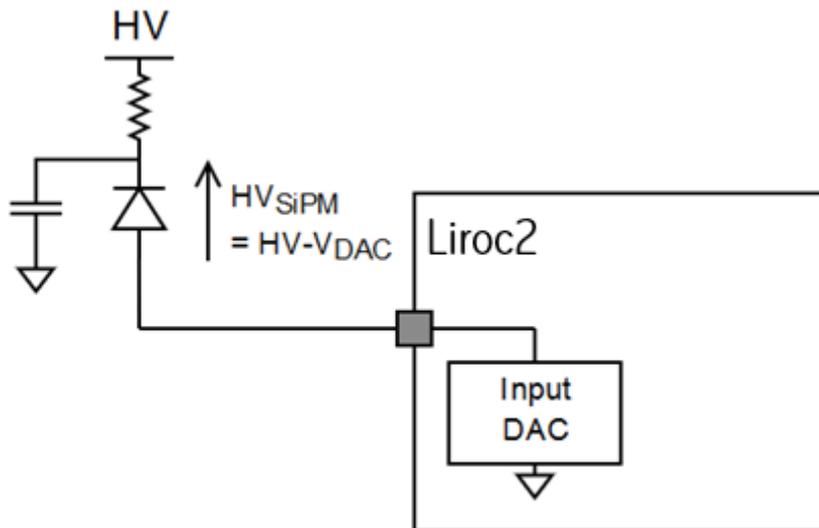# Application note

LIROC2 – Trigger Threshold Trimming Application Note

1   Overview

Input DAC with a SiPM is essential for providing a precise and adjustable bias voltage, which is crucial for optimizing the SiPM's performance in terms of sensitivity and homogeneity. In Liroc, each channel can be adjusted using a 6 bits DAC.
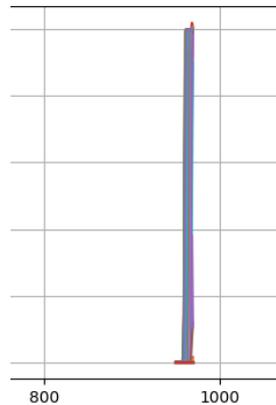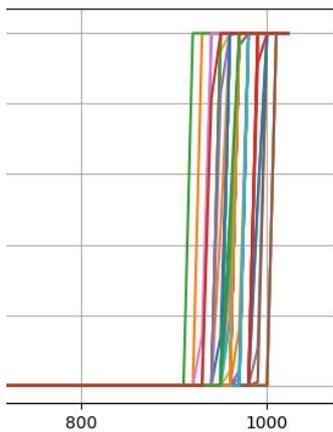
Application note

Trigger Threshold Trimming is an adjustment of the general Threshold independently per channel.
Allowing ASIC's channels to be fully homogeneous for photo detection, especially in the first few photo-electrons. As you can in the next figures:

2 problems have been noted between the Input DAC and the trigger threshold trimming.
The first one is that the Calibration DAC doesn't have the range to calibrate all channels. The second one is that the Input DAC and the wasn't usable to calibrate SiPM gain because it depolarized the Calibration DAC.

This application note explains what modification needs to be made. You will find below the solution proposed whether you are a client using the ASIC on your board or a client using our evaluation board.

2 Solution proposed

Without adding a resistor, the auto-calibration can't work. That is why the use of a 330k ohms resistor is advised.

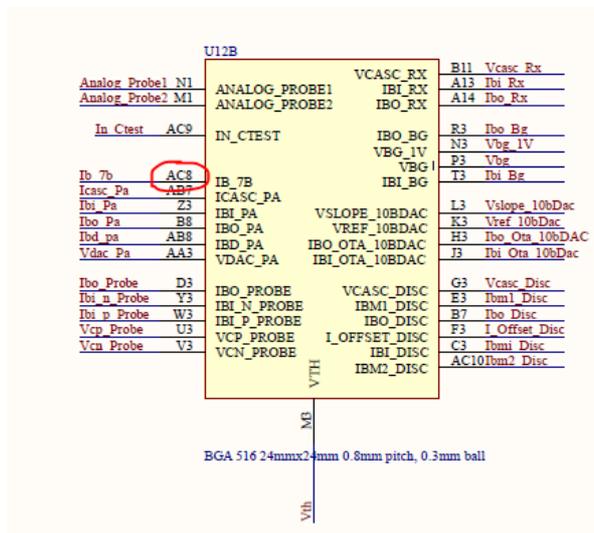For clients using ASIC on their board, Ib_7b corresponds to the ball AC8.

