

# SiD Pigtail Cable Design

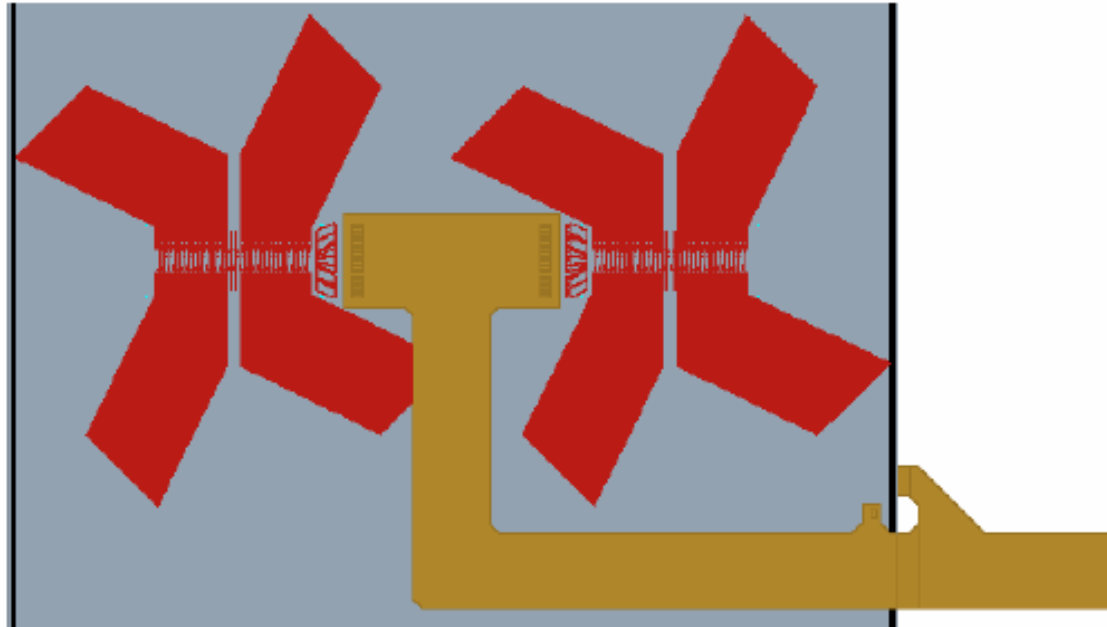
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# Introduction

- The Pigtail+Extension Cables are low-mass readout cables which connect KPIX chips mounted on tracker modules to the concentrator boards mounted at the ends of each barrel.



- This cable has two components:
  - Pigtail, a short cable glued to the module
  - Extension, a long cable connecting the Pigtail to the concentrator

