



*LAT Monthly
Technical Review
January 2004*

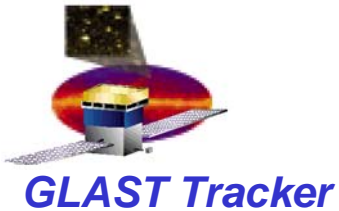
**Monthly Technical / Cost / Schedule Review
GLAST LAT Tracker
January 2004**

February 25, 2004

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Santa Cruz Institute for Particle Physics

University of California at Santa Cruz



Accomplishments & Status

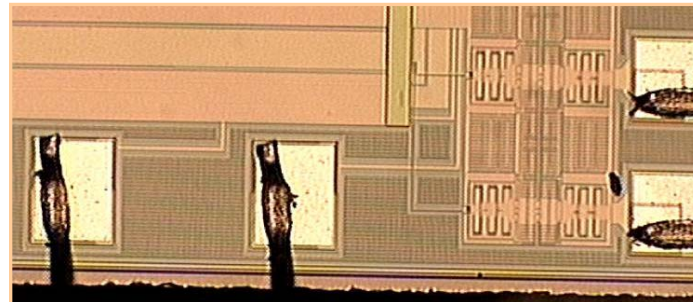
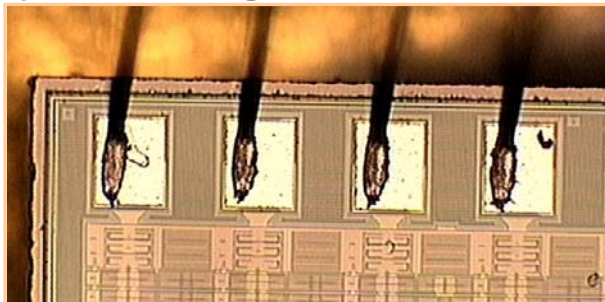
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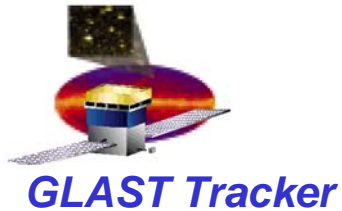
□ MCM Front-End Electronics

- MCM preproduction continued, but the last sets of boards were delayed to make sure that we could incorporate all process changes and the GTRC-V7 chips into some of the preproduction. The last 10 boards are in assembly now with V7 chips (pre-encapsulation testing today and tomorrow).
- 28 preproduction boards have passed all the way through burn-in and final test. 10 are in Italy, 10 more are shipping to Italy, and 5 are undergoing 200 thermal cycles (as part of the qualification program).
- The MCM PRR was completed on February 10. Since then we have been taking care of several actions to get flight production started:
 - Get all SLAC furnished materials to Teledyne to kit the first lot. They were shipped last Friday, including
 - New Omnetics connectors.
 - Machined PWBs from panels with coupon tests completed and passed.
 - Revise the wire bonding program at Teledyne. Done; see next slide.
 - Incorporate epoxy degassing into the process. In progress.
 - Update and release the procedure documents. Done.
 - Vacuum test some preproduction MCMs. Done.
 - Finalize the purchase order. In progress. *Need help to expedite!*

MCM Die Rework

- ❑ **With 26 ICs and >3000 wire bonds on one MCM it is impractical to eliminate occasional rework of chips and wire bonds prior to encapsulation.**
 - If a die is bad, it is removed and replaced. This requires rebonding 8 wires to each of the neighboring chips.
 - If wire bonds fail or are damaged by handling, then new wire bonds have to be made.
- ❑ **Mil Spec requires that if the second bond is made on top of the foot of the previous, then it must overlap by at least 75%. If the previous foot is removed first, then the second bond must be at least 50% on new, undisturbed metal.**
- ❑ **Teledyne found that rebonding on top of the old foot could not reliably satisfy the Mil Spec.**
- ❑ **We decided to remove the old bond foot first. To satisfy the Mil Spec, Teledyne reprogrammed the first bond to be to one side of the pad.**





