

Accos User manual

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1. Accos (TPX3CAM and CheeTah user interface) Guide

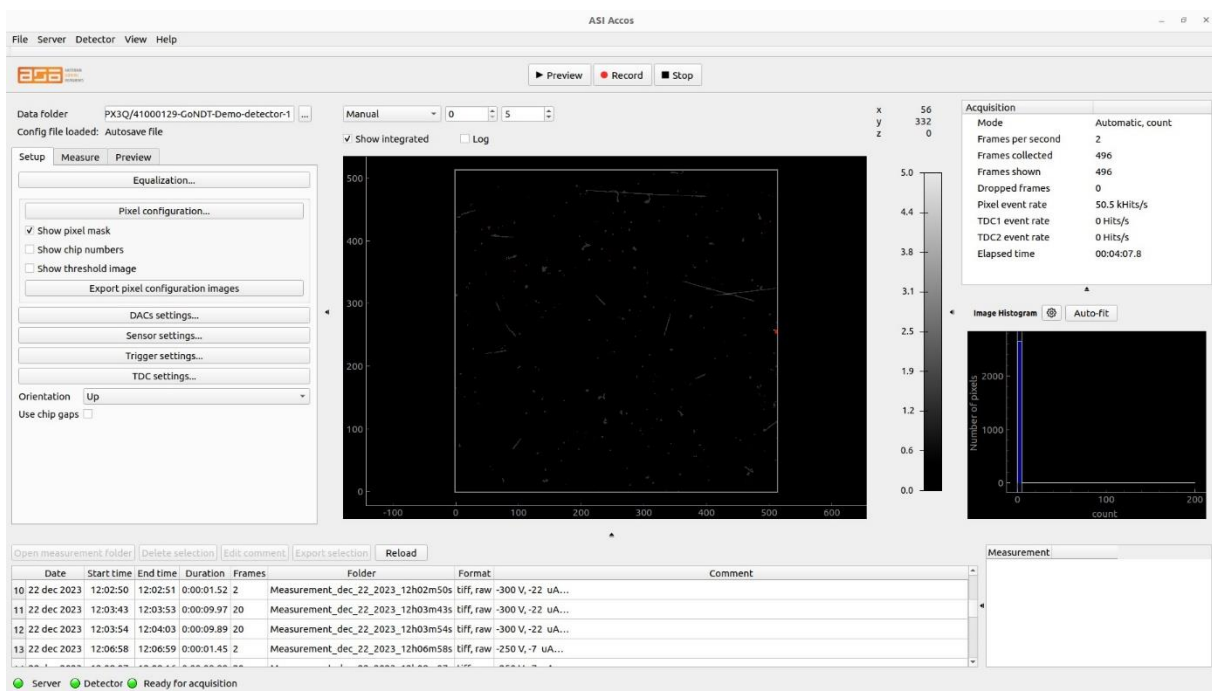
Accos is a powerful tool used for acquiring and displaying data from ASI cameras. To start using Accos, follow these steps:

- Before starting the software, check that the power and data cables are properly connected and that network settings are set according to the description in the hardware manual.
- Once all cables are connected, switch on the detector. (Note: some cameras do not have a power button, but will switch on automatically when the power is connected.)
- Locate and launch the "Accos" program, which can be identified by its distinct icon.  It is usually located on the desktop or in the start menu on the left side of the screen.
- Upon launching Accos, the main control window will appear. Please note that the layout may vary depending on the version of the software you are using. Refer to Figure 1 for a sample layout of the main control window.
- You can customize the size of each panel by dragging its borders. Additionally, some panels contain multiple items that can be adjusted relative to one another. This allows you to further customize the layout of the control window to suit your needs.

Important Note: Prior to using the Accos, it is recommended to read the user manual thoroughly to gain a comprehensive understanding of its features and functionality. Additionally, ensure that all hardware components are installed and configured correctly. Any technical issues or troubleshooting can be addressed by referring to the user manual or contacting customer support.

