TPX3CAM

User manual

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Date of release 15th Oct. 2021

Contents

1 Safety Information

Thank you for choosing our product!

Please carefully read the safety instructions before operating the TPX3CAM detector system.

LIFE DANGER DUE TO DAMAGED POWER CABLE OR POWER PLUG

Before operating the detector, make sure there is no damage to the power cable. The malfunctioning of this cable and of the power plug may cause electric shock, result in hazardous condition for your health, and damage of the devices.

ELECTRIC SHOCK RISK DUE TO VOLTAGE COMPONENTS

Do not insert any item into the detector. The modification of the electronic circuitry may result in an electric shock due to the presence of internal voltage components.

TRIPPING RISK

During installation of the detector, do not leave any loose cables. These may obstruct the safety of the user during operation and can also do damage the detector interfaces.

GENERAL PRECAUTIONS

→When mounting the objective lens, it is recommended to place the detector at the right orientation so that the sensor chip is not facing up. In doing so, no particles from the external ambient can drop onto the sensor, located underneath the objective aperture.

→When the detector is not equipped, always store it safely on a stable surface.

→Make sure the detector is protected from liquids, dust, and extreme heat or humidity.

→As the sensor chips are very sensitive, never leave the detector without the mounted objective lens or the protective cap.

→Never attempt to clean the bare sensor chip by yourself! If you suspect there might be a problem with the sensor chip due to damage or contamination, please contact ASI for support.

2 TPX3CAM Hardware Setup

1. During TPX3CAM installation, make sure that the exposed sensor area does not come into direct contact with any objects including tools, e.g. cleaning stick or paper, etc. (The 1.4 x 1.4 cm^2 Timepix3 sensor chip is recessed ~ 1 cm inside the metal detector housing and is centered within the objective lens orifice). Physical contact with the sensor will lead to electrical damage.
2. A focus lens, such as the included 50-mm fixed focal length objective, will be used with the TPX3CAM in most configurations. The TPX3CAM has C-mount compatible 25.4 mm diameter hole with a female thread of 32 threads per inch for lens attachment. Once the lens is mounted on the TPX3CAM, the detector is ready for installation on the experimental setup.
3. Securely position the TPX3CAM on your system to ensure the detector body remains stationary and unpowered during the installation.
4. Connect either the 1 Gb ethernet or 10 Gb fiber cable, the optional HDMI cable and the optional TDC cable to the TPX3CAM. Then connect 12 V power supply cable to the power

adaptor. Note the power interface located on the detector PCB is delicate and may be damaged if too much force applied to it.

5. Press the power button to switch the detector on. To switch the detector off, hold the power button down for 3 seconds.

Figure 1. *TPX3CAM connections diagram (The port panel may look different for different version of the TPX3CAM): 1. Power supply input jack; 2. TDC channels; 3. One 1Gb/s Ethernet; 4. One 10Gb/s Ethernet; 5. Two HDMI interfaces; 6. Display screen; 7. Power on/off button (only available for the new version of TPX3CAM).*

3 Configuration of Software & Communication

1. The software provided by ASI to operate the TPX3CAM is called SoPhy. It will be replaced by ACCOS, the latest GUI software developed by ASI recently. SoPhy is provided on a USB flash drive delivered with the TPX3CAM detector. Choose the version of Sophy assigned for your computer's operating system. For instance, run "Sophy.jar" (Type command in CMD: *java -jar sophy-x.x.x.jar*) in the MS windows/Mac OS, and run "Sophy.jar" or install .deb package in Ubuntu (see the SoPhy manual for more details.). To be able to run Sophy, the PC must have

Java Development Kit (JDK) 11.0, or a higher version installed first. To check your Java version by entering command “*java -version”* in Windows CMD, Mac OS and Ubuntu terminal.

2. Please check the detector delivery detail to identify the appropriate Ethernet connection assignments (notice that 1Gb and 10Gb Ethernet of the TPX3CAM can’t be used at the same time, you have to configure and choose one of these two connections to the PC).
    a. For 1 Gb Ethernet, the computer IP address should be set to 192.168.1.1 with netmask 255.255.255.0.
    b. For 10 Gb optic fiber Ethernet, the computer IP address should be set to 192.168.100.1 with netmask 255.255.255.0. A 10 Gb optical fiber card needs to be installed in the PC before connecting to the 10 Gb Ethernet interface of the TPX3CAM.
3. Ethernet *MTU* value should be set to 9000 if using Windows, the firewall must be disabled. *Jumbo Frame* needs to be 9014 Bytes. WiFi and internet LAN should be also disabled temporarily, to avoid any communication issue when first connecting the PC to the detector.
4. The 1 Gb Ethernet or 10 Gb fiber cable should be connected to the PC before turning on the TPX3CAM.
5. Once the TPX3CAM is powered on, an initial communication between the PC and the TPX3CAM through Ethernet for 1 Gb mode (network: “Spidr 1Gb”) or through the optical fiber for 10Gb mode (network: “Spidr 10Gb”) will start automatically.
6. The connection to the TPX3CAM can be tested on using the OS command line interface (e.g. CMD in Windows, terminal in Linux) with a ping command to the IP address 192.168.1.10 as

"ping 192.168.1.10" for the 1 Gb connection or for 192.168.100.10 as "ping 192.168.100.10" for the 10 Gb connection.

7. Launch the SoPhy program. SoPhy should automatically recognize and connect to the TPX3CAM. The successful connection can be confirmed by checking the chipboard ID shown in Sophy.

4 SoPhy Startup Guide

Once the TPX3CAM cables have all been properly connected, power on the detector and open the SoPhy program. When SoPhy first launches, the main control window and the toolbox window should appear as shown in Figure 2.

