POSTER #04

Innovations in Testing for Truly Known Good High Bandwidth Memory Stacks

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High Bandwidth Memory Market Size & Kown Good Die/Stack Test Demands

HBM Market Size

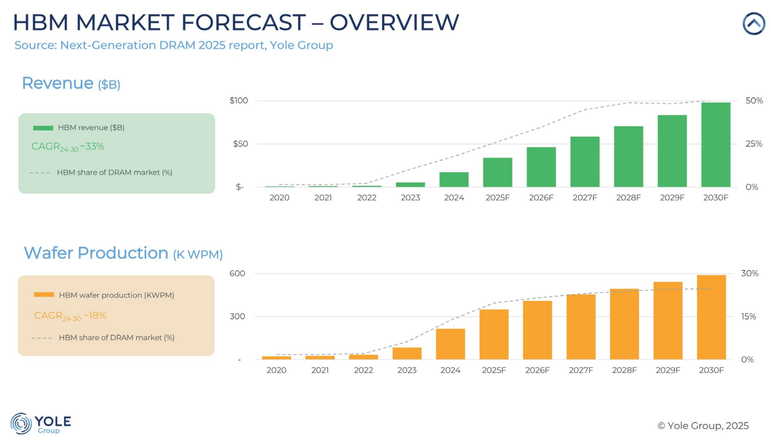
- Revenue CAGR 23 ~ 29 at 38%
- Wafer Production 23 ~ 29 at 23%

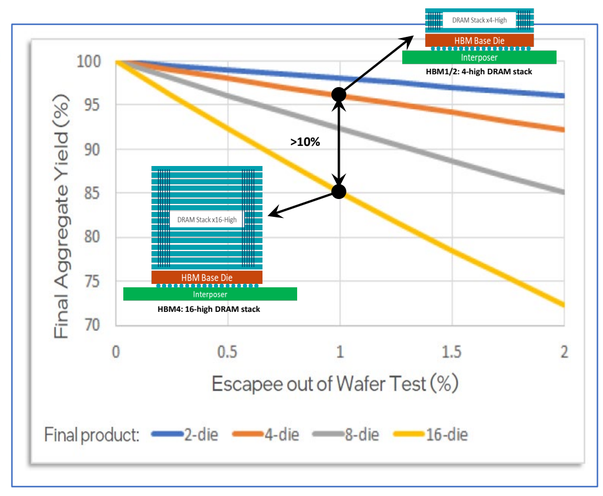
Package final test is necessary, but provides limited insight to improve performance & yield Ideally, each component is good before integration

- Nirvana is Known Good Die (KGD), just test everything

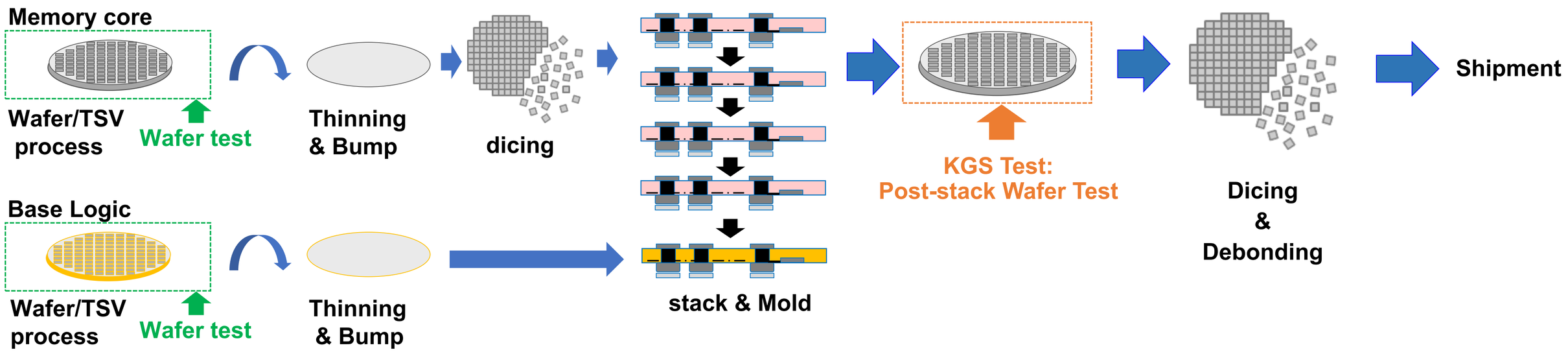
Economics may dictate something shy of KGD

