DCEM 1.3

Nov 29nd, 2023

Dante Totani

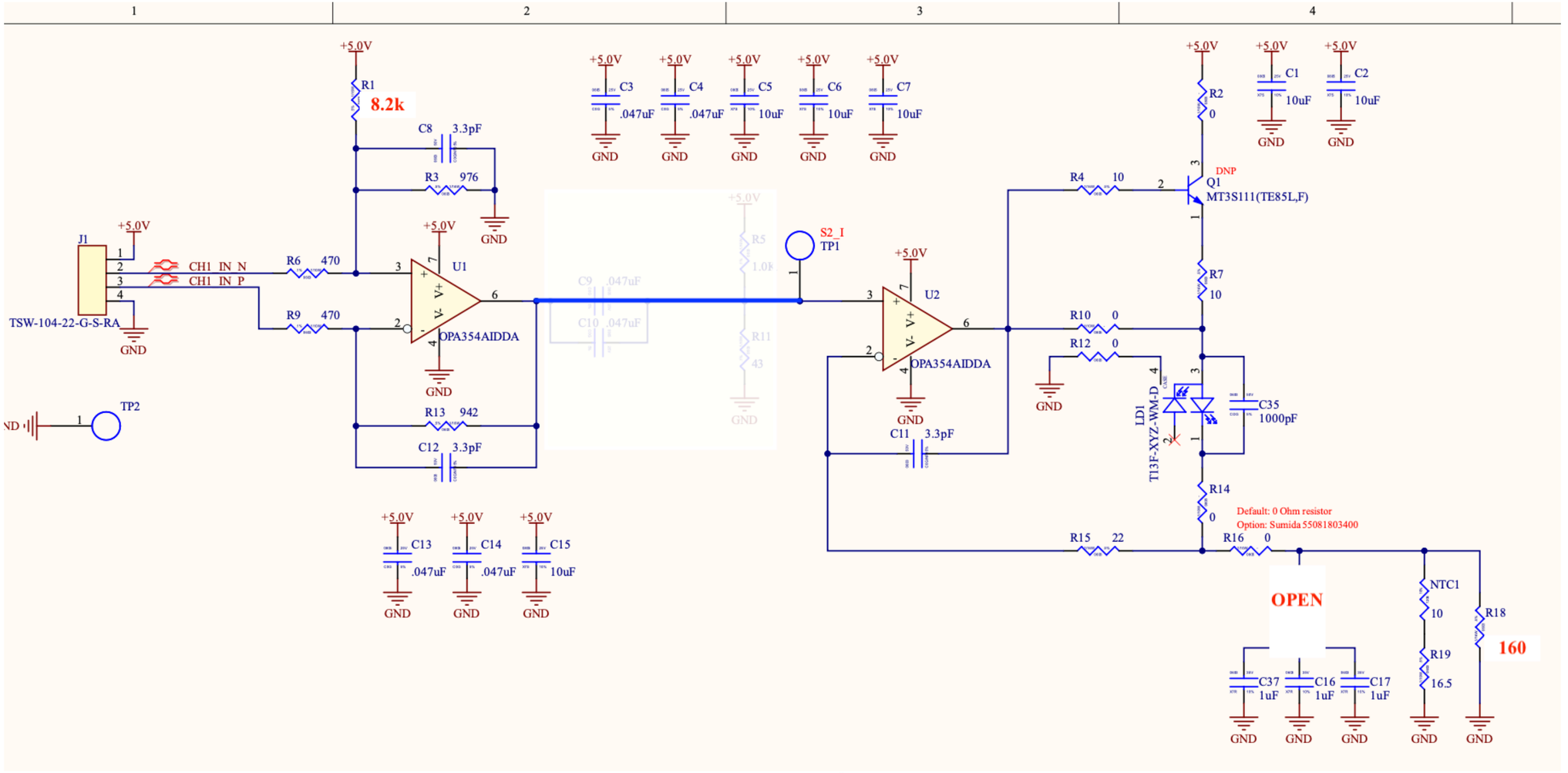
“Final” configuration:

Laser Output Load: R18 = 160 Ohm (only DC)

Offset 2nd OpAmp in: R1 = 8.2k Ohm

$V_{offset} = 414.2\,mV$

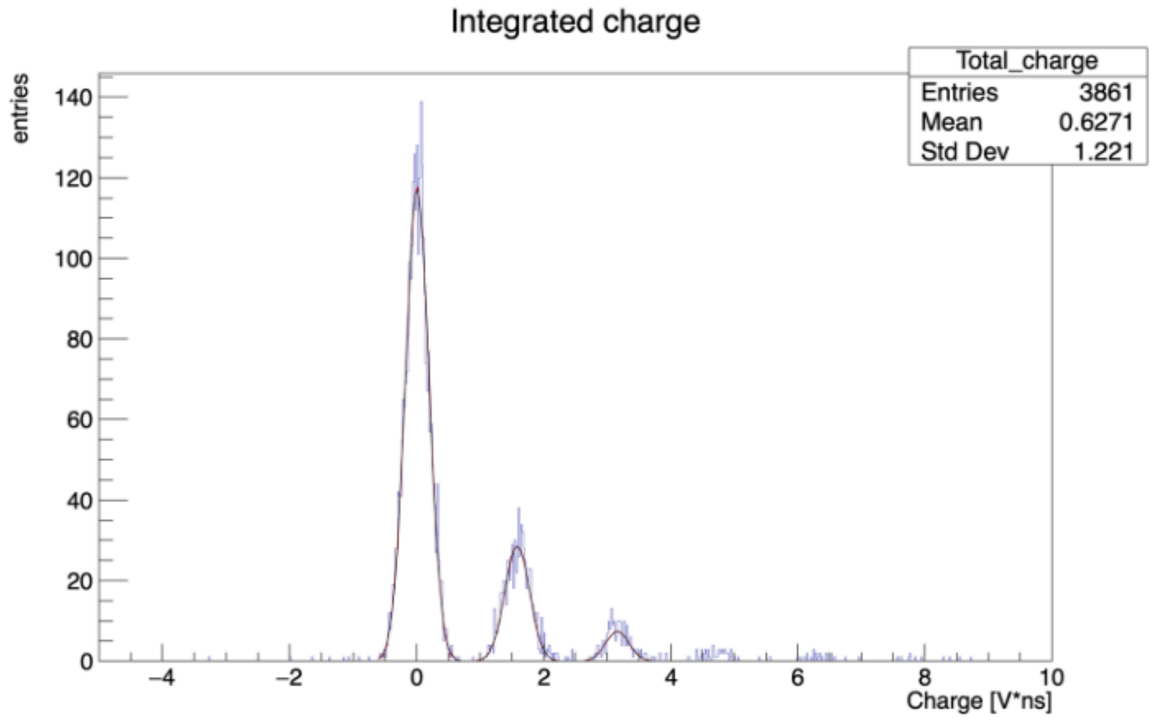
$I_{laser} = 2.589\,mA$



Config 11 board 2 ch 1(Board2_dcem1p3_LAr_ch1_conf11_47p5v.txt)

