Monthly Technical / Cost / Schedule Review
GLAST LAT Tracker
October 2003

October 29, 2003

R.P. Johnson

Santa Cruz Institute for Particle Physics

University of California at Santa Cruz

Outline

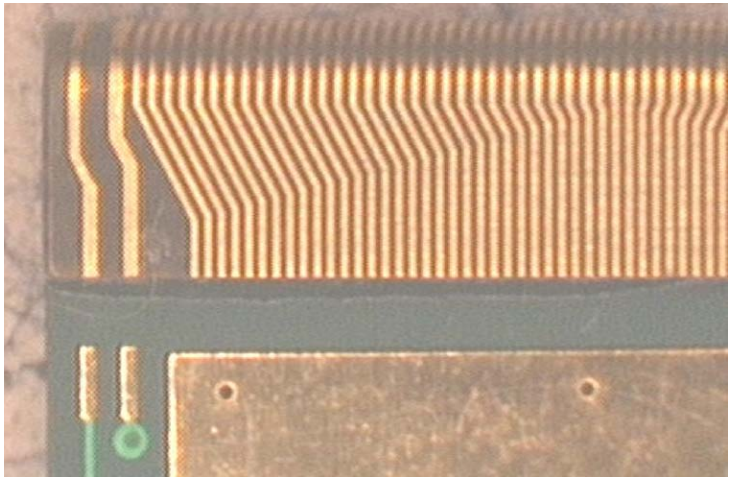
- Last Month's Accomplishments
- Summary of issues & concerns
- Open issues
- Status of Subsystem's Parts List & qualification program
- Key Milestones for next 3 months
- Cost and Schedule status

October Accomplishments

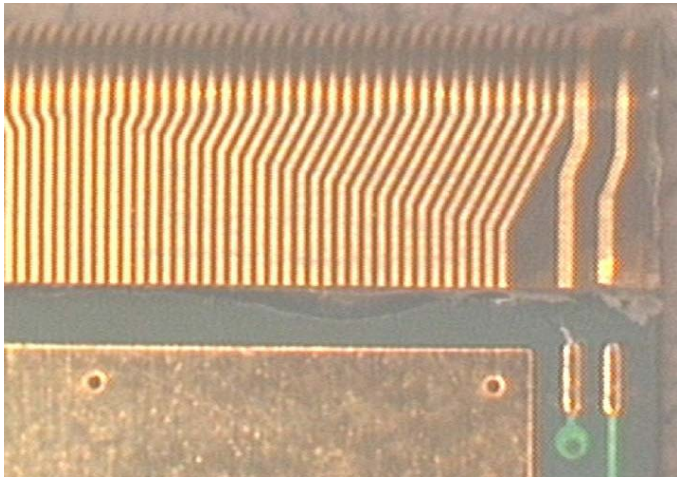
- **ASIC procurement**
  - Was complete until the GTRC problems surfaced…
  - Tracker supported the GTRC design update by
    - Testing the new VHDL code in FPGAs both with the TEM and with a stand-alone system that executed the full GTRC wafer-probing test-vector set, including a new test that detects the TOT time-out problem in the V6 chip.
    - Testing FIB modified GTRC V6 chips on MCMs. Tests resolution of timing issues.
  - Studied margins of the existing GTRC over frequency, temperature and voltage.
  - Electronics group has understood in detail the delays in the existing design, from transistor-level simulation of layout-extracted netlists.
  - Electronics group has fixed and verified the GTRC design:
    - New core logic corrects the TOT-induced timeout bug. Tested in simulation and in FPGAs.
    - New core logic corrects the GTRC-to-GTRC timing problems by removing clock inverters that made the data output on the falling clock edge. Tested by simulation, by FPGA, and by FIB modification of existing chips.
    - No design changes outside of the logic core.

October Accomplishments

- **MCM Front-End Electronics**
  - Implemented machining of the PWB radius at a commercial shop, with good results, and updated the PWB drawings accordingly.
  - Finalized the MCM assembly drawings and BOM (out for release).
  - All parts for the preproduction are at Teledyne, as are the drawings.
  - Reworked the SOW with comments from N. Virmani and Teledyne.
  - Teledyne improved the fixtures and processes for flex trimming.
  - Teledyne made new fixtures for wire-bond protection during handling and testing pre-encapsulation and for screening of solder paste.
  - Preproduction is starting today…

