May 2003 PAR@RAL
S. Terada; KEK

SCT Barrel "PC" Hybrid Status

Japanese SCT group

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5. Summary

1. Assembly and QA Procedure

i) Cu/Polyimide flexible PC

- Visual inspection
- Integrity test

ii) Carbon-carbon bridge gluing

- Visual inspection

iii) Passive components stuffing

- Visual inspection

iv) Pitch adapter gluing

- Visual inspection
- Mechanical tests
- Electrical tests

v) Temperature cycling

(-25 to 40 deg. C times 5 cycles; 10 hours)

- Visual inspection
- Mechanical tests
- Electrical tests

vi) Barcode and Data sheet entry

2. QA items

i) Electrical tests (before and after TC)

Items	Nominal	Tolerances	Comments
C_{cc}	11.88 μF	± 10 %	AG bypath C at 1kHz
C_{dd}	11.88 μF	± 10 %	DG bypath C at 1kHz
Z_{hv} at 0.1kHz	33 kΩ	± 10 %	HV net. at 0.1kHz
Z_{hv} at 1kHz	10 kΩ	± 10 %	HV net. at 1kHz
Z_{hv} at 10kHz	6.7 kΩ	± 10 %	HV net. at 10kHz
Z_{hv} at 100kHz	6.1 kΩ	± 10 %	HV net. at 100kHz
R_{27}	100 Ω	± 2 Ω	Termination R
R_{28}	100 Ω	± 2 Ω	Termination R
R_{29}	100 Ω	± 2 Ω	Termination R
R_{30}	100 Ω	± 2 Ω	Termination R
TM_0	10 kΩ	± 2 %	Thermistor R at 25°
TM_1	10 kΩ	± 2 %	Thermistor R at 25°
I_{cc}	-	< 50 nA	Leakage at 10V
I_{dd}	-	< 50 nA	Leakage at 10V
I_{hv}	-	< 10 nA	Leakage at 500V

ii) Mechanical tests (before and after TC)

- Thickness; 620 ± 50 μm

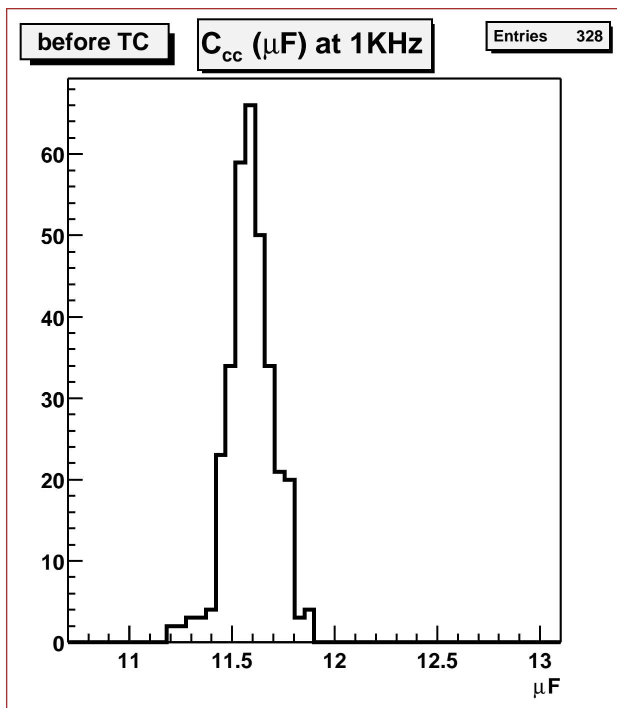
- Flatness
  Bow (long); < 75 μm
  Bow (short); < 75 μm
  Twist; < 100 μm

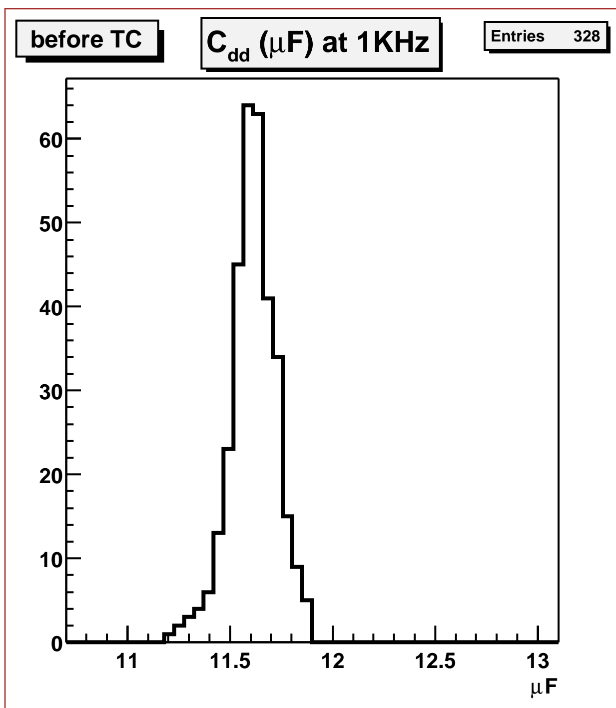
- Height of the critical components (after TC only)
  < 2.63 mm

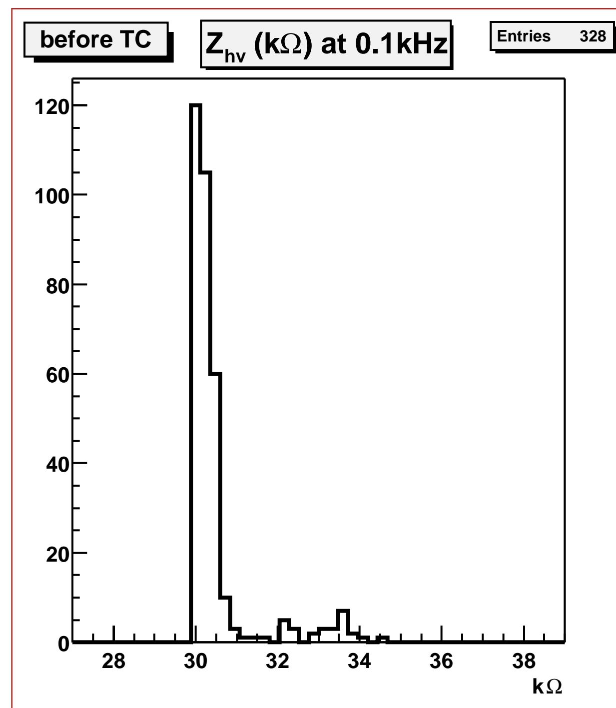
iii) Wire bonding pull tests (after TC)

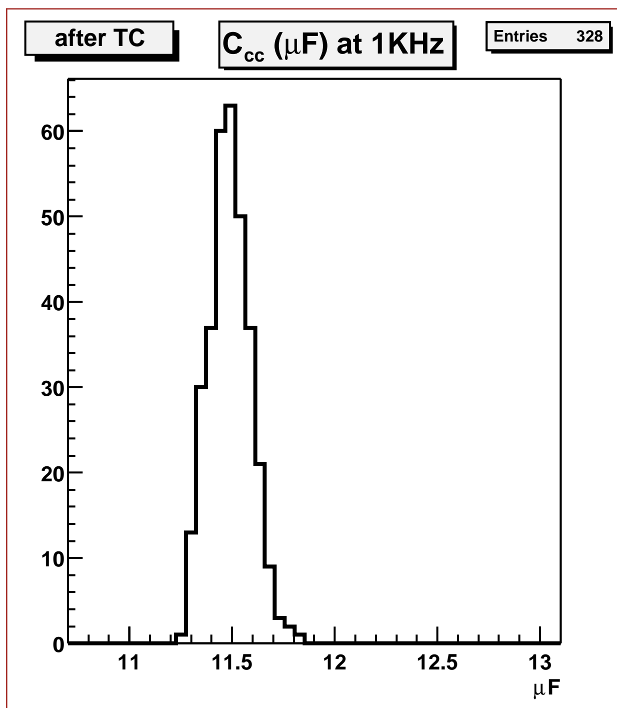
- Flex. PC bond test
  Four test pads (one wire/pad) /FPC;
  > 6 gr

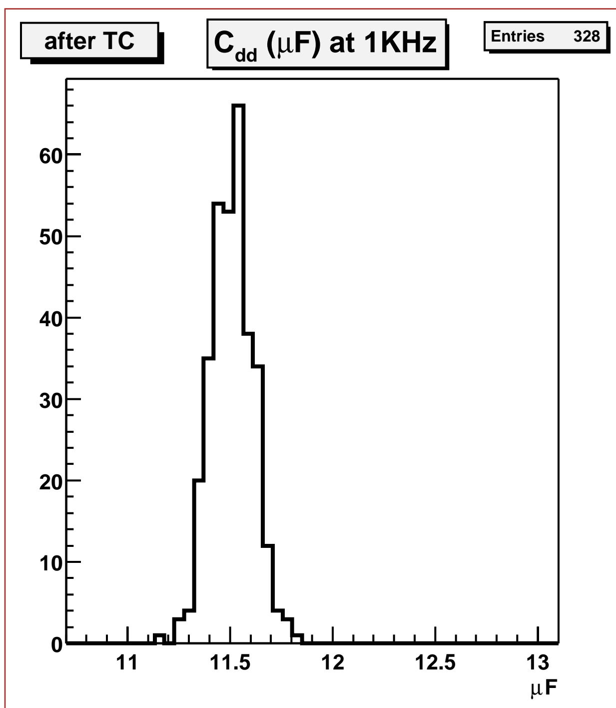
- Pitch adapter bond test
  10 places/lot ;
  > 6 gr
  (25 PAs'/sheet, 10 sheets/lot)