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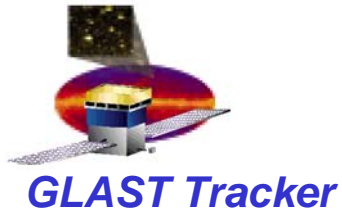
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□ **Flex-circuit cables**

- A lot of work on these designs was done in the past month.
- The first design, C0, is done, and an order has been placed for non-flight cables for EGSE.
- Mechanical layouts are ready for most of the other designs, and electrical layouts are being worked. SLAC is hiring a new designer to expedite this, while allowing the electronics group to continue their work.
- Issues are still being worked on those cables that stick above the top of the tower.

□ **Sidewalls**

- Ben Rodini worked with COI and YLA to define specifications for the prepreg.
- Plyform is using those specs and preparing to order prepreg.
- Drawings have been modified to put 25 microns on aluminum on both sides and to increase the countersinks to 120 degrees.
- EM coupons have been sent out for measurements of thermal conductivity.

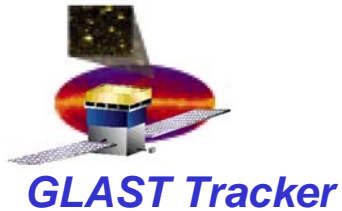


Accomplishments & Status

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□ Mid Tray Panel Production

- The Delta-PRR at Plyform went well, with no new action items.
- Procedures and drawings were finished and reviews completed, except that the assembly drawing is being revised to match better the actual procedure agreed to for installation of the ground connection to the core.
- The new aluminum cores arrived at Plyform and were received and inspected.
- Plyform has started tray panel production, with bare panels expected to start coming off the line at the end of February.
- LAT QA is at Plascore today inspecting new honeycomb cores.
- New problem: the bias circuits have to be remade.
 - The existing circuits were found to have a 0.25 mm shift between the wire bonding pads and the alignment holes.
 - We are also taking this as an opportunity to improve clearances between the ground pads and the SSDs and between all of the wire bonding pads and the tray edge.
 - We are scrambling to get the new circuits into Plyform's production flow without delaying them (the bias circuit is the last step in tray panel assembly).

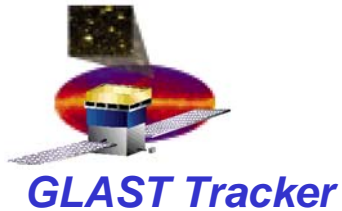


Accomplishments & Status

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□ Bottom Trays and Grid Interface

- Productive engineering meetings were held in Pisa, leading to agreement on all aspects of the interface design and assembly and finalization of most of the details in the interface drawings.
- Drawings for the titanium flexures and corner brackets went to SLAC purchasing last Friday. PDF files went out to 2 vendors Monday (lowest bidders in the previous RFQ), with responses requested by COB Wednesday. We will push to expedite the selection by Friday. Next week Martin Nordby will travel to the selected vendor.
- **Fabrication of the titanium parts needed in bottom-tray assembly is still the critical item in the Tower-A schedule.**
- Detailed drawings of the cones, studs, washers etc. for completion of the interface are being worked by Arthur Scholz.
- Closeout drawings are being finalized this week by Mike Foss, to allow COI to start machining the parts.
- Hytec completed and is documenting the stress analysis. Further analysis work will be done at SLAC by Mike Opie analysis. Hytec has agreed to supply the Tracker tower FEM to SLAC.
- A CR was approved this morning to cover this work, plus a lot of work still required to test and qualify the design.



Accomplishments & Status

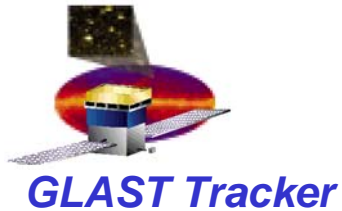
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□ EM Vibration Test

- The test last autumn nearly completed the validation of the Tracker structure.
- We need a new test primarily for the Tracker/Grid interface.
- This will be done using a new bottom tray, assembled in parallel to the Tower-A bottom tray, with the existing EM tower mounted on top.