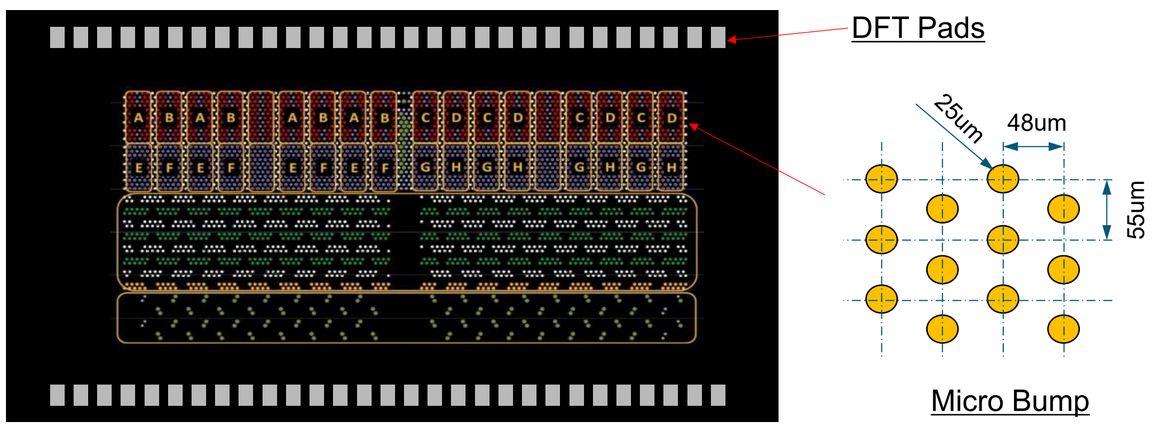
- Pre-package wafer test → scrap-cost avoidance
- Final-test and system-test opportunities prevent escapes





Typical HBM Test Insertion – Pros & Cons on KGD PAD Testing

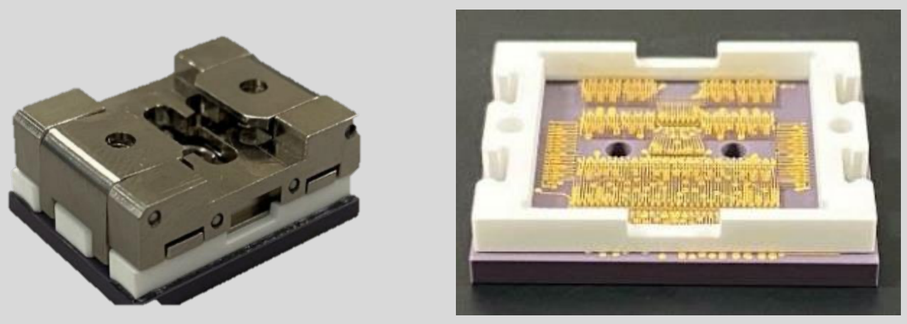




	Micro-bump probing test	DFT pad probing test
Pros	All 8ch simultaneously test can be executed. Test close to actual usage conditions	Do not damage Micro-bumps. Big number of parallel test can be executed.
Cons	Deep bump coining unusable in production. Small number of parallel test due to many I/O pins.	Test different from actual usage conditions

HBM test cell solution by “Die Carrier”

➢ Die Carrier (Interposer , Lid , Probe)



➢ Inserter/Remover

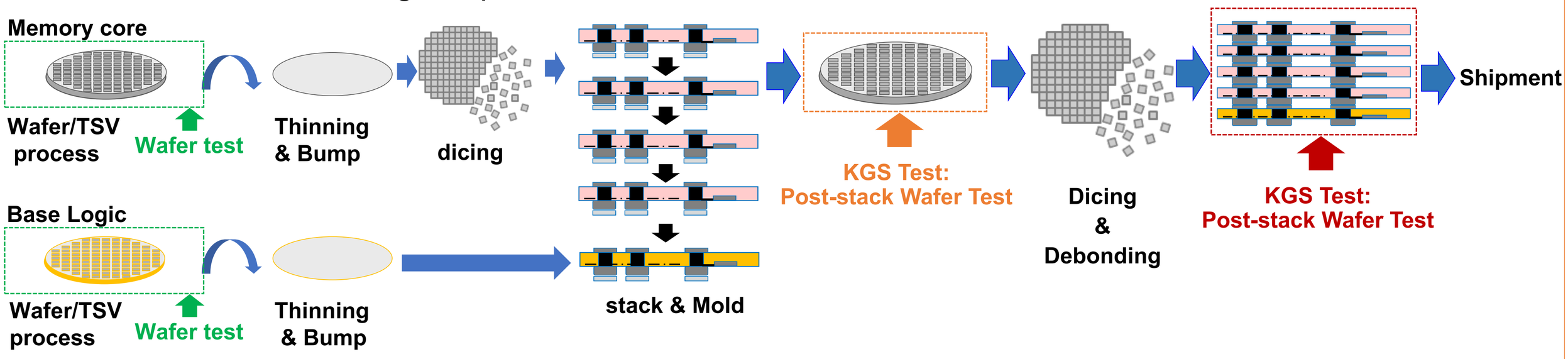
FFI HBM Singulated Stack Die Test Solution