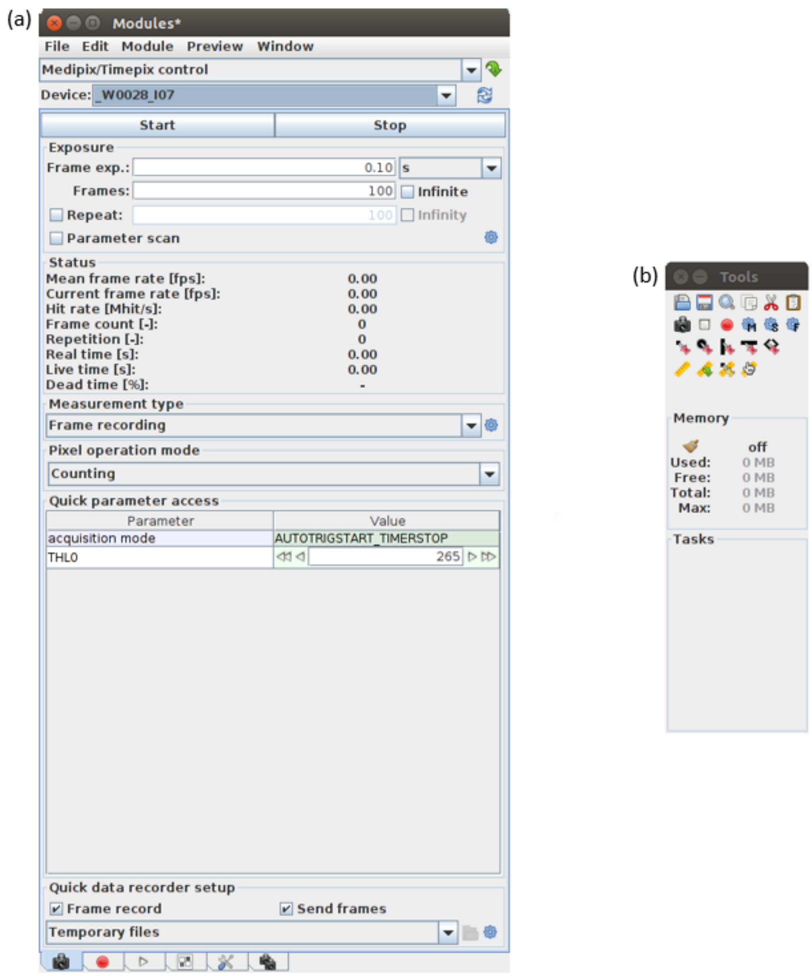
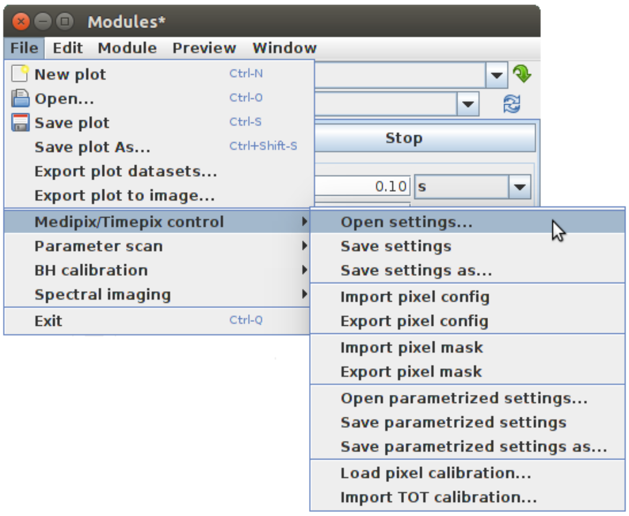
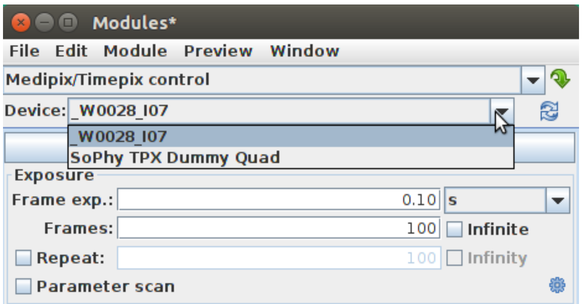


Figure 2. *SoPhy main control (a) and toolbox (b) windows. GUI may look different for different versions.*

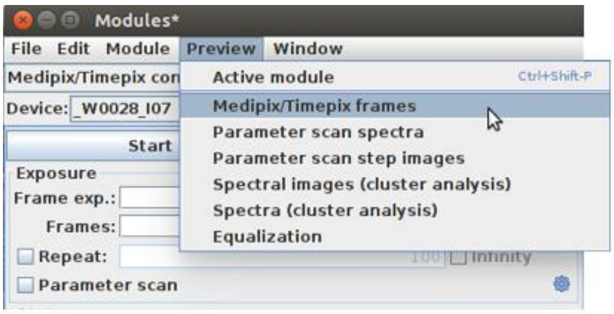
When using Sophy and the TPX3CAM for the first time, a settings file (.spx) must be loaded before initiating measurements. Once the settings file has been loaded successfully, it is not necessary to repeat this step every time Sophy is launched unless the settings file needs to be replaced with a new one (Sophy will load the most recently saved settings automatically). To load the factory default settings file, click **File**, select "Medipix/Timepix control", then "Open settings…" and choose the ".spx" file from the USB drive included in the TPX3CAM delivery package. This file contains all necessary settings generated in the factory testing for your TPX3CAM. It is recommended to copy this file into the acquisition computer and a back-up drive.



If connected properly, the device will be identified by its chipboard ID, e.g. "_W0028_I07" shown here in the pop-up window.



To display the preview window of previous window of images while recording acquisitions, select "Medipix/Timepix frames" under the menu **Preview** in the main control window.



SoPhy loads with factory settings by default, unless previously acquired/changed settings were saved to a new default configuration. If a new detector is connected, SoPhy again applies its factory default settings when the software is restarted. If the setting files for this detector are not available in the PC, then the user has to load the setting files manually.

4.1 Factory settings

During initial detector startup, a factory setting file with suffix ".spx" must be loaded/opened in Sophy. The installation file is stored on the provided USB drive. If you can't find it, please contact ASI. The factory setting file contains all necessary configuration for the detector, so it doesn't need to change during using the detector.

4.2 Bias voltage

- By default, and in the case that no previous configuration files were loaded, the bias voltage for a new detector is 12 V. In SoPhy, this value can be adjusted in the hardware settings as shown in Figure 3. If it is the case, please load the .spx setting file in Sophy, and check this value again. It should read 40 V or 50 V now. Improper bias voltage applied on the sensor, may cause the problem to obtain good images from the detector.
- The recommended bias voltage for the TPX3CAM is 40 or 50 V depending on the detector chip. With higher voltages, the light sensitivity-enhanced sensors will experience a larger leakage current, which results in higher noise level. To access this parameter, select the settings tab (5th tab, window bottom - see figure below). Under **Devices**, select the connected device, then select **HW info 0**. The **BiasSupplyEnabled** box must be checked so the bias voltage is applied with the value set in the **BiasAdjust**. If the factory setting file has been loaded when Sophy is

running, then the bias voltage for the TPX3CAM doesn't need to be changed during measurements.

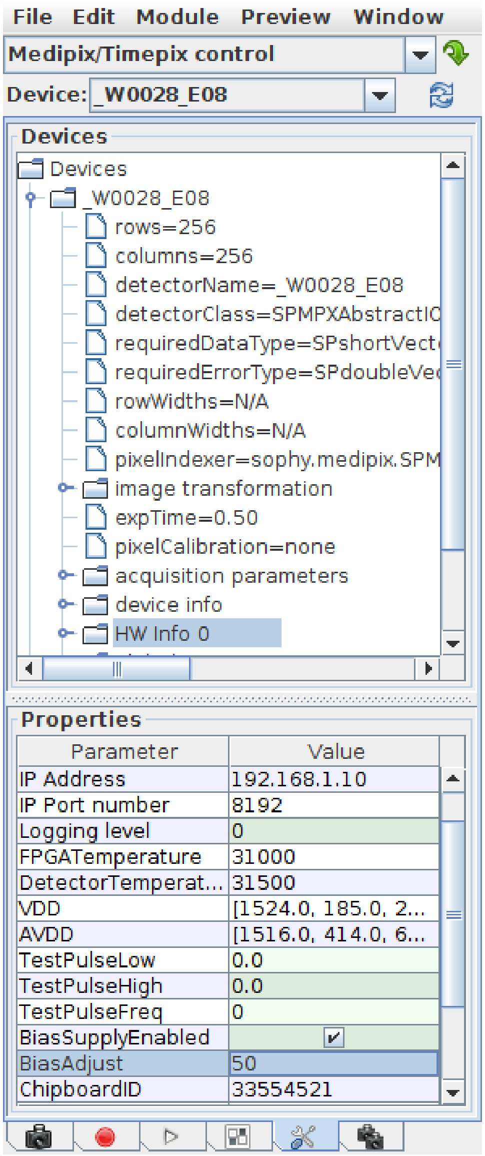


Figure 3. Detector settings panel.

4.3 File saving

TPX3CAM data can be saved and exported in different formats, e.g. binary, TIFF or .txt (as shown in Figure 4). TIFF file and Raw Pixeldata file are the most used data format. The destination folder can be defined in "Export options".

