User Manual

Xeva FPA Cameras

ENG-2013-UMN002-R005

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Revision History

Issue	Issue date	Reason for changes	Modified by	Approved by
000.01	01/01/2013	New document	JBT	
000.02	28/01/2013	Reviews included of RVN, JEY, JDH, GGS	JBT	
000.03	30/01/2013	Review, layout check	CDU	
001	01/02/2013	First released issue	CDU	PMN
002	05/02/2013	Second released issue	CDU	PMN
003	21/01/2014	Ref 1 and Ref 2 updated, third released issue	CDU	PMN
004	14/03/2014	Updated mechanical drawings	JDH	PMN
004.01	30/04/2014	Sensor cleaning added	JBT	PMN
004.02	08/01/2015	Xeva T2SL added	PDO	JDS
004.03	02/04/2015	Power Supply Updated	PDO	JDS
004.04	09/04/2015	Update software interface	GGS	
004.05	08/05/2015	Update figure 4.9 (camera mechanics of the Xeva-T2SL)	KNB	JDS
005	08/05/2015	5th released issue	KNB	JDS

Change Details

This table lists all changes of this issue compared to the previous released one.

Chapter/Section	Changes	Modified by

Table of Contents

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List of Abbreviations

ADU	Analog to Digital Unit
FPN	Fixed Pattern Noise
ID	Identity
InGaAs	Indium Gallium Arsenide
ITR	Integrate Then Read
IWR	Integrate While Read
LED	Light Emitting Diode
LVDS	Low Voltage Differential Signaling
MCT	Mercury Cadmium Telluride
MDR	Mini D Ribbon Connector
NTSC	National Television Standards Committee (analog video standard)
NUC	Non-Uniformity Correction
PAL	Phase Alternating Line (analog video standard)
PRNU	Photo-response Non-uniformity
PSF	Power Supply Filter
PSU	Power Supply Unit
PWM	Pulse Width Modulation
SDK	Software Development Kit
SDR	Shrunk D Ribbon Connector
SWIR	Short-Wave InfraRed
T2SL	Type II Super Lattice detector
TE1	Single Stage Thermoelectric Cooler
TE3	3 - Stage Thermoelectric Cooler
TE4	4 - Stage Thermoelectric Cooler
TTL	Transistor-Transistor Logic
USB	Universal Serial Bus

List of Figures

List of Tables

1. Introduction

1.1. Scope

This User Manual describes the technical specifications, dimensions, image processing, basic and advanced parameters and related subjects for the following Xeva cameras:

Camera	Part number
Xeva-USB-320-InGaAs	
Xeva-USB-FPA-1.7-320-TE1-100Hz	XEN-000100
Xeva-USB-FPA-1.7-320-TE1-100Hz-PAL	XEN-000102
Xeva-USB-FPA-1.7-320-TE1-100Hz-NTSC	XEN-000159
Xeva-USB-FPA-1.7-320-TE1-100Hz-GATED	XEN-000158
Xeva-USB-FPA-1.7-320-TE3-100Hz	XEN-000101
Xeva-USB-FPA-1.7-320-TE3-100Hz-PAL	XEN-000103
Xeva-USB-FPA-1.7-320-TE3-100Hz-NTSC	XEN-000160
Xeva-USB-FPA-1.7-320-TE1-100Hz-VisNIR	XEN-000147
Xeva-USB-FPA-1.7-320-TE1-100Hz-VisNIR-PAL	XEN-000162
Xeva-USB-FPA-1.7-320-TE1-100Hz-VisNIR-NTSC	XEN-000164
Xeva-CL-320-InGaAs	
Xeva-CL-FPA-1.7-320-TE1-060Hz	XEN-000104
Xeva-CL-FPA-1.7-320-TE1-100Hz	XEN-000105
Xeva-CL-FPA-1.7-320-TE1-350Hz	XEN-000107
Xeva-CL-FPA-1.7-320-TE3-060Hz	XEN-000108
Xeva-CL-FPA-1.7-320-TE3-100Hz	XEN-000109
Xeva-CL-FPA-1.7-320-TE3-350Hz	XEN-000110
Xeva-CL-FPA-1.7-320-TE1-060Hz-VisNIR	XEN-000165
Xeva-CL-FPA-1.7-320-TE1-100Hz-VisNIR	XEN-000106
Xeva-CL-FPA-1.7-320-TE1-350Hz-VisNIR	XEN-000148
Xeva-CL-320-MCT	
Xeva-CL-FPA-MCT-2.5-320-TE4-60Hz	XEN-000128
Xeva-CL-FPA-MCT-2.5-320-TE4-100Hz	XEN-000129
Xeva-CL-FPA-MCT-2.5-320-TE4-200Hz	XEN-000270
Xeva-CL-640-InGaAs	
Xeva-CL-FPA-1.7-640-TE1-25Hz	XEN-000111
Xeva-CL-FPA-1.7-640-TE1-90Hz	XEN-000112
Xeva-CL-FPA-1.7-640-TE3-25Hz	XEN-000113
Xeva-CL-FPA-1.7-640-TE3-90Hz	XEN-000114
Xeva-CL-320-T2SL	
Xeva-CL-FPA-T2SL-2.35-320-TE4-100Hz	XEN-000538
Xeva-CL-FPA-T2SL-2.35-320-TE4-350Hz	XEN-000539

Figure 1-1 Camera overview - Xeva cameras

Target group: This technical manual is written for professional users.

i — Please read this manual thoroughly before operating the camera!

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1.2. Conventions Used in This Manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

The styles used in this manual are:

- **Bold**: used for programs, inputs (commands or parameters) or highlighting important things
- `Courier New`: used for code listings and output.
- *Italics*: used for modes and fields.

The symbols used in this manual:

i Note: This symbol highlights important information.

! Warning: This symbol highlights important instructions. These instructions must be followed to avoid malfunctions!

1.3. Manual Overview

This section provides a chapter overview:

- This Chapter 1 (this chapter) gives an overview of the conventions used in this manual (styles and symbols), the safety warnings, conformity information about Xenics cameras and the contact information.
- Chapter 2 describes the Xeva camera in general
- Chapter 3 describes the SDK software
- Chapter 4 describes the mechanical interfaces with the dimensions, the power supply, the power supply filter and the camera weight
- Chapter 5 describes the electrical interfaces with all necessary cables
- Chapter 6 provides an overview of the lenses used with the Xeva cameras
- Chapter 7 describes the forced air cooling
- Chapter 8 describes the used command and control to drive the camera
- Chapter 9 describes the used frame grabbing
- Chapter 10 describes the possible camera settings
- Chapter 11 describes the camera characteristics with more info about the used sensors
- Chapter 12 describes used calibration packs and the way to recalibrate the camera
- Chapter 13 describes radiometry including the filter change.

1.4. Safety Warnings

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

The following safety warnings must be followed:

Be sure to follow all the precautionary instructions in this section, which contain important warnings regarding safety. After reading, keep this manual for future reference.

Supply voltage polarity: Use the correct polarity of the 12 V supply voltage. Use the camera unit only with the power supply unit delivered by Xenics. Using another voltage than specified may result in fire or electric shock. The use of an unspecified power supply may also result in fire or electric shock.

Warranty: The warranty becomes void in case of unauthorized tampering or any manipulations not approved by the manufacturer. Do not open, disassemble, repair or modify the housing of the camera in order to prevent a fire or electric shock. Refer all inspection, adjustment, cleaning and repair work to Xenics.

Electrostatic discharge: The camera contains sensitive electronic components which can be destroyed by means of electrostatic discharge. Use sufficient grounding to minimize the risk of damage.

Environmental conditions: Operate the camera in dry and dust free environment. Regarding the signal quality of the camera it is an advantage to operate the camera under constant ambient air temperature (~20°C). Beneath or above ambient temperature a sufficient heating or cooling may be necessary. Avoid installing or mounting the camera and power supply in unstable locations, such as on a rickety table or a slanted surface. Do not install the equipment on an unstable or inclined location or locations subject to vibration or impact, otherwise, the equipment can topple over which may result in the camera falling down and causing personal injury.

Do not install the unit outdoors since it is designed for indoor use. If installed outdoors, this will accelerate the aging of all parts. Do not expose the camera to humidity like rain, water, etc … Do not use the equipment in locations subject to water splashes. It may result in an electric shock and damage the camera. Do not handle the camera and cables roughly. This can damage the cables and/or the camera. Avoid giving a strong shock against the camera body. If the camera is used in a system where its connectors are subjected to strong repetitive shocks, they can possibly break. If the intension exists to use the camera in such a situation, if possible, bundle and fix the camera cables in place near the camera, and avoid applying shocks to the camera connector. The camera components are sensitive to mechanical, electrical, and thermal shocks.

Follow these guidelines for safe operation of the camera:

1. If the camera is supported on a moving device, such as a manipulator, optical mounting, microscope, telescope, or etc…, be sure to secure the cable with cable ties and allow enough slack so that the cable connector is not stressed or broken during movement. If the cables are bended regularly, contact Xenics about cable lifetime. In some cases it might be necessary to apply special flexible robot cables.
2. Always ground yourself to dissipate electrostatic charge before handling the camera.
3. Try to avoid contact with any of the electrical components of the camera.
4. Lightning can damage the camera and interface, even indirectly. Always disconnect the Xenics camera and remove it from grounded equipment whenever there is thunderstorm activity in the direct area.

Should any of the following abnormal conditions be present during the use of the camera, immediately switch off the power, and disconnect the power supply. Do not attempt to further use the camera and power supply because a fire or electric shock may result or when detecting smoke or a strange smell coming from the camera.

- If ingress of water or a foreign object enters the camera.
- If the unit falls, is dropped or the camera housing breaks.
- If the power supply cable is damaged (exposure of core or disconnection).

Picture quality may suffer if camera cables are wired close to other electrical equipment, such as fluorescent lamps. In such cases, reroute the wiring. Images may become distorted or roll if the camera is used in locations influenced by strong electrical or magnetic fields like motors, transformers. In such cases, install the cables inside a shielded cable conduit.

Do not install the camera in locations where solvents or chemicals are used, as exposure to such chemicals could damage it.

To clean, wipe with a soft cloth. Never use benzene, thinner or chemically treated towels to avoid damage to the camera's finish. The anodized aluminum camera housing can be cleaned with a soft, non-static cloth and glass cleaner. Never spray liquids directly on the Xenics camera. Apply cleaning solution to the cloth, and then wipe the camera body with an isopropyl-alcohol dampened cloth.

During storage and operation the Xenics cameras optical window will collect dust particles and other dirt. Be careful with cleaning this window! First try to clean the window with pressurized oil free air or applicable cleaning gas out of an aerosol dispenser. If this is not sufficient, try to clean the optical surface gently wiping the dirt away with a soft, lint-free, non-static cloth or lens tissue; avoid heavy rubbing, which may scratch or break the optical glass. Avoid large temperature differences between optical glass and cleaning gas or cleaning fluids.

Do not cover the camera with a cloth or other objects that may prevent the camera cooling. Do not cover the ventilation slots as this may result in fire or electric shock. Note that some cameras also have ventilation slots on the bottom plate of the camera. For this type of camera, small spacers are required so that the air can flow through the ventilation slots in the bottom plate of the camera. The fan disperses the heat as it radiates away from the heat sink. If the airflow is blocked by an obstacle or by dust, the thermoelectric cooler may run hotter than normal and the camera body could overheat, causing damage to some of the more sensitive components. After a period of operation, dust will collect on the dust filter and the cooling fan. It may be necessary to regularly clear away the dust with a vacuum cleaner. Never clean a turning fan! Do not apply too much pressure on the dust filter and on the fan. This may damage the fan; block the fan motor or make the fan turn irregularly hitting the dust filter and the fan support spikes.

Respect rigorous following environmental conditions:

- Always store or operate the camera in none condense conditions.
- Never spray fluids onto the camera!
- Make sure the camera is kept out of electrical conductive and dusty zones.
- To guarantee the correct sensor temperature, the operating temperature must be between -0 to +50°C. Sudden changes in ambient temperature and/or humidity should be avoided. For the Xeva-2.35-320, the max ambient temperature is +40°C.
- Storage temperature: -0 to +70 °C.

1.5. Contact Information

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  sales@sinfrared.com

- **Distributors worldwide**
  Xenics is a European based provider of infrared imaging products and has representatives and distributor locations around the world to service our many customers.

  Please visit our website for more contact details:
  www.xenics.com

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When some extra information is required, always mention the camera type and its serial number.

1.6. Reference Documents

(Ref. 1) Xeneth Installation Manual:
ENG-2013-UMN024-Rxxx_Xeneth-v2.5-Installation-Manual

(Ref. 2) SDK Installation Manual
ENG-2013-UMN023-Rxxx_SDK-v2.5 Installation Manual

2. General Information Xeva Cameras

The Xenics Xeva USB camera combines a thermo-electrically cooled detector head and control and communication electronics. The installed infrared detector's exceptional efficiency makes it possible to perform analysis on light emitted in wavelengths not visible to the naked eye.

The camera head is designed within an anodized aluminum housing. In front, a lens fitting can be found. Any standard C-mount lens, which is able to process the infrared light, can be mounted on the housing. The camera is supplied with a standard C-mount lens. Also U-mount or Canon bayonet mount lenses are compatible if an additional adapter is used.

At the rear end of the camera, one can find the fan inlet. The fan is used to cool the thermo-electric cooler. All the electrical connectors can be found at the rear end. The XEVA FPA digital camera is operated from one single 12 V – 5 A (24 V - 5A, for Xeva T2SL 320 CL TE4) power supply (included in the configuration) and includes all voltage regulating circuits, a temperature stabilization circuit for the cooling of the detector and the signal output analog to digital conversion. The camera head interfaces to a PC via a standard USB 1.1 or 2.0 bus.

For Xeva cameras with camera link connector, images in preview mode can be grabbed over USB. For those cameras the USB port is only used to set the required settings on the infrared camera. It is recommended to use a frame grabber.

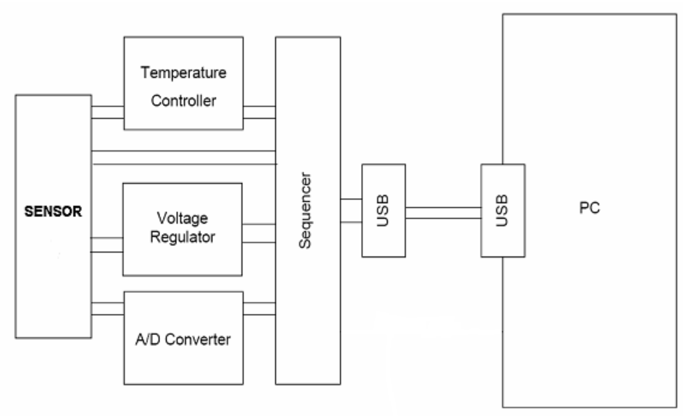


Figure 2-1 Xeva Camera interfaces

The IR sensor is connected with 3 interfaces:

- A temperature controller to regulate the thermo-electric cooler, to stabilize the detector working temperature.
- A voltage regulator, to control the sensor circuits.

- An Analogue to Digital Convertor, to translate the pixel information into useful information.

Inside the camera a sequencer will control the data flow towards and from the sensor in the right order and at the correct time. All information is transferred digitally over a USB cable to the host PC. In case of a XEVA-CL-FPA, the Camera Link cable transfers all images directly to the frame grabber card in the PC. In those circumstances, the USB port is only used to set the required settings on the infrared camera.

3. Software - API/SDK

Consult the installation manual to install Xeneth and to install the SDK (see chap. 1.6.)

This Xeneth GUI is mainly intended for a quick evaluation of the camera under test where all the basic camera settings and the FPA configuration parameters can be set on the desktop.
Make sure the camera is connected to the PC. First connect the USB cable and afterwards connect other cables (Camera Link …). At last, power up the camera by connecting the power supply to the camera.

⚠ Always power the camera before starting the software!