Figure 1 – ASIC BGA schematic

For clients using the evaluation board this resistor must be place between the signal Ib_7b and 1.2V analog power supply.
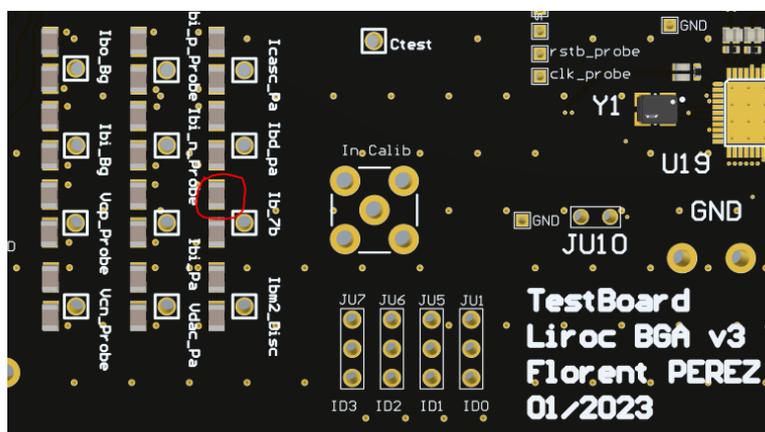

Figure 2 – 330k ohms resistor spot

With a 330k ohms resistor, a proper functioning was observed between Input Dac 0 and Input Dac 32. Input Dac 32 is the limit to have an auto-calibration on scale. Also, at this value the linearity of the Trigger Threshold from 0 to 1023 was verified.

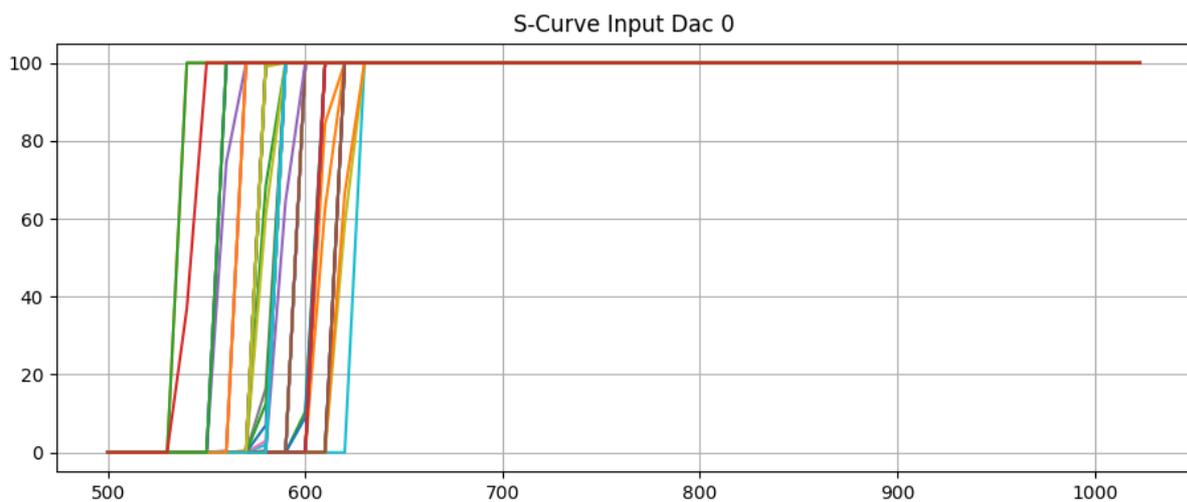## 3   Measurements – Without additional bias resistance at ib_7b (AC8)