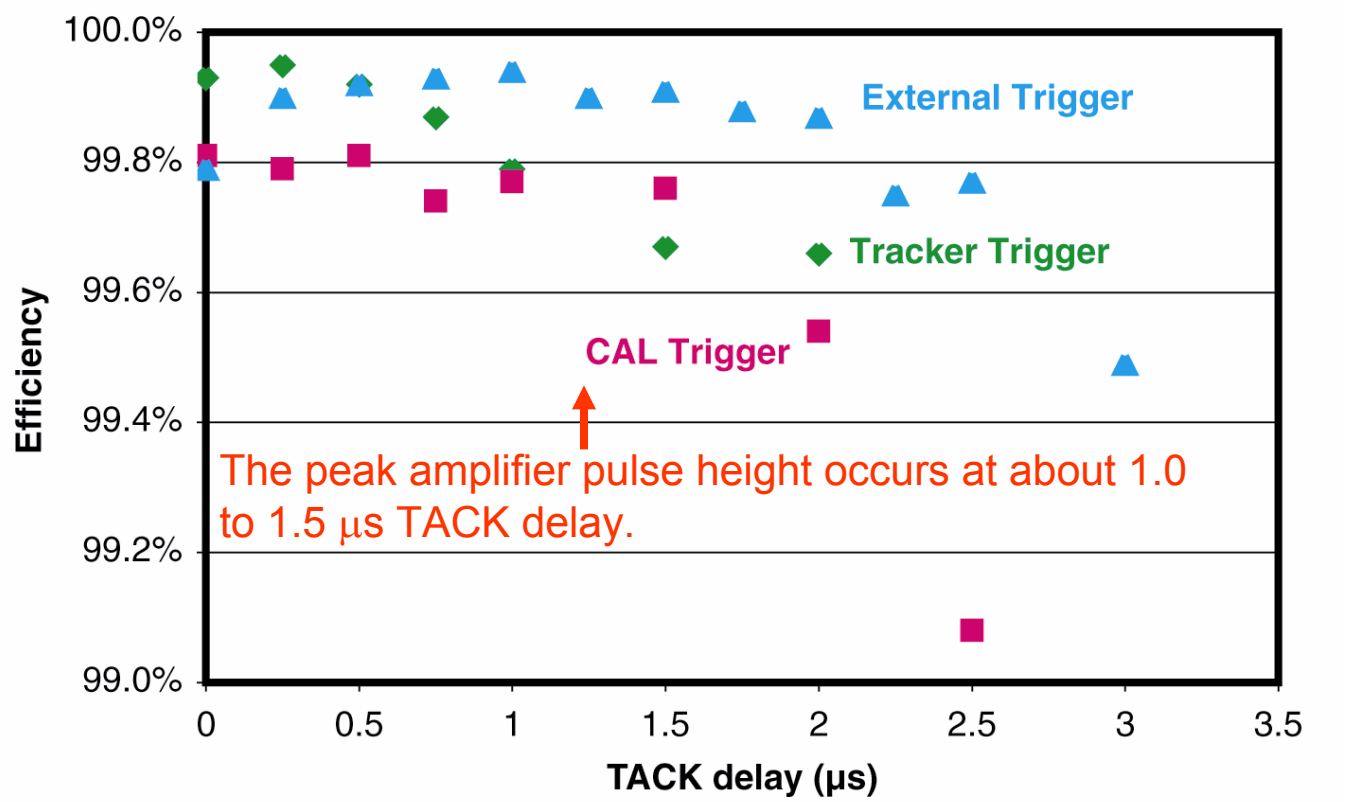


Example of flex-attach bonding and trimming.



October Accomplishments

- **Mini-Tracker Tower**
  - Continued testing, with detailed results on Tracker hit efficiency.
  - Began weekly working meeting to coordinate further development of test scripts for Tracker tower and stacked-tray testing.



October Accomplishments

- **Flex-circuit cables**
  - Review of the interface issues and mechanical design was held yesterday.
  - Mechanical layouts are being finalized.
  - Work is proceeding on updating the electrical layout and preparing for a PRR.
  - Still working the Flex-Circuit Cable Assembly SOW.
  - Fabricating a printed circuit to act as an interface between a cable and the electronic cable-tester.
  - Drawings are in good shape but still in the review and release cycle.
- **EM Tower environmental tests**
  - Updated the vibration test plan, including model predictions. Test Readiness Review next week.
  - Thermal-Vacuum test plan is being worked at SLAC and in Italy.

