



ITAINNOVA
INSTITUTO TECNOLÓGICO DE ARAGÓN



PXD Grounding & Shielding

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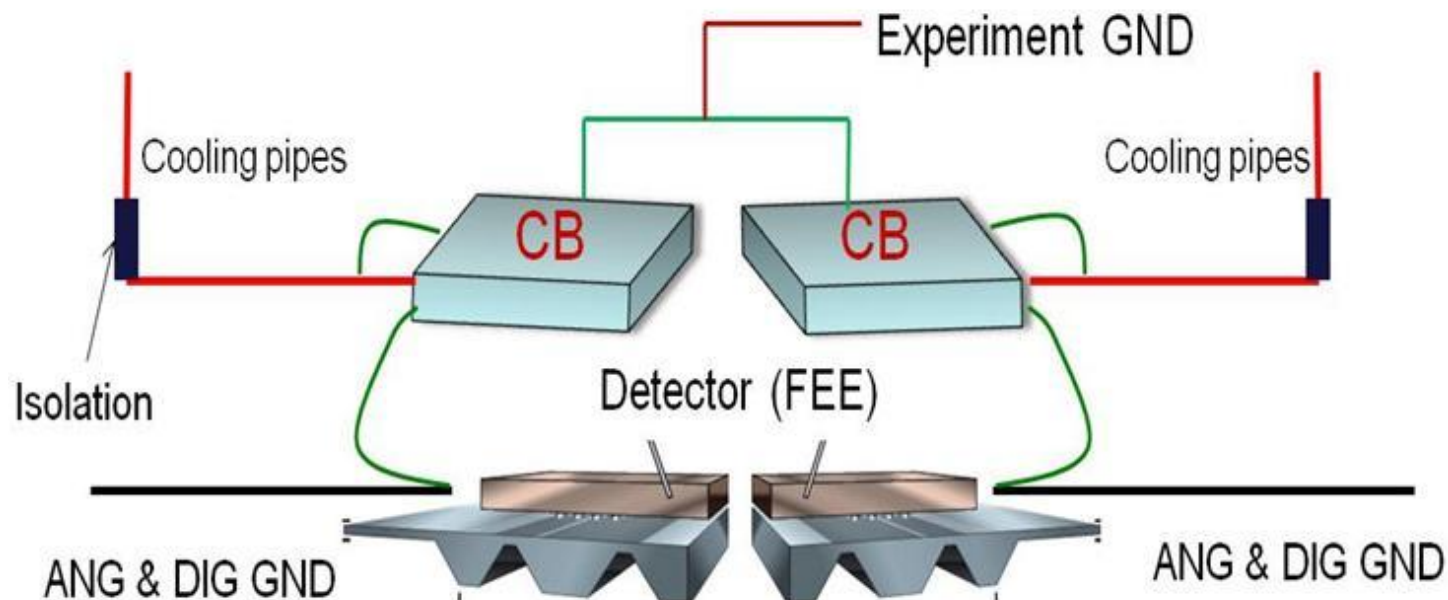
MPI - February 2017

1. PXD GROUNDING

- PXD ground have been defined in several documents that have been prepared during the project.
 - Safety and equipment protection ground
 - Detector Performance ground (Noise ground)
- Safety & Equipment protection ground (Installation)
 - Metal parts that can be energized – should be grounded
 - Ground connections - Bonding and straps (size, etc)
 - Electrical Laboratory codes and Low Voltage directive
 - IEC 61000-5-2 Ed 1.0 (1997): EMC-Installation and mitigation guidelines: Earthing and cabling
 - IEC 62305-1 to 4 Ed 1.0 (2006): Protection against lightning
 - IEC 60364-5-54 Ed 3.0 (2011): Electrical installations of buildings. Selection and erection of electrical equipment- Earthing arrangements, protective conductors and protective bonding conductors.
- Detector performance ground

1. PXD GROUNDING

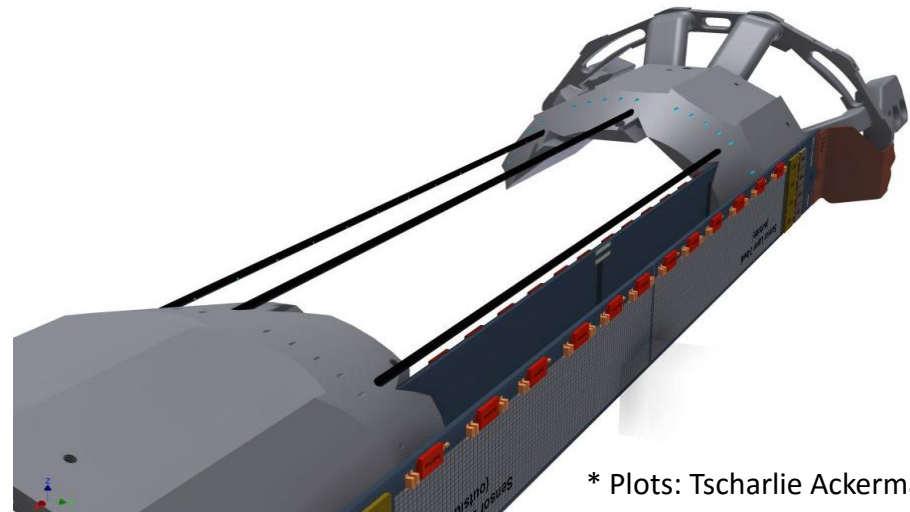
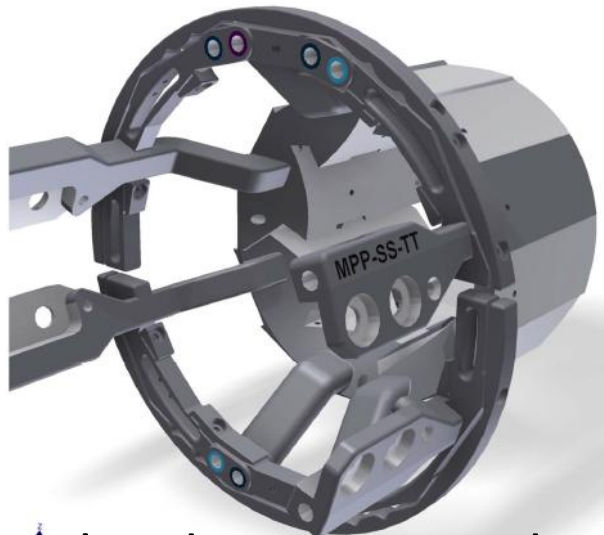
- Cooling blocks is defined as PXD local ground
 - Cooling blocks (both sides) connected via low impedance
 - PXD local ground connected to experiment ground
- PXD electronics ground (each leader) is connected to the cooling blocks (Multipoint ground topology)
- Cooling pipes isolated & grounded



