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The interoperability test results of PCDs

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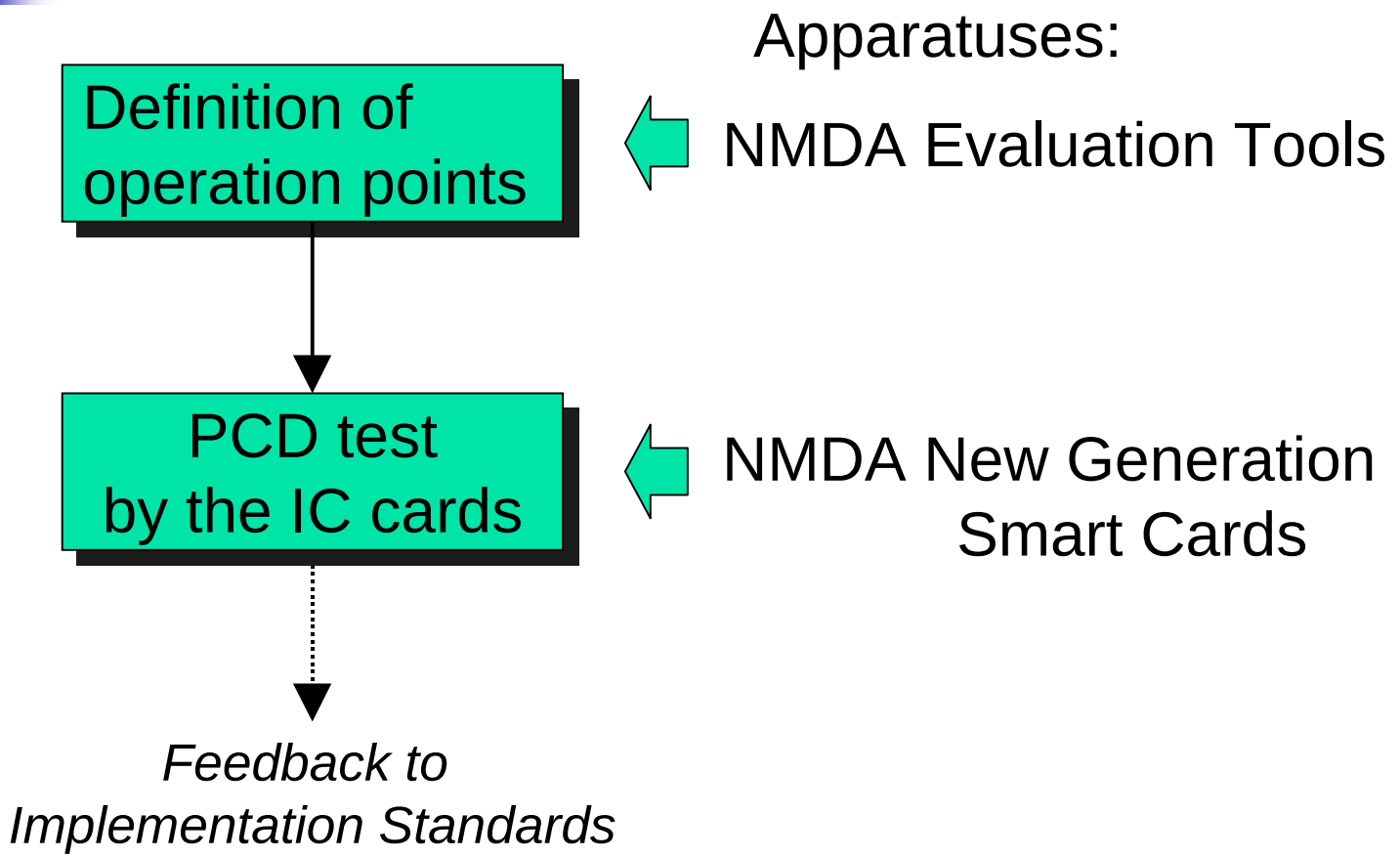
Today's contents

