Technical Note

Migrating from S29GL-N/P Devices to MT28EW NOR Flash Devices

Introduction

This technical note describes the process for converting a system design for the Spansion S29GL-N and S29GL-P devices to Micron's MT28EW, single-level cell, automotive NOR Flash device, including 512Mb and 1Gb densities.

This document is written based on device information available at publication time. In case of inconsistency, information contained in the relevant MT28EW data sheet supersedes the information in this technical note. This technical note does not provide detailed device information. The standard density specific device data sheet provides a complete description of device functionality, operating modes, and specifications.

Table 1: 512Mb Part Number Comparison

Package Type	Part Number		
	Micron MT28EW	Spansion S29GL-N	Spansion S29GL-P
56-pin TSOP (14mm x 20mm)	MT28EW512ABA1HJS-0AAT	S29GL512NxxTFA01	S29GL512PxxTFA01
		S29GL512NxxTFAV1	S29GL512PxxTFAV1
		–	S29GL512PxxTFAR1
	MT28EW512ABA1LJS-0AAT	S29GL512NxxTFA02	S29GL512PxxTFA02
		S29GL512NxxTFAV2	S29GL512PxxTFAV2
		–	S29GL512PxxTFAR2
64-ball LBGA (11mm x 13mm)	MT28EW512ABA1HPC-0AAT	S29GL512NxxFFA01	S29GL512PxxFFA01
		S29GL512NxxFFAV1	S29GL512PxxFFAV1
		–	S29GL512PxxFFAR1
	MT28EW512ABA1LPC-0AAT	S29GL512NxxFFA02	S29GL512PxxFFA02
		S29GL512NxxFFAV2	S29GL512PxxFFAV2
		–	S29GL512PxxFFAR2

Notes:
1. To integrate line items on a variety of customer applications, the MT28EW device unifies the speed and voltage options.
2. For valid combination details, refer to www.micron.com/products and www.spansion.com.

Table 2: 1Gb Part Number Comparison

Package Type	Part Number	
	Micron MT28EW	Spansion S29GL-P
56-pin TSOP (14mm x 20mm)	MT28EW01GABA1HJS-0AAT	S29GL01GPxxTFA01
		S29GL01GPxxTFAV1
		S29GL01GPxxTFAR1
	MT28EW01GABA1LJS-0AAT	S29GL01GPxxTFA02
		S29GL01GPxxTFAV2
		S29GL01GPxxTFAR2
64-ball LBGA (11mm x 13mm)	MT28EW01GABA1HPC-0AAT	S29GL01GPxxFFA01
		S29GL01GPxxFFAV1
		S29GL01GPxxFFAR1
	MT28EW01GABA1LPC-0AAT	S29GL01GPxxFFA02
		S29GL01GPxxFFAV2
		S29GL01GPxxFFAR2

Notes:
1. To integrate line items on a variety of customer applications, the MT28EW device unifies the speed and voltage options.
2. For valid combination details, refer to www.micron.com/products and www.spansion.com.

Comparative Overview

The MT28EW is compatible with the S29GL-S 512Mb and 1Gb devices, but provides superior program and erase performance.