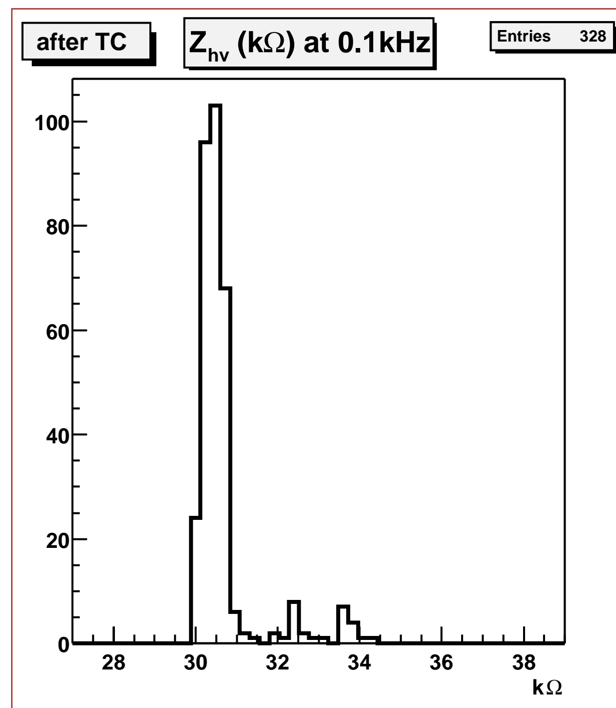

before TC
C_{cc} (μF) at 1KHz
Entries 328
0
10
20
30
40
50
60
11
11.5
12
12.5
13
μF

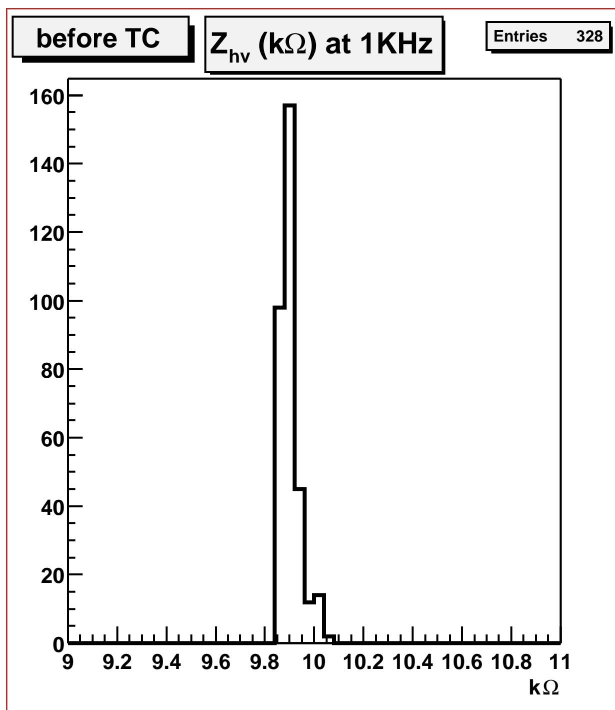

before TC
C_{dd} (μF) at 1KHz
Entries 328
0
10
20
30
40
50
60
11
11.5
12
12.5
13
μF

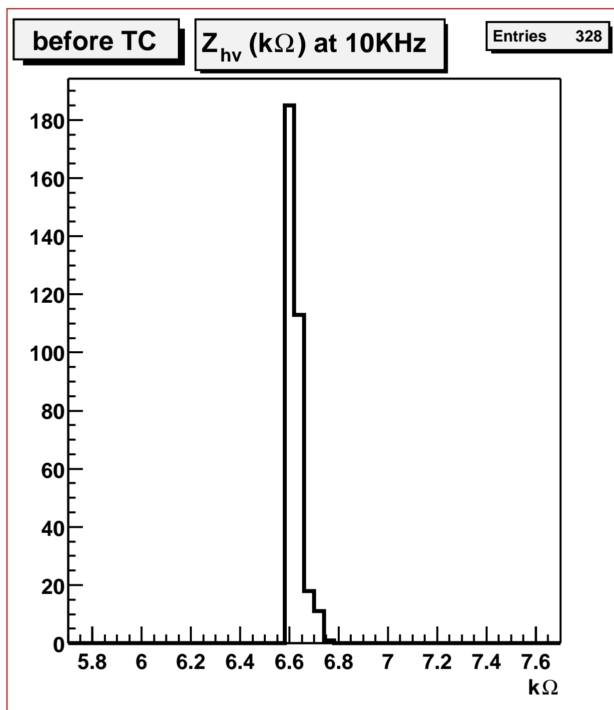

before TC
Z_{hv} (kΩ) at 0.1kHz
Entries 328
0
20
40
60
80
100
120
28
30
32
34
36
38
kΩ

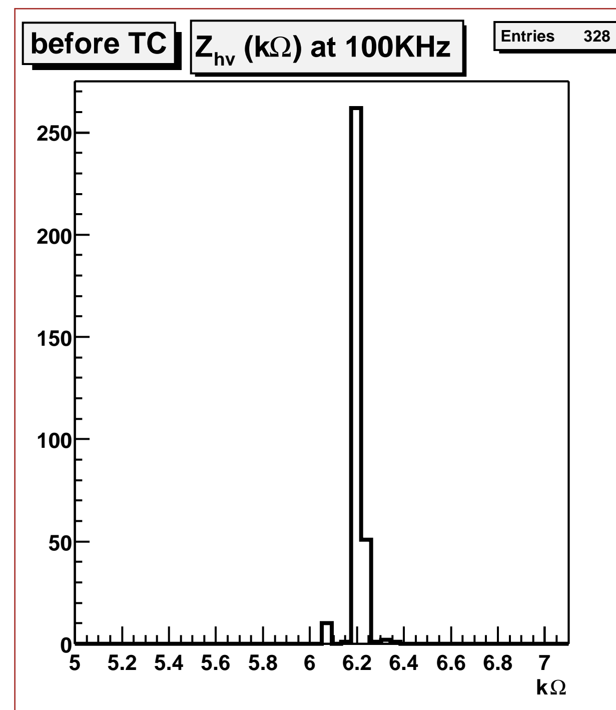

after TC
C_{cc} (μF) at 1KHz
Entries 328
0
10
20
30
40
50
60
11
11.5
12
12.5
13
μF

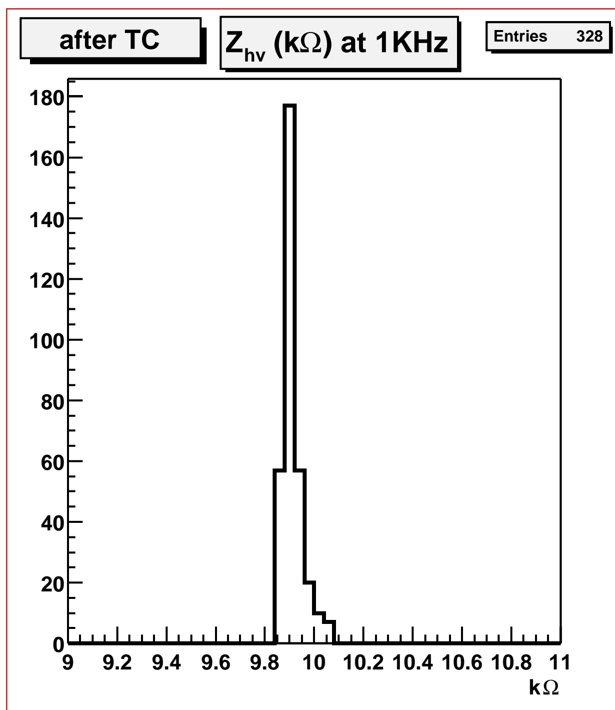

after TC
C_{dd} (μF) at 1KHz
Entries 328
0
10
20
30
40
50
60
11
11.5
12
12.5
13
μF

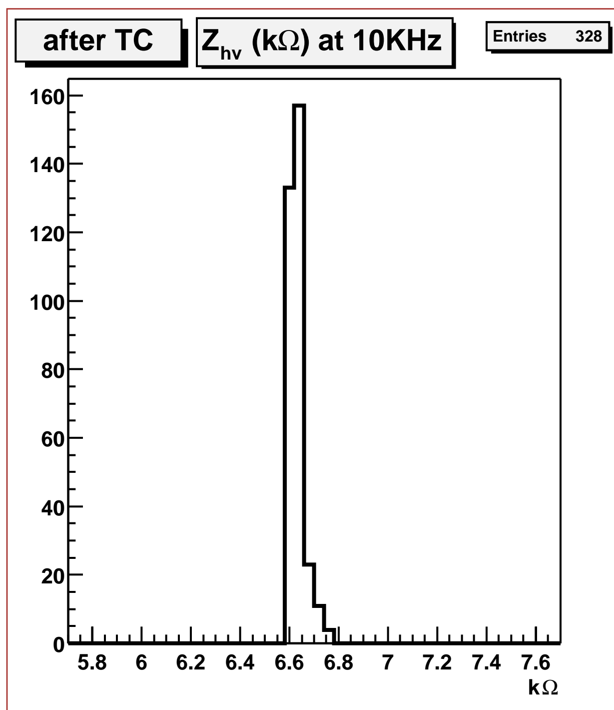

after TC
Z_{hv} (kΩ) at 0.1kHz
Entries 328
0
20
40
60
80
100
28
30
32
34
36
38
kΩ

