

Updates on SRS situation

Hans Muller CERN/RD51

New SRS system cards

Digital adapter (DCARD) for readout of digital chips

Plug compatible with ADC card
HDMI ports for digital chips

12 prototypes built and in use
different configurations (ITS, VMM..)

New dual power via HDMI to be added

Production for CERN store planned



FEC V6

successor of previous FEC cards

More powerful FPGA (Virtex 6)
More I/O connectors
Dual network
New pluggable DDR3
Backwards compatible

10 prototypes built and in use
Final revision completed
Tests completed

Production for general availability
Is imminent

Revised Minicrate AB

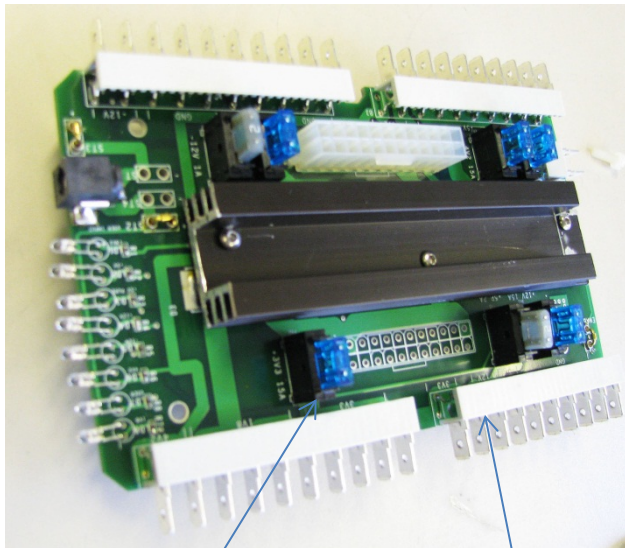


Simple ATX adapter for desktop SRS power

Now available via CERN store SCEM 07.89.00.110.9

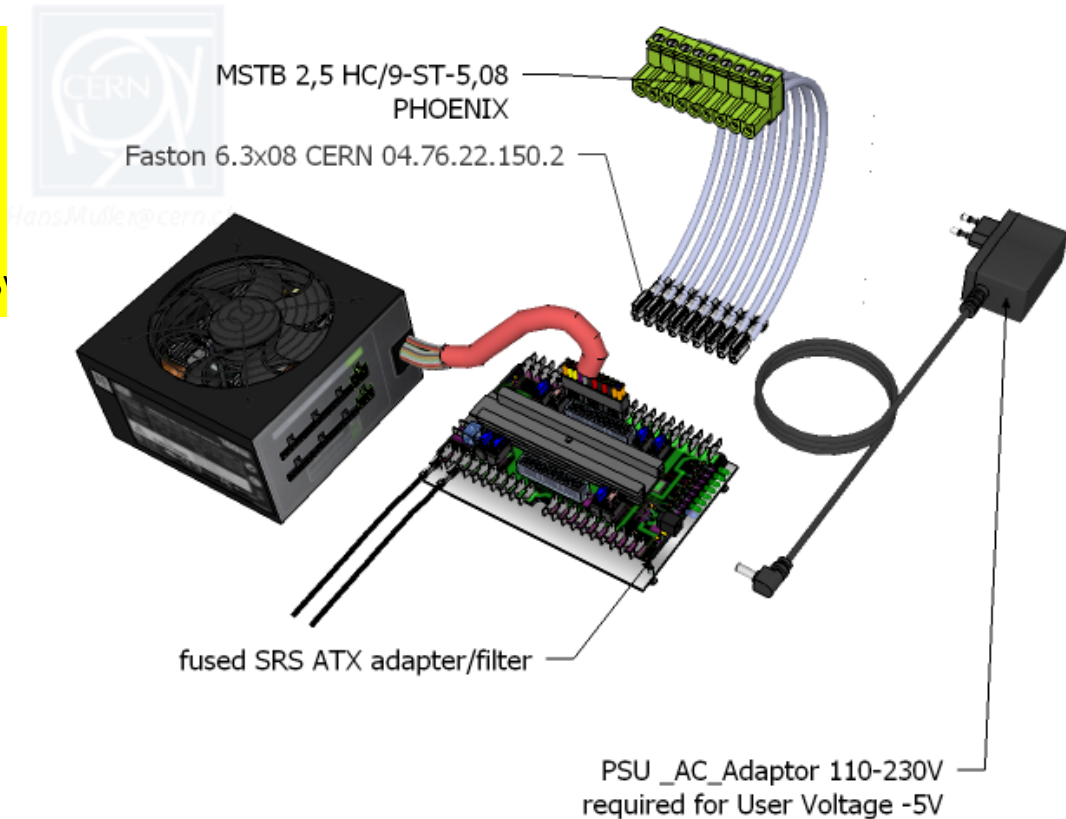
adapts and filters Power
from a standard ATX power
supply for use by SRS

+12V
-12V
+5V
+4.2V
+3.3V
+1.8V
Extern (-5V)



Car fuses

Noise filters

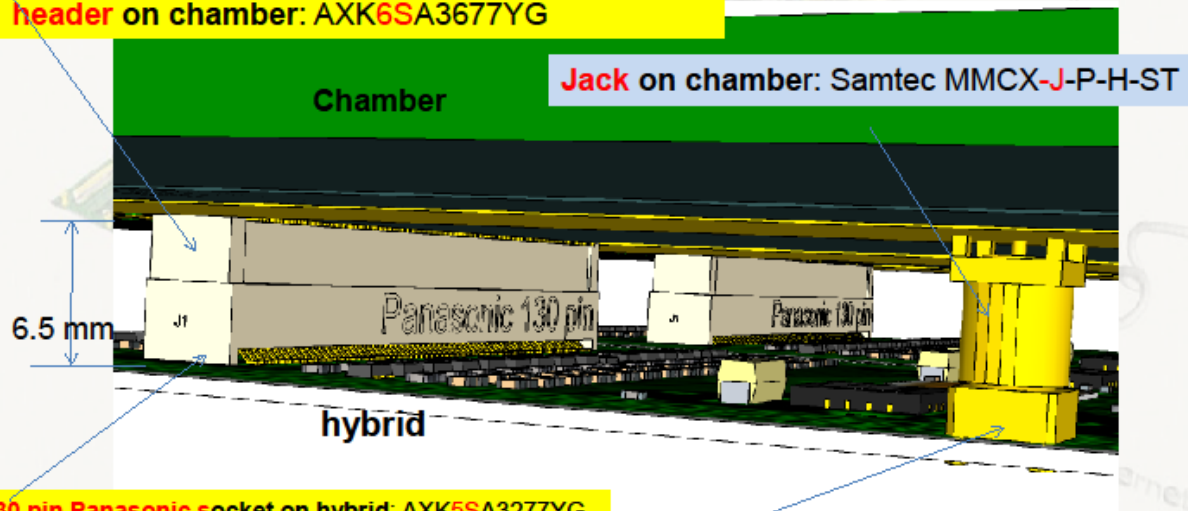


MPGD connectors

Panasonic will stop production ! CERN store has ordered 5k of each, do we need more ?

RD51 standard connectors

130 pin Panasonic 6.5 mm stackheight
header on chamber: AXK6SA3677YG



Chamber

Jack on chamber: Samtec MMCX-J-P-H-ST

6.5 mm

J1

Panasonic 130 pin

J1

Panasonic 130 pin

hybrid

130 pin Panasonic socket on hybrid: AXK5SA3277YG
lifetime insertion cycles: 50
60 mOHM contacts

chamber ground and screwless fixation:
Plug on hybrid: Samtec MMCX-P-P-H-ST
2.5 mOHM, 0-6 GHz

Panasonic AXK5SA3277YG:
for hybrids SCEM 09.55.42.400.3

Panasonic AXK6SA3677YG
for detectors SCEM09.55.42.410.6

SAMTEC Jacks
SCEM 07.89.00.200.8

Samtec Plugs
SCEM 07.89.00.205.3

1/6/2011

H.Muller CERN PH

SRS progress

Mai 2013- Mai 2014

User purchases from ~ 30 teams:

- ~ 40 SRS classic system orders from CERN store
- ~ 10 SRS classic part orders from RD51 via TID/RFF
- 4 SRS – ATCA systems delivered from EicSys GmbH

Number of SRS APV channels sold:

2014-2015 130 k (prediction)

2013-2014 60 k

2012-2013 50 k

2010-2012 25 k

Total SRS turnaround 12 month

~ 370 kFs

Major SRS experiments plans 2014/15, please contact us if you plan for larger SRS systems

