SiD Pigtail Cable Design

Martin Hoeferkamp, Sally Seidel
U. of New Mexico
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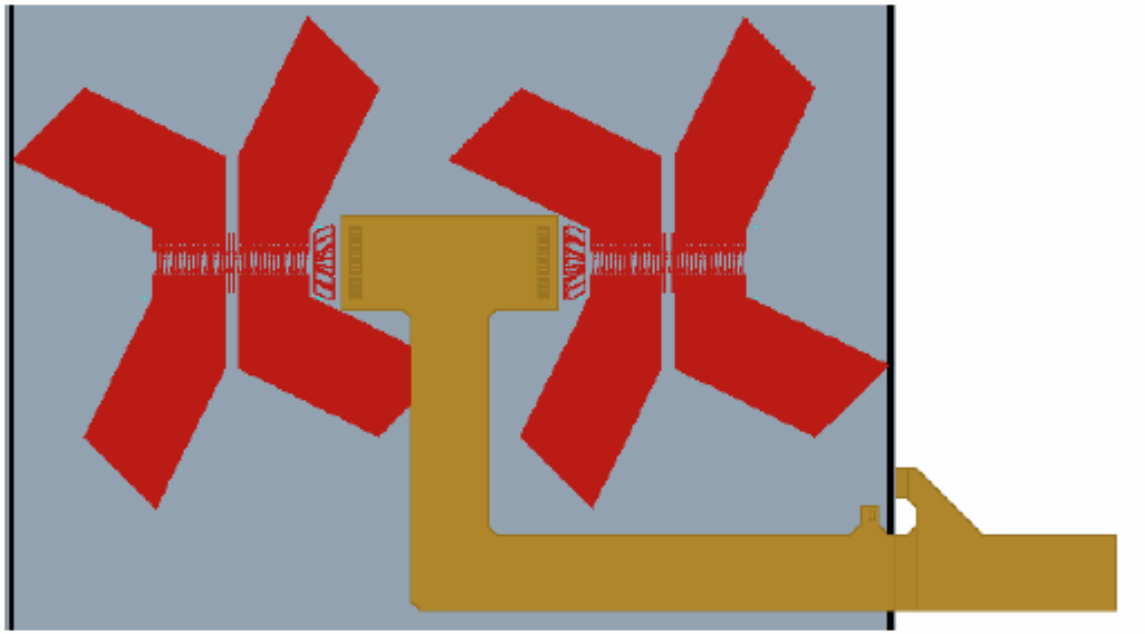
Introduction

- Low-mass readout cables connect tracker modules to the concentrator boards mounted at the ends of each barrel.



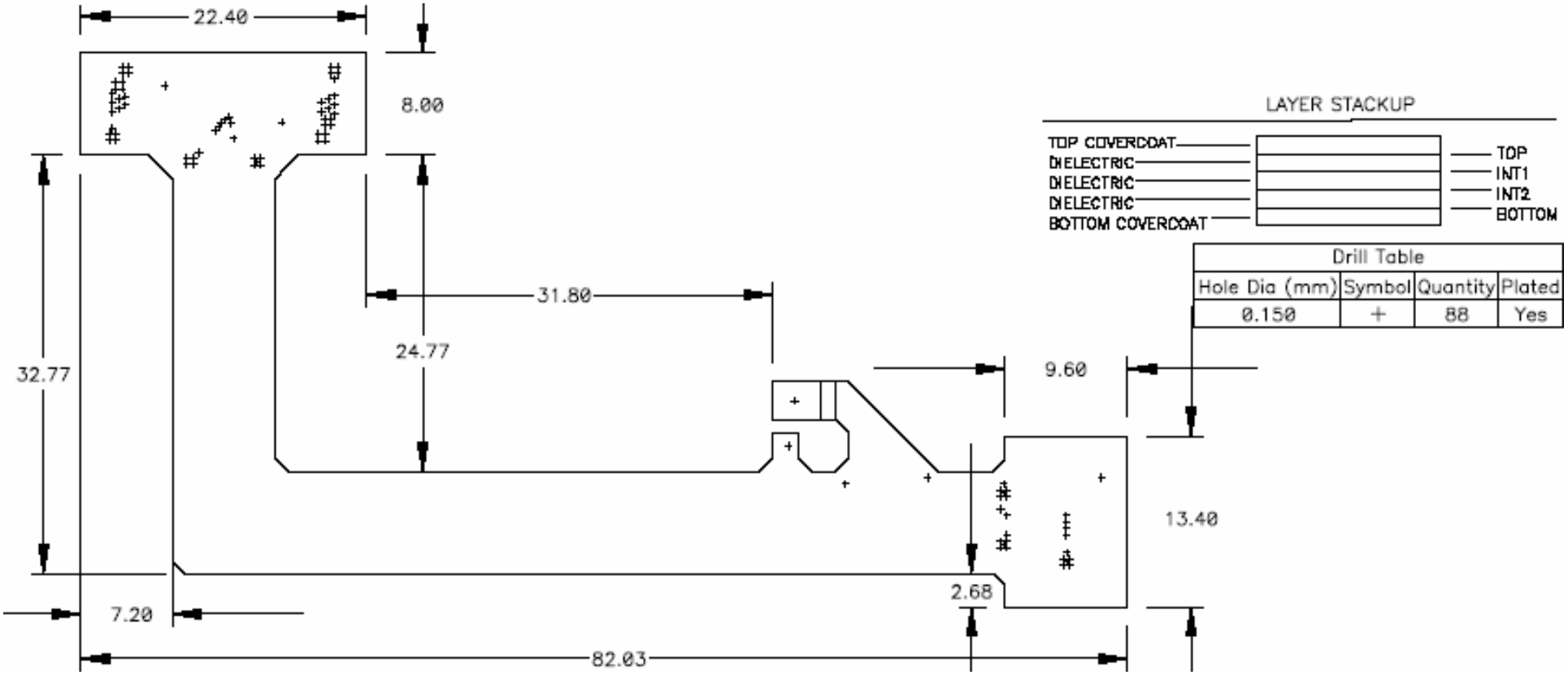
- This cable has two components:
  - Pigtail, a short cable glued to the module
  - Extension, a long cable connecting the Pigtail to the concentrator