□ EM Thermal Vacuum Test

- This is on track to be completed in March.
- The TRR will be held tomorrow.
- The EM tower and other equipment will move to Alenia Spazio March 1.
- The thermal balance test will commence March 8.
- All will be completed by the end of March.

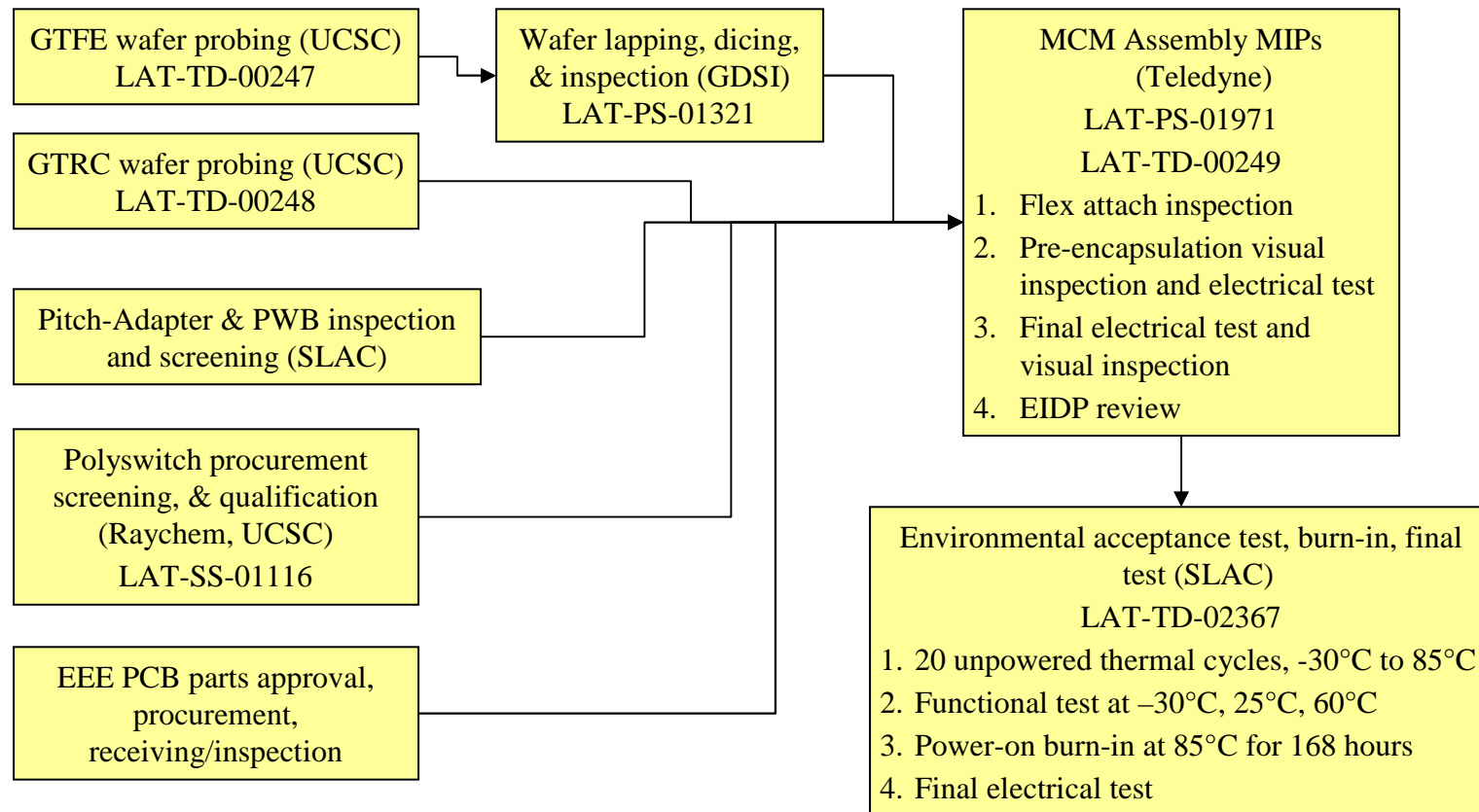


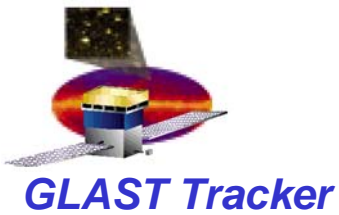
MCM/ASIC Qualification

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- ❑ **The plan is documented in LAT-TD-02366, presently under review for release. This plan follows the flow presented by Nick Virmani at CDR.**
