Migrating Spansion S29GL_P to Macronix MX29GL_F

1. Introduction

Macronix offers MX29GL _F parallel flash from 128Mb to 1Gb for diverse applications, and provide high performance Read and Write functionality. MX29GL_F and Spansion S29GL-P are hardware, software, and feature compatible. This application note explains how to simply and easily replace Spansion S29GL_P with Macronix MX29GL_F.

2. Feature Comparison

Both flash device families have similar features and functions. The following table shows the basic features provided:

Type / Function		Macronix MX29GL_F	Spansion S29GL_P
Vcc voltage		2.7V ~ 3.6V	2.7V ~ 3.6V
I/O voltage range		2.7V ~ 3.6V (H/L type[*1]) 1.65V ~ 3.6V (U/D type[*2])	2.7V ~ 3.6V (01/02 type[*1]) 1.65V ~ 3.6V (V1/V2 type[*2])
WP# pin function		Highest/Lowest address sector	Highest/Lowest address sector
Software Protected Mode		Password (64bits) Solid Protection[*3]	Password (64bits) Persistent Protection[*3]
Bus Width		x8 / x16	X8 / x16
Sector Size		128KB	128KB
Page Read buffer		8Words / 16Bytes	8Words / 16Bytes
Write buffer		32Words / 64Bytes	32Words / 64Bytes
OTP Security Region		128Words / 256Bytes	128Words /256 Bytes
Manufacture ID		C2h	01h
Device ID	128Mb	227E/2221/2201	227E/2221/2201
	256Mb	227E/2222/2201	227E/2222/2201
	512Mb	227E/2223/2201	227E/2223/2201
	1Gb	227E/2228/2201	227E/2228/2201
Package		56-TSOP (14x20mm) 64-LFBGA (11x13mm)	56-TSOP (14x20mm) 64-LFBGA (11x13mm)

Note:
1. Macronix 'H/L' is same as Spansion '01/02' definition.
   H / 01 type is "VI/O = Vcc = 2.7 ~ 3.6V, highest address sector protected."
   L / 02 type is "VI/O = Vcc = 2.7 ~ 3.6V, lowest address sector protected."
2. Macronix 'U/D' is same as Spansion 'V1/V2' definition. Macronix: 128Mb~256Mb; Spansion: 128Mb~1Gb
   U / V1 type is "VI/O = 1.65 ~ Vcc, Vcc = 2.7 ~ 3.6V, highest address sector protected."
   D / V2 type is "VI/O = 1.65 ~ Vcc, Vcc = 2.7 ~ 3.6V, lowest address sector protected."
3. Solid Protection is same function as Persistent Protection, which is just different naming.

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3. Performance Comparison

The following table shows MX29GL_F series and S29GL_P series Read/Write performance; this should be used as a reference for the design.

Read Function Performance (random read and page read):

Read function		Macronix MX29GL_F	Spansion S29GL_P
Random Read Access time	128Mb	90ns (H/L type) 110ns(U/D type)	100ns (01/02 type) 110ns (V1/V2 type)
	256Mb	100ns (H/L type) 110ns(U/D type)	100ns (01/02 type) 110ns(V1/V2 type)
	512Mb	110ns (H/L type) *	110ns (01/02 type) 120ns(V1/V2 type)
	1Gb	110ns (H/L type) *	120ns (01/02 type) 130ns(V1/V2 type)
Page Access time		25ns (H/L type) 30ns (U/D type)	25ns (01/02/V1/V2 type)

* Macronix 512Mb and 1Gb devices only offer VI/O = Vcc (H/L type).

Write Function Performance (program and erase):

Write Function		Macronix MX29GL_F	Spansion S29GL_P
Word Program time		11us	60us
Total Write Buffer time	128Mb	120us	480us
	256Mb	120us	480us
	512Mb	120us	480us
	1Gb	70us	480us
Sector Erase time		0.6s	0.5s
Chip Erase time	128Mb	64s	64s
	256Mb	128s	128s
	512Mb	256s	256s
	1Gb	512s	512s
Write/Erase Cycles(Endurance)		100,000	100,000

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4. DC Characteristics Comparison

Both flash series characteristics are similar in primary features and functions. However, there are minor differences in DC characteristics. Designers should evaluate these differences to determine if they would be a concern in their application.

