R&D on frontend and service devices

Hans Muller CERN PH

VMM-128 hybrid frontend for SRS

S.Martoiu IFIN, A. Rusu IFIN, Byungchul KIM Tsukuba, H.Muller CERN

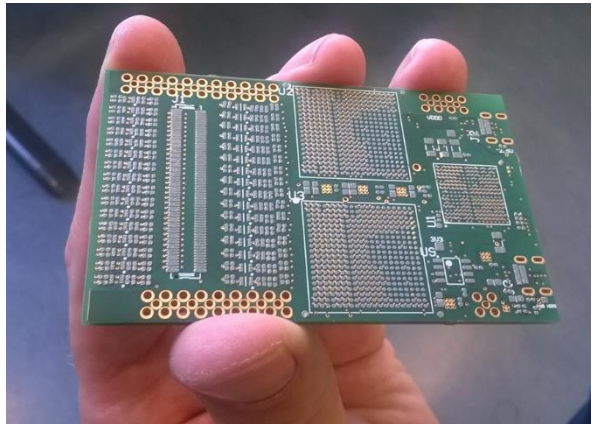
VMMx : new, high-rate frontend for SRS

VMM-2 hybrid prototyping (ATLAS code name: Mini-2)

(S.Martoiu, A.Rusu, H,Muller)

- 8/2014 –Feb 2015: 2 pre-versions V1, designed and assembled by RD51, tested by ATLAS NSW
- 5/2015: 2 revised v2, designed and assembled by RD51, tested by ATLAS NSW and Tsukuba TECH in GDD lab
- 8/2015: production of 19 hybrids V2 in Israel (NSW 16 + RD51 3)

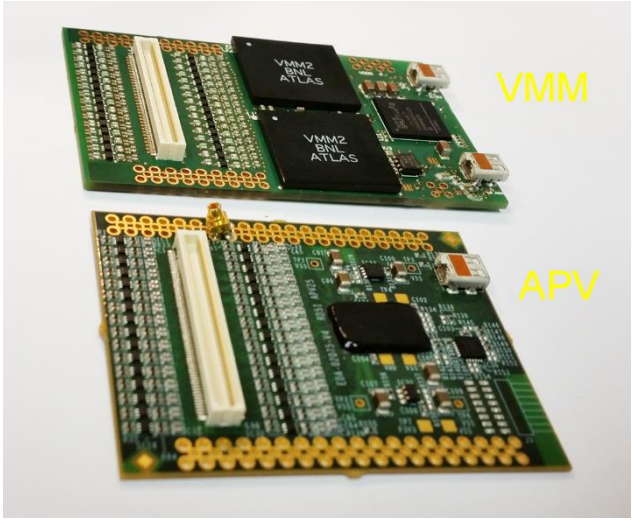
Test results on MINI-2 are presented in various ATLAS NSW meetings



8-layer PCB (80 x 50 mm) RD51

VMM –SRS Applications/Users (waiting for VMM3 version)

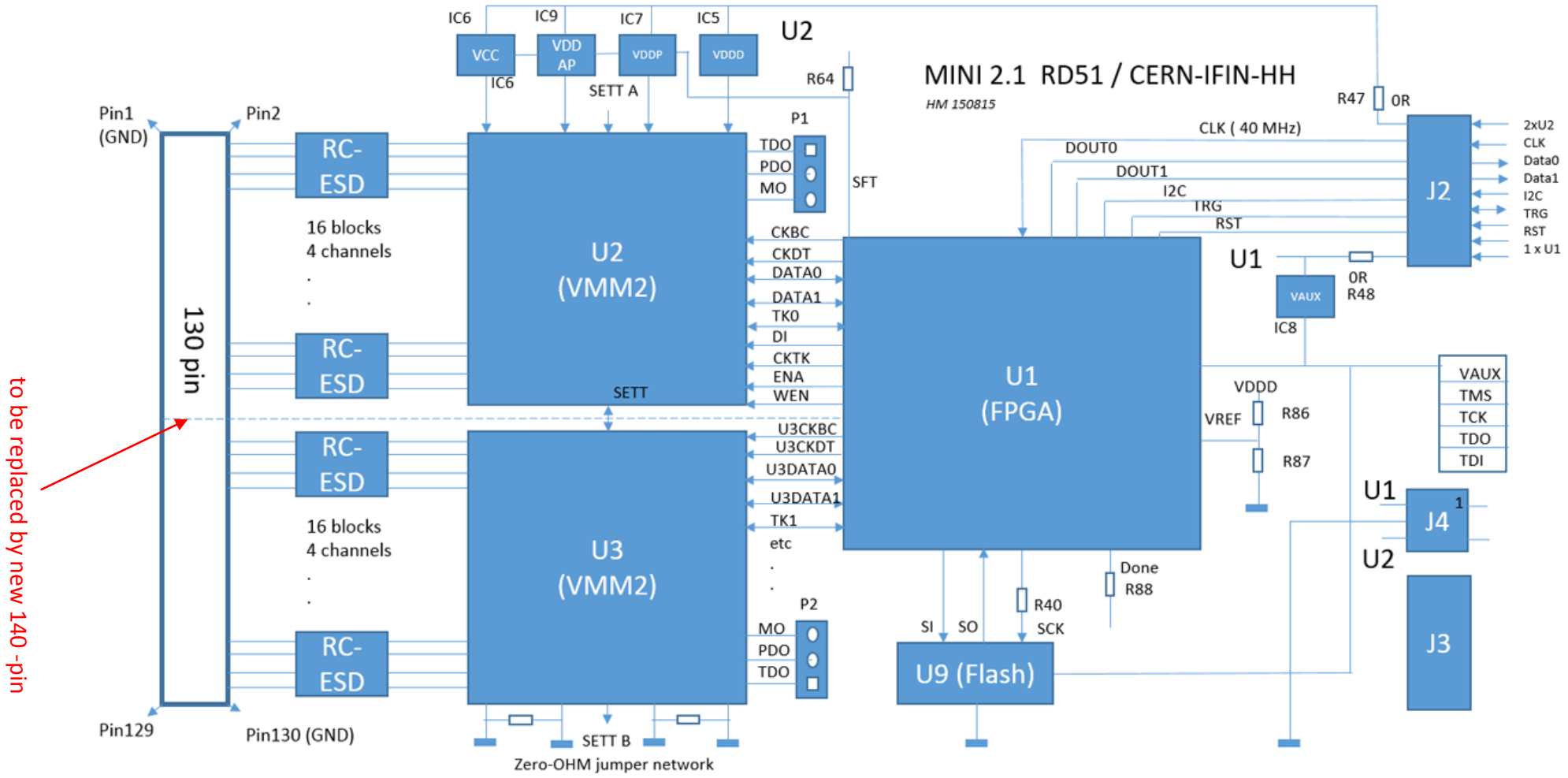
-RD51 institutes: high-rate alternative to APV hybrid
-ATLAS NSW (Mini-2.1): testbeams
-ESS Spallation source: neutron detectors
-Tsukuba Tech: modified VMM for ALICE FOCal
-T2DM2: for MUST detector @ LSBB
-more in discussion



APV and VMM hybrids:
128 ch, 50 mm width
same sparc protection and RC coupled frontend
DTCC and power via HDMI link to SRS

VMM -128 architecture (V2)

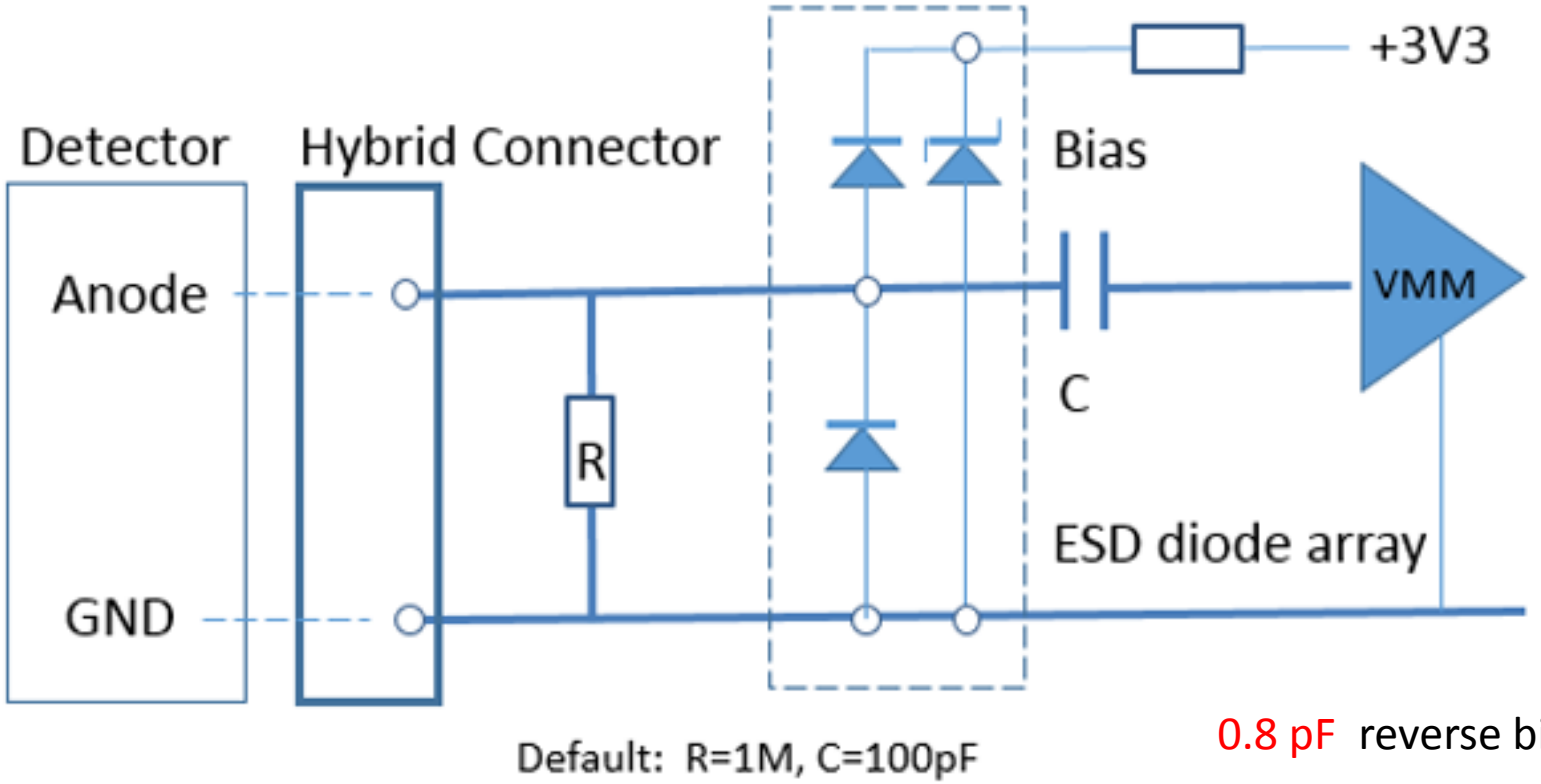
design S.Martoiu
routing and prototypes A.Rusu
concepts, decoupling, resources H.Muller



VMM-128 sparc-protected, AC coupling

IEC 61000–4–2 Spec. for ESD diodes used on APV and VMM

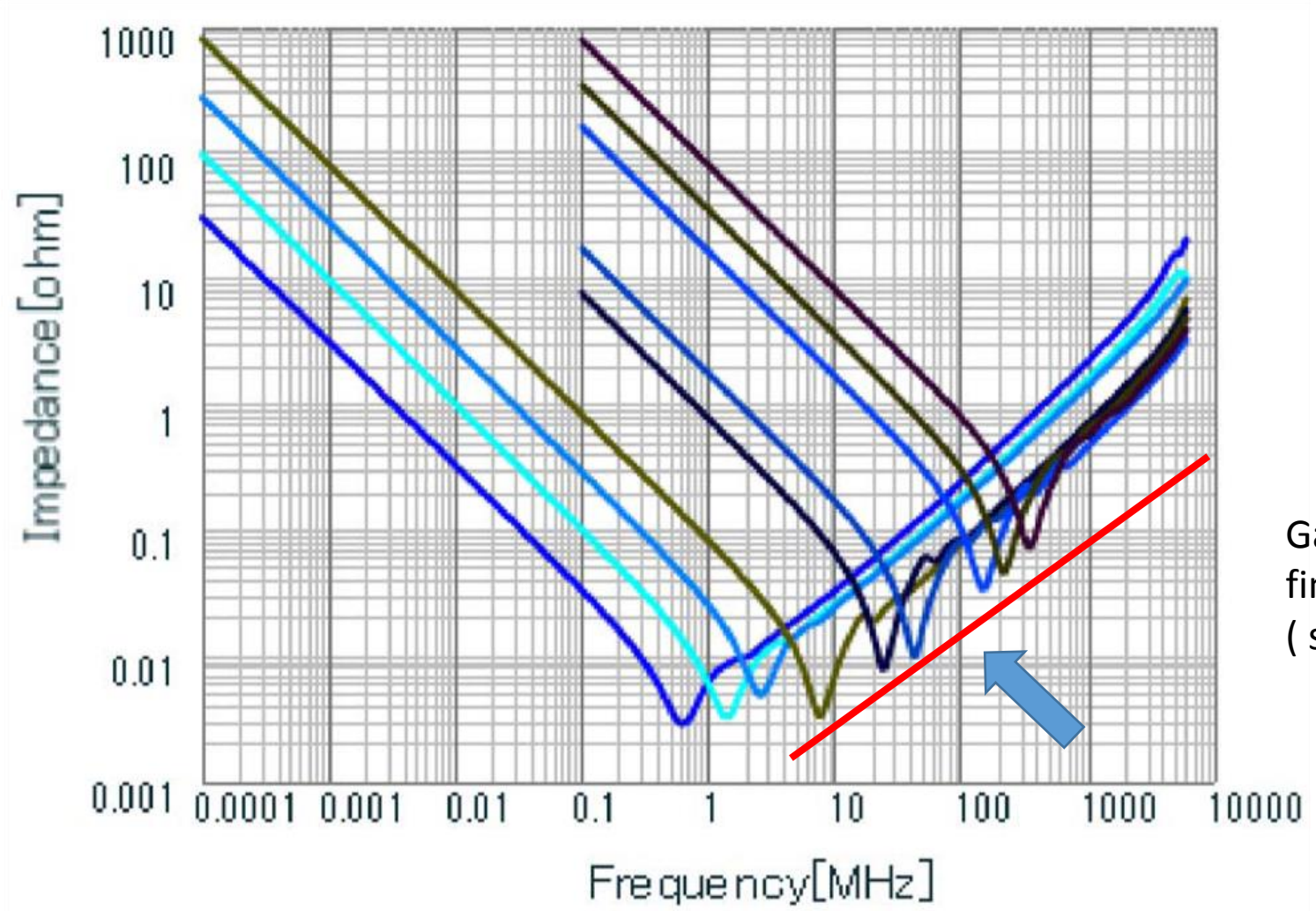
Test Voltage (kV)	First Current peak (A)	Current @ 30 ns (A)	Current at 60 ns (A)
8	30	16	8



