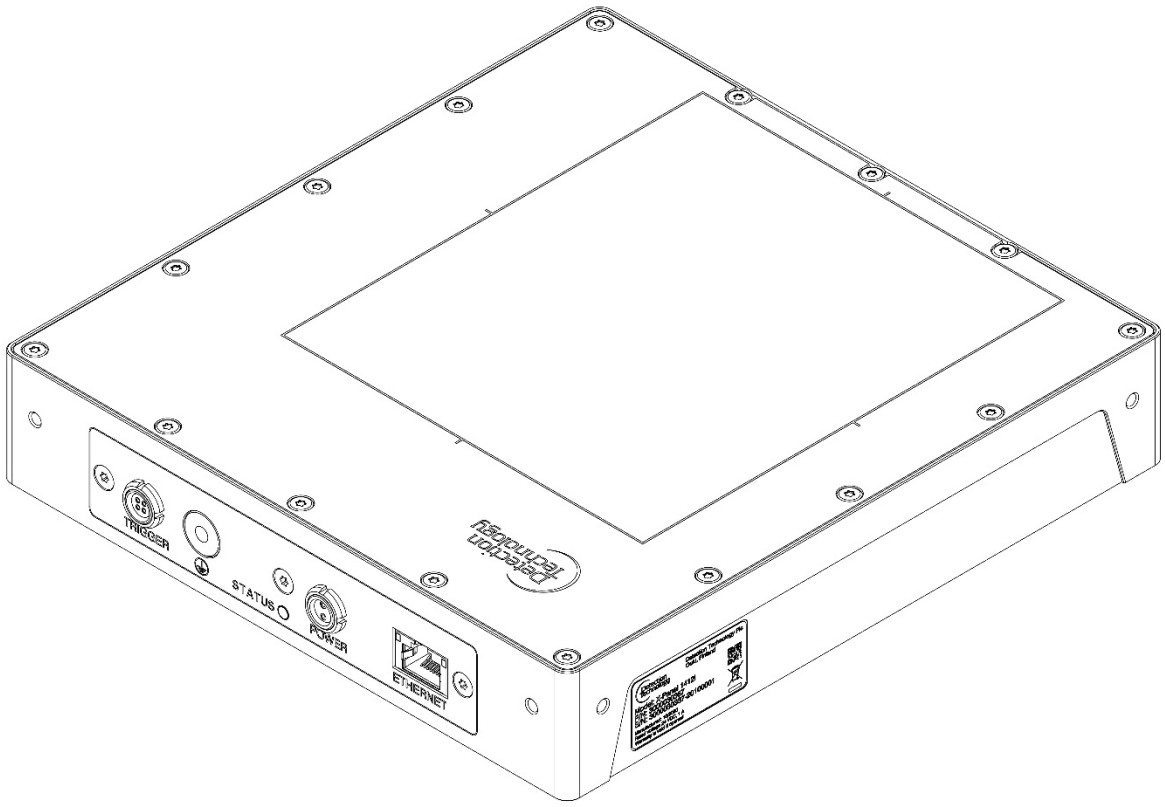
Users Manual X-PANEL 1412i



CONTENTS

1. SYSTEM PRECAUTIONS

Warning

Detection Technology, Plc. assumes no liability for damages resulting from the use of the product presented in this manual.

Disclaimer

All information presented in this manual is believed to be accurate and reliable. However, Detection Technology, Plc. assumes no responsibility for the use of such information for any infringements of patents or other rights of third parties that may result from its use. Due to continuous product development, the information in this document is subject to change without notice.

Copyright

Warranty

Please refer to the Warranty section in the General Terms and Conditions of Sale of Detection Technology, Plc. It should be especially noted that the Warranty is void if the detector housing is opened without authorization by Detection Technology, Plc. Please contact Detection Technology, Plc regarding training and authorization for service.

Safety instructions

Observe the safety precautions below during all phases of installation, operation, service, repair and disposal of this system. Failure to comply with these precautions, or with specific warning noted in this manual, violates the safety standards of design, manufacture and the intended use of this system. Detection Technology, Plc assumes no responsibility for the user's failure to comply with these requirements.

For safety reasons, the on-time of the X-ray source should never by controlled directly by the detector synchronization output. Control of the X-ray source remains a system/host responsibility.

Detection Technology, Plc assumes no responsibility for the proper installation of the detector, installation of X-ray shielding, X-ray shield enclosure testing, or safe and appropriate operation of the imaging system in the end-user's installation. The users and end-users must ensure that local and federal guidelines regarding the installation and operation of X-ray sources are followed.

The power requirements of the product, especially the voltage specifications, must be strictly adhered to, or the warranty will be void.

Obey proper ESD/static control procedures, such as wearing a properly grounded wrist strap, when handling system components.

The use of accessories, power supplies and cables other than those specified, with the exception of cables sold by Detection Technology, Plc as replacement parts, may result in increased emission of decreased immunity of the detector.

Discarding

The product contains lead (Pb) for radiation shielding purposes. This must be taken into consideration when disposing the product.

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2. General

2.1. Scope of this manual

This manual contains information for the installation, initialization and use of the X-Panel 1412i X-ray flat panel detector.

2.2. X-Panel operation overview and applications

X-Panel is a flat panel designed for industrial Computed Tomography (CT) and Digital Radiography (DR) X-ray imaging applications. The main components of a typical imaging system are presented in Figure 1.

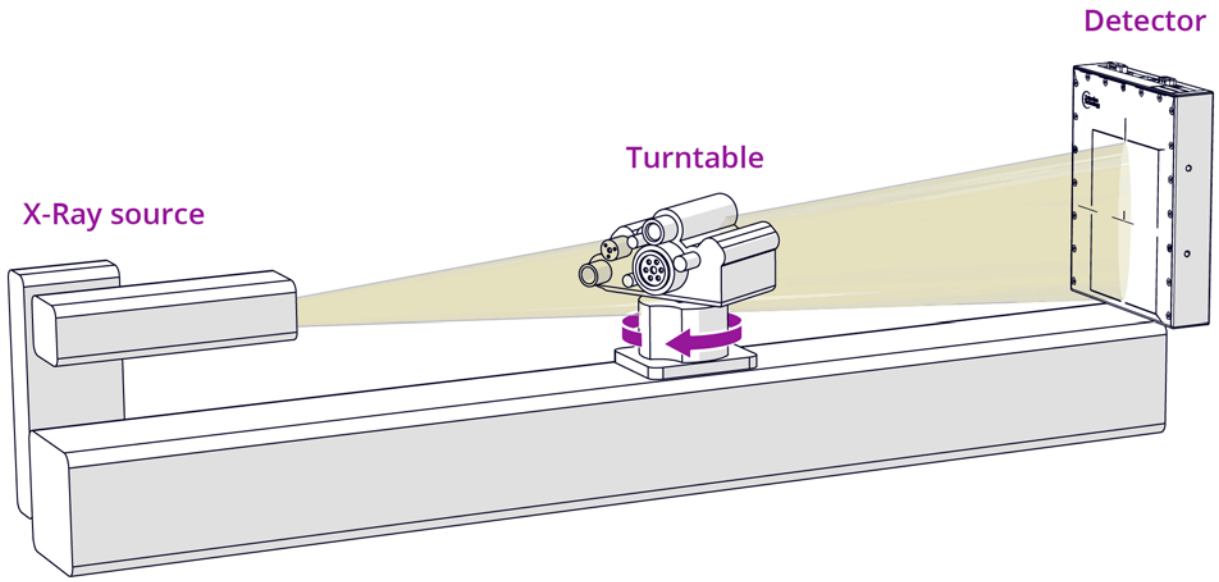

Figure 1. Overview of typical X-ray system with X-Panel 1412i.

2.3. Key features

- X-ray source energy range: 20 kvp – 225 kvp
- Size of active detector area: 120 mm x 140 mm
- Pixel pitch: 100 um
- Up to 30 fps at full resolution, up to 60 fps in 2x2 pixel binning mode and up to 300 fps in panoramic mode
- 14 bit AD conversion
- 1000Base-T Gigabit Ethernet (GigE) data interface
- Programmable pixel sensitivity, frame rate, operation modes and region of interest (ROI) readout

2.4. Ordering codes

The order codes for X-Panel 1412i and its accessories are presented in Table 1.

