

Precision of electrical modules fabricated in the Hybrid/Module programme in Oct. - Dec., 99

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- **1 ABCD2T (Mod0) and 1 CAFE/ABC(Mod4) were measured**
 - The modules were made in a hurry, paying not-too-much attention to the precision
 - The dowel holes/slots were a bit loose to the dowel pins of the assembly jig
- **Precision: Maximum**
 - Detector centres: $dy < 2.14 \mu\text{m}$, $dx < 3.99 \mu\text{m}$
 - Fiducials along the centre line: $dy < 3.16 \mu\text{m}$, $dx < 4.0 \mu\text{m}$
 - Front-back: $midxf < 2.2 \mu\text{m}$, $midyf < 1.7 \mu\text{m}$
 - Dowel hole and slot: $dy < 16 \mu\text{m}$, $dx \text{ (hole)} < 10.2 \mu\text{m}$
- **Summary**
 - Although too-much attention was paid in the assembly precision, the precision of the assembled modules was satisfactory

Temp. assembly

25deg.C

Temp. measure

21deg.C

Design(63.5+0.59)

Module-abcd/k3103

Module-cafe/k3301

	dx [μm]	dy [μm]	dpsi [mrad]	dx [μm]	dy [μm]	dpsi [mrad]	dx [μm]	dy [μm]	dpsi [mrad]
Displacement Front									

Left detector

0.00

0.00

0.00

3.08

0.23

-0.02

-0.86

-2.14

-0.03

Right detector

0.00

0.00

0.00

1.20

1.54

0.05

-3.19

-1.14

0.02

Back

Left detector

0.00

0.00

0.00

-0.29

-0.78

-0.02

1.93

1.27

0.05

Right detector

0.00

0.00

0.00

-3.99

-1.00

0.01

2.11

2.01

-0.01

Displacement

dx [μm]dy [μm]

dpsi [mrad]

dx [μm]dy [μm]

dpsi [mrad]

dx [μm]dy [μm]

dpsi [mrad]

Left

0.00

0.00

0.00

-10.22

-0.32

0.01

-2.10

-15.59

0.01

Right

0.00

0.00

-27.81

-5.21

-32.22

2.39

back to back

dx [μm]dy [μm]dx [μm]dy [μm]dx [μm]dy [μm]

