Quality Comparison of SLC, MLC and eMLC.

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Agenda

- The features of SLC, MLC and eMLC.
  - Read, Write and Erase Time
- Read Bit Error VS P/E Cycle.
- Program/Erase Error VS P/E Cycle
- Bit Error with Power Cycling

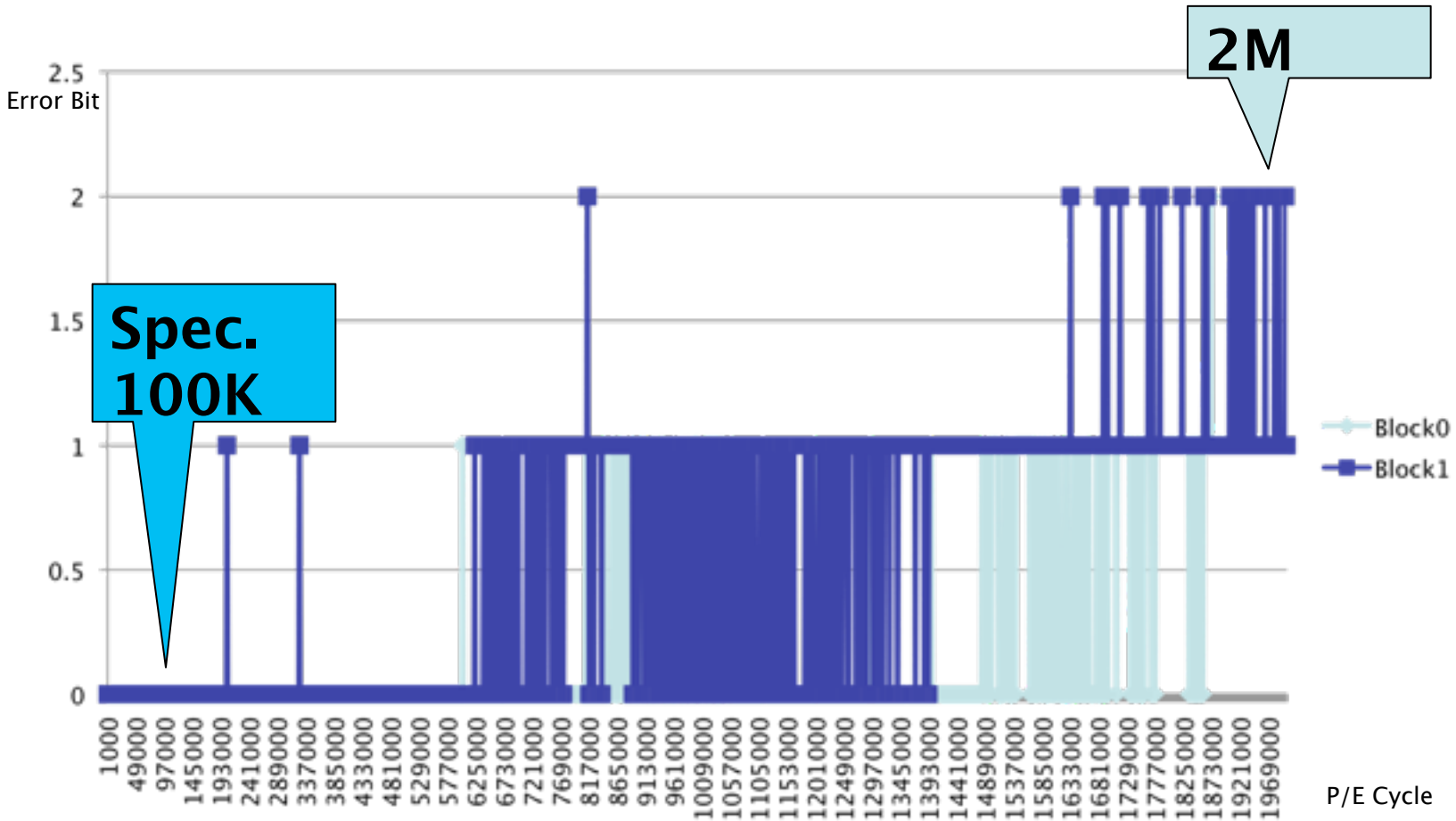
SLC, MLC, eMLC

	Read Page	Program Page	Erase Block	P/E Cycle	ECC
SLC(5xnm) A	25us	200us	1.5ms	100,000	1Bit/512
SLC(4xnm) A	25us	250us	2ms	100,000	1Bit/512
SLC(3xnm) A	50us	500us	1.5ms	100,000	24Bits/1K
SLC(3xnm)	25us	230us	0.7ms	100,000	4Bit/512
SLC(2xnm)	35us	300us	0.7	100,000	8Bit/512
MLC(3xnm)	50us	900us	3ms	5,000	24Bits/1K
MLC(2xnm)	75us	1300	4ms	3,000	24Bits/1K
eMLC (3xnm)	50us	1600us	5.5ms	30,000	24Bits/1K

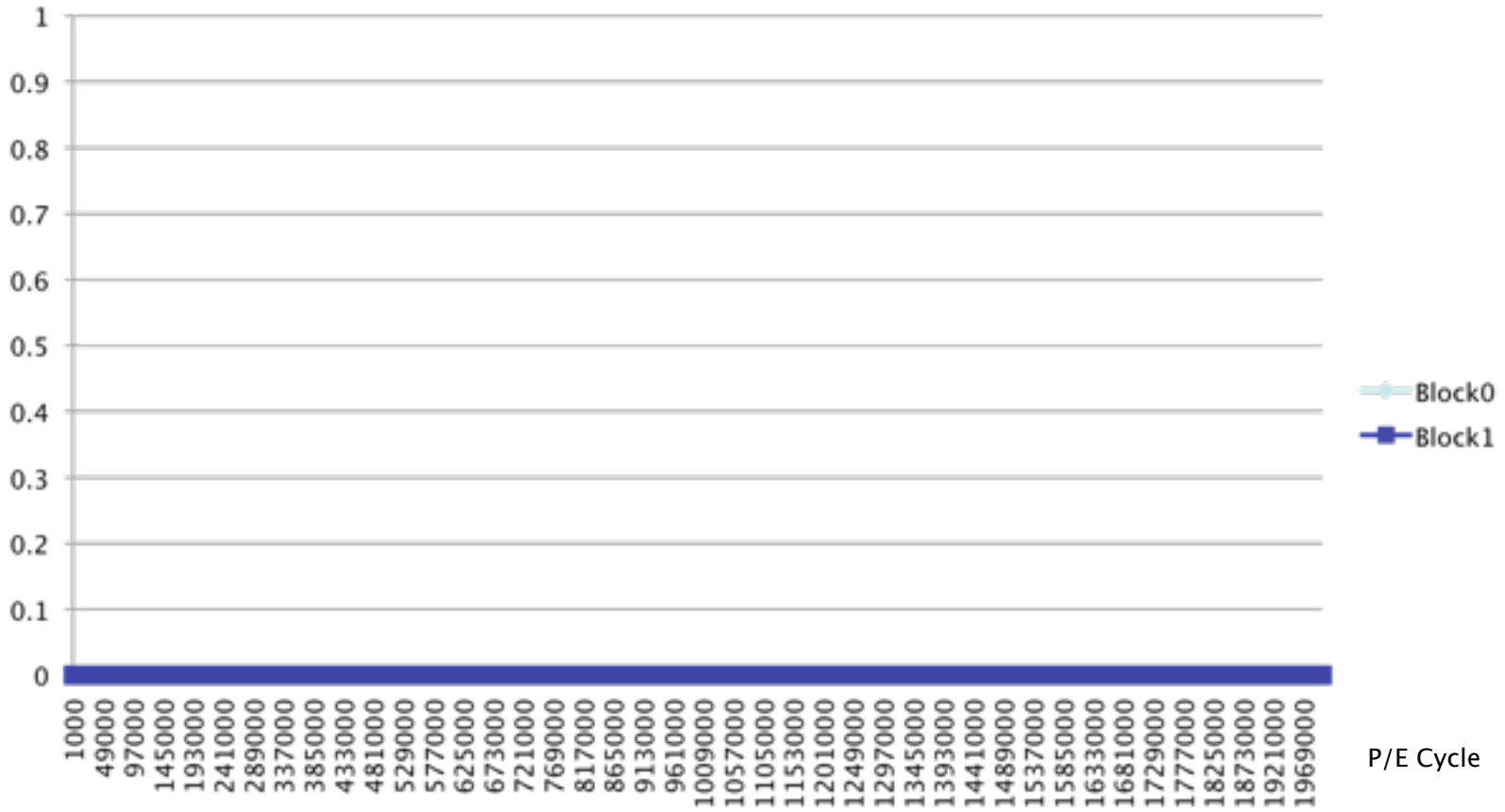
Flash test condition

- Test 2 to 5 blocks of each flash chip.
- The testing sample is not enough to approve flash quality.
- We just make comparison for different process of flash chip, but not going say the flash chip has such good quality according this report.
- 1K BCH16/24 ECC Engine for testing