Figure 3- S-Curve Input Dac 0

Without adding a resistor, the dispersion of the S-Curves is too high to be calibrated using the DAC of the Trigger Threshold Trimming. The full range of the Trigger Threshold Trimming without the 330k ohm resistor is +/- 5 DAC Unit. The full dispersion of the non-calibrated S-Curves is more than 5 DAC Unit.
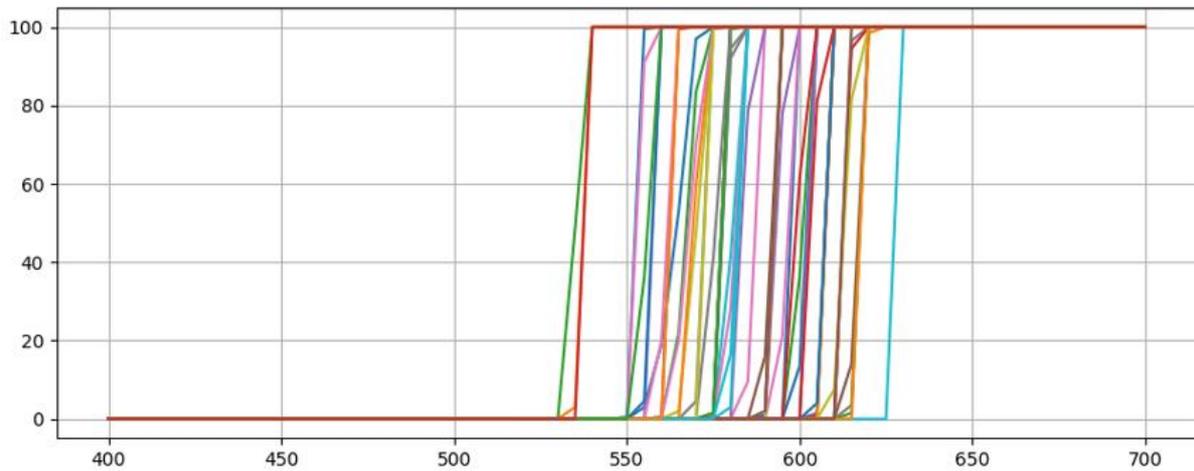
Figure 4– S-Curve Input Calibrated Dac 0
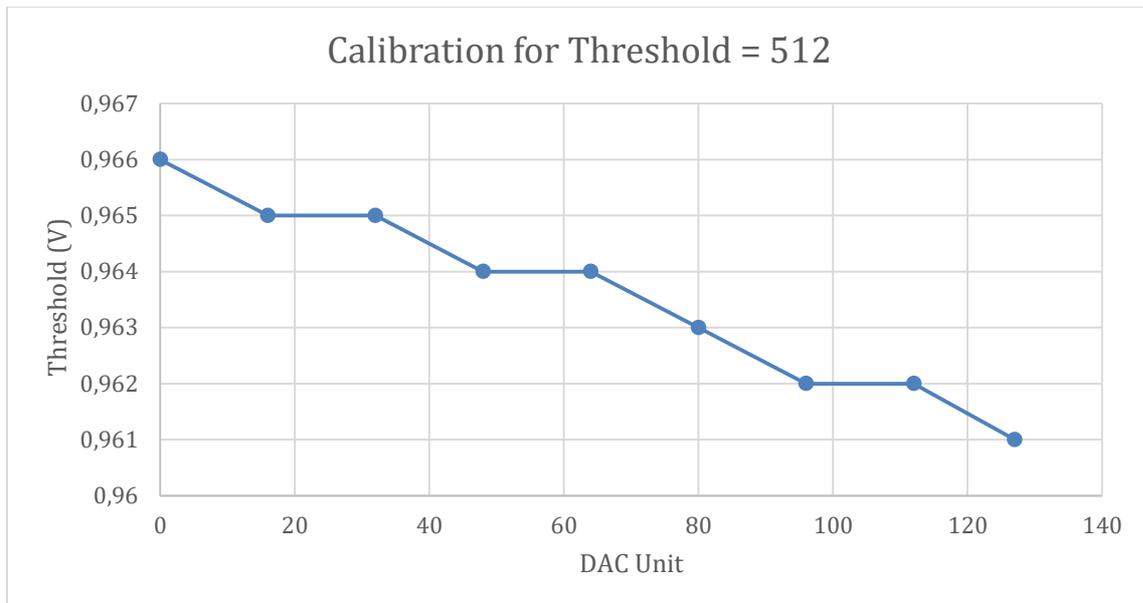