Table 1. Ordering codes for X-Panel 1412i

Product code	Product Name	Description
3000030367	1412i X-Panel	CMOS flat panel X-ray detector
30000032077	SDK for X-Panel	Software development kit including: **1.** X-Panel Programmer's manual **2.** "X-Panel 1412 SDK" DLL **3.** "X-Demo" GUI (simplified)
3000025652	X-Panel 1412 trigger cable	2 m long trigger cable with an open end at the customer side
3000025659	X-Panel 1412 power cable	2 m long DC power cable between the PSU and the panel
13010423	+12V power Adapter Set (EU)	DC +12V power unit with an EU-type power cord
13011420	+12V power Adapter Set (CN)	DC +12V power unit with an CN-type power cord
13012343	+12V power Adapter Set (JP)	DC +12V power unit with an JP-type power cord
13012341	+12V power Adapter Set (US)	DC +12V power unit with an US-type power cord

2.5. System requirements

A system computer is needed to control the X-Panel detector. The customer must ensure that the system computer is capable of handling the data interface at the required rate and processing data from the detector module.

The X-Demo software and DLL-libraries are provided by Detection Technology, Plc. The library takes care of image grabbed into the PC memory. The X-Demo software can be used for functional verification and basic visualization of the image. The customer is expected to take responsibility for the further image analysis and inspection system user interface software.

A Network Interface Card (NIC) is required to acquire images and control the detector. A NIC with Jumbo packet support up to 9014 bytes is required for receiving streaming video. Due to the high bandwidth used by the detector, a direct connection between the NIC and the detector is recommended.

3. SPECIFICATIONS

The specifications of X-Panel 1412i are listed in Table 2.

Table 2. General Characteristics of X-Panel 1412i

General characteristics	X-Panel 1412i
X-ray tube voltage kVp range	20-225 kVp
Scintillator type	GOS screen options, optimized for industrial imaging
Active area	120x140 mm
Pixel matrix	1200x1400
Pixel pitch	100 um
Maximum scanning speed	Full size, 14 bit: 30 fps
	2x2 binning, 16 bit: 60 fps
	Panoramic mode, 14 bit: 300 fps
A/D resolution	14 bit
Data interface	1000Base-T Gigabit Ethernet
Operational voltage	+12V /+24 V DC
Power consumption	<7 W (typical @operation)
IP Classification	IP40
Operational temperature	+10 - +40 °C
Operational humidity	10% - 95 %
Storage temperature	-10 - +55 °C
Gain modes	2 (LFW/HFW)
Binning	Full resolution, 2x2
Operation modes	Continuous with internal timing / Continuous with external synchronization / Non-continuous with external synchronization
ROI mode	Programmable

4. FUNCTIONAL DESCRIPTION

The functionalities of the detector module are described in the following section.

4.1. Operation principle

After power-up and initialization, the detector module starts to integrate the signal from the pixels and sends the processed data line to the system computer via a GigE interface. During each integration period the sent data output is from the previous integration period. The integration period is set by acquisition board default value or set by system computer or controlled by an external trigger. The new integration period starts immediately after the previous period. The sensor is rolling shutter sensor type and thus it also integrates during the readout period.

4.2. Image orientation and multiplexer column

The multiplexer column contains additional circuitry and does not respond to the X-ray. The multiplexer column occupies a single pixel column width and can be corrected with standard image processing methods. In normal full resolution mode, the multiplexer column is the 20th column and in 2x2 binning mode the multiplexer column in the image is the 10th column. Figure 2 presents the column position of the multiplexer column and image orientation in full resolution.

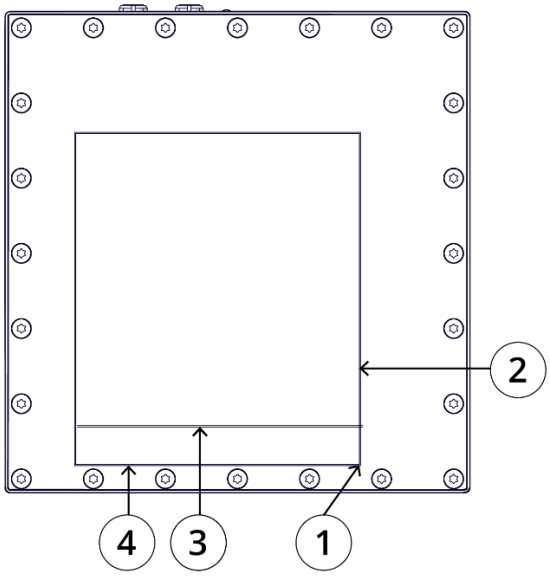

Figure 2. Image orientation and location of the multiplexer column.

1) Origin 1,1
2) Image columns 1 – 1400
3) Multiplexer column
4) Image rows 1 – 1200

4.3. Gain modes

The detector supports two gain modes: Low Full Well (LFW) and High Full Well (HFW):

- LFW – High gain mode, where less charge can be stored in a pixel, but the gain (sensitivity) is higher.
- HFW – High dynamic range mode, where more charge can be stored in a pixel, but the gain (sensitivity) is lower.

It is possible to change between LFW and HFW modes between frames. To ensure optimal performance, it is required to have minimum 30 ms gap between the frames, if the full well selection is changed.

4.4. Readout modes

The detector supports two readout modes – normal full resolution mode and 2x2 binning mode. In 2x2 binning mode, the intensity of the pixel is a sum of intensities of the four neighboring pixels. Formation of the 2x2 binning mode is presented in Figure 3.

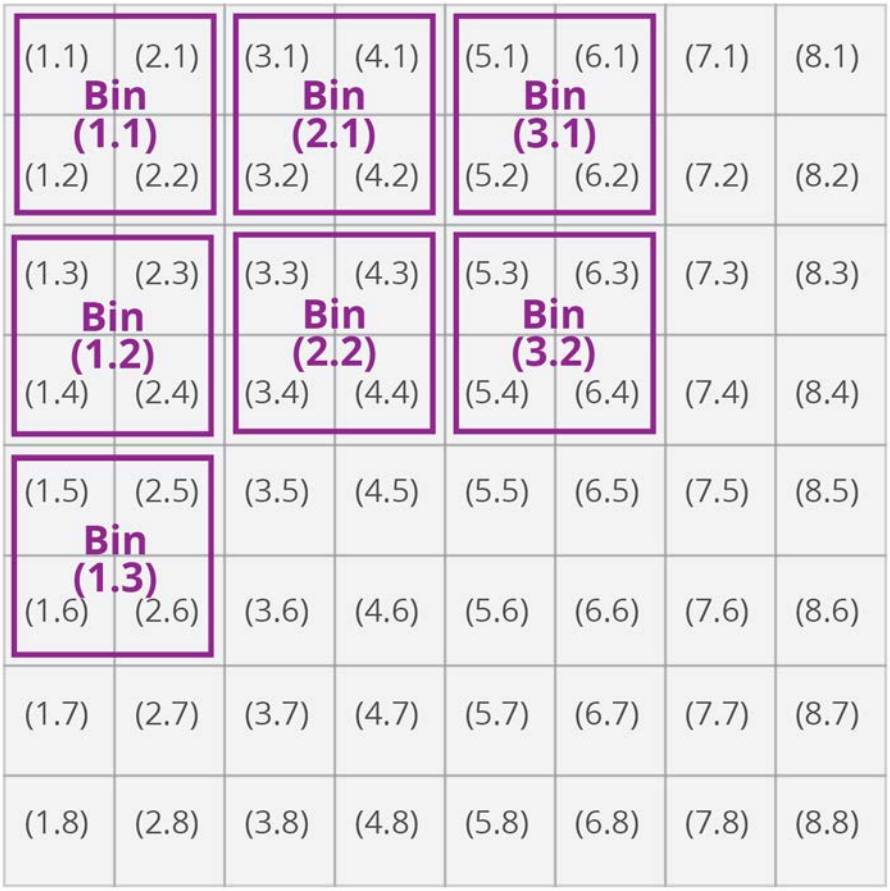

Figure 3. 2x2 binning mode.

The differences of the readout modes are presented in Table 3.

Table 3. Readout modes

Parameter	Full resolution mode	2x2 binning mode
Pixel depth	14 bit	16 bit
Pixel pitch	100 um	200 um
Maximum scanning rate	30 fps	60 fps
Pixel matrix	1400x1200	700x600

4.5. Region of interest

In the Region of Interest (ROI) mode, the user can select the pixel matrix that is transferred to the host system. The ROI mode is implemented in both readout modes – full resolution and 2x2 binning modes. However, in both readout modes the ROI selection coordinates are defined from the full resolution frame. A ROI area example is presented in Figure 4.

