



News on L0 Analog Cables



- new samples of analog cables from Dyconex received by end of February
- We ordered 5x each of the two longest cable pairs for the upcoming L0-module test:
 - S1A: 463.65 mm length, delivered: 11x
 - S1B: 461.45 mm length, delivered: 6x
 - S2A: 425.20 mm length, delivered: 12x
 - S2B: 423.00 mm length, delivered: 11x
 - plus four 'lower grade' cables for tests
- additional: received two laminated cable assemblies S2A+B

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3/9/03



News on L0 Analog Cables



- new cable design as of Nov '02 has a “jog” at sensor side, where traces are shifted vertically by ~ 0.6 mm over a length of a few mm



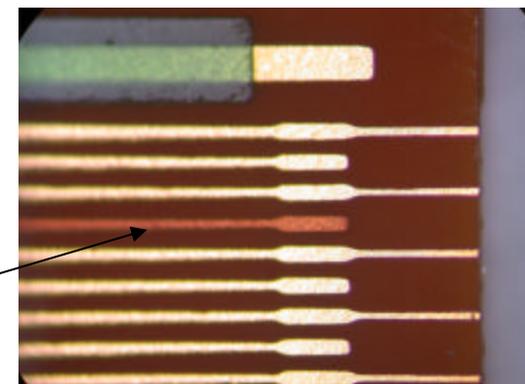


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- all cables are Ni-Au plated ($\sim 1.2\mu\text{m}$) over the full length, solder mask only on HV+GND traces
- did visual inspection in pad regions on all 40 cables
 - open traces would easily be identified by missing gold layer on one cable end
 - no single open trace on the 40 good ones detected

This is a picture of one of the four delivered "bad" cables

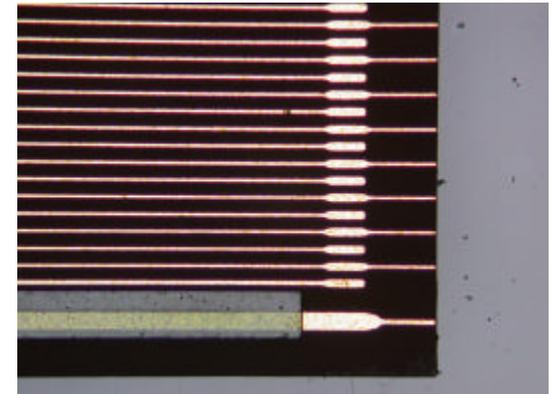
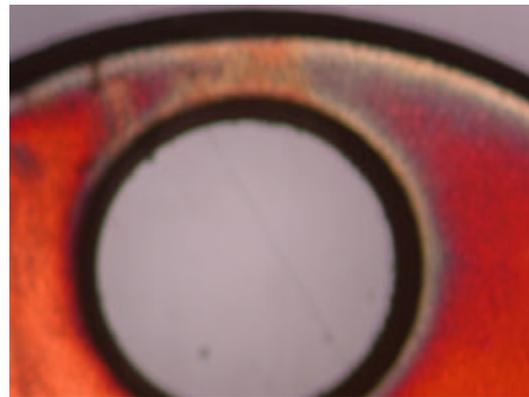
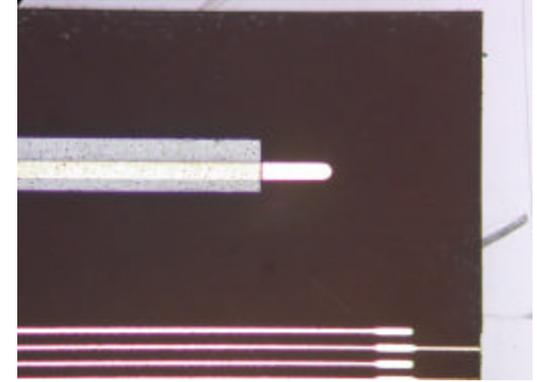
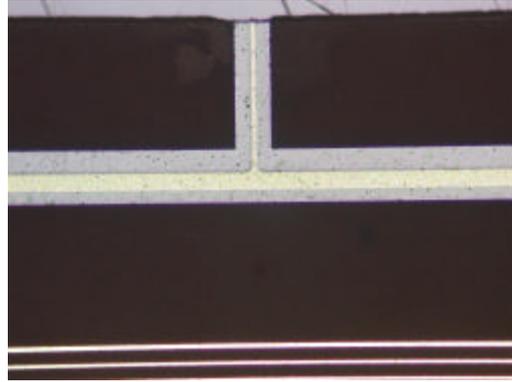




analog cables - some features



- solder mask on HV+GND trace
- rounding of HV trace
- T-connection of HV-trace to outer shortening bar
- Cu-reinforced holes at ears for fixation purposes

