



MAROC3A  
SOFTWARE & TEST BOARD USER GUIDE

*Version: 7 August 2024*

Abstract

MAROC3A is a 64-channel front end ASIC dedicated to read-out MA-PMT and SiPM detectors.

This guide explains how to install and use the test board for MAROC3A and how to operate with the associated software.





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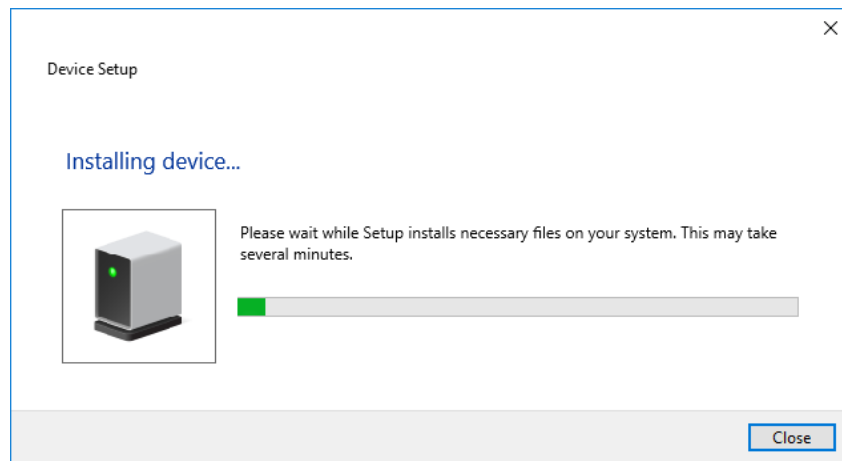
## 1 Installation & Test of the Test Board

### 1.1 Pre requisites

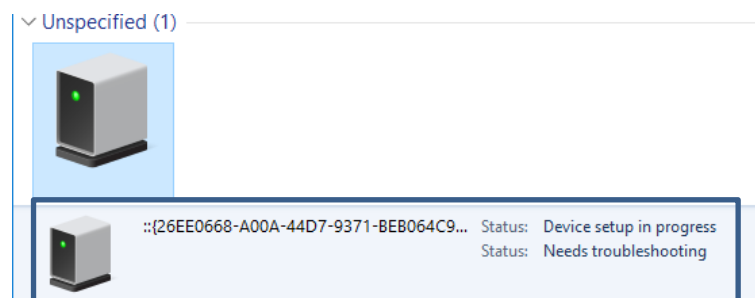
The use of this PCB requires:

- A computer (windows OS) with USB connection
- The FTDI driver that you can find on their website:  
<https://www.ftdichip.com/Drivers/D2XX.htm>
- A USB-A to mini-USB cable
- Optional : A positive output power supply (delivering 500mA)

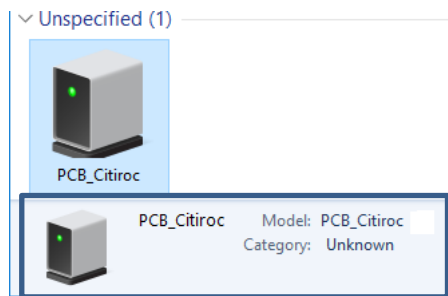
The first time a Weeroc testboard is plugged, the following message should prompt.



In order to verify that the drivers are correctly installed, go in the control panel under the “Devices and Printers” window. the PCB\_Maroc3A device should have gone from



to



## 1.2 Installation guide

Before running the software for the first time, please verify that the testboard is correctly identified in the "Devices and Printers" window under the control panel. The release of the MAROC3A user interface can be found in the Weeroc download center on the website <http://www.weeroc.com>.

## 2 Evaluation board description

Brief description of the evaluation board features and I/Os. Other hardware setup can be included in subsection.

The evaluation board incorporates the following I/Os (non exhaustive list):

- Charge injection input (Ctest)
- Analog signal outputs (OUT\_FS and OUT\_Q)
- HOLD signal inputs (HOLD1 and HOLD2)
- External Clock Input (CLK\_GENE\_EXT)
- OR Trigger output
- External power supply
- Mini-B type USB connector
- MA-PMT footprint





### 3 Software description

The software has been written in the C# language with the help of visual studio (free version). The source code is available to help comprehend the functioning of the software. This is especially useful if users aim to develop their own DAQ system.

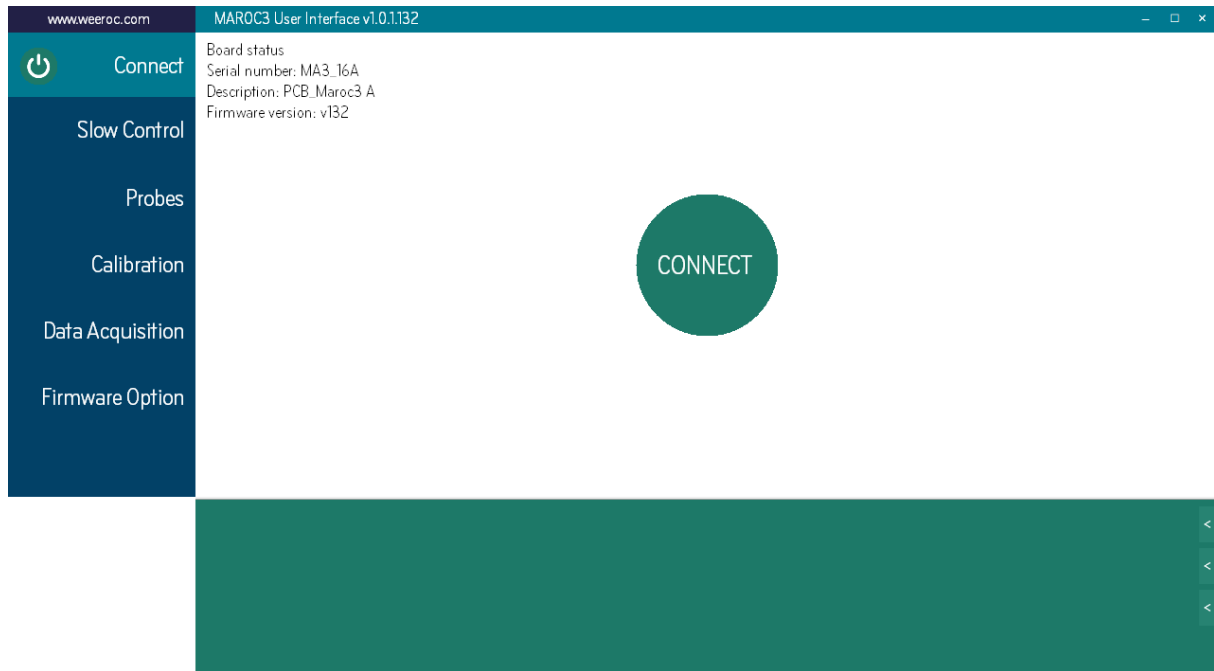


Figure 2 – Maroc3 software connect tab.