Figure 5– Calibration for Threshold = 512

4   Measurements – With 330k at ib_7b (AC8) to 1.2V

Input Dac 32 has been has given these results. The first graphic shows the S-Curves not calibrated. The second one represents the S-Curves calibrated which cannot be obtained without adding the 330k resistor.
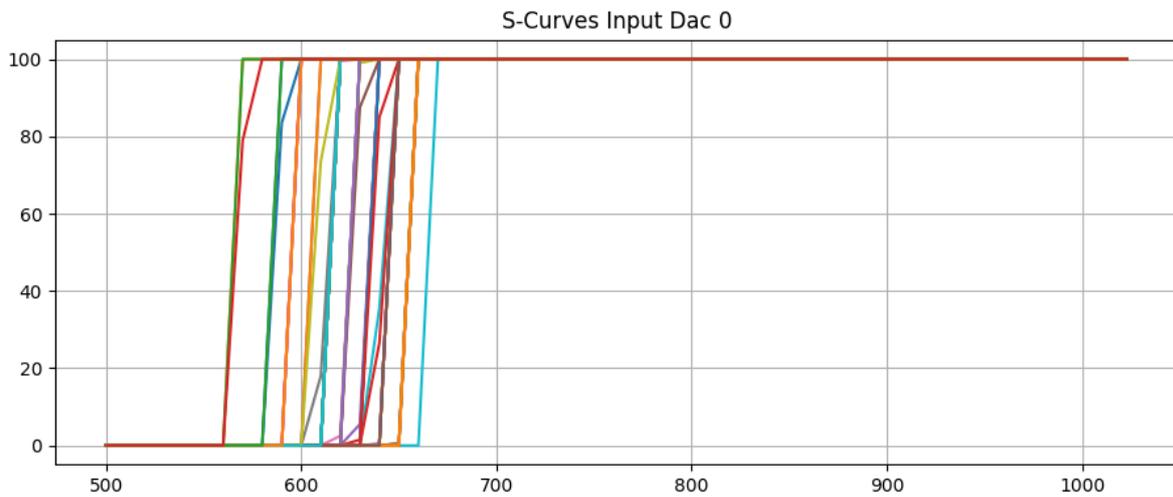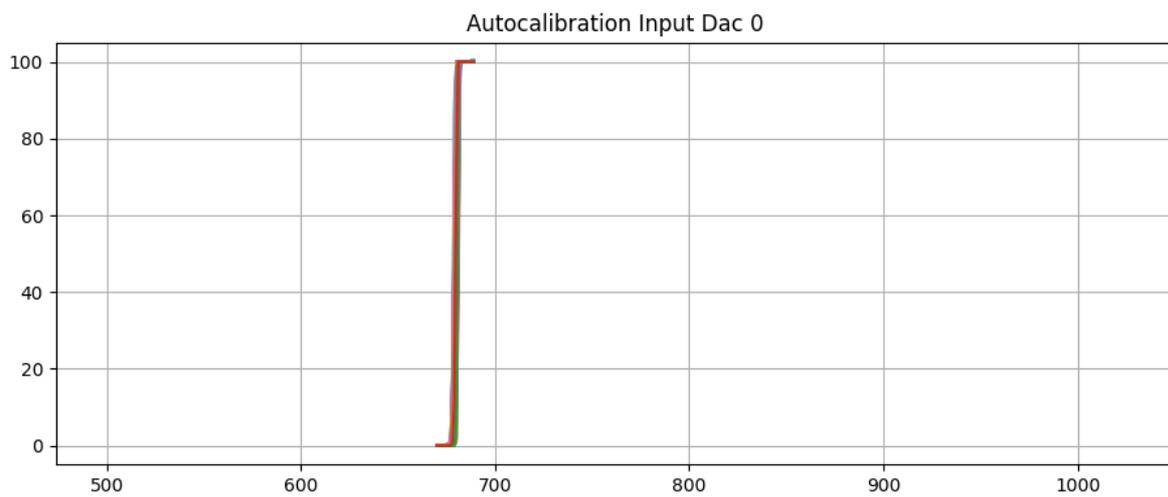