Pigtail Cable Specifications

- Length: ~ 82 mm
- Width: ~ 8 mm
- Thickness: ¼ Oz Cu , 100 micron Kapton thickness
- Connectivity: Detector end connected with wirebonds,
  Extension cable end has a connector,
  HV Bias tabs at sensor edge
- Traces: two pair for Analog and Digital Power
- Traces: one pair for High Voltage Bias
- Traces: 8 traces for Digital Control and Readout
- Metallization: Gold plating on all exposed pads and traces
- *Resistance: Power and Ground traces < 1 ohm
- Filtering: of KPIX and HV Bias on the Pigtail Cable
- Signals: Digital signals are LVDS (low voltage differential signaling)
- Pickup and Crosstalk: big concern, want to minimize

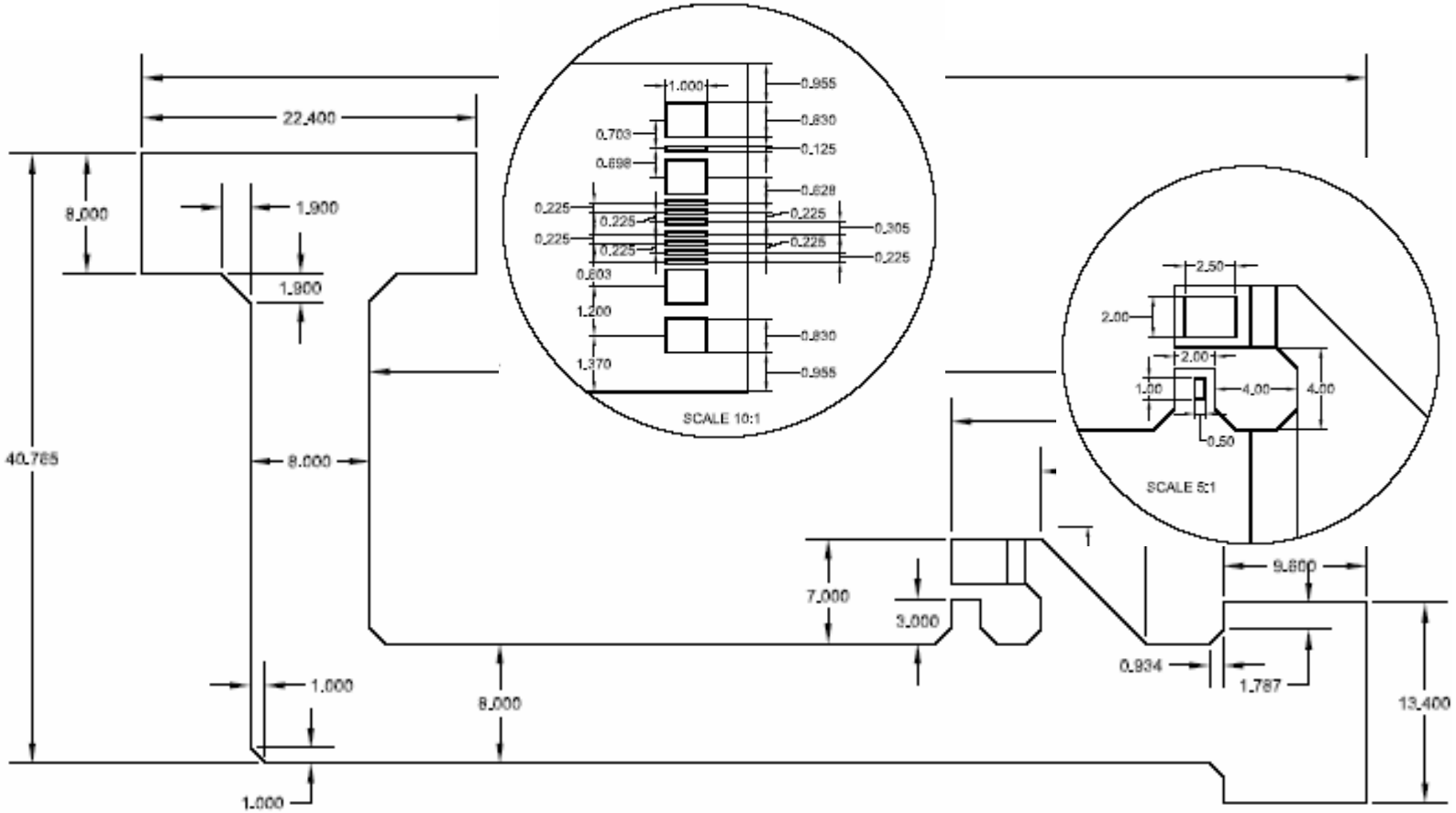