To start the test board you need to:

1. Connect the USB cable from the PCB to your computer.
2. Provide power supply to the PCB if not provided by the USB (the power supply can be switched between external and USB with the jumper on the top right of the evaluation board).
3. Start the software and click on the “Connect” round button.

When connecting the evaluation board, drivers for the USB device should install automatically. If it is not the case, the drivers can be found on the FTDI website (<http://www.ftdichip.com/Drivers/D2XX.htm>).

When this software is launched and the “Connect” button clicked, no error should occur, meaning that the installation has been done successfully and all the drivers and dll have been found. If a crash occurs or if you need assistance for any other issue with the software, contact the Weeroc support by opening a new support ticket at the address <http://www.weeroc.com/my-weeroc/support>.

While this user guide will help the user to use the software and evaluation board, it should be noted that there is an embedded help in the software. By hovering controls with the mouse, the green bottom part will be filled with information on the object being hovered.



The firmware version is automatically detected by the software. If the firmware version doesn't correspond to the expected version, the software will propose to load the correct firmware version. The expected firmware version corresponds to the last number in the software version. The firmware version is 1 on Figure 2, while the software version is 0.9.0.1. On the title bar is also displayed the temperature of the board given by the TMP275 component on the board.

### 3.1 Slow Control page

All the slow control parameters of the MAROC3A are displayed on this tab control, allowing tuning & tests for different settings.

To program the MAROC3A, users must set the Slow Control parameters and click on the "Send SC" button on the bottom right of the page. The slow control parameters are loaded twice in the ASIC and a checksum is done to verify that the slow control has been correctly loaded in the ASIC. The "Send SC" button turns green if the load succeeded. If it turns red, then there is an error in the slow control bits loading. Verify the board is plugged and powered correctly.

The settings can be saved in a text format file thanks to "Save SC" button, and reloaded from this file by the "Load SC" command or by drag and dropping the file on the software window. This is very helpful as there are 1144 bits of slow control.

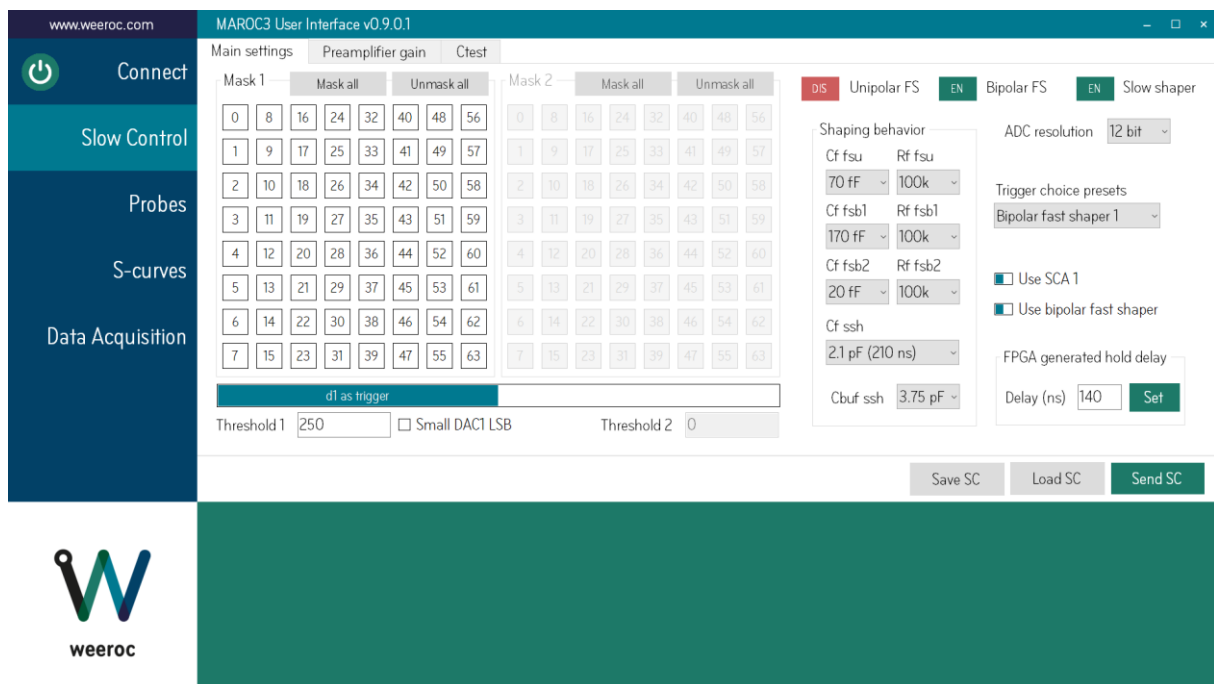


Figure 3 - Main page of the slow control tab.

On the main settings tab of the slow control page the user can choose to mask triggers from the trigger lines d1 or d2. The trigger thresholds and fast shaper used for triggering are also chosen from this tab. The shapers behaviour can also be changed by tuning the feedback capacitors and resistors values. The delay value is not a slow control parameter, it is set in the FPGA so it can deliver a hold signal for the track&hold cell.