October Accomplishments

Sidewalls

- Production of EM sidewalls is on track for the November vibration test.
- Sidewalls and coupons are being assembled at COI (San Diego) and Plyform (Milan).
- COI has already tested coupons in tension, compression, and short-beam shear, with acceptable results.
- COI will be the first to assemble short sidewalls for the static-test fixture, so those will be used starting next week to repeat the bottom-tray static test with K13D sidewalls prior to the EM tower vibration testing. Plyform short sidewalls will be used later to repeat the static tests.
- We plan to use Plyform full-size sidewalls for assembly of the EM tower for environmental testing.

Flexure Qualification

- Hytec completed a suite of bottom-tray static tests designed to take the flexures to qualification levels according to the CLA predictions.
- The loads were taken 5% above qual levels with no problems found.

October Accomplishments

- **Tray panel fabrication**
  - First lot of mid-tray closeout machining (40 parts) was completed.
  - Fixtures are ready for mid trays.
  - The bottom tray panel assembly fixtures are being reworked and improved, including changes to allow flexures to be assembled into corner brackets prior to assembly (G&A fixtures for integration of ladders and MCMs are also being redesigned to allow bottom trays to be handled with flexures installed.)
  - Bias circuit order was worked with Parlex but presently held up with cost issues related to procurement of ¼-oz copper.
  - Working toward a November 17 start date for panel assembly. A follow-up PRR is needed for final closeout of issues that remained from the PRR held at Plyform.
  - Bottom tray closeouts material is ready at COI, but production of parts awaits release of the drawings.
- **Flexures, corner brackets, thermal straps**
  - Working drawing release to prepare for procurement of flight parts.
- **Tower shipping container and vibration fixtures**

Issues and Concerns

GTRC ASIC

- Use of the present V6 chip would mean
  - No TOT, unless implemented in the TEM Cable-Controller ASIC (under test).
  - Running the LAT at no higher frequency than 16 MHz. Even this may be optimistic, with 14 MHz a safer bet. See my presentation from last Thursday's meeting (Tracker web page).
- A new submission is being made this week for V7, which will repair both of these problems. Most likely we will also submit a parallel "hand-edit" chip (V6-b) that will implement only the timing correction, as a backup.
- Schedule impacts:
  - We have to do the MCM preproduction, qual-level testing, new mini-tower trays, and trays for environmental testing with the existing V6 chip. Qual testing and radiation testing will have to be repeated with the V7 chips.
  - If the V7 chips are available tested and diced, as expected, by the end of January, the impact on the Tower-A schedule may be only a couple of weeks.
  - Introduction of the V7 chips into the MCM flight production at that point will be somewhat at risk of potential new problems found during thorough functional, qual, and radiation testing. I think that this risk is low, however.

Issues and Concerns

- **Difficulties in starting the MCM assembly line**
  - We are finally ready to start the preproduction, as of today.
  - We are waiting for a Teledyne production manager to return to firm up a schedule for completion of the preproduction, but the target is mid December. 6 MCMs will go to the front line and serve as pathfinders for each process step prior to committing the remaining 44. SLAC will closely monitor the quality after each process, especially the flex-attach.
  - There still is a concern that the dimensional tolerance of the flex attach at Teledyne cannot meet what G&A would like to have for optimal wire bonding efficiency and quality at their end. G&A is starting development work on a different fixturing and bonding method that may replace the Teledyne method.
  - David Rich will continue to concentrate on preparation of the PRR needed prior to the flight production. Having him available to concentrate on this has made a huge difference in getting the ball rolling.
  - Our QA survey this Monday fell through due to airline problems and will be rescheduled.

Issues and Concerns

- **Drawings and Document Release**
  - Our design manpower is getting overwhelmed with the large number of drawings getting completed and edited at this time. This is the limiting factor in the schedule of a number of items, such as the flex-circuit cables.
  - We are all getting overwhelmed with the large number of drawings out for review. Release closure is seemingly impossible in many cases, so the number of drawings in the release cycle continually increases.
    - Ideally the Tracker should probably have a dedicated person to organize and monitor all of the Tracker drawings and documents.
    - The signature loop is often too broad and not thought out (signatures of people who don't have time to study so many drawings is detail aren't useful).
    - Dedicated meetings to focus on release of particular drawings or sets of drawings could be useful, but we generally lack manpower to organize this, there are geographical difficulties, and it isn't useful unless everybody in the signature loop attends (otherwise the drawing is still held hostage by those who didn't attend).