- ❑ **20 preproduction MCMs, 10 with GTRC-V7 chips, will be used for qualification.**
- ❑ **These MCMs all pass through the complete flight screening and burn-in process prior to qualification testing.**
- ❑ **5 are already in the thermal chamber undergoing 200 cycles.**
- ❑ **Radiation testing has been completed, except for a repeat of the TID test on the GTRC-V7 chips.**

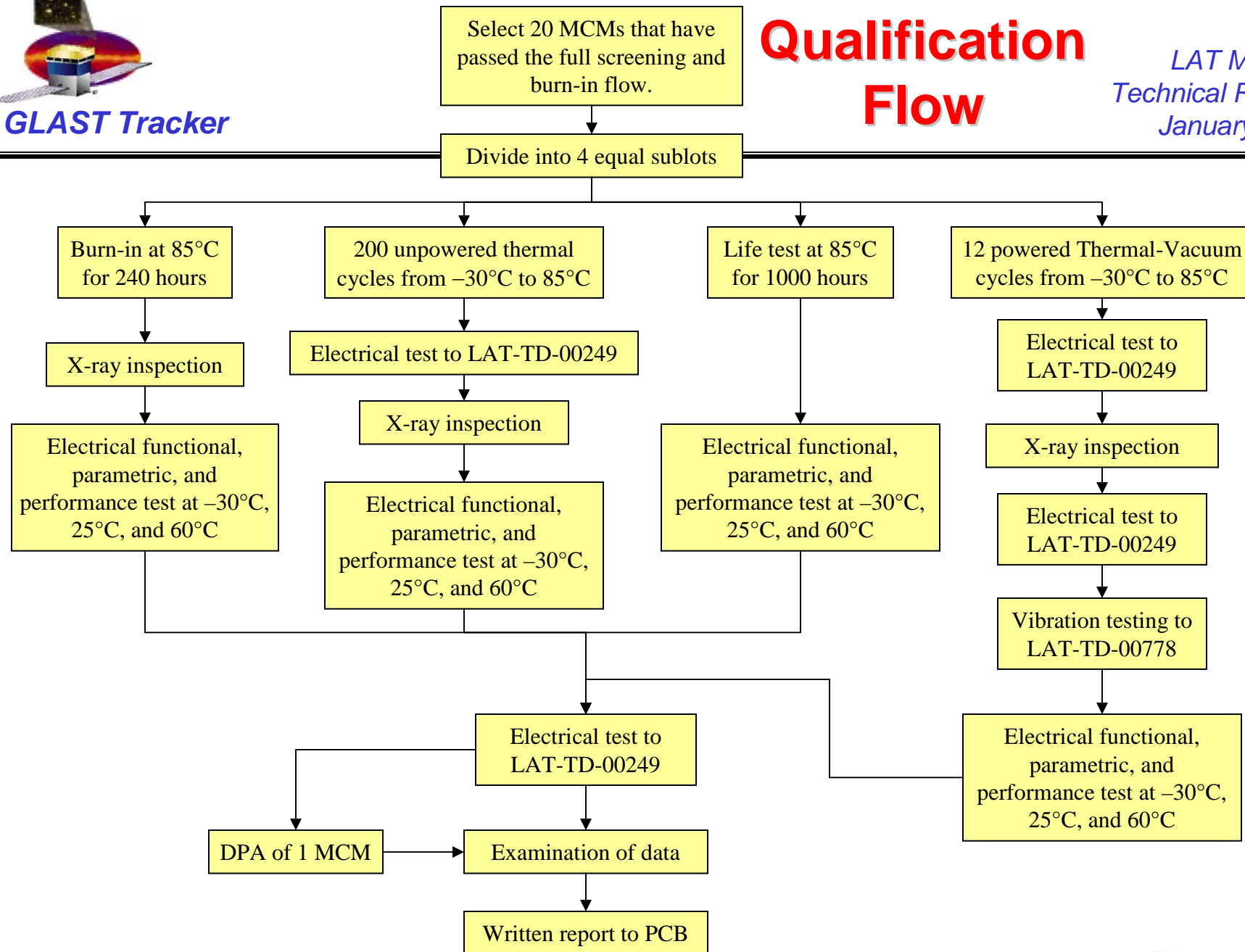
Screening flow followed for all flight and preproduction MCMs, including the qualification units.

