

SiD Pigtail Cable Design

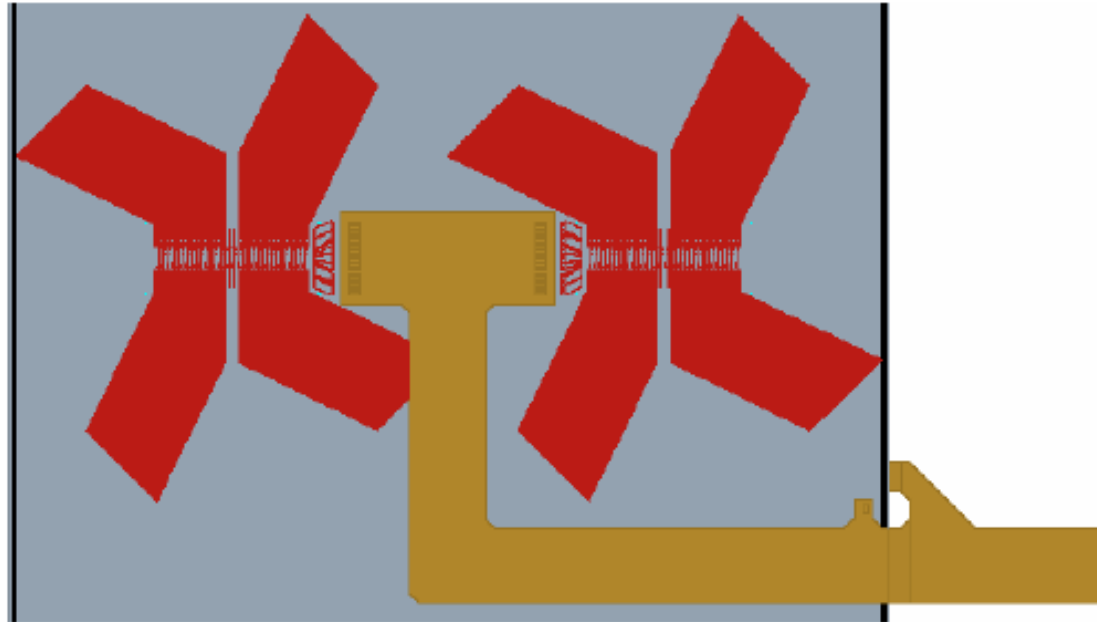
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U. of New Mexico

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Introduction

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



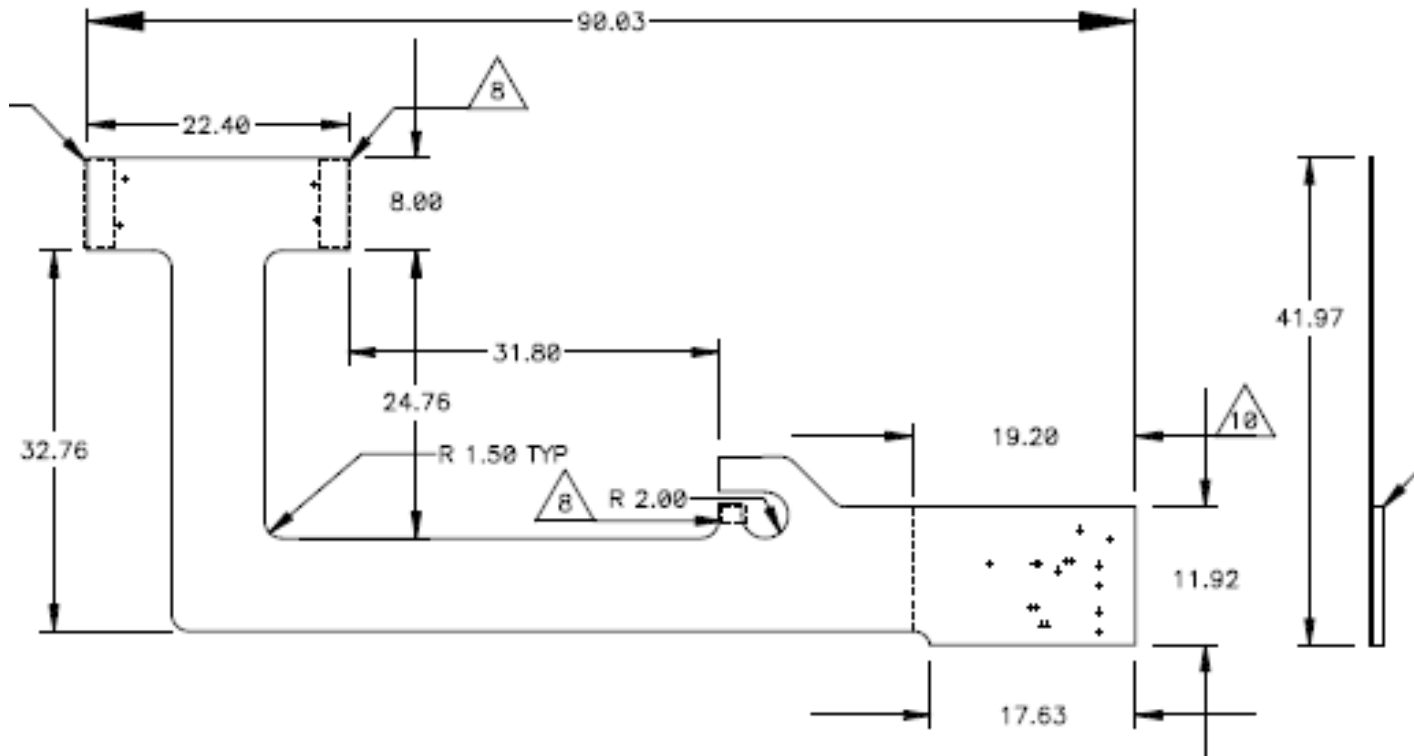
- This cable has two components:
 - Pigtail, a short cable glued to the module
 - Extension, a long cable connecting the Pigtail to the concentrator

Pigtail Cable Specifications

- 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
- Metallization: Gold plating on wirebond pads only
- Filtering: of KPIX and HV Bias on the Pigtail Cable
- Signals: Digital signals are LVDS (low voltage differential signaling)

