Tracker Flex Cable Design Overview & Parlex Production

1 December 2004

Stanford Linear Accelerator Center
Stanford, CA
Flex cable schematic

- ~ one meter long
- Four layer, 0.030 thick
- Eight cables per tower
- Eight varieties
- Power, 1.25 watts
- LVDS signals
- 20 MHz clock
- Data daisy chained
Flex Cable Stack-up

- Over thickness is 0.030 inch
- All layers 1 oz copper
- 8 mil dielectric for 75 Ohm impedance
- Eight varieties

Layer 1
Layer 2
8 mils Kapton
Layer 3
Layer 4
Mechanical drawing of C4
Design Challenges

- Long four layer
- Registration for drilling
- Thickness due to impedance requirements
- Fabricated from 36 inch panels.
  - Only one cable fits on a panel for a few of the cable designs
- Crosses several interface boundaries, DAQ, CAL, Grid, Tracker
  - Tolerance stack-up issues
Photos of two sides of LAT tower

- TEM Calorimeter
- Tracker
- MCMs
- Flex Cables
Parlex Fabrication & Assembly Schedules

- Two Qualification cables due ~ July 2004
- First articles of two complete sets, (16 cables), due ~ Aug 2004
- Cable fabrication is currently stopped
  - Coupon failures
  - Debris inside cable
  - Lifted traces
- Cable assemble currently stopped
  - Damage to connectors
  - Connector adhesive issues
  - Packaging and handling issues
Cable Fabrication Issues

- Sample NCR

| 00152 | C4, C5 & C6 flex cables | 011, 013, 37, 39, 11, 16 | IS: Coupons had several separations between barrel plating and internal layers, SN 011 also had several internal annular rings missing. S/B: specification does not allow for any separations between the conductive layers, or missing annular rings.


Per GSFC Report EC-- 40514: Coupon: S/N 37-39 failed [see Attachment 2]. These coupons represent C6 flex cable S/N 002, LAT-DS-00728, rev.6, DLC 0427. Cable is in Italy. (R. Gobin 8-34-2004)

Per GSFC Report EC 40516: Coupons: S/N 11, & 16 failed. SN 011 had several internal annular rings missing [see Attachment 3]. These coupons represent C4 flex cables S/N's 001, & 003, LAT-DS-00726, rev.6, DC's 0426, 0427. Cables are in Italy. (bj 8-26-04)
Pre Processing Issues

- Micro sections of preprocessing via failures
# Preprocess cable status

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- Pucks
- Coupons
Pre/Post Processing

- Change in processing
  - Replacing drills more often
  - Increased etch back
- Results
  - Still poor yields
Post Processing Issues

- Micro sections of post processing via failures
Post Processing Actions

- In Process Issues Not understood
  - Parlex chemical supplier brought in
    - No significant issues found
      - Suggested to Run a tin plating
        » Parlex finished this and sent coupons to Goddard
  - Parlex coupon results is not consistent with Goddard’s coupons
    - Third party coupon testing was consistent with Goddard’s
  - Action Item
    - Change coupon processing at Parlex to include additional polishing step.
      - Purchase additional polishing material – On order
      - Rent a scope – Still not done
  - Goddard is to train Parlex on Goddard’s process. Hopefully next week.
Post Processing Actions (Cont)

- Hire a consultant
  - Two of mine rejected.
  - The Goddard consultant rejected.
  - Still looking
- Make four in process coupons
  - After Drill, no plasma
  - After plasma no micro etch
  - After micro etch no deposition
  - After deposition
- Samples sent to Goddard today
  - Goddard equipment is done
- Daily meeting with Parlex representative to status action items
- Found debris inside flex cable
  - Parlex QA is working on this
## Post Process Cable Status

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Cable Assembly Issues & Actions