4. Mechanical Interface

4.1. Camera Dimensions

4.1.1. Xeva InGaAs 320 USB TE1

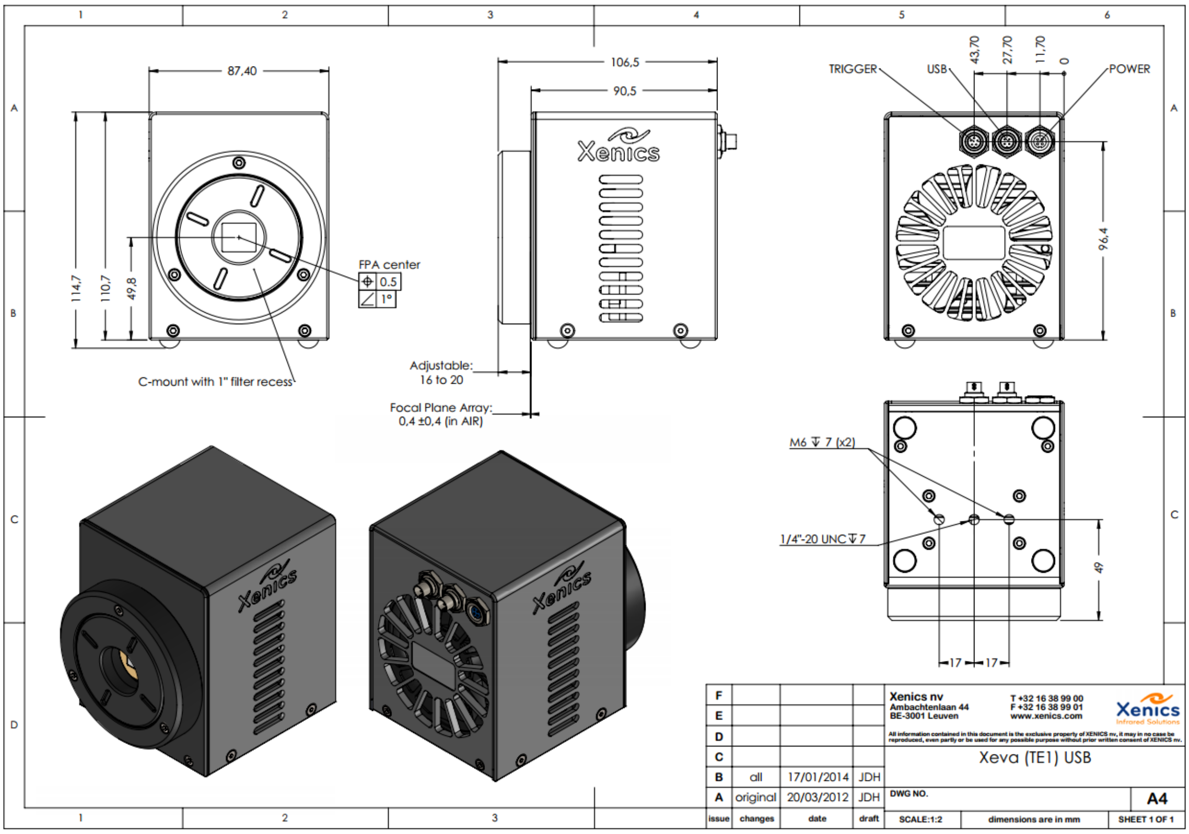


Figure 4-1 Mechanical drawing Xeva InGaAs 320 USB TE1

4.1.2. Xeva InGaAs 320 USB TE3

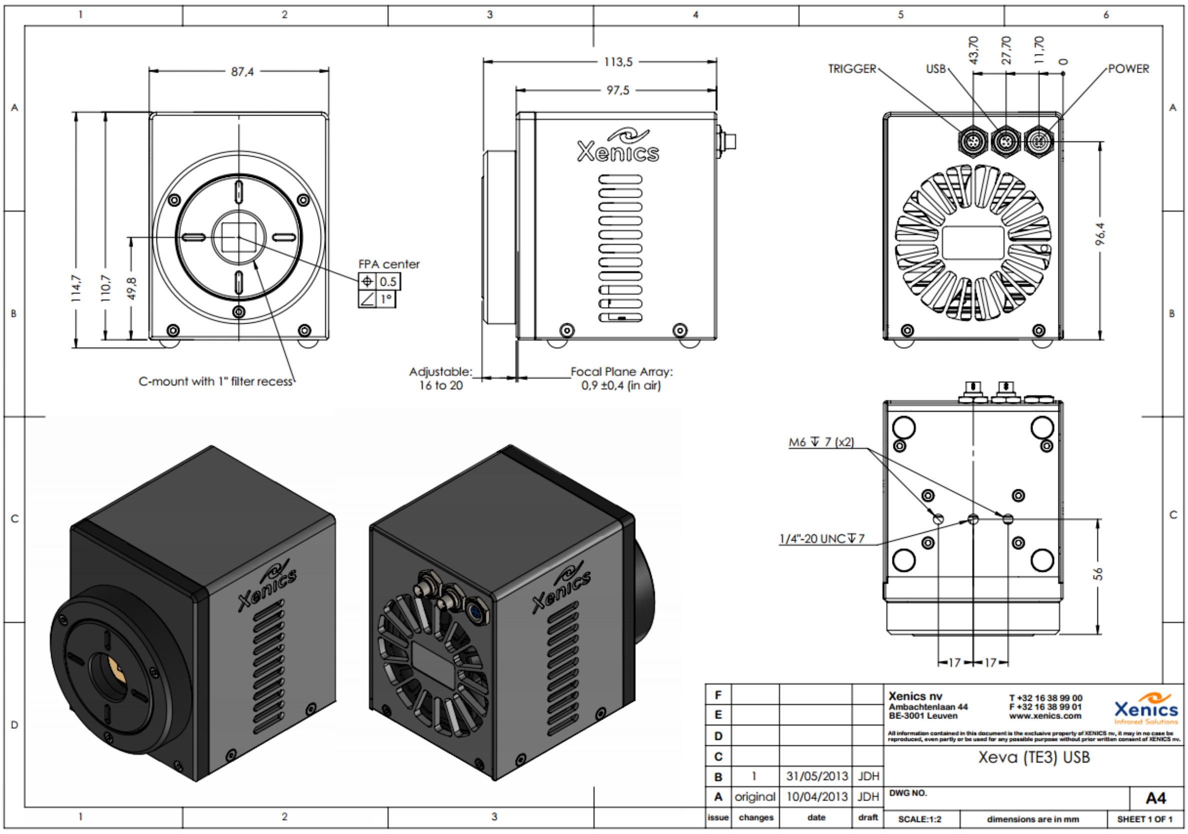


Figure 4-2 Mechanical drawing Xeva InGaAs 320 USB TE3

4.1.3. Xeva InGaAs 320 CL TE1

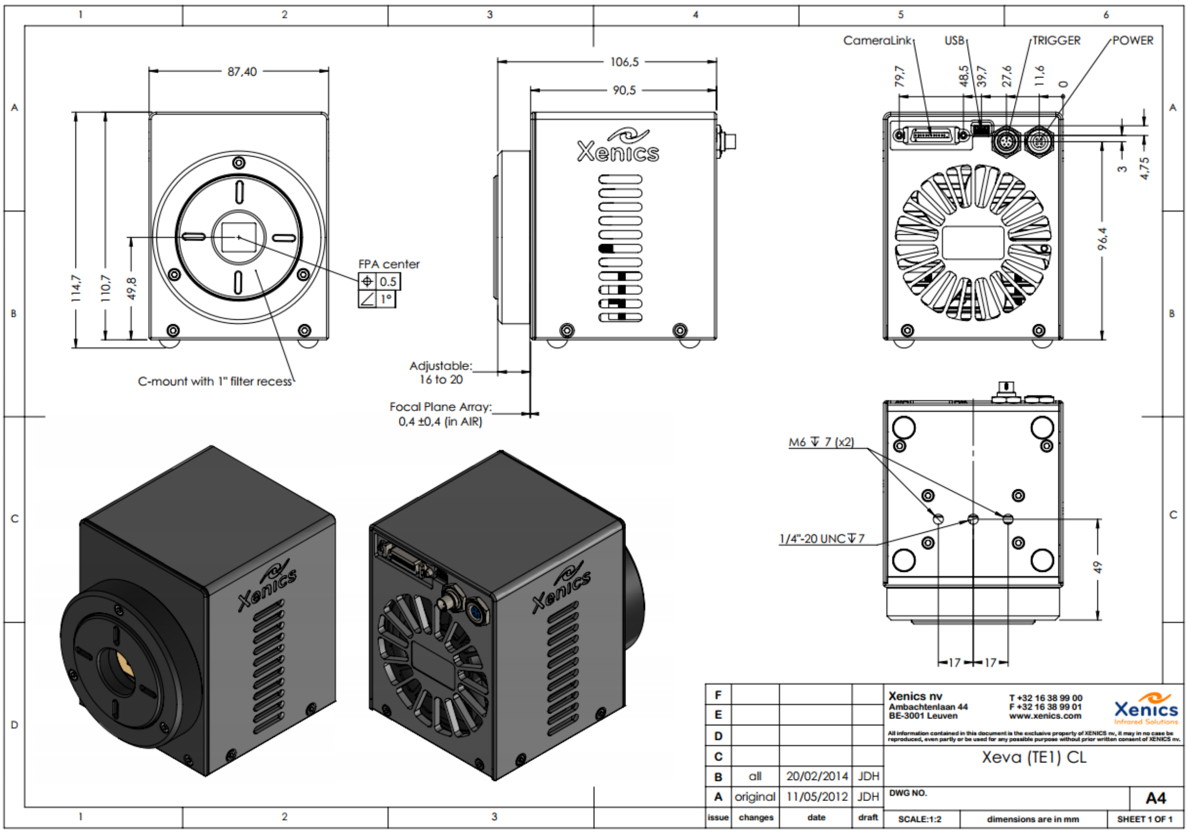


Figure 4-3 Mechanical drawing Xeva InGaAs 320 CL TE1

4.1.4. Xeva InGaAs 320 CL TE3

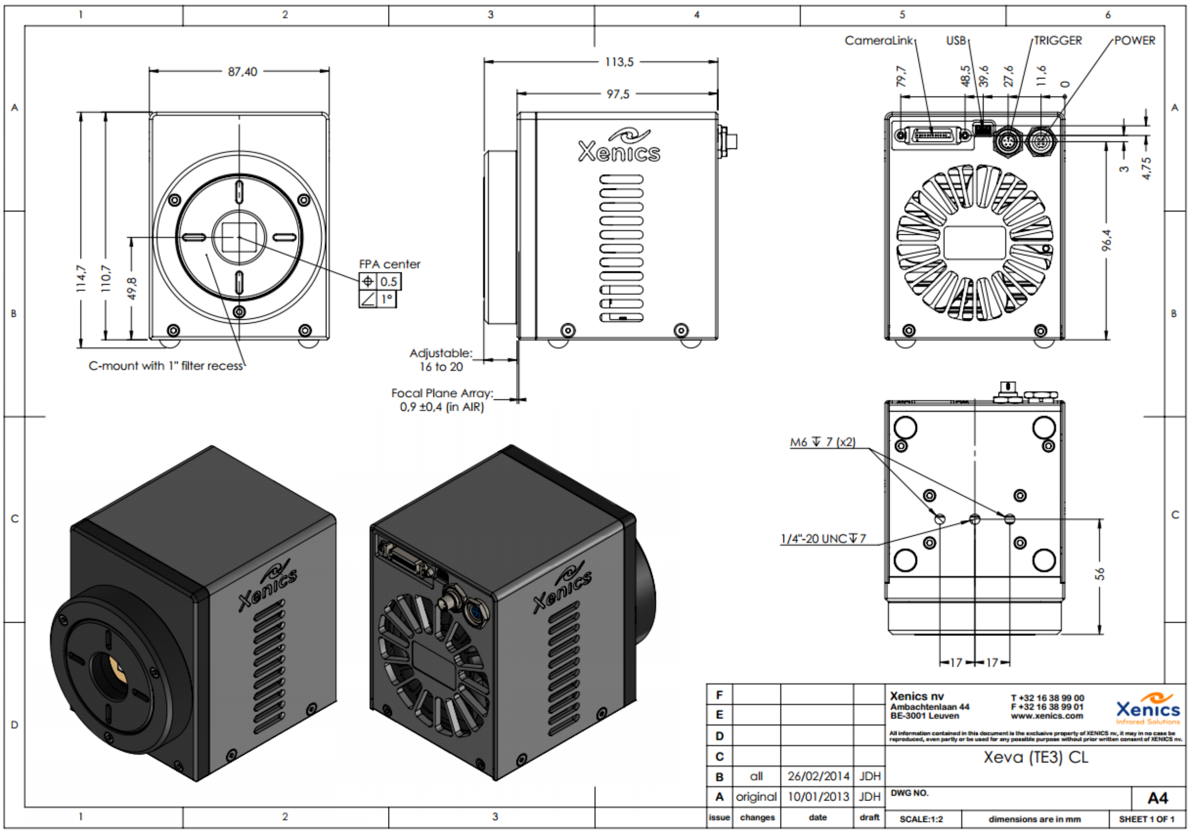


Figure 4-4 Mechanical drawing Xeva InGaAs 320 CL TE3

4.1.5. Xeva InGaAs 640 CL TE1

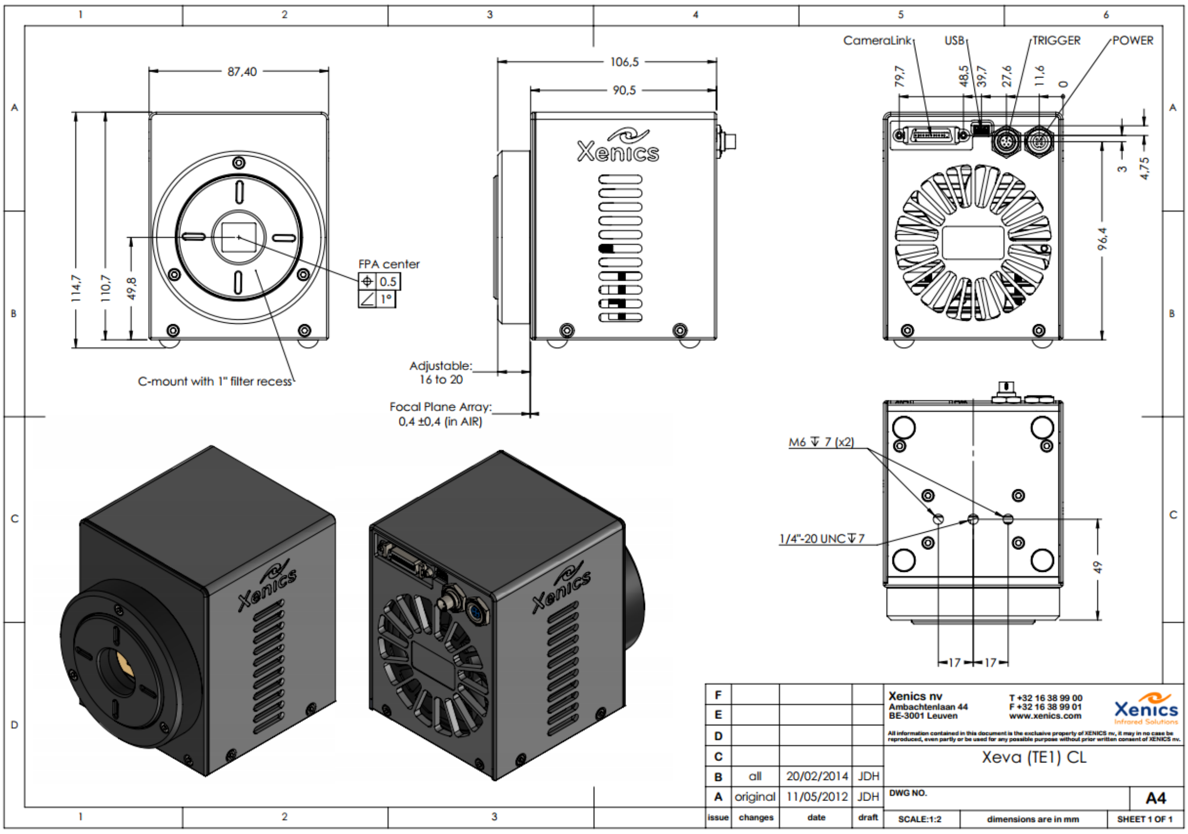


Figure 4-5 Mechanical drawing Xeva InGaAs 640 CL TE1

4.1.6. Xeva InGaAs 640 CL TE3

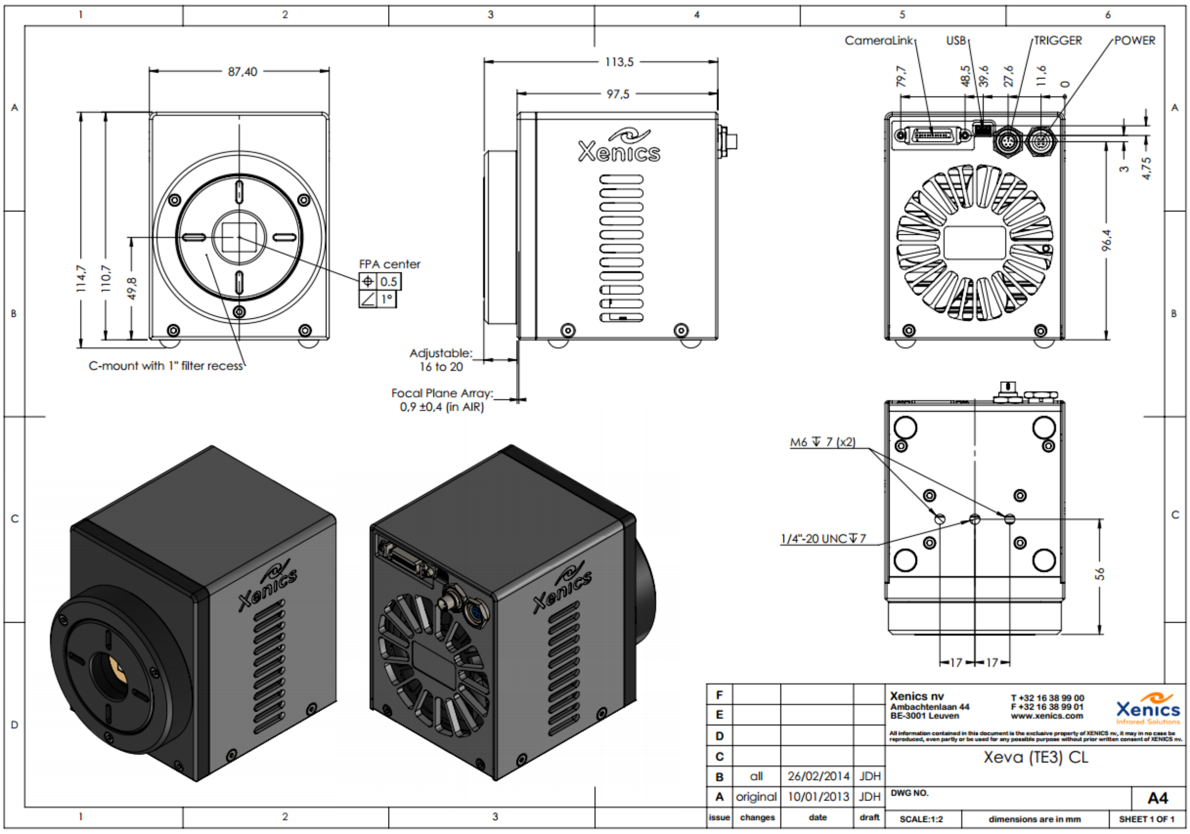


Figure 4-6 Mechanical drawing Xeva InGaAs 640 CL TE3

4.1.7. Xeva MCT 320 CL TE4

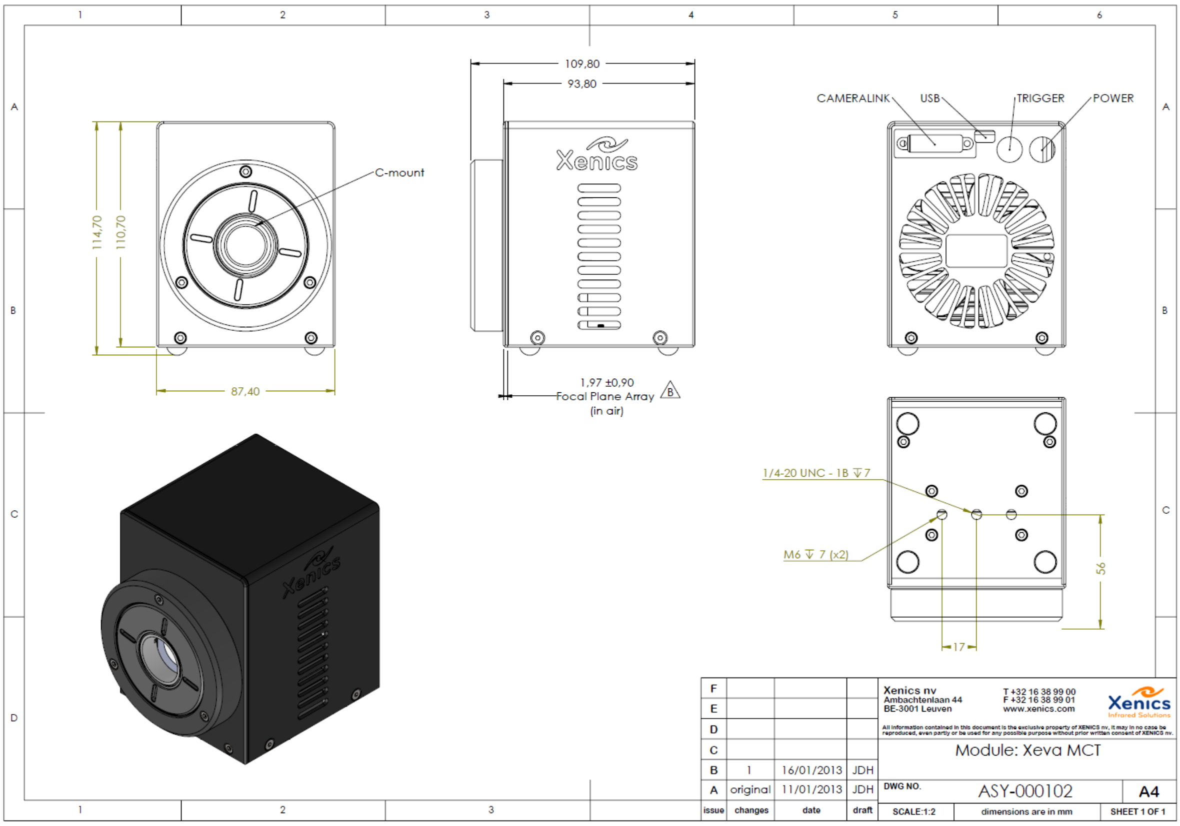


Figure 4-7 Mechanical drawing Xeva MCT TE4

The distance from the front plate to the FPA detector material is indicated.

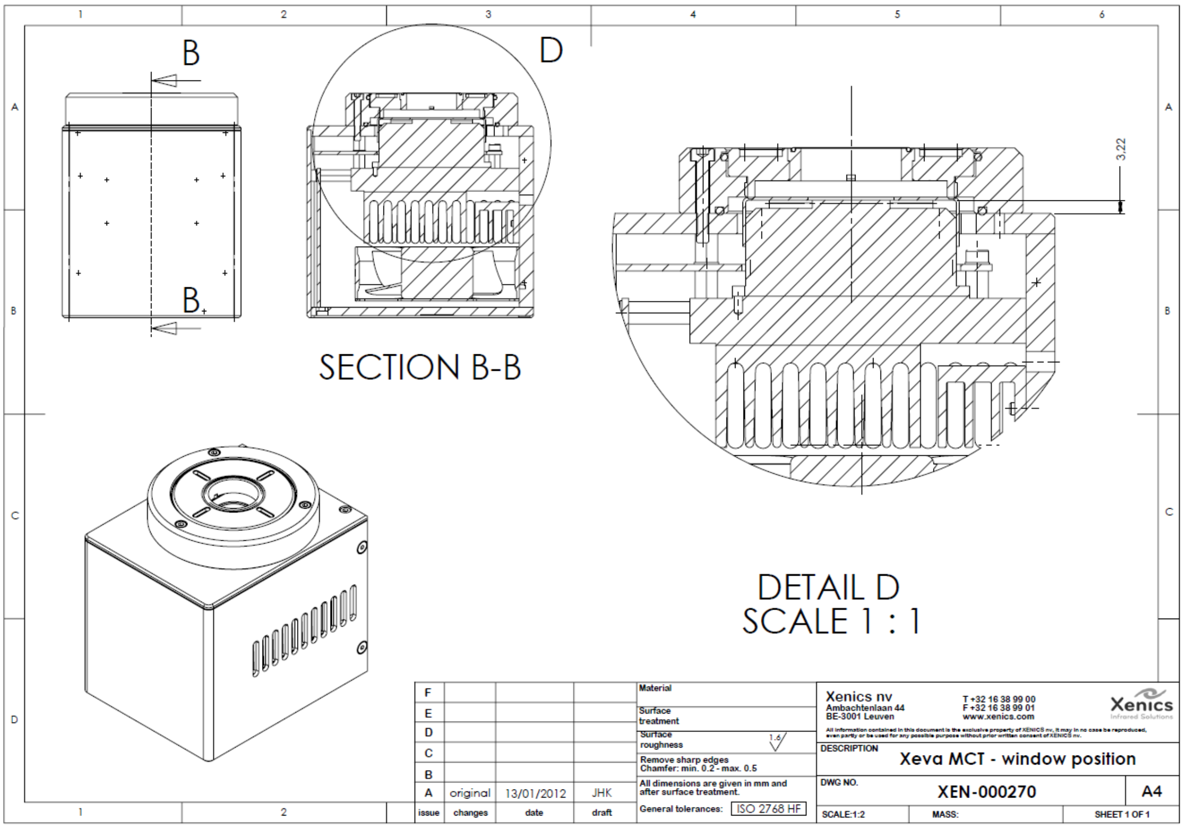


Figure 4-8 Sensor window position Xeva MCT TE4

The distance from the front plate to the window of the FPA detector is indicated.

4.1.8. Xeva T2SL 320 CL TE4

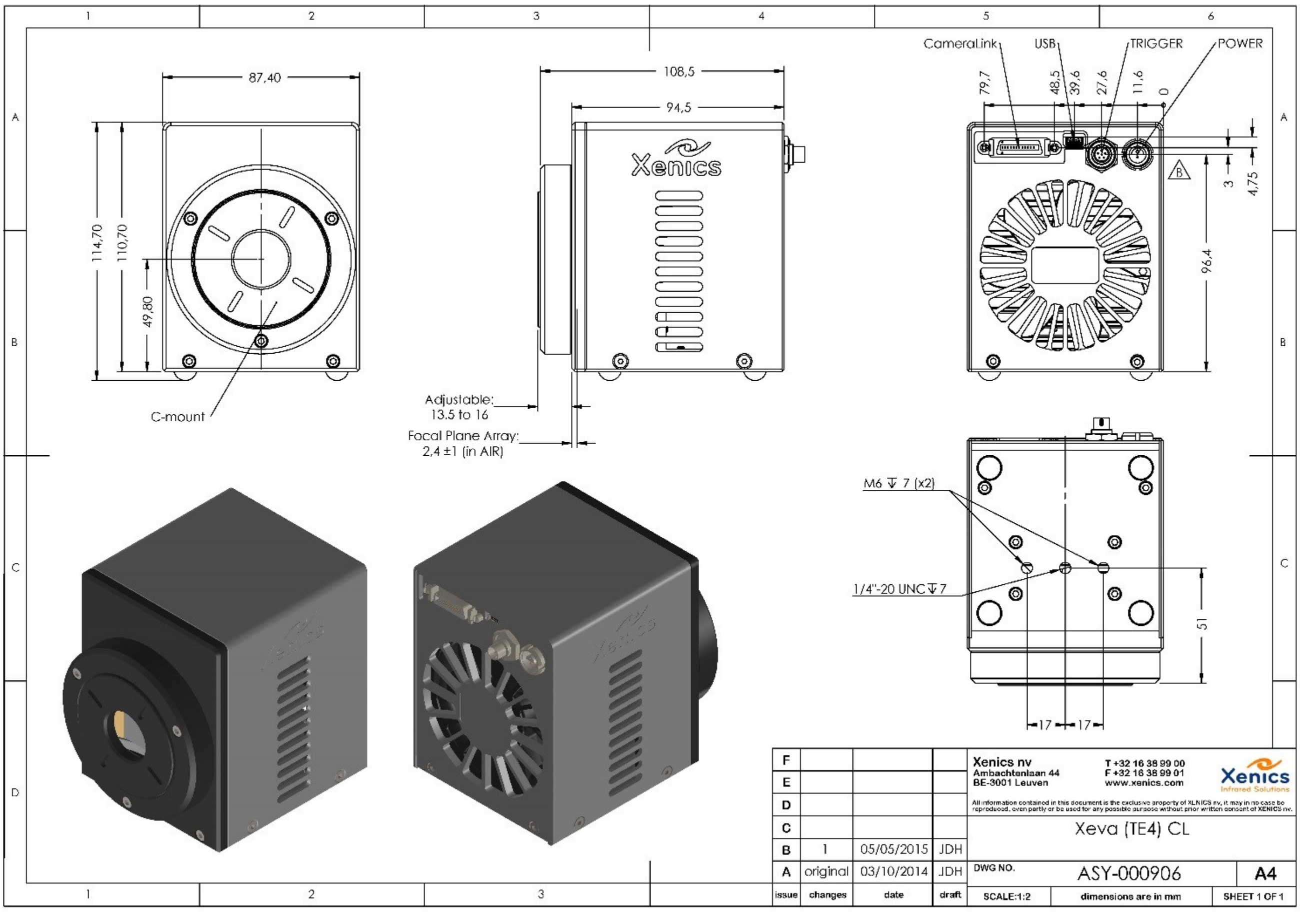


Figure 4-9 Mechanical drawing Xeva-T2SL-2.35-320-TE4

4.2. Power Supply

Power supply reference:

- **ASY-001266** (for all Xeva's except the Xeva-2.35-320-TE4)
- **ASY-001271** (for Xeva-2.35-320-TE4)

The power supply delivered with the camera has the following dimensions.

4.2.1. Power Supply Model ASY-001266 (PSG60-12-02 ES)

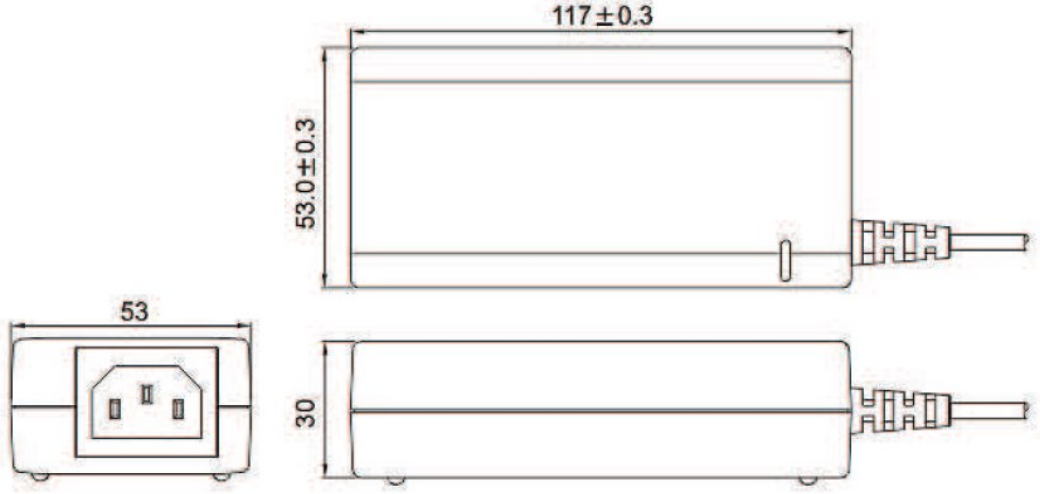


Figure 4-10 PSU mechanical drawing model PSG 60-12-02 ES (ASY-001266)

4.2.2. Power Supply Model ASY-001271 (PSG150-24-01)

This power supply is only used for the Xeva-320-T2SL-TE4. The used connector is Lemo FFA.1S.302.CLAC52.