SNR = 8.5; Offset = 0.105 V (mean)

SPE amplitude = 1.10245e-3 V, Gain =1.58

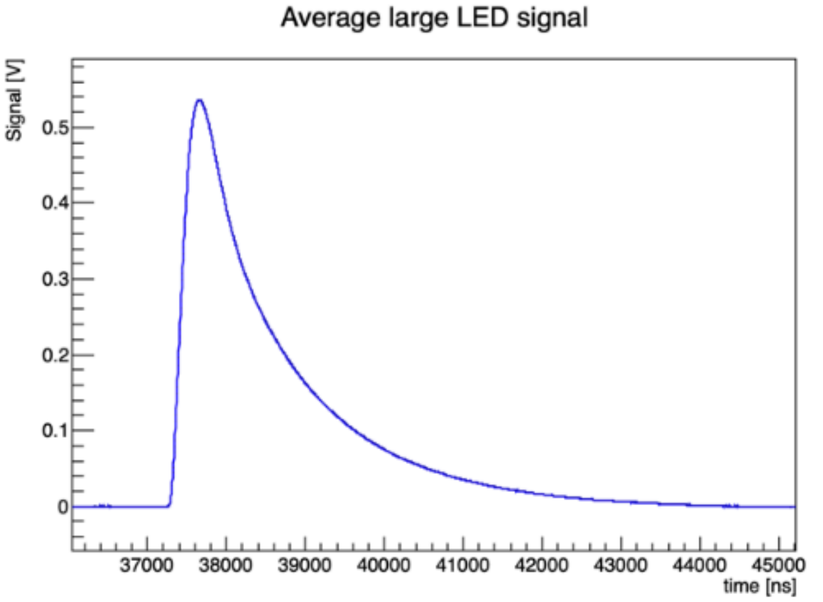


Amplitude max = 1.60723V

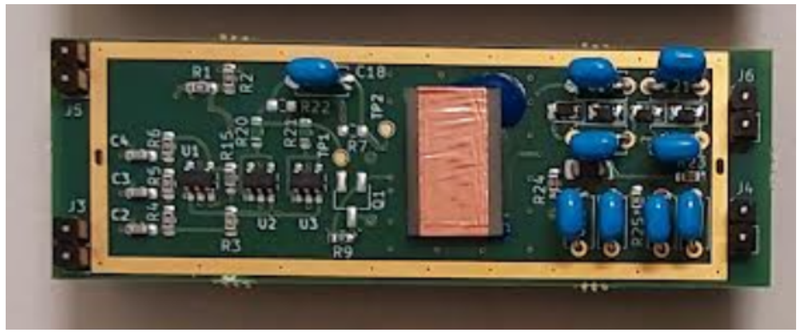
Range = 1458

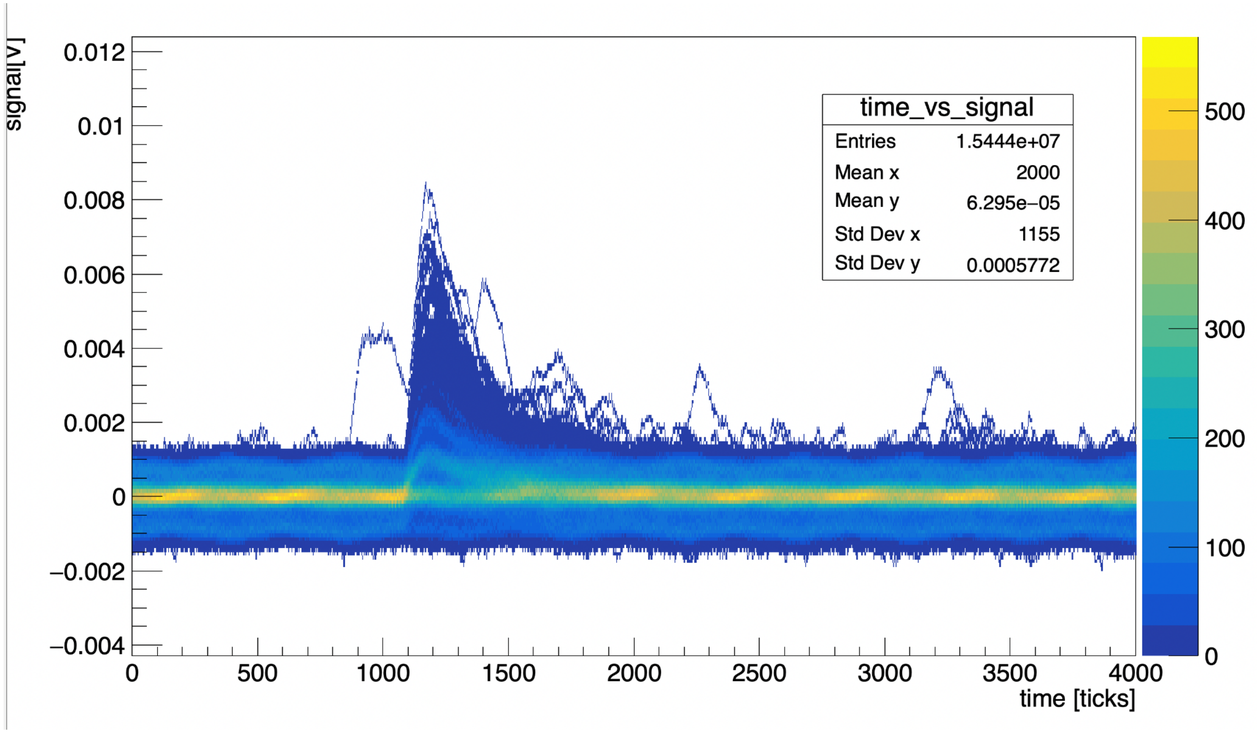
rise time 220ns decay time =2636ns

undershoot fraction 0.845148 %



