Replacing Spansion® S34ML02G100 with Macronix MX30LF2G18AC

1. Introduction

This application note is a guide for migrating to the Macronix MX30LF2G18AC from the Spansion® S34ML02G100 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, whereas the Spansion device only requires 1-bit ECC.

Table 2-1: Feature Comparison

Feature	Macronix MX30LF2G18AC	Spansion S34ML02G100
Vcc voltage range	2.7V ~ 3.6V	2.7V ~ 3.6V
Bus Width	x8	x8
Operating Temperature	-40℃ ~ 85℃	-40℃ ~ 85℃
Interface	ONFI 1.0 Standard	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	64 pages
Guarantee Good blocks at shipping	Block 0	Block 0 & 1
Unique ID	ONFI standard	ONFI standard
ID Code	C2h/DAh/90h/95h/06h	01h/DAh/90h/95h/44h
ONFI signature	4Fh/4Eh/46h/49h	4Fh/4Eh/46h/49h
Data Retention	10 Years	10 Years
Package	48-TSOP (12x20mm) 63-VFBGA (9x11mm)	48-TSOP (12x20mm) 63-VFBGA (9x11mm)

3. Performance

Table 3-1 and Table 3-2 show MX30LF2G18AC and S34ML02G100 Read/Write performance.

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

Read function	Macronix MX30LF2G18AC	Spansion S34ML02G100
Read Latency time (tR)	25us (max.)	25us (max.)
Sequential Read time (tRC)	20ns (min.)	25ns (min.)

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

Write Function	Macronix MX30LF2G18AC	Spansion S34ML02G100
Page Program time (tPROG)	300us (typ.)/600us (max.)	200us (typ.)/700us (max.)
Block Erase time (tERASE)	1ms (typ.)/3.5ms (max.)	3.5ms (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	Spansion S34ML02G100
Sequential Read Current (ICC1)	20mA (typ.)/30mA (max.)	15mA (typ.)/30mA (max.)
Program Current (ICC2)	20mA (typ.)/30mA (max.)	15mA (typ.)/30mA (max.)
Erase Current (ICC3)	15mA (typ.)/30mA (max.)	--mA (typ.)/30mA (max.)
Standby Current – CMOS	10uA (typ.)/50uA (max.)	10uA (typ.)/50uA (max.)

Table 4-2: Input / Output Voltage

DC Characteristic	Macronix MX30LF2G18AC	Spansion S34ML02G100
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.)

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 Spansion devices. The S34ML02G100 can be replaced by the MX30LF2G18CA without pin conflicts. Only 48-TSOP pin #38 (63-VFBGA ball G5) may need special attention because the pin is designated "PT" which is Chip Protected function on the MX30LF2G18AC-TI.

Figure 5-1: 48-TSOP (12x20mm) Package and Pin Layout Comparison
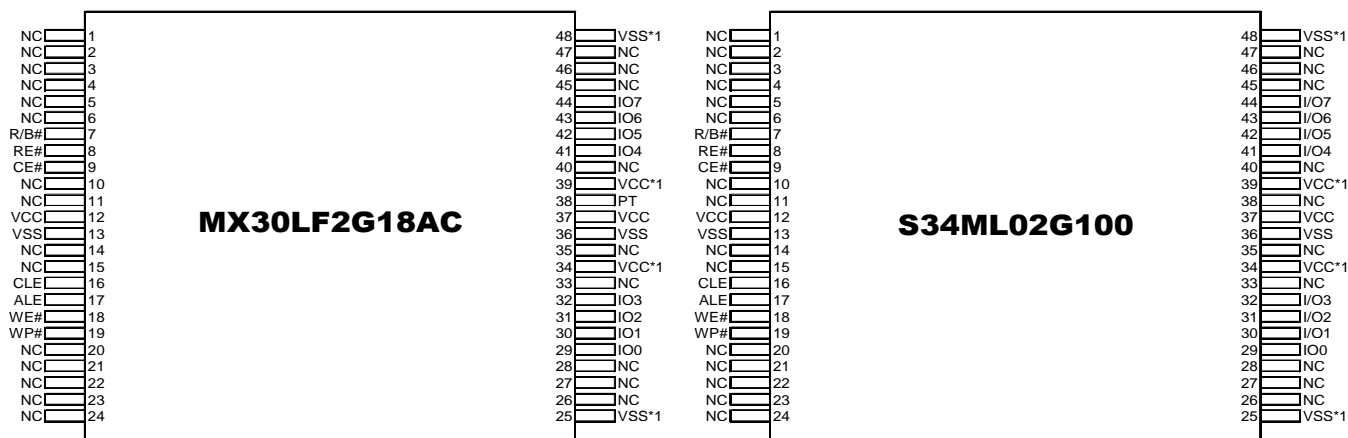
Pin38: PT