EEE Parts List and Qualification Plan

- **ASICs**
  - Wafer probing, lapping, dicing, wafer inspection all approved and completed.
  - But this all has to be repeated with the V7 GTRC.
  - Qualification plan (MCM level) is in the works, based on a flow-chart by N. Virmani.
- **PWB**
  - Spec, drawing, and procurement approved.
  - Flight boards are in production. Coupons need to be evaluated by GSFC.
  - Documentation of the post machining step still needs final approval and release.
  - Qualification testing is done at the assembled MCM level.
- **Pitch-Adapter Flex**
  - Drawings and specifications are approved.
  - Flight production is in progress.
  - Qualification testing is done at the MCM level.
- **Nano Connectors**
  - Still need approval of a qualification sample.
  - MCM preproduction is proceeding with connectors already delivered.
- **Micro-D Connectors**
  - Approved. Qualification testing to be done at GSFC.

EEE Parts List and Qualification Plan

- **SMT Parts**
  - All are approved and in hand.
  - A set of polyswitches are being retested by the manufacturer to correct their previous error in implementation of the test procedure.
- **Bias-Circuit Flex**
  - Drawings and specifications are approved.
  - Flight production needs to start ASAP.
  - Qualification testing is done at the tray level.
- **Flex-Circuit Cables**
  - Spec is approved but being updated (layer stack-up). It includes specification of the qualification testing.
  - Drawings are nearing readiness of review and release.
  - The SOW is still hung up in the release cycle.

Mechanical Parts & Materials

- **Materials needing final approval, awaiting out-gassing tests of samples:**
  - Carbon-Carbon for tray closeouts (manufactured by Alcomp). All flight material is in hand.
  - M55J carbon-composite for bottom-tray closeouts.