2. Main view

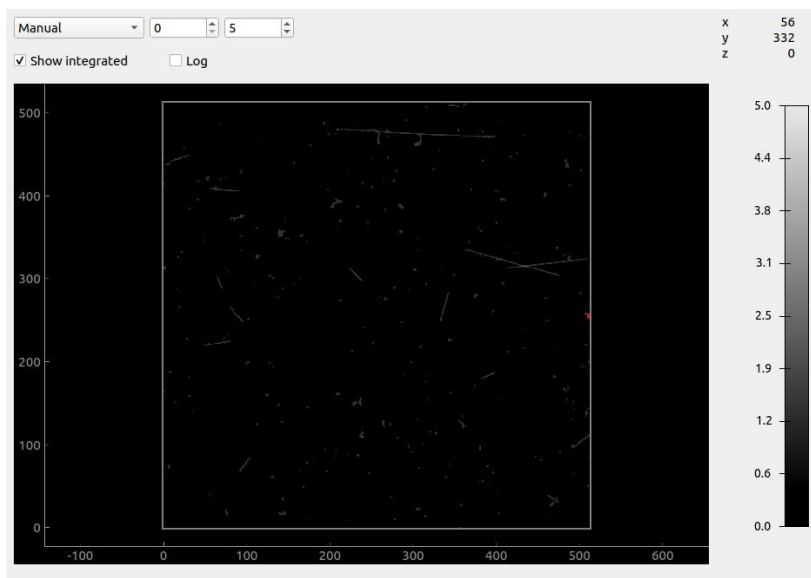
Accos features an interface that is comprised of several key components, including:



- **Image display window:** Located in the center of the control window, this displays the acquired data in real-time.

- **Settings panel:** Located on the left-hand side of the control window. This is where you configure the settings of the detector, such as the exposure time, frame rate, etc.
- **Acquisition control buttons:** Located in the top bar of the control window. Use these to start, stop, or pause the acquisition.
- **Current acquisition information:** Displayed in the top right-hand corner of the control window. This shows the current status of the acquisition, including the elapsed time, remaining time, and the number of frames acquired.
- **Histograms:** Located in the right-hand panel. The histogram has a configurable data display, showing either the grayscale values or time of flight (ToF) data in real-time (for Timepix3 based cameras).
- **Saved measurements:** Located in the bottom panel, this displays the measurements contained within the current data folder.
- **Toolbar menu:** Located at the top of the control window. Several general settings are available here.
- **Bottom toolbar:** Displays the status of the server, detector, and acquisition.

2.1 Image display (preview)



The image display window is the central component of the Accos interface. It displays the preview image in real-time, allowing you to monitor the acquisition progress and adjust the settings as needed. The scale can be adjusted using the controls located above the image. These controls allow you to set the range, which determines how the pixel values are displayed. There are four options available:

- **Full:** This option uses the full dynamic range of the image.
- **Auto range:** This option automatically adjusts the range of the current image. This means that the pixel values are scaled to fit the current data, ensuring that the full range of data is displayed on the screen.
- **Manual:** This option allows you to manually select the boundaries. You can adjust the minimum and maximum values to display a specific range of pixel values, giving you greater control over how the data is displayed.
- **Percentile:** This option allows you to manually select the boundaries as a fraction of the full dynamic range. You can adjust the minimum and maximum values as a percentage of the full range of pixel values, allowing you to display a specific range of values and exclude outliers.

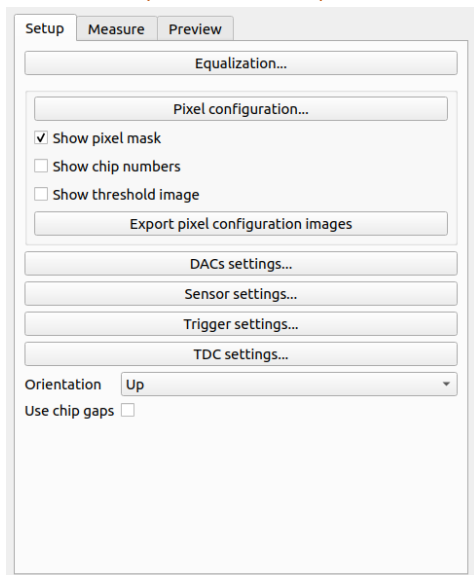
The color scale bar is located on the right-hand side of the preview image. It shows the range of colors used to represent the pixel values in the data. The colormap can be changed by clicking on the color scale bar. This allows you to choose from a variety of different color maps, each of which emphasizes different aspects of the data.

