

Replacing Samsung K9F2G08U0C with Macronix MX30LF2G18AC

1. Introduction

This application note is a guide for migrating to the Macronix MX30LF2G18AC from the Samsung K9F2G08U0C 2Gb, 3V, NAND flash memory.

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 10. Newer versions of the datasheets may override the contents of this document.

2. Features

Both flash device families have similar features and functions as shown in Table 2-1. The primary difference is that the Macronix device requires 4-bit ECC.

Table 2-1: Feature Comparison

Feature	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Vcc voltage range	2.7V ~ 3.6V	2.7V ~ 3.6V
Bus Width	x8	x8
Operating Temperature	-40°C ~ 85°C	-40°C ~ 85°C
Interface	ONFI 1.0 Standard	-
Block Size	128KB+4KB	128KB+4KB
Page Size	2KB+64B	2KB+64B
ECC Requirement	4b /528B	1b /528B
OTP size	30 pages	-
Guarantee Good blocks at shipping	Block 0	Block 0
Unique ID	ONFI standard	-
ID Code	C2h/DAh/90h/95h/06h	ECh/DAh/10h/15h/44h
ONFI signature	4Fh/4Eh/46h/49h	-
Data Retention	10 Years	10 Years
Package	48-TSOP (12x20mm) 63-VFBGA (9x11mm)	48-TSOP (12x20mm) 63-VFBGA (9x11mm)



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3. Performance

Table 3-1 and Table 3-2 show MX30LF2G18AC and K9F2G08U0C Read/Write performance.

Table 3-1: Read Performance (Read Latency and Sequential Read)

Read function	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Read Latency time (tR)	25us (max.)	40us (max.)
Sequential Read time (tRC)	20ns (min.)	25ns (min.)

Table 3-2: Write Performance (Program and Erase)

Write Function	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Page Program time (tPROG)	300us (typ.) / 600us (max.)	250us (typ.) / 750us (max.)
Block Erase time (tERASE)	1ms (typ.) / 3.5ms (max.)	2ms (typ.) / 10ms (max.)
NOP	4 (max.)	4 (max.)
Write/Erase Cycles* ¹ (Endurance)	100,000	100,000

Note: 100K Endurance cycle with ECC protection.

4. DC Characteristics

Read/Write power requirements (Table 4-1) and I/O voltage limits (Table 4-2) are similar.

Table 4-1: Read / Write Current

DC Characteristic	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Sequential Read Current (ICC1)	20mA (typ.) / 30mA (max.)	20mA (typ.) / 35mA (max.)
Program Current (ICC2)	20mA (typ.) / 30mA (max.)	20mA (typ.) / 35mA (max.)
Erase Current (ICC3)	15mA (typ.) / 30mA (max.)	20mA (typ.) / 35mA (max.)
Standby Current – CMOS	10uA (typ.) / 50uA (max.)	10uA (typ.) / 80uA (max.)

Table 4-2: Input / Output Voltage

DC Characteristic	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Input Low Voltage (VIL)	-0.3V (min.) / 0.2VCC (max.)	-0.3V (min.) / 0.2Vcc (max.)
Input High Voltage (VIH)	0.8VCC (min.) / VCC+0.3V (max.)	0.8Vcc (min.) / Vcc+0.3V (max.)
Output Low Voltage (VOL)	0.2V (max.)	0.4V (max.)
Output High Voltage (VOH)	VCC-0.2V (min.)	2.4V (min.)

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5. Package Pin/Ball Definition

Package physical dimensions are similar to each other. For detailed information, please refer to the individual datasheets. Table 5-1 and 5-2 shows differences in pin assignments between the Macronix and Samsung devices. The K9F2G08U0C can be replaced by the MX30LF2G18AC without pin conflicts. Only 48-TSOP pin #38 (63-VFBGA ball G5) may need special attention because the pin is designated “PT” which, if high during power-up, enables a memory protection function on the MX30LF2G18AC. The PT pin can be left unconnected as it has a weak internal pull-down to disable the protection feature.

