R/W	E	Controls the analog black level as an absolute physical value.
<u>GainAutoBalance</u>	IEnumeration	R/W	B	Sets the mode for automatic gain balancing between the sensor taps.
<u>BlackLevelAutoBalance</u>	IEnumeration	R/W	B	Controls the mode for automatic black level balancing between the sensor taps.
<u>NIGainAutoBalanceCtrl</u>	ICommand	R/W	B	Same as GainAutoBalance but for NI (National Instruments) driver. Compatibility issue.
<u>NIGainAutoBalanceAbort</u>	ICommand	R/W	B	Abort for function GainAutoBalance only for NI driver.
<u>NIBlackLevelAutoBalanceCtrl</u>	ICommand	R/W	B	Same as BlackLevelAutoBalance but for NI (National Instruments) driver. Compatibility issue.
<u>NIBlackLevelAutoBalanceAbort</u>	ICommand	R/W	B	Abort for function BlackLevelAutoBalance only for NI driver.



Ultimate Concept: A different way to set the Gain in order to improve the Tap balance

The "U" Concept has been developed to get a real improvement in term of tuning for the multi-Tap sensors : As each sensor tap is driven by a different analog Chain, for an increasing of the global gain of the Camera, each tap can have a different behavior on its own Gain and offset. This means that to be perfectly adjusted, a balance of the taps should be performed ideally after each change of the Gain. The Ultimate Concept offers a solution as following:

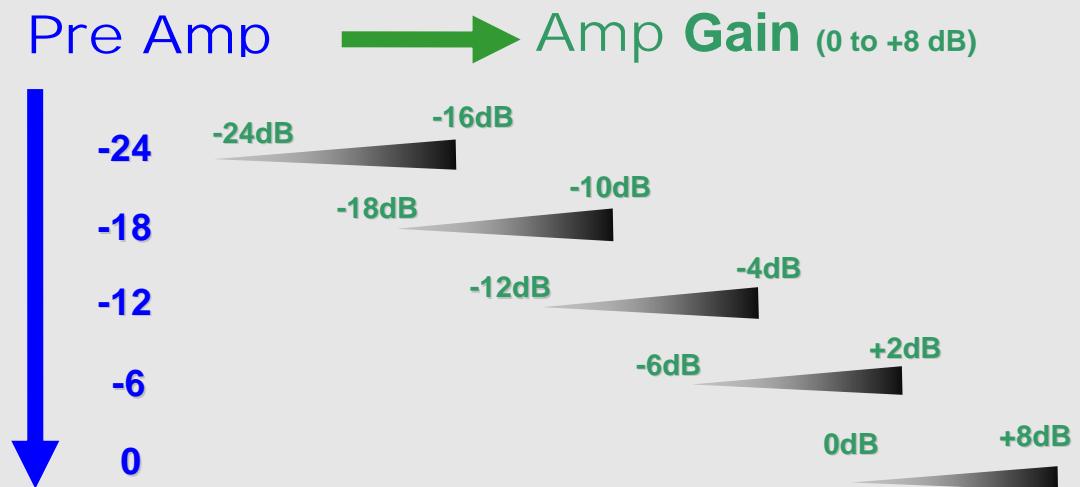
The Global analog Gain of the Camera is divided in 2 parts :

- A preamp-Gain which is composed of several steps (5 x steps of 6dB, from -24dB to 0dB on the AVIIVA EMx series)
- An amplification Gain with a continuous tuning (from 0dB to +8dB on the AVIIVA EMx series)

At each step of Preamp Gain, a Tap balance has been performed in factory for both Gains and Offsets and saved in ROM memory. When a new value of Preamp Gain is set, the factory settings of the both Gain and offset balance is automatically reloaded.

For sure, the user can also perform his own balance (automatically or manually) and can save it in one of the four dedicated memory banks.

After the Preamp Gain level, the user can add more gain by using the Amplification Gain:

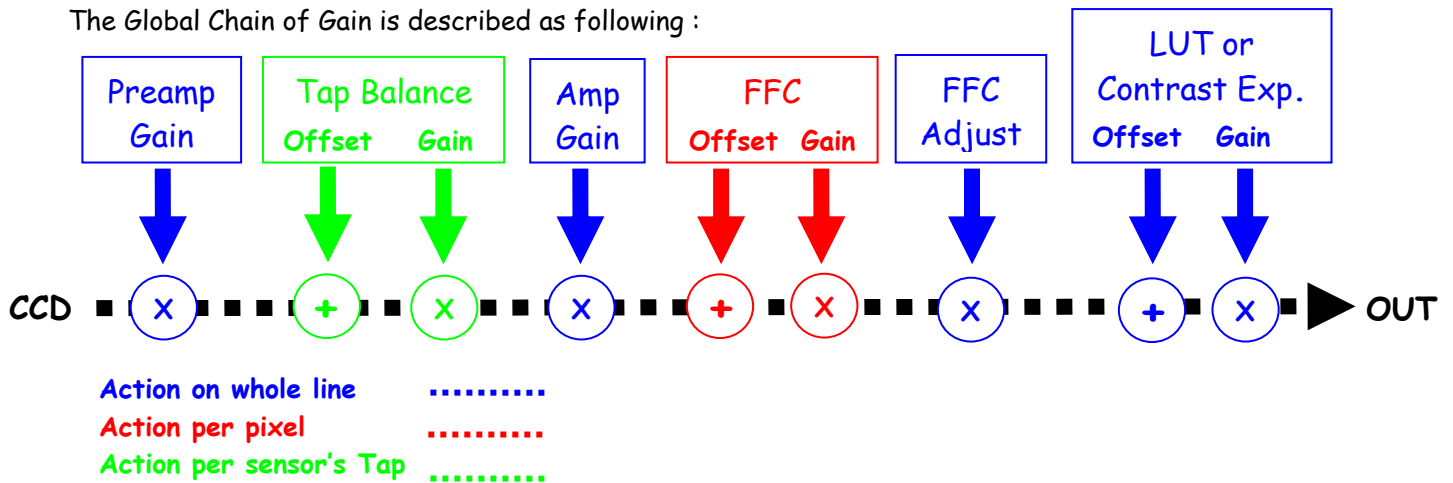


- The best tuning is when the Amplification Gain is set at its minimum possible
- Each change of Preamp Gain value loads automatically the associated values of the Tap balance (Gain and offset for each sensor tap).



This action takes more time than simply changing the Amplification Gain

The Global Chain of Gain is described as following :



6.3.9.1 Analog Gain

- **Preamp Gain:** (*GainAbs* with *GainSelector= AnalogAll*)

The Preamp Gain is set by step of 6dB :

- 0 : (-24dB)
- 1 : (-18dB)
- 2 : (-12dB)
- 3 : (-6dB)
- 4 : (0dB)

- **Gain:** (*GainAbs* with *GainSelector= GainAll*)

Value from 0 to 6193 corresponding to a Gain range of 0dB to +8dB calculated as following :

$$\text{Gain(dB)} = 20 \cdot \log(1 + \text{Gain}/4096).$$

6.3.9.2 Digital Gain & Offset (Contrast Expansion)

- **Digital Gain** (*GainAbs* with *GainSelector= DigitalAll*).

Integer value from 0 to 255.