Default: R=1M, C=100pF

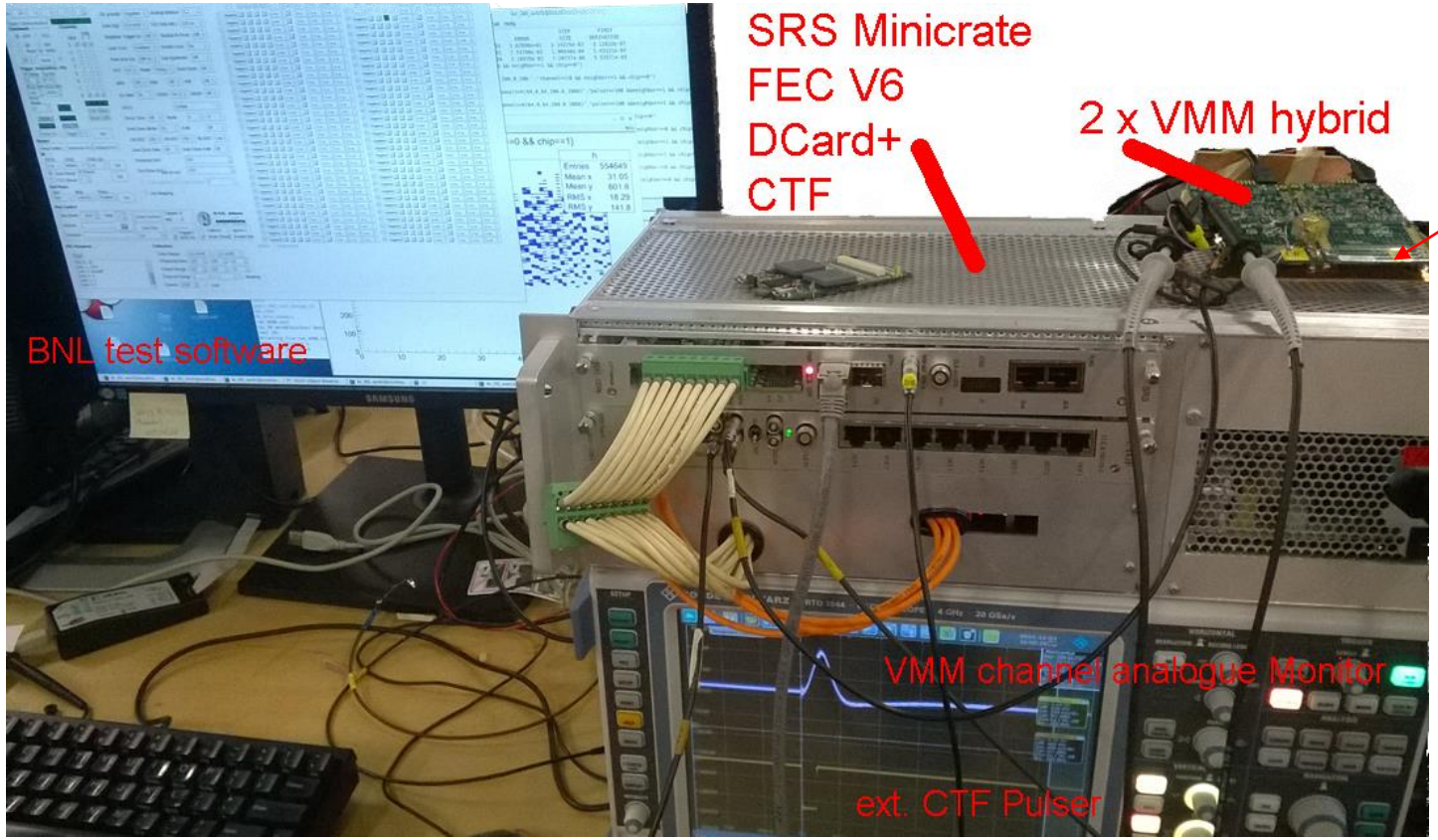
0.8 pF reverse bias capacitance

Capacitive Impedance analysis VMM-128, v2

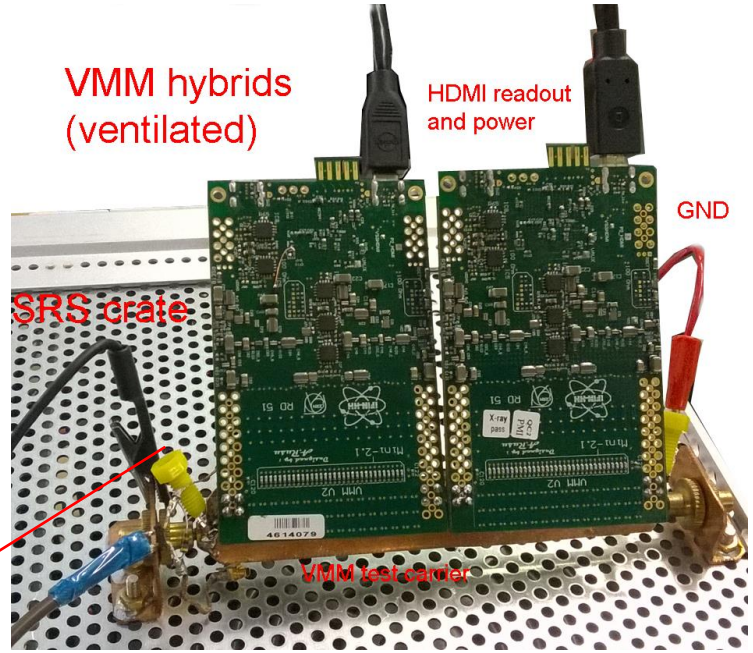


Gaps around 80-110 MHz to be closed in final version
(see FFT noise spectrum page 8)

GDD-lab test station VMM



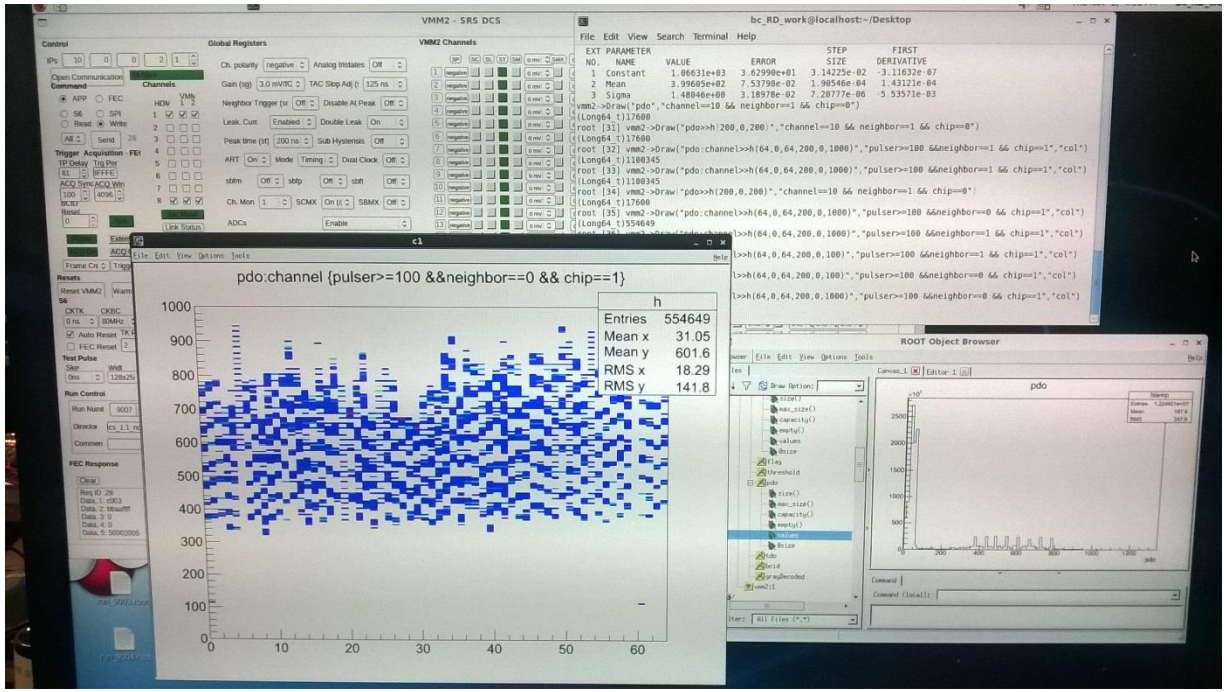
VMM test station in GDD lab (RD51/Tsukuba)

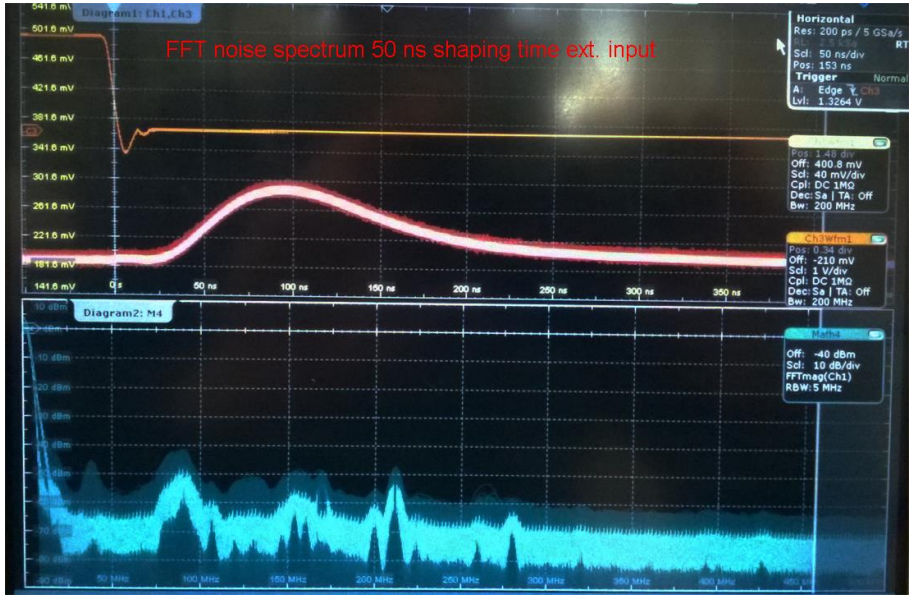


Cooling “via SRS crate”

External pulse injection with variable “detector” capacitance

VMM Test Analysis





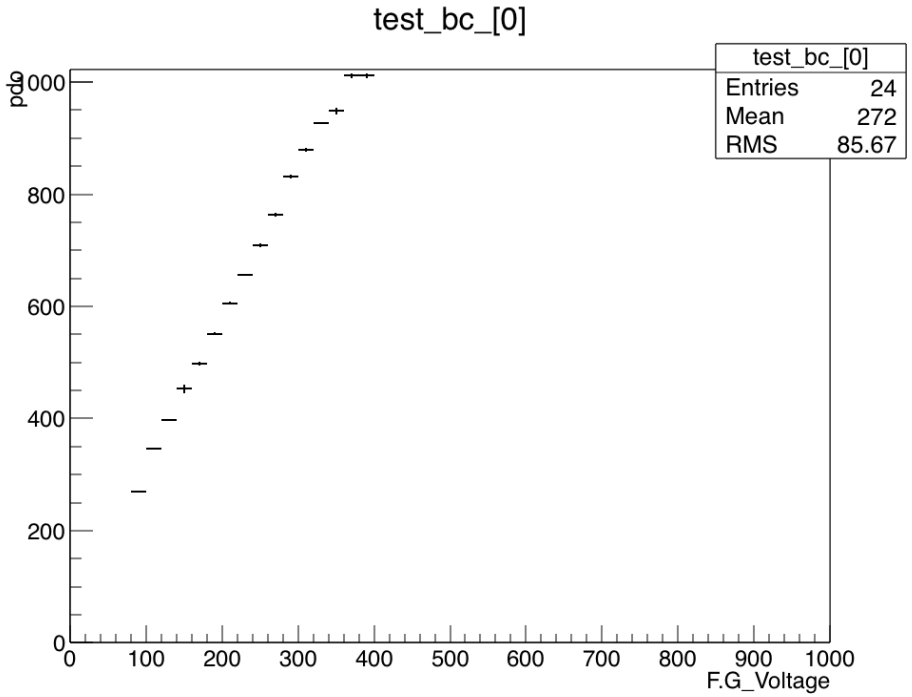
BNL software (George) on Linux PC

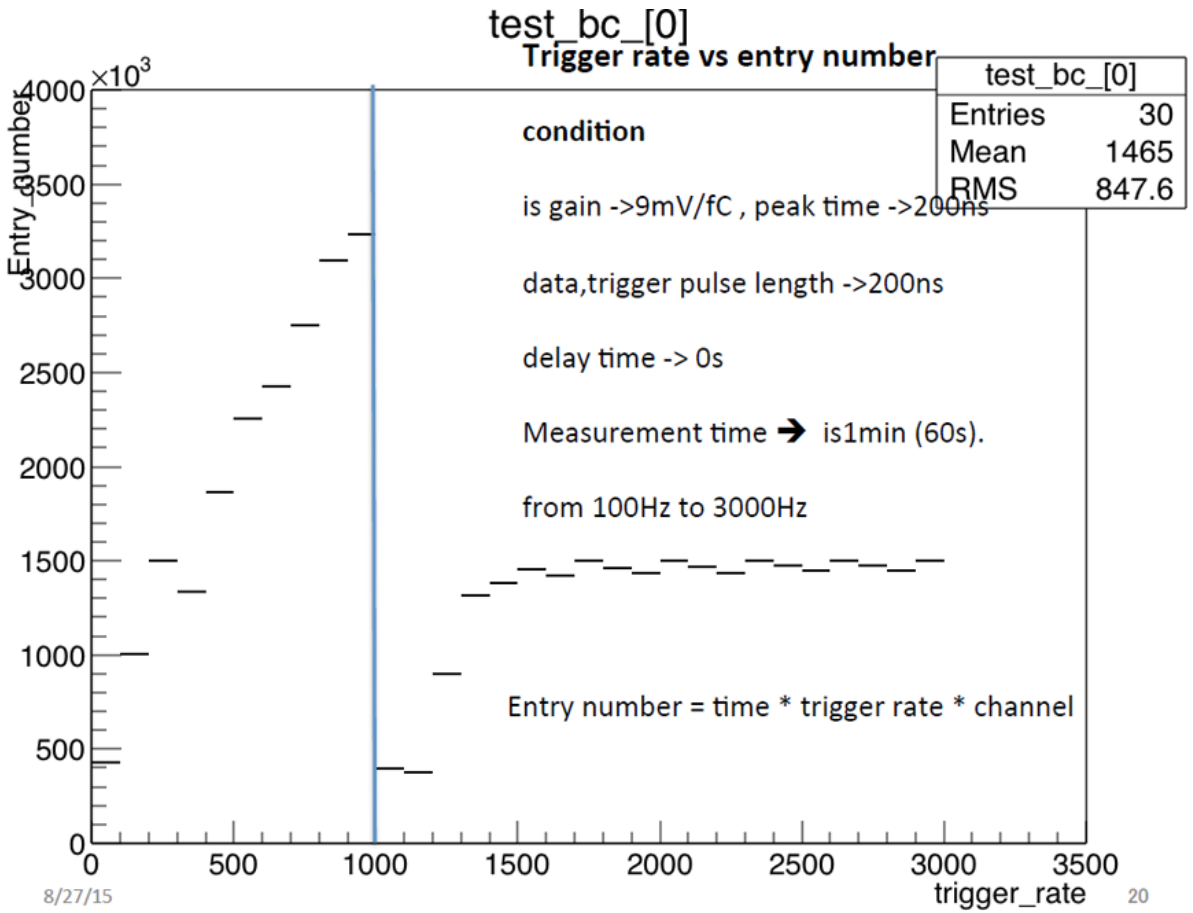
PDO = pulse height vs. VMM-internal pulser DAC for all 64 channels

