Diagnostic plan for ATE production test board of large-scale chip

Jiang Lei
UNISOC

TestConX中国 China

Shanghai ▪ October 31, 2024

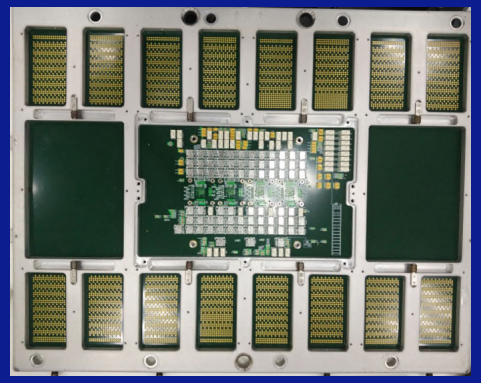
紫光展锐 UNISOC

Contents

- Current situation of ATE board
- Diagnostic method of ATE board
- Dummy Device design & fabrication
- Dummy Device reference case
- Diagnostic program of ATE board
- Summary of diagnostic plan

Current situation of ATE board

- High Site Count,12 or 16 Sites
- Large Size
- Too many devices
- Difficulty in Design & Fab
- Long delivery cycle
- High Cost
- Difficulty in Debug & Maintenance



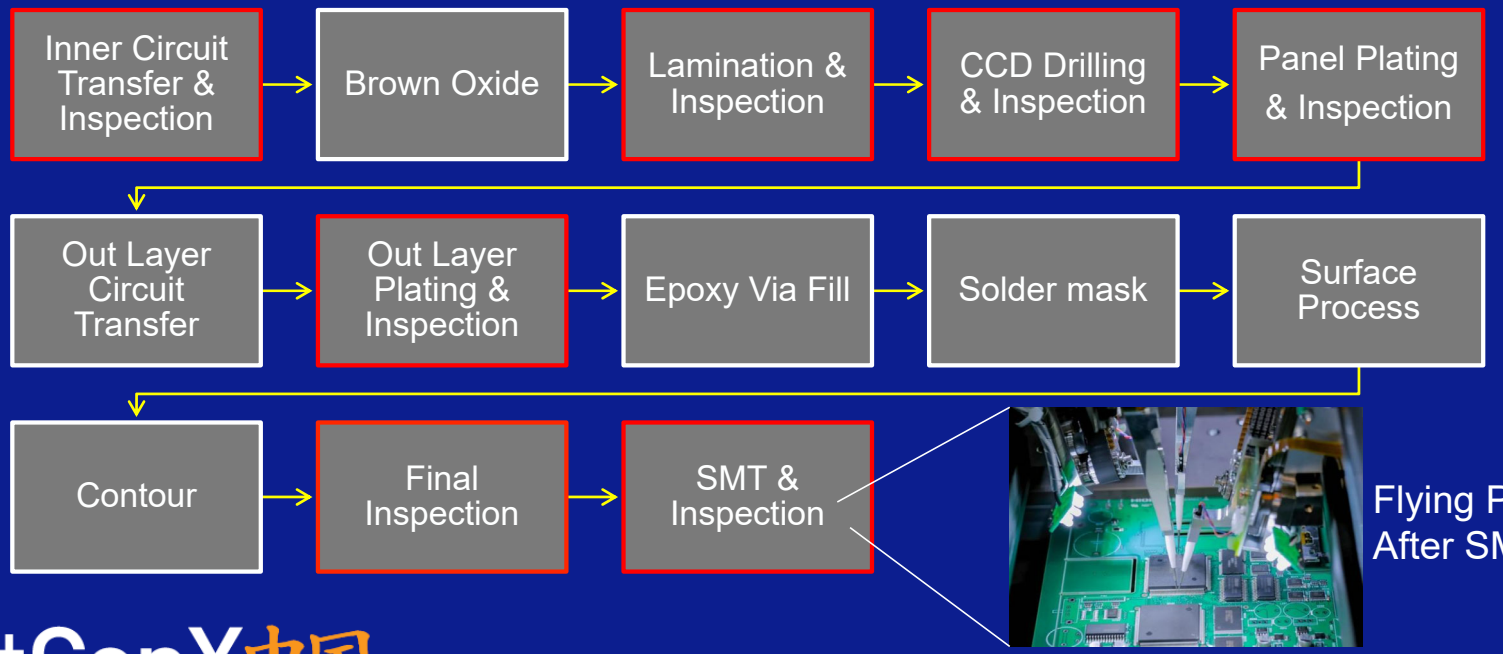
few years ago

Currently

Diagnostic plan for ATE production test board of large-scale chip

Current situation of ATE board

- Only PCB testing was completed during the fab process.
- The components have not been tested.



TestConX中国 China

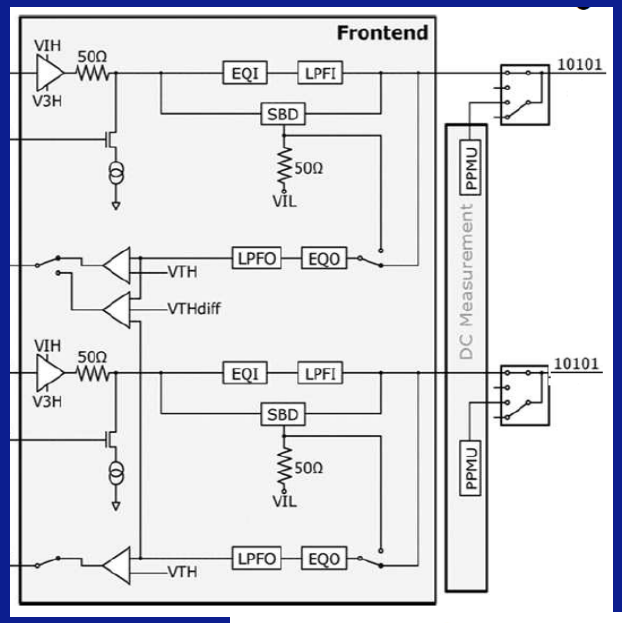
Diagnostic plan for ATE production test board of large-scale chip

4

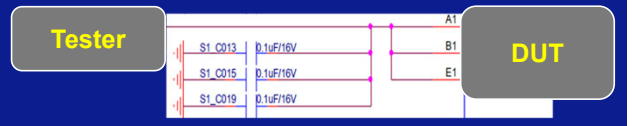
4

Diagnostic method of ATE board

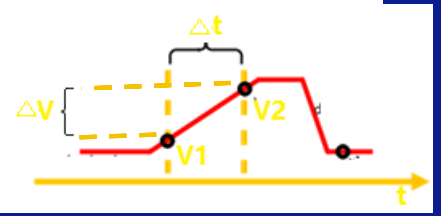
- Tester pin function:
  - Pin Parametric Measurement Units(PPMU）
  - Arbitrary Waveform Generator（AWG）
  - Driver
  - Digitizer
  - Comparator
  - Active Load



V = I * R



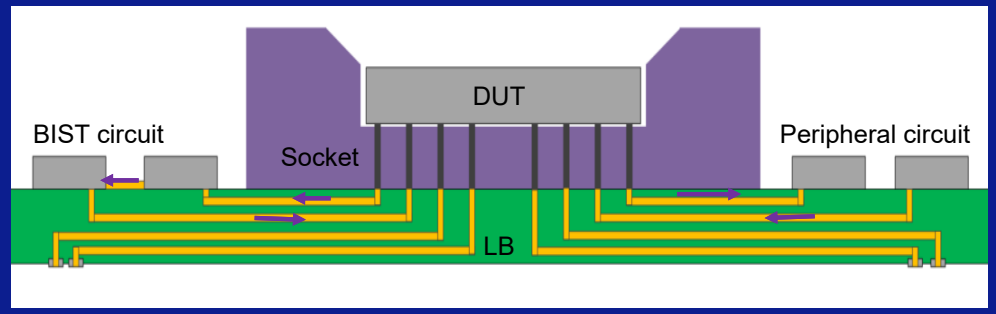
ΔT= C * ΔV / I



Diagnostic plan for ATE production test board of large-scale chip

Diagnostic method of ATE board

- Large proportion of components are not connected to the tester
- Dummy Device or additional design is needed to improve test coverage



General ATE Test Circuit

Module	Circuit on ATE board	Testability of Components
High Speed BIST	DUT → Switch → DUT	No
Resistance /Voltage Trim	DUT → Peripheral circuit → Tester	Partial Yes
RF Circuit	DUT → RF Matching Network →Tester	No
ADC/DAC	DUT → Op-Amp Circuit → Tester	No
Clock Input	TCXO/CLK IC → DUT	No

TestConX中国 China

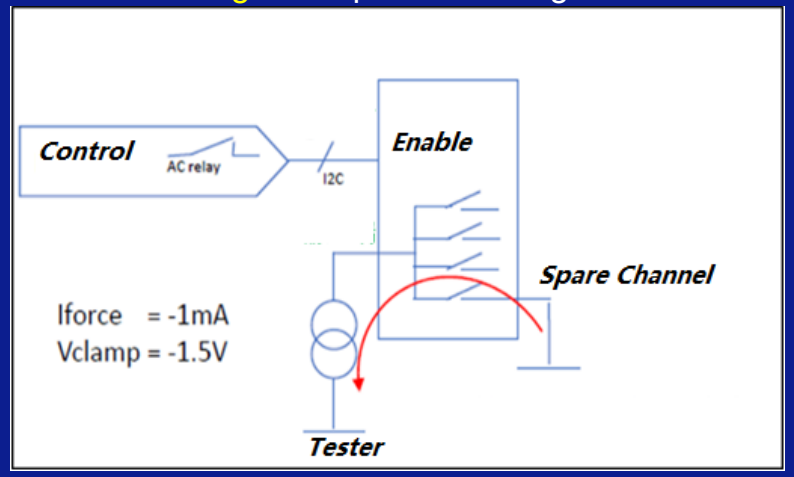
Diagnostic plan for ATE production test board of large-scale chip

25th ANNIVERSARY SINCE 2005

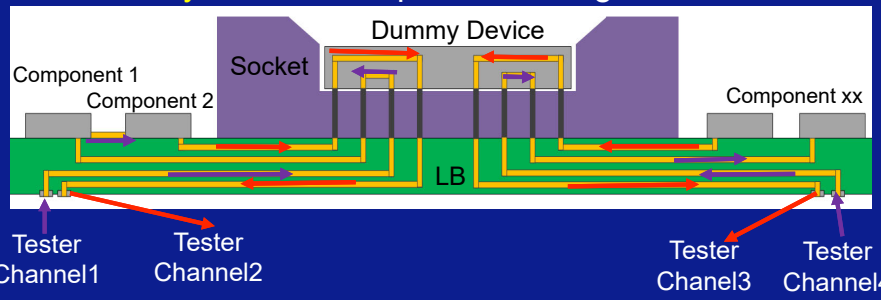
6

Diagnostic method of ATE board

Additional Design to improve coverage



With Dummy Device to improve coverage



Original Coverage 44%

Test Items			Additional Design			With Dummy Device	
		Total Qty	Testable Qty	%		Testable Qty	%
Path	IO Leakage	4080	3664	0.898		3664	0.898
	IO Connectivity	4080	3632	0.8902		3632	0.8902
	Power Leakage	496	496	1		496	1
	Path Resistance	4576	0	0		0	0
	Path Functionality	0	0	0		0	0
Relay	Coil Status	240	220	0.9167		240	1
Cap	Capacitor	413	121	0.293		329	0.6804
	Cap Bank	424	336	0.7925		368	0.8679
Resistor		1319	571	0.4329		1109	0.724
Diode		233	229	0.9828		229	0.9828
IC	xc6219a182mr	16	0	0		16	1
	wl2820d18-4/tr	16	0	0		16	1
	tmuxhs4412iruat	160	80	0.5		160	1
	tmp451aqdqwrq1	16	0	0		16	1
	mic39102ym	16	0	0		16	1
	adg1606bruz	64	64	1		64	1
	52mhz	16	0	0		16	1
	mt25ql128	1	1	1		1	1
	mc33063ad	4	0	0		4	1
Component Overall		**2938**	**1622**	**55.21%**		**2584**	**87.95%**

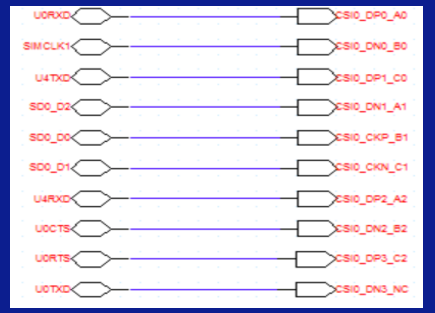
TestConX中国 China

Diagnostic plan for ATE production test board of large-scale chip

7

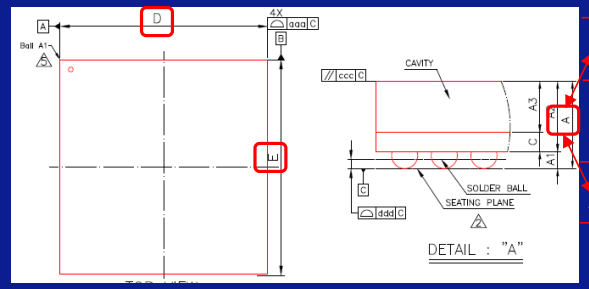
Dummy Device design & fabrication

- Easy to design
- Same Size with chip POD
- PCB PTH(Plated through hole) Process
- With Solder Ball or NiPdAu PAD
- Panel Fab

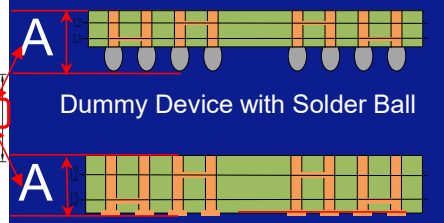


Schematic Design

PCB Design

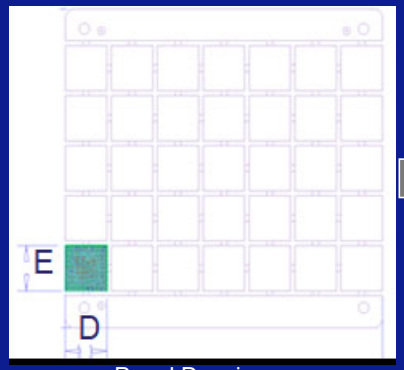


Chip POD

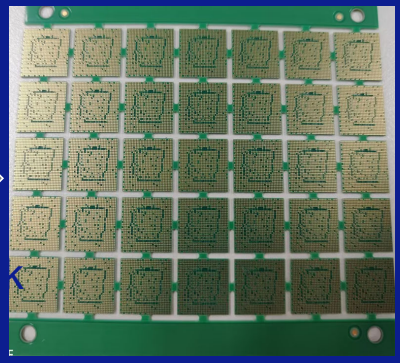


Dummy Device with Solder Ball

Dummy Device with NiPdAu PAD



Panel Drawing



PCB with NiPdAu PAD

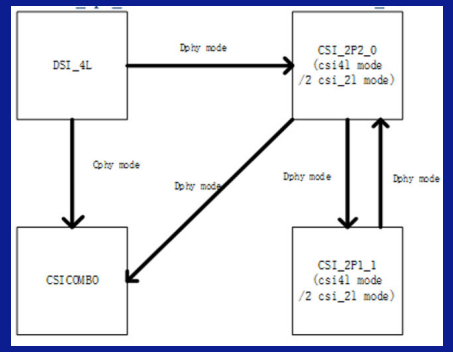
TestConX中国 China

Diagnostic plan for ATE production test board of large-scale chip

8

Reference case1 – High Speed BIST

- With Dummy Device, we can test all the high speed analog switch



ATE Test Diagram

Tester Channel A

Tester Channel C

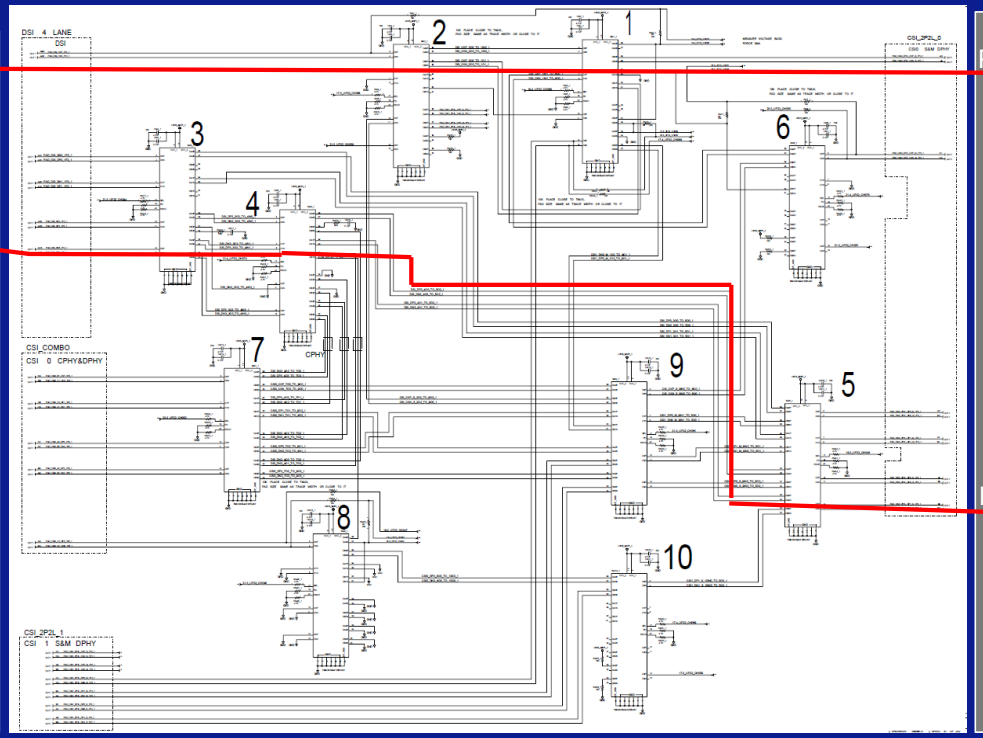
Pin1

Pin2

Pin5

Pin6

Dummy Device



Real High speed BIST Schematic on ATE Board

Pin3 Pin4

Pin7 Pin8

Dummy Device

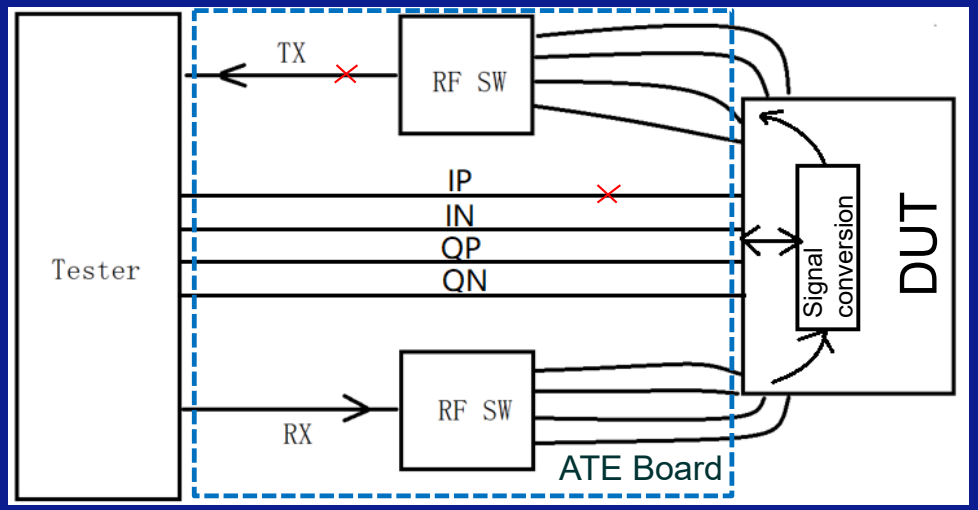
Tester Channel E

Tester Channel G

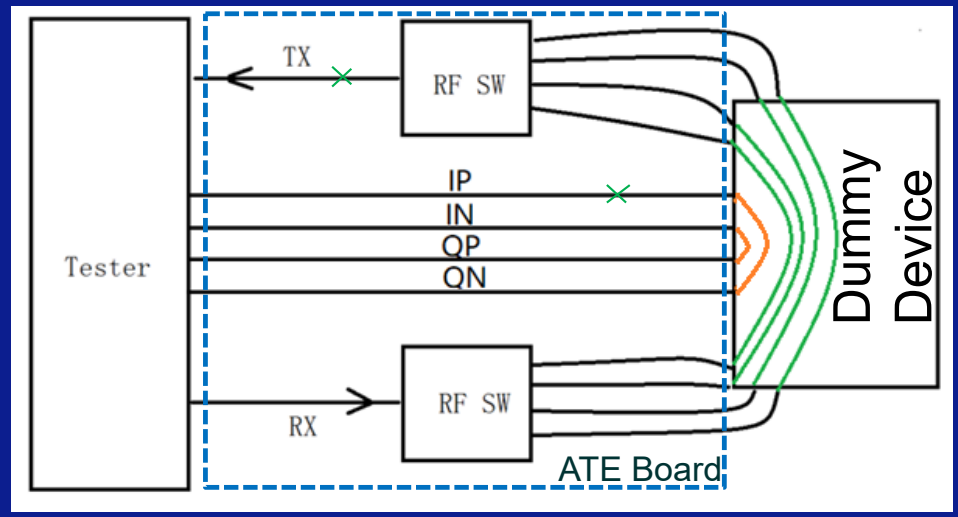
Diagnostic plan for ATE production test board of large-scale chip

Reference case2 – RF Chip

- With Dummy Device, we can test both the RF Path and IQ Path



RF Chip ATE Test Diagram



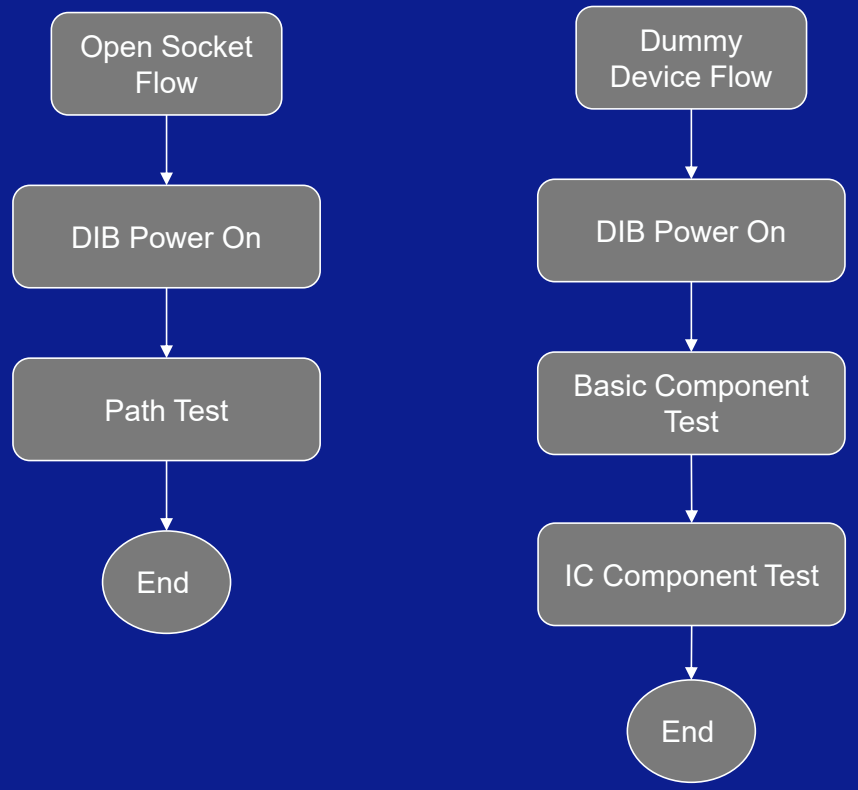
Dummy Device Test ATE Board

Diagnostic Program of ATE board

- Open Socket Flow(Without Dummy Device）
  - IO Path
  - Power Path
  - UDB Path
  - User Power
- Dummy Device Flow

  Basic Component
  - Res
  - Cap
  - Relay ….

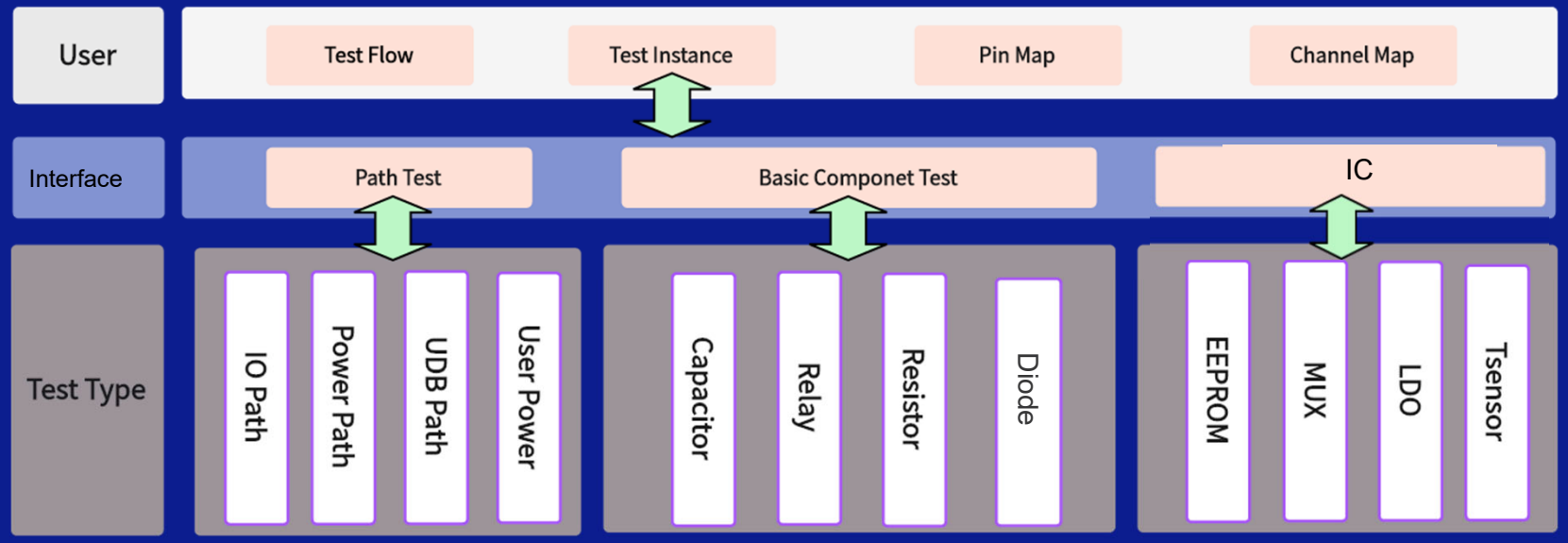
  IC Component
  - Analog Switch
  - Clock IC
  - Op-Amp….



Diagnostic plan for ATE production test board of large-scale chip

Diagnostic Program of ATE board

- Hierarchical Modular Design For Program



TestConX中国 China

Diagnostic plan for ATE production test board of large-scale chip

25th ANNIVERSARY SINCE 2005

12

12

Diagnostic Program of ATE board

- Easy to develop programs

	Test Pin Parameters			Initial Pin Parameter	Relay Control Setup Parameters			Datalog Results Parameters				Datalog Results	
TestType	TestPin	Force Value	Clamp Value	Initial Value	UDB CtrlOn	UDB CtrlOff	PPMU Ctrl Pin Volt	Limit Hi	Limit Lo	Expect Value	Unit	Setup Time	Coms On Path
RES_FIMV	Pin1	I_value	H:1;L:0	Pin2=0V	Utility Pin1	Utility Pin5	CtrlPin1=0; CtrlPin2=3.3	R_limitHi	R_limitLo	R_Value	Ohm	Waiting Time	Rxx; Kxx;
CAP_FIMV	Pin3	I_value	H:1;L:0	Pin4=0V	Utility Pin2	Utility Pin6	CtrlPin3=0; CtrlPin4=3.3	C_limitHi	C_limitLo	C_Value	F	Waiting Time	Cxx; Kxx
RLY_FIMV	Pin5	I_value	H:1;L:0	Pin6=0V	Utility Pin3	Utility Pin7	CtrlPin5=0; CtrlPin6=3.3	V_limitHi	V_limitLo	/	V	Waiting Time	Kxx; Kxx

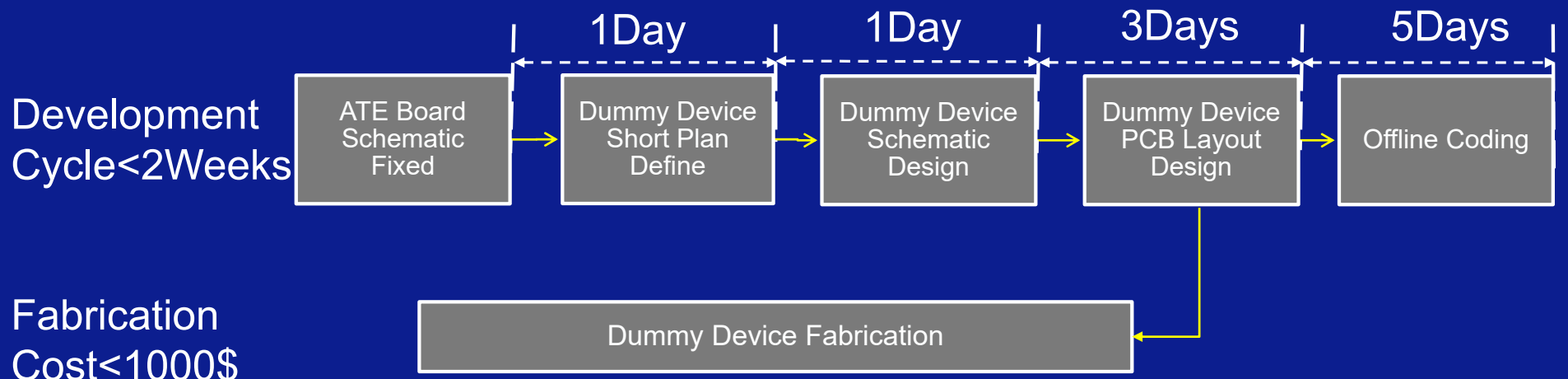
TestConX中国 China

Diagnostic plan for ATE production test board of large-scale chip

13

13

Summary of Diagnostic Plan



TestConX中国 China

Diagnostic plan for ATE production test board of large-scale chip

COPYRIGHT NOTICE

TestConX中国™ China

25th ANNIVERSARY