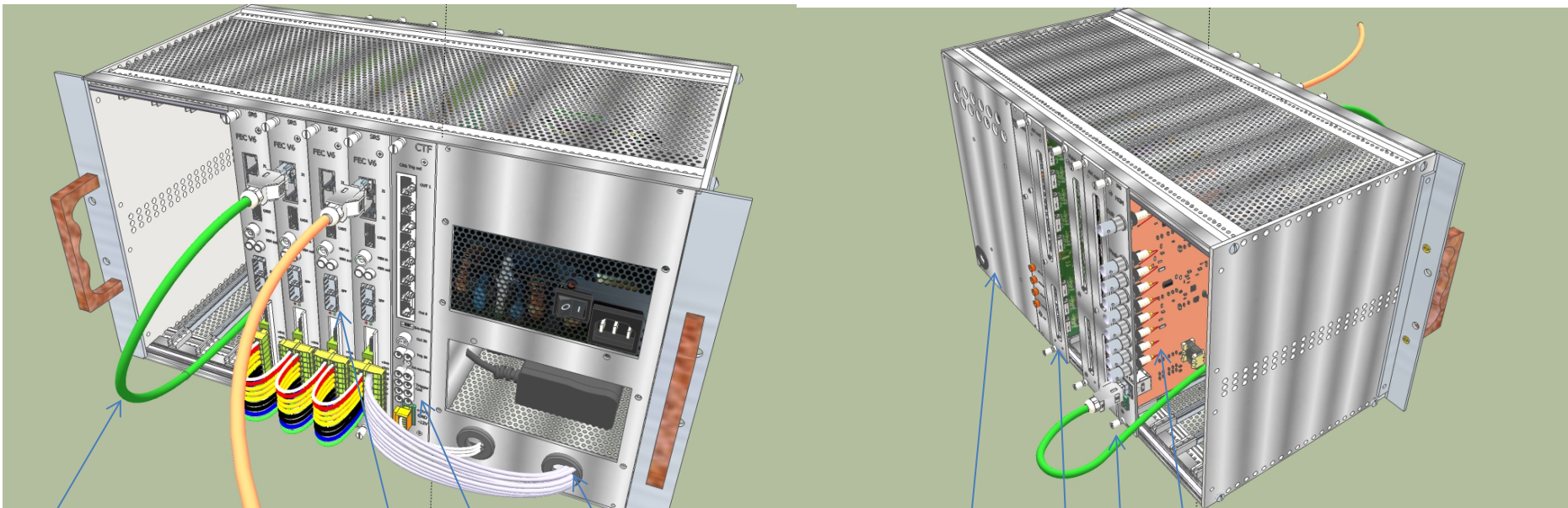
Planned 2014-2015 Experiments with SRS readout (130 k APV channles, 15k VMM channels, 10k Beetle channels, 10 k

Nr. Channels	EDH Nr	type of SRS	Experiments	Name	Team
15 k APV		SRS Classic	JPARC E16 experiment first phase	Tomonori Takahashi	RIKEN Nishia / E16
30 k APV		SRS Classic	JPARC E16 experiment second phase	Tomonori Takahashi	RIKEN Nishia / E16
72 k APV		SRS ATCA	JLAB SBS GEM back tracker	Kondo Gnanvo	Univerity Virginia
15 k VMM		SRS ATCA	ATLAS NSW test systems	Joerg Wotschack	CERN
10 k Beetle		SRS ATCA	ALICE FOCAL Si tracker	David Silvermyr	ORNL
10 k SiPM		SRS ATCA + SRS Classic	NEXT TPC readout system	Jose Toledo	UPV Valencia / NEXT
Timepix arrays		SRS Classic	LC TPC project	Jochen Kaminski	Bonn Univ
8k APV		SRS classic	T2DM2 Project	Stephane Gaffet	LSBB Laboratoire CRNS / Rustrel
10 PMT		SRS ATCA	CETAL High Intensity laser	Sorin Martoiu	IFIN-HH

Eurocrates

SRS Eurocrate frontside

SRS Eurocrate backside



remote I2C cable

4 FEC cards

dual power for up to 8 FEC cards

1 CTF card: clock and trigger synchronization

Ethernet cable to Online Computer

Power for SRU

planned 8ctal HV card for Micromegas

Remote I2C cable to peripheral card

4 ADC cards with HDMI ports

SRS-ATCA (Minicrate)

functionally equivalent SRS-classic with triple channel density
(4 systems delivered)

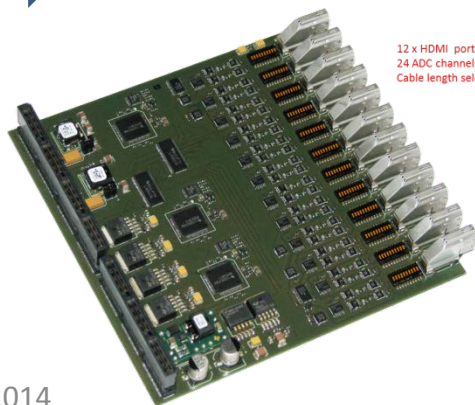


SRS-ATCA minicrate EicSys

1 Blade with 2 x ADC mezzanines for 6 k APV readout channels



Talk by EicSys

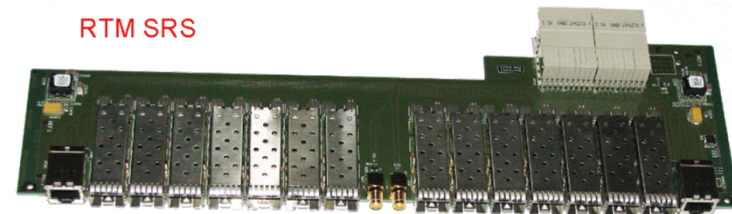


12 x HDMI ports
24 ADC channels 12 bit
Cable length selection

2 x Mezzanines (ADC):

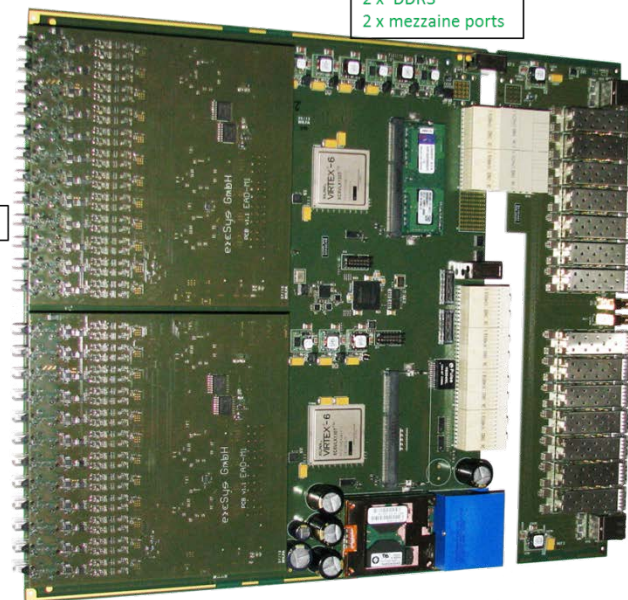
2 mezzanines:
max 6144 channels
APV/Beetle/VFAT

RTM SRS



Blade main board:
2 x Virtex 6 FPGA
2 x DDR3
2 x mezzanine ports

RTM I/O card:
2 x SFP+ ports
2 x RJ45 (DTCC)
2 x NIM (SMA)



Detector Hybrids for SRS

connected and powered via HDMI

VMM 128

more

talk by Sorin

New, expect for Aug 2014

digital with zero suppression, self triggering

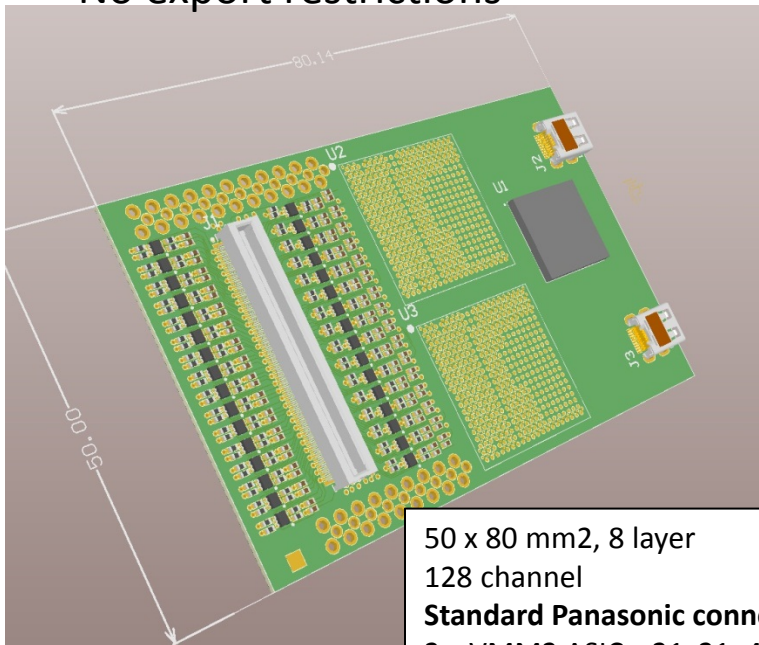
No export restrictions

APV 128 V4 (=> New V5 revision*)

