

Preproduction Status & Results

Serial No.	Type	PWB from DDI	Receiving Inspection complete	Radius Machined	Inspection of machining	Shipped to Teledyne	Flex Adaptor bond & trim	Flex Adaptor Inspection	SMT parts installed	Connectors installed	ASIC die installed	Wire bond	Elect. Test (pre-encap)	Encapsulate	Conformal Coating	Final Elect. Test	Final Inspection	Shipped to SLAC	Receiving inspection	Baseline Elect. Test	T/C & Burn in	Final Test	Final Inspection	Shipped to INFN	Storage Bldg. 33	
176	LAT-DS-00077-5																									
174	LAT-DS-00077-5																									
574T	LAT-DS-00077-5																									
512	LAT-DS-00077-5																									
227	LAT-DS-00077-5																									
225	LAT-DS-00077-5																									
196	LAT-DS-00077-5																									
169	LAT-DS-00077-5																									
175	LAT-DS-00077-5																									
197	LAT-DS-00077-5																									
224	LAT-DS-00077-5																									
228	LAT-DS-00077-5																									
519T	LAT-DS-00077-5																									
572	LAT-DS-00077-5																									
226	LAT-DS-00077-5																									
173	LAT-DS-00077-5																									
576	LAT-DS-00077-5																									
513	LAT-DS-00077-5																									
587	LAT-DS-00077-5																									
528	LAT-DS-00077-5																									
562	LAT-DS-00077-5																									
374	LAT-DS-00077-5																									
347	LAT-DS-00077-5																									
364	LAT-DS-00077-5																									
593	LAT-DS-00077-5																									
518	LAT-DS-00077-5																									
578	LAT-DS-00077-5																									
187	LAT-DS-00077-5																									
584	LAT-DS-00077-5																									
516	LAT-DS-00077-5																									
509	LAT-DS-00077-5																									
523	LAT-DS-00077-5																									
514	LAT-DS-00077-5																									
359	LAT-DS-00077-5																									
524	LAT-DS-00077-5																									
571	LAT-DS-00077-5																									
185	LAT-DS-00077-5																									
190	LAT-DS-00077-5																									
510	LAT-DS-00077-5																									
519	LAT-DS-00077-5																									
394T	LAT-DS-00077-5																									
206	LAT-DS-00077-5																									
184	LAT-DS-00077-5																									
335	LAT-DS-00077-5																									
515	LAT-DS-00077-5																									
573	LAT-DS-00077-5																									
194	LAT-DS-00077-5																									
147	LAT-DS-00077-5																									
227	LAT-DS-00077-5																									
563	LAT-DS-00077-5																									
236	LAT-DS-00368-4																									
230	LAT-DS-00368-4																									
235	LAT-DS-00368-4																									
237	LAT-DS-00368-4																									
242	LAT-DS-00368-4																									
1107	LAT-DS-00368-4																									
1113	LAT-DS-00368-4																									
1104	LAT-DS-00368-4																									
1102	LAT-DS-00368-4																									
1077	LAT-DS-00368-4																									
1119	LAT-DS-00368-4																									
1080	LAT-DS-00368-4																									

Qty. 4 completed thermal cycle, burn-in and final electrical test, Sent to SLAC

Qty. 10 completed thermal cycle, burn-in and final electrical test, Sent to INFN

Qty. 14 thermal cycle complete, burn-in and final electrical test (ECD 2/12/04)

Qty. 6 pre-encap electrical test (ship to SLAC ECD 2/13/04)

Qty. 3 wire bonding (ECD 2-13-04)

Qty. 4 "Short" TMCM, install pitch adaptor & SMT parts (ECD 2/20/04)

Qty. 2 samples of Pitch Adaptor sent to INFN
Qty. 4 Scrap

Qty. 10 "Tall TMCM" (ECD 2/24/04)
+2 spare parts on hand

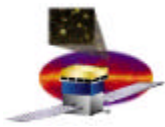
Qty. 40 short TMCM
Qty. 10 tall TMCM
Qty. 50 preproduction total