Dimensions

- Length: ~ 82 mm, Width: ~ 8 mm, Thickness: ~ 250 μm



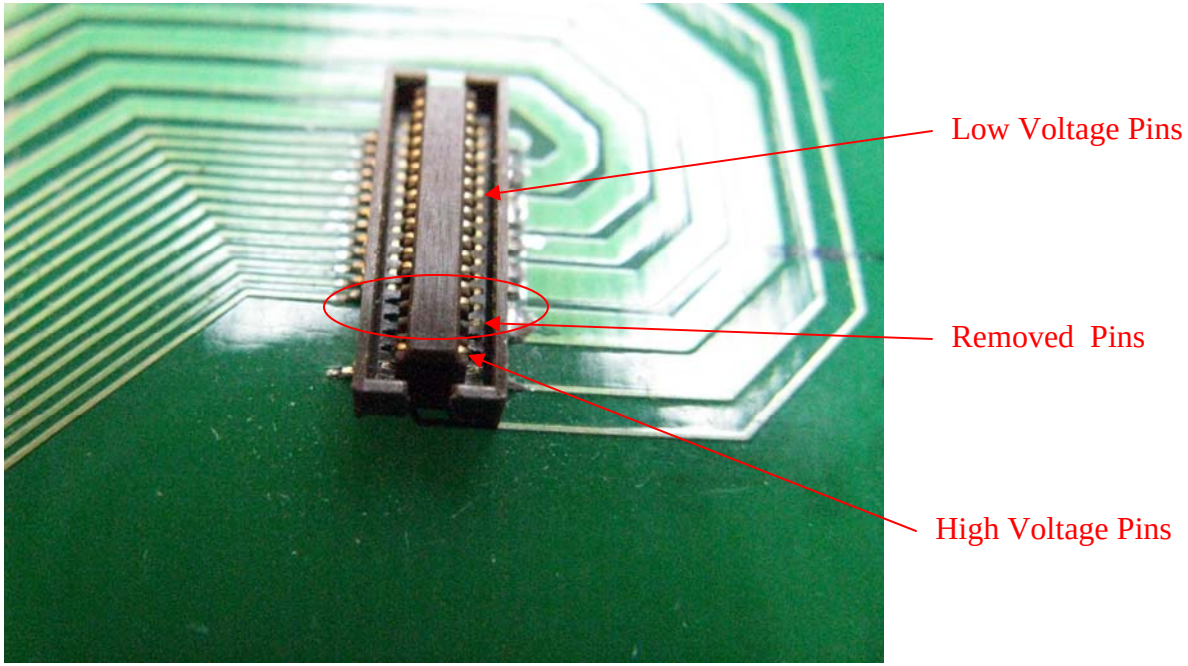
Connectivity

- Detector end connected w/wirebonds, cable has gold plated pads
- HV Bias tabs at sensor edge have gold plated pads
- Connector to Extension cable (AVX/Elco 5087, Hirose DF18)



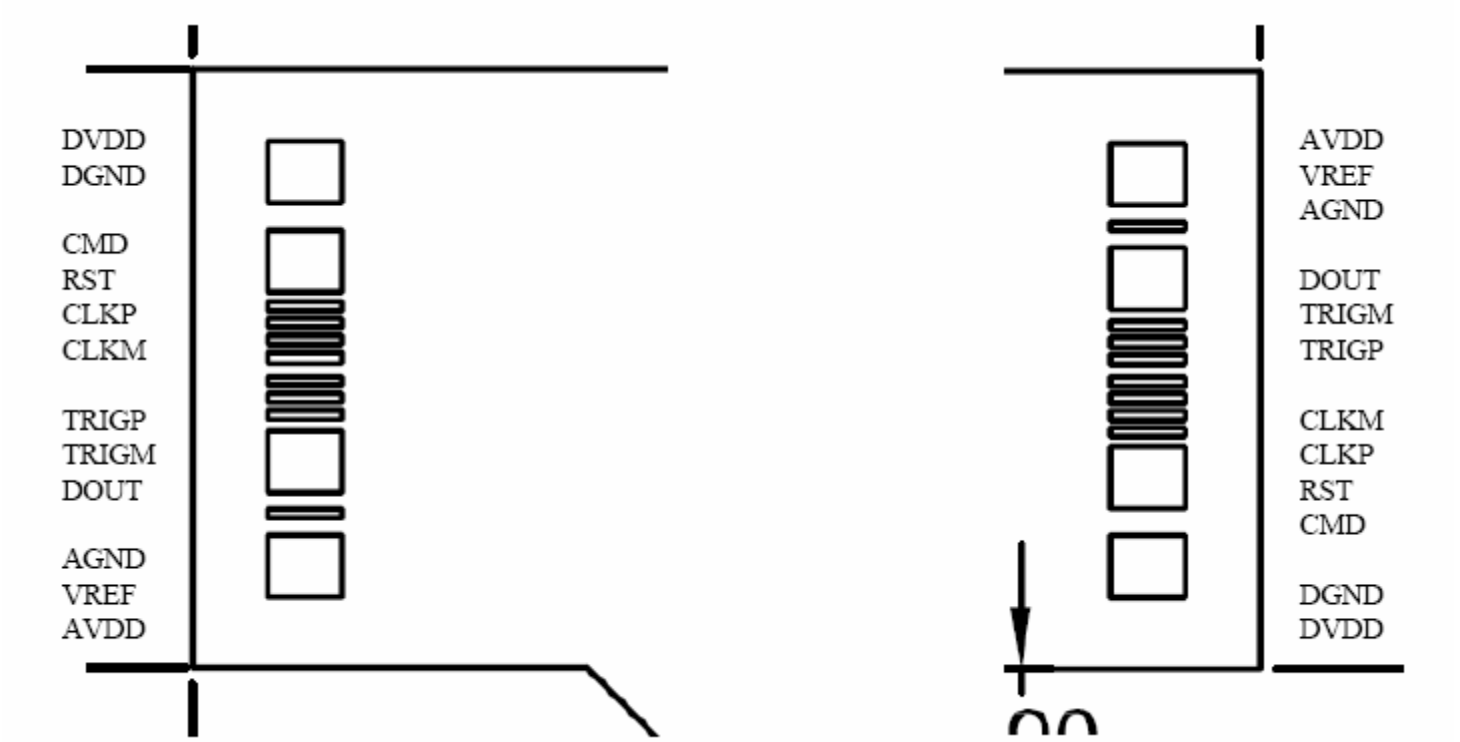
Connectivity

- High density connectors only have a 30V to 50V rating.
- High Voltage pins must be isolated from low voltage signals.
- One option is to remove unused pins between high and low voltage signals.
- Another option is to use separate connectors for high and low voltages.
- This issue still needs to be resolved.