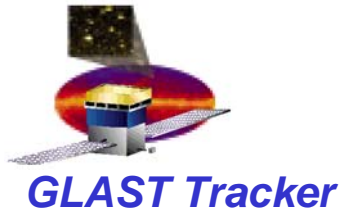




Qualification Flow

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Open Design Issues

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❑ **Tracker/Grid interface design issues**

- We still need vendor agreement on the details of the corner brackets and flexures. Martin Nordby will work this at the vendor next week.
- Detailed design of the cones, washers, nuts, and bolts for the interface is not yet mature.
- Bottom-tray closeout drawings are getting finalized this week.

❑ **Flex-Circuit Cable Design**

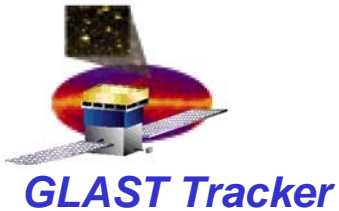
- We don't yet have 100% resolution on issues at the top of the Tracker on those cables that stick up and threaten the stay clear. The best choice may be to make them significantly longer and bend them over the top.
- The detailed drawings have to be finalized and reviewed.



Issues and Concerns

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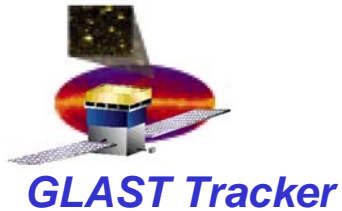
- ❑ Time for procurement of the titanium parts.
- ❑ Time for procurement of new bias circuits.
- ❑ Late validation of the Tracker-Grid interface. We will be taking a risk here as we proceed with tower fabrication.
- ❑ Late MCM/ASIC qualification overlapping flight production. Testing done to date (thermal and vacuum) suggests that we don't need to be too concerned here.
- ❑ MCM assembly cost: negotiations are in progress to reduce some charges, such as the cost for supporting our source inspector, but the total is looking \$200k to \$300k over budget.
- ❑ Documentation of Italian processes. In general their preparedness for doing the work is far ahead of the LAT documentation. Risk of delays trying to get through the PRRs. The newly hired QA person in Pisa is already working hard on this.



Tracker Drawings

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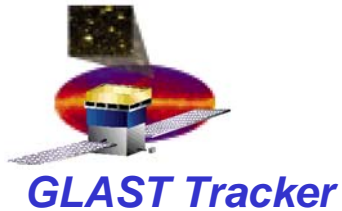
- ❑ The formal drawing review is in progress for the Tracker drawing set. STEP files are now on the SLAC web site. Goddard/Swales is adding a second senior reviewer. They will concentrate on the mid-tray and bottom-tray drawings in the first 2 weeks, but the complete review will take 4 weeks.
- ❑ Jeff Tice is preparing a comprehensive Tracker drawing configuration-control spreadsheet. It will include all materials and parts, as well as the drawings.
- ❑ **Mid Tray Panel Drawings (3 different tray types):**
 - 21 drawings total. All but 2 have been released at one time or another.
 - 5 assembly drawings are undergoing minor revision to correct the assembly sequence for installation of the grounding connection to the core.
 - The grounding tube drawing is getting fabrication notes added by Clinton.
 - The bias circuit drawings were corrected in the past week and are being re-released.
- ❑ **Mid Tray Assembly:**
 - 3 drawings, all released, but need revision and review.