2.2 Settings

In this panel, the acquisition parameters are set. At the top of the panel, the data folder is set. For each measurement, a subfolder will be made in the data folder. All other settings are contained within the 3 tabs **Setup**, **Measure** and **Preview**.

In general, the acquisition will start by first adjusting the settings in the Setup tab in the left panel, and then moving to the Measure tab for taking the data.

2.3 Left panel – Setup



The left panel's first tab is **Setup**. This contains buttons that guide the user to different setting windows:

➤ **Equalization**

The equalization procedure is a calibration that is aimed at getting a threshold that is as close to the noise as possible for each pixel. It is a critical procedure that optimizes the per-pixel logic of the chip to account for pixel-to-pixel variation during production. All cameras are calibrated at production, with the result stored in a configuration file (.bpc). It is usually not required to repeat this procedure. Re-calibration should only be done upon instruction from an ASI engineer.

➤ **Pixel configuration**

In the pixel configuration window, the calibration file resulting from the equalization procedure (.bpc file) is set. In addition, pixels can be masked (turned off) from this window.

Pixels may be either masked through their configuration contained within the .bpc file, or from a pixel mask image. The pixel mask image provides a simple way to mask larger regions of the detector image plane. The pixel mask image should be a 2D image file in either PNG or TIFF format, with dimensions that match the detector image size, which can be 256x256, 512x512, 256x1024 or 1024x1024. Pixels in the mask image with luminance value of 0 and alpha value of 255 (i.e. black

pixels) are masked. Note that the pixel mask source should be set to 'Pixel mask image' for this setting to take effect.

- **Show pixel mask:** this option allows the user to display the selected pixel mask image on the detector image plane. This is helpful for visualizing and verifying pixels or areas that have been masked.
- **Show chip number:** This option enables the display of the chip number of the current pixel. This can be useful in cases where the pixel array consists of multiple chips, allowing the user to easily identify which chip a given pixel belongs to. When this option is enabled, the chip number is displayed as an overlay on top of the image.
- **Show threshold image:** This option allows the user to display the threshold level set to each pixel. It can be used to confirm that a proper pixel configuration (.bpc file) has been used. A random color distribution should appear as an overlay of the image.

The option 'Export pixel configuration image' produces files with the pixel mask and threshold image(s).

➤ **DACs settings**

The camera uses digital to analog converters (DACs) on the chip to establish voltage levels for various functions, such as sensor bias voltage, discriminator threshold, and pulse height calibration. The DAC settings are contained within a calibration file (.dacs file). Note that these settings will influence the operation of the chip and should generally not be changed from their factory settings.

The option 'Advanced view' or 'Simple view' allows the user to toggle off the settings that are typically not changed. The threshold level may be adjusted to change the sensitivity to low energy interactions or to decrease noise.

➤ **Sensor settings**

This tab allows users to adjust two key settings related to the sensor

- **Bias Voltage:** For the TPX3CAM, it is advised to set the bias voltage at either 40 or 100V. For special sensor types, other voltages may be required. Utilizing higher voltages may cause an increase in leakage current for the light-sensitivity enhanced sensors, leading to higher noise levels. It is advised to adjust the bias voltage only upon consultation with an ASI engineer.
- **80Mhits/s:** this setting should be switched on to allow the maximum hit rate for the Timepix3CAM.

➤ **Trigger settings**

This allows users to adjust settings related to the trigger mode, the number of frames and exposure time. Users are advised to refer to the trigger setting manual to ensure proper configuration.

➤ **TDC settings**

The Timepix3CAM and some versions of the CheeTah contains two on-board time-to-digital converters, which offer high resolution and low jitter timestamps of external signals. The TDCs can be individually enabled or disabled and can be set to trigger on the rising or falling edge of a signal, or both.

