



TDC Software user guide

TDC Software commit: 7e11ca35

Felix Firmware commit: 7ea0505c

Installation

Download and install the software from our [website](#); it is available for Linux (Flatpak) or Windows (.exe installer).

Device detect and connection

Upon connecting Tediell's time taggers to you PC, the device image appears together with information regarding the communication link and the device's serial number.



Figure 1: Connection view





Click on “Connect” to open the device.

A successful connection spawns a green “Connected” pop-up, as well as the modules available for the device.

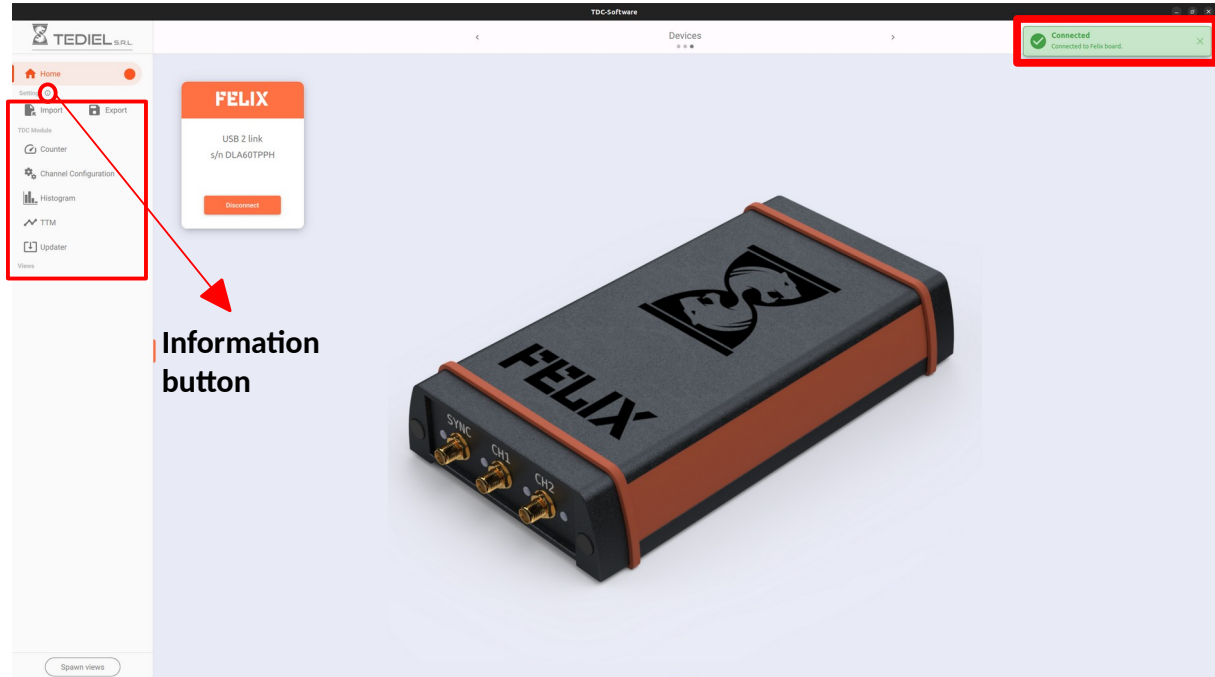



Figure 2: Device connected and modules loaded

Information regarding the firmware/software versions is shown upon clicking on the information button .

TDCSoftware and C++ libraries version			
TDCSoftware	0.8.0 (Version built by gitlab-runner-debian13 at 2025-09-12 18:49:36 CEST)		
libTDC	1.18.4.6 (Version v1.18.4-6-gf764a68 built by gitlab-runner-debian13 at 2025-09-12 10:49:36 CEST)		
libGA	1.2.6.55 (Version v1.2.6-55-gd1794cf built by gitlab-runner-debian13 at 2025-09-12 18:49:36 CEST)		
TDCModules version			
Counter	Frontend: 3.0.0	Backend: v3.0.0	Firmware: v3.10.12
Channel Configuration	Frontend: 1.0.0	Backend: v1.0.0	Firmware: v1.0.0
Histogram	Frontend: 11.0.0	Backend: v11.0.0	Firmware: v11.1.2
TTM	Frontend: 2.0.0	Backend: v2.0.0	Firmware: v2.2.12
Updater	Frontend: 4.0.0	Backend: v4.0.0	Firmware: v4.4.4
Firmware informations			
Compile time	2025-09-12 09:59:36 CEST		
Name	CI/CD automatic build		
Repo	felix_firmware		
Hash	ec3b5e71ce89a4be526a56b6b49f348191a77f []		
Branch	vivado_2025_1		