If no data needs to be saved, select "Temporary files" under the "Recorder" tab.

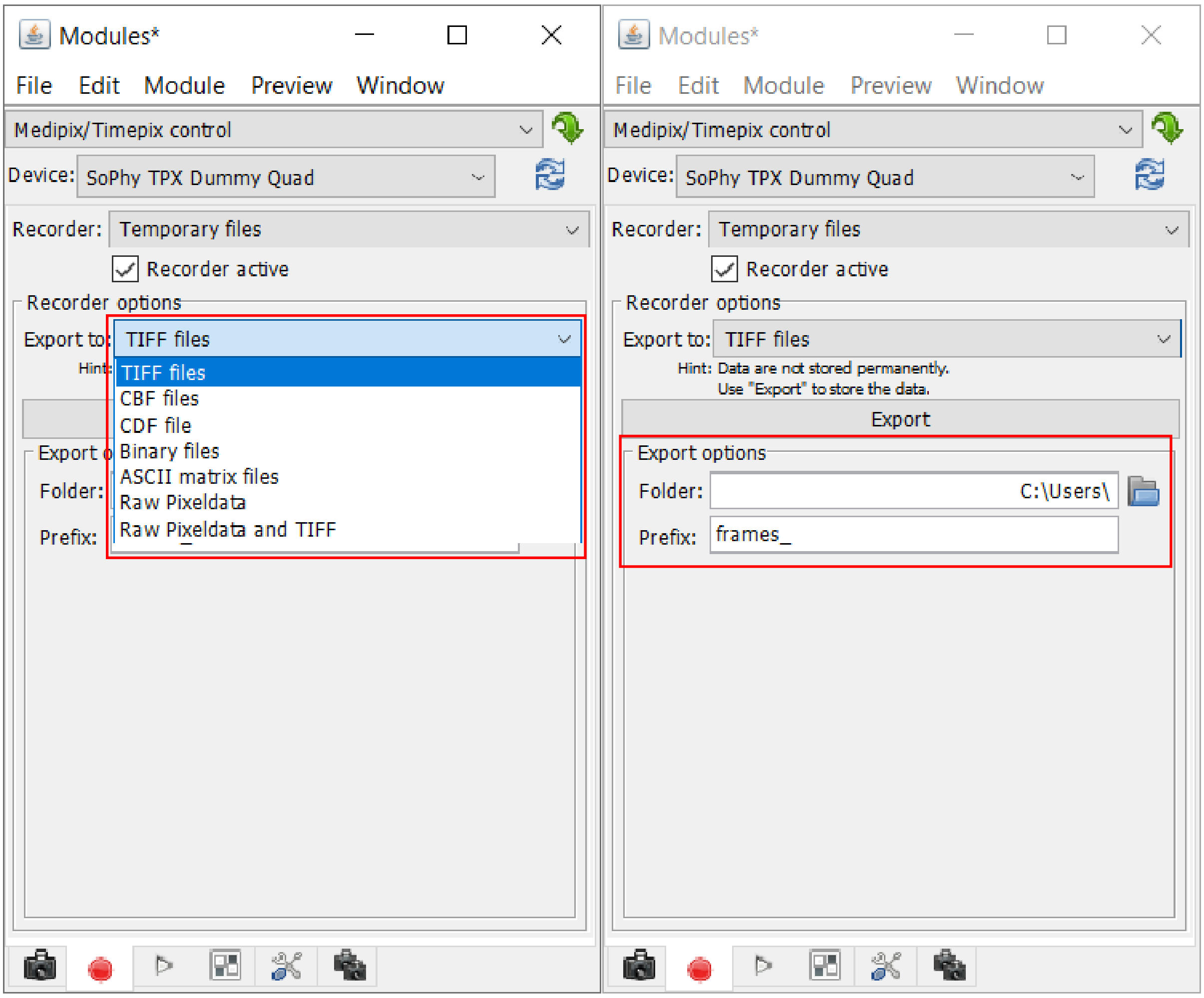


Figure 4. Image/data file saving

When the data is saved as Raw Pixeldata file, by default, all stream data will be stored as one single file. Sometimes it could become a GB or even TB data file, which is inconvenient for post-processing and analyzing. In Sophy, a maximum data size can be set so that once the maximum value is reached, Sophy will automatically and continuously generate new files, and save the data stream into it untill the data acquisition ends.

To configure, click menu **Edit**/**Performances**..., to change fileSizeLimit, e.g. as shown below it is set as 524 288 000 that is 500 × 1024 × 1024 B. The unit is Byte.

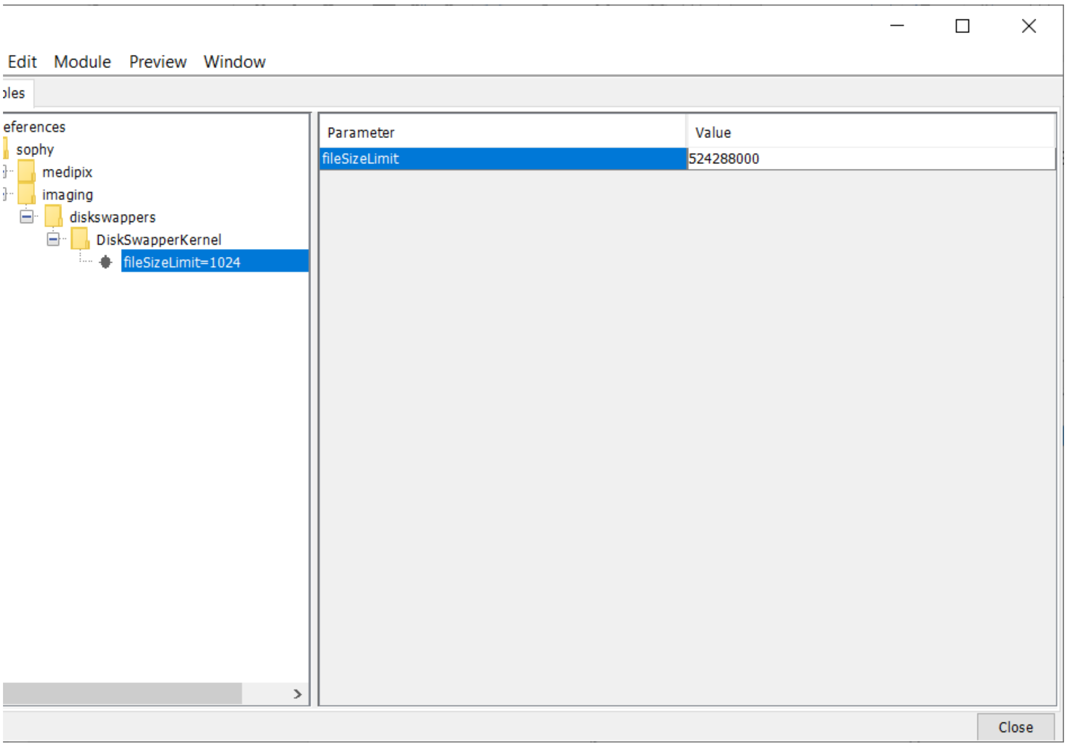


Figure 5. The maximum size of raw data file

4.4 Equalization

Equalization is a procedure in which the per pixel logic of the Timpix3 chip is optimized to account for pixel-to-pixel variation in production. In principle, the equalization has to be done only **once**; however, it is recommended to repeat this procedure once a year or if the detector operation environment temperature has drastically changed, e.g. the detector was near to a baked chamber with high temperature. The first equalization was already performed by ASI during factory testing. The setting files from this equalization have been saved on the USB drive for your specific TPX3CAM.