➤ **Camera orientation**

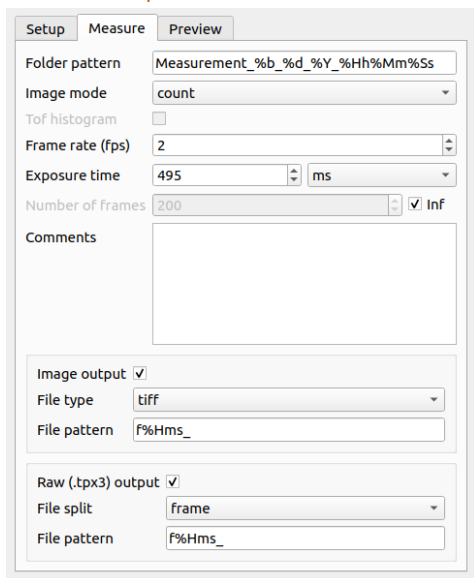
This feature in Accos allows users to choose the orientation of their camera. The available options includes Left, Right, Up and Down. Selecting the correct orientation ensures that the acquired images are properly oriented and easy to interpret.

➤ **Use chip gap**

When a camera with multiple ASICs is used (such as for the quad modules), there is a region between the chips where no pixels are present. This region is either 2 or 4 pixels, depending on the sensor used. Please consult the hardware manual for the specifications of the sensor. For the CheeTah1M camera type, a calibration file containing the chip locations is set (see 'Advanced settings' in the top toolbar).

If the chip gap feature is enabled, the location of the pixels is corrected by inserting empty rows of pixels in the image. For instance, if a quad system with 2 pixel gap is used, the resulting image will be extended from 512x512 to 514x514 pixels.

2.4 Left panel – Measure



The screenshot shows the 'Measure' tab in the Accos software interface. It contains several configuration options:

- Folder pattern:** A text field with the value 'Measurement_%b_%d_%Y_%H%Mm%Ss'.
- Image mode:** A dropdown menu set to 'count'.
- ToF histogram:** An unchecked checkbox.
- Frame rate (fps):** A dropdown menu set to '2'.
- Exposure time:** A text field with '495' and a unit dropdown set to 'ms'.
- Number of frames:** A text field with '200' and a checkbox for 'Inf' which is checked.
- Comments:** A large text area for entering notes.
- Image output:** A checked checkbox.
- File type:** A dropdown menu set to 'tiff'.
- File pattern:** A text field with 'f%Hms_'.
- Raw (.tpx3) output:** A checked checkbox.
- File split:** A dropdown menu set to 'frame'.
- File pattern:** A text field with 'f%Hms_'.

The left panel in Accos contains several tabs, one of which is the Measure tab. This tab allows users to adjust the settings of the measurement they wish to run. A measurement is created by pressing the record and stop buttons, and each measurement generates a folder containing all the collected data. By default, the measurement folder names include a timestamp based on the % notation, but users can also choose their own name instead. In this case, a number will be appended, so that each measurement has a unique folder name.

All measurements are saved as sub-folders of the base folder selected above the tab layout. Any comments made about a measurement will be saved as a .txt file within the measurement folder. Users can modify comments before or during measurement using the text box provided or update comments later by using the Measurements overview feature.

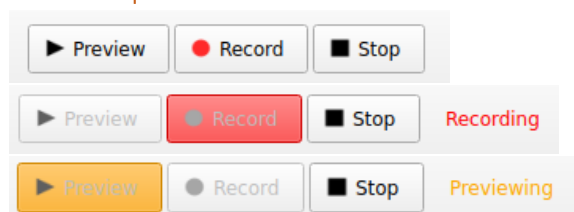
In addition to the comment, all settings relevant to the acquisition will be saved in a .json format within the measurement folder.

Users can choose to save their output data in different formats. The two available options are.

1. Image output.
2. Raw (.tpx3) output (Timepix3 based systems only).

The image output visualizes the measurement data, while the raw output is a binary file format that contains the pixel packet data with pixel coordinates, timestamp and time-over-threshold. Please consult the Serval API manual for a detailed description of the binary .tpx3 data format.

2.5 Acquisition controls



The acquisition controls can be found in the top bar of the Accos interface. The three buttons displayed in this section are Preview, Record, and Stop.