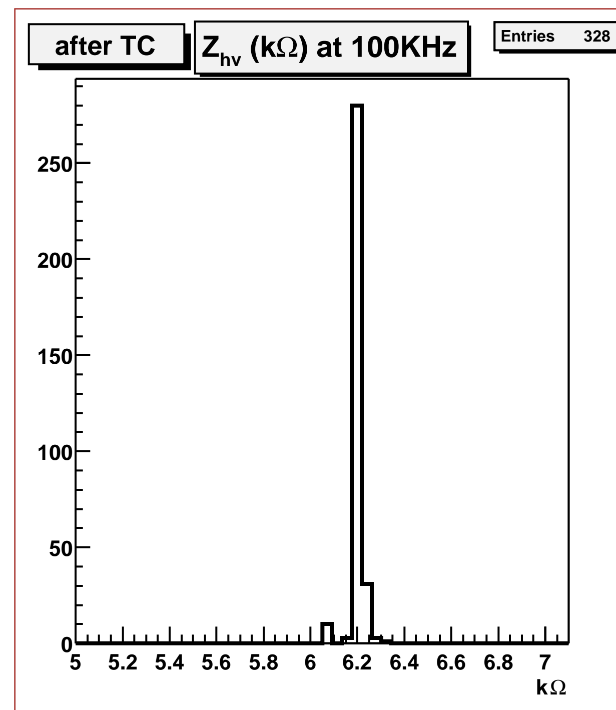

before TC
Z_{hv} (kΩ) at 1KHz
Entries 328
kΩ


before TC
Z_{hv} (kΩ) at 10KHz
Entries 328
kΩ


before TC
Z_{hv} (kΩ) at 100KHz
Entries 328
kΩ


after TC
Z_{hv} (kΩ) at 1KHz
Entries 328
kΩ


after TC
Z_{hv} (kΩ) at 10KHz
Entries 328
kΩ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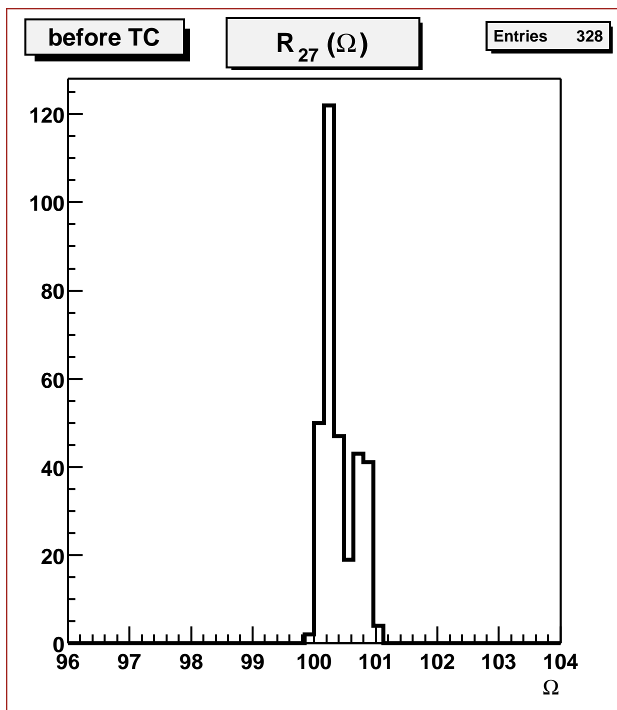
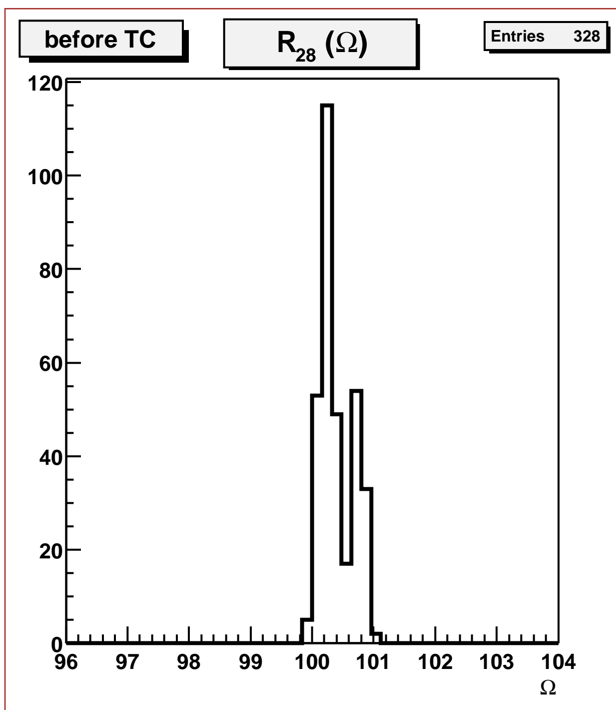
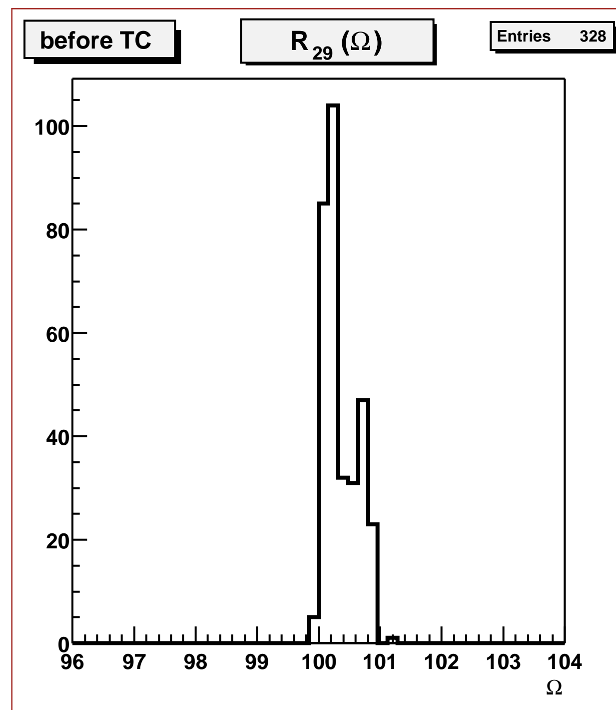
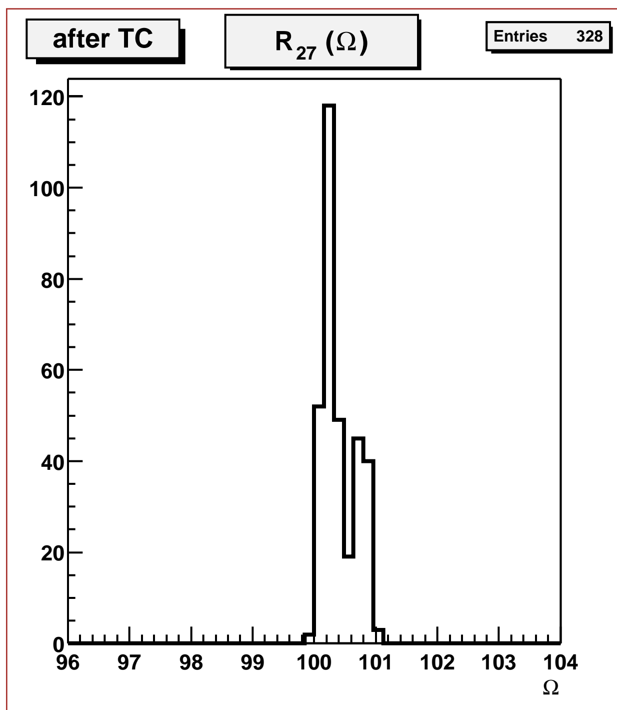
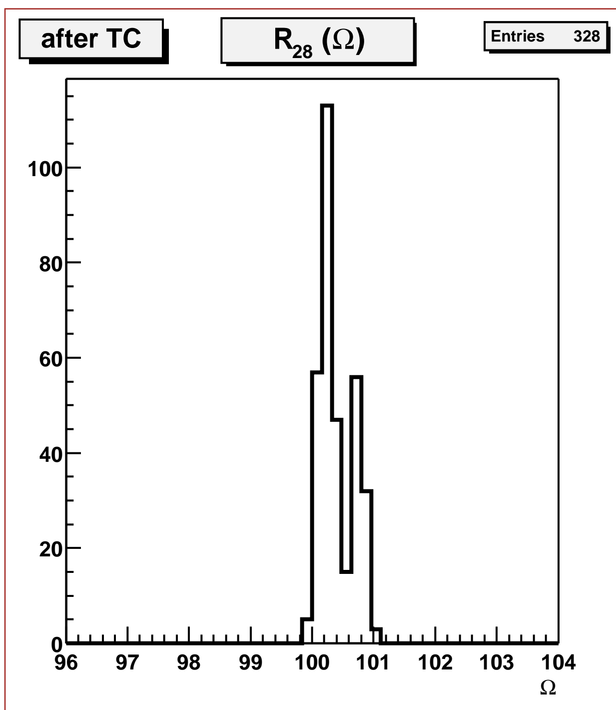
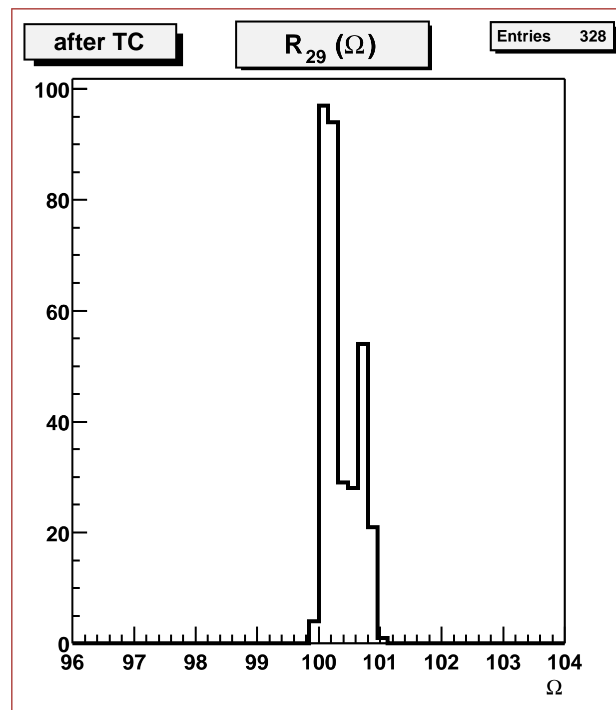
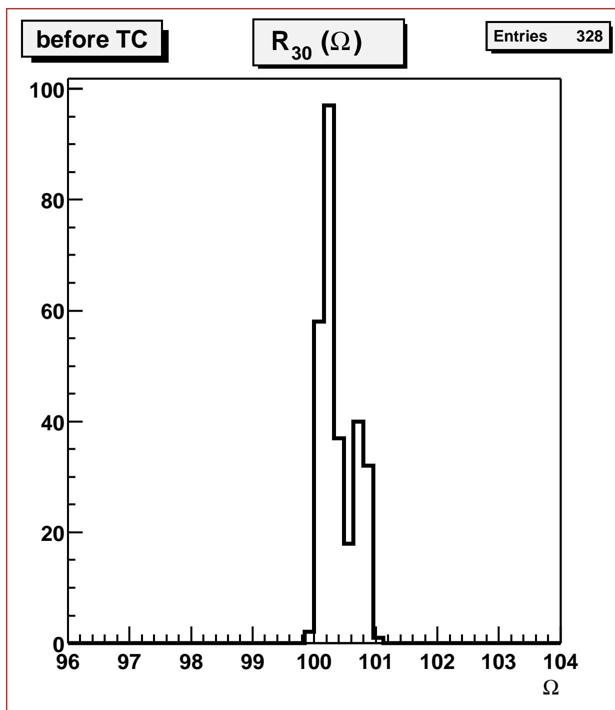
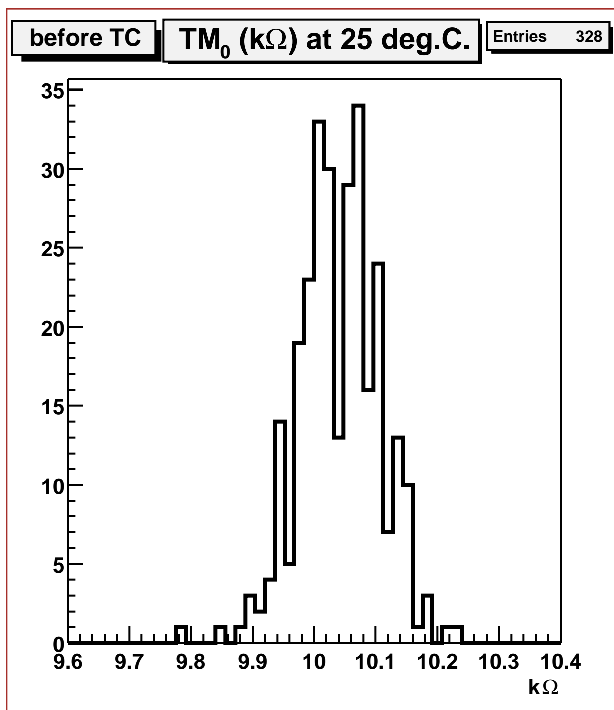
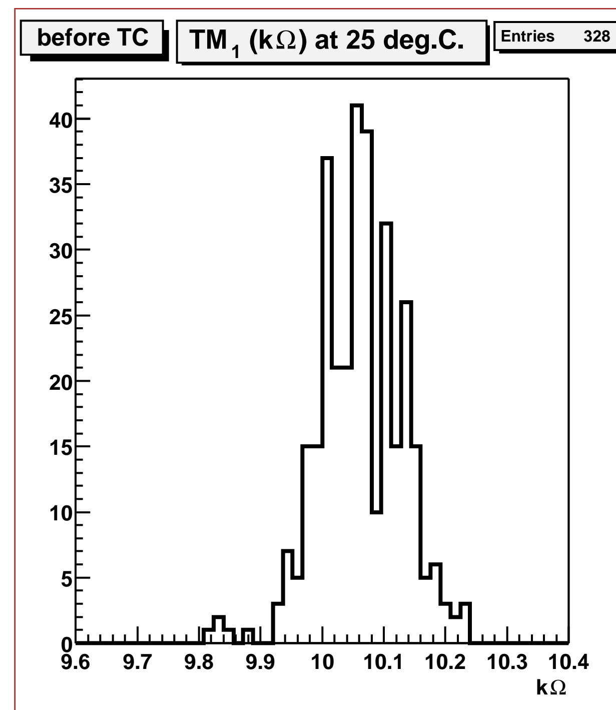
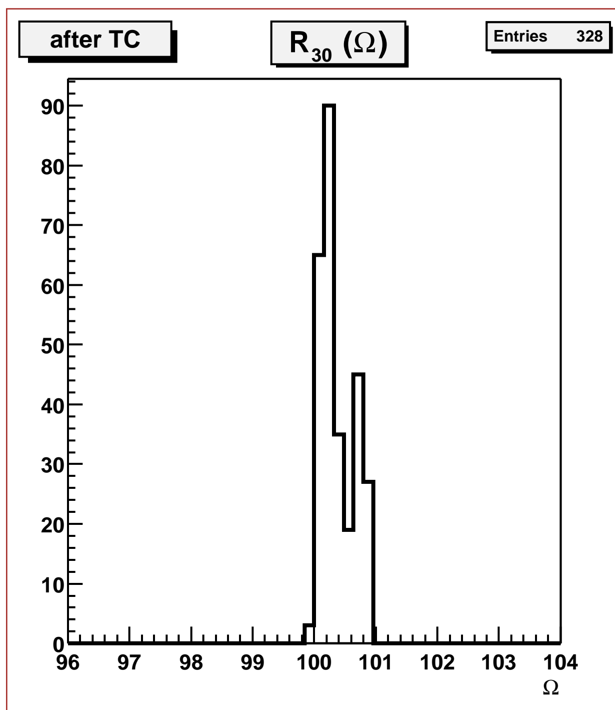
Z_{hv} (kΩ) at 100KHz
Entries 328
kΩ