Steps to equalize the detector:

1. Run Sophy, bring the main control window into view and select the “Equalization” option in the **Measurement type** box, set the **acquisition mode** as “AUTOTRIGSTART_TIMERSTOP”, and **Pixel operation mode** as “Counting”.
2. Click on the cogwheel symbol next to the **Measurement type** box to enter the settings window for equalization.
3. Change **Pre-set parameters** to “PRECISE” for a precise equalization (a precise equalization is recommended for standard measurements). To show the equalization progress, click “Equalization” under the menu **Preview**.
4. Click **Start** to start the equalization. During the equalization, please don’t interrupt the PC and use it for other tasks.
5. Once the equalization procedure is completed, the new settings must be saved manually in SoPhy. Click **File**, then under the menu “Medipix/Timepix control” choose “Save settings as”.

Notice that the option “save settings” will overwrite the previous setting file if it exited. Therefore, backup the previous setting file first if necessary.

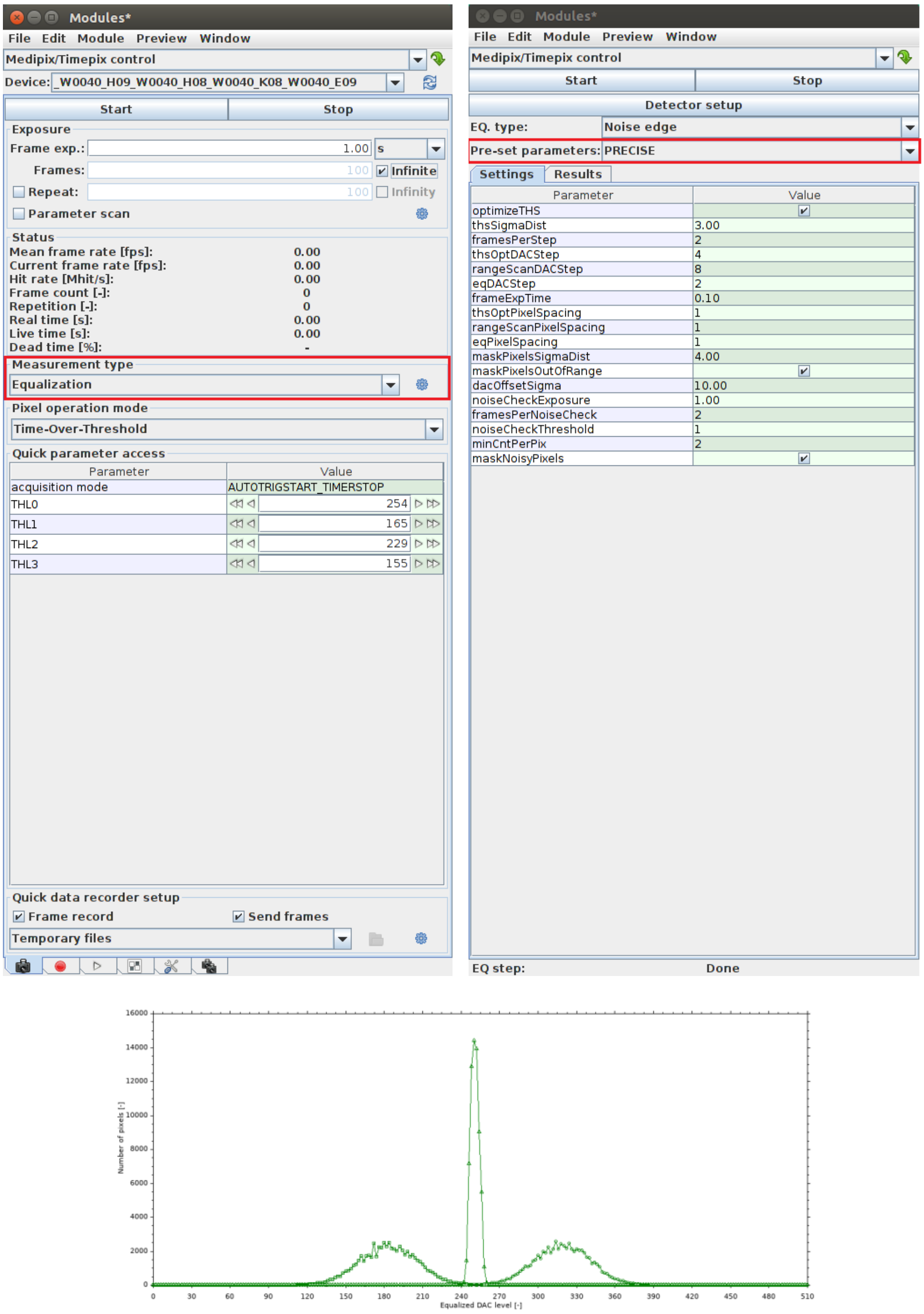


Figure 6. Equalization settings and result

5 Signaling Time-to-Digital Converter

The TPX3CAM has two time-to-digital converter (TDC) channels available for recording timestamps from an external signal with a 260 ps time resolution. The dual TDC channel feature could be useful for synchronizing acquisition with multiple trigger sources (i.e. laser intensity, delay time, motor position, etc.) during the measurement. The TDC parameter can encode a time variable of the external signal fed into the TDC channel. The TDC timestamps will be merged into the data stream from the detector chip. Therefore, data acquisition does not need to be halted in order to change the parameter. The TDC data will be saved in a raw data file together with the chip data when choosing the option “Raw pixeldata” in the data recording menu. The TDC only accepts a standard LVTTL signal pulse (+**3.3 V**) (Table 1), and **not** TTL pulse which has the maximum voltage +5 V. Misusing improper pulses could damage the trigger box and the detector TDC channels! For data extraction and processing, TDC timestamps are organized in a 64-bit packet under the data packet header “0x6?” (see Table 2). The “?” indicates a letter “F”, “A”, “E”, or “B” depending on the TDC setting in Sophy (See Table 4 and Figure

7). The meaning of the letters in the packet header is specified in Table 3. Please refer to ASI example codes for detailed information on how to extract TDC timestamps.

Table 1. TDC Parameters

Amplitude	LVTTL, +3.3 V
Duration	>25 ns
Maximum rate	<10 MHz@10 Gb/s <1 MHz@1 Gb/s
Time bin	260 ps
Maximum timestamp	107.3741824 s
Counter depth	12 bits

Table 2. TDC Headers

Header (HEX)	Meaning
0x6F	TDC 1, rising edge event
0x6A	TDC 1, falling edge event
0x6E	TDC 2, rising edge event
0x6B	TDC 2, falling edge event

The TDC edge can be defined in **TdcEdges** settings in Sophy under HW Info 0 (see Figure 7). The specific setting values and their meanings are listed in Table 4.