DCDC for HPK





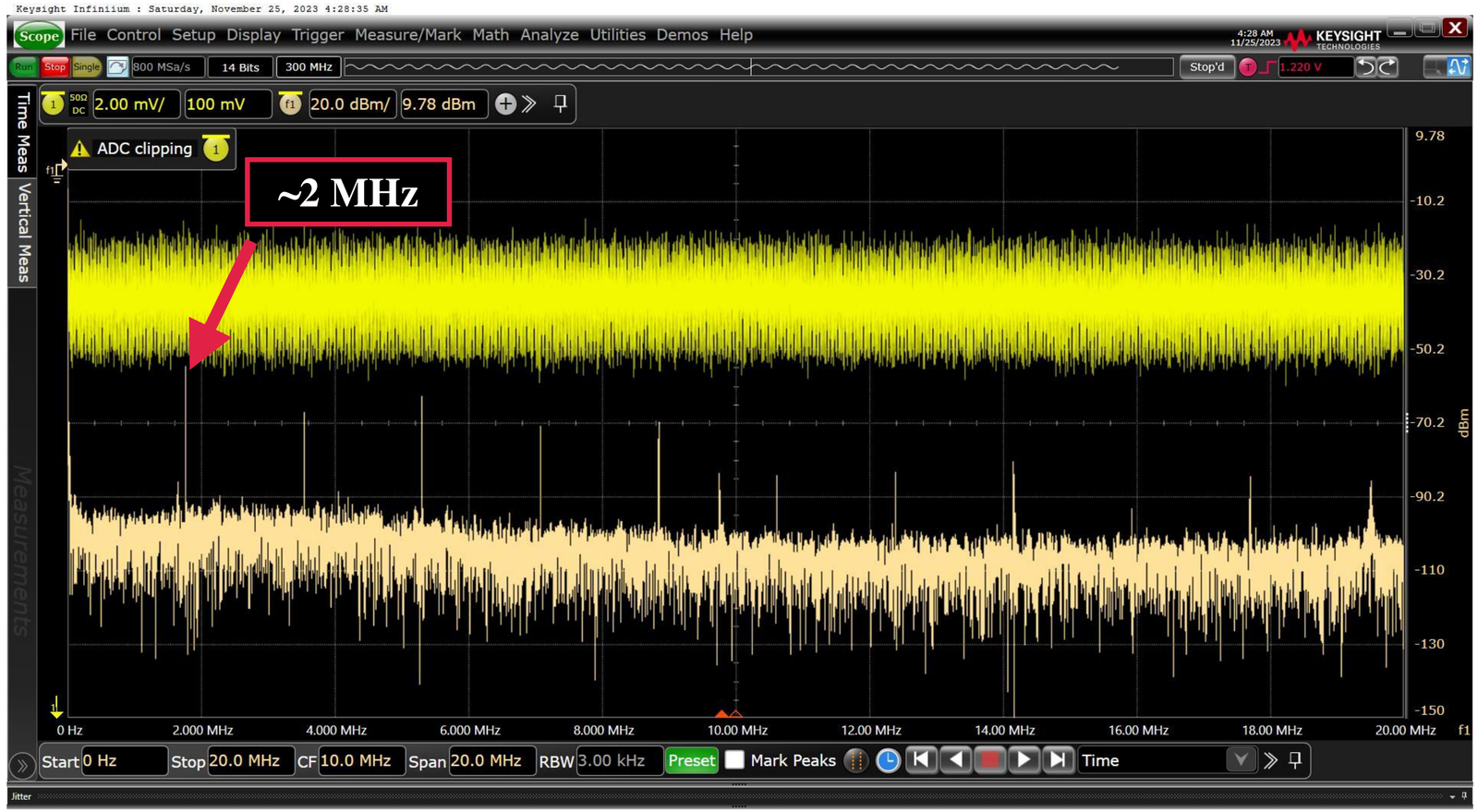
DCDC SN09 4 flex connected

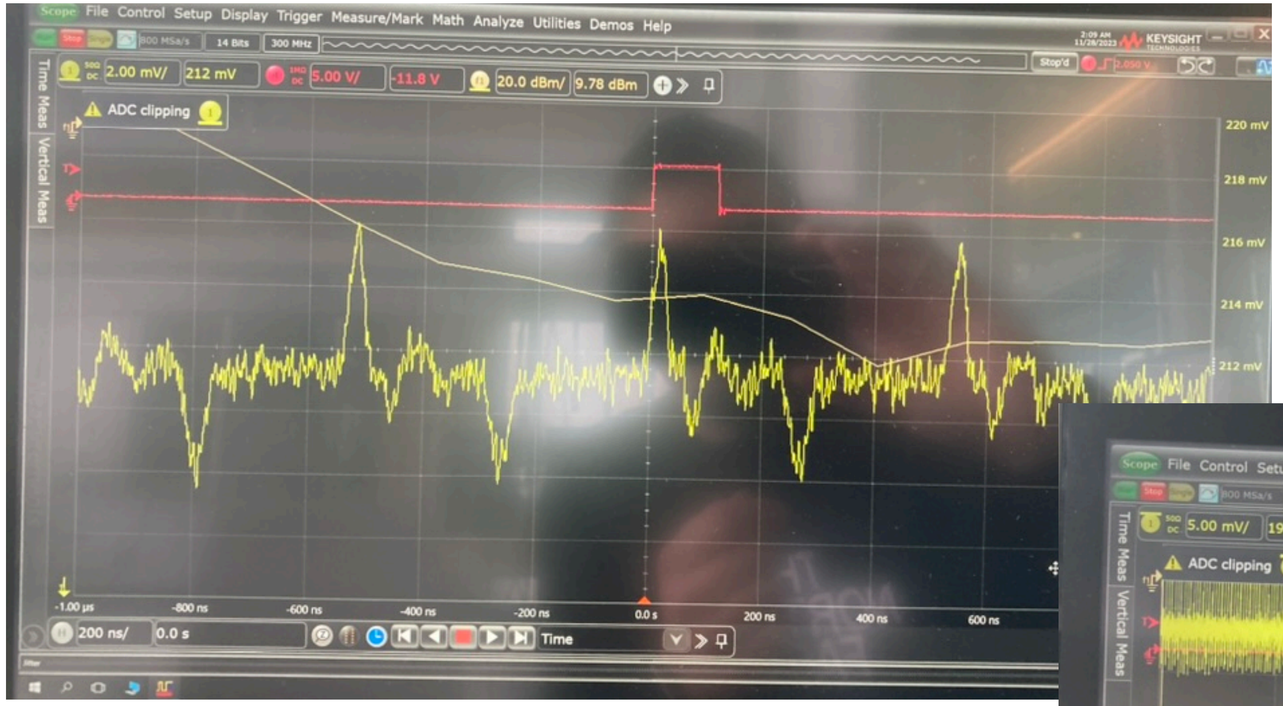
Room T	LAr
V_ldo_in = 5.3 V I_ldo_in = 126 mA	V_ldo_in = 5.3 V I_ldo_in = 60 mA
V_dcdc_out= 52.9 V	**V_dcdc_out= 47.1 V**
LED pulses well visible	LED pulses well visible Noise ~2Mhz