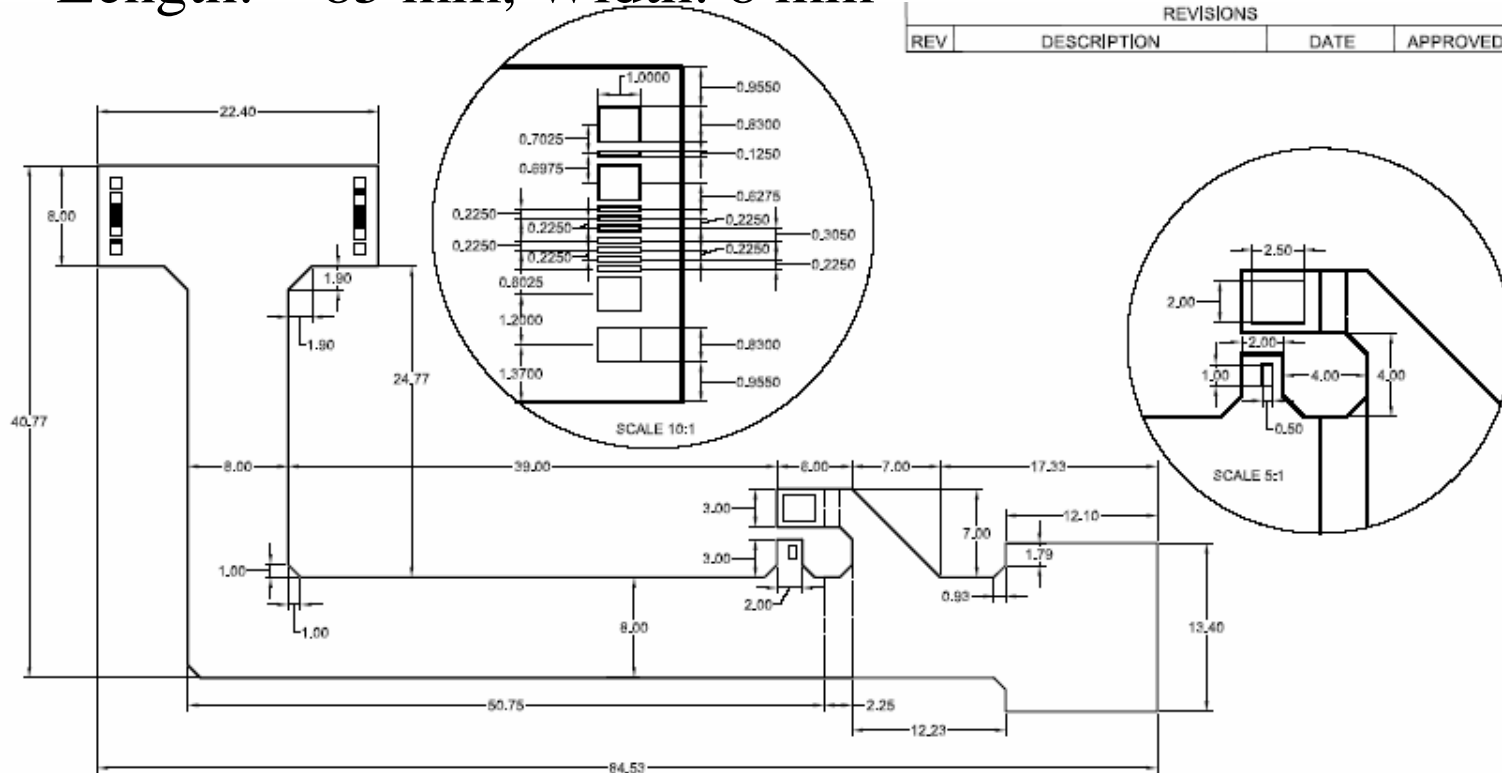
# Pigtail Cable Specifications

- Dimensions: compatible with the Sensor
- Thickness: low mass Kapton
- Connectivity: Detector end connected with wirebonds, Extension cable end has a connector, HV Bias tabs at sensor edge
- Traces: two pair for Analog & Digital Power
- Traces: one pair for High Voltage Bias
- Traces: **16** traces for Digital Control and Readout, **no longer bussed**
- Metallization: Gold plating on all **wirebond pads only**
- Resistance: Pwr and Gnd traces < 1ohm **roundtrip including extension**
- Filtering: of KPIX and HV Bias on the Pigtail Cable
- Signals: Digital signals are LVDS (low voltage differential signaling)
- Pickup and Crosstalk: want to minimize
- Option to jumper connect DGND and AGND

# Dimensions

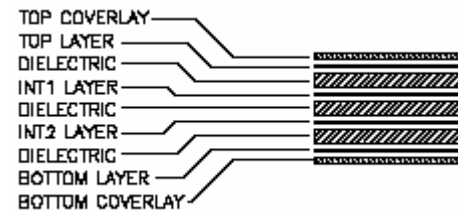
- Length: ~ 85 mm, Width: 8 mm

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



- Thickness: ~ 280  $\mu\text{m}$

Coverlay = 38  $\mu\text{m}$   
 Layer = 12  $\mu\text{m}$   
 Dielectric = 51  $\mu\text{m}$



# Connectivity

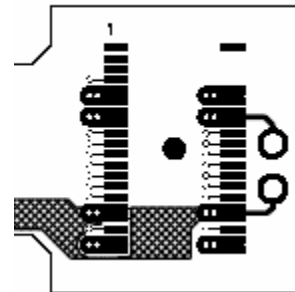
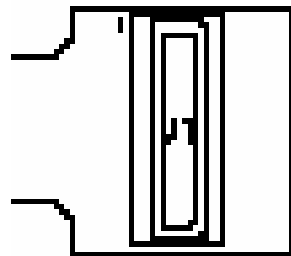
- Detector end connected w/wirebonds, cable has gold plated pads
- HV Bias tabs at sensor edge have gold plated pads



- Pads & Traces: two pair for Analog and Digital Power
- Pads & Traces: eight for Digital Control and Readout