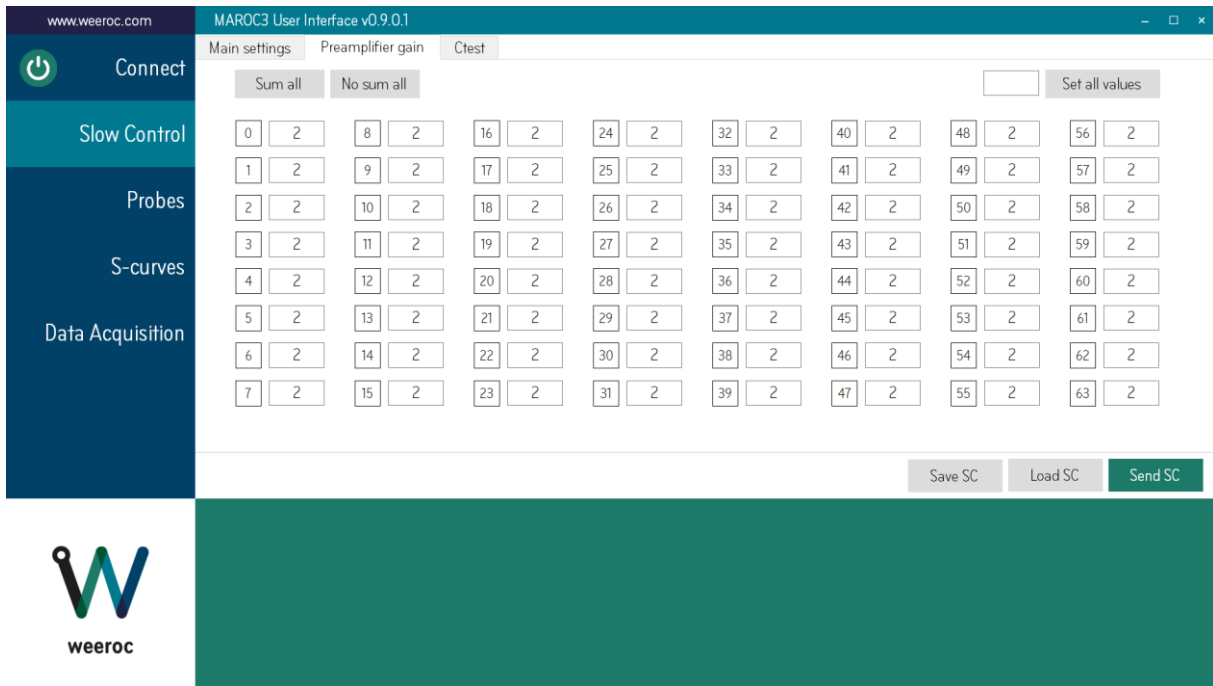


Figure 4 - Pre-amplifier settings tab

On the preamplifier page the individual preamplifiers gains (maximal gain is 4) can be tuned and the output signals can be summed by groups of 8 (e.g. 0 to 7, 8 to 15, etc.). The summed output are to be found on the testboard on the test pins “sum1” (channels 0 to 7) to “sum8” (channels 56 to 63).

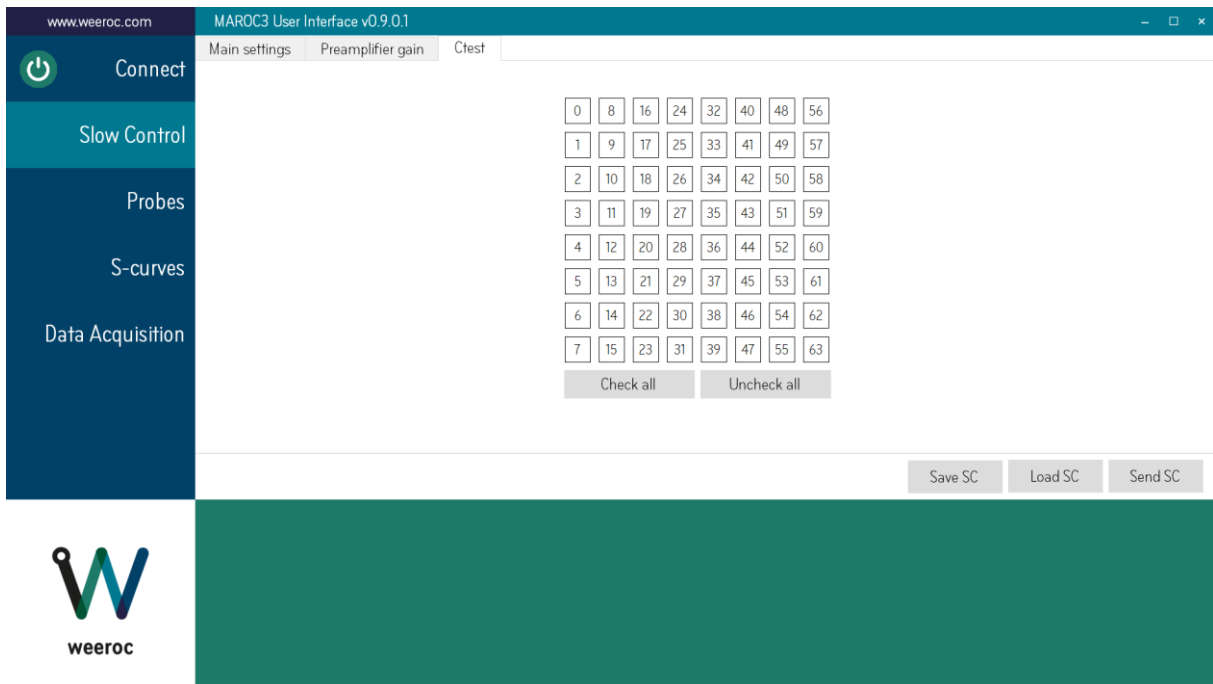


Figure 5 - Ctest injection tab.



On the Ctest tab the user can chose the channels in which the injection must be done. This injection is done via the SMA connector Ctest on the top left of the board and is for test purpose only. Do not try to inject in multiple channels at the same time. (Analog input will not be spread in between the ASIC channels)

### 3.2 Probe page

An internal ASIC shift register allows to monitor each channel and to display them on oscilloscope. User can chose to monitor SCA output 1 or 2 on the "OUT\_Q" SMA connector. The fast shaper will be outputted too.

This probe system is usually used for debugging. In typical ASIC operation, it is advised to click the "Reset Probes" button in order to avoid analogue performances degradation.