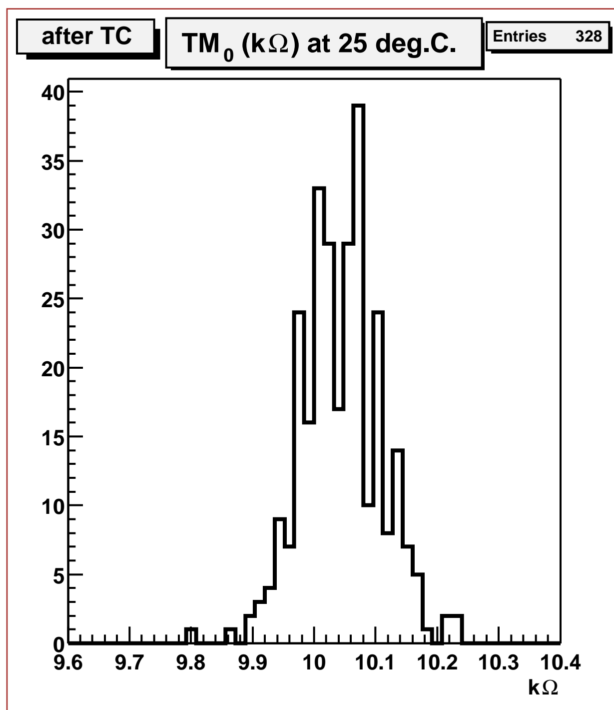

before TC
R 27 (Ω)
Entries 328
120
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

before TC
R28 (Ω)
Entries 328
120
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

before TC
R 29 (Ω)
Entries 328
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

after TC
R 27 (Ω)
Entries 328
120
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

after TC
R28 (Ω)
Entries 328
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

after TC
R 29 (Ω)
Entries 328
100
80
60
40
20
0
96 97 98 99 100 101 102 103 104
Ω