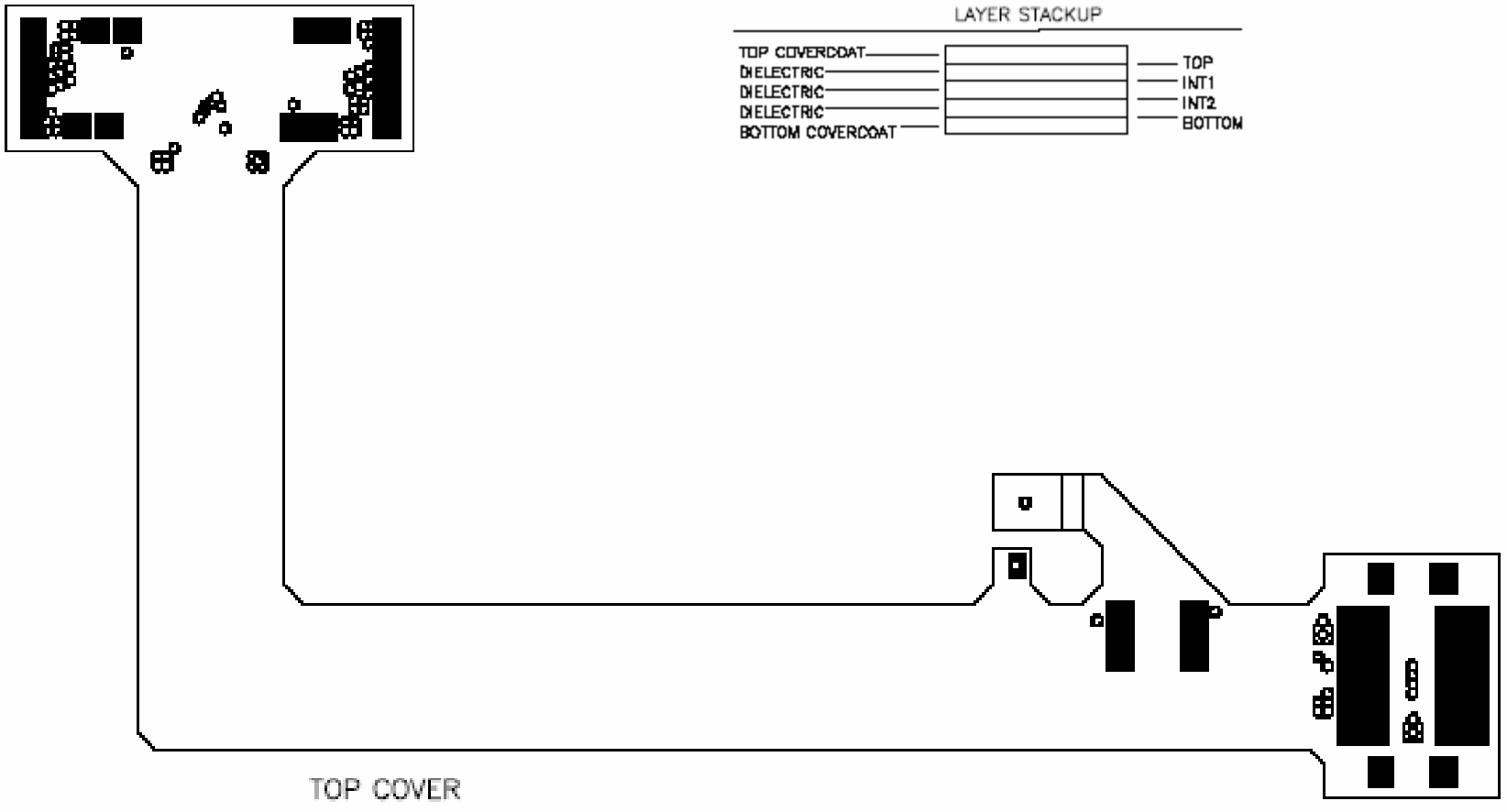
Cable Traces

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



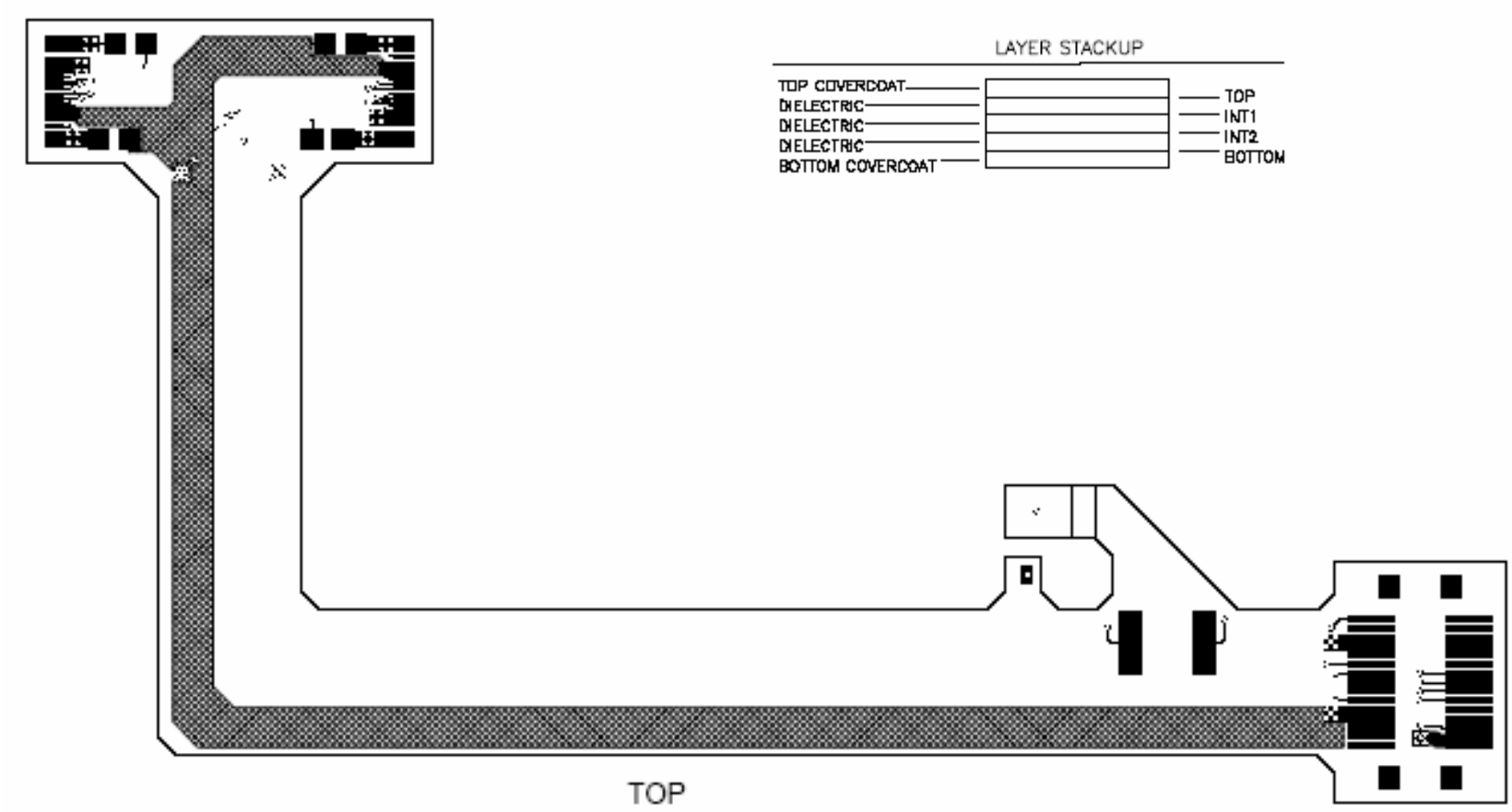
Layers, Top Cover

- Surface layer of photoimageable covercoat 38 μm thick, to protect the exposed traces.