The corresponding Gain is calculated as $20 \log(1 + \text{val}/64)$ in dB

- **Digital Offset** (*BlackLevelRaw* with *BlackLevelSelector= All*)

Value from -4096 to +4095 in LSB



The Contrast Expansion (both Digital Gain & Offset) will be automatically disabled if the LUT is enabled..

6.3.9.3 Tap Balance



How to perform a Tap Balance ?

Why and when performing a Tap Balance ?

Each output of the sensor (Tap) has its own analog Chain and behavior. There could have some discrepancies between these outputs in extreme conditions of Gain or temperature

The Tap balance is already performed in factory for each level of Preamp-Gain. If necessary, the Tap balance can be performed again by the User on both Offsets and Gains

The Procedure is the following :

Tap Balance by Offsets

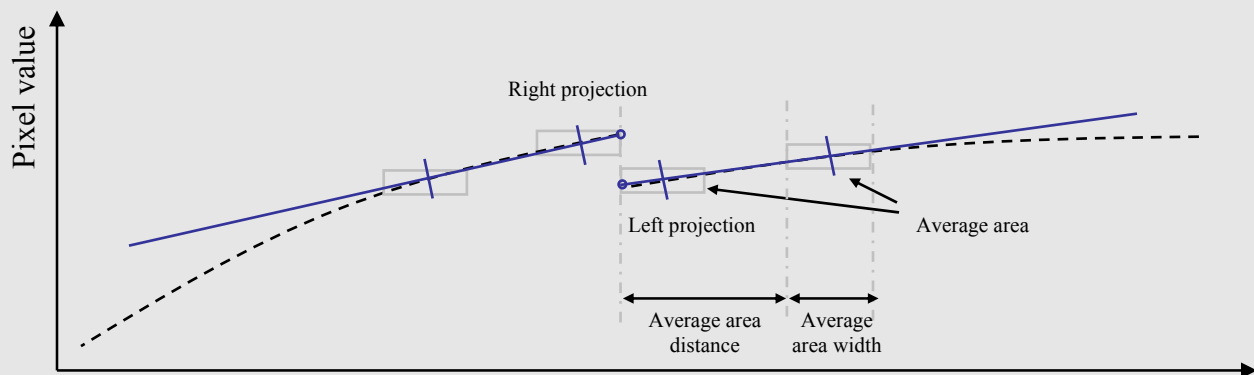
- Cover the Lens of the camera to get a dark uniform target. This is not recommended to perform an Offset balance under light conditions.
- Launch the Tap Offset Balance
- The process takes a few seconds and can be interrupted when you want

Tap Balance by Gains

- Provide an uniform light target to the camera : This is recommended to have a global level of around at least 70% of the saturation, otherwise, with a low light level (< 30% of the Saturation) the Gain has less effect than the Offset and your balancing won't be efficient.
- Launch the Tap Gain Balance
- The process takes a few seconds and can be interrupted when you want
- You can save the result in memory (result for both Gains and offsets).

Internal Process

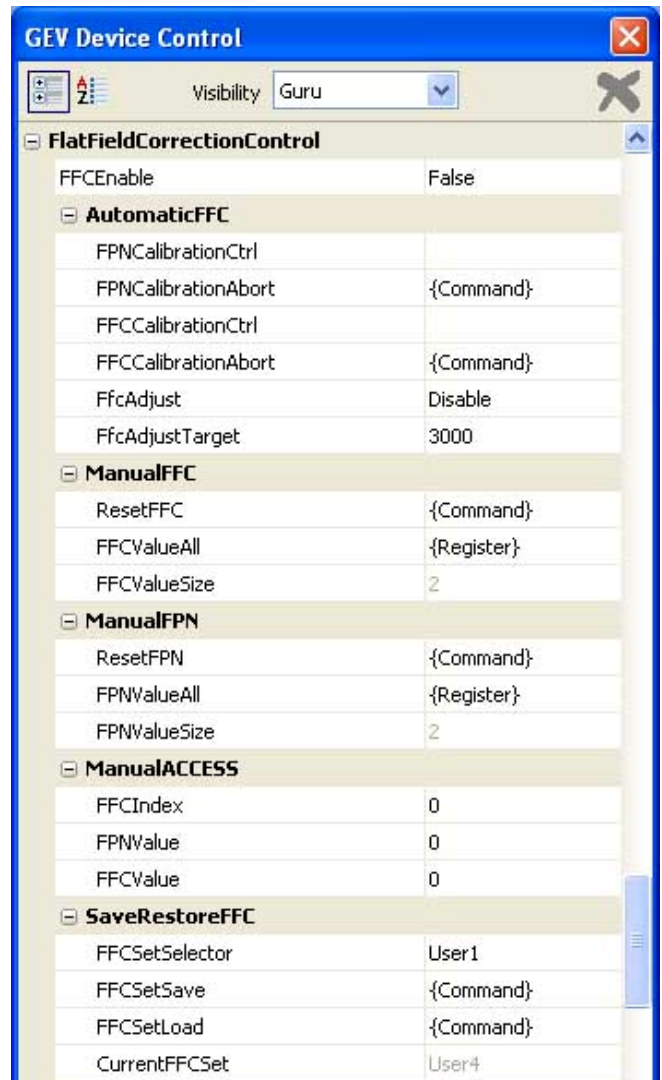
During the calibration process, the Camera calculates averages on some strategic ROIs (around the junction between taps) and then estimates the slope of the tangents and then the projections on each side of the junction.



The adjustment between these two neighbor taps is calculated to cancel the difference between the two projections (right and left).

6.3.10 FlatFieldCorrectionControl

All these features are out of the SFNC standard. The functions are exactly the same as the EMx series in Cameralink interface.



Some Warnings can be issued from the PRNU/FPN Calibration Process as "pixel Overflow" or "Pixel Underflow" because some pixels have been detected as too high or too low in the source image to be corrected efficiently.

The Calculation result will be proposed anyway as it's just a warning message.

The Status Register is changed and displayed in "Status" section (detailed chap S6.4.5)

Name	Interface	Access	Visibility	Description
<i>FFCEnable</i>	IBoolean	R/W	B	Enables or disables the current FFC
<i>FPNCalibrationCtrl</i>	ICommand	R/W	B	Starts the FPN (DSNU) calibration. The Camera must be in black and ready to grab (triggering active)
<i>FPNCalibrationAbort</i>	ICommand	R/W	B	Abort the running FPN Calibration Process
<i>FFCCalibrationCtrl</i>	ICommand	R/W	B	Starts the FFC (PRNU) calibration. The Camera must be in the non saturating and ready to grab (triggering active)
<i>FFCCalibrationAbort</i>	ICommand	R/W	B	Abort the running PRNU Calibration Process
<i>FFCAdjust</i>	IBoolean	R/W	B	Enables or disables the FFC Adjust function (see below)
<i>FFCAdjustTarget</i>	IIInteger	R/W	B	Sets the Target value (in LSB 12bits) for the FFC Adjust function.
<i>ResetFFC</i>	ICommand	R/W	B	Reset all the current FFC (Gains) parameters.
<i>FFCValueAll</i>	IRegister	R/W	G	Accesses all the current FFC (Gains) coefficients in a single access without using individual FFCIndex.
<i>FFCValueSize</i>	IIInteger	R	G	Indicates the size (in Bytes) of FFC (Gains) coefficients
<i>ResetFPN</i>	ICommand	R/W	B	Reset all the current FPN (Offsets) parameters.
<i>FPNValueAll</i>	IRegister	R/W	G	Accesses all the current FPN (Offsets) coefficients in a single access without using individual FFCIndex.
<i>FPNValueSize</i>	IIInteger	R	G	Indicates the size (in Bytes) of FPN (Offsets) coefficients
<u><i>FFCIndex</i></u>	IIInteger	R/W	G	Control the index (offset) of the coefficient to access in the current LUT
<i>FPNValue</i>	IFloat	R/W	G	Returns or set the FPN (Offset) Value at entry FFCIndex of the current FFC.
<i>FFCValue</i>	IFloat	R/W	G	Returns or set the PRNU (Gain) Value at entry FFCIndex of the current FFC.
<u><i>FFCSetSelector</i></u> User1 User2 User3 User4	IEnumeration	R/W	G	Selects the FFC memory to save/load
<i>FFCSetSave</i>	ICommand	R/W	G	Save the current FFC
<i>FFCSetLoad</i>	ICommand	R/W	G	Load the FFC in the memory defined by FFCSelector in the current FFC.
<i>CurrentFFCSet</i>	IIInteger	R	G	Indicates the last FFC memory has been Saved/loaded and is active