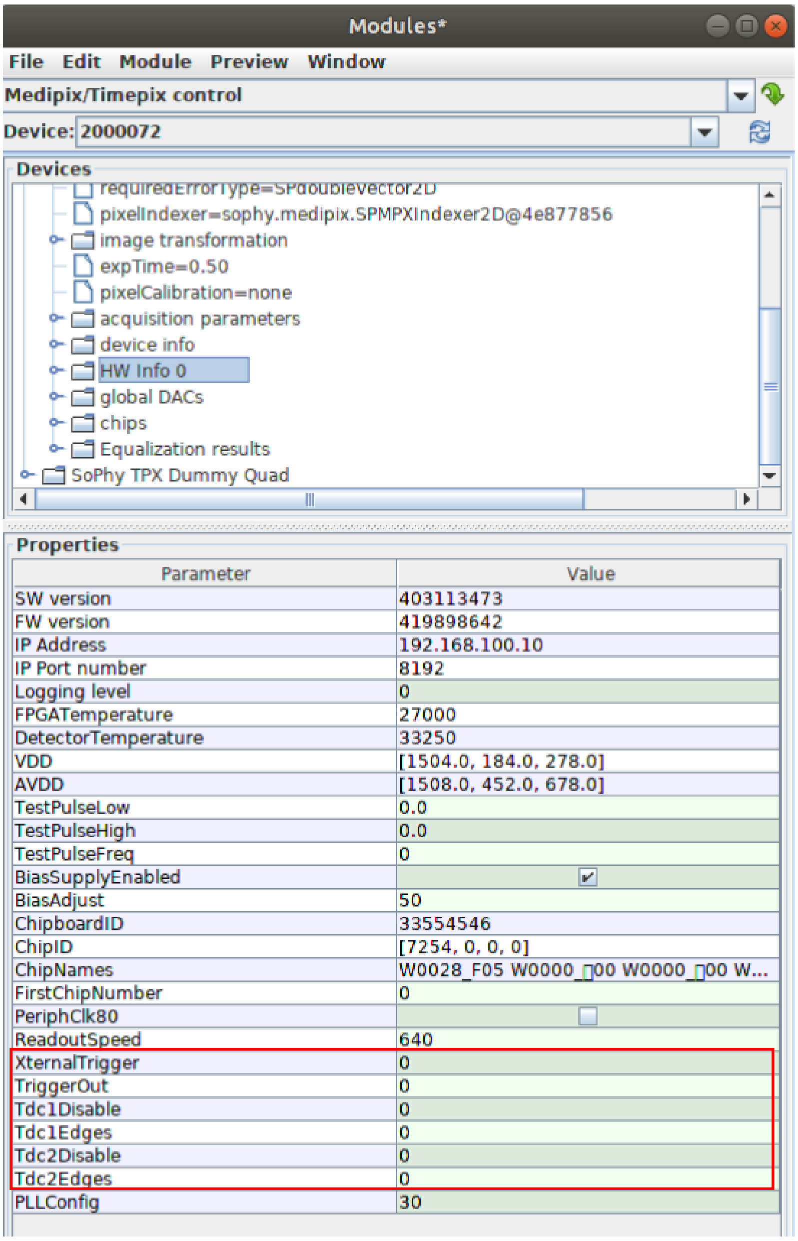


Figure 7. Settings for the TDC and external triggering

For the TPX3CAM detector (with a single chip), both of the TDC inputs can be disabled under the setting **TdcDisable.** The set value “15” will disable the TDC, while the value “0” is enabled. The default value is “0”.

Table 3. TDC1 and TDC2 disable ("0B1") and enable ("0B0")

	Value set in Sophy	Meaning
0B0000	0	Enable all TDC values
0B0001	1	Disable one of TDC values
0B0011	3	Disable two of TDC values
0B0111	7	Disable three of TDC values
0B1111	15	Disable all TDC values

Table 4. TDC Time Stamping Edges

	Value set in Sophy	Meaning
0B00	0	Both rising and falling edge
0B01	1	Falling edge only
0B10	2	Rising edge only

6 Triggering Externally via HDMI

6.1 Connections

Use the HDMI cable to connect the TPX3CAM and the trigger box. The HDMI 1 interface (see Figure 1) on the back panel of The TPX3CAM is preferred since the HDMI 2 can be used for an output for triggering other TPX3CAM for multiple detector synchronization later if needed.

The HDMI ports on the TPX3CAM can be used to externally control the shutter of the . In this way, the TPX3CAM can be operated like a conventional CCD/CMOS frame-based camera to generate images within a certain exposure time window. In order to use external triggering via the HDMI, the TPX3CAM requires a software version Sophy 1.5.7 or higher. ASI provides a trigger box (shown in Figure 8) for coupling the trigger signal through standard BNC interfaces to the detector. The trigger box is included in the TPX3CAM delivery package.

Figure 8. Trigger box for external triggering to the TPX3CAM, showing the max allowed voltage LVTTL +3.3V pulse

*Figure 9. Label on the trigger box indicates its channels as input or output. e.g. S/n: T024-IOIO. It means channel 1: input port, channel 2: output port, channel 3: input port, and channel 4: output port. When using external triggering with channel1, please set the value "1" for "**XternalTrigger**" in sophy (see Figure 10).*

6.2 Settings in software

1. Run the Sophy program (Sophy v1.5.7 or higher).
2. After the chip was connected and set up correctly, go to the detector settings tab (see Figure 10). Set the **XternalTrigger** to "1" instead of the default value "0" (Note that the specific value may vary depending on the trigger box, please check the label on the trigger box).
3. Navigate to the Sophy settings tab from the bottom panel of the main window. Here, the external triggering can be enabled as shown in Figure 11. The default setting is automatic acquisition "ACQSTART_TIMERSTOP". For a quick testing, the acquisition mode can be set as

"PEXSTART_TIMERSTOP," which means the shutter will open at the rising edge of the external signal and close after the exposure time set in **Frame Exp.** on the main module (Figure 11).

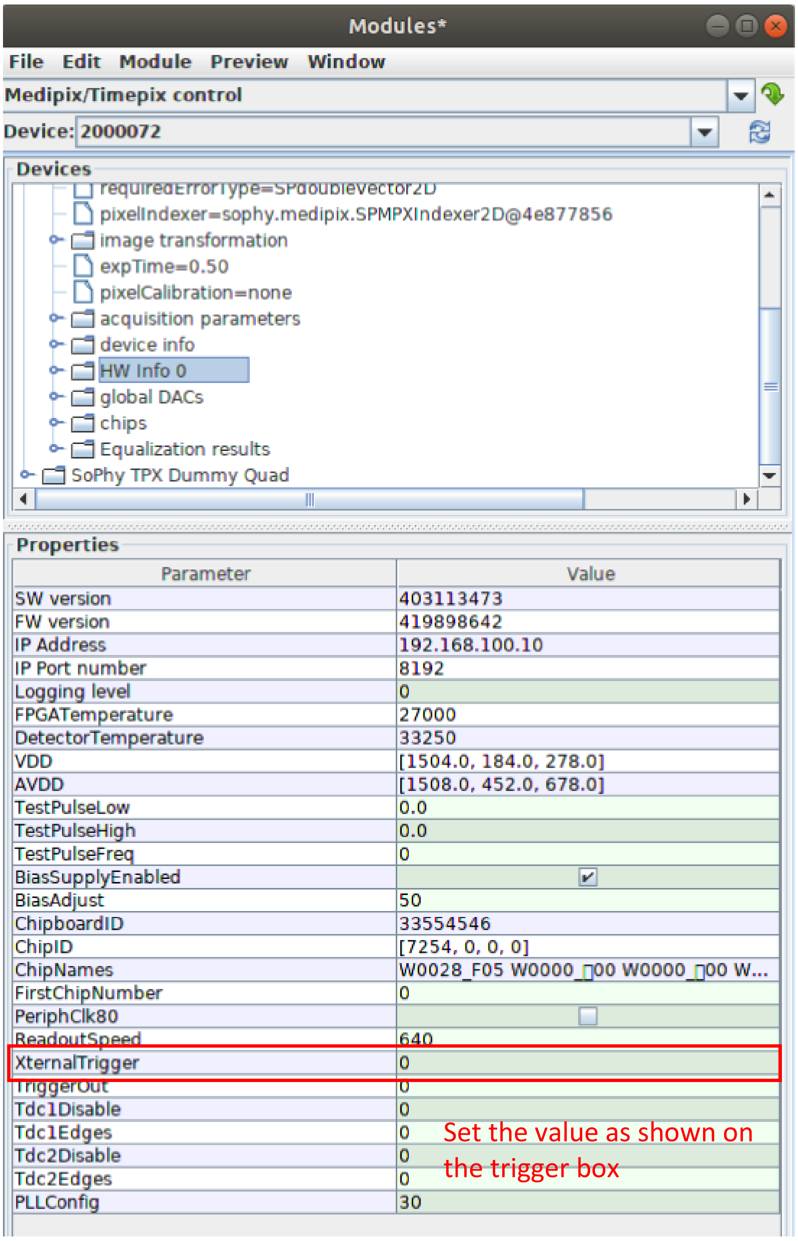


Figure 10. Setting to enable HDMI 1 for external triggering. Please check the value labeled on the trigger box.

