

**LMU - Cluster Universe**  
Stefan Rummel

# Electrical Services

**5th International Workshop on DEPFET  
Detectors and Applications**

**29.09-30.09. Valencia**





- Cables: low voltage, high speed
- Patch Panel location
- PP geometry, layout



## •TDR assumes:

- 5 Ohm/km high I → AWG 12 3.3mm<sup>2</sup>
- 20 Ohm/km mid I → AWG 18 0.9mm<sup>2</sup>
- 150 Ohm/km low I → AWG 26 0.13mm<sup>2</sup>

## •High current (AWG 12):

- Analog: DCD\_AVDD, DCD\_AGND, DCD\_Amp Low
- Digital: DCD\_DVDD, DCD\_DGND, DHP\_DVDD, DHP\_DGND

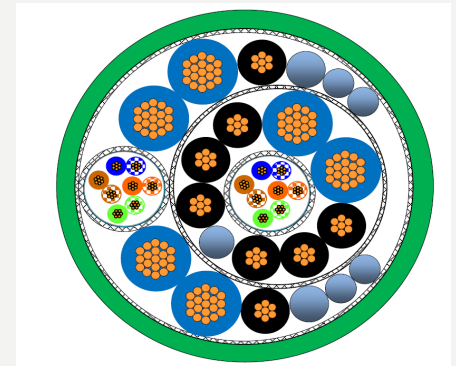
## • Mid current (AWG 18):

- Analog: CL\_HIGH, CL\_LOW, GATE\_ON, GATE\_OFF, V\_SOURCE, DCD\_REFIN
- Digital: SW\_DVDD, SW\_DGND

## • Low current (AWG 26):

- Analog: V\_BULK, V\_CCG, HV, V\_GUARD, 2\*3 Sense (DCD\_AVDD, DCD\_AMP\_LOW, V\_SOURCE)
- Digital: 2\*2 Sense

- Look into an individual assembly
  - $40 \times 30 \text{m} = 1.2 \text{km}$  is reasonable for production
  - Price from: 26/m (Prototyping 65/m, 12/m + Cu)
- Both digital and analog supplies in one cable
  - Try to separate both
  - Two shields
    - Analog - digital
    - Towards outer world
- First layouts:  $< \varnothing 20 \text{mm} = 295 \text{mm}^2$ 
  - $\sim 60 \text{cm}^2$  /half shell