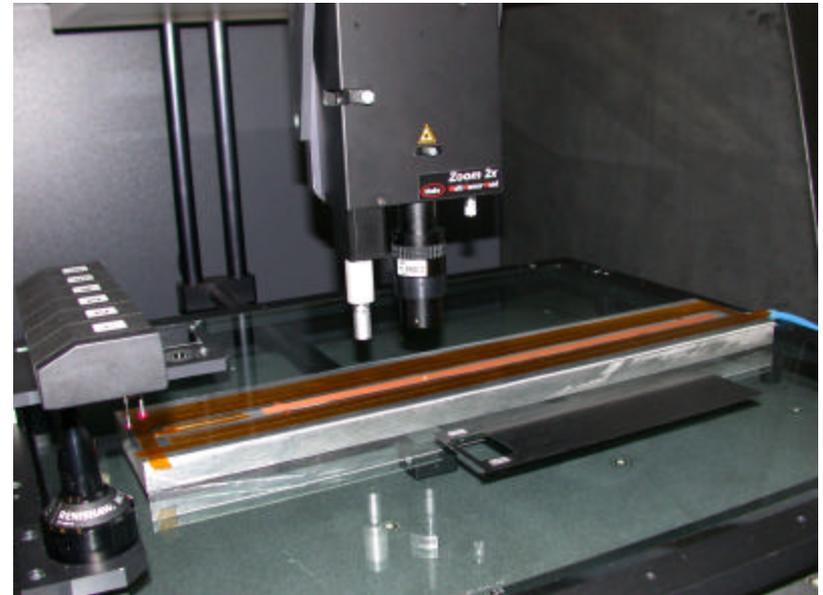
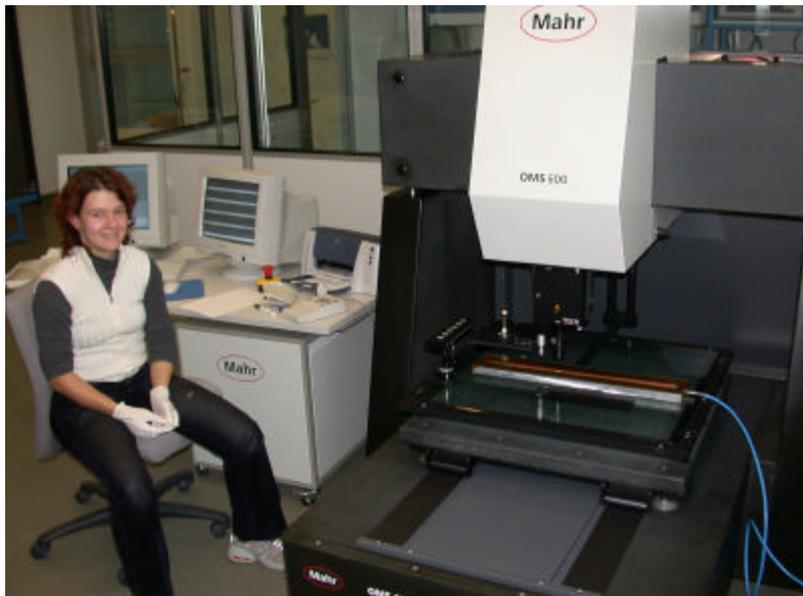




Metrology measurements



- did some optical metrology measurements in Zurich:





Metrology Results



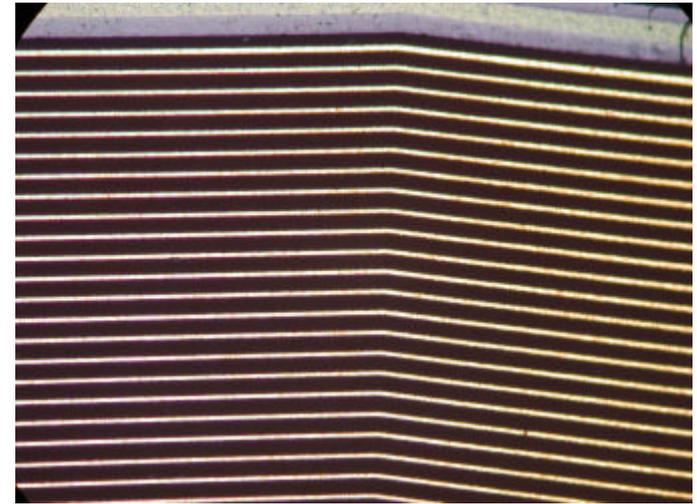
- measured only two cables of S1-A type:
 - hole diameter: 1.52 ± 0.02 mm OK!
 - hole-hole distances:
 - ✓ 413.67 ± 0.05 mm -> OK?
 - ✓ 27.27 ± 0.02 mm -> OK?
 - full length: 463.718 mm and 463.644 mm (should be 463.650 mm)
 - trace width: 19 μm , RMS < 0.5 μm
 - ✓ however 1st and 129th trace have thickness of ~ 28 μm . Effect understood by company
 - ✓ specified 15 μm , but could also live with 19 μm
 - pitch: 91.5 μm , RMS < 0.6 μm
 - HV & GND trace width: 0.1 mm
 - pad size: 45 x 120 μm



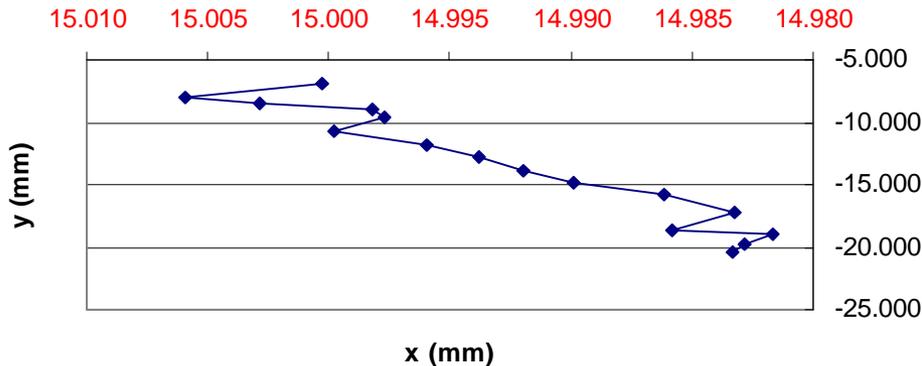
Metrology Results



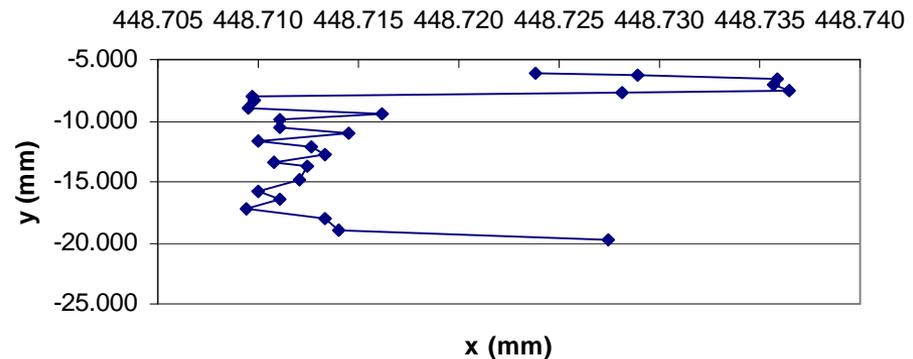
- measurement on jog
 - angle $\sim 8.5^\circ$
 - traces shifted vertically by 0.6 mm over 4.1 mm
- trimming edge accurate and parallel within $\pm 20\mu\text{m}$