Table 3: Features Comparison

Feature	Micron MT28EW	Spansion S29GL-N	Spansion S29GL-P	Notes
Process technology	Single–level cell (SLC) floating gate	110nm MirrorBit	90nm MirrorBit	1
Density	512Mb, 1Gb	128Mb, 256Mb, 512M, –	128Mb, 256Mb, 512M, 1Gb	
Package	64-ball LBGA (11mm x 13mm), 56-pin TSOP (14mm x 20mm)	64-ball fortified BGA (LAA064) (11mm x 13mm), 56-pin TSOP (14mm x 20mm)	64-ball fortified BGA (LAA064) (11mm x 13mm), 56-pin TSOP (14mm x 20mm)	
Block architecture	Uniform 128KB	Uniform 128KB	Uniform 128KB	
Data bus	x8/x16	x8/x16	x8/x16	
Page read size	16 words	8 words	8 words	2
Extended memory block	128 words (8 + 120)	128 words (8 + 120)	128 words (8 + 120)	
Program write buffer size	256-byte (x8 mode) 512-word (x16 mode)	16-word	32-word	3
V_{CC} range	2.7V to 3.6V	2.7V to 3.6V	2.7V to 3.6V	
V_{CCQ} range	1.65 to V_{CC}	1.65 to V_{CC}	1.65 to V_{CC}	
V_{PP} accelerated (TYP)	9V	12V	12V	4, 5
CFI version	1.3	1.3	1.3	
High voltage auto select (A9)	No	Yes	Yes	4, 6
Individual block write protection	Yes	Yes	Yes	
Permanent block locking (OTP block)	Yes	Yes	Yes	
Hardware protection	Yes	Yes	Yes	
Unlock bypass	Yes	Yes	Yes	4, 5
Chip erase	Yes	Yes	Yes	
RY/BY# pin	Yes	Yes	Yes	
Blank check	Yes	No	No	7
Multiblock erase	Yes	Yes	Yes	
Data polling	Yes	Yes	Yes	

Table 3: Features Comparison (Continued)

Feature	Micron MT28EW	Spansion S29GL-N	Spansion S29GL-P	Notes
EFI CRC	Yes	No	No	

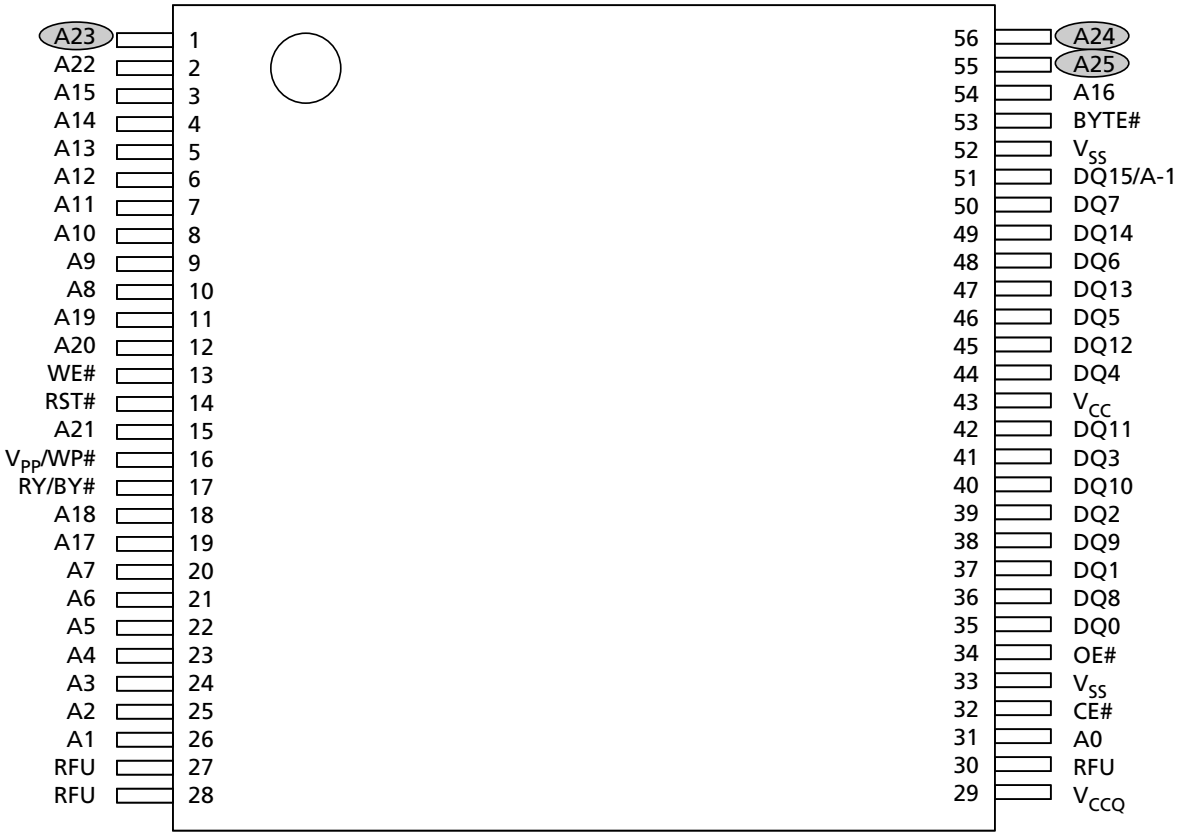
Notes:
1. MT28EW SLC floating-gate technology provides improved performance, optimized quality, and reliability.
2. Although the MT28EW provides a larger program write buffer than S29GL-P or S29GL-N, no software updates are required during migration. However, software updates leveraging the MT28EW device's larger write buffer can yield improved read performance. To configure the MT28EW device's software, query CFI word address 4Ch.
3. The MT28EW features a larger program write buffer than either the S29GL-P or S29GL-N, no software updates are required during migration. However, software up- dates leveraging the MT28EW device's larger write buffer can yield improved performance. To configure the MT28EW device's software, query CFI word address2Ah on the buffer size option, in either x8 or x16 mode(Refer to TN-13-07 for detail patch).
4. To avoid damaging the device, designs applying V_{PP}/WP# voltages higher than 9.5V (MAX) should be modified. V_{PP}/WP# should not remain at V_{PPH} for than 80 hours cumulative.
5. By applying 9V (nominal) to the V_{PP}/WP# pad, the MT28EW device supports V_{PPH} UNLOCK BYPASS, ACCELERATED BUFFERED PROGRAMMING, and ACCELERATED CHIP ERASE operations. In the 56-pin TSOP package, pin 16 should be modified, and in the 64-ball LBGA package, ball B4 should be modified
6. The MT28EW device does not support high-voltage auto select on address A9. Instead, use the following command sequence to enter auto select mode: AAh/55h/90h. Applying 12V to address A9 or V_{PP} may damage the device.
7. Refer to the Micron data sheet for detailed BLANK CHECK command sets.