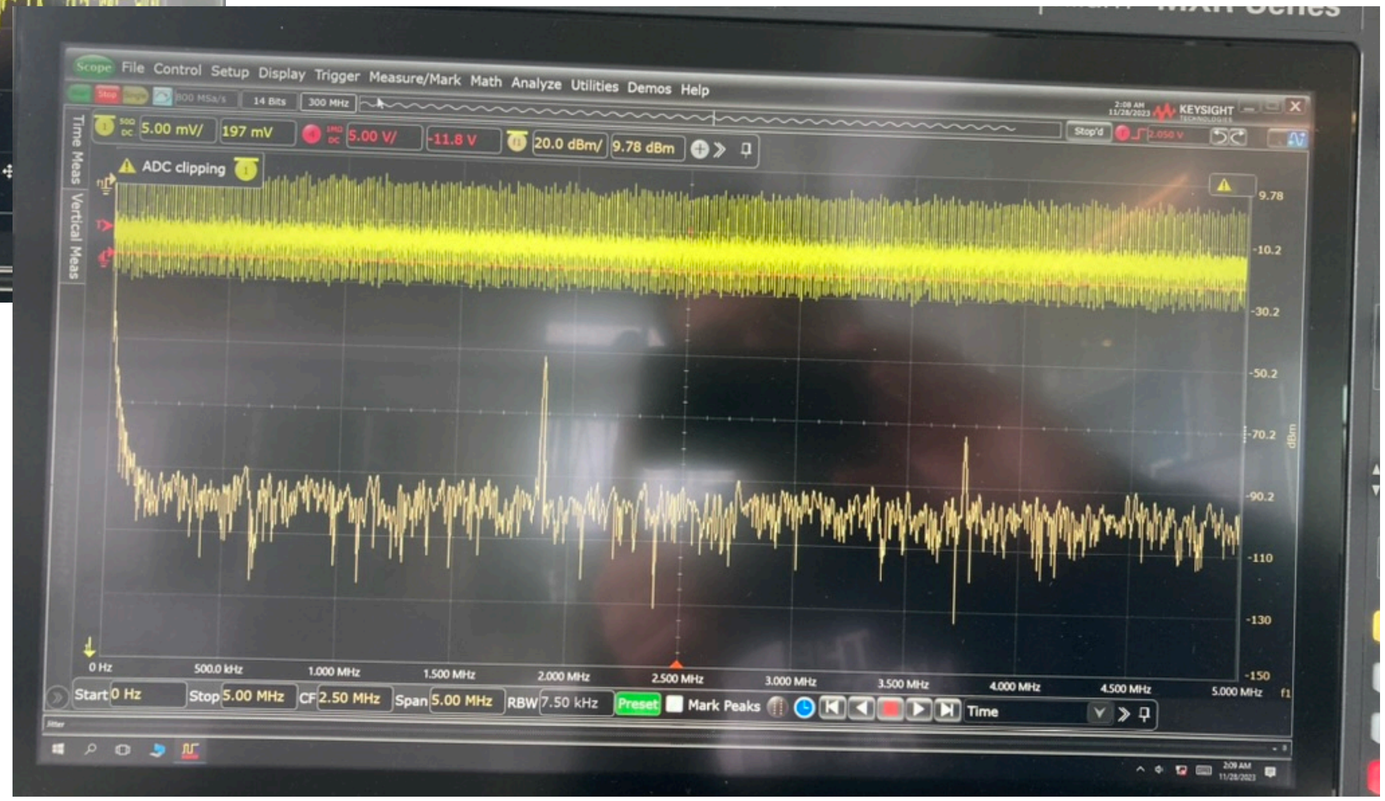
DCDC

A “large” ~2 MHz noise comes from the DCDC
Noise looks to be radiative:

- DCDC connected to DCEM through 1m cables, noise disappear
- Hands made shielding (copper tape) remove almost completely the noise.




Scope File Control Setup Display Trigger Measure/Mark Math Analyze Utilities Demos Help
2.00 mV/ 212 mV
5.00 V/ -11.8 V
20.0 dBm/ 9.78 dBm
ADC clipping
220 mV
218 mV
216 mV
214 mV
212 mV
-1.00 µs -800 ns -600 ns -400 ns -200 ns 0.0 s 200 ns 400 ns 600 ns
200 ns/ 0.0 s
Time


Scope File Control Setup Display Trigger Measure/Mark Math Analyze Utilities Demos Help
5.00 mV/ 197 mV
5.00 V/ -11.8 V
20.0 dBm/ 9.78 dBm
ADC clipping
9.78
-10.2
-30.2
-50.2
-70.2
-90.2
-110
-130
-150
dBm
0 Hz 500.0 kHz 1.000 MHz 1.500 MHz 2.000 MHz 2.500 MHz 3.000 MHz 3.500 MHz 4.000 MHz 4.500 MHz 5.000 MHz
Start 0 Hz Stop 5.00 MHz CF 2.50 MHz Span 5.00 MHz RBW 7.50 kHz Preset Mark Peaks
Time