- Connector damage
  - No connector savers on test fixture.
    - Sent cable pig tails to Parlex to repair tester
    - Sent connector savers to use with test fixture
    - Started a mate log
    - Instructed Parlex on proper inspection of mating connectors
  - No connector covers for protection during assembly and shipment.
    - Sent first batch of covers to Parlex
- Improper shipping
  - Instructed Parlex of proper shipping methods.
    - Use connector protectors
- Connector damage
  - Instructed Parlex on proper handling of parts
Summary (1)

- Parlex is slow on meeting action items
  - Not enough manpower
  - Other customers such as the military is diverting resources
  - We were to get dedicated help and didn’t
- Daily meeting is helping.
- No solid solution to the fabrication
  - Still looking for an acceptable consultant
    - Parlex is now looking into a competing chemical vendor for help
  - Goddard SEM & FTIR results shows no smoking gun
  - In process coupons just sent to Goddard may show something
  - There remains a cleanliness issue that is being looked into
- Assembly is converging, slowly
  - Test station is to be fixed this week
  - Connector will be covered
  - Rework procedures are being addressed
  - Shipping & handling is being addressed
Corrective Action Plan SLAC (1)

SLAC

Revise SOW to reflect in process inspection to be performed prior to any encapsulation, Flex PWB MIL-P-50884, FM 73 adhesive film to be bubble free. (Dave Nelson) 11-15-04 Closed Rev2

***** Review REV3 with Parlex (Dave Nelson) 11-19-04

Redline flex drawings to list MIL-P-50884, FM adhesive film to be bubble free. * redline resistor, thermistor measurement, Submit drawings to Parlex for review. (Dave Nelson / Dave Rich) 11-23-04

Provide Parlex a revised SOW rev 2 (Dave Nelson) Closed

Provide Parlex connector saver (Dave Rich) 11-10-04 Closed

Submit NCR’s to Parlex (Esther Rodriguez) 11-09-04 Closed

Provide Parlex Fax No. for submittal of PMR/QCMR’s

(Esther Rodriguez) 11-09-04 Closed

Review and approve Parlex’s Qual Procedure. (Frank Golden/ Esther Rodriguez) 11-30-04
Corrective Action Plan SLAC (2)

- Review and approve Parlex’s Qual Procedure. (Frank Golden/ Esther Rodriguez) 11-30-04
- RTV 18 flex cables with anomalies Pending MRB 11-08-04
- Placed product on hold
- Review contract for packaging material / who supplies material customer or vendor (Esther Rodriguez) 11-09-04 Closed
- Provide Parlex with a contact list (Esther / Daren) 11-12-04
- Red line drawing LAT-DS-03040 to list FM73 adhesive material. Pending Parlex to determine what die will be selected for build. (Dave Nelson)
- Confirm Sets of cables required for build 19 or 21 sets (Dave Nelson / Dave Rich) 11-23-04
- Provide Parlex a Mate and Demate Form (Esther) 11-24-04
- Perform a physical count on flex kit. (Esther) 11-16-04 Closed
- SLAC to provide (test fixture) 18” pig tails to Parlex. (Dave Rich)
- SLAC to purchase custom ESD bags and send to Parlex for shipment of the flex cables. (Dave Nelson)
Corrective Action Plan Parlex (1)

- Parlex

- Rework the 18 flexes cables. – LAT QA to hold MRB (rejected from LAT QA)
- Placed product on hold
- Parlex to submit rework traveler for review of remove and replacement of connectors

Closed
- Redline the appropriate documentation to incorporate connector savers. 12-03-04
- Inspection process before and after test when mate and demate occurs.
- No date given / Parlex requested Mate and Demate form from SLAC then will implement step into their traveler.
  - Parlex to confirm their mate and demate process as to who will be performing this function. (tech / QA)
- Review test fixture of cleanliness. Results of inspection 3 connector savers pins were found to have damage.
  - Parlex to remove and replace the damaged pig tails on the test fixture. Parlex indicated that they would use the connector savers that were shipped by (SLAC) on 11-10-04. Parlex to confirm date as to when this repair has been completed
  - Parlex to remove and replace the remaining pig tails (pending SLAC to provide)
Corrective Action Plan Parlex (2)