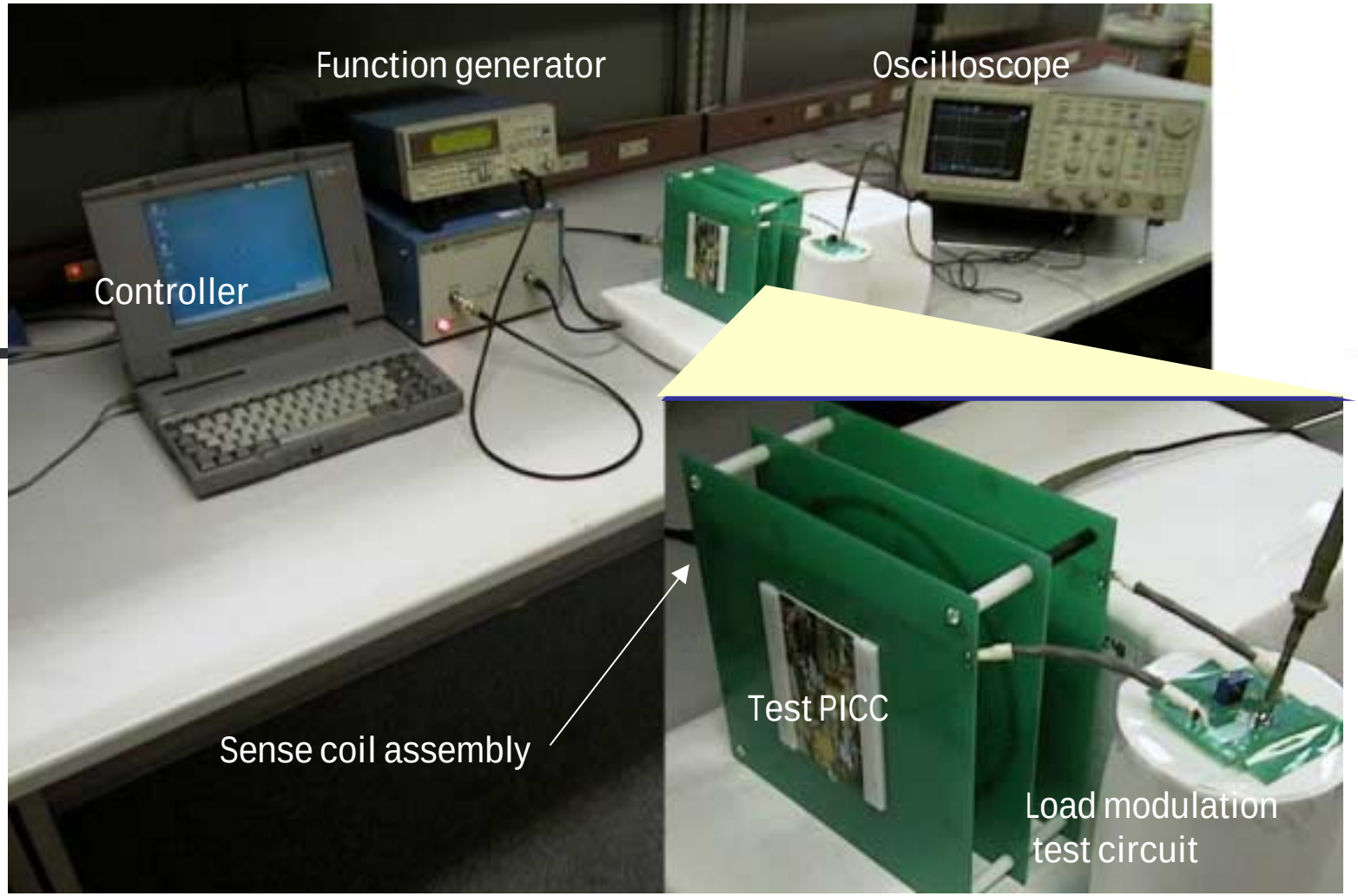
- **Interoperability test method**
- **Test Results**
  - **10 points operation test**
  - **Operating space measurement**
- **Conclusions**

Work flow for Interoperability Test



PICC TEST APPARATUS

ISO/IEC 10373-6 Test Method



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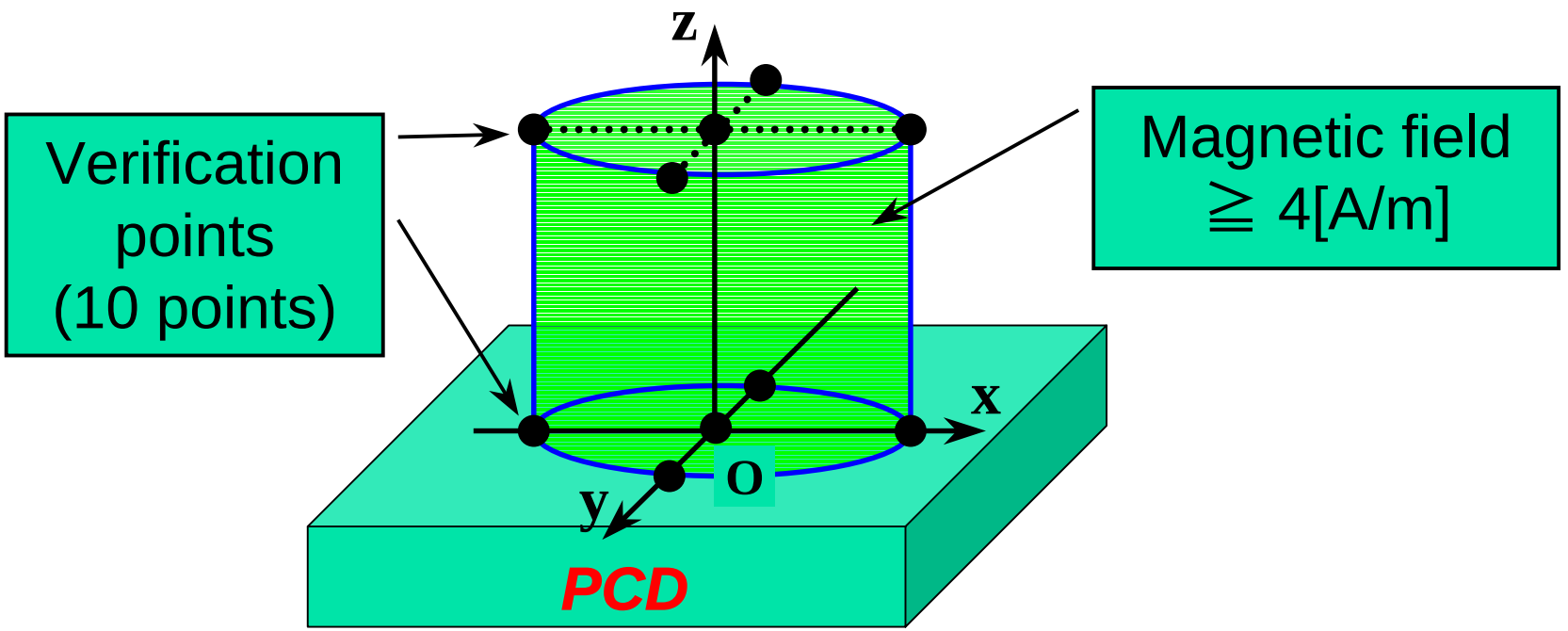
Definition of operation points