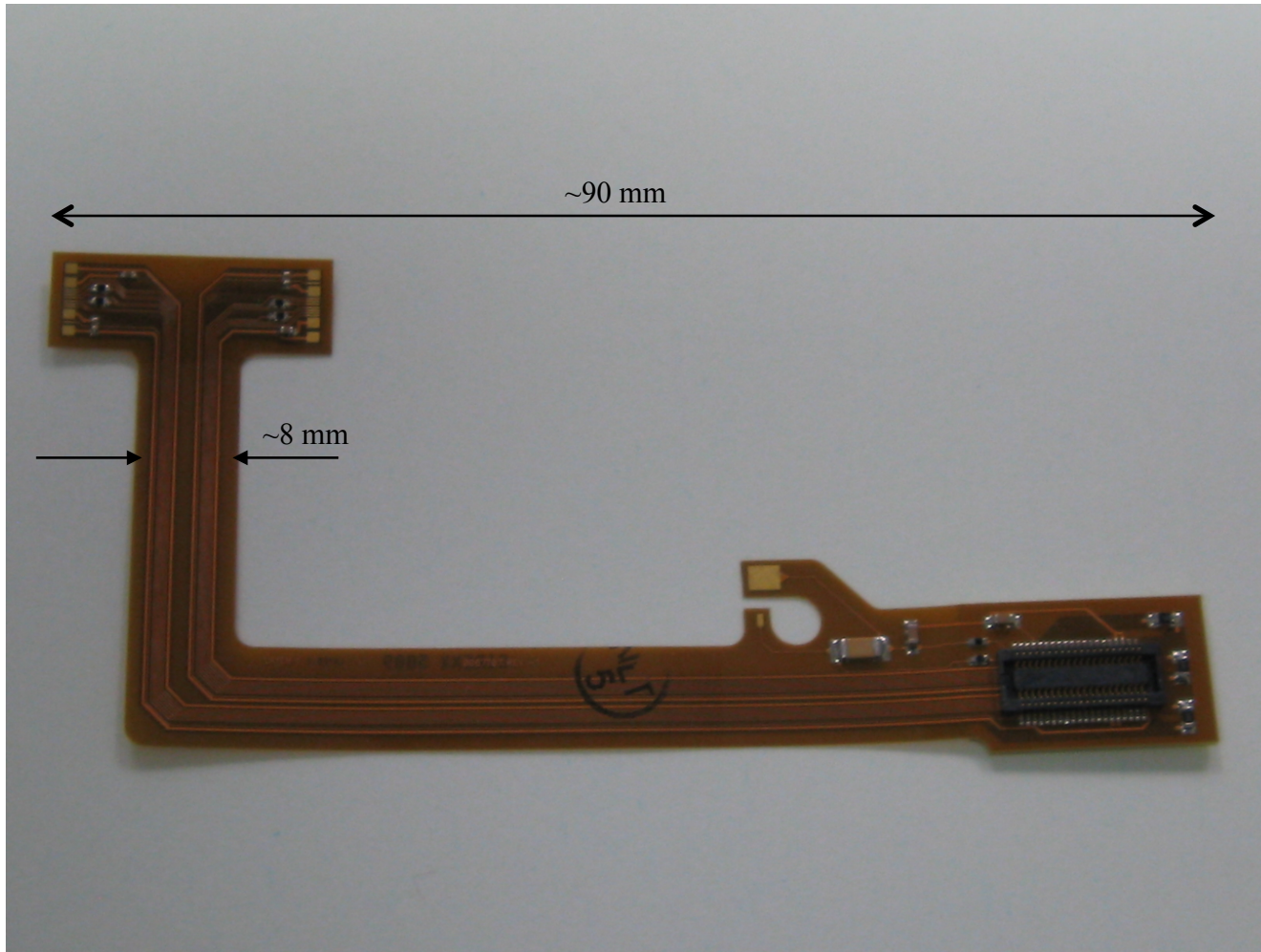
Dimensions

- Length: ~ 90 mm, Width: ~ 8 mm, Thickness: ~ 170 μm



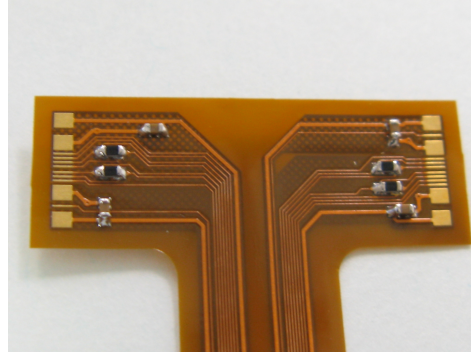
Dimensions

- Length: ~ 90 mm, Width: ~ 8 mm, Thickness: ~ 170 μm

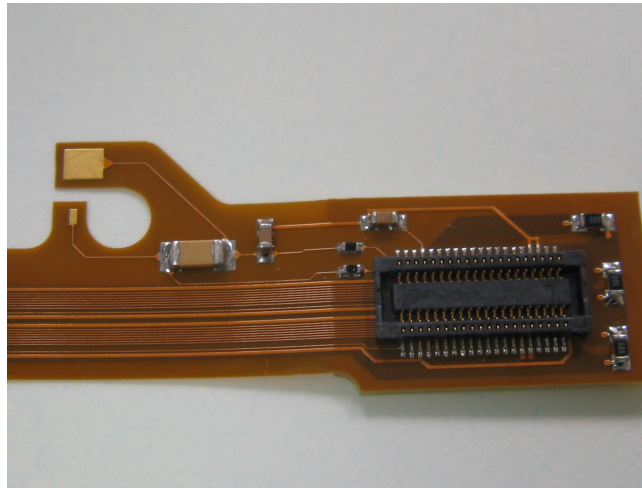


Connectivity

- Detector end connected w/wirebonds, cable has gold plated pads

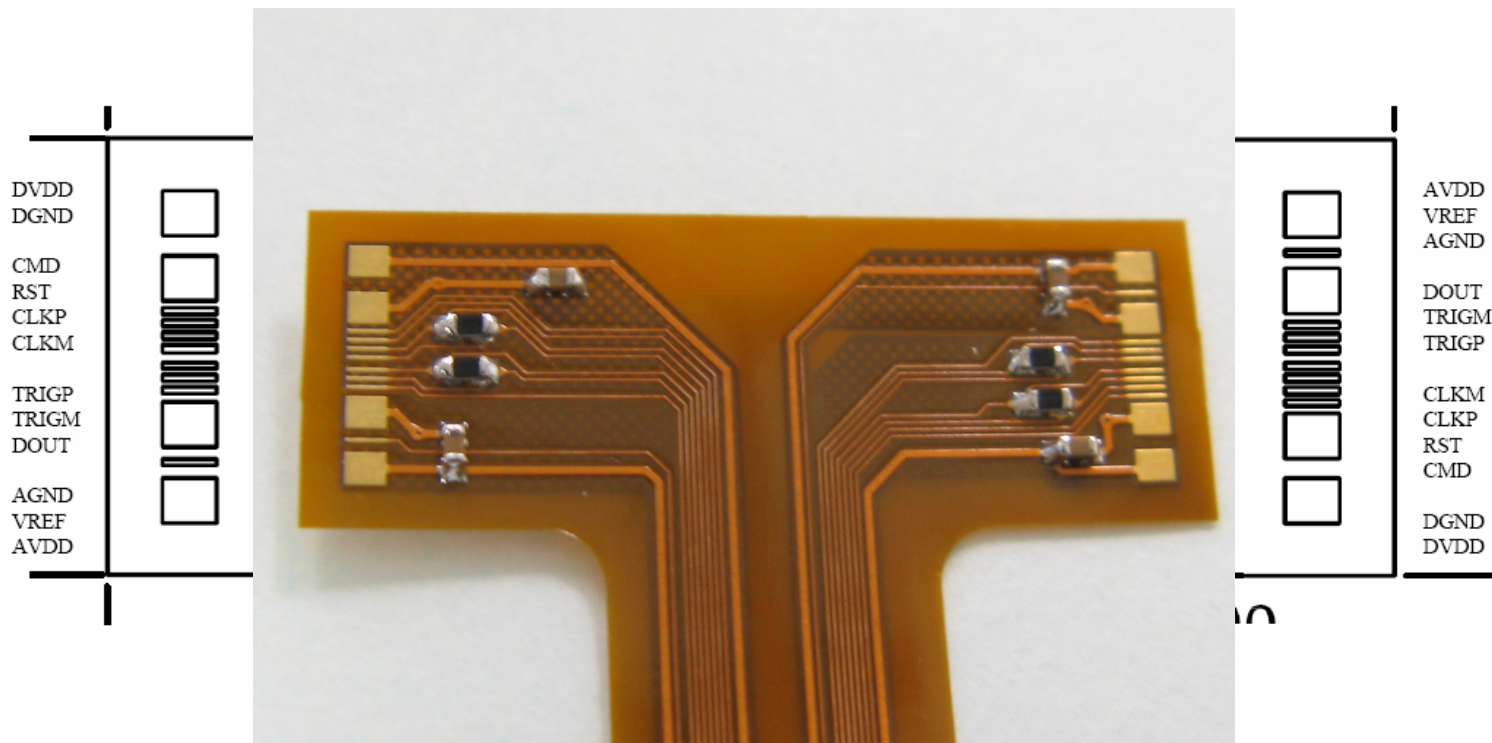