Pre-Encapsulation Test Results

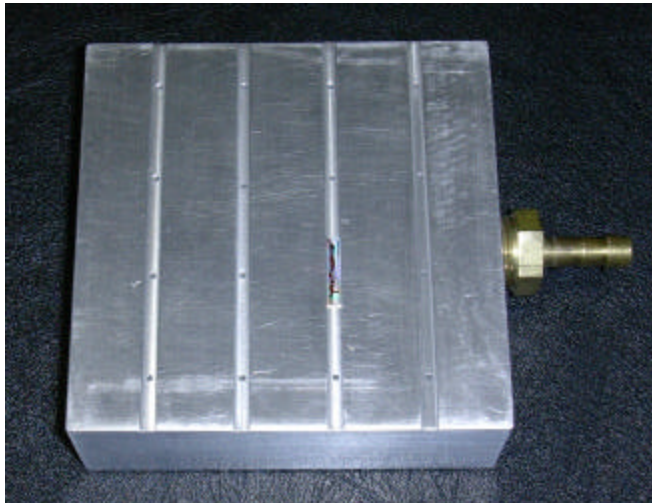
Example Pre-Encapsulation Test Session

- Results from the most recent test session at Teledyne, SN 173, 359, 509, 516, 523, 524, 562, 571, 576, 578, 584, 593.
- SN 523:
 - One GTFE chip had a broken calibration mask and drew excess current. It was the only chip out of 312 that had to be replaced.
- SN 516:
 - One wire bond lifted on a GTFE address line.
 - Shorts cleared on the pitch adapter between two pairs of channels.
- SN 516
 - Passed the electrical test, but with 2 shorted channels. Inspection of that region uncovered damaged wire bonds that had to be repaired.
- SN 509
 - Passed the electrical test, but with 2 shorted channels. Debris could be seen between the two traces and was cleaned out.
- These 4 were reworked and tested perfect the following day.
- The other 8 were perfect in the initial test.



Failed ASICs

- The incidence of ASIC failure, requiring reworking of MCMs, is low enough that we can live with it, but...
- All chips were fully tested on the wafer before dicing, so in principle we should not find any failures.
 - Damage during lapping, dicing, picking, inspection?
 - Damage during MCM assembly?
- We are starting a program to isolate the problem by probing
 - Failed dice returned from Teledyne.
 - Fresh dice from GDSI.

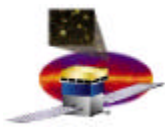


New vacuum fixture to be used for probe testing loose GTFE chips.

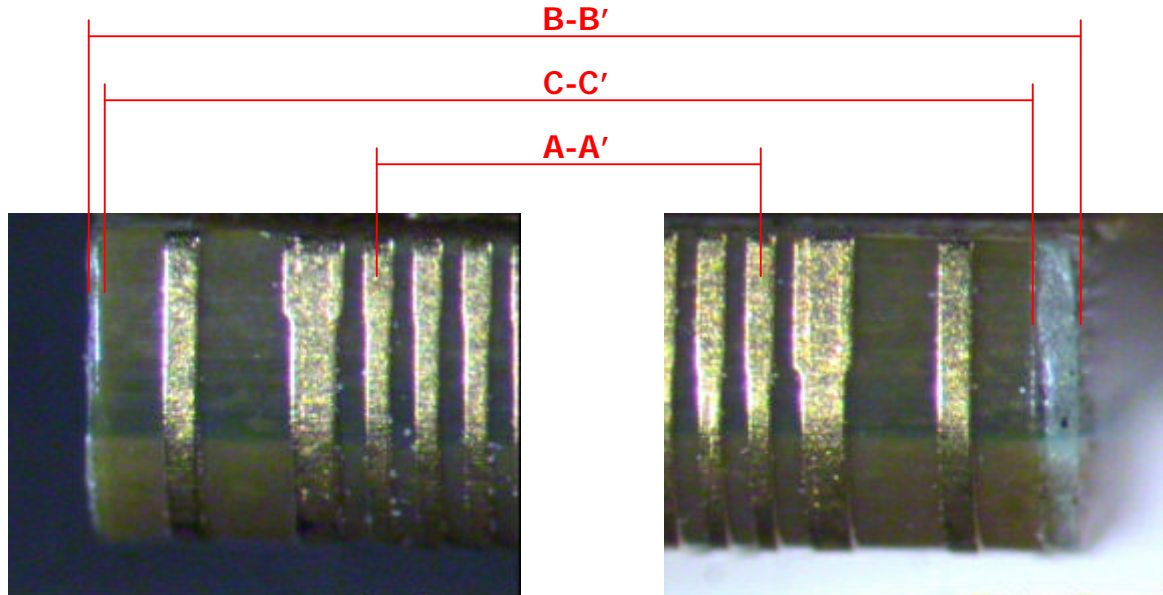


Preproduction Electrical Results

- So far, no MCMs have failed at
 - Post encapsulation/conformal coat test at Teledyne.
 - 3-temperature test following thermal cycling at SLAC.
 - Burn-in.
 - Final test after burn-in.
- In fact, the number of bad channels has not increased at any of those test points with respect to the pre-encapsulation test.
- Of 4 MCMs checked so far by probing, none has even a single broken trace or wire bond at the channel inputs.
- Note that we have yet not seen any chips go bad on MCMs following encapsulation and final test, in the Mini-Tower or preproduction.
 - This is evidence that the chips are robust when protected from physical damage and that the ASIC failures seen during pre-encapsulation testing *are not* results of infant mortality.