- The definition of 10 operation points.
- Magnetic Field Strength more than 4[A/m].

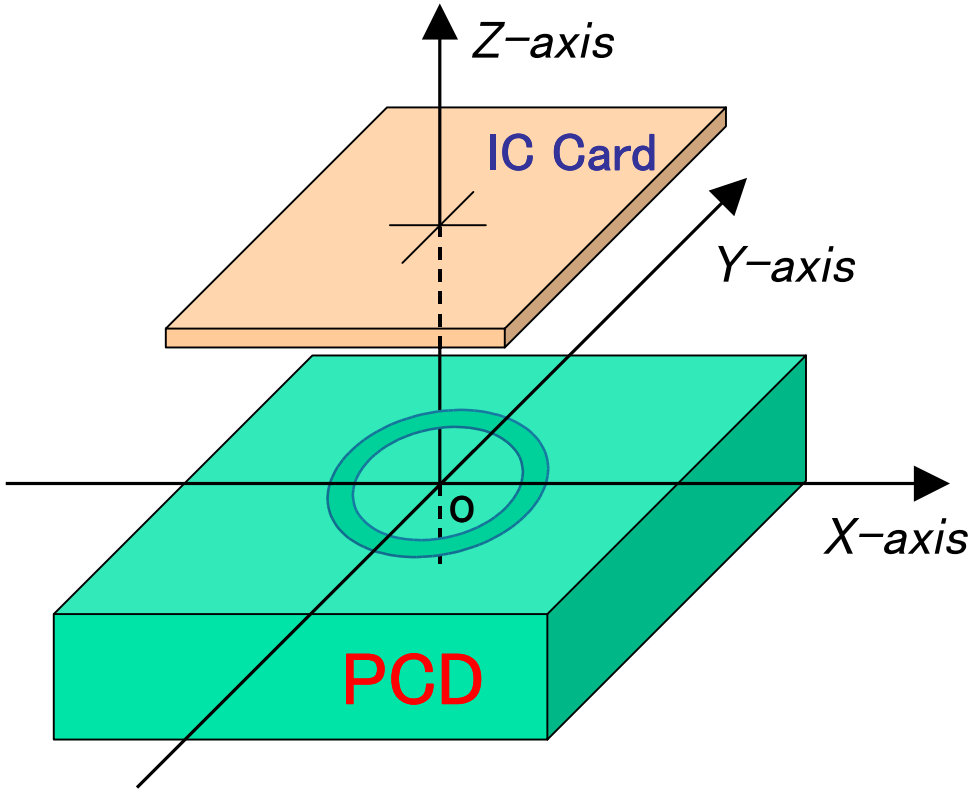


PCD test by the IC cards

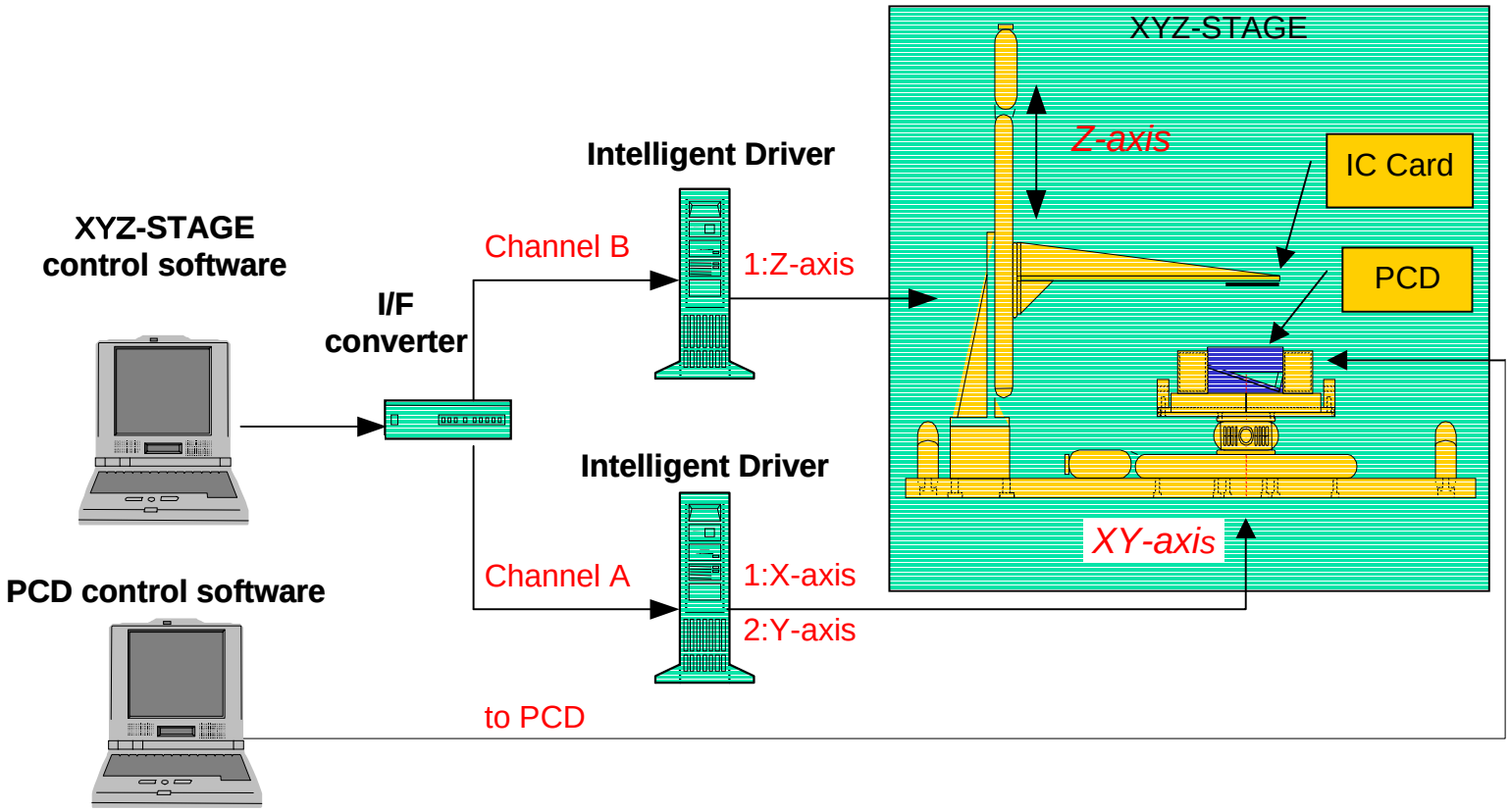
- **10 points operation test**
  - On the defined point, It checks that IC cards operates.

- **Operating space measurement**
  - Measurement of a critical point of operation