Figure 3: Information on software and firmware versions



The available modules (based on license) are:

- Counter
- Channel configuration
- Histogram (optional)
- Time Tagging Module (TTM)
- Updater

Counter module

The “counter” modules show 3 different information for each input channel:

- **Input event rate**, which refers to the input rate of events on the channel SMA that overcome the channel threshold voltage
- **Processed event rate**, which refers to the rate of processed events per channel
- A **time trace** representing the event count rate (both Input and Processed events) occurred in the last 15 seconds

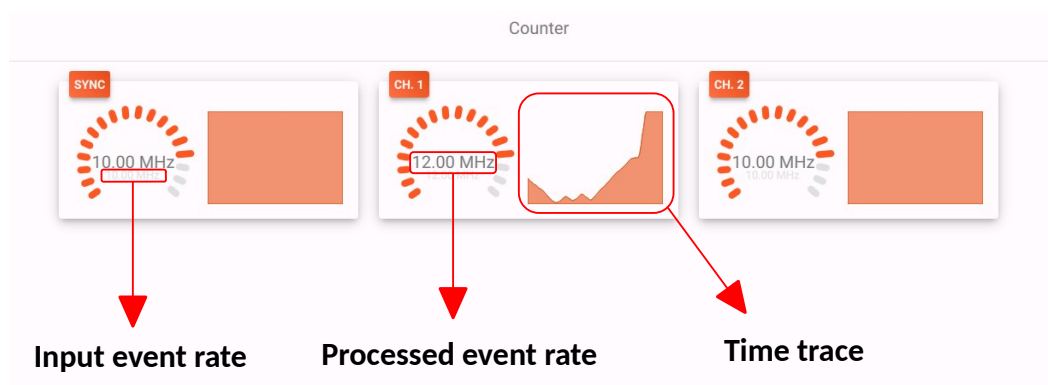


Figure 4: Counter details




Channel configuration


The “channel configuration” module allows the user to configure the parameters of each input channel. The available parameters are:

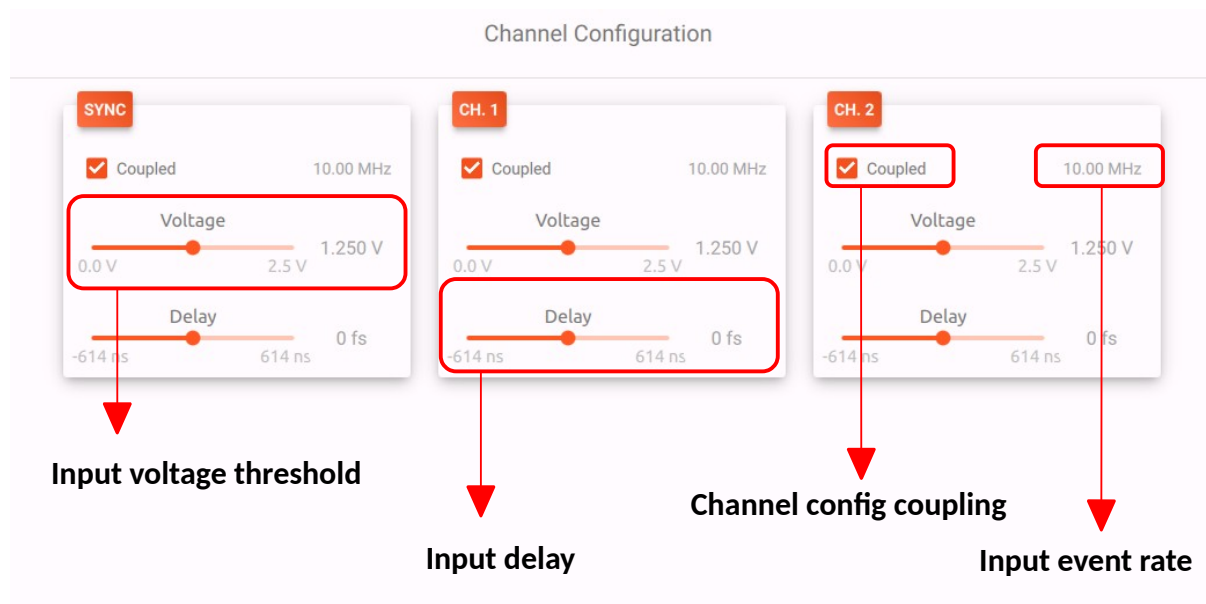
- **Input Voltage Threshold:** sets the voltage of the input comparator for leading edge discrimination, range is 0 – 2.5 V. Use either the text box or the slider.
- **Virtual channel delay:** sets an input virtual delay to the channel, useful to compensate trace or cable delays. Range is -614 ns to +614 ns. Use either the text box or the slider. Right click and drag to fine-tune the delay