- HV Bias tabs at sensor edge have gold plated pads
- Connector to Extension cable (Molex)



Wirebond Pads

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

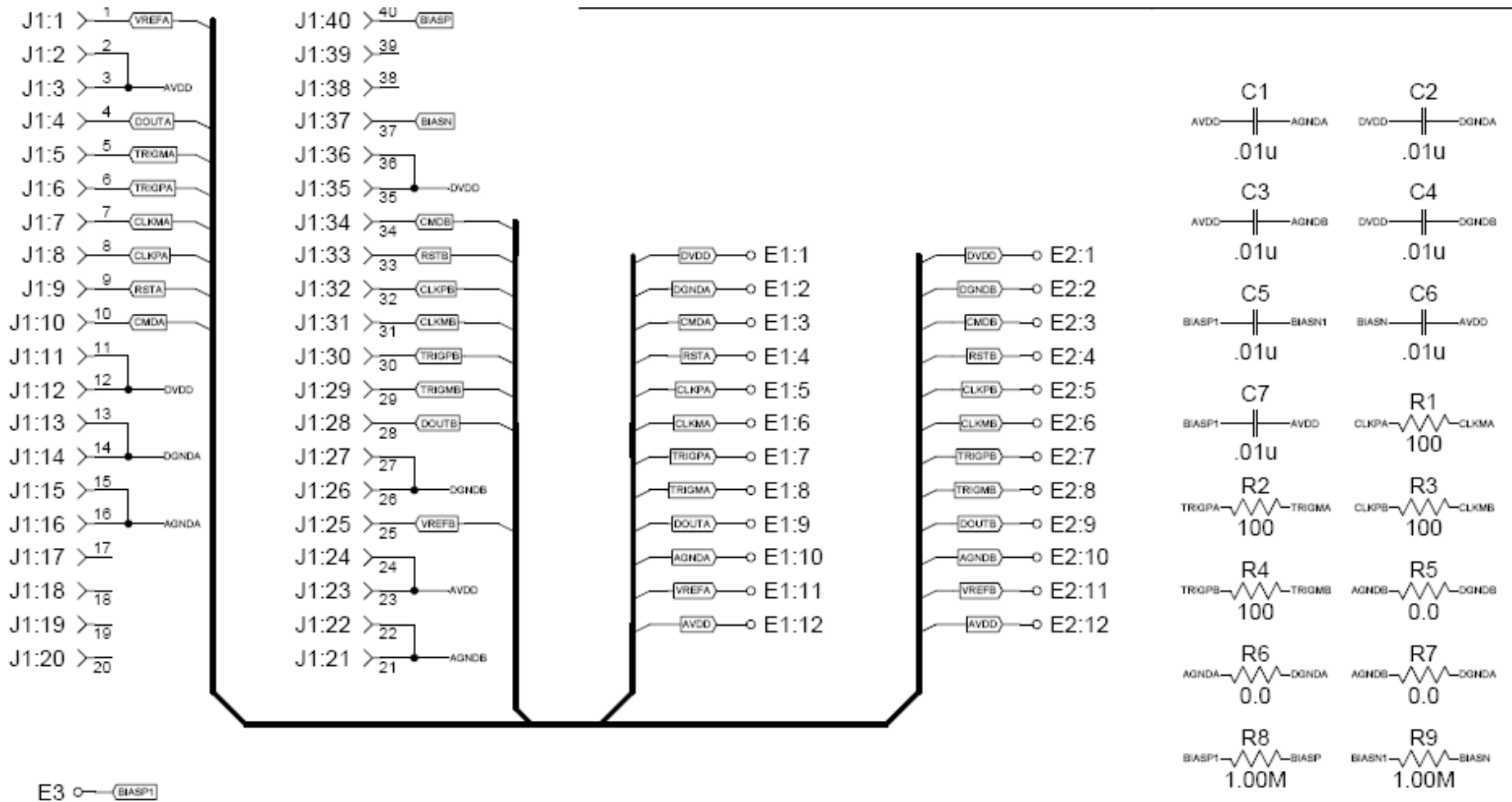


Layers

- Double-sided design
- Top and Bottom have coverlay 38 μm thick, to protect the exposed traces.
- Top side has all signal and power traces
- Bottom side has DGND plane
- Stiffener is 1 mm thk FR-4