SRS standard

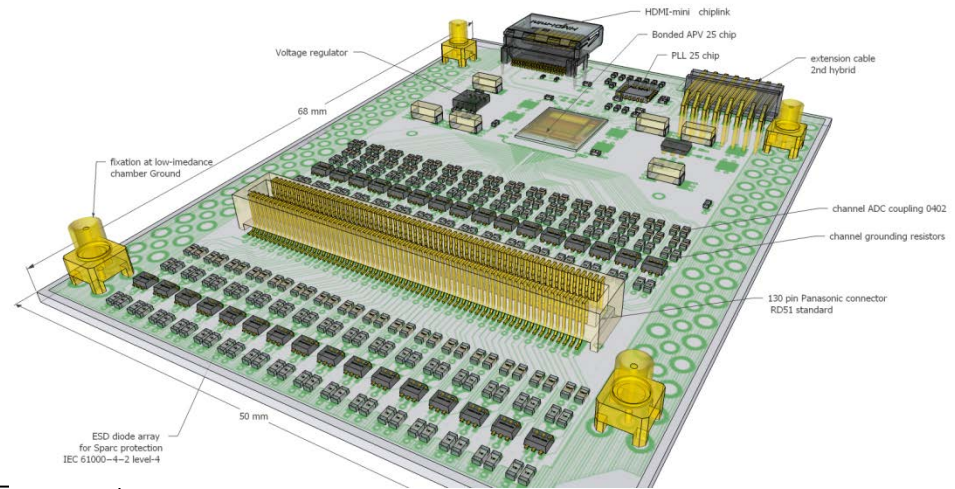
analogue without zero suppression

Rad-hard restricted export !



50 x 80 mm², 8 layer
 128 channel
Standard Panasonic connector
 2 x VMM2 ASICs, 21x21, 400 pin BGA
 1 x Spartan + 1 Flash
 dual readout 2x HDMI-Micro
 4mA/ch max

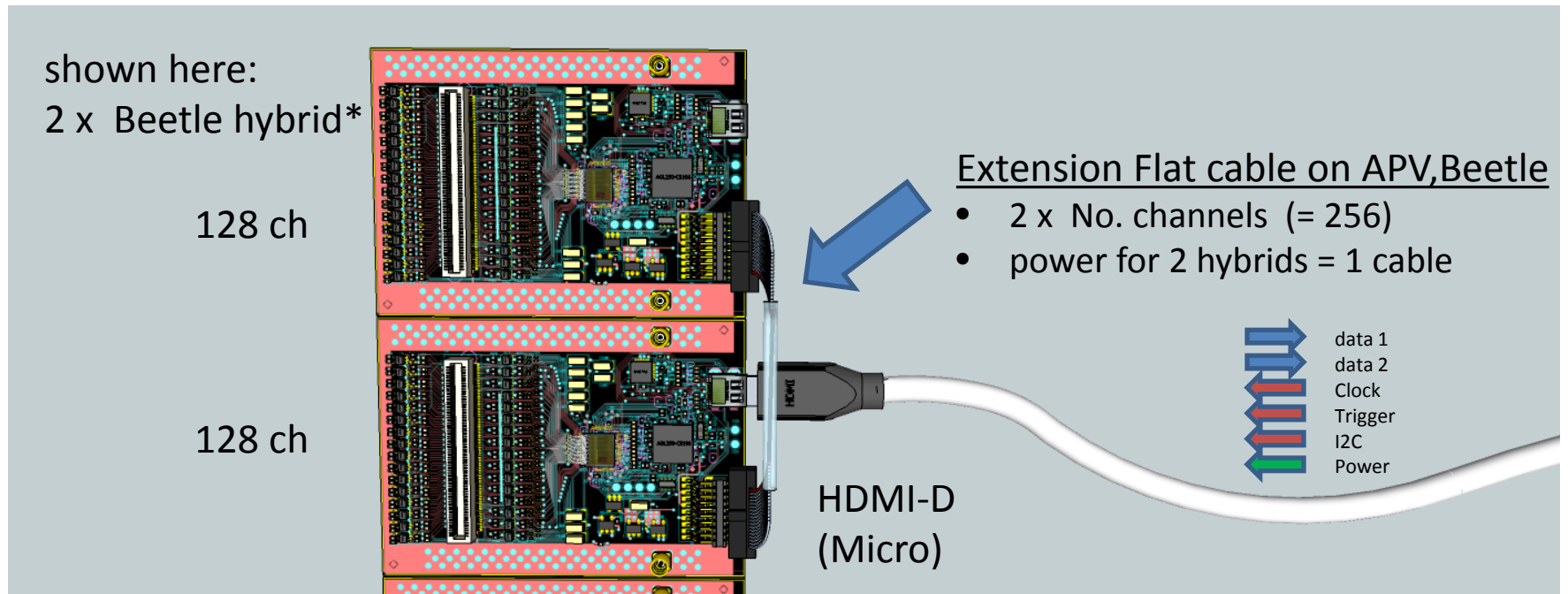
new systems



50 x 60 mm², 4 layer
 128 channel
Standard Panasonic connector
 1 x APV ASICs, Radhard, wire bonded !
 1 x PLL radhard, limited qty
 1 x HDMI-Micro
 3 mA/ch max

- planned, without LDOs

HDMI frontend APV, Beetle analogue or digital

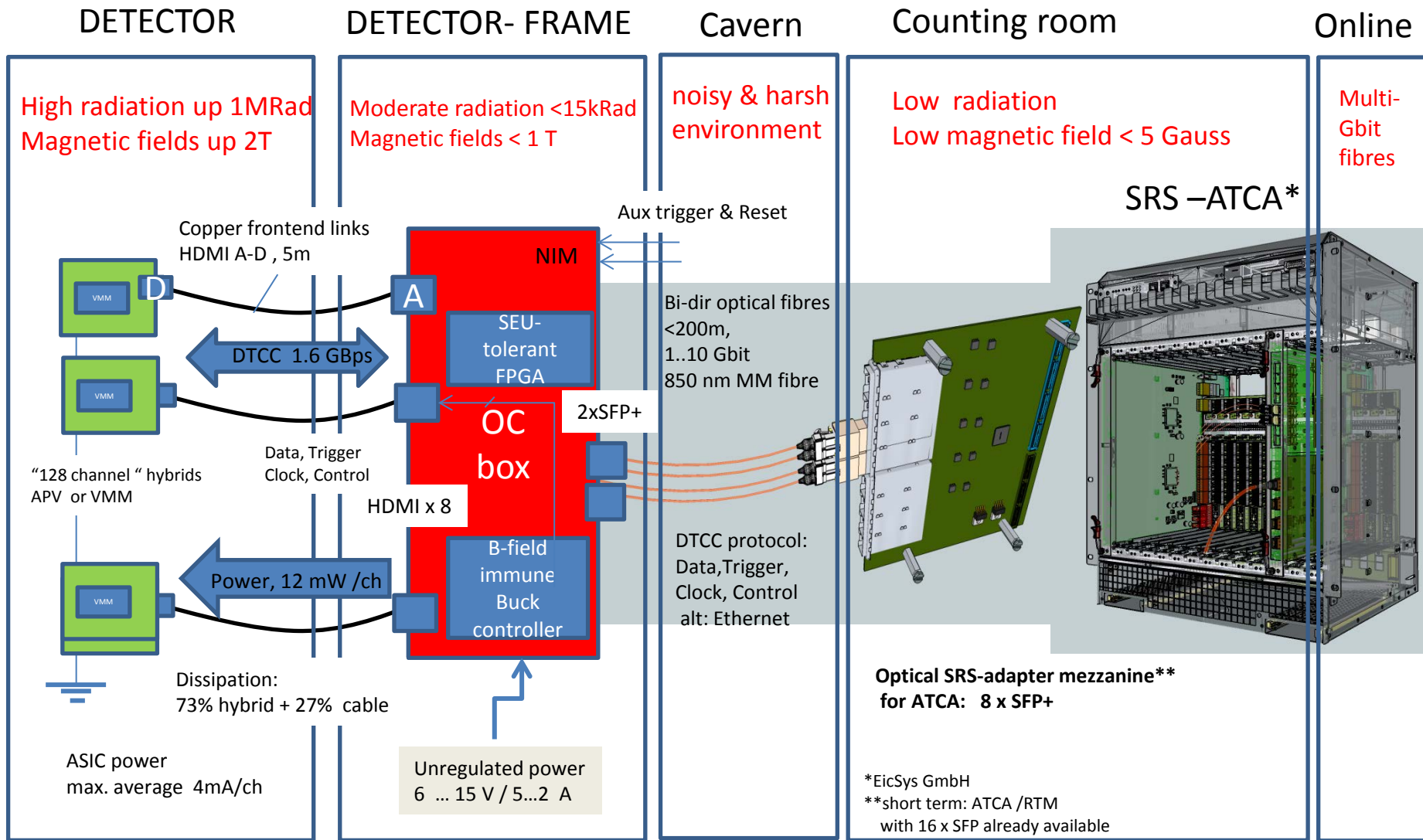


*PS: **what happened to the Beetle hybrid?** NEOHM has abandoned its fabrication due to major issues on the PCB and due to difficulties with 4 superimposed bonding layers. We look for a team that has manpower and resources for the rework.