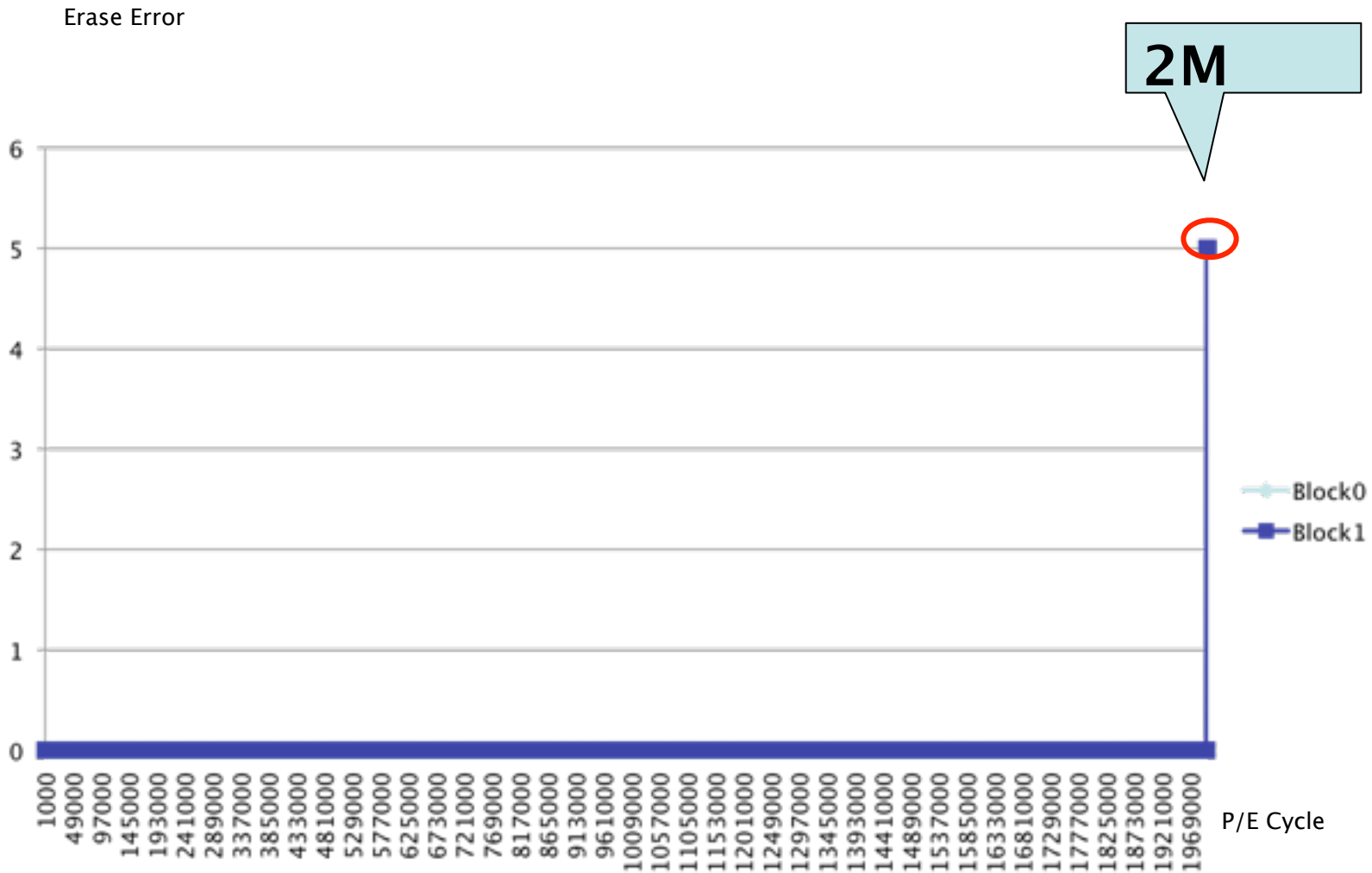
Bit Error VS P/E Cycle
5xnm SLC(Brand A)



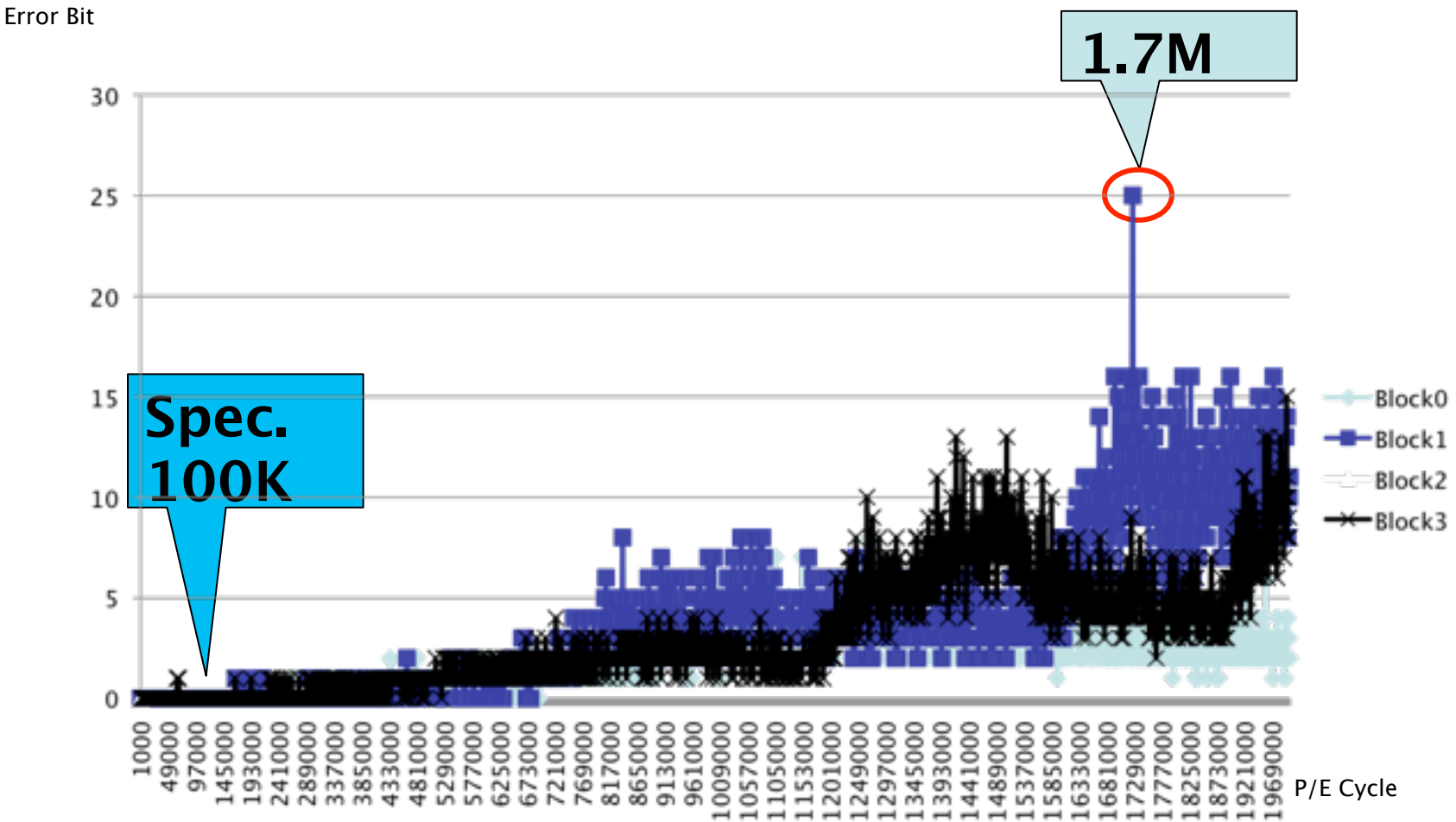
Program Error VS P/E Cycle
5xnm SLC(Brand A)



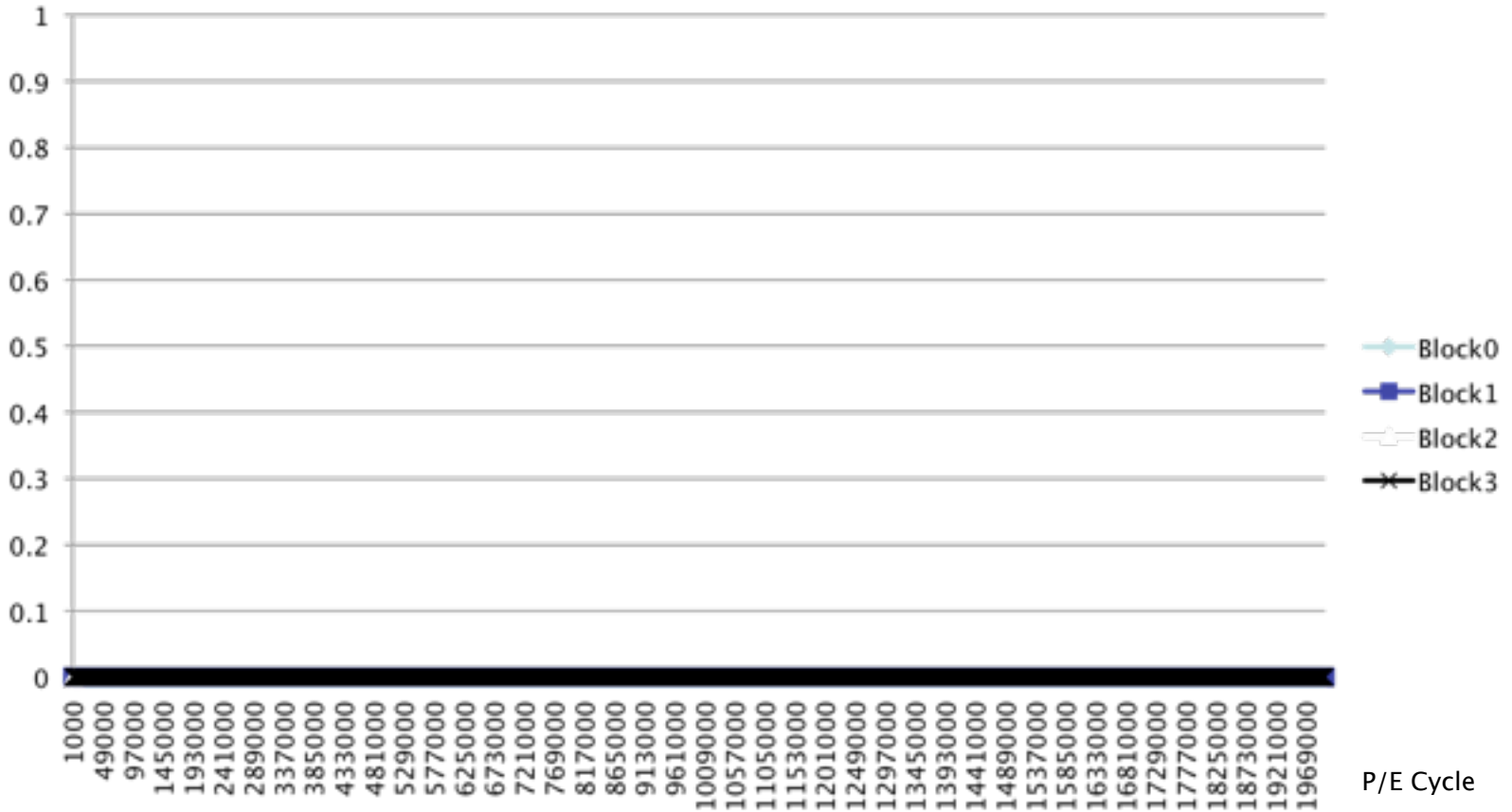
Erase Error VS P/E Cycle
5xnm SLC(Brand A)