Figure 5-1: 48-TSOP (12x20mm) Package and Pin Layout Comparison

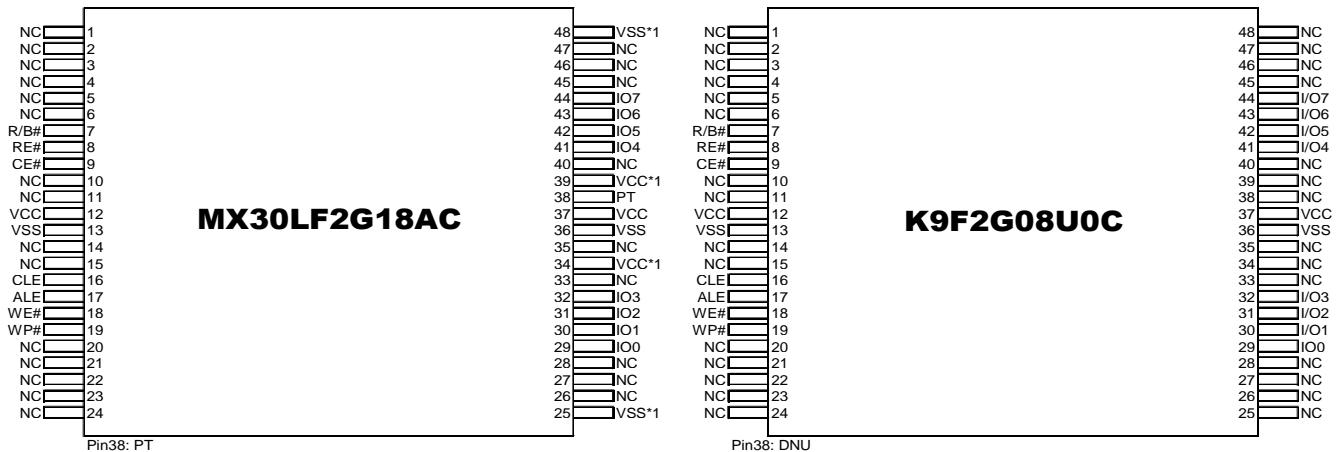


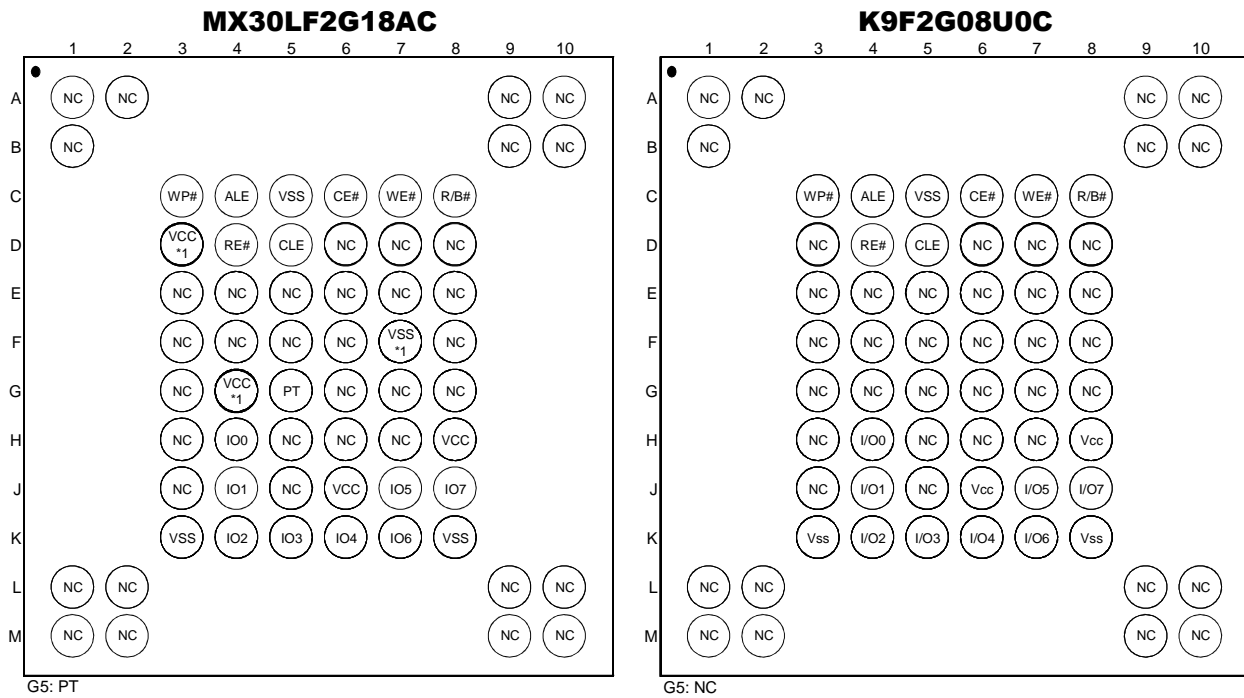
Table 5-1: 48-TSOP Package Pin Definition

Brand	Macronix	Samsung
Part Name	MX30LF2G18AC-TI	K9F2G08U0C-SIB0
#38 pin	PT	NC

Note: The PT pin can be left unconnected as it has a weak internal pull-down to disable the protection feature. Please refer to the datasheet for more details.

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Figure 5-2: 63-VFBGA (9x11mm) Package and Pin Layout Comparison



G5: PT

G5: NC

Note:

1. These pins might not be connected internally. However it is recommended to connect these pins to power(or ground) as designated for ONFI compatibility.