1. PXD GROUNDING

- Local ground implementation : Cooling blocks

- A unique ground structure for all PXD (Stainless steel)
 - It should guarantee the same potential from DC to hundreds of MHz of all PXD electronics

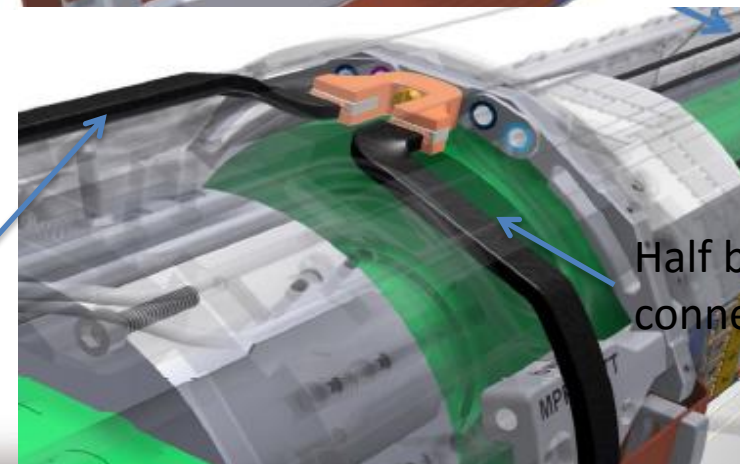
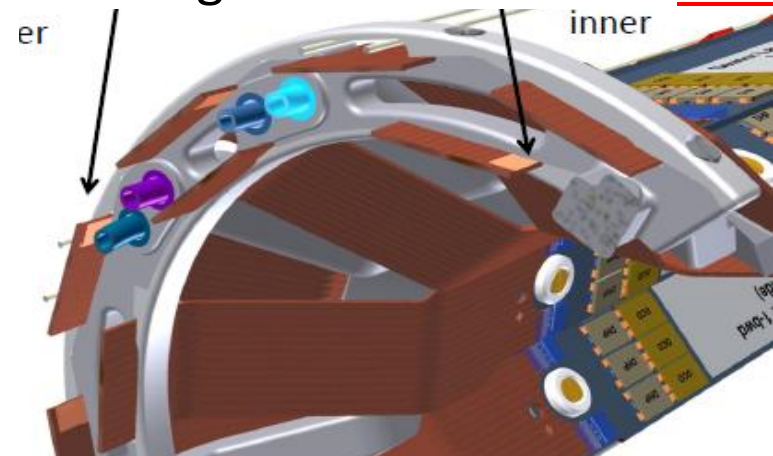
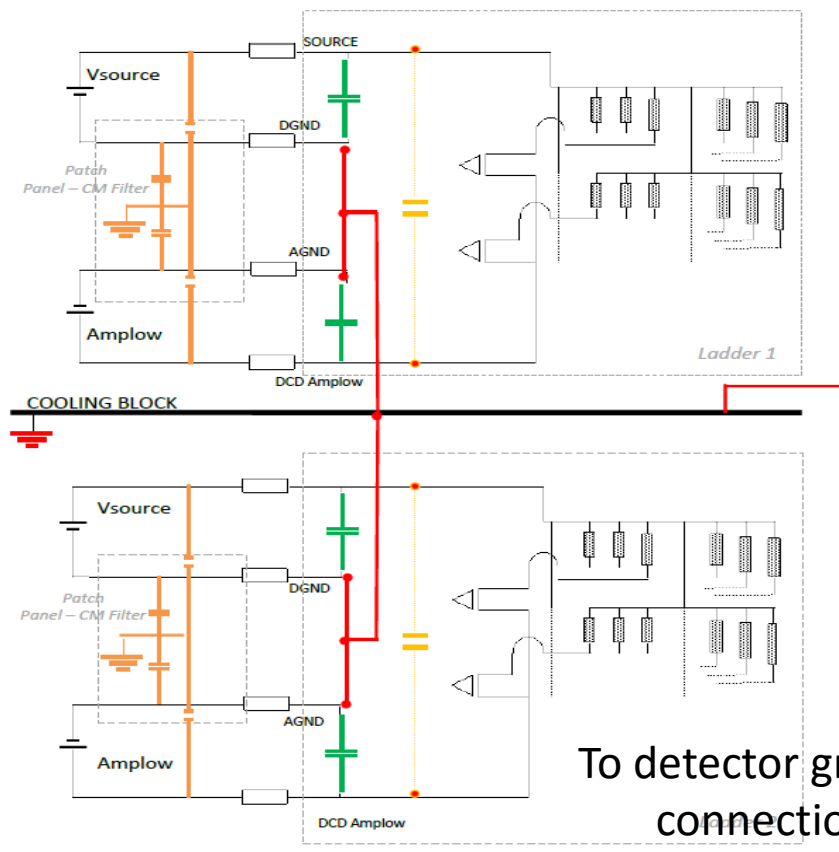


* Plots: Tscharlle Ackermann

- Both sides connected together via CF tubes
 - Beam pipe connection is not allowed
 - Special coating needed to guarantee DC connection
 - **$R < \text{????? mohm}$**

1. PXD GROUNDING

- Local & detector ground implementation : electronics gnd connection
 - AGND-DGND: Already have a common point at module level
 - A connection to local ground and detector ground are needed **????**