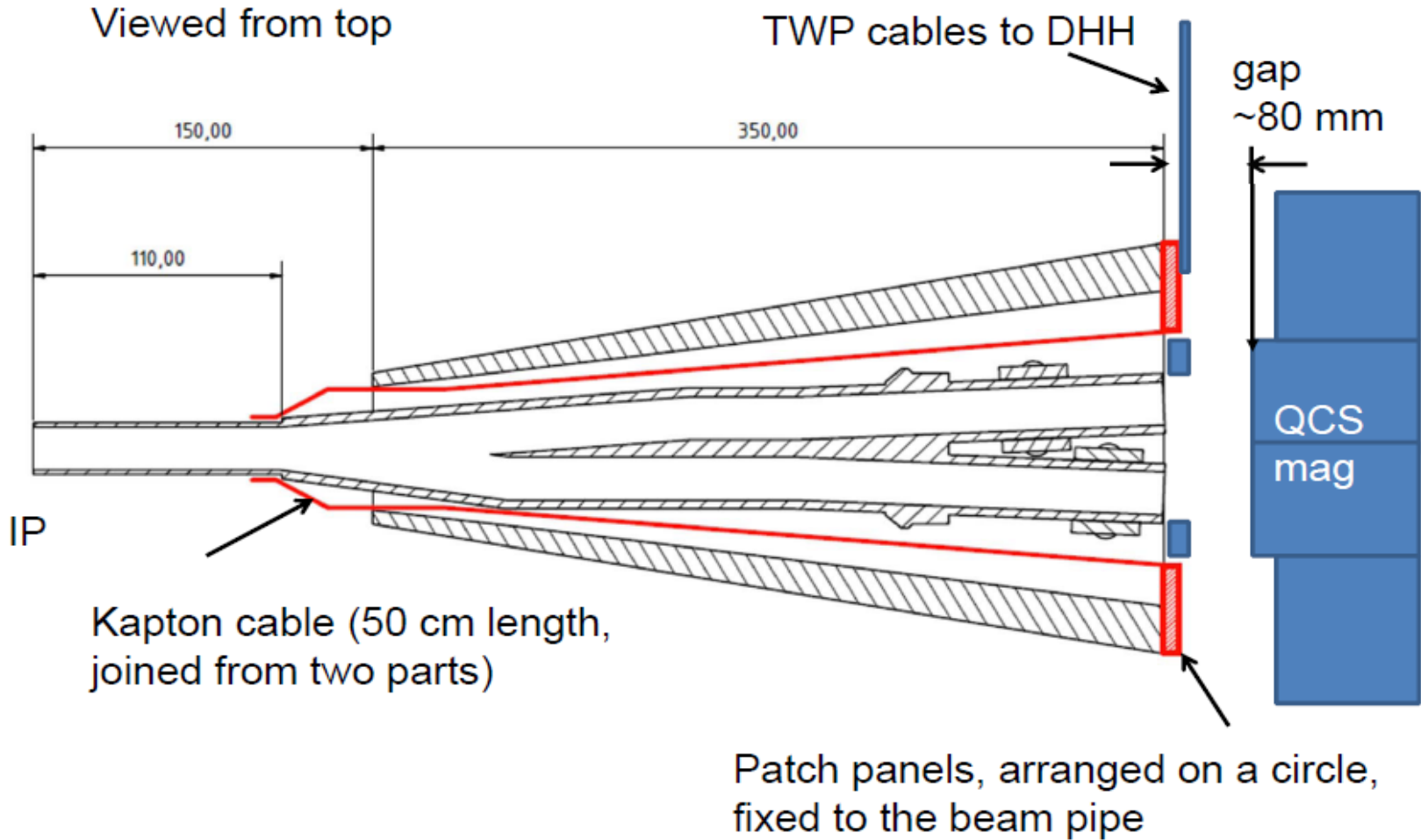


- Low voltage: 20 cables per half  $\sim 60\text{cm}^2$
- High speed links: 3 Cat6/7 cables per module  $\rightarrow$  60 assuming dia. 7mm  $\sim 23\text{cm}^2$
- In total  $\sim 83\text{cm}^2$  for electrical services on each side

# Connectivity



- 12 differential high speed links
- ~30 wires (power, sense lines) up to 2.5A
- Available space depends strongly on length of Kapton flex ~ DHP driving capability, signal integrity
- Baseline now: long flex (50cm) beyond QCS shield – Hans will report on that
  - Significant more space for services

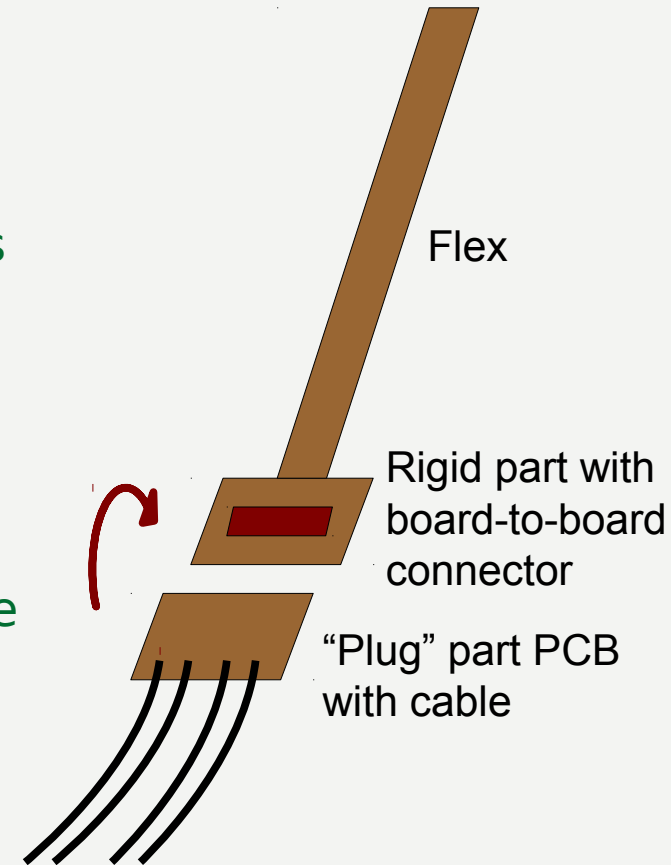


[C. Kiesling MPP]