Optical –Copper Junction box (OCx)

- Need a solution for Counting room distance (>30m)
- Maintain hybrid power/readout via short copper HDMI
- Data, Trigger, Clock, Control (DTCC) via long fibre or cable
- SEU's mitigated by off-detector copper-fiber conversion box
- Backward compatibility with APV analogue readout (OCA)
- Integrate new VMM128 hybrid digital readout (OCD)
- Hybrid powering included via HDMI cables
- Accessibility to hybrid power, connectors and links
- Single point failure range reduced to 1 single HDMI cable
- Ground-loop scope reduced to detector area

SRS Data Transmission from detector to counting room: OC box



DTCC link protocol for OCx*

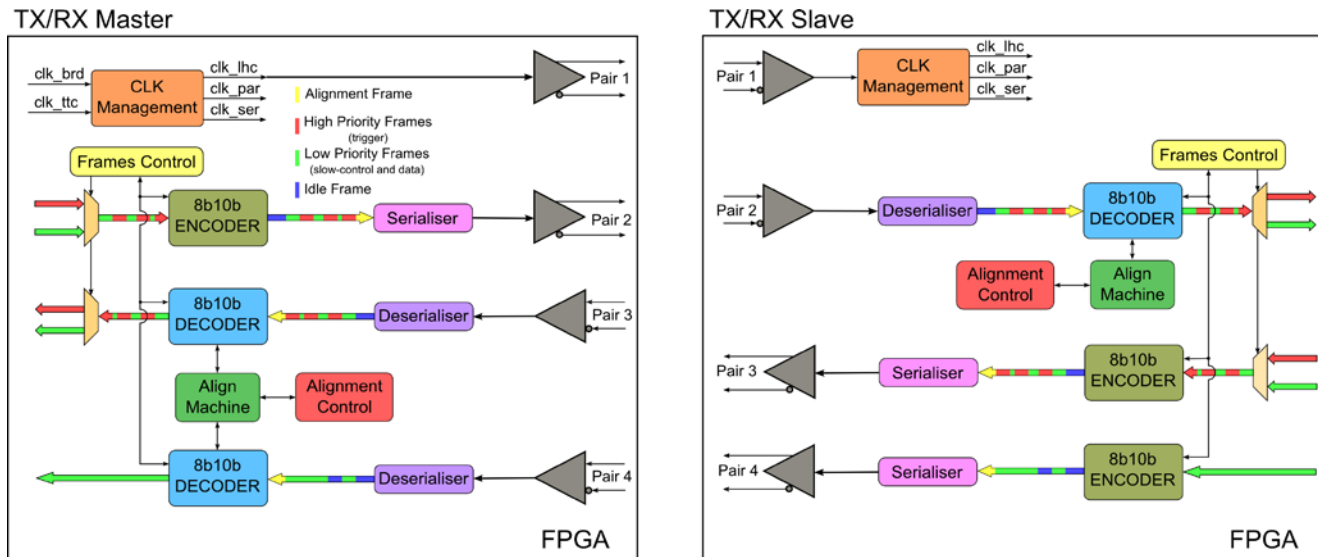
Data Trigger Clock Control over copper or fibre

Designed for SRS and part of the (CERN,IFIN,UPV) Intellectual Property definition of SRS !

Implemented so far in FPGA on SRU as standard link between FEC and SRU

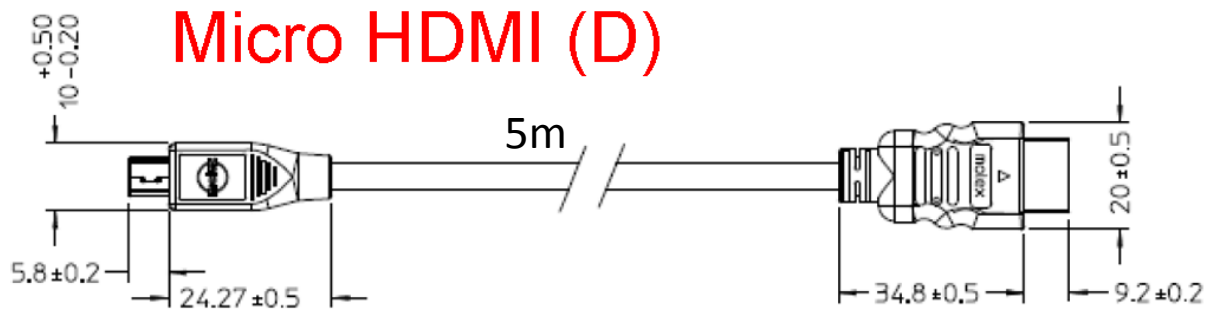
DTCC Properties:

bidir, 8b10b, dynam. synchronized, fixed latency, frames for: Trigger, Data, Ethernet Controls



*JINST Technical report "A point-to-point link for data, trigger, clock and control over copper or fibre" A.Tarazona et. Al. to become RD51 note

SRS copper frontend links: HDMI A-D Cable Assemblies



Micro HDMI (D)

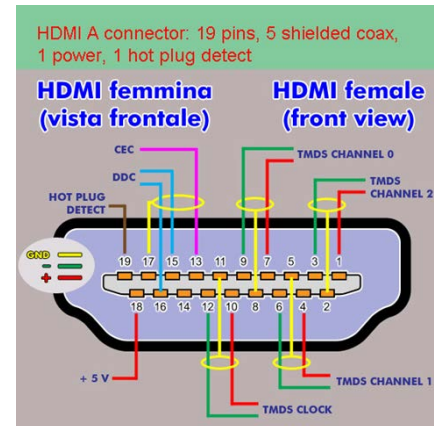
Molex, SEA etc

CERN store SCEM 07.89.00.220.2

Standard HDMI (A)

- Micro connector withdrawal force 5...25 N*
- TDMS (differential pairs) risetime (20-90%) 100 OHM, ≤ 200 ps
- Contact resistance: 10 milliohm (max)
- Durability: 5000 cycles
- Wrench on mated connectors, 15 cm from connector: 0..20 N no damage
- Current max 0.8 A
- Voltage max 30 V
- Temperature: -20 ..+80 C

*Note: a force of 40 N over 1 min can rip cables out **locked** connectors



- 5 x shielded pairs 3.3Gbps
- Power, I2C, Reset

HDMI link for VMM2

Downlink (to Hybrid):

3 x power

1 x diff. clk (default 40 MHz)

1 x diff configuration data

1 x Reset

Uplink (to SRS):

2 x diff. data or trigger (default 40 MHz)

Bi-directional

1 x I2C

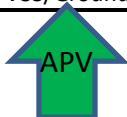


HDMI-MICRO D	HDMI-standard A	SRS	SRS	SRS	HDMI 1.4	Color	Color
hybrid side	SRS adapter side	VMM2	APV V5	Beetle	HDMI signal Assignment	32 AWG	34 AWG
		chiplink	chiplink	chiplink		0.538 Ohm/m	0.856 Ohm/m
1	19	Power2a	SCL_B	TGOUT	hot plug detect	black	orange
2	14	Power2b	SDA_B	TGOUT*	Utility	brown	brown
3	1	DOUT0	AOUT0	AOUTA	TDMS DATA2+	white	white
4	2	VSS/G	VSS/G	VSS/G	TDMS Data 2 Shield	drain wire	drain wire
5	3	DOUT0*	AOUT0*	AOUTA*	TDMS Data2-	red	red
6	4	DOUT1	AOUT1	AOUTB	TDMS Data1+	white	white
7	5	VSS/G	VSS/G	VSS/G	TDMS Data 1 Shield	drain wire	drain wire
8	6	DOUT1*	AOUT1*	AOUTB*	TDMS Data1-	green	green
9	7	CONFIN	TRGIN	TRGIN	TDMS Data0+	white	white
10	8	VSS/G	VSS/G	VSS/G	TDMS Data 0 Shield	drain wire	drain wire
11	9	CONFIN*	TRGIN*	TRGIN*	TDMS Data0-	blue	brown
12	10	CLK	BCLK	BCLK	TDMS CLK+	white	white
13	11	VSS/G	VSS/G	VSS/G	TDMS CLK Shield	drain wire	drain wire
14	12	CLK*	BCLK*	BCLK*	TDMS CLK-	yellow	blue
15	13	RST*	RST*	RST*	CEC	red	red
16	17	VSS/G	VSS/G	VSS/G	CEC/CEC (I2C) GROUND	yellow	yellow
17	15	SCL_C	SCL_C	SCL_C	SCL (I2C clock)	green	green
18	16	SDA_C	SDA_C	SDA_C	SDA (I2C data)	blue	blue
19	18	Power 1	P3V3/G	5V	5V Power	white	white
SHELL	Shell	VSS/Ground	VSS/Ground	VSS/Ground	cable shell	braid	braid