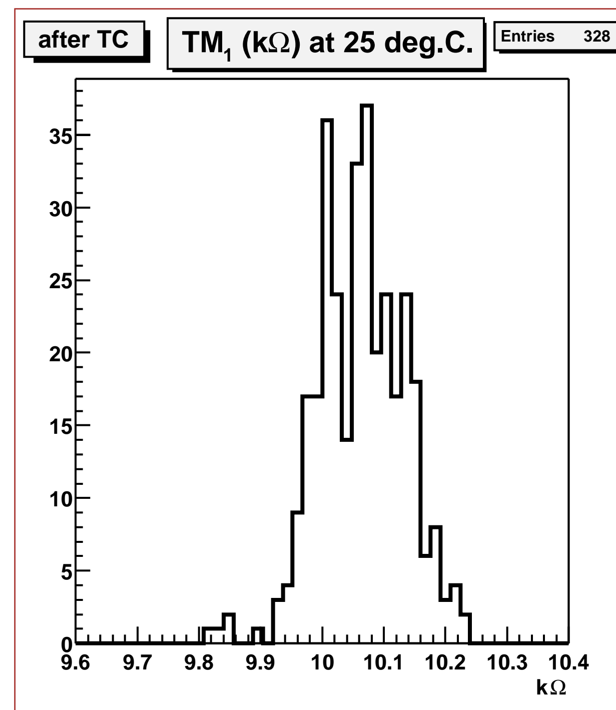

before TC
R30 (Ω)
Entries 328
Ω

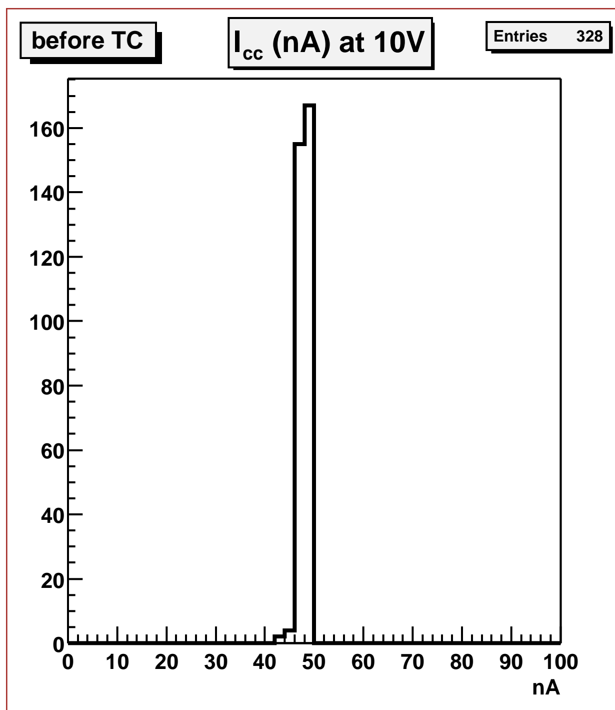
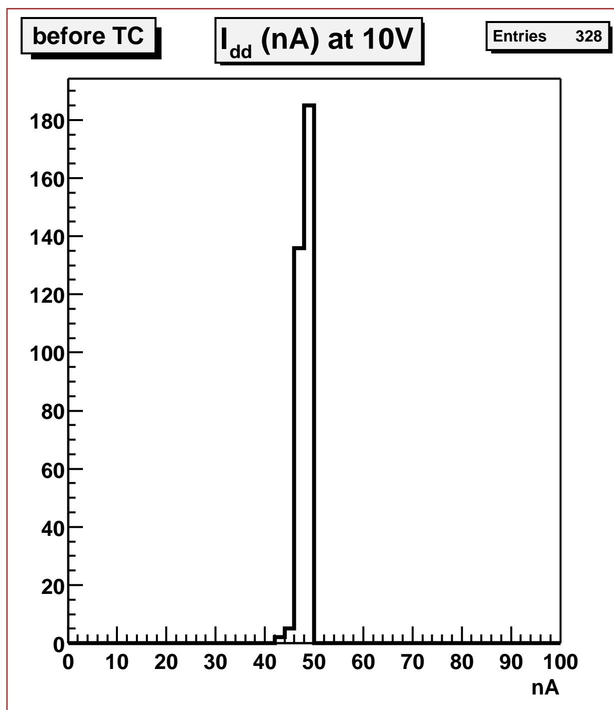
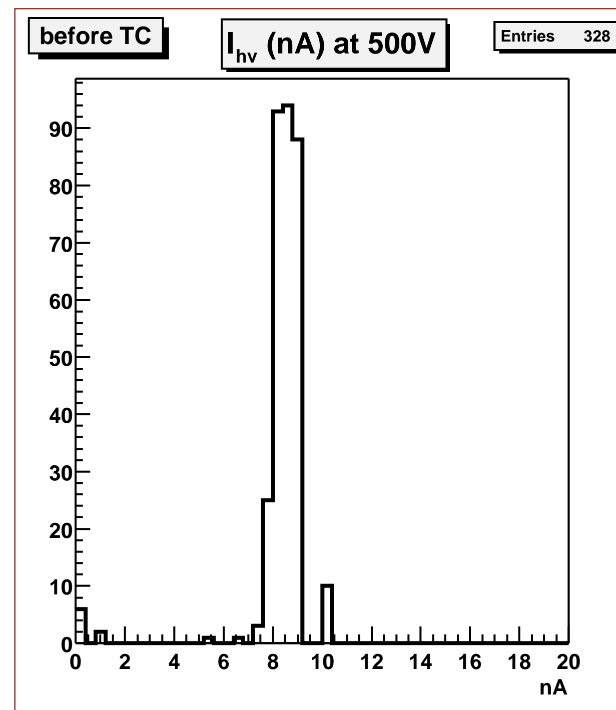
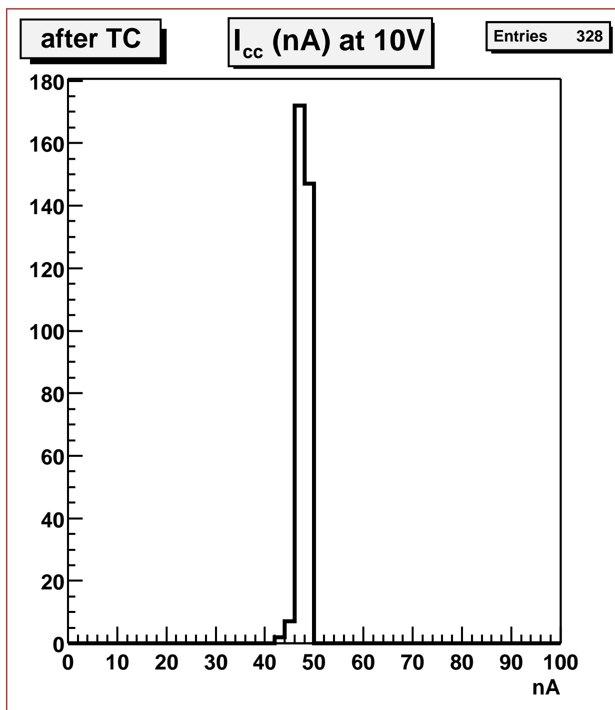
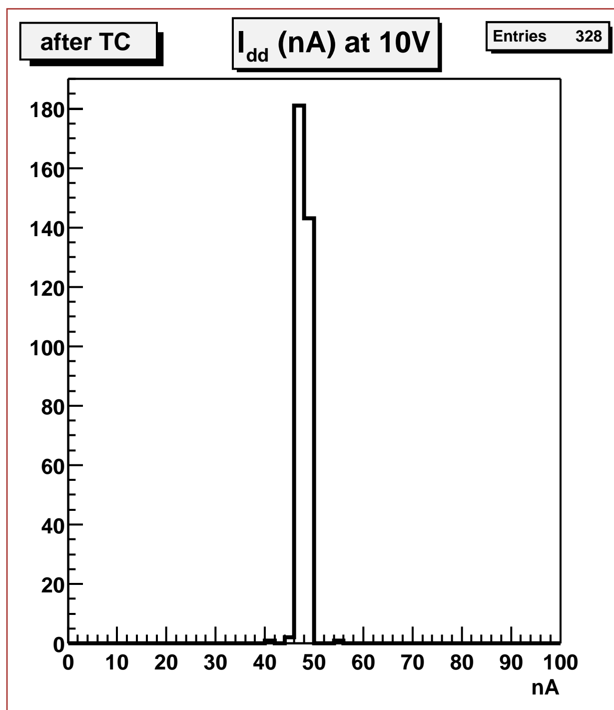
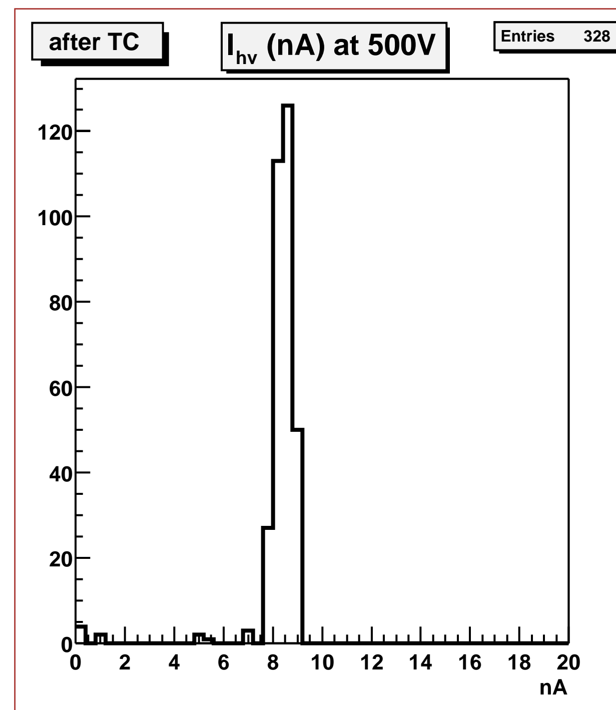