Oscilloscope

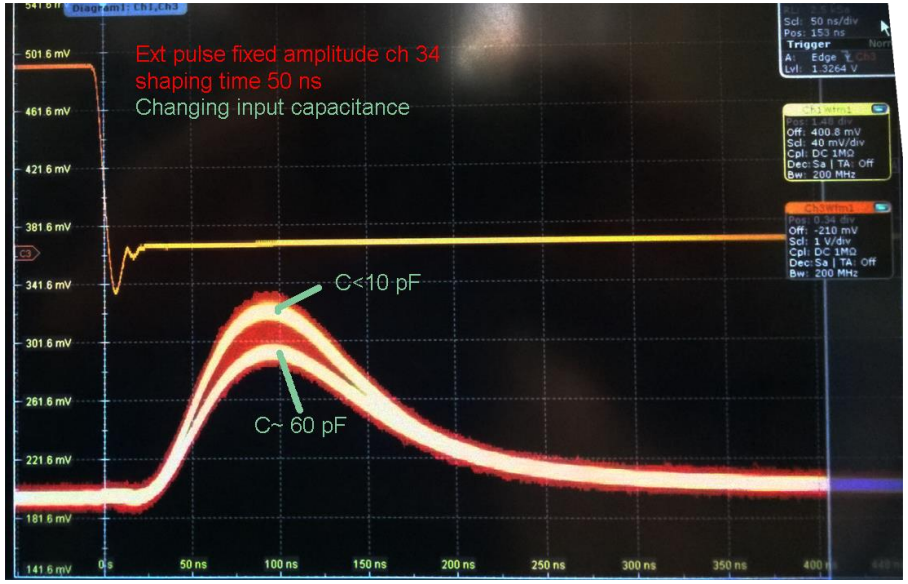
FFT noise analysis of channel 34
pulsed from external pulser @ 10 pF

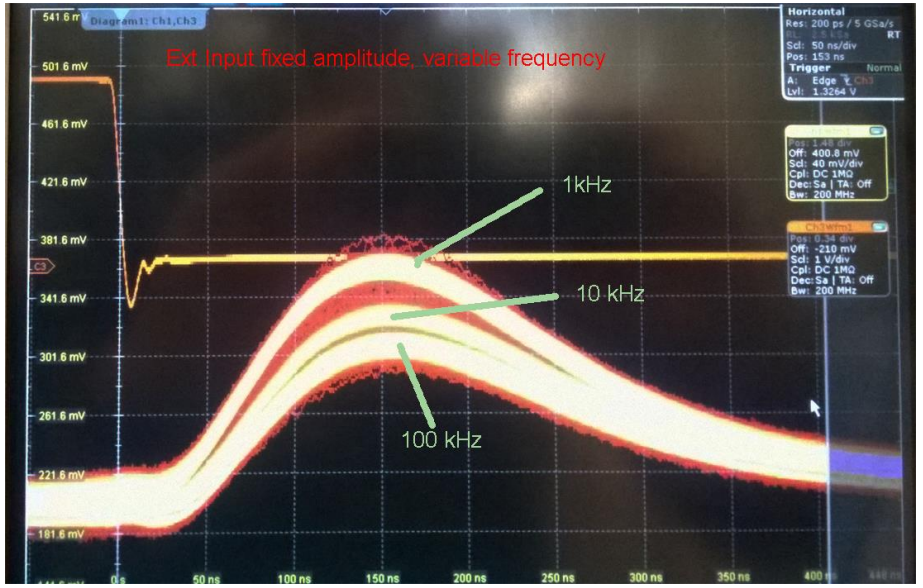
Offline Root Analysis (prelim. Aug 15)

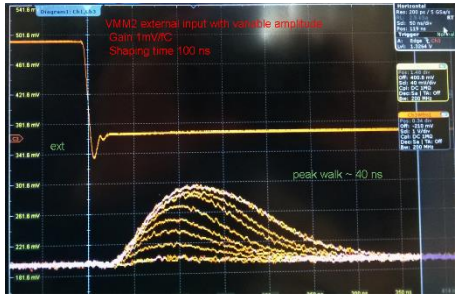


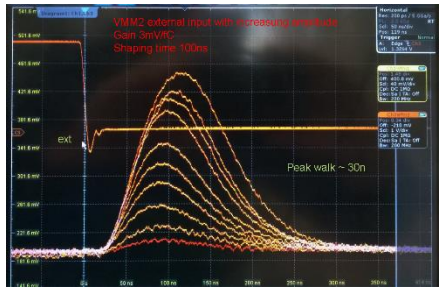


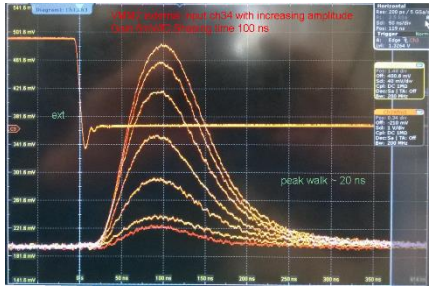
Realtime oscilloscope analysis

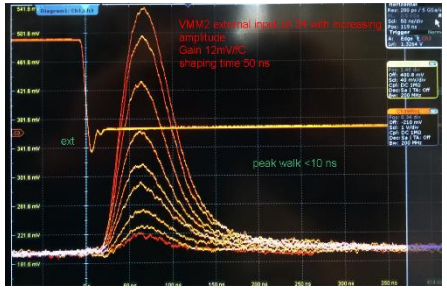




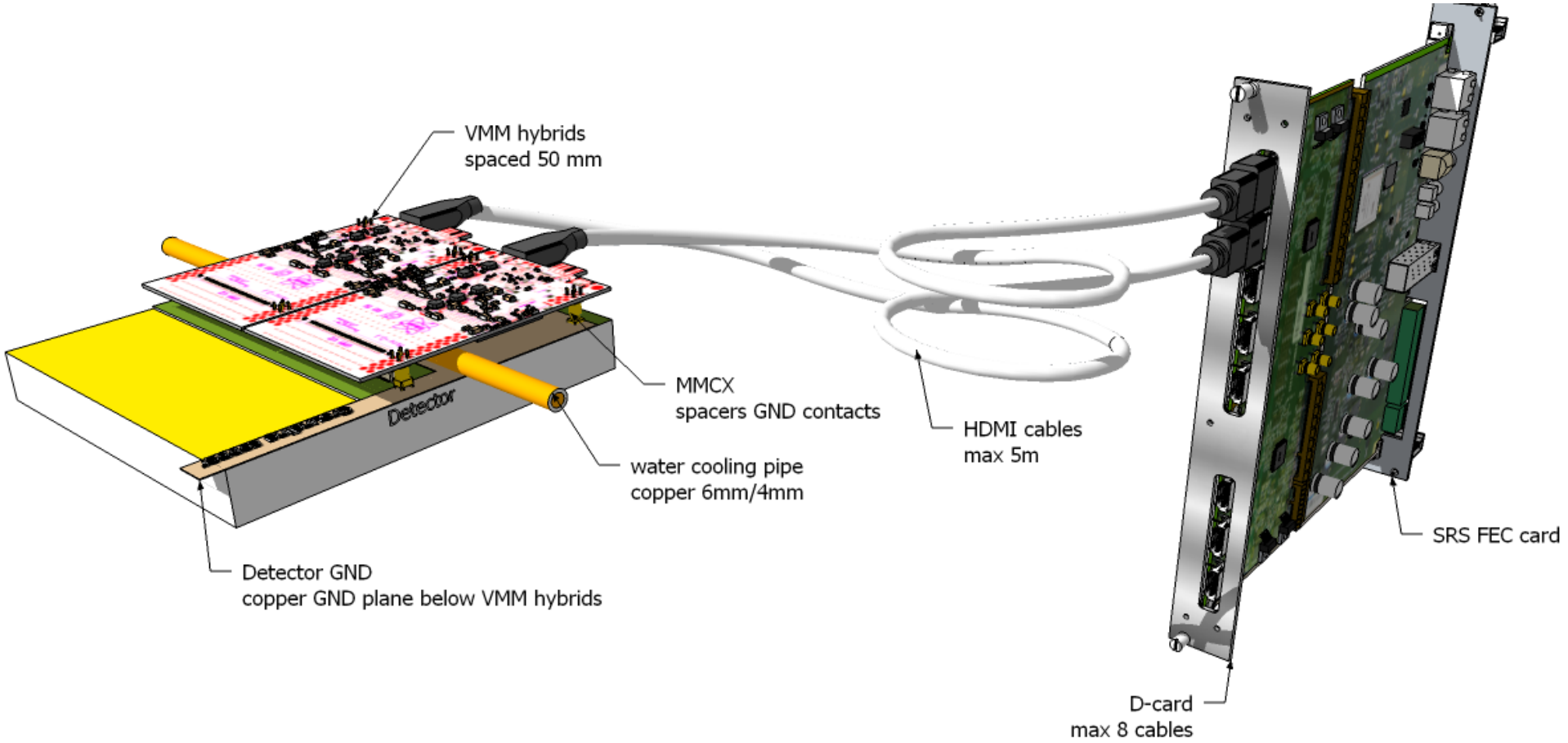








DCard+ , a revised Digital card Adapter for SRS



VMM Power issues

test with one VMM-128 hybrid*

Dcard: **U2=2.88V , U1=3V26**

Power input 1 hybrid= **7W**-20%

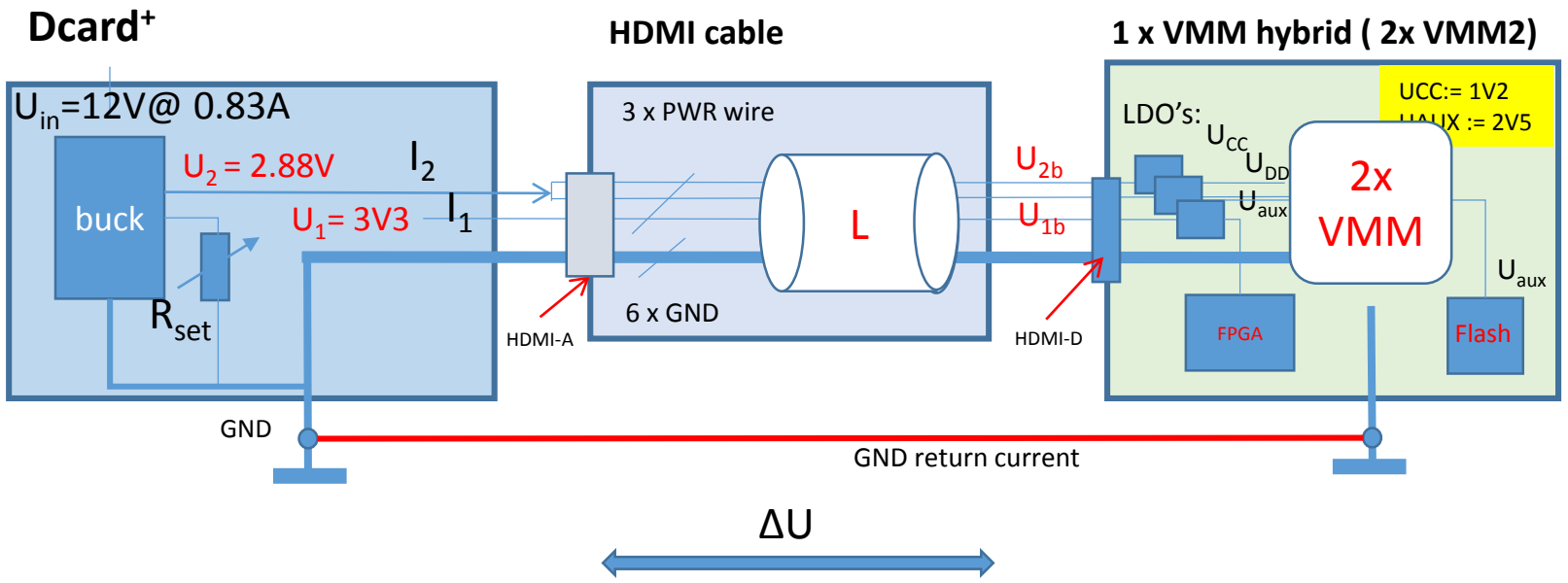
Buck input = 8.5 W
LDO (3V3) = 0.6 W

= **1.3 W** (2m cable AWG32

VMM-128 = 3.7W*

LDOs U2= 1W
LDO U1= 0.2W

2 x VMM = 2 W
FPGA = 0.5W

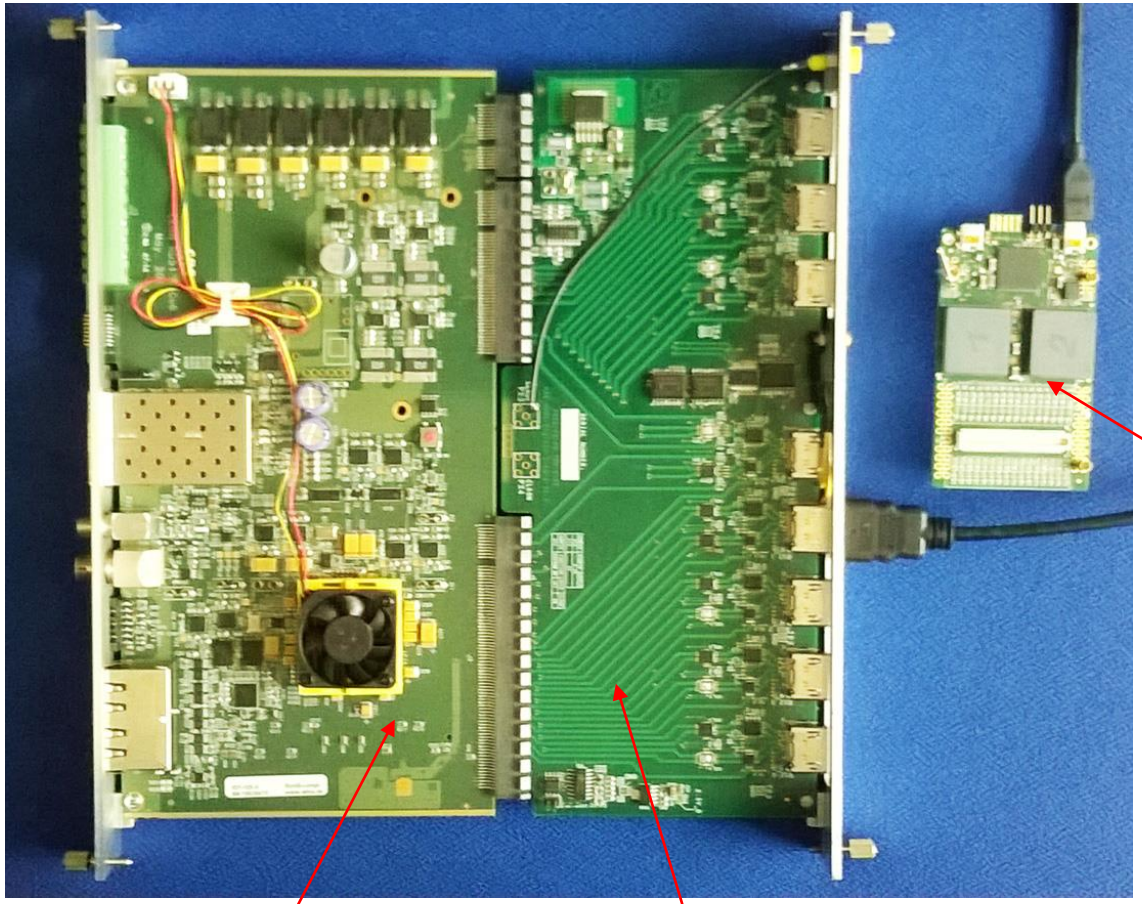


L cable lenght	2m	5m
ΔU_2	0.8V	1.48V
ΔU_1	0.2V	
I_2	1.55A	
I_1	0.18A	
U_{1b}	3.1V	3 V
U_{2b}	1.98V	1.4V
$U_{CC,DD}$	1.21V	1.21V
U_{aux}	2.52V	2.52V