The channels can be “**coupled**” to apply the same configuration to all the selected channels.

This view also shows the input event rate, to facilitate the configuration.

- **Threshold auto-tuning**  : this useful feature scans the inputs looking for the optimal threshold level, and sets it.

A **list view**  is also available to compact the visualization of the configuration of all channels.



The screenshot displays the 'Channel Configuration' interface with three channels: SYNC, CH. 1, and CH. 2. Each channel has a 'Coupled' checkbox checked and an event rate of 10.00 MHz. The 'Voltage' slider is set to 1.250 V (range 0.0 V to 2.5 V) and the 'Delay' slider is set to 0 fs (range -614 ns to 614 ns). Red boxes highlight the 'Coupled' checkbox and the event rate for CH. 2. Red arrows point from the 'Voltage' slider of the SYNC channel to the label 'Input voltage threshold', from the 'Delay' slider of CH. 1 to 'Input delay', from the 'Coupled' checkbox of CH. 2 to 'Channel config coupling', and from the event rate of CH. 2 to 'Input event rate'.

Figure 5: Channel configuration grid view





Channel Configuration						
<input type="checkbox"/>	Name	Voltage	Counts	Chart	Delay	
<input type="checkbox"/>	Sync	0.0 V 2.5 V 1.250 V	10.00 MHz		-614 ns 614 ns 0 fs	
<input type="checkbox"/>	Channel 1	0.0 V 2.5 V 1.250 V	10.00 MHz		-614 ns 614 ns 0 fs	
<input type="checkbox"/>	Channel 2	0.0 V 2.5 V 1.250 V	10.00 MHz		-614 ns 614 ns 0 fs	

Figure 6: Channel configuration list view

Histogram

The Histogram module(s) are hardware processing modules designed to calculate and accumulate time differences between events occurring on the selected Reference and Measurement channels.

This operation is performed at the highest rate the channels can register incoming events (e.g. 80 Msample/s per channel), and the result is accumulated on a histogram.

Histograms have a fixed number of “bins” onto which they accumulate the time differences.

The histogram module is started by the “**Enable**” toggle and can be widely configured to match the user needs:

- **Channel selection:** the user selects what edge of what channel is used for Meas and Ref (Sync can only be used as Ref, rising edge only)
- **Bounds:** left and right bounds can be configured in the range -322 ms to +322 ms; the **Bin Width** can be set to change to the minimum that allows to reach the selected range
- **Configuration:** allows the selection of
 - **Refresh time**, that allows to modify the visualization refresh time (> 1 ms)





- **Multi-hit:** computes and accumulates one (**not selected**) or multiple (**if selected**) Meas events per Reference occurring in the selected range.