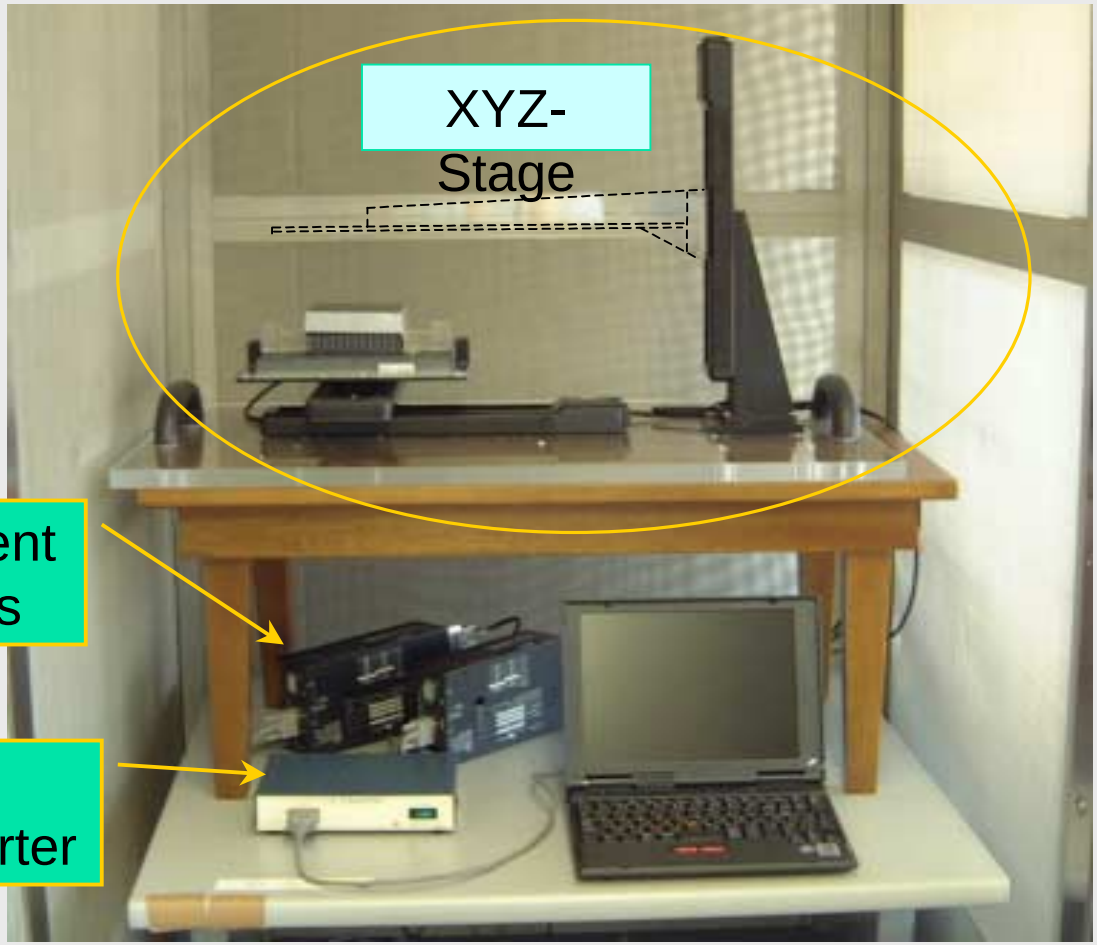
The direction of each axis



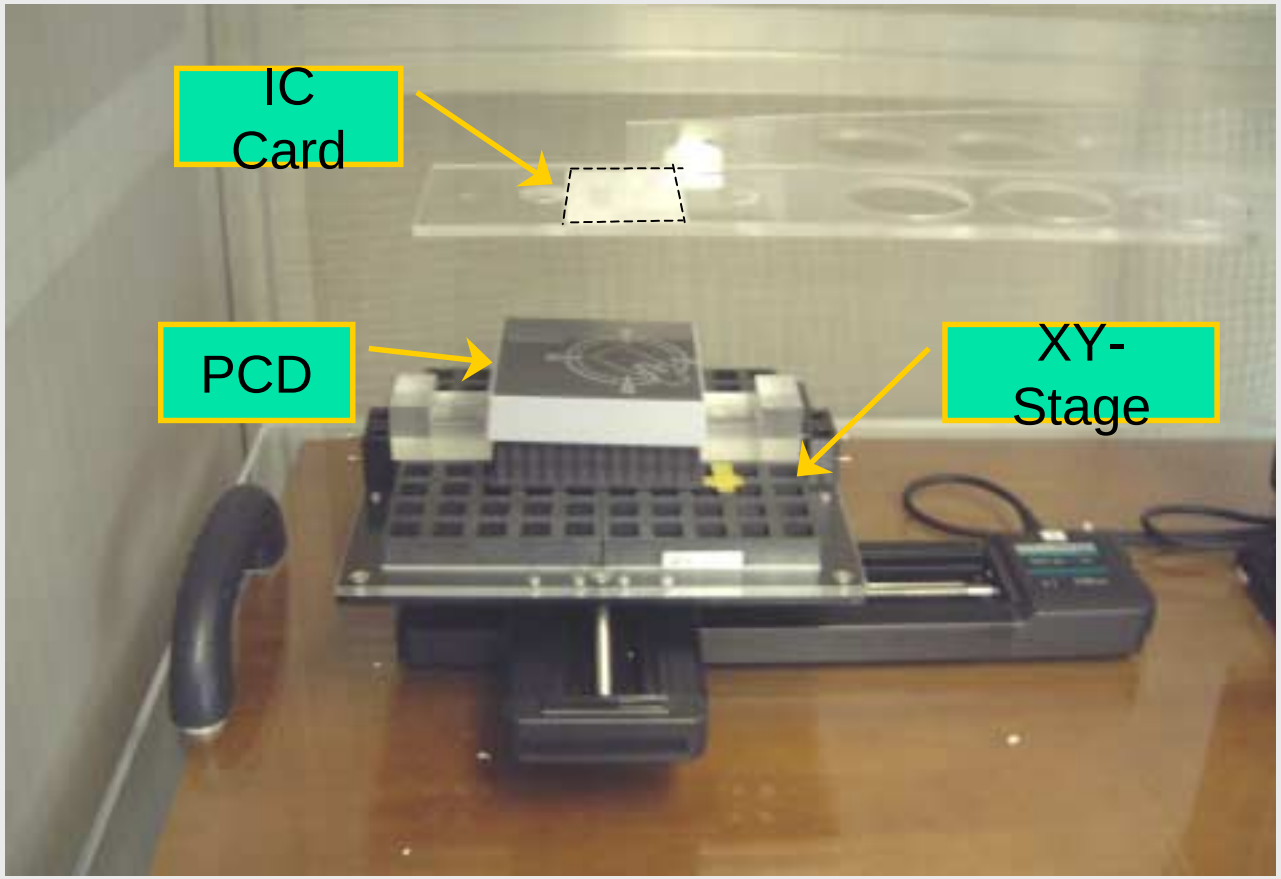
Test Apparatus (1/4)



Test Apparatus (2/4)



Test Apparatus (3/4)



Test Apparatus (4/4)

Stage move buttons

XYZ-Stage control software

Current positions

10 points operation test

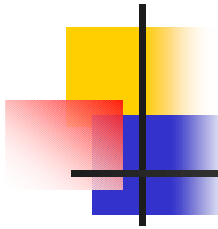
- ***Purpose***

  - Verification of interoperability between IC-cards and PCDs at the all defined pionts.

