Tuesday 04 March 2003

Barrel Modules (09:00->18:00) Chair: Carter, A., Unno, Y.

Room: 40-R-C10 with portable projector borrowed from ATLAS secretary

09:00 Module Database

- **a) module database documentations (20')** — **Unno, Y.**
- **b) module database implementation (20')** — **Ferrere, D.**
- **c) module database uploading interface (30')** — **Robinson, D.**

10:30 Coffee

11:00 Component Updates and Delivery Plans

- **a) ASICs (15')** — **Grillo, A.**
- **b) Detectors (15')** — **Carter, J.**
- **c) Baseboards (15')** — **Carter, J.**
- **d) Hybrids (15')** — **Terada, S.**

12:00 Module Production reports - ASIC stuffing, Module assembly and QA

- **a) Japan (1h00')** — **Unno, Y.**

  Status, Defect ASICs, Study on Large Gain Spred chips, "Partbonded" ASICs, Metrology distributions, Latest 20 history, I-V, Summary of hybrids/modules
- **b) UK (45')** — **Phillips, P.W.**
- **c) Scandinavia (45')** — **Brenner, R., Kristoffer O.**
- **d) US (45')** — **Haber, C., Ciocio, A.**

  Status, QA

16:30 Coffee

17:00 Irradiations, beamtests, in 2003 — **Carter, J.**

17:15 Site Qualification and Series Production issues

- **Reports** — **Carter, A.**

  Aug 4, 2002, Dec 10, 2002, Feb 21, 2003, Feb 28, 2003
- **Proposal for the module categories** — **Unno, Y.**

18:00 AOB

	Definitions of the barrel modules and link with the SCT database - Internal to the barrel community		
ATLAS Project Document No:	Institute Document No.	Created: 13/12/2002	Page: **1 of 8**
		Modified: 16/2/2003	Rev. No: E

(DRAFT)

Definitions of the barrel modules and link with the SCT database - Internal to the barrel community

Abstract

Prepared by:	Checked by:	Approved by:
Y.Unno, D.Robinson, D.Ferrere, K.Nagai, P.W.Phillips, D.Charlton		

Distribution List

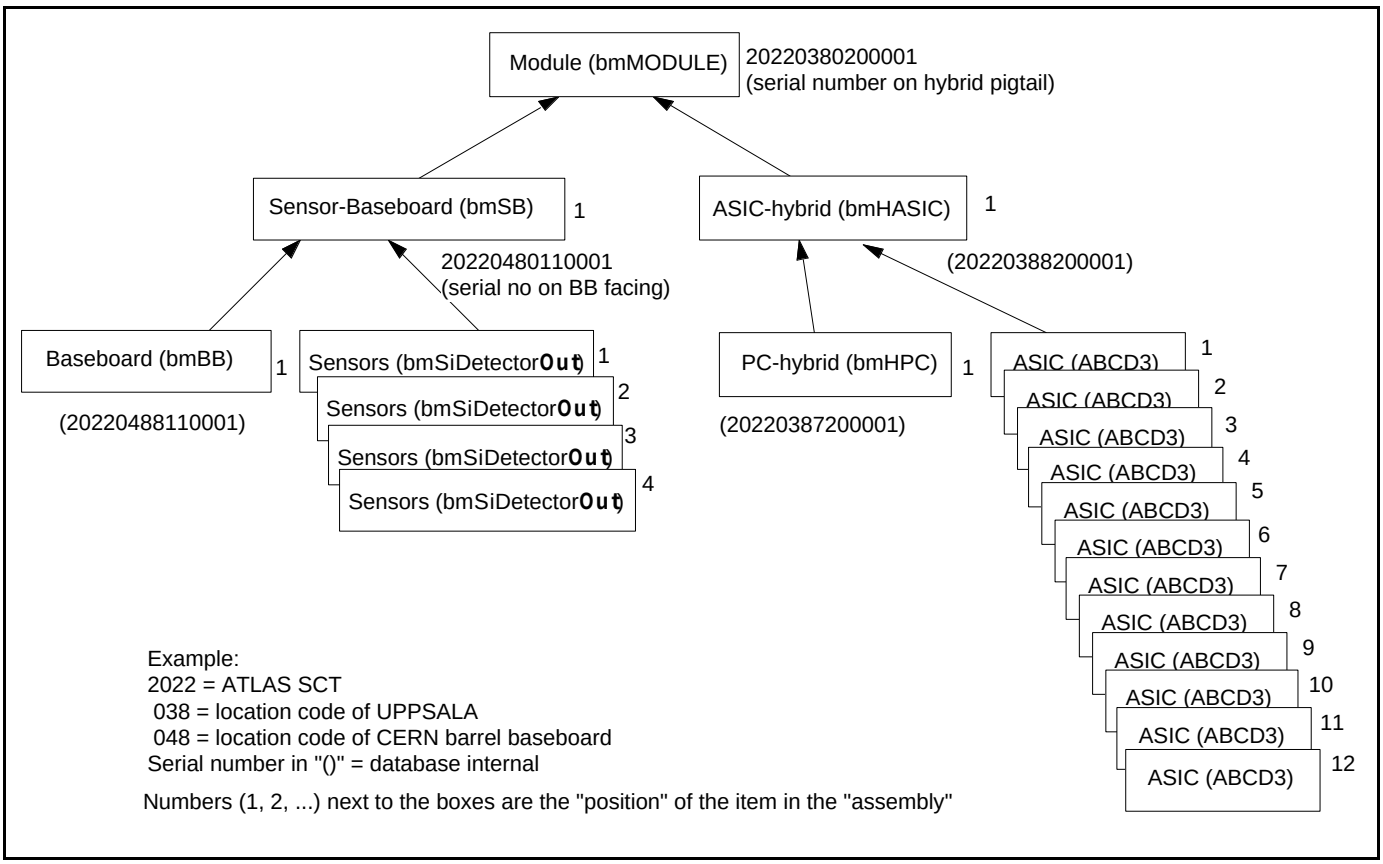


Figure 1 Definition of "Items" in the module part of the SCT database. The arrows show the "Assembly" of the barrel modules. The serial numbers of the sensors and ASICs are defined separately

SCT Production DB

- **DB General scheme and working group**
- **Simplified DB model – Recall**
- **Table space as of February 25, 2003**
- **DB definition and the barrel module activities**
- **Recall of the existing tool interfaced to the DB**
- **BM survey implementation**
- **SCTDAQ recall + Redundancy test (New)**
- **Other things: Change of rule for chip logistic**

DB definition and the barrel module activities

Any data entry can be entered according to a the definition like for: items, assemblies, tests, events, …

Please refer to Nobu's document: ***"Definitions of the barrel modules and link with the SCT database"***

Component type	Pos.	Component type	Pos.
bmHASIC	1		
		bmHPC	1
		chABCD3T	1
		chABCD3T	2
		chABCD3T	3
		chABCD3T	4
		chABCD3T	5
		chABCD3T	6
		chABCD3T	7
		chABCD3T	8
		chABCD3T	9
		chABCD3T	10
		chABCD3T	11
		chABCD3T	12
bmSB	1		
		bmBB	1
		bmSiDetectorOut	1
		bmSiDetectorOut	2
		bmSiDetectorOut	3
		bmSiDetectorOut	4

Barrel Module and its components

Test lists example:
bmSB: ModBarXYsurvey, ModBarZsurvey, Visual inspection
bmModule: SCTDAQ test (11), detModIV, ModBarXYsurvey, ModBarZsurvey, ModBarZProf, Visual Inspection
bmHASICs: SCTDAQ test (11), Visual Inspection

BM survey implementation

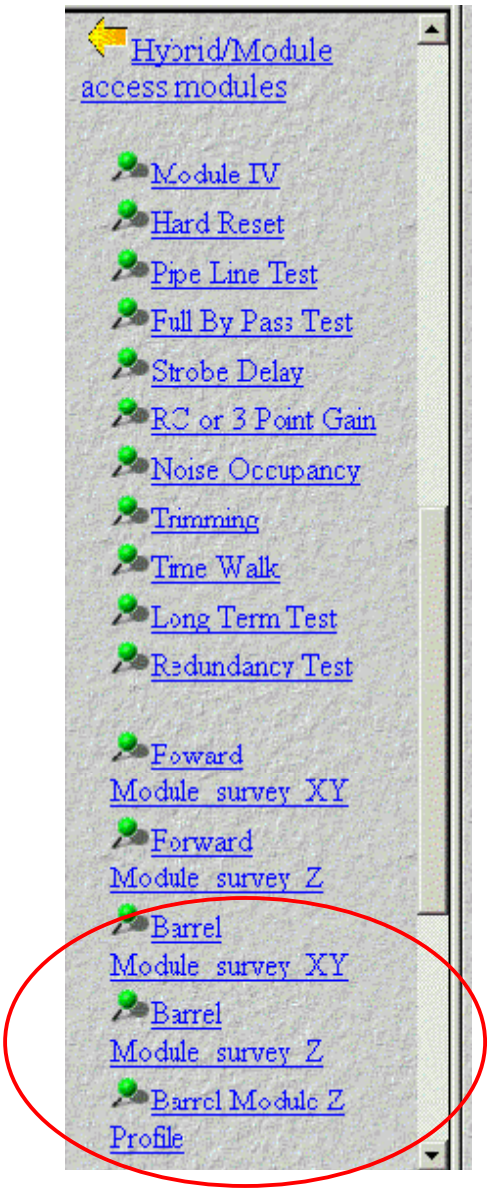
Following working discussion with Nobu and Dave it has been agreed to implement specifically for the barrel modules the following entity and the related application: BMSurveyXY, BMSurveyZ, BMZProfile

All the implementation and tools were completed last week and it has been documented on the web!

For the data upload, the user must download the java application SCTTEST_3_17_P.jar

The template upload files are documented on the web at the usual place.

WEB access:



Change of rule for chip logistic

Rule change: **No assembly upload of chips to gelpack anymore**

New rule: **Once the chips are dices they are physically placed into a gelpack. Then into the DB a shipment box is created for a single gelpack and its chips.**

ABCD Production Status

Alex Grillo
SCT Week Mar-03

As of end of Feb-03 (minus a few days of testing):

Number of wafers received from ATMEL:	**1009**
Number of wafers tested:	**967**
Percentage of perfect chips needed for SCT so far found:	**81%**
Yield of accepted wafers:	**24.8%**
Percentage of wafers rejected:	**20.7%**

The concern we had during December SCT Week about low yield of recently fabricated lots has proved to be a big problem.

For the 13 lots fabricated since the re-start of fabrication in Jun-02, 46% of the wafers have been rejected for low yield and the yield of accepted wafers is only 17%.

So far, studies by ATMEL and SCT have not found a cause for this.

Assuming current low yields and ATMEL's schedule for wafer starts, we will not complete production until end of this calendar year.

We are negotiating with ATMEL to accelerate this.

BARREL DETECTOR DELIVERIES
4th March 2003

Contract	Ordered (including Purchase Options)	Delivered
Japan	6000	5513
Norway	1950	1950 – complete
UK	2750	2750 – complete
Total	10,700	10,213

95% of total delivered
All QA completed for UK detectors

2. Baseboard Statistics

- **2444 Series Baseboards have so far been started in the extended production pipeline**

- **Despatch Statistics to-date for Series Baseboards:**

KEK (Type 1)	UK (Type 2)	US (Type 2)	Scand (Type 1)
569 (81%)	361 (57%)	173 (23%)	100 (22%)

Total despatched = 1327 (47.5% of maximum final number)

- **March delivery for Scand and April for KEK will contain Type 2 BBs**

- **Please inform us without delay if any problem is seen with a delivered baseboard**

3. Summary

- **We are keeping up with the production and delivery totals we planned in June 2002 (which is a lot of hard work)**
- **We expect to close the BB production line in October 2003**
- **After that, no additional BBs can be made – ie the supply is strictly to the planning totals**

Status of the Barrel Hybrid Production and Delivery

(As of 28 Feb 2003)

- **"PC" Hybrid**

  Produced:
  1089 pcs of "PC" hybrids
  (including ones with old PA and "white" PA (159 pcs))

  Delivered:

UK	US	Nordic	Japan
147(47)	97(9)	33(4)	499(57)

- **Delivery schedule update:**

Mar 2003	400
Apr 2003	400
May 2003	400
Jun 2003	211
Total	2500

Series production summary as of Mid. February, 2003

1. Deliveries

- Sensors (to assembly site)	**2356**
- Baseboards (to KEK)	**519**
- ASICs (to KEK, including in undiced wafers)	**9181**

2. Assemblies

- ASIC stuffed hybrids (to KEK)	**450**
- ASIC-hybrids (to assembly site)	**307**
- Modules (to KEK)	**273**

Temperature and Vcc Study on "Large Gain Spread" chips

Select 3 hybrids with "Large Gain Spread (LGS)" chips

- Mfr ID = 720, 736, 749

Vary environment temperature to change the hybrid/ ASIC temperature

- Hybrid temp ~ 0, 27, 37 C

Vary Vcc from 3.3V to 3.8V by a step of 0.1V

Hybrid temp ~27 C

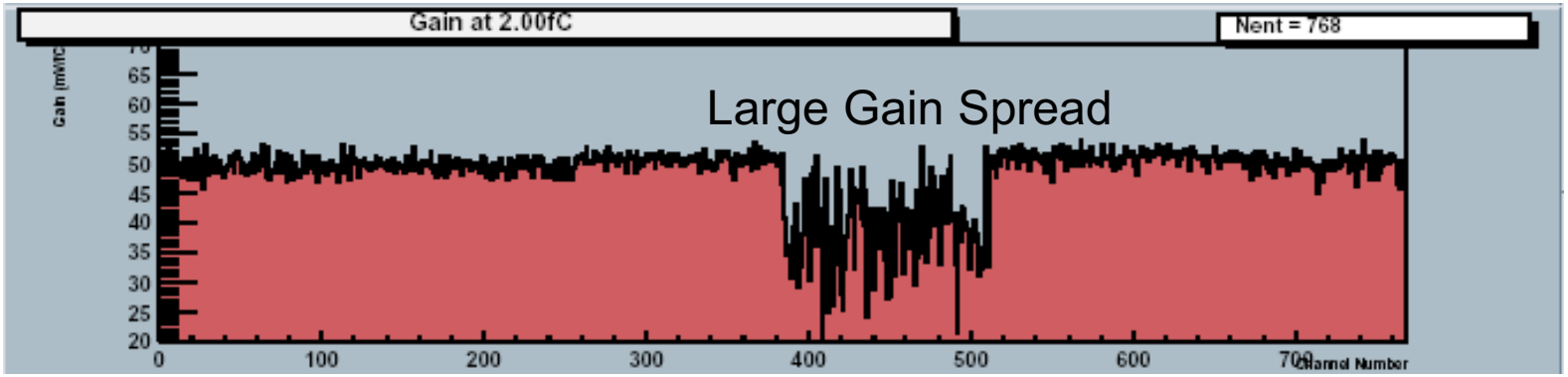
	ID=720	ID=736	ID=749
3.3[V]	E05	S11	S11
3.4[V]	OK	OK	OK
3.5[V]	OK	OK	OK
3.6[V]	OK	OK	OK
3.7[V]	OK	OK	S11(HighGain)
3.8[V]	OK	OK	S11(HighGain)