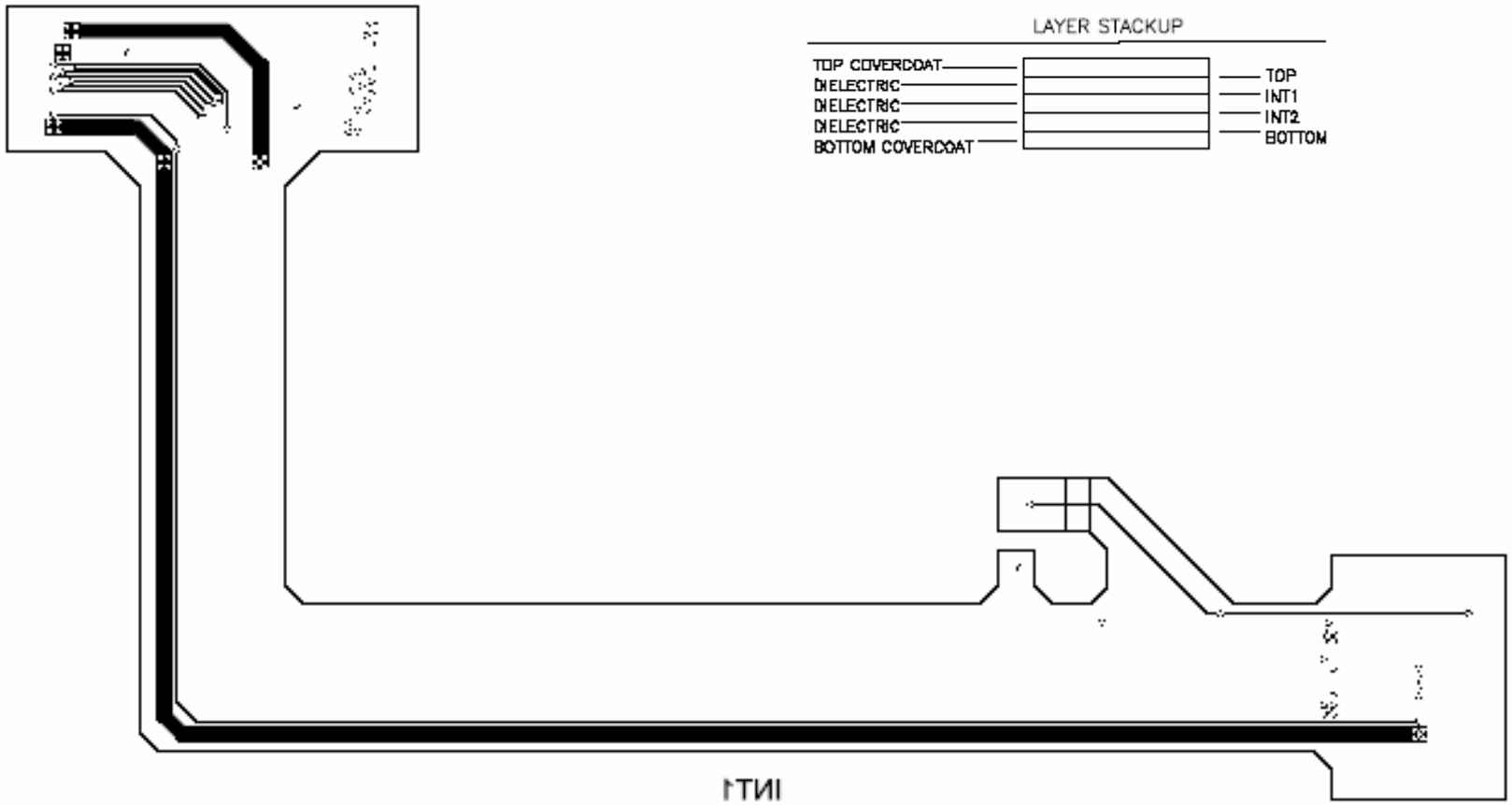
Layers, Top Layer

- Analog Return



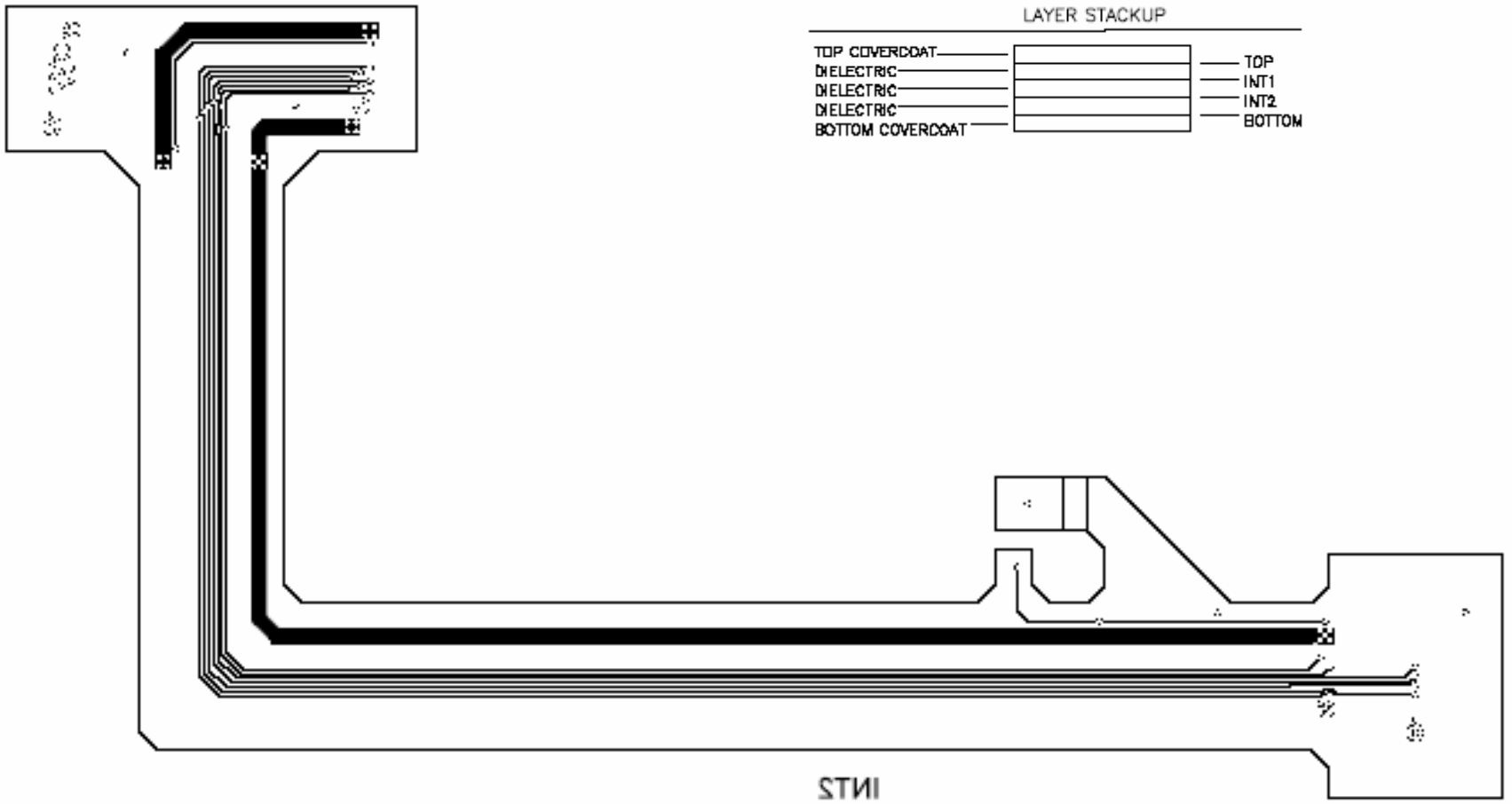
Layers, Internal 1 Layer

- Analog and Digital Power
- Vref, Digital Control and Readout
- High Voltage Bias