Product Features:

- Compatible with T11 series probe
- Offer same high-speed performance as HFTAP
- Cold and Hot temperature capability
- Design with Advantest handler and tester build in vision alignment feature

Product Benefits:

- Offer solution for **truly** known good stack/die test solution
- Enable quality screening post HBM stack wafer dicing
- HBM KGD test capability up to 4GHz
- Fast soak time switching temperature



Known Good Stack Wafer Test Flow

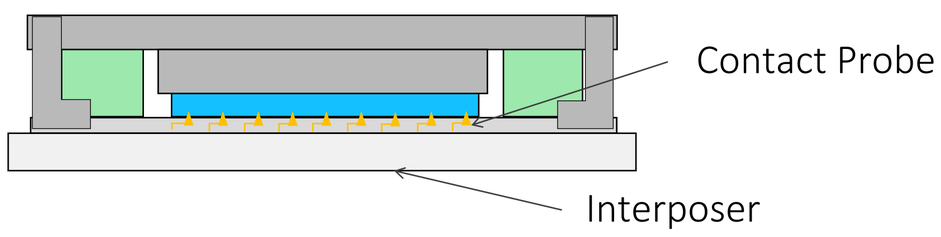
DC & Simple Function Test		Test efficiency: 90%
Cold & Hot Temp Test		80%
High Freq Test		70%

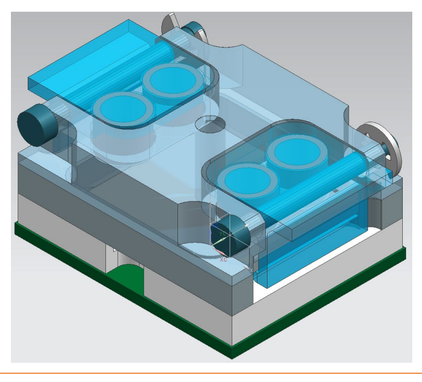
Known Good Stack Die Test Flow

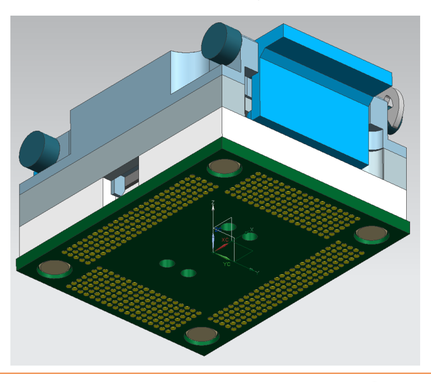
	Test efficiency: 100%
	100%
	100% *reject a failure die between the test steps and keep efficiency

Carrier structure and SI/PI Simulation result

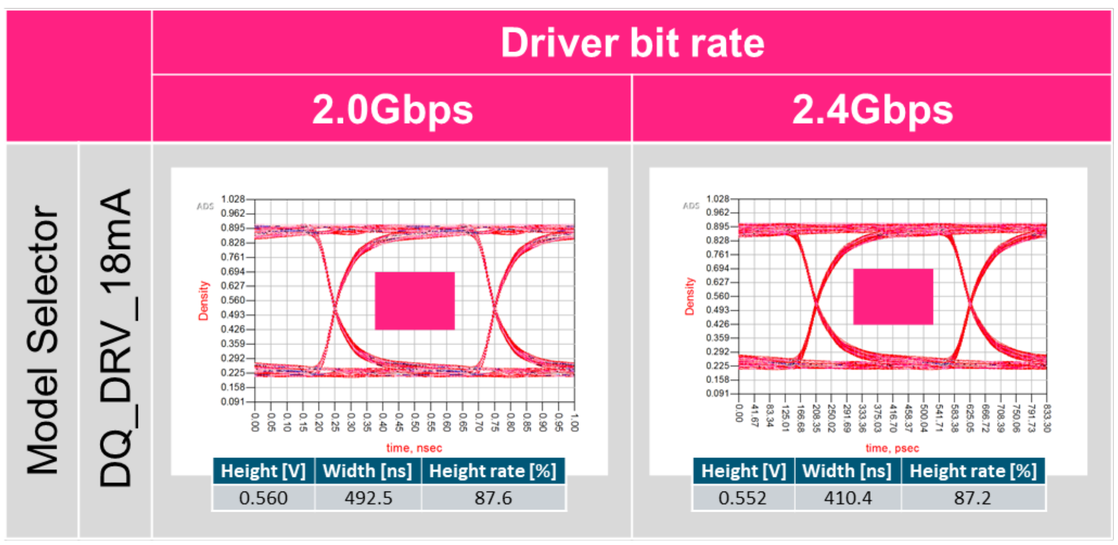
- **Carrier structure**
- **Structure**
  - Contact to HBM device : MEMS Probe
  - Contact to test socket : Interposer
- **Pros**
  - High electrical performance can be expected
  - Similar pad scrub behavior with wafer test