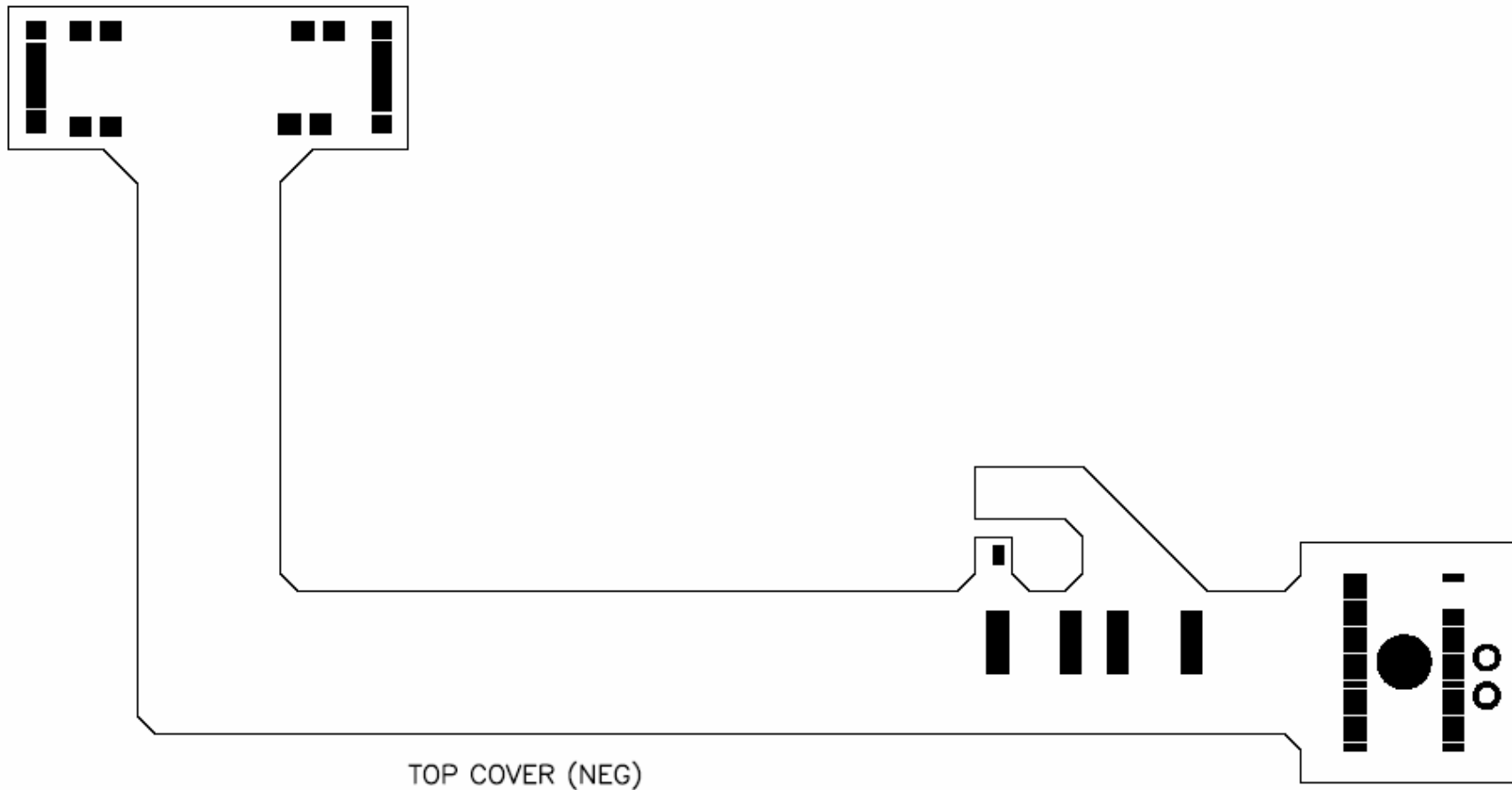
# Connectivity

- Connector to Extension cable (J1) is 40 pin Molex 54722 receptacle, the mating connector is Molex 55560 plug.
- May need to have a stiffener attached to the backside of the Pigtail cable opposite this connector.
- High density connectors only have a 30V to 50V rating, and the maximum detector Bias voltage ~ 150V.
- By removing three unused pins the high and low voltage signals are isolated on the connector.