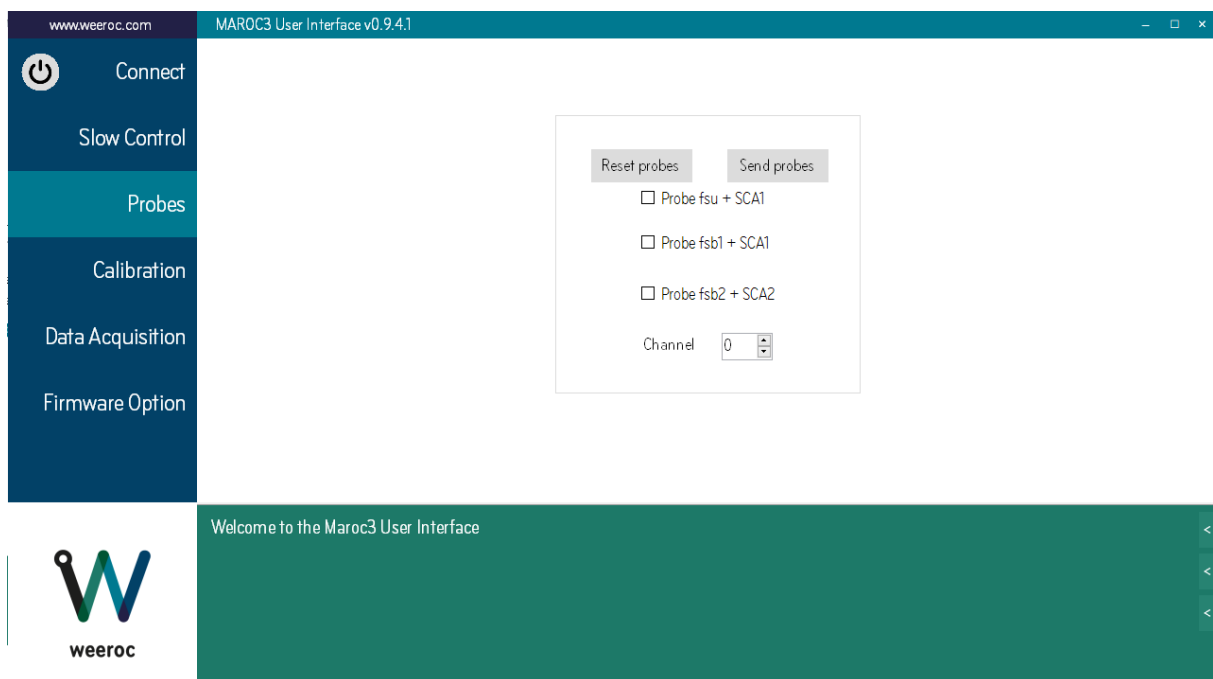


Figure 6 – Probes register page

When looking for the SCA2 the user will visualize also the bipolar fast shaper 2. The visualized channel for the SCA and fast shaper will be the same. When looking for SCA1 the user will visualize the unipolar fast shaper or the bipolar fast shaper 1 depending on the selected shaper in the slow control tab.

### 3.3 Calibration page

#### 3.3.1 S-Curves

This test is meant to perform trigger efficiency test (named S-curves). It is done by scanning through several values of threshold and measuring if a trigger happens on the output signal of the fast shaper. The acquisitions are windowed by a clock set in the FPGA which toggle the “valid event” signal. If a trigger happens outside the window it will not be taken into account.

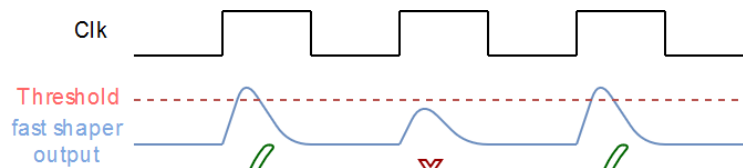


Figure 7 - S-curves acquisition chronogram

When the threshold is way below the signal, the trigger efficiency will be 100%. With a threshold way over the signal, trigger efficiency drops to 0%. On Figure 7 the threshold is set near the tip of the noiseless signal so the ASIC will have a ~50% chance of triggering depending on the noise. Following the Figure 7 the ASIC would trigger 2 times in 3 acquisition windows, resulting with a 67 % trigger efficiency. The acquisition is started by clicking on the “Start” button.

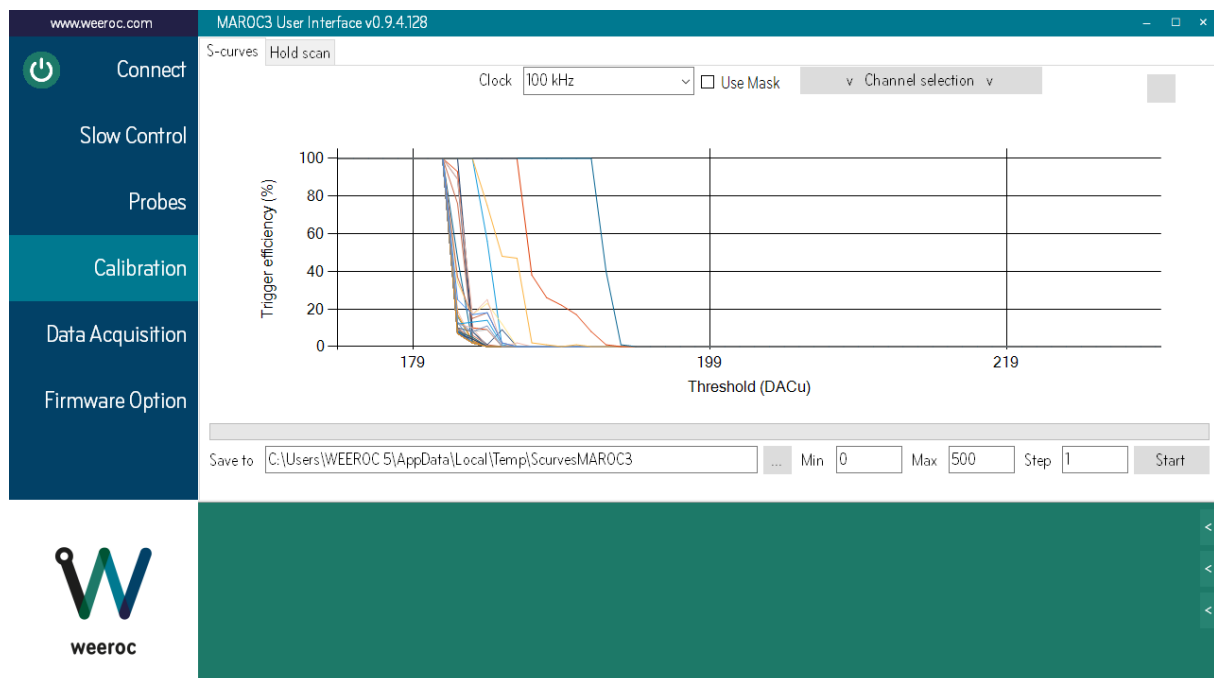


Figure 8 – S-curves tab.