Hardware and Mechanical Considerations

The MT28EW device is available in 56-pin TSOP and 64-ball LBGA packages, both lead-free.

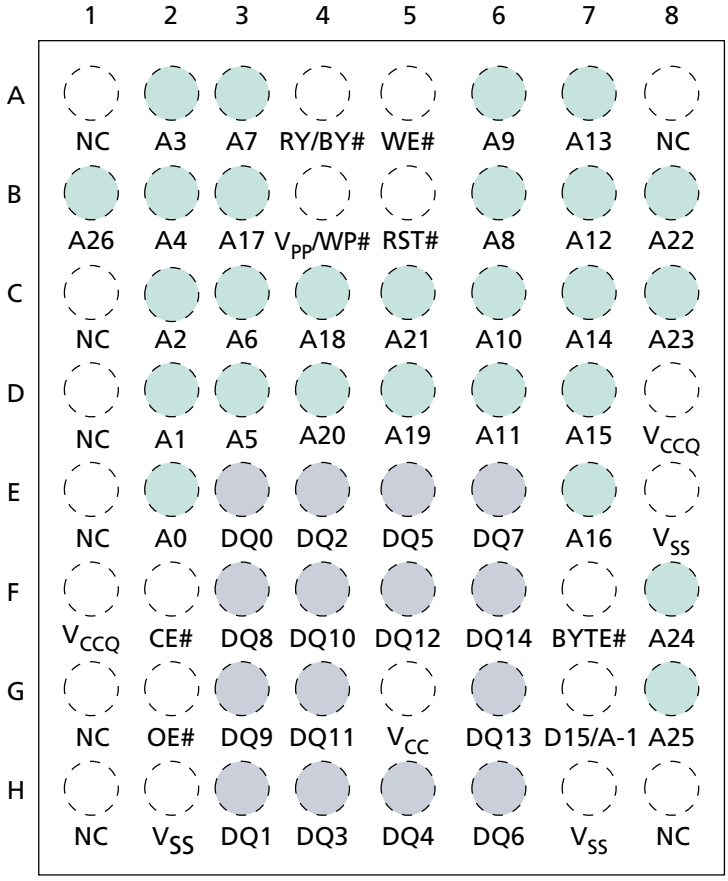
For compatibility, the MT28EW device pin and ball assignments and physical dimensions are equivalent to those in the S29GL-N and S29GL-P devices. Systems migrating from a fortified BGA to an LBGA should not need to modify the reflow process in manufacturing.