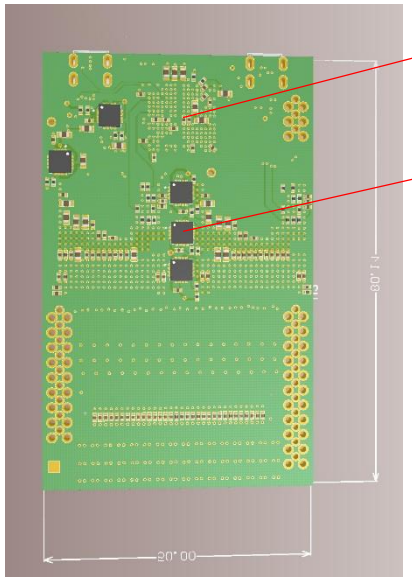
* average few active channels, may increase when active with high rate and high occupancy

VMM 128 v2 temperature issues

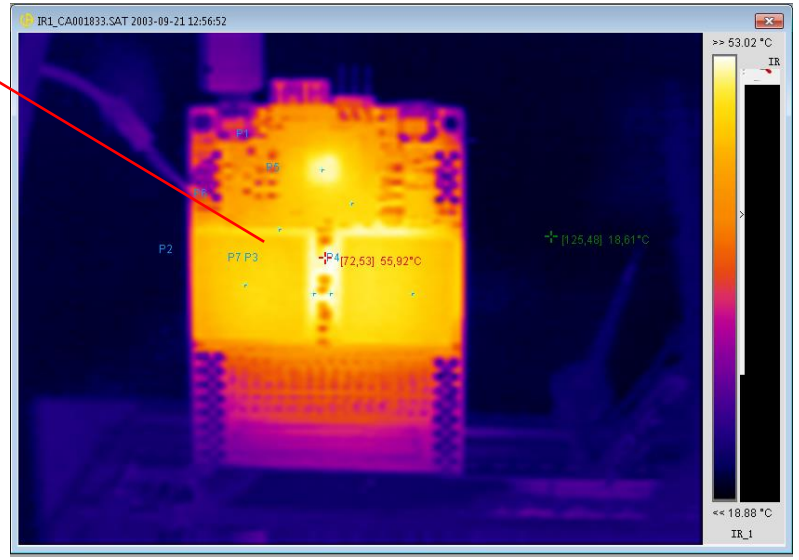
=> improved cooling strategy for v3



Hot spots



2 Watt , hotspots in central LDO area



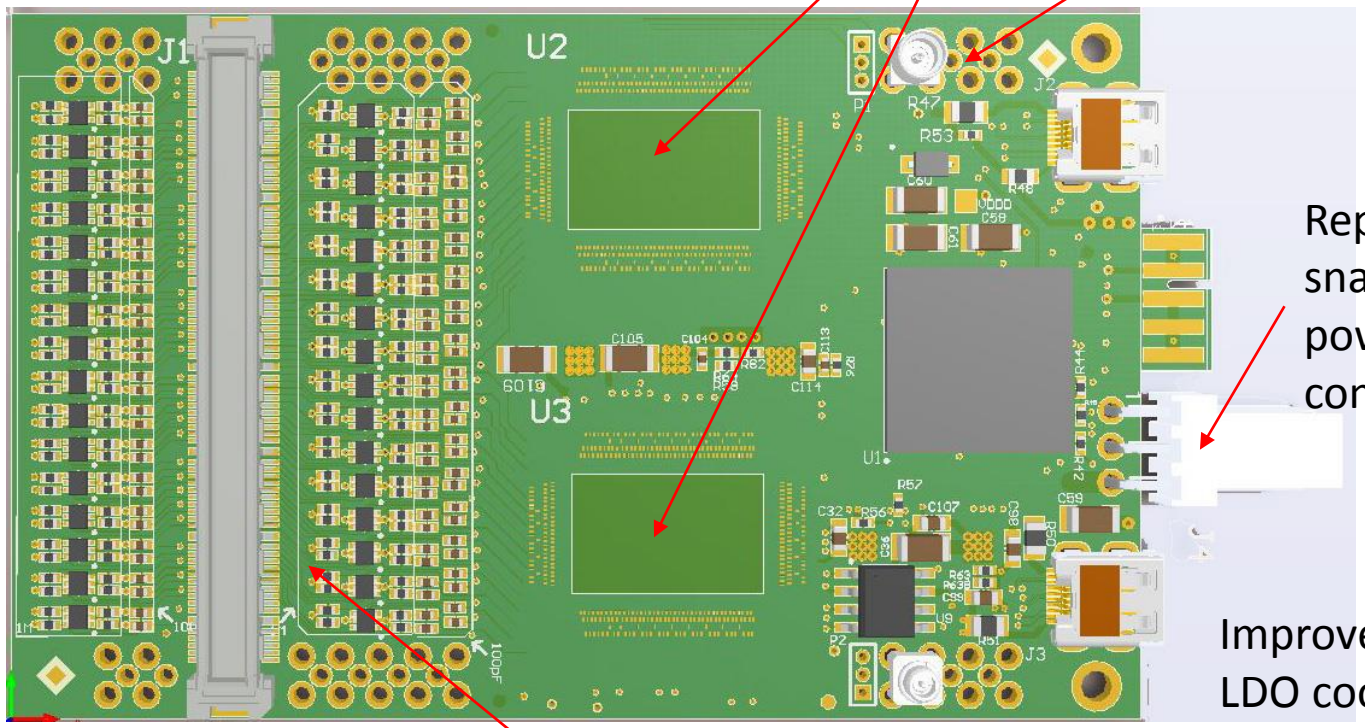
VMM-128 Version -3 (wire-bonded, still VMM2)

Wire bonded VMMs with low-profile globtop

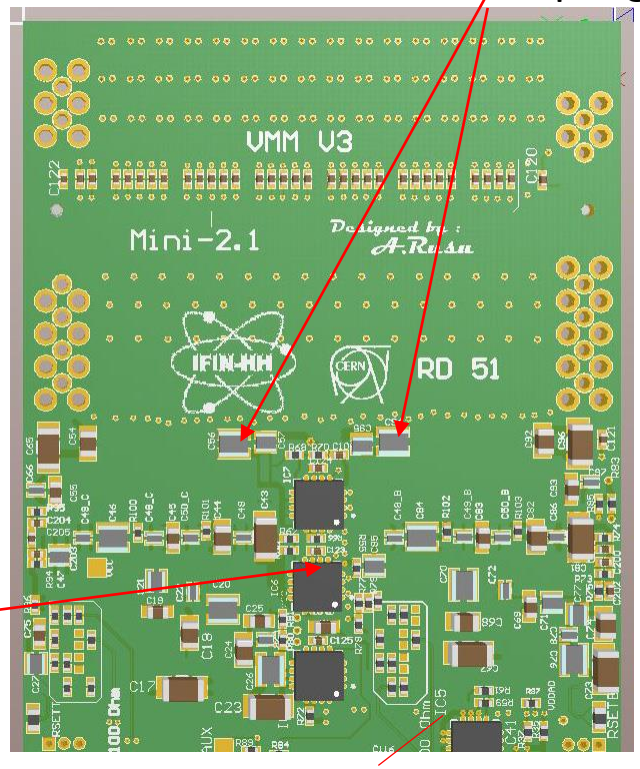
New 140 in connector
added functions geo +I2C

Added daisy chain connectors

Improved
FFT decoupling



Repl. By
snap-in local
power
connector

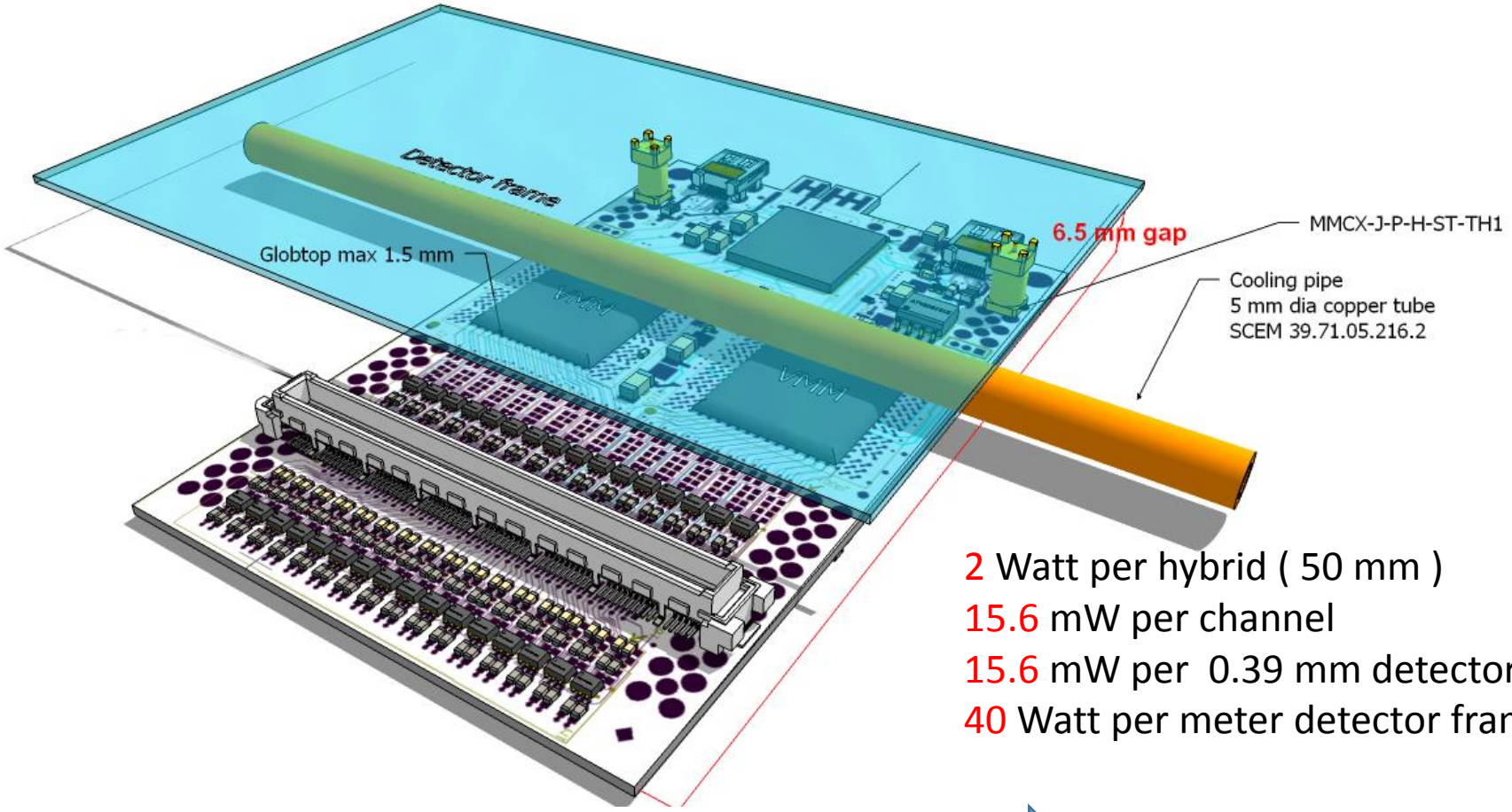


Improved
LDO cooling

Improved Reference Voltage circuit

Agree on channel routing for cluster-continuity
external on detector, Internal on Hybrid, or on flex adapter

VMM-128 cooling (conceptual)

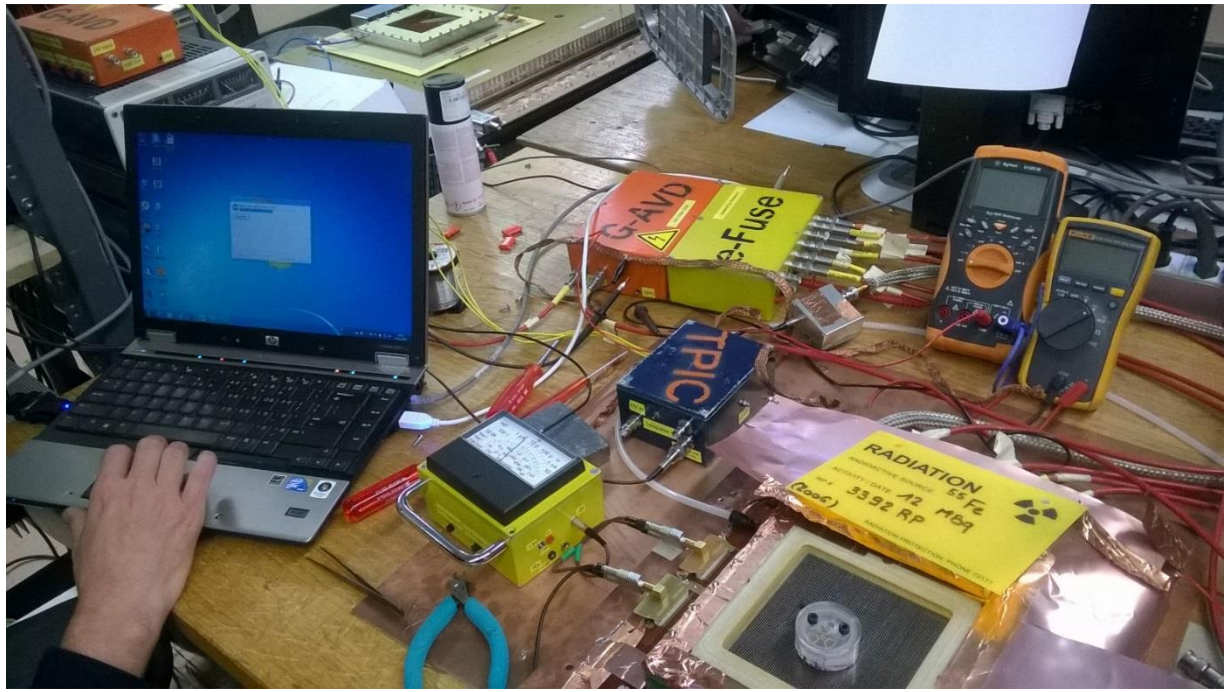


2 Watt per hybrid (50 mm)
15.6 mW per channel
15.6 mW per 0.39 mm detector frame length
40 Watt per meter detector frame !