2x 2V4

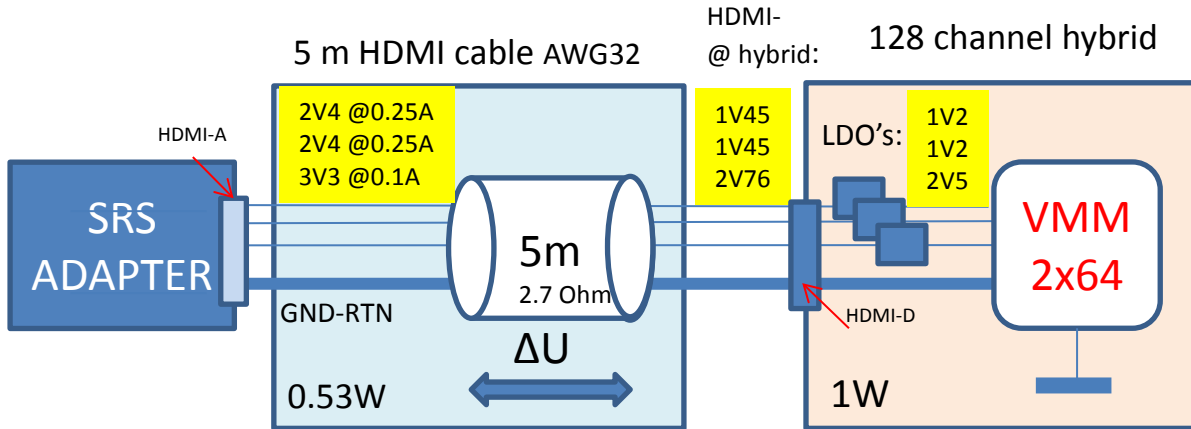
3V3

planned APV – 5 hybrid revision :
adopt VMM power scheme and
use unused SCL for Power



Power sharing cable/hybrid

based on **4 mA/ch** average of VMM



One 5m HDMI cable / 2 VMM's
Standard AWG32 HDMI A-D (Micro) cable assemblies

total dissipation / 128ch hybrid
 $P = P1 + P2 = 1.53 \text{ Watt}$
Hybrid only: $P2 = 1 \text{ Watt}$
Effective total / channel
11.9 mW

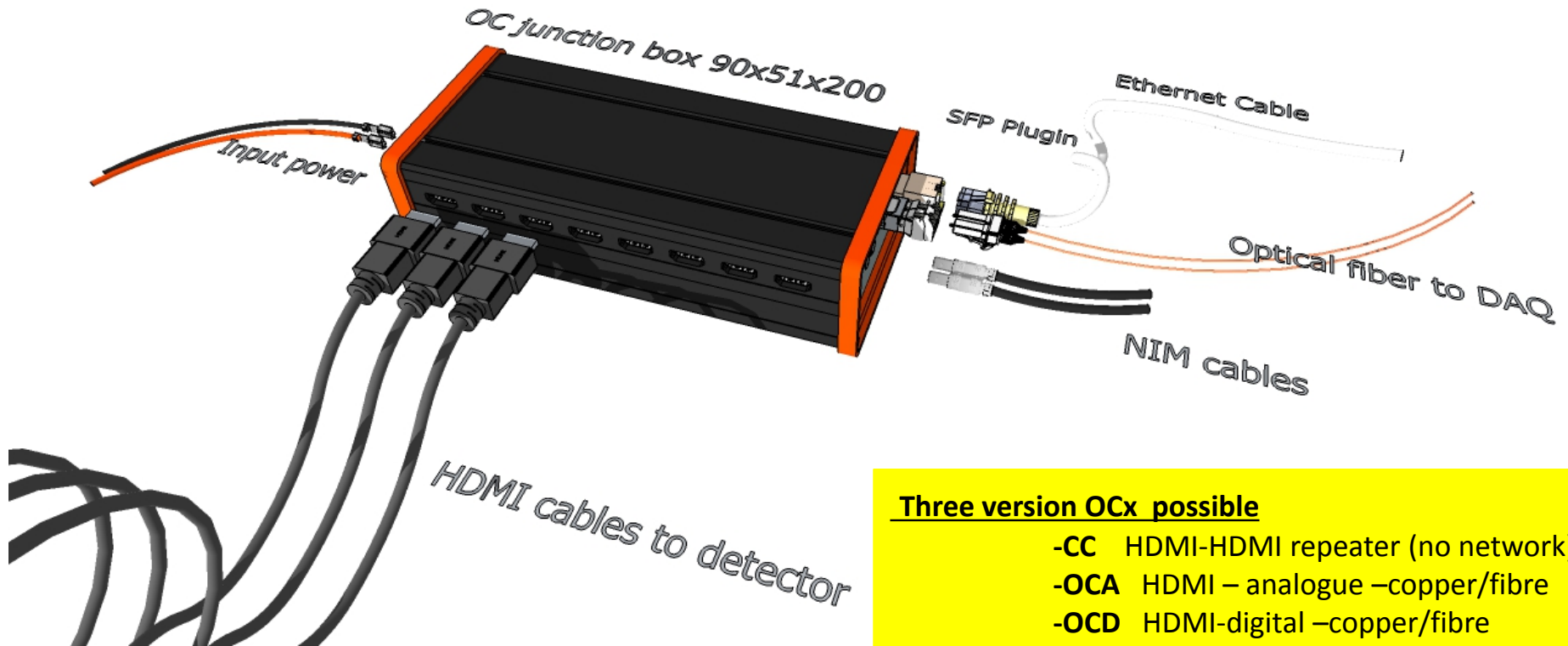
V_{in} From HDMI-A adapter	I supply (A) from Adapter	$P1$ Cable dissipation (W) $P1 = (I)^2 R$	R (5m AWG32) (OHM)	ΔU drop on cable (V)	Eff. Hybrid Volt @ HDMI-D (V)
2x 2V4	$2 \times (+0.256)$ = + 0.5	$2 \times 0.256^2 \times 2.7$ = 0.34	2.7	0.675	$2.4 - 0.675 - 0.27$ = 1.455 @ 0.5A
1x 3V3	$1 \times (+0.1)$ = + 0.1	$0.1^2 \times 2.7$ = 0.027	2.7	0.27	$3.3 - 0.27 - 0.27$ = 2.76 @ 0.1A
GND-RTN	= - 0.6	$0.6^2 \times 0.45$ = 0.16	$2.7 / 6$ = 0.45	0.27	

cable : $P1 = 0.53 \text{ Watt}$

hybrid: $P2 = 1 \text{ Watt}$

Dissipation sharing:
 65 % Hybrid
 35 % Cable

Planned OCx box connectivity



Three version OCx possible

- CC HDMI-HDMI repeater (no network)
- OCA HDMI – analogue –copper/fibre
- OCD HDMI-digital –copper/fibre

* All 3 versions provide power to the hybrids

OCx Connections

2x NIM 50 OHM

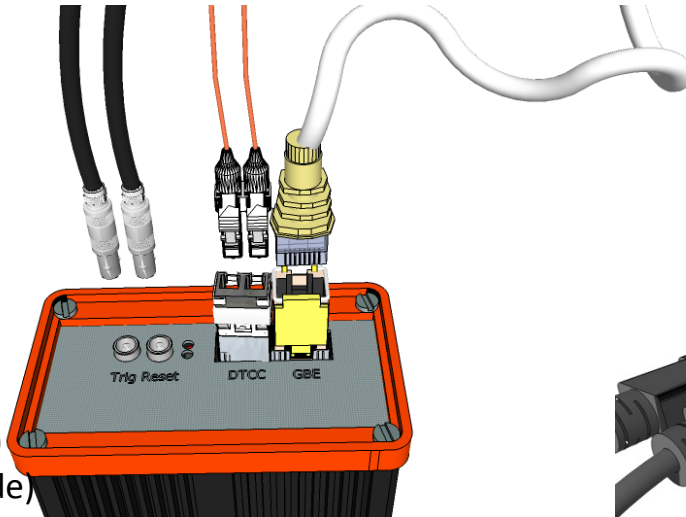
- Remote RESET
- AUX IN (Trig, Test)

2x SFP+

- DTCC fiber /copper
- Ethernet copper

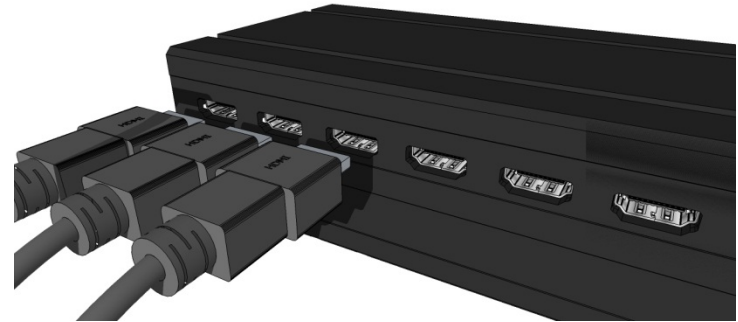
2x LED indicators

- Event Upload (green)
- Config Download (red)
- Error (simult. blink code)