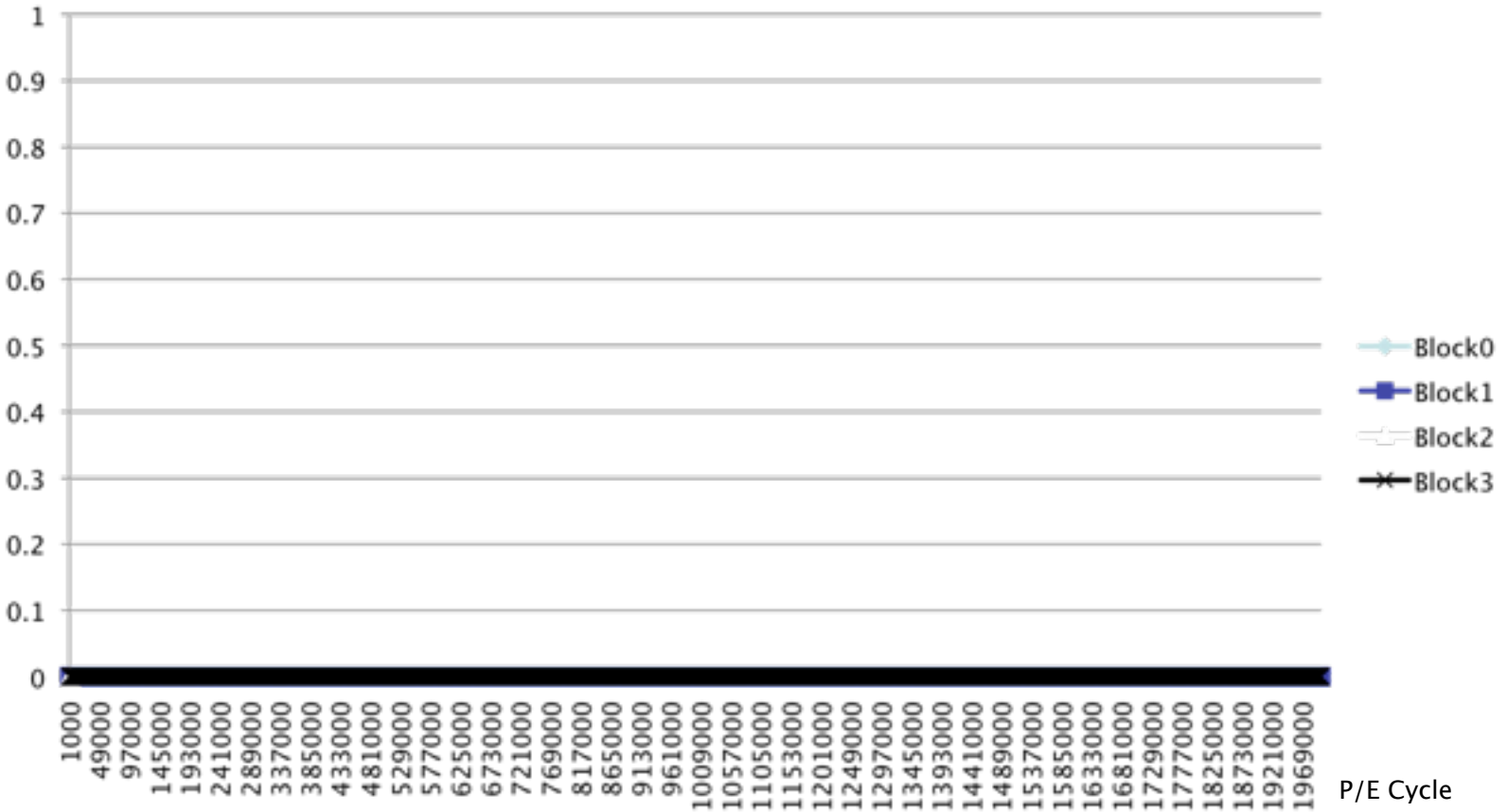
Bit Error VS P/E Cycle
4xnm SLC(Brand A)



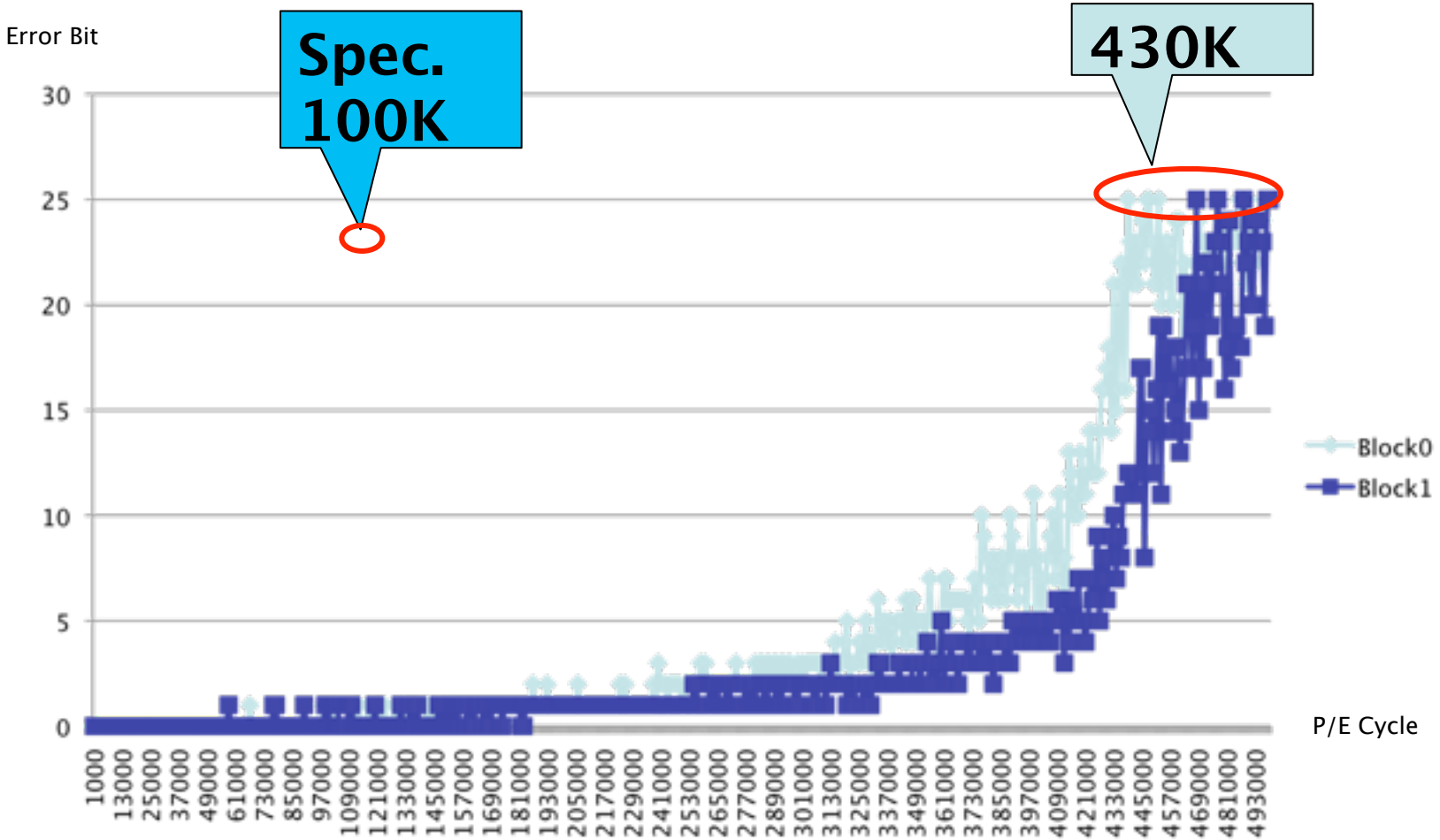
Program Error VS P/E Cycle
4xnm SLC(Brand A)



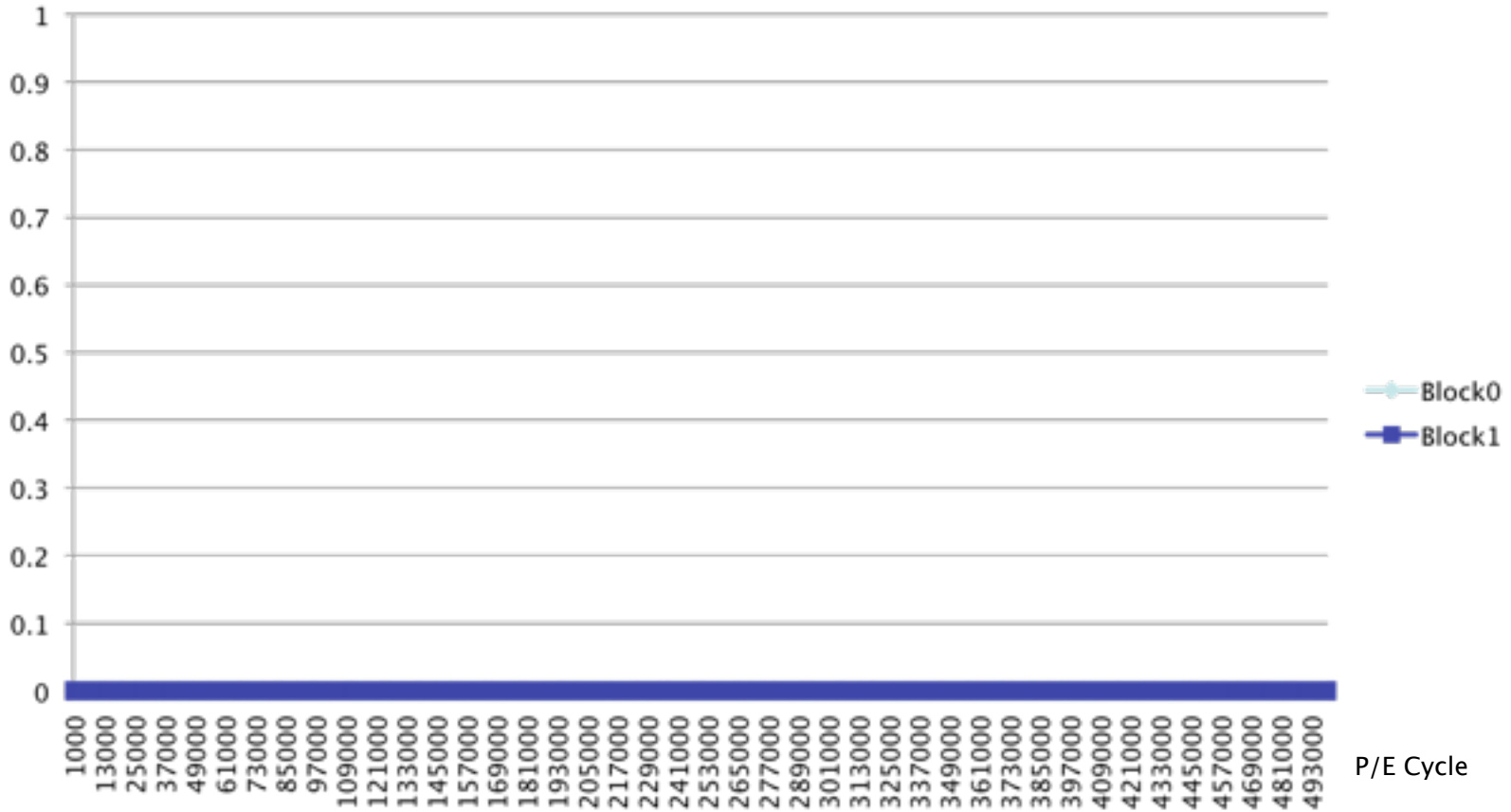
Erase Error VS P/E Cycle
4xnm SLC(Brand A)