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.
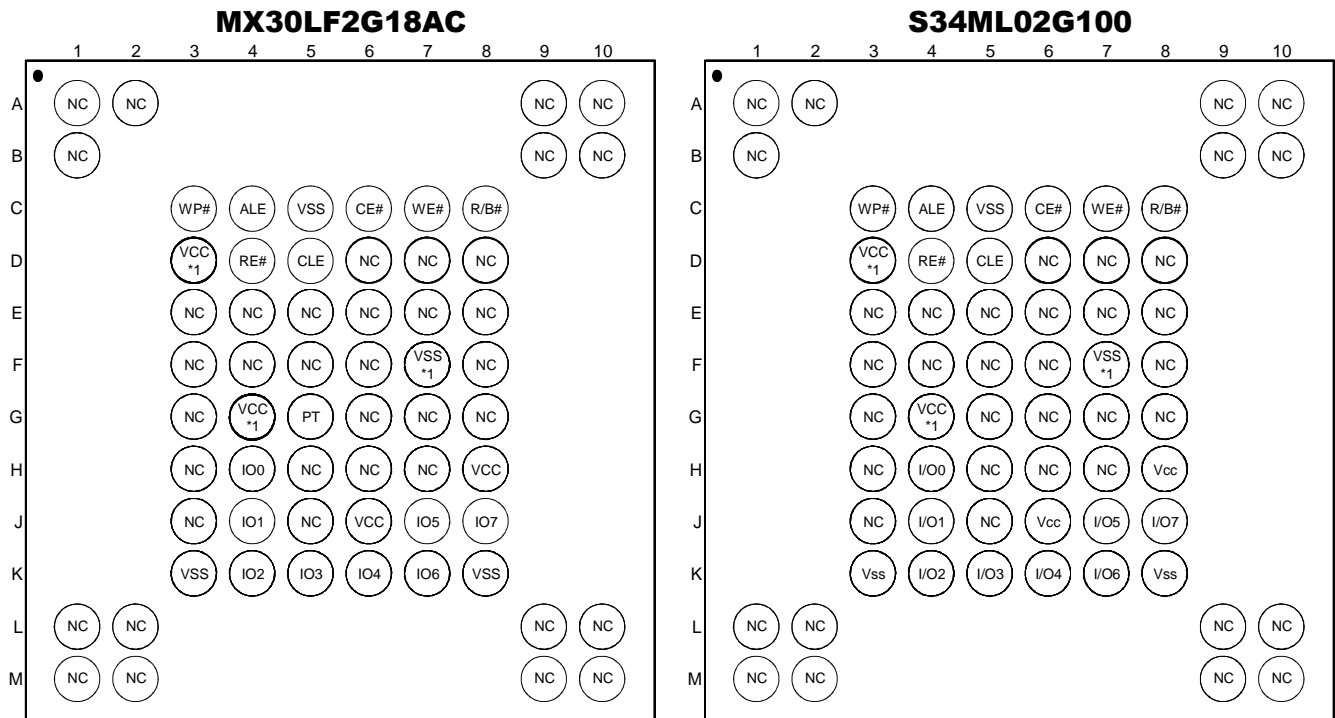
Table 5-1: 48-TSOP Package Pin Definition

Brand	Macronix	Spansion
Part Name	MX30LF2G18AC-TI	S34ML02G100TFI00
#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

MX30LF2G18AC

S34ML02G100

G5: PT

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	Spansion
Part Name	MX30LF2G18AC-XKI	S34ML02G100BHI00
#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.