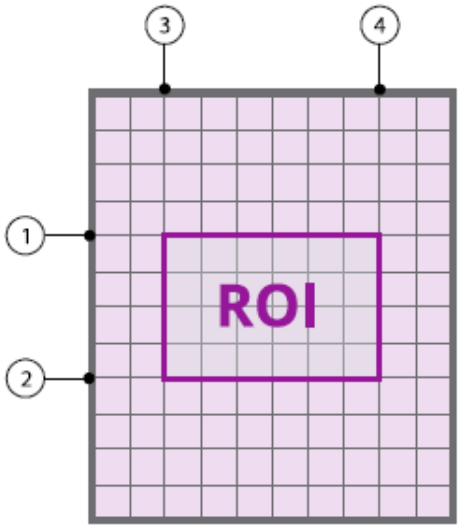

Figure 4. Example of a ROI area.

In Figure 4 the start and end of the row and column direction are:

1) ROI row start address, must be an odd number

2) ROI row end address, must be an even number

3) ROI column start address, must be an odd number

4) ROI column end address, must be an even number

The minimum area for ROI is 2 rows and 2 columns.

ROI mode settings can be changed only when scan is not active.

Selecting less sensor rows in provides the possibility of increasing the frame rate as less rows need to be read out from the sensor. Selecting less detector columns does not increase the possible frame rate of the sensor, but it might be useful if the GigE bandwidth is limiting the frame rate.

The minimum integration time of the sensor can be calculated with the following equation:

$$MinimumIntegrationTime1_{ROI} = N_{row} * 10.6us + 60us$$

The minimum integration time limited by GigE bandwidth can be calculated with the following equation:

$$MinimumIntegrationTime2_{ROI} = \frac{\big((RoiColEnd - RoiColStart + 1) * (RoiRowEnd - RoiRowStart + 1)\big) * pixel\ depth}{700 * 10^6} s$$

The pixel depth is 14 in full resolution mode and 16 in 2x2 binning mode.

From the previous two equations, the larger minimum integration time will be the minimum integration time for the panel.

4.6. Operation modes

The detector supports three different operation modes: continuous operation mode with internal timing, continuous operation mode with external synchronization, and non-continuous operation mode with external synchronization. In all of the modes, the user can enable/disable trig out and select if the trig out polarity is low level or high level. The output trigger active time is the readout time.

4.6.1. Continuous operation mode with internal timing

In this mode, the detector will run continuously with internal timing, even if the host is not acquiring frames. External synchronization is not necessary in this mode. When a grab is started, the forthcoming integration period will be acquired and send to the host. If an integration period is in progress when a grab is started, this frame will be dropped and the forthcoming frame will be sent to the host.

The frame rate is determined by the time between two successive frame readouts. The timing chart for continuous exposure mode with internal timing is presented in Figure 5. The requirements for timing parameters with different read out options are presented in Table 4.

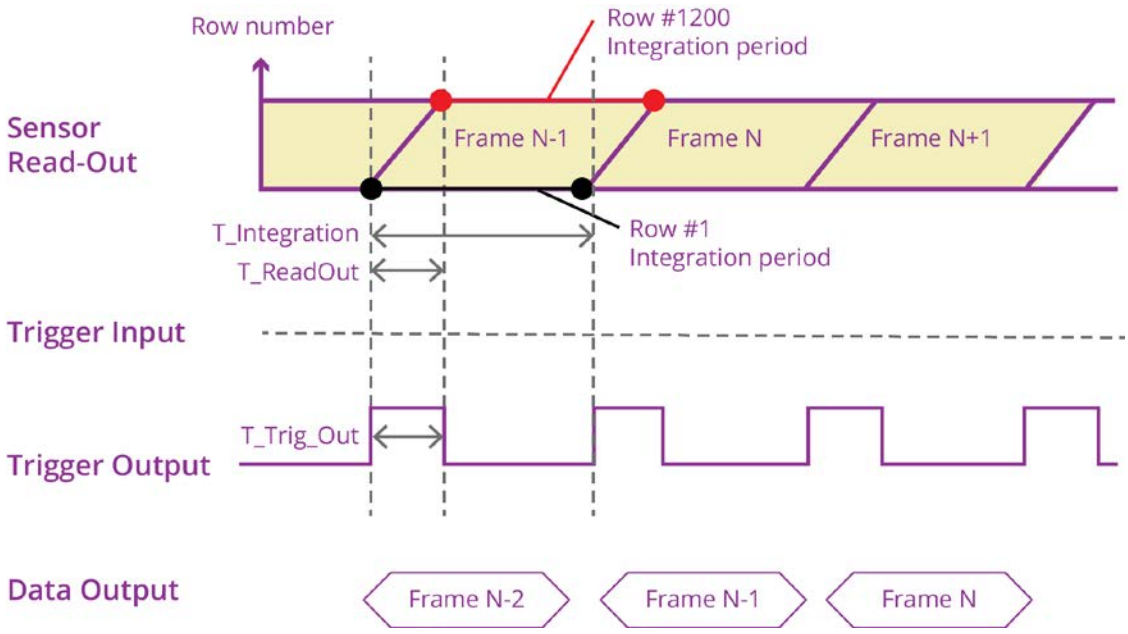

Figure 5. Timing chart for the continuous operation mode with internal timing.

Table 4. Continuous operation mode with internal timing

Operation mode	Full resolution	2x2 binning	ROI
Integration time (T_Integration)	33 ms – 65 s	16.6 ms – 65 s	See 4.5
Read out time (T_ReadOut)	12.8 ms	12.8 ms	N_{row}* 10.6 us + 60 us

4.6.2. Continuous operation mode with external synchronization

In this mode, the detector will capture a single image whenever an input trigger signal is applied to the detector. The user can select if the active polarity of the input trigger signal is a rising edge or negative edge. The frame rate is determined by the time between two successive frame read outs.

The timing chart for the continuous operation mode with external synchronization is presented in Figure 6. The requirements for timing parameters with different read out options are presented in Table 5. Note that with N external pulses the data output gives N-1 frames, so if all N frames need to be captured in the output, it is necessary to add one extra trigger pulse to the system design.

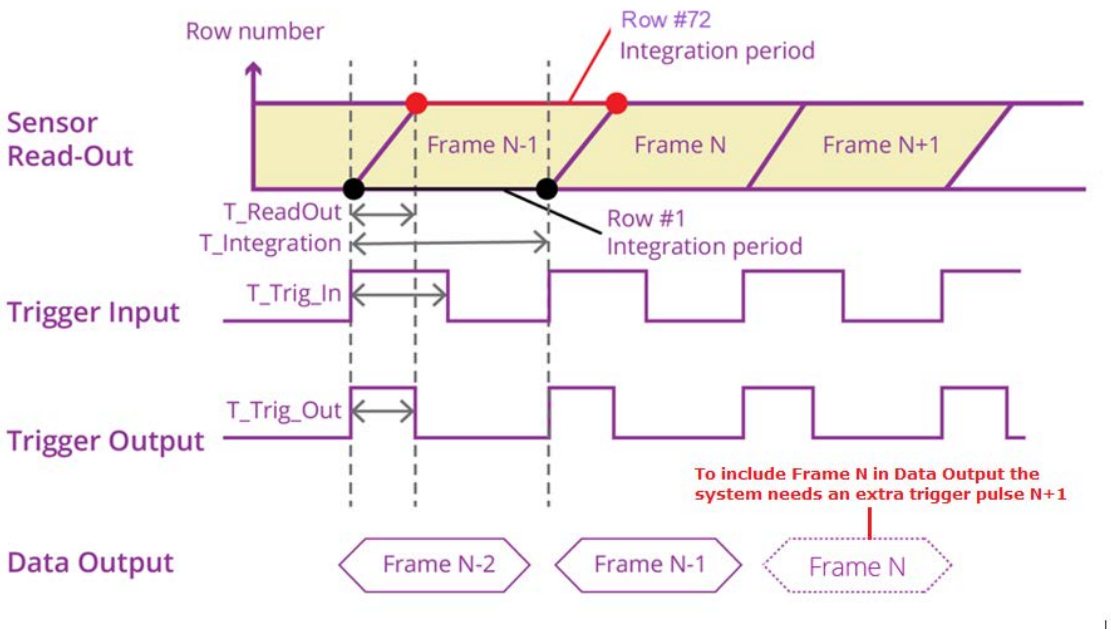

Figure 6. Timing chart for the continuous mode with external synchronization.