User can mask the channels directly in the menu by checking the channels in the mask options. User can select the clock frequency (100 kHz, 50 kHz, 10 kHz, 1 kHz).

Channel selection is available for enabling S-curves testing on channel checked.



### 3.3.2 Hold Scan

The second tab under the calibration page is the “hold scan”. It traces the slow shaper output signal by varying the “hold” delay value. In order to have it working properly a signal should be injected in the measured channel and a trigger must start the data acquisition. A fit on the result of the scan is performed and the x-axis value corresponding to the maximum of the fit is automatically extracted. The delay parameter (in Main settings tab – Figure 3) is updated with the extracted value. The fit is meant to be used with the SCA.

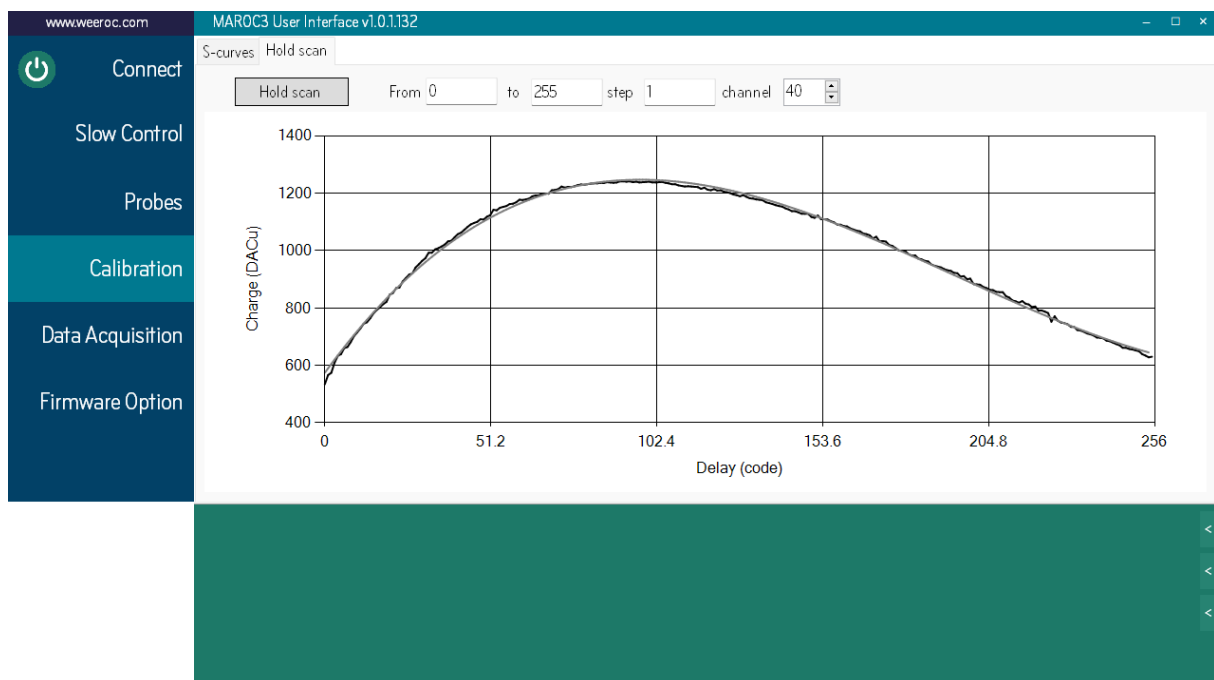


Figure 9- Per channel Hold scan data.

To make the hold scan test possible the threshold has to be higher than the noise (the user can change this parameter in the slow control section) and the user have to check that the good channel is selected.

Holdscan is done using the internal conversion of Maroc3



## 3.4 Data Acquisition page

### 3.4.1 Visualization per channel or per acquisition

The user can choose the number of acquisitions to perform and the output file save path. When ready, click the "start acquisition" button. The energy measurement can be visualized per channel (energy spectrum for a given channel) or per acquisition, visualizing all the channels' energy measurements at once.

External ADC can be started using the "Start External" button.

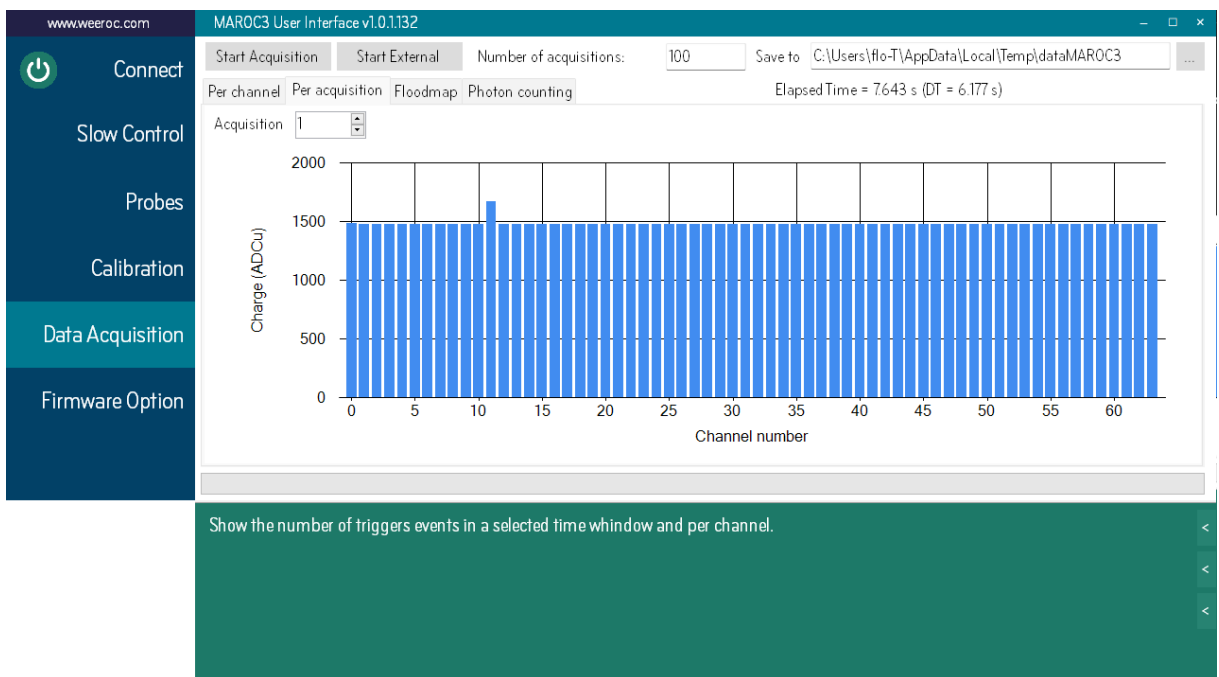


Figure 10 - External ADC Visualisation

The user can be choosing between internal and external data acquisition system, Internal ADC resolution can be determined using the first page of the slow control.