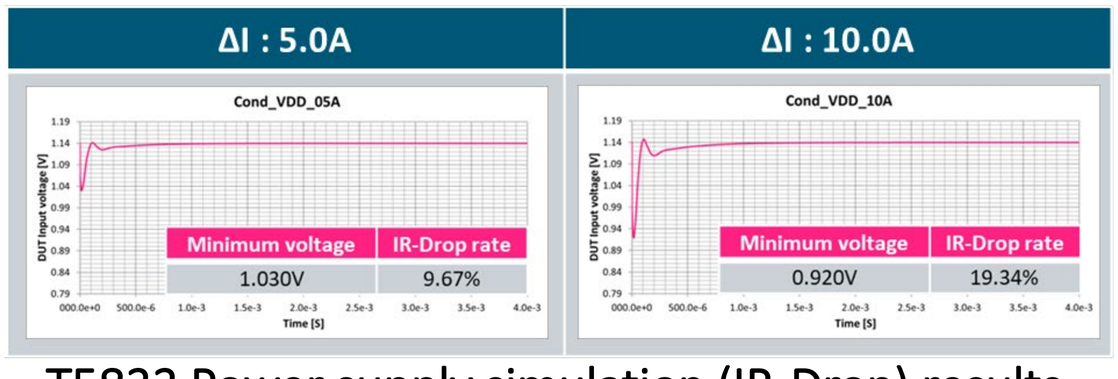


- **SI Simulation result**



T5833 Read cycle simulation results on Carrier Solution

- **PI Simulation result**

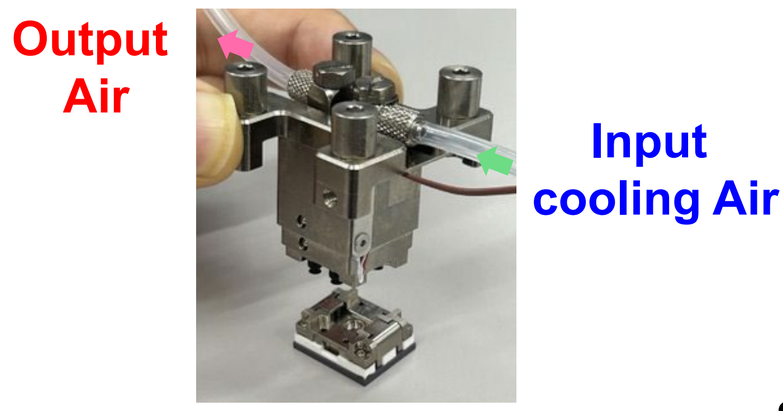


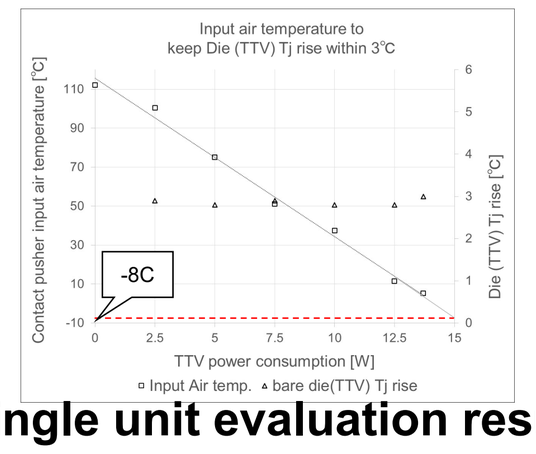
T5833 Power supply simulation (IR-Drop) results