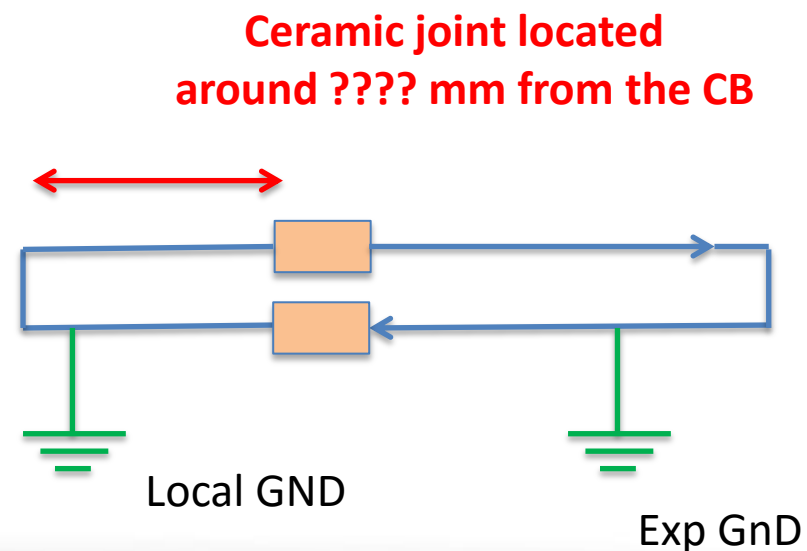
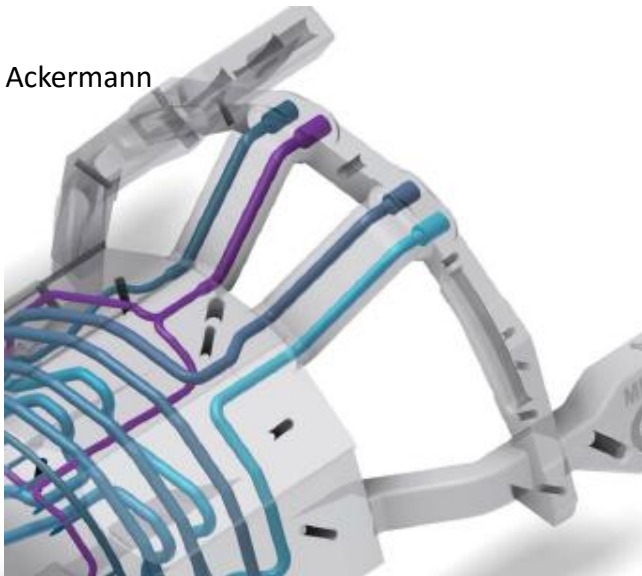
* Plots: Tscharlle Ackermann

To detector ground connection

1. PXD GROUNDING

- Local ground implementation : Cooling pipes
 - CO₂ and airflow pipes are electrically isolated towards the outside via ceramic joint
 - Inner part is grounded to cooling blocks
 - It avoids any noise penetrated to detector electronics
 - External part should be grounded to detector
 - Safety requirement (Belle II requirements) – No floating metallic pieces

* Plots: Tucharlie Ackermann



- PXD have a complex topology for cabling the sub-detector.
 - Voltages & Currents: Signal, Power & slow control cables
- Cables has been changed since last grounding discussion (2014)
- Attention has been paid to the cabling shielding because it may lead to some integration problems.
- Cable shield connection mainly defined by **Belle II rules**
 - Both sides connection will be the preferred option
 - Floating shields has to be minimized
 - Other options need to be justified

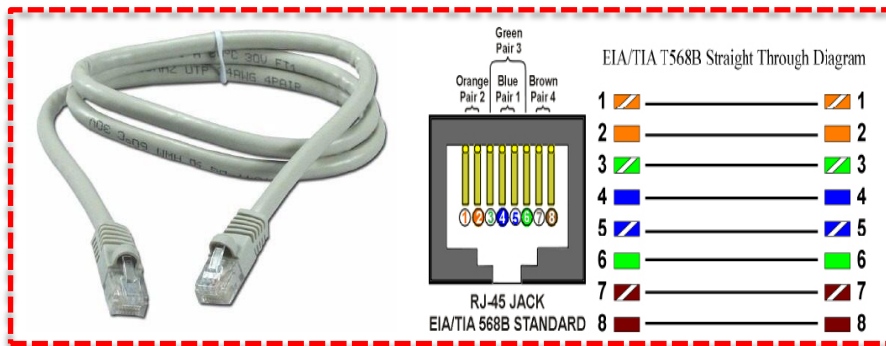
2. CABLING



- **Kapton**: Power, control & Data
 - Power (up to 30V , 2A)
 - Sensing (LV , mA) ??
 - Data, Ctrl, JTAG

- **Infiniband**: Data Transmission

- Shielded & TSP
- Data, Ctrl, sense



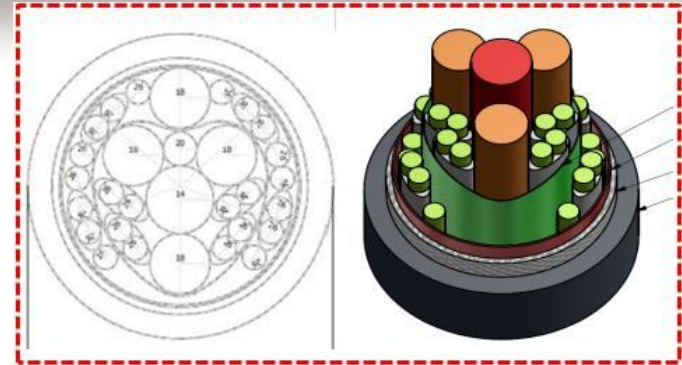
- **CAT6** :

- JTAG
- Shielded ??

2. CABLING

- **Service cable 1 (x2)**: Power

- Power
- Inner Shields
- External Shields



- **Service cable 2**: Power & control

- Power (up to 30V , 2A)
- No inner shields



- **LVDS cable (20pin)**: Power & control

- Ctrl
- Power ??
- Sensing (LV , mA)
- JTAG
- Shielded ??