Tracker Drawings

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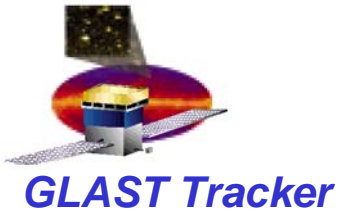
- ❑ **Top Tray Panel Drawings**
 - 8 drawings, all released.
 - However, the assembly drawing needs to be revised to include the grounding tube and to move the Kapton and tungsten installation down to this drawing level (since they are installed at Plyform, not G&A).
- ❑ **Top Tray Assembly: released but needs revision and review.**
- ❑ **Bottom Tray Panel Drawings**
 - 21 drawings total. 6 closeout drawings were released, but recent reviews require them to be re-released (in revision this week).
 - Corner bracket and flexure drawings are out for sign-off and release.
- ❑ **Bottom Tray Assembly and Grid Interface**
 - 13 drawings. All are presently in work.
- ❑ **IDD: in work.**
- ❑ **Tower Assembly: draft, never released yet.**



Tracker Drawings

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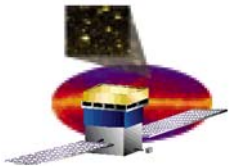
- ❑ **Sidewalls**
 - 10 drawings, 6 released.
 - However, the 4 released sidewall drawings are in revision to change to 120 degree countersinks and to bond aluminum on both sides of the panel.
- ❑ **Flex-Circuit Cables**
 - 17 drawings, 1 released (schematic).
 - C0 drawings are completed; the others are in work.
- ❑ **Electronics and Detectors**
 - 16 drawings, all released.
- ❑ **See http://www-glast.slac.stanford.edu/Tracker-Hardware/TKR_drawing_tree.html for the complete list and the hierarchy.**



Schedule Variance

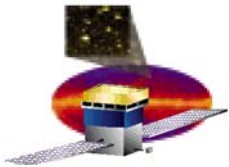
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- **-\$295k of schedule variance in January**
 - **-\$170k for bias circuits and converters.** No credit has been taken for this line item. Converters are in hand, and 2/3 of the bias circuit production was completed and then scrapped. A C.R. is in preparation for funds and schedule to redo the bias circuits. We are pushing to get bias circuits for Tower A by 2 weeks from now (drawings went to Parlex today).
 - **-\$115k for MCM preproduction.** No credit has been taken, but 28/50 have been delivered. The final units are under test today and tomorrow, and all should be delivered in the next 2 weeks. The front end of the production pipe is now getting loaded with flight production, so start of flight production *will not* wait for completion of the remaining preproduction.
- **-\$321k of schedule variance total**