6. Command Set

Basic command sets and status checking methods are similar. Read, Write, and Erase operation commands are identical (Table 6-1). Macronix implements the ONFI 2-Plane Block Erase command sequence (Table-2).

Table 6-1: Command Table

Command	Macronix MX30LF2G18AC		Spansion S34ML02G100	
	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	31h	-
Read Mode	00h	30h	00h	30h
Cache Read End	3Fh	-	3Fh	-
Read ID	90h	-	90h	-
Reset	FFh	-	FFh	-
Page Program	80h	10h	80h	10h
Cache Program	80h	15h	80h	15h
Block Erase	60h	D0h	60h	D0h
Read Status	70h	-	70h	-
Read Parameter Pg.	ECh	-	ECh	-
Unique ID Read	EDh		-	
Set Feature	EFh		-	
Get Feature	EEh		-	
Status Enhance Read	78h		78h	

Table 6-2: Two-Plane Command Table

Command	Macronix MX30LF2G18AC				Spansion S34ML02G100			
	1st Cycle	**2nd Cycle**	**3rd Cycle**	**4th Cycle**	**1st Cycle**	**2nd Cycle**	**3rd Cycle**	**4th Cycle**
2 Plane Program	-	-	-	-	80h	11h	81h	10h
ONFI 2 Plane Program	80h	11h	80h	10h	80h	11h	80h	10h
2 Plane Cache Program	-	-	-	-	80h	11h	81h	15h
ONFI 2 Plane Cache Program	80h	11h	80h	15h	80h	11h	80h	15h
2 Plane Block Erase	-	-	-	-	60h	60h	D0h	-
ONFI 2 Plane Block Erase	60h	D1h	60h	D0h	60h	D1h	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 output provided by the Enhance Read Status command (78h) is compatible.

Table 6-3: Status Output

Status Output	Macronix MX30LF2G18AC	Spansion S34ML02G100
SR[0]	PGM/ERS status: Pass/Fail	PGM/ERS status: Pass/Fail
SR[1]	Cache Program status: Pass/Fail	Cache Program status: Pass/Fail
SR[2]	Reserved	Reserved
SR[3]	Reserved	Reserved
SR[4]	Reserved	Reserved
SR[5]	PGM/ERS/Read internal controller: Ready/Busy	PGM/ERS/Read internal controller: Ready/Busy
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	Spansion S34ML02G100
SR[0]	Selected Plane PGM/ERS status: Pass/Fail	Selected Plane PGM/ERS status: Pass/Fail
SR[1]	Selected Plane Cache Program status: Pass/Fail	Selected Plane Cache Program status: Pass/Fail
SR[2]	Reserved	Reserved
SR[3]	Reserved	Reserved
SR[4]	Reserved	Reserved
SR[5]	PGM/ERS/Read internal controller: Ready/Busy	PGM/ERS/Read internal controller: Ready/Busy
SR[6]	PGM/ERS/Read status: Ready/Busy	PGM/ERS/Read status: Ready/Busy
SR[7]	Write Protect	Write Protect