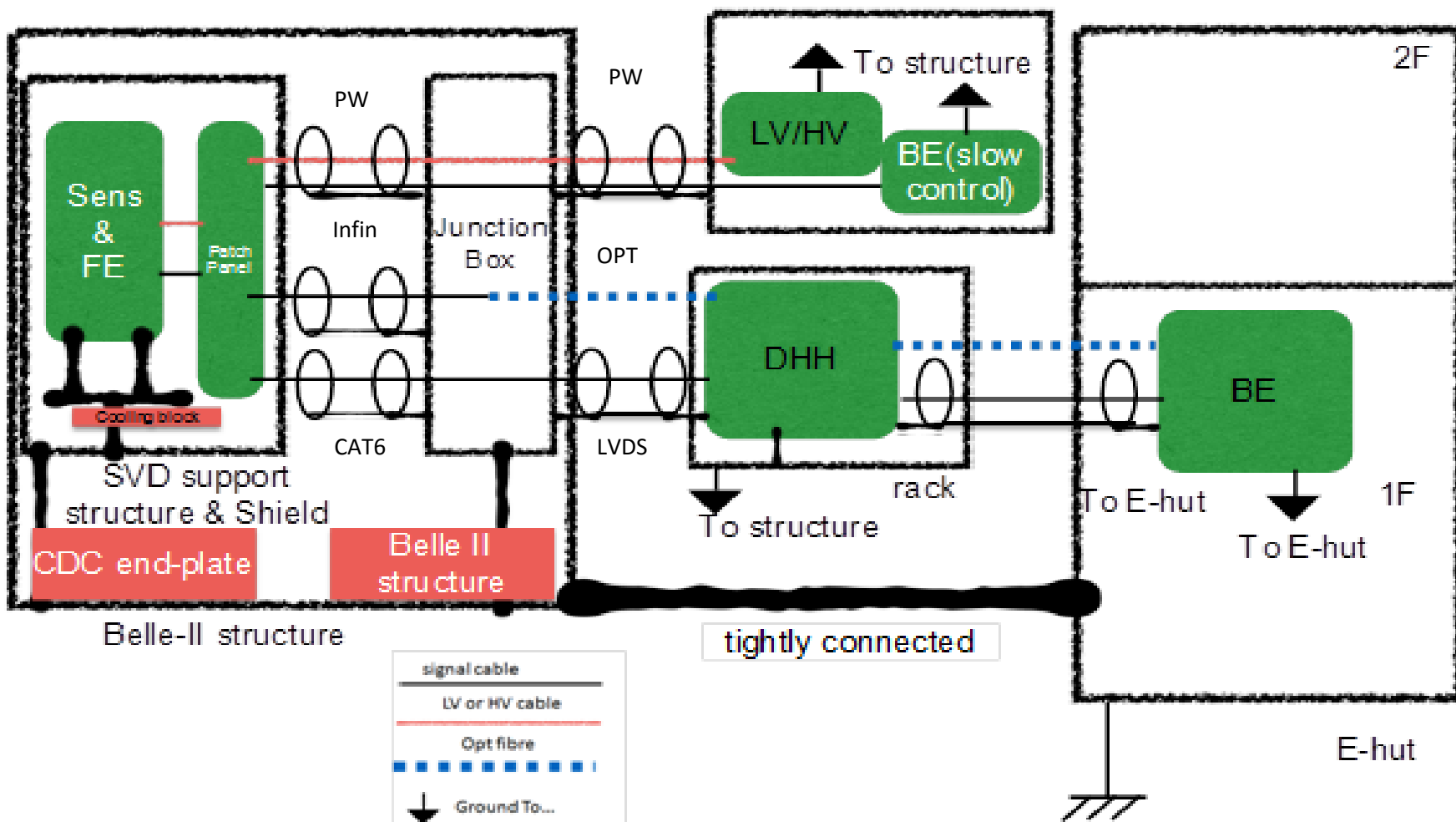


2. CABLING

- JBX is considered the entrance to Vertex volume
 - It is the last good ground
- Shields connections:
 - External shields
 - 15m long cables – Shield connected to **both sides**
 - It protects against electric and magnetic fields
 - It decreases the ability of the cable to radiate
 - 2m long cable – Shield connected **1 side** (JBX side)
 - Electrostatic protection
 - External and inner shields are independent
 - Inner Shields
 - Floating or connected 1 side (JBX side)
 - Drain wires not connected

3. SUMMARY

PXD grounding/shielding scheme@2016

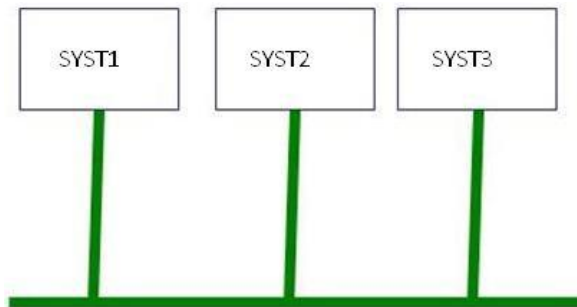


BACKUP SLIDES

2. PXD GROUNDING

- Several issues have been considered in the grounding definition of PXD systems.

Multipoint grounding topology.