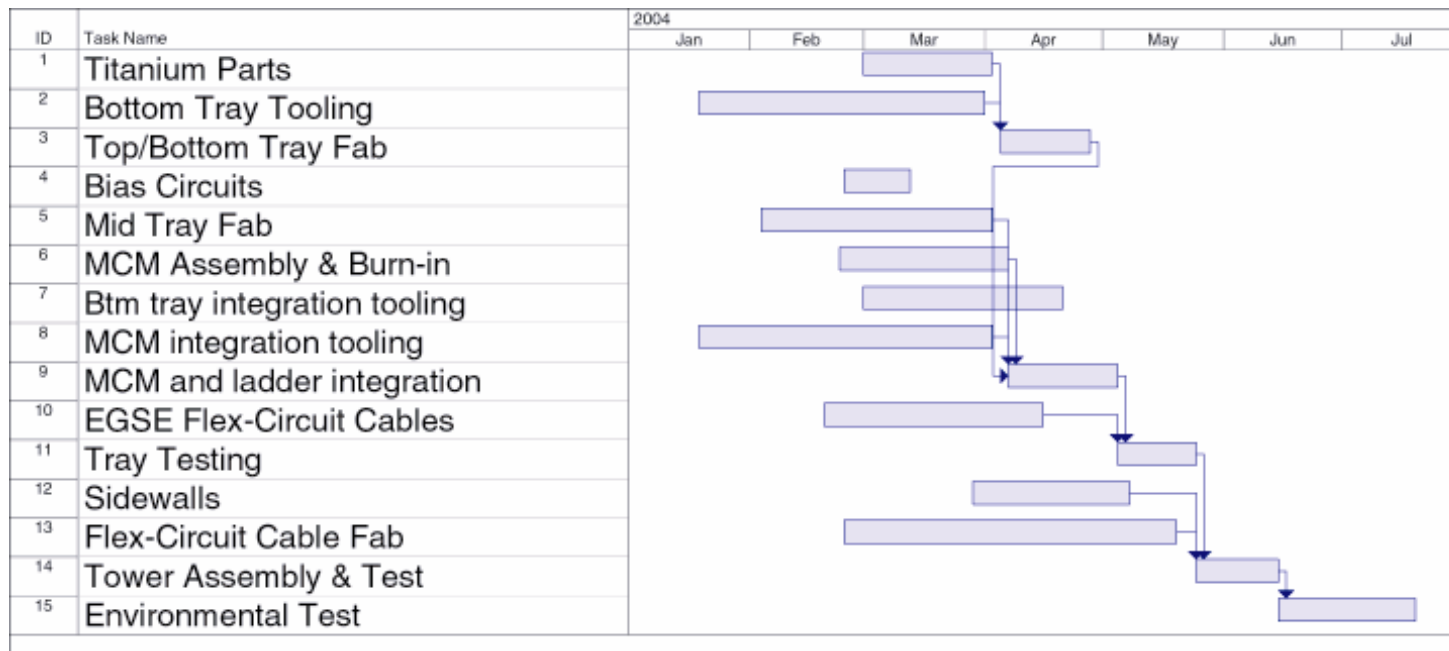


Near Term Schedule for Tower A

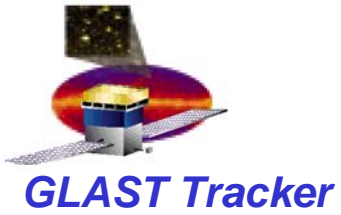
	Start	End
Titanium machining & shipping	Mar 1	Apr 2
Bottom tray assembly tooling	In progress	Mar 31
Top/bottom tray fabrication, test, and bakeout	Apr 5	Apr 27
New bias circuits	Today	Mar 12
Mid tray fabrication, test, and bakeout	In progress	Apr 2
MCM assembly, test, burn-in, and shipping	Feb 24	Apr 6
Tooling for integration of ladders & MCMs onto btm trays	Mar 1	Apr 20
Tooling for mounting MCMs onto trays	In progress	Apr 2
Mounting MCMs and ladders onto trays and test	Apr 7	May 4
Fabrication of flex-circuit cables for EGSE	In progress	Apr 15
Tray thermal cycle and stacked tray test	May 5	May 24
Sidewall fabrication	Mar 29	May 7
Flex-circuit cable fabrication	?	May 19
Tower assembly and test	May 25	June 14
Tower environmental test, plus final comprehensive test	June 15	July 19



Near Term Schedule for Tower A



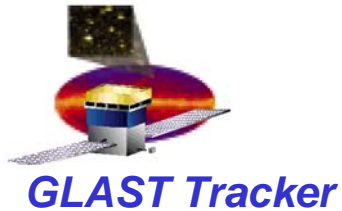
- Schedule issues:
 - Low confidence that the first titanium parts will come in only 4 weeks.
 - Flex circuit cable design still isn't finished for all 8 varieties, and I don't have a good handle on how quickly Parlex will deliver.
 - MCM fabrication is still almost on the critical path; need to get the Teledyne PO signed off so that Teledyne doesn't stop work.