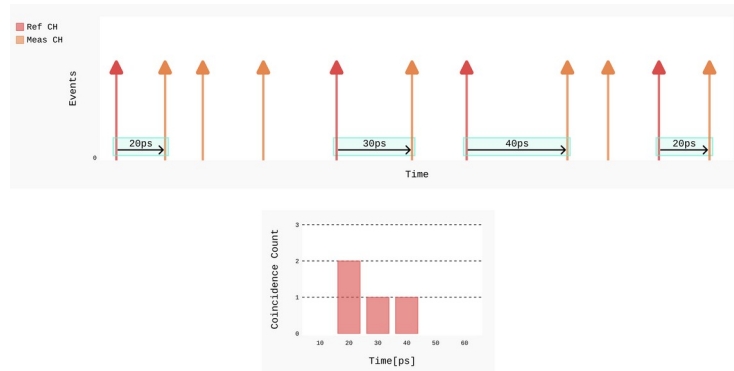


Figure 7: Single hit histogramming process

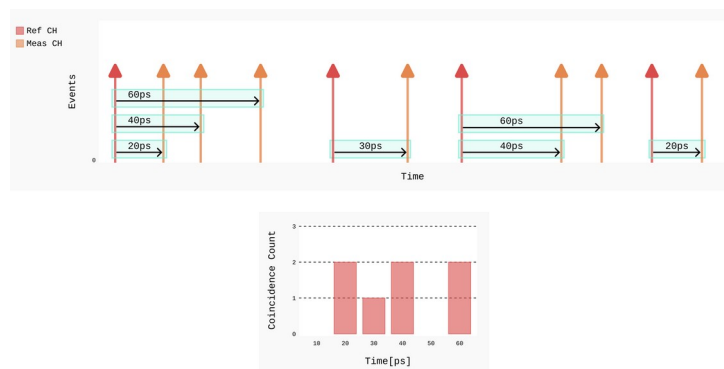


Figure 8: Multihit histogramming process

- **Accumulate:** if selected, the computed histogram is accumulated until manually stopped. If unselected, the histogram is reset every Refresh time.

By clicking on a histogram preview the user can create a new **ChartView**, or add it to an existing one, for better visualization of both the histogram and some computed characteristics. A further, advanced method to acquire histograms is by using the **Time Trigger** functionality.



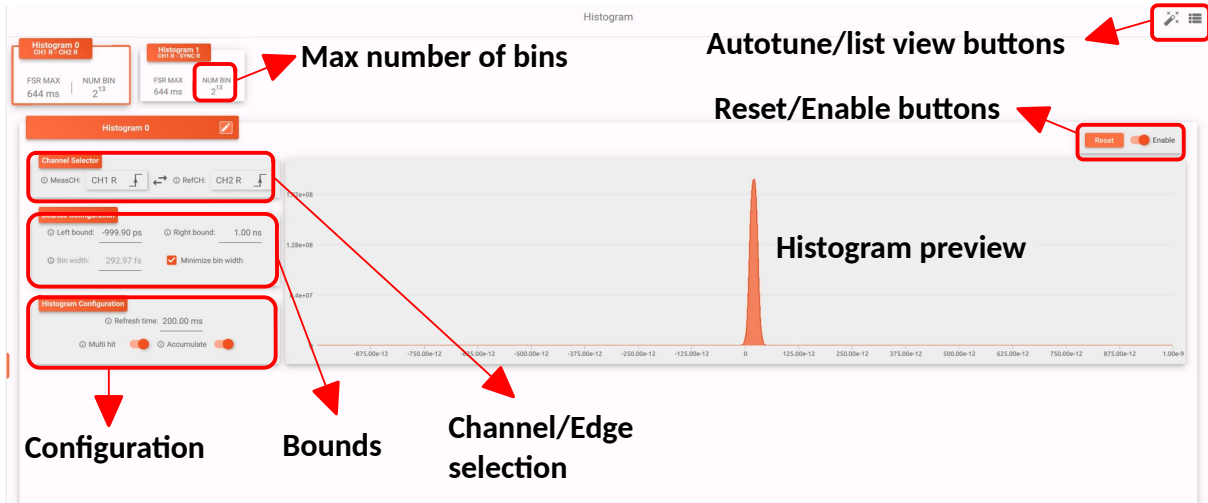


Figure 9: Histogram configuration view

Just like Channel Configuration, histograms can be viewed and configured from a list view, with the option of copying the same configuration to other histogram instances or to select and apply the same parameters to multiple histograms.

<input type="checkbox"/>	Name	Enable	Mess. CH	Ref. CH	Left Bound	Bin Width	Right Bound	Refresh T	Multi Hit	Accum	Chart
<input type="checkbox"/>	Histogram 0	<input type="checkbox"/>	CH1 R	CH2 R	-999.90 ps	292.97 fs	1.00 ns	200.00 ms	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	Histogram 1	<input type="checkbox"/>	CH1 R	SYNC R	-999.98 ps	292.97 fs	999.98 ps	200.00 ms	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Figure 10: Histogram list view

The autotuning feature allows the user to look for either coincidence peaks or non-zero bins, in the currently selected range or starting from the maximum available range.