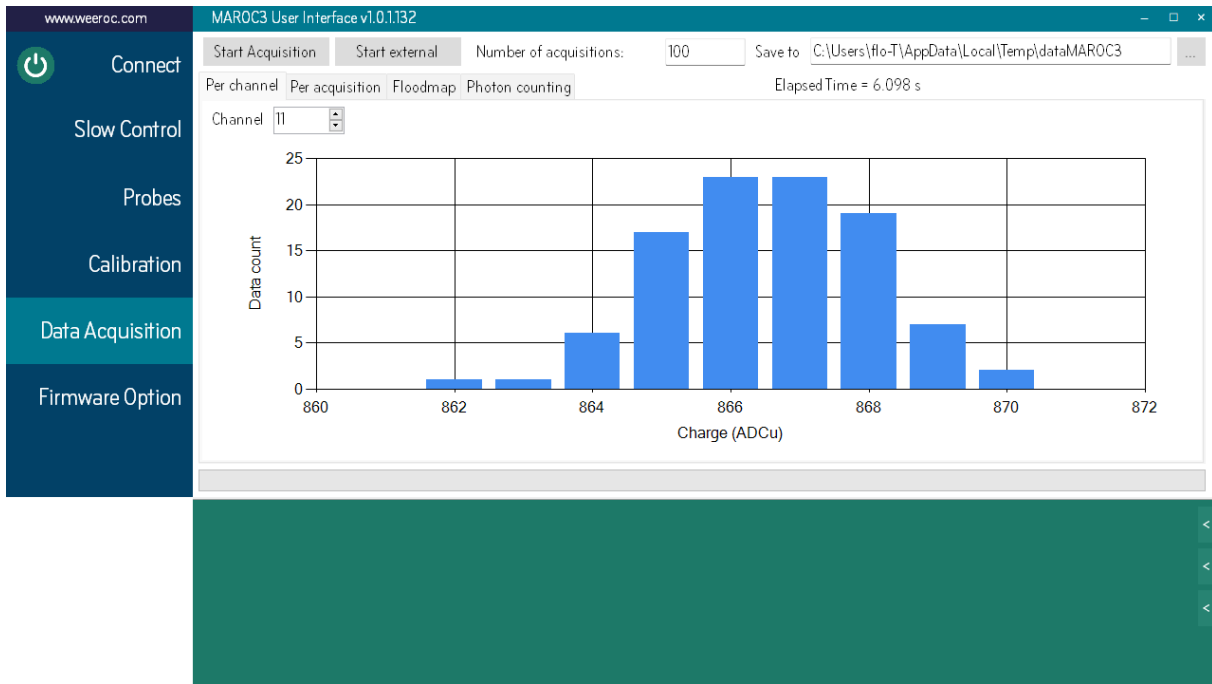


Figure 10- Per channel data visualisation.

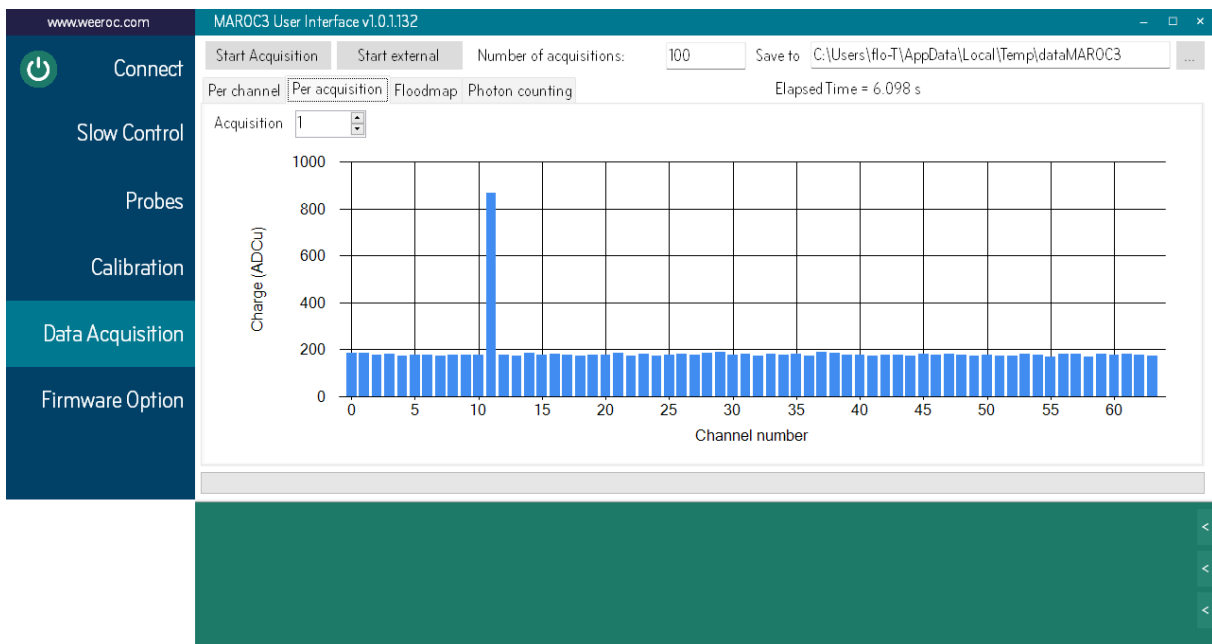


Figure 11 - Per acquisition data visualisation.