Figure 6- S-Curve Input Dac 0

Figure 7- Autocalibration Dac 0
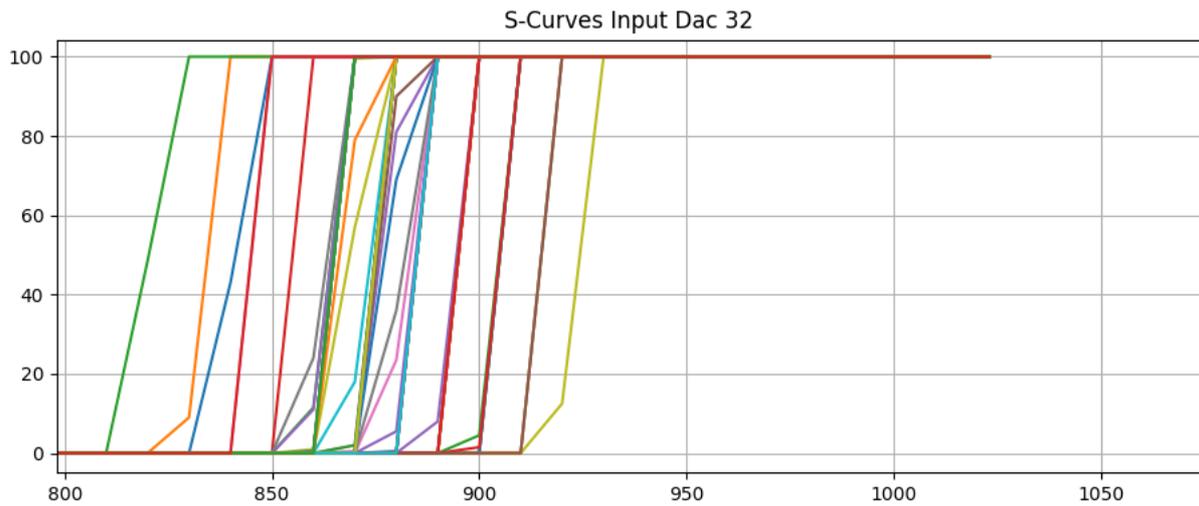
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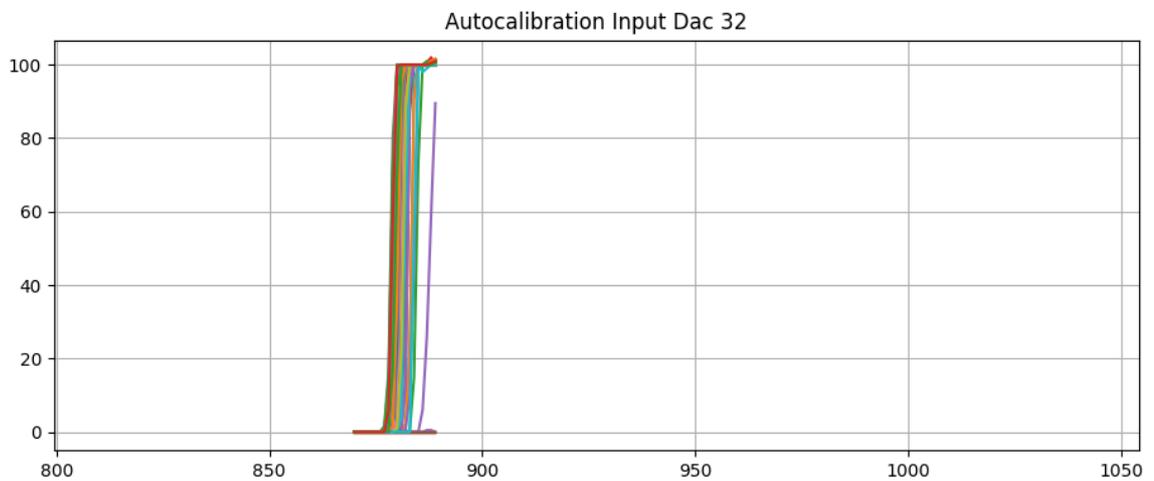