Water cooling

Service Electronics for MPGDs

G-AVD / eFuse / Arduino readout / TPIC / Femtometer



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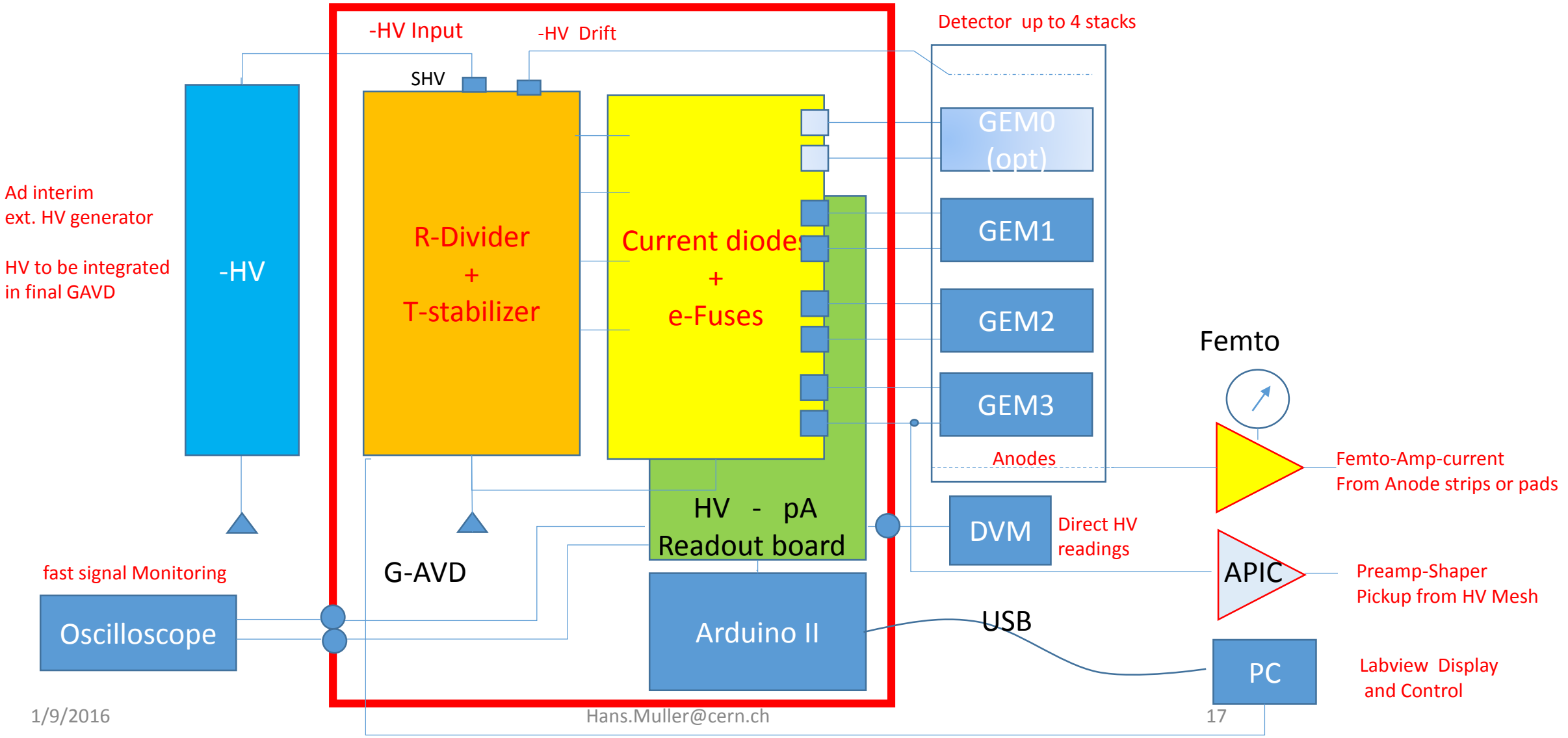
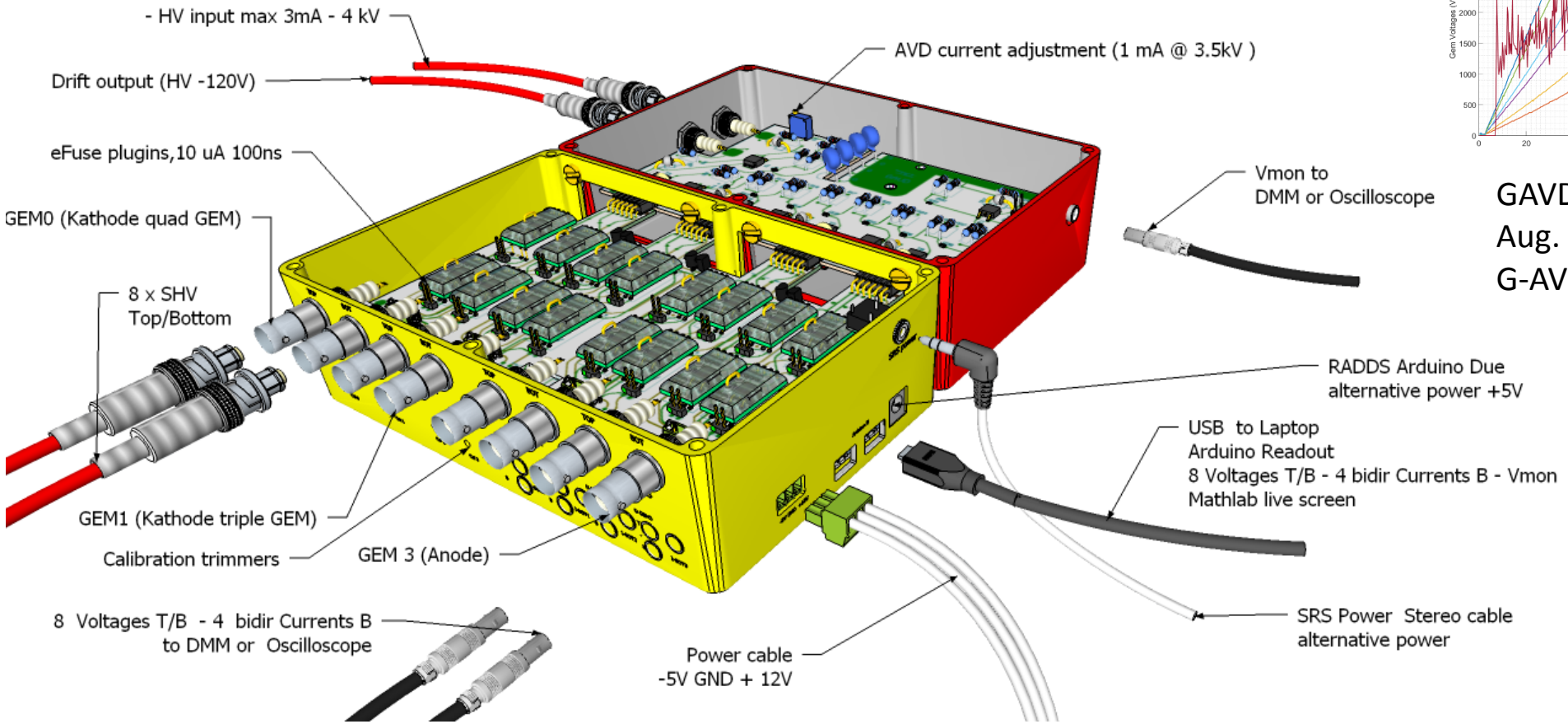
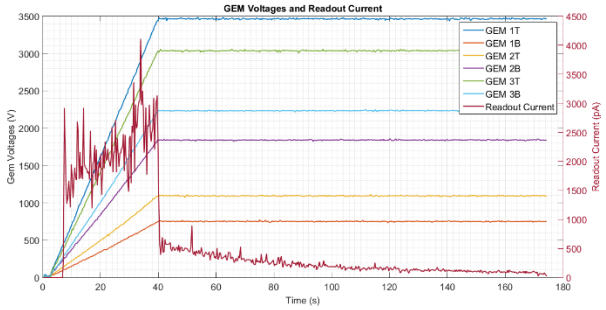
Detector Service Electronics Overview



GAVD and eFuse box, status Nov. 2015





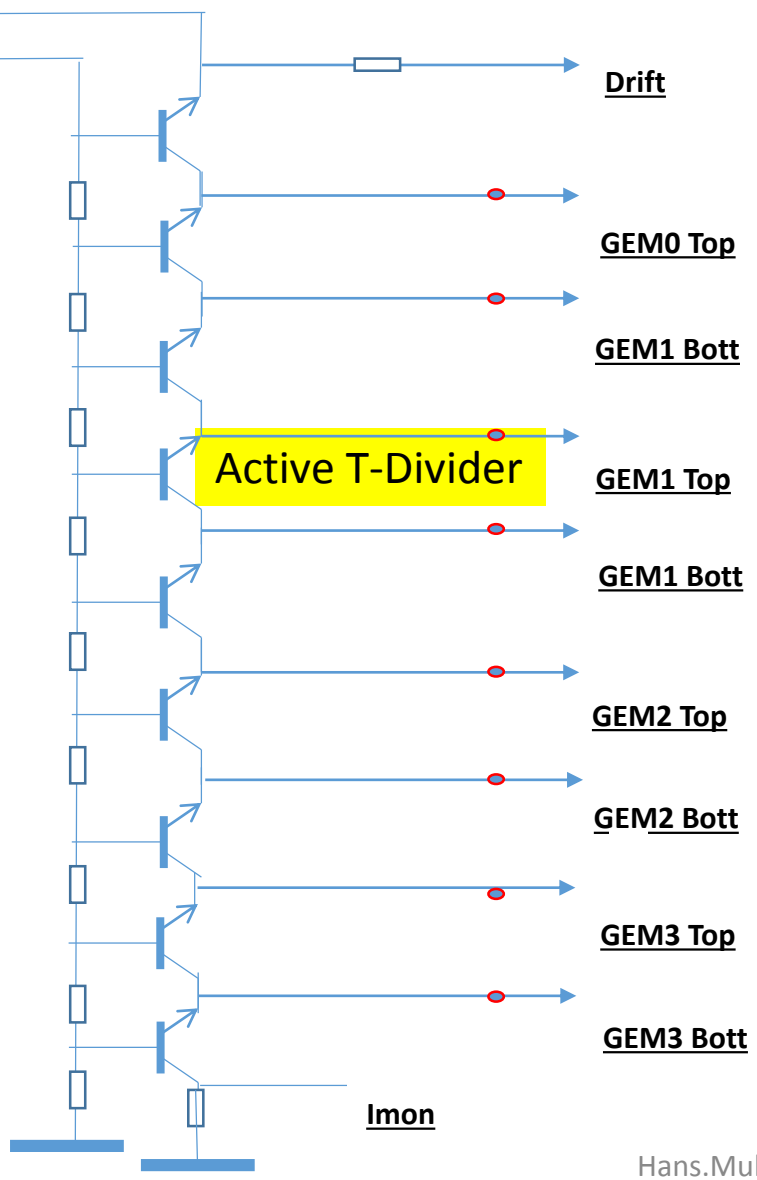
GAVD summer student project
Aug. 2015 V. Karaventzas
G-AVD ramping and Vmon current

G-AVD voltage and current measurement:

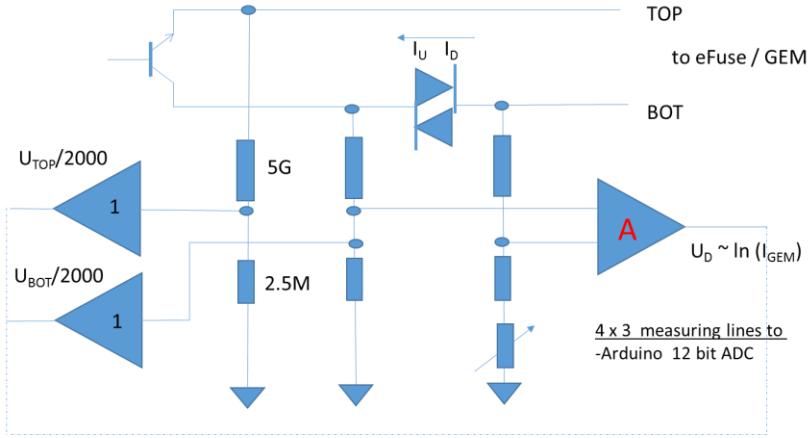
-HV max 5kV

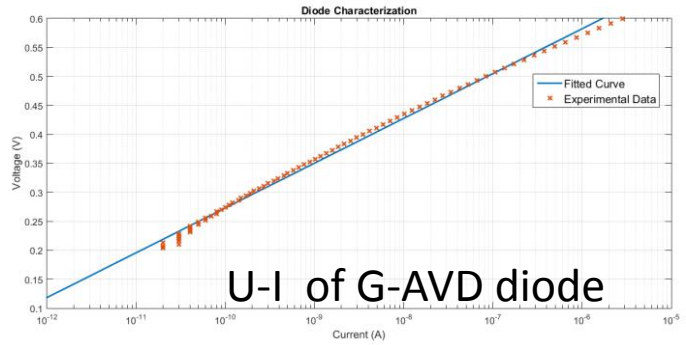
Variable current up 5 mA

Primary resistor Divider



12 measuring points





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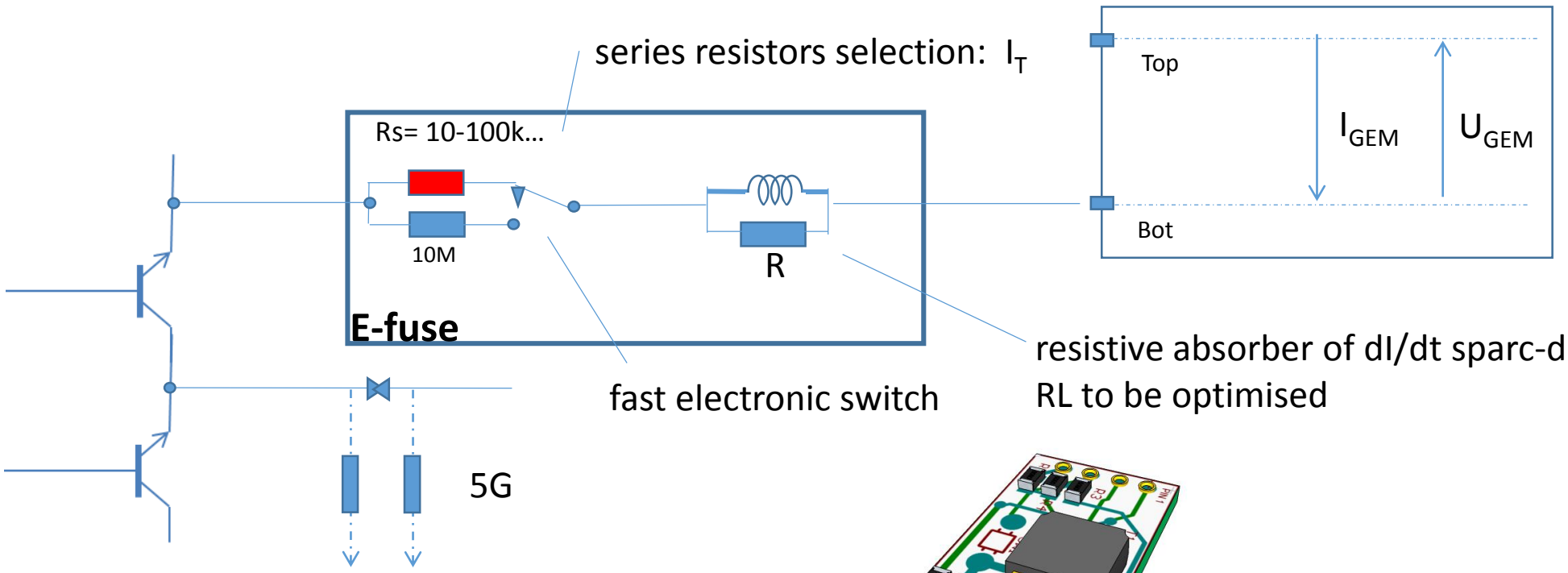
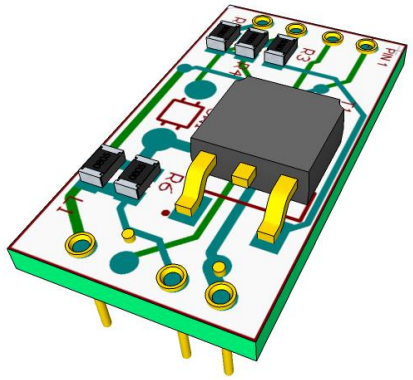
eFuse* for GEM's