Short ground connections

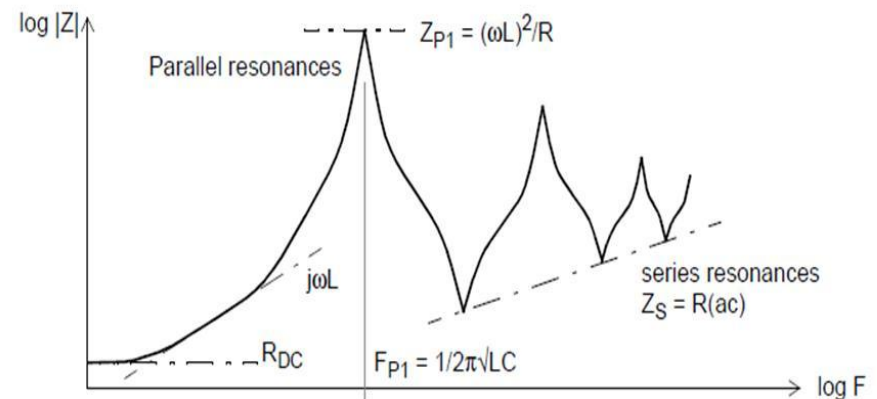
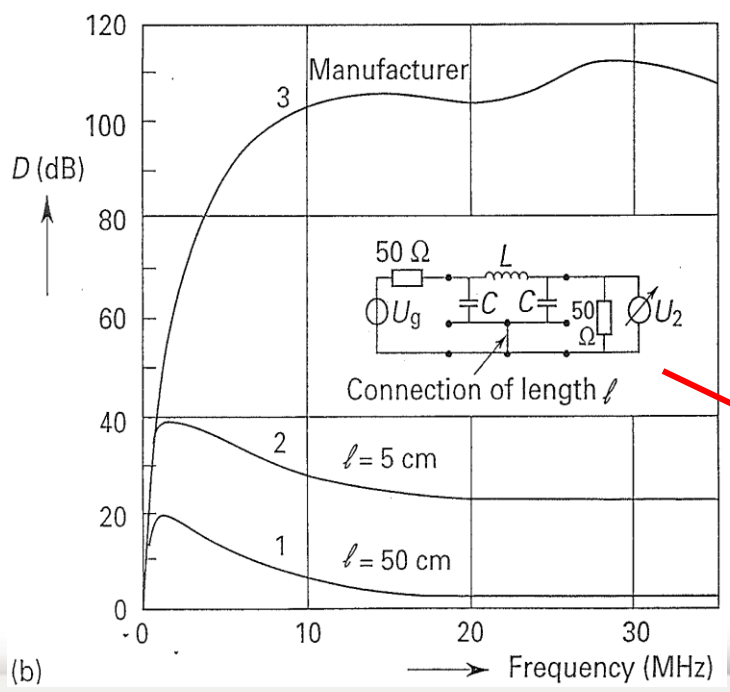
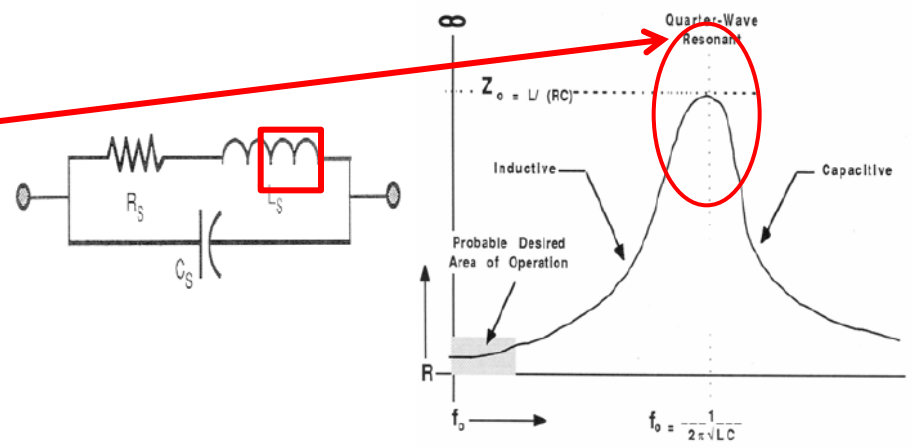


Figure 6.7 The impedance of long ground wires

2.2 Grounding topology: Grounding implementation - Straps

- Multiple equipment or units must be connected to a signal reference system (SRS) → for direct connection **bonding straps** are required

- Bonding straps: impedance highly influenced by inductance L , dependent on geometry
→ **resonances must be avoided**