Hybrid temp ~0 C

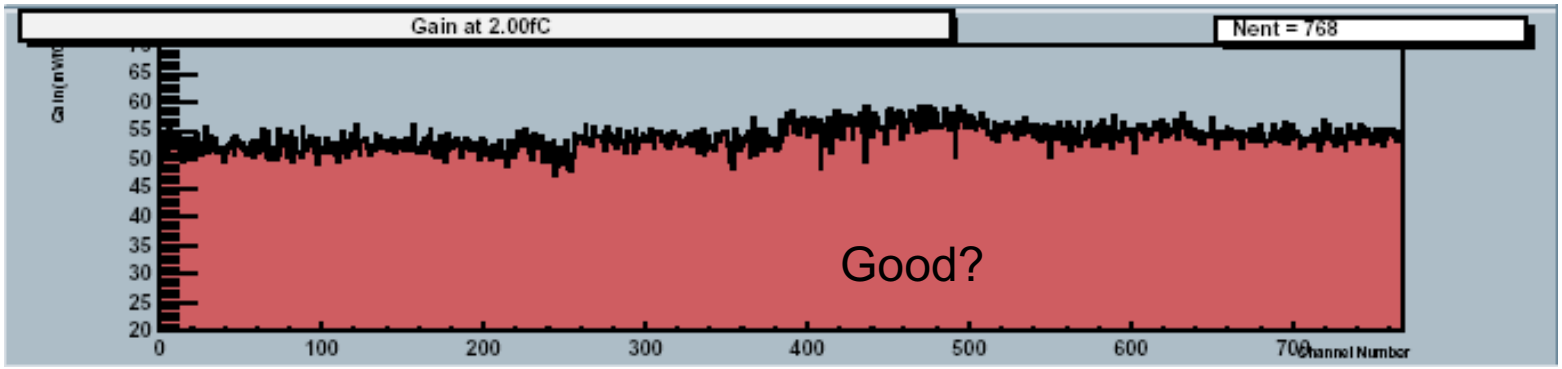
	ID=720	ID=736	ID=749
3.3[V]	E05	S01+S3+E5+M08 +S09+S10+S11	S11+others?
3.4[V]	E05	S10+S11	S11
3.5[V]	E05	S11	S11
3.6[V]	OK	OK	OK
3.7[V]	OK	OK	OK
3.8[V]	OK	OK	S11(HighGain)

ID=749 Hybrid temp ~27 C

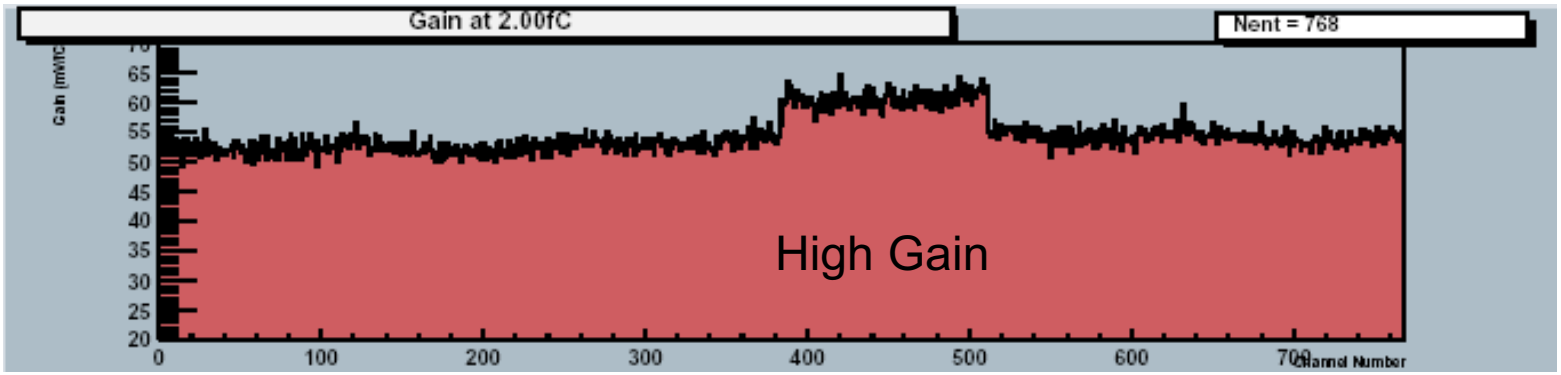
Vcc=3.3V



Vcc=3.5V
(Nominal)

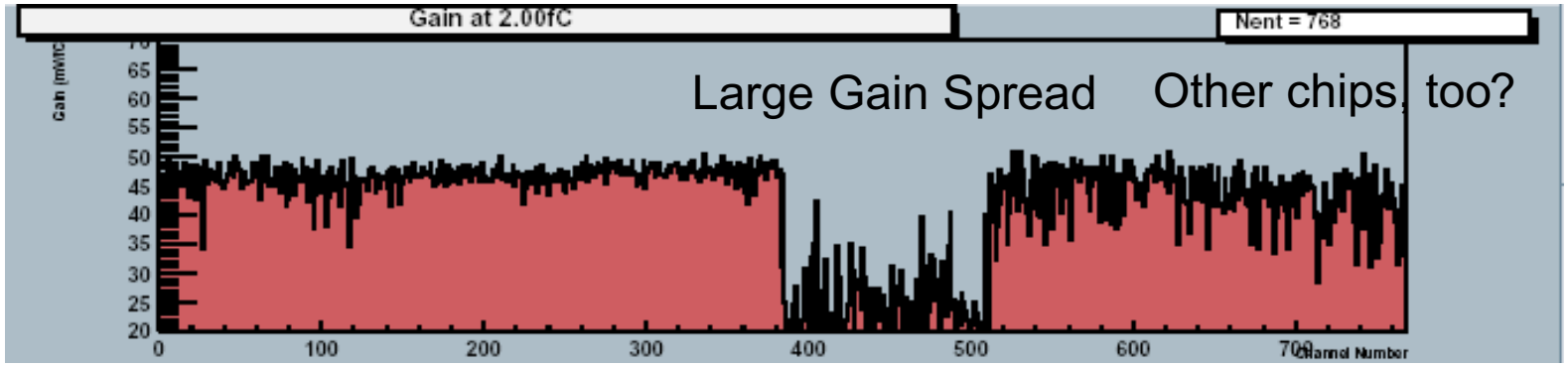


Vcc=3.8V

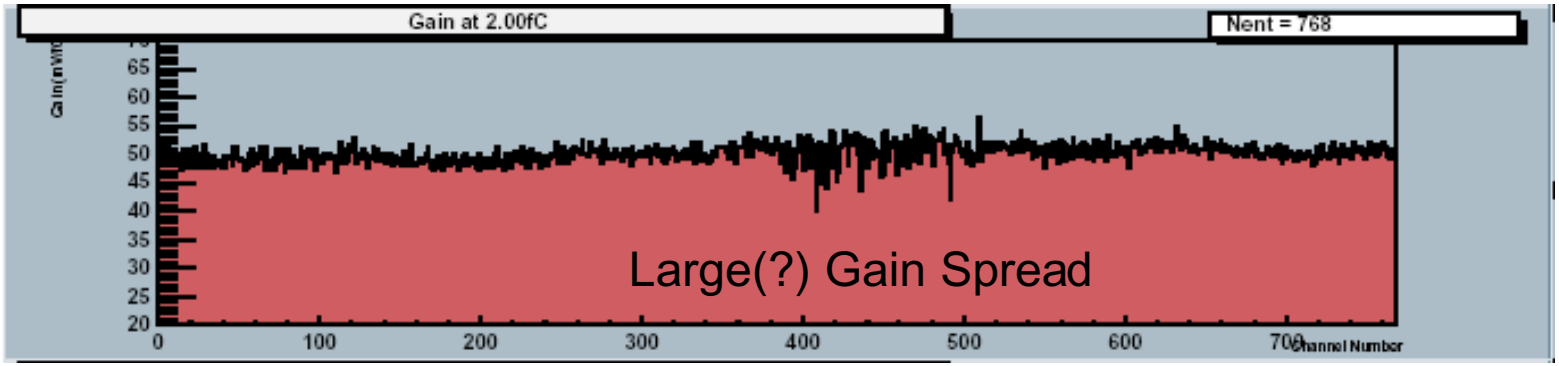


ID=749 Hybrid temp ~0 C

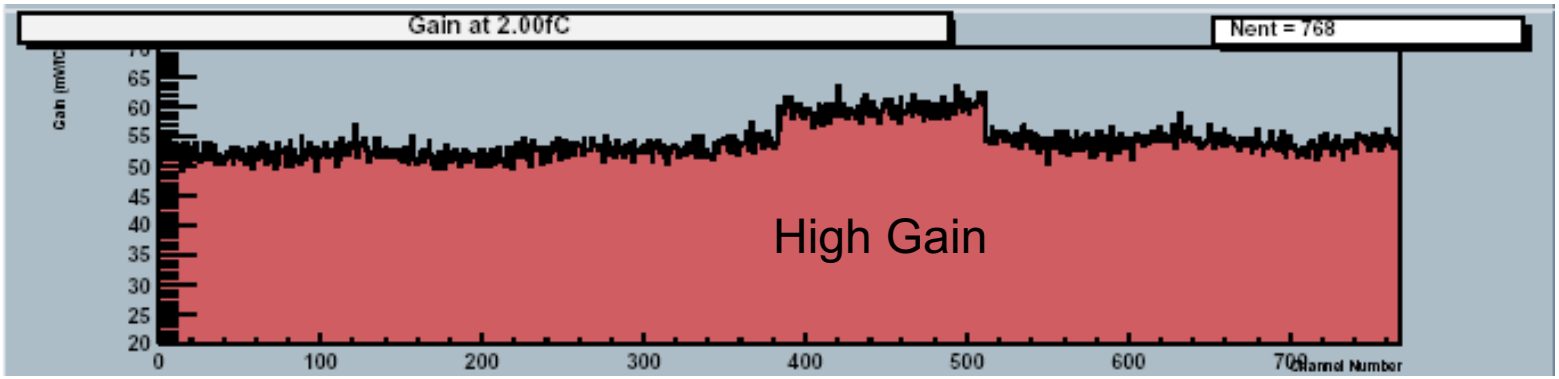
Vcc=3.3V



Vcc=3.5V
(Nominal)



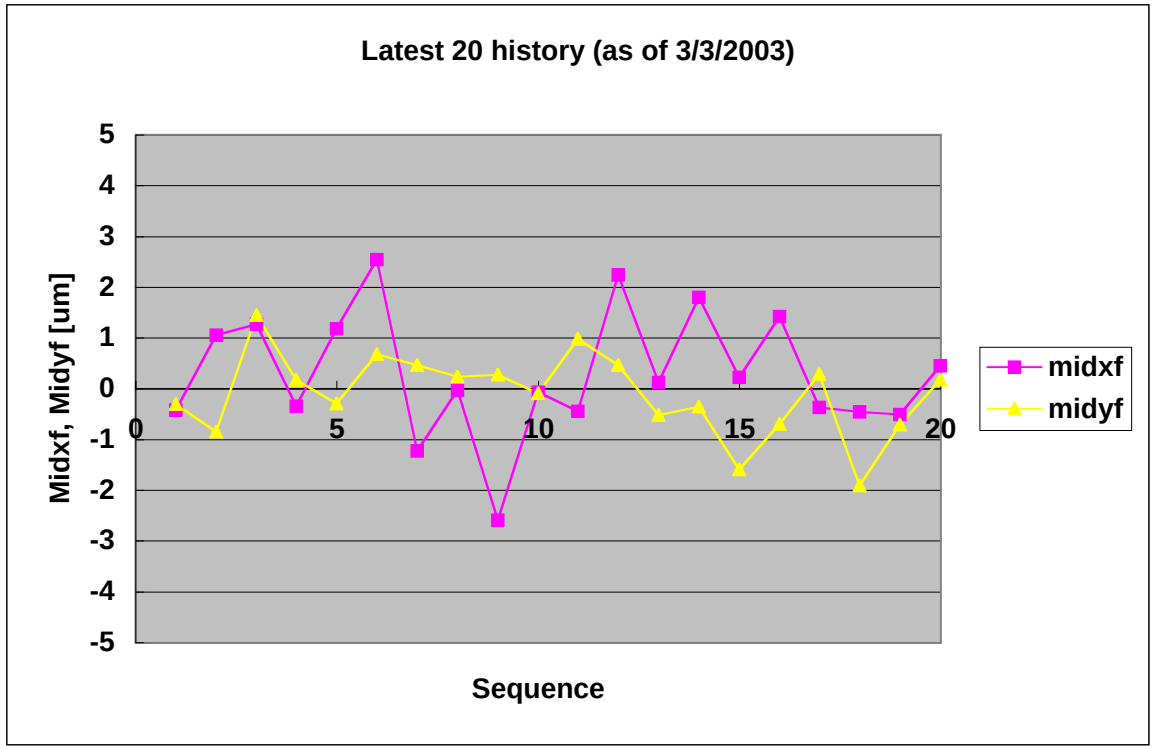
Vcc=3.8V



Conclusions?

- ✓ The effect seems ASIC/chip intrinsic
- ✓ The LGS chips are more sensitive to the temperature and Vcc
- ✓ The problem is severer in lower temp.
- ✓ Wafer testing at Vcc = 3.3V may detect the problematic chips easily

	sigma	1.230	0.809
	ID	midxf	midyf
20	20220480110591	0.446	0.174
19	20220480110490	-0.507	-0.713
18	20220480110479	-0.462	-1.906
17	20220480110420	-0.366	0.279
16	20220480110409	1.424	-0.703
15	20220480110404	0.215	-1.591
14	20220480110401	1.794	-0.359
13	20220480110399	0.123	-0.529
12	20220480110398	2.244	0.458
11	20220480110335	-0.444	0.979
10	20220480110330	-0.065	-0.09
9	20220480110328	-2.591	0.266
8	20220480110323	-0.028	0.234
7	20220480110321	-1.234	0.454
6	20220480110319	2.542	0.671
5	20220480110311	1.178	-0.299
4	20220480110303	-0.348	0.166
3	20220480110302	1.264	1.447
2	20220480110299	1.054	-0.854
1	20220480110298	-0.427	-0.303



