Application note

LIROC2 – Input DAC Application Note

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Introduction

The input DAC allows tuning the bias voltage for each channel individually. In Liroc2, the it is on 6 bits. Although it should be independent from the local calibration threshold DAC, it seems that it has a huge influence on it. Also, without using any bias, when all the channels have an input DAC higher than 14, the general threshold is depolarized.
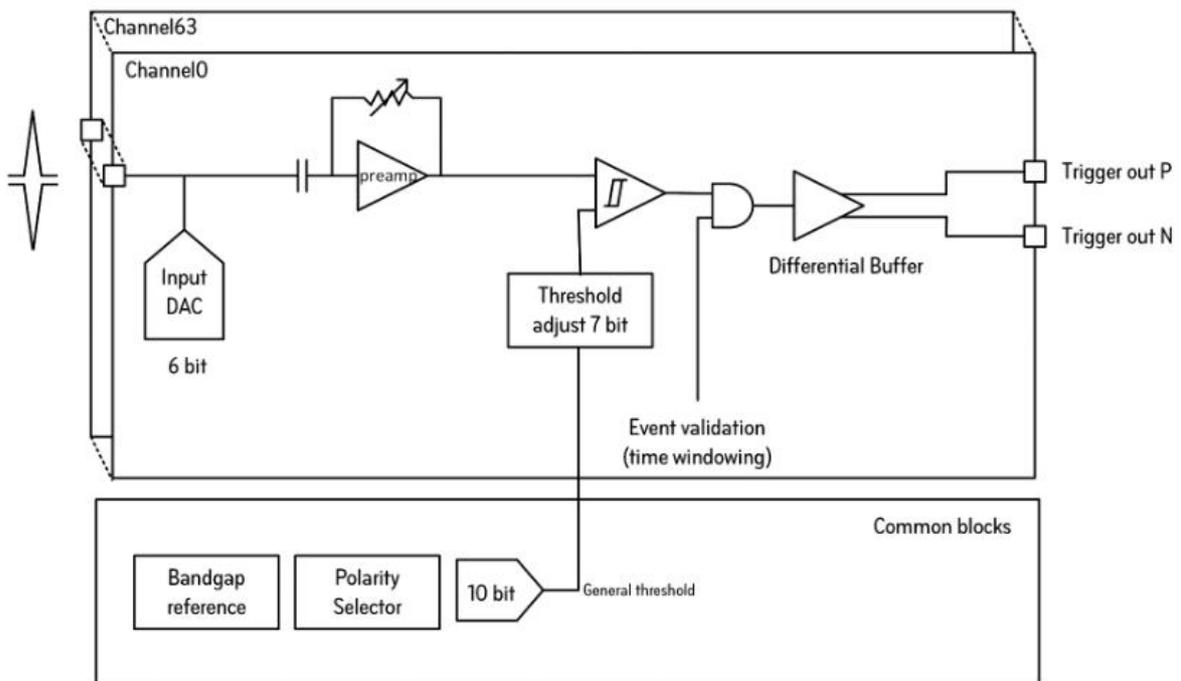