6.3 Trigger mode

There are six different acquisition modes. Four of them are external triggering modes:

1. AUTOTIGSTART_TIMERSTOP: internal triggering mode, the shutter opens for the selected exposure time, then closes, and opens again later for the next exposure.
2. CONTINUOUS: the shutter stays open, and the software chops the stream of hits in time slices of the set frame time.

3. PEXSTART_TIMERSTOP: external triggering mode, rising edge opens the shutter, closes after exposure time.
4. PEXSTART_NEXSTOP: external triggering mode, rising edge opens the shutter, falling edge closes the shutter.
5. NEXSTART_PEXSTOP: external triggering mode, falling edge opens the shutter, and rising edge closes the shutter.
6. NEXSTART_TIMERSTOP: external triggering mode, falling edge opens the shutter, closes after exposure time.

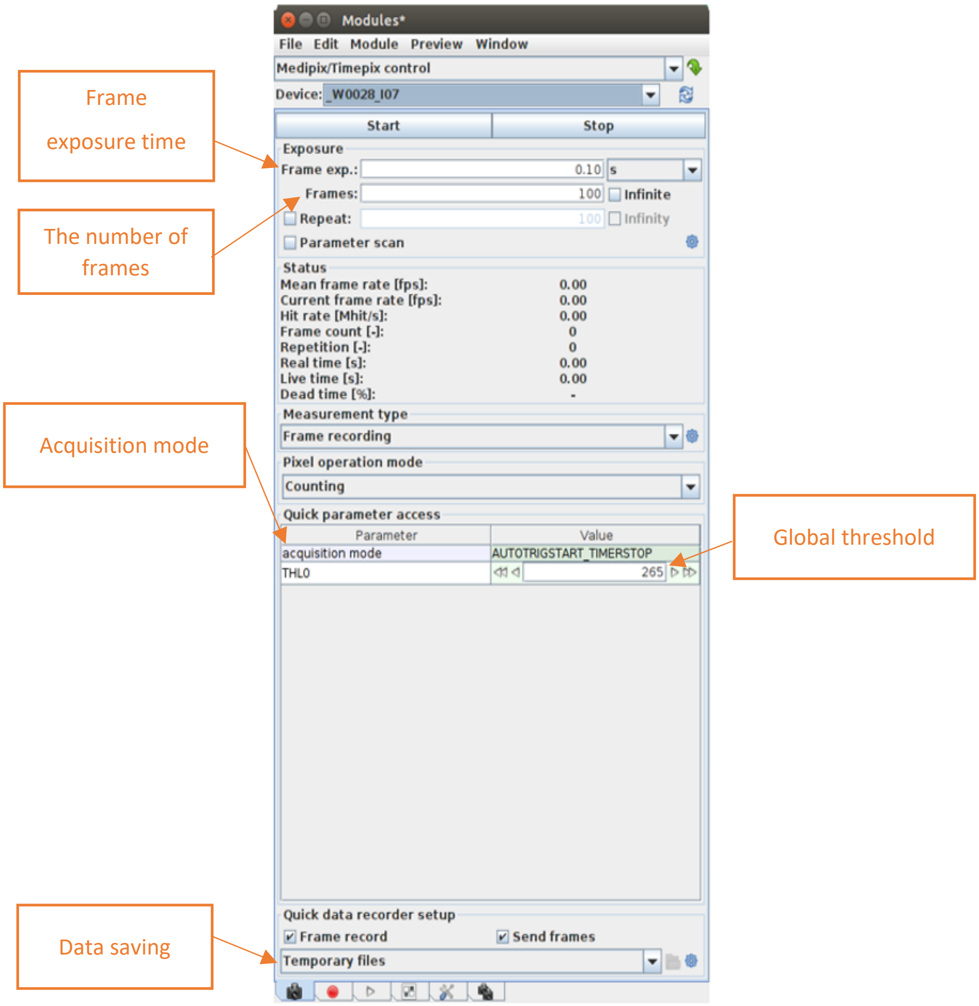


Figure 11. Setting to acquisition mode and frame exposure time

Be careful to set the shutter opening time, the period, and duty cycle of the external signal. The shutter opening time (Frame exposure time) should be shorter than the external signal period.

7 Global Time Extension and Data Synchronization

The chip data has a maximum timestamp value of 26.8435456 s, while the TDC data has a maximum value of 107.3741824 s. The timer will be initialized at the beginning of the acquisition. Both the TDC and the chip timestamps start at 0 s, but roll over independently once the maximum is reached. Normally, during data processing, the highest 2 bits of the TDC timestamps can be neglected. By doing this, the TDC timestamp will have the same maximum timestamp as the chip's. It will help to synchronize the TDC and the chip timestamps when time difference between them need to be calculated. For the detailed method, please check the ASI example codes.

Since both timestamps could roll over, an absolute global timestamp to track data acquisition time is hard to obtain. To overcome this, Sophy can be configured to generate so-called "heart-beat" global timestamps in the chip and TDC data stream, with a 48-bit depth and 25 ns time bin. It allows for continuous measurement lasting about 81 days.

To enable this function, go to **Edit**/**Preference** on the main panel (see Figure 12) and define the parameter **getTimerInterval** with a value in millisecond units. For example, a value of 1000 will allow the detector to generate a timestamp every second. Like the chip and the TDC timestamps, this global timestamp can be also extracted easily by using the ASI example codes.

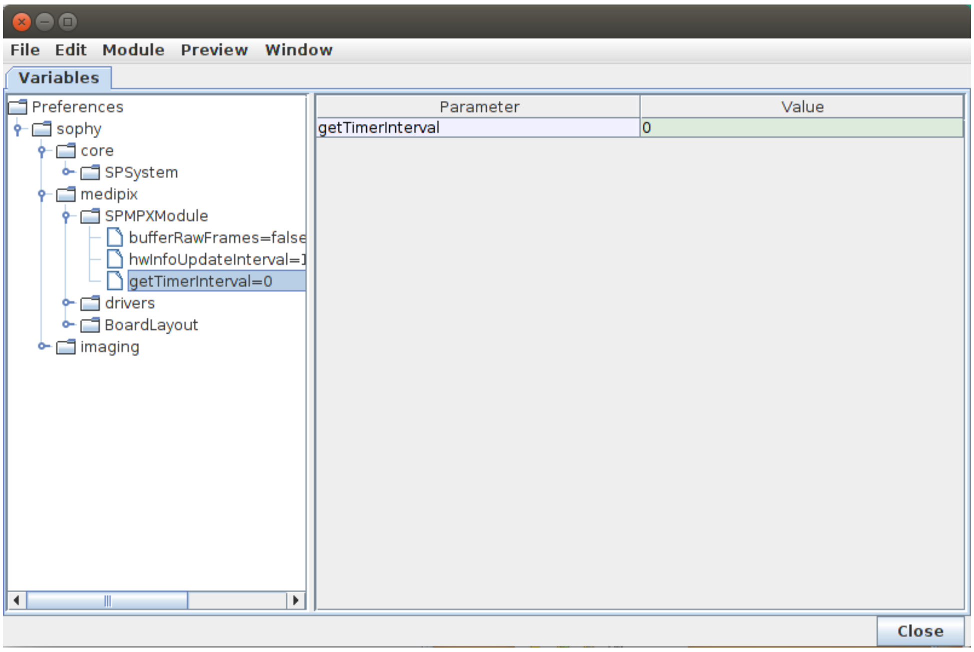


Figure 12. Setting for generating the global timestamp. (The unit is ms) If set 1000, it means every second, there is a global timestamp to be added to the raw data stream with a header "0x4".