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	Spansion S34ML02G100
Value		**C2h**/DAh/90h/95h/**06h**	**01h**/DAh/90h/95h/**44h**
1st Byte		Manufacturer Code	Manufacturer Code
2nd Byte		Device Identifier	Device Identifier
3rd Byte	IO1, IO0	Number of Die per Chip Enable	Number of Die per Chip Enable
	IO3, IO2	Cell Structure	Cell Structure
	IO5, IO4	Number of Simultaneously Programmed Pages	Number of Simultaneously Programmed Pages
	IO6	Interleaved Programming Between Multiple Chips	Interleaved Programming Between Multiple Chips
	IO7	Cache Programming	Cache Programming
4th Byte	IO1, IO0	Page Size (exclude Spare Area)	Page Size (exclude Spare Area)
	IO2	Size of Spare Area (Byte per 512Byte)	Size of Spare Area (Byte per 512Byte)
	IO7, IO3	Sequential Read Cycle Time (tRC)	Serial Access Time (tRC)
	IO5, IO4	Block Size (exclude Spare Area)	Block Size (exclude Spare Area)
	IO6	Organization	Organization
5th Byte	IO0, IO1	ECC Level Requirement	Reserved
	IO2, IO3	Number of Planes per CE	Number of Planes per CE
	IO4~IO6	Plane Size	Plane Size
	IO7	Reserved	Reserved

8. Power-Up Timing

Macronix and Spansion® 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	Spansion S34ML02G100
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.)	100us (max.)
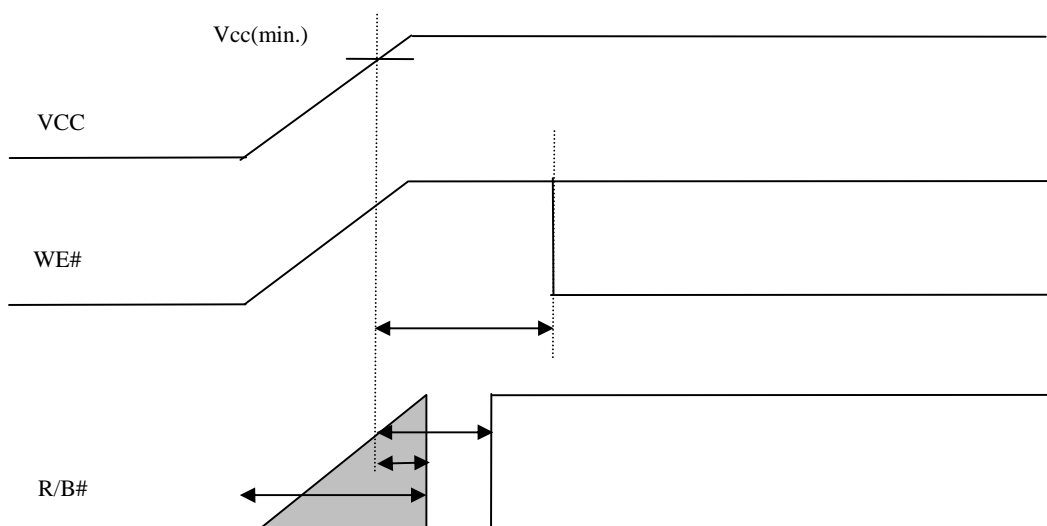
Figure 8-1: Power-Up Timing

9. Summary

Macronix MX30LF2G18AC and Spansion® S34ML02G100 NAND have similar features and pin outs. 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.

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	-	Jul. 04, 2014	Rev. 0.01
S34ML01G1_04G1	Website	Feb. 10, 2014	Rev. 17

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 Spansion® S34ML02G100 product.

Table 11-1: Part Number Cross Reference

Density	Macronix Part No.	Spansion Part No.	Package	Dimension
2Gb	MX30LF2G18AC-TI	S34ML04G100TFI00	48-TSOP	12x20mm
	MX30LF2G18AC-XKI	S34ML04G100BHI00	63-VFBGA	9x11x1.0mm

12. Revision History

Revision	Description	Date
1.0	Initial Release	Jul. 14, 2014

For the contact and order information, please visit Macronix's Web site at: http://www.macronix.com