How is performed the Flat Field Correction ?

What is the Flat Field correction (FFC) ?

The Flat Field Correction is a digital correction on each pixel which allows :

- To correct the Pixel PRNU (Pixel Response Non Uniformity) and DSNU (Dark Signal Non Uniformity)
- To Correct the shading due to the lens
- To correct the Light source non uniformity



How is calculated / Applied the FFC ?

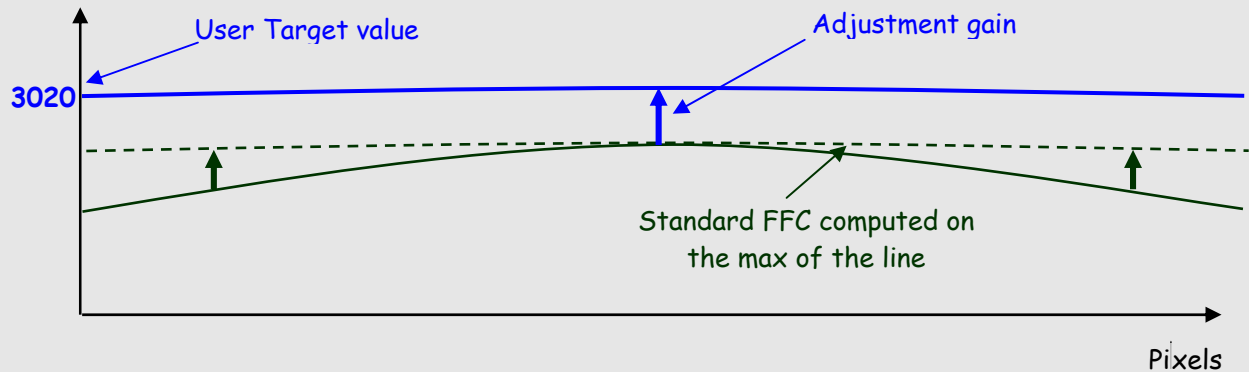
The FFC is a digital correction on the pixel level for both *Gain* and *Offset*.

- Each Pixel is corrected with :
 - An *Offset* on 8 bits (Signed Int 5.3). They cover a dynamic of $\pm 16\text{LSB}$ in 12bits with a resolution of $1/8 \text{ LSB}$ 12bits.
 - A *Gain* on 14 bits (Unsigned Int 14) with a max gain value of $\times 3$
 - The calculation of the new pixel value is : $P' = (P + \text{Off}).(1 + \text{Gain}/8192)$

The FFC processing can be completed with an automatic adjustment to a global target. This function is designed as "**FFC Adjust**". This adjustment to a User target is done by an internal hidden gain which is recalculated each time the FFC is processed while the FFC adjust function is enabled.

The FFC is always processed with the max pixel value of the line as reference. If enabled, the FFC adjust module (located at the output of the FFC module) calculates the adjustment gain to reach the target defined by the User.

When the FFC result is saved in memory, the adjust gain and target are saved in the same time in order to associate this gain value with the FFC result.



How to perform the Flat Field Correction ?

FPN/DSNU Calibration

- Cover the lens
- Launch the FPN Calibration : Grab and calculation is performed in few seconds

PRNU Calibration

The User must propose a white/gray uniform target to the Camera (not a fixed paper).

The Gain/Light conditions must give a non saturated image in any Line.

The Camera must be set in the final conditions of Light/ Gain and in the final position in the System.

If required, set a user target for the FFC adjust and enable it.

- White uniform (moving) target
- Launch the FFC
- Enable the FFC
- You can save the FFC result (both FPN+PRNU in the same time) in one of the 4 x FFC User Banks.
- The user target and Gain are saved with the associated FFC in the same memory.

Advices

The AVIIVA EM1 Cameras have 4 x FFC Banks to save 4 x different FFC calibrations. You can use this feature if your system needs some different conditions of lightning and/or Gain because of the inspection of different objects : You can perform one FFC per condition of Gain/setting of the Camera (4 Max) and recall one of the four global settings (Camera Configuration + FFC + Line Balance) when required.



FFC Adjust : A good usage.

When there are several Cameras to set up in a system on a single line, the most difficult is to have a uniform lightning whole along the line.

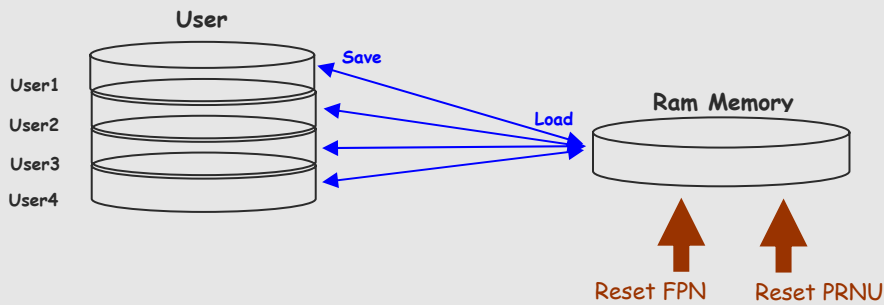
If each Camera performs its own Flat field correction, relative to the max of each pixel line, the result will be a succession of Camera lines at different levels.

=> The FFC Adjust function allows to set the same target value for all the Cameras in the system and then to get a perfect uniform line whole along the system with a precision of 1 LSB to the Target.

The reasonable value for the User Target is not more than around 20% of the max value of the line.



FFC User Bank Usage



At the power up :
 - Last User Bank used is loaded in RAM
Reset a User bank :
 - Reset the RAM (FPN/PRNU individually)
 - Save in the bank to reset

6.3.11 LUTControl

The User can define or upload a LUT in the Camera that can be used at the end of the processing.

The LUT is defined as a correspondence between each of the 4096 gray levels (in 12 bits) with another outputted value. For example, a "negative" or "reverse" LUT is the following equivalence :

Real value	Output value
0	4095
1	4094
2	4093

Then the size of each value is 12bits but the exchanges with the Application/PC are done on 16 bits :

For 4096 gray levels (from 0 to 4095) the total file size for a LUT is 8Ko.