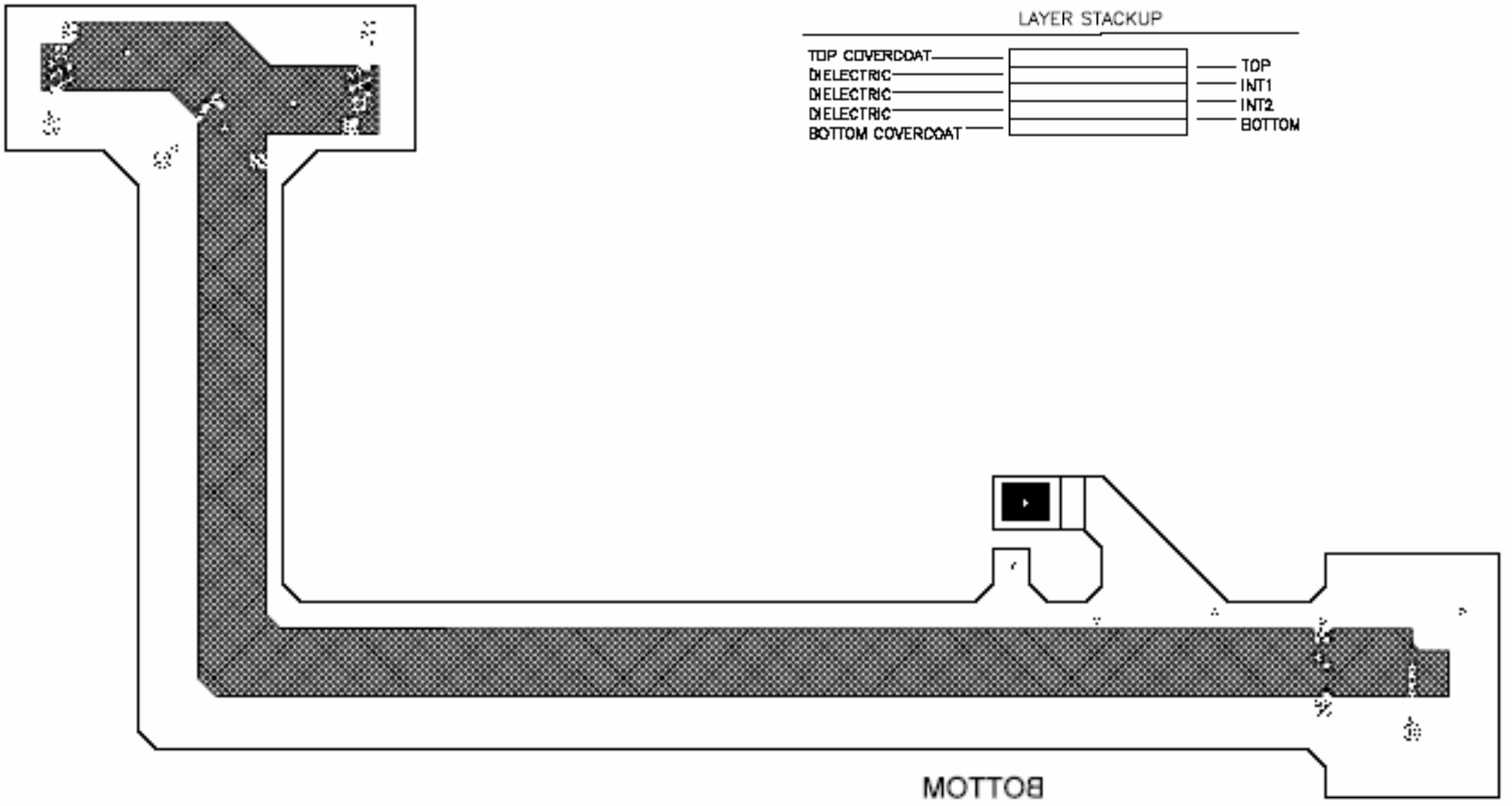
Layers, Internal 2 Layer

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



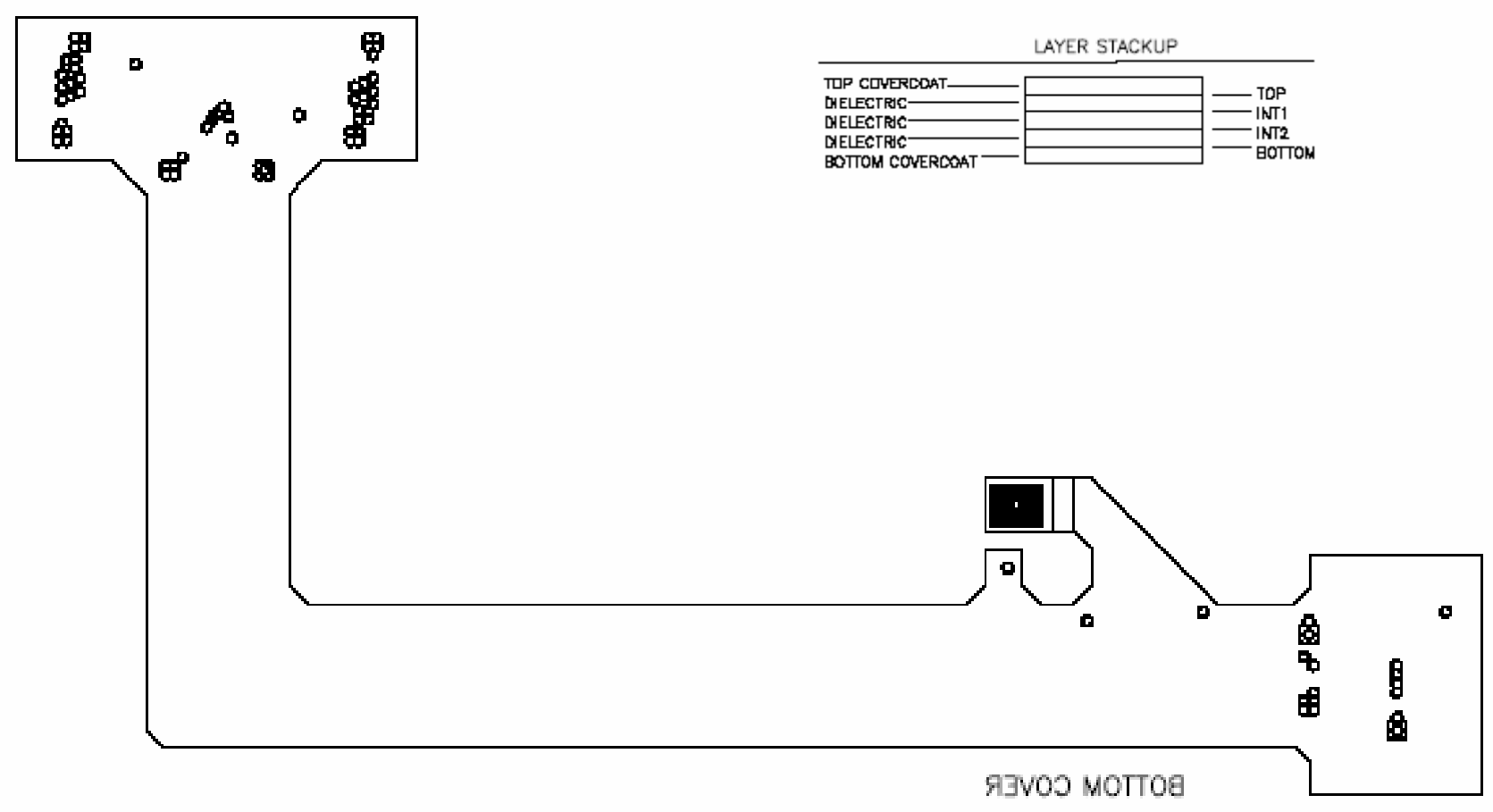
Layers, Bottom Layer

- Digital Return



Layers, Bottom Cover

- Need to cover all plated thru vias with a layer of photoimageable covercoat 38 μm thick on the surface which contacts the sensor, to avoid scratches or shorts.