trimming cable end



trimming cable end right

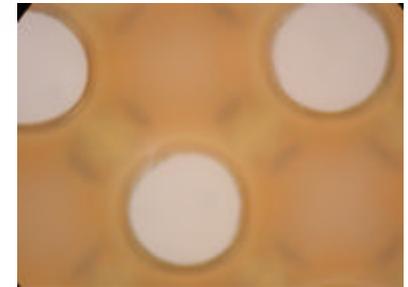
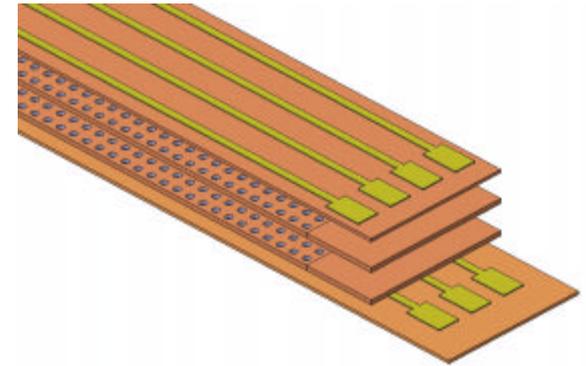




Cable assembly



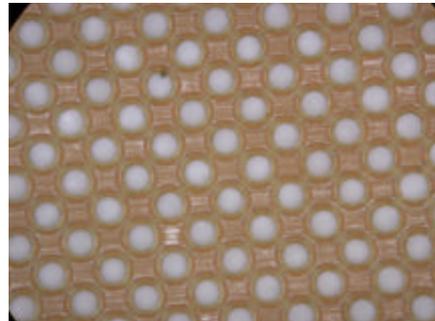
- proposal for lamination of cable pair
 - sandwich of cables and kapton mesh (kapton with plasme etched holes) to reduce dielectric constant
 - Dyconex has produced three different meshes for evaluation
 - ✓ hole radius: 60 μm
 - ✓ hole-distance: 190, 210 and 230 μm
 - ✓ corresponding to $\epsilon_r \sim 1.95, 2.2$ and 2.45



190 μm

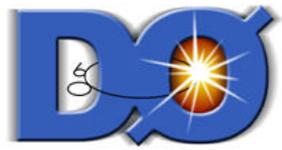


210 μm



230 μm

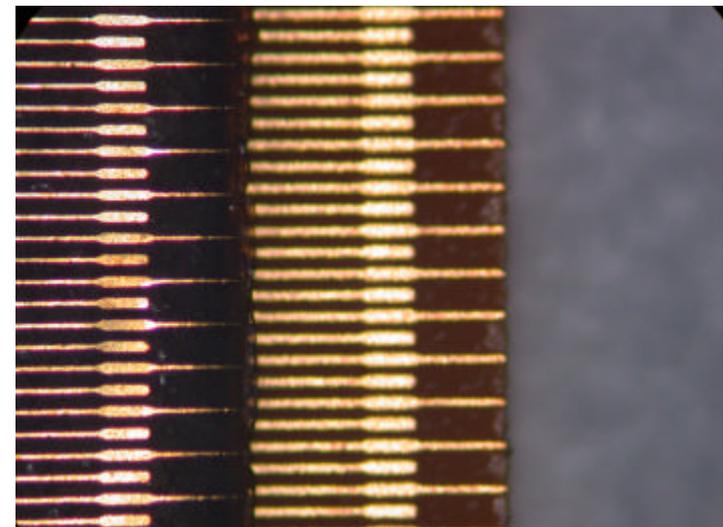
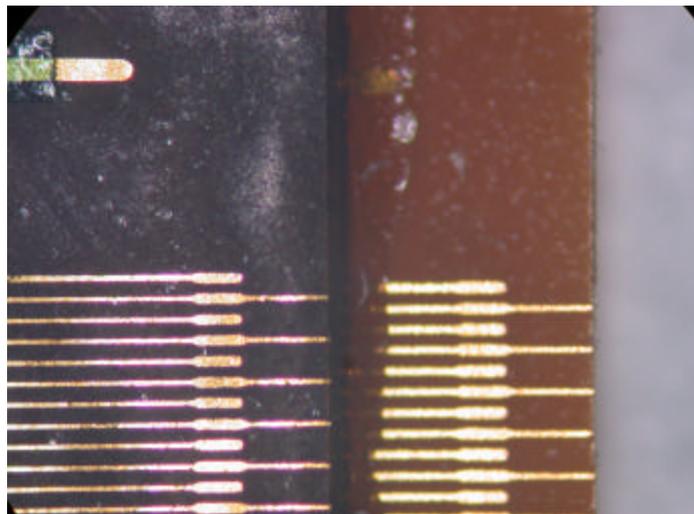
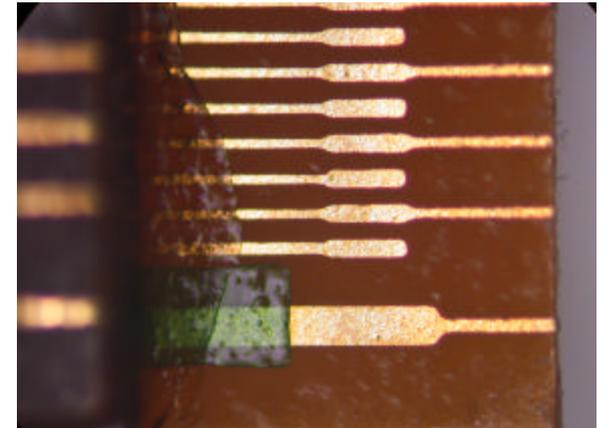