### 3.4.2 Visualization with a flood map

The user can visualize all the channels charges averages with a flood map, where the color of the channel case depend on this charge average value. The charge values depend on the DAC resolution you choose on the slow control table (Figure 3).

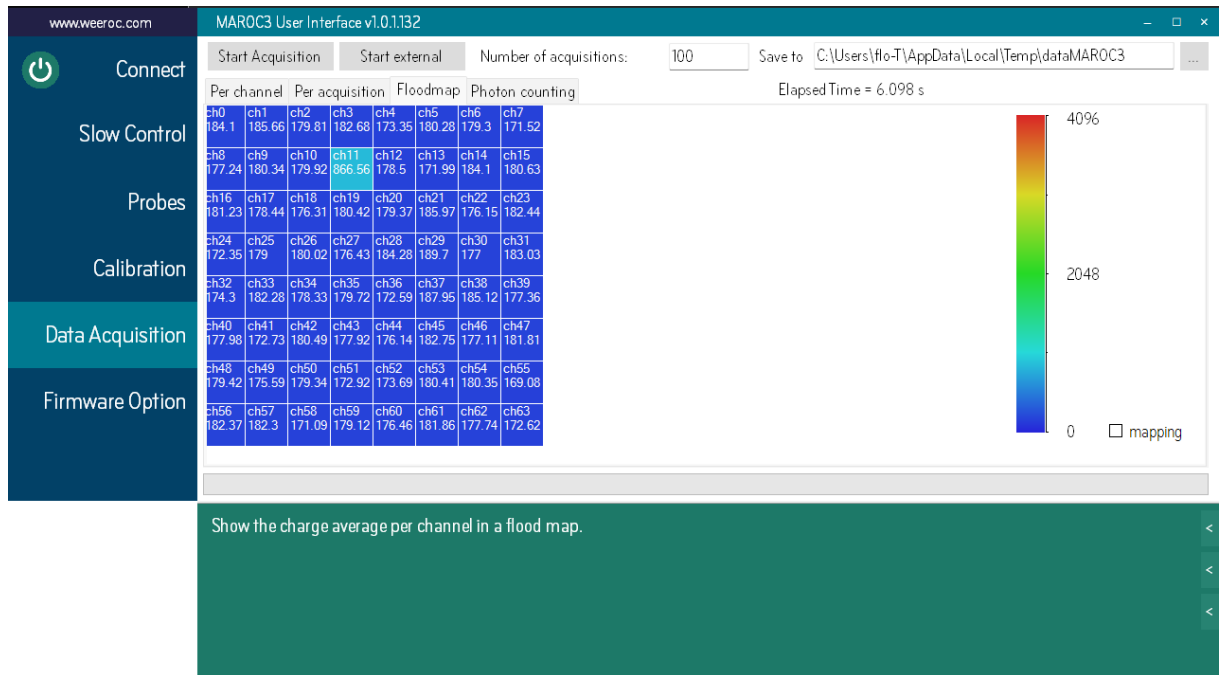


Figure 12 – Flood map with an injection on channel 11

The user has to check that the threshold is higher than the noise, the user also has to check the channel mask (the user can change this parameter in the slow control section).

### 3.4.3 Photon Counting

The last tab of the Data acquisition section allows user to have a count of the photons for the entire channel and for a selected time window of 2ms, 1ms, 500 $\mu$ s, 100 $\mu$ s, 50 $\mu$ s and 10 $\mu$ s. The data are reported in a flood map per channel.

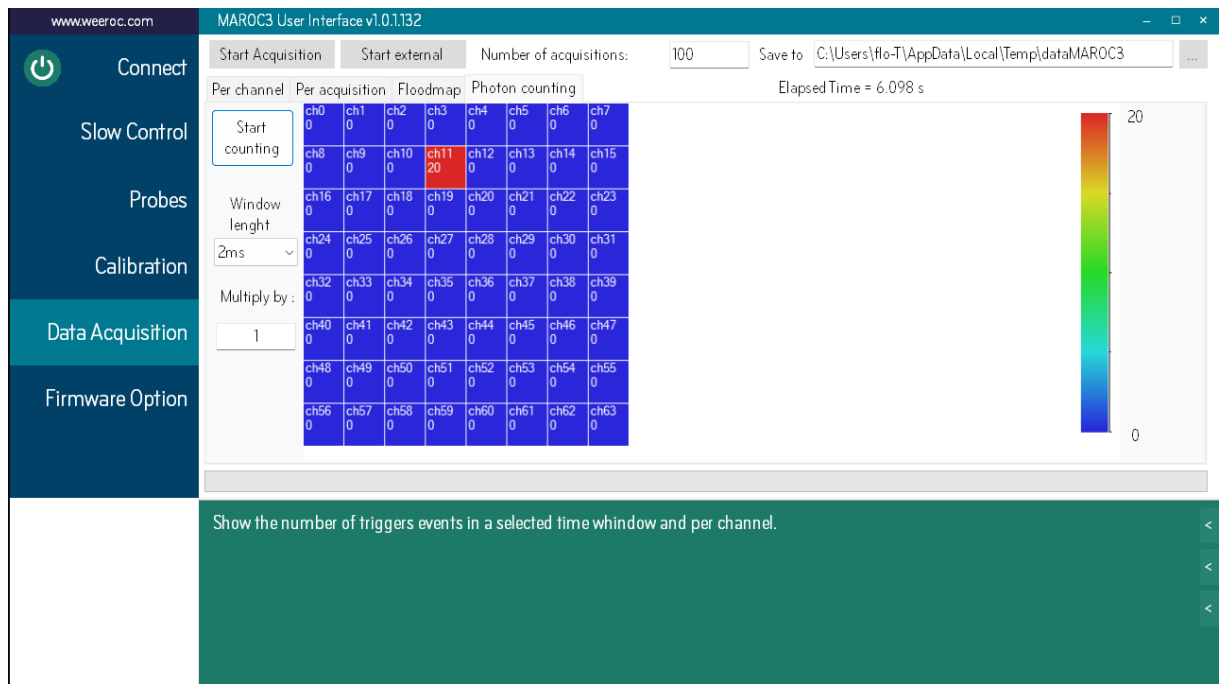


Figure 13 – Photon counting with an injection on channel 11

User has to check that the threshold is higher than the noise, he also have to check the channel mask (the user can change this parameter in the slow control section). User should select the windows time require.

