Data is the New Horse Power
3D NAND & Automotive

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Director of Marketing for Automotive Solutions

August 7, 2018
Forward-Looking Statements

Safe Harbor | Disclaimers

This presentation contains forward-looking statements that involve risks and uncertainties, including, but not limited to, statements regarding our managed flash products and solid-state technologies, growth opportunities, and demand and market trends. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

Key risks and uncertainties include volatility in global economic conditions, business conditions and growth in the storage ecosystem, impact of competitive products and pricing, market acceptance and cost of commodity materials and specialized product components, actions by competitors, unexpected advances in competing technologies, difficulties or delays in manufacturing, and other risks and uncertainties listed in the company’s filings with the Securities and Exchange Commission (the “SEC”) and available on the SEC’s website at www.sec.gov, including our most recently filed periodic report, to which your attention is directed. We do not undertake any obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future developments or otherwise, except as required by law.
The Automotive Industry is Changing

From Performance and Horsepower . . .
To Connectivity, Infotainment, Service-Based Models, Autonomous Drive
Connected Cars Driving Data

USD$450B - $700B
Value of data per year*

*McKinsey - 2030

5 Zettabytes per year

5G

Telematics /OTA

Delivery Services

Auto OEM

Traffic Management Center

Fleet Management

Insurance

Parking/Charging Station

Flash Memory Summit 2018, Santa Clara, CA
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Automotive Storage Trends

**DENSITY** needs increasing

**COST** of NAND flash decreasing

**USAGE** models also changing

**QUALITY** targets are still ZERO dppm!
Flash Technology in Automotive

How TLC 3D NAND is Optimal for Automotive
2D TLC ≠ 3D TLC
Western Digital 3D TLC NAND Reliability Attributes Comparable to 2D MLC Technology

- Larger reliability margin
- Reduces cell-to-cell interference
- More electrons per charge trap layer
- Better data retention
3D NAND Has Lower Cell to Cell Interference

Large reliability margin

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Reliability Margin
Managed NAND Is Much More Than Just Memory

Reliability

Sophisticated Flash Management Mechanisms

- Advanced ECC
- Adaptive Read Thresholds
- Read Refresh
- Defect Management

Raw NAND Reliability Characteristics

- Write Endurance
- Data Retention Read Disturb
- Raw DPPM

Health Report

TBW (Terabyte Written)

Operational/Data Retention and Read Endurance

DPPM/UBER (Uncorrectable Bit Error Rate)
Other Considerations

- Packaging/Assembly to meet harsh environmental requirements
- Test flows to reduce DPPM
- Design review & check — especially on usage model
- User OS like Android poses special challenges — need to monitor platform performance
Summary

- 3D NAND is coming to Automotive!
- System level solution for automotive — it is more than just the memory!
- Engage with us early to ensure success!
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