Read current is similar. Macronix is better in Write Current; Spansion is better in Standby Current.

Read / Write Current:

DC Characteristic		Macronix MX29GL_F	Spansion S29GL_P
Read Current		50mA (Max) @ 5MHz	55mA (Max) @ 5MHz
Page Read Current		20mA (Max) @ 33MHz	20mA (Max) @ 33MHz
Standby Current	128Mb	100uA (Max)	5uA (Max)
	256Mb	100uA (Max)	5uA (Max)
	512Mb	200uA (Max)	5uA (Max)
	1Gb	400uA (Max)	5uA (Max)
Write Current	128Mb	30mA(Max)	90mA (Max)
	256Mb	30mA(Max)	90mA (Max)
	512Mb	30mA(Max)	90mA (Max)
	1Gb	60mA(Max)	90mA (Max)

This section will show voltage values between the two families. Generally they are same when VI/O is connected to Vcc. If VI/O is used below Vcc, the input/output voltage has a slight difference.

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Input / Output Voltage:

DC Characteristic		Macronix MX29GL_F	Spansion S29GL_P
Very High Voltage		9.5V ~ 10.5V*[1]	11.5V ~ 12.5V*[1]
Input Low Voltage	128Mb/256Mb	-0.1V (Min) / 0.3VI/O (Max)	-0.1V(Min) / 0.3VI/O(Max)
	512Mb/1Gb	-0.1V (Min) / 0.3Vcc (Max)*[2]	-0.1V(Min) / 0.3VI/O(Max)
Input High Voltage	128Mb/256Mb	0.7VI/O (Min) / VI/O+0.3V (Max)	0.7VI/O (Min) / VI/O+0.3V (Max)
	512Mb/1Gb	0.7Vcc (Min) / Vcc+0.3V(Max)* [2]	0.7VI/O(Min) / VI/O+0.3V(Max)
Output Low Voltage		0.45V (Max)	0.15VI/O (Max)
Output High Voltage	128Mb/256Mb	0.85VI/O (Min)	0.85VI/O (Min)
	512Mb/1Gb	0.85Vcc (Min)*[2]	0.85VI/O (Min)

Note:
(1) The major difference is Very High Voltage range, it may damage flash device, if designer inputs wrong voltage.
(2) Macronix 512Mb and 1Gb devices only offer VI/O = Vcc option, the Input and output voltage are defined by Vcc range.

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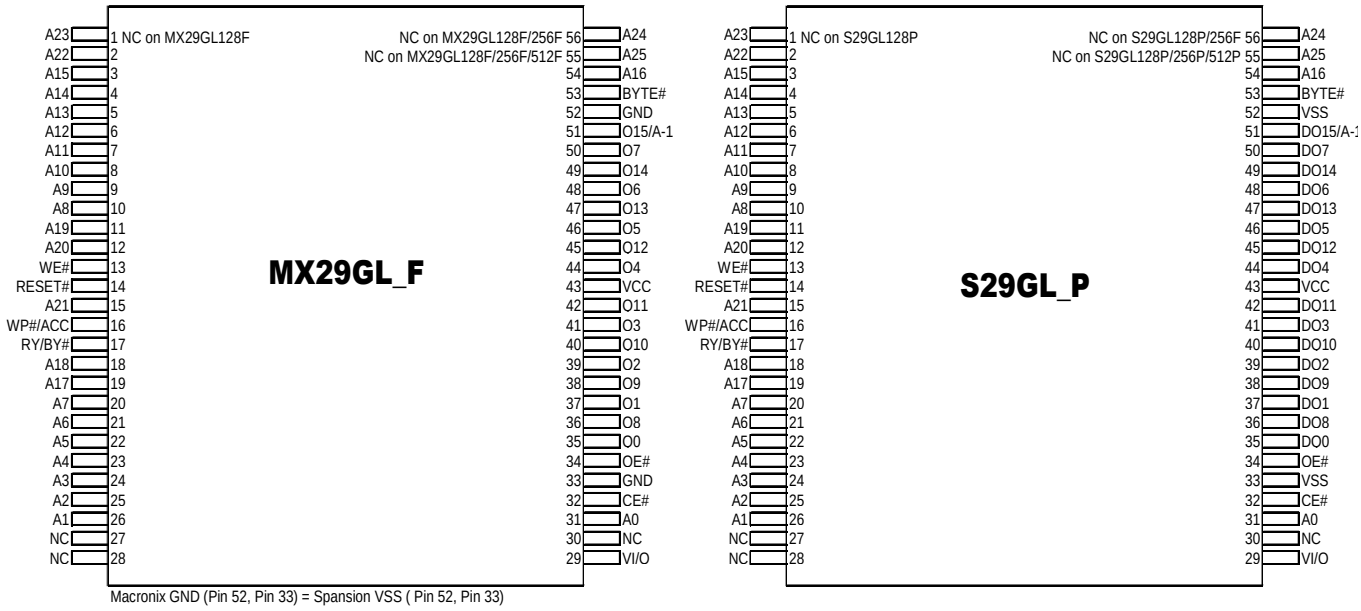
5. Hardware Consideration