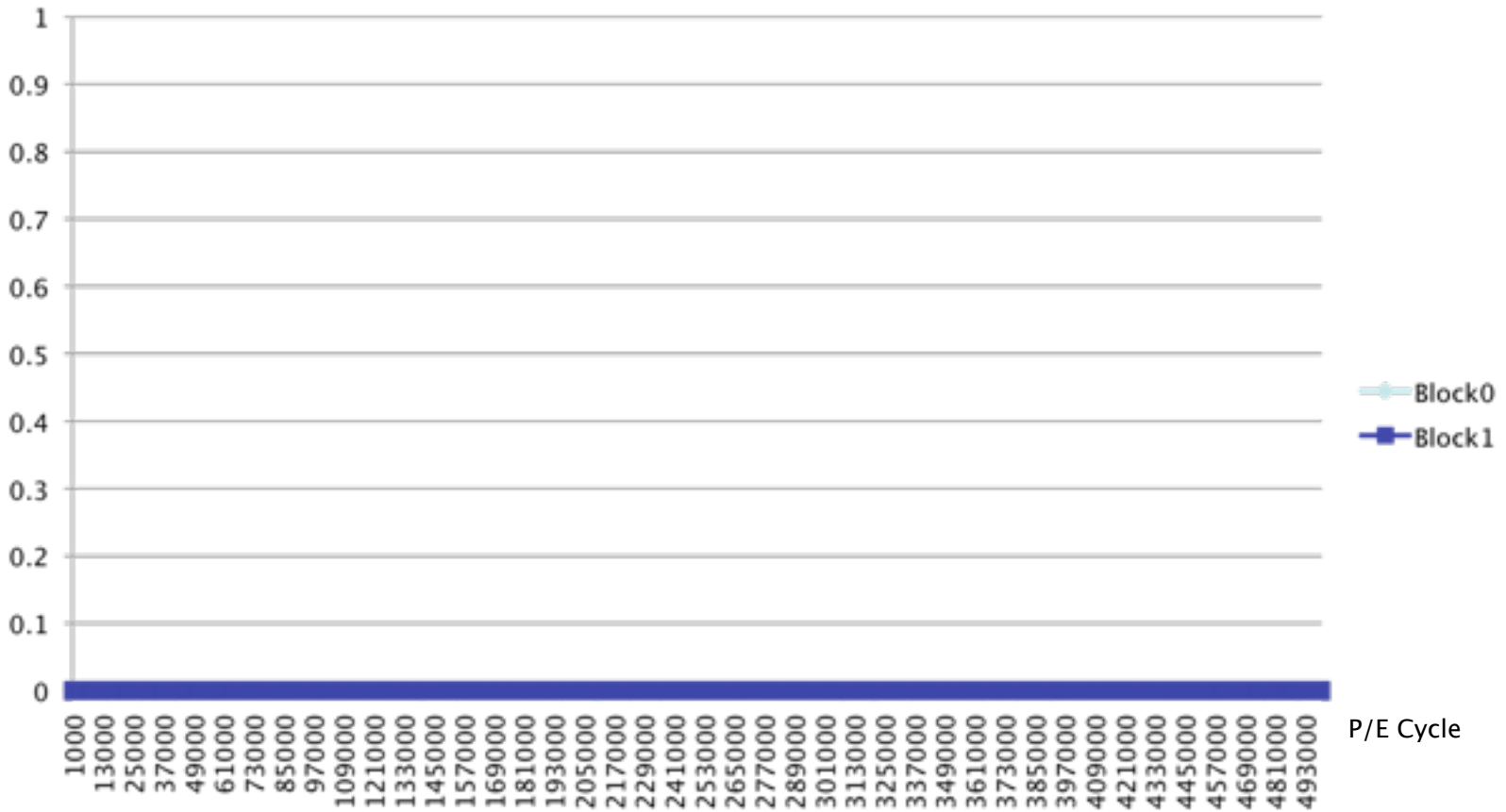
Bit Error VS P/E Cycle
3xnm SLC(Brand A)



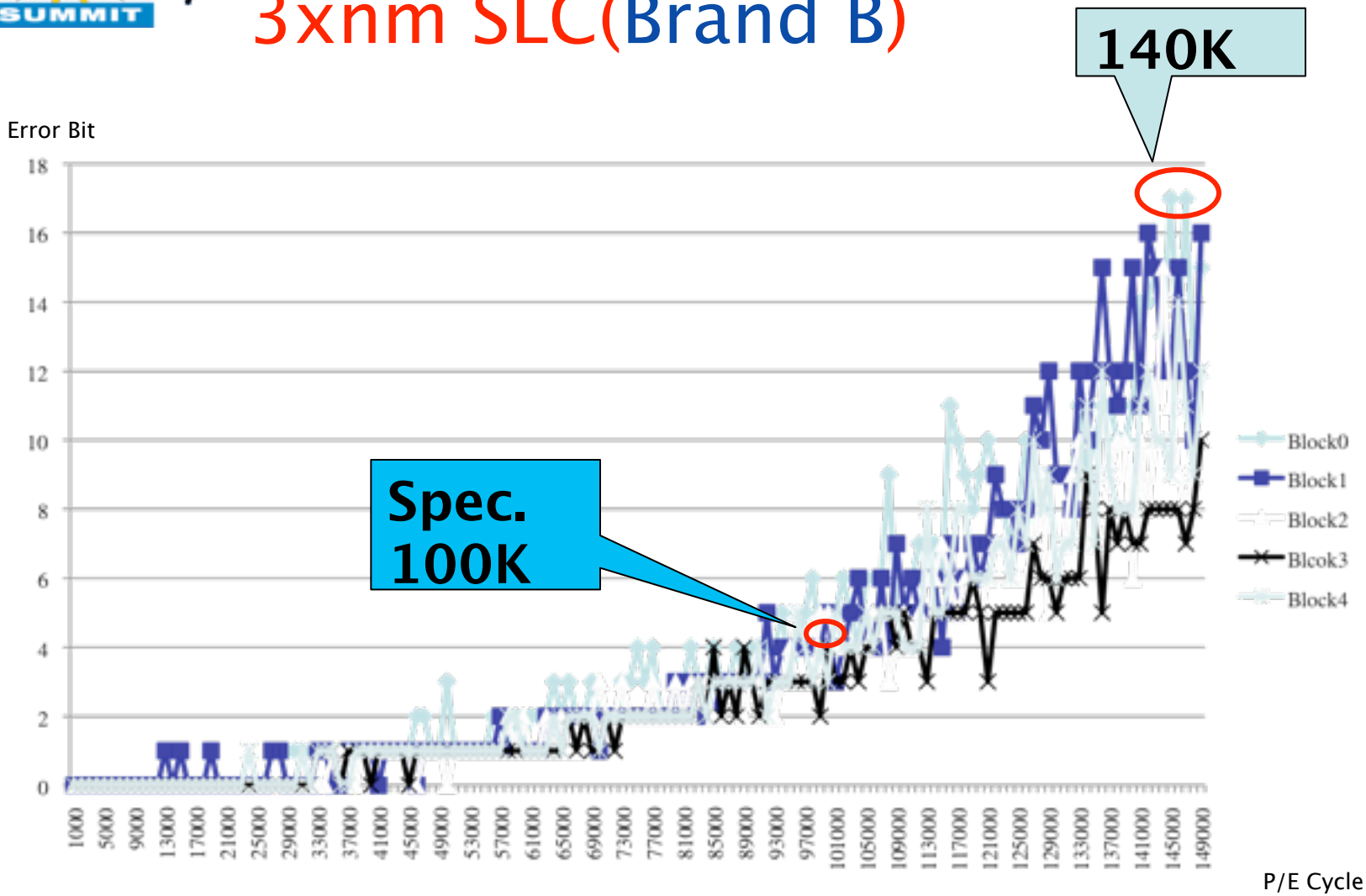
Program Error VS P/E Cycle 3xnm SLC(Brand A)



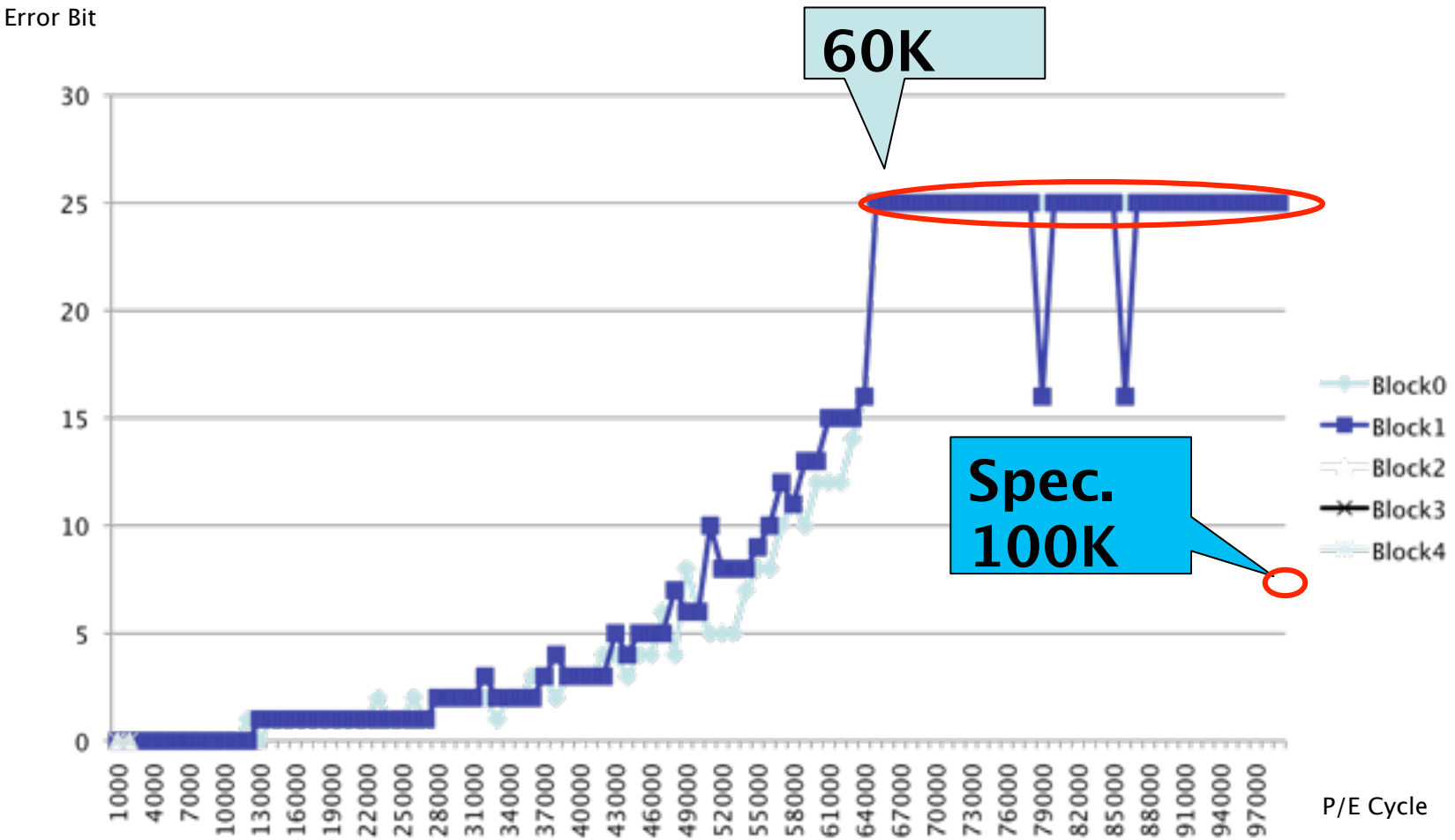
Erase Error VS P/E Cycle
3xnm SLC(Brand A)



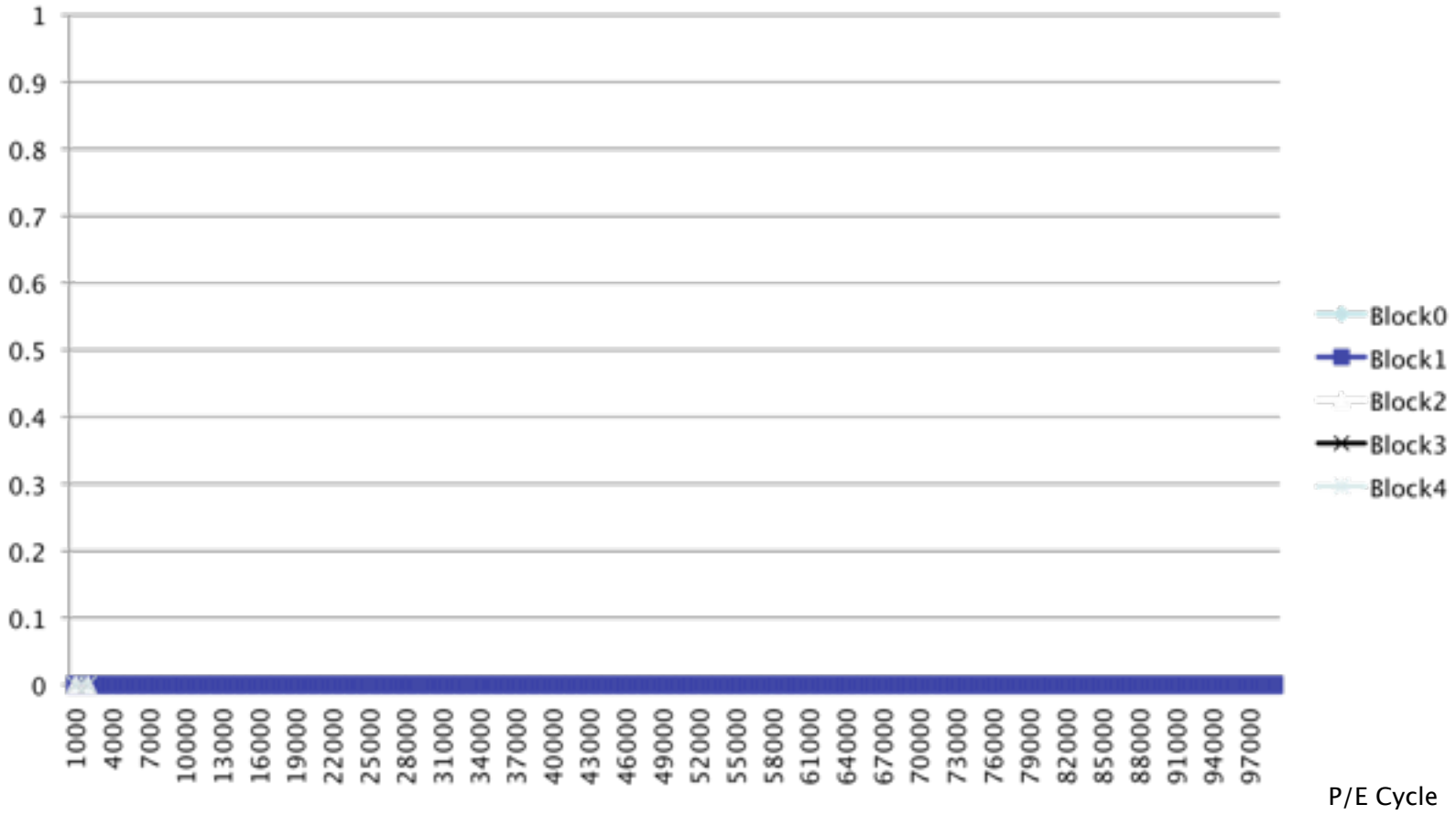
Bit Error VS P/E Cycle
3xnm SLC(Brand B)



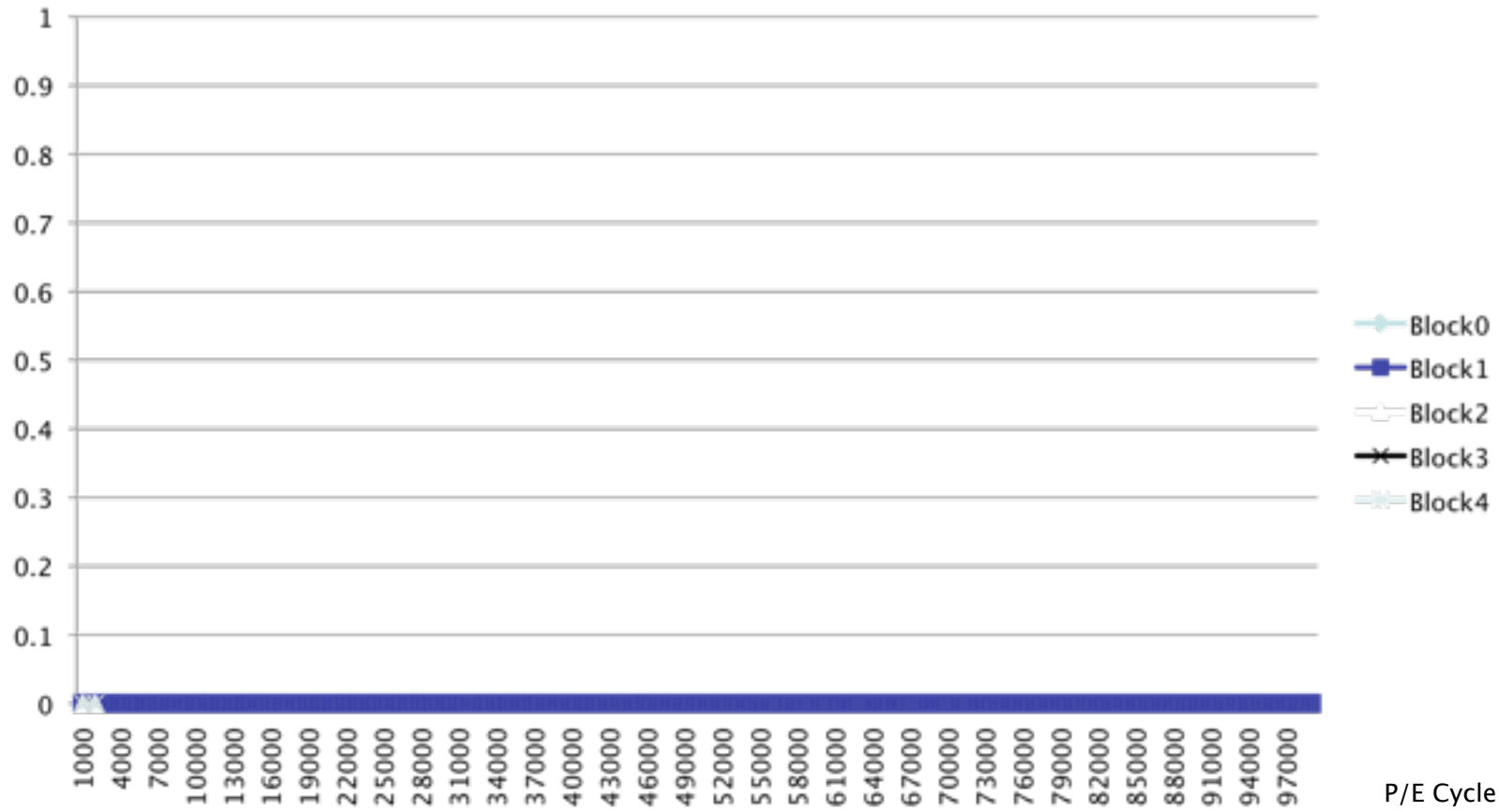
Bit Error VS P/E Cycle
2xnm SLC(Brand B)



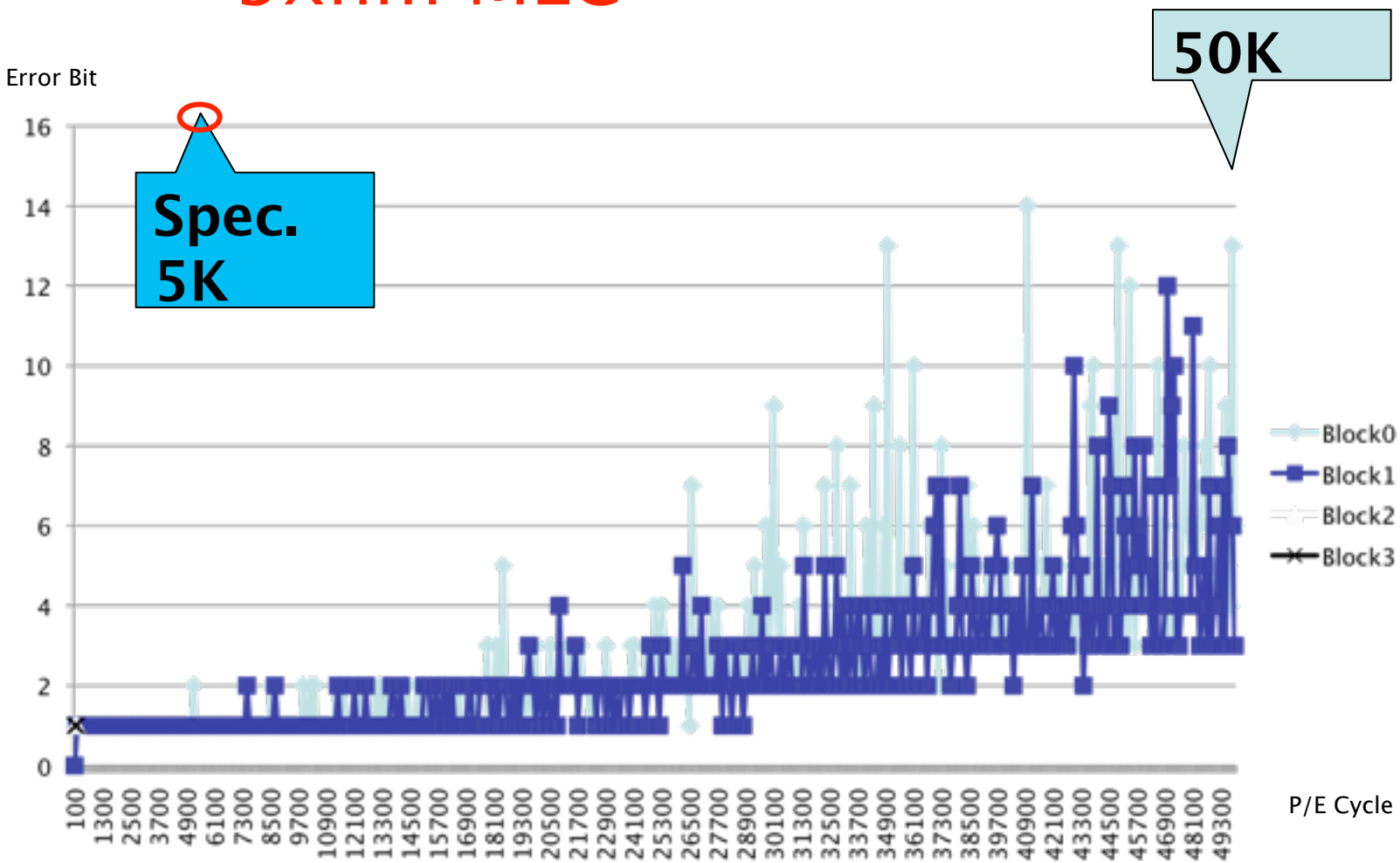
Program Error VS P/E Cycle 2xnm SLC(Brand B)



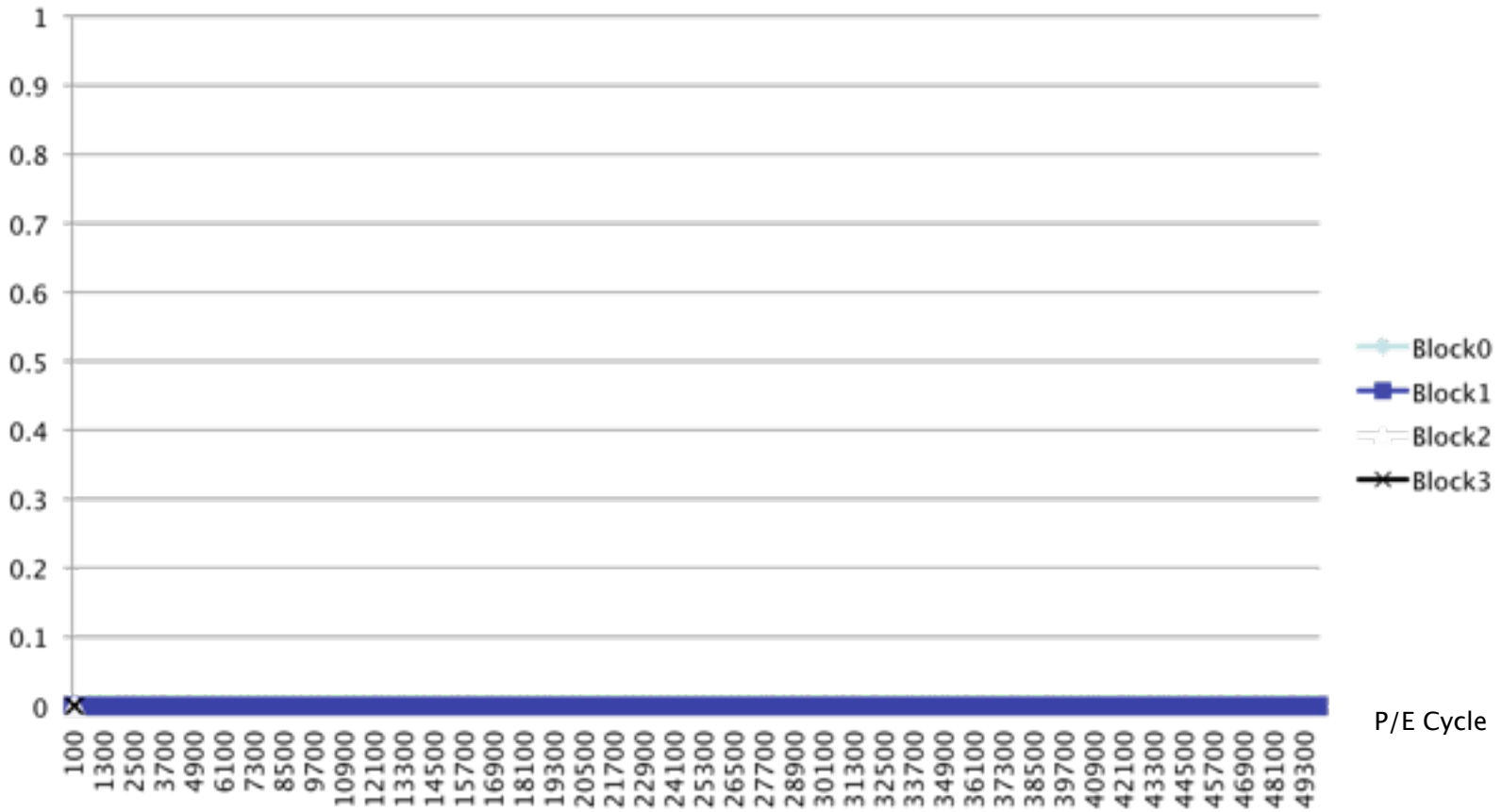
Erase Error VS P/E Cycle
2xnm SLC(Brand B)



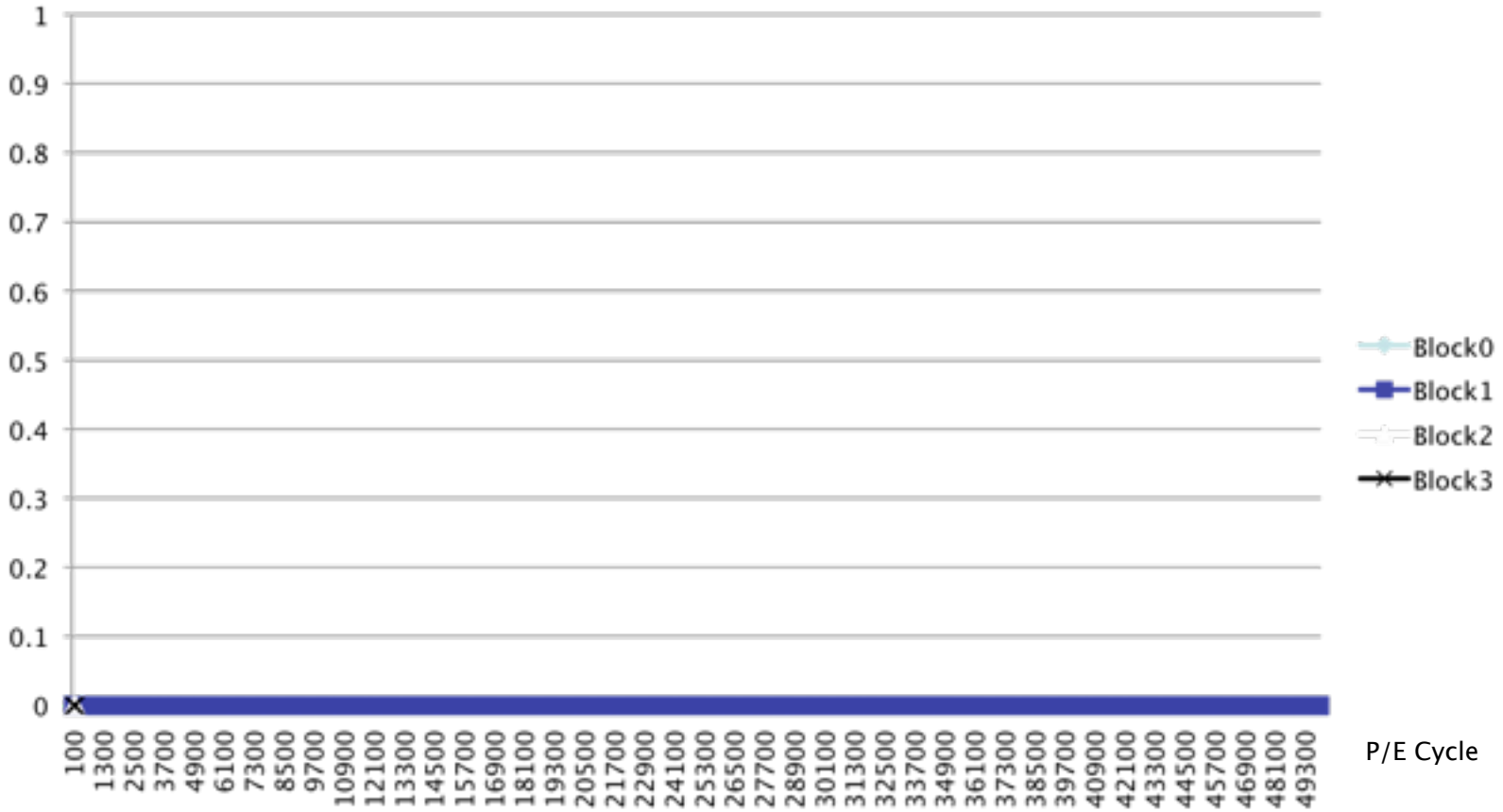
Bit Error VS P/E Cycle
3xnm MLC



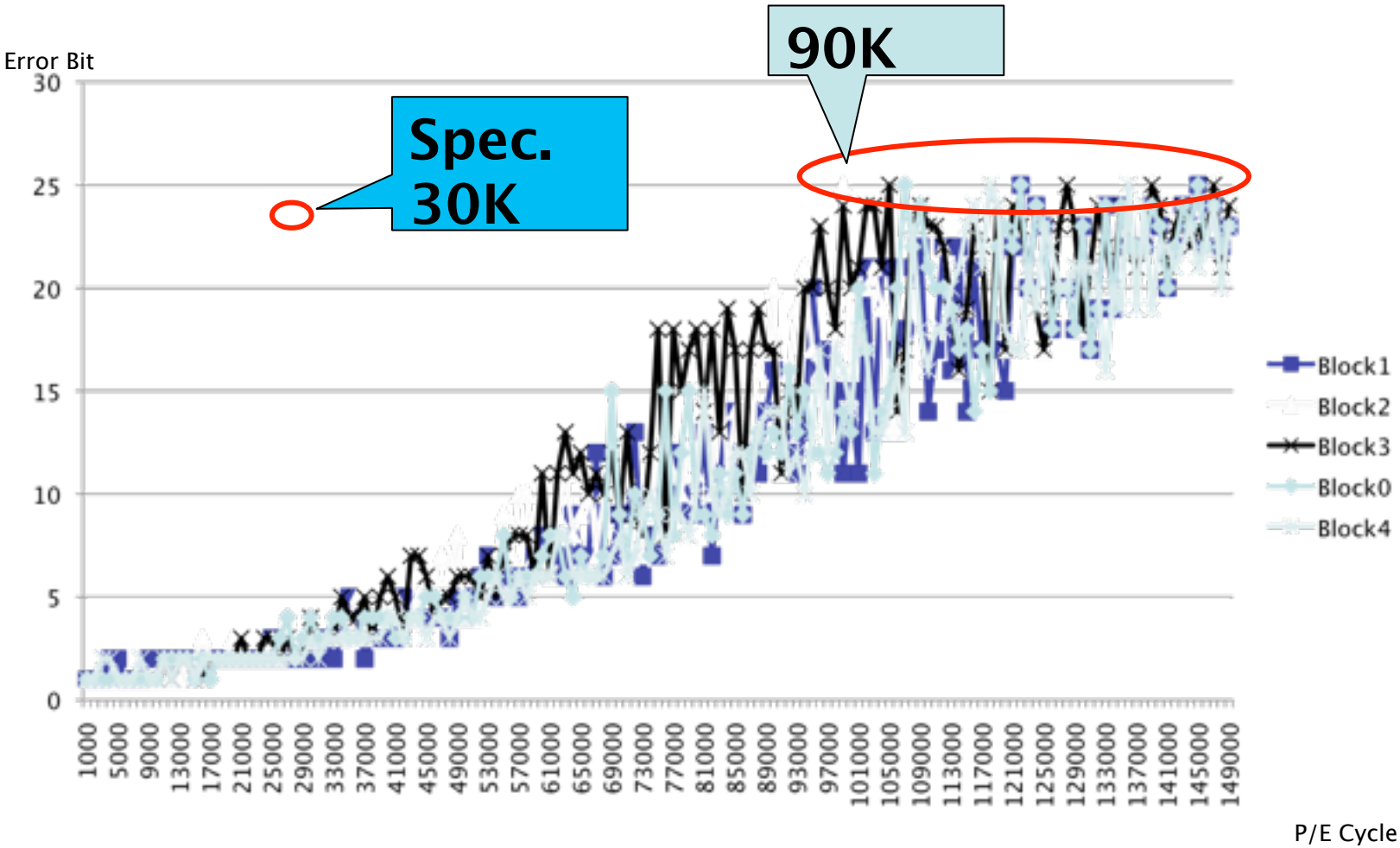
Program Error VS P/E Cycle 3xnm MLC



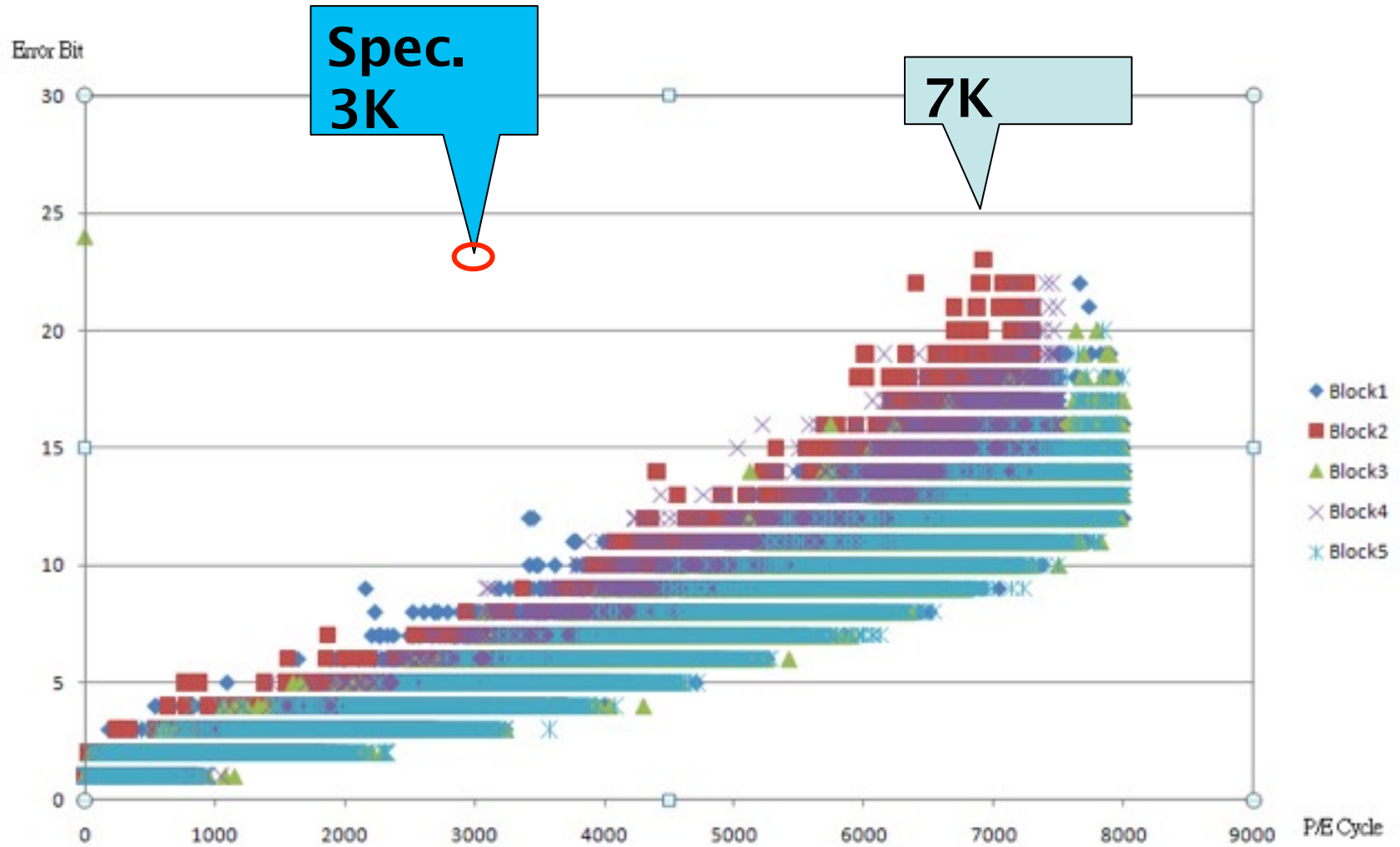
Erase Error VS P/E Cycle
3xnm MLC



Bit Error VS P/E Cycle
3xnm eMLC



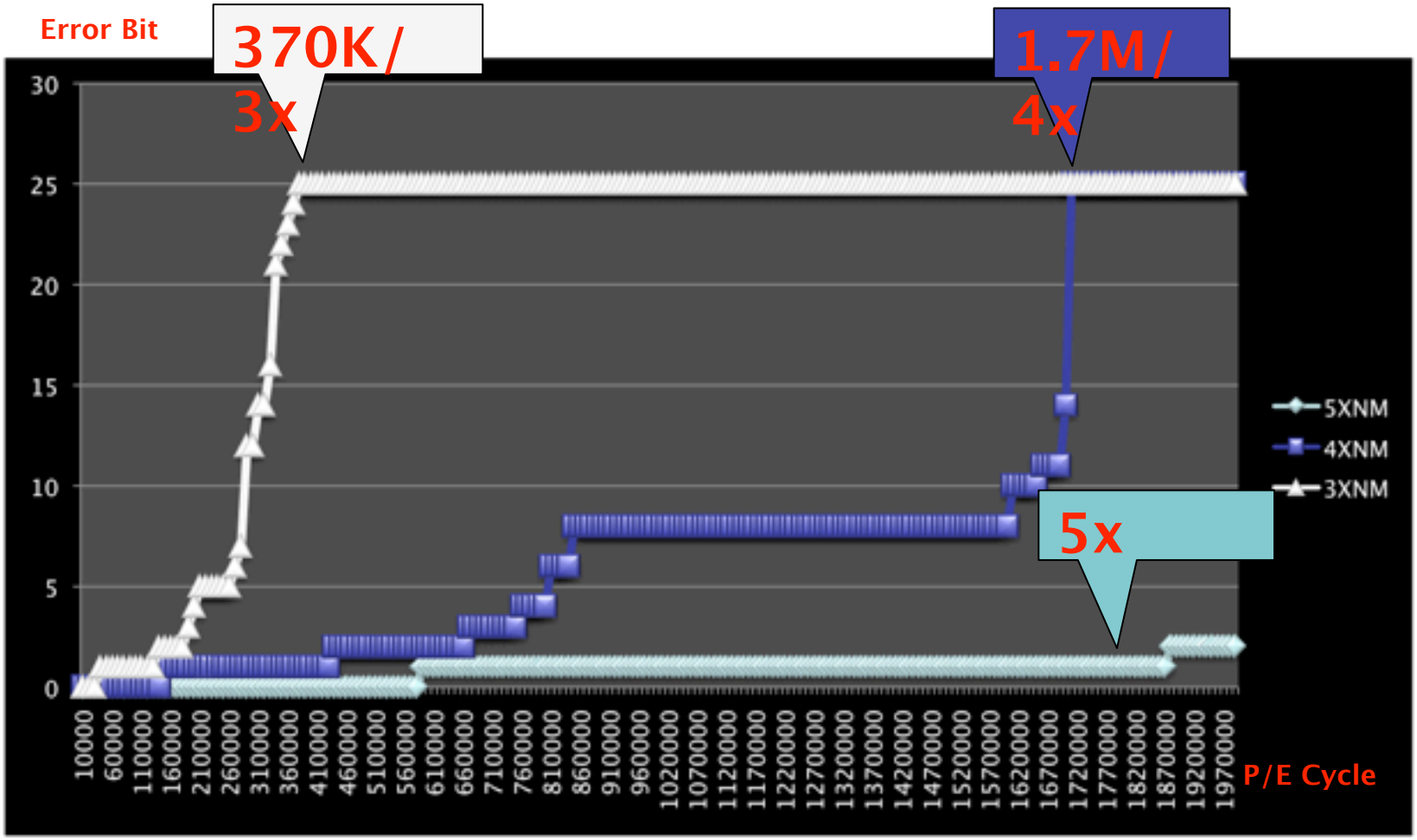
Bit Error VS P/E Cycle
2xnm MLC



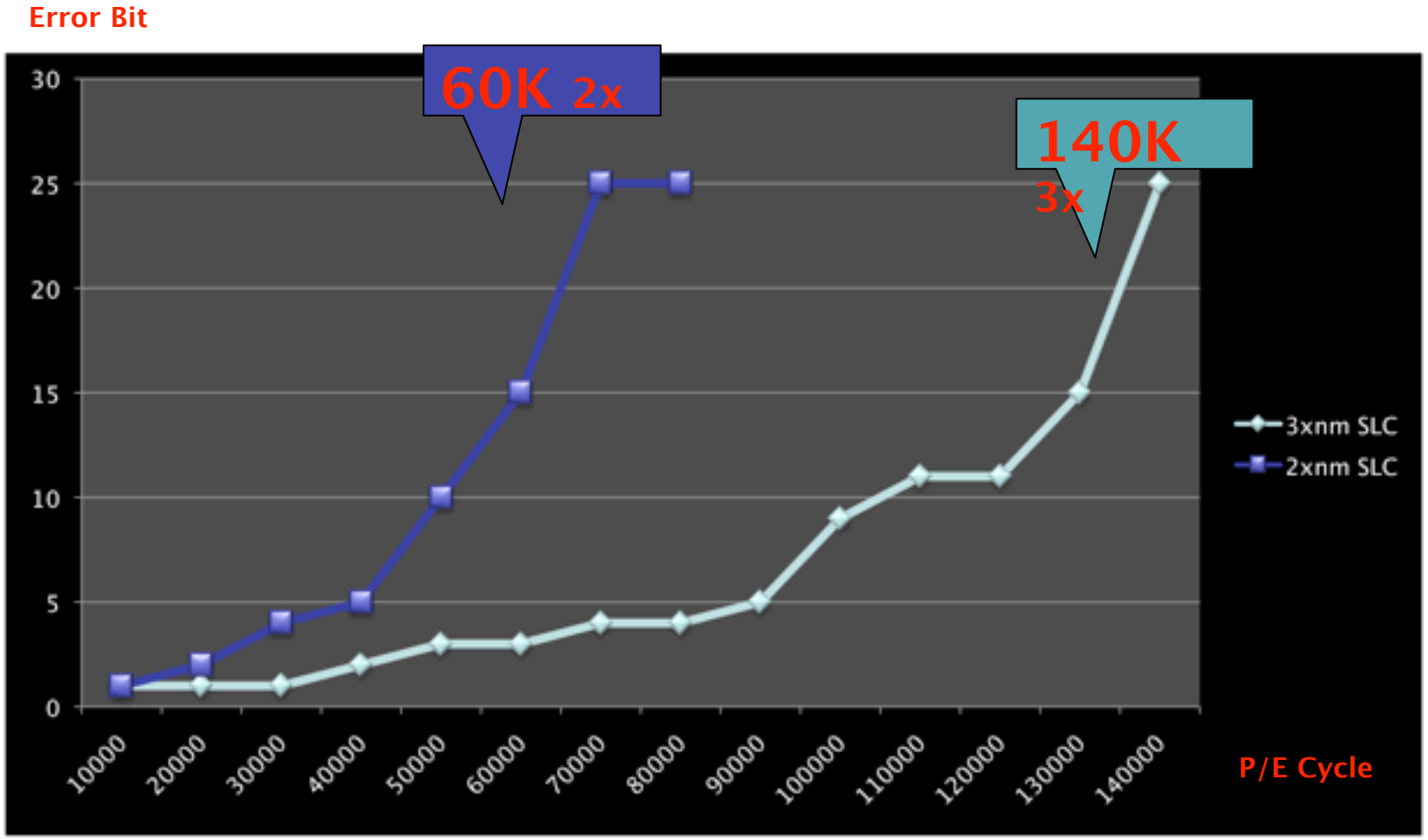
Program/Erase Error VS P/E Cycle

- We get program/erase error with early bad block.
- We got every few program/erase error during testing.

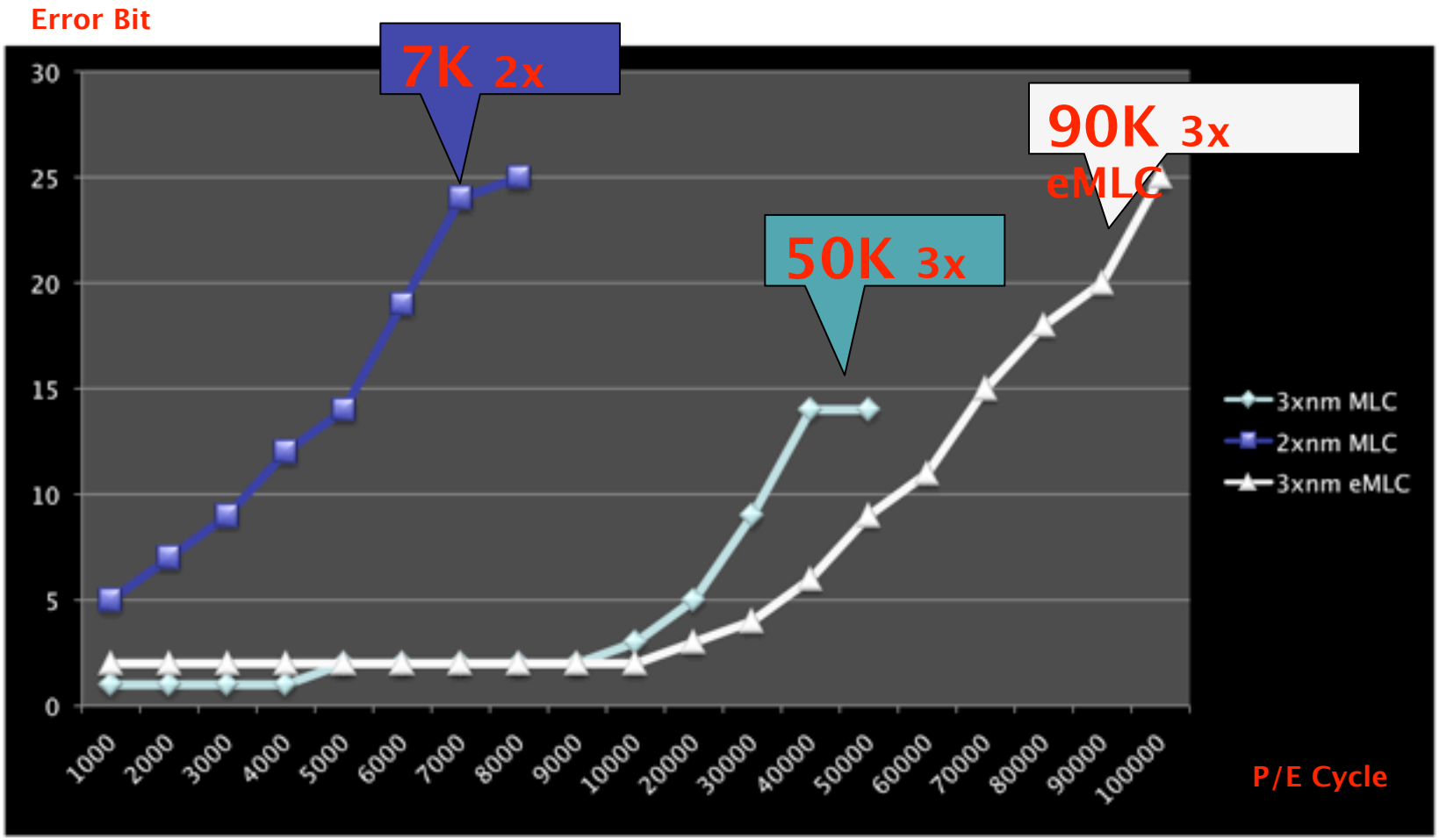
SLC Quality (5x,4x,3x) in different process Brand A



SLC Quality (3x,2x) in different process Brand B

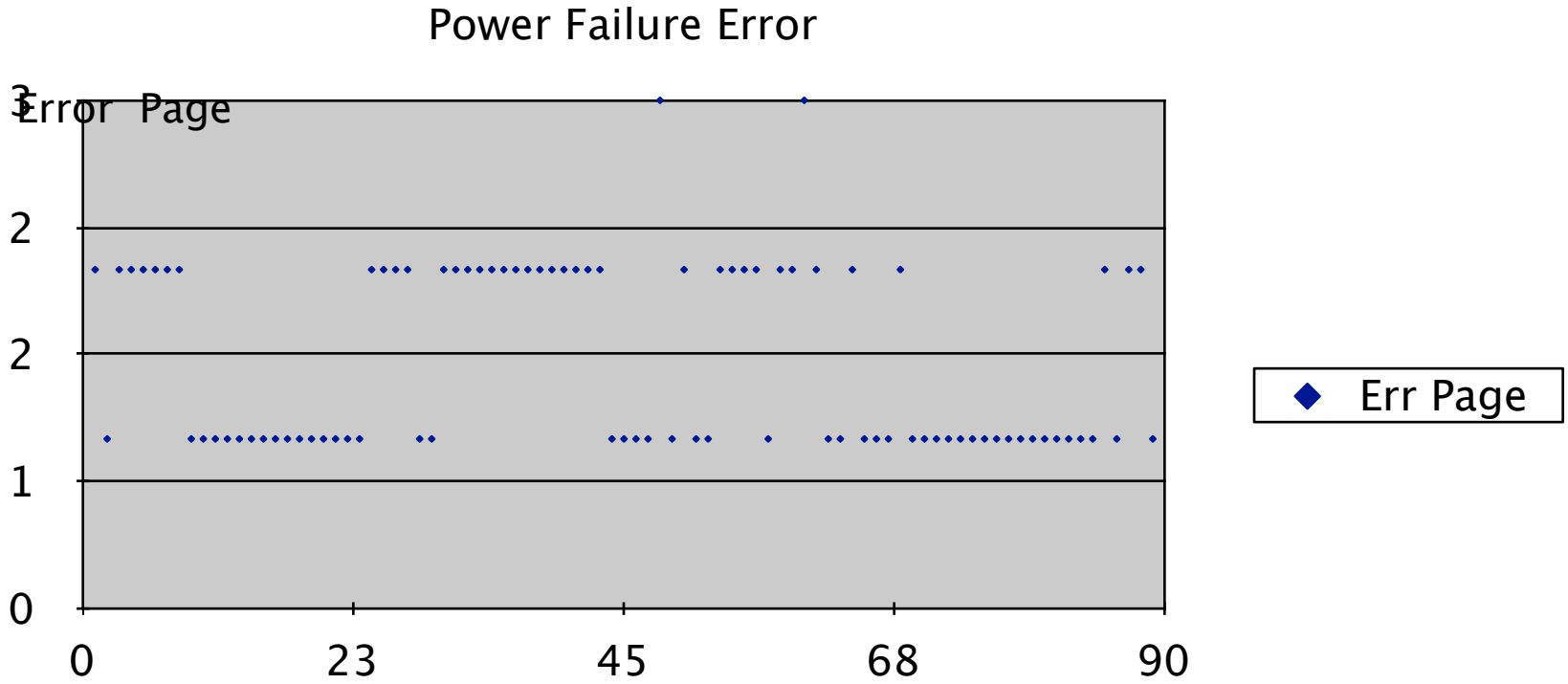


MLC (3x,2x) /eMLC (3x) Quality



Bit Error of Power Cycling

- Cut the power while writing data to SSD
- The flash is MLC



Bit Error of Power Cycling

- Pair of page will be corrupted together

	Page1	Page2
1	0x26	0x2C
2	0x6A	0x70
3	0x0B	0x11
4	0x73	0x79
5	0x5B	0x61

Key of SSD's quality

- A good ECC Engine to enhance SSD's P/E Cycle.
- Select a good quality flash chip to extend SSD's lifespan.
- Need a power cycling recover capability to cover MLC's weakness.

End

- InnoDisk Corp. www.innodisk.com

EDC 8000 40pin

EDC8000 44pin