8 Quick check on the TPX3CAM

Once hardware and software are set up correctly, you can do a quick check on the TPX3CAM detector. Since the TPX3CAM has a minimum threshold, it is hard to see the visible light signal only from the background in sophy preview screen, however, some high energy particles like cosmic rays, can be observed (see Figure 13). You can shine the detector via the lens by using a blue LED or a mobile flashlight. By doing this, you should see some pixels are illuminated in preview window in real time.

Save some raw data files (see Figure 4), and check illuminated pixels information, i.e. (X,Y, ToA, ToT) using ASI analytical program.

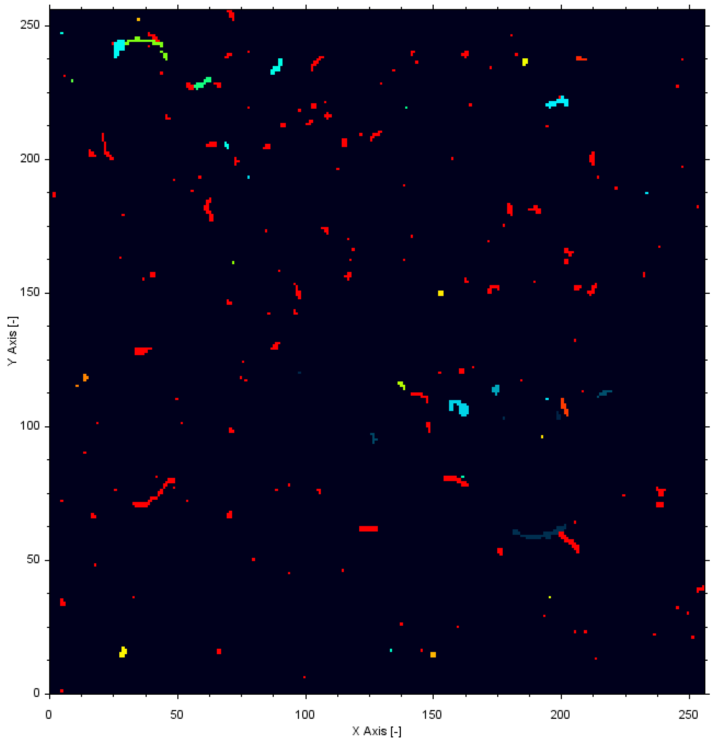


Figure 13. Cosmic rays in the background. The integral time is about 10 mins. The number of high energy particles in background depends on the location where the camera is used.

9 Using TPX3CAM with an Image Intensifier

You should receive an image intensifier with the TPX3CAM if you have ordered it from ASI as one packet. Before mounting the intensifier on the TPX3CAM, please read the manual of the intensifier carefully. Improper use could easily degrade its imaging performance or even damage it completely.

Don't shine LED light or mobile flash light directly to an image intensifier with the TPX3CAM. It can damage the intensifier!

When installing the intensifier and the lens to the detector, it is always better to lay the detector down like below, so that any dust from C-mount interfaces will not fall onto the sensor.

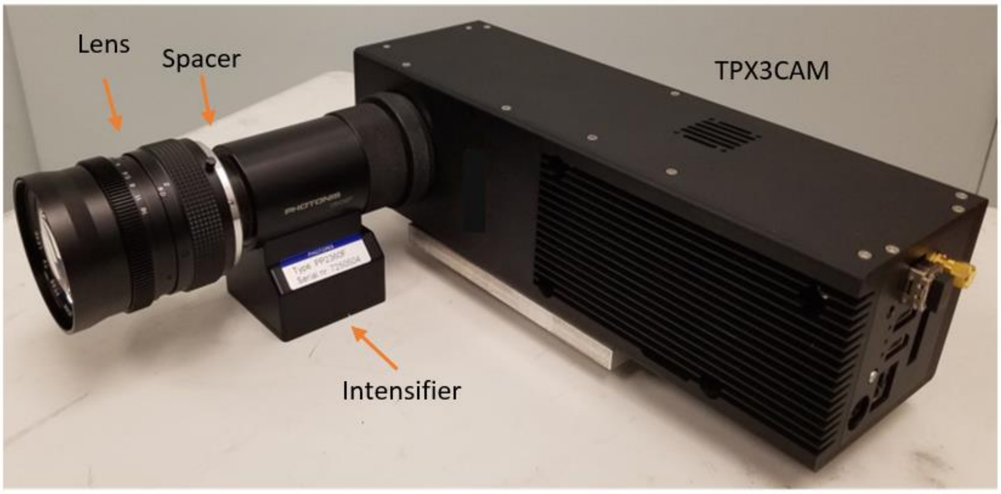


Figure 14. Combination of the TPX3CAM and the image intensifier with a lens.

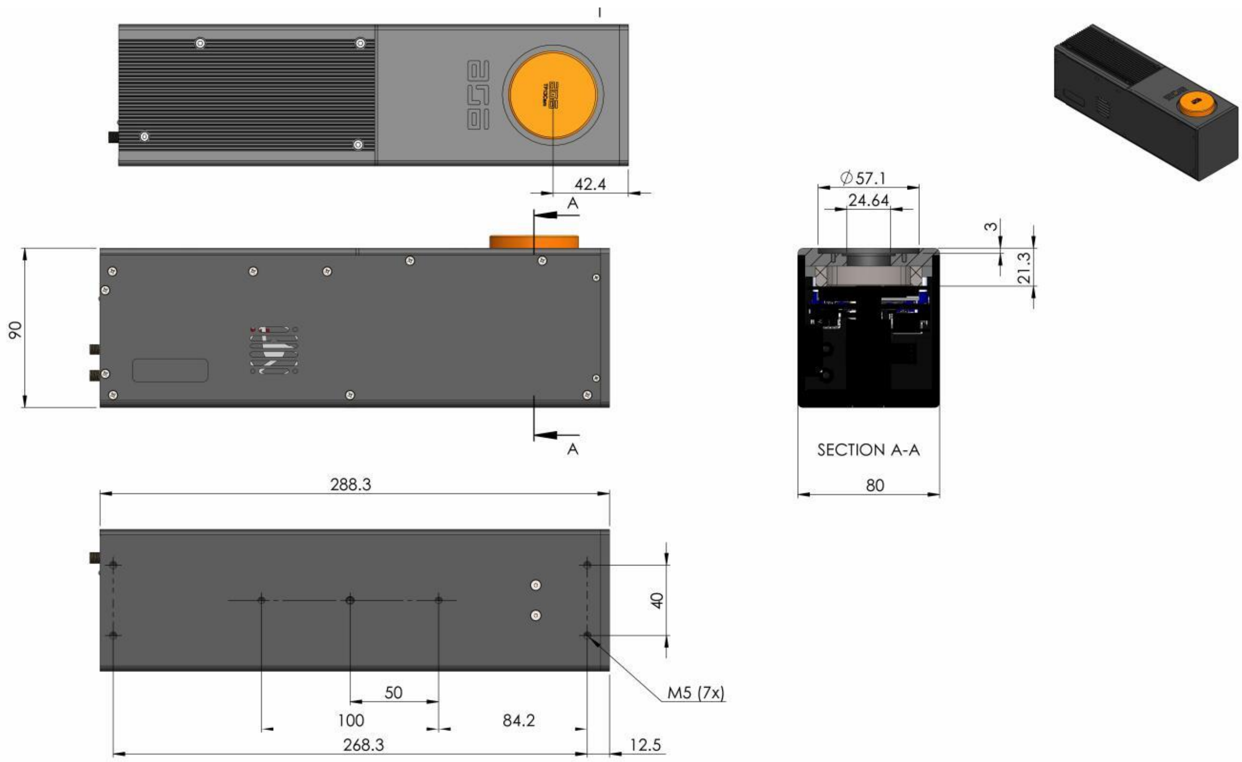
Unlike the TPX3CAM with ~ 1000 photons threshold at pixel level, the image intensifier is single-photon sensitive. Therefore, you should be always careful to operate it. The intensifier with the TPX3CAM should be put into a dark room or a special black box to prevent any over exposure from background light when it is powered on. We recommend keeping the cap on the intensifier or lens, and only remove it in a dark environment before the measurement starts.