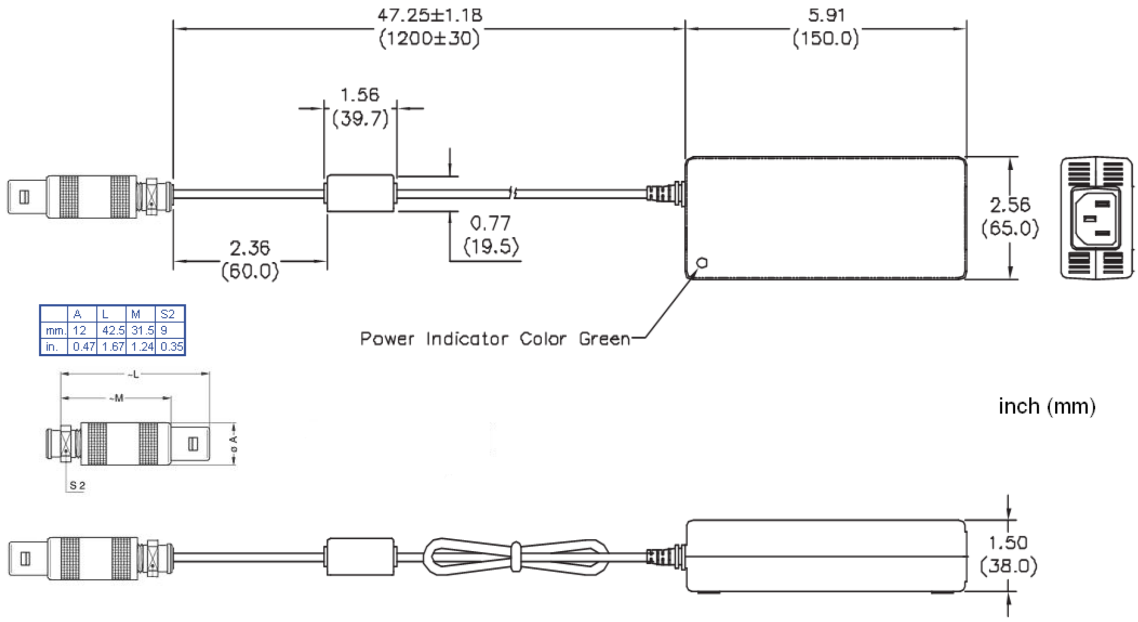


Figure 4-11 PSU mechanical drawing model PSG150-24-01

4.2.3. Power Supply Voltages

The power supply necessary for the camera depends on the camera model.

Camera	Specification
Xeva-320-InGaAs-TE1	12V +/- 1 V, 2 A max
Xeva-320-InGaAs-TE3	12V +/- 1 V, 2 A max
Xeva-CL-320-MCT-TE4	12V +/- 1 V, 4.5 A max
Xeva-CL-640-InGaAs-TE1	12V +/- 1 V, 3 A max
Xeva-CL-640-InGaAs-TE3	12V +/- 1 V, 3 A max
Xeva-CL-320-T2SL-TE4	24V +/- 1 V, 3.5 A max

Figure 4-12 Power supply voltages

4.3. Power Supply Filter

This filter is only necessary for the Xeva InGaAs 640 CL models. Reference: ASY-000059.

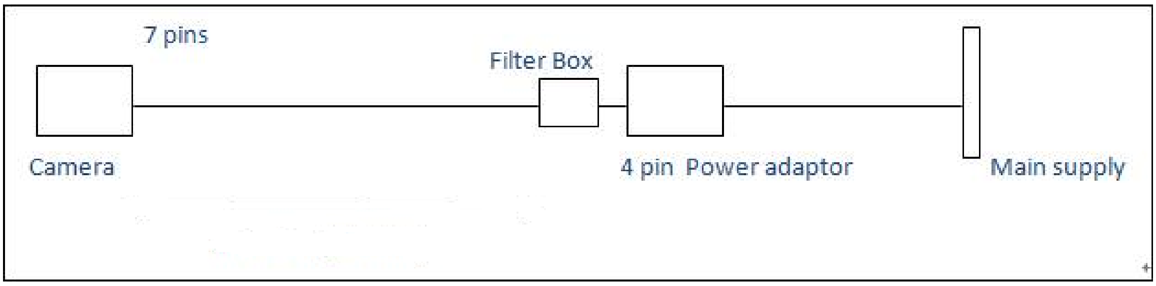


Figure 4-13 PSU filter for Xeva InGaAs 640 CL models

4.4. Weight

The camera has a maximum weight of 1.8 kg without the lens.

5. Electrical Interface

⚠ Do not apply voltages higher than the absolute maximum rating. Permanent damage will occur!

⚠ Do not connect power or signals in reverse polarity to the camera. Permanent damage will occur!

⚠ Do not connect driving sources to output signals of the camera. Permanent damage will occur!

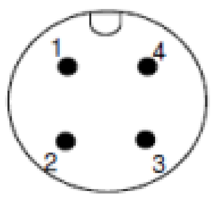
5.1. Power In

5.1.1. All Xeva Models, except Xeva-2.35-320-TE4

Figure 5-1 shows the power cable in on the rear panel. The complete power supply has as reference ASY-001266.

Triad '01' series 4-pole male (pin) Farnell 130-734 Tyco 1-1437719-8	Cable from PSU		Power Supply Unit 12 volt DC PSGE65-12-02
	Length: as supplied		

Pin	Signal	aka	Pin
1	+12 v.		Black wire with printing
2	+12 v.		(common with 1)
3	Ground		Plain black wire
4	Ground		(common with 3)



Connectors viewed from mating side

NOTE: Check voltages on pins after assembly

Figure 5-1 Power in for all Xeva cameras

All the connector housings are electrically connected to the camera ground.

5.1.2. Xeva-2.35-320-TE4

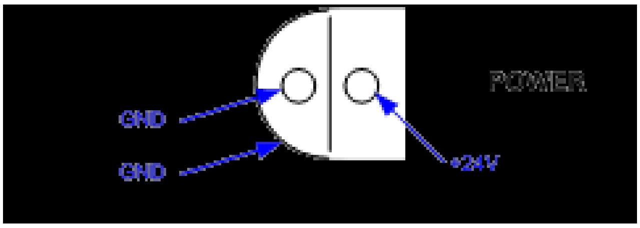


Figure 5-2: Power in for Xeva-CL-320-T2SL-TE4

The connector used on the backside of the camera is: Lemo EXP-1S-302-HLN.

5.2. USB

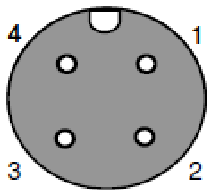
5.2.1. Triad USB (for Xeva USB)

Cable reference: ELC-001272.

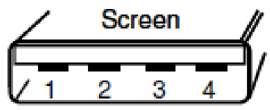
Triad '01' series 4-pole female (socket) Farnell 130-783 Tyco 3-1437719-3			USB Connector Male Moulded connector

Length: 5m.

Pin	Signal	Colour	Pin
1	+5V	Red	1
2	D-	White	2
3	D+	Green	3
4	Ground	Black	4
Housing	Screen	Silver	Screen



Connectors viewed from mating side



NOTE: Check voltages on pins after assembly

Figure 5-3 Triad USB for Xeva USB camera

5.2.2. Mini USB (for Xeva CL)

Cable reference: ELC-001503.

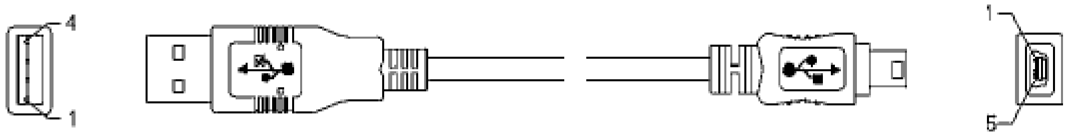


Figure 5-4 Mini USB for Xeva 320/640 camera link camera

5.3. Trigger

5.3.1. Trigger In and Out (for Xeva USB Only)

Cable reference: ASY-001273

Signal	Pin	Cable
Input	1	Core BNC1
Not connected	2	Not connected
GND	3	Shield BNC1 + BNC2
Output	4	Core BNC2
Not connected	5	Not connected

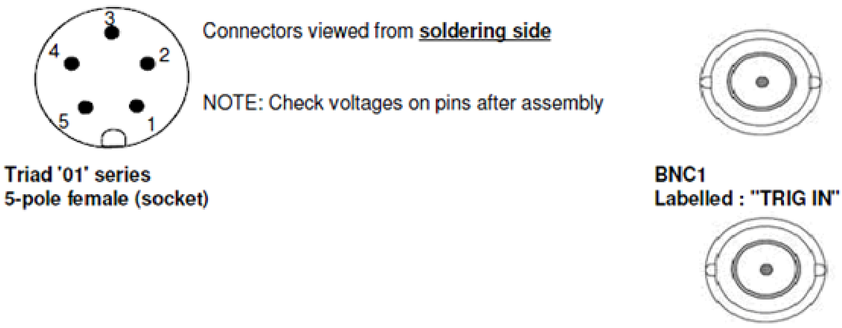


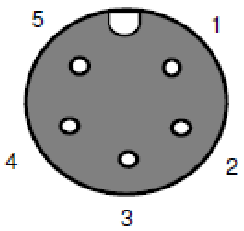
Figure 5-5 Trigger in and out cable for Xeva 320 InGaAs USB only

5.3.2. Trigger in (for Xeva CL and USB)

Cable reference: ASY-000060.

Triad '01' series 5-pole female (socket) Farnell 130-795 Tyco 3-1437719-6	Cable: RG59 75ohm Coax Cable 200 cm.		BNC Connector Plug

Pin	Signal		Pin
1	Trigger 0	Trig0	Center Pin
2	Trigger 1	Trig1	
3	Ground	Gnd	Shield
4	Trigger 2	Trig2	
5	Trigger 3	Trig3	
Shield	Ground		



Connectors viewed from mating side
(not to scale)

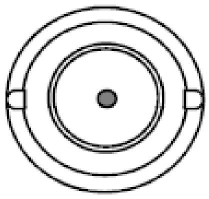


Figure 5-6 Trigger in for all Xeva models

5.4. Analog Out

5.4.1. Xeva USB with Analog Out Only

Cable reference: ASY-000056.

Triad '01' series 5-pole male (pin) Farnell 130-746 Tyco 2-1437719-1	Coaxial cable RG59 75 ohm Farnell 235-702		Cinch (RCA) coax connector Farnell 804-1784

Length: 5m.

Pin	Signal	aka	Pin
1	C (Crominance)	R	
2	C Ground		
3	Y (Luminance)	G	
4	Y Ground		Outer ring
5	Comp.Vid.	B	Pin

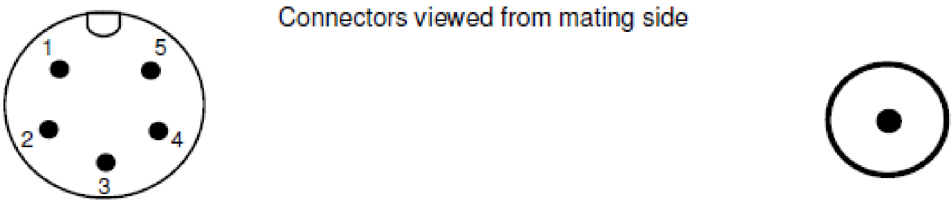


Figure 5-7 Analog out for Xeva 320 InGaAs USB only with analog out

5.5. Power Supply Filter

Cable reference: ASY-000059, for Xeva CL 640 ONLY!

Mating side of the connector on the camera:

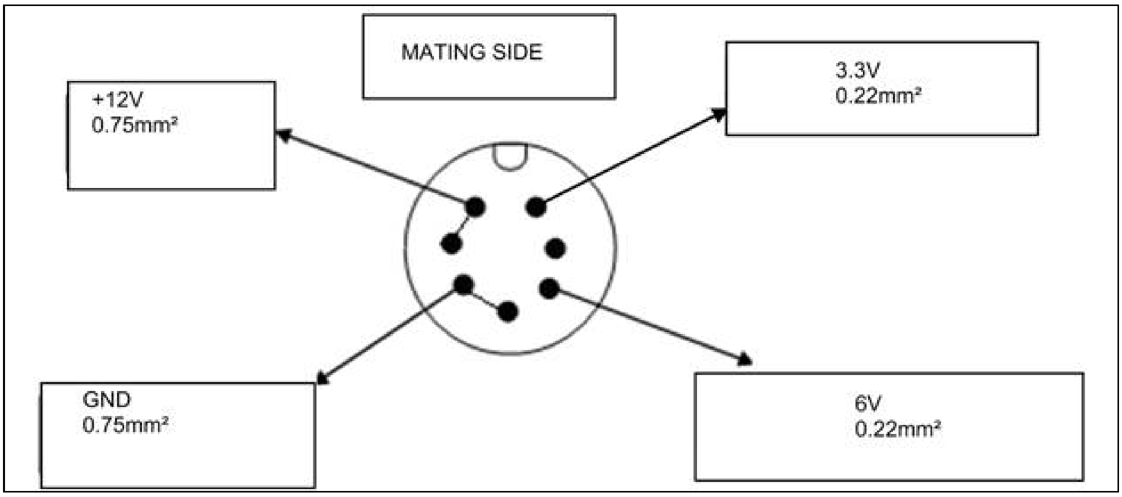


Figure 5-8 Psf for Xeva 640 InGaAs only

Mating side means looking to the holes of the connector on the camera, or to the pins of the connector on the cable of the power supply filter box.

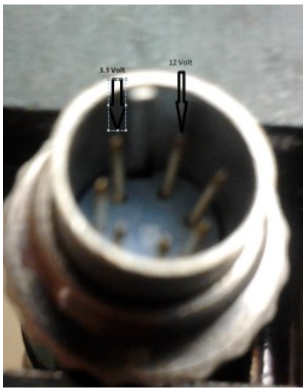


Figure 5-9 Psf connector for Xeva 640 InGaAs only (connector side)

5.6. Power Supply

The nominal power supply voltage is 12.0 V, except for the Xeva-CL-320-T2SL-TE4: here the required supply voltage is 24V

5.7. Triggering

5.7.1. Trigger Input

Trigger from 0V to 5V ±10% (4.5 to 5.5 V) TTL signal.

The integration will start on the detection of the rising edge of the 5 Volt TTL signal (rising edge from 0 Volt to 5 Volt). In addition, there is a small read out time.

Stop the capturing in Xeneth. Connect the trigger cable. It is not necessary to already set a trigger signal. Start the grabbing in Xeneth. To start the triggering (set the trigger input signal) with a 0V to 5V trigger signal on the trigger input of the camera.

See cable reference table (Table 5-1) to order a trigger cable.

When triggering, do not trigger faster than the maximum frame rate of the camera. When triggering faster, the camera will omit some of the triggers and will run slower.

The integration time will determine the maximum trigger frequency to set (let the camera run in free running mode to see the max frame rate). The longer the integration, the lower the frame rate the camera can run on. When exceeding that rate with the trigger frequency, the camera will omit some of the trigger pulses.

So measure first the maximum frame rate of the camera in continuous mode in Xeneth, to know the maximum trigger rate for the concerned integration time.

5.7.1.1. Trigger Input Control in Xeneth

Read Chapter 8 Getting Started. for connecting to the camera via the Xeneth GUI software interface.

You can set the capture mode in the settings pane.

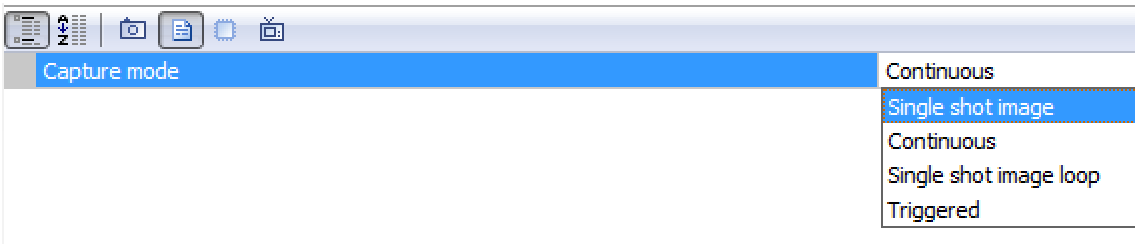


Figure 5-10 Different capture modes in Xeneth

1. Single shot image: After one image is captured the capturing is stopped.
2. Continuous: The camera continuously captures images. This is the fastest mode.
3. Single shot image loop: The camera captures an image after the software driver has processed the previous image and asks for a new one. The speed can be affected by the CPU load of the computer.
4. Triggered: The camera captures an image following an external trigger. At each trigger pulse, a new integration cycle is started. The trigger rate should not exceed the maximal frame rate of the camera for the given settings (i.e. the integration time), otherwise triggers can be skipped and the frame rate could drop.

5.7.2. Trigger Output

Trigger output is only possible with the Xeva-USB-320-InGaAs.

5.7.2.1. Trigger Output Control in Xeneth

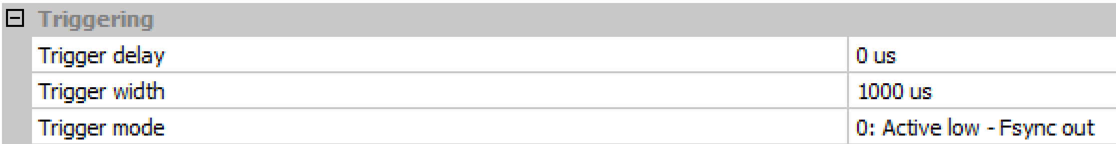


Figure 5-11 Trigger out control in Xeneth

Trigger delay
Property name: TriggerDelay
The delay (expressed in µs) on the trigger signal as defined in Trigger out mode
Values: number in [0, 20000000]

Trigger width
Property name: TriggerWidth

The width (expressed in µs) of the trigger signal as defined in Trigger out mode
Values: number in [0.025, 20000000]

Trigger mode
Property name: TriggerMode
Trigger out mode determines the behavior of the output trigger.
Values: 0,1, ... 7

Possible trigger out pulsed events:
event 1 == start of integration pulse (SOI)
event 2 == end of integration pulse (EOI)

0: Active low - Fsync out
The output pulse is low while integrating the image.

1: Active low - Pulse = start integration pulse (SOI)
After starting integration of the image, the output pulse is low for a period of Trigger width, after a period of Trigger delay.

2: Active high - Fsync out
The output pulse is high while integrating the image.

3: Active low - Pulse = end integration pulse (EOI)
After completing the integration of the image, the output pulse is low for a period of Trigger width, after a period of Trigger delay.

4: Active high - Fsync out
The output pulse is high while integrating the image.

5: Active high - Pulse = start integration pulse (SOI)
After starting integration of the image, the output pulse is high for a period of Trigger width, after a period of Trigger delay.

6: Active low - Fsync out
The output pulse is low while integrating the image.

7: Active high - Pulse = end integration pulse (EOI)
After completing the integration of the image, the output pulse is high for a period of Trigger width, after a period of Trigger delay.

5.8. Camera Link

5.8.1. Camera Link Interface

The Camera Link signals are LVDS according to the ANSI/TIA/EIA-644 standard.

LVDS uses differential signaling, with a nominal signal swing of 350 mV differential. The differential signals are immune to ±1 V common volt noise.

Camera link can be used for frame grabbing only, on all Xeva CL models. This CL channel cannot be used for command and control of the camera.

5.8.2. Xeneth Frame Grabbers

5.8.2.1. National Instruments: MDR

National Instruments1433 PCIe can be used.
2 MDR connectors
Xenics reference: ELC-001986.

Figure 5-12 National Instruments: 2 MDR connectors

5.8.2.2. Euresys: SDR

Euresys Grablink Full
2 SDR connectors
Xenics reference: ELC-001986.

Figure 5-13 Euresys Grablink Full: 2 SDR connectors

5.8.3. Camera Link connector

The camera link connector on a Xeva CL is an MDR connector.

Figure 5-14 MDR camera link connector on Xeva CL

5.8.4. Camera Link Cables

5.8.4.1. MDR to MDR: NI

Xenics reference: ELC-001328 (length: 5 m).
This cable is suited to grab images from a Xeva CL with a National Instruments1433 PCIe frame grabber in the Xeneth software.

Figure 5-15 MDR to MDR

5.8.4.2. MDR to SDR: Euresys

Xenics reference: ELC-001281 (length: 5 m).
The National Euresys Grablink Full frame grabber is suited to grab images from a Xeva CL using the Xeneth software.

Figure 5-16 SDR to SDR

5.9. Cable Reference

Connector	Cable
Xeva-USB-320-InGaAs	
Power supply	ASY-001266
USB	ELC-001272, USB Cable Triad to USB 5m
Trigger	ASY-001273, trigger in/out cable Triad to BNC ASY-000060, trigger in cable Triad to BNC
Video	ASY-000056, Video cable Triad to Cinch
Camera Link	-
Power supply filter	-
Xeva-CL-320-InGaAs	
Power supply	ASY-001266
USB	ELC-001503, Mini-USB Cable
Trigger	ASY-000060, trigger in cable Triad to BNC
Video	-
Camera Link	ELC-001281, SDR to MDR connector 5m (Euresys) ELC-001328, MDR to MDR connector 5m (National Instruments)
Power supply filter	-

Xeva-CL-320-MCT	
Power supply	ASY-001266
USB	ELC-001503, Mini-USB Cable
Trigger	ASY-000060, trigger in cable Triad to BNC
Video	-
Camera Link	ELC-001281, SDR to MDR connector 5m (Euresys) ELC-001328, MDR to MDR connector 5m (National Instruments)
Power supply filter	-
Xeva-CL-640-InGaAs	
Power supply	ASY-001266
USB	ELC-001503, Mini-USB Cable
Trigger	ASY-000060, trigger in cable Triad to BNC
Video	-
Camera Link	ELC-001281, SDR to MDR connector 5m (Euresys) ELC-001328, MDR to MDR connector 5m (National Instruments)
Power supply filter	ASY-000059, Power supply filter XEVA 640
Xeva-CL-320-T2SL	
Power supply	ASY-001271
USB	ELC-001503, Mini-USB Cable
Trigger	ASY-000060, trigger in cable Triad to BNC
Video	-
Camera Link	ELC-001281, SDR to MDR connector 5m (Euresys) ELC-001328, MDR to MDR connector 5m (National Instruments)
Power supply filter	-

Table 5-1 Cables and reference numbers

6. Lenses

6.1. C-mount Lenses

The Xeva camera is equipped with a C-mount lens support.

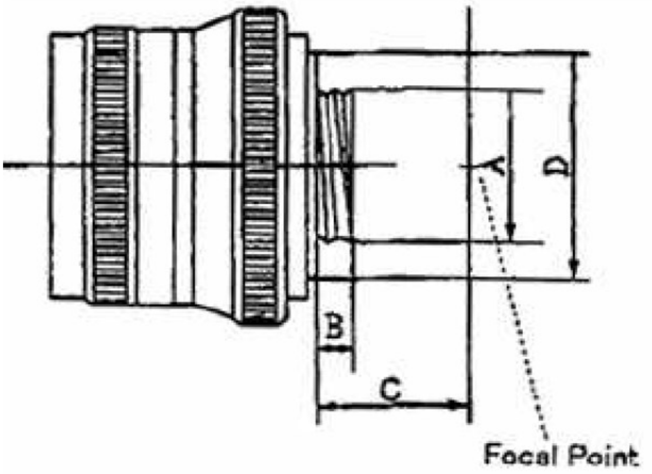


Figure 6-1 C-mount lens

A = Basic Outside Diameter 25.40mm
C = Flange Focal Distance 17.526mm

- C-mount thread: 1”-32 UN 2A

The C-mount flange of the camera’s optical support is adjustable. Thanks to this, it is possible to adjust the back focal length. Xenics provides a special key to adjust this length. When a lens is used at different operating temperatures, the focus needs to be readjusted. For specific defocus over temperature it is best to contact the lens manufacturer of the specific lens type.

6.2. Temperature Ranges

The operational temperature range is 0°C to 50°C.
The storage temperature range is -40°C to 80°C.

6.3. Lens and Sensor Cleaning

6.3.1. Lens Cleaning

It is possible to use the following different solvents to clean a lens:

- Ethanol: removal of fingerprints and other contaminants
- Alcohol: final cleaning before use.

Perform the following steps to clean a lens:

1. Immerse lens tissue in Alcohol / Propanol or Ethanol (reagent grade).
2. Wipe the lens in "S" motion in such way that each lens area will not be wiped more than once!
3. Repeat stage 2 until the lens is clean. Use a new lens tissue each time!

6.3.2. Sensor Cleaning

Be careful with cleaning! First try to clean the window with pressurized oil free air or applicable cleaning gas out of an aerosol dispenser. If this is not sufficient, try to clean the optical surface gently wiping the dirt away with a soft, lint-free, non-static cloth or lens tissue; avoid heavy rubbing, which may scratch or break the optical glass. Avoid large temperature differences between optical glass and cleaning gas or cleaning fluids.

Sensor window cleaning: use IPA and a cotton-cleaning-stick (see Figure 6-2).

Figure 6-2 cotton-cleaning-stick

6.3.3. Lens Aperture

Make sure to manipulate the integration time and not the lens aperture for intensity levels. (f/1.4). Keep the aperture of the lens always fully opened.

6.4. Lens Convertors

6.4.1. U-Mount

U-mount thread: M42x1

Xenics reference: MEC-000430.