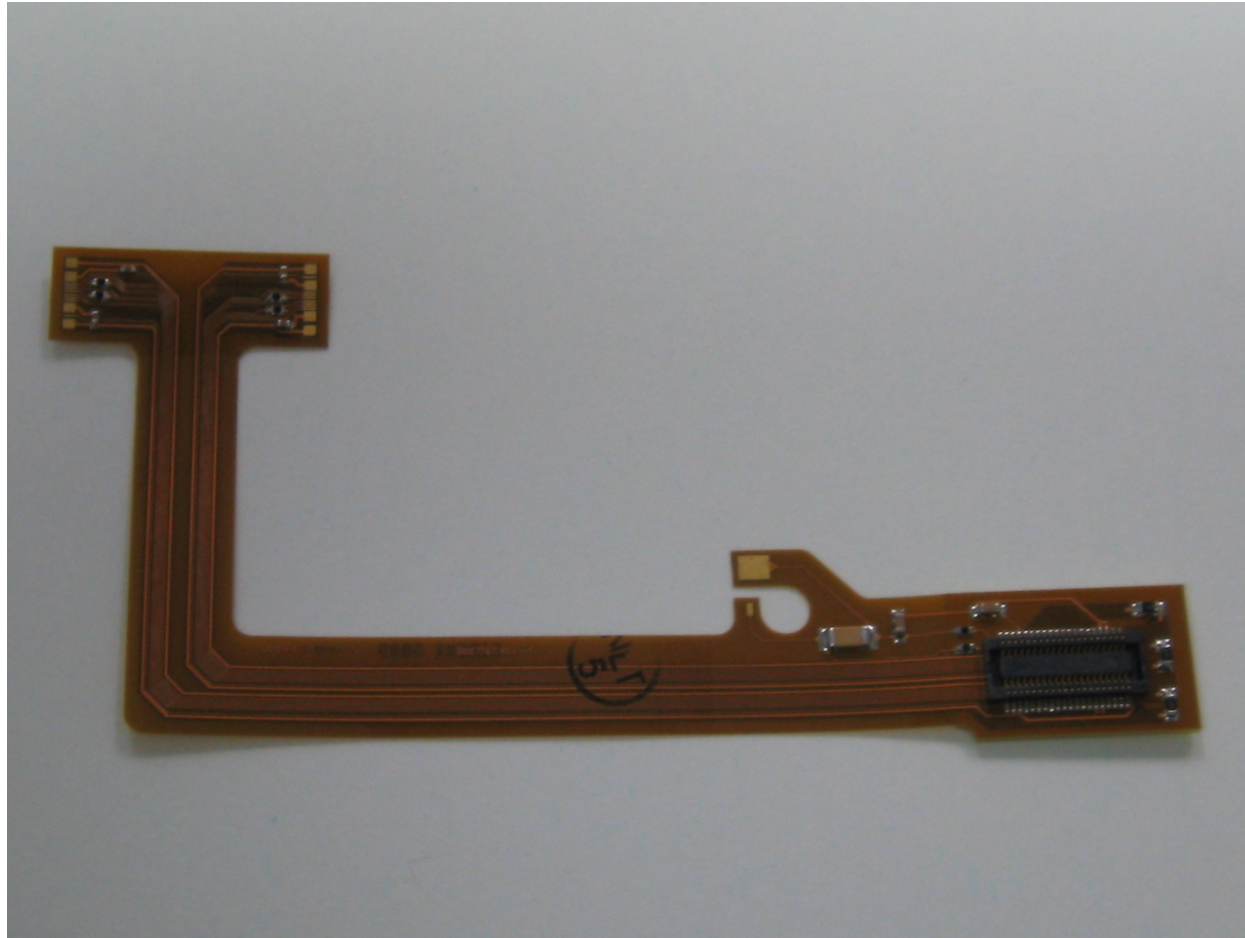


Schematic



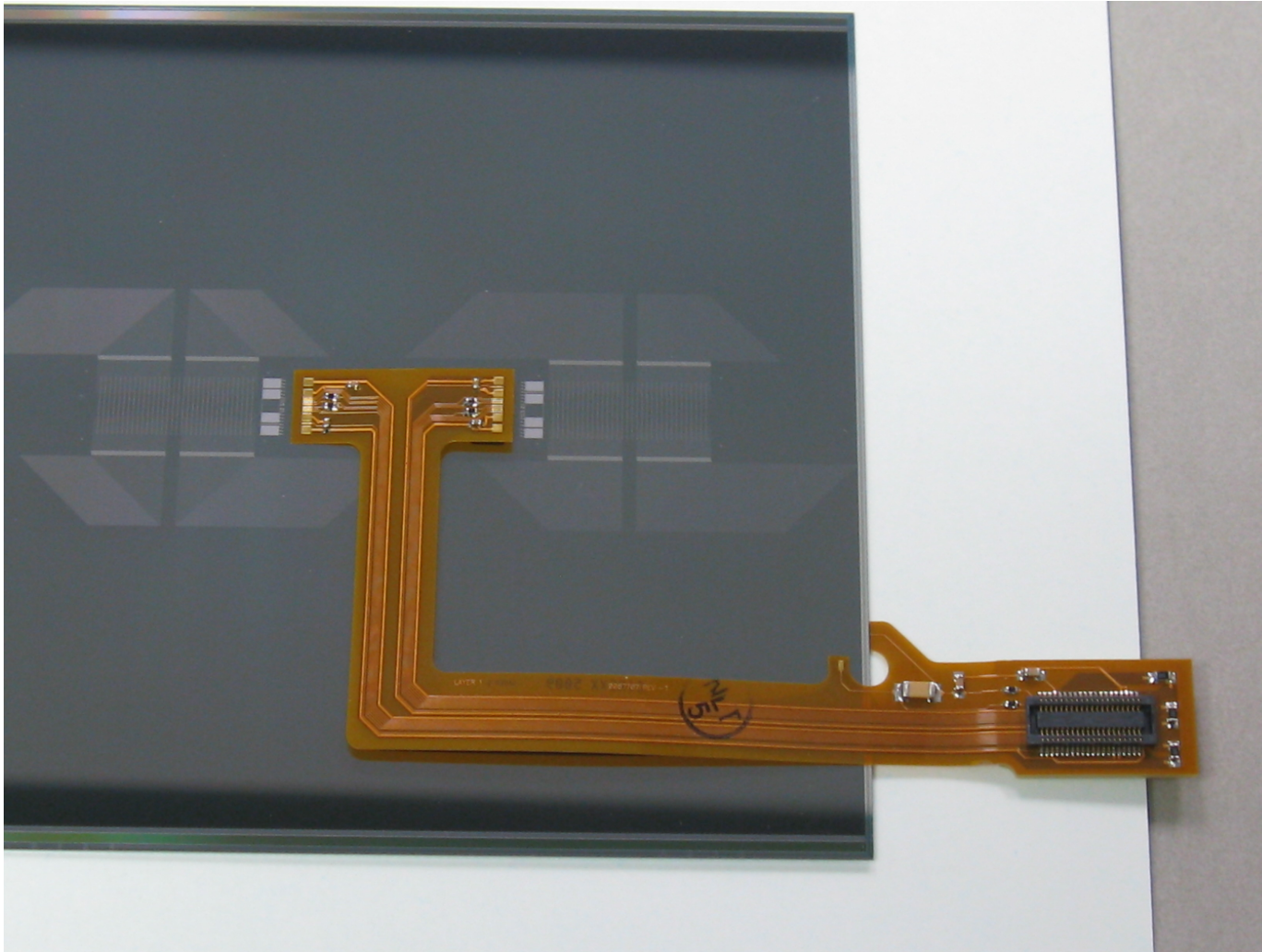
Manufacturing & Assembly

- 10 cables were manufactured at Cirexx for \$210.00/ea (thanks to Marcel)
- The parts were soldered on at FNAL with no problems (thanks to Marcel and Johnny Green)



