# Migrating from MX60LF8G18AC to MX60LF8G28AD

## 1. Introduction

This application note is a guide for migrating Macronix NAND device from the MX60LF8G18AC to the MX60LF8G28AD. Both NAND devices are 8Gb SLC NAND Flash built with two stacked 4Gb chips. The document does not provide detailed information on the individual devices, but highlights the major similarities and differences between them. The comparison covers the general features, performance, command codes and other differences.

The information in this document is based on datasheets listed in Section 8. Newer versions of the datasheets may override the contents of this document.

## 2. General Features

With the exception of some additional features of the MX60LF8G28AD, such as “Randomizer”, “Special read for data recovery”, and the different page/spare/block size, both flash devices have similar features and functions as shown in **Table 2-1**. Feature differences are highlighted in ***Bold Italic*** type in the table.

**Table 2-1. Key Features Comparison**

| Part Name | MX60LF8G18AC | MX60LF8G28***AD*** |
|---|---|---|
| Voltage | 2.7V-3.6V | 2.7V-3.6V |
| Bus Width | x8 | x8 |
| Operating Temperature | -40°C to 85°C | -40°C to 85°C |
| Interface | ONFI 1.0 Compliant | ONFI 1.0 Compliant |
| Page Size | (2K+64)B | (***4K+256***)B |
| Block Size | (128K+4K)B | ***(256K+16K)***B |
| ECC Requirement | 4 bit/528B | 8bit/***544***B |
| Interleaved Die Operations | Supported | Supported |
| Cache Read/ Cache Program | ONFI Standard | ONFI Standard |
| OTP | 30 Pages | 30 Pages |
| Unique ID | ONFI Standard | ONFI Standard ***(PUF type)***[note] |
| ***Randomizer*** | N/A | ***Supported*** |
| ***Special Read for Data Recovery*** | N/A | ***Supported*** |
| Guaranteed Good Blocks at Shipping | Block#0 | ***Block#0-7*** |
| Data Retention | 10 Years | 10 Years |
| Endurance | 100K Cycles | ***60***K Cycles |
| Package | 48TSOP (12x20mm)<br>63-VFBGA (9x11mm) | 48TSOP (12x20mm)<br>63-VFBGA (9x11mm) |

***Note:*** *PUF (physical unclonable function)*

# 3. Electrical Performance

The key performance specifications are similar for the two devices. Performance differences are highlighted in Bold Italic type in **Table 3-1**.

**Table 3-1. Key Performance Comparison**

| Part Name | | MX60LF8G18AC | | | MX60LF8G28*AD* | | |
|---|---|---|---|---|---|---|---|
| **Performance** | | Min. | Typ. | Max. | Min. | Typ. | Max. |
| **Access Time** | Random (tR) | - | - | 25us | - | - | 25us |
| | Cache Read Busy time | - | 2us | 25us | - | ***4.5us*** | 25us |
| | Sequential | 20ns | - | - | 20ns | - | - |
| **Program Time** | Page Program | - | 300us | 600us | - | ***320us*** | ***700us*** |
| | Cache Program Busy time | - | 3us | 600us | - | 5us | ***700us*** |
| **Erase Time** | Block | - | 1ms | 3.5ms | - | ***4ms*** | ***6ms*** |
| **Current Consumption** | Standby (TTL) | - | - | 2mA | - | - | 2mA |
| | Standby (CMOS) | - | 20uA | 100uA | - | 20uA | 100uA |
| | Active Read | - | 20mA | 30mA | - | 20mA | 30mA |
| | Active Program | - | 20mA | 30mA | - | 20mA | 30mA |
| | Active Erase | - | 15mA | 30mA | - | 15mA | 30mA |
| | Power-up Current (Including POR Current) | - | - | 60mA | - | - | ***50mA*** |
| | Input Leakage | - | - | +/- 20uA | - | - | +/- 20uA |
| | Output Leakage | - | - | +/- 20uA | - | - | +/- 20uA |
| **Partial-Page Programs** | NOP | - | - | 4 cycles | - | - | 4 cycles |

# 4. Command Set

The command set is the same for the two devices (**Table 4-1 Command Set**).

**Table 4-1. Command Set**

| Part Name | MX60LF8G18AC | | MX60LF8G28*AD* | |
|---|---|---|---|---|
| Command Description | 1st Command Cycle | 2nd Command Cycle | 1st Command Cycle | 2nd Command Cycle |
| Read | 00h | 30h | 00h | 30h |
| Random Data Input | 85h | - | 85h | - |
| Random Read Data Output | 05h | E0h | 05h | E0h |
| Cache Read Random | 00h | 31h | 00h | 31h |
| Cache Read Sequential | 31h | - | 31h | - |
| Cache Read End | 3Fh | - | 3Fh | - |
| Read ID | 90h | - | 90h | - |
| Parameter Page Read (ONFI) | ECh | - | ECh | - |
| Read Unique ID (ONFI) | EDh | - | EDh | - |
| Get Features (ONFI) | EEh | - | EEh | - |
| Set Features (ONFI) | EFh | - | EFh | - |
| Reset | FFh | - | FFh | - |
| Page Program | 80h | 10h | 80h | 10h |
| Cache Program (Start) | 80h | 15h | 80h | 15h |
| Cache Program (End) | 80h | 10h | 80h | 10h |
| Block Erase | 60h | D0h | 60h | D0h |
| Status Read | 70h | - | 70h | - |
| Status Enhanced Read (ONFI) | 78h | - | 78h | - |
| Two-plane Program (ONFI) | 80h-11h-80h-10h | | 80h-11h-80h-10h | |
| Two-plane Cache Program - Start/Cont.(ONFI) | 80h-11h-80h-15h | | 80h-11h-80h-15h | |
| Two-plane Cache Program - End (ONFI) | 80h-11h-80h-10h | | 80h-11h-80h-10h | |
| Two-plane Block Erase (ONFI) | 60h-D1h-60h-D0h | | 60h-D1h-60h-D0h | |

# 5. Status Register Comparison

Status Register bit functions are the same (**Table 5-1 Status Register Comparison**). Please refer to the Macronix datasheet for additional details.