10 Versions

Version	Date
V2.4	15.10.2021

Appendix A

Product dimensions for mounting



Specifications

Sensor	
Material	Silicon with enhanced light sensitivity
Wavelength range	400 – 1000 nm
Detection threshold (min.)	~ 1000 photons per pixel hit
Optics	
Sensor active area	14.1 x 14.1 mm^2
Type	C-mount
Imaging ASIC	
Type	Timepix3
Pixel pitch	55 µm
# of pixels	256 x 256
# of thresholds	1
Throughput	Up to 80 Mhits/s for 10 Gb/s ethernet Up to 15 Mhits/s for 1 Gb/s ethernet
Read-out dead time	Dead time zero, within allowed throughput
Time resolution	1.6 ns
Effective frame rate	> 500 MHz
Pixel hit dead time	~1 us
Read-out mode	Data driven Simultaneous position, time and intensify by per pixel, ToA and ToT detection
Other	
Computer interface	1 Gb/10 Gb Ethernet
External shutter control	Yes
External signal time stamping	260 ps
# of triggering modes	4
# of time-to-digital converter (TDC)	2
Weight	2.2 kg
Dimensions (length x width x height)	288 x 80 x 90 mm^3
Cooling	Air
Acquisition software	GUI for Windows/Linux/Mac
APIs	Yes

Appendix B

Raw Data File

There are four types of data in the raw .tpx3 data stream (little-endian):

1. Data chunk package, with information on "TPX3", mode, chip number and the number of data
2. 8-byte pixel hit information with header 0xb, the maximum timestamp is 26.8435456 s
3. 8-byte TDC time stamps data with header 0x6, the maximum timestamp is 107.3741824 s
4. 8-byte Global time stamps with header 0x4, the maximum is ~81 days.

The decoding of the specific information from the raw data is shown in the example codes (C++, Python, Matlab, Java, Igor pro, etc.) provided by ASI.

Table 5. Data packet header

63 - 48 bit	47 - 40 bit	39 - 32 bit	31 - 24 bit	23 - 16 bit	15 - 8 bit	7– 0 bit
Number of Bytes in chunk	Mode	Chip_Nr	"3"	"X"	"P"	"T"

Table 6. TDC data packet

63 - 56 bit	55 - 44 bit	43 - 9 bit	8 - 5 bit	4 – 0 bit
0x6	Trigger counter	Timestamp	Stamp	Reserved

Table 7. Pixel hit data packet

63 - 60 bit	59 - 44 bit	43 - 30 bit	29 - 20 bit	19 – 16 bit	15 – 0 bit
0xb	PixAddr	ToA	ToT	FToA	SPIDR time

In Table 5 :

"T", "P", "X" and **"3"** are char, and can be used to confirm this packet is a tpx3 data header;

Chip_Nr: is the chip number to show which chip the pixel data from. e.g. for quad chip detector, the chip nr. is 0, 1, 2, 3;

Mode: fixed value for data driven;

Number of Bytes in chunk: provides how much pixel data packets (64-bit or 8-Byte each) follow this header. Please refer to the example code showing how to extract this information;

In Table 6 :

Stamp: 4-bit (0x1 - 0xC) fine timestamp with a 260 ps time bin, while value 0 means a decoded error;

Timestamp: is 35-bit 320MHz timestamp with a 3.125 ns time bin. Therefore, the final TDC timestamp is combination of **Stamp** and **Timestamp**. The formula is: **TDC_timestamp** = **Stamp** + **Timestamp**;

Trigger counter: counts the number of TDC timestamps;

In Table 7 :

SPIDR time: has a unit 409.6 µs that is 25 ns * 2^{14}. The SPIDR time is provided by the readout board to extend the chip timestamp which is a limit of 14 bits with 25 ns bin;

FTOA: is a fine time stamp with 1.5625 ns (25 ns/ 2^4);

ToT: with a unit 25 ns. It is proportional to particle energy deposited in the pixel. Correlation and calibration are needed to obtain the **ToT** vs **Energy** relationship curves;

ToA: the unit is also 25 ns. The final pixel **Chip_ToA** should be combination **ToA** and **FToA**. The formula is: **Chip_ToA** = **ToA** – **FToA***1.5625 ns;

PixAddr: pixel coordinates. When a quad chip detector is used, have to combine **Chip Nr.** in Table 5 to determine the correct pixel coordinate. For specific conversion, please refer to the example conversion codes;

Image File

In Sophy, image files can be saved alone or together with raw data in TIFF (.tiff) format with the following specification limits: 256 x 256 pixels and 32-bit range.

It is possible to save .tiff files and raw data files simultaneously.

Appendix D

Maintenance

- When not in use, always keep the protective cap or the lens mounted on the detector. This prevents the detector sensor coming in contact with any dust and/or sharp objects.
- Store the detector in dry place at room temperature.
- Avoid dusty environments when installing the detector lens.
- If cleaning the detector is unavoidable, please contact ASI first.

About Amsterdam Scientific Instruments

Amsterdam Scientific Instruments B.V. (ASI) is a fast-growing high-tech company based at the Science Park in Amsterdam. The company was founded in 2011 as a spin-off of Nikhef, the National institute of particle physics, the NWO Institute for Subatomic Physics, and AMOLF, the NWO Institute for Physics of Functional Complex Matter.

ASI develops imaging detectors for X-rays, electron microscopy and mass spectroscopy. Our advanced imaging detectors differ in many ways from conventional detectors. For instance, our detectors can give continuous streams of photon hits with coordinates and nanosecond timestamping information instead of just frames.

Our hybrid pixel detectors are based on CERN's Timepix/Medipix technology and have been implemented by many leading research institutes worldwide. It is our absolute goal to deliver and continue developing high-performance, high-quality detection and imaging products for and also with our clients.

Making the Invisible Visible is not only about technology. As a small company we are close to our clients and offer support and expertise so they will make optimal use of our products.