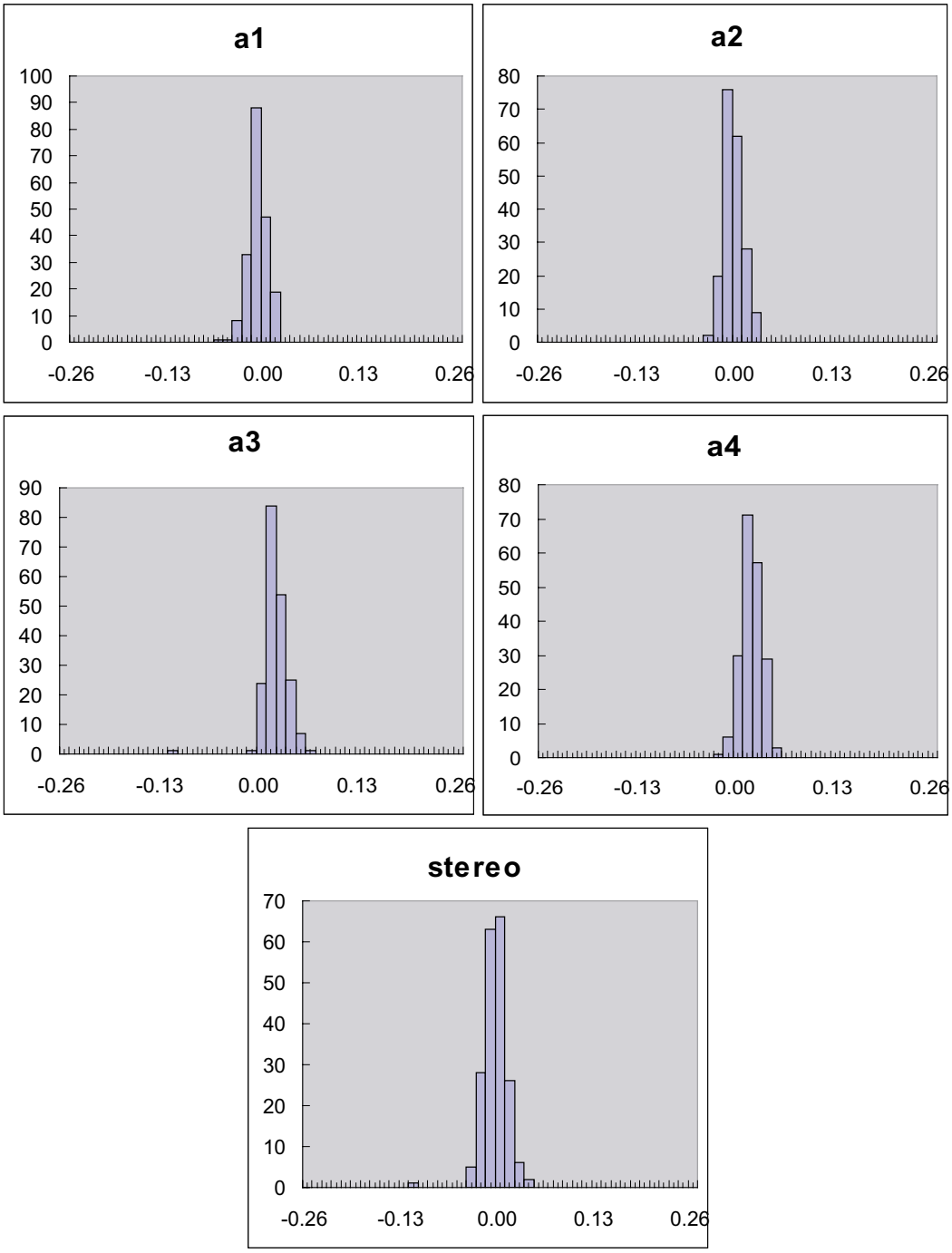
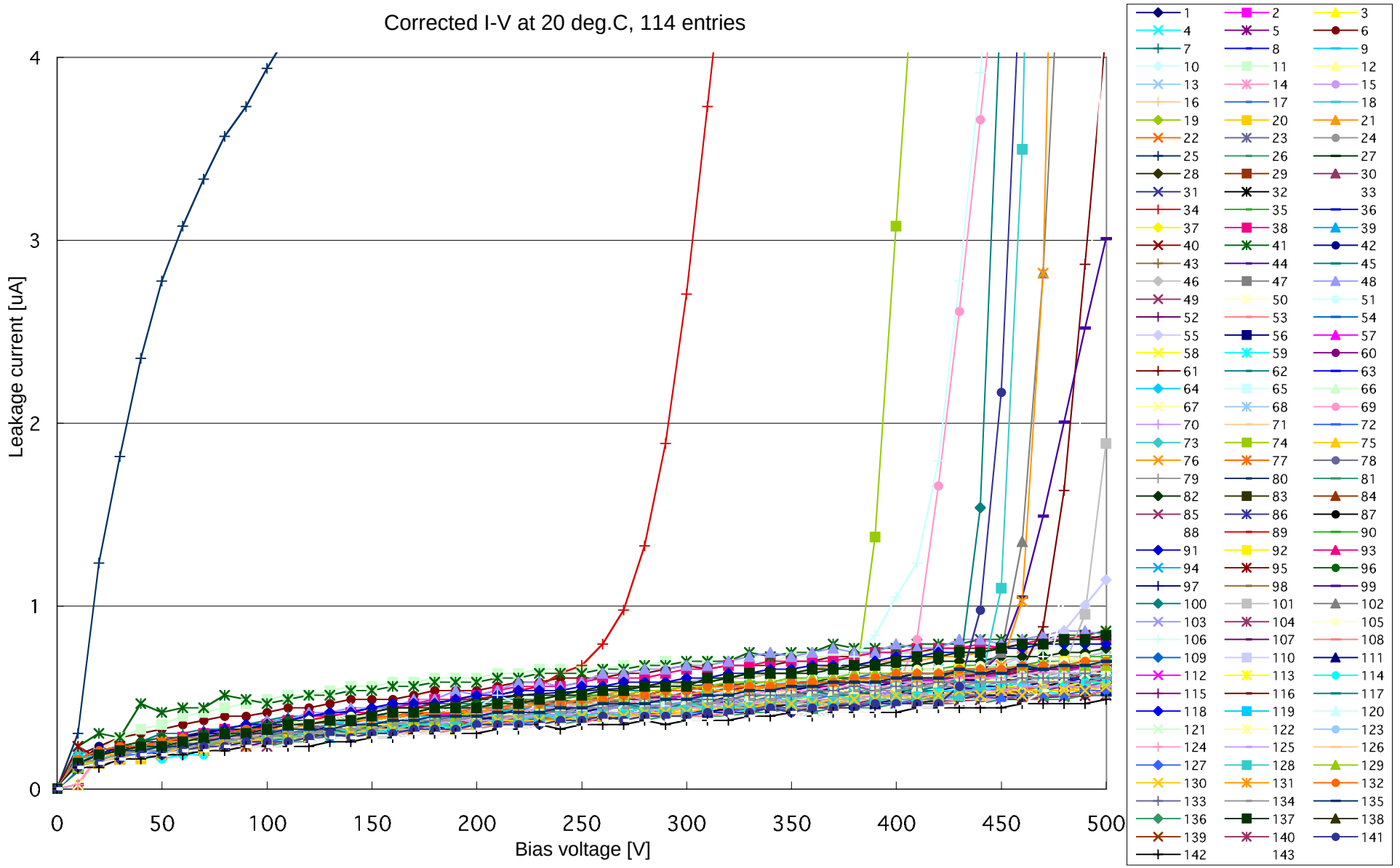


図 5.3: 位置精度検査結果 3.横軸は，許容値の 2 倍の範囲をとってある．単位：mrad


Corrected I-V at 20 deg.C, 114 entries
Leakage current [uA]
Bias voltage [V]
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450
500
1 2 3
4 5 6
7 8 9
10 11 12
13 14 15
16 17 18
19 20 21
22 23 24
25 26 27
28 29 30
31 32 33
34 35 36
37 38 39
40 41 42
43 44 45
46 47 48
49 50 51
52 53 54
55 56 57
58 59 60
61 62 63
64 65 66
67 68 69
70 71 72
73 74 75
76 77 78
79 80 81
82 83 84
85 86 87
88 89 90
91 92 93
94 95 96
97 98 99
100 101 102
103 104 105
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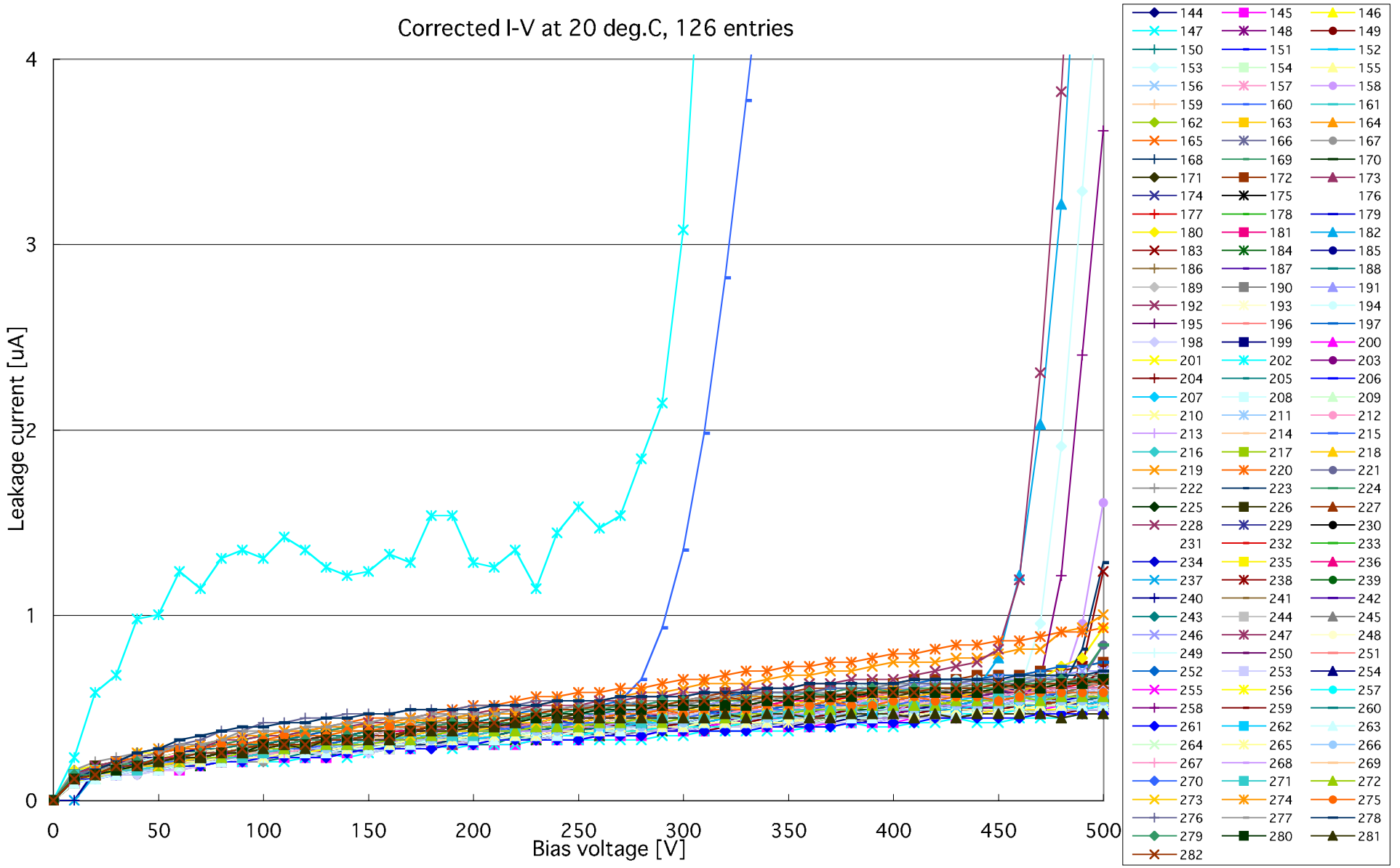
136 137 138
139 140 141
142 143


Corrected I-V at 20 deg.C, 126 entries
Leakage current [uA]
Bias voltage [V]
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450
500
144 145 146
147 148 149
150 151 152
153 154 155
156 157 158
159 160 161
162 163 164
165 166 167
168 169 170
171 172 173
174 175 176
177 178 179
180 181 182
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261 262 263
264 265 266
267 268 269
270 271 272
273 274 275
276 277 278
279 280 281
282

Defect ASICs summary

	Feb/02-Sep/02	Sep/02-Dec/02	Dec/02-Feb/03	All
Total	113	102	206	421
# of Hybrid with defect ASICs	11	20	22	53
# of defect ASICs	11	20	27	58
Rate (Hybrid)	9.73%	19.61%	10.68%	12.58%
Rate (ASIC)	0.81%	1.63%	1.09%	1.14%

Defect ASICs breakdown

	No.
DEAD	5
STUCK CELL	2
Large gain spread	9
Trim DAC loading failed	0
Negative offset	7
High offset	2
Low gain	1
Abnormal calibration line	1
Total	27
Rate(ASIC)	1.14%

Summary of Defect Channels in Hybrids

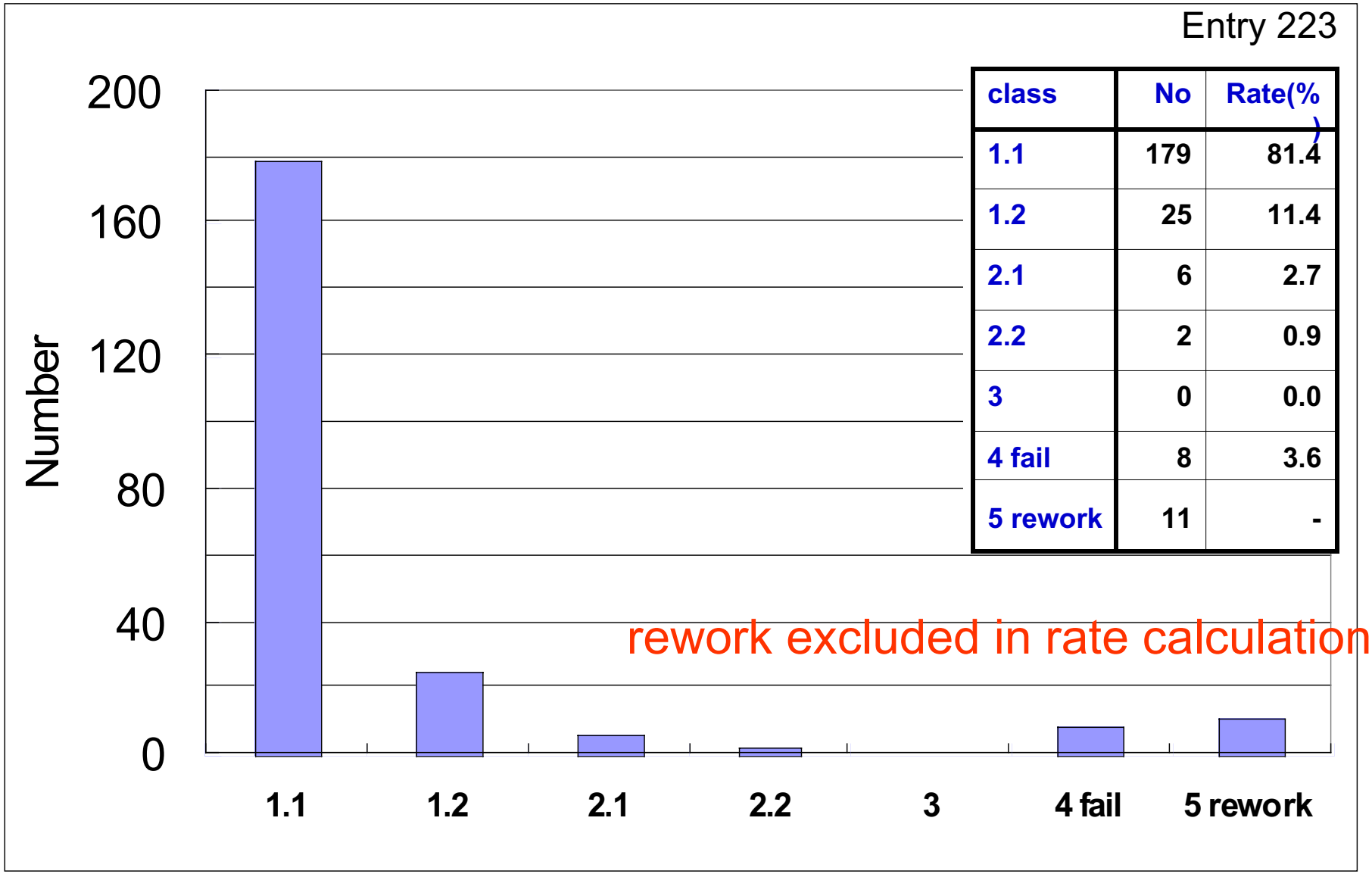
	Feb/02-Sep/02 (1-165)	Sep/02-Dec/02 (166-244)	Dec/02-Feb/03 (245-343)	All (1-343)
Entry(hybrid)	137	77	95	309
Pipeline(ch)	2	4	0	6
DEAD(ch)	2	9	0	11
STUCK(ch)	3	13	0	16
Noisy(ch)	29	15	18	62
Total(ch)	36	41	18	95
average(ch)	0.26	0.53	0.19	0.31

Summary of Defect Channels in Modules

	Feb/02-Sep/02 (1-125)	Sep/02-Dec/02 (126-184)	Dec/02-Feb/03 (185-282)	All (1-282)
Entry(Module)	95	50	90	235
Pipeline(ch)	1(1)	1(1)	3(4)	5(6)
DEAD(ch)	3(2)	0(0)	9(9)	11(11)
STUCK(ch)	3(3)	0(0)	13(13)	16(16)
Noisy(ch)	32(17)	25(14)	40(19)	97(50)
unbonded(ch)	95	76	9	180
Total(ch)	134	102	74	310
average(ch)	1.4	2.0	0.8	1.3

* (Hybrid)

Module Class categories



class	No	Rate(%)
1.1	179	81.4
1.2	25	11.4
2.1	6	2.7
2.2	2	0.9
3	0	0.0
4 fail	8	3.6
5 rework	11	-

Failure Modules

Module ID	Reason
20220170200018	facing crack
20220170200025	IV (high current, MD<350V)
20220170200029	sensor crack
20220170200034	IV (high current, MD<350V)
20220170200146	# of unbonded 16
20220170200160	IV (high current, MD<350V)
20220170200188	sensor surface distortion
20220170200202	IV (high current, MD<350V)

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UK-B
Production Status

Peter W Phillips
Rutherford Appleton Laboratory

On behalf of the UK-B Cluster
Birmingham, Cambridge, Queen Mary U of L, RAL

4th March 2003

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Of the 89 starts (since Dec02):

- 71 through QA, 62 of these delivered to RAL (38)
- 6 in production
- 7 awaiting rework (ASIC replacement) (4)