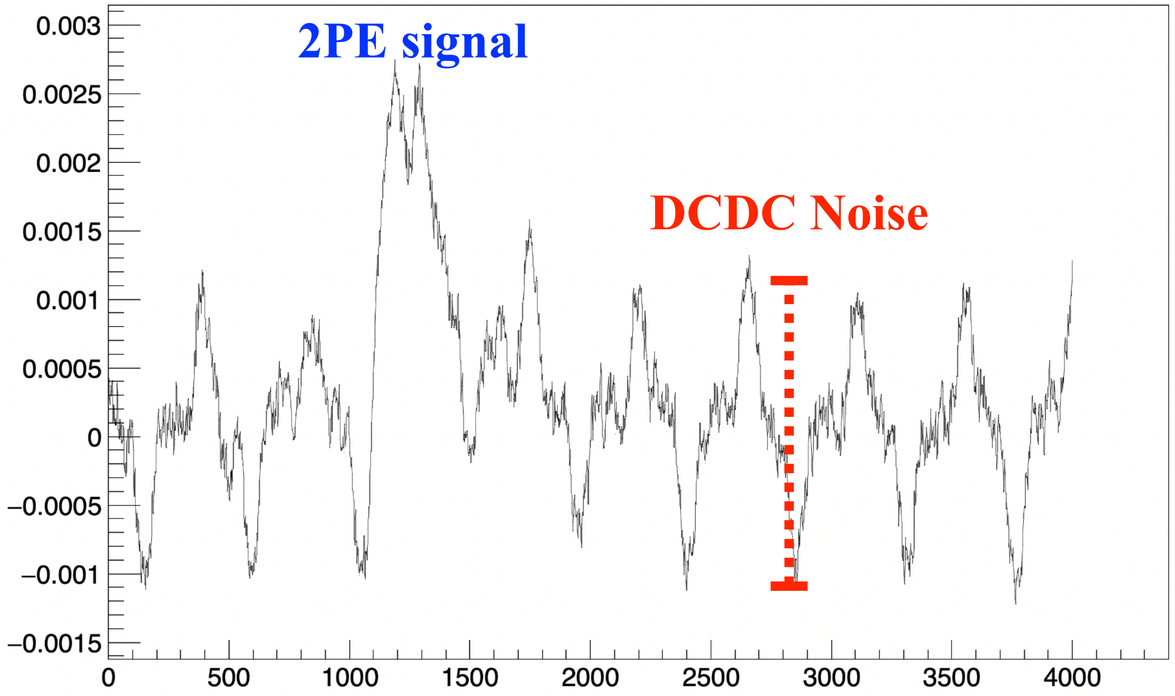
DCDC

- Noise itself is small but it is amplified tighter with the signal.
- Hard to see it looking only at the DCDC.
- Needs to be compared to SPE amplitude.

Noise at the Koheron output:

- Room T ~10 mV pkpk
- LAr ~ 2 mV pkpk

(Differences are due to different gain cold vs. warm, see NTC)



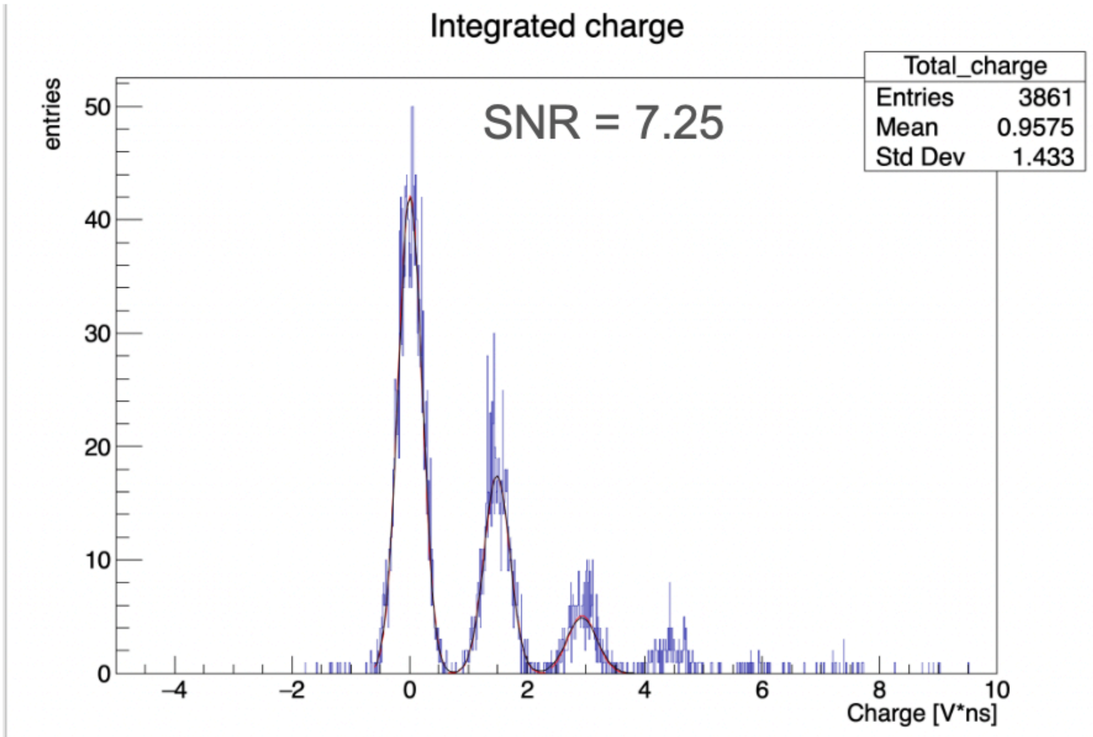
In LAr situation, the noise level is high compared to SPE amplitude:

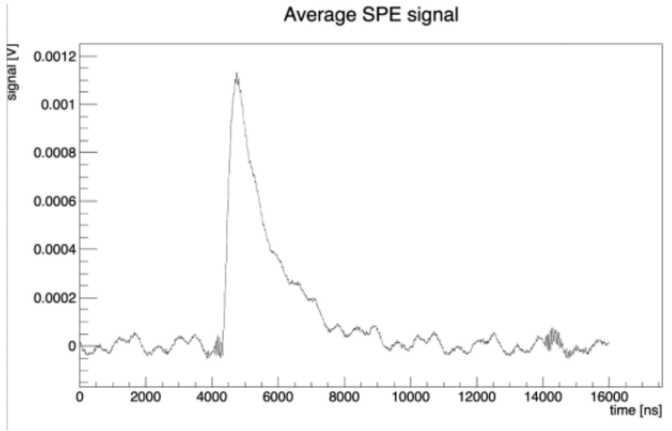
Noise = 2mV pkpk,
SPE = 1.1mV

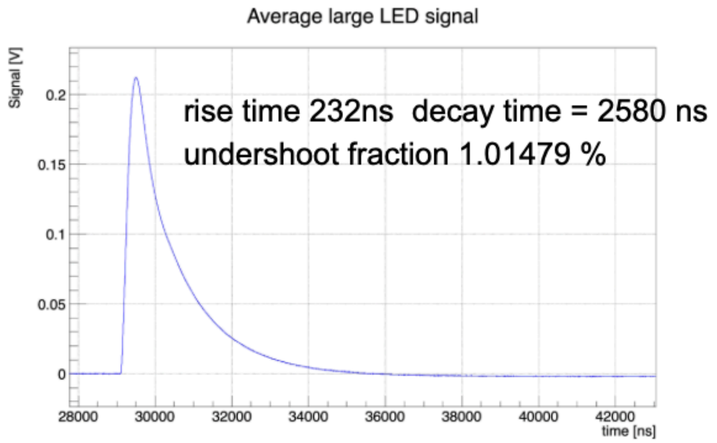
However the 2MHz frequency is fast enough to lie inside the signal integration window → it is possible to recover the performances obtained with no DCDC even before including a shielding.

“Final” configuration + DCDC

Maximum amplitude = 1.60994 V
SPE amplitude = 1.13 mV
Range = 1424
Gain = 1.49







Note that the DCDC bias is 47.1V

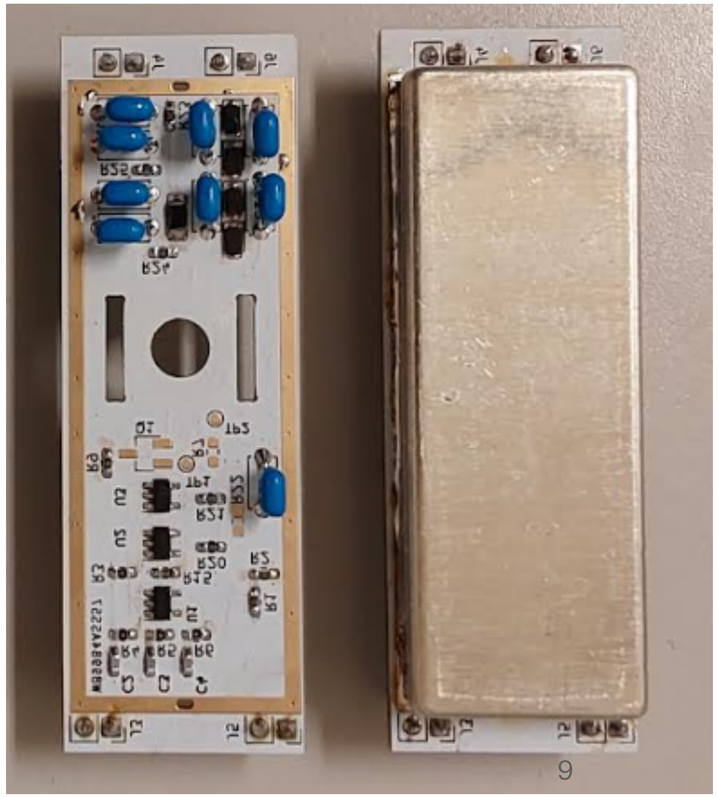
The SNR~8 obtained with an external bias was for 47.5V.

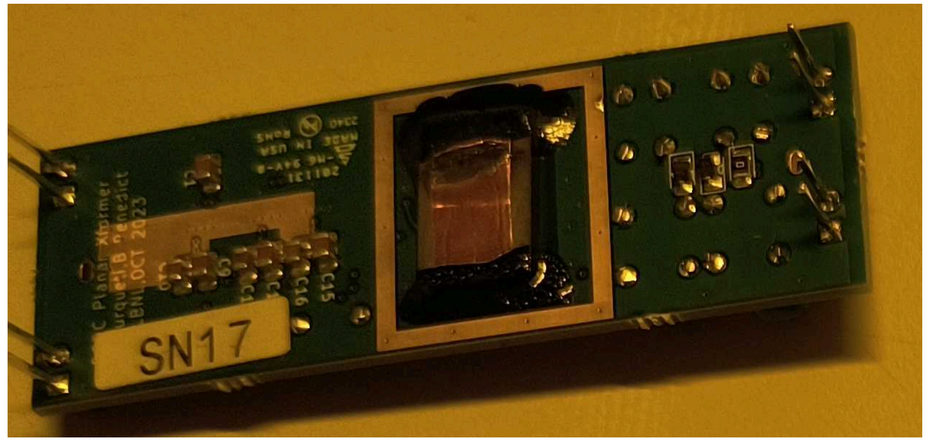
A smaller SNR is expected independently from the noise introduced by the DCDC

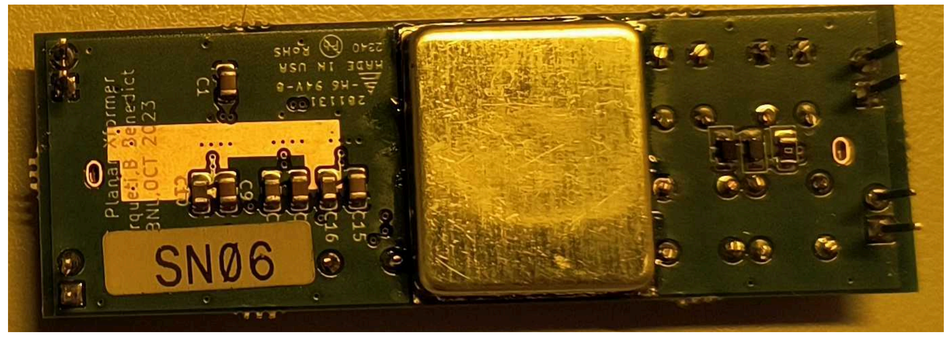
DCDC dedicated shielding

We have a dedicated shielding
Right now, it is installed in one HPK DCDC and one FBK DCDC.
The two DCDCs shielded are both at CERN.

Waiting to receive more DCDC and shielding at Fermilab, needs to check how it works.
In the main time using a handmade shielding, hoping it stay in place when in LAr.