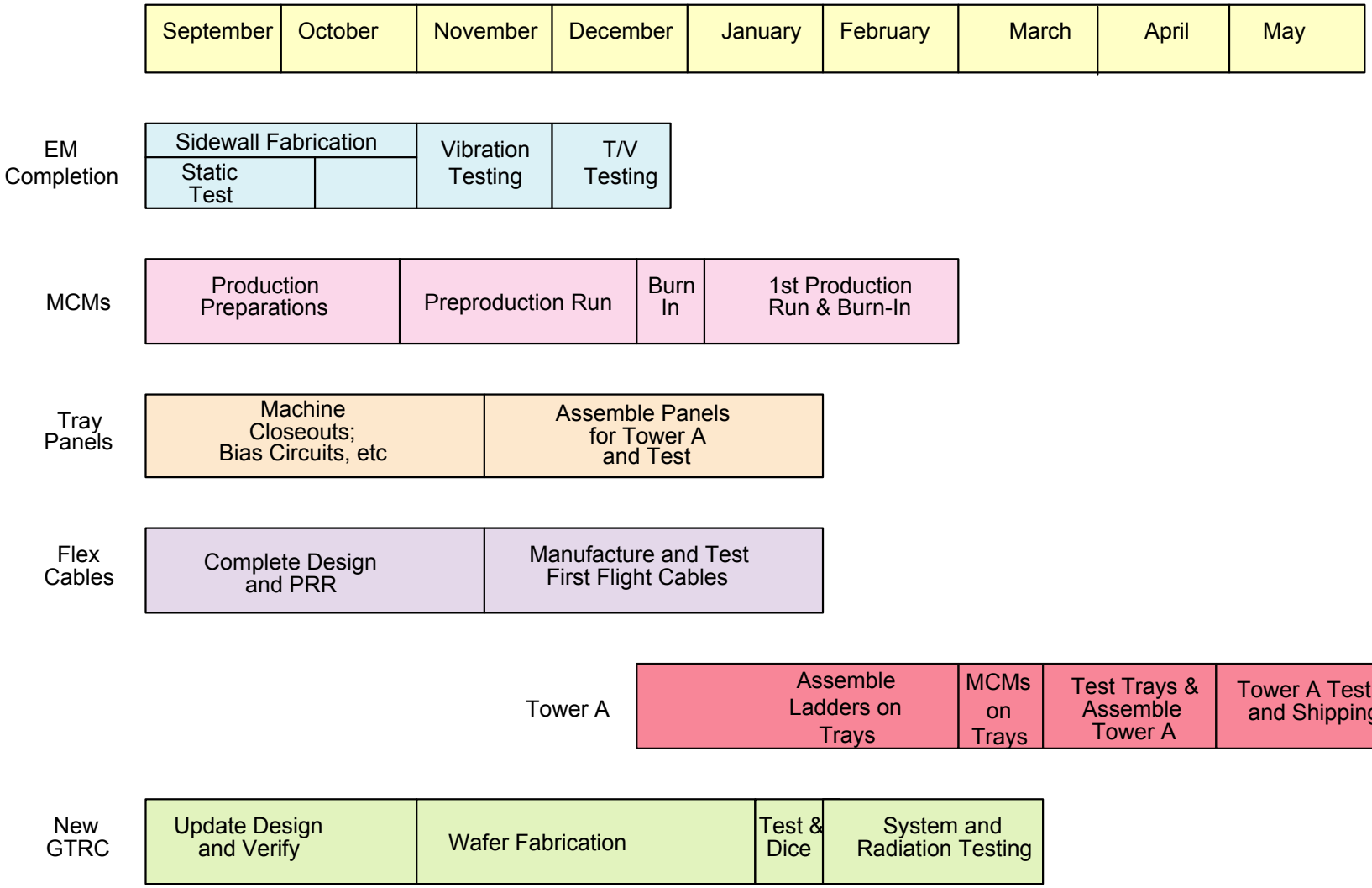
Open Issues

- **MCM Burn-in requirement**
  - Polyswitches are not allowed to go above 85°C for extended periods of time.
  - Significant extension of the burn-in time beyond 168 hours would impact the Tracker schedule or else would require significant investment in a second burn-in station.

Tracker Near-Term Milestones

Milestone Description	Original Date	Current Date	Major Reqmnts to Achieve Milestone	Notes
Static Test Bottom Tray	07/25/03	12/20/03	Fabrication of short sidewalls in K13D material, followed by repeat of the static test using those sidewalls, both from COI and Plyform.	Bottom tray qualification tests completed. Flexure qualification tests completed.
Vibration and T/V Test of EM Tower	08/01/03	12/20/03	Fabricate conforming sidewalls. Static test of a bottom tray with K13d mini sidewalls. Completion of coupon tests, including fastener pullout tests.	Prepreg has been procured. Drawings are updated. Work on sidewalls is starting. Vibration test in November, T/V in December.
AV: Delv of TKR EM to SLAC I&T/MGSE	08/22/03	01/02/04	Complete vibration and T/V testing. Ship to SLAC.	
Deliver 36 MCMs and 8 flex cables to electronics	09/15/03	09/15/03	We have provided the MCM and burn-in cable parts to the electronics group. We are helping them with testing and debugging, but it is their schedule now to complete these	9 are completed and 33 more are in progress.
Composite tray panels assembled for tower A	09/30/03	12/16/03	Bias circuits. Drawing review & release. Closure of PRR action items	Machining of closeouts in progress. Still need to complete drawing release and a closure PRR. Panel assembly will start 11/17/03
Top and Bottom tray panel assembled for tower A	01/31/04	01/31/04	Drawing completion and release. Procure flexures, corner brackets, thermal straps. Procure bottom-tray closeouts from COI. Complete new assembly fixtures.	In progress. Need to concentrate on making flight-qual bottom-tray closeouts.
Start flex-circuit cable production	09/30/03	11/20/03	Complete design. PRR	Design review completed. Need to complete drawings and hold PRR still. SOW still not released.
Start flight sidewall production	10/15/03	01/05/04	Successful completion of EM sidewalls and coupon tests. Completion of EM T/V testing. Order material in advance.	EM sidewall production is looking good at this point.
Start the MCM preproduction run	09/30/03	10/29/03	Complete	The preproduction has begun. The preproduction review was held at Teledyne this Monday.
Deliver 1st lot of flight MCMs to Italy	10/29/03	02/28/04	Completion, burn-in, and test of the preproduction lot. Completion of the PRR. New GTRC chips.	New date is an estimate assuming use of new V7 GTRC chips.

Near Term Schedule Summary



Schedule Variance Report

- Schedule variance: -$186k for September
  - **Scheduled MCM production start did not happen, per baseline schedule, accounting of the majority of the negative variance.**
- Schedule variance: –$793k total accumulated
  - **Delays in starting MCM production**
  - **Delays in starting flex-circuit production**

Cost Variance Report

- Cost variance: -$368K for September
  - **-$33.8k for electronics test engineer and staff engineer**
  - **-$238k flight tower design, materials (Carbon-Carbon) and inspection effort**
  - **-$21.7k for grinding and dicing of ASICs**
  - **-$98.6k for Electronic Parts, inspection**
  - **-$6.0k misc small variances in labor**
- Cost variance total: –$715K
  - **Cost variance due to backlog of CCB actions that need to be done for many of the items above**