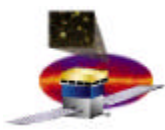


Measures on MCM Board

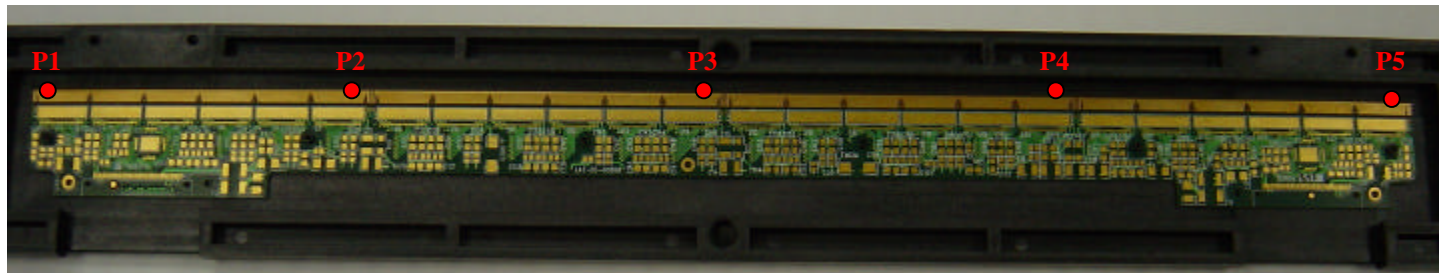


MCM Board	A-A'		B-B'		C-C'
	Nominal	Measured	Nominal	Measured	Measured
S/N 196	356.424	356.375	359.000	359.337	358.930
S/N 224		356.397		359.139	358.892
S/N 227		356.417		359.278	358.727



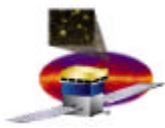


Planarity on MCM Board

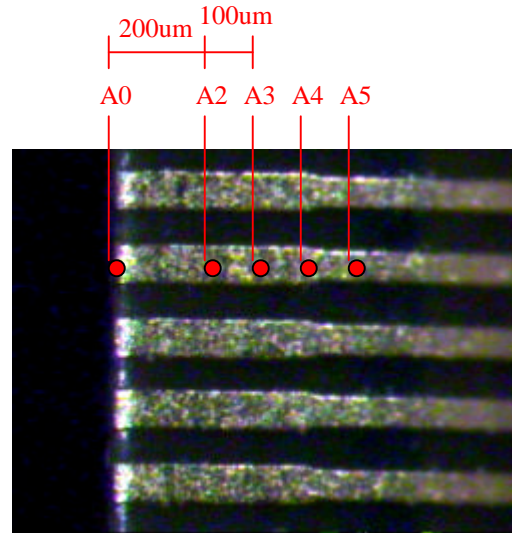


	Reference points	S/N 227	S/N 224	S/N 196
Distances from best fit plane	P1	0.005	0.005	0.013
	P2	-0.014	-0.012	-0.033
	P3	0.015	0.008	0.028
	P4	-0.006	0.000	-0.006
	P5	0.001	-0.002	-0.001
	Max	0.015	0.008	0.028
	Min	-0.014	-0.012	-0.033
	? (Max-Min)	0.029	0.020	0.061



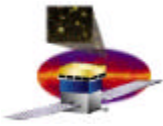


Planarity of the Strips



Difference of Z coordinate between marked points and A0					
	Position on MCM Board	zA3 (300 μ m from edge) - zA2	zA4 (400 μ m from edge) - zA2	zA5 (500 μ m from edge) - zA2	Angle (degrees)
s/n 227	P1	0.007	0.021	0.021	7.9696
	P2	0.000	-0.001	-0.002	-0.5729
	P3	-0.006	-0.012	-0.019	-3.4336
	P4	0.006	0.006	-0.005	0.0000
	P5	0.003	-0.003	-0.010	-3.4336
s/n 224	P1	-0.001	-0.001	-0.003	0.0000
	P2	0.000	-0.002	-0.004	-1.1458
	P3	0.000	-0.010	-0.017	-5.7106
	P4	0.000	0.002	-0.006	1.1458
	P5	0.005	0.006	0.010	0.5729
s/n 196	P1	0.000	0.000	-0.002	0.0000
	P2	-0.001	-0.001	-0.002	0.0000
	P3	-0.009	-0.027	-0.036	-10.2040
	P4	0.000	-0.005	-0.017	-2.8624





Conclusions

- The MCM assembly procedure is able to deliver boards that meet all electrical requirements, generally with much less than the maximum of 8 bad channels per MCM.
- Some rework is required after wire bonding and before encapsulation.
 - The incidence of bad dice is low and seems to be decreasing.
 - We will do some work to understand whether chips are damaged during lapping, dicing, picking, and inspection at GDSI.
 - The largest amount of rework results from physical damage to wire bonds during handling. New fixtures will be made to reduce this.
- The finished MCMs conform to the designed height and straightness of the top edge, where G&A will wire bond.
- The perpendicularity of the top edge may be improved with a new fixture, but G&A is confident that it is adequate for good quality wire bonds to the SSDs (but possibly at a cost in wire bonding time).