Figure 1: Liroc2 bloc diagram

Influence on the individual threshold

To characterize this influence, we used Liroc Testboard #10 (Liroc2 2405-0143) and programmed it with the slow control given in annex 1. We configured the Analog Probe on DC Level channel 0 and measured the tension on the a_prob1 test point while changing channel 0's local threshold. We performed this test for 3 different general threshold values.
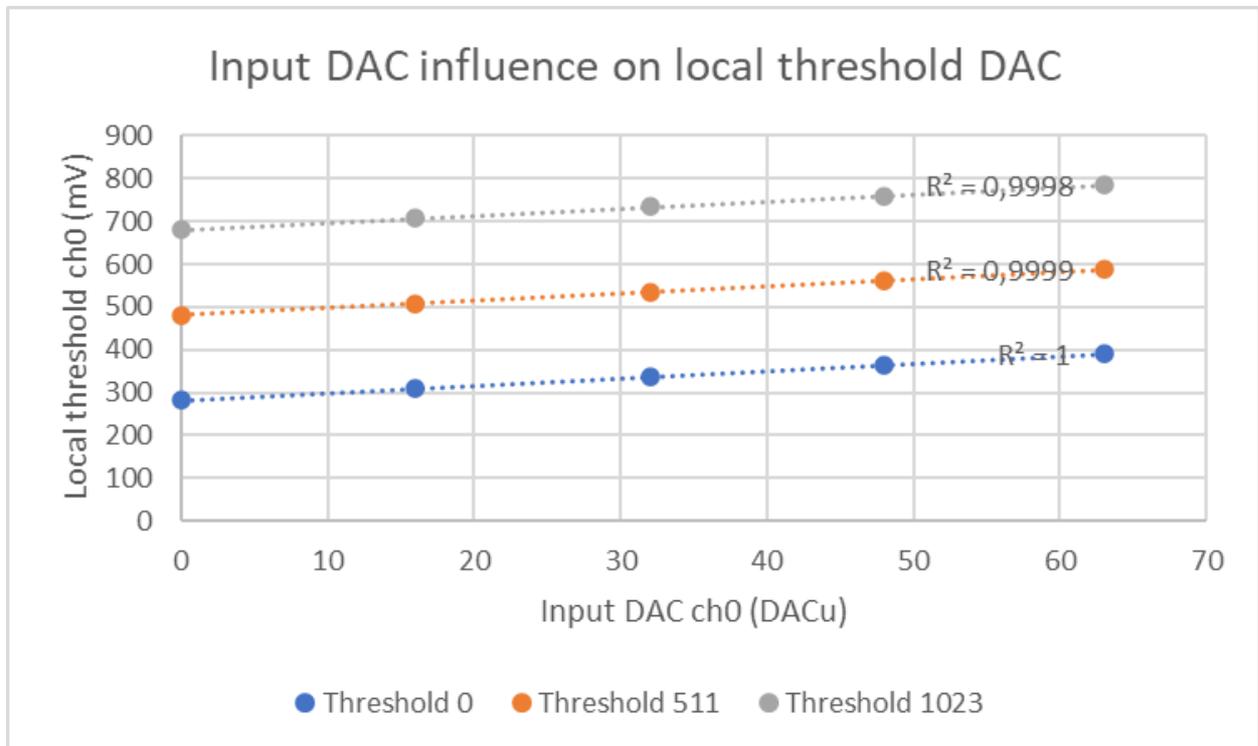

Figure 2: Input DAC influence on local threshold DAC

Unexpectedly, we observe a linear correlation between the input DAC and the local DAC. The local threshold increases by about 100mV in the whole input DAC dynamic range. On the contrary, the local threshold does not have an impact on the input DAC. So, to calibrate the device, we must start by calibrating the input DAC, so that the local threshold can compensate the induced shift. However, as the induced shift is huge, the threshold DAC dynamic range may have to be increased by placing a resistor (several hundred kΩ) between Ib_7b and 1.2V. This will impact the input DAC resolution and make the calibration less precise.

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Influence on the pre-amplifier DC level

Using the same setup (except for the analog probe which was set on the preamplifier output), we characterized the influence of the input DAC on the pre-amplifier DC level.
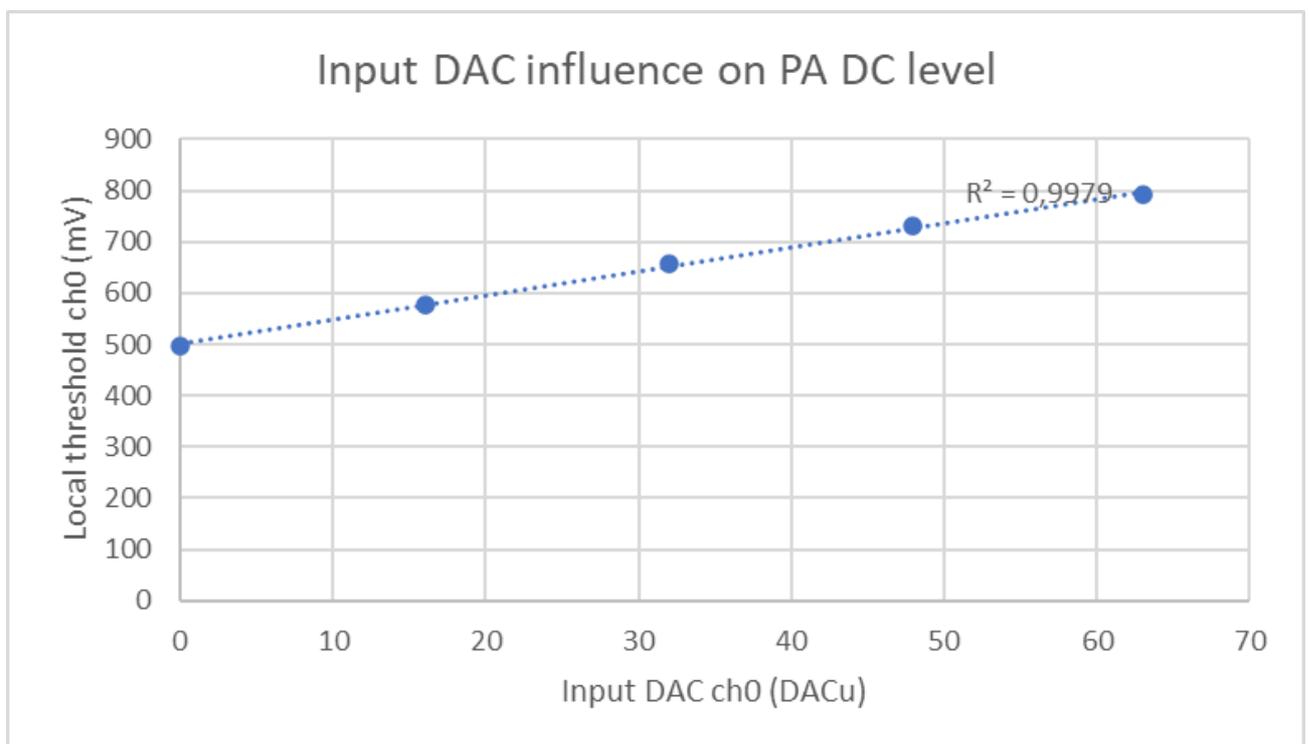