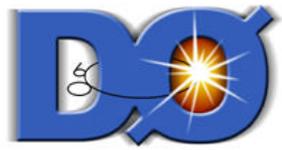


Cable assembly



- Dyconex laminated two full-size pairs of "lower grade" cables
- adhesive was applied only underneath bonding pad area
- small spots of squeezed out adhesive visible
- cable offset 1.1 mm on each side

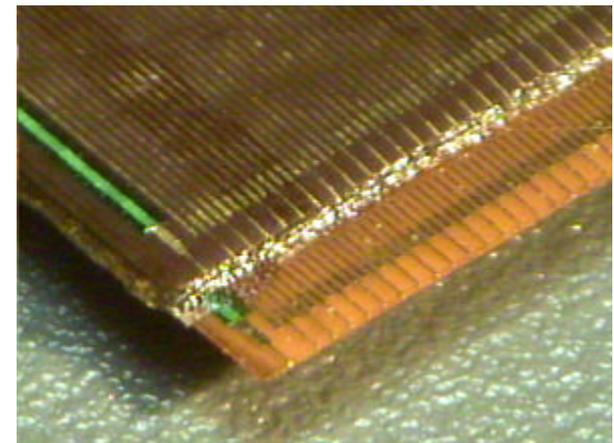
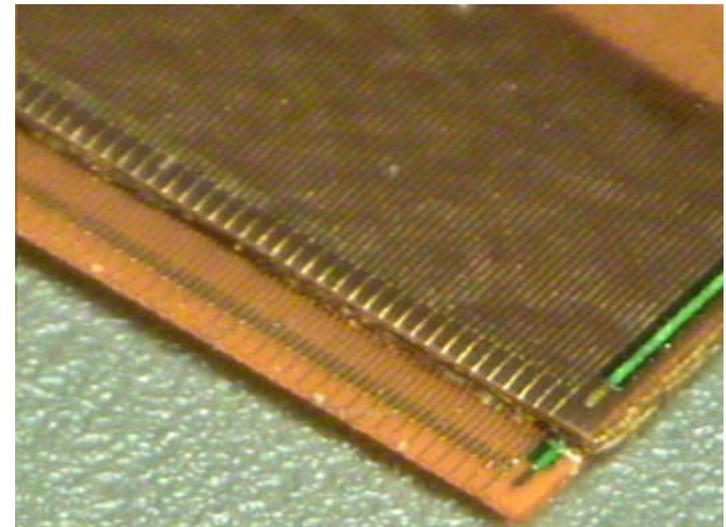