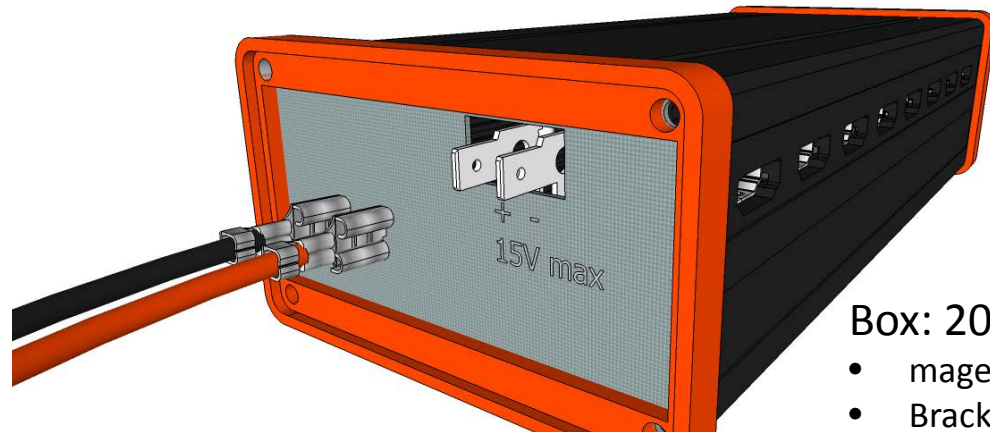
Frontend links

- 8x HDMI-A lateral
- Individually fused
- OCD: DTCC protocol
- OCA: Analogue APV



Input Power

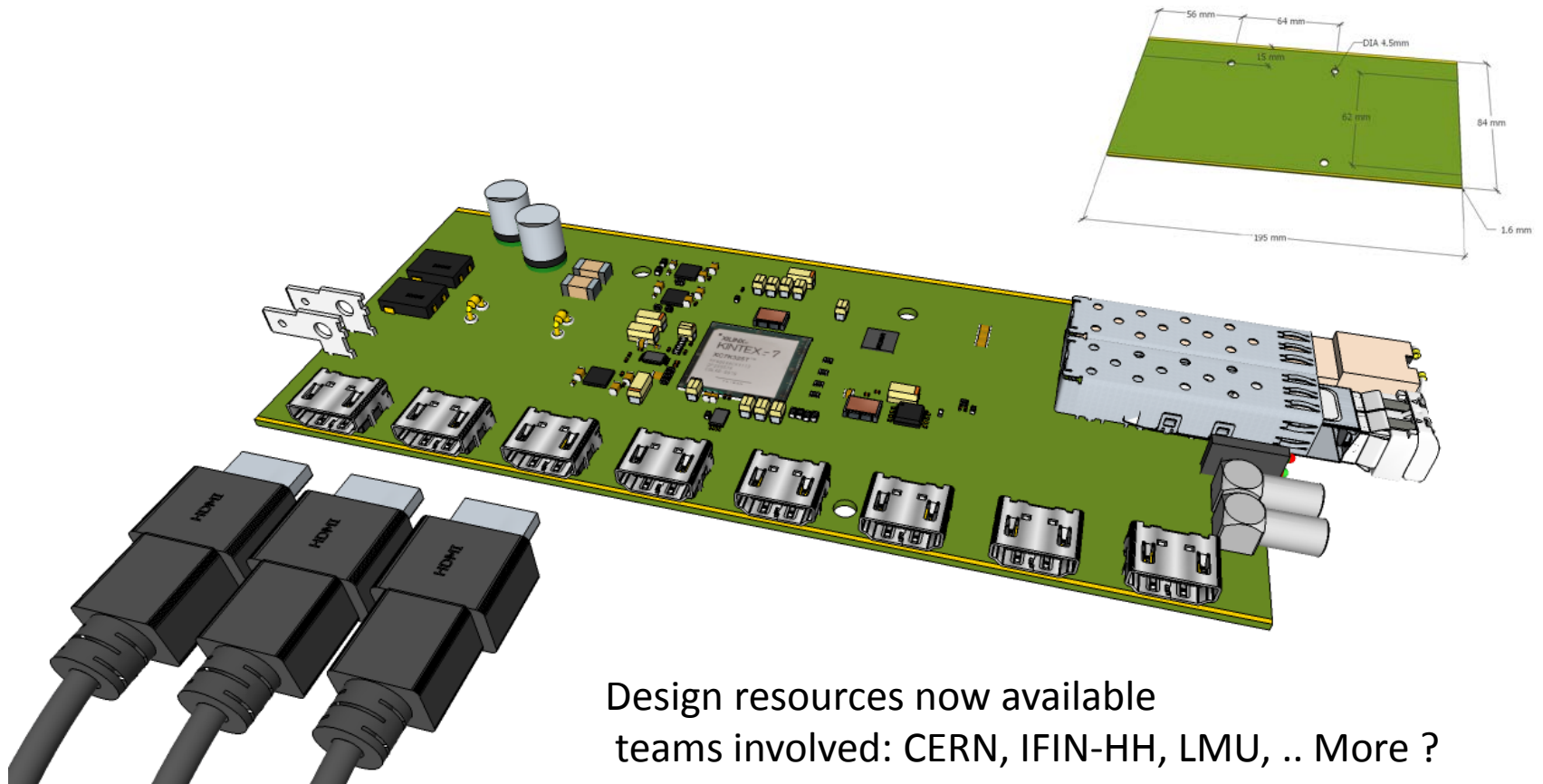
- Faston Plus-Minus
- 2.5 mm² cables
- 30 W input
- unreg. 5-15V , 6-2 A
- Box dissipation 10W



Box: 200x90x51

- magetics free
- Bracket mountable

OCx board (draft)



Design resources now available
teams involved: CERN, IFIN-HH, LMU, .. More ?
+ discussion with EicSys about possible involvement

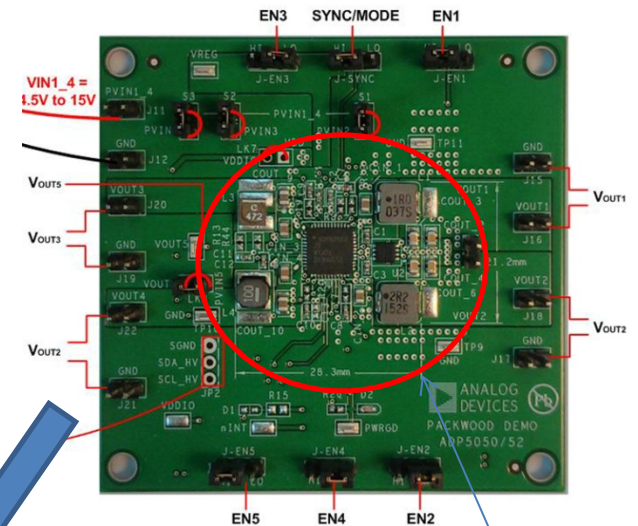
OCx powering

Need a magnetics-free small solution to provide 5 voltages with up to 8 A

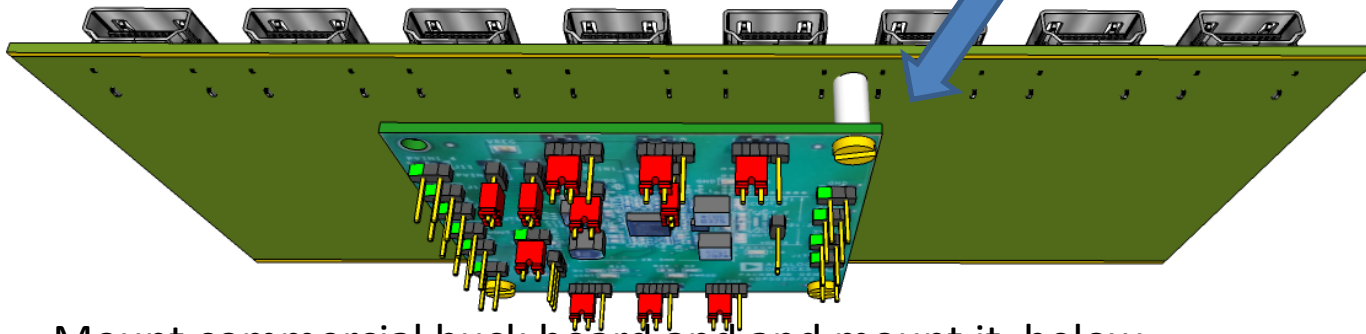
Tests with ADP5050 boards were successful