Figure 3 : Input DAC influence on pre-amplifier DC level

As in the previous measurement, we observe an unexpected linear correlation between the input DAC and the preamplifier DC level. This time, the local threshold increases by about 300mV.

Influence on the s-curves

Given the two previous measurements, we should be able to see clearly the shift when performing the s-curves. We performed a general threshold sweep between 400 and 1023 for 3 different input DAC value for channel 2.
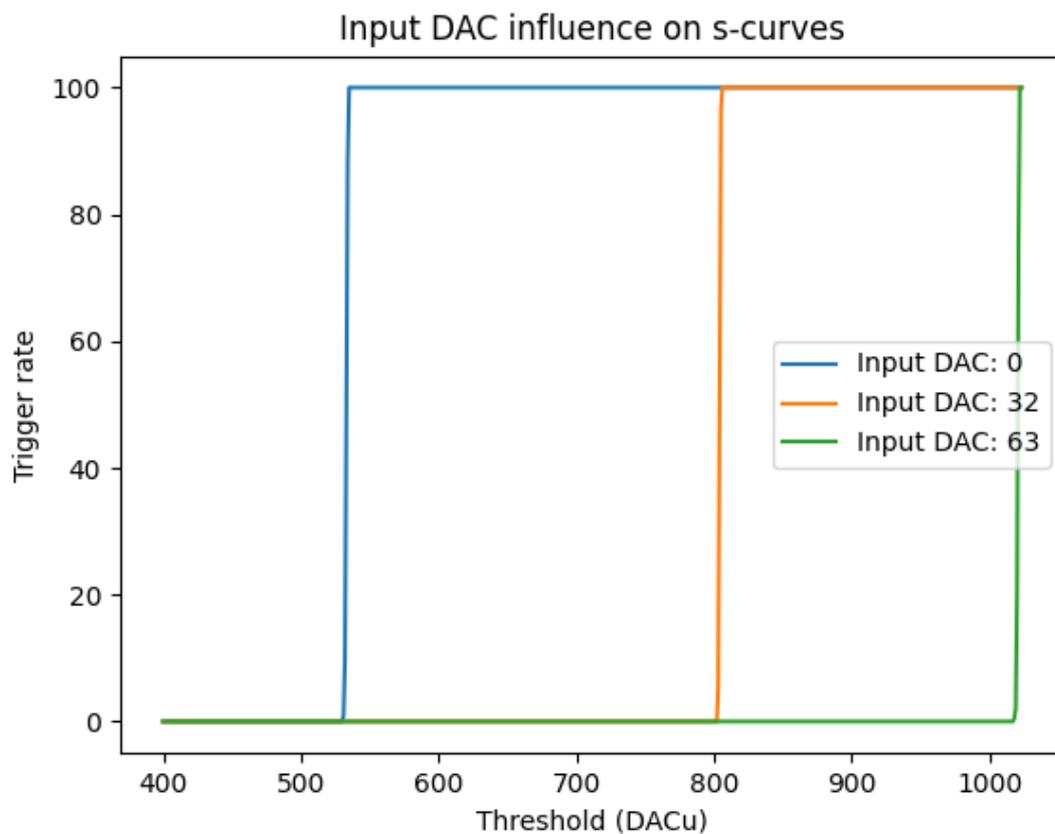