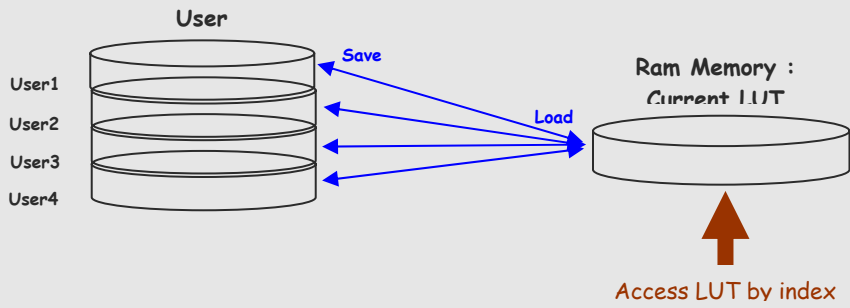


If the LUT is enabled, The Contrast Expansion (both Digital Gain & Offset) will be automatically disabled..

Name	Interface	Access	Visibility	Description
LUTEnable	IBoolean	R/W	E	Activates the current LUT.
LUTValueAll	IRegister	R/W	G	Accesses all the current LUT coefficients in a single access without using individual LUTIndex.
LUTValueSize	IInteger	R	G	Indicates the size (in Bytes) of LUT coefficient
LUTIndex	IInteger	R/W	G	Control the index (offset) of the coefficient to access in the current LUT
LUTValue	IInteger	R/W	G	Returns or set the Value at entry LUTIndex of the current LUT.
LUTSetSelector User1 User2 User3 User4	IEnumeration	R/W	G	Selects the LUT memory to save/load .
LUTSetSave	ICommand	R/W	G	Save the current LUT
LUTSetLoad	ICommand	R/W	G	Load the LUT in the memory defined by LUTSelector in the current LUT.
CurrentLUTSet	IInteger	R	G	Indicates the last LUT memory has been Saved/loaded and is active



LUT User Bank Usage



At the power up :
- Last User Bank used (CurrentLUTSet) is loaded in RAM
reset

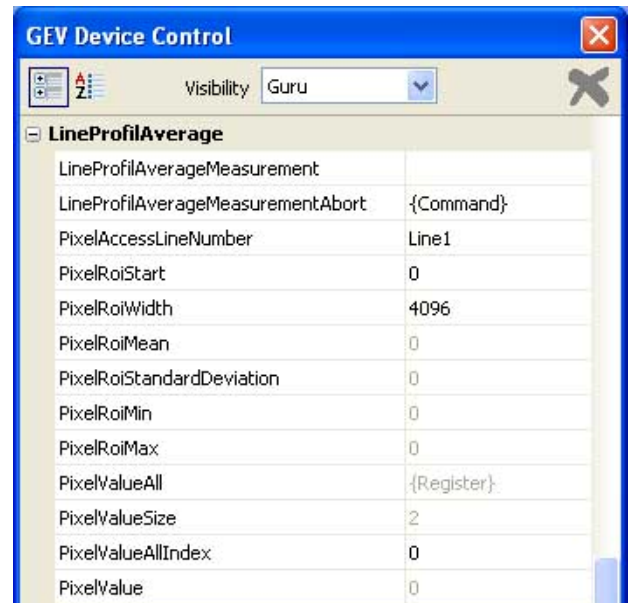
6.3.12 Statistics and Line Profile

This function allows the User to get some statistics on a pre-defined ROI. On request, the Camera acquires and then calculates some key values as the min, the max, the average or the standard deviation in this Region of Interest.

The grab and calculation command and also the collection of the results is not performed in real time as it is done through the register access.

The Calculated values are detailed as following :

- **Pixel average Value (*PixelROIMean*)** : Average gray level value calculated on whole Region of interest : Unsigned format value : U12.4
- **Pixel Standard deviation (*PixelROIStandardDeviation*)** : standard deviation of all the pixel gray level values of Region of interest : Unsigned format value : U12.4
- **Pixel Min value (*PixelROImin*)** : Minimum gray level pixel value on the whole region of interest.: Unsigned format value : U12.4
- **Pixel Max Value (*PixelROIMax*)** : Maximum gray level pixel value on the whole region of interest.: Unsigned format value : U12.4



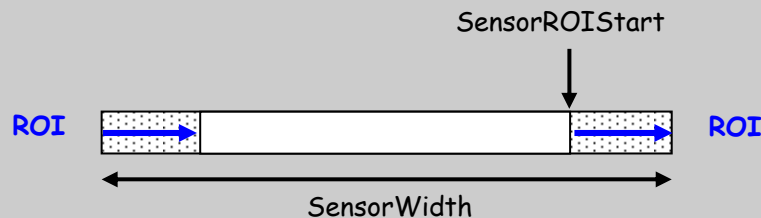
Name	Interface	Access	Visibility	Description
<i>LineAverageProfileMeasurement</i>	ICommand	R/W	E	Activates the current LUT.
<i>LineAverageProfileMeasurementAbort</i>	ICommand	R/W	G	Accesses all the current LUT coefficients in a single access without using individual LUTIndex.
<i>PixelAccessLineNumber</i> Line1 Line256 Line512 Line1024	IEnumeration	R/W	G	Select the number of lines to accumulate for the Line Profile processing : 1, 256, 512 or 1024 lines.
<i>PixelROIStart</i>	IInteger	R	G	Define the start of the ROI for the line processing.
<i>PixelROIWidth</i>	IInteger	R	G	Define the size of the ROI.
<i>PixelROIMean</i>	IFloat	R	G	Indicates the Average value on the ROI in LSB 12bits
<i>PixelROIStandardDeviation</i>	IFloat	R	G	Indicates the Standard deviation on the ROI in LSB 12bits
<i>PixelROImin</i>	IInteger	R	G	Indicates the Minimum Value on the ROI in LSB 12bits
<i>PixelROIMax</i>	IInteger	R	G	Indicates the Maximum Value on the ROI in LSB 12bits

Name	Interface	Access	Visibility	Description
<i>PixelValueAll</i>	IRegister	R	G	Accesses all the current Pixel values in a single access without using individual PixelValueAllIndex.
<i>PixelValueSize</i>	IInteger	R	G	Indicated the size (in Bytes) of Pixel values (2 bytes)
<u><i>PixelValueAllIndex</i></u>	IInteger	R	G	Control the index (offset) of the Pixel to access in the ROI
<i>PixelValue</i>	IInteger	R	G	Returns the Value of the Pixel in the ROI pointed by PixelAllValueIndex



If $\text{PixelROIStart} + \text{PixelROIWidth} > \text{SensorWidth}$, then end of the ROI is set at :
 $\text{PixelROIStart} + \text{PixelROIWidth} - \text{SensorWidth}$

It's the way to define a ROI composed of 2 x strips at the two sides of the sensor line :



6.3.13 SaveRestoreSettings

The settings (or Main configuration) of the Camera can be saved in 4 different User banks and one Integrator bank. This setting includes also the FFC and LUT enable parameters



Name	Interface	Access	Visibility	Description
<u>UserSetSelector</u> User1 User2 User3 User4 Integrator	IEnumeration	R/W	B	Selects the feature User Set to load or save.
<u>UserSetSave</u>	ICommand	(R)/W	B	Save the User Set specified by UserSetSelector to the non-volatile memory of the device.
<u>UserSetLoad</u>	ICommand	(R)/W	B	Loads the User Set specified by UserSetSelector to the device and makes it active.
<u>CurrentUserSet</u>	IInteger	R	B	Indicated the last User Set memory Saved/loaded



The integrator bank (5) can be written only if the Camera is set in integrator mode (Privilege level = 1). This integrator bank can be used as a « Factory default » by a system integrator.