B-field test* up 1 Tesla Ok



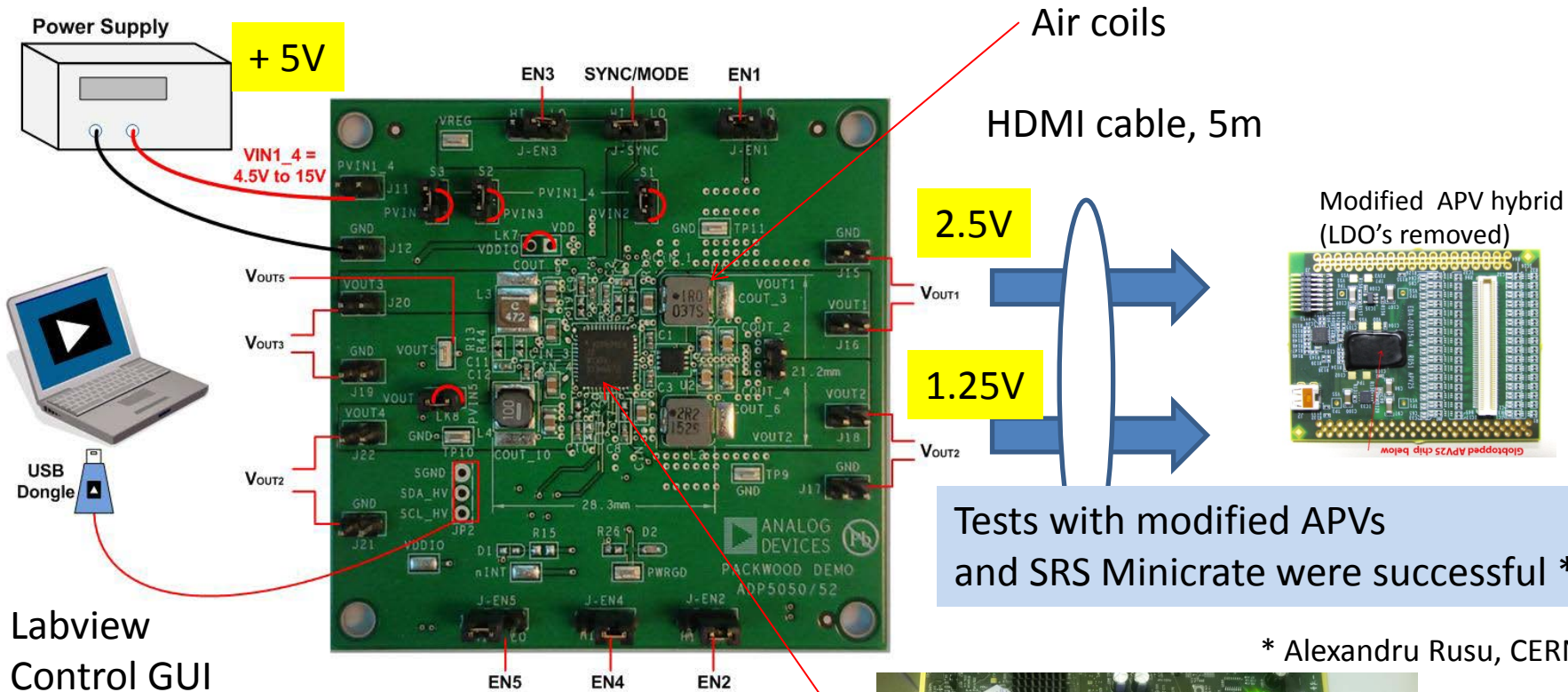
area to be passively cooled via Thermpad to Chassis



Mount commercial buck board and and mount it below OC board with plastic ! 10 mm spacers

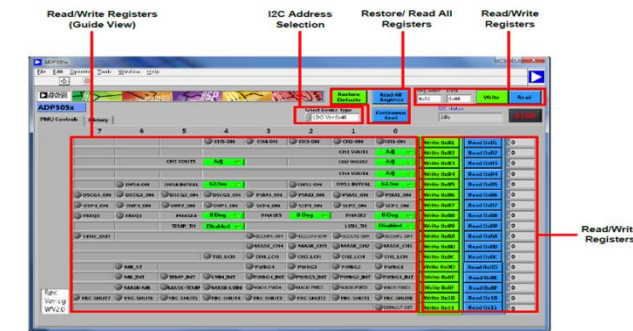
* Givi Sekhniaidze

ADP5050 in test environment

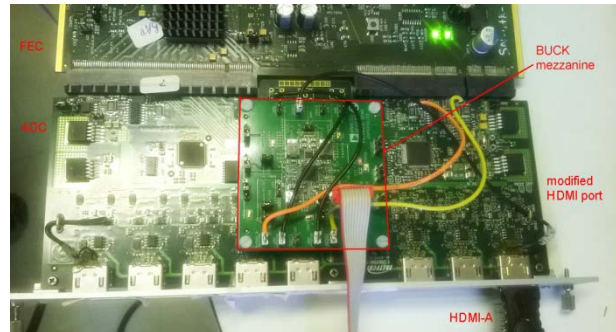


Tests with modified APVs and SRS Minirate were successful *

* Alexandru Rusu, CERN/IFIN



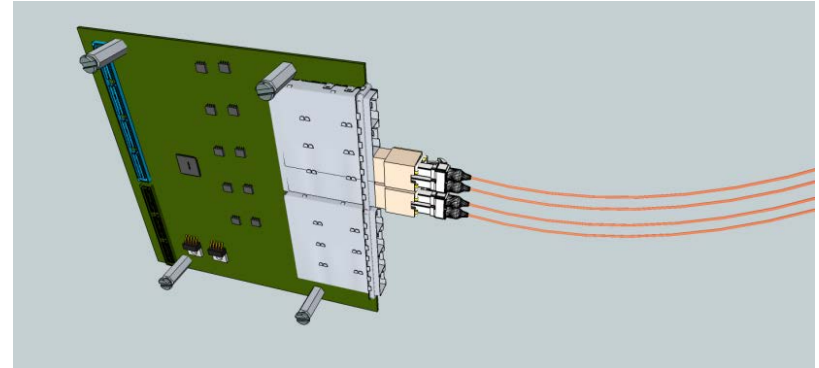
Buck chip



Optical receivers for DTCC

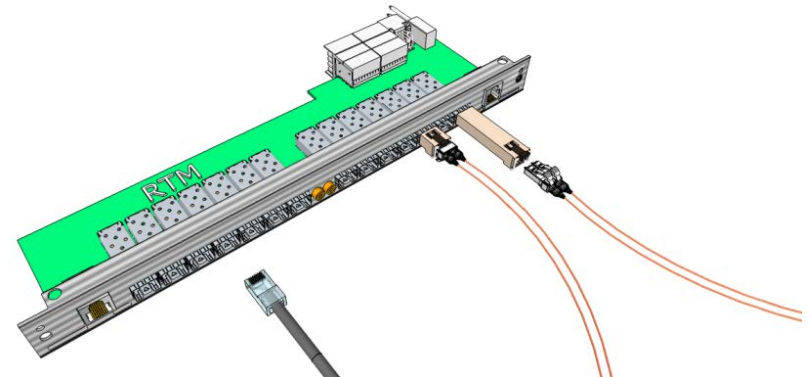
SRS-ATCA optical mezzanine 8 x SFP+

schematics: S.Martoiu (done)
PCB layout: S.Martoiu (advanced)