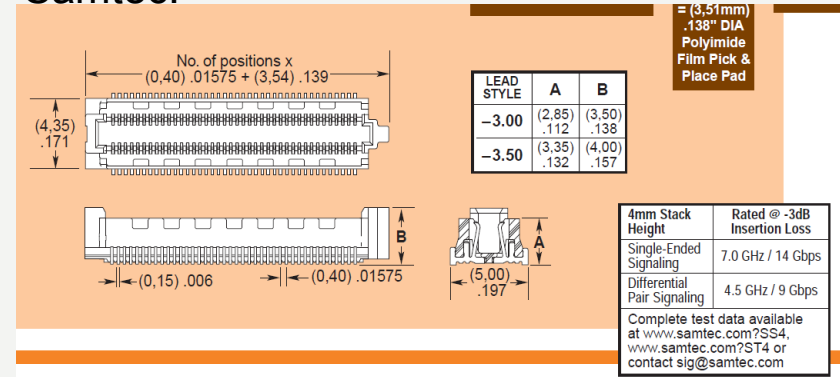
- Board to wire connectors are not satisfactory
  - High speed stuff is often bulky
  - LV provide only connectivity for thin wires
- Baseline: board to board connector and PCB with solder pads for cable
  - HS, low profile, high CCC connectors are widely available
  - PCB can be made flexible with appropriate pads for large diameter wires





- Requirements:
  - 24 pins - signals
  - 45 pins - power, sense wires, overhead to distribute current
- Two 20 pin/row connectors or one 40 pin/row connector

SS4/ST4 connectors from Samtec:



1.3A @ 80degC

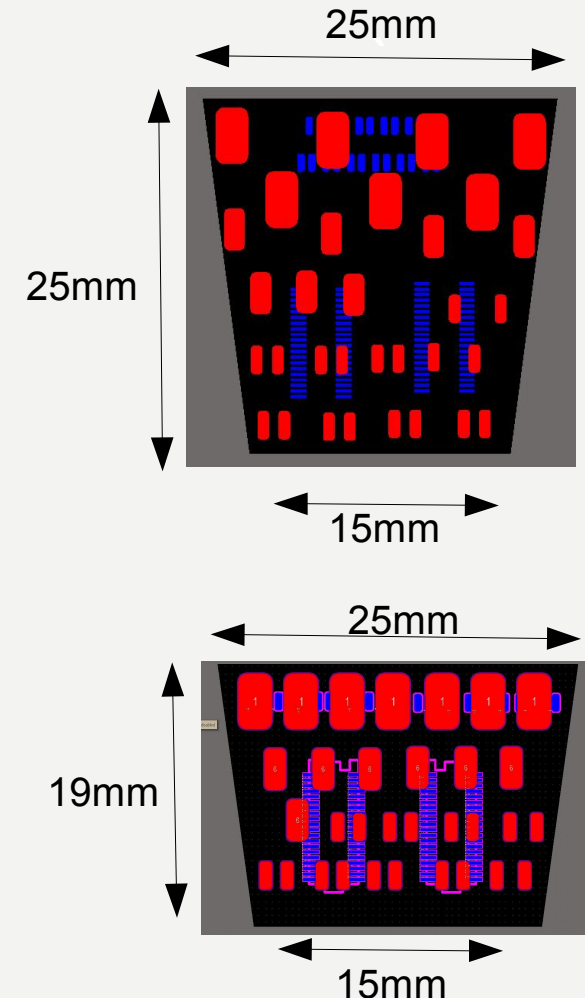
0.4mm pitch

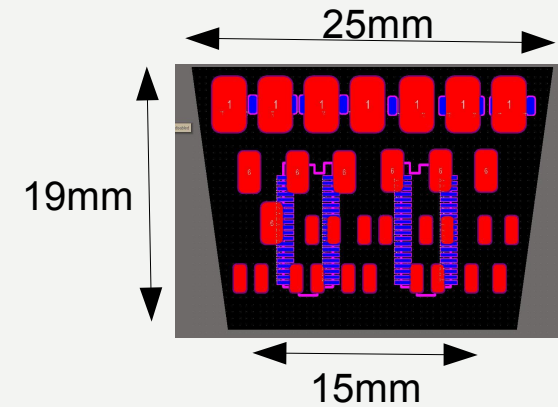
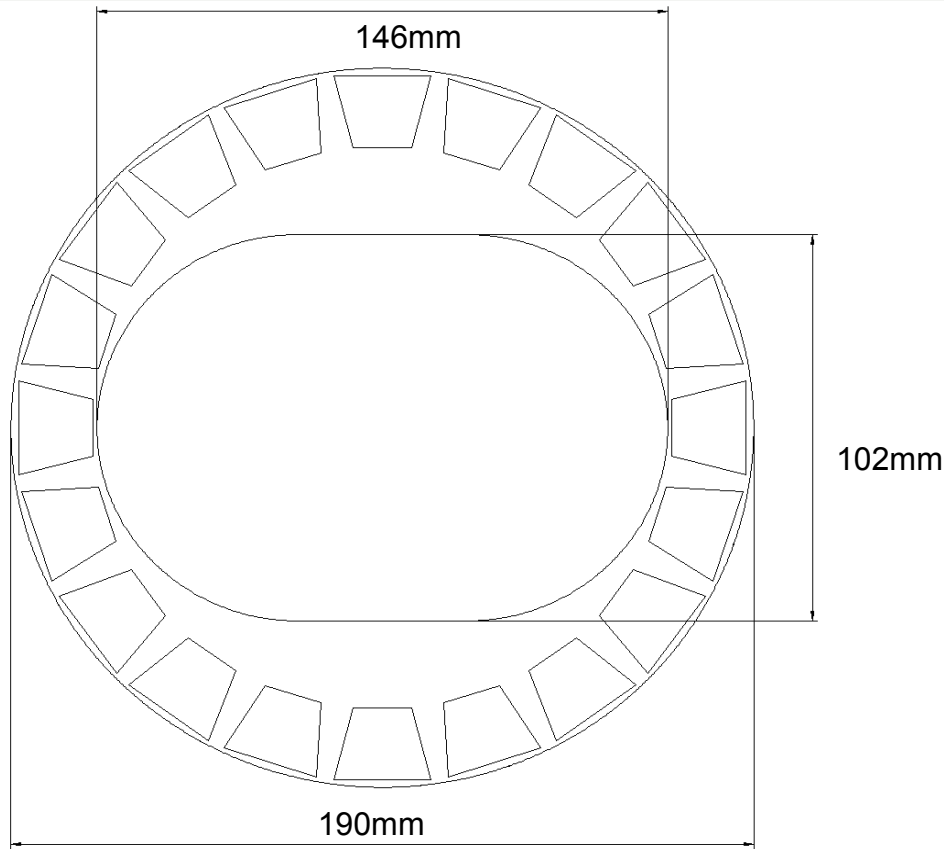
Width: 11.54mm@40 pins

19.54mm@80 Pins

Mated height: 4mm

- Using two 40 pin SS4/ST4 connectors
- Width is 25mm – fits on a radius of 80mm (QCS has an outer radius of 95mm)
- Area is dominated by pads for soldering the wires
- Force on PP:
  - 20mm diameter cable
  - 3 Cat6/7 cables (~7mm dia. each)
  - Cable strain relieve
- Next steps / issues to check:
  - Mating/unmating force of connectors
  - Potting with epoxy?
  - Space assigned to pads – solderability
  - Signal integrity





- PP distributed on a radius of 93mm
- QCS final dimensions not known
- OVP still missing



- Long flex allows to go in regions with more space
  - Only thin flex between QCS shield and beam pipe
  - No connectors inside QCS shield
  - Width of flex can be increased to decrease resistance for high currents
  - Cables can be attached after assembly of PXD and QCS
- Combination of board to board connector with PCB gives significant more flexibility as commercial solutions
- Need a cable strain relieve and mounting structure for the PP



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- Backup solution if signal integrity requires shorter flex
- Rigid part within desired distance + low profile connector (eg. SS4 with 2\*20Pins, allows ½ Signal/Ground ratio)
- Solution size can be 15\*16mm<sup>2</sup>
- Profile height: 4mm + 2\* PCB thickness + wires
- Power lines can be connected outside of QCS (still long flex)