Figure 1: 56-Pin TSOP (Top View)



Notes:
1. A-1 is the least significant address bit in x8 mode.
2. A23 is valid for 256Mb and above; otherwise, it is RFU.
3. A24 is valid for 512Mb and above; otherwise, it is RFU.
4. A25 is valid for 1Gb and above; otherwise, it is RFU.

Figure 2: 64-Ball LBGA (Top View – Balls Down)



Notes:
1. A-1 is the least significant address bit in x8 mode.
2. A23 is valid for 256Mb and above; otherwise, it is RFU.
3. A24 is valid for 512Mb and above; otherwise, it is RFU.
4. A25 is valid for 1Gb and above; otherwise, it is RFU.
5. A26 is valid for 2Gb and above; otherwise, it is RFU.

Table 4: Signal Comparison

MT28EW	S29GL-N S29GL-P	Type	Description
A[MAX:0]	A[MAX:0]	Input	Address inputs
BYTE#	BYTE#	Input	Byte/Word (cannot be floated)
CE#	CE#	Input	Chip enable
OE#	OE#	Input	Output enable
RST#	RESET#	Input	Reset
WE#	WE#	Input	Write enable
V_{PP}/WP#	WP#/Acc	Input	V_{PP}/Write Protect
DQ15/A-1	DQ15/A-1	I/O or input	Data I/O or address input

Table 4: Signal Comparison (Continued)

MT28EW	S29GL-N S29GL-P	Type	Description
DQ[14:8]	DQ[14:8]	I/O	Data I/O
DQ[7:0]	DQ[7:0]	I/O	Data I/O
RY/BY#	RY/BY#	Output	Ready/Busy
V_{CC}	V_{CC}	Supply	Supply voltage
V_{CCQ}	V_{IO}	Supply	I/O buffer supply voltage
V_{SS}	V_{SS}	–	Ground
NC	NC	–	No connect

Input/Output Capacitance

Table 5: Input/Output Capacitance Comparison

Parameter	Description	MT28EW		S29GL-N		S29GL-P		Unit
		Min	Max	Typ	Max	Typ	Max	
C_{IN}	Input capacitance	3	11	3.5	9	6	10	pF
C_{OUT}	Output capacitance	3	7	5.4	12	10	12	pF

Note: 1. C_{IN} values for RESET, WP#/A_{CC}, and CE# in Spansion's S29GL-N/S29GL-P devices are likely higher than the listed value.

Power Supply Decoupling

Flash memory devices require careful power supply decoupling to prevent external transient noise from affecting device operations, and to prevent internally generated transient noise from affecting other devices in the system. Ceramic chip capacitors of 0.01µF to 0.1µF should be used between each V_{CC}, V_{CCQ}, and V_{PP} supply connections and system ground. These high-frequency, inherently low-inductance capacitors should be placed as close as possible to the device package, or on the opposite side of the PCB close to the center of the device package footprint.