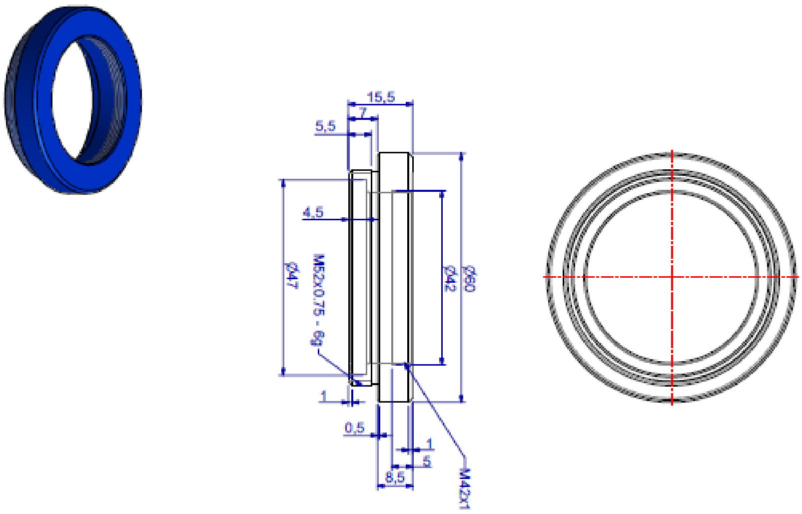


Figure 6-3 U-Mount convertor

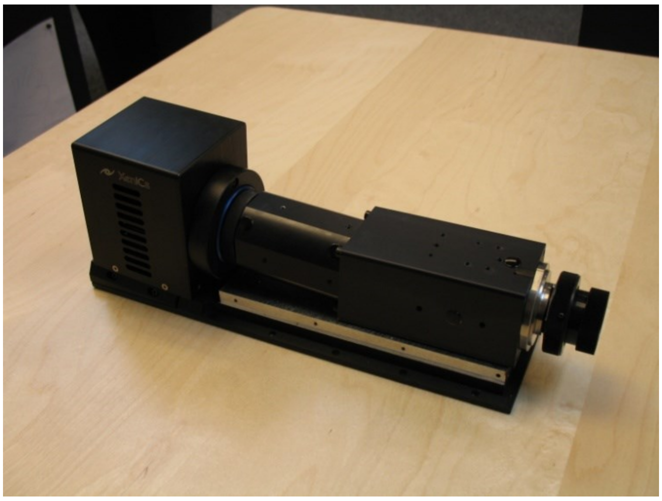


Figure 6-4 U-Mount convertor to connect inspector with Xeva

6.4.2. Canon-Mount

Xenics reference: MEC-000306.

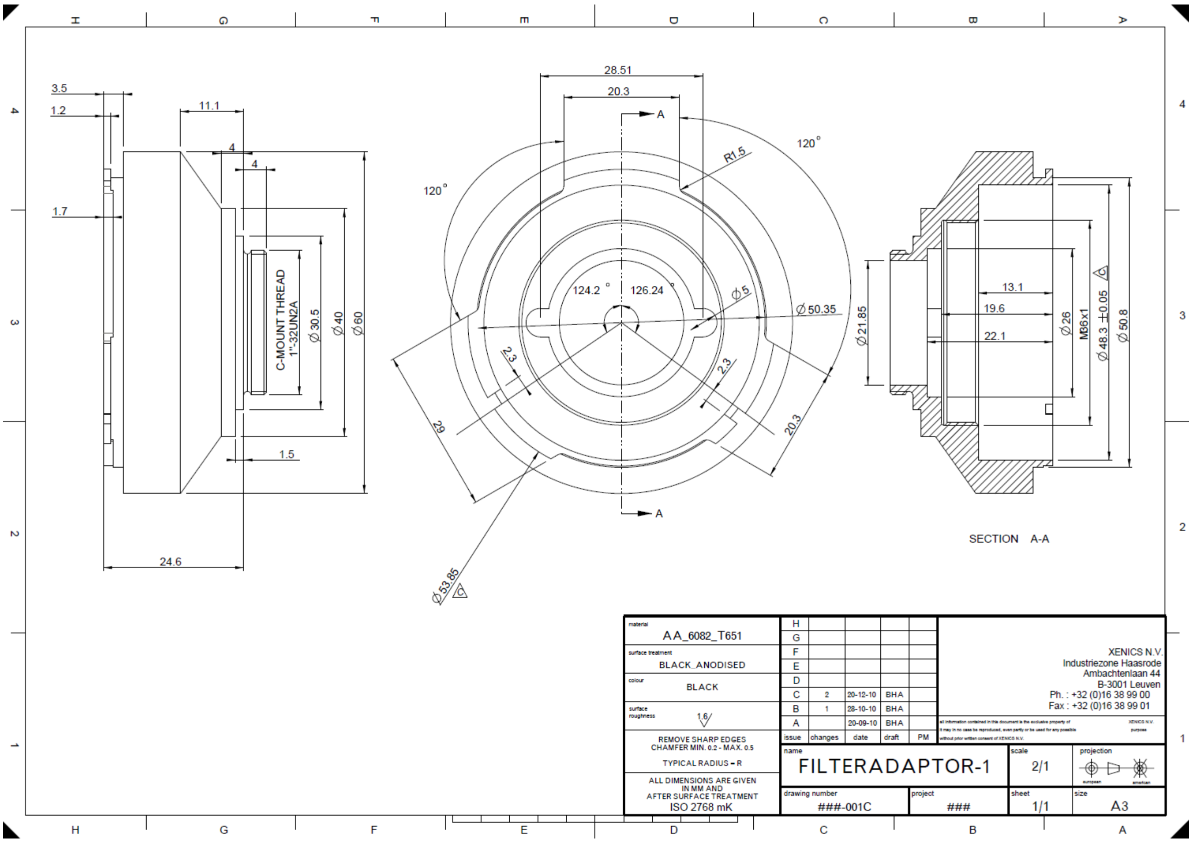


Figure 6-5 Canon-Mount convertor – filter holder

In this convertor, it is possible to fit a one inch filter. So it is an adaptor from C-mount to Canon-bayonet. And at the end of the conic part, the filter can be placed. So a filter has to have a diameter of about 25.4 mm +0/-0.2 mm.

http://www.spectrogon.com/ndstock.html

6.4.3. C-Mount with Filter Holder

It is possible to fit a one inch filter in the cavity behind the C-mount thread.

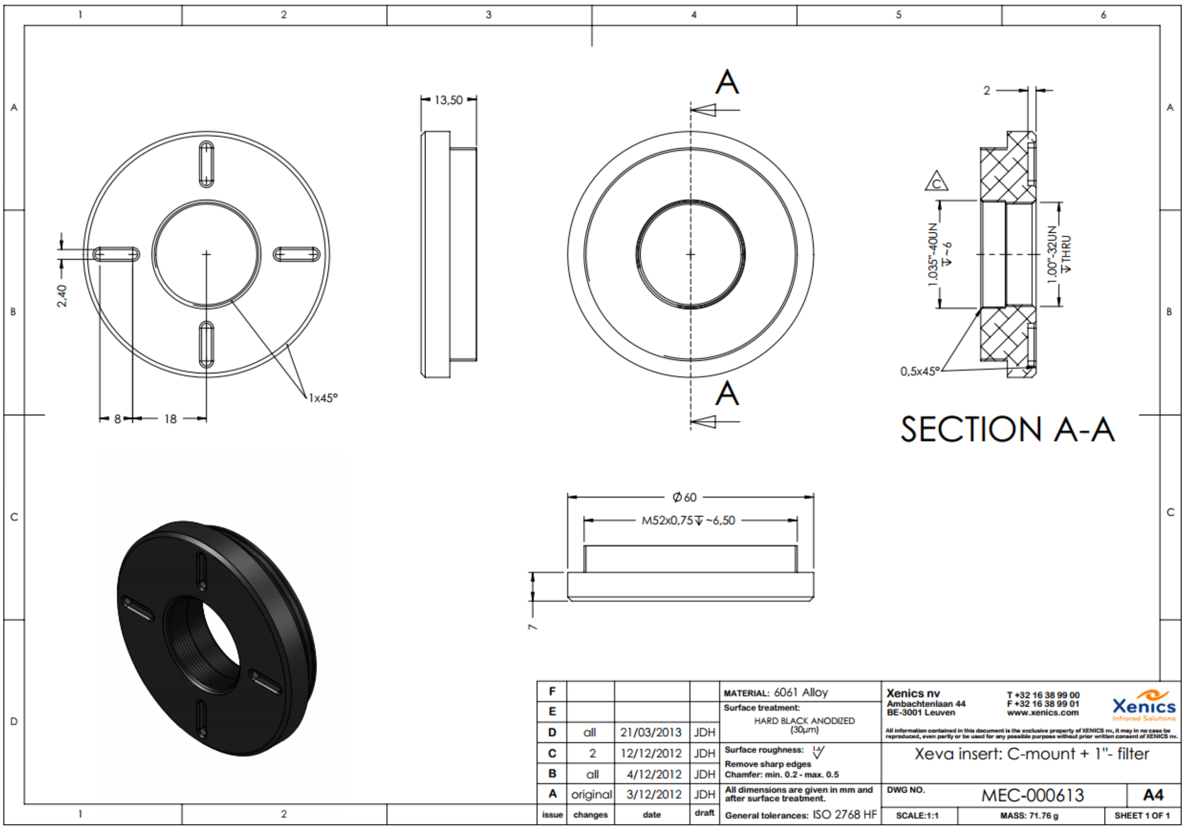


Figure 6-6 C-Mount with filter holder

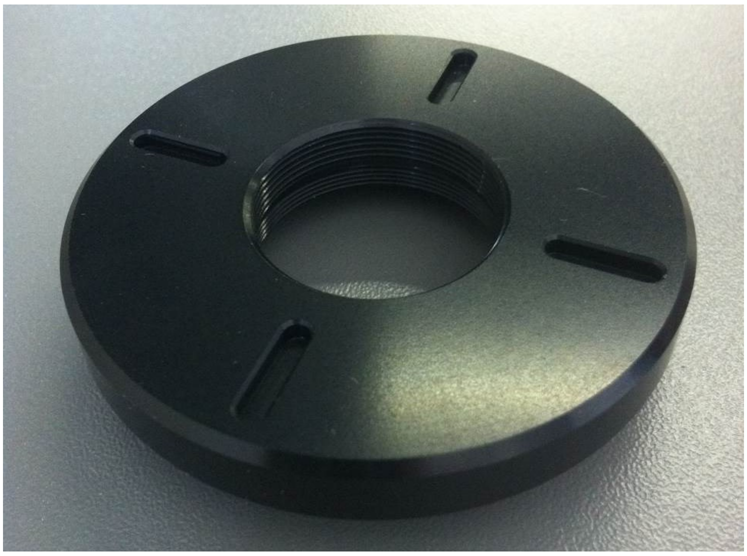


Figure 6-7 C-Mount with filter holder front site

Figure 6-8 C-Mount with filter holder back site

7. Forced Air Cooling

The camera uses forced air cooling.

⚠ The air vents must be left open. Otherwise the camera can overheat and stops functioning. Permanent damage can occur! It is the customer's responsibility to ensure open vents.

Keep the filter clean in front of the fan by using dry low pressurized compressed air.

Figure 7-1 Dust on filter in front of the cooling fan

Dust on the filter might result in a lower cooling capacity of the camera due to limited air flow on the cooling elements of the sensor. Especially for the heavily cooled engines (TE3 and TE4) this can result in an increasing and unstable dark current and noise.

8. Getting Started.

The camera is controlled via the USB. When the USB is not connected to the PC, it is impossible to drive the camera.

8.1. Connection Overview

The target is to prepare a PC to work with the camera. The camera can be accessed for command and control (to set or change settings, start and stop grabbing, etc.) over the USB channel. For Xeva cameras with camera link connector, it is NOT possible to do serial command and control over camera link.

8.2. Cable Connections

1. Connect the triad USB cable connector on the back side of the camera. In case of a Xeva CL, this is a mini USB connector.
2. Connect the triad power connector on the back side of the camera.
3. Connect the flat type A USB connector in the PC to one on the USB ports.

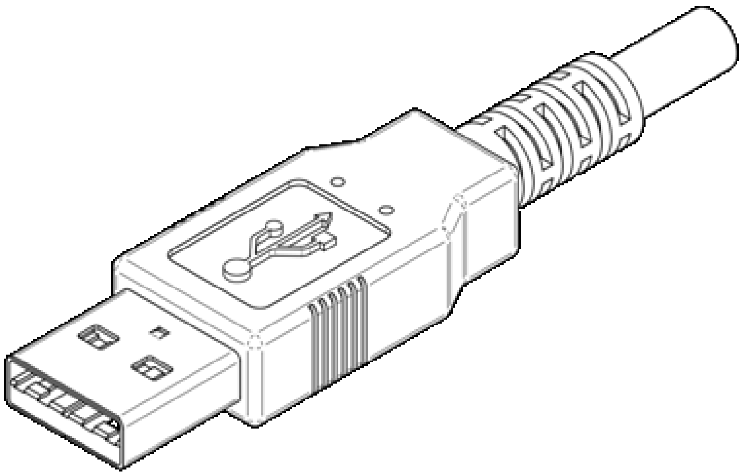


Figure 8-1 Type A USB-connector

4. Connect the Camera Link cable to the frame grabber. (See Section 9.2)
5. Connect the trigger cable. (See Section 5.3 Trigger.)

8.3. Software installation

Before being able to start the camera, the Xeneth imaging suite (at least version 2.4) and its graphical user interface must be installed, so that the data coming from a wide variety of Xenics detectors and cameras can be easily operated on and analyzed.

8.3.1. Xeneth Installation

It is a good practice to first uninstall a previous Xeneth version when installing a new one.

To use USB cameras, you need to select the component Device support > Camera Drivers (USB) during installation.

When using camera link cameras, it is also necessary to pre-install the frame grabber before installing Xeneth! Refer to the frame grabber manual for installation instructions.

For more details, refer to the Xeneth installation manual (Ref. 1) .

8.3.1. SDK Installation

The optional SDK installation is delivered on the CD together with the camera. Install the SDK software using this file.

After the SDK installation, the SDK manual, together with the samples and header files can be found in the C:\Program Files\Xeneth\SDK directory

For more details, refer to the Xeneth SDK installation manual (Ref. 2).

8.4. Connection Dialog

When starting the Xeneth GUI software a dialogue is presented that enumerates the connected cameras together with the installed calibration packs.

Xenics nv
Ambachtenlaan 44
BE-3001 Leuven • Belgium
T +32 16 38 99 00
F +32 16 38 99 01
www.xenics.com

Doc Ref: ENG-2013-UMN002
Issue: 005
Date: 08/05/2015
XF-104_03/20-12-2012

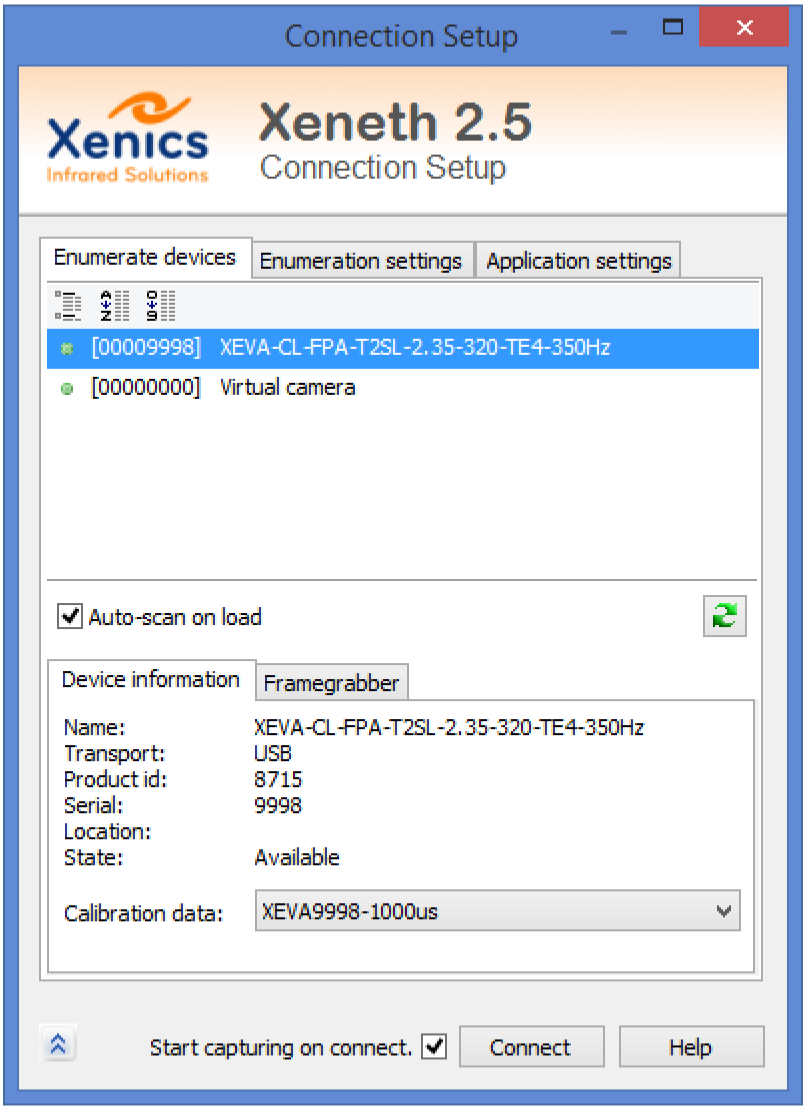


Figure 8-2 Connection dialog over USB

A Xeva camera only can be connected by a single application. When another application is connected to the camera, the icon in front is red to indicate that the camera is in use. When the camera is available, the icon is green.

The command and control channel for all Xeva is USB.

The data channel can be either USB or Camera Link (CL). For the CL cameras, the USB should only be used for command and control or as a preview channel.

9. Frame Grabbing

9.1. Data transport

You can define the transport channel via the frame grabber tab of the connection set up.

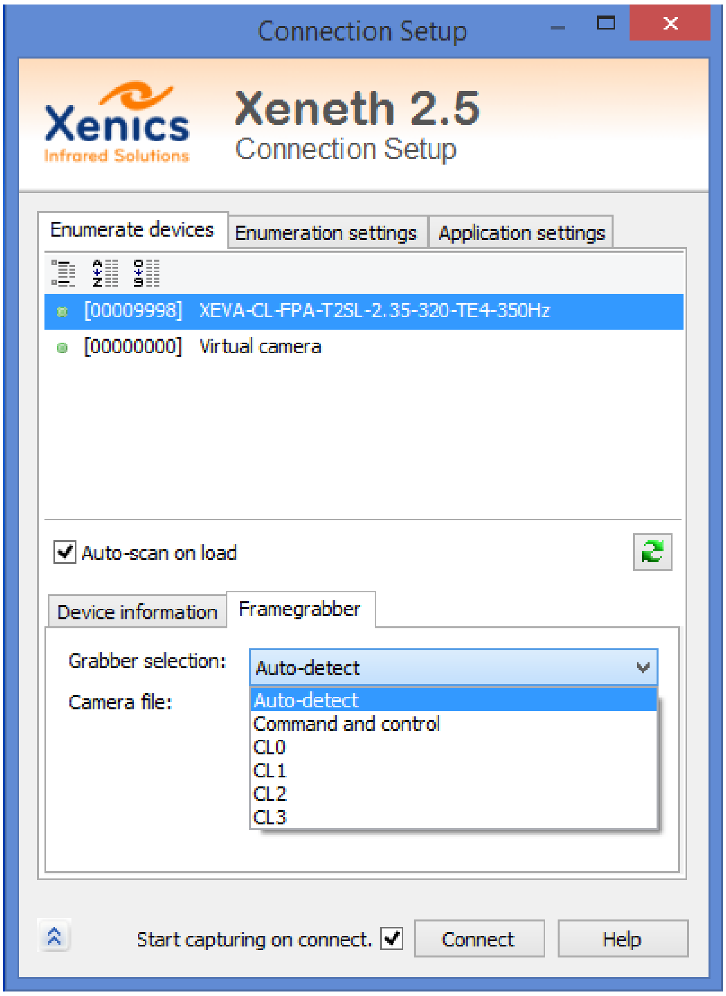


Figure 9-1: Select transport mode.

The following modes are available to grab images:

1. Auto-detect: Grabbing images over USB. For Camera Link cameras this should only be used as a preview channel.
2. Command and control: Grabbing images in a third party application, while using Xeneth for command and control.
3. CLx: Grabbing images in Xeneth over Camera Link. “x” defines the Camera Link frame grabber port onto which the camera is attached.

9.2. Use the Available Frame Grabber

If the National Instruments PCIe 1429/1433 or Euresys Grablink Full camera link frame grabber is installed on the computer (equipped with a Windows operating system) before Xeneth is installed images can be grabbed in Xeneth GUI and SDK.

9.2.1. Settings for the Camera Link frame grabber

The Camera Link settings needed to configure the supported Camera Link frame grabbers are defined in proprietary camera files, i.e. .icd files for National Instrument frame grabbers and .cam files for Euresys frame grabbers.

The files for Xenics cameras are included in the Xeneth installer.

Do not forget to mark the checkbox during installation!

When using a National Instruments frame grabber 1433 or 1429, mark the concerning check button (see Figure 9-2).

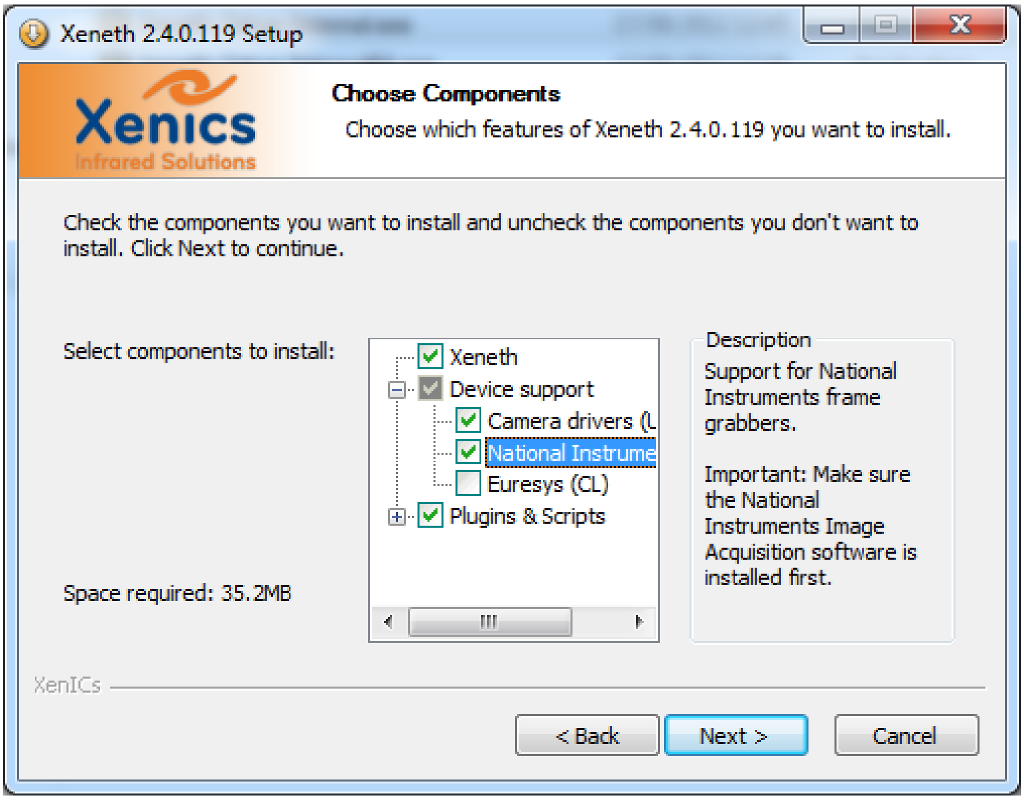


Figure 9-2 Check the National Instruments Frame grabber during the install

Mark the concerning check button when using a Grablink Full Euresys card (see Figure 9-3).