Table 5. Continuous operation mode with external synchronization

Operation mode	Full resolution	2x2 binning	ROI
Integration time (T_Integration)	33 ms – 65 s	16.6 ms – 65 s	See 4.5
Read out time (T_ReadOut)	12.8 ms	12.8 ms	N_{row}* 10.6 us + 60 us
Minimum trigger input active time	20 us	20 us	20 us
Minimum time between two input trigger active edges	33 ms	16.6 ms	See 4.5

4.6.3. Non-continuous operation mode with external synchronization

In this mode, the detector will initiate a detector reset at the active edge of the trigger input and after this it will read out the detector at the non-active edge of the trigger input. This is a normal read out period of the detector, but the data will not be transmitted to the host. The trigger output is active during the reset and read out periods.

The timing chart for the non-continuous exposure mode with external synchronization is presented in Figure 7. The requirements for timing parameters with different read out options are presented in Table 6.

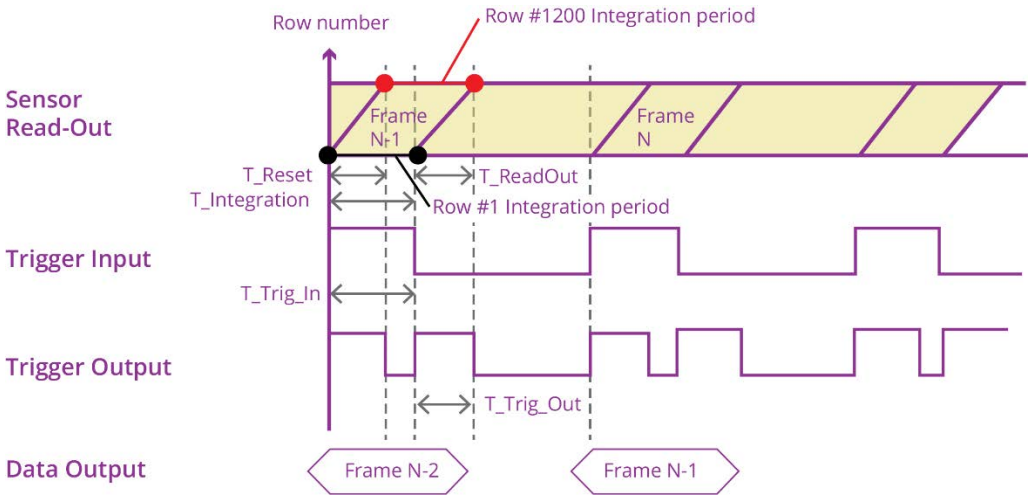

Figure 7. Timing chart for the non-continuous operation mode with external synchronization.

Table 6. Non-continuous operation mode with external synchronization

Operation mode	Full resolution	2x2 binning	ROI
Integration time (T_Integration)	33 ms – 65 s	16.6 ms – 65 s	See 4.5
Read out time (T_ReadOut)	12.8 ms	12.8 ms	N_{row}* 10.6 us + 60 us
Reset time (T_Reset)	12.8 ms	12.8 ms	N_{row}* 10.6 us + 60 us
Minimum trigger input active time	12.8 ms	12.8 ms	N_{row}* 10.6 us + 60 us
Minimum time between two input trigger active edges	33 ms	16.6 ms	See 4.5.

4.7. Image corrections

The X-Demo software supports flat-field correction and defect pixel corrections. Flat field correction contains the offset correction, gain correction and baseline correction. Flat field correction is used to correct the dark response level and X-ray response non-uniformities. Defect pixel correction is used to correct artifacts in the image that are not compensated by flat field correction. Flat field correction is performed with the following equation:

$$Raw_{FF} = \frac{Raw - Offset}{Gain - Offset} * Target + B_L,$$

Where:

Raw_{FF} = flat field corrected image

Raw = the image that will be flat field corrected

Offset = averaged dark response image

Gain = averaged nominal response image

Target = target average intensity value for the corrected image

B_L = the baseline offset value used to prevent the noise clipping

5. INTERFACES

This section contains information about the X-Panel interfaces and image formats.

5.1. Detector connectors and cables

The detector module contains three connectors (Ethernet connector, trigger connector and power connector), a detector status LED and a grounding point. In addition, Detection Technology, Plc can supply suitable trigger and power cables as an accessory to the detector.

5.1.1. Ethernet connector

The Ethernet connection type is RJ45 and the mating cable should be a CAT6 Ethernet cable. There are two LEDs in the connector – an Ethernet connection LED and a data transmission LED. The Ethernet connection LED is steady orange when the connection has been successfully established. The data transmission LED is blinking green when the detector is either transmitting or receiving data. The Ethernet connector is presented in Figure 8.

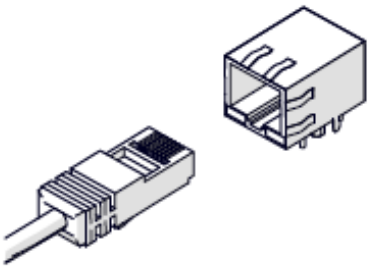

Figure 8. Ethernet connector.

5.1.2. Power connector

The power connector type is Lemo EXG.0B.302.HLN, or similar, and the mating connector should be Lemo FGG.0B.302.CLAD52 or similar. The power connector is presented in Figure 9 and the pinout is specified in Table 7.

Figure 9. Power connector.

Table 7. Power connector

Port Name	Type	Pin index	Description
Power_IN	I	1	+12 V – +24 V
Power_RET	O	2	GND

The maximum power consumption of the detector is 7 W and it requires a single voltage input.

5.1.3. Power cable

The length of the external power cable is 2 m. The panel side of the cable is presented in Figure 10 and the pinout is specified in Table 8.

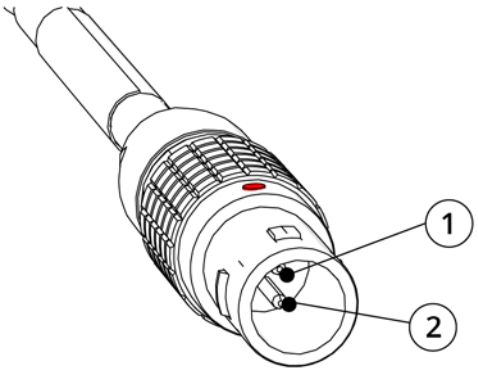

Figure 10. Panel side of the power cable.

Table 8. Power cable pinout

Pin index	Description
1	+12 V - +24 V
2	GND

The connection side of the power cable is a 2.35 mm plug DC Power Jack connector.

5.1.4. Detector status LED

There is one status LED indicator on the detector, marked with number 1 in Figure 11. The LED has two operational modes:

- Green – The detector is scanning
- Orange – The detector is operational

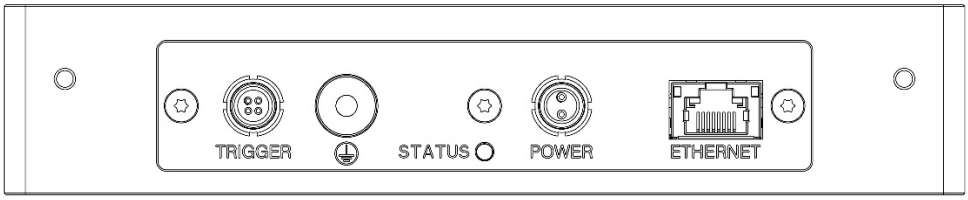

Figure 11. LED and grounding point indicator.

5.1.5. Grounding point

To ensure the safety use of the X-Panel 1412d, the panel must be grounded from grounding point to end systems main chassis. Grounding point is M5 threaded hole. The grounding point is presented in Figure 11.

5.1.6. Trigger connector

The trigger connector type is a Lemo EXG.0B.304.HLN or similar and the mating connector should be a Lemo FGG.0B.304.CLAD52 or similar. The trigger connector is presented in Figure 12 and the pinout is specified in Table 9.

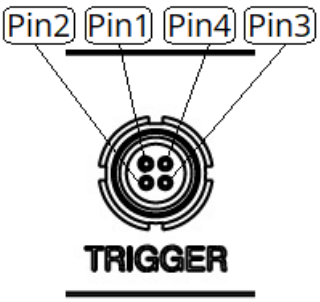

Figure 12. Trigger connector.