Tracker Milestones

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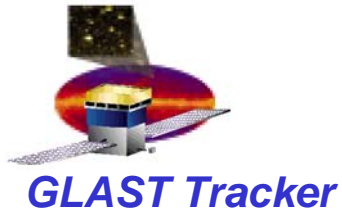
AV	Activity ID	ND	Activity Description	Baseline Finish	Propose Finish	FY04				FY05					
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
4.1.4 Tracker															
4	1M1000200	9	Tracker Modules A RF	07/02/04	07/28/04				▼						
4	1M1000201	9	Tracker Modules B RF	07/23/04	08/18/04				▼						
4	1M1000220	9	Tracker Modules 1 RF	07/23/04	08/18/04				▼						
4	1M1000221	9	Tracker Modules 2 RF	08/13/04	09/08/04				▼						
4	1M1000250	9	Flight Tracker Tower 3 RF	08/13/04	09/08/04				▼						
4	1M1000251	9	Flight Tracker Tower 4 RF	09/20/04	10/14/04				▼						
4	1M1000260	9	Flight Tracker Tower 5 RF	09/20/04	10/14/04				▼						
4	1M1000261	9	Flight Tracker Tower 6 RF	10/11/04	11/05/04				▼						
4	1M1000270	9	Flight Tracker Tower 7 RF	10/11/04	11/05/04				▼						
4	1M1000271	9	Flight Tracker Tower 8 RF	11/02/04	11/24/04				▼						
4	1M1000280	9	Flight Tracker Tower 9 RF	11/02/04	11/24/04				▼						
4	1M1000281	9	Flight Tracker Tower 10 RF	11/23/04	12/17/04				▼						
4	1M1000290	9	Flight Tracker Tower 11 RF	11/23/04	12/17/04				▼						
4	1M1000291	9	Flight Tracker Tower 12 RF	12/07/04	01/11/05				▼						
4	1M1000300	9	Flight Tracker Tower 13 RF	12/07/04	01/11/05				▼						
4	1M1000301	9	Flight Tracker Tower 14 RF	12/21/04	01/25/05				▼						
4	1M1000310	9	Flight Tracker Tower 15 RF	12/21/04	01/25/05				▼						
4	1M1000311	9	Flight Tracker Tower 16 RF	01/13/05	02/08/05				▼						



Milestone Variances

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- ❑ **Last month the flexure/Grid I/F design was starting to pull ahead of the MCMs as the critical path.**
- ❑ **Since then we've lost a month, due to the need to have the new design team go through all the drawings carefully and update them, including a trip to Italy. This explains the nearly 4 week slip from the baseline in the Tower-A delivery.**
- ❑ **The MCM production startup has also slipped a couple of weeks in getting the parts and processes ready.**
- ❑ **The bias circuit fiasco poses a danger of slipping the mid-tray production and making it critical also, but we think we have this one under control to get new circuits to Italy barely in time.**



Cost Variance

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□ **-\$294k cost variance in January**

- -\$99k of Teledyne charges for preproduction and other flight production preparations. This will be partially resolved when preproduction completes, but we have identified \$30k in additional tooling and engineering support that Teledyne will invoice for preproduction and flight production prep.
- -\$31k to Parlex for flex circuits. This will be resolved by completion of the bias circuits, including the bias circuit C.R.
- -\$63k Hytec. Payment for more than one month. The PMCS has \$100k for Hytec spread uniformly over the year, but we are phasing them out now. This morning's C.R. includes up to \$45k additional for that closeout, to finish needed support for the redesign and the bottom-tray static test.
- -\$81k COI. Invoices coming in for EM sidewall work of last year, plus bottom tray closeout fabrication. I have an action to go back through all the EM sidewall charges to check the total against the budget in the rebaseline.
- -\$16k for Nelson and Huong for flex-circuit cable work and Nakashima for pitch-adaptor/MCM CMM work. C.R.s need to be prepared for these items, which are going out of scope. The flex-circuit cable design is a never-ending saga, and we did not anticipate having to do so much dimensional screening of the MCM parts.

□ **-\$317k total cost variance**