Macronix device has same footprint with Spansion device. Refer TSOP56 & LFBGA64.
Note: Macronix 512Mb, 1Gb devices only offer a VI/O = Vcc option; VI/O = 1.65 ~ Vcc is not supported.

56-TSOP (14x20mm)



Macronix GND (Pin 52, Pin 33) = Spansion VSS (Pin 52, Pin 33)

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64-LFBGA (11x13mm)

MX29GL_F

	A	B	C	D	E	F	G	H
8	NC	A22	A23	VIO	GND	A24	A25	NC
7	A13	A12	A14	A15	A16	BYTE#	Q15/A-1	GND
6	A9	A8	A10	A11	Q7	Q14	Q13	Q6
5	WE#	RES-ET#	A21	A19	Q5	Q12	VCC	Q4
4	RY/BY#	WP#/ACC	A18	A20	Q2	Q10	Q11	Q3
3	A7	A17	A6	A5	Q0	Q8	Q9	Q1
2	A3	A4	A2	A1	A0	CE#	OE#	GND
1	NC	NC	NC	NC	NC	VIO	NC	NC

C8: NC on MX29GL128F
F8: NC on MX29GL128F/256F
G8: NC on MX29GL128F/256F/512F

S29GL_P

	A	B	C	D	E	F	G	H
8	NC	A22	A23	VIO	VSS	A24	A25	NC
7	A13	A12	A14	A15	A16	BYTE#	Q15/A-1	VSS
6	A9	A8	A10	A11	DQ7	DQ14	DQ13	DQ6
5	WE#	RES-ET#	A21	A19	DQ5	DQ12	VCC	DQ4
4	RY/BY#	WP#/ACC	A18	A20	DQ2	DQ10	DQ11	DQ3
3	A7	A17	A6	A5	DQ0	DQ8	DQ9	DQ1
2	A3	A4	A2	A1	A0	CE#	OE#	VSS
1	NC	NC	NC	NC	NC	VIO	NC	NC

C8: NC on S29GL128P
F8: NC on S29GL128P/256P
G8: NC on S29GL128P/256P/512P

6. Software Considerations

Basic command sets and writes status checking methods used by both flash families are similar. The algorithm descriptions may be slightly different, but the concepts are the same. The flow charts on pages 7 and 8 are applicable to both flash families. It may have minor modification on algorithm using in different applications.

Basic Command Table (Word mode)

MX29GL_F and S29GL_P have same basic command set. The read operation and write command could be used directly without any modification. Below table shows the command set in Word mode.