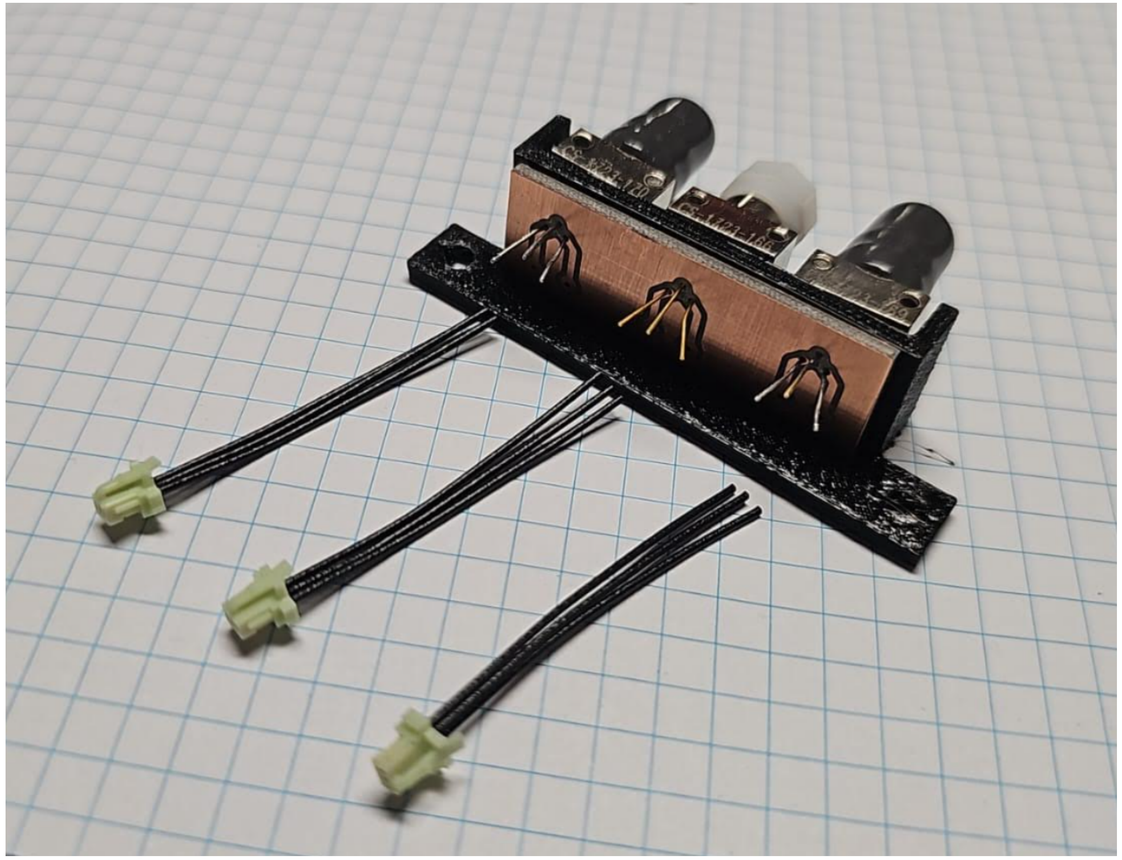


Next step: POF

One POF module is ready to be plugged in one DCEM at Fermilab.

Waiting for the laser box to power it and for more Liquid Argon for cold test.

Three OPC should be much more than needed for cold and probably two will be enough even for warm test.



Test Plan: (first warm and then cold)

Powering the full chain (DCEM + 4 HPK flex + DCDC) with 1, 2 and 3 of PoF plugged, monitoring the voltage at:

1- LDO in (=OPC out). **2-** LDO_OpAmp OUT. **3-** LDO_DCDC OUT (=DCDC in). **4-** DCDC out (SiPM in).

Boards at CERN

4x almost full set of electronics is at CERN
(OPC for PoF not there yet… Bill and Drew will carry them next week?)

- 4 DCEM
- 4 laser daughter cards
- 4 (3+1) DCDC

The 4 DCEM at CERN needs to be set in the final config (see next slides).
And tested…

X-Arapuca modules form NIU are ready to be shipped (@Kurt).
X-Arapuca modules form Spain are at CERN (@Manule).

I can prepare extra 4 DCEM boards to be carried by Bill and Drew at CERN.
I have no extra DCDC in my hands right now, (they should arrive before Bill and Drew leave).

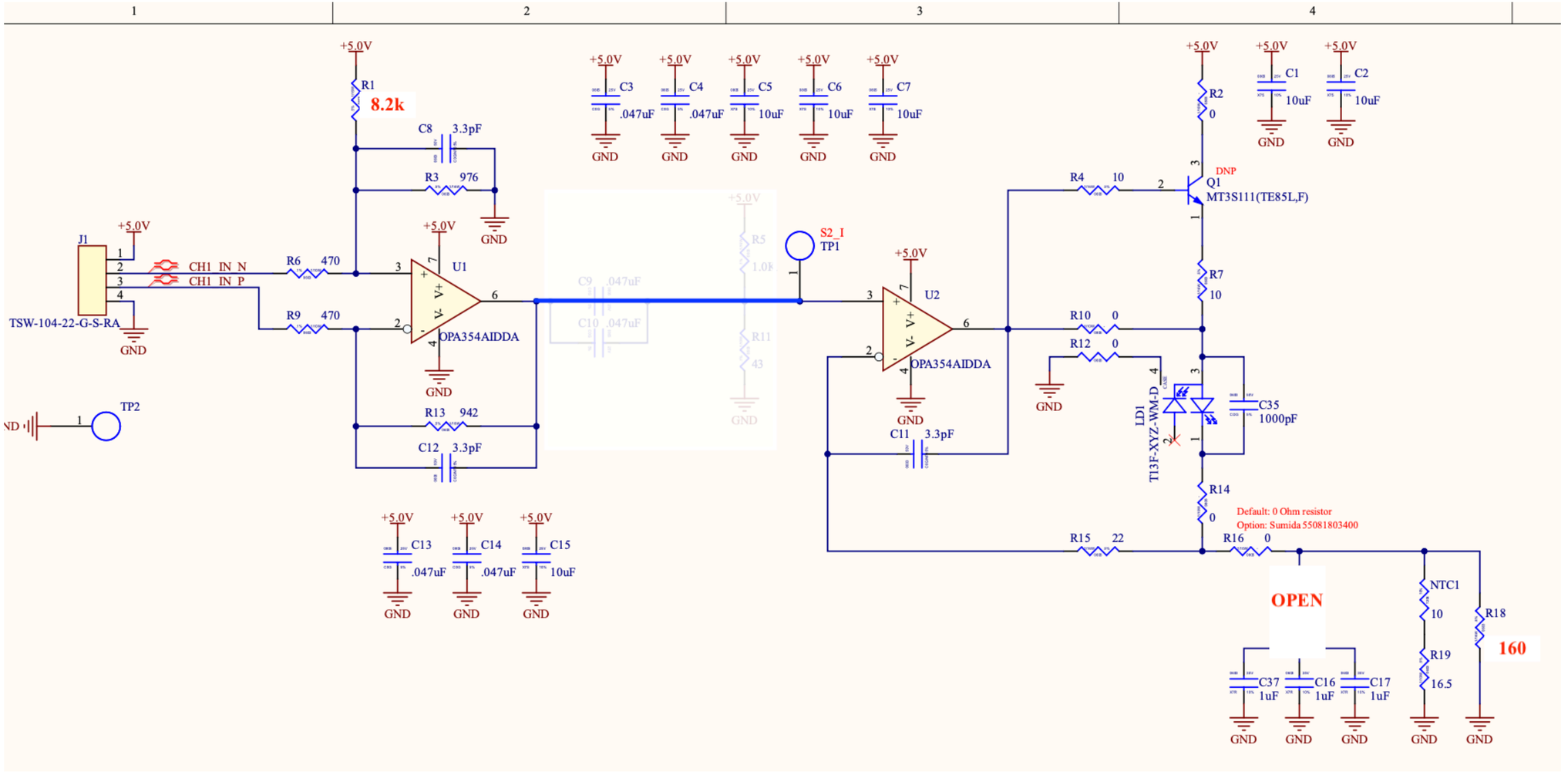
“Final” configuration:

Laser Output Load: R18 = 160 Ohm (only DC)

Offset 2nd OpAmp in: R1 = 8.2k Ohm

$$V_{offset} = 414.2\,mV$$

$$I_{laser} = 2.589\,mA$$

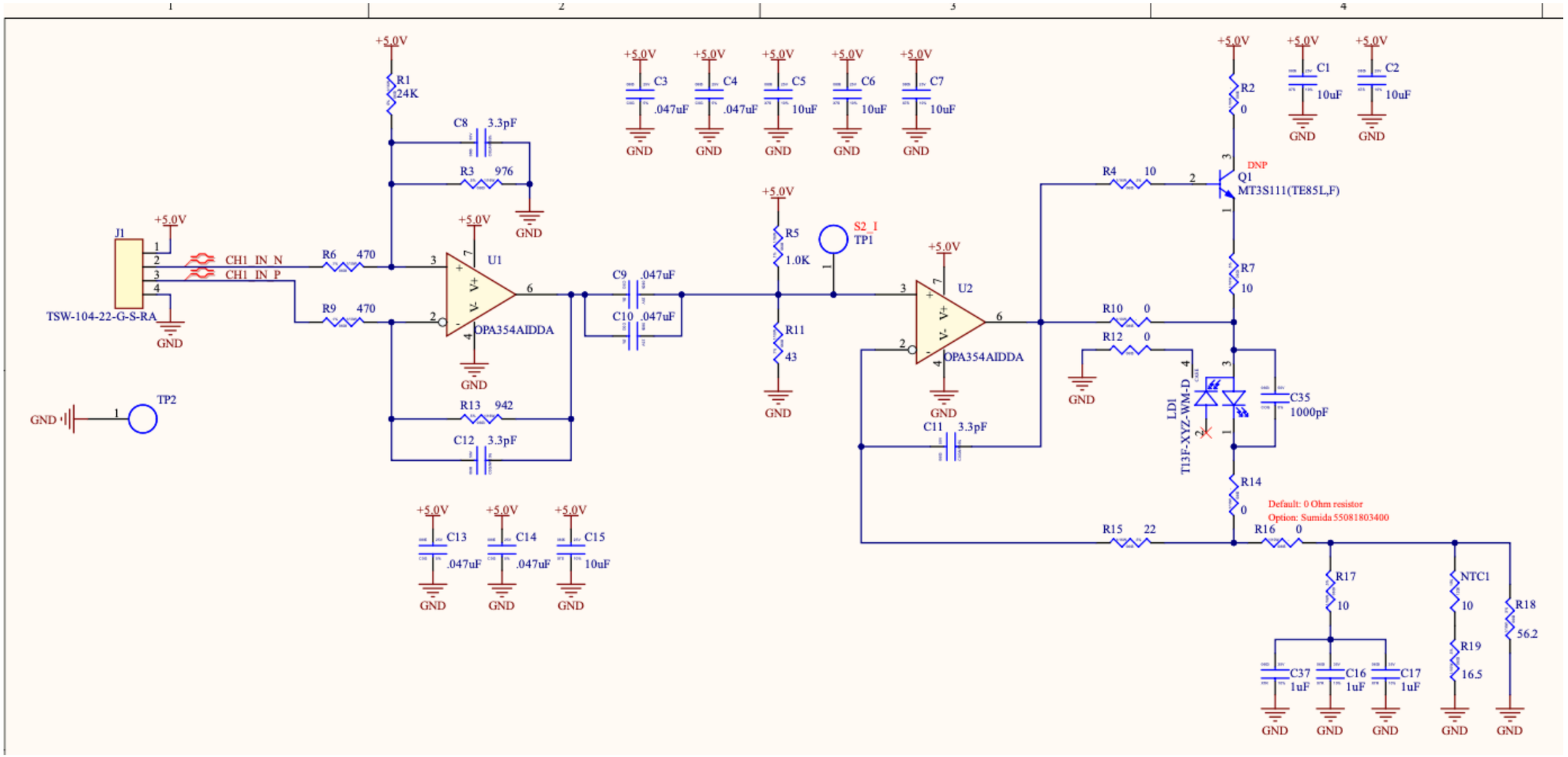


List of changes

- R1, R20 -> replace with 8.2 kΩ
- R18, R37 -> replace with 160 Ω
- R5, R11, R17, R24, R30, R36 -> remove
- C9, C10, C26, C27 -> remove and jumper (0 Ω) on C9 and C26

Channel 1

Original schematic for part number reference



Channel 2

Original schematic for part number reference