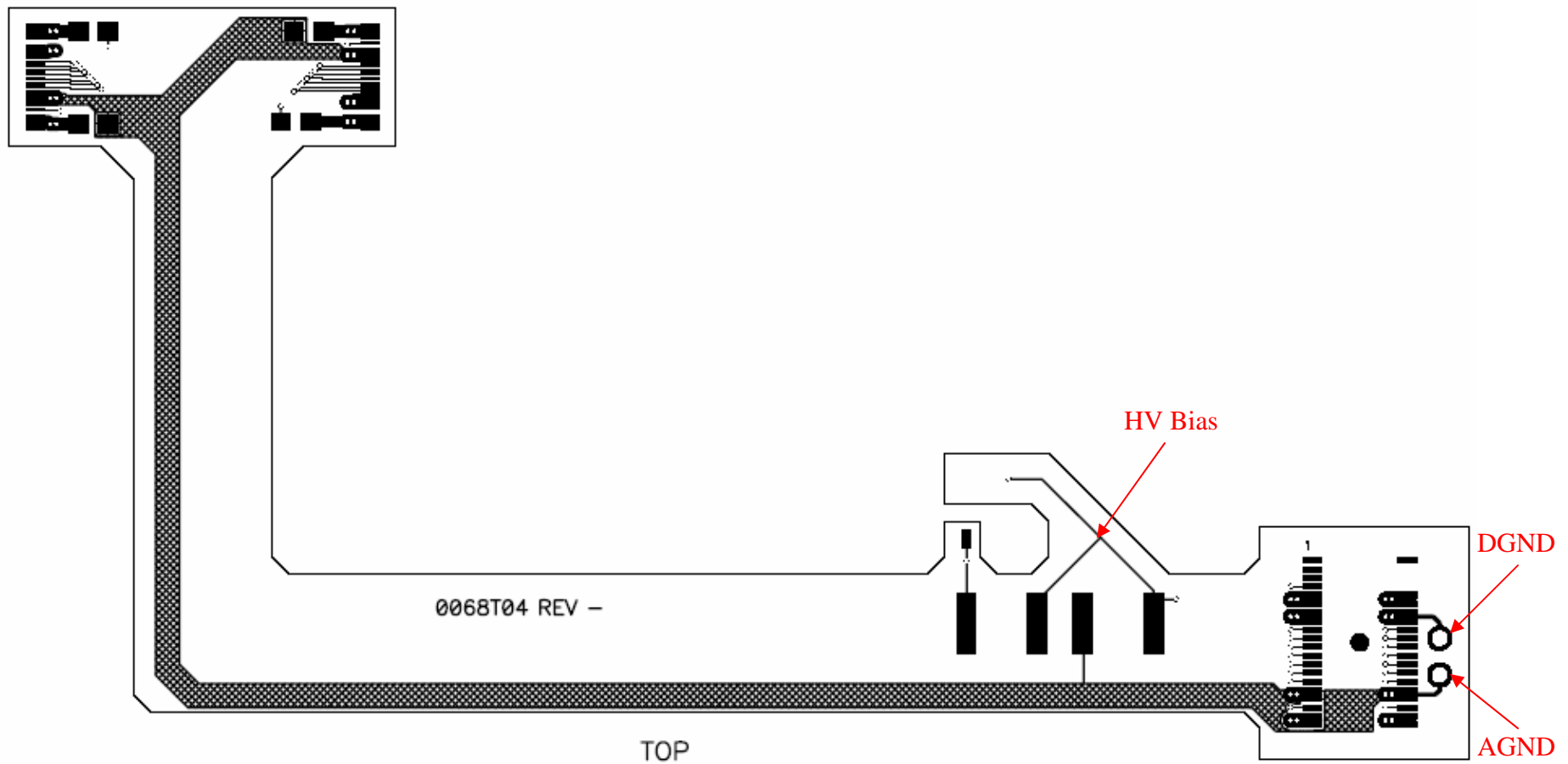
# Layers, Top Cover

- Surface layer of photoimageable covercoat 38  $\mu\text{m}$  thick, to protect the exposed traces.