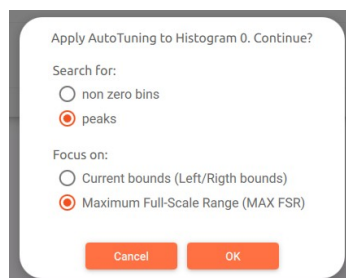


Figure 11: Histogram autotuning options





Time Tagging Module (TTM)

Using time tagging module (TTM) is the most straightforward way to obtain data from TediEl's Time Taggers: the timestamps are directly sent to the host PC and stored in a file for offline processing.

On Felix, you can reach lossless data transmission rate to the PC up to 11 Msample/s.

The configuration window allows to tune several parameters to obtain the desired data:

- **Channel selection**, to select the channel and edges only for the desired events
- **Format selection**: choose either text (csv) or binary formats. Binary reaches higher throughput and can be easily converted
- **Destination file**: choose where to save your TTM file and its name.
- **Acquisition duration**: you can acquire for a predefined amount of time or continuously, manually stopping the acquisition.
- **File split option**: you can enable file splitting at a user-defined file dimension to keep each single file smaller and easily manageable

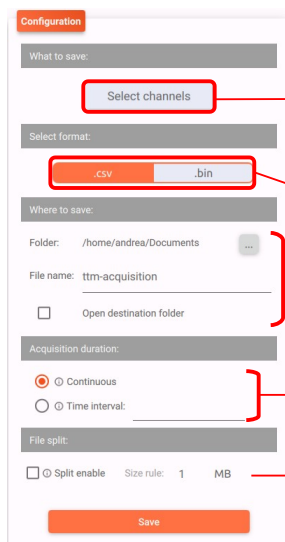


Figure 12: TTM configuration view

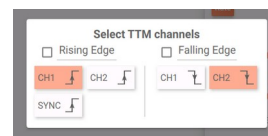


Figure 13: Channel/edge selection

Format selection

File destination and name

Acquisition mode/duration

Splitting option



In the middle of the screen the user can see the stats of the current TTM acquisition:

- The current transfer rate to the PC
- The acquisition duration
- The number of samples in the acquisition
- The file dimension

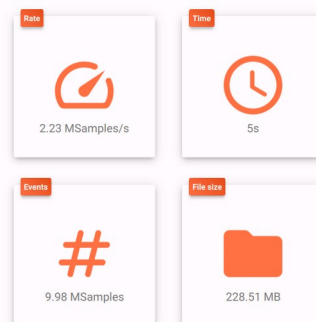


Figure 14: TTM stats

If the rate of events on the selected channel and edges overcomes the link capacity, some events will be lost, and a pop-up will appear to warn the user that the acquisition was lossy.



Updater

The updater module allows the user to easily and quickly update the time tagger firmware, by selecting the path location of the new bitstream file.



Figure 15: Updater view

Upon update completion, the user must disconnect the device, power cycle the board and connect it again.

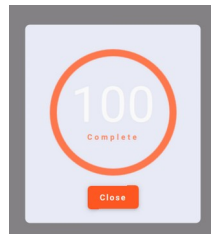


Figure 16: Update completed

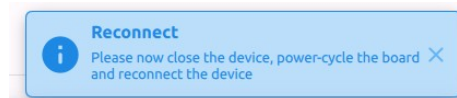


Figure 17: Reconnection pop-up

ChartView

A ChartView is created either by clicking on a Histogram preview, or by clicking on **Spawn views** (the latter allows to create it empty, or to directly import any present histogram).

The user may add any histogram to one ChartView.