Migrating Spansion S29GL_P to Macronix MX29GL_F

Basic Command Table of MX29GL_F and S29GL_P									
Command		Read	Reset	Program	Write to Buffer	Chip Erase	Sector Erase	Program/Erase Suspend	Program/Erase Resume
1st Bus Cycle	Addr	Addr	XXX	555h	555h	555h	555h	XXX	XXX
	Data	Data	F0h	AAh	AAh	AAh	AAh	B0h	30h
2nd Bus Cycle	Addr			2AAh	2AAh	2AAh	2AAh		
	Data			55h	55h	55h	55h		
3rd Bus Cycle	Addr			555h	SA*1	555h	555h		
	Data			A0h	25h	80h	80h		
4th Bus Cycle	Addr			Addr	SA	555h	555h		
	Data			Data	N-1*2	AAh	AAh		
5th Bus Cycle	Addr				WA*3	2AAh	2AAh		
	Data				WD*4	55h	55h		
6th Bus Cycle	Addr				WBL*5	555h	SA		
	Data				WD	10h	30h		

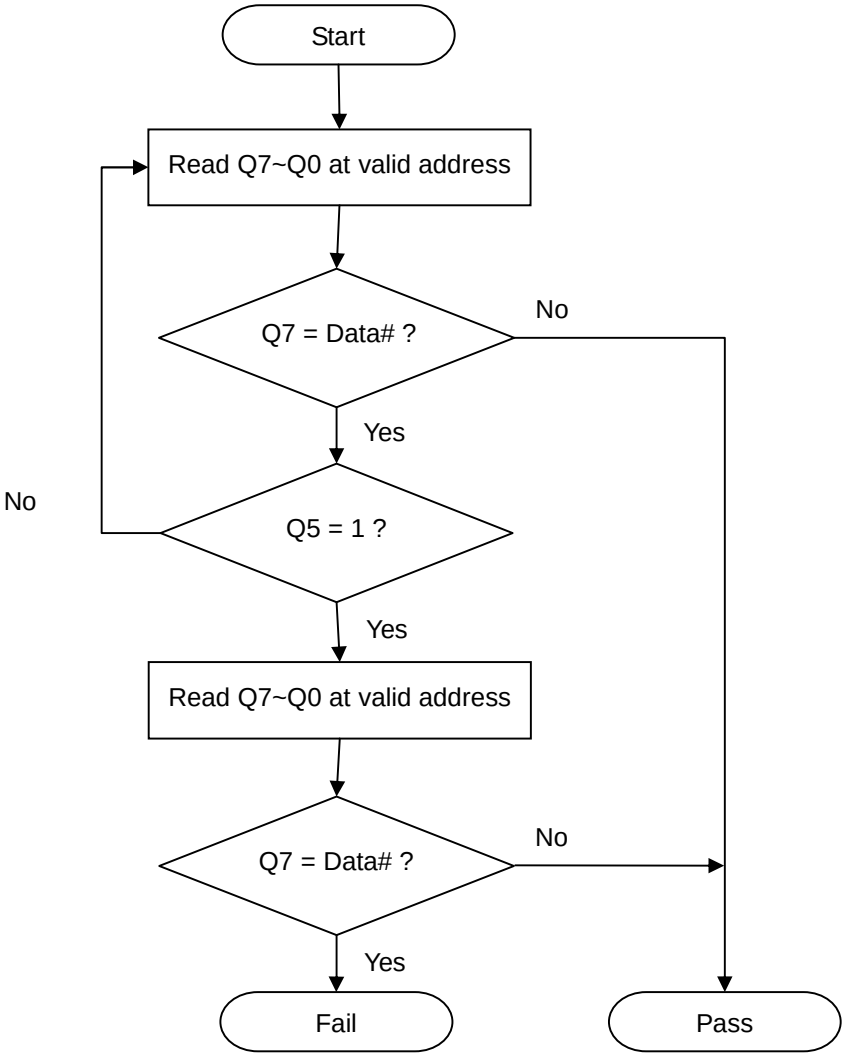
Note:
1. SA: Sector Address
2. N-1: Word Count
3. WA: Write Address
4. WD: Write Data
5. WBL: Write Buffer Location

Write Status Checking Method

When flash is in program/erase process, designer can use either the “Polling Method” or the “Toggle Bit Method” to monitor the write operation. Both are standard algorithms in parallel flash. Both methods are described in the following sections.