- Special handling procedures for omnetics connectors, to be implemented from incoming inspection through shipment. 11-19-04
- Adhesive between pins of the omnetics connectors review adhesive (FM 73) process. 11-11-04
- Develop process for bubble free adhesive and incorporate Die cut in place of routing. 11-11-04
  - Parlex is not to change the adhesive material (FM 73) (Eloy/Steve Kenny)
  - Parlex to confirm heat temperature of the inside of the flex tool fixture
  - Parlex to purchase several dies 12-13-04
  - Parlex to perform a Lap shear test on a number of test samples to confirm the strength of the bond. (Frank Golden) to contact their other facility if they have a lap shear machine.
- Material handling /lifted conductors prior to overcoat operation /review process.
- 11-24-04 (requesting corrective action)
- Formal request for review of defects (QCMRS) with in 24 hrs / up date travelers.
- 11-12-04 Closed
- Material traceability by assembly lot. All materials solder, potting, conformal coat and epoxy / up date traveler and add to test report. 11-12-04 Closed
- Assembly to provide lot traceability. 11-12-04 Closed
- Review packaging of cables. Parlex indicated that QA will be packaging the flex cables for shipment. Requesting Traveler change or packaging procedure that indicates QA
- Document rework procedure for retest of flex cables. 11-19-04 Closed
Corrective Action Plan Parlex (3)

- SEM analysis of possible acrylic separation. 11-10-04 Parlex is not performing a Sem Analysis Closed
- Review and evaluate the polishing process from Goddard (critical) 11-11-04
  - QA Supervisor Nancy Snow to receive and review polishing procedure  Closed
  - Generate P.O. to purchase Grit and other materials required
  - Scope Rental/ or purchase
  - Training personnel at Parlex by GSFC
- Parlex will physically mark the coupons as to where the locations of the coupons were physically located on the board. 11-11-04 Closed
- Perplex to confirm as to what holes are exhibited in the micro-sections, VIA or Connector. Parlex to fax document that indicates what holes will be used for micro-sections. 11-23-04
- Parlex to submit additional micro-section samples of scrap lots to GSFC for inspection. 11-16-04, SLAC additional samples shipped on 11-23-04
- To review chemical bath, Micro-etch process, contact chemical supplier of any changes in the chem. (critical) 11-19-04
  - Consultant
- To provide Cause and Corrective action concerning the NCR anomalies 11-19-04
- Flow chart or traveler of the micro-section build (critical)  Closed
- Parlex to ship adhesive material FL01 (DuPont) to GSFC for evaluation Closed
- Parlex to send samples of micro sections to GSFC Plasma etch, Micro etch, as drill, electro copper. 11-24-04
- What type of adhesive used for bonding of the connector stiffener (cristek / J1)
- Flex cables exhibited foreign debris in the internal layers of the build. Requesting corrective action
Corrective Action Plan Goddard (1)

- **GSFC**
  - GSFC will perform a SEM test on cross-section s/n 58-60
  - SEM results will be sent to Parlex (11-08-04) Closed
  - GSFC to return micro-section back to Parlex Closed
  - GSFC will perform a barrel separation to detect as to why the material separation
  - Results will be sent to Parlex
    - Pending material sample from Parlex / GSFC received material samples
  - GSFC will perform additional inspection on micro-sections that are from scrap lots. Parlex / SLAC to submit samples, SLAC additional samples shipped out on 11-24-04
  - GSFC will check at their facility if they might possibly have a spar microscope to lend Parlex to help with the in process inspection of the micro-sections. If not they would provide the microscope model no. and manufactures name in order for Parlex to purchase one. (11-08-04) Closed
  - Review Qual procedure Closed