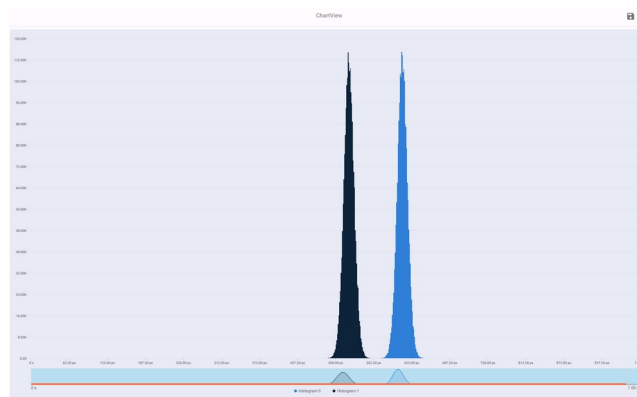


Figure 18: ChartView with two histograms

Zoom options:

- **Zoom rect** - zooms the selected X-axis range. Click and drag the cursor to the bottom-right of the ChartView



- **Zoom fit** – zooms out to the histogram full scale range. Click and drag the cursor to the top-left of the ChartView
- **Zoom in** – zooms in to the left half of the current visualized ChartView. Click and drag the cursor to the bottom-left of the ChartView
- **Zoom out** – zooms out to the right doubling the current visualized ChartView range. Click and drag the cursor to the top-right of the ChartView

On every ChartView you can show a Panel by clicking on the small label with an arrow on the right side of the view. The Panel shows:

- **Configurations:** to change global or single histogram parameters
 - **Global:** set Linear o Logarithmic Y-Axis and X-axis offset
 - **Histogram:** for each histogram you can enable/reset/remove it from the ChartView and move the offset. Right click and drag on the slider for fine adjustments.

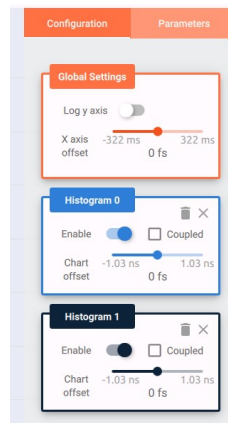


Figure 19: ChartView configuration

- **Parameters:** some parameters, calculated in real time, are available to obtain insights of the current histogram:
 - **Std dev** and **Chart std dev:** arithmetic std dev calculated on the FSR of the histogram or only on the visualized portion of the chart






- **Mean** and **Chart mean**: Mean of the populated bins of the FSR of the histogram or only of the visualized portion of the chart
- **Rate** and **Chart rate**: Mean of the populated bins of the histogram FSR or only of the visualized portion of the chart
- **Events** and **Chart events**: Number cumulated coincidences among the histogram FSR or only on the visualized portion of the chart
- **Time**: time elapsed from the last histogram reset

Configuration		Parameters				
Name	Chart STD	Chart Mean	Rate	Events	Time	
Histogram 0	5.439 ps	87.762 ps	10.00 MHz	2.00 MSa	29s	
Histogram 1	5.425 ps	-88.966 ps	10.00 MHz	2.00 MSa	42s	

Figure 20: ChartView parameters

To save the ChartView the user should click on the disk  icon on the top right corner. This modality simply exports the currently visualized data, either as .csv file or as an image.

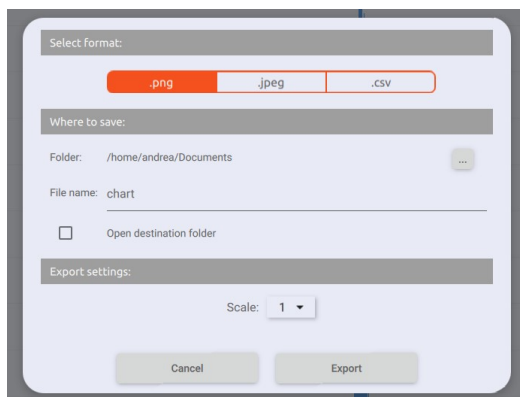


Figure 21: Saving the ChartView





TimeTrigger

The Time Trigger is the most advanced acquisition mode available, and takes advantage of the performance and data compression offered by the Hardware Histogram.

This functionality allows the user to acquire subsequent, contiguous histogram windows, separating them based on different triggering options.

Basically, the user can obtain the evolution in time of one or more histograms, in a movie-like manner, which may give useful insights on the phenomena that generates the time events.