- ***Test method***

  - Setup IC-card and PCD on the defined point.
  - 10-times REQB-ATQB communication at each point.
  - 3-kinds of IC-cards developed for NMDA are applied.

Feature of IC-card



IC-card A	Typical performance and middle power consumption
IC-card B	Typical performance and low power consumption
IC-card C	High performance and high power consumption

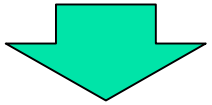
Results of 10 points operation test

PCD	Definition Area [mm]			Result on Z-axis					
				Card A		Card B		Card C	
	X	Y	Z	z0	z+	z0	z+	z0	z+
A	0,±10	0,±10	0,+7	O	O	O	O	X	O
B	0,±10	0,±10	0,+4	O	O	O	O	X	O
C	0,±10	0,±10	0,+14	O	O	O	O	O	X
D	0,±10	0,±10	0,+20	O	O	O	O	O	X
E	0,±10	0,±10	0,+5	O	O	O	O	X	X
F	0,±10	0,±10	0,+12	O	O	O	O	O	O
G	0,±10	0,±10	0,+10	O	O	O	O	O	X

O:Pass
X:Failure

Summary *of 10 points operation test*

- Card A and Card B operate satisfactory in a defined cylindrical space for all PCDs.
- Card C operates for a specified PCD, otherwise in failure on Z=0 or Z=+ point.



→ The power consumption of Card C is over 4 [A/m].

→ Mismatching may occurre between IC card and PCD.

Operating space measurement

- ***Purpose***

  - To measure the critical operation distance in the condition of interoperability operation between PCD and IC card.

- ***Test method***

  - Move IC card from point to point on the X-Z plane and Y-Z plane.

  - 10-times REQB-ATQB communication at each point.

  - 2 kinds of IC cards are used.(Card B,Card C)

