Maskrom Auto Fail Bitmap Monitoring Algorithm & Applied Effect in Mass Product

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Samsung Electronics

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Auto Fail BitMap Monitoring Method

Agenda

- Purpose of Auto Fail BitMap Setup In Mass Product
- BitMap Analysis and Monitoring Method
- Fail Bit Analysis Result
- Applied Effect

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Purpose of Auto Fail Bitmap Setup In Mass Product

- For maintain Static Device Yield.
- Rapid feedback to FAB about device main fail type.
- Decision of New Repair Scheme.
- Save the manufacturing cost.

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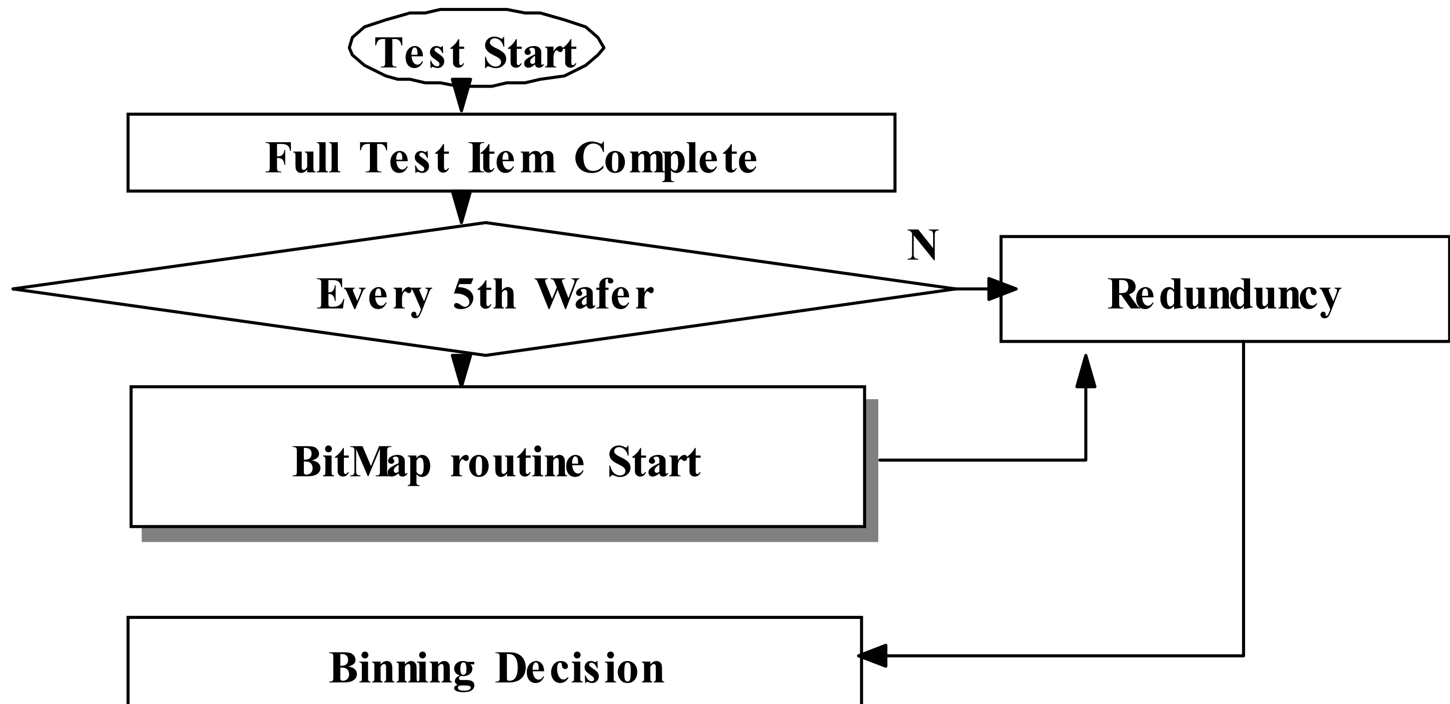
BitMap Analysis and Monitoring Method



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BitMap Analysis and Monitoring Method

Flow Chart

- **Address Store**
- **User scramble**

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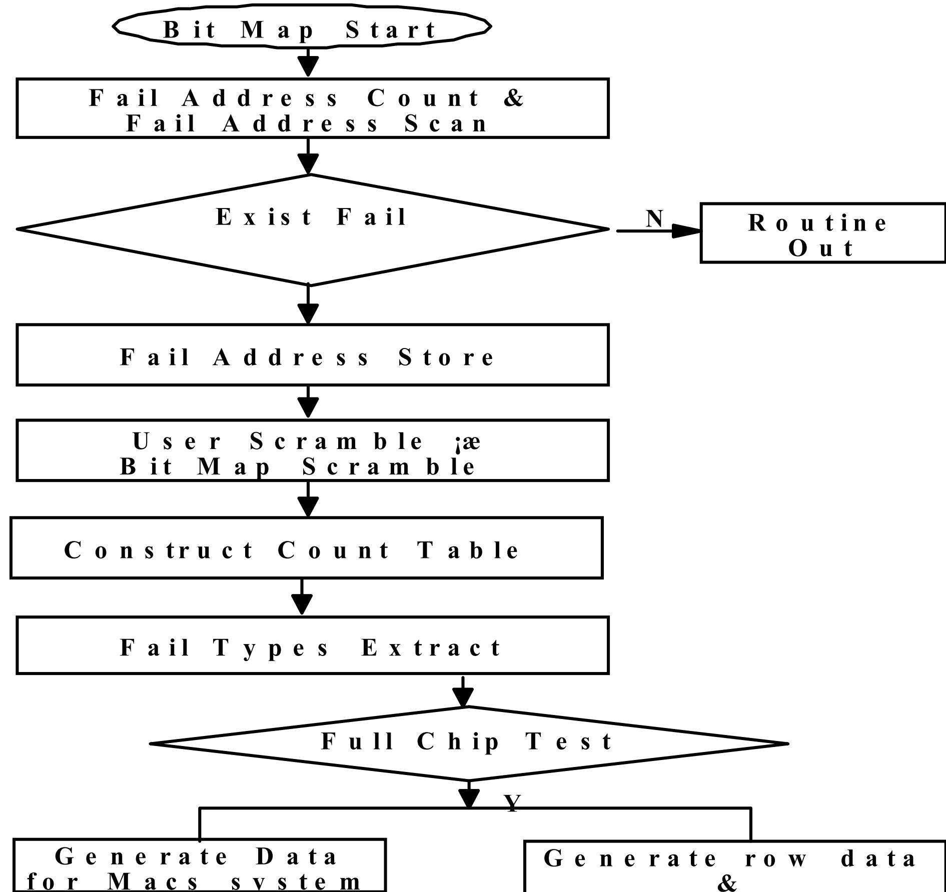
  Physical Scramble
- **Fail type extract**
- **Store to Global DB**



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Fail Type Definition

Fail Type	Definition
Gate Oxide	• Data 0 Fail / Less Than 1 String (0x1F) • More Than 5 Address Fail Bit
BN+ Open	• Data 1 Fail / Less than 1 String (0x1F) • More than 5 Address Fail Bit
Contact Not Open	• Data 1 Fail / Between 1 ~ 2 String Fail (0x20~0x3F) • More than10 Address Fail Bit
Bit Line Fail	• Data 0 or 1 Fail / More than 2 String(0x20) • More than 30 Address Fail Bit
Wore Line Fail	• More than 30 Address Fail Bit at X Address
Single Bit Fail	• Only 1 or 2 Fail Address Fail Bit

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Fail Bit Analysis Result (Fail Type/Per Chip)

LotID	WaferID	X,Y	FAILBIT	GOX	BN+	CON	WL	XDEC	BL	SINGLE
BMWG2828	W01	37,32	19	0	1	0	0	0	0	0
BMWG2828	W01	38,32	169	2	1	0	0	0	1	1
BMWG2828	W01	39,33	226	0	0	0	2	0	0	0
BMWG2828	W01	38,33	16	1	0	0	0	0	0	0
BMWG2828	W01	29,33	98	1	0	1	0	0	0	0
BMWG2828	W01	30,33	82	1	0	0	0	0	0	1
BMWG2828	W01	29,34	8430	0	0	0	0	0	1	0
BMWG2828	W01	30,34	117	1	0	0	0	0	0	0
BMWG2828	W01	35,34	125	2	0	0	0	0	0	1
BMWG2828	W01	36,34	132	2	0	0	0	0	0	1

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Fail Bit Analysis Result
(Raw Data of Fail/Per Chip)

Chip Inform

Fail Type

Fail Addr

X: 0030

Y: 0030

FAILBIT: 232

GOX: 1

BN+: 0

CONATCT: 0

WORDLINE: 1

XDECODER:0

BITLINE: 0

SINGLE: 0

Xadd	Yadd	FailIO	FailData	Fail Pattern
282	3A6	8	0	GOX
287	3A6	8	0	
281	3A6	8	0	
288	3A6	8	0	
28A	3A6	8	0	

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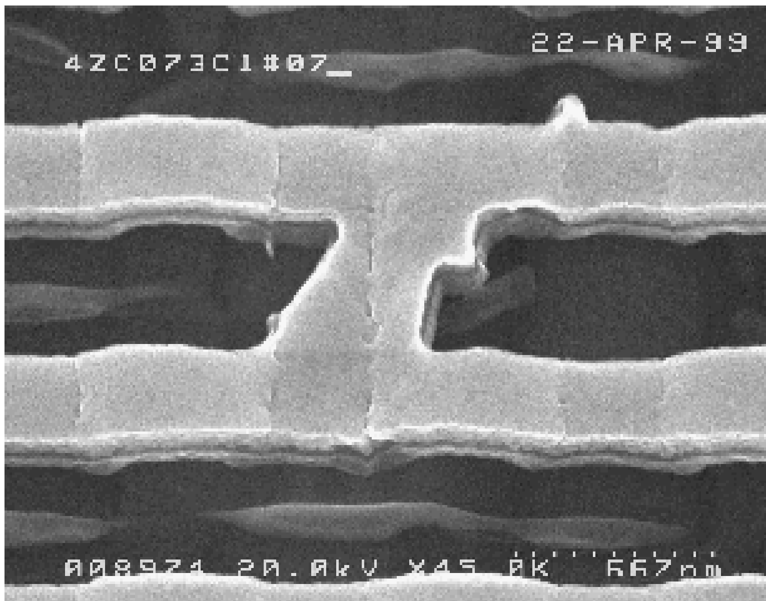
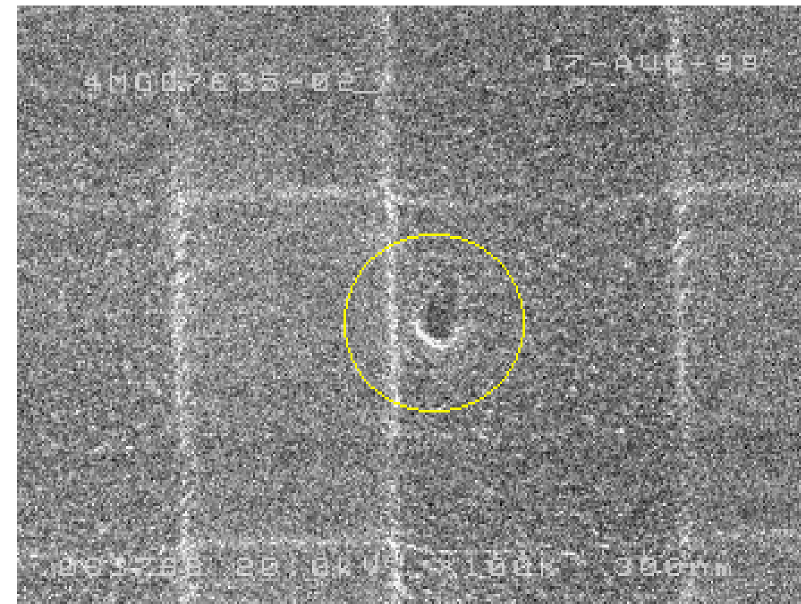
Applied Effect
(Visual Inspection)

W/L Bridge

Gate Oxide





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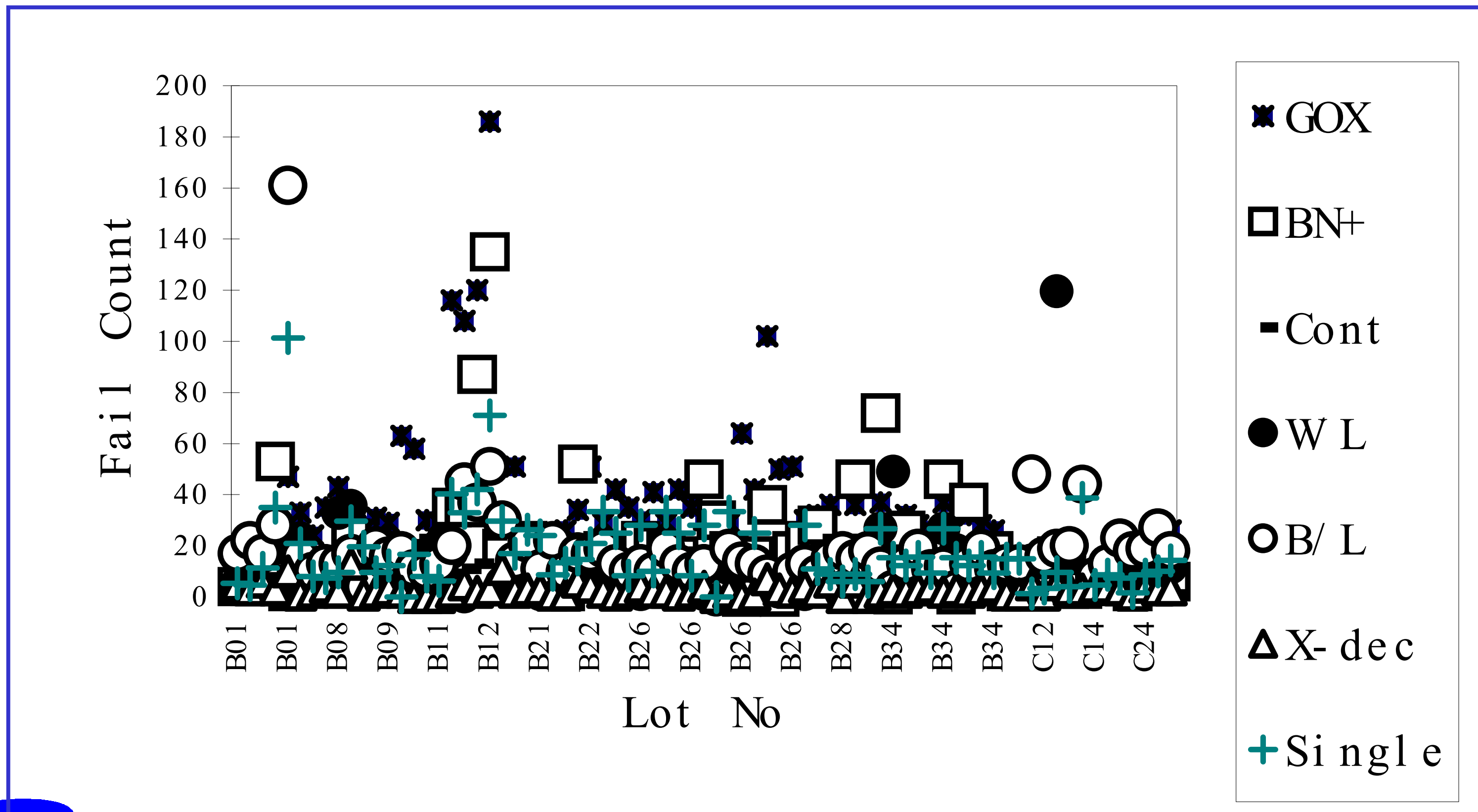
Applied Effect
(Fail Trend Plot)



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Hit Ratio (MS3490 & BitMap Analysis)

Fail Types	Exist Tool MS-3490	BitMap Tool (GII)	Hit Ratio
Gate Oxide	276	257	93.1
BN+ Open	229	204	89.1
Contact Not Open	12	11	91.7
Bit Line	293	317	91.8
Word Line	185	173	93.5
Single Bit	43	50	83.7
Other	57	--	--
Total	1127	1041	85.4

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Derivation (Repair Scheme)

- **MaskRom Repair Scheme Change**

  (8 Bit Repair -> 8 String Repair)

Fail Type Change (Extract Data from BitMap Algorithm)

Fail Type	String Fail			WL	B/L	Bit	Other
	GOX	B/N+	Active Bridge				
NAND Cell	7.3	----	9.2	32.5	27	15	9
Nor Cell	23.8	20.4	4.4	12.7	8.1	18.6	12

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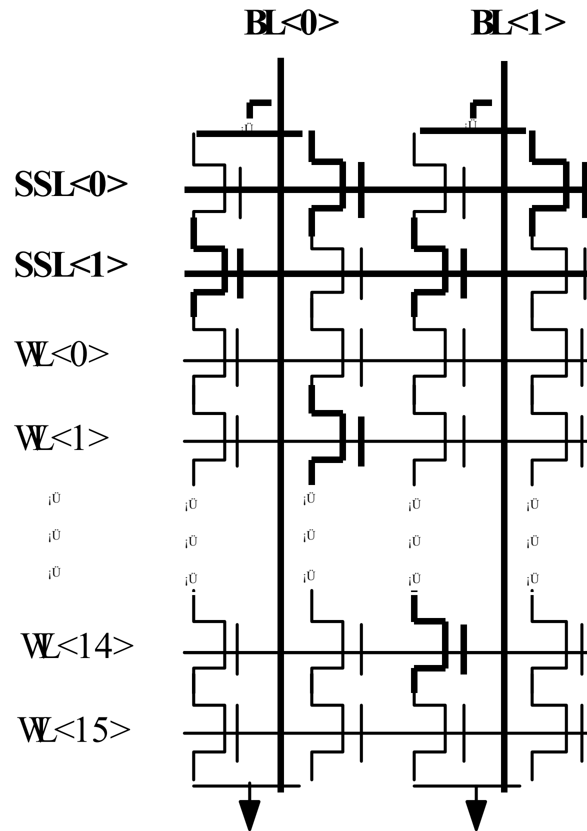
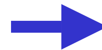
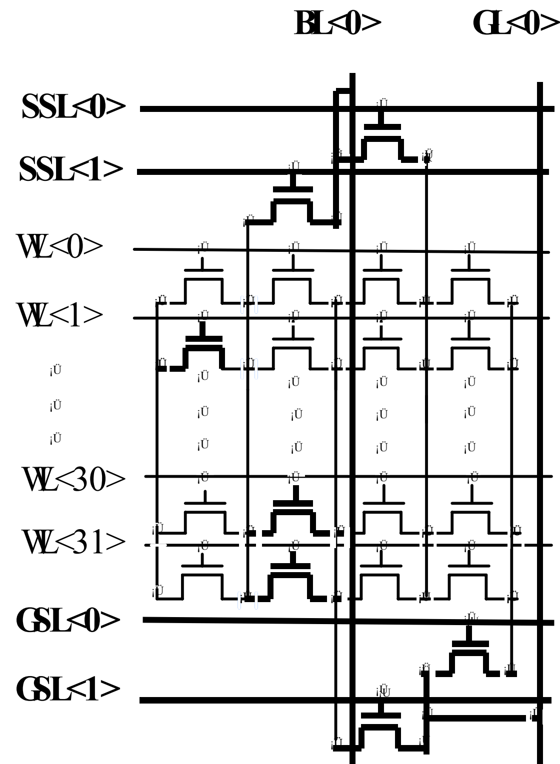
Cell Scheme Change

Nand Cell





Nor Cell



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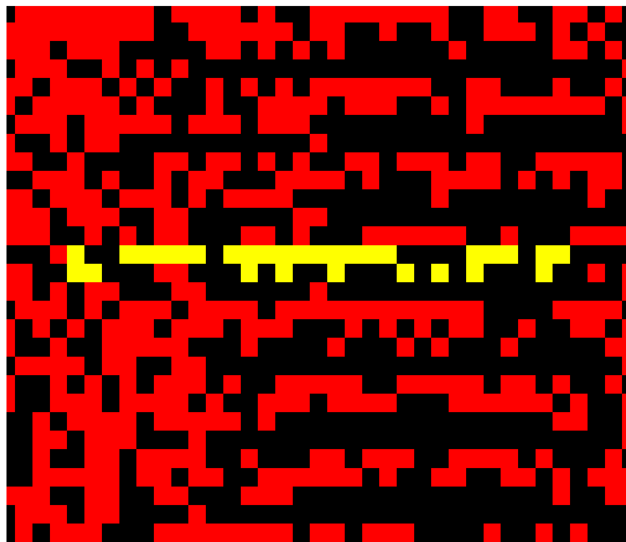
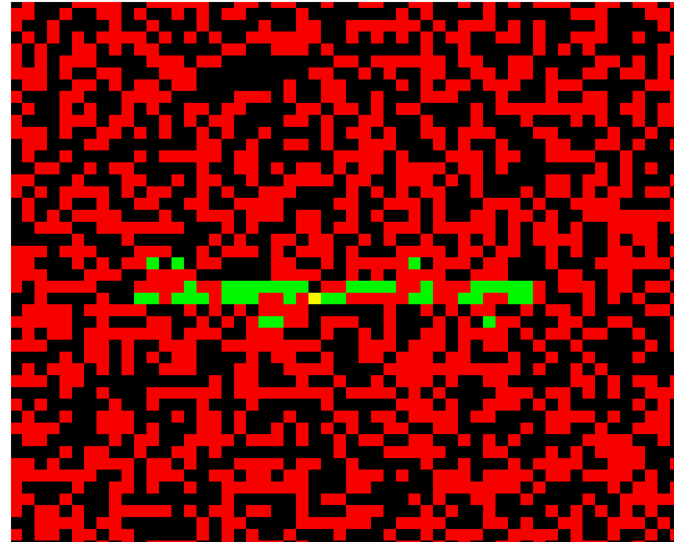
Limitation of 8 Bit Repair

Fail type Change(String Fail)-> Decrease Repair rate

-NAND Cell : 75% - FLAT Cell : Less than 5%





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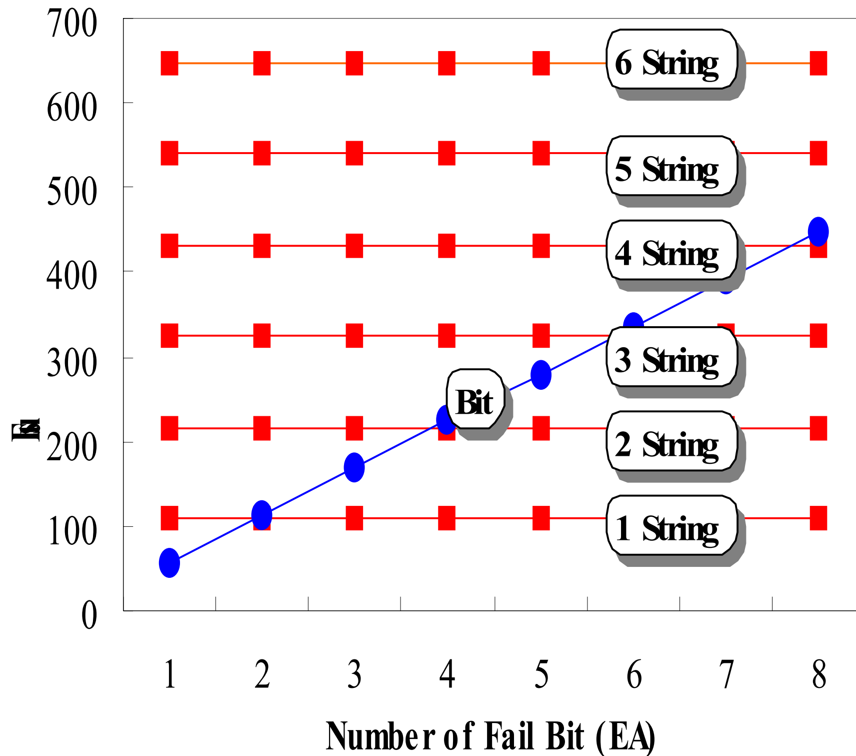
Number of Fuse (String Red vs Bit Red)



- Z = N*2(α+32) @ String Repair
- N=2n(α+6) @ Bit Repair Scheme
- Z: Fuse No for String/Bit Repair
- α:String Add Fuse + I/O Fuse
- N: Number of Fail String
- n: Number of Fail Bit

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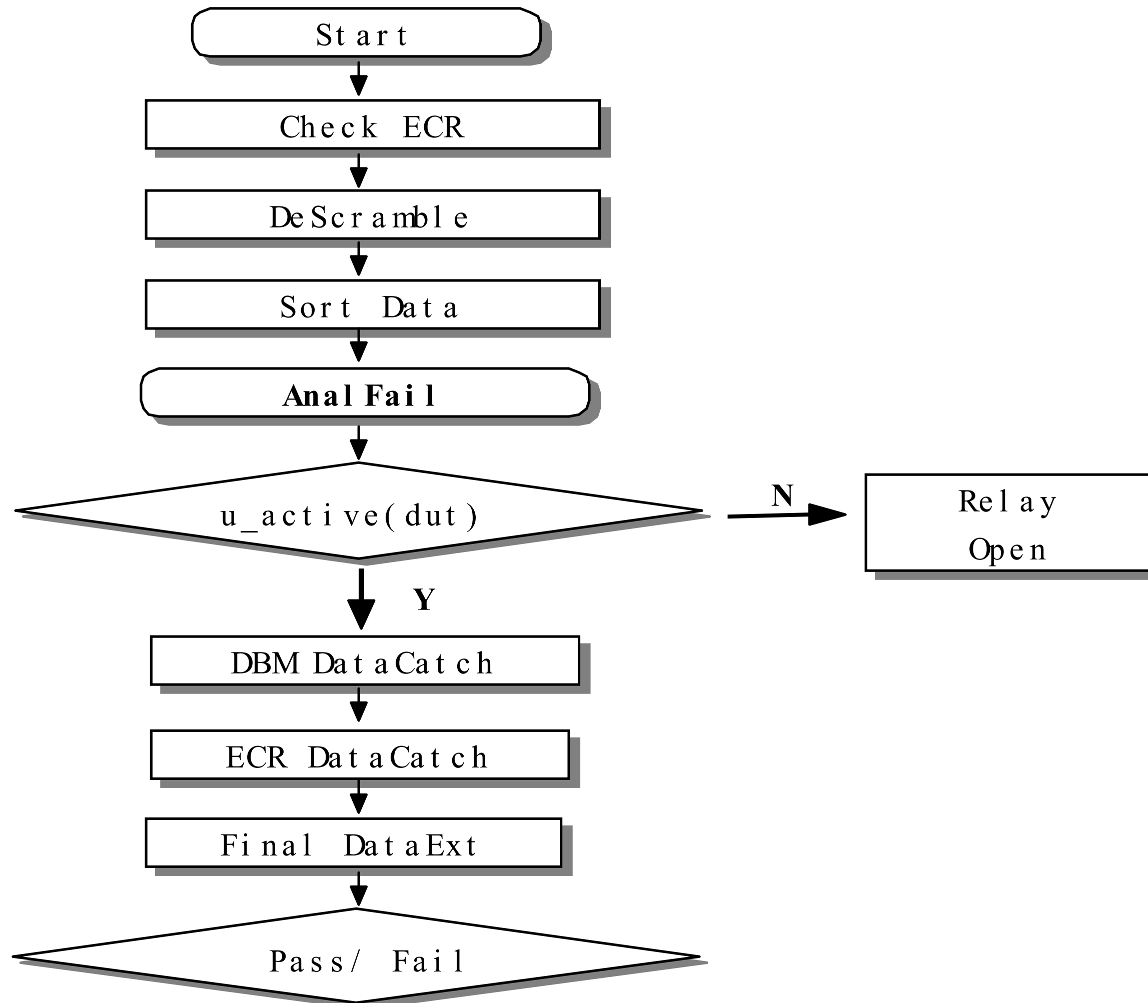
String Repair Algorithm Flow Chart



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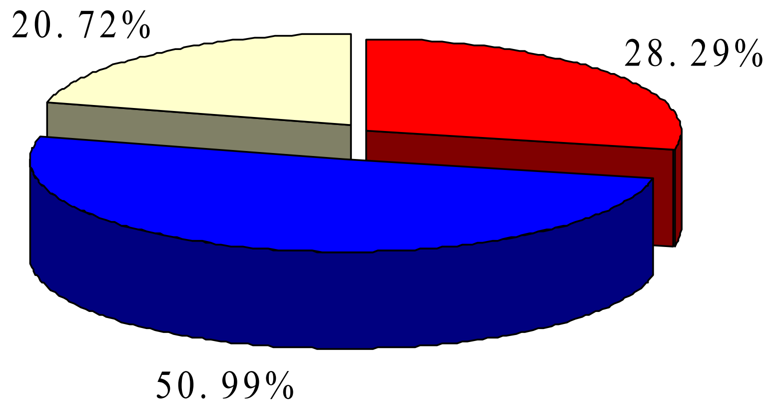
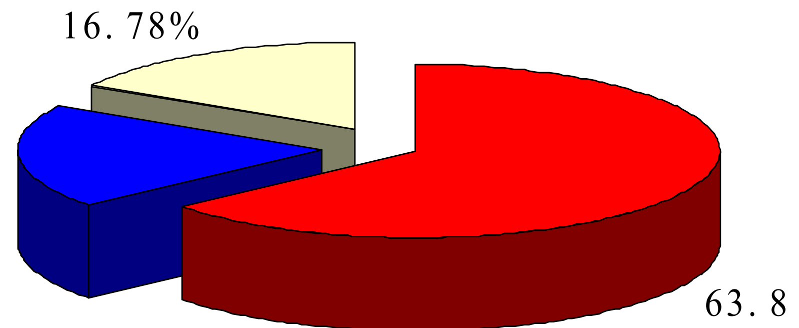
String Redundancy using ratio (64M X 16 B-Die) (Normal YLD & Low YLD)

Normal YLD



Low YLD



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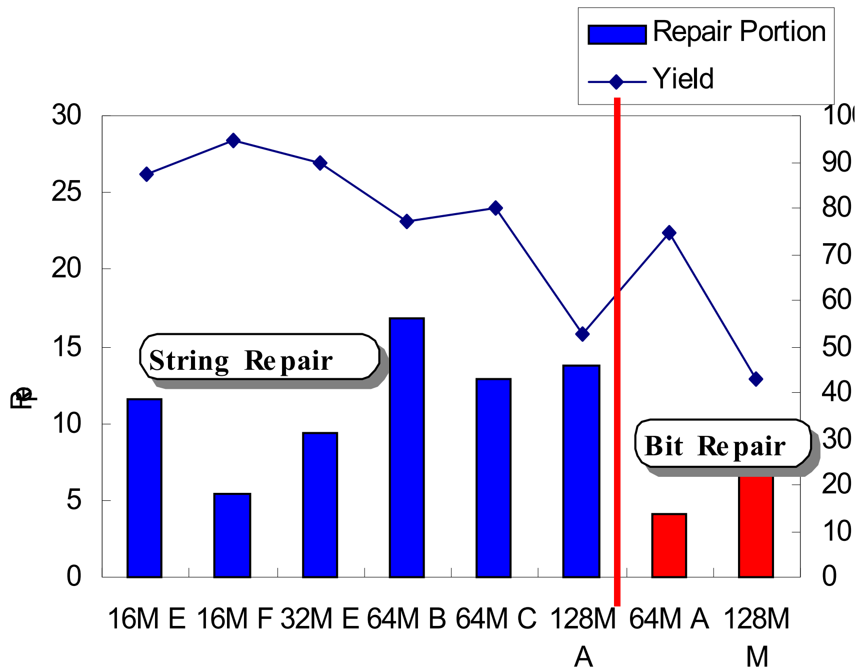
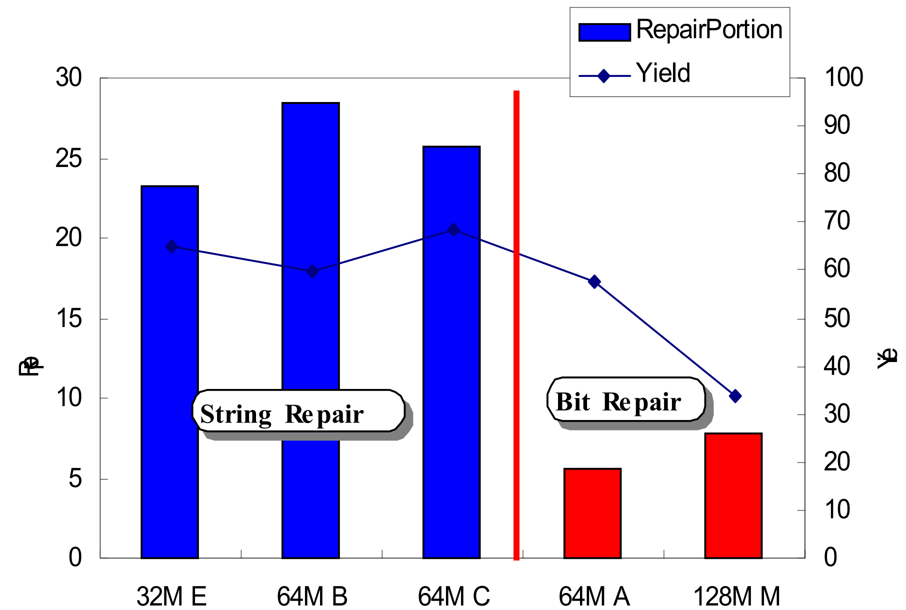
Derivation(Repair Scheme)





Results

- Average YLD Up

  (15% Up -> Repair Portion elevation)
- Obtained the static objected Data & Utilize at anytime.
- Real Time Fail Analysis & Feed Back.
- Customer order meets(An Order Product) (Possible to forecast device yield)

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