The differences with respect to standard histogram mode lay in:

- **Integration mode**
 - **Period:** the single integration windows last the requested time (> 1 ms), after which the current window is closed, and the following one is started
 - **Trigger Channel:** uses one edge of the selected channel (which must not be in use by the histogram itself as Meas or Ref) to separate the integration windows

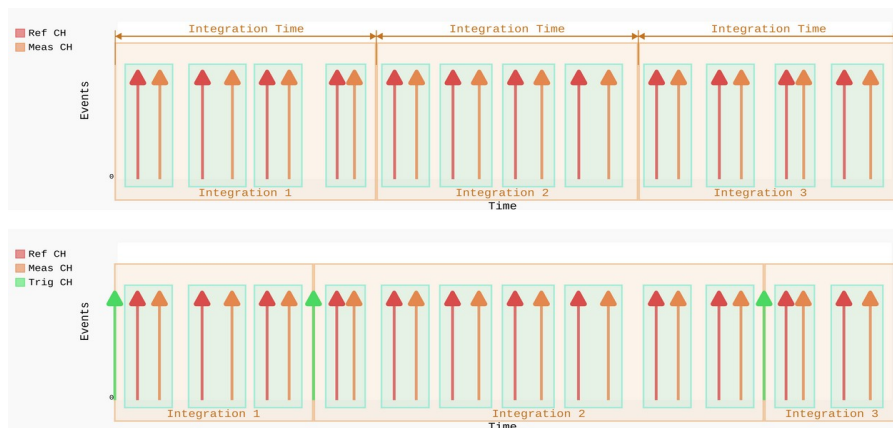
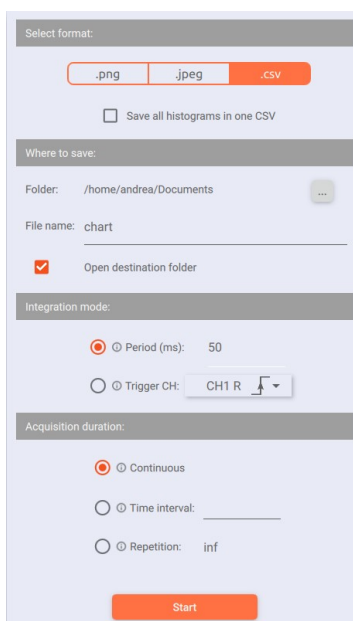


Figure 22: Period vs Trigger Channel integration modes



- **Acquisition duration**
 - **Continuous:** the user manually starts and stops the acquisition
 - **Time interval:** the acquisition lasts the requested time
 - **Repetition:** the acquisition stops upon acquiring the requested number of windows



Select format:

.png .jpeg .csv

Save all histograms in one CSV

Where to save:

Folder: /home/andrea/Documents

File name: chart

Open destination folder

Integration mode:

Period (ms): 50

Trigger CH: CH1 R

Acquisition duration:

Continuous

Time interval: _____

Repetition: inf

Start

Figure 23: TimeTrigger configuration view

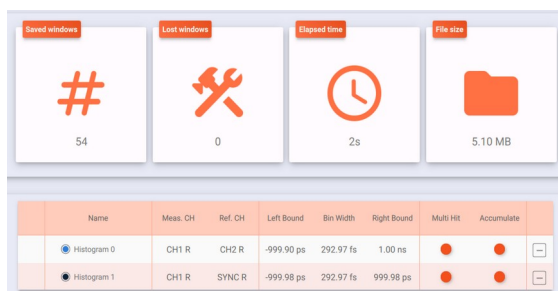


Figure 24: TimeTrigger recap view

Import/Export TDC-Software configurations

As for some experiments the configuration of the device may be recurring, we offer the possibility of saving the user configuration and import them again in an easy way.

By clicking on “**Export**” the user will generate a JSON file containing the current selected configuration, which can be then retrieved by clicking on “**Import**”.

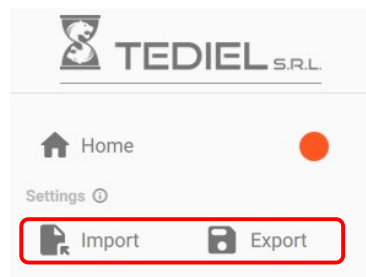


Figure 26: Import/Export buttons

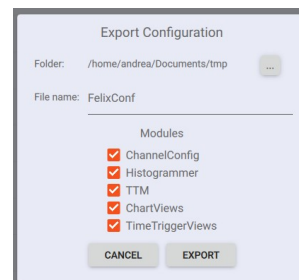


Figure 25: Import/Export options