6.3.14 FreeArea

In the memory of the camera there is a free area where the user can read and write his own values. This memory size is **1kByte** and allows the customer to save, for example, configuration of his system.

Feature **UserMemoryValueAll** is only available with the SDK and gives directly all memory values. It is possible to acces (R/W) with interactive tool if each block or 4 Bytes (32bits) written in this memory area with **UserMemoryIndex** and **UserMemoryValue** and save modifications with **UserMemorySave**.



Name	Interface	Access	Visibility	Description
<i>UserMemoryValueAll</i>	IRegister	R	G	Accesses all the Data in a single access without using individual UserMemoryAllIndex.
<i>UserMemoryValueSize</i>	IInteger	R	G	Indicated the size of the Data pointed by UserMemoryAllValueIndex (4 bytes)
<u><i>UserMemoryAllIndex</i></u>	IInteger	R	G	Control the index of each value to access in The User Memory area
<i>UserMemoryValue</i>	IInteger	R	G	Returns the data of the User Memory area pointed by UserMemoryAllValueIndex
<i>UserMemorySave</i>	ICommand	R	G	Save the User Memory in EEPROM

APPENDIX A : Test Patterns

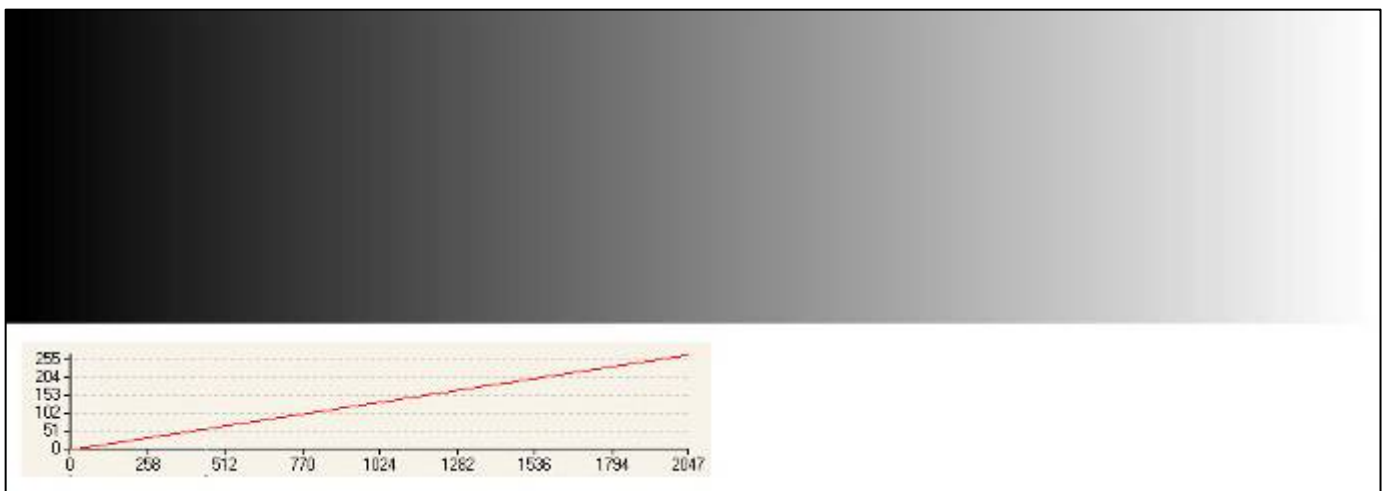
6.4 Test Pattern 1 : Vertical wave

The Test pattern 1 is a vertical moving wave : each new line will increment of 1 gray level in regards with the previous one.

- In 12 bits the level reaches 4095 before switching down to 0
- In 8 bits the level reaches 255 before switching down to 0

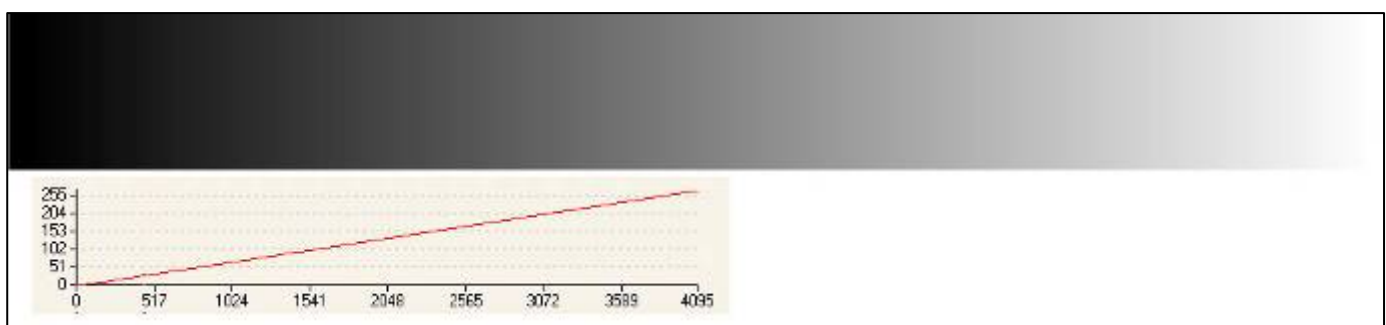
6.5 Test Pattern 2 : In 8 bits format

6.5.1 2048 Pixels



Pixel :	1	2	3	...	8	9	...	2040	2041	...	2047	2048
Value :	0	0	0	...	0	1	...	254	255	...	255	255

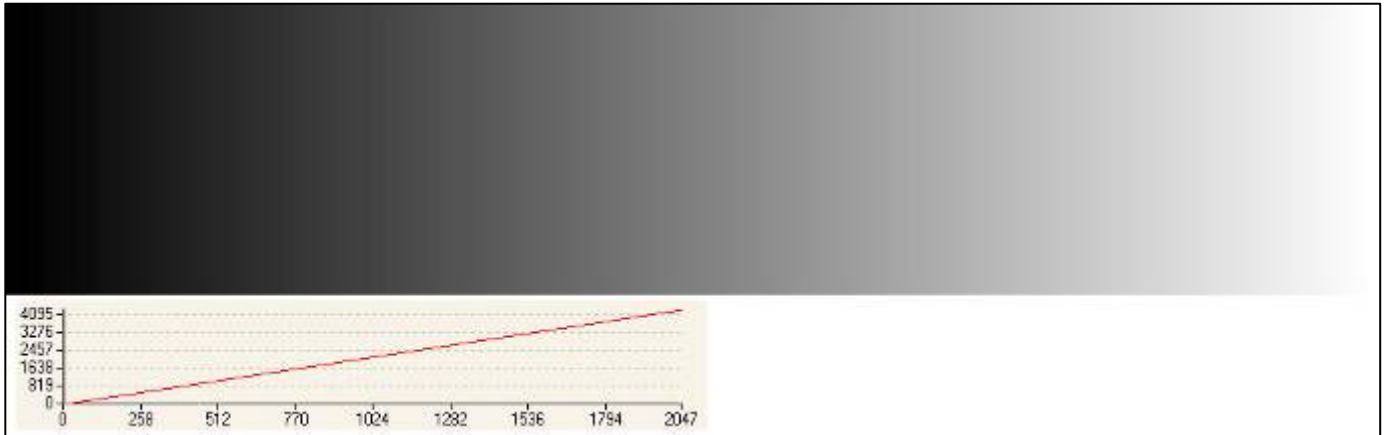
6.5.2 4096 Pixels



Pixel :	1	2	3	...	16	17	...	4080	4081	...	4095	4096
Value :	0	0	0	...	0	1	...	254	255	...	255	255