Table 9. Trigger connector

Port Name	Type	Pin index	Description
Trigger_output+	O	1	Trigger output (POS)
Trigger_output-	O	2	Tigger output (NEG)
Trigger_input+	I	3	Trigger input (POS)
Trigger_input-	I	4	Trigger input (NEG)

The recommended connection for trigger output is as follows:

- Trigger output (POS) must be pulled up externally to max 24 V with a resistor of 10 kΩ.
- Trigger output (NEG) must be connected to the ground.

The absolute maximum voltage is 24 V and voltage with reversed polarity must not be applied.

The recommended connection for trigger input is as follows:

- Trigger input (POS) must be used as a driving source.
- Trigger input (NEG) must be connected to ground.

The recommended voltage is 5 V and the absolute input voltage range is 2 V – 10 V. Input voltage with reversed polarity must not be applied.

5.1.7. Trigger cable

The length of the external trigger cable is 2 m. The connector side of the cable is presented in Figure 13 and the pinout is specified in Table 10.

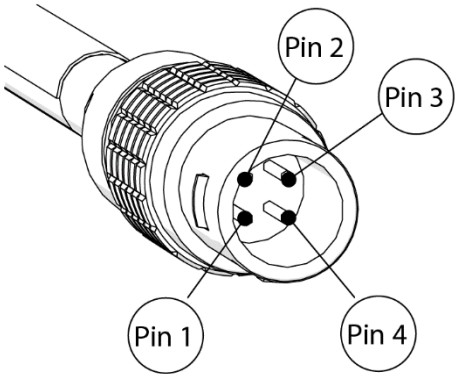

Figure 13. The connector side of the trigger cable.

Table 10. Trigger cable pinout

Pin Index	Color	Description
1	White	Trigger output (POS)
2	Black	Tigger output (NEG)
3	Red	Trigger input (POS)
4	Green	Trigger input (NEG)

5.2. Image format

The desired amount of captured frames are saved consecutively within a single raw data file (.dat). The image file format is 16 bit unsigned, little-endian byte order, without offset and gaps between frames.

A separate header file with width, height and image count information is generated. The image header file format is text (.txt) file. The information in the file is in format “Parameter = value”. The content of the image header file is presented in Table 11.

Table 11. Image header file format

Parameter	Description
ImageFileName	The name of the image file (.dat)
SerialNumber	The serial number of the detector
Firmware	Firmware version
Width	The width of the image (in pixels)
Height	The height of the image (in pixels)
PixelDepth	The pixel depth of frames(s)
NumberOfImages	The number of frames within the image file
GainRange	The gain mode: LFW/HFW
BinningMode	The pixel binning mode: Full resolution/2x2
RoiRowStart	The address of Roi start row
RoiRowEnd	The address of Roi end row
RoiColumnStart	The address of Roi start column
RoiColumnEnd	The address of Roi end column

5.3. Defect pixel map

The defect pixel map contains information about the position of defect pixels in the detector. Each defect map is detector-specific, and is generated and stored in the detector during the manufacturing process. Four separate defect map files for different gain and binning modes are provided. The host application can use the defect maps to apply correction for the defect pixels in the acquired frame.

The defect status of a pixel is indicated as one bit (0 = no defect, 1 = defect). The defect map file also contains defect row and column information. The file format is binary and byte order is little-endian. A defect map file format is presented in Table 12.

Table 12. Defect pixel map file format

Parameter	Description	Length (bytes)
Serial Number	The serial number of the detector	32
Width	The width of the image (in pixels)	2
Height	The height of the image (in pixels)	2
Type	0, High full well – Full resolution 1, Low full well – Full resolution 2, High full well – 2x2 pixel binning 3, Low full well – 2x2 pixel binning	1
Version	Version number	1
Reserved	Reserved	6
Data	1 bit per pixel: 0 = no defect, 1 = defect	Width * Height / 8
Number of defect columns	Number of defect columns (max. 32)	1
Defect columns	List of defect columns	2 * Number of defect columns
Number of defect rows	Number of defect rows (max. 32)	1
Defect rows	List of defect rows	2 * Number of defect rows
CRC	CRC32 of the file without the CRC field	4

5.4. Mechanical interface

The location of the active area in the detector is presented in Figure 14.

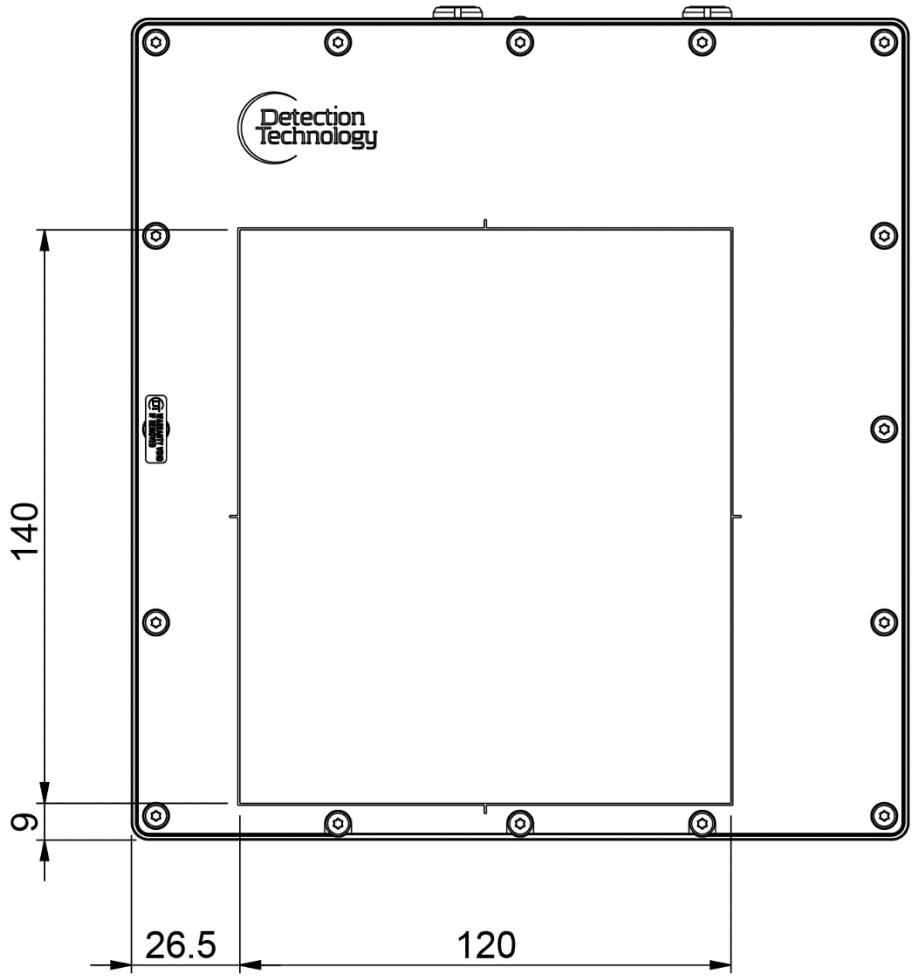

Figure 14. Location of the active area.

The detector has two M4 threaded holes on each sides, four M4 threaded holes on bottom side and four M5 threaded holes on bottom side. The detector must be fastened to the mechanical system either using at least four M4 screws (tightening torque 2.5 Nm ± 0.2 Nm) or using at least four M5 screws (tightening torque 4.0 Nm ± 0.2 Nm). The locations of the threaded holes are presented in Figures 15 and 16. During operation, there should be adequate airflow around the detector.