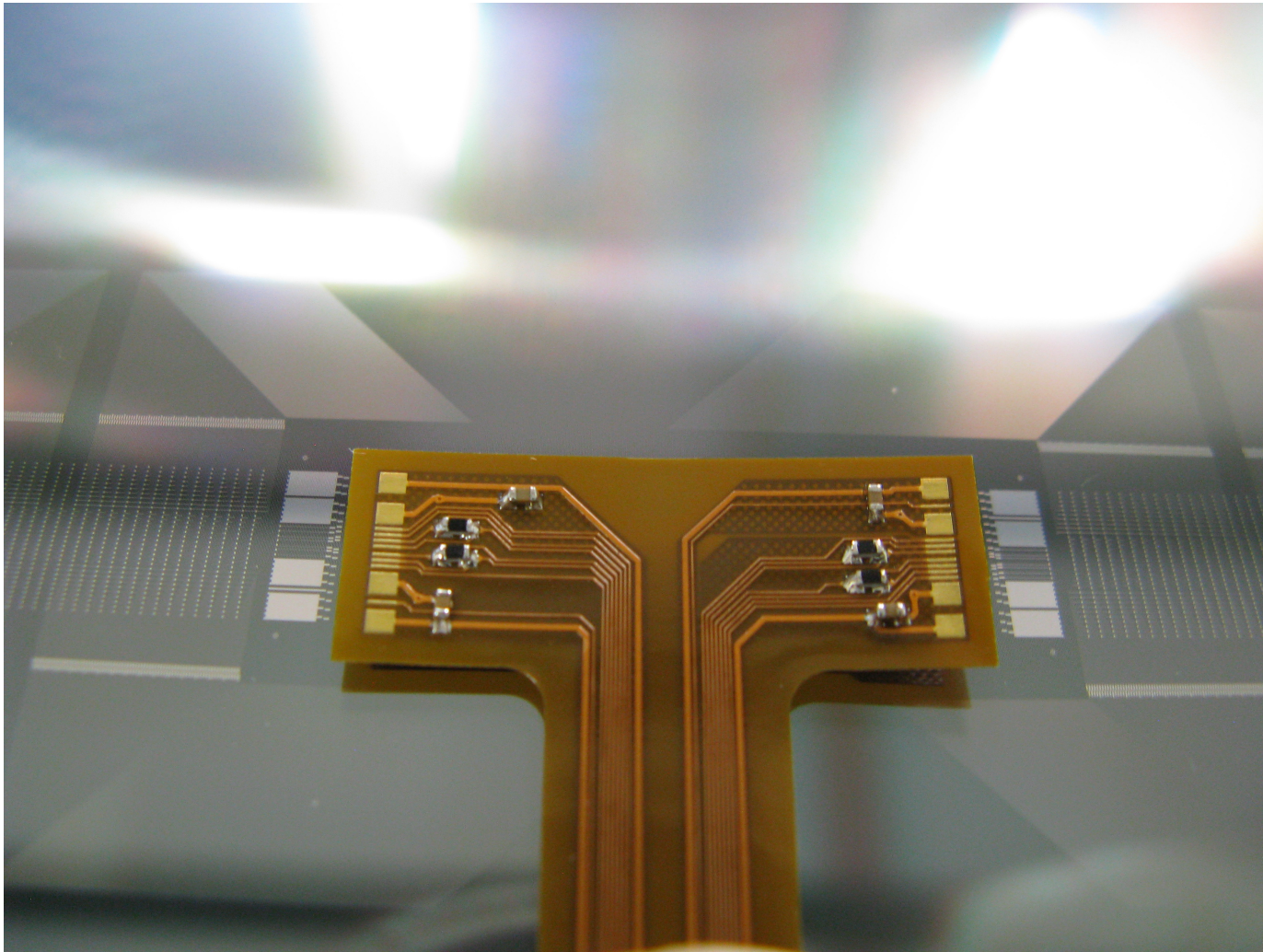
Pigtail Cable on a Sensor

- Cable is just laying on the sensor & is not attached



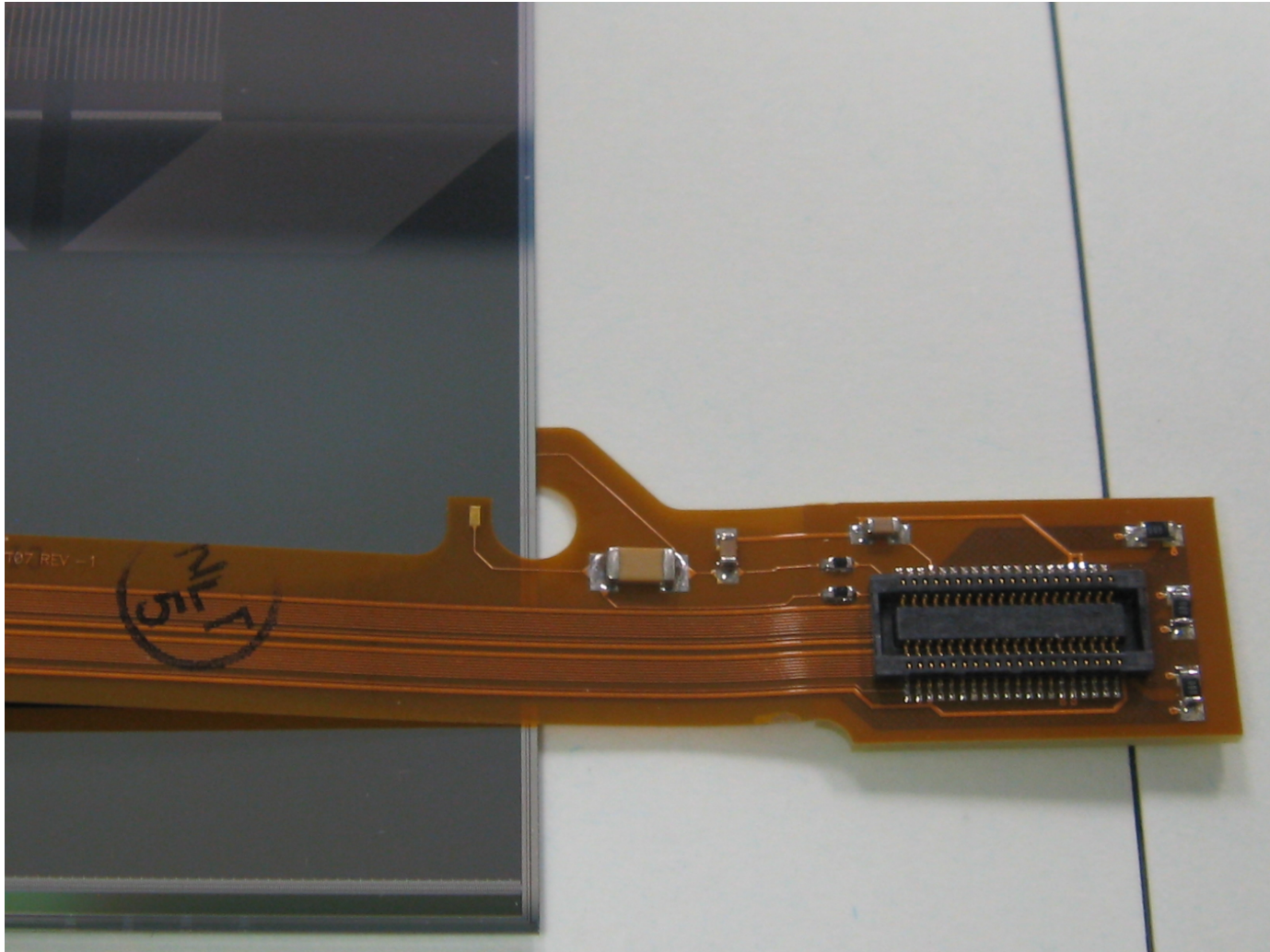
Pigtail Cable on a Sensor

- Sensor end



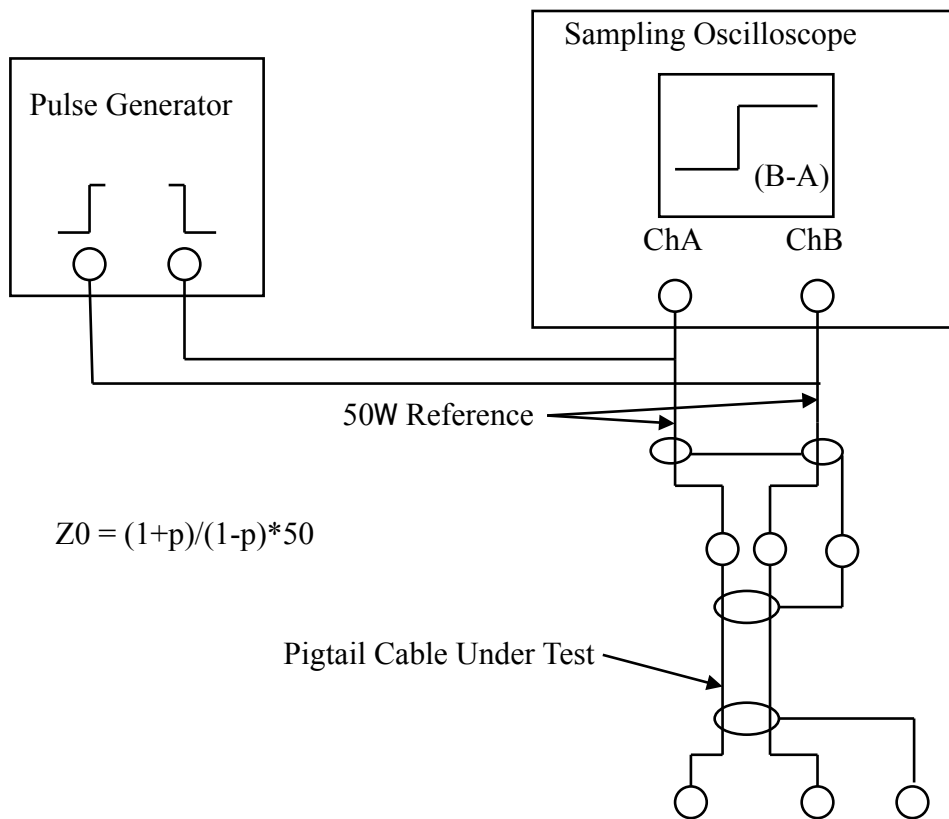
Pigtail Cable on a Sensor