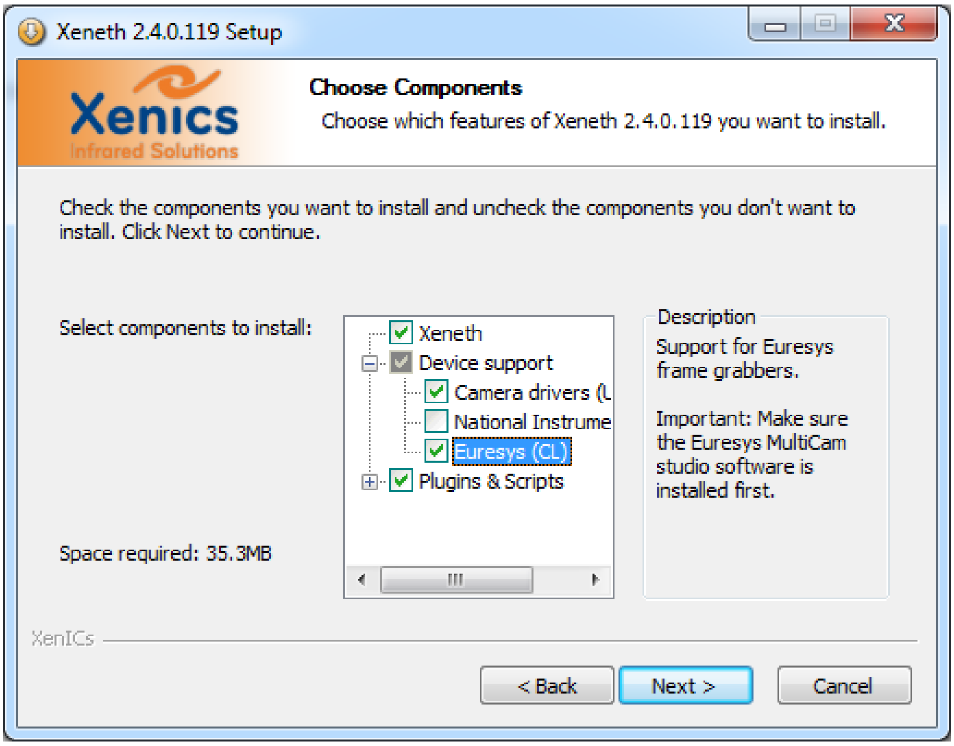


Figure 9-3 Check the Euresys Frame grabber during the install

9.2.2. Circular Buffer for Frame Grabbing

When the grabbing is via Camera Link, frame grabber settings become available in Xeneth on the settings pane. When you select the dedicated green frame grabber tab you can find the list below. (For more details refer to the Xeneth manual.)

Figure 9-4 Frame count in the circular buffer for frame grabbing by the CL grabber card

The frame count is the number of circular buffers the frame grabber puts the images in.

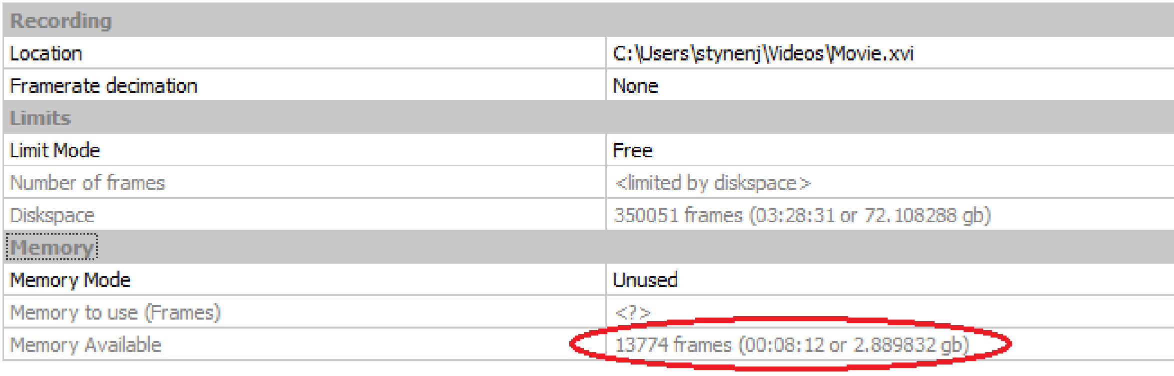
The value you enter should be such that the required memory does not exceed the memory available on your computer.

Example for a Xeva CL 14 bit camera:

320 x 256 pixels per image x 2 bytes per pixel = 163840 bytes per image.

This means that about 6000 images will fill about 1 GB.

The free memory space is always indicated in the recording pane.



Recording	
Location	C:\Users\stynenj\Videos\Movie.xvi
Framerate decimation	None
Limits	
Limit Mode	Free
Number of frames	<limited by diskspace>
Diskspace	350051 frames (03:28:31 or 72.108288 gb)
Memory	
Memory Mode	Unused
Memory to use (Frames)	<?>
Memory Available	13774 frames (00:08:12 or 2.889832 gb)

Figure 9-5 Frame grabbing circular buffer - available memory

9.3. Video out

This is only possible for some of the Xeva USB 320 cameras.

The output can generate PAL or NTSC signal levels on a 50Hz and 60Hz frequency.

Xeneth is not capable of processing analog signals.

10. Camera Settings

10.1. Generic Settings

Integration time

Property name: IntegrationTime

This parameter makes it possible to display the actual integration time in µseconds.
When a setting of zero is applied, the real integration time is 1 µseconds.
Values: number in the interval [0.025, 107374182.375]
The mentioned range is the one what is possible to apply with the software or SDK. The minimal and maximum integration time will depend on the sensor type (read out) and cooling.

ADC Vin

Property name: ADCVIN

Using this parameter it is possible to change the settings of the mean output value of the IR detector and the central point of Video Analog-to-Digital Converter (ADC). The histogram values will move left when lowering this setting. The histogram values will move right when raising this setting.
Values: integer in [0, 4095] for InGaAs (expressed in 12 bit digital)
Values: number in [0, 5.0] for MCT (expressed in Voltage).
Values: integer in [0, 4095] for T2SL (expressed in 12 bit digital)

ADC Vref

Property name: ADCVREF

Half of the ADC conversion window width, defines the range (half of the full range) in which the analog output signal can vary. Normally the extremes of the video signal have to be contained within these limits (ADC Vin-ADC Vref) and (ADC Vin+ADC Vref). Reduce this value to stretch the histogram. Raise this value to compress it. This value determines how wide the sensor output can vary around an offset. When taking this value too small, the data will be too much black and white. When it is too large, the image will only give a grey shade.
Values: integer in [0, 4095] for InGaAs (expressed in 12 bit digital)
Values: number in [0, 2.048] for MCT (expressed in Voltage).
Values: integer in [0, 4095] for T2SL (expressed in 12 bit digital)

Frame rate

Property name: Framerate

The camera frame rate reduction is expressed in Hz.

Values:“min”, “max”, integer in [“min”, “max”].

Temperature

Property name: Temperature
This setting reads the actual temperature of the IR sensor. The read out value depends on the unit chosen when starting up Xeneth.

Image source
Property name: ImageSource
Image source should read 'sensor' (0), camera diagnose: X-Diagnostic (1), Y-Diagnostic (2) or X0RDiagnostic (3).
Values: 0, 1, 2, 3

Cooling
Property name: Fan
Switch on the cooling or fan of the camera. The fan should always run when cooling is applied to the sensor. It is recommended to leave the Fan ON. To be able to cool the camera, cooling or fan should be set to 1.
Values: 0, 1

Cooling temperature, Settle Temperature
Property name: SETTLE
This setting is used to set the sensor cooling temperature in the units chosen during startup (e.g. Kelvin, Celsius). The camera and the software are designed to cool the sensor.
Values: temperature in the units defined at startup. The acceptable range is described below for the different types.

Camera	Minimal temperature (K)
Xeva-320-InGaAs-TE1	263
Xeva-320-InGaAs-TE3	223
Xeva-CL-320-MCT-TE4	190 Advised to use between [215, 220]
Xeva-CL-640-InGaAs-TE1	263
Xeva-CL-640-InGaAs-TE3	230
Xeva-CL-320-T2SL-TE4	198

Table 10-1: Cooling temperature

Offset Temperature
Property name: TemperatureOffset
The offset temperature is a value that is added to the temperature.
The value compensates the difference between the real temperature and the value read from the camera.
Values: number in [-100.00, 100.00]

Manual PWM cooling, manual cooling drive power
Property name: PWM

This setting defines the cooling power when using the manual cooling. In case of manual cooling, 0 means that there is no cooling power, 4095 means the maximum cooling power. To avoid that the sensor package overheats, the PWM should only be higher than 3700 for a limited time.

To turn on manual cooling, the values P, I and D should be set to zero (see below).

In the old XControl software all our Xeva cameras were cooled by an internal loop of PWM cooling (software cooling). The PWM setting was automatically modulated in the Xcontrol software in function of the attained cooling temperature.

```
// Set PWM-value to cool more or less, Max cooling == 4095
if (SettleTemperature > ReadTemperature)
{
    PWM = PWM - 30;
    if (PWM > 4095) PWM = 4095;
    if (PWM < 0) PWM = 0;
    . . .
}
else if (SettleTemperature < ReadTemperature)
{
    PWM = PWM + 30;
    if (PWM > 4095) PWM = 4095;
    if (PWM < 0) PWM = 0;
    . . .
}
```

Figure 10-1 PWM cooling loop

PID cooling settings, P, I, D
Property name: P
Property name: I
Property name: D

PID settings of the hardware cooling control system.
These parameters are used to select the type of cooling of the camera.

For PWM cooling both P,I and D should be set to zero.

In case of hardware cooling (PID cooling), the proportional (P), integral (I) and derivative (D) factors have a value in [0, 4095]

i

COOLING: To override the hardware cooling control loop, PWM should be non-zero while PID cooling settings are all zero (P=0, I=0, D=0).

To activate the hardware operated cooling control, PWM should be set to zero while PID cooling settings should according to the following guidelines:

- Xeva-CL-320-T2SL-TE4: P = 1500, I = 75, D = 0
- Other: P=3000, I=150, D=1

10.2.Xeva 320 InGaAs CL/USB

Following settings are only applicable on a Xeva 320 InGaAs CL and USB camera.

VDetcom
Property name: VDETCOM
Detector substrate voltage is the parameter used to bias the sensor. Max value: 4095, optimal value between 2000 and 4000 depending on temperature setting. Advised setting is 3500, for high speed applications it must be set to a higher value than 3500.
Values in [0, 4095]

Bandwidth
Property name: CMDBANDW
This parameter selects the CTIA stage amplifier bandwidth limiting capacitors. Default value is “Bandwidth 1”. In high gain, it can be interesting to change to the “Bandwidth 3” position to further reduce the CTIA noise. In low gain, position 2 and 3 are discarded.
Values: 0, 1, 2, 3

Bias
Property name: CMDBIAS
This parameter selects the ROIC’s CTIA Bias.
Values: 011nA (0), 033nA (1), 056nA (2), 078nA (3), 100nA (4), 122nA (5), 144nA (6), 167nA (7)

Current
Property name: CMDCURRENT
This parameter sets the ROIC’s master Current Adjust. The Current is set to values between 0.73 to 1.47uA
Values: 073uA (0), 079uA (1), 086uA (2), 093uA (3), 100uA (4), 114uA (5), 129uA (6), 147uA (7)

Power
Property name: CMDPOWER
This parameter sets the sensor power.
Peripheral circuit power, best in nominal position “power 2”. When selecting another position the overall power consumption will be increased or decreased with about 30% per

step relatively to the default position.
Values: 0, 1, 2, 3

The advised settings for un-cooled cameras are used for bandwidth and power, 100 µA current and 100 nA bias. The advised settings for cooled cameras are zero for bandwidth and power, 73 µA current and 11 nA bias.

Low gain
Property name: LowGain
This parameter enables the secondary readout capacitor.
A large integration capacitor is used in the trans-impedance amplifier circuit. Therefore, the overall system noise is reduced but longer integration times are necessary. Enabling this option, the array's sensitivity is multiplied by a factor 20. In high gain mode the output conversion factor of the FPA is about 16 microvolt/electron, and in low gain mode this factor is about 0.8 microvolt/electron.
Values: 0 or 1
0: 10 fF
1: 210 fF

Multiple Readouts or Continuous integration
Property name: CMDMULRD
Enabling this option has a consequence that the feedback capacitor in the readout is not reset. This mode is useful when the user wants to use very long integration times. However, using standard integration times, this option should be left unchecked. By default this option is not activated.

Y-Invert
Property name: FlipY
Flips the image along the vertical axis, inverts the image vertically.
Values: 0, 1
0: The image is not flipped.
1: the image is flipped.

X-Invert
Property name: FlipX
Flips the image along the horizontal axis, inverts the image horizontally.
Values: 0, 1
0: The image is not flipped.
1: the image is flipped.

Start
Property name: WoiSX(0)
This parameter defines the X coordinate starting point of the window of interest. This needs to be a multiple of 64.

Values: integer in the interval [0, 319]

EndX
Property name: WoiEX(0)
This parameter defines the X coordinate end point of the window of interest. This needs to be a multiple of 64 minus 1.
Values: integer in the interval [0, 319]

StartY
Property name: WoiSY(0)
This parameter defines the Y coordinate starting point of the window of interest. This needs to be a multiple of 4.
Values: integer in the interval [0, 254]

EndY
Property name: WoiEY(0)
This parameter defines the Y coordinate end point of the window of interest. This needs to be a multiple of 4 minus 1.
Values: integer in the interval [1, 255]

i Do not manipulate CMDOUTPUTS because it is depending on the camera model!

10.3.Xeva 640 InGaAs CL

Following settings are only applicable on a Xeva 640 InGaAs CL camera.

VDetcom
Property name: VDETCOM
The detector substrate voltage is the parameter used to bias the sensor. Max value: 4095, optimal value 1309 is recommended for the Xeva 640.
Values in [0, 4095]

Bandwidth
Property name: CMDBANDW
This parameter selects the CTIA stage amplifier bandwidth limiting capacitors. Default value is “Bandwidth 1”. In high gain, it can be interesting to change to the “Bandwidth 3” position to further reduce the CTIA noise. In low gain, position 2 and 3 are discarded.
Values: 0, 1, 2, 3
Bias
Property name: CMDBIAS
This parameter selects the ROIC’s CTIA Bias.

Values: 011nA (0), 033nA (1), 056nA (2), 078nA (3), 100nA (4), 122nA (5), 144nA (6), 167nA (7).

Current
Property name: CMDCURRENT
This parameter sets the ROIC's master Current Adjust. The Current is set to values between 4 different levels.

Least	= 0
Lower than average	= 1
Higher than average	= 2
Most	= 4

Power
Property name: CMDPOWER
This parameters sets the sensor power.
Peripheral circuit power, best in nominal position "power 2". When selecting another position the overall power consumption will be increased or decreased with about 30% per step relatively to the default position.
Values: 0, 1, 2, 3

Gain
Property name: CMDGAIN
Relative signal gain of the readout

Least, relative gain	= 1	→ argument level = 0
Lower than average, relative gain	= 1, 33	→ argument level = 1
Higher than average, relative gain	= 2	→ argument level = 2
Most, relative gain	= 4	→ argument level = 3

Values: 0, 1, 2, 3
Advised Gain value is Higher than average (2).

Y-Invert
Property name: FlipY
Flips the image along the vertical axis, inverts the image vertically.
Values: 0, 1
0: The image is not flipped.
1: The image is flipped.

X-Invert
Property name: FlipX
Flips the image along the horizontal axis, inverts the image horizontally.
Values: 0, 1
0: The image is not flipped.
1: The image is flipped.

StartX
Property name: WoiSX(0)
This parameter defines the X coordinate starting point of the window of interest. This needs to be a multiple of 64.
Values: integer in the interval [0, 639]

EndX
Property name: WoiEX(0)
This parameter defines the X coordinate end point of the window of interest. This needs to be a multiple of 64 minus 1.
Values: integer in the interval [1, 639]

StartY
Property name: WoiSY(0)
This parameter defines the Y coordinate starting point of the window of interest. This needs to be a multiple of 4.
Values: integer in the interval [0, 511]

EndY
Property name: WoiEY(0)
This parameter defines the Y coordinate end point of the window of interest. This needs to be a multiple of 4 minus 1.
Values: integer in the interval [0, 511]

10.4.Xeva 320 MCT CL

Following settings are only applicable on a Xeva 320 CL MCT camera.

Sensor Vin
Property name: SensVIN
Sensor level shifts. An Offset (expressed in Voltage) is added to the analog signal in the analog path.
This parameter makes it possible to change the settings of the sensor‘s input voltage. Changing this parameter, results in a crude positioning of the histogram peak.
Values: number in [0, 2.048] (expressed in Voltage)

Sensor Vref
Property name: SensVREF
Sensor range shifts. The analog signal (expressed in Voltage) is stretched in the analog path. This parameter makes it possible to change the settings of the sensor’s reference voltage. Changing this parameter, results in a crude positioning of the histogram peak.
Values: number in [0, 2.048] (expressed in Voltage)

i Y-Invert, X-Invert and windowing settings (Start X, End X, Start Y, End Y) are not available on the Xeva 320 MCT CL.

10.4.1. Conversion AD to Volt

In Xcontrol, all settings (ADC Vin, ADC Vref, Senor Vin, Sensor Vref) were expressed as 12 bit numbers. In Xeneth, those setting are expressed as voltages.

- Voltages over AD convertor:
  ADCVin = 5 Volt x (Value / 4096)
  ADCVref = 2,048 x (Value / 4096).

- Voltages over the sensor:
  Sensor Vin = 2,048 Volt x (Value / 4096)
  Sensor Vref = 2,048 x (Value / 4096).

- Old settings in XControl, converted to voltage settings in Xeneth:
  ADCVin = 1625 ➔ 1.9836V
  ADCVref = 2000 ➔ 1V
  sensor_vref = 1900 ➔ 0.95V
  sensor_vin = 2000 ➔ 1V.

10.5.Xeva-CL-T2SL-2.35-320-TE4

The Xeva-CL-T2SL-2.35-320-TE4 specific settings are listed below. The other settings are either covered under the ‘generic’ section or are inherited from the Xeva-320 InGaAs CL/USB.

VDetcom
Property name: VDETCOM
Detector substrate voltage is the parameter used to bias the sensor. Default (and max) value: 4095, which corresponds to 5.5V

Bandwidth
Property name: CMDBANDW
This parameter selects the CTIA stage amplifier bandwidth limiting capacitors.
Default value is “Bandwidth 0”. Values: 0, 1, 2, 3

Power
Property name: CMDPOWER
This parameter sets the sensor power peripheral circuit power, best in nominal position “power 3”. When selecting another position the overall power consumption will be increased or decreased with about 30% per step.
Values: 0, 1, 2, 3

10.6. Load a Calibration Pack

To properly initialize the camera, a calibration pack should be loaded at start up (see chap. 12 Calibration Packs). In this way suitable values for the key features (voltages, cooling,…) are applied.

……

11. Camera Characteristics

11.1.Detector Material

11.1.1. InGaAs – VisNIR Response

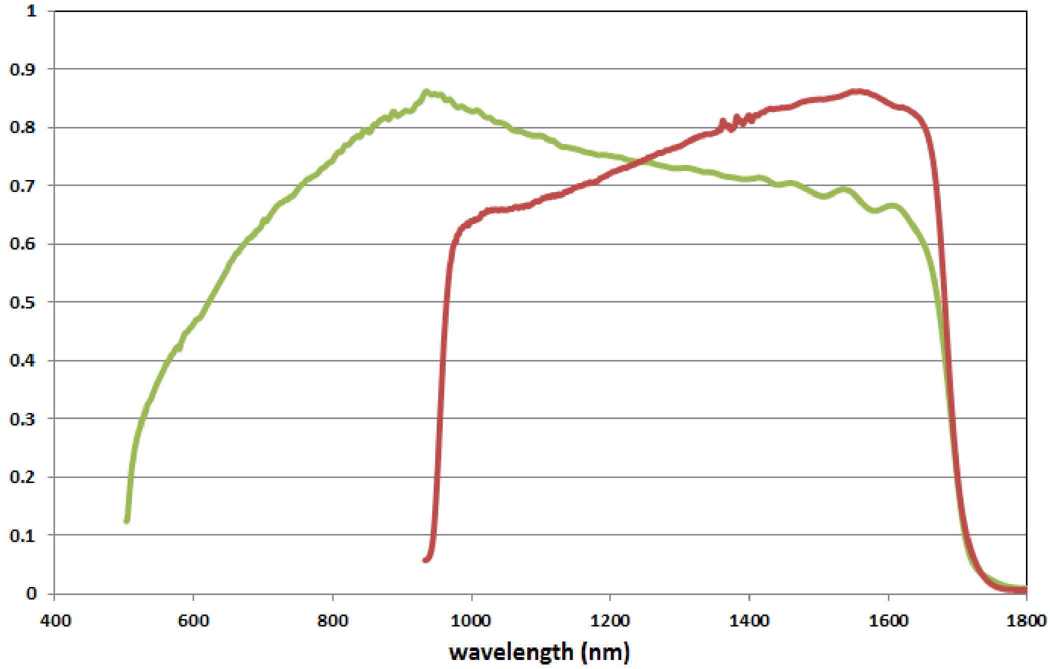


Figure 11-1 Quantum efficiency InGaAs and VisNIR InGaAs

11.1.2. VisNIR InGaAs

Blue represents the InGaAs, the red part is extended due to the InP removal of the senor.

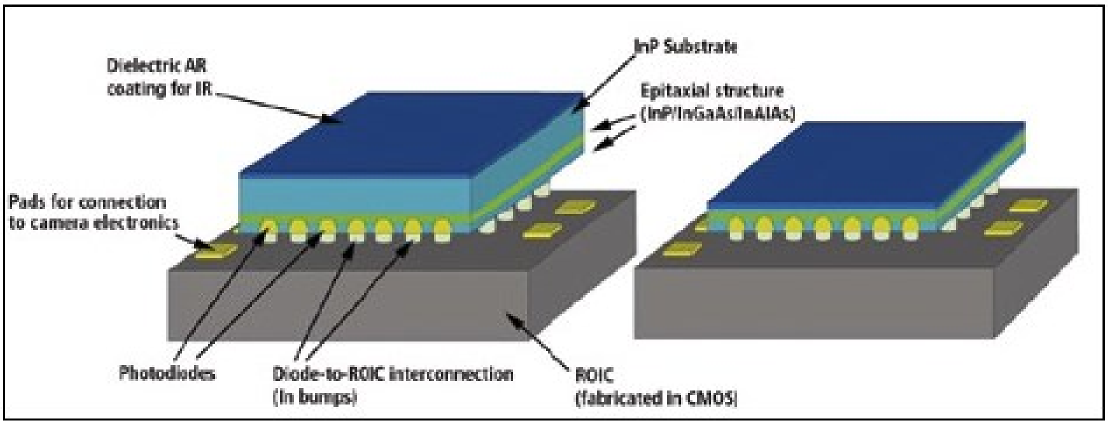


Figure 11-2 VisNIR: InP removal

For the VisNIR, back-thinning of the substrate is used. The InP cap or substrate on an InGaAs sensor absorbs the wavelengths below 920 nm, resulting in only wavelengths bigger than 920 nm reaching the InGaAs. It is the InP absorption below 920 nm, not the capabilities of the InGaAs itself, that limits an InGaAs sensor to 920 nm.
The thick InP layer on top an InGaAs sensor allows only wavelengths above 920 nm to the sensor. The InP layer has a certain absorption as well, for wavelengths above 920 nm. The VisNir InGaAs sensor has no InP layer, so there is no absorption for wavelengths above 920 nm. In addition, extended sensitivity in the visual wavelengths is available.

11.1.2.1. Xeva 320 only

The extended VisNIR option is only available on the Xeva 320 USB/CL. The extended VisNIR option is NOT available on the Xeva 640 CL.

11.1.2.2. VisNIR – Night Vision

Thermal imaging cameras, such as LWIR un-cooled micro bolometers, have excellent detection abilities at night. However SWIR InGaAs cameras are a good complement to thermal imaging cameras. While thermal imaging can detect the presence of a warm object against a cool background, a SWIR camera can actually identify what that object is. SWIR night vision is based on reflection of infrared rays from atmospheric glow rather than on thermal radiation what is the case for LWIR; moreover SWIR InGaAs cameras have a much better dynamic range than thermal imagers. Obviously, a VisNIR InGaAs camera benefits from its ability to see more wavelengths, which adds sensitivity to visible wavelengths in addition to the SWIR. Thermal imaging tends to provide a binary view of the world, with only modest gray-scale response. VisGaAs, on the other hand, provides the user with a view that more closely resembles the visible world. Additionally, by using SWIR illumination for example 1550nm LEDs or lasers, a scene can be covertly illuminated, i.e. viewing is only possible with a VISNIR InGaAs camera.

11.1.3. Xeva InGaAs Cooling

In addition to the cooling, the relative quantum efficiency shifts. Cooling more the sensor of the camera, the quantum efficiency shifts to lower wave lengths. One of the particularly noteworthy behaviors of InGaAs FPAs is that their long-wavelength cutoff is reduced when they are cooled. As a rule of thumb, the long-wavelength cutoff shifts by 8 nm for every 10°C of sensor cooling. This phenomenon can actually be advantageous, as the sensor is insensitive to background signal beyond the shifted far-end wavelength cutoff. In other words, the sensor acts like a “tunable” low pass optical filter.