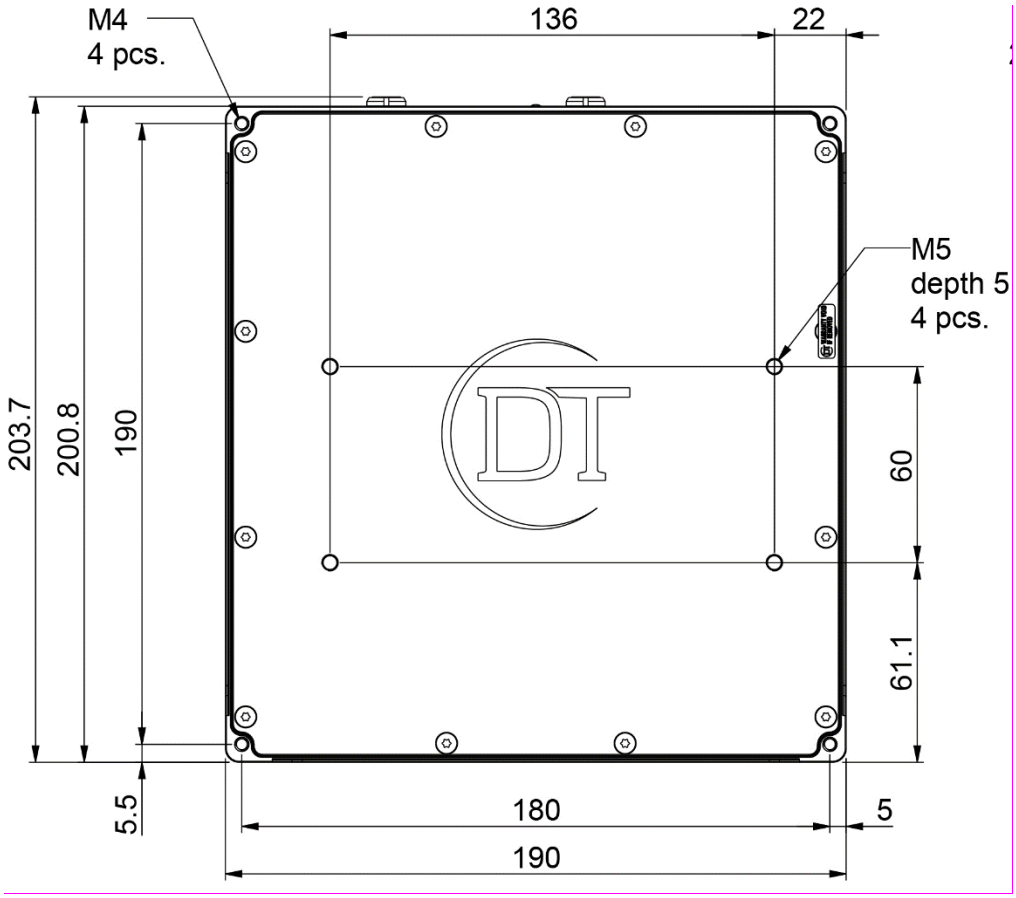

Figure 15. Location of threaded holes in the bottom of the detector.

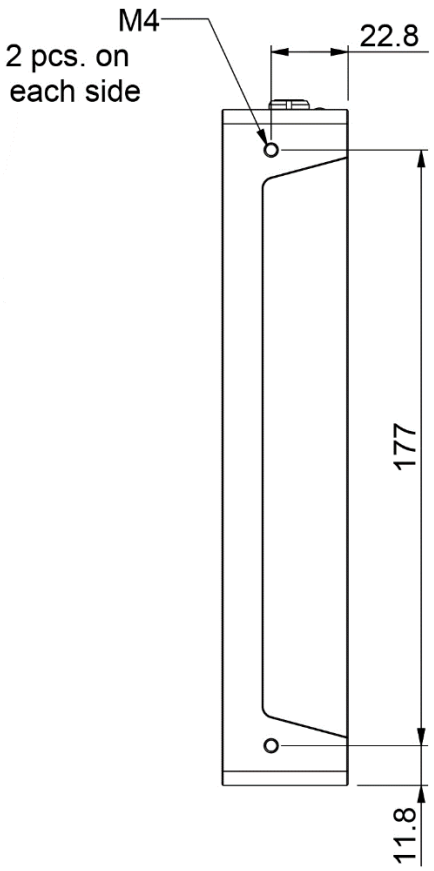

Figure 16. Location of threaded holes in the side of the detector.

6. QUICK START GUIDE

This section contains installation and maintenance instructions for X-Panel 1412i.

6.1. Installation guide

This section contains installation instructions for X-Panel 1412i and for X-Demo software.

6.1.1. Installing the X-Demo software

DT supports the X-Demo control software development kit (SDK) with a simple GUI. For use of SDK, please refer to the "X-Panel Programmer's manual of X-Lib Software Library" document.

Proceed as follows when installing the X-Demo software:

1. Download the X-Demo installation package.
2. Double-click the executable file to run the installation wizard.

The default IP address of the detector is 192.168.1.2. The IP address of the computer should be at the same subnet, i.e. 192.168.1.X, where the X is between 1 and 255, but not the same as that of the detector. Subnet mask should be 255.255.255.0.

We recommend changing the following network connection settings to achieve the best functionality: Jumbo packet and Receive buffers.

Instructions:

- Open Control Panel\Network and Internet\Network Connections
- Right click on the correct network connection, choose Properties
- IP address:
  - Click Internet Protocol Version 4
  - Click Properties
  - Click Use the following IP address
  - Set the correct IP address and subnet mask
- Jumbo packet and Receive buffers:
  - Click Configure
  - Open Advanced tab
  - Set Property: Jumbo Packet to 9014
  - Set Property: Receive Buffers to 2048
- Optional settings that may reduce host PC load in some cases
  - Configure
  - Advanced tab
  - Set Energy Efficient Ethernet: Off
  - Set Flow Control: Tx Enabled

6.1.2. Installing the X-Panel

Figure 17 presents cable instructions for the detector. Proceed as follows when installing the detector:

1. Mount the detector in its place.
2. Connect the CAT-6 STP Ethernet cable to the Ethernet connector (1).
3. Connect the power cable to the power connector (2) with a supply voltage between 12-24 V and capable of delivering 8 W power.
4. Connect the trigger cable to the trigger connector (3) in order to use external trigger or readout output trigger.
5. Connect the grounding point to the end systems main chassis (4)

When the detector is connected to a host system, the software will recognize it within 60 seconds. The software indicates a successful connection by a green background color on the **DETECTOR** field, in the bottom left-hand corner of the user interface.

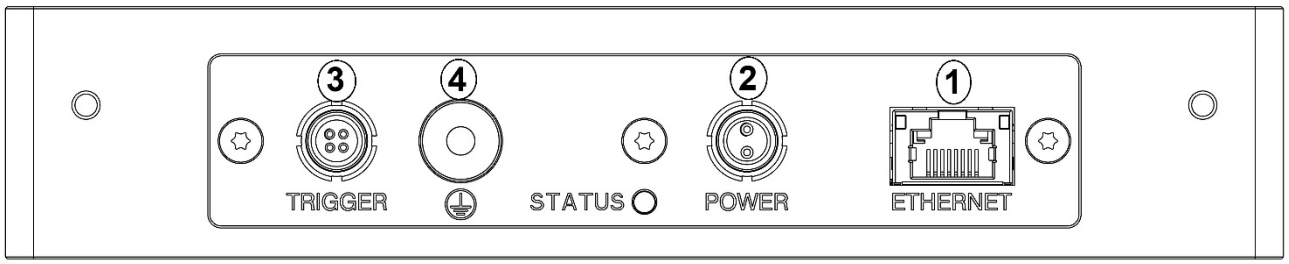

Figure 17. Connection instructions.

6.2. X-Demo software user interface

The operation tab is depicted in Figure 18.