  …4 new bad chips:

  1 large gain spread (**UK100**)

  1 large gain spread cold (**UK019**)

  1 bad strobe delay setting (**UK056**)

  1 bad s-curves (**UK050**)
- 1 has a damaged PA not noticed in initial inspection (**UK107**)
- 2 destroyed(?) shipping to Japan (UK059,UK060)
- 1 destroyed in Birmingham (glue accident) (UK061)

We now remove the PA blue film before initial visual inspection, after bad experiences not seeing defects through it (film often quite dirty, but most dirt lifts off with film)

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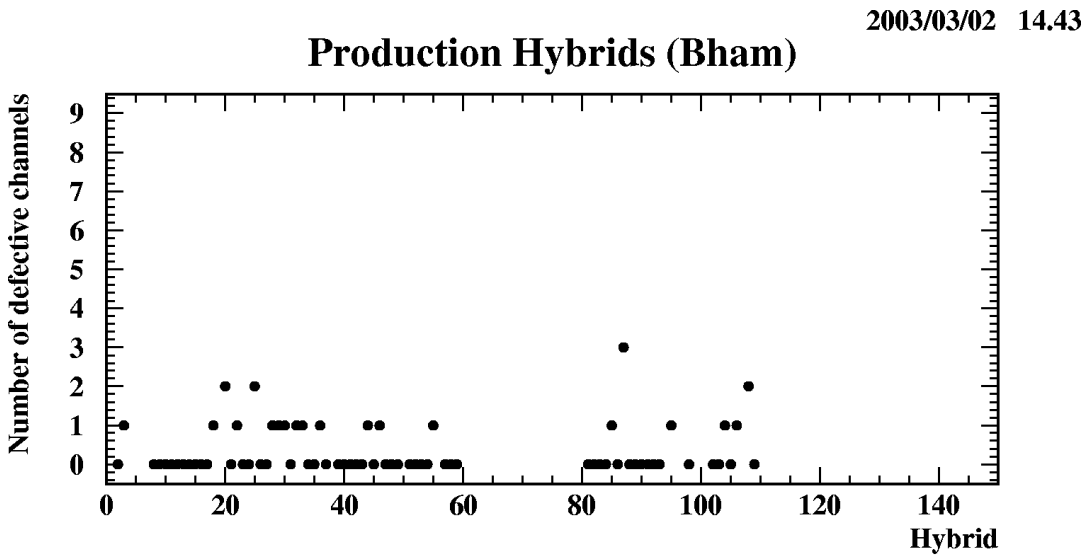
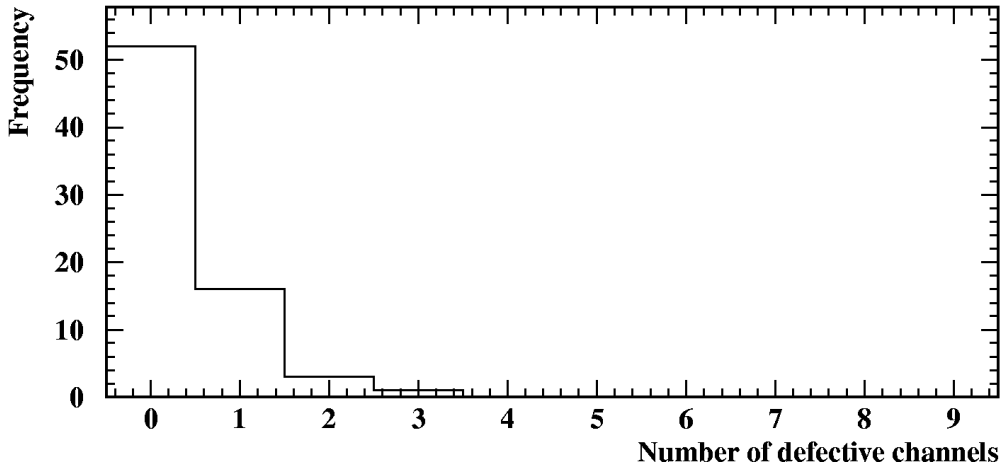
Defective ASICs and Channels on Hybrids

So far in Birmingham:
Bad ASICs: 6 / 1068 (0.6%)





Mean number of
defective **channels** / hybrid
= 25 / 72 = **0.3**
(not all are completely dead)

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Module Production Status at end of February 2003

Modules Started	57
In Progress	4
Shipped	26
Ready to be shipped	14
On Hold	6
Failed	6
Test Beam and Irrad	1

29 Completed Modules at end Jan

41 Completed Modules at end Feb (6.9% of 550)

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6 Failed Modules – no chance of recovery

- PR1 —M 002
  - —Misplaced hybrid, damaged bonds
- PR12 — BB804
  - —Fractured Baseboard, Result of accident
- PR39 — BB917
  - —Wild-In-plane Metrology. Operator Error
- PR42 — BB 890
  - —midyf at 14micron, msy at 77micron (tolerance=30)
- PR50 — BB941
  - —Control of Hybrid lost in hybrid mount.
- PR55 — BB937
  - —Glue in gap between and up on to sensors.
  - —Miscalculation of spacers on new jig.

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6 "On Hold" modules

- PR3 (M 09), PR9, PR10
  - Bad midyf (greater than 5 and less than 10)

- PR 16 (M 21)
  - Chip dead after HV breakdown
  - Put aside for later repair

- PR 24 (M 23)
  - Cracked pitch adaptor (23 channels missing)

- PR 28 (M 26)
  - HV Problems
  - For investigation and possible repair

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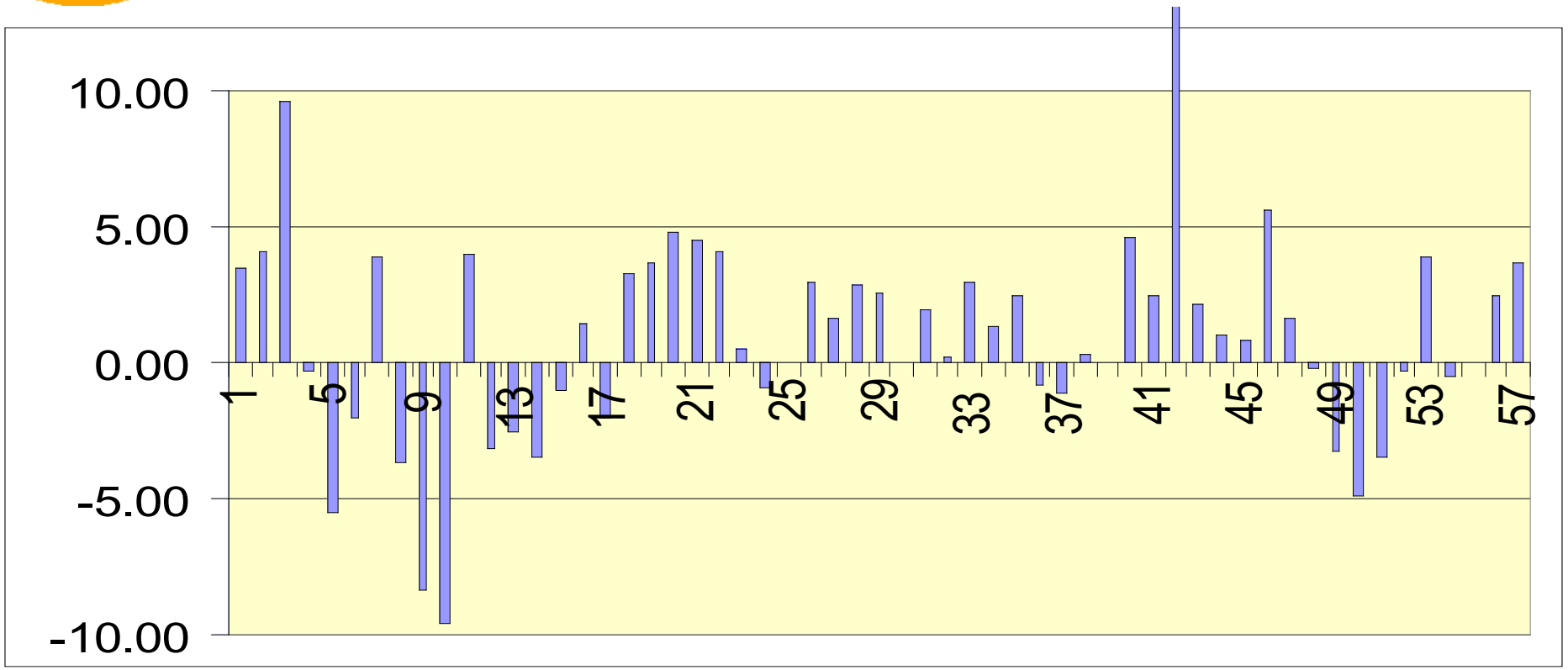
UK-B midyf History



Excluding point 42 and early data (<16):
RMS of 2.4µm with mean 1.3µm

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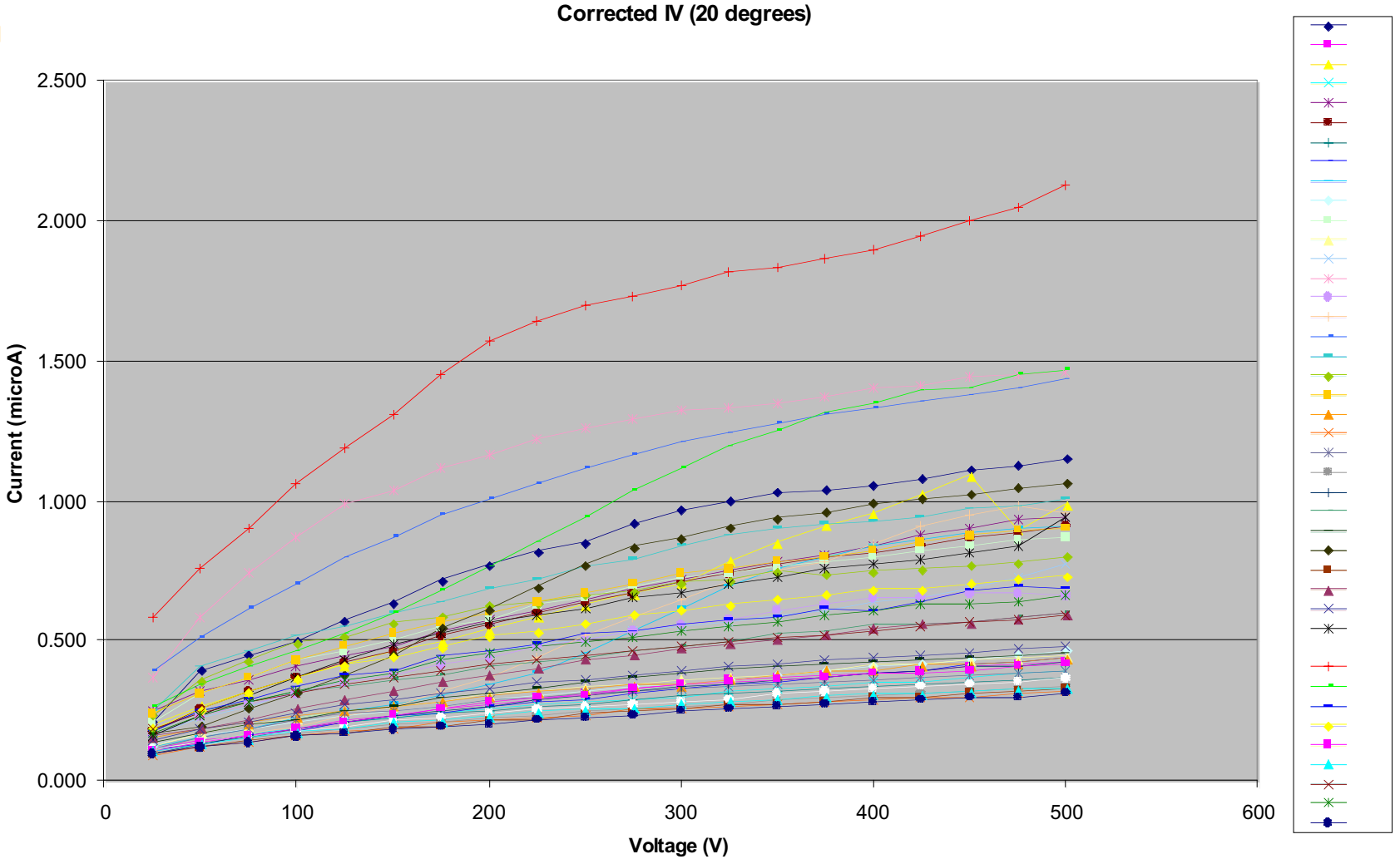
Leakage Current



4th March 2003

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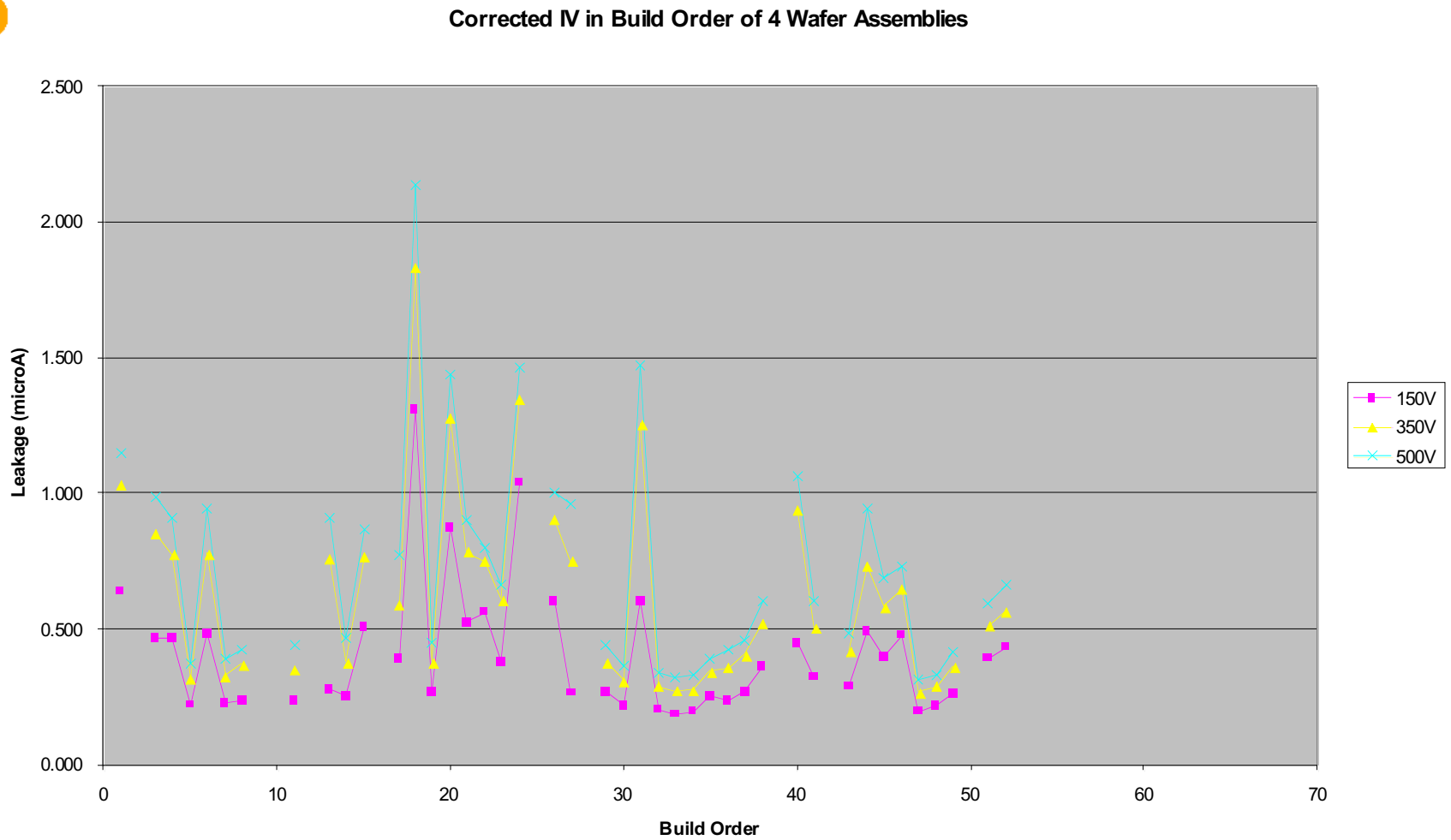
Leakage Current