- HV Tab and connector to Extension Cable



Pigtail Cable Testing

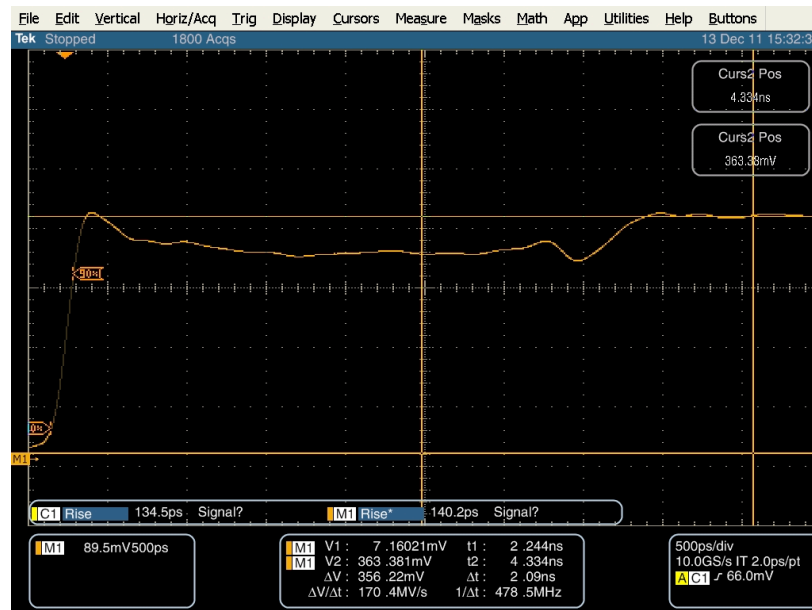
- Goal: verify the differential impedance of $Z_0 = 100\Omega$ on the LVDS signal traces
- Method: differential Time-Domain Reflectometry (TDR) measurement per specifications IPC-TM-650 and IPC-2141