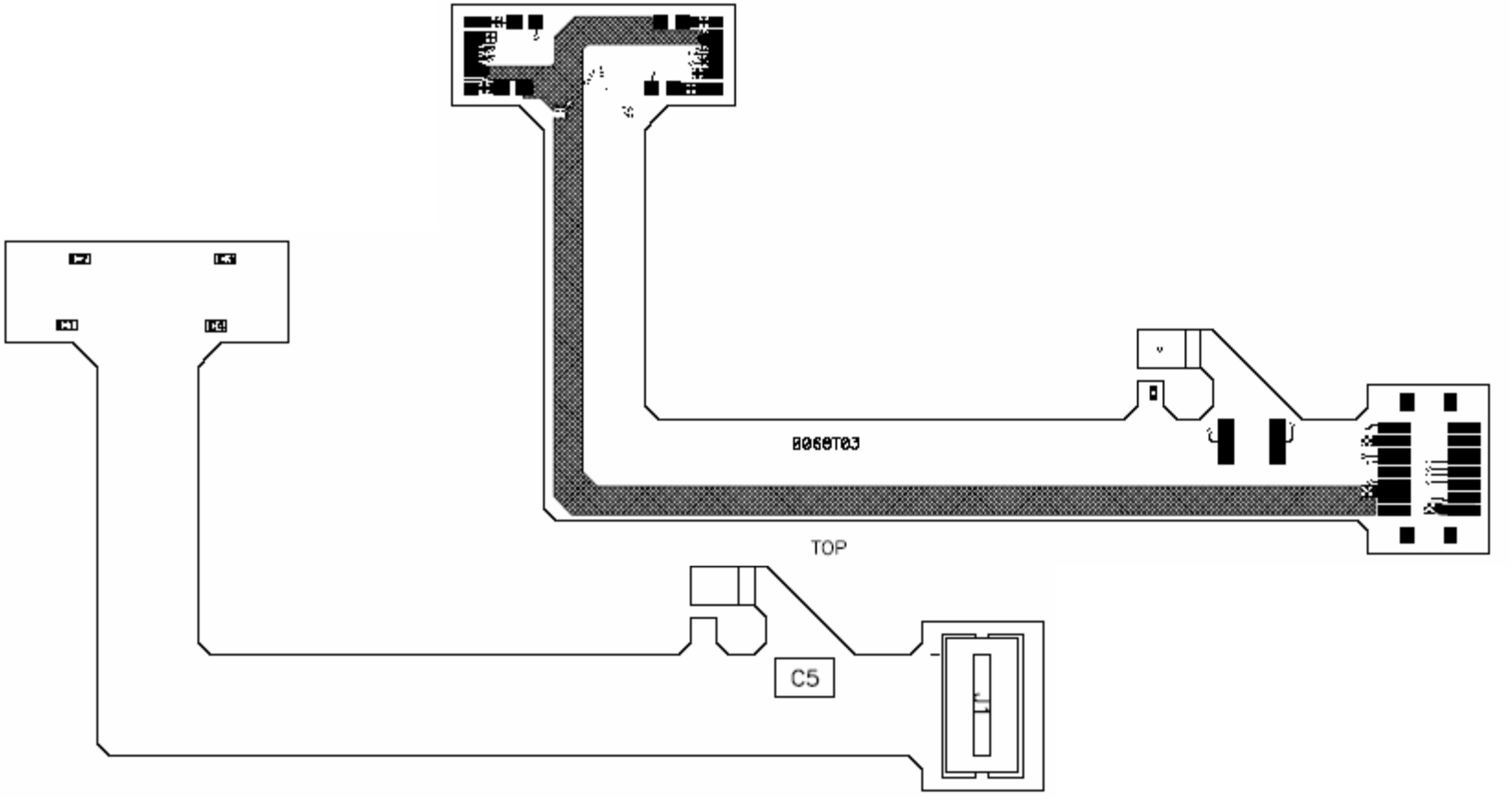


Metallization and Resistance

- Metallization: ¼ Oz Cu, Gold plating on the wirebond pads
- Resistance: Power and Ground traces < 1 ohm
- AVDD and DVDD power conductors are 800 um (30 mils) width, and AGND and DGND are wide planes

Power Filtering

- Filtering of KPIX power and HV Bias on the Pigtail Cable
- C1-C4 are standard 1206 sized surface mount, C5 is 1812 sized High Voltage (ex, Johanson MLCC 0.1μF 500V , height ~ 3mm)

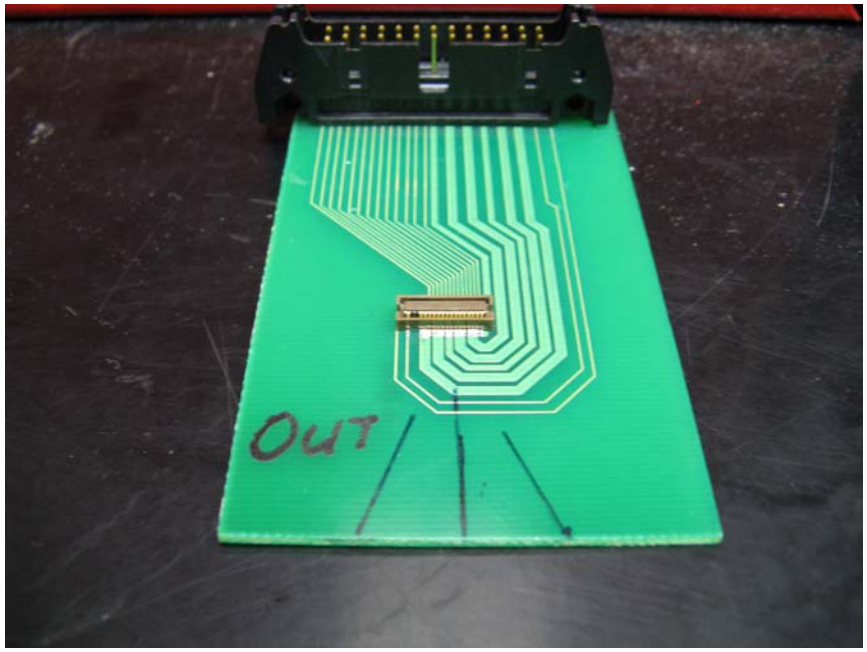


Signals, Pickup and Crosstalk

- 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.

Extension Cable

- The Extension can be up to 2 m in length.
- As soon as Pigtail cable is verified the Extension cable design should be straightforward.
- Pigtail cable alone can be used for sensor testing if we make an adapter to interface to a more standard type connector, for example:



Summary

- The Pigtail cable design has been updated:
  - Changed solid planes to crosshatched patterns
  - Added missing low voltage filter capacitors
  - Added High Voltage filter capacitor
  - Fixed routing of High Voltage Return
  - Added ELCO 5087 connector to end of cable
- Need to resolve issue of whether Low and High Voltage can go on the same connector.
- Need a final review of design before fabricating prototypes.
- Cost estimates for 20 pieces are ~ $5000.00