4th March 2003

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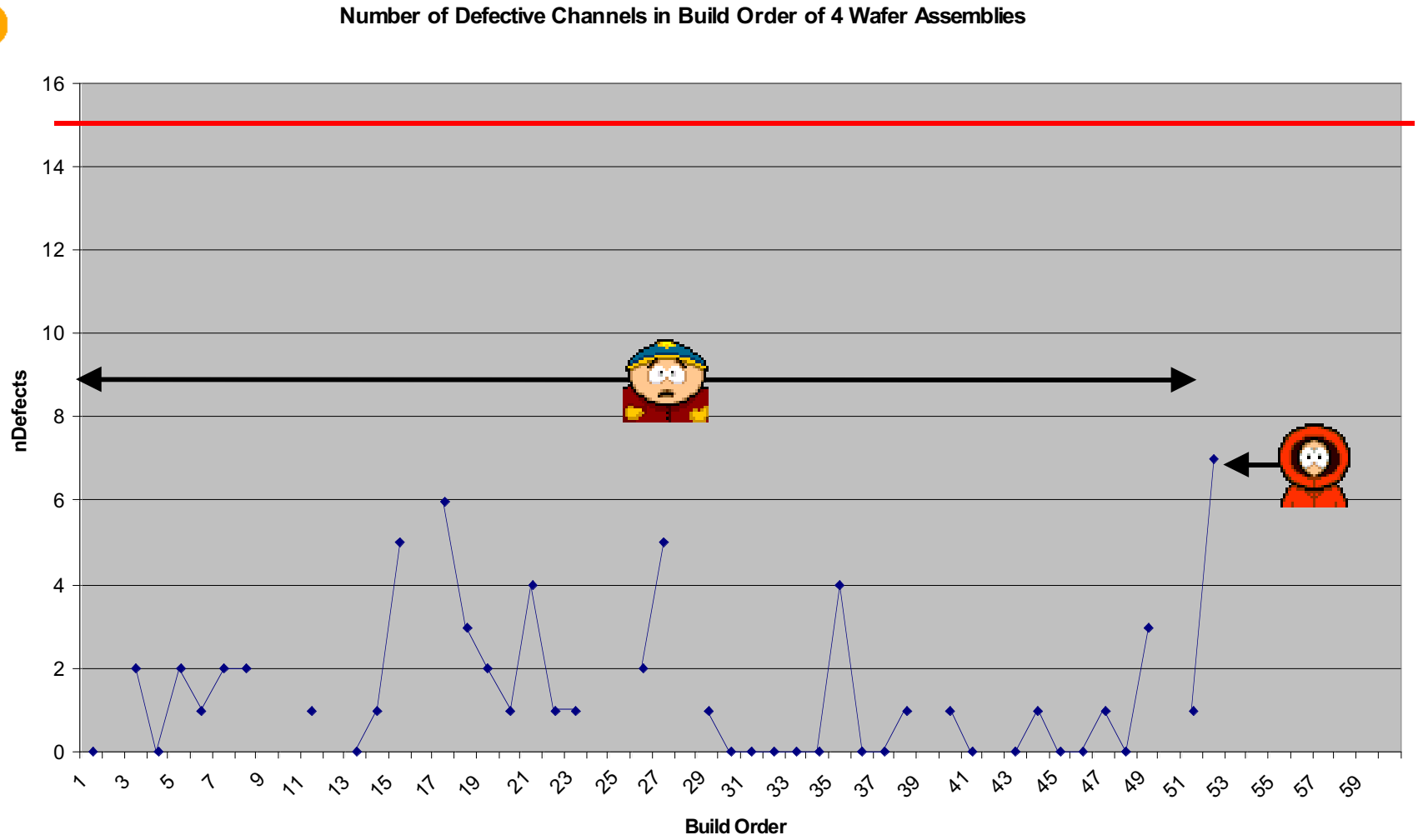
Defective Channels



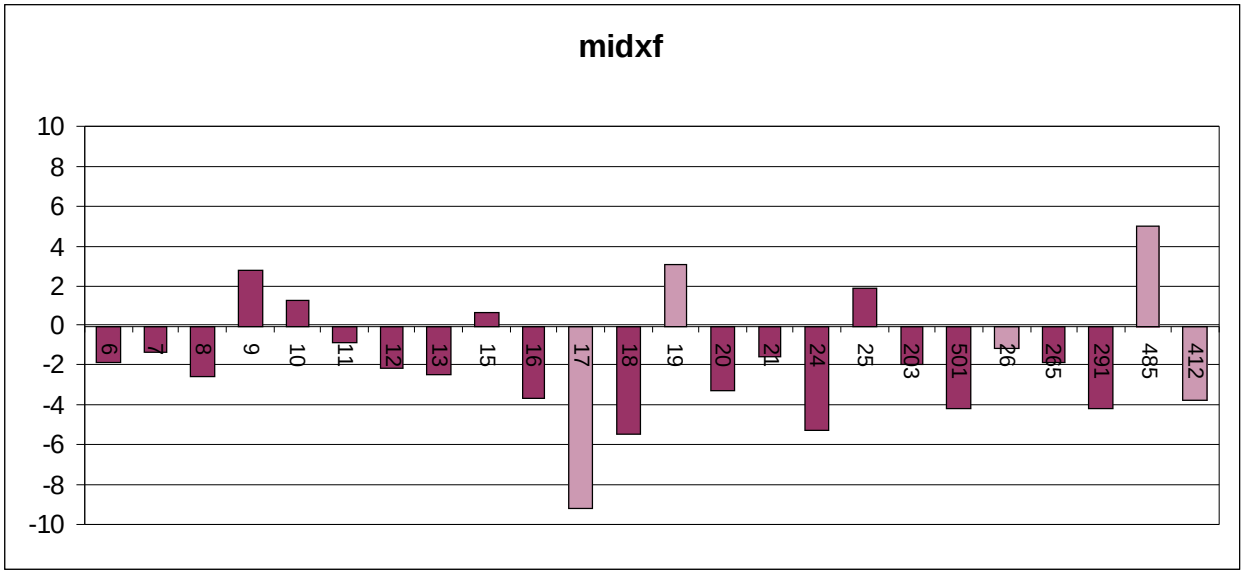
SCANDINAVIA cluster summary

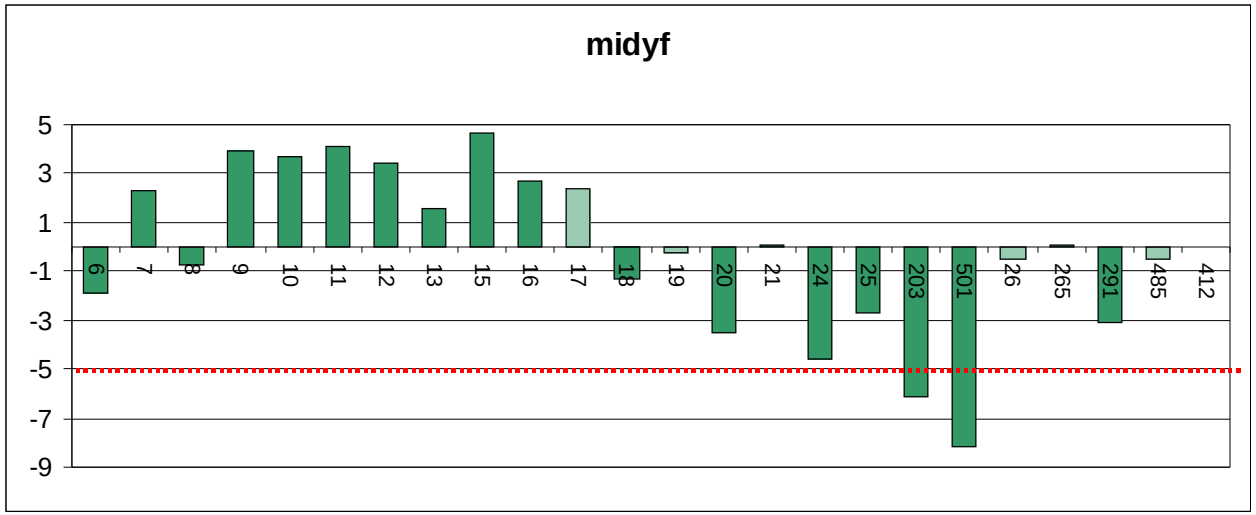
Production status

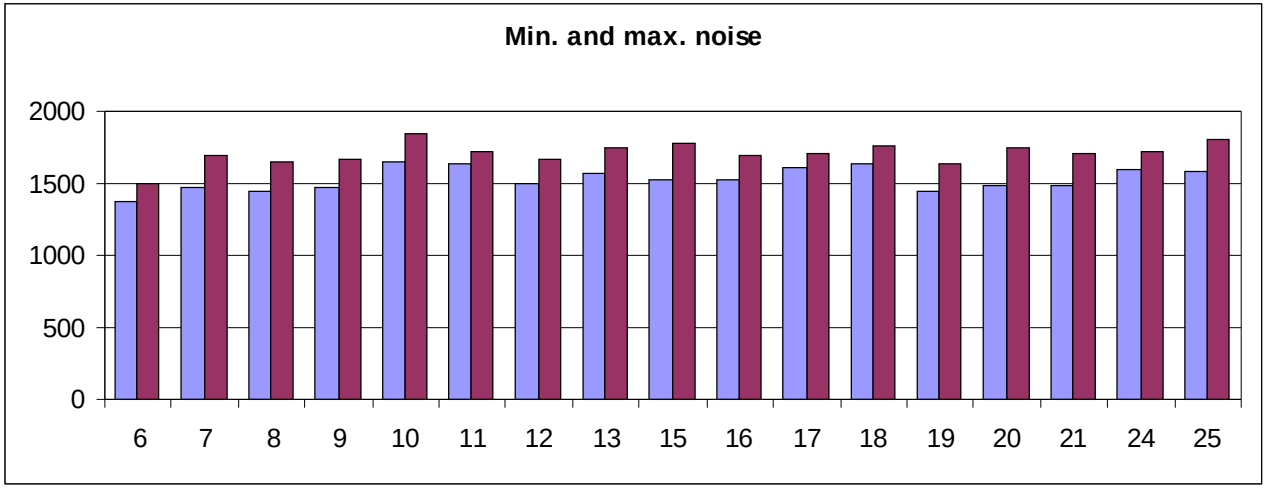
Date: **03-03-03**

	Baseboard # /Hybrid(Module) #	Mod. Assy.	IV	Ini. Surv.	Hyb. Assy.	Bond	Elect. Conf.	Therm. Cyc.	Long. Term.	Elect. Char.	Final. Surv.	Shipping
1	20220480110031/**20220380200006**											Bergen
2	20220480110032/**20220380200007**											Bergen
3	20220480110165/**20220380200008**											Bergen
4	20220480110256/**20220380200009**		skip									Bergen
5	20220480110337/**20220380200010**		skip									Bergen
6	20220480110258/**20220380200011**		skip								midyf=5.4 & b	
7	20220480110333/**20220380200012**		skip									Bergen
8	20220480110334/**20220380200013**		skip									Bergen
9	20220480110316/**20220380200015**		skip								midyf=5.5	
10	20220480110158/**20220380200016**		skip									
11	20220480110355/**20220380200017**		skip									
12	20220480110376/**20220380200018**		skip									
13	20220480110378/**20220380200019**		skip									
14	20220480110612/**20220380200020**		skip									
15	20220480110613/**20220380200021**		skip									
16	20220480110196/**20220380200024**		skip									
17	20220480110377/**20220380200025**		skip									
18	20220480110203/		skip	midyf=6.1								
19	20220480110209/**20220380200026**		skip									
20	20220480110501/			midyf=-8.5								
21	20220480110265/											
22	20220480110291/											
23	20220480110412/											
24	20220480110485/											

INITIAL Metrology results (midxf, midyf and thickness)






Min. and max. noise
2000
1500
1000
500
0
6
7
8
9
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11
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16
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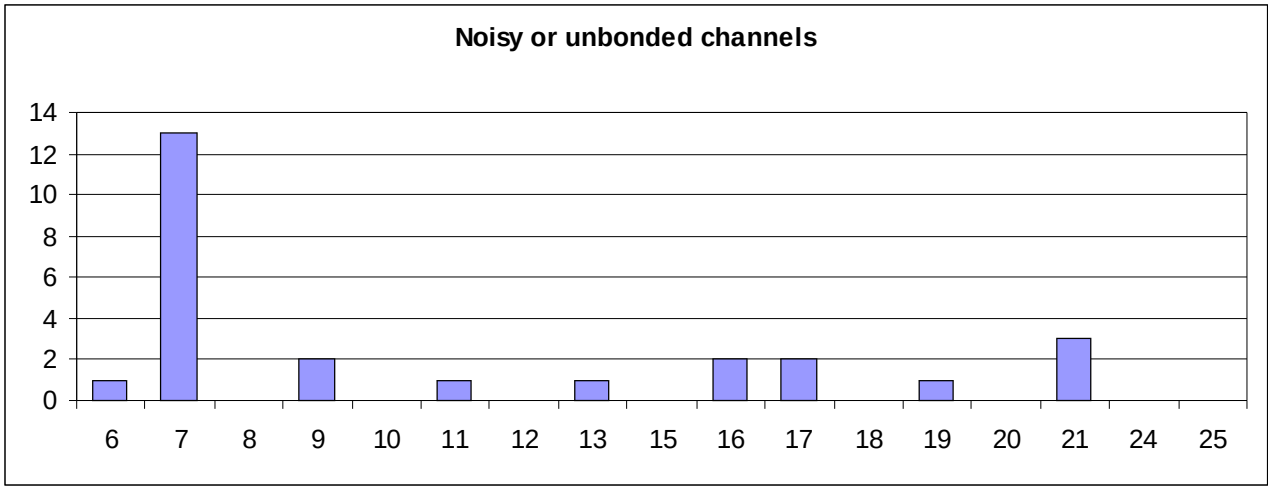
20
21
24
25