100 ns electronic current limiter and sparc absorber circuit, T_s =O(100 ns) I_T = 10…500 uA



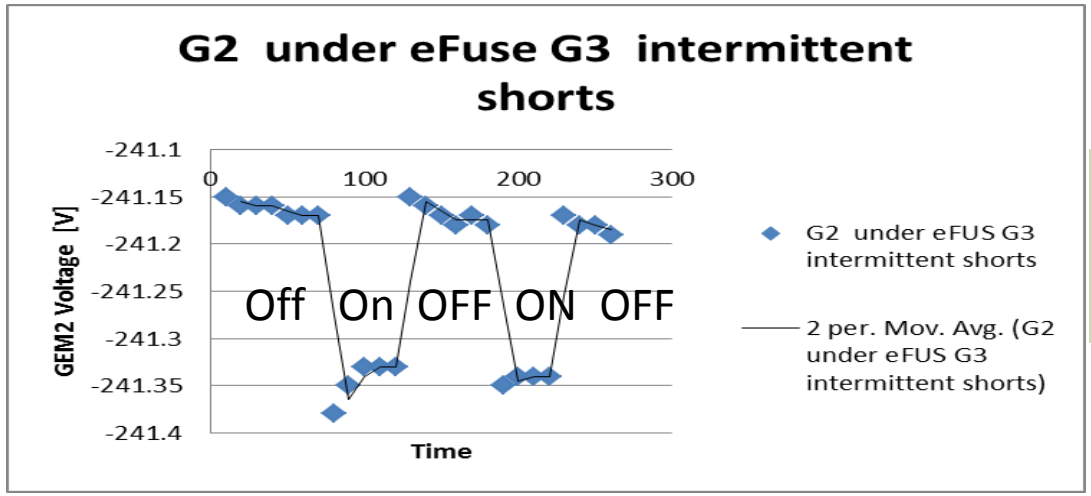
Voltage and current monitoring
via 12 bit ADC



eFuse implementation GAVD

*codename RD51

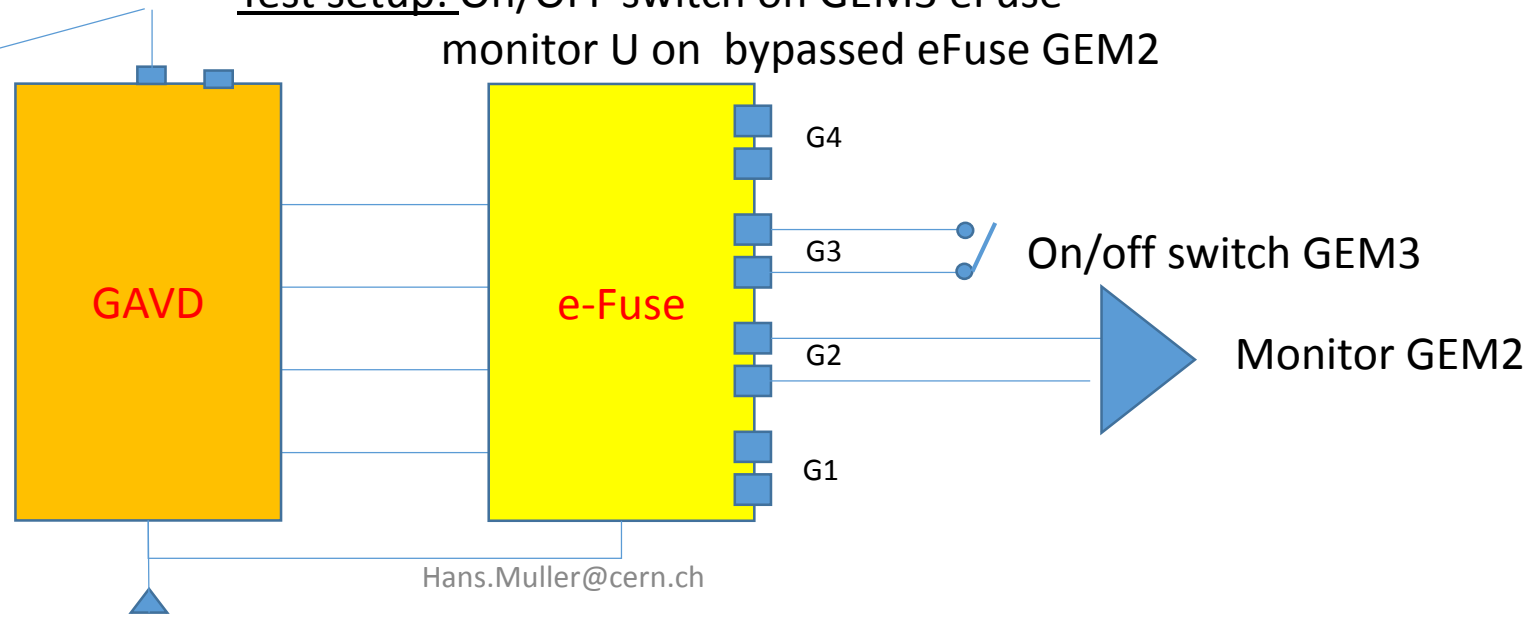
eFuse short circuit test



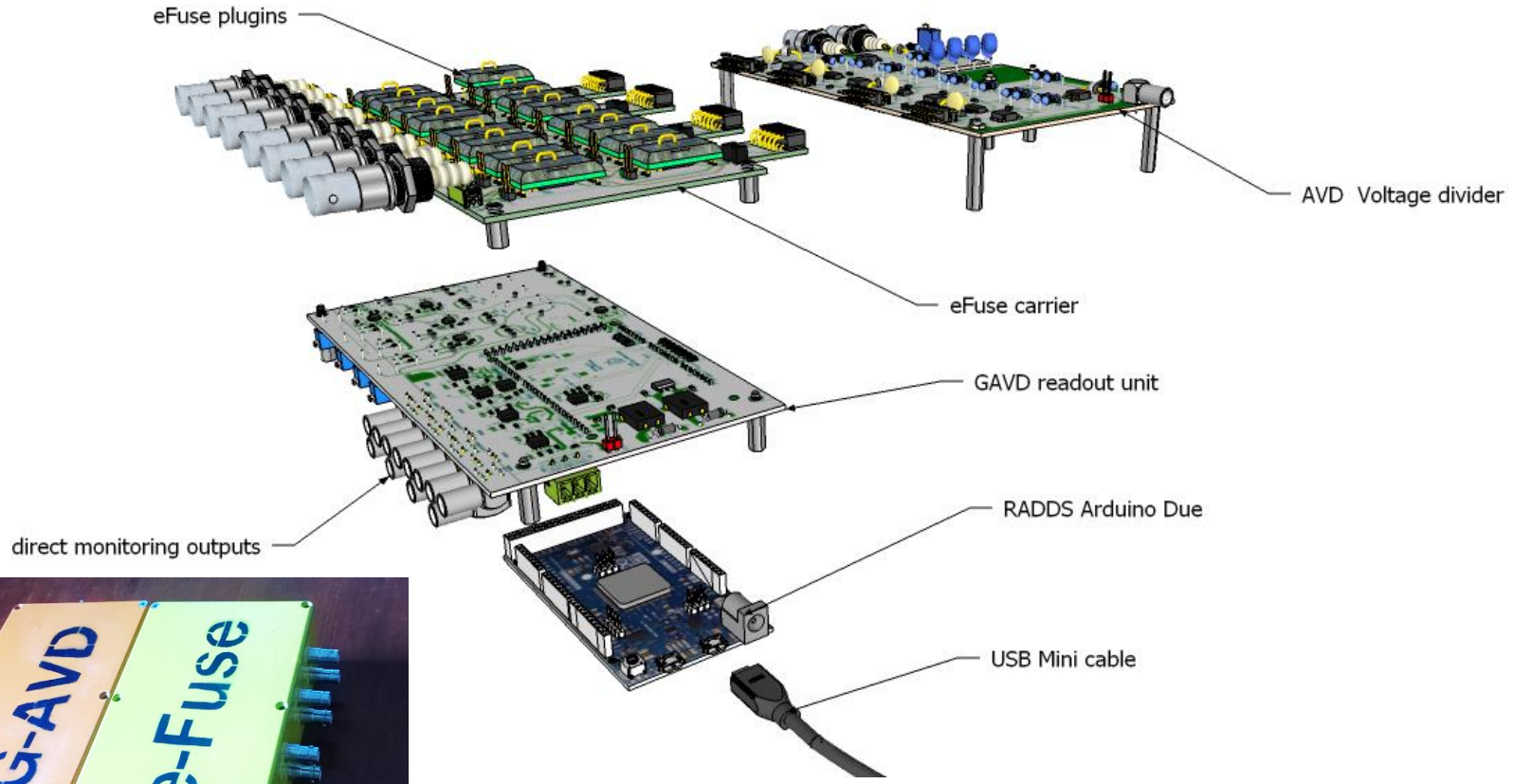
Short circuit influence on neighboring GEM is 0.2Volt

-HV Input
3220V
@1.5 mA

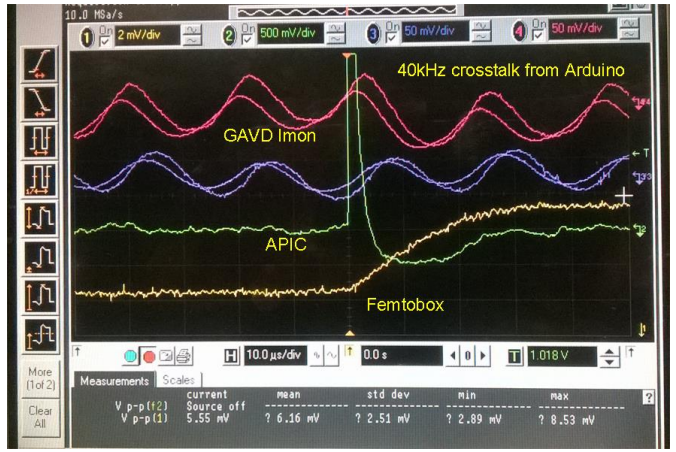
Test setup: On/OFF switch on GEM3 eFuse
monitor U on bypassed eFuse GEM2



Electronic boards inside GAVD + eFuse



Problem:

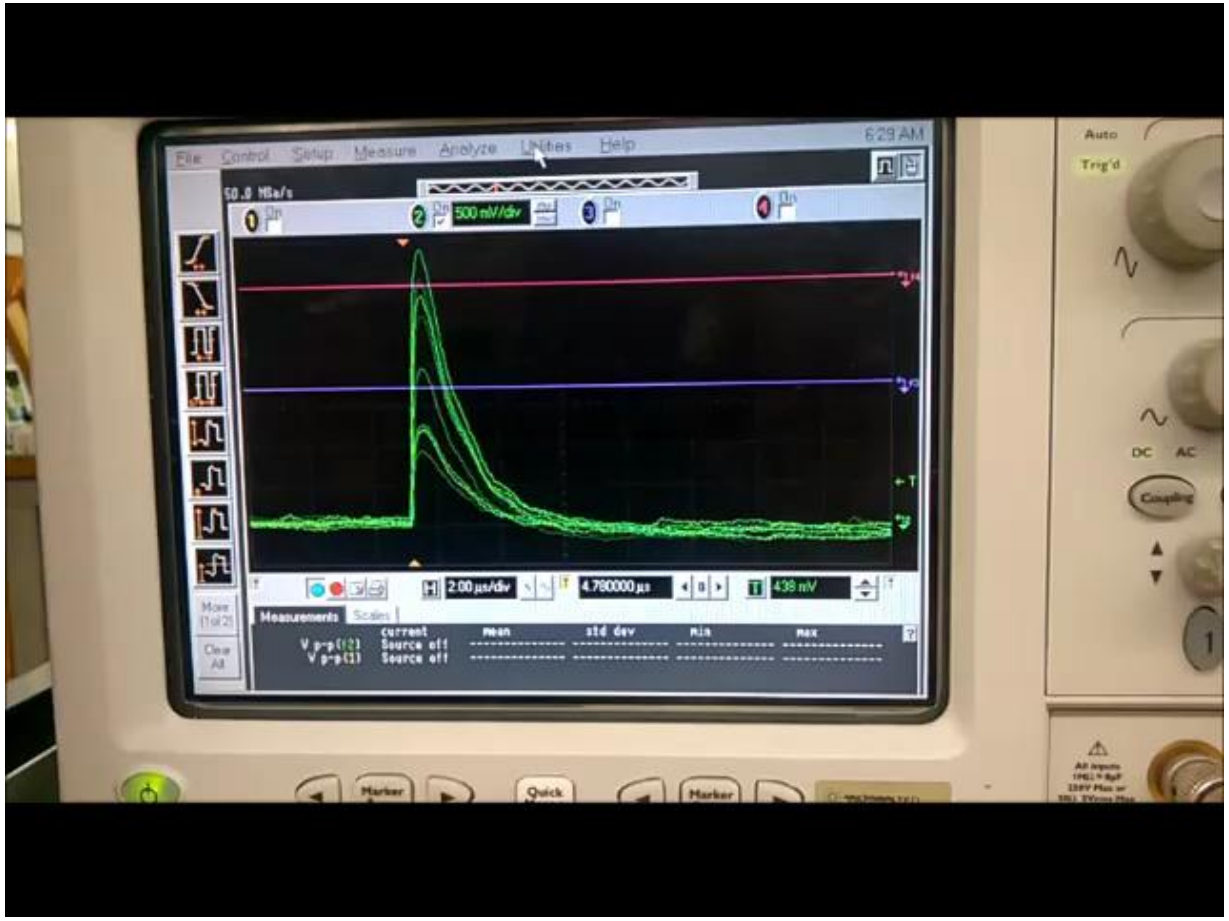


Next version: put Arduino outside the box too much crosstalk

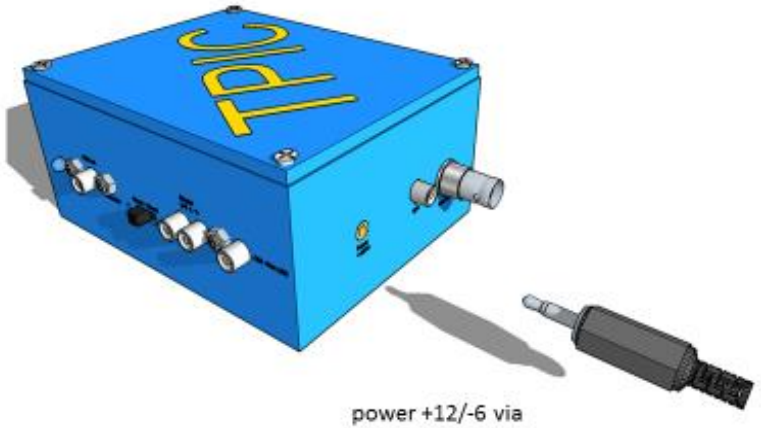
G-AVD Labview Display and Control

External HV Inout

APIC pickup box



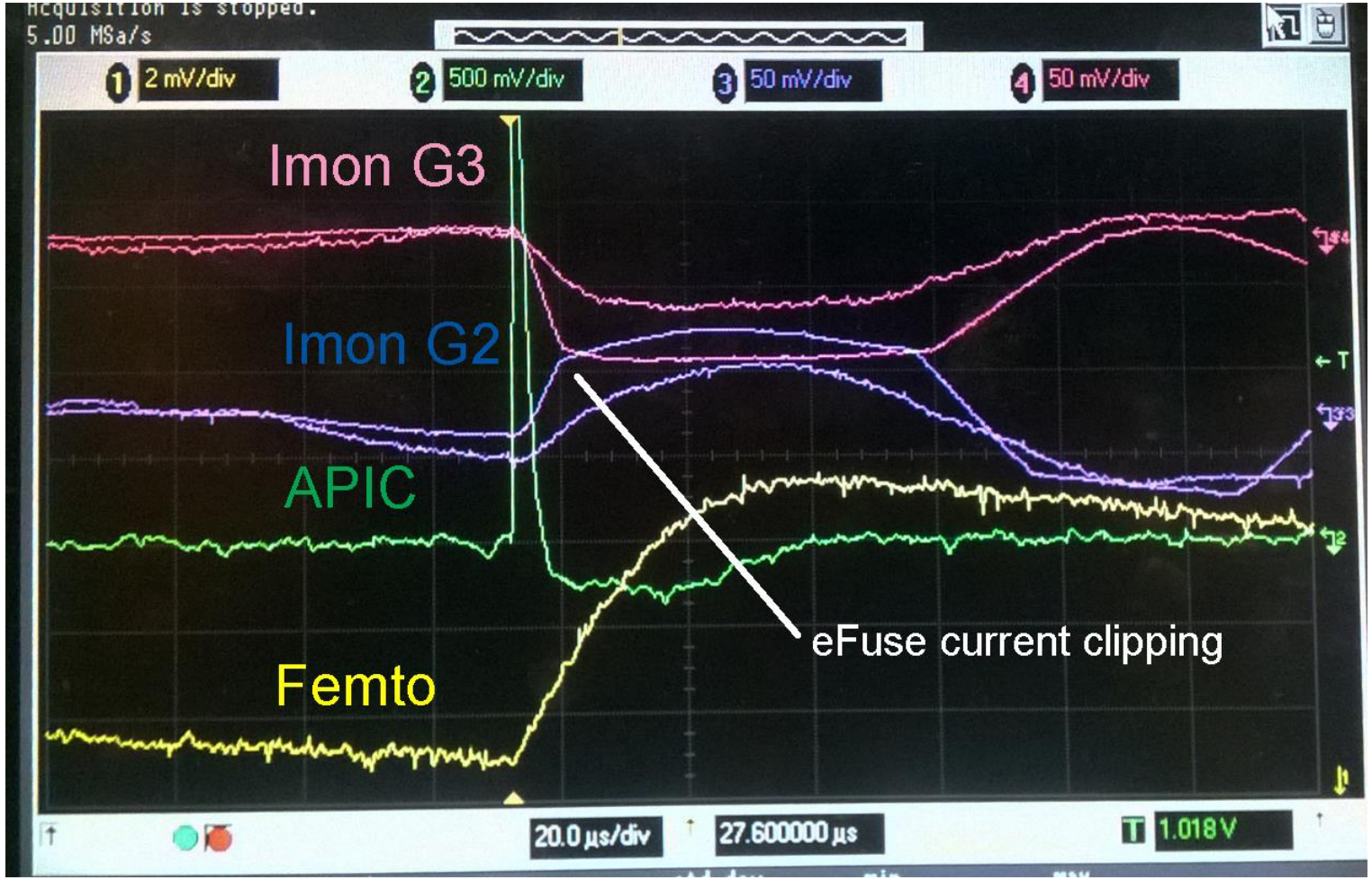
capacitive pickup from HV meshes
-positive or negative
-sparc immune



power +12/-6 via
Stereo jack/cable
from distributor (Minicrate panel)

+/- complementary 50 OHM output
200 ns peaking time
adjustable gain 1…10

Realtime G-AVD monitoring



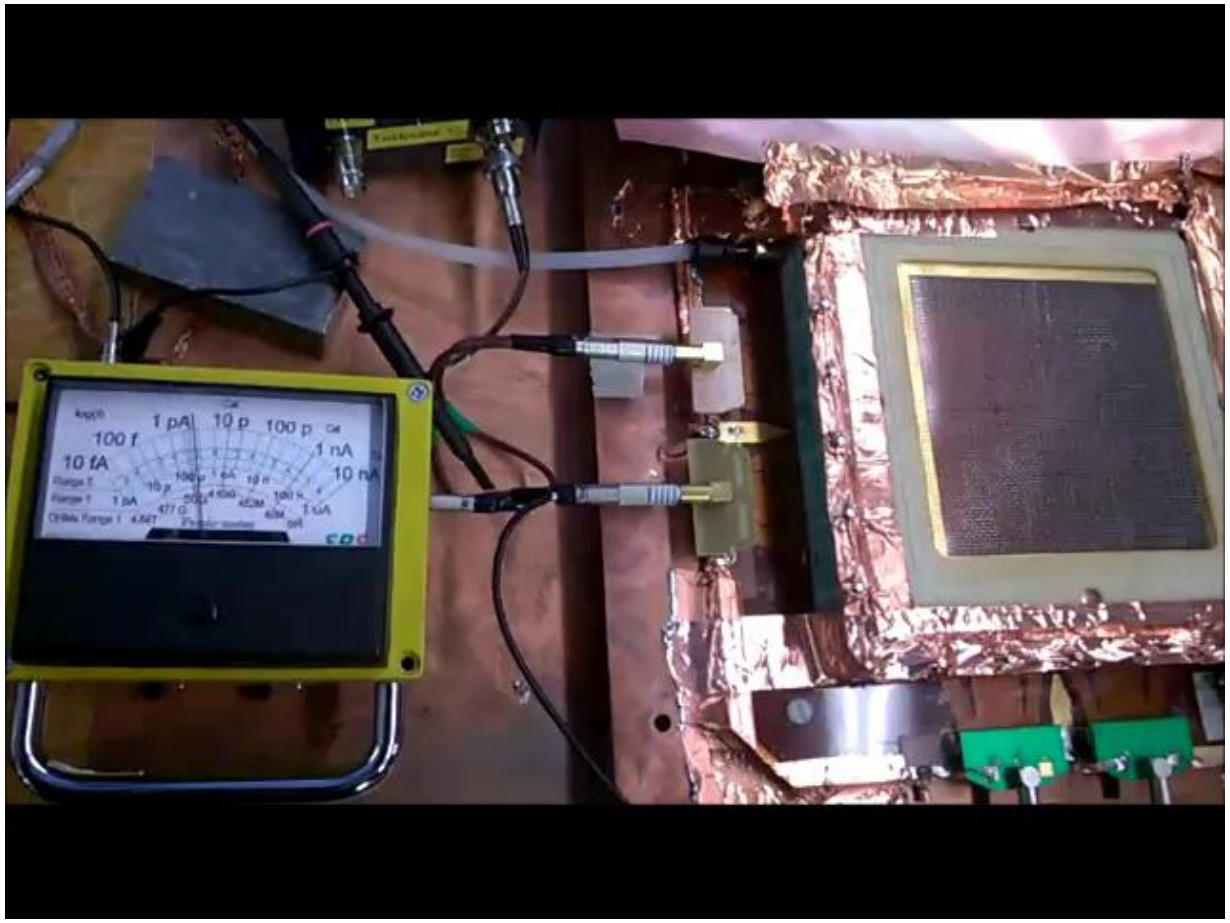
Current of GEM3 from single event
Log scale from readout board

Current of GEM2 from same event
Log scale from readout board

Femtobox

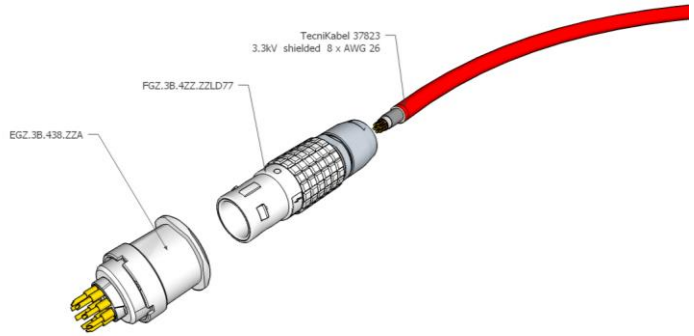
-log range from 10 fA to 1 uA
-negative and positive input
-sparc protected
-2 ranges 10 nA, 1 uA
-direct readout, average and prompt
-battery operated