# Layers, Top Layer

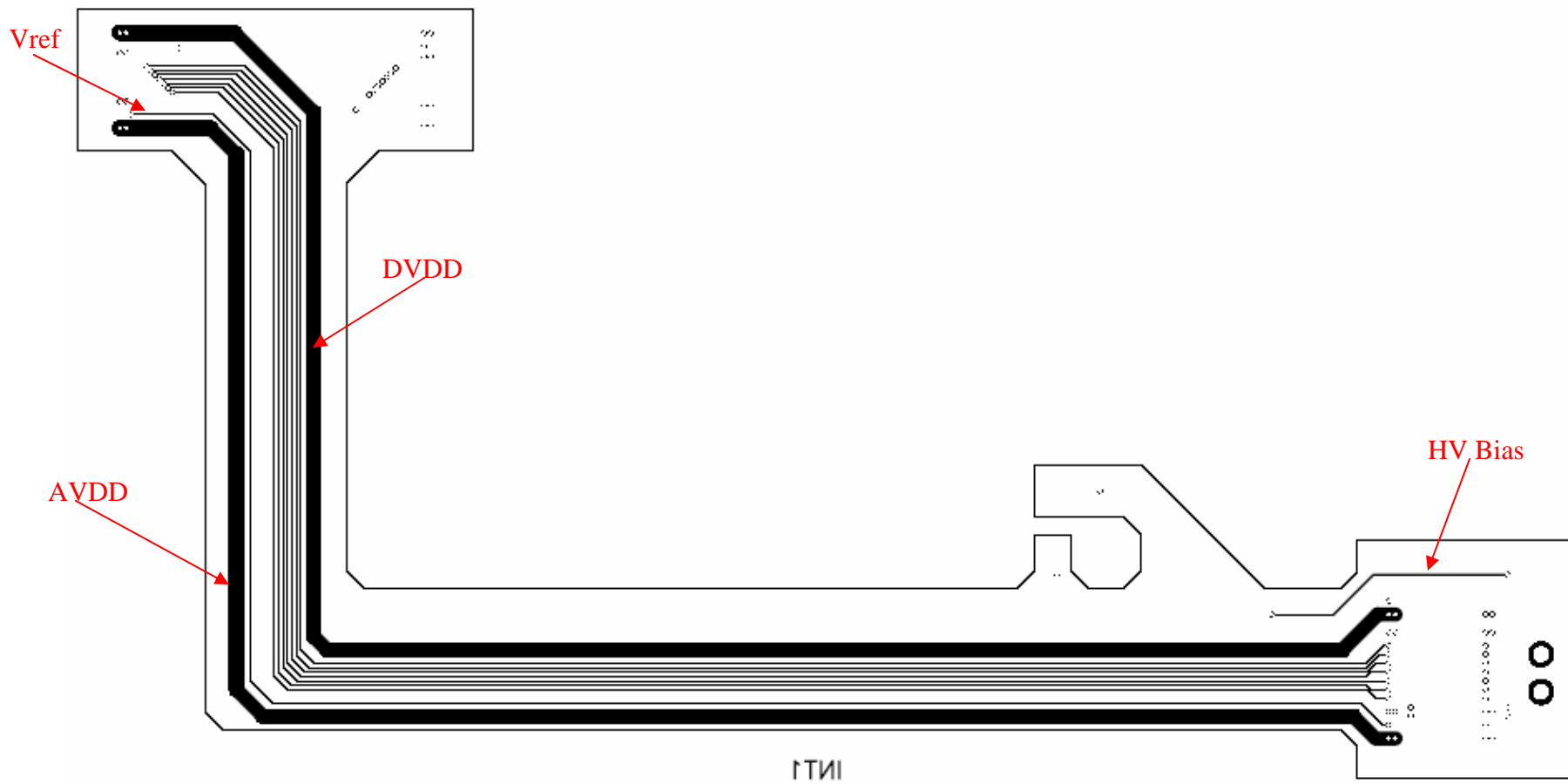
- Analog Return (AGND)
- HV Bias
- Pads to jumper connect AGND and DGND