Results *of operating space measurement*

PCD C - Card B <X-axis>

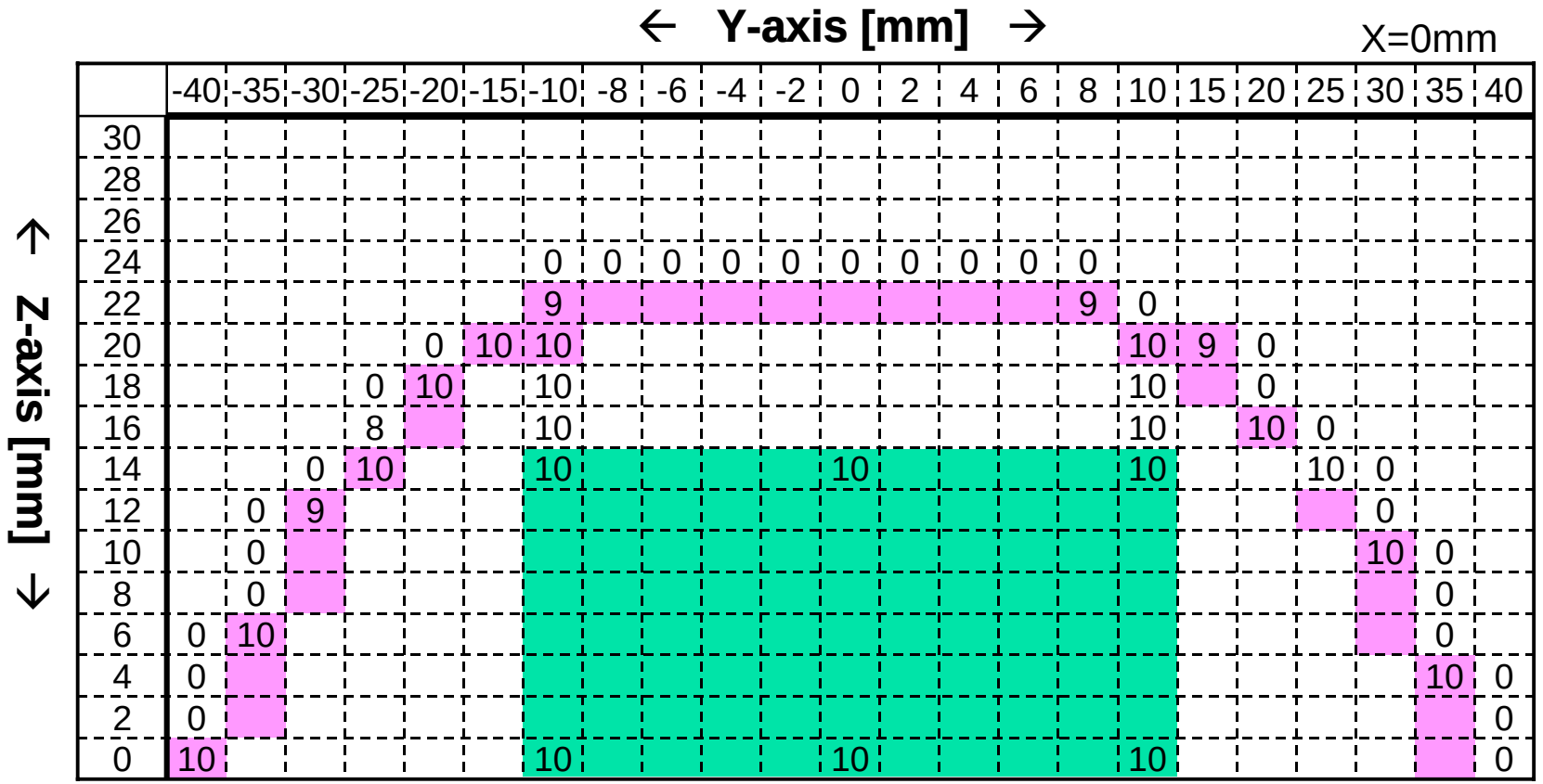
← X-axis [mm] →

Y=0mm

Z-axis [mm]	-40	-35	-30	-25	-20	-15	-10	-8	-6	-4	-2	0	2	4	6	8	10	15	20	25	30	35	40
30																							
28																							
26																							
24								0	0	0	0	0	0	0	0	0	0						
22							2	9									10	0					
20					0	10	10										10	10	0				
18				0	10		10										10		10	0			
16				8			10										10			10	0		
14			0	10			10										10				0		
12		0	9									10									10	0	
10		0																				0	
8		0																				10	0
6	0	9																					0
4	0																						0
2	0																						0
0	0						10					10					10						0

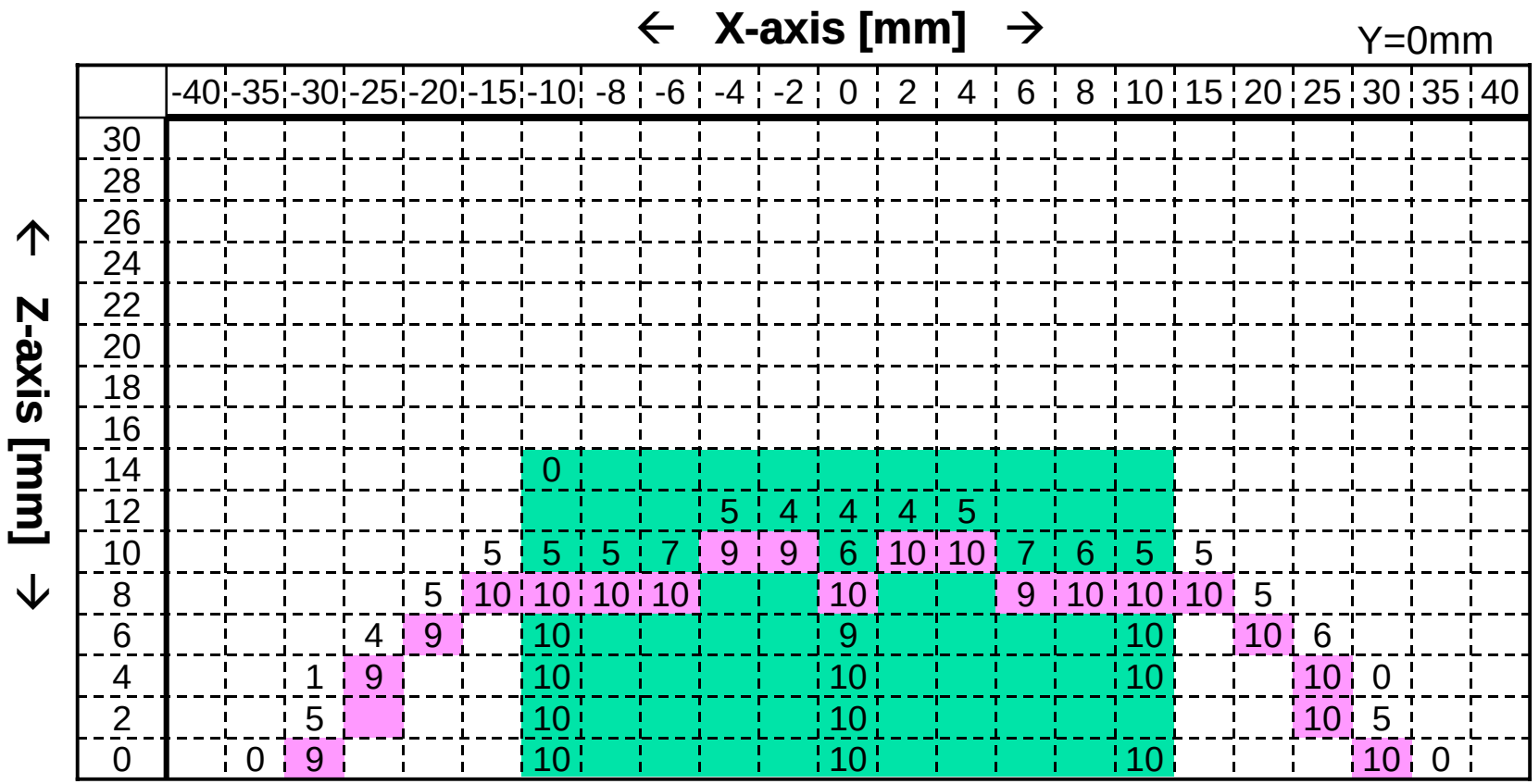
Results of operating space measurement

PCD C - Card B <Y-axis>



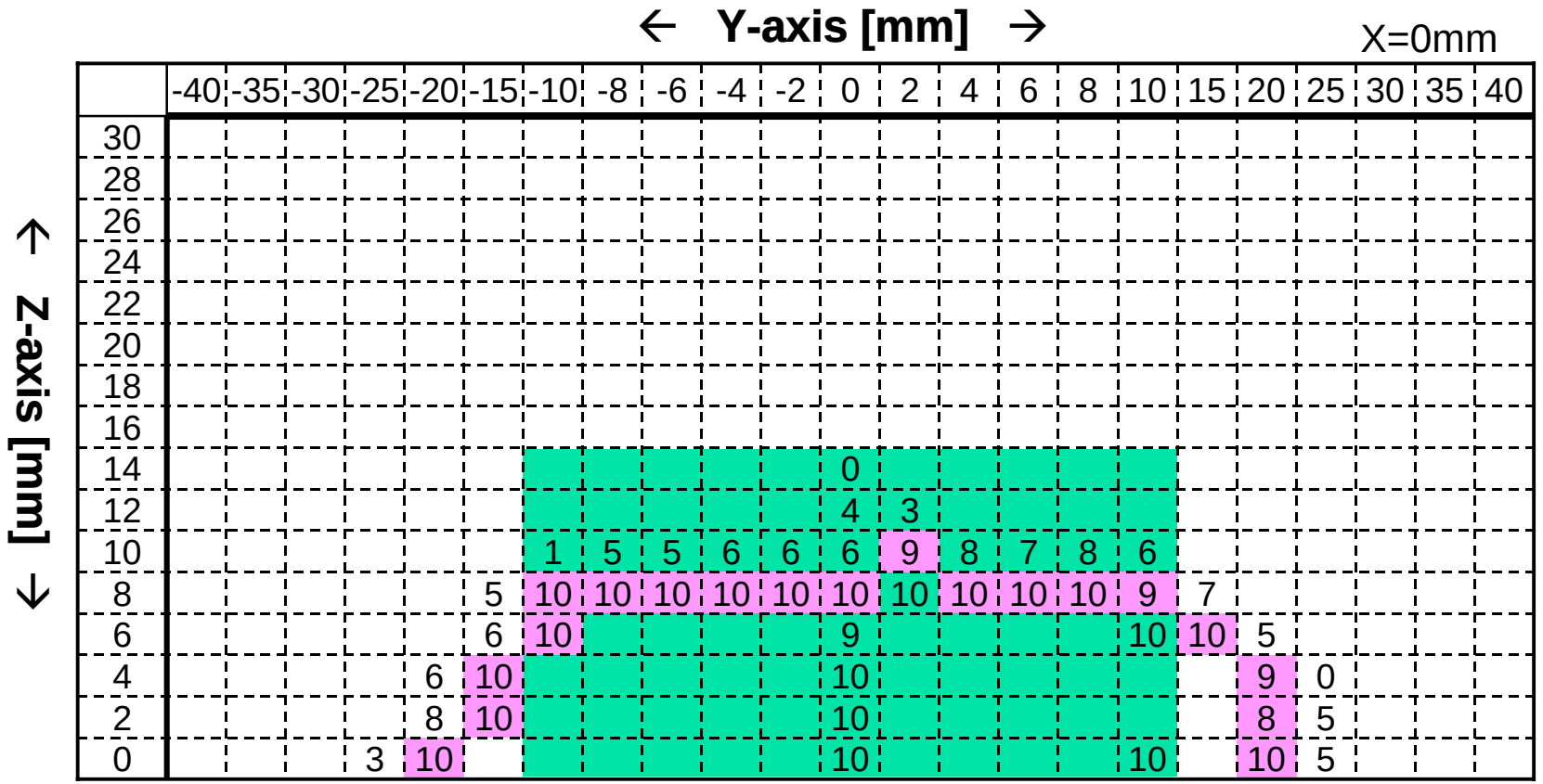
Results *of operating space measurement*

PCD C - Card C <X-axis>



Results of operating space measurement

PCD C - Card C <Y-axis>



Summary *of operating space measurement*

- Card B have a sufficient margin in the direction of the Z-axis for all PCDs.

→ The power consumption of Card B is enough low (below 4 [A/m]).

- Card C operation doesn't reached the definition point of the Z-direction for some PCDs.

→The power consumption of Card C is high (over 4 [A/m]).

- Unstable or false operation is observed at the point on the Z=0 plane for some PCDs.

→Impedance mismatching may occurs between a card and PCD.

Conclusions

- The interoperability is verified in 4A/m defined cylindrical space between two cards and seven PCDs which were independently developed by different makers.
- For high performance IC card, unstable or false communication occurred between six PCDs at the top edge or bottom edge of defined space.
- The operation space on the PCD-PICC communication is like a cap shape whose base area depends on the diameter of PCD antenna and whose height depends on RF power and IC card power consumption.

-fin –

Thank you for your attention