- Two closely matched pulses of opposite polarity are simultaneously transmitted down balanced conductors to the Pigtail under test.
- The reflections are monitored on a sampling oscilloscope on each conductor of the differential signal lines and the differential impedance is calculated.
- Equipment:
 - Tektronix TDS7254B 2.5GHz
 - Tektronix Differential Probe
 - PPL Pulser, 100 pSec rise time
 - Maury Microwave 50Ω References (really need 100Ω References)

Pigtail Cable Testing

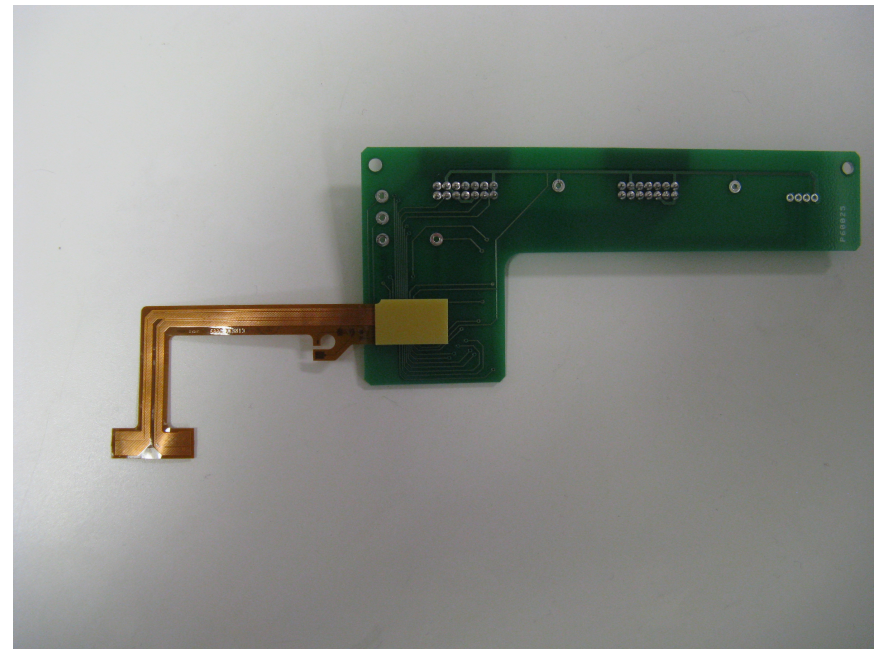
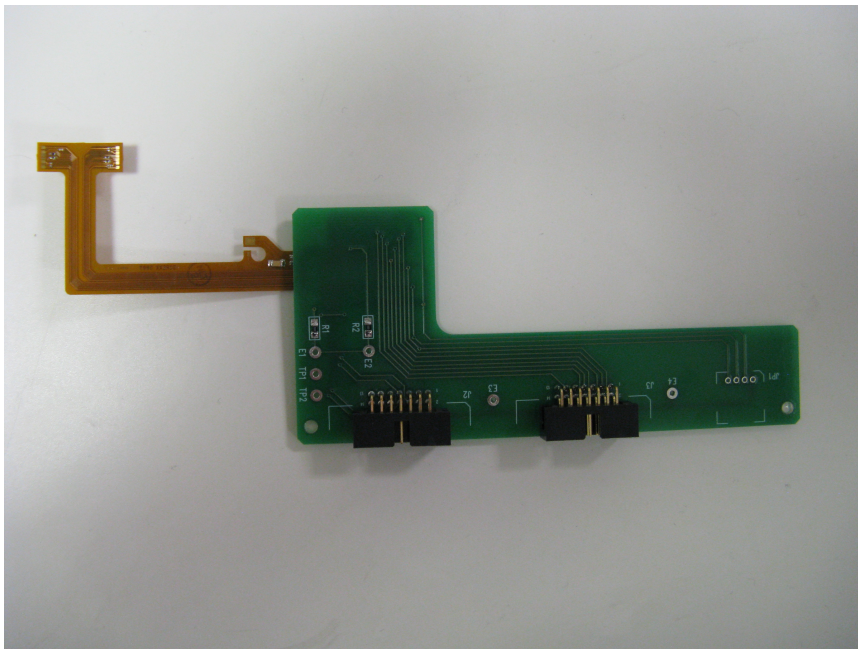
- Goal: verify the differential impedance of $Z_0 = 100\Omega$ on the LVDS signal traces.



- The measured result is $Z_0 = 72\Omega$, we found a typo on the fabrication drawing where we specified the polyimide base material to be the wrong thickness.
- Ron has agreed to help us fabricate new ones to the correct required thickness .