Figure 4: Input DAC influence on S-curves

The input DAC has a huge impact on the s-curve as it shifts by about 500 DAC units (~200mV). It is coherent with the two previous measurements as the preamplifier DC level is 300mV higher but the individual threshold is also 100mV higher.

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General threshold depolarization

Another unexpected effect we observed was when setting all input DAC higher than 14 DACu, the general threshold DAC was depolarized (Vth = 1.2V). Using the same setup as before, we tried placing different resistors between Vdac_pa and GND to draw current from the DAC, thereby requiring a higher DAC value to depolarize.
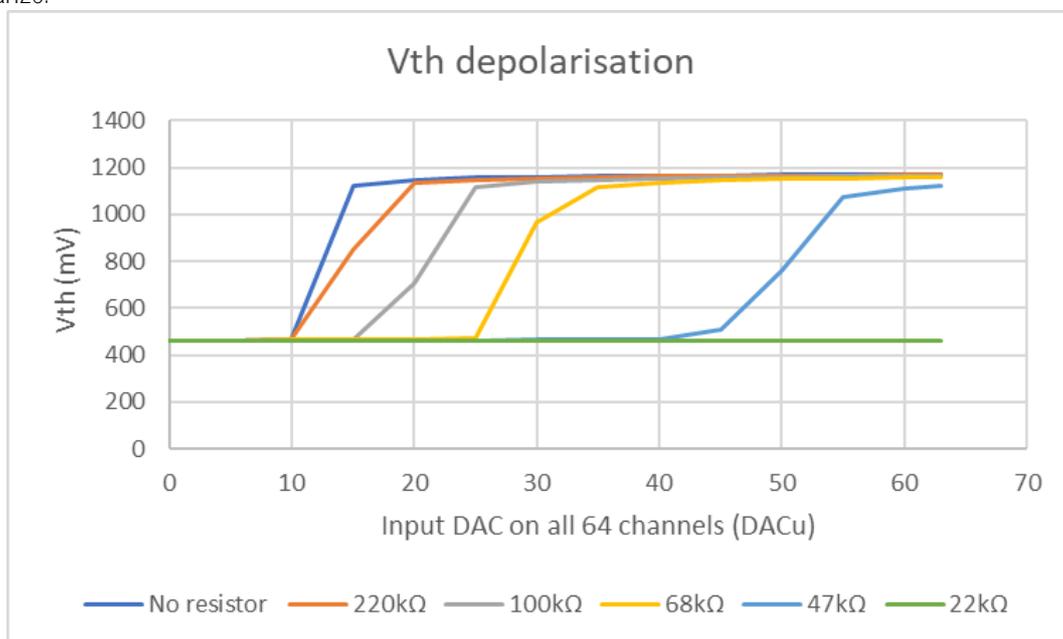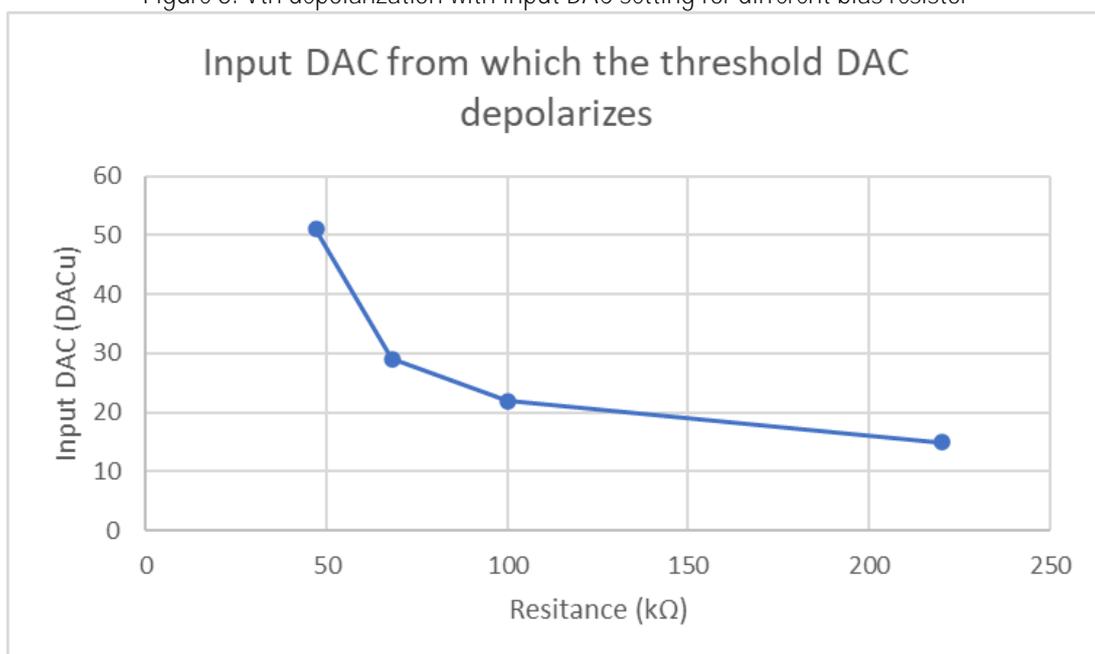