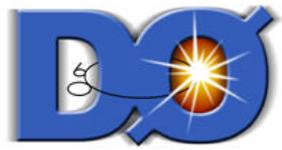


Cable assembly



- rough thickness measurement: ~ 0.31 mm
- decomposition:
 - 2 x 50 μ m cables
 - 2 x 75 μ m mesh
 - 2 x 30 μ m layers glue
- other samples with only one mesh expected soon

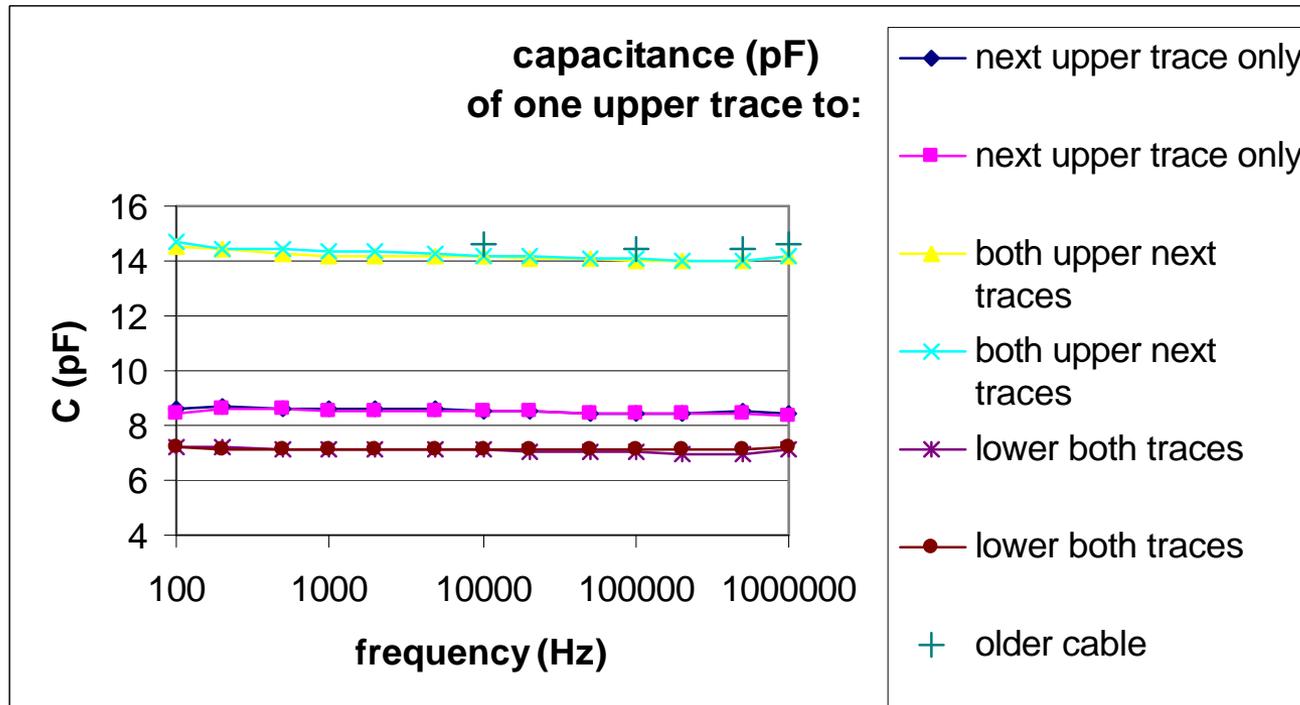




Short look at capacitances of cable assembly

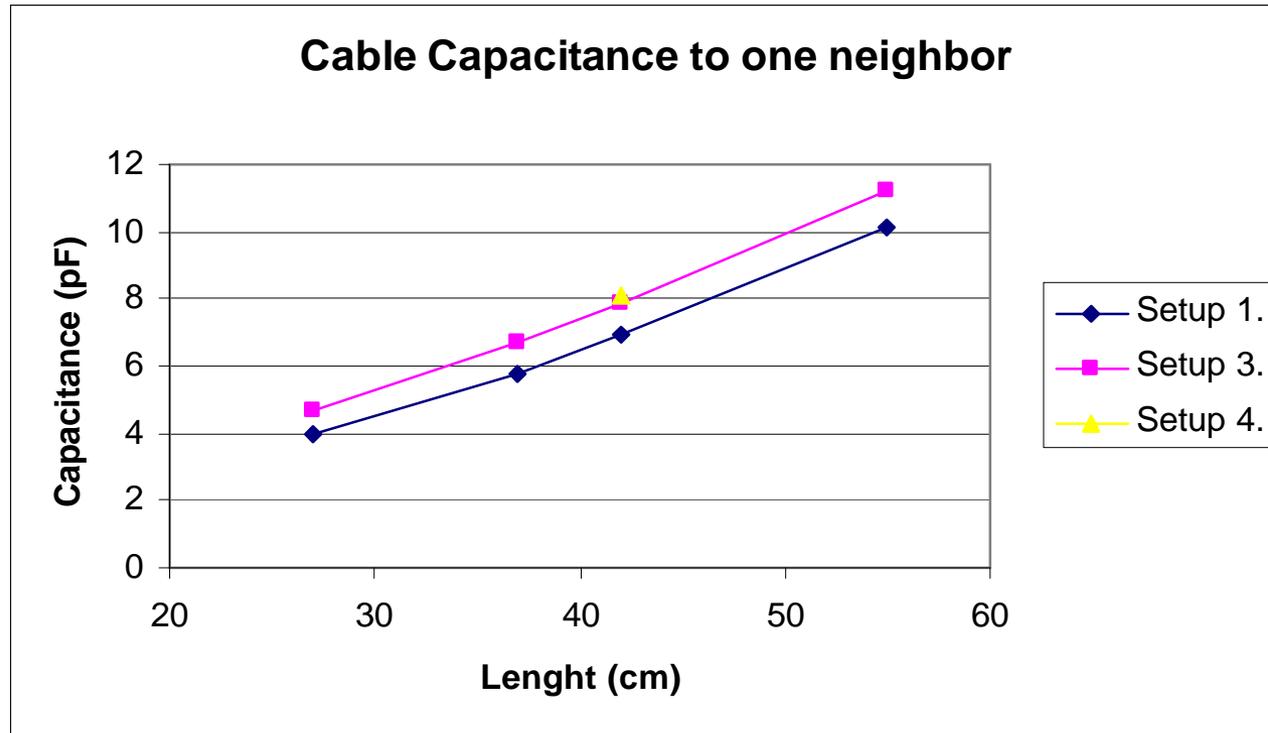


- 0.34 pF/cm averaged to both neighbors
- add 0.17 pF/cm to lower cable
- total cap: 0.51 pF/cm for cable stack plus ~10% for higher orders
- ANSYS calculation by Kazu: 0.47 pF/cm for 200um spacer with dielectric constant of 2.0 (we have ~2.5)

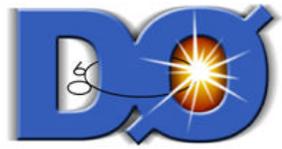




Capacitance as function of length



- measurement on a 55 cm long cable
- red line shows cap to next neighbor + further next neighbor



Other issues



- Information to solder mask on HV and GND trace:
 - WPS 80 from Multiline International
 - Photo-imagable covercoat
 - dielectric constant: $\sim 3.5 @ 1 \text{ MHz}$
 - dielectric strength: 3 kV/mil
 - actual thickness $\sim 10 \mu\text{m}$
 - tested HV trace up to $500 \text{ V @ } 1\text{-}2 \text{ mA}$
- glue for lamination:
 - Pyralux LF adhesive sheets from Dupont
 - acrylic adhesive
- we have to irradiate a short cable assembly sample
 - at KSU?



Conclusions + prospects



- 40 S1-A,B and S2-A,B analog cables in hand
- excellent quality, no open trace visible
- jogged design caused no problem
- metrology results match requirements well
- Dyconex has cable production well under control
- first prototype of two laminated cable pairs produced
 - lamination process and gluing well controlled
 - have to start bonding tests on these assemblies
 - expecting two more samples with smaller mesh thickness
- production of cables:
 - Anticipated production time: 2-3 month
 - Dyconex' proposal: we should send one tech to the company
 - tech will be trained there and will work on the lamination of the cables under the supervision of Dyconex engineers
 - cuts down cost