U-L-L

0.00

-0.01

3.09

0.73

-0.84

-1.22

U-L-R

0.00

-0.01

3.07

-0.28

-0.88

-3.06

U-R-L

0.00

0.00

1.16

-0.08

-3.20

-1.72

U-R-R

0.00

0.00

1.21

3.16

-3.22

-0.56

L-L-L

0.00

-0.01

-0.30

-0.19

1.96

-0.40

L-L-R

0.00

0.00

-0.28

-1.37

1.90

2.92

L-R-L

0.01

-0.01

-3.98

-1.17

2.11

2.35

L-R-R

0.00

0.00

-4.00

-0.84

2.12

1.67

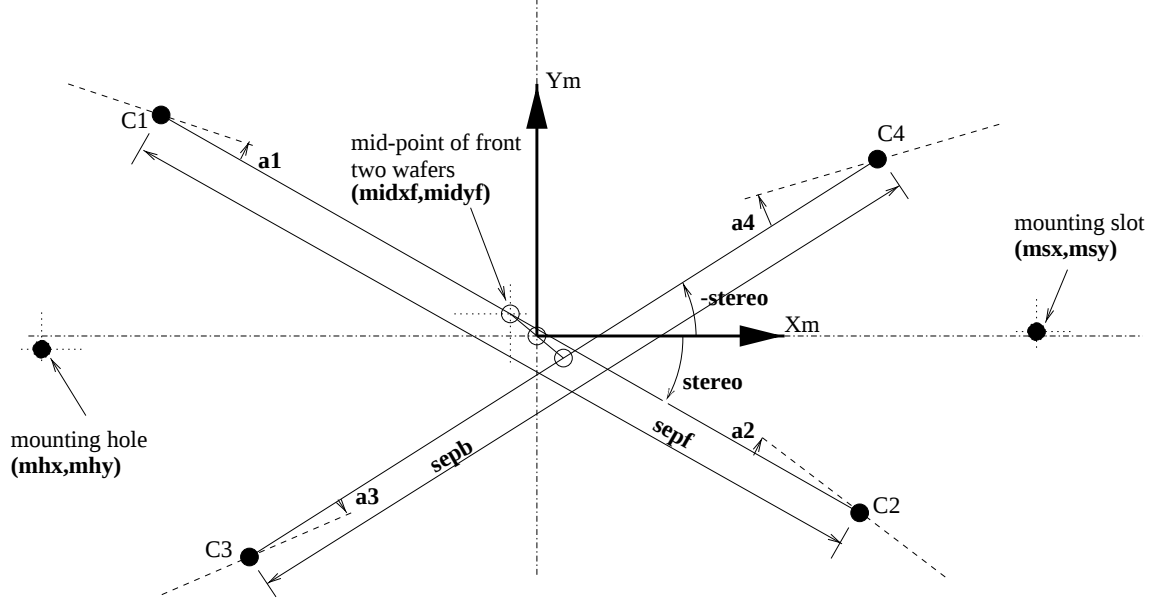


Figure 3: Definition of the parameters which describe the geometry of a standard module. Black circles $C1$ to $C4$ are the measured centers of the four wafers. The dashed line through each center gives the measured orientation of each wafer. Open circles are the center points of lines. The module is described in the database with 13 numbers: three coordinate pairs in the X_m, Y_m system (mhx, mhy) , (msx, msy) and $(midxf, midyf)$, two wafer separations $sepf$, $sepb$ the angle **stereo** and four wafer angles $a1$, $a2$, $a3$, $a4$. Stereo angle is measured from the X_m axis and wafer angles from the stereo axis, with anti-clockwise rotation being positive.

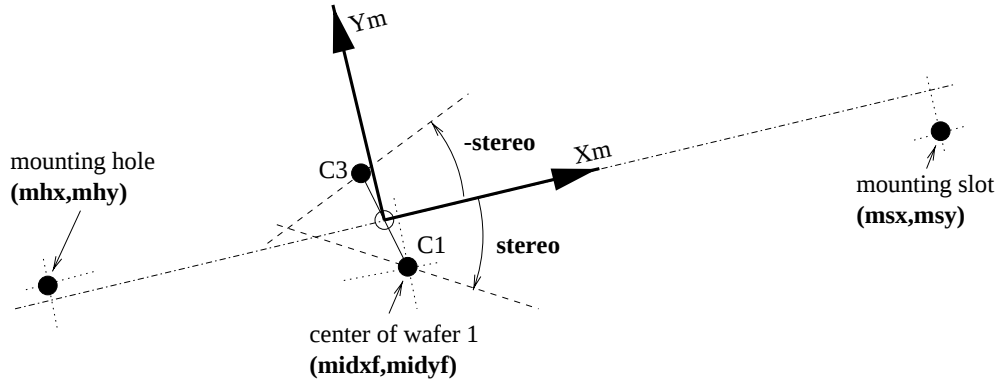


Figure 4: Definition of the parameters which describe the geometry of a two-wafer module. Black circles $C1$ and $C3$ are the measured centers of the two wafers. The dashed line through each center gives the measured orientation of each wafer. Open circles are the center points of lines. The module is described in the database with 7 numbers: three coordinate pairs in the X_m, Y_m system (mhx, mhy) , (msx, msy) and $(midxf, midyf)$ and the angle **stereo**.

Parameter	Tolerance	Design(63.5+0.59)		Module-abcd/k3103		Module-cafe/k3301	
		[mm],[rad]	[μ m],[mrad]	[mm],[rad]	[μ m],[mrad]	[mm],[rad]	[μ m],[mrad]
mhd _x	30 μ m	-6.50000	0.00	-6.51022	-10.22	-6.50210	-2.10
mhd _y	30 μ m	-37.00001	0.00	-37.00032	-0.32	-37.01559	-15.59
msd _x	100 μ m	38.50000	0.00	38.47219	-27.81	38.46778	-32.22
msd _y	30 μ m	-37.00000	0.00	-37.00522	-5.21	-36.99761	2.39
sepf	10 μ m	64.09000	0.00	64.08809	1.91	64.08765	2.35
sepb	10 μ m	64.09001	-0.01	64.08630	3.70	64.09020	-0.20
mid _x f	10 μ m	0.00000	0.00	0.00214	2.14	-0.00202	-2.02
mid _y f	5 μ m	0.00000	0.00	0.00089	0.89	-0.00164	-1.64
a ₁	0.13mrad	0.00000	0.00	-0.00002	-0.02	-0.00003	-0.03
a ₂	0.13mrad	0.00000	0.00	0.00005	0.05	0.00002	0.02
a ₃	0.13mrad	0.00000	0.00	-0.00002	-0.02	0.00005	0.05
a ₄	0.13mrad	0.00000	0.00	0.00001	0.01	-0.00001	-0.01
stereo-f	0.13mrad	-0.02000	0.00	-0.01998	-0.02	-0.01999	-0.01
stereo-b	0.13mrad	0.02000	0.00	0.02000	0.00	0.02001	0.01