Figure 5: Vth depolarization with input DAC setting for different bias resistor

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Figure 6: Vth depolarization with input DAC setting for different bias resistor

add	subadd	data	add	subadd	data	add	subadd	data	add	subadd	data
0	0	00000000	17	1	01000000	35	0	00000000	52	1	01000000
0	1	01000000	18	0	00000000	35	1	01000000	53	0	00000000
1	0	00000000	18	1	01000000	36	0	00000000	53	1	01000000
1	1	01000000	19	0	00000000	36	1	01000000	54	0	00000000
2	0	00000000	19	1	01000000	37	0	00000000	54	1	01000000
2	1	01000000	20	0	00000000	37	1	01000000	55	0	00000000
3	0	00000000	20	1	01000000	38	0	00000000	55	1	01000000
3	1	01000000	21	0	00000000	38	1	01000000	56	0	00000000
4	0	00000000	21	1	01000000	39	0	00000000	56	1	01000000
4	1	01000000	22	0	00000000	39	1	01000000	57	0	00000000
5	0	00000000	22	1	01000000	40	0	00000000	57	1	01000000
5	1	01000000	23	0	00000000	40	1	01000000	58	0	00000000
6	0	00000000	23	1	01000000	41	0	00000000	58	1	01000000
6	1	01000000	24	0	00000000	41	1	01000000	59	0	00000000
7	0	00000000	24	1	01000000	42	0	00000000	59	1	01000000
7	1	01000000	25	0	00000000	42	1	01000000	60	0	00000000
8	0	00000000	25	1	01000000	43	0	00000000	60	1	01000000
8	1	01000000	26	0	00000000	43	1	01000000	61	0	00000000
9	0	00000000	26	1	01000000	44	0	00000000	61	1	01000000
9	1	01000000	27	0	00000000	44	1	01000000	62	0	00000000
10	0	00000000	27	1	01000000	45	0	00000000	62	1	01000000
10	1	01000000	28	0	00000000	45	1	01000000	63	0	00000000
11	0	00000000	28	1	01000000	46	0	00000000	63	1	01000000
11	1	01000000	29	0	00000000	46	1	01000000	64	0	10101000
12	0	00000000	29	1	01000000	47	0	00000000	64	1	10000000
12	1	01000000	30	0	00000000	47	1	01000000	64	2	10100000
13	0	00000000	30	1	01000000	48	0	00000000	65	0	10000000
13	1	01000000	31	0	00000000	48	1	01000000	65	1	10000001
14	0	00000000	31	1	01000000	49	0	00000000	65	2	11011000
14	1	01000000	32	0	00000000	49	1	01000000	66	0	01000000
15	0	00000000	32	1	01000000	50	0	00000000	66	1	00000000
15	1	01000000	33	0	00000000	50	1	01000000	66	2	00100000
16	0	00000000	33	1	01000000	51	0	00000000	67	0	10000100
16	1	01000000	34	0	00000000	51	1	01000000	67	1	10100000
17	0	00000000	34	1	01000000	52	0	00000000			

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