Polling Method

Polling method is one of the techniques for checking write status. It checks Q7 (data complement bit) and Q5 (time out bit) values during the operation. During write operations, Q7 continues to output Data# and Q5 outputs “0”. After the write operation completes, Q7 will output true Data. The flow chart below shows the polling algorithm.



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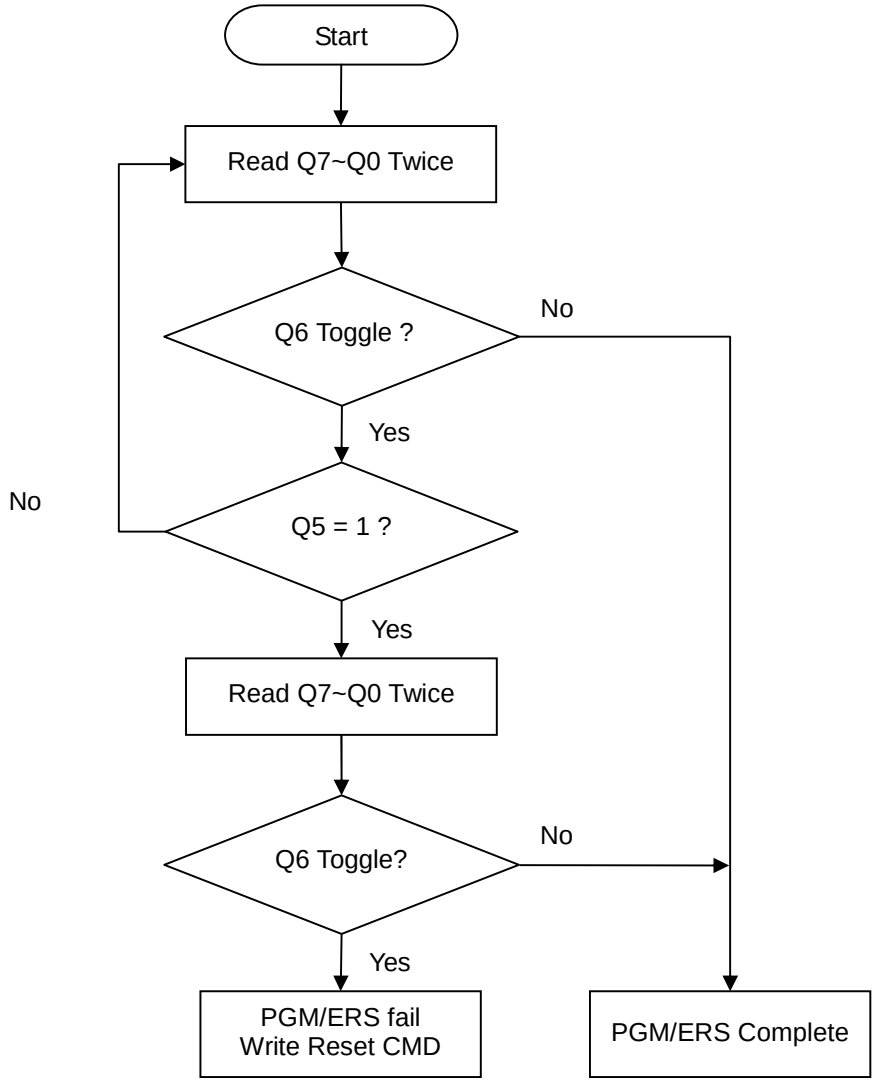
Toggle Bit Method

Toggle bit method is the other technique for checking write status. It checks the Q6 (toggle bit) value during the write operation. While the operation is in progress, Q6 will toggle between "1" and "0" after each consecutive read. When the write operation finishes, Q6 will stop toggling. The flow chart below shows the toggle bit algorithm.



7. Manufacturer ID & Device ID Command

Manufacturer IDs are different and permits software to identify the device manufacturer, but Device IDs are the same. The same command set is used read the different Manufacturer IDs.