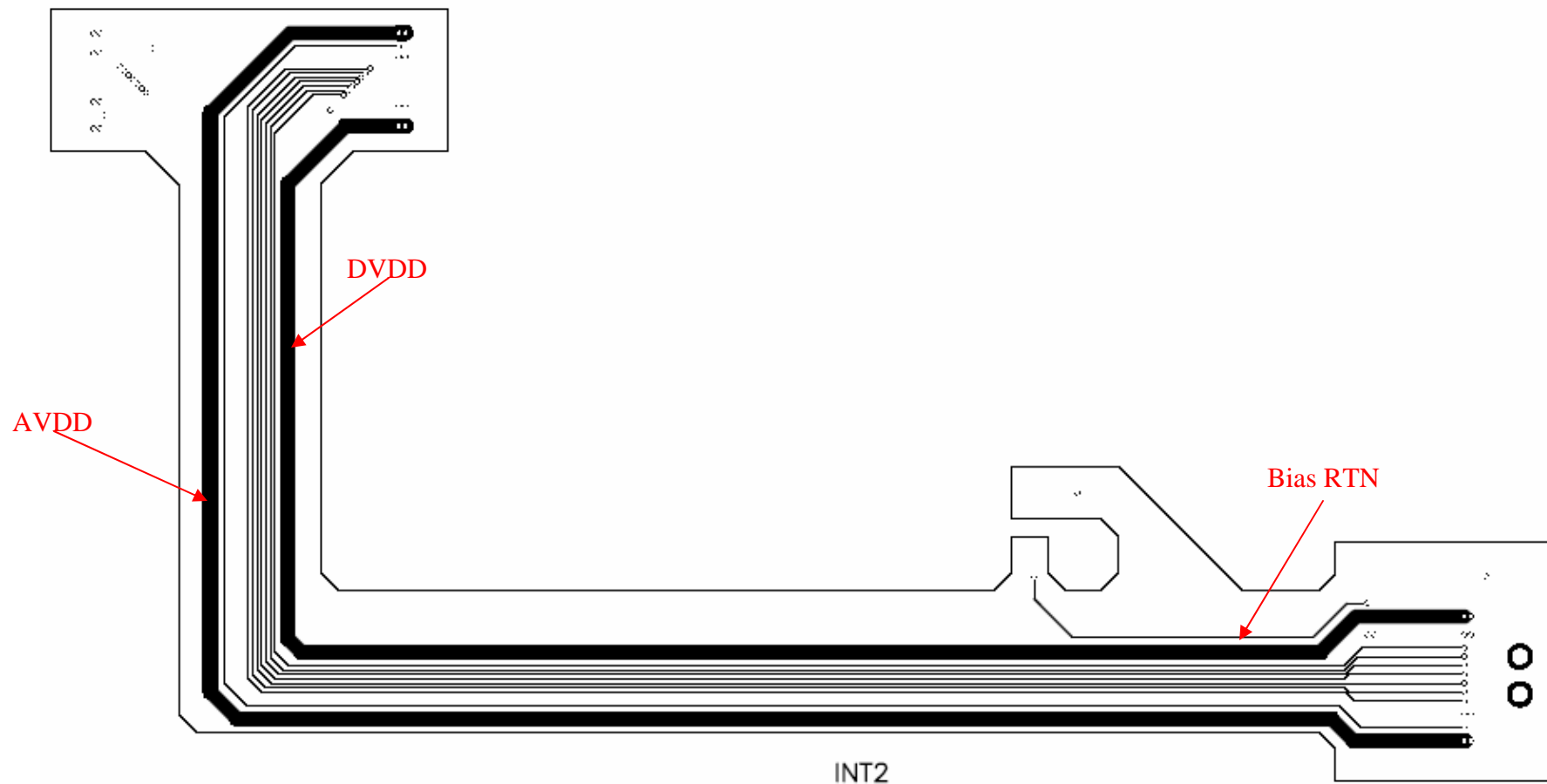
# Layers, Internal 1 Layer

- Analog and Digital Power
- Vref, Digital Control and Readout (75  $\mu\text{m}$  width, 250  $\mu\text{m}$  pitch)
- High Voltage Bias