Figure 8 – S-Curves Input Dac 32

Figure 9 – Autocalibration Input Dac 32

Figure 5 shows the linearity of the Trigger Threshold with the Input Dac 32.
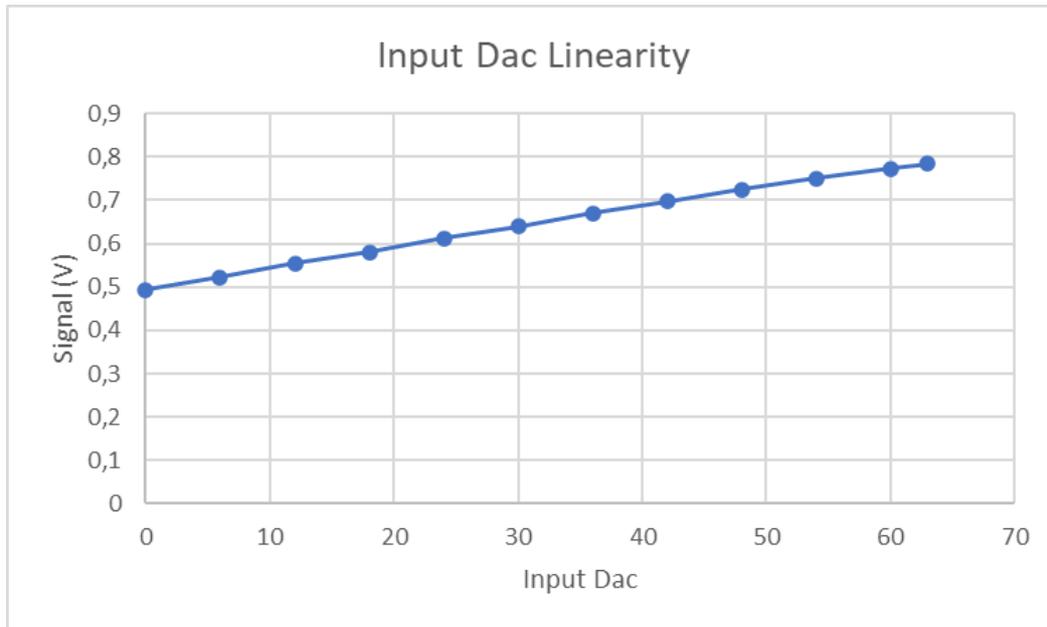For this measurement the value of the Trigger Threshold was changed from 0 to 1023 with a 50 step and we focused on channel 12.
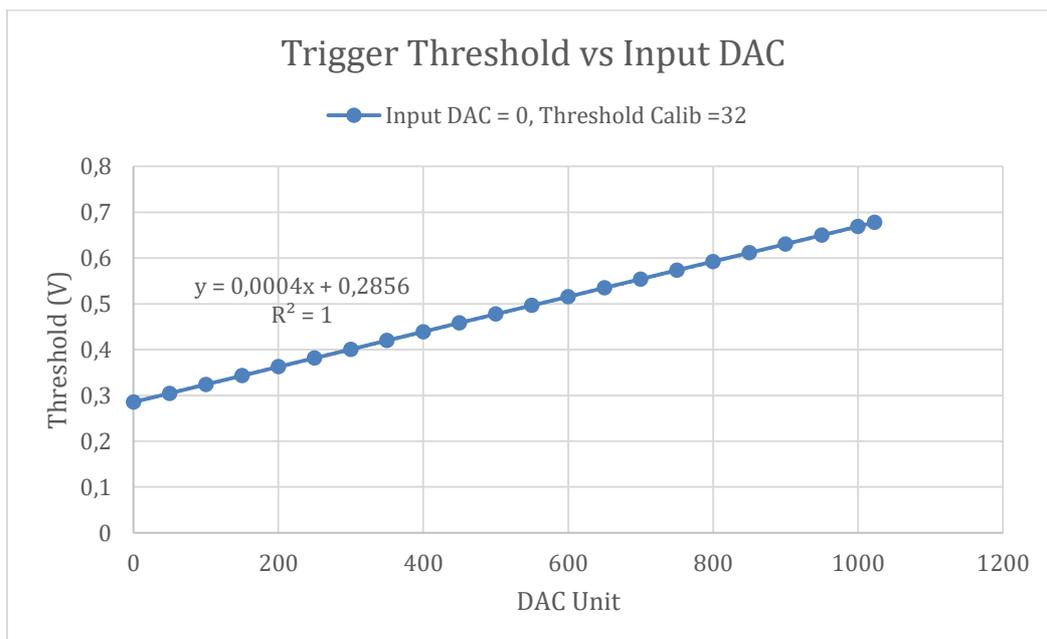
Figure 10-Input Dac Linearity