## 4 Firmware Option

In this section user can have an interaction with the firmware and modified the different options with the checkboxes or directly with the “WORD” communicate to the firmware.

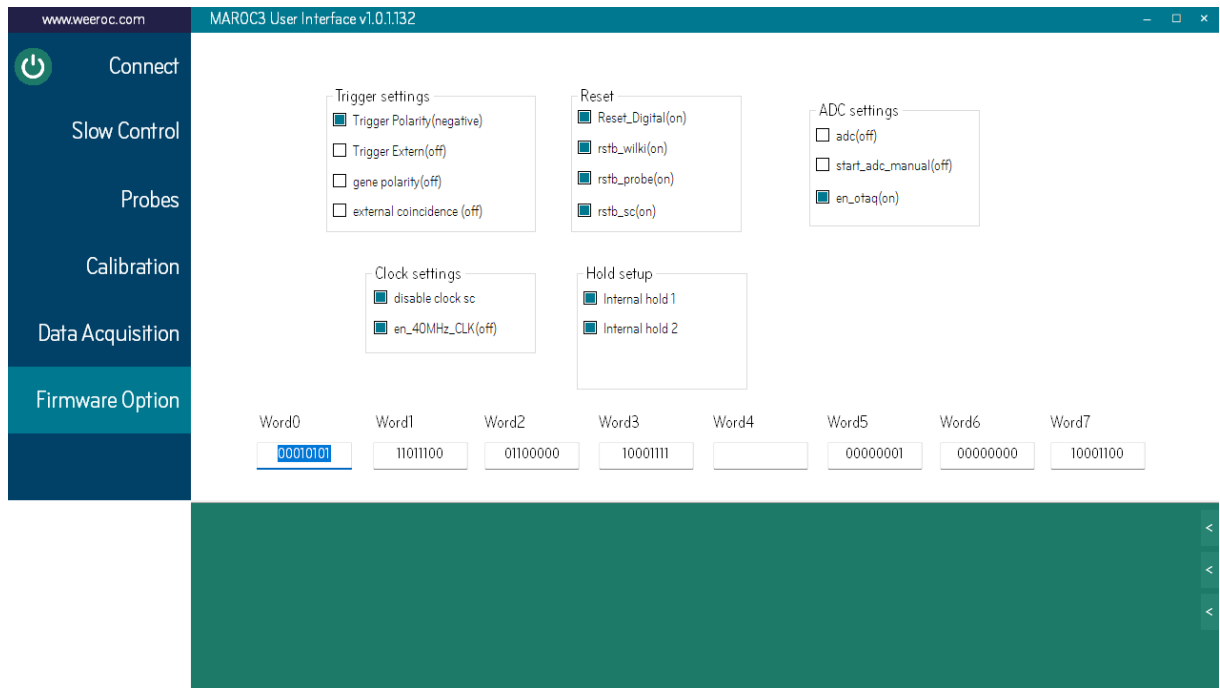


Figure 14 – Firmware option section

In this section there are four categories of firmware option, the first one allows user to change the different trigger settings. User can change the trigger polarity with the first checkbox; select which trigger required to be enabled between the one from the FPGA and the external one. User can also select to synchronize the FPGA with a rising or falling edge on the external trigger. External OR for Data acquisition start is available on In Alt1 if needed by the user (3V3 signal is needed if the check box is checked)

The second category allowing the user to reset some parameter like the FPGA with the Reset Digital if the enable serial is activates. It's possible to reset the ADC Wilkinson (with “rstb\_wilki”); the ASIC input probe chain (with “rstb\_probe”) and the ASIC input slow control register chain (with “rstb\_sc”)

The third category deal with ADC settings, it's allowing the user to select the auto start of the ADC (if “adc” is activated). This is possible to start the process for eternal ADC without looking for event (with the “start\_ac\_manual”) and this is also possible to enable the multiplexed analogue output (“with th en\_otaq”).

About clock settings, it is possible to enable the slow control clock (with “enable\_sc”) and to enable the 40MHz clock from an external component.



User can send the hold signal directly using SMA connector Hold1 and Hold2, this allow the user to hold the signal at the timing the want and acquire the data at the right timing. By default it is done using the FPGA delay line between the trigger and the hold.

## 5 Setup to inject signals

First tests to be more familiar with the board and the software should be done using the following setup. A negative voltage step can be injected into the Ctest SMA connector. The slow control need to be set accordingly to inject in the desired channel. A slow negative ramp allows to inject no significant signal in the ASIC before the next step. A voltage attenuator is needed to diminish the noise from the waveform generator.

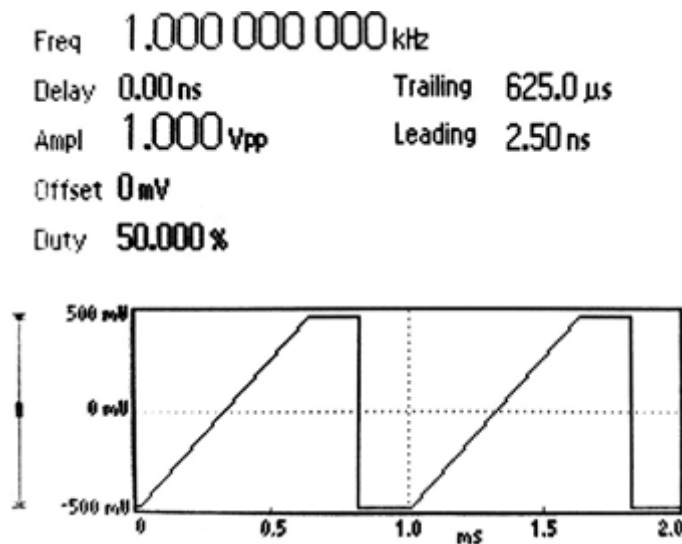


Figure 15 – Injection in each channel

## 6 Document version

That section log the document version within major release.

Version	Date	Change log
0_9_0_1	27/01/2016	Initial version
0_9_3_128	24/08/2017	Implementation: Hold Scan, Flood map Acquisition view, Photon counting menu, Mask and clock for the S-curves menu



0_9_1_132	13/07/2024	Implementation : External ADC and Internal ADC start for DAQ system. + Hold choice
1_0_1_132	07/08/2024	Implementation : Coincidence available on "In alt1"