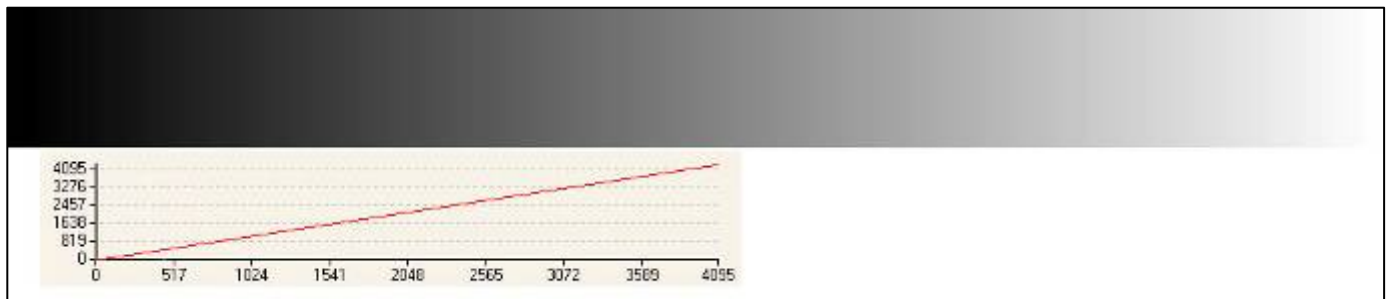
6.6 Test Pattern 2 : In 12 bits format

6.6.1 2048 Pixels



Pixel :	1	2	3	...	1024	1025	1026	...	2045	2046	2047	2048
Value :	0	2	4	...	2046	2049	2051	...	4089	4091	4093	4095

6.6.2 4096 Pixels



Pixel :	1	2	3	4	5	6	...	4092	4093	4094	4095	4096
Value :	0	1	2	3	4	5	...	4091	4092	4093	4094	4095

7 APPENDIX B : Thermal Management

7.1 Heat Sinks

The most important source of heat in the camera is around the sensor.

The EM1 Camera dissipates around 11W max with 4 taps at 31.25MHz (4K pixels version)

The Camera has been designed to dissipates the maximum of the internal heat through its front face :
The packaging of the sensor is larger to increase the surface in contact with the front face and then improves the dissipation.

In the system, the camera has to be fixed by its front face with the largest contact possible with a metallic part.

Without any specific cooling system, a simple air flow around the camera will improve roughly the dissipation.

The EMx Camera series are already delivered with 2 Heat Sinks, but if necessary, additional heat sinks are available (set of 2) and they can be fixed on any side of the front face :



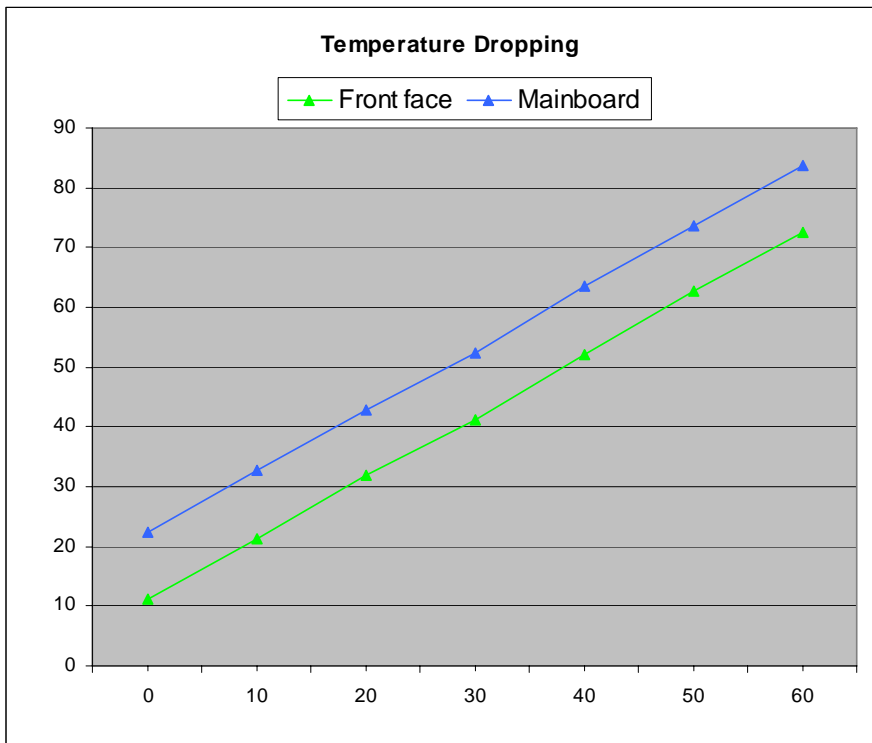
Set of 2 x Heat Sinks : Part number AT71KFPVIVA-CAA

One heat sink can decrease the temperature of the front face of about 5°C down.

7.2 Temperature dropping

Some measurements have been done to establish the dropping temperature steps between different control points :

- Ambient room temperature (burning room with controlled pulsed air)
- Front Face of the Camera
- Internal Temperature sensor (measure available with DemoGev).



It has been established that the steps are the following (after a certain time) :

- Ambient room to Front Face about : + **10°C**
- Front Face to internal sensor about : + **15°C**

Then an average of + **25°C** between the room ambient temperature and the internal sensor.

The specification limits have been fixed at :

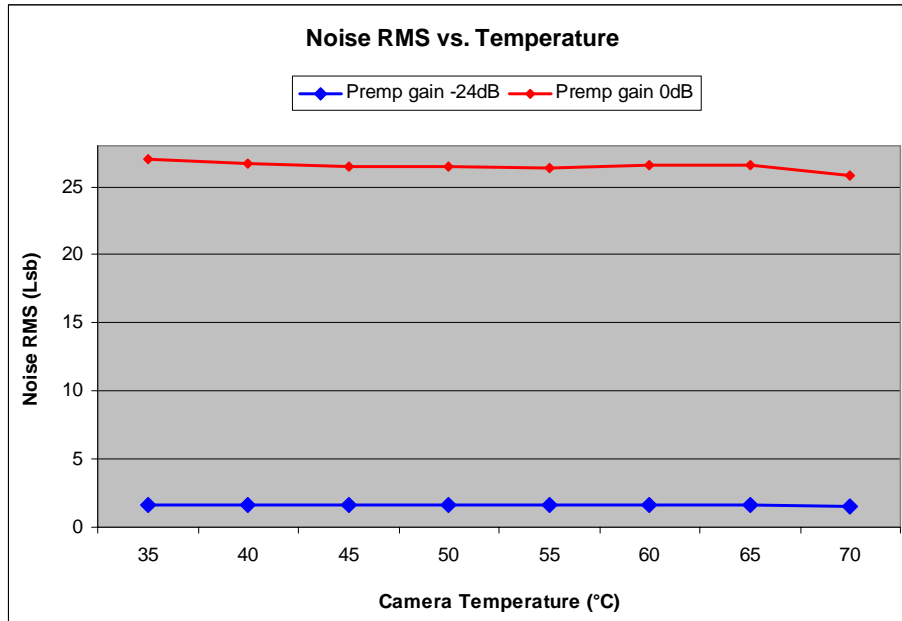
- **45°C for the ambient temperature**
- **55°C for the Front Face**
- **70°C internal Sensor.**