Noisy or unbonded channels
14
12
10
8
6
4
2
0
6
7
8
9
10
11
12
13
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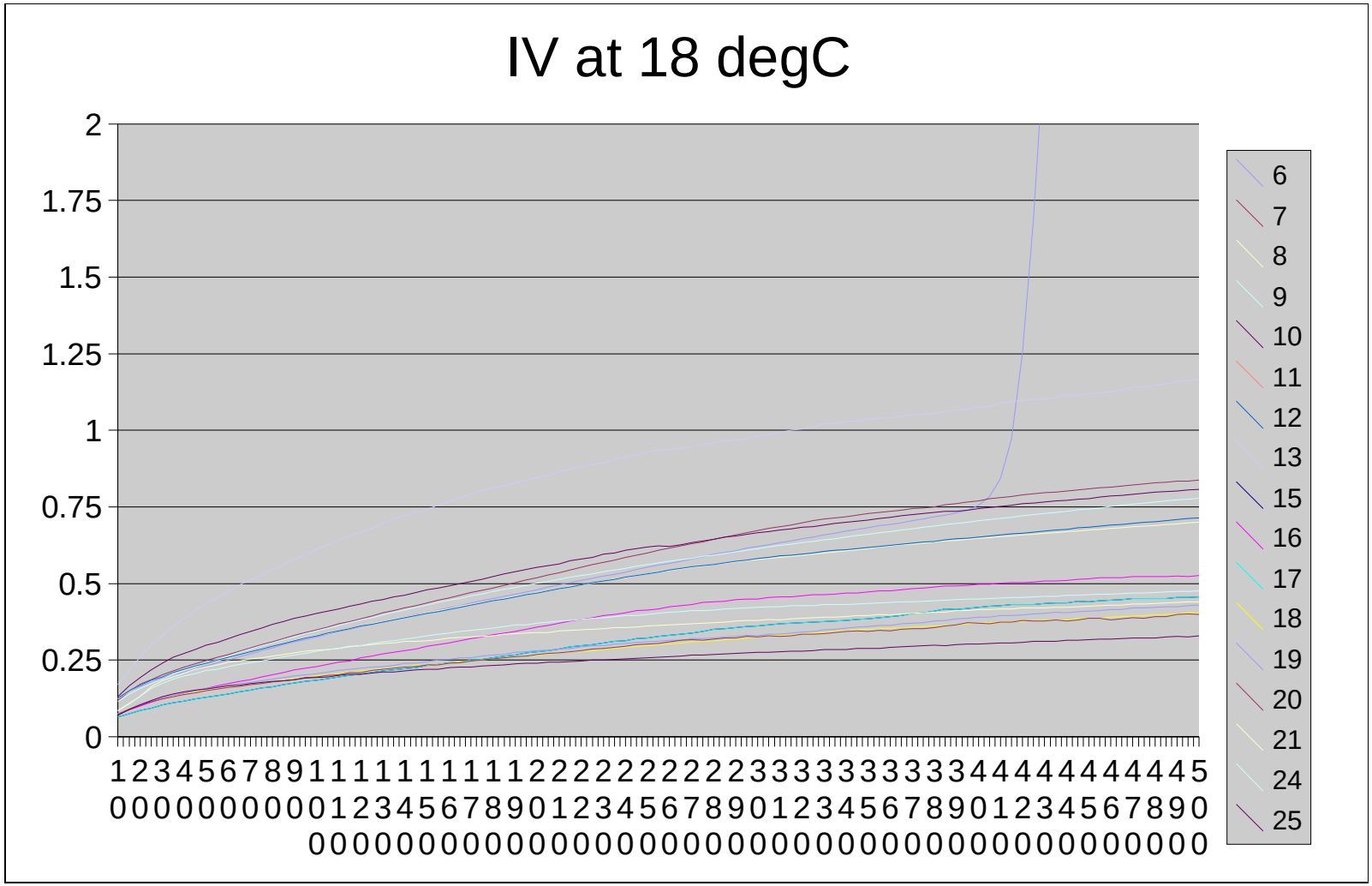
16
17
18
19
20
21
24
25


IV at 18 degC
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
1 2 3 4 5 6 7 8 9 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 5
0 0 0 0 0 0 0 0 0 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6
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USA Atlas SCT Barrel Module Assembly

Status Report

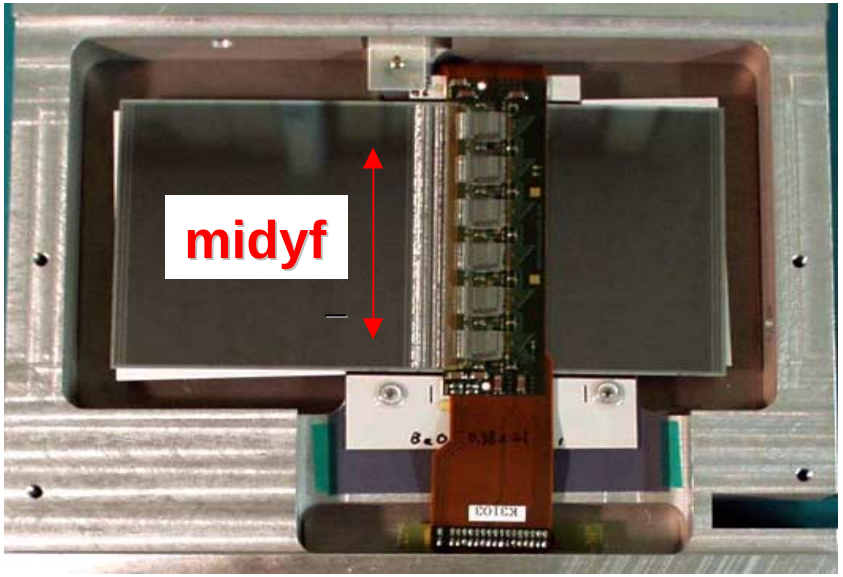
March 2003

module	? 4@500V	bonded 150C	unbonded	total bad	status and comments	fanout vintage
P1	500				on hold	
P2	480	1370	9	11		old
P3	510	441	1	2		old
P4	740	395	7	14		old
P5	560				on hold	old
P6	660**	1279	9	10	12 channels rebonded	old
P7	410	473	14	14	2 channels rebonded	old
P8	840**	1051	9	9	7 channels rebonded	old
P9	370	395	10	10	11 channels rebonded	old
P10	330	716	4	5	10 channels rebonded	old
P11	370	746	11	11	11 channels rebonded	old
P12	390	426	5	7	4 channels rebonded	old
P13	380	700	10	13	9 channels rebonded	old
P14	450	716	11	12	10 channels rebonded	old
P15	410	456	12	12	10 channels rebonded	old
P16	340	670	6	6		new
P17	380	334	4	7		new
P18	400	366	0	0		old
P19	380	366	0	0		new
P20	320	319	0	1		old
P21	330				on hold-stereo	
P22	350				on hold-damage	
P23	330	700	0		in electrical test	new
P24	420	760	0		in electrical test	old
P25	30000				on hold-1 det IV	
P26	350				on hold-sepf	
P27	340	370	0		in electrical test	new
P28	277		5		ready for IV	old
P29	380				in hybrid fold	old
P30					in glue	
P31					in glue	

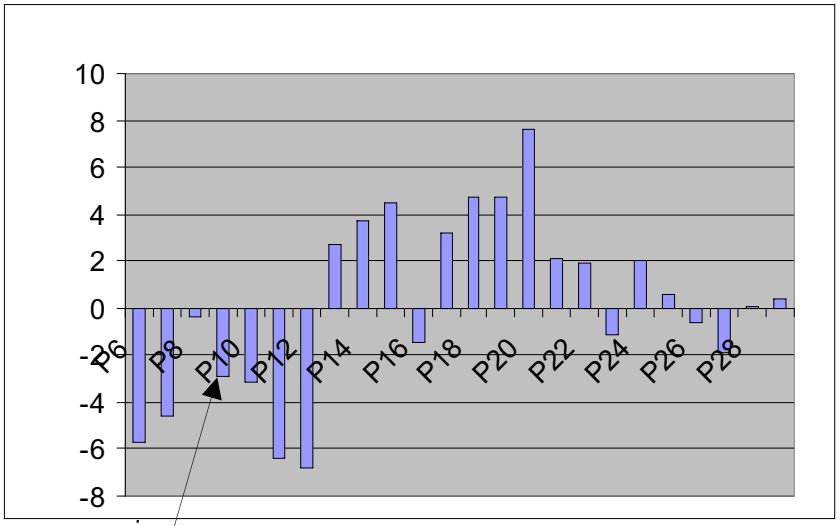
Mechanical Summary

module	midyf	midxf	stereo	glue	assym	sepf	sepb	fixture	comments, other issues
P1	**-52.8**	-5.6	**0.396**	226	-10	-5.9	-2.7	A1	wrong DIMS file loaded
P2	3.3	-4.7	-0.057	269	52	-4.5	-2	A1	**error in shim calc, too thick +14um**
P3	-3	-1.5	-0.12	164	11	-4.2	-6.5	A1	b/b b=3.2, spec is 3 (not assy issue)
P4	**-5.9**	-0.5	**-0.136**	165	6	-7	-3	A1	
P5	-0.6	-1.7	**-0.173**	147	-9	-7	-6.5	A1	
P6	**-5.7**	-1.9	0.03	199	27	-7.6	-5.8	A1	
P7	-4.6	1.2	0.021	176	20	-3.4	-1	A1	
P8	-1.1	7	0.01	165	7	-0.5	-4	A1	
P9	-2.9	0.5	0.018	175	13	-2.3	-3	A1	
P10	-3.7	0	0.029	157	3	-0.3	0.7	A1	
P11	**-6.4**	1.8	0.014	191	-21	-3.3	-2.3	A1	
P12	**-6.8**	7	0.017	213	50	-2.4	-3.8	A1	
P13	2.7	0.7	0.011	160	37	-3.7	-7.9	A1	
P14	3.7	3.6	-0.005	164	23	-6.4	-8.1	A1	hybrid height too high
P15	4.5	0	0.032	102	43	-7.1	-4.8	A1	
P16	-1.5	9.3	0.094	230	54	-3.8	-3	A0	**error in shim calc**
P17	3.2	1.3	0.034	148	25	-5.1	-3.3	A1	
P18	4.7	1.7	0.011	146	24	-3	-9	A0	
P19	4.7	8	0.117	122	17	-6	-3.1	A1	
P20	**7.6**	0.8	0.026	149	12	-8	-10	A1	
P21	2.1	2.5	**0.165**	130	6	-2.4	0.4	A0	
P22	1.9	-0.5	0.009	158	7	-10	-2.5	A2	
P23	-1.1	4.4	0.024	160	25	-2.8	**-15.1**	A1	
P24	2	5.5	-0.054	135	6	-6.9	-1.3	A0	
P25	0.6	1.3	-0.007	174	17	**-10.7**	-6.7	A2	
P26	-0.6	3	-0.01	147	23	**-23.1**	-5.7	A1	
P27	-1.9	7.8	0.026	159	31	4.1	1.7	A1	
P28	0.1	4.7	0.023	149	24	1.6	2.3	A1	
P29	0.4	1.9	0.041	161	25	3.5	3.4	A1	

Front/Back Alignment



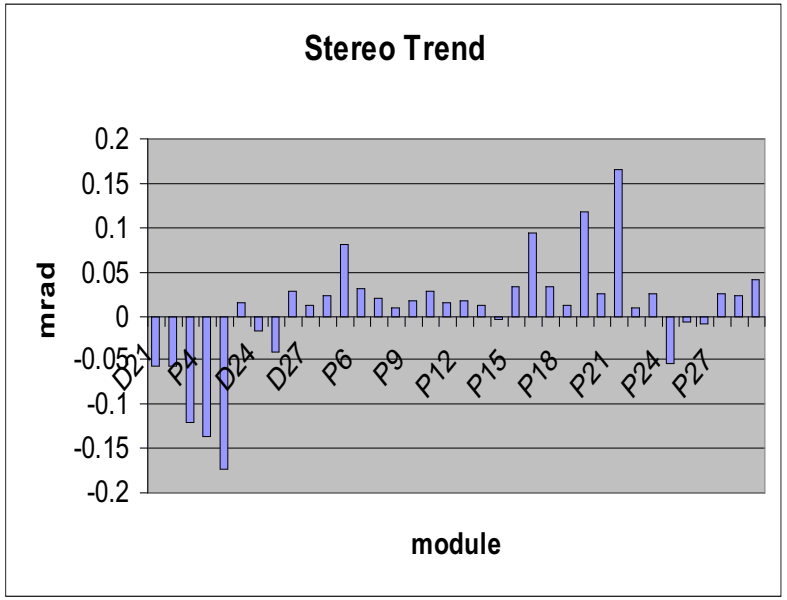
Modules Built since Dec 02



With RAL adjustment procedure P10 and after.

Stereo Angle Trend

- Data include 3 fixtures in use
- Adjustment procedure in use
- Large steps are DIMS file changes or new fixtures



Hybrid/Module Production Test Results

A. Ciocio - LBNL

Status - Hybrids

Hybrids Built	Hybrids tested OK	Hybrid on hold	Hybrids burn-in	Hybrids fanout done	Modules
73	63	10	56	34	19 *

- All current production hybrids and modules built at LBL
- UCSC getting ready with
  - hybrid-chip gluing and bonding
  - Chip replacement
  - Burn-in

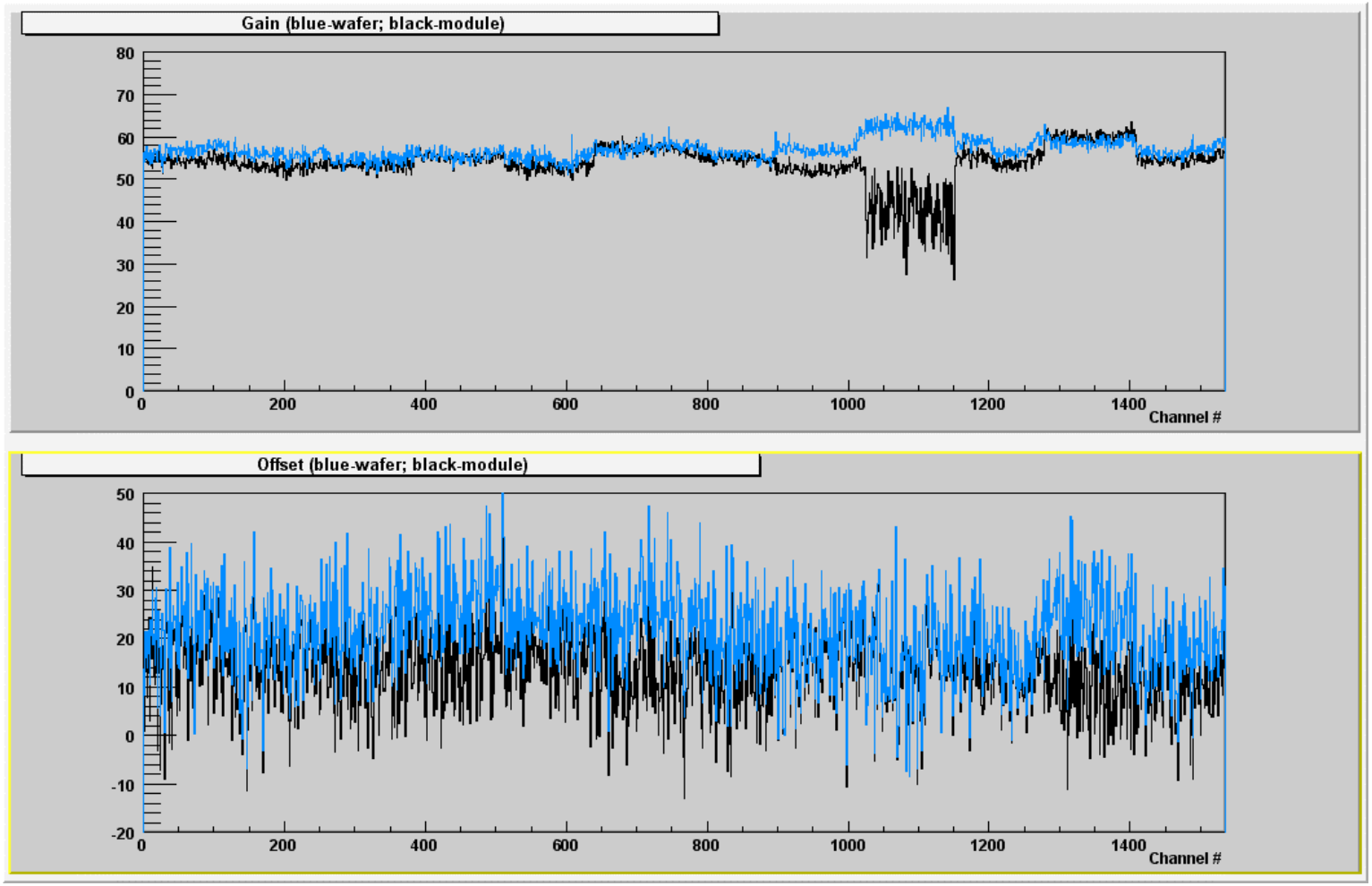
* As of Feb 27 – 2 new modules have been built since then but not electrically tested yet