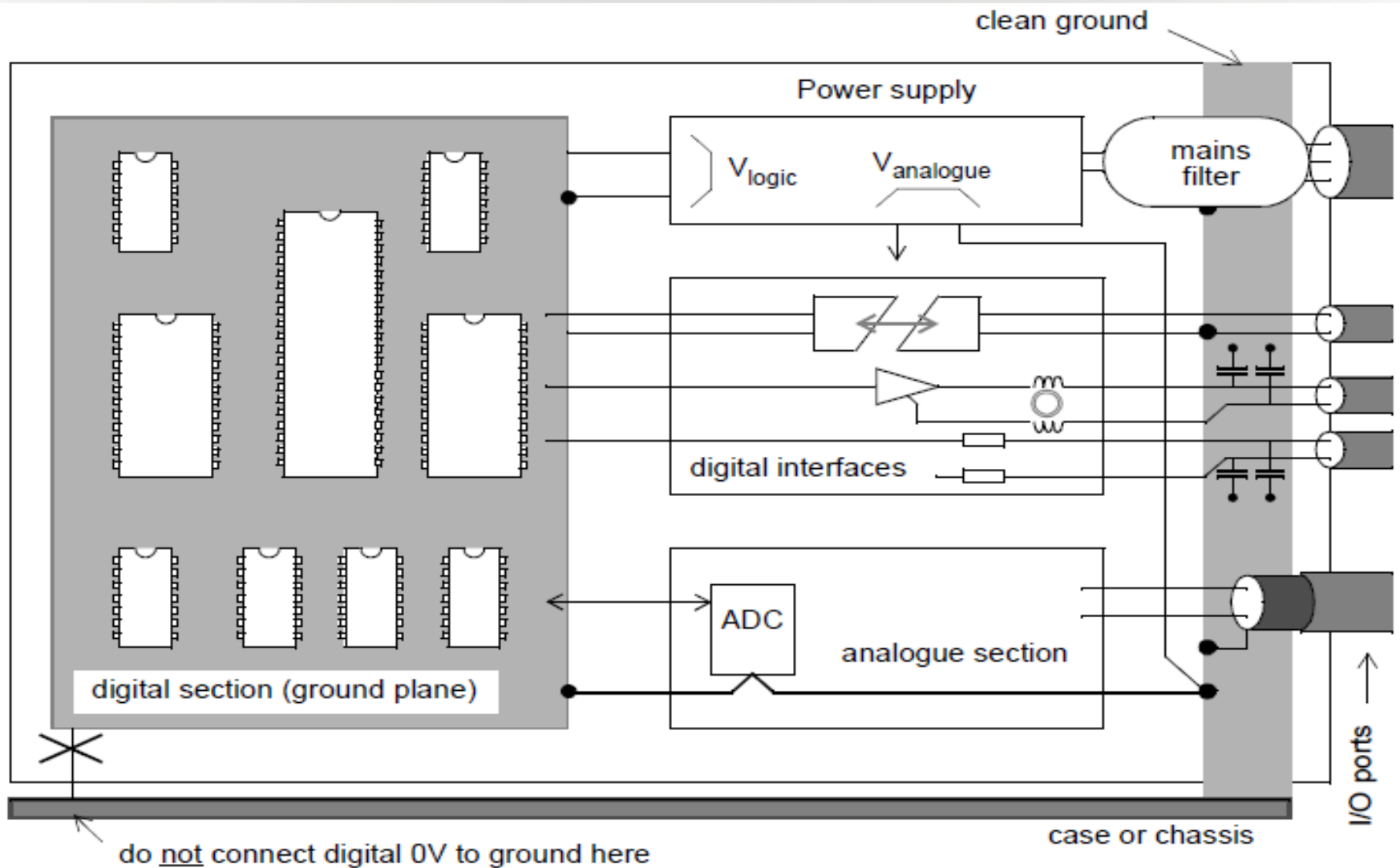


Local ground at detector level (HF connection)

→ **Short connections**

(b)