Table 5-2: 63-VFBGA Package Ball Definition

Brand	Macronix	Samsung
Part Name	MX30LF2G18AC-XKI	K9F2G08U0C-HIB0
#G5 ball	PT	NC

Note: The PT pin can be left unconnected as it has a weak internal pull-down to disable the protection feature. Please refer to the datasheet for more details.



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6. Command Set

Basic command sets and status checking methods are similar. Read, Write, and Erase operation commands are identical (Table 6-1). There are differences in 2-Plane commands (Table 6-2).

Table 6-1: Command Table

Command	Macronix MX30LF2G18AC		Samsung K9F2G08U0C	
	1st Cycle	2nd Cycle	1st Cycle	2nd Cycle
Random Data Input	85h	-	85h	-
Random Data Output	05h	E0h	05h	E0h
Cache Read Begin	00h	31h	-	-
Read Mode	00h	30h	00h	30h
Cache Read End	3Fh	-	-	-
Read ID	90h	-	90h	-
Reset	FFh	-	FFh	-
Page Program	80h	10h	80h	10h
Cache Program	80h	15h	-	-
Block Erase	60h	D0h	60h	D0h
Read Status	70h	-	70h	-
Read Parameter Pg.	ECh	-	-	-
Unique ID Read	EDh	-	-	-
Set Feature	EFh	-	-	-
Get Feature	EEh	-	-	-
Status Enhance Read	78h	-	F1h	-

Table 6-2: Two-Plane Command Table

Command	Macronix MX30LF2G18AC				Samsung K9F2G08U0C			
	1st Cycle	2nd Cycle	3rd Cycle	4th Cycle	1st Cycle	2nd Cycle	3rd Cycle	4th Cycle
2 Plane Program	80h	11h	80h	10h	80h	11h	81h	10h
2 Plane Cache Program	80h	11h	80h	15h	-	-	-	-
2 Plane Block Erase	60h	D1h	60h	D0h	60h	D0h	-	-



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6-2 Status Register

When a flash Read/Program/Erase operation is in progress, either the “Ready/Busy# Pin Checking” or “Status Output Checking” method may be used to monitor the operation. Both are standard NAND flash algorithms and can be used for both device families. Table 6-3 shows that Status Output content provided by the Read Status command (70h) is compatible. Table 6-4 shows that Two-plane Operation Status by Macronix Status Enhance Read Status command (78h) is similar to Samsung’s Read Status 2 Register (F1h).

Table 6-3: Status Output

Status Output	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
SR[0]	PGM/ERS status: Pass/Fail	PGM/ERS status: Pass/Fail
SR[1]	Cache Program status: Pass/Fail	Reserved
SR[2]	Reserved	Reserved
SR[3]	Reserved	Reserved
SR[4]	Reserved	Reserved
SR[5]	PGM/ERS/Read internal controller: Ready/Busy	Reserved
SR[6]	PGM/ERS/Read status: Ready/Busy	PGM/ERS/Read status: Ready/Busy
SR[7]	Write Protect	Write Protect

Table 6-4: Two-plane Status Output

Status Output	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
SR[0]	PGM/ERS status: Pass/Fail	PGM/ERS status: Pass/Fail
SR[1]	Cache Program status: Pass/Fail	Plane 0 PGM/ERS status: Pass/Fail
SR[2]	Reserved	Plane 1 PGM/ERS status: Pass/Fail
SR[3]	Reserved	Reserved
SR[4]	Reserved	Reserved
SR[5]	PGM/ERS/Read internal controller: Ready/Busy	Reserved
SR[6]	PGM/ERS/Read status: Ready/Busy	PGM/ERS/Read status: Ready/Busy
SR[7]	Write Protect	Write Protect



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7. Read ID Command

The ID of the Macronix MX30LF2G18AC begins with a one-byte Manufacturer Code followed by a four-byte Device ID. While the same command set is used to read the Manufacturer ID, Device ID, and flash structure, the IDs are different, allowing software to identify the device manufacturer and device type (Table 7-1).