Defective Chips

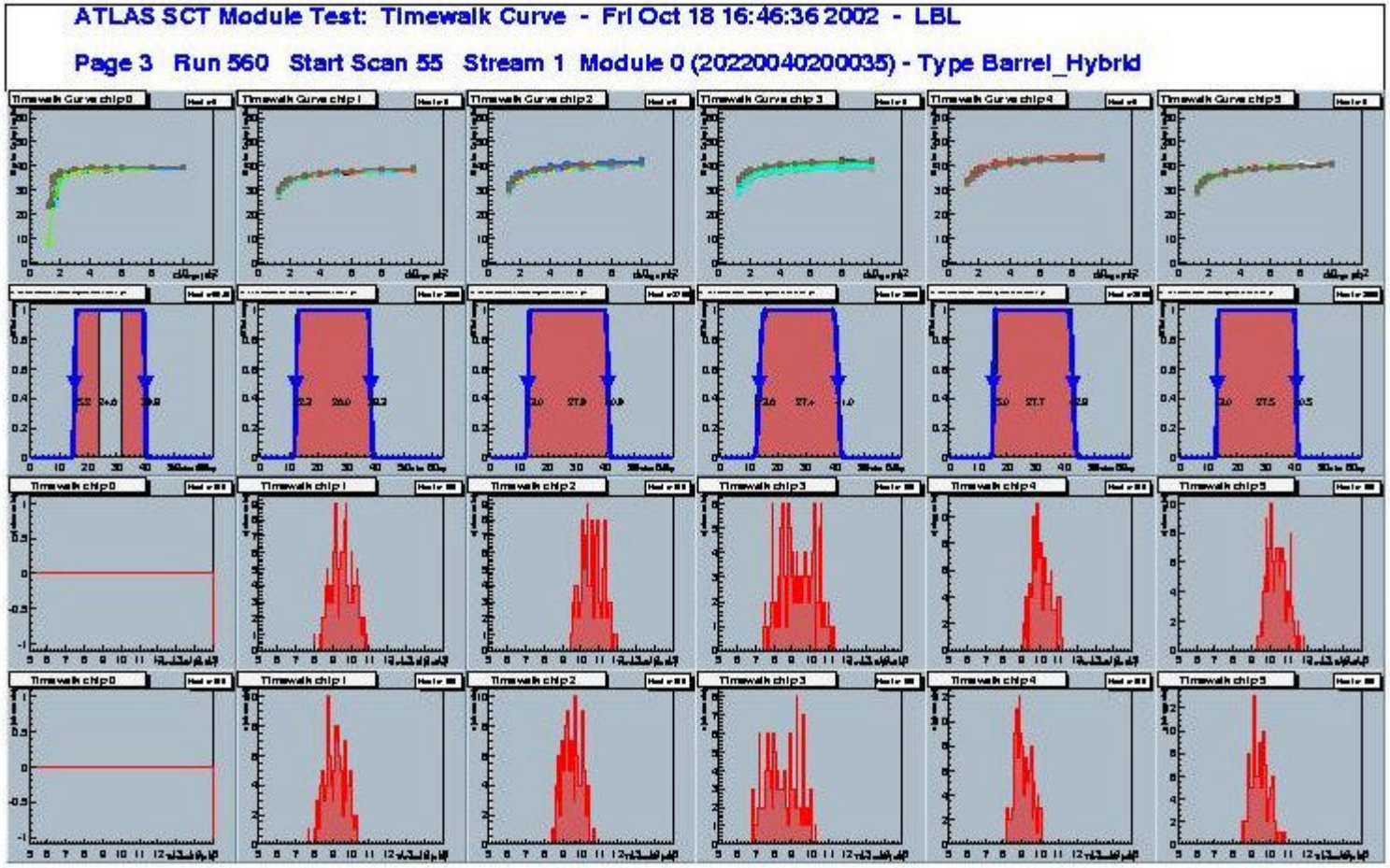
73 Hybrids built - 876 Chips - 12 (+2) defective ASIC's (1.6%)

Hybrid ID		ASIC ID	Defect
20220040200011	Chip 11	Z40859-W11-253	Large Gain Spread
20220040200013	Chip 6	Z40859-W02-51	chipped
20220040200020	Chip 1	Z40859-W014-5	TOKEN failure
20220040200021	Chip 8	Z40859-W09-136	Large Gain Spread
20220040200022	Chip 10	Z40859-W09-196	High Offset
20220040200035	Chip 6	Z40859-W01-171	Time Walk test failure
20220040200039	Chip 2	Z40859-W04-223	Large Gain Spread
20220040200039	Chip 10	Z40859-W09-204	chipped
20220040200046	Chip 9	Z40803-W02-132	Large Gain Spread
20220040200047	Chip 0	Z40862-W11-10	TrimDAC loading
20220040200054	Chip 4	Z40803-W05-18	Large Gain Spread
20220040200058	Chip 7	Z40803-W05-158	Trim DAC loading
20220040200068	Chip 1	Z40862-W02-232	Large Gain Spread
20220040200073	Chip 0	Z40803-W01-1	Strobe Delay failure

Hybrid 20220040200021
Wafer/Hybrid Comparison

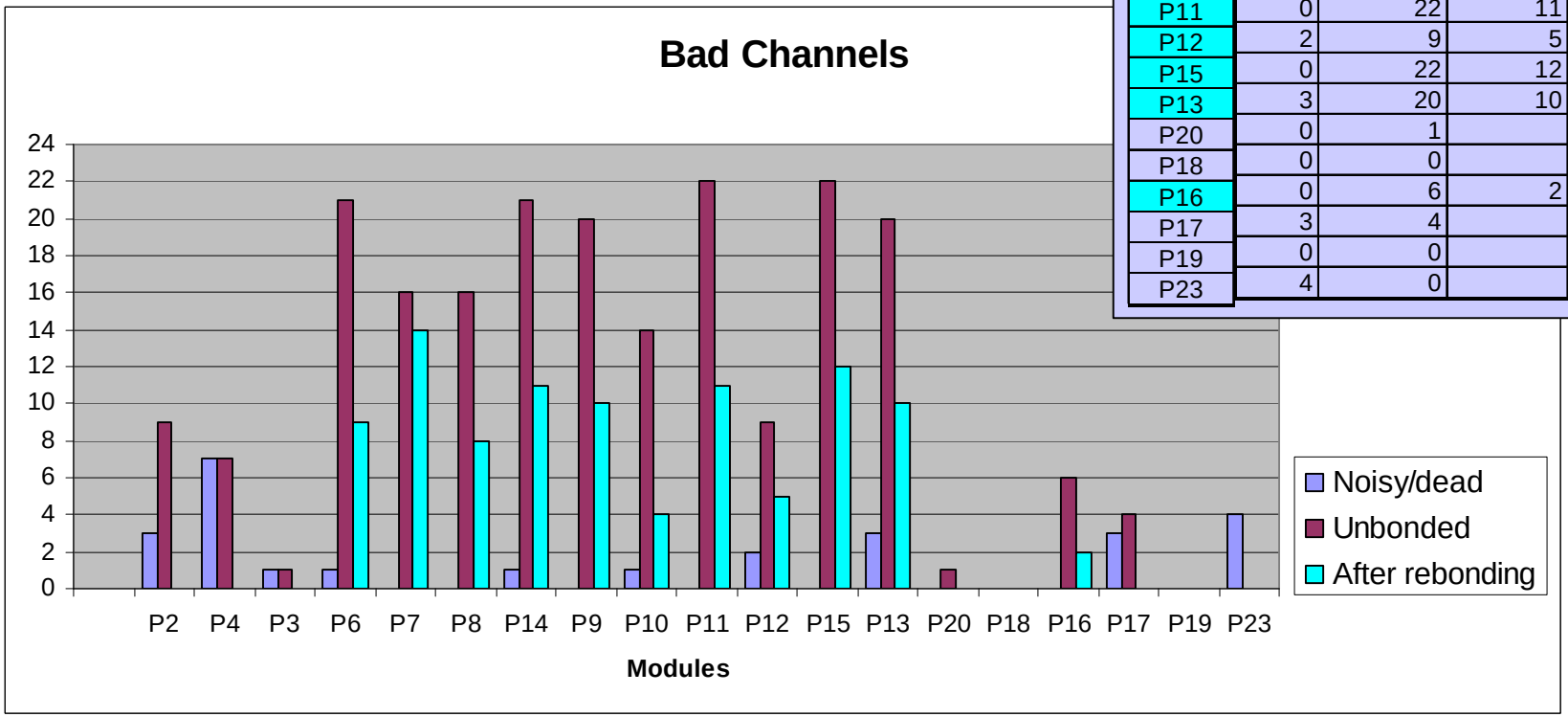


Hybrid 20220040200035
Chip 6 (M8) Time Walk Failure

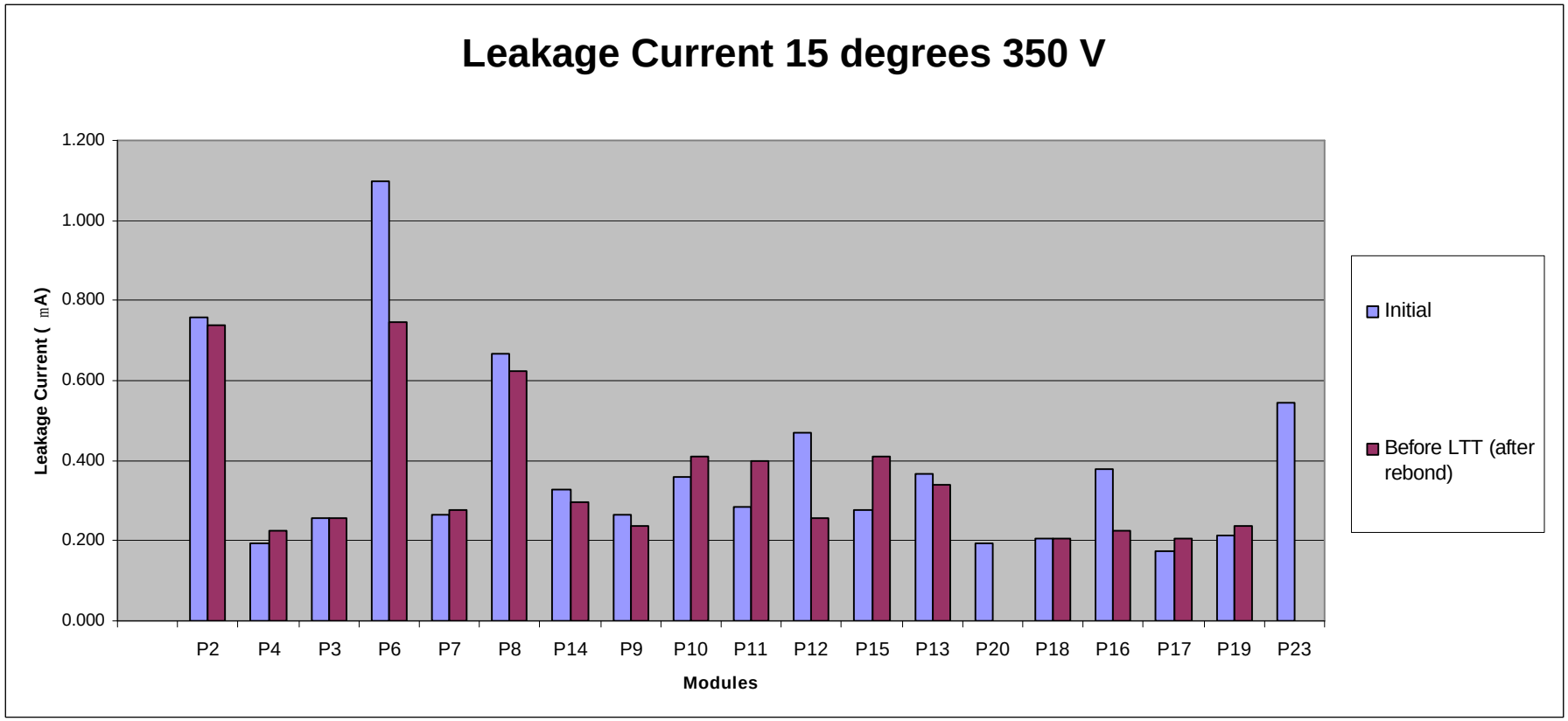


Bad Channels

Module	Noisy/ dead	Unbonded	After rebonding	Total bad channels (Module)
P2	3	9		12
P4	7	7		14
P3	1	1		2
P6	1	21	9	10
P7	0	16	14	14
P8	0	16	8	8
P14	1	21	11	12
P9	0	20	10	10
P10	1	14	4	5
P11	0	22	11	11
P12	2	9	5	7
P15	0	22	12	12
P13	3	20	10	13
P20	0	1		1
P18	0	0		0
P16	0	6	2	2
P17	3	4		7
P19	0	0		0
P23	4	0		4



Leakage current after rebonding



Summary

HYBRIDS

- **Defective Chips**
  12 chips defective after electrical testing + **2** damaged (chipped)
  Gain(6) Token(1) TW (1) Strobe Delay (1) TrimDAC (2) High Offset (1)
- **Wafer/Hybrid comparison**
  - used regularly and especially when anomalies are present
  - effective tool for chip selection
- New features/cuts in the software helps with anomalous chip response
- **LT-Tests** show no time dependence for defects: time could well be reduced to a few hours

MODULES

- **19 modules built** as of Feb 27 **+ 2** just assembled
- 17 modules completed with testing + 2 in progress
- **PA defect** on first batch of 29 hybrids
  - 15 hybrids already used in modules (11 rebonded)
  - 9 modules with 8-14 final unbonded channels (50% channel regained)
  - 14 hybrid still to be used but fixing bonds during rebonding -> good yield
  - 4 new hybrids used in modules
- HV boards communication/protocol more stable after Peter's upgrade of the software
- **No additional defect found in modules through sequence of tests**

Aug 4, 02

Preliminary Report on US Barrel Module Site Qualification Request

The US Cluster submitted their Site Qualification Request on July 19th 2002, and provided data and results on five modules (Q1 to Q5). Information was also provided on two modules made earlier (E3 and E4). The module numbers are:

Q1	20220040200004
Q2	20220040200003
Q3	20220040200006
Q4	20220040200007
Q5	20220040200005
E3	20220040200001
E4	20220040200002

These are the first modules seen from the US Cluster and are a significant achievement towards Site Qualification. This preliminary report is provided now, to help the US Cluster advance with its module assembly programme. The features of each module have been assessed and are commented upon, as are the overall procedures, and a recommendation is provided. Discussion of the exchanged modules is in the attached documents.

1. Module Assessments:

Bonding: for several modules (Q1, Q2, Q4) the leakage currents are significantly more than the sum of those for the individual detectors after strip wire-bonding, and also bond-shorts are reported on some modules.

Damage: two of the qualification modules were damaged during assembly, Q2 by scratching a detector, and Q4 by a bonding machine accident requiring replacement of ASICs

Electrical readout: both E3 and E4 had failed timewalk, and Q5 had 5 chips with rather severe s-curve anomalies. Otherwise the results as satisfactory.

Mechanical: most xy results are within specification; midyf is slightly out of tolerance for Q4. The spread of midyf in the qualification modules is worrying. Although the z-shape is understood with the flatter detectors, the asymmetry of the shape in the upper and the lower side is noticeable and should be corrected (see the "CommonProfile" from the 5 US site qualification modules shown in the KEK cross-check report).

Hybrid mounting: from the visual inspection of module Q1 and from the temperature difference in T0 and T1 in several modules (Q1, Q2, and to some degree in Q3, Q5), it may be concluded that there is insufficient adhesion in the hybrid mounting, or possible asymmetries. The mounting was done with a different fixture from that to be used in the Series Assembly. Similarly, the adhesion of ASIC's appears to be insufficient in some chips (Q1).

Metrology: in Series Assembly the metrology of hybrids and the big capacitors has to be made.

Cleanliness: from the inspection of modules (Q1 and Q3) the cleanliness of the assembly and/or testing environment must be improved.

Consistency/Cross-check: for the exchanged Q1 module, there is good consistency in the results obtained, both mechanically and electrically. Measurements of Q3 are still in progress.

2. Site Qualification Requirements

In the SQ requirements it was agreed 5 successful modules must be achieved for site qualification. Clearly, if for example 6 attempts are made then 1 is allowed to fail. We do not believe that the US Cluster has yet completed the necessary number of successful modules for SQ. However this should not be allowed to inhibit the progress in module building at the Cluster provided the necessary improvements are achieved. The main requirements relate to the following:

(a) It is clear that achieving leakage currents for completed modules that are close to the sum of the intrinsic currents of the bare detectors has proved difficult but E4 and Q5 show that this may have been achieved. However the detector temperature of the US measurements is unclear. It needs to be assured that little excess current is induced in module assembly.
(b) 2 modules out of 5 (Q1 to Q5) suffered damage, and it needs to be demonstrated that this is not a recurring problem.
(c) The results of all mechanical and electrical data from Q1 at KEK and Q3 at RAL need to be fully assessed for checking both performance and consistency of measurements (the Q1 KEK cross-check is appended)
(d) Given the importance of the hybrid mounting technique it is necessary to assess modules made with the final US tool.
(e) The difficulty mentioned over detector bonding is worrying, as other sites have used the existing glue pattern for a long period of time for many successful modules. There are definitely implications in now changing this pattern: glue will be placed closer to detector edges and hence be more liable to emerge on detector surfaces. Further discussion would be needed before such a change could be implemented.
(f) It is necessary for the US site to guarantee insurance for all the module components that are being provided to it, and for the completed modules.
(g) The US site is requested to provide the specification of cleanliness of the areas used for module assembly and for testing, and to confirm that either face masks are worn during assembly, or else appropriate protection schemes are in place. The cleanliness of the exchanged modules is not satisfactory.
(h) Demonstration of complete metrology is required before getting into large scale series production.