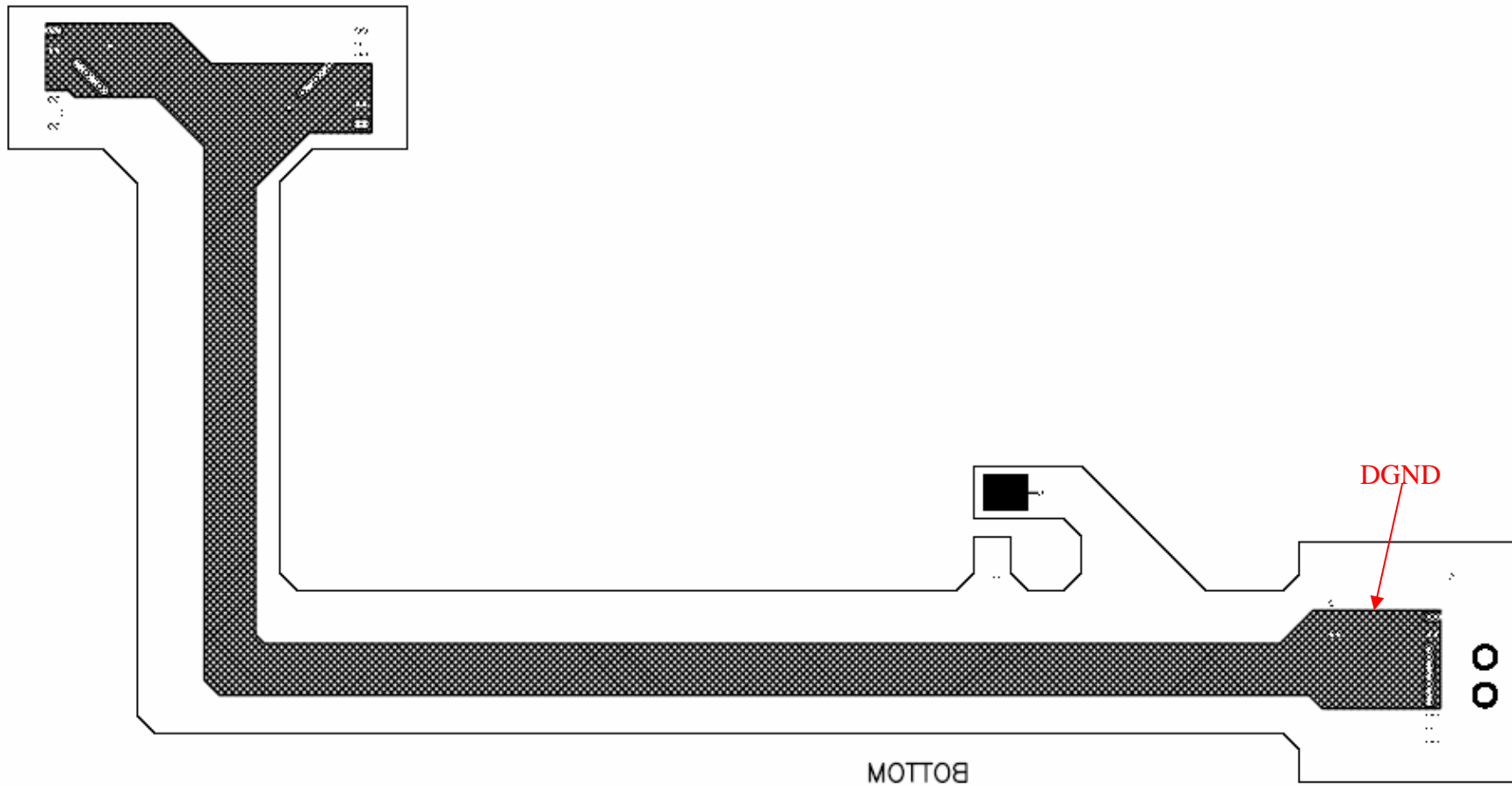
# Layers, Internal 2 Layer

- Analog and Digital Power
- Traces for Digital Control and Readout
- Bias Return



# Layers, Bottom Layer

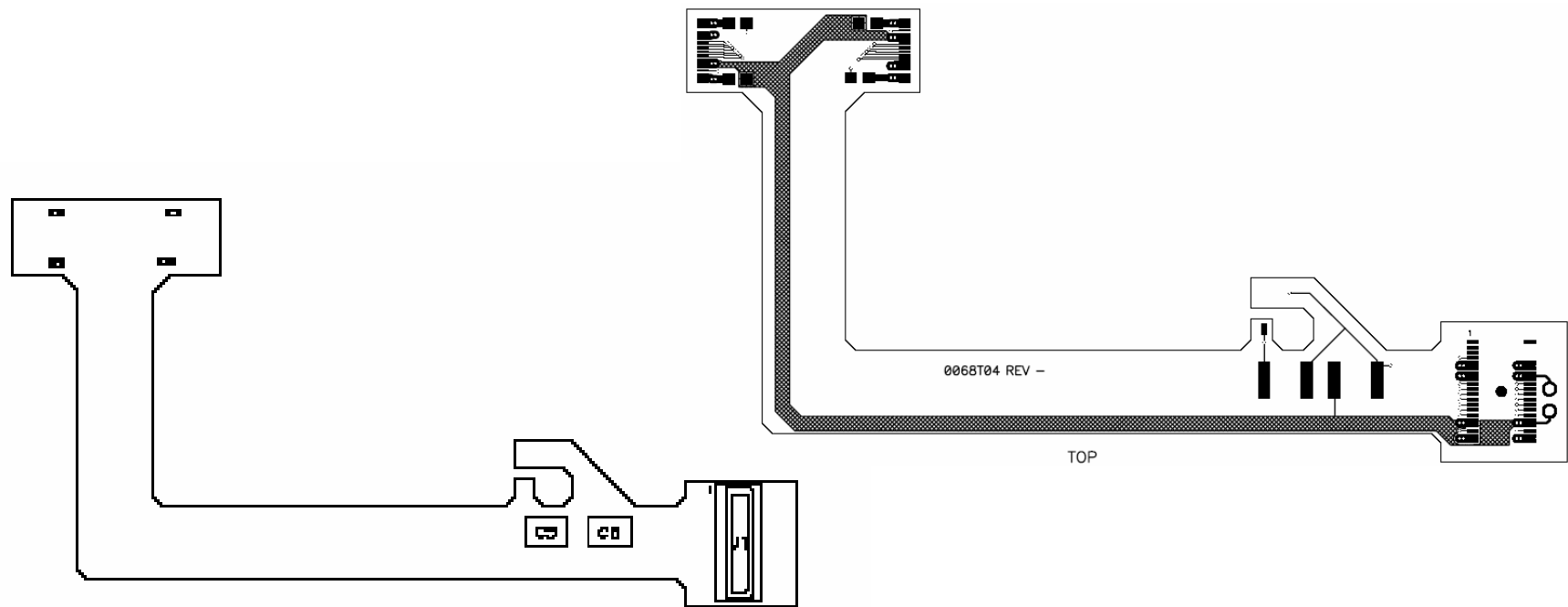
- Digital Return





# Power Filtering

- Filtering of KPIX power and HV Bias on the Pigtail Cable
- C1-C4 standard 0603 sized surface mount, C5 & C6 are 1812 sized high voltage (ex, AVX 0.1 $\mu$ F 500V , height ~ 3mm)