Table 7-1: Manufacturer and Device IDs

ID code		Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Value		C2h/DAh/90h/95h/06h	ECh/DAh/10h/15h/44h
1 st Byte		Manufacturer Code	Manufacturer Code
2 nd Byte		Device Identifier	Device Identifier
3 rd Byte	I/O0	Number of Die per Chip Enable	Number of Die per Chip Enable
	I/O1		
	I/O2	Cell Structure	Cell Structure
	I/O3		
	I/O4	Number of Simultaneously Programmed Pages	Number of Simultaneously Programmed Pages
	I/O5		
	I/O6	Interleaved Programming Between Multiple Chips	Interleaved Programming Between Multiple Chips
I/O7	Cache Programming	Cache Programming	
4 th Byte	I/O0	Page Size (exclude Spare Area)	Page Size (exclude Spare Area)
	I/O1		
	I/O2	Size of Spare Area (Byte per 512Byte)	Size of Spare Area (Byte per 512Byte)
	I/O3	Sequential Read Cycle Time (tRC)	Sequential Read Cycle Time (tRC)
	I/O4	Block Size (exclude Spare Area)	Block Size (exclude Spare Area)
	I/O5		
	I/O6	Organization	Organization
I/O7	Sequential Read Cycle Time (tRC)	Sequential Read Cycle Time (tRC)	
5 th Byte	I/O0	ECC Level Requirement	Reserved
	I/O1		
	I/O2	Number of Planes per CE	Number of Planes per CE
	I/O3		
	I/O4	Plane Size	Plane Size
	I/O5		
	I/O6		
I/O7	Reserved	Reserved	

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8. Power-Up Timing

Macronix and Samsung power-up sequences are similar, but the timing is slightly different. Although both devices use 2.7V (VCC min.) as the start point, timing references are different. Check the system timing to determine if adjustments are needed.

Table 8-1: Power-Up Timing

H/W Timing Characteristic	Macronix MX30LF2G18AC	Samsung K9F2G08U0C
Vcc (min.) to WE# low	1ms (max.)	N/A
Vcc (min.) to R/B# high	N/A	5ms (max.)
Vcc (min.) to R/B# low	10us (max.)	1ms (max.)
Vcc ramp start to R/B# low	N/A	N/A

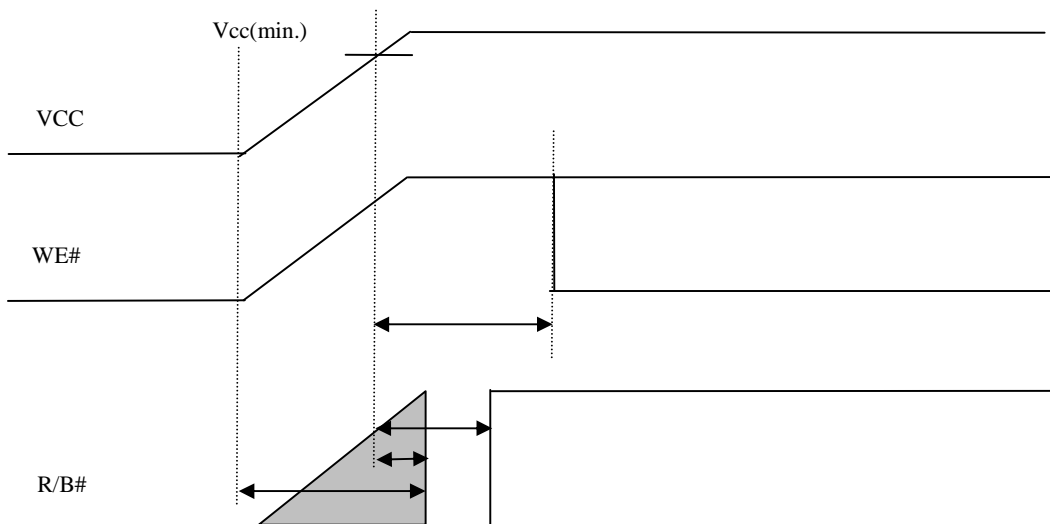


Figure 8-1: Power-Up Timing

9. Summary

Macronix MX30LF2G18AC and Samsung K9F2G08U0C NAND have similar features and pinouts. Because basic Read/Program/Erase commands as well as block, page, and spare area sizes are the same, device migration may require minimal or no firmware modifications to accommodate differences in ECC requirements and 2-plane command sequences.



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10. Reference

Table 10-1 shows the datasheet versions used for comparison in this application note. For the most current, detailed Macronix specification, please refer to the Macronix website at <http://www.macronix.com>

Table 10-1: Datasheet Version

Datasheet	Location	Date Issue	Revision
MX30LF2G18AC	-	Sep. 05, 2014	Rev. 0.02
K9F2G08U0C	-	May. 03, 2010	Rev. 0.2

Note: Macronix data sheet is subject to change without notice.

11. Appendix

Cross Reference Table 11-1 shows basic part number and package information for the Macronix MX30LF2G18AC and Samsung K9F2G08U0C product.

Table 11-1: Part Number Cross Reference

Density	Macronix Part No.	Samsung Part No.	Package	Dimension
2Gb	MX30LF2G18AC-TI	K9F2G08U0C-SIB0	48-TSOP	12 x 20 mm
	MX30LF2G18AC-XXI	K9F2G08U0C-HIB0	63-VFBGA	9 x 11 mm

12. Revision History

Revision	Description	Date
1.0	Initial Release	Aug. 11, 2014



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APPLICATION NOTE

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