3. Recommendation

The US Cluster should address each of the points mentioned above, some of which need collaboration with other Clusters. After reviewing the necessary changes that may be required in procedures and training we believe that the Cluster should then start to use the Series Assembly components recently provided to make up to 10 more modules. Data on each module should be fed back to the Module Co-ordinators regularly, and exchange of the first two of these modules urgently with UK-B and Japan is requested. We expect that site qualification will be achieved within the assembly of the coming 10 modules. If problems do arise during this sequence, further US Series Assembly should be halted after 10 modules for SCT re-appraisal.

Barrel Module Assembly: Site Qualification work for US and Scandinavian Clusters

At the Barrel Module Working meeting on December 10th 2002 it was agreed:

The US and Scandinavian Clusters had both made important progress towards final SQ, as shown in their recent documentation, and in their presentations at the meeting. It is now necessary for them to complete their SQs in efficient programmes, and then move to continuous Series Assembly.

The proposals are:

1. For the Scandinavian Cluster:

   a) 10 modules should now be assembled with Series components, to be completed during January 2003. The results of these (mechanical and electrical) will be made available regularly to the committee, and particular importance will be put upon maintaining the mechanical tolerances to be within the specifications, and electrical performance to be demonstrated using the improved readout systems now existing in Bergen and Uppsala

   b) the committee would be updated on their plans for baseboard-wafer assembly transport, and for final module boxes, as needed for transport to Oxford for mounting.

2. For the US Cluster:

   a) Module assembly progresses with series components, paying particular attention to achieving:

      I. improved leakage current performance after bonding
      II. close checking for verification of no glue emerging from wafer edges or junctions, as the community agrees to allow this Cluster to use a modified glue pattern if this can continue to be shown to be successful in large scale production.
      III. reducing damage, for example from surface scratches of wafers, during assembly
      IV. all mechanical tolerances being maintained within the BM specifications.

   b) The stated aim of the Cluster is to move rapidly to assembly of two modules per day, as the initial target. This should allow completion of around 40 quality modules in 5 working weeks. It is suggested that after this number of completed modules there is a review by the committee to help the Cluster agree its future workplan and to assess yields and performance.

Information considered in the review will include:

I. ability of jigging schemes and bonding quality to meet the necessary specifications
II. consideration of the total time for assembly and QA, from start to final checked and approved module ie available for shipping to UK for mounting
III. with breakdown of times needed to carry out sub-items of this chain.

3. From the module assembly rates estimated by the Cluster it is expected that the review should be scheduled for mid-February 2003.

Dated : 13th December 2002 Mike Tyndel, Tony Carter, Nobu Unno.

Draft Minutes of the Phone Meeting of the Site Qualification Committee for US Barrel Module Production

Held on Friday 21st February 2003

Present: Bjarne Stugu (Scand)
Nobu Unno, Susumu Terada (Japan)
Tony Carter, Janet Carter (UK-B)
Apologies: Richard Brenner (Scand)

1. Introduction

The Committee had been asked to consider the report submitted by the US cluster (3rd US update, 12th February 2003) on modules P1 to P27 constructed (or started) in the US from series components. It was asked by the Project Leader to reach one of the following conclusions before March 3rd:

(a) Recommend to accept the US proposal for altered specifications (not yet received)
(b) Reach an agreement with the US cluster to invest more resources
(c) Reach an agreement on an alternative proposal
(d) Refer the matter to the PL and ATLAS review

The results in the report were discussed. The recommendations focussed on (c), with agreement reached between the representatives of the 3 Clusters. See section 3 below.

2. Assessment of US Modules

The modules from P8 onwards (newer production) were assessed against the agreed proposals for the US Cluster coming from the Barrel Module Working meeting on December 10th 2002. The proposals are reproduced below, followed by the assessment of the Committee (SQ):

For the US Cluster:

a) Module assembly progresses with series components, paying particular attention to achieving:

I. improved leakage current performance after bonding

SQ: A welcome improvement is seen in the data provided. However, the final result, following the necessary bonding rework, is the most important one (not yet available).

II. close checking for verification of no glue emerging from wafer edges or junctions, as the community agrees to allow this Cluster to use a modified glue pattern if this can continue to be shown to be successful in large scale production.

SQ: No information provided.

III. reducing damage, for example from surface scratches of wafers, during assembly

SQ: No information provided, but the leakage current values suggest that the wafers are undamaged.

IV. all mechanical tolerances being maintained within the BM specifications.

SQ: This is not met. Information was not provided on all mechanical parameters, but from that given, 9 out of 20 modules/4 wafer assemblies were out of specification. Of these the SQ judged that 4 were only slightly outside the specification boundary. Another 2 arose from operator error. Hence the committee is still hopeful that, with tightened procedures and more experience, the US cluster will be able to make modules within or very close to the mechanical specifications with high yield.

b) The stated aim of the Cluster is to move rapidly to assembly of two modules per day, as the initial target. This should allow completion of around 40 quality modules in 5 working weeks. It is suggested that after this number of completed modules there is a review by the committee to help the Cluster agree its future workplan and to assess yields and performance.

SQ: It is premature to hold this review, as only 18 modules (P1 to P18) have been reported as bonded.

Information considered in the review will include:

I. ability of jigging schemes and bonding quality to meet the necessary specifications

SQ: The production quality coming from the jigging schemes and checking and adjustment procedures still needs to be improved.
The bonding quality is not yet fully proven (the committee took note of the quality of the old fan-ins). We expect much less than 1% unbonded or partially bonded channels for nearly all modules, as achieved by all the 3 other clusters. We regard it as very important to minimise the number of bad channels in a module caused by assembly problems, given all the effort taken to provide essentially perfect detectors and ASICs with no bad channels. The NO and s-curves of the modules seem satisfactory.

II. consideration of the total time for assembly and QA, from start to final checked and approved module ie available for shipping to UK for mounting

III. with breakdown of times needed to carry out sub-items of this chain.

SQ: It is premature to consider II and III as a routine quality production procedure has not yet been established.

2. From the module assembly rates estimated by the Cluster it is expected that the review should be scheduled for mid-February 2003.

SQ: It is premature to consider the review. See the section 3.

3. Recommendations

3.1 The SQ Committee does not consider that the US Cluster has yet met the necessary standards to be qualified for full series production.

3.2 It requests that the existing modules be completed, including full bonding rework, and the results are presented in SCT week.

3.3 It recommends that new production be continued with full checking and adjustments as necessary, with the intention that specifications are routinely and consistently met.

3.4 There is concern that the limited number of series module components must not be wasted. In particular, the US cluster is asked to review and report its yield performance on a fortnightly basis, and also to put carefully on hold any 4 wafer assembly that is outside the agreed specifications, without mounting the hybrid.

3.5 The SQ Committee expects a further general review of quality to take place in 2 months time.

3.6 The Barrel Module Community will agree sensible acceptance tolerances just beyond the existing mechanical specifications to cover the tails of distributions. Beyond this, the SQ Committee, representing 3 clusters of the Barrel Module Community, does not wish to see any change in the agreed mechanical or electrical specifications.

3.7 The SQ Committee recognises that these recommendations will slow the rate of module production in the US over at least the next 2 months. It recommends that discussions take place between the Clusters during the next 2 weeks to finalise a plan for building some additional modules in Japan.

3.8 The committee unanimously agreed these recommendations.

From a.a.carter@qmul.ac.uk Tue Mar 4 16:08:29 2003
Date: Fri, 28 Feb 2003 16:57:10 +0100
From: Tony Carter <a.a.carter@qmul.ac.uk>
To: Mike Tyndel <m.tyndel@rl.ac.uk>
Cc: Bjarne Stugu <bjarne.stugu@fi.uib.no>,
Richard Brenner <brenner@tsl.uu.se>,
Susumu TERADA <susumu.terada@kek.jp>, YoshiNobu Unno <unno@post.kek.jp>,
Janet Carter <jrc1@hep.phy.cam.ac.uk>,
Tony Carter <a.a.carter@qmul.ac.uk>
Subject: US SQ phone meeting of Feb 28th

Dear Mike,

Below are notes on the various items and discussions from the phone meeting of the US Cluster SQ Committee this morning.

Tony and Nobu

Notes from our phone meeting of Friday 28th February:

We noted the progress achieved by Mike T in discussions with Abe Seiden; namely

"....many areas of complete agreement between [US SQ Committee] and the US and we should try and build on these:

1) The electrical performance of the modules is crucial and must be closely controlled.
2) A high yield is essential and loss of components is unacceptable
3) Careful checking during assembly should be continued to catch mistakes
and maintain high yield.
4) Regular reporting & review of performance is useful - especially now at start-up. ..."

The contents of all four items were welcomed and fully endorsed by the US SQ Committee.

The Committee also welcomed (and commented upon) the further proposals from Abe:

1)The US agree to work to the existing (or slightly modified spec along the lines you suggested & to be finalised next week)

Welcomed, and Committee will propose the extended values corresponding to the 'pass' grade of module for discussion and agreement in SCT week.

2)The US will attempt to purchase a 2nd smartscope but cannot afford to extend the time scale beyond 1 year.

Welcomed, as positive contribution to project succeeding in quality and timesecale.

3)As the additional time needed to do the adjustments is ~ 20% another cluster (Japan) should take responsibility for ~200 of the US modules.

The Committee welcomed acceptance of their proposal, and agree to study how to provide the approx. 200 modules from Japan.

4)Any 4 wafer assemblies outside spec are put on 'hold'.

Again, seen as positive wish to collaborate with other Clusters in achieving a uniform and high quality module production.

5)After 100 modules are complete there should be a review looking at progress and performance

Committee would like to modify this to be 100 modules, or in June, whichever is the sooner.

The Committee will meet again on Monday to prepare suggestions to present at the BM meeting on Tuesday. The objective of the Committee is to get agreement by Wednesday on the US Cluster procedures and objectives for Series modules assembly.

28-February-2003

Communication from Mike on Thursday:

> Subject: US Module production
> Date: Thu, 27 Feb 2003 19:50:34 -0000
> From: "Tyndel, M (Mike) " <M.Tyndel@rl.ac.uk>
> To: "'Tony Carter'" <a.a.carter@qmul.ac.uk>, "'Nobu Unno'" <unno@post.kek.jp>
> CC: "'Abe Seiden'" <abs@scipp.ucsc.edu>, "'Janet Carter'" <jrc1@hep.phy.cam.ac.uk>, "Tyndel, M (Mike) "
>
>
> Dear Tony & Nobu,
>
> I have just had a very positive discussion with Abe in an attempt to
> understand how we make progress. He and the US are committed to producing
> 'good' modules for the SCT but are also under a lot of pressure to work
> within a fixed budget and to meet the schedule.
>
> >From our discussion, I see that there are many areas of complete agreement
> between you and the US and we should try and build on these:
>
> 1)The electrical performance of the modules is crucial and must be closely
> controlled.
> 2)A high yield is essential and loss of components is unacceptable
> 3)Careful checking during assembly should be continued to catch mistakes and
> maintain high yield.
> 4)Regular reporting & review of performance is useful - especially now at
> start-up.
>
>
> The only real difference is the need to maintain such a tight specification
> on the front-back alignment. Abe accepts that this should be resolved in a
> collaborative spirit and proposes the following:
>
> 1)The US agree to work to the existing (or slightly modified spec along the

> lines you suggested & to be finalised next week)
> 2)The US will attempt to purchase a 2nd smartscope but cannot afford to
> extend the time-scale beyond 1 year.
> 3)As the additional time needed to do the adjustments is ~ 20% another
> cluster (Japan) should take responsibility for ~200 of the US modules.
> 4)Any 4 wafer assemblies outside spec are put on 'hold'.
> 5)After 100 modules are complete there should be a review looking at
> progress and performance
>
> Mike

Proposals for Barrel Module Categories

1. Good

Fully completed and tested module, satisfying all specifications (mechanical and electrical).
For electrical performance, it is expected that the large majority of modules will have considerably less than the 1% bad channels of the specification.
Within **Good** are the subcategories:
1.1 Good for any barrel
1.2 Use only for barrel 5 or 6
(See separate proposal for these subcategories)

2. Pass

The module just misses satisfying one or more of the mechanical specifications. The purpose of the category is to keep modules in the *tails* of the expected mechanical distributions. The number of *Pass* modules should therefore be much less than the number of *Good* modules.
A Pass module must still fully satisfy the electrical specification.
Pass modules are agreed to be usable in ATLAS, without further discussion.
Within **Pass** are the subcategories:
2.1 Pass for any barrel
2.2 Use only for barrel 5 or 6

The limits of quantities as measured for the **Pass** category: see the attached table

3. Hold

These are modules outside one or more of the **Pass** limits. *They are stopped in production at the point they are found to be outside the limit* (ie a hybrid is not fitted if the baseboard-sensor sandwich is outside 'pass' metrology values). They are carefully stored for later assessment by the Barrel Module community.

4. Fail

Modules that could never go in ATLAS – for example broken or badly scratched detectors, gross mechanical errors, many bad channels due to bonding problems, broken ASICs that can't be replaced.

5. Rework

Modules held back for rework that might make them usable – eg replacing an ASIC, gluing on a replacement pitch adapter, re-bonding work.

6. Started

6.1 Total number of 4 wafer assemblies started
6.2 Total number of hybrids mounted

Module categories

(The values are including measurement errors)

Parameters	Good	Pass	Hold
mhx [um]	+/-30	+/-40	>+/-40.000
mhy [um]	+/-30	+/-40	>+/-40.000
msx [um]	+/-100	+/-140	>+/-140.000
msy [um]	+/-30	+/-40	>+/-40.000
sepf [um]	+/-10	+/-20	>+/-20
sepb [um]	+/-10	+/-20	>+/-20
midxf [um]	+/-10		>+/-10
midyf [um]	+/-5	+/-8	>+/-8
a1 [mrad]	+/-0.13		>+/-0.13
a2 [mrad]	+/-0.13		>+/-0.13
a3 [mrad]	+/-0.13		>+/-0.13
a4 [mrad]	+/-0.13		>+/-0.13
stereo [mrad]	+/-0.13		>+/-0.13
maxZlower [mm]	-0.2		>-0.2
maxZupper [mm]	0.2		>0.2
moduleThickness [mm]	+/-0.1		>+/-0.1
optimalMaxZerrorLower [mm]	0.05	0.07	>0.07
optimalMaxZerrorUpper [mm]	0.05	0.07	>0.07
optimalRMSZerrorLower [mm]	0.025		>0.025
optimalRMSZerrorUpper [mm]	0.025		>0.025
loCoolingFacing a [mrad]	+/-0.5		>+/-0.5
b [mrad]	+/-3	+/-5	>+/-5
loCoolingFacingConcavity [mm]	+/-0.03		>+/-0.03
capMaxThickness [mm]	6.44		>6.44

First proposals for Modules to Select for Barrels 3 and 4

1. Series (not pre-series) detectors.

2. No sign of IV 'microdischarge' up to 500V bias (in nitrogen or dry air atmosphere)

3. No history of unexplained bad IV behaviour (eg current very big on first test of module)

5. No bad visual inspection features that could relate to HV robustness (eg unusual amount of debris/marks near detector edges, messy detector-detector bonding that leaves any bonds flat near detector surface, broken bits of bond wire, etc.)

6. Thermistor temperatures are as expected for test setup and difference in their temperature is ≤1 deg C

7. Cooling facing b-angle within specification

8. Any conclusions on irradiation hardness that might be established in future