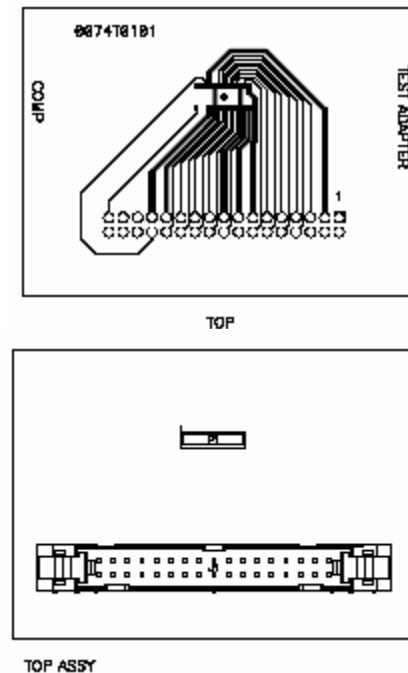
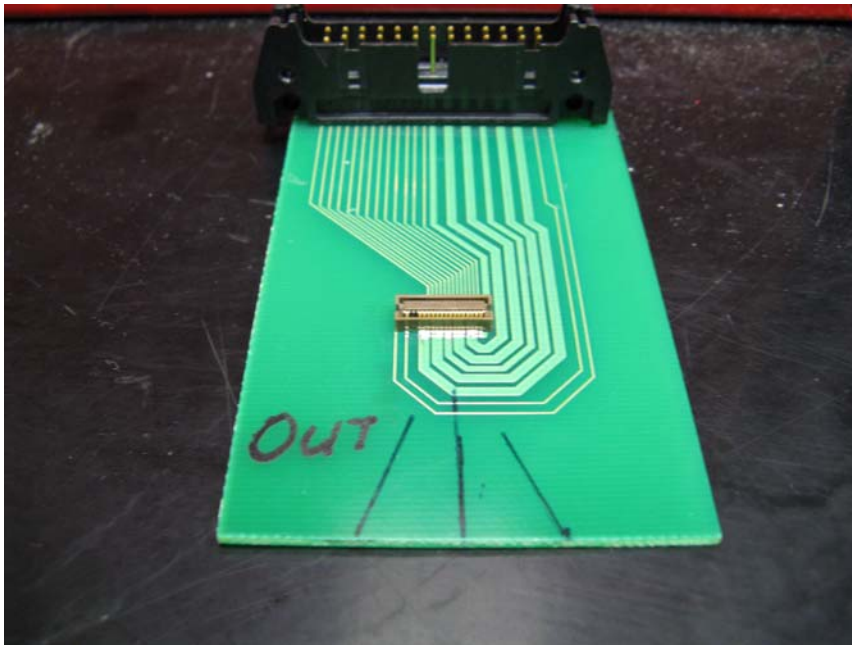
# Signals, Pickup and Crosstalk

- Digital signals are LVDS (low voltage differential signaling)
- Pickup and crosstalk must be minimized
- LVDS: balanced differential lines have tightly coupled polar opposite signals which reduce EMI pickup and crosstalk.
- LVDS: signal rise and fall times are very fast,  $< 1$  ns typical so one must consider the possibility of reflections depending on the length of the Extension cable.
- We may need to consider options for terminating the LVDS lines

# Extension Cable

- The Extension can be up to 2 m in length.
- When Pigtail cable is verified, Extension cable design can proceed.
- Pigtail cable alone can be used for sensor testing if we make an adapter (connector saver) to interface to a standard connector
- This way we don't have to wait for Extension cable to begin testing.

(Example)



# Summary

- The Pigtail cable design has been updated with the following:
  - Add option to jumper connect Analog and Digital Grounds
  - Have gold plating only on wirebond pads (and not on component or connector pads)
  - Add an additional High Voltage filter cap from HV Bias to AGND
  - No longer bus the digital Control & Readout lines to the two readout chips, now we have 8 separate lines to each KPIX chip.
  - Use Molex connector since ELCO is difficult to get.