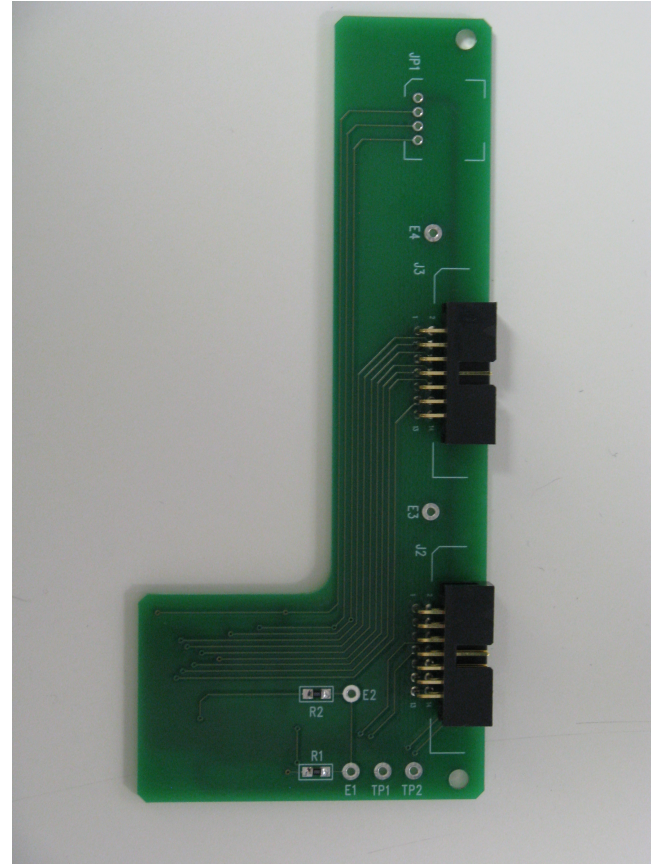
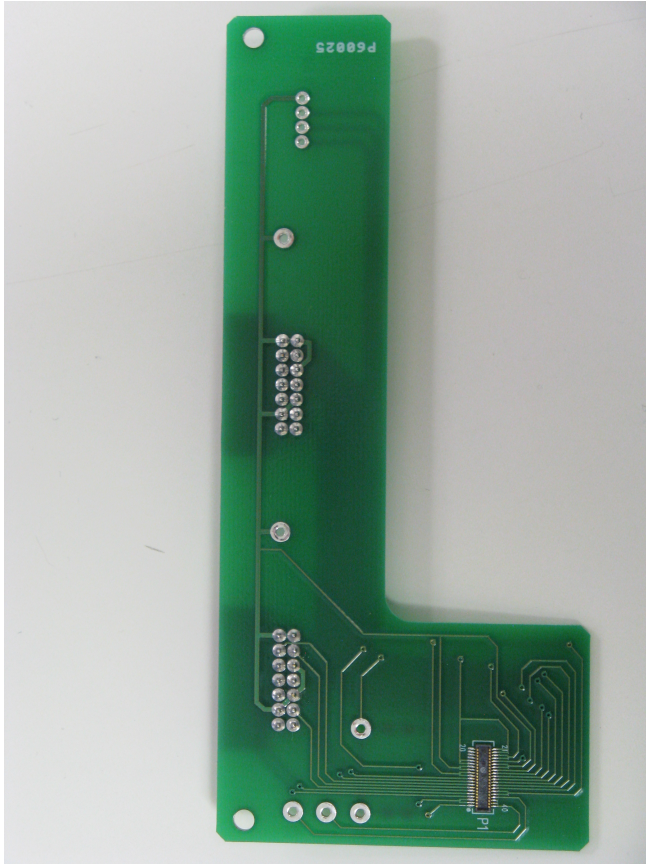
Adapter Board

- Interfaces the Pigtail Cable to standard dual-row ribbon cable connectors
- In this way the Pigtail Cable alone (without the Extension Cable) can be used to test the sensor



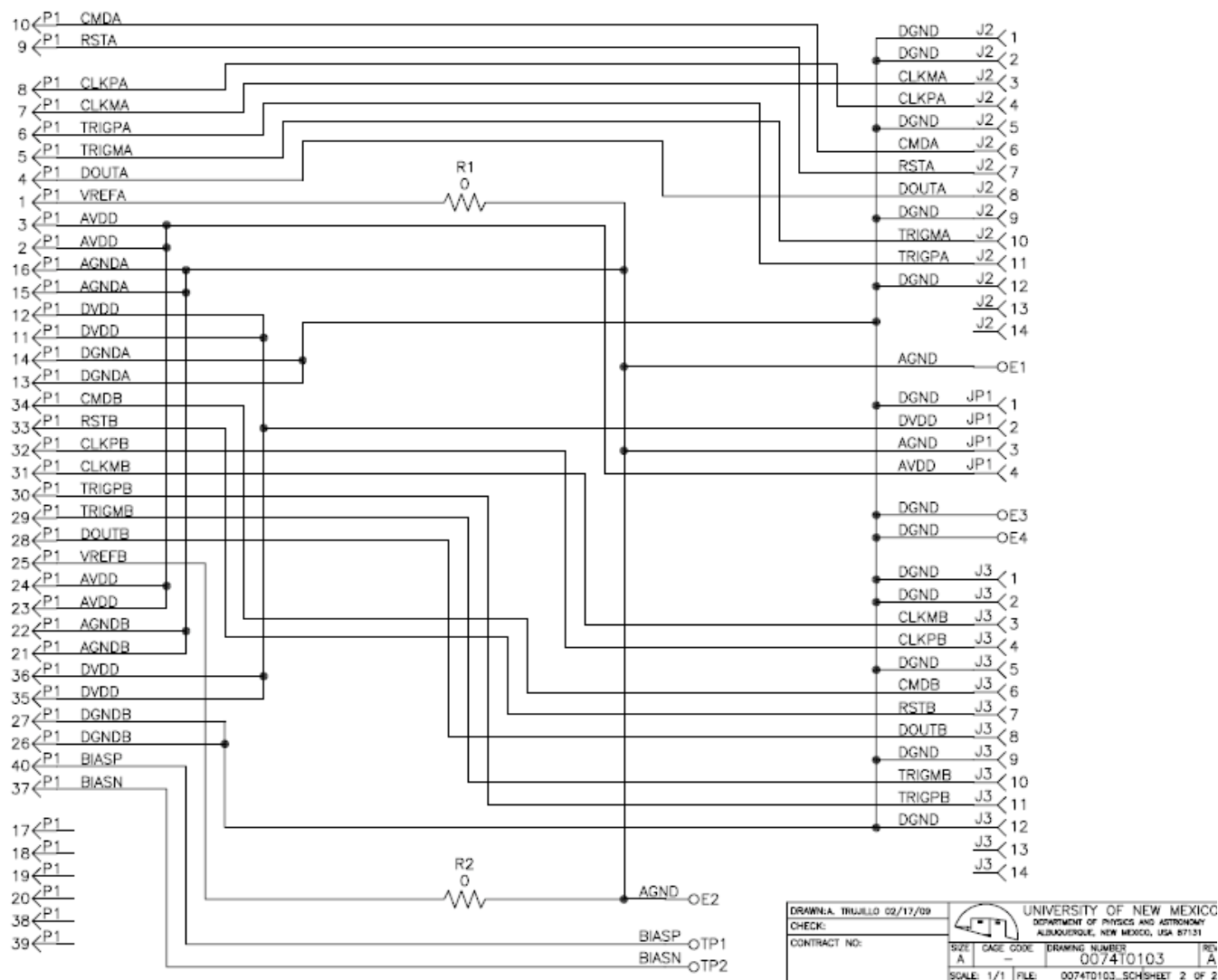
Adapter Board

- High density cable is on one side, ribbon cable connectors on the other side



Adapter Board

- Schematic



Summary

- The Pigtail cable design has been prototyped and no problems were encountered in the Manufacturing and Assembly.
- The goals of low mass (two-sided design) and low cost have been achieved.
- Point-to-point connectivity testing was done, electrical tests showed a problem with the differential impedance of the LVDS signals, new cables will be fabricated.
- The Adapter Board has been designed, built, and sent to SLAC for further evaluation. We are waiting for some feedback.
- The Extension Cable is under design now.

- There are two issues we will be discussing with colleagues:
 - Connectivity (wirebonding) of the Pigtail Cable to the sensor
 - Magnetic field issues