Ad interim: RTM card for ATCA blade

Production: EicSys GmbH

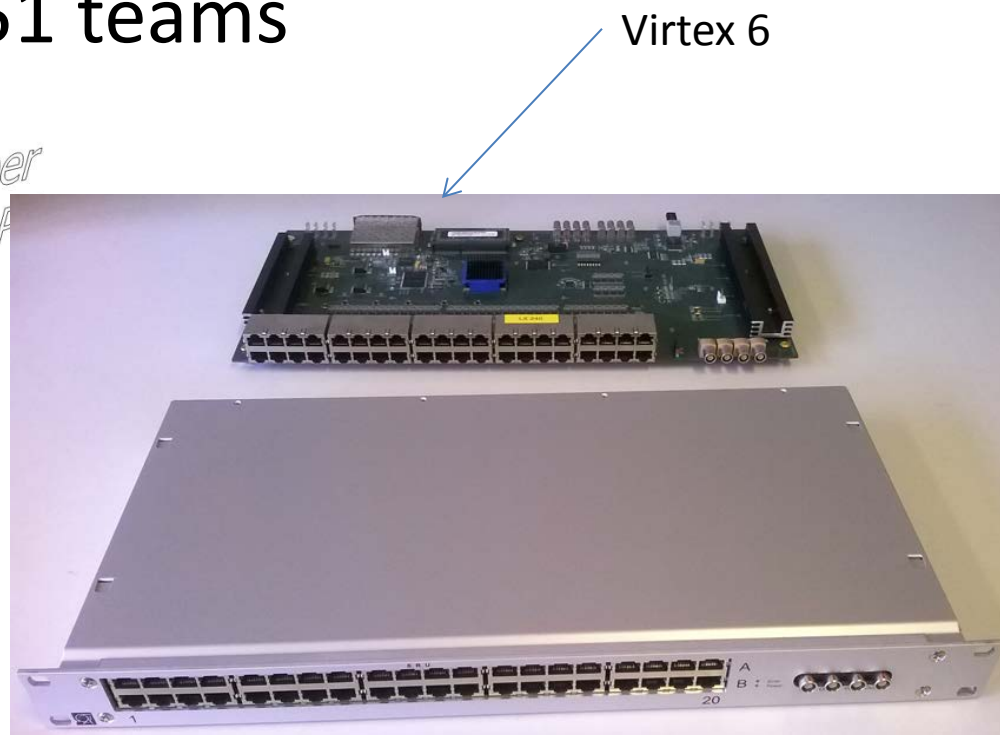
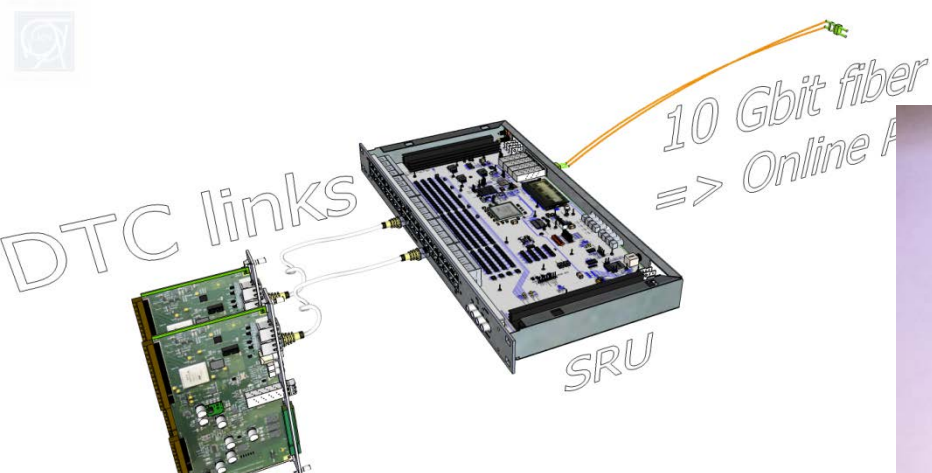


Talk by EicSys

Scalable Readout Units (SRU)

Last 12 month:

- 12 produced for ALICE PHOS
- 4 produced for RD51 teams



A special SRU magnetics-free ALU chassis has been produced by Rotronic

SRS Respository

<https://svn.cern.ch/repos/srsfw/FEC/trunk/>

- 3 levels of SVN users

Administrators (access rights) Sorin Martoiu, Adrian Fiergolski

Core developers (firmware developers)

SRS users (downloading of documentation and bitfiles) read only

For SRS users, documentation and latest bit files will be made available on SVN

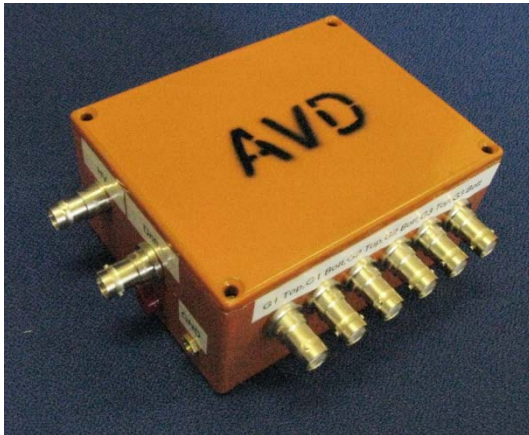
Licenced:

- SRS DTCC link firmware
- SRS slow controls firmware
- ADC phase alignment and readout firmware
- FEC core (operation of the different basic functionalities in the FEC)

SRS Lab equipment

AIDA2 resources requested for finalization

AVD active Voltage Divider for GEMs



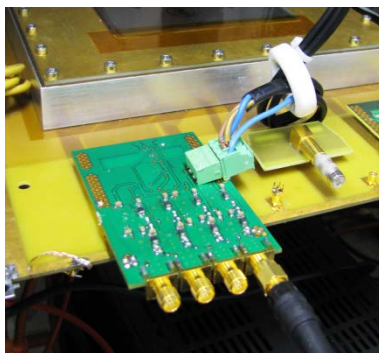
Several prototypes built: tested OK with triple GEM incl. readout of GEM foil voltages via SRS
New version: continued operation with short circuit on one GEM foil sector

Trigger pickup box for MPGD meshes



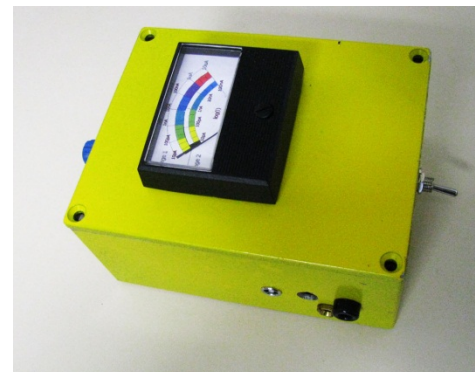
5 TP boxes built and is use. Integrate HV filter and charge sensitive preamplifiers

QUAD MPGD signal amplifier 2 GHz, 25dB



One prototypes built: tested on MicroMega
1 channel works OK
3 Channels have ringing problem
New version: Improvement of shielding, new 50 OHM PCB

Femto-ampere measuring box



Several FEMTO prototypes built: sensitivity over 8 decades 10 fA – 1 uA
Tested Ok with MPGD detector pickup.
New version: larger analogue display, triax input connector, Oscilloscope 50 Ohm output

SRS procurement and sales situation

- APV hybrids are produced and tested by NEOHM , Italy
 - ➔ yield and delivery delays are very good
- Crates, FEC cards, ADC cards and ATX cards are produced by Prisma Electronics, Greece
 - ➔ unacceptable delays* up to 1 year
- SRS accessories are purchased in quantity by CERN store for resale in small qty.
 - ➔ for large quantities cables, connectors contact us
- Commercial SRS ATCA is directly sold by ElcSYS GmbH, Hamburg
- APV hybrids sales is restricted and requires special procedure
- New VMM hybrid sales will be open, in principle also to sales via SRS companies

* the reason for delays between Prisma and Cern store logistics is not known to us

SRS intellectual property and licence

CERN + IFIN HH Bucharest + UPV Valencia



Talk by Eduardo Del Castillo Sanchez

Scope of the IP:

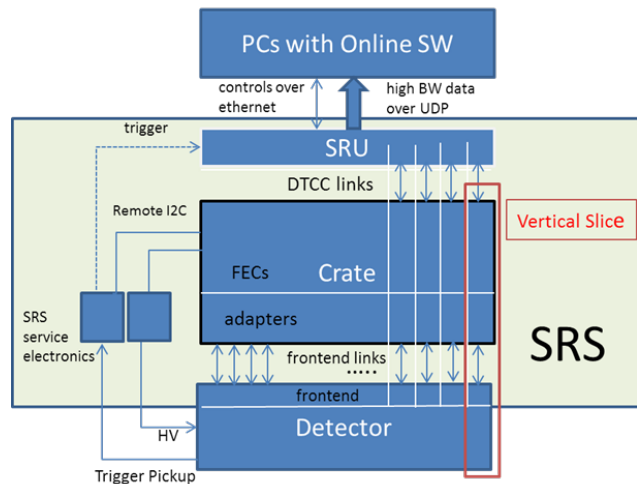
- scalable vertical readout slices
- peripheral service electronics
- DTCC links
- firmware on Repository

CERN agreement:

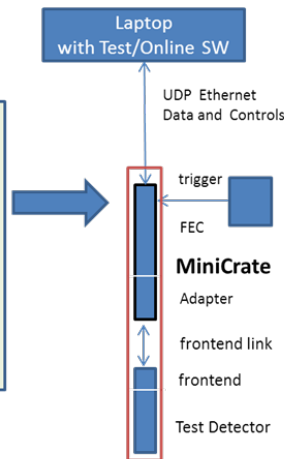
KN2288/KT/PH/203A

SCALABLE READOUT SYSTEM, SRS

Full SRS architecture



Minimal SRS architecture



1st Licence taker*

- EicSys GmbH, Hamburg

* royalties for CERN/RD51

SRS logo



Scalable Readout System

Summary

- New SRS system cards and modules ready
- New VMM digital chip readout in preparation
- New FEC card for more power and flexibility ready
- First SRS ATCA system deployed
- Long distance SRS links via DTCC protocol with OC box
- SRS as vertical, scalable slices is intellectual property
- SRS lab equipment gets a new boost of resources
- SRS Repository for sharing files and downloads
- SRS is very popular, 1 year sales reach 0.35 MFs
- Delivery problems must be solved