Femtobox on bottom of GEM



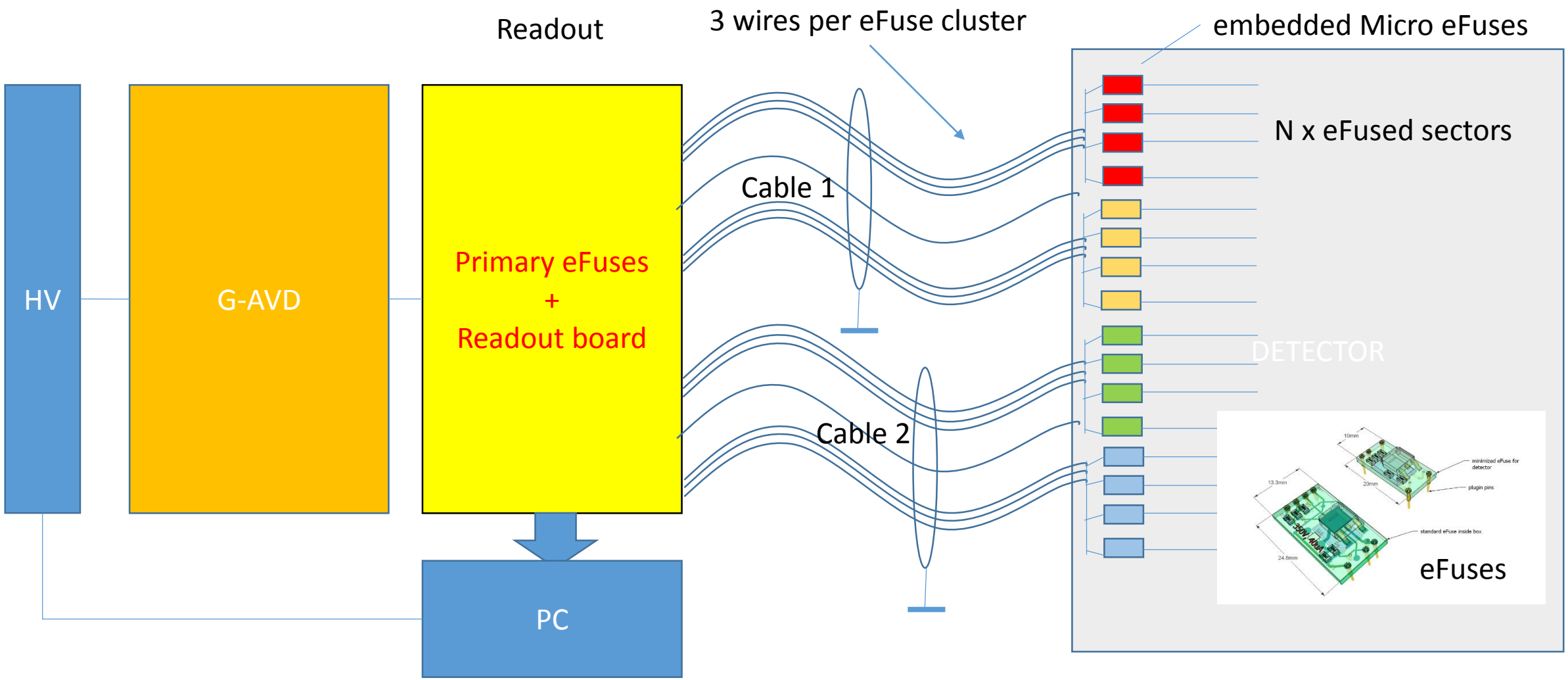
HV cabling for next G-AVD

Lemo HV connector pair Cable/chassis under design for this cable for CERN

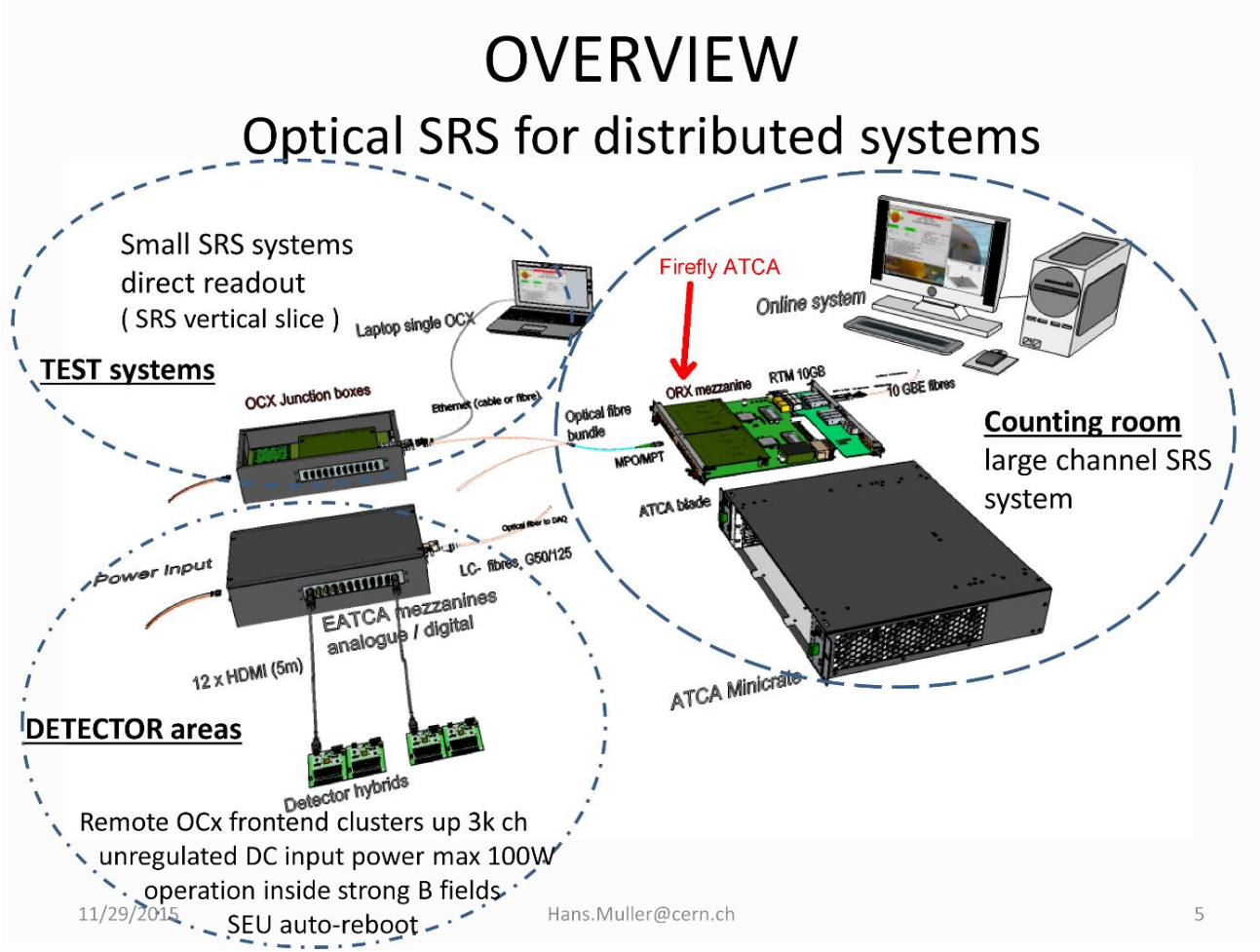


8 pin HV collector-chassis plug

Multicore HV cable: eFuse placement in detectors



OCX optical SRS, where we are…



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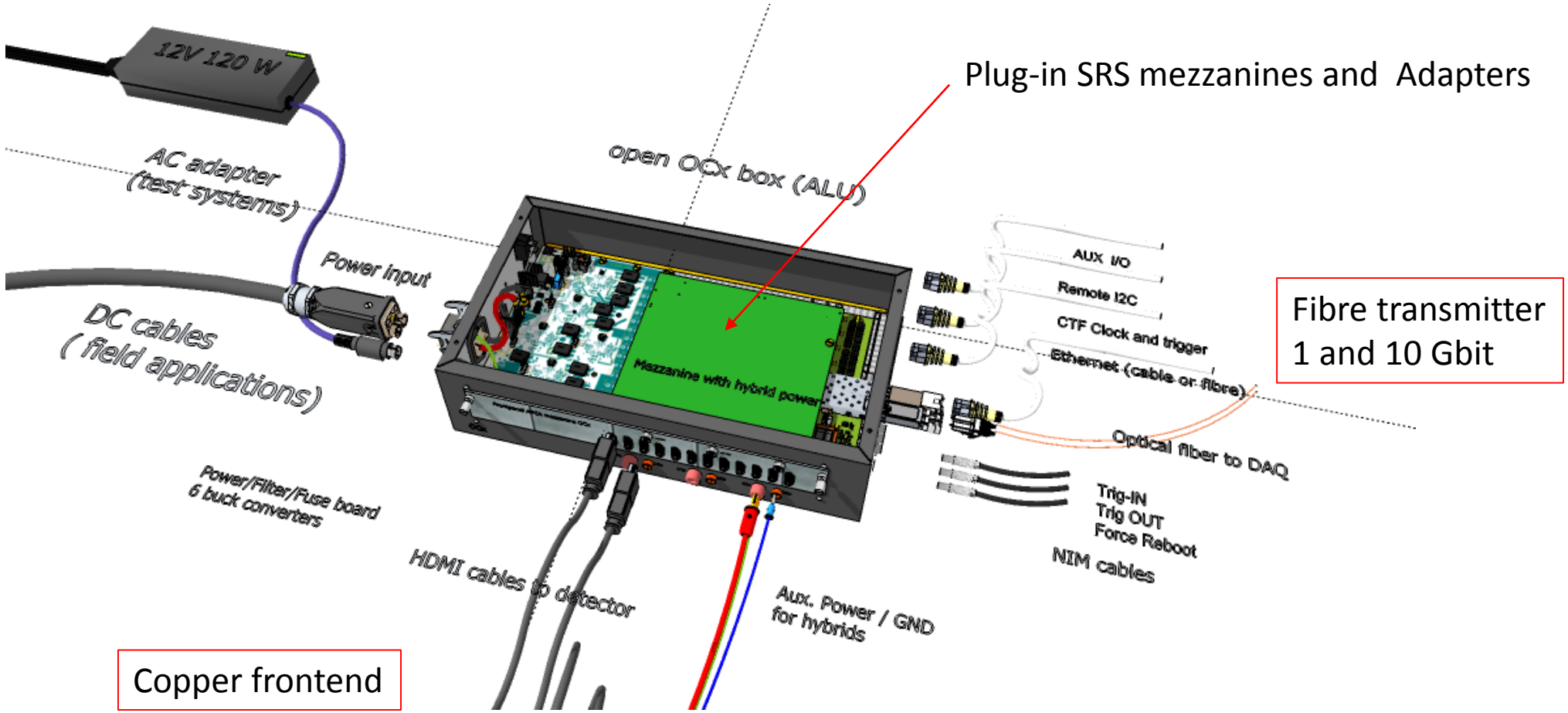
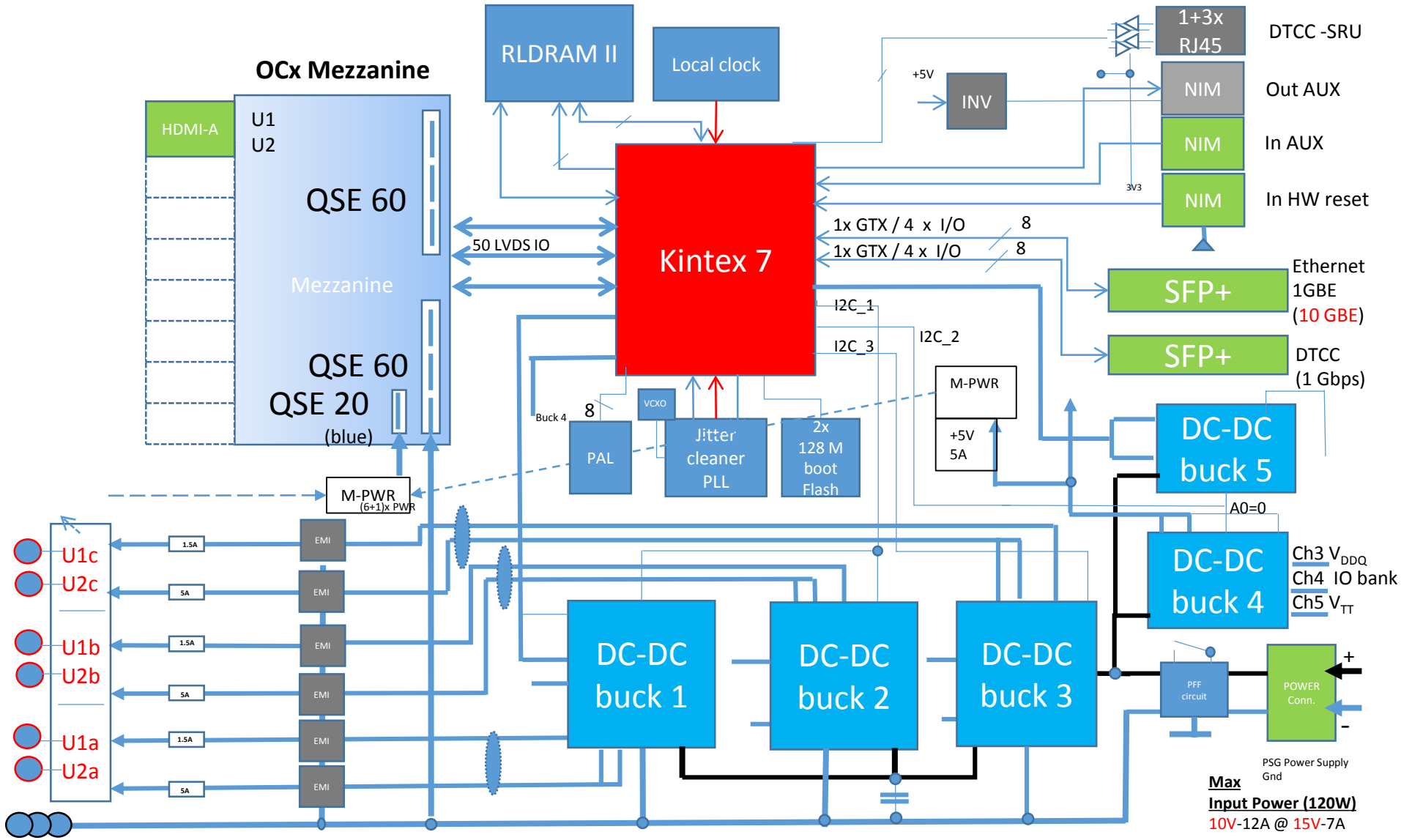
Project stalled early 2015
due to lack of manpower
(main players moved to new
responsibilities)

60 % done, restart in 2016

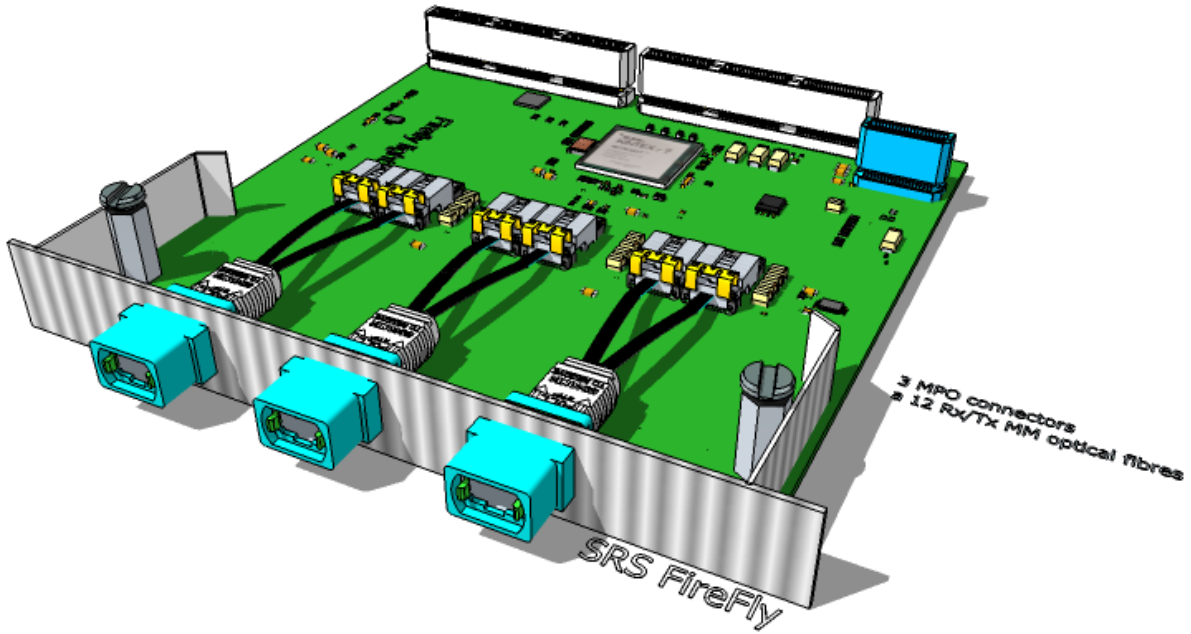
OCx box (Optical - Copper Transmitter)



OCx block diagram



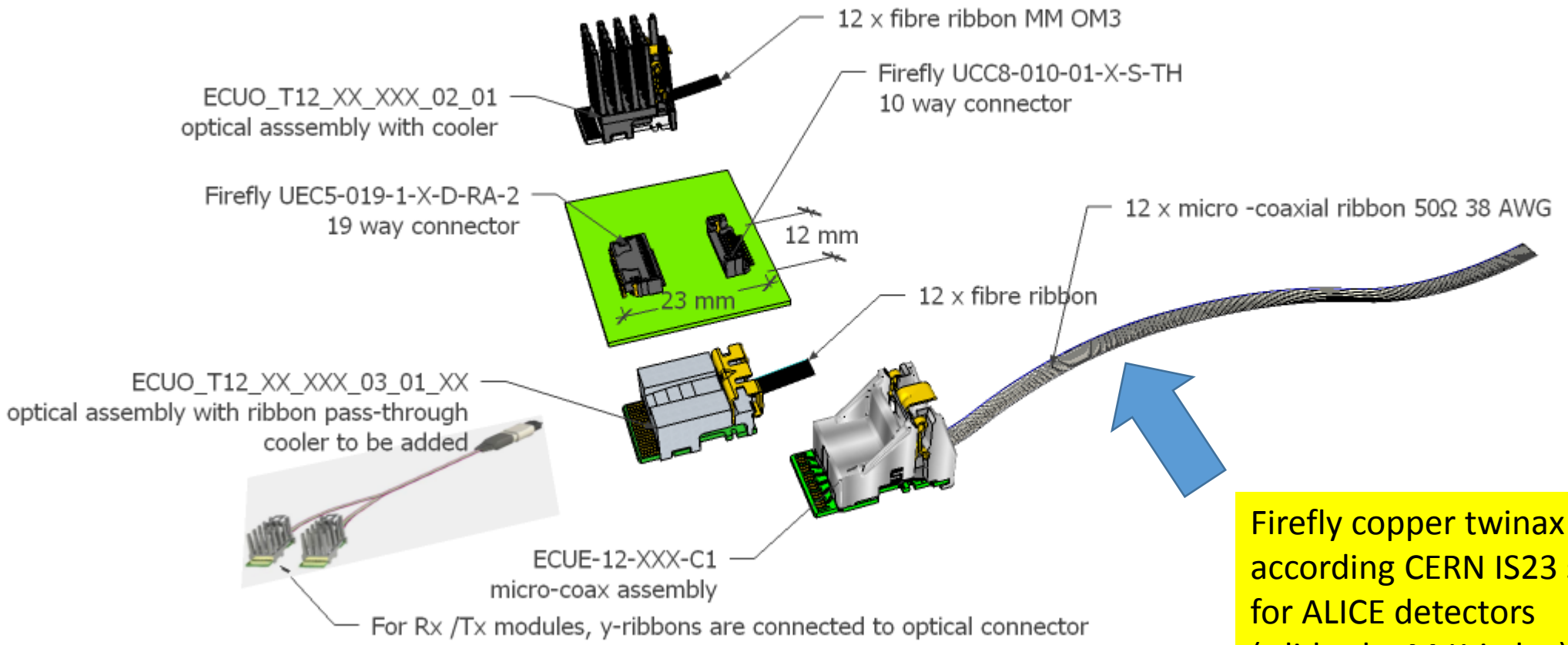
Firefly mezzanine for ATCA (planning)



Motivation:

- allows for integration of 36 bidir fibres
- fits on EicSys blade
- Mux data from distributed OCx
- Compatible with micro FireFly Twinax > 5m

Samtec Firefly:
optical or copper use the same connector



Firefly copper twinax cables according CERN IS23 specs for ALICE detectors
(slides by M.Krivda)

Infos for SRS users

- Please test all channels of your SRS electronics cards immediately after receiving from CERN store. Factory defects can in this way better screened
- Check mechanics of the Crates, misplaced cardguides and /or wrongly placed panels can lead to malfunction of the FEC-ADC card combos
- Check the power supplies in your crates they must either have a switch for 110/240V or have an automatic power inlet for 110/240V.
- Please handle APV hybrids with care, in particular the Flat cable connectors are fragile and repair is mostly impossible
- Please place your test detectors on a shielded Gnd plane to avoid environmental pickup noise
- The NIM output of the FEC cards provides a NIM signal for accepted triggers