before TC
TM0 (kΩ) at 25 deg.C.
Entries 328
kΩ

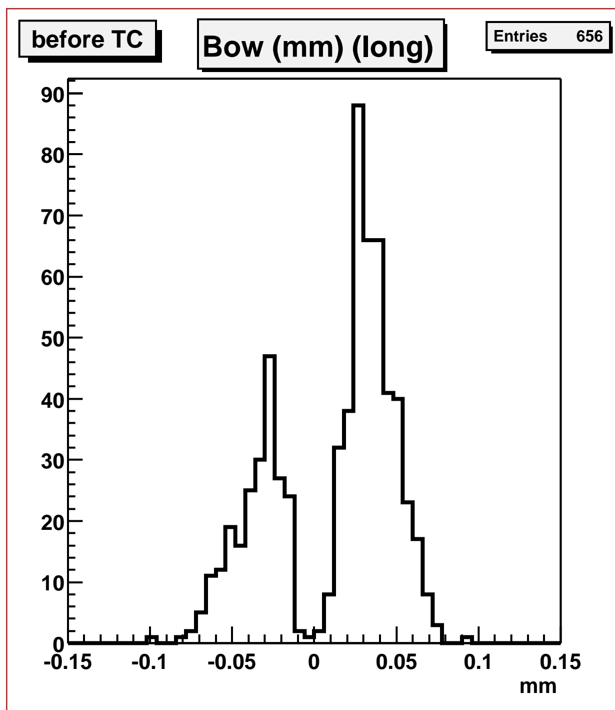

before TC
TM1 (kΩ) at 25 deg.C.
Entries 328
kΩ

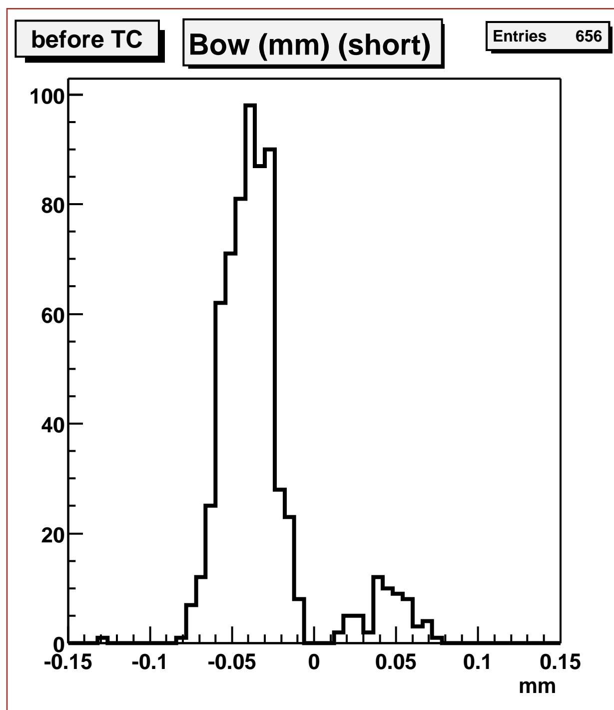

after TC
R30 (Ω)
Entries 328
Ω

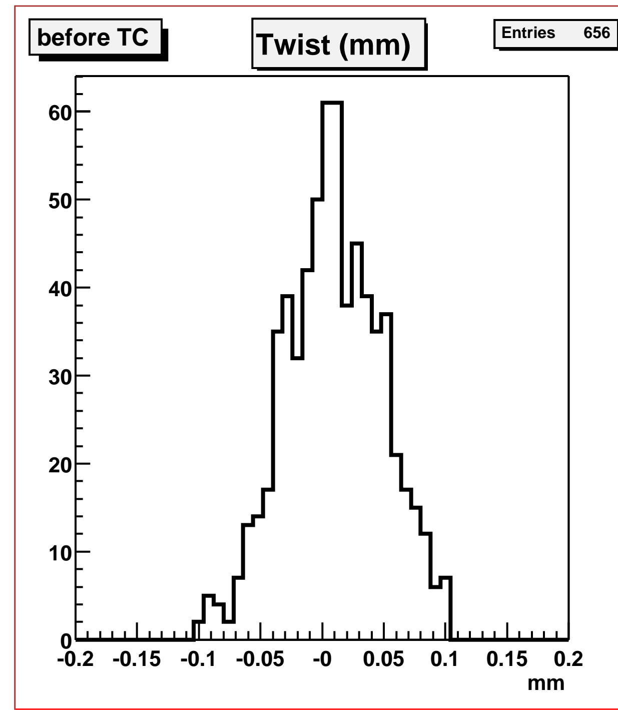

after TC
TM0 (kΩ) at 25 deg.C.
Entries 328
kΩ

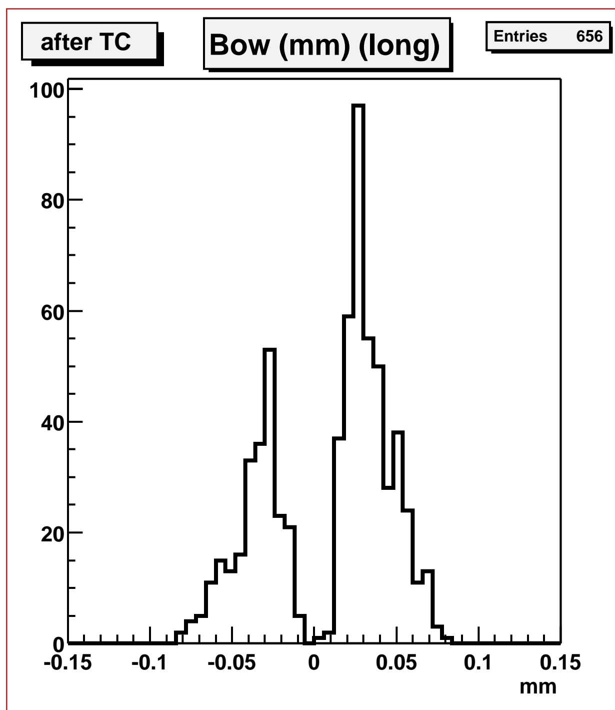

after TC
TM1 (kΩ) at 25 deg.C.
Entries 328
kΩ

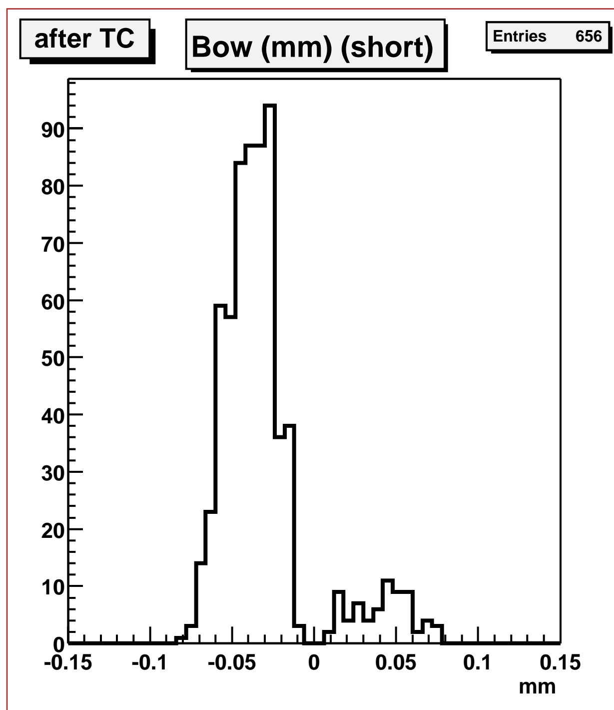

before TC
I_{cc} (nA) at 10V
Entries 328
nA

before TC
I_{dd} (nA) at 10V
Entries 328
nA

before TC
I_{hv} (nA) at 500V
Entries 328
nA

after TC
I_{cc} (nA) at 10V
Entries 328
nA

after TC
I_{dd} (nA) at 10V
Entries 328
nA

after TC
I_{hv} (nA) at 500V
Entries 328
nA

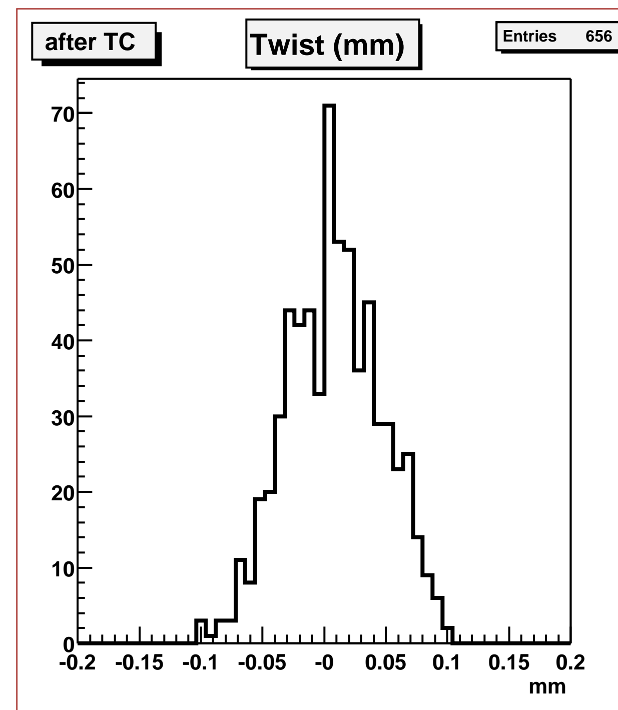

before TC
Bow (mm) (long)
Entries 656
mm

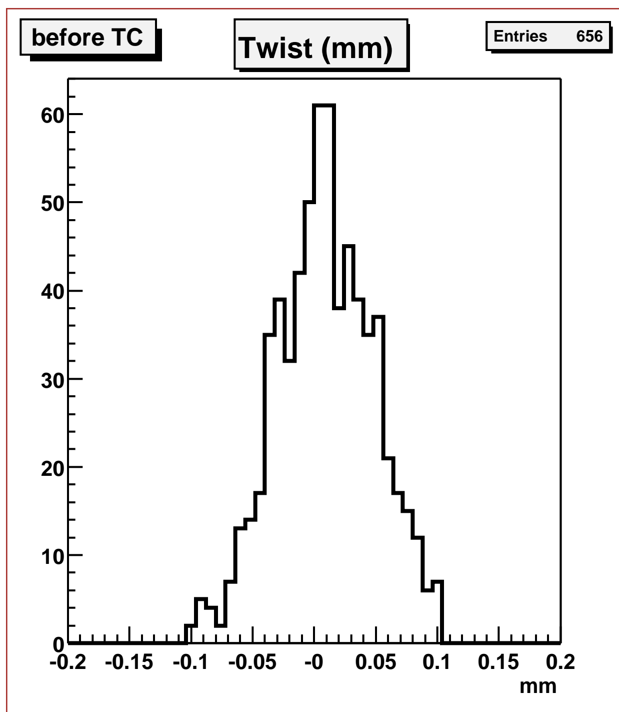