11.1.4. Xeva MCT

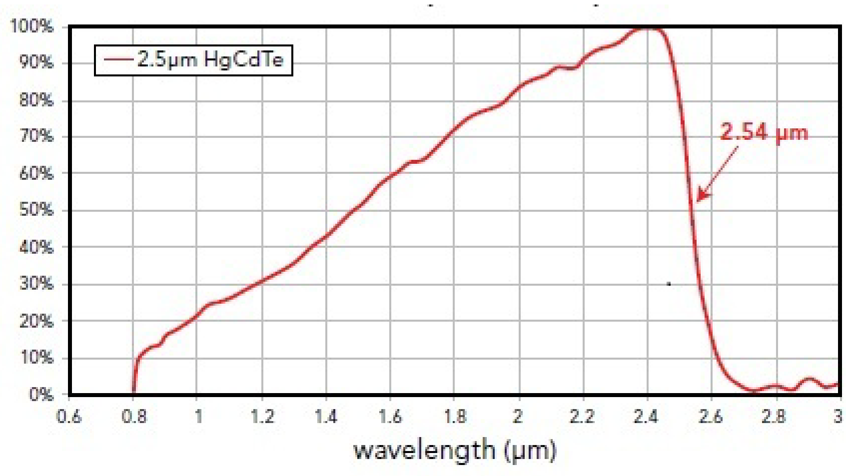


Figure 11-3 Quantum efficiency SWIR MCT

This graph is supplied by Sofradir (MARS SWIR, http://www.sofradir.com/produits/pdf/10.pdf).

11.1.5. Xeva-T2SL

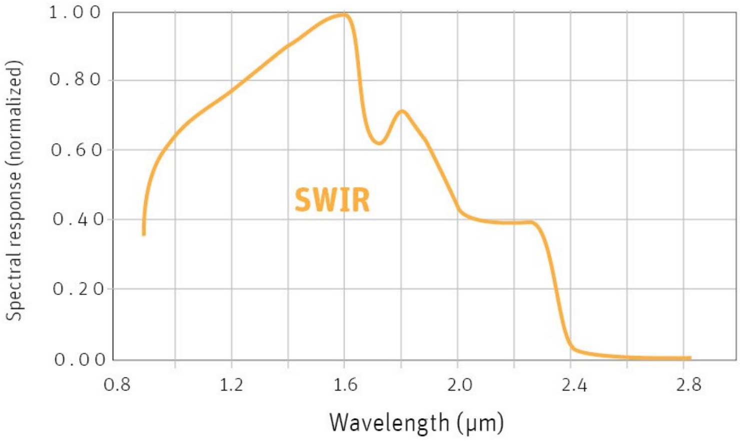


Figure 11-4 Spectral Response of the T2SL detector.

Read-out Topology

Camera type	Read out type
Xeva 320 InGaAs USB/CL	Capacitance Trans-Impedance Amplifier (CTIA)
Xeva 640 InGaAs CL	Direct injection (DI)
Xeva 320 MCT CL	Capacitance Trans-Impedance Amplifier (CTIA)
Xeva 320 T2SL CL	Capacitance Trans-Impedance Amplifier (CTIA)

Table 11-1 Camera type – readout type

11.1.6. Xeva 320 InGaAs Versus Xeva 640 InGaAs

The XEVA 640 with DI integrator is a 9901 readout IC (http://www.flir.com/uploadedFiles/9901spec.pdf). The XEVA 320 with CTIA integrator is a 9908 readout IC (http://www.corebyindigo.com/pdf/spie/3698-98.pdf).

The readout of the XEVA 640 is a design of the current integrator in the pixel – i.e. it is a DI integrator, which is more optimized for longer integration times and larger currents. Moreover, the gain in a XEVA 640 is provided in the output amplifier of the camera.

In the CTIA based 320 XEVA the gain can change inside the pixel – which is useful for people working with gated imaging at long distances – i.e. when not much IR light comes back to the camera.

The CTIA based devices can be “faster”, i.e. they react better to short integration times and need a lower background light level.

The Xeva 640 camera has about the same sensitivity as Xeva-320 in low gain mode, which is about 20 times lower than high gain for the Xeva 320.

The Xeva 320 and the Cheetah-640Cl have comparable sensitivity.

The read of a reduced window (ROI, region of interest) is possible on both camera types.

11.1.7. Xeva 320 MCT

The read of a reduced window (ROI, region of interest) is not possible on Xeva 320 MCT camera. Frames have always to be grabbed in full window mode (320 x 256 pixels).

Due to a relative high dark current for longer integration times, it is recommend to limit the integration time to about 18 milliseconds.

11.1.8. Xeva 320 T2SL

The Xeva-320 T2SL is based on the ISC9809 Indigo CTIA.

Region of interest (ROI) selection is fully supported. It can be activated using Xeneth or the SDK,

The dark current decreases logarithmically with sensor temperature. The maximum exposure time before saturation thus depends heavily on the cooling setting. To compensate for the fact that for higher integration times, the number of electrons without illumination will be higher, it is possible to adjust the ADCVin and ADVref setting to recover the full 14 bit ADC range. This is advised for higher sensor temperatures, while not necessarily needed for lower sensor temperatures because the dark current is significantly reduced anyway for the latter.

12. Calibration Packs

You can select a calibration pack in the Connection dialogue of Xeneth (See Figure 12-1) or via the “Select” button above the Property pane (See Figure 12-2).

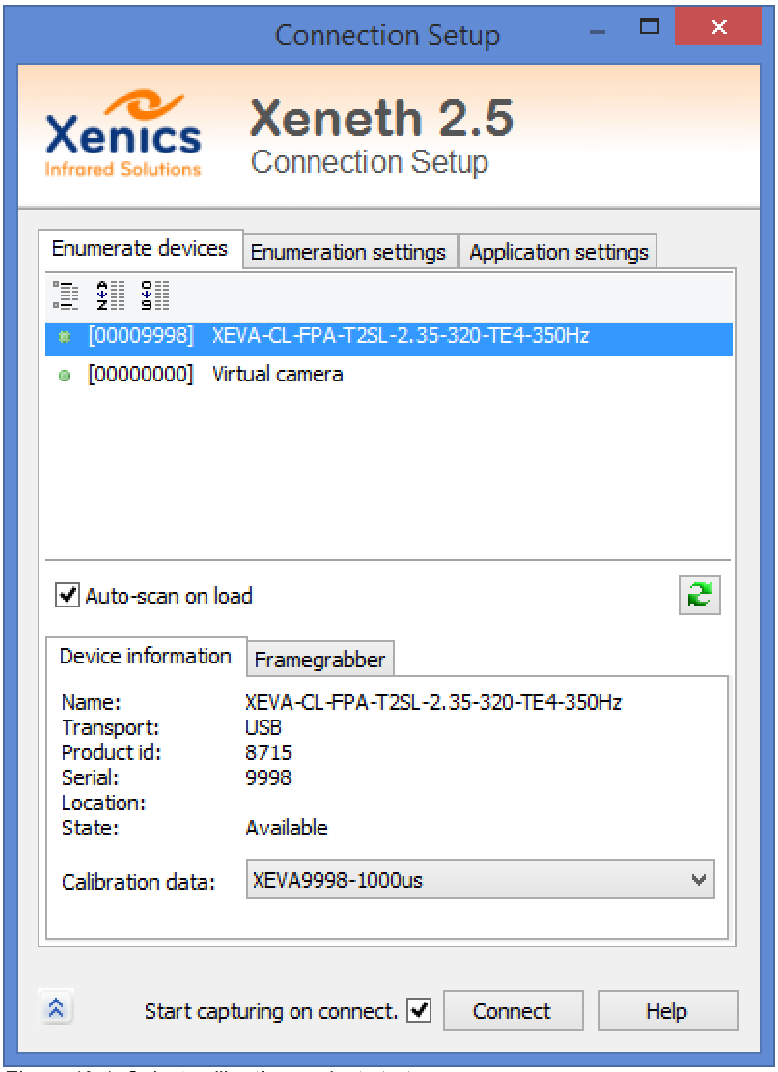


Figure 12-1: Select calibration pack at start up.

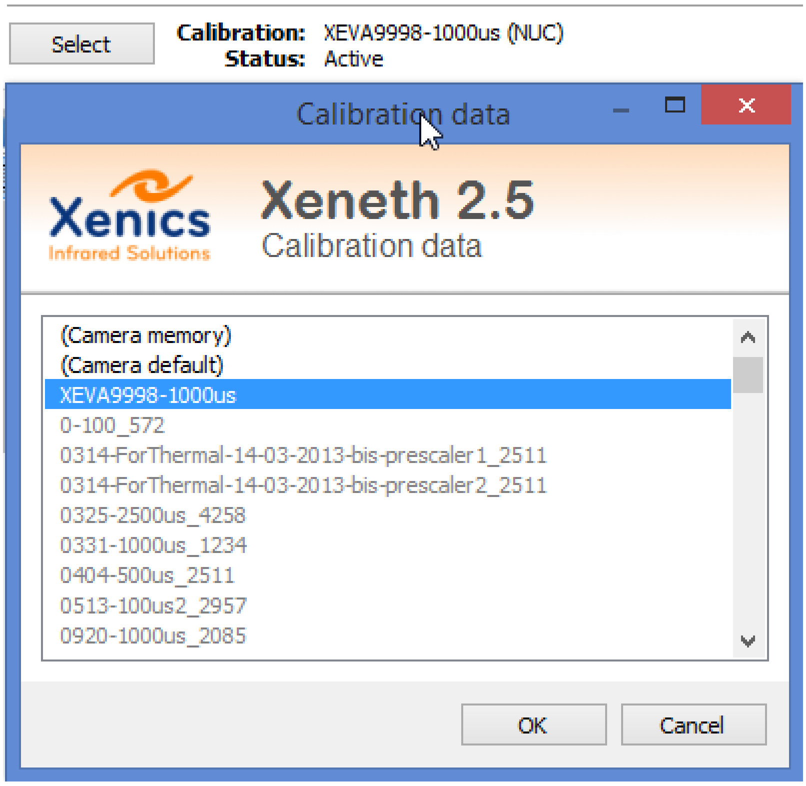


Figure 12-2: Select calibration via "Select".

The Calibration pack stores non-uniformity correction data as well as the settings used to make these calibrations. After selecting the calibration pack, Xeneth will upload the settings of the concerned calibration pack to the camera if the serial number in the camera corresponds with the identifier in the filename of the calibration pack.

If the calibration pack cannot be loaded by the Xeneth software, Xeneth shows the 'Invalid calibration' message (see Figure 12-3).

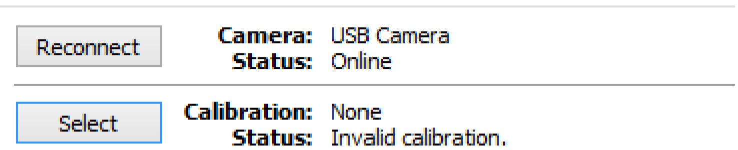


Figure 12-3 Invalid calibration

If no valid calibration pack is loaded at the Xeneth startup, Xeneth will load a default initialization file with auto_XXXX.xcf as extension (note that the filename ends with 4 digits, indicating the Product Identifier). This initialization file can be found in the settings subdirectory of Xeneth. When the user shuts down Xeneth in those circumstances, the user will be asked whether or not the settings have to be saved in the corresponding initialization file. One of the following dialogs will appear when leaving Xeneth:

- If the user chooses “YES”, the settings will be stored in the default initialization file with auto_XXXX.xcf as extension. If “YES” and “Do not ask me again” is checked, the setting will always be saved if no calibration pack is loaded.
- If the user chooses “No”, the settings will not be stored in the default initialization file with auto_XXXX.xcf as extension. If “No” and “Do not ask me again” is checked, the setting will never be saved.

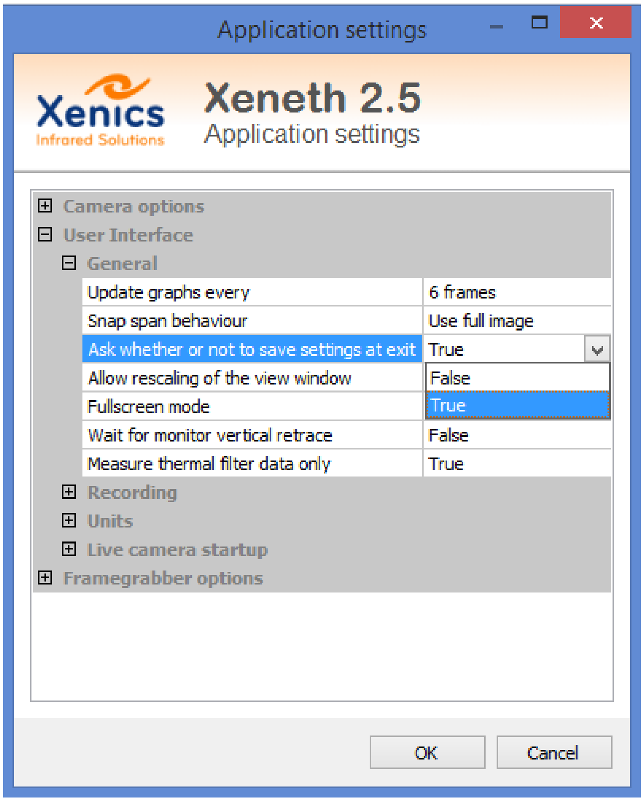


Figure 12-4 Save settings.

- If once “No” and “Do not ask me again” is chosen on the Save Settings dialog, the Save settings dialog will never appear again. To be able to show the “Save Settings” dialog again, set “Ask whether or not to save settings at exit” on the Connection Dialog on true (as shown in Figure 12-4).

12.1.Calibration Packs

A calibration pack for image correction consists of the following 3 main parts:

- Offset correction
- Gain correction
- Bad pixel replacement.

12.1.1. Offset

When no light is incident on the detector, the raw image might still generate an offset. These are typically free electrons generated by the detector itself (= dark current). The generation rate is mainly dependent on the temperature of the detector, the used integration time and the sensor bias. For a fixed integration time, one could therefore expect a quasi-constant offset signal. During the calibration procedure the offset signal is determined per pixel. When the correction is loaded, this offset is deducted from the signal, which is called “offset correction”. This is called the Fixed Pattern Noise correction.

So the raw dark image is by the correction reduced to the zero origin of the histogram. The dark calibration image is subtracted from the image. This is the preferred option for non thermal cameras.

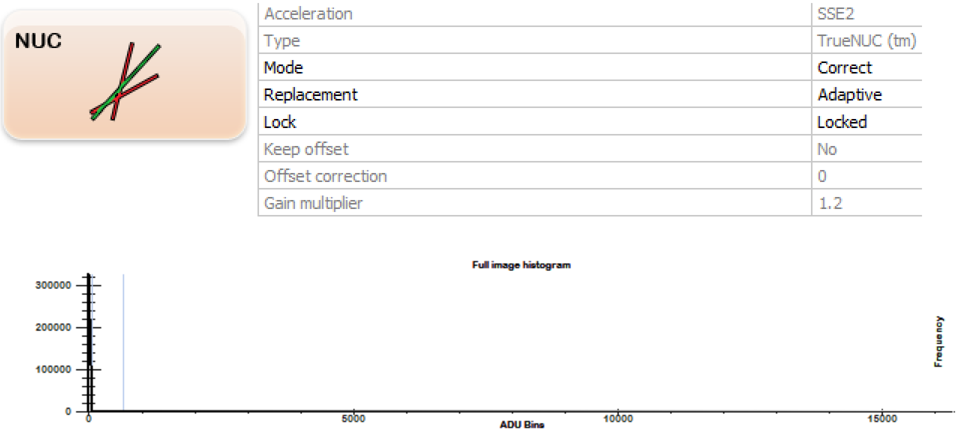


Figure 12-5 Corrected dark image

The dark image in the calibration pack contains 2 components: the variation of the pixels and the distance to the origin of the histogram. In the above image, both components are subtracted from the corrected image.

To eliminate the subtraction of the distance to the origin of the histogram, it is possible to keep the offset to true by unlocking the NUC image correction filter in Xeneth. The overall camera signal is kept at the same level as on the raw image. This is the preferred option for thermal cameras.

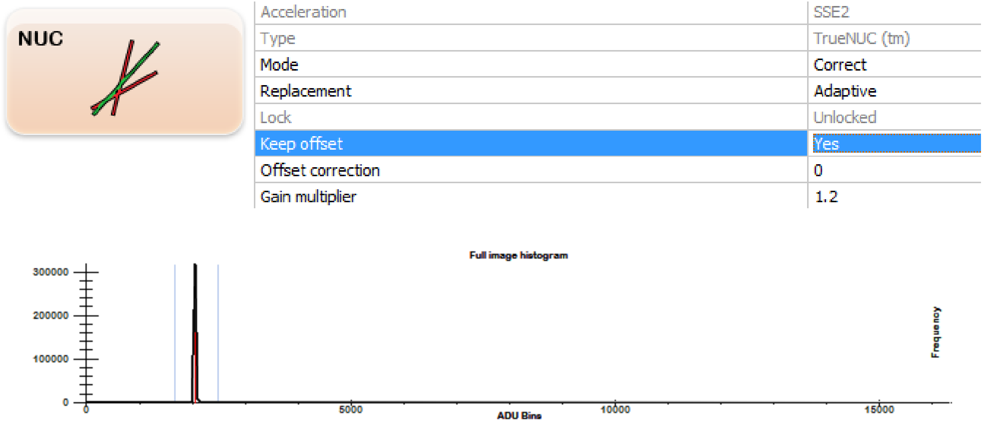


Figure 12-6 Corrected dark image keep offset level

12.1.2. Gain

Because not all pixels have exactly the same response to light, this response is corrected in order for all pixels to have the same response or gain, which is called “gain correction”. This is also called the Photo-response Non-uniformity (PRNU) correction.

12.1.3. Gain and Offset

In order to have a uniform response over the complete array, it is necessary to apply a correction to the signal of each pixel. The principle of Non-uniformity Correction (2 point) or a Flat field correction is to apply a gain multiplier and offset subtraction correction to each pixel output in such a way that all the pixels of the array have the same signal level (corrected output level) and linear behavior.

12.1.4. Bad Pixel Replacement

Pixels can be considered bad pixels for several reasons: when they have a too high dark current, deviating gain or when they are badly connected. A non-uniform pixel demonstrates greater or less photosensitive response than the surrounding pixels (i.e. its response, though linear, differs from the average response demonstrated by the rest of the device’s array). A dark pixel, meanwhile, is unresponsive to light and appears black in an image. Finally, a bright pixel is a pixel that saturates independently of incident light and appears as a white spot in an image. Bad pixels are replaced by the output of their working neighbors.

Different algorithms to perform bad pixel replacement are implemented in the Xeneth software.

Figure 12-7 Bad pixel replacement algorithms

12.2.Image Correction Calibration Packs

12.2.1. NUC Pack for One Integration Time

The most simple calibration pack is the one that can only be used for one integration time.

i With the last calibration pack type, the user is allowed to change the integration time.

12.2.2. True NUC Calibration Pack

The True NUC calibration pack can be used for different integration times.

The minimum and maximum integration time is limited by minimum and maximum integration time defined in the True NUC calibration pack. In a true NUC calibration file, a series of black or dark images is recorded for different integration times. When you change the integration time and the true NUC calibration is applied, the dark image for the offset correction is interpolated with the recorded image.

For the Xeva 320 MCT, no True NUC calibrations are available.

12.2.3. Remark

When a calibration pack is loaded in Xeneth the critical camera features are applied and greyed out. As soon as one of these features is changed the image quality may get worse.

12.2.4. Enable/Disable Correction

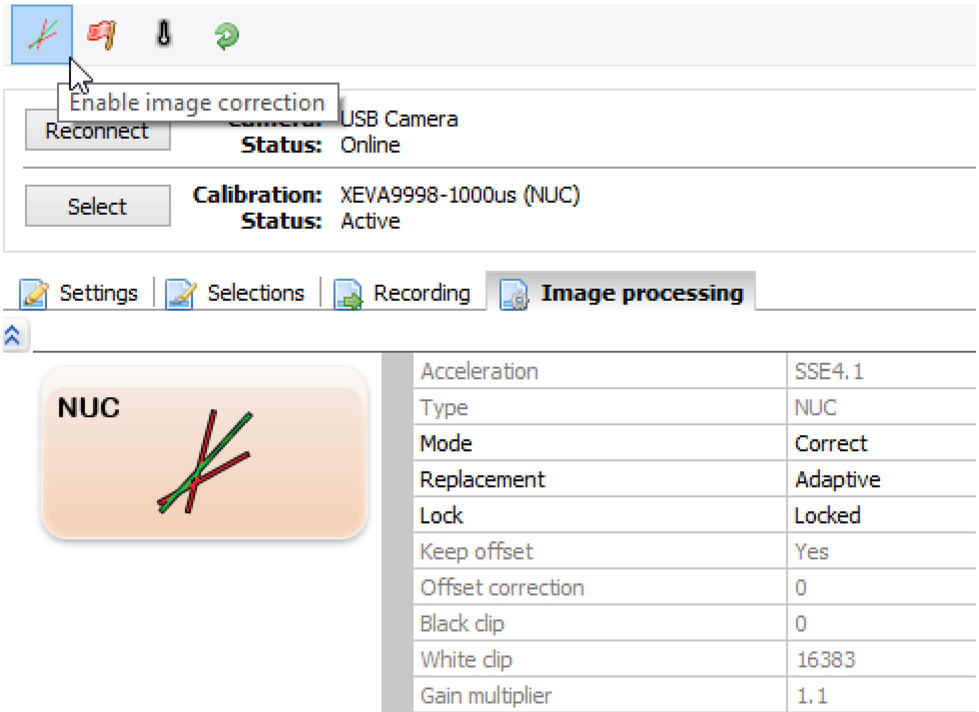


Figure 12-8 Enable-disable correction

12.2.5. Thermal Calibration Pack

Only one polynomial fit is necessary to correlate grey values to temperatures. The integration time cannot be changed. The calibration pack contains the NUC for one integration time as well.

12.2.6. True Thermal Pack

Those calibration packs allow changing the integration time during the thermal conversion of the data coming from the camera. So, the calibration pack contains similar polynomial fits that correlate grey values to temperatures taking different integration times into account. If the calibration pack is loaded in the software (and thermal conversion is on), it is possible to change the integration time between a max integration time and a min integration time.

These kind of calibration packs are called TRUE THERMAL = TRUE NUC + THERMAL

For different integration times, the temperature curves are made. The following can be assumed:

integration time1	Temp1	Temp2	Temp3	Temp4			
integration time2		Temp2	Temp3	Temp4	Temp5		

integration time3		Temp2	Temp3	Temp4	Temp5		
integration time4			Temp3	Temp4	Temp5	Temp6	
integration time5				Temp4	Temp5	Temp6	Temp7

Table 12-1 Integration time – temperature curve

So, when applying integration time X (a bit bigger than integration time3, but smaller than integration time4), the temperature of the object will be made due to linear interpolation.

12.2.7. Enable/Disable Radiometry

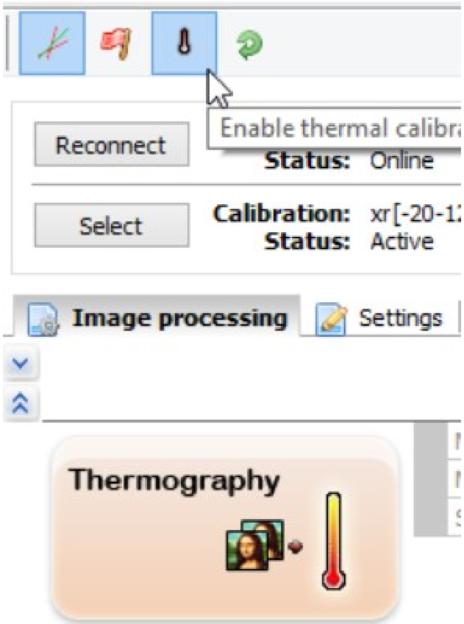


Figure 12-9 Enable-disable radiometry

12.3.On-board Correction

'Camera Memory' is not a valid option for a Xeva camera.

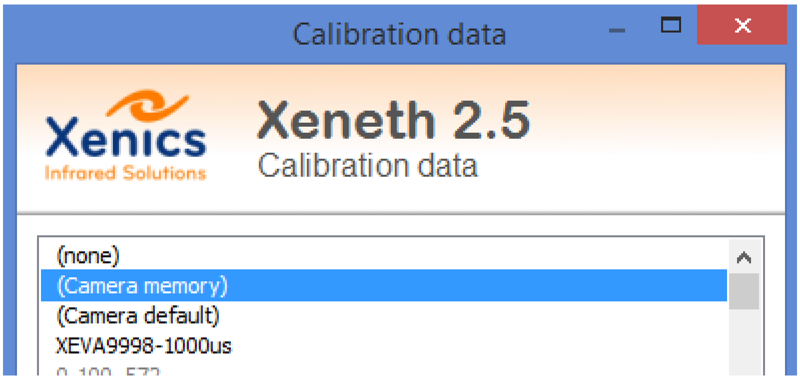


Figure 12-10 Camera Memory is not valid for Xeva cameras

12.4.Xeva Calibration

12.4.1. Optimize AD Settings

Before calibration, load an existing Xenics calibration pack so that the temperature offset and other default parameters are set (such as 'sensorVin' and 'sensorVref' for a Xeva 320 CL MCT, or like cooling parameters).Adjust now the integration time to the scene.