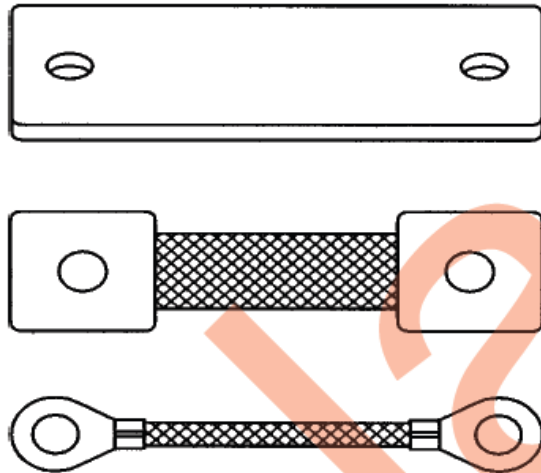
2. PXD GROUNDING



2. PXD GROUNDING

- Standards

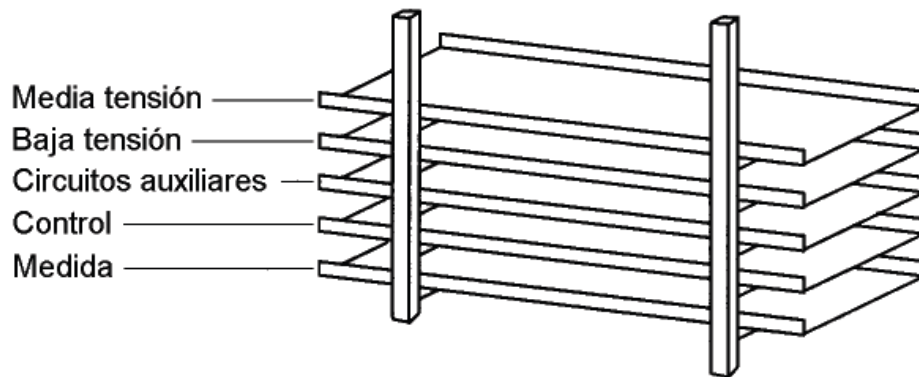
Tabla 2

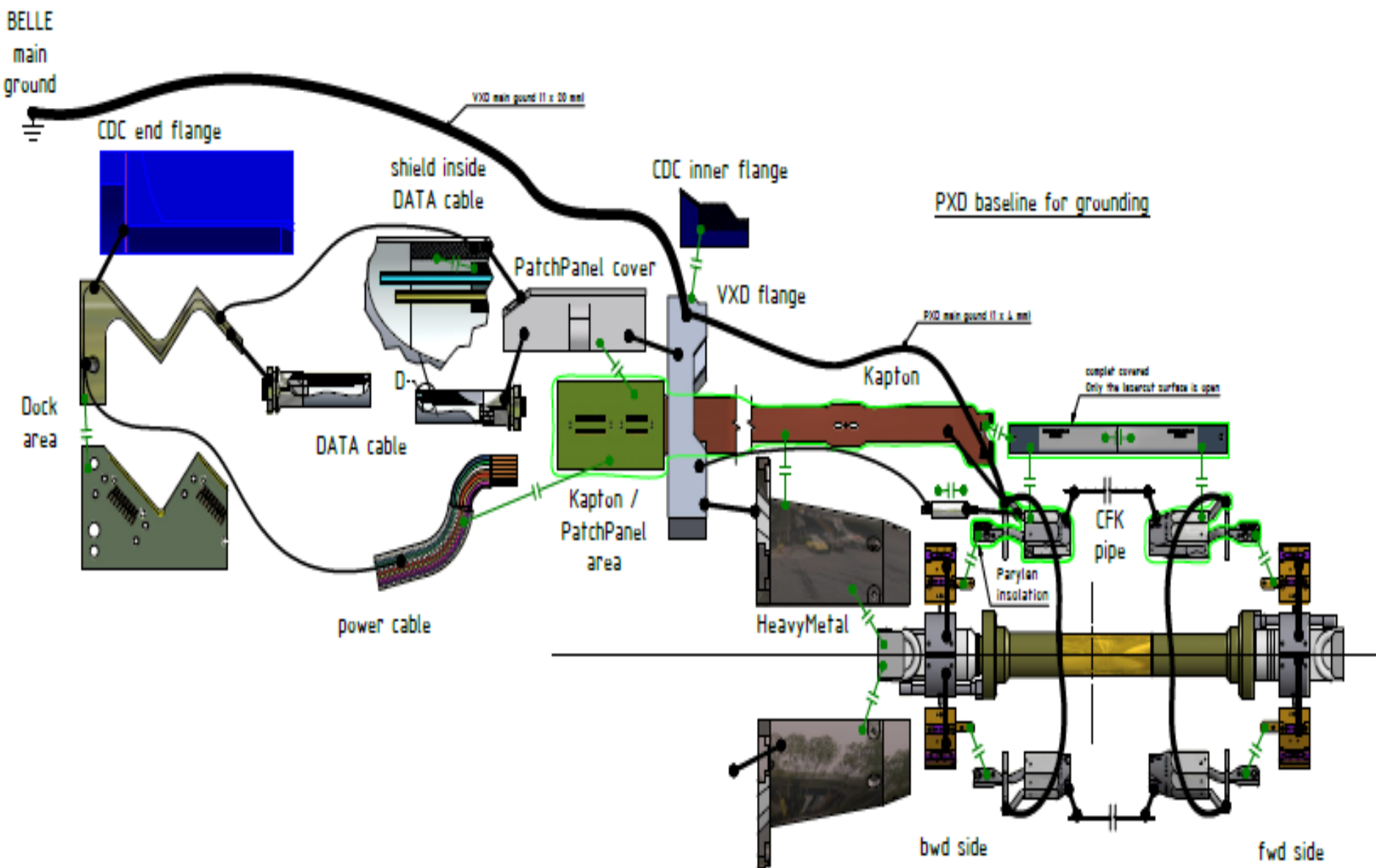


Secciones de los conductores de fase o polares de la instalación (mm ²)	Secciones mínimas de los conductores de protección (mm ²)
$S \leq 16$	$S^{(*)}$
$16 < S \leq 35$	16
$S > 35$	$S/2$




(*) Con un mínimo de:

- 2,5 mm² si los conductores de protección no forman parte de la canalización de alimentación y tienen una protección mecánica.
- 4 mm² si los conductores de protección no forman parte de la canalización de alimentación y no tienen una protección mecánica.