before TC
Bow (mm) (short)
Entries 656
mm


before TC
Twist (mm)
Entries 656
mm

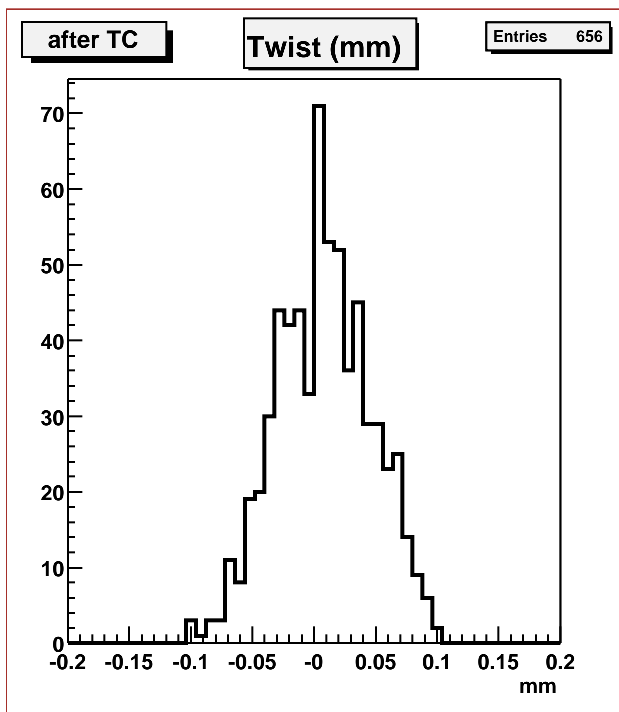

after TC
Bow (mm) (long)
Entries 656
mm


after TC
Bow (mm) (short)
Entries 656
mm

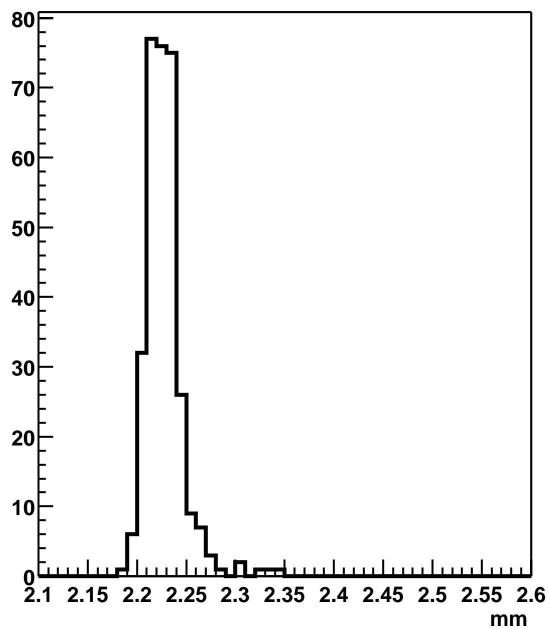

after TC
Twist (mm)
Entries 656
mm

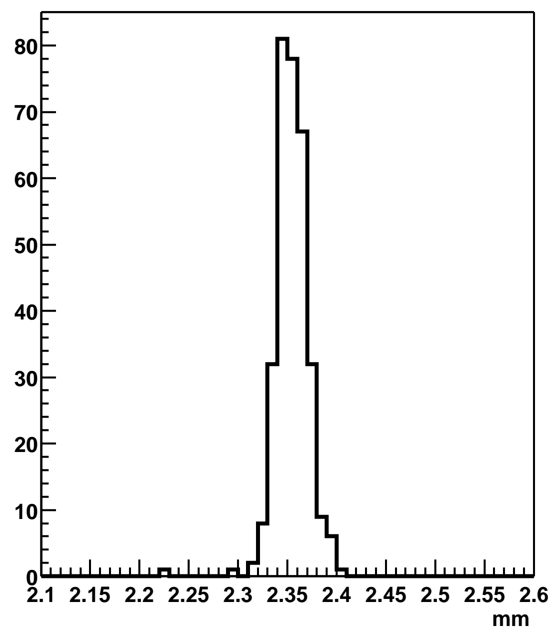


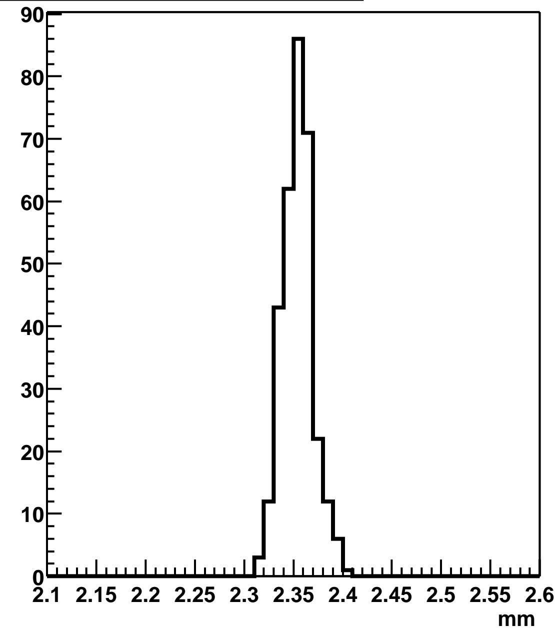
before TC
Twist (mm)
Entries 656
60
50
40
30
20
10
0
-0.2
-0.15
-0.1
-0.05
-0
0.05
0.1
0.15
0.2
mm

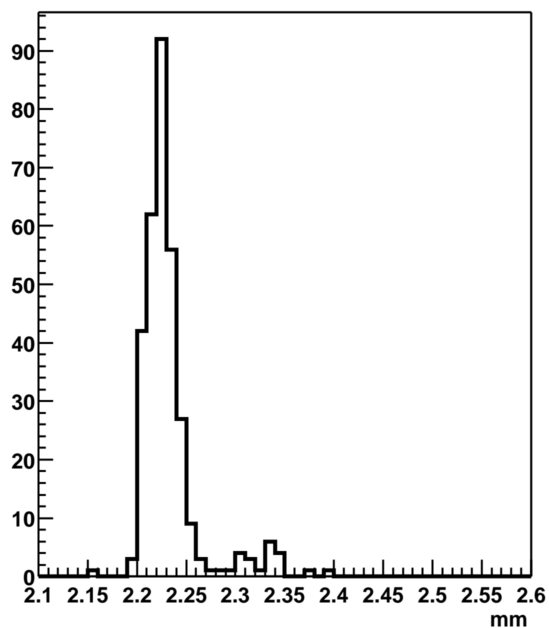


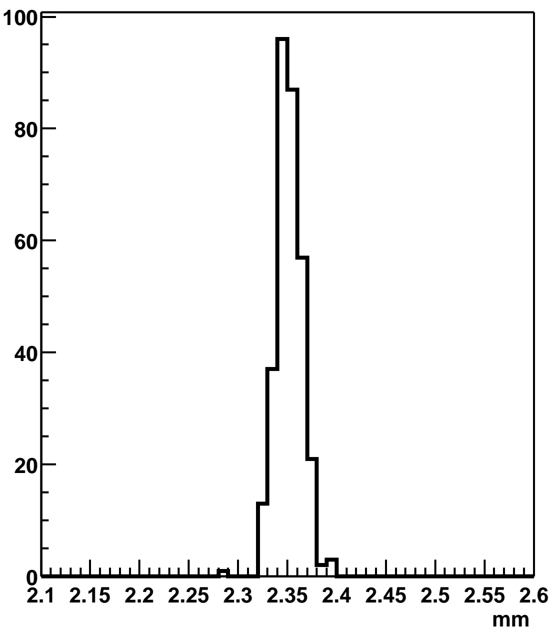
after TC
Twist (mm)
Entries 656
70
60
50
40
30
20
10
0
-0.2
-0.15
-0.1
-0.05
-0
0.05
0.1
0.15
0.2
mm

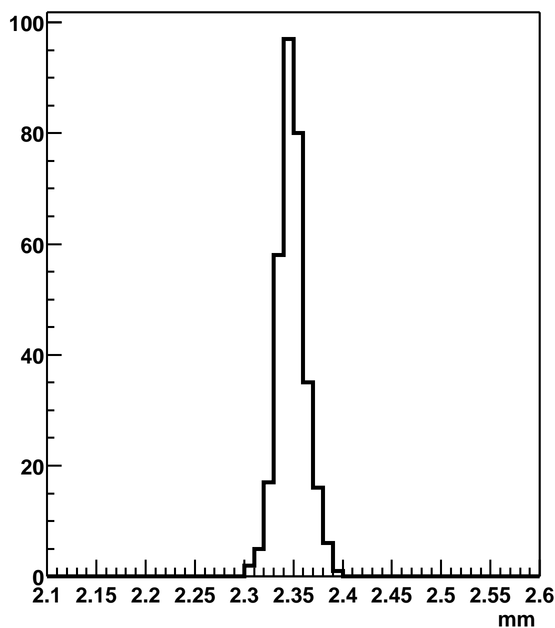

Height of Component C53 (mm)
Entries 318
80
70
60
50
40
30
20
10
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