Larger electrolytic or tantalum bulk capacitors (4.7µF to 33.0µF) should also be distributed as needed throughout the system to compensate for voltage sags and surges caused by circuit trace inductance. Transient current magnitudes depend on the capacitive and inductive loading on the device's outputs. For the best signal integrity and device performance, high-speed design rules should be used when designing the PCB. Final signal reflections (overshoot or undershoot) may vary by each system.

Software Considerations

Micron MT28EW and Spansion S29GL-N/P command sets are compatible. Micron provides some unique commands to support enhanced features such as EFI BLANK CHECK and EFI CRC functions.

Manufacturer ID and Auto Select Comparison

On MT28EW, the only way to use auto select mode is to issue an AUTO SELECT ENTRY (90h) command. The S29GL-N/S29GL-P can use the auto select mode via a high voltage (A9) method.

Micron and Spansion have different manufacturer ID and different protection register indicators. Therefore, a slight modification in the software is required during migration.

Table 6: Auto Select Comparison – Word Mode

Description		Address	MT28EW	S29GL-N	S29GL-P
Manufacturer ID	–	(Base) + 00h	0089h	0001h	0001h
Device ID (cycle 1)	512Mb	(Base) + 01h	227Eh	227Eh	227Eh
	1Gb	(Base) + 0Eh	2223h	2223h	2223h
Device ID (cycle 3)	–	(Base) + 0Fh	2228h	-	2228h
Protection register indicator (V_{PP}/WP# locks highest block)	Factory locked	(Base) + 03h	0099h	0098h	0099h
	Factory unlocked		0019h	0018h	0019h
Protection register indicator (V_{PP}/WP# locks lowest block)	Factory locked		0089h	0088h	0089h
	Factory unlocked		0009h	0008h	0009h
Block protection	Protected	(Base) + 02h	0001h	0001h	0001h
	Unprotected		0000h	0000h	0000h

Unlock Bypass Mode

The use of MT28EW auto select mode (AAh/55h/90h) is not recommended when the device is in unlock bypass mode (AAh/55h/20h). However, auto select mode can be used to read information when the device is in unlock bypass mode. In this case, an additional F0h command must be issued after the AUTO SELECT READ command to return to unlock bypass mode. In addition, a subsequent AUTO SELECT MODE command must be issued to read out correct ID information. This additional command is not required for S29GL-N or S29GL-P. In the following code example, the F0h command is written to any address during the first cycle:

```
FlashWrite(ANY_ADDR, (uCPUBusType)CMD(0x00F0));
```

To access auto select information, use the following command sequence (AAh/55h/90h), but only when the device is not in unlock bypass mode. The following example demonstrates how to use auto select mode to read information from the device:

```
ReturnType ReadAutoSelectCode(uCPUBusType *addr, uCPUBusType
*ucrCode) { /*Send the auto select command */ /* First cycle */
FlashWrite(ConvAddr(0x00555),(uCPUBusType)CMD(0x00AA)); /* Sec-
ond cycle */ FlashWrite(ConvAddr(0x002AA),(uCPUBus-
Type)CMD(0x0055)); /* Third cycle */ FlashWrite(Con-
vAddr(0x00555),(uCPUBusType)CMD(0x0090)); /* Read the code */
*ucrCode = FlashRead(addr); /* Return to read array mode */ /*
First cycle: write 0x00F0 to any address */ FlashWrite(ANY_ADDR,
(uCPUBusType)CMD(0x00F0); /* Check flash response (more flashes
could */ /* give different results) */ return FlashResponseInte-
grityCheck(ucrCode); }
```

EXIT PROTECTION COMMAND SET Command

MT28EW provides three software protection modes: Volatile, nonvolatile, and password protection. The device is shipped with all blocks unprotected. On first use, the device can be activated in either nonvolatile protection mode or password protection mode.

The EXIT PROTECTION COMMAND SET (90/00h) command is used to exit the lock register, password protection, nonvolatile protection, volatile protection, and non-volatile protection bit lock bit command set modes and return the device to read mode.

The MT28EW second command cