A Graphical Journey into 3D NAND Program Operations

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Outline

- A graphical journey into four types of program operation
- The reason for 2-Pass program operation: 1-Shot vs 2-Pass
- The shortcoming of 2-Pass program and the solution
- About YeeStor
One Shot TLC Program Operation

Vt Distribution

Vt Distribution (Log)

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Santa Clara, CA
2-Pass TLC Program Operation (4-8)
2-Pass TLC Program Operation (2-8)
2-Pass QLC Program Operation (8-16)
1-Shot vs. 2-Pass Program

- 1-Shot program operation: Charge Trap Cells 3D NAND
- 2-Pass program operation: Floating Gate Cells 3D NAND
- 2-Pass program operation is much more complex and slower than 1-Shot program. But why should 2-Pass program be employed by FG 3D NAND?
1-Shot Program for 3D FG NAND
1-Shot vs. 2-Pass for FG 3D NAND(TLC)

Vt Distribution (Log)

1-shot program for FG 3D NAND

2-pass program for FG 3D NAND
1-Shot vs. 2-Pass for FG 3D NAND (QLC)
The shortcoming of 2-Pass program
The reason and the solution

- The possibility of introducing HRE (High Reliable Error) is the key shortcoming of 2-Pass program, which is especially harmful for LDPC soft bit decode.
- The reason is the second pass program have to read the result of first pass programed data, which will introduce some bit errors. These bit errors will be expanded by the second pass program operation.
- The solution is re-inputting the first-pass data for second pass program, instead of reading from the first programed WL.
Result with re-input first pass data
About YeeStor

Established in 2017

SSD
- SATA SSD Controller
- PCIe SSD Controller
- NoF SSD Controller

Established in 2007

Embedded
- UFS Controller
- eMMC Controller
- SPI NAND Controller

Established in 2015

General
- USB Controller
- SD Controller

Security
- Security SSD Controller
- Other security Controller & solution
Thank you.

Feel free to email me with any questions & feedback

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