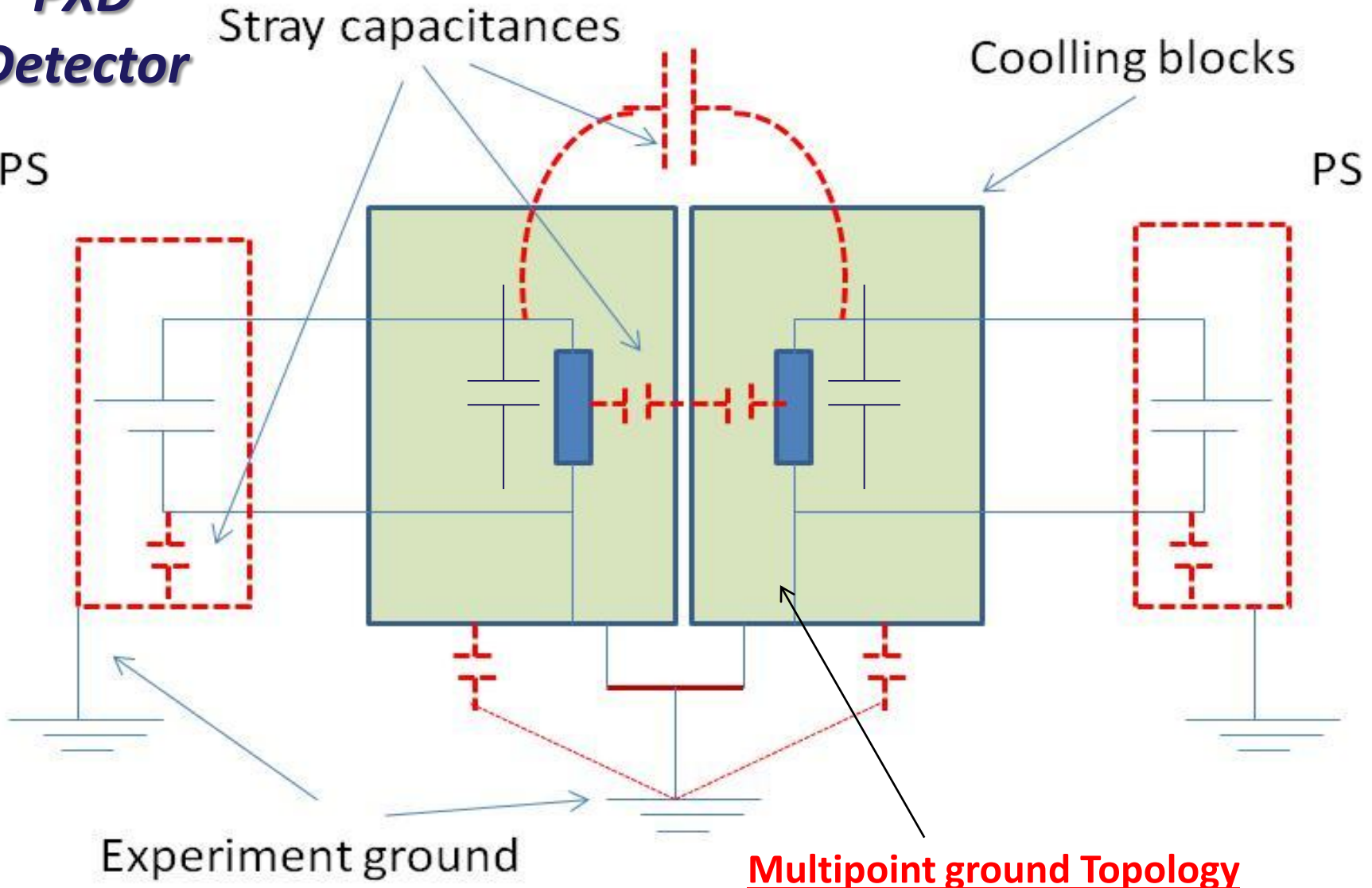


PXD baseline for grounding

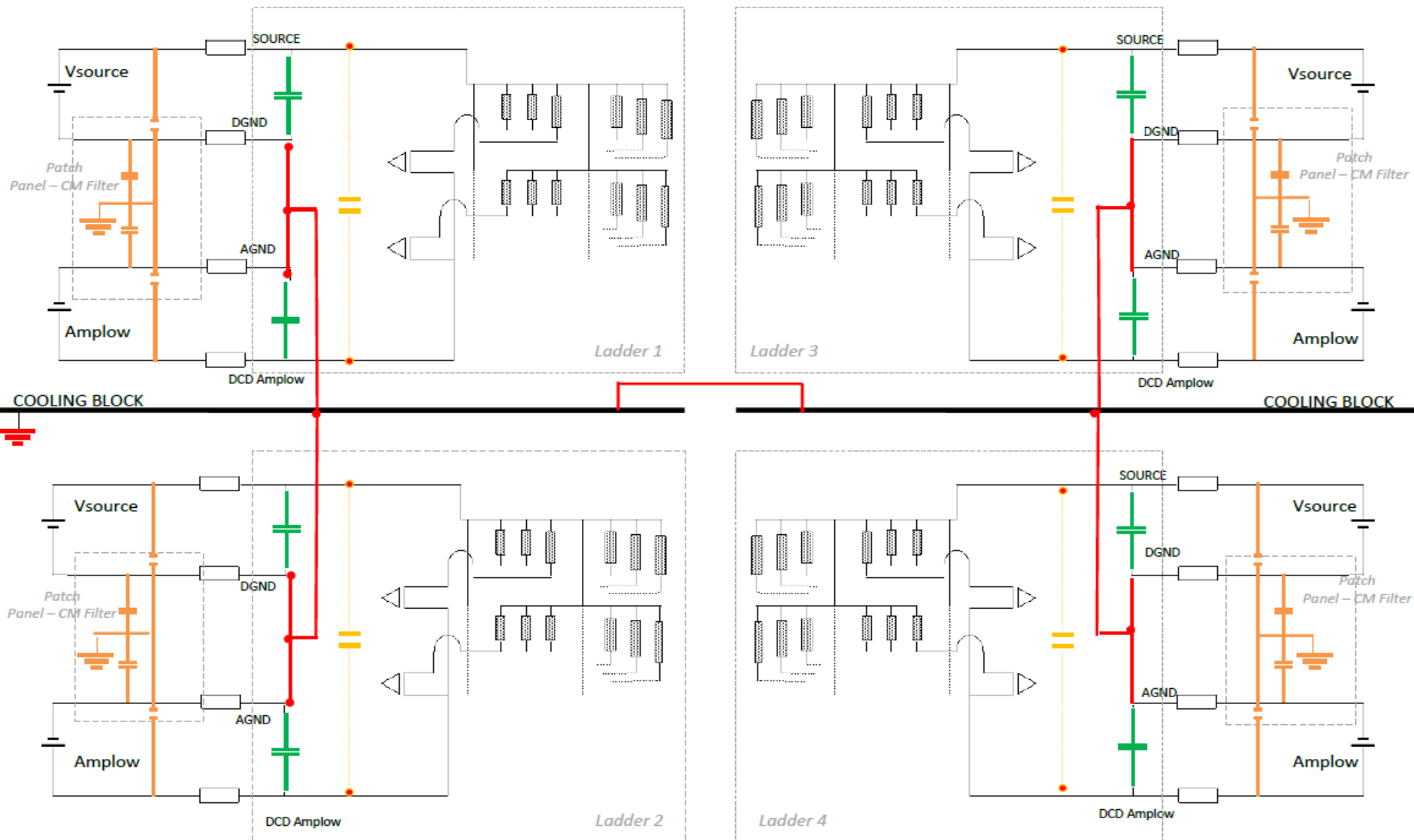
-  this parts is covered with insulation
-  ground connection between this parts
-  Insulation between this parts

1.1 PXD GROUNDING: Topology

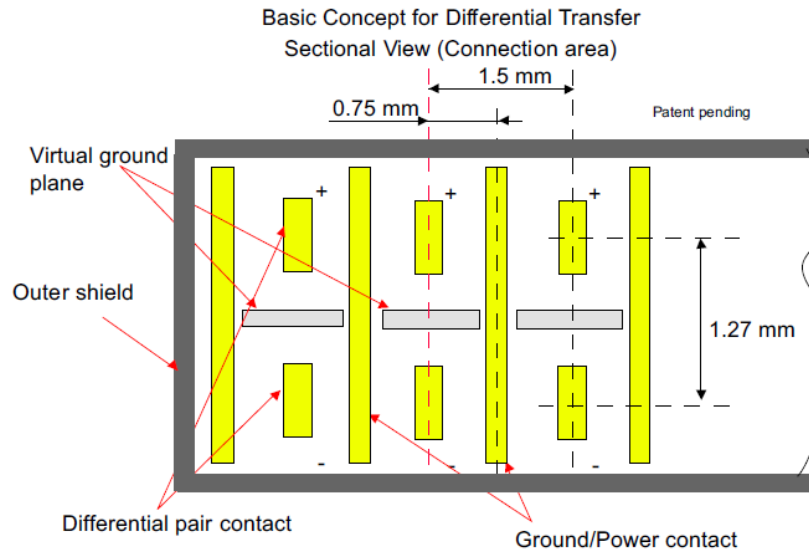
**PXD
Detector**



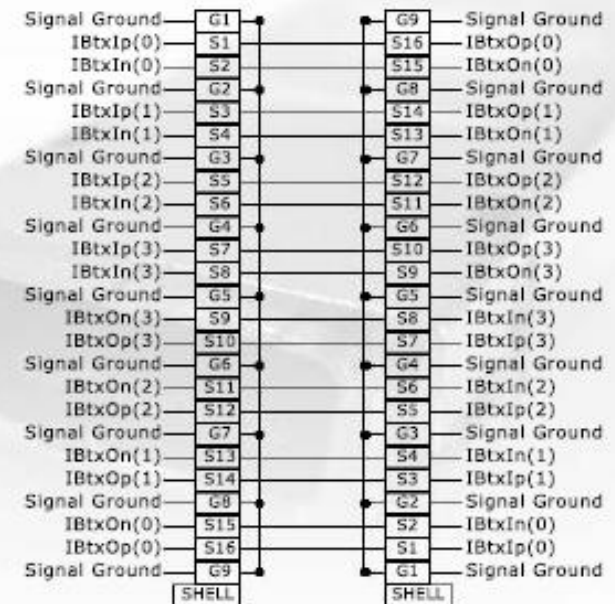
2.1 PXD GROUNDING: Topology



Basic Concept for Differential Transfer



Product Specification are subject to change, please check our website (<http://us.fujitsu.com/connectors>) for the latest specifications.



3.CABLING