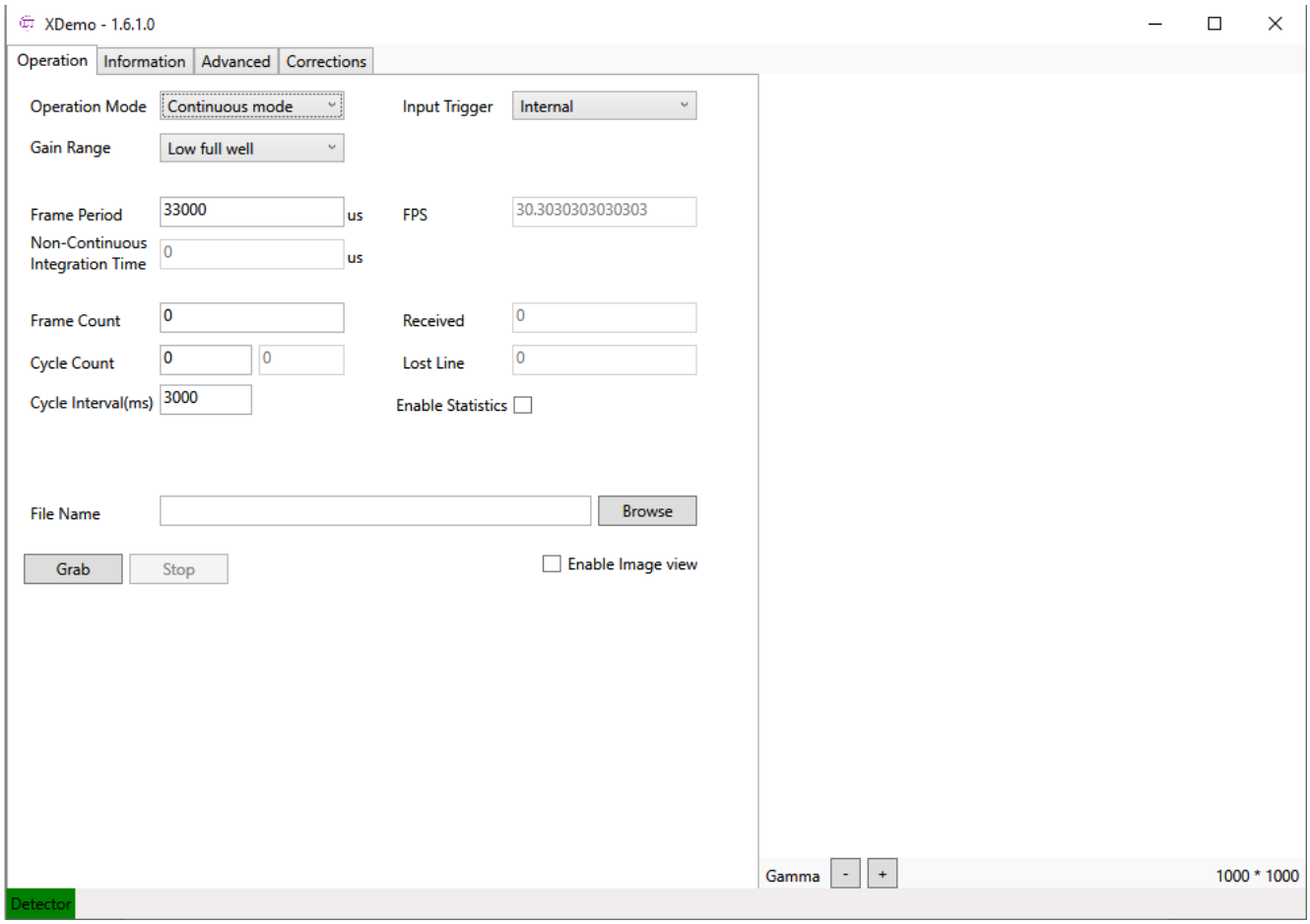

Figure 18. Operation tab of X-Demo.

The fields and buttons in the operation tab are as follows:

- **Operation Mode**
  - Continuous mode
  - Non-continuous mode
- **Input Trigger**
  - Internal
  - External
- **Gain Range**
  - Low full well
  - High full well
- **Frame period**: Enter the preferred frame period in continuous mode with internal timing, the rules are specified in section 4.6.1.
- **FPS**: The frame rate, which is calculated automatically by the software.
- **Non-Continuous Integration Time**: This is reserved for debugging purposes. Enter the preferred frame period in non-continuous mode with internal timing, the rules are specified in section 3.6.3.

- **Frame Count**: Enter the number of frames to be grabbed. With '0' the software will grab frames until stop is selected.
- **Cycle Count:** Enter the number of grab cycles. Total frame number will be Cycle Count x Frame Count. With '0' the software will grab frames until stop is selected.
- **Cycle Interval:** Set the time interval in ms between two grab cycles.
- **Received**: Indicates the number of frames already captured.
- **Lost Line**: Indicates the number of UDP packets lost in transmission.
- **File Name**: Enter the file name for the image file.
- **Grab**: Press this button to capture the image.
- **Stop**: Press this button to stop capturing the image.

The captured image will appear on the area to the right.

- **Gamma**: Use the + and – buttons to adjust the gamma setting of the image.

The information tab is depicted in Figure 19. This tab shows information about the detector and the fields are read-only.

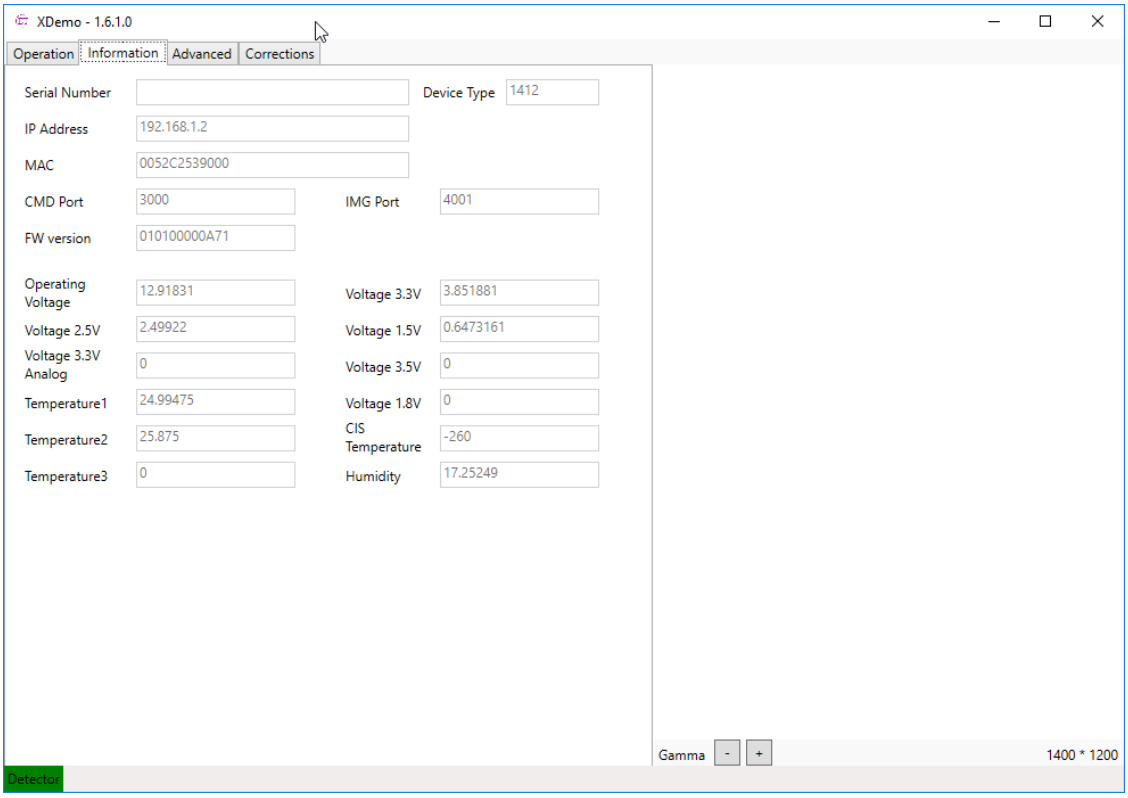

Figure 19. Information tab of X-Demo.

The Advanced tab is depicted in Figure 20.