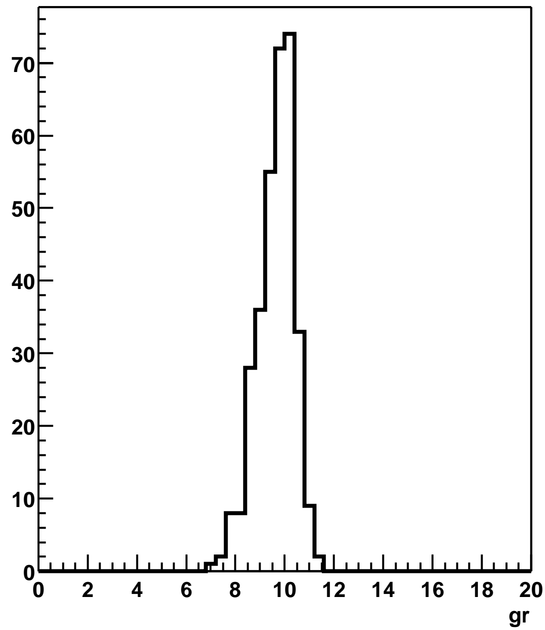

Height of Component C54 (mm)
Entries 318
80
70
60
50
40
30
20
10
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

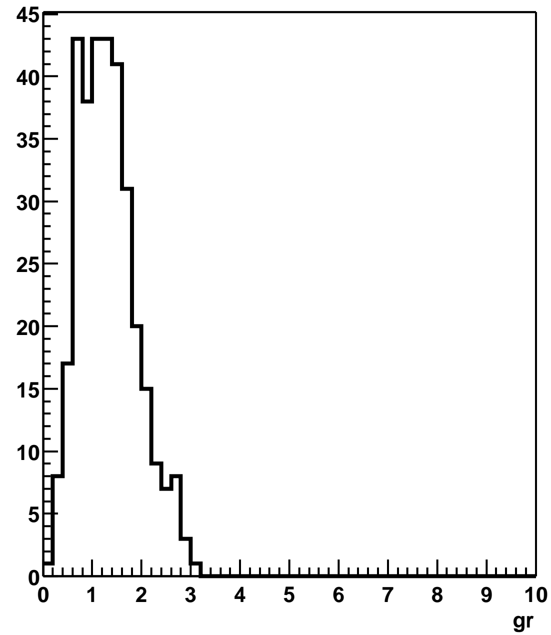

Height of Component C73 (mm)
Entries 318
90
80
70
60
50
40
30
20
10
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

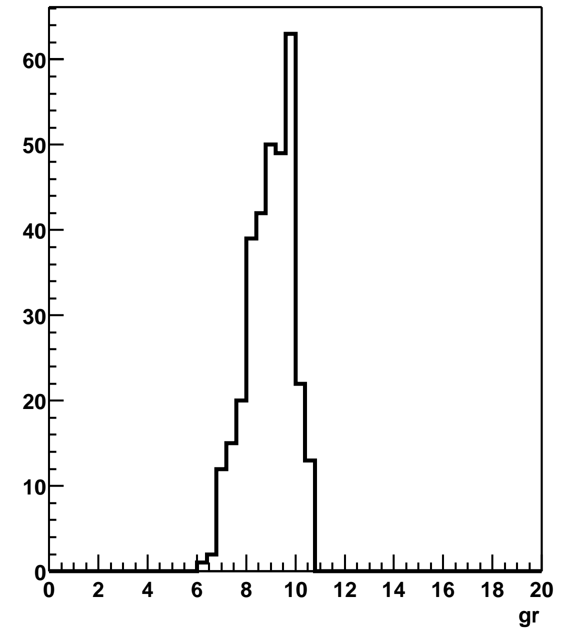

Height of Component C55 (mm)
Entries 318
90
80
70
60
50
40
30
20
10
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

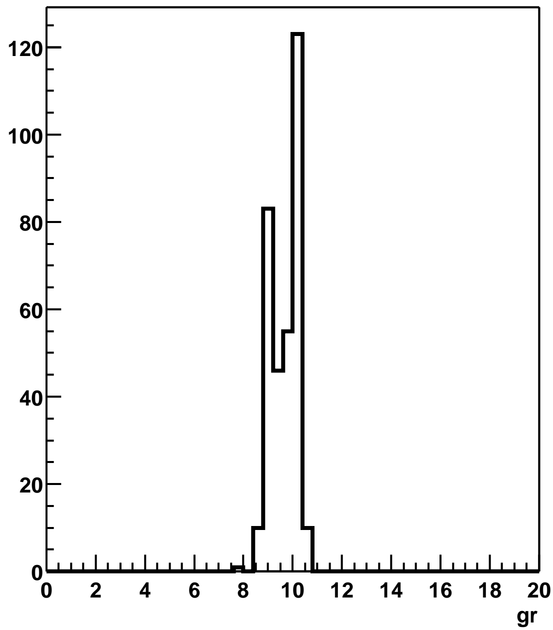

Height of Component C56 (mm)
Entries 318
100
80
60
40
20
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

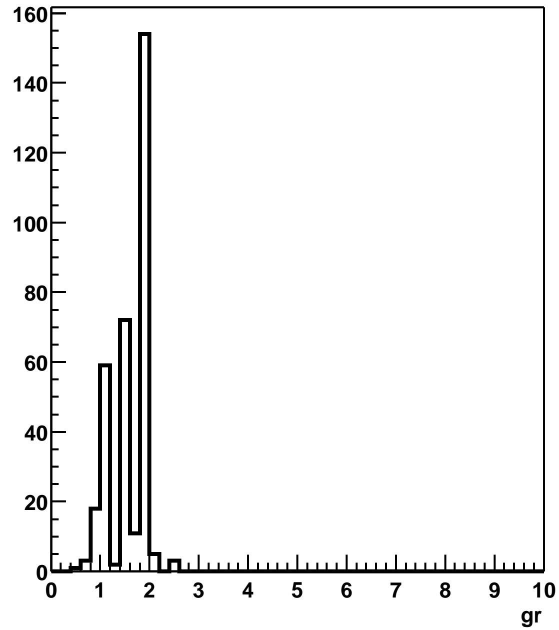

Height of Component C74 (mm)
Entries 318
100
80
60
40
20
0
2.1 2.15 2.2 2.25 2.3 2.35 2.4 2.45 2.5 2.55 2.6
mm

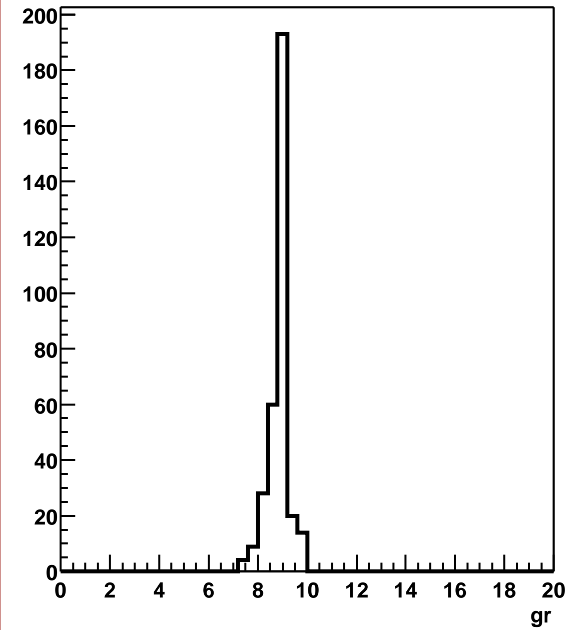

WB pull average (hybrid)
Entries 328
gr


WB pull range (hybrid)
Entries 328
gr


WB pull min (hybrid)
Entries 328
gr


WB pull average (PA)
Entries 328
gr


WB pull range (PA)
Entries 328
gr


WB pull min (PA)
Entries 328
gr

3. Pitch adapter problem

"White PA" problem;

We have recently encountered the "white PA" problem.
The PAs' in the sixth lot (about 200 pcs') were found to have an Al layer of slightly whiter and rougher surface. They had such a poor bonding quality as reported by Hamamatsu that the failure rate of the bonding between the PA and Si-sensor (mostly 1st bond) was about 2 %.
Since then the company seems to have lost control over the PA production process.

After elaborated studies and trials with not only this company but also the other companies, we found that the critical conditions to be maintained and controlled were i) cleanliness of the glass surface, ii) contamination free environment, iii) temperature of the glass during the Al deposition and vi) growth rate of the Al layer.

Concerning the above four conditions, we have

instructed as in the followings ;

i) Thorough baking and bombarding at high temperature in high vacuum should be required to achieve a clean glass surface.

ii) The camber for the Al deposition process should be purged with Ar and kept at sufficiently high vacuum during the operation.

iii) The glass should be kept at high temperature, e.g. 150 deg. C, during the Al deposition. In fact, depositing at room temperature in a poor vacuum, the Al layer became too hard for the wire bonding.

vi) High rate of the Al layer deposition, e.g. 20 Å/sec, makes the Al surface too smooth like a mirror, and on such surface the wire bonding quality was generally poor.

We found that the Al layer growth rate of 5 Å/sec seemed to be optimum.

Now we feel we have sufficient understandings to control the process. We expect we could resume the PA production soon.

4. Production and Delivery

(as of 30 Apr. 2003)

- So far produced;

1214 pcs' of good "PC" hybrids
(incl. the ones with old PA and "white" PA(159))

So far delivered to;

	UK	US	Nordic	Japan	
	194 (47)	161 (9)	69 (4)	555 (57)	pcs'

(with "white" PA)

- Delivery schedule update;

May. 2003	400
Jun. 2003	400
Jul. 2003	400
Aug. 2003	86
Total	2,500

"ASIC" Hybrid

So far delivered to;

Nordic	Japan	
69 (4)	555 (57)	pcs'

(with "white" PA)

5. Summary

- The SCT barrel "PC" hybrid production has been carried on under the rigorous QA procedure.

- We have finished half of the "PC" hybrid production successfully.

- The "White PA" problem has been understood and is expected to be overcome without halting the production.

- The production will be completed in Aug. '03.