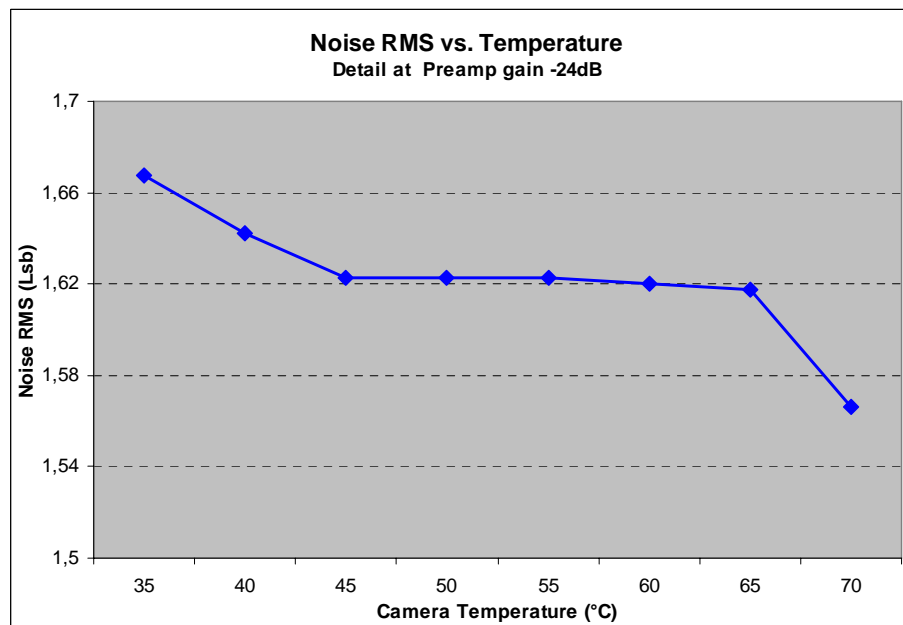
The ambient temperature is necessary defined here as a pulsed air or with an air flow around the camera otherwise the temperature around the Camera is not homogeneous and can be much more important than the one measured in the room.

7.3 Performance curves versus Temperature

- These curves have been established with a 4k Pixel Camera (worst case).
- The "Camera Temperature" is given by the internal Sensor of the Camera.
- All the values in LSB are in 12 bits



Darkness Noise vs Temperature : For both Min an Max preamp Gain values

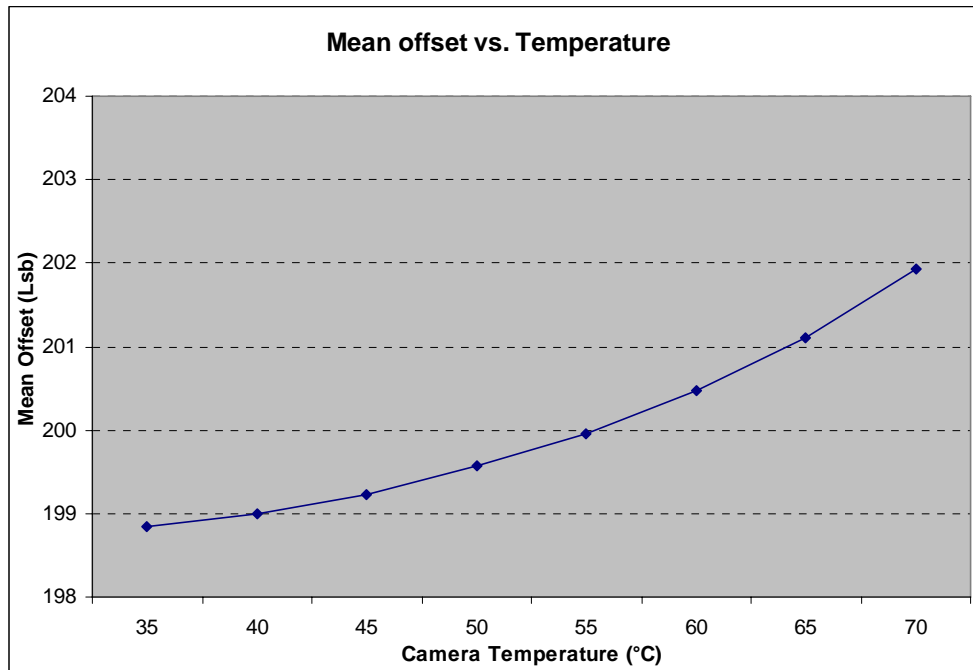


Darkness Noise vs Temperature : Detailed curve for the Min preamp Gain value

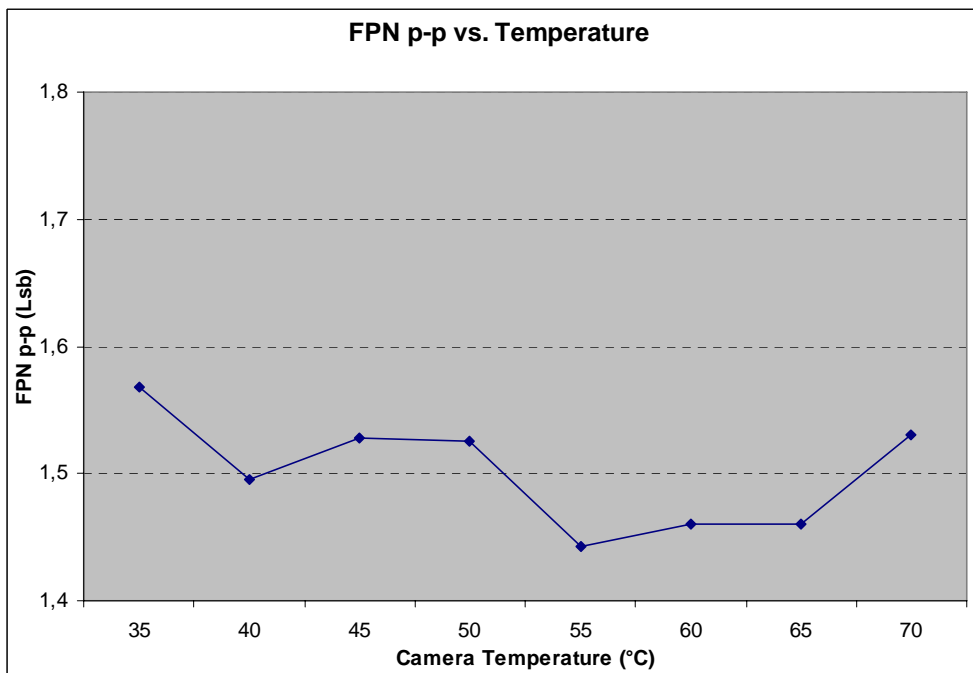


The Cameras tuning is done in factory after a certain time of warm up (close to a "normal condition of use) in order to ensure that the Camera will give its best while runing 24h a day. This explains a slight decreasing of the noise when the temperature rises up.