The Preview button allows the user to view the acquired frames without saving any data to disk. This mode is useful for quickly checking the quality of the acquisition setup and for adjusting the settings to achieve the desired outcome. The preview image can be seen in the central display of the Accos interface.

The Record button, when clicked, enables the software to start storing data on disk as per the settings specified in the Measure tab. This mode should be selected when the user is ready to capture the required data.

The Stop button is used to terminate the current acquisition. Note that the acquisition will automatically stop when the number of frames set in the Measure tab is reached.

2.6 Acquisition information

Acquisition	
Mode	Automatic, count
Frames per second	2
Frames collected	496
Frames shown	496
Dropped frames	0
Pixel event rate	50.5 kHits/s
TDC1 event rate	0 Hits/s
TDC2 event rate	0 Hits/s
Elapsed time	00:04:07.8

The top right panel of the user interface displays important information regarding the current acquisition. This information includes details such as the measurement time, the number of frames acquired, and the time elapsed since the start of the measurement and dropped frames. These details can be essential in evaluating the quality of the data being collected and in identifying any issues that may arise during the acquisition process. The acquisition information panel provides real-time feedback on the current acquisition, allowing users to monitor and adjust the acquisition settings as needed to ensure the highest quality data is collected.

2.7 Measurements overview

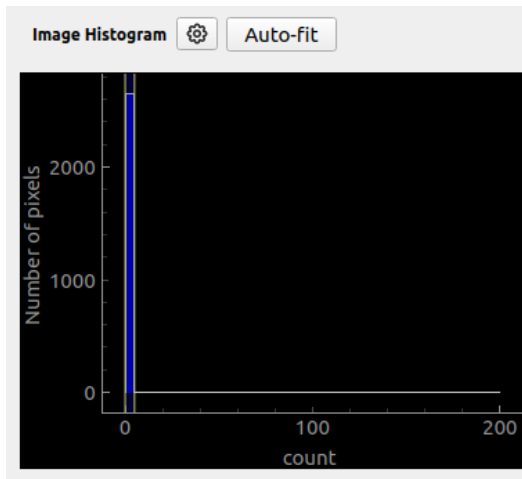
Open measurement folder Delete selection Edit comment Export selection Reload									
	Start date	Start time	End time	Duration	Frames	Folder	Pattern	Type [mode]	Comment
4	24 sep 2020	14:00:46	14:00:47	0:00:00.89	51	Measurement_sep_24_2020_14h00m46s	f%Hms_, f%Hms_	tiff [tot], tpx3	
5	24 sep 2020	14:17:23	14:17:25	0:00:02.02	193	Measurement_sep_24_2020_14h17m23s	f%Hms_, f%Hms_	tiff [tot], tpx3	

In Accos, the bottom panel displays a list of all the measurements contained within the selected data folder, which can be chosen from the dropdown menu located at the top left of the panel. One or more measurements can be selected from the list. The buttons located at the bottom of the panel provide the following options:

- **Open measurement folder:** This option allows the user to open a file browser at the location of the selected measurement, providing quick access to the measurement's raw data.
 - **Delete selection:** This option allows the user to delete all the data associated with the selected measurement(s) from the data folder. It should be used with caution as the deleted data cannot be recovered. Note that it will take a few seconds to delete large data sets, during which time Accos is not responsive.
 - **Edit comment:** This option allows the user to edit the comment associated with the selected measurement. The comment can also be edited by double-clicking the comment text box. It is important to note that to see the updated comment in the display, the user must click the Reload button.
 - **Export selection:** This option allows the user to export the displayed meta-data of the current selection to a .json or .csv file format, which can be read by Excel. This feature can be useful for sharing measurement data or for further data analysis.
 - **Reload:** This option allows the user to refresh the measurement information of the current data folder, which is especially useful when changes have been made to the data folder outside of Accos.
- The view on the bottom right of the Accos interface provides detailed information on the currently selected measurement, such as the measurement ID, acquisition time, number of events, and comments. This information is useful for tracking and organizing measurement data.