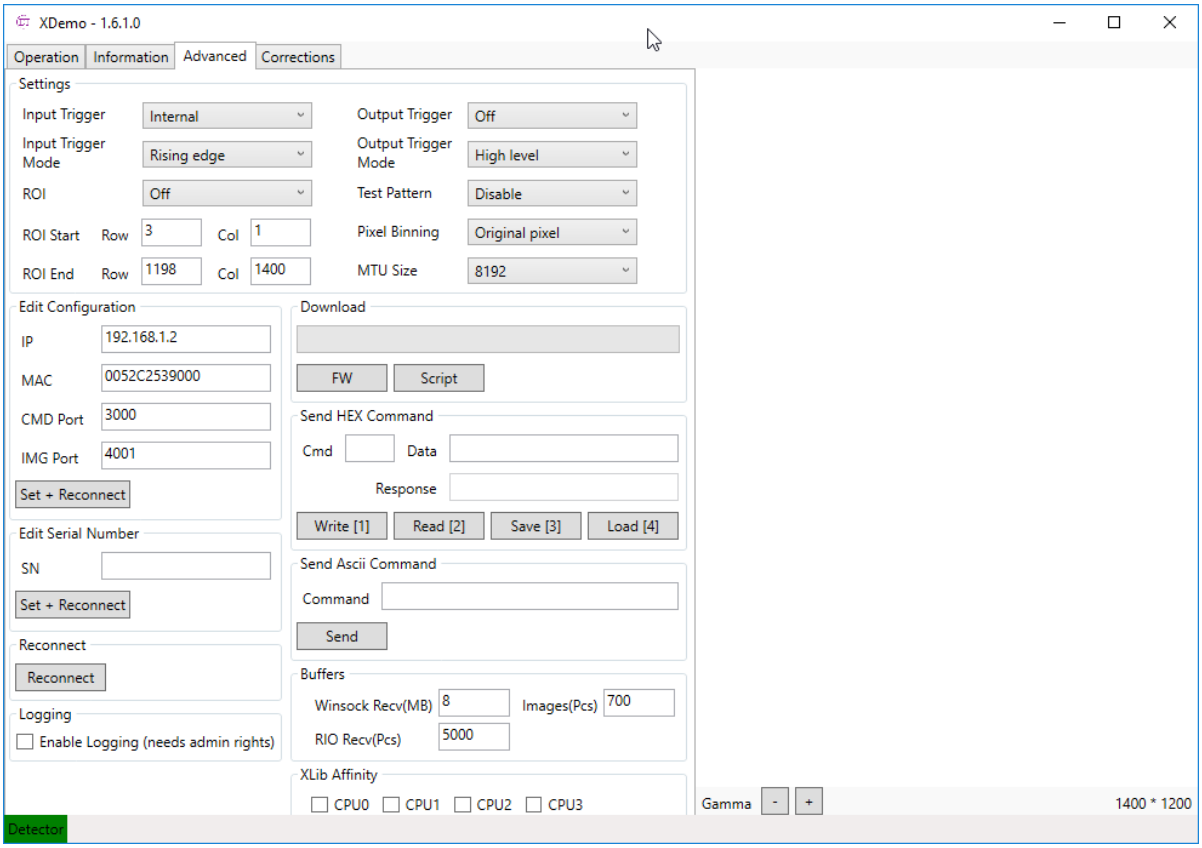

Figure 20. Advanced tab of X-Demo.

The fields and buttons in the advanced tab are as follows:

- **Input trigger**: Select the internal / external trigger mode.
- **Output Trigger**: Enable / disable output trigger.
- **Input Trigger Mode**: Select the input trigger edge polarity.
- **Output Trigger Mode**: Select the active polarity of output trigger.
- **ROI**: Enable / disable ROI mode. If enabled also define the coordinates of ROI according to the rules specified in section 4.5.
- **Test pattern**: The detector supports four different test patterns for debugging purposes.
- **Pixel binning**: Select the full resolution or 2x2 binning mode.
- **MTU Size**: Select the size of the MTU packet.
- **Reconnect**: Can be used to connect to the detector, if the connection is lost.
- **Frame Buffer size**: User can adjust the size of the frame buffer.

The Corrections tab is depicted in Figure 21.

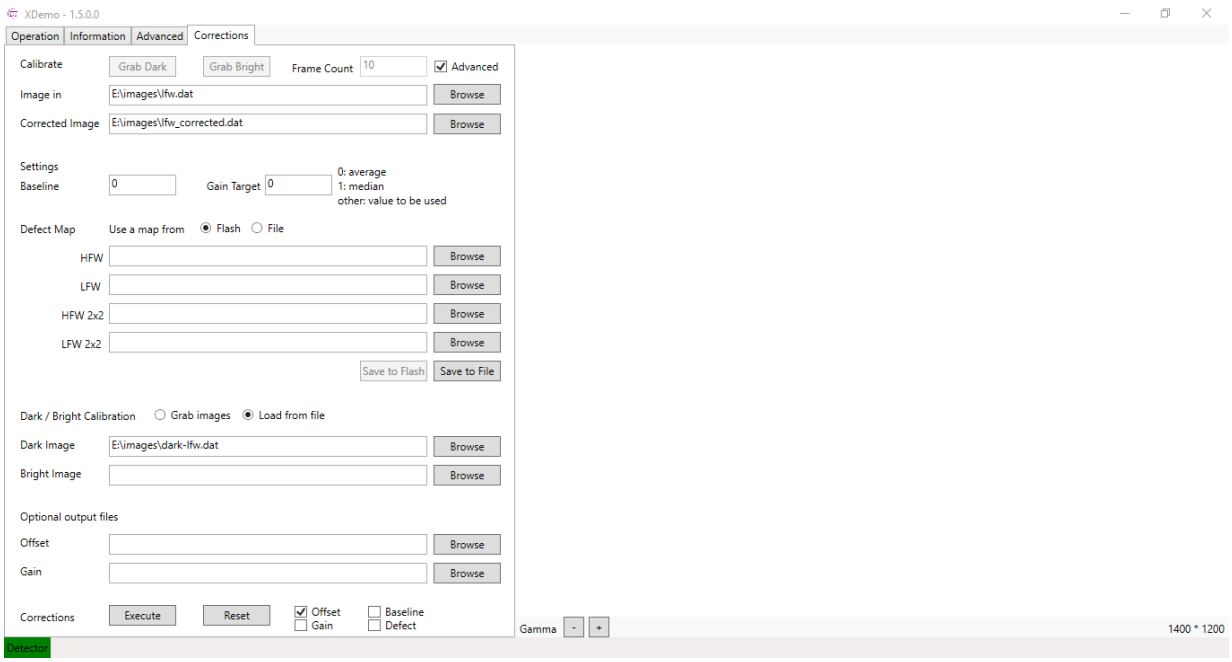

Figure 21. Corrections tab of X-Demo.

It is recommended to perform offset, gain and defect pixel corrections for the images. The corrections tab performs the image corrections based on the section 4.7.

- **Grab Dark:** If the preference is not to use existing files, grab the dark frames.
- **Grab Bright:** If the preference is not to use existing files, grab the bright files.
- **Frame Count:** The number of dark and bright frames to be grabbed, default 10.
- **Advanced:** Click to open more parameters.
- **Image in:** Select the frame that will be corrected, it must be in .dat format.
- **Corrected image:** The preferred name and path of the corrected image.
- **Baseline:** The preferred baseline value [ADC].
- **Gain Target:** The target intensity value for the corrected image, 0 for average intensity value of gain image, 1 for median intensity value of gain image, and any other number allows the user to select the target intensity value [ADC].
- **Defect map:** Use a defect map from flash or from the external defect file (must follow the defect map format). Selecting from the external defect file will speed up the corrections.
- **Dark / Bright Calibration:** Select either *Load from file* for existing files of *Grab images* to grab the images now.
- **Dark Image:** The name and path of the dark image.
- **Bright Image:** The name and path of the bright image.
- **Corrections:** Execute to perform the corrections. The user can select the preferred corrections (Offset / Gain / Baseline / Defect).

6.3. Operation after standby

After standby mode, the images might contain unwanted data from dark signal accumulation. Thus, it is recommended to read and discard at least two images after standby period.

6.4. Maintenance guide

This system has no components that the (end-) user needs to replace, modify or adjust. Contact Detection Technology, Plc for assistance, if needed.

The system design minimizes the amount of electromagnetic interference it may generate in a medical installation. However, this equipment generates and can radiate in the radio frequency energy range and, unless installed and operated according to the instructions, may cause harmful interference with other devices in the area.

6.4.1. Handling precautions

When handling the X-Panel detector and the X-Panel power supply, note the following:

1. Treat the detector front cover with care, as scratches or debris in this area may produce artifacts in the X-ray image.
2. The detector power supply must be disconnected during installation.
3. The connections and boards have components that are sensitive to Electrostatic Discharge (ESD). Proper precautions are necessary during handling.

6.4.2. Cleaning the detector

You can clean the detector body and front cover with a mild, non-abrasive cleanser, such as isopropyl alcohol. Do not use any harsh cleansers or solvents that may damage the detector.

Proceed as follows:

1. Place a small amount of cleanser on a soft cloth.
2. Rub gently over the detector body surface.
3. Wipe off with a clean soft cloth.

6.4.3. Calibration

In order to achieve the best image performance, we recommend correcting the raw image data generated by the detector at the host, by using offset, gain and defect pixel corrections. As the offset (dark) calibration signal depends on, for example, the ambient temperature conditions of the detector, we recommend generating calibration images frequently at times when the X-ray source is switched off. We recommend to re-calibrate the gain correction image at least once per year and whenever the X-ray tube is replaced or there are changes in the X-ray imaging environment. The detector may contain deviating pixels. To achieve the best possible image quality, we recommend creation of a new defect pixel maps at least every year, or more frequently if the system is in heavy use.

Outline drawing of X-Panel 1412i