- The mean offset is the average value of the whole line of the sensor.
- The FPN peak to peak is the worst value for the whole line of the sensor.
- All the LSB values are in 12 bits



Average Offset vs Temperature : At min preamp Gain value (-24dB)



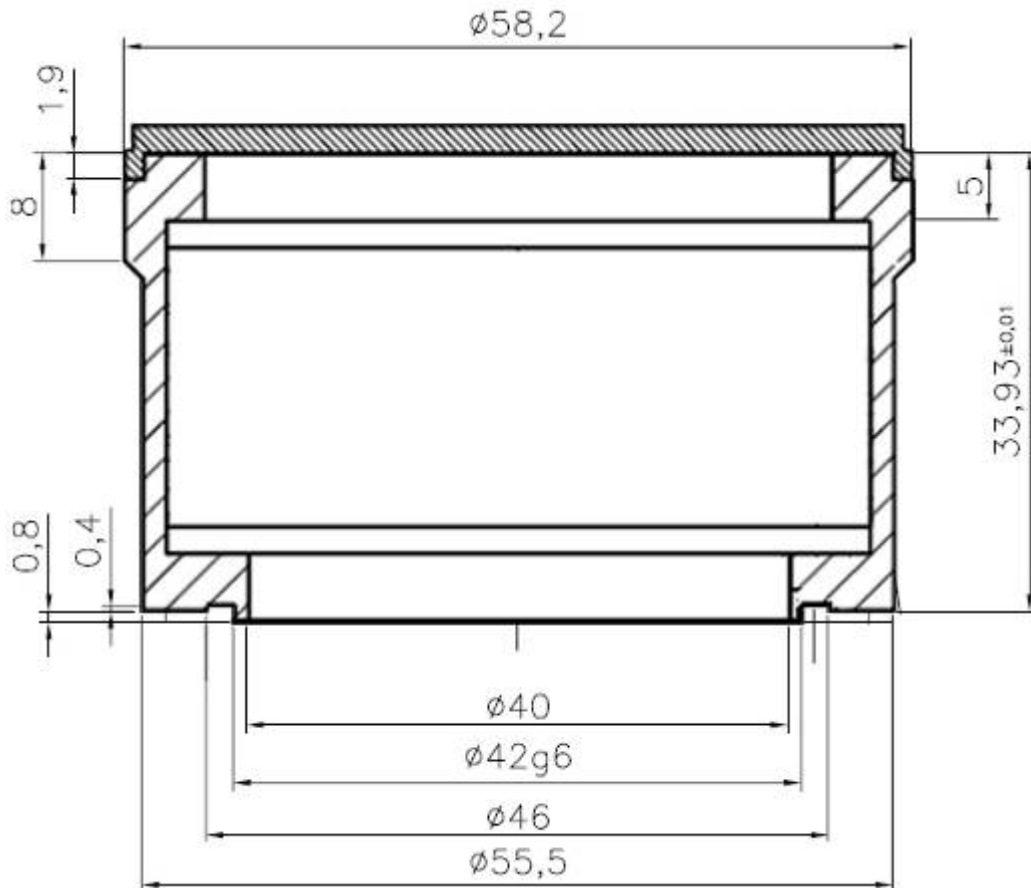
FPN peak-peak vs Temperature : At min preamp Gain value (-24dB)

8 APPENDIX C : Optical Mounts available

8.1 F-Mount



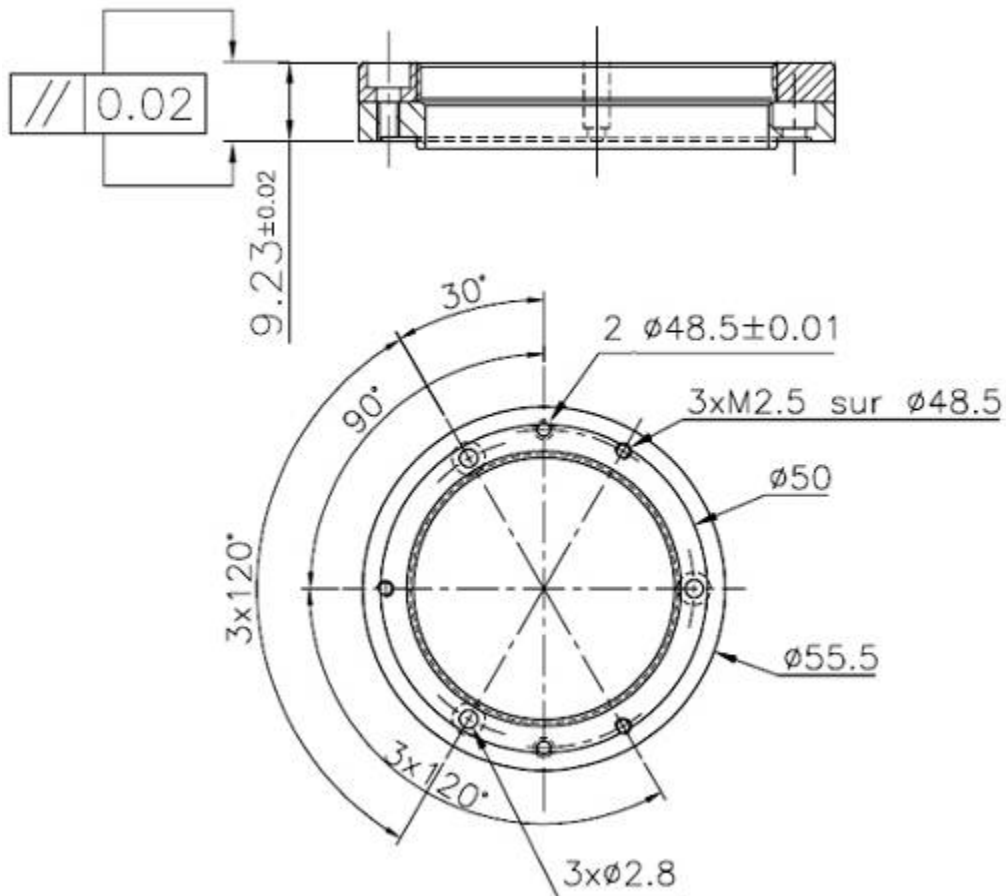
F Mount : Kit10 (Part number AT71KFPVIVA-ABA)



8.2 T2 & M42x1 Mounts



M42x0,75 (T2 Mount) : Kit30 (Part number AT71KFPVIVA-AKA)
 M42x1 Mount : Kit40 (Part number AT71KFPVIVA-ADA)



9 APPENDIX E : Index

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10 APPENDIX E : Revision History

Manual Revision	Comments / Details	Firmware version	
1043A	First release of this manual	EM1 4010 BA0	1.6.4
		EM1 2014 BA0	1.9.4
		EM1 2014 BA9	1.3.4
		EM1 2010 BA9	1.3.4

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