Figure 11 - Trigger Threshold

The following graphic shows the calibration with a threshold equal to 512.
For this measurement the value of the Threshold VTH was changed from 0 to 63 and we focused on channel 12.
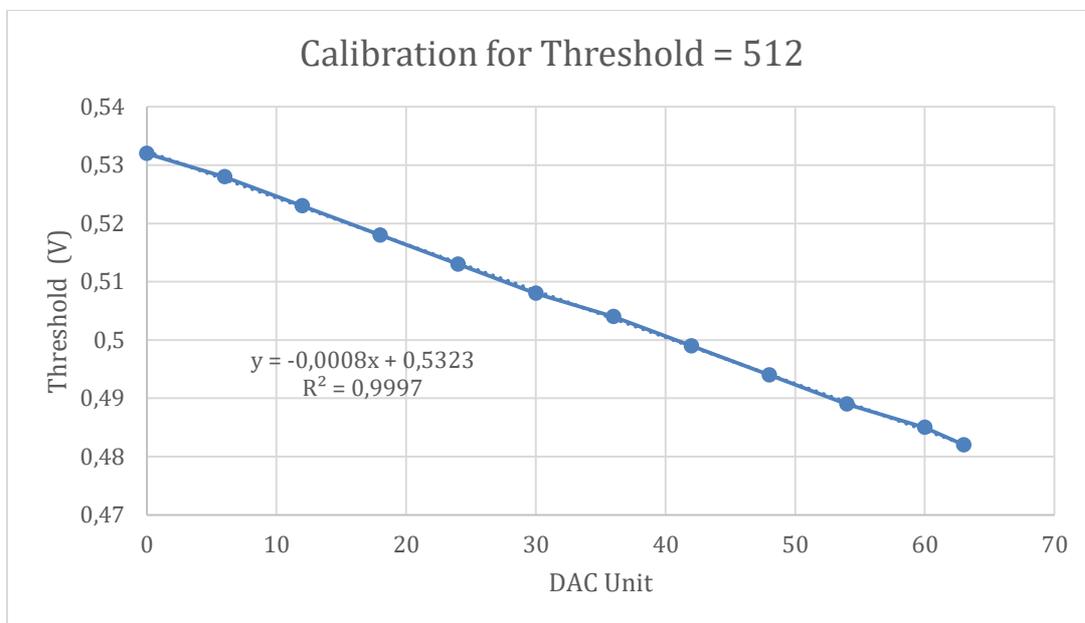

Figure 12 – Calibration for Threshold 512

When adding a 330k resistor the Input Dac from 0 to 32 is usable and it is possible to calibrate all channels to have homogeneity in trigger behavior.