Manufacturer & Device ID command					
Flash Vender		**MX29GL_F**	**S29GL_P**	**MX29GL_F**	**S29GL_P**
1st Bus Cycle (command)	Address	555h	555h	555h	555h
	Data	AAh	AAh	AAh	AAh
2nd Bus Cycle (command)	Address	2AAh	2AAh	2AAh	2AAh
	Data	55h	55h	55h	55h
3rd Bus Cycle (command)	Address	555h	555h	555h	555h
	Data	90h	90h	90h	90h
4th Bus Cycle (ID output)	Address	X00h	X00h	X01h	X01h
	Data	C2h	01h	227Eh	227Eh
5th Bus Cycle (ID output)	Address			X0Eh	X0Eh
	Data			2221h (128Mb) 2222h (256Mb) 2223h (512Mb) 2228h (1Gb)	2221h (128Mb) 2222h (256Mb) 2223h (512Mb) 2228h (1Gb)
6th Bus Cycle (ID output)	Address			X0Fh	X0Fh
	Data			2201h	2201h

Note.
(1) Device ID can be read out after Manufacturer ID with proper address and does not need another command sequence.
(2) Use Reset command (F0h) to return to normal read mode.

With the exception of the Manufacturer ID, all other commands are the same in usage and response, such as Erase, Read, Page read, and Buffer write functions.

8. Conclusion

Macronix MX29GL_F and Spansion S29GL_P Parallel Flash have identical PCB footprints, similar software functions, and similar features. Overall, the S29GL_P to Macronix MX29GL_F migration only requires minimal software modifications.

Migrating Spansion S29GL_P to Macronix MX29GL_F

9. Appendix

The table will show basic part number and package information cross reference between Macronix MX29GL_F and Spansion S29GL_P.

Density	Macronix Part	Spansion Part	Package	Dimension
128Mb	MX29GL128FHT2I-90G	S29GL128P10TFI01	56-TSOP	14x20mm
	MX29GL128FLT2I-90G	S29GL128P10TFI02		
	MX29GL128FUT2I-11G	S29GL128P11TFIV1		
	MX29GL128FDT2I-11G	S29GL128P11TFIV2		
	MX29GL128FHXFI-90G	S29GL128P10FFI01	64-LFBGA	11x13x14mm 0.6mm ball
	MX29GL128FLXFI-90G	S29GL128P10FFI02		
	MX29GL128FUXFI-11G	S29GL128P11FFIV1		
	MX29GL128FDXFI-11G	S29GL128P11FFIV2		
256Mb	MX29GL256FHT2I-90Q	S29GL256P10TFI01	56-TSOP	14x20mm
	MX29GL256FLT2I-90Q	S29GL256P10TFI02		
	MX29GL256FUT2I-11G	S29GL256P11TFIV1		
	MX29GL256FDT2I-11G	S29GL256P11TFIV2		
	MX29GL256FHXFI-90Q	S29GL256P10FFI01	64-LFBGA	11x13x14mm 0.6mm ball
	MX29GL256FLXFI-90Q	S29GL256P10FFI02		
	MX29GL256FUXFI-11G	S29GL256P11FFIV1		
	MX29GL256FDXFI-11G	S29GL256P11FFIV2		
512Mb	MX29GL512FHT2I-10Q*[1]	S29GL512P11TFI01	56-TSOP	14x20mm
	MX29GL512FLT2I-10Q*[1]	S29GL512P11TFI02		
	MX29GL512FHXFI-10Q*[1]	S29GL512P11FFI01	64-LFBGA	11x13x14mm 0.6mm ball
	MX29GL512FLXFI-10Q*[1]	S29GL512P11FFI02		
1Gb	MX68GL1G0FHT2I-11G*[1,2]	S29GL01GP12TFI01	56-TSOP	14x20mm
	MX68GL1G0FLT2I-11G*[1,2]	S29GL01GP12TFI02		
	MX68GL1G0FHXFI-11G*[1,2]	S29GL01GP12FFI01	64-LFBGA	11x13x14mm 0.6mm ball
	MX68GL1G0FLXFI-11G*[1,2]	S29GL01GP12FFI02		

Note:

1: MX68GL1G0F and MX29GL512F-10Q are2 dies solution, they're same family as MX29GL_F, and it will use MX29GL_F to present it.

2. MX68GL1G0F performance is based on advance information.

Migrating Spansion S29GL_P to Macronix MX29GL_F

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