Disable the image correction before adjusting the ADC parameters.

Before calibration for the new integration time, tune the camera settings in such way that dark image and white image are visible within the histogram. This is only possible when changing the 'ADCVin' and 'ADCVref' settings which are explained next:

- **ADC Vin**
  The histogram values will move left by lowering this setting. The histogram values will move right by raising this setting.
- **ADC Vref**
  Reduce this value to stretch the histogram. Raise this value to compress it.

Remove the lens from the camera and face the camera to your desk to simulate the dark image. The mean value of the dark image in the histogram should be near an ADU value of 0, so that the fixed pattern noise is visible! Point the lens opening to an infrared source to see a saturated image.

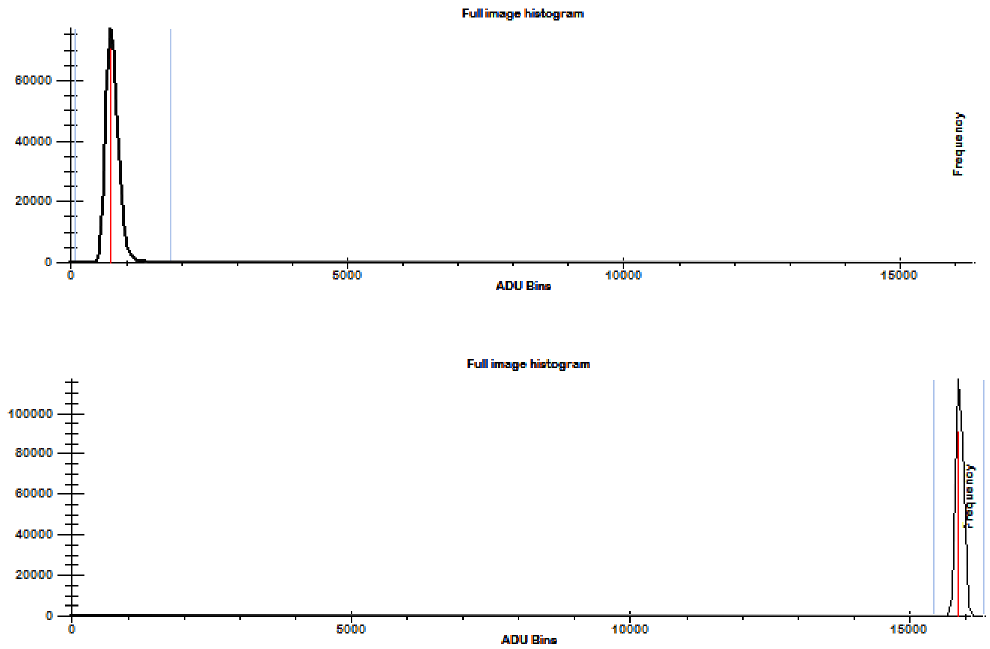


Figure 12-11 Uncorrected dark and saturated image in the histogram

Start now the calibration wizard as shown in Figure 12-12.

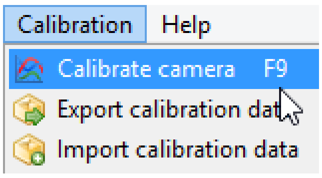


Figure 12-12 Start the calibration wizard

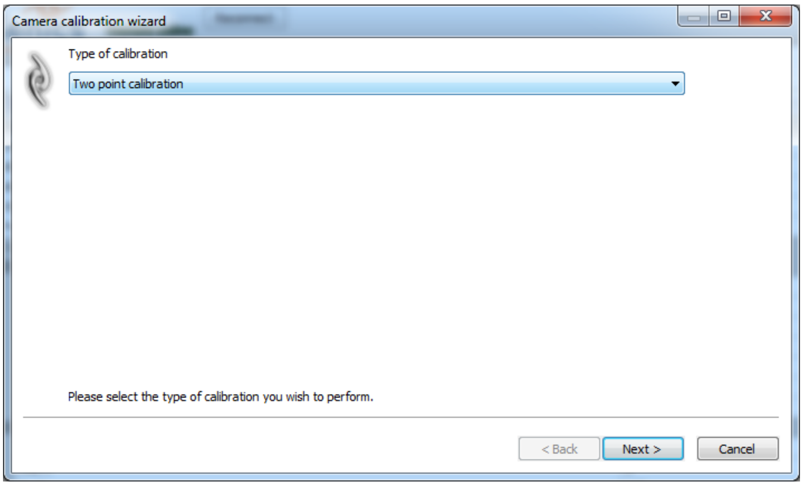


Figure 12-13 Two Point calibration

The first analysis to perform is the dark image Analysis. To start the dark image analysis click the analysis button ( ).

Bad Pixel Criteria	
Frames to use	128
Fixed pattern noise	500 %
Temporal noise	500 %
Tint response non uniformity	120 %

Figure 12-14 Bad pixel criteria dark image analysis

The black image is the sum of a fixed pattern noise and dark current or temporal noise. The non-uniformity response is a maximum percentage deviation to fit the pixel during a TRUE NUC calibration. In addition to all the pixels which are removed by the regular correction algorithm for one integration time, the True NUC algorithm also detects pixels with a non-linear response and removes them.

When creating a True NUC pack for a range (e.g. the 100us – 5ms range), a series of dark images is taken with integration times varying between the range in discrete steps.

Grey image Analysis is the second step.

It is mandatory to provide diffuse dimmable light to properly calibrate InGaAs technology. Best is to use a DC lamp to do the grey calibration in Xeneth, because the grey image calibration is done over a number of images in Xeneth.

To obtain a grey image, remove the camera lens and set the camera in front of a white object. The closer the camera is put to the object, the darker the image.
Or just use a tunable DC lamp.

The prerequisite for a grey level image is to have a histogram peak at around 3/4th of the maximum ADU value. Preferably is to have a sharp peak (minimize light gradients).

The aim of this analysis is to calculate a gain factor for each pixel. To calculate the gain factor per pixel, the algorithm uses the average ADU values of the dark images analysis and the ADU values of the grey image.

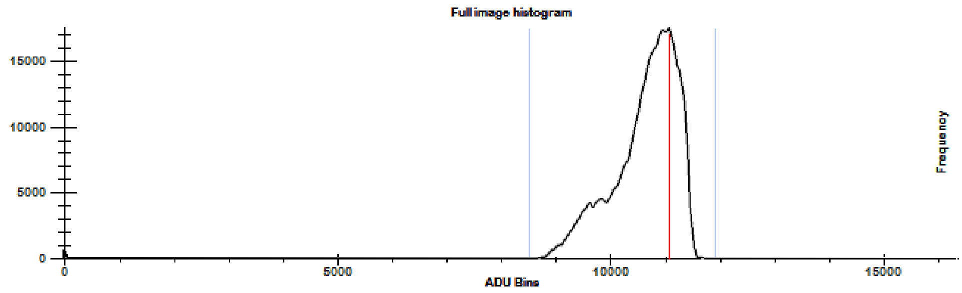


Figure 12-15 Bad pixel criteria dark image analysis + post processing

Similar to the dark image analysis, the bad pixel criteria contains a non-uniform component as well as a temporal component.

If the black level that was captured during the calibration process must be maintained, set the 'keep offset' level to true. In the calibration wizard, in the grey image analysis a flag exists to maintain the level of the dark image when the calibration process was done. If the corrected data of the histogram must be pushed to zero, set the 'keep offset' level to false.

It is possible to overrule the 'keep offset' of the calibration procedure. Therefore, enable or disable the black image subtraction while using the NUC filter, by means of an argument in the NUC filter.

Figure 12-16 Keep offset setting in the NUC filter

Gain adjustment setting.

This setting allows stretching up the image with an additional general gain factor.

- 1 ms integration time; high gain, digital gain 1.3

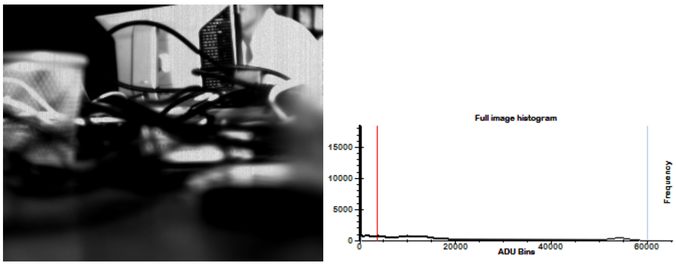


Figure 12-17 Digital gain 1.3

- 1 ms integration time; high gain, digital gain 1.8

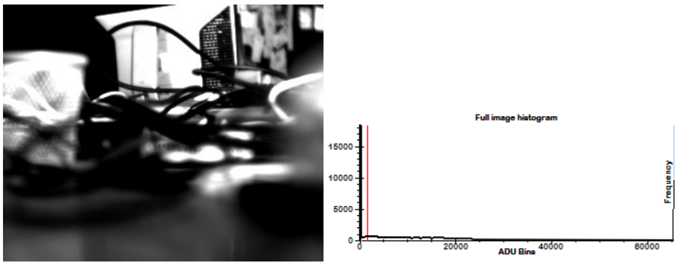
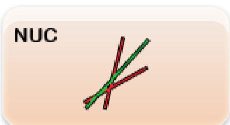


Figure 12-18 Digital gain 1.8

It is possible to overrule the additional general gain factor by means of an argument in the NUC filter.



Acceleration	SSE2
Type	NUC
Mode	Correct
Replacement	Adaptive
Lock	Unlocked
Keep offset	Yes
Offset correction	0
Gain multiplier	1.6

Figure 12-19 General gain factor in the NUC filter

12.5.AD Setting for Xeva 320

Following table contains an average of AD settings used on some Xeva 320 cameras in combination with long integration times and high gain. The settings of Table 12-2 are only added to this manual as an indication of the settings to use.

Integration time	AD	AD value
1 second	ADCvin	2956
	ADCvref	3176
2 seconds	ADCvin	2824
	ADCvref	3106
3 seconds	ADCvin	2790
	ADCvref	2996
4 seconds	ADCvin	2704
	ADCvref	2942
5 seconds	ADCvin	2694
	ADCvref	2847
6 seconds	ADCvin	2651
	ADCvref	2773
7 seconds	ADCvin	2575
	ADCvref	2677
8 seconds	ADCvin	2567
	ADCvref	2632
10 seconds	ADCvin	2450
	ADCvref	2434
12 seconds	ADCvin	2380
	ADCvref	2244
15 seconds	ADCvin	2298
	ADCvref	2055

Table 12-2 AD values for Xeva 320 long integration times

12.6.Recalibrate

The camera must be recalibrated for image correction in the following cases:

- When the AD convertor board is changed (that biases the detector)
- When the detector is changed, because of another dark image, other bad pixel map, other gain and offset values to apply, etc.
- When the power supply circuit is changed in the camera (it contains different capacitors to moderate the power supply to the detector, cooler, interface board, etc.)
- When the cooling is changed, sensor bias is changed, the way to grab images is changed (from ITR mode to IWR mode).

The thermal calibrated camera must be recalibrated in the following cases:

- When the lens is changed on the camera, the camera is thermal calibrated for one lens. The lens influences gain and offset values, the photon absorption, etc. So, for each kind of lens, another radiometric calibration pack exists.

12.6.1. Recalibrate Offset

When using an existing calibration pack and a lot of bad pixels appear in the corrected image, perform an offset recalibration.

When the dark image is a lot different from the dark image in the calibration pack, the recalibration of the offset is performed when the fixed pattern noise (FPN) drifts.

If an existing calibration pack is loaded for one integration time, it can be compensated to use it with another integration time.

i It is possible to see the dark image in the calibration pack when using Xeneth (see Figure 12-20).

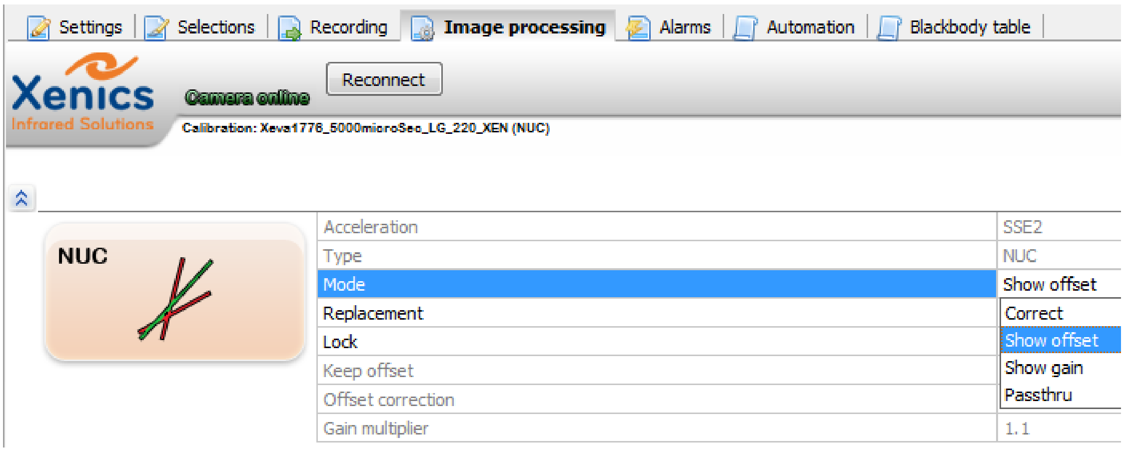


Figure 12-20 Show offset or subtracted dark image

12.6.2. Recalibrate Gain

The aim is to correct an existing calibration pack to obtain a better uniform corrected image.

A gain recalibration is advised if the corrected dark image is still quite uniform, but a grey image is not uniform (e.g. vertical stripes).

A gain recalibration can be useful if another lens is being used on the camera.

i It is possible to see the gain factors in the calibration pack when using Xeneth (see Figure 12-21).

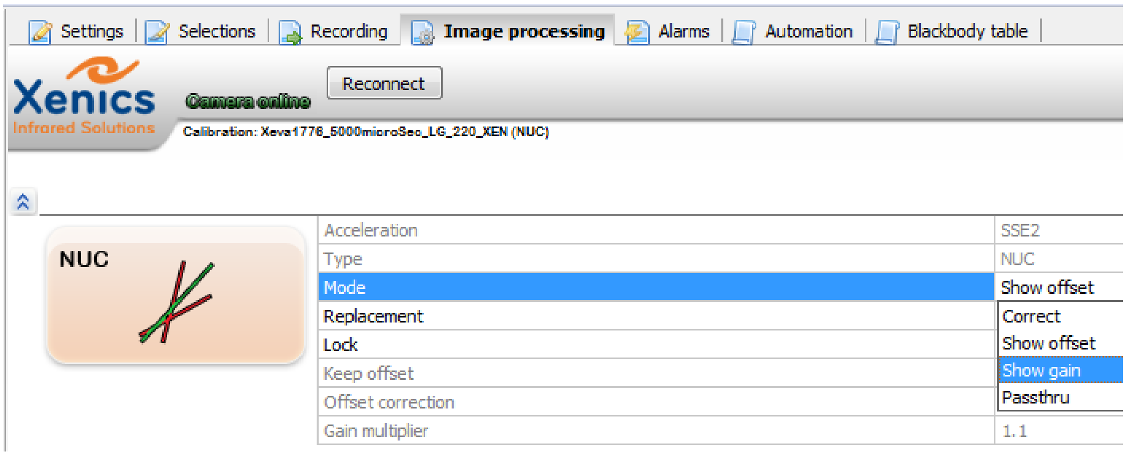


Figure 12-21 Show gain factors

12.6.3. Edit Bad Pixel Map

If a few bad pixels appear in the corrected image when using an existing calibration pack, it is possible to mark those pixels to correct them afterwards.

12.6.4. Recalibrate Offset Procedure

The recalibration of the offset is performed when the fixed pattern noise (FPN) drifts, or when more bad pixels appear in the image.

If an existing calibration pack is loaded for one integration time, it can be compensated to use it with another integration time. Set the required new integration time.

Switch off all means of image correction and start up the calibration wizard.

The offset recalibration procedure is the following:

1. Load the calibration pack (see Figure 12-22)

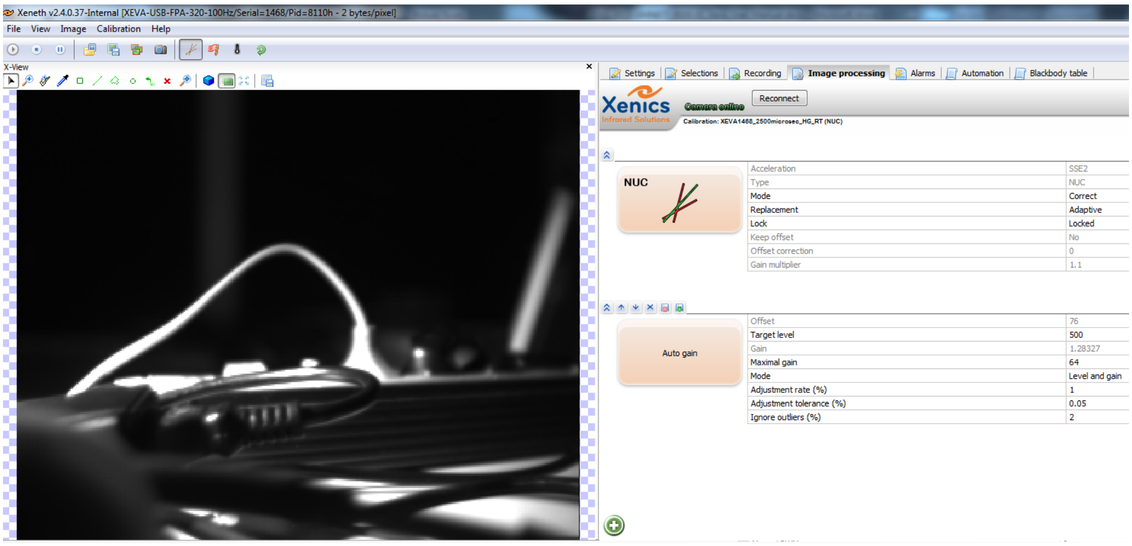


Figure 12-22 Enabled software filters

2. Disable the temperature conversion, auto gain and NUC (all filters in the image processing pane) (see Figure 12-23)

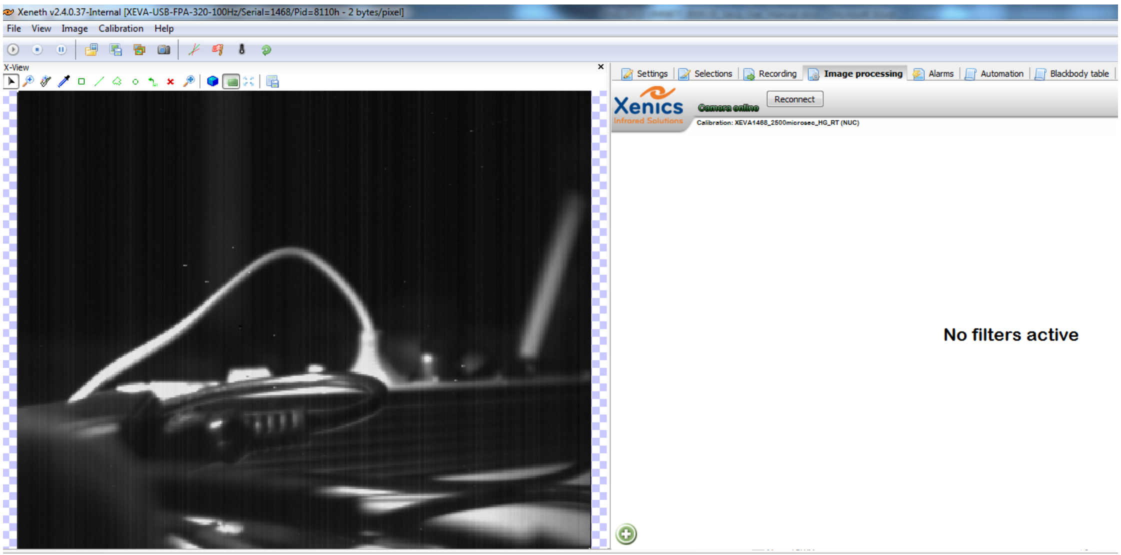


Figure 12-23 Disabled software filters

3. Change the integration time to the desired value. Go to the Calibration menu and select ‘Calibrate camera’.

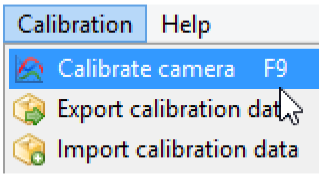


Figure 12-24 Calibration wizard

4. Select ‘Recalibrate offset’ and click ‘Next’.

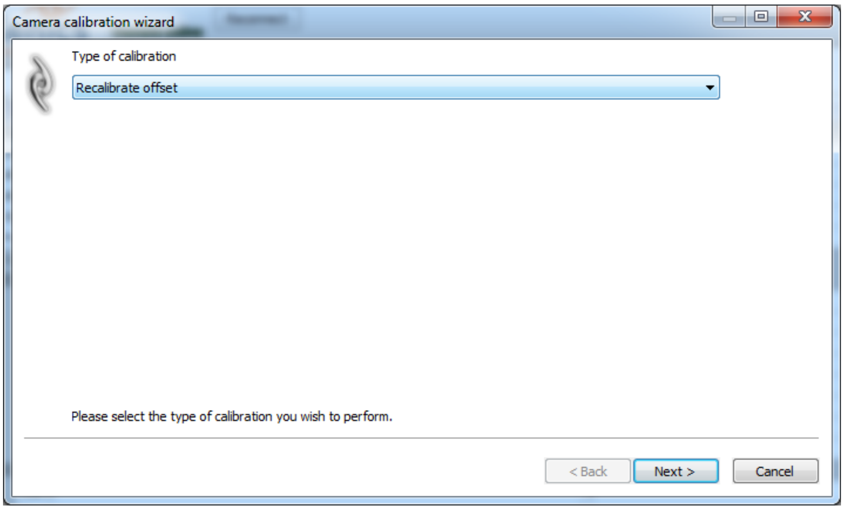


Figure 12-25 Recalibrate offset

The grey analysis will remain the same (as well as the gain factors), but only the dark analysis will be changed.

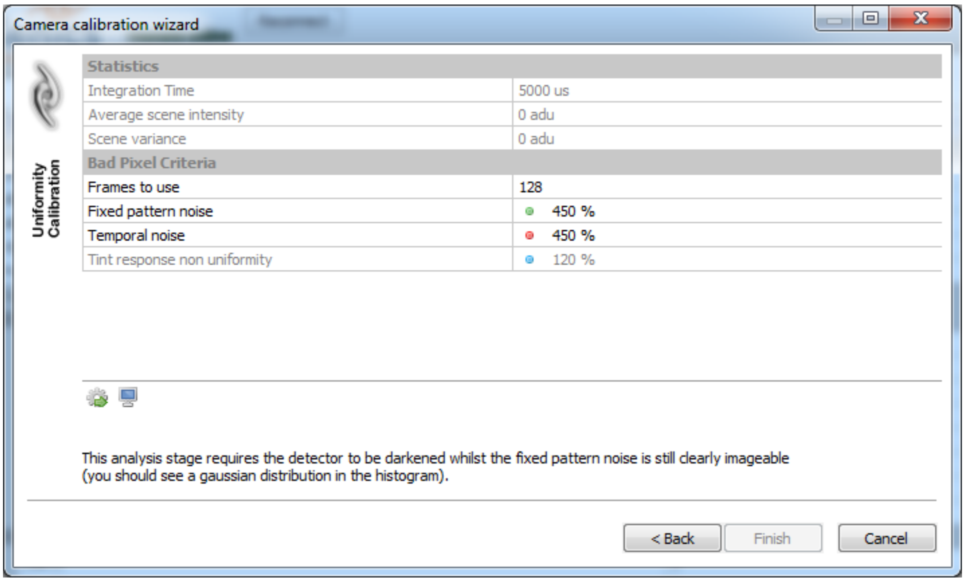


Figure 12-26 Dark image calibration

5. Put the camera without lens with the C-mount on the table. Click the small wheel at the bottom. Click 'Finish' and save the calibration pack with the modified black images. Notice that the image is improved.

i This procedure can also be performed to optimize the black image subtraction when the integration time becomes small.

12.6.5. Recalibrate Gain

Do not change the settings of the loaded calibration pack. Disable the temperature conversion, auto gain and NUC (all filters in the image processing pane).

Disable all means of image correction and start up the calibration wizard.