**Table 5-1. Status Register Comparison**

| Part Name | MX60LF8G18AC | MX60LF8G28*AD* |
|---|---|---|
| SR[0] | Program/Cache program(page N)/ Erase Pass or Fail | Program/Cache program(page N)/ Erase Pass or Fail |
| SR[1] | Cache Program (page N-1) Pass or Fail | Cache Program (page N-1) Pass or Fail |
| SR[2] | Not Used | Not Used |
| SR[3] | Not Used | Not Used |
| SR[4] | Not Used | Not Used |
| SR[5] | Ready/Busy for Internal Controller Program/Erase/Read Operation | Ready/Busy for Internal Controller Program/Erase/Read Operation |
| SR[6] | Ready/Busy | Ready/Busy |
| SR[7] | Write Protect | Write Protect |

# 6. Package Pin Definition

The package physical dimensions and pin definitions of the MX60LF8G18AC and the MX60LF8G28AD are identical in 48-TSOP and 63-VFBGA.

# 7. Device Identification

The Device ID lengths of the MX60LF8G18AC and the MX60LF8G28AD differ by one byte. The ID of the MX60LF8G18AC begins with a one-byte Manufacturer Code followed by a four-byte Device ID. The ID of the MX60LF8G28AD begins with a one-byte Manufacturer Code followed by a five-byte Device ID. The ID codes of the MX60LF8G18AC and the MX60LF8G28AD are identical for the first three byte, but different for the 4th byte and 5th byte which indicate differences in page/spare/block size/ECC requirement and the extended 6th byte of MX60LF8G28AD for device generation (**Table 7-1 Device Identification**).

**Table 7-1. Device Identification**

| Part Name | | MX60LF8G18AC | MX60LF8G28***AD*** |
|---|---|---|---|
| **ID Code** | | C2h/D3h/D1h/95h/5Ah | C2h/D3h/D1h/***A2h/5Bh/03h*** |
| **ID Definition** | 1st Byte | Manufacturer ID | Manufacturer ID |
| | 2nd Byte | Device ID | Device ID |
| | 3rd Byte | Number of Die per CE | Number of Die per CE |
| | | Cell Structure | Cell Structure |
| | | Number of Concurrently Programmed Pages | Number of Concurrently Programmed Pages |
| | | nterleaved operations between Multiple die | Interleaved Programming between multiple devices |
| | | Cache program | Cache program |
| | 4th Byte | Page Size (2KB, bit1=0 & bit0=1) | Page Size ***(4KB, bit1=1 & bit0=0)*** |
| | | Spare Area Size (16-byte per 512-byte), bit2=1 | Spare Area Size ***(32-byte*** per 512-byte), bit2***=0*** |
| | | Sequential Read Cycle Time (bit7, bit3=1,0) | Sequential Read Cycle Time (bit7, bit3=1,0) |
| | | Block Size ( 128KB excluding spare area, bit5=0 & bit4=1) | Block Size ***(256KB excluding spare area, bit5=1 & bit4=0)*** |
| | | Organization | Organization |
| | 5th Byte | ECC level requirement, ***4-bit ECC required (bit 1:0=10b)*** | ECC level requirement, ***8-bit ECC required (bit 1:0=11b)*** |
| | | Number of Planes per CE | Number of Planes per CE |
| | | Plane Size | Plane Size |
| | | Reserved | Reserved |
| | 6th Byte | N/A | ***Device Generation*** |

# 8. References

**Table 8-1** shows the datasheet versions used for comparison in this application note. For the most current, detailed specification, please contact Macronix website.

**Table 8-1. Datasheet Versions**

| Datasheet | Location | Date Issued | Revision |
|---|---|---|---|
| MX60LF8G18AC | Website | Jan. 2017 | Rev. 1.1 |
| MX60LF8G28AD | Website | Aug. 2019 | Rev. 0.00 |

# 9. Summary

The Macronix MX60LF8G18AC and MX60LF8G28AD NAND flash share the same basic Read, Program, and Erase commands and have the same package dimension and pin-outs. However, migrating to the MX60LF8G28AD may require firmware modifications to accommodate differences in page/spare/block size/ ECC requirement.

# 10. Part Number Cross-Reference

**Table 10-1. Part Number Cross Reference**

| Bus Width | Voltage | Package | Part Number | Part Number |
|---|---|---|---|---|
| x8 | 3V | 48-TSOP | MX60LF8G18AC-TI | MX60LF8G28AD-TI |
| x8 | 3V | 63-VFBGA | MX60LF8G18AC-XKI | MX60LF8G28AD-XKI |

# 11. Revision History

**Table 11-1. Revision History**

| Revision No. | Description | Page | Date |
|---|---|---|---|
| REV. 1 | Initial Release | ALL | Jan. 03, 2020 |

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