Thermal technical challenge

- **High Power Density in HBM Stacks:**
  - An HBM 3D memory stack die can dissipate significant power during test
  - In a high-parallel testing, the total heat load poses a serious thermal management challenge
- **Thermal control by memory handler**
  - Die temperature is well controlled by connecting memory handler
  - The handler has individual sensor and applies cooling air to keep die Tj

item	value
Parallelism	64
Heat generation	15W
temperature	105℃
Tj rise(all Die)	≦3℃





Single unit evaluation result

Alignment accuracy & repeatability

- **Automated alignment processes:**

Detect the die reference bumps from each hole with the camera

↓

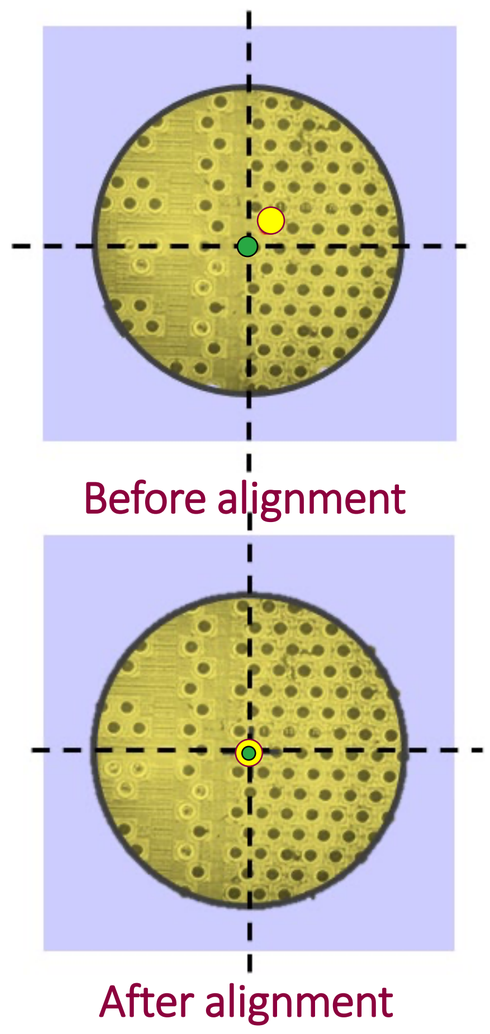
Calculate X,Y and theta

↓

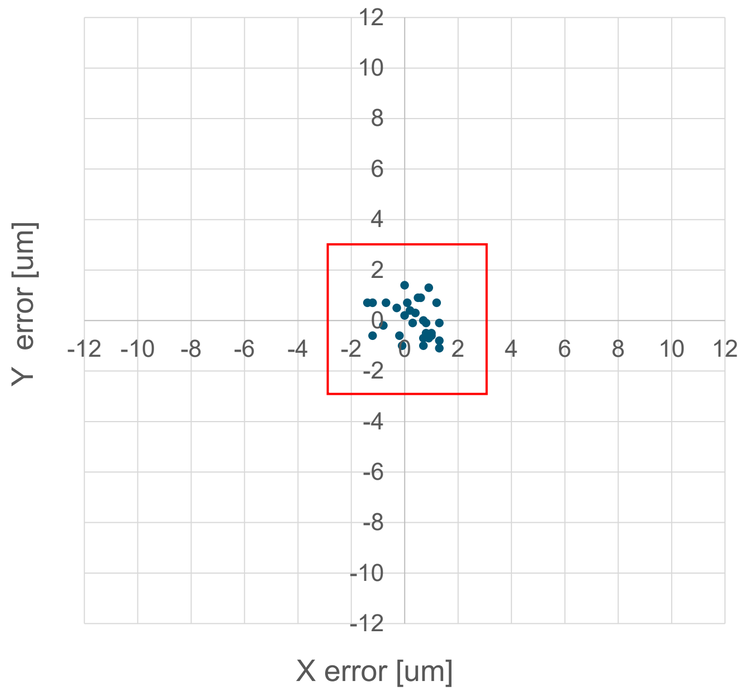
Move the alignment actuator to the correct position

↓

Check the position of the die reference bump with the camera



Validation result



Align the centers of the two reference points on the carrier and the die

Conclusion

- **Technical Advantage – Die-Level Testing**
  - Singulated die testing allows full-speed, multi-temperature screening before stacking
  - One-time contact via die carrier achieves complete test coverage (DC, functional, etc.) in a single insertion
  - Supports high parallelism, improving overall throughput without compromising test quality
- **Scalability and Future Applications**
  - The short transmission path of the die carrier architecture enables reliable multi-GHz test performance
  - Well suited for wafer-level high-speed memory testing and future chiplet architectures

Acknowledgement & Contact information

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