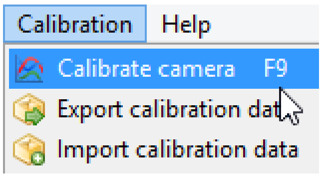


Figure 12-27 Calibration wizard for gain recalibration

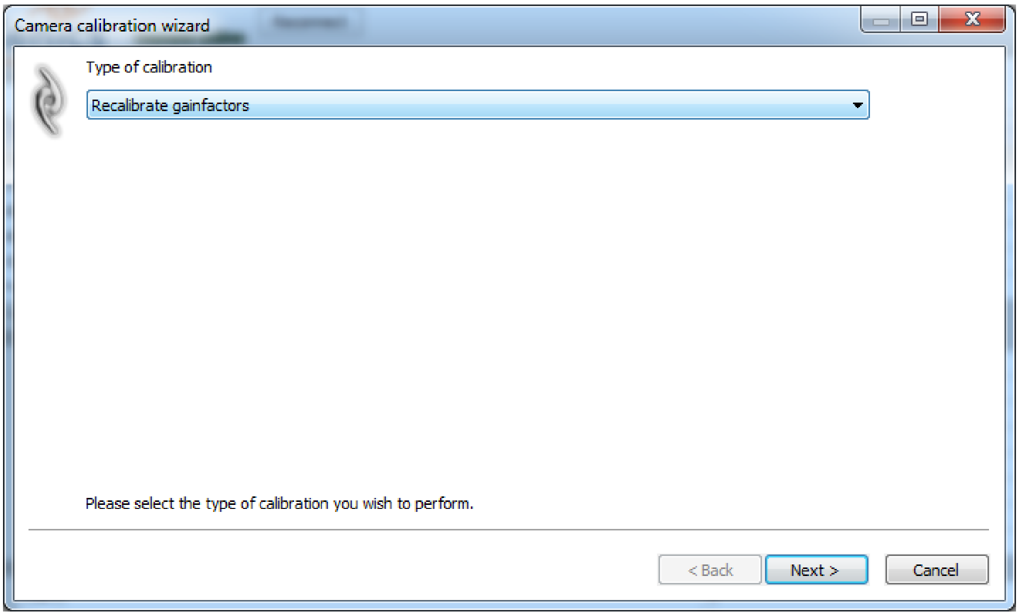


Figure 12-28 Recalibrate gain factors

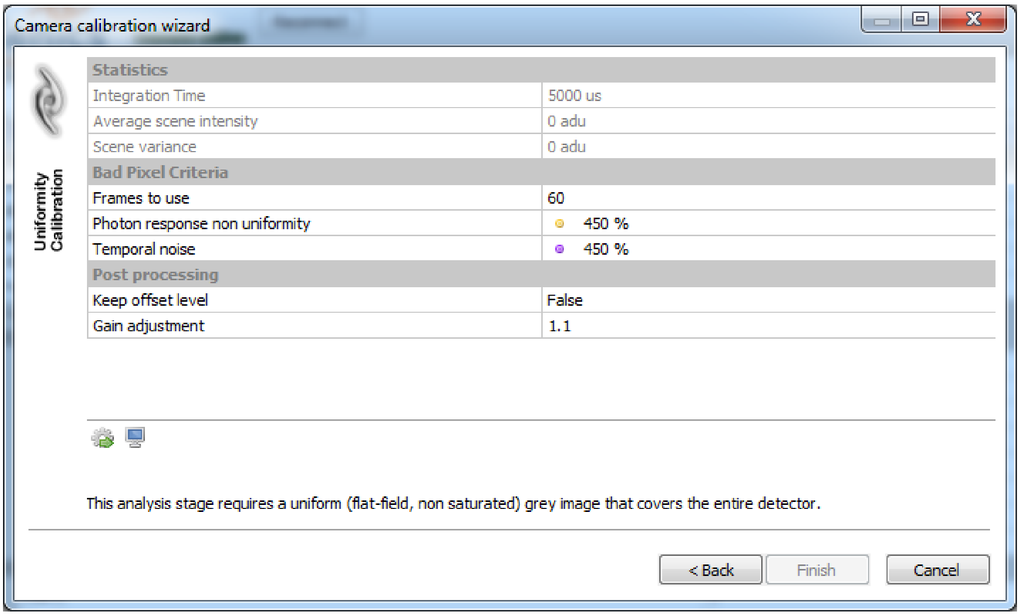


Figure 12-29 Grey image calibration

Now, only the grey analysis will be perfomed (as well as replacement of the gain factors).

Make an image with a peak at 2/3 of the histogram.

The analysis procedure starts when pushing the button on the corresponding wizard page.

After execution, the compensated calibration pack for the gain factors can be stored.

The PRNU correction also contains a part of the BPR correction. This means that the individual pixel gains are adjusted within the mean deviation (400%) and they are seen as bad pixels if they go over these boundaries. The red pixels are the rejected bad pixels.

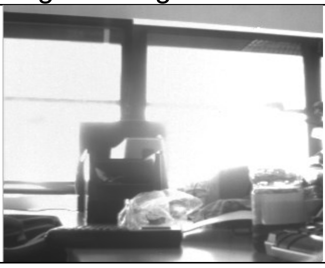
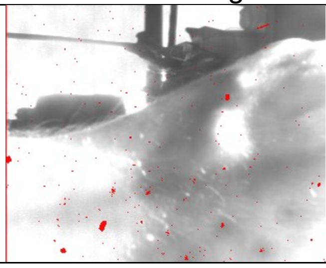
Original image	Introducing impurities	After Recalibrate gain factor
		

Figure 12-30 Recalibrate for gain

It is possible to let the impurities disappear visually, but they are seen as bad pixels and they are just being replaced. When increasing / decreasing the bad pixel criteria a fairly good result bad pixels/adjusted gain pixels can be obtained.

12.6.6. Edit Bad Pixel Map

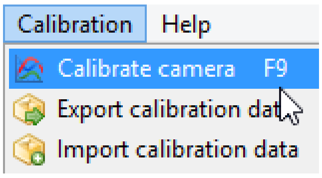


Figure 12-31 Calibration wizard to edit the bad pixel map

Over time it might happen that a few extra bad pixels appear in the image. To maintain optimal performance and image quality, keep the bad pixel map up-to-date, which can only be executed when the software correction is loaded. The ‘Bad Pixel Map’ can be edited when selecting ‘Calibration -> Calibrate Camera’ and selecting ‘Edit Bad Pixel Map’. The procedure of replacing the bad pixels is called “bad pixel replacement”.

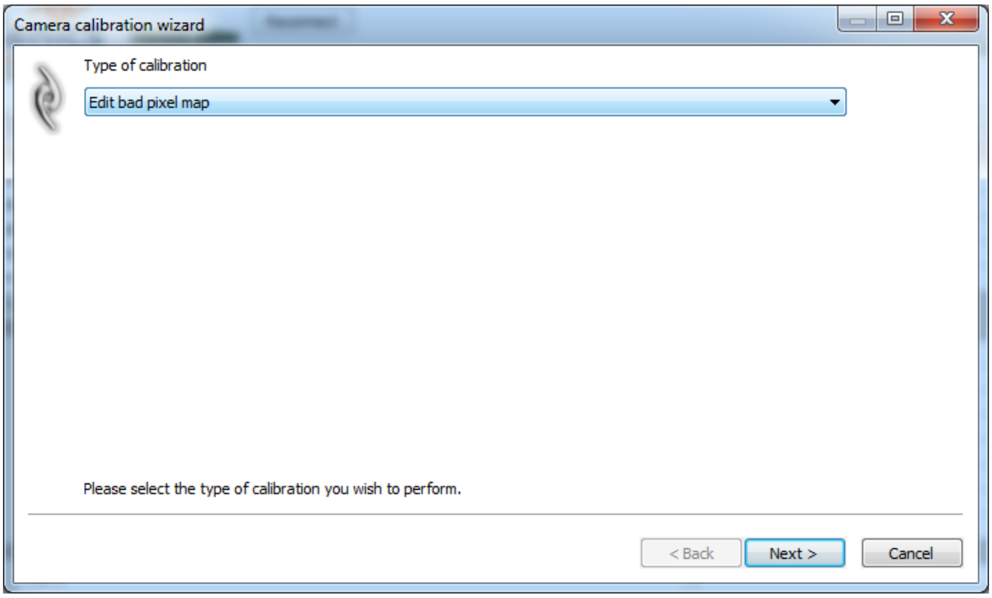


Figure 12-32 Edit bad pixel map

The bad pixel map editor allows to un-/mark bad pixels as assigned by the criteria during the two point calibration process.

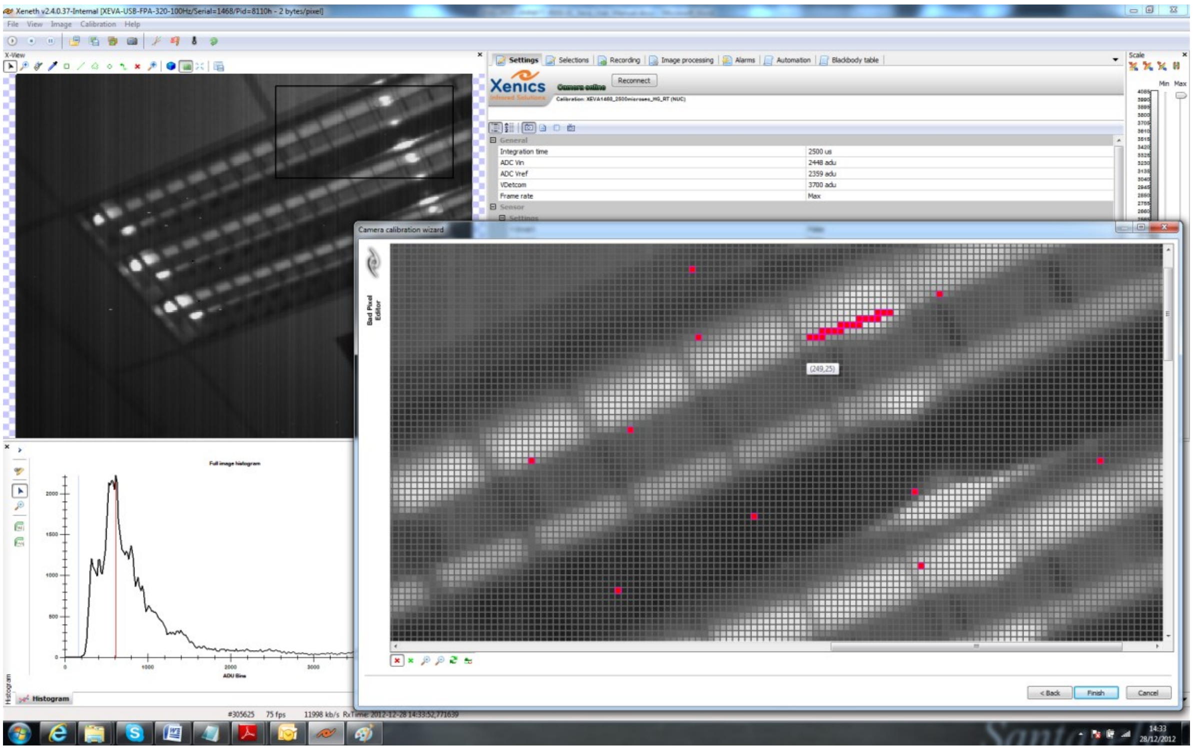


Figure 12-33 Bad pixel map editor

Tip: enlarge the bad pixel editor by dragging the borders. In the camera live view of Xeneth, a rectangular area indicates the editing zone.

More info of the bad pixel editor can be found in the Xeneth manual.

13. Radiometry

At startup of Xeneth, set the 'Measure thermal filter data' flag to true (see Figure 13-1).

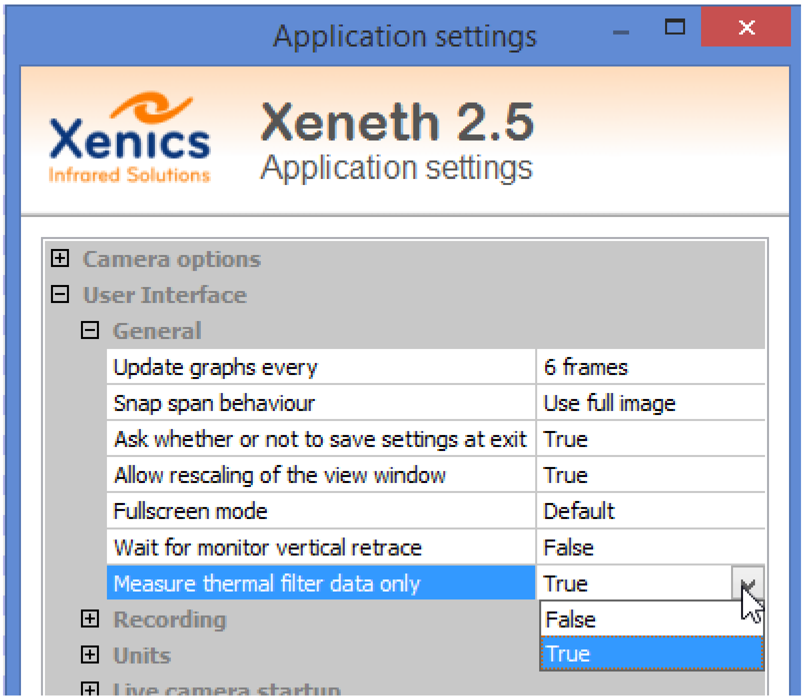


Figure 13-1 Measure thermal data true

When this flag is set to true, the data used to calculate temperatures (for instance in the Xeneth selection pane) are extracted immediately after the thermal filter is applied, yet before all other image filters come into play.

For instance suppose that the auto gain filter is switched on to obtain more image contrast. Although the filter modifies the image, the temperature via the pixel picker remains correct.

When the 'Measure thermal data' flag is false, the radiometric data are extracted after all the image filters are applied. This may result in an wrong temperature read out when the image is modified by other filters.

Besides the non-uniformity correction data, the calibration pack to load in Xeneth radiometric contains thermal data.

The thermal characterization of the camera is not processed on board of the camera, but is processed within Xeneth.

For ultimate temperature precision, the user should indicate to the software the exact temperatures in the “Settings” window, as well as the F number of the lens and the atmospheric transmission.

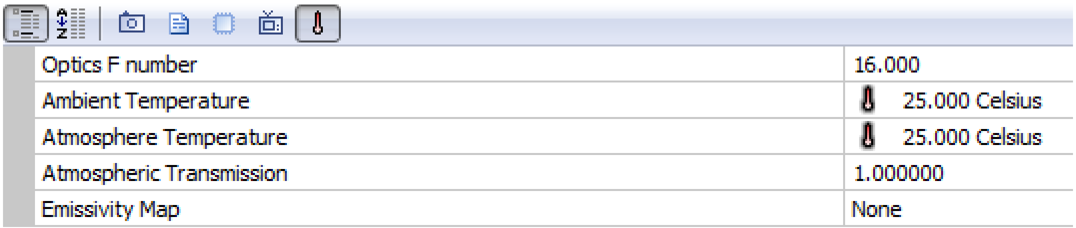


Figure 13-2 Radiometric settings

The response of the camera is related to the amount of photons that fall onto the sensor in its typical sensitivity interval. For a Xeva InGaAs camera this interval is between 0.9 and 1.7 µm, while for the Xeva MCT it as a range from 0.85 to 2.5 µm.

The source of the photons is merely the observed object, but there is also a contribution of the environment of the object and the atmosphere between the object and the observer.

The photons of the environment are partially absorbed by the object and partially reflected on the object, which is shown in the emissivity and the ambient Temperature.

The photons coming from the object (by radiation or by reflection) are partially observed by the intermediate atmosphere. Yet, the same atmosphere contributes to the amount of photons that fall onto the sensor, which is shown in the Atmospheric transmission and temperature.

The following website can help in relating temperatures and photons: http://spectralcalc.com/blackbody_calculator/blackbody.php

More information on how to deal with thermally calibrated cameras can be found in the Xeneth manual: the different thermography settings are explained and the recalibration procedure is available.

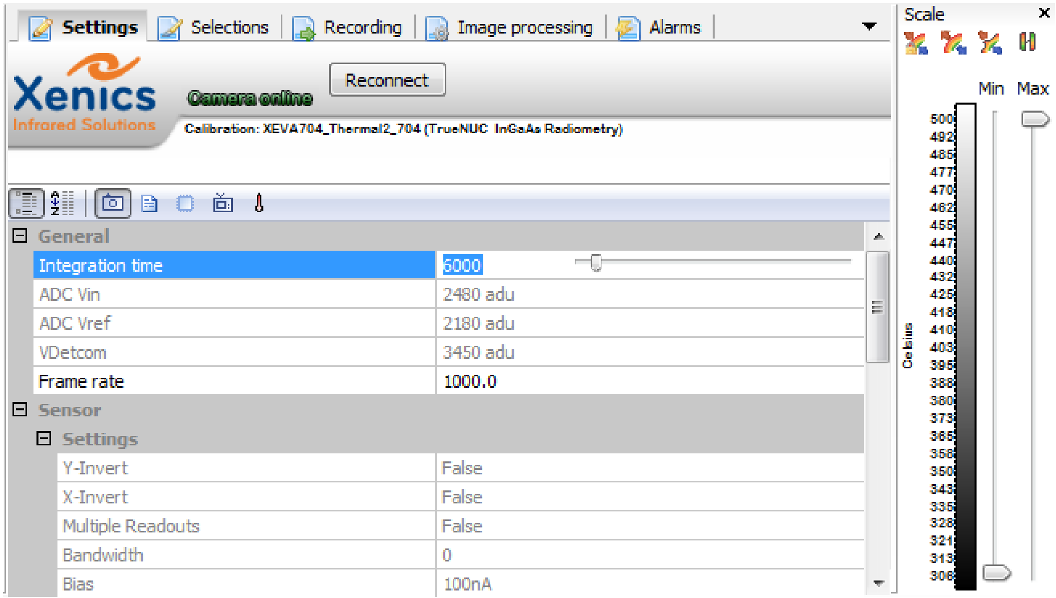


Figure 13-3 Possible radiometric conversion range in function of integration time (6000)

i

The temperature calibration is only valid for the camera settings defined in the calibration pack and the correct position of the diaphragm is defined on the camera as well in the Xeneth software. So after loading the calibration data to the camera and software, do NOT change the settings in the camera setting pane. Only when the calibration pack is a TRUEthermal pack, it may be possible to change the integration time.

To observe the desired temperature range of the camera, make the integration time smaller or bigger.

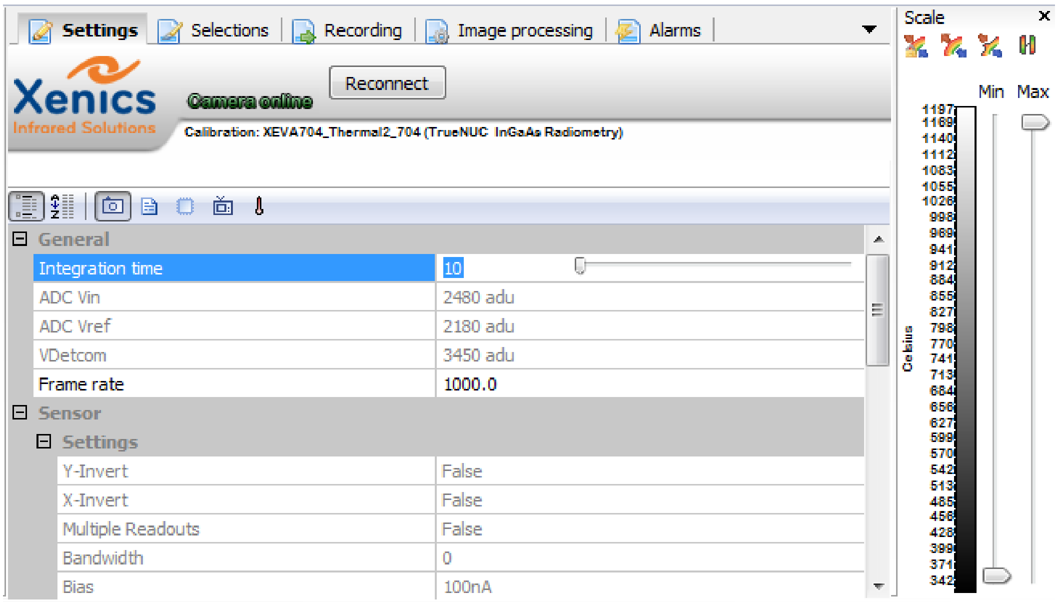


Figure 13-4 Possible radiometric conversion range in function of integration time (10)

The following 2 kinds of calibration packs exist:

- Temperature calibration 300°C – 1200°C.
- Temperature calibration 1000°C – 2000°C.

13.1.Change C-mount with Filter Holder

The way to change a C-mount with filter holder is the following:

1. Unscrew the F-mount (3 Alan screws) (see Figure 13-5)

   Alan key 84 2.5

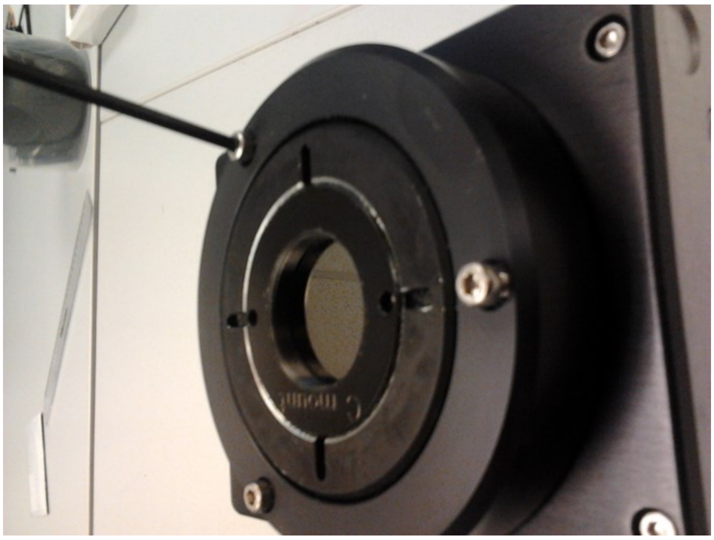


Figure 13-5 Unscrew 3 Alan keys of the F-mount

2. Take out the Alan screws and remove the F-mount from the camera.

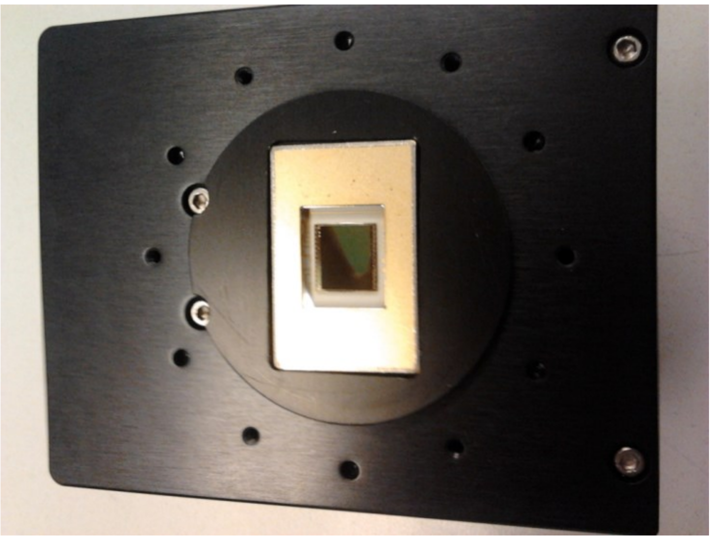


Figure 13-6 Camera without F-mount and C-mount

1. Put the other F-mount with C-mount (this C-mount has no ND filter)

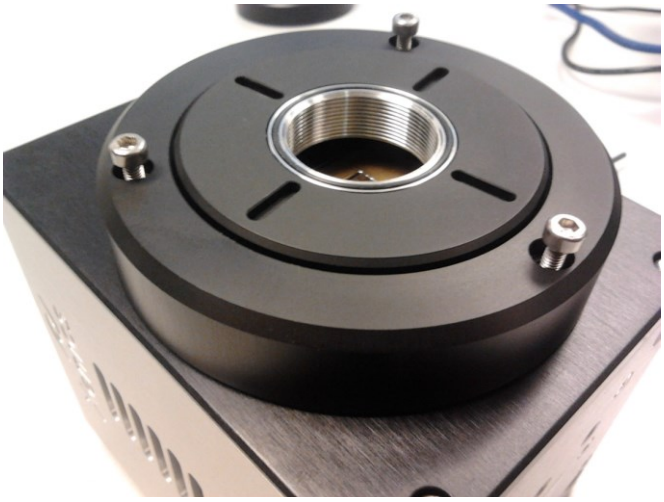


Figure 13-7 Camera without filter

2. Tight the Alan screws.

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