Measurement	5
Stop time	14:17:25
Stop date time	2020-09-24T14:17:25.706241
Start time	14:17:23
Start date time	2020-09-24T14:17:23.686084
Start date	24 sep 2020
Number of frames	193

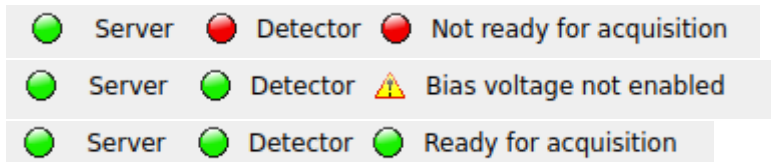
2.8 Image histogram



The panel on the right-hand side of the software interface displays a histogram that shows the distribution of intensity values in the currently displayed image. This histogram is similar to the brightness histogram found in image editing software like Photoshop. The blue shading in the histogram represents the range of colors in the displayed image. This range can be adjusted by clicking and dragging the borders of the blue area.

When you right-click on the image, a menu with various options appears. This menu allows you to adjust settings related to the display of the image, such as zooming in or out, adjusting the color scale, and changing the color map.

2.9 Status information



The lower-left section of the Accos interface displays the system's status indicators that indicate whether it is ready for the acquisition process. There are three different status indicators that can be seen in this section.

The first one is for the server state, which shows whether the server (Serval) is currently connected and functioning correctly.

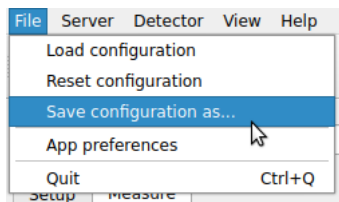
The second indicator is for the detector, which shows if it is properly connected and communicating with the software.

The third and last indicator is for the validation of the settings, which indicates whether the current settings for the measurement are valid and ready for acquisition.

A system that is ready for acquisition should show a green light for all three states. Relevant settings can be quickly accessed by clicking on the status indicator.

3. Toolbar menu

3.1 File menu

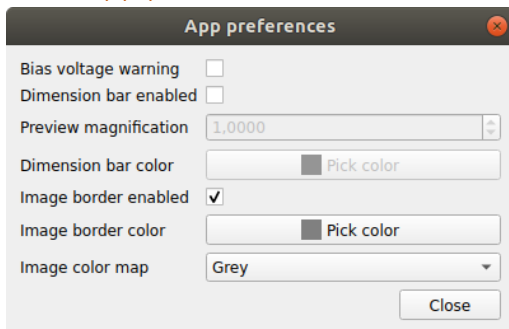


The file menu in Accos allows users to store or load the current configuration of the software. This means that the settings used during the last session of Accos will be automatically loaded when the software is started. This feature can save time and make it easier for users to resume their work without having to manually set up the software every time they use it.

By default, all settings are retained when Accos is shut down and restarted. The user can go back to the default settings by choosing the “Reset configuration” option.

The **App preferences** window can be accessed from this menu.

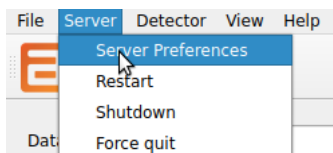
3.2 App preferences



The App preferences window in Accos contains various settings related to the displayed functionality of the software. Here are some of the settings that can be adjusted in this window:

- **Bias voltage warning:** This setting can be enabled to receive a warning in the bottom status bar if the bias voltage is not enabled or is too low. This can help prevent data acquisition issues due to incorrect voltage settings.
- **Dimension bar:** When enabled, this setting displays a bar on the preview image that indicates the size of the object in the image. This can be useful for measurement and analysis purposes.
- **Image border:** Enabling this setting will show a border around the preview image. This can make it easier to differentiate between the preview image and other elements on the screen.
- **Color map:** This setting adjusts the color map used in the preview image. Different color maps can be used to highlight different aspects of the image or to make it easier to distinguish between different features.

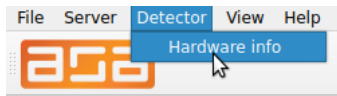
3.3 Server menu



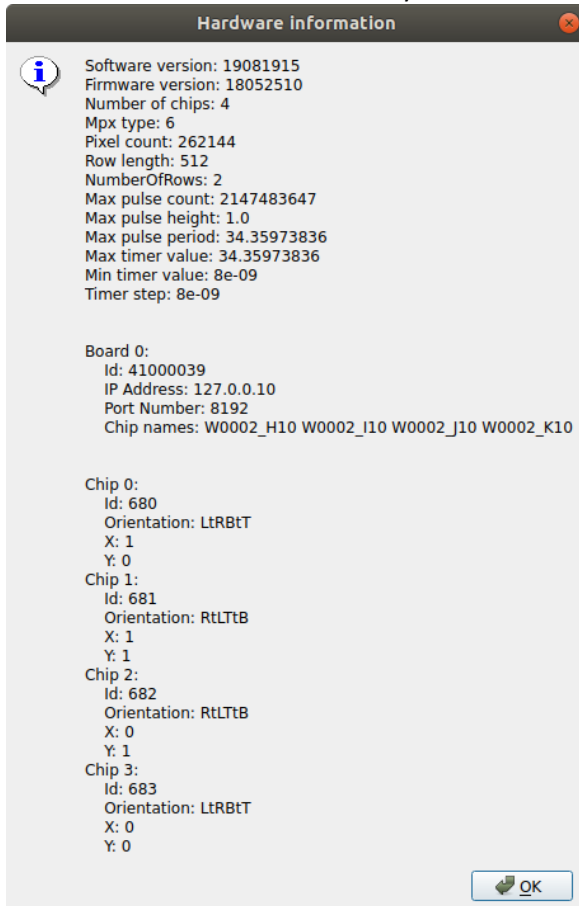
The "Serval" process is an integral part of Accos that enables communication with the detector and controls its operations. It is started automatically when Accos is launched. However, in some cases, it may be necessary to control the Serval process manually, such as when there are issues with the

communication between the software and the detector. The menu bar provides options to manage the Serval process, such as starting, stopping, and restarting it as required.

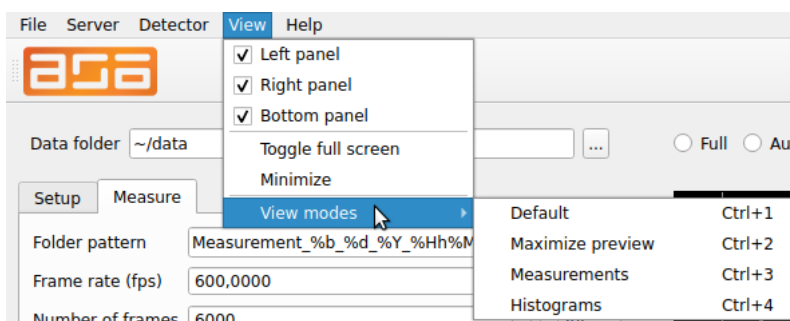
3.4 Detector menu – Hardware info



In Accos, the hardware information of the detector can be accessed from the Detector menu. This option provides detailed information about the chips and readout electronics currently in use. The information includes the type and version of the chips, the firmware version, and the operational status of the detector. The hardware info menu is helpful in troubleshooting issues related to the detector and to ensure that the system is working properly.

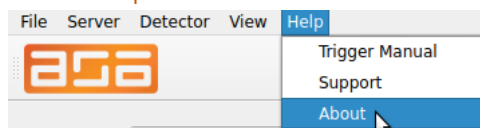


3.5 View menu



Some of the options available in the View menu include toggling the visibility of different panels, resizing panels, resetting panel positions, and changing the overall layout of the software.

3.6 Help menu



Accos has a built-in help menu that provides users with useful information, manuals, and support options. The help menu can be accessed by clicking on the designated button on the main menu bar. The information available on the help menu includes details about Accos and its functionalities. Users can also find manuals that provide step-by-step guidance on how to use Accos effectively. Additionally, there are support options available to users, such as contacting the support team for technical assistance.

The help menu is an essential tool for users who need assistance with any aspect of Accos. It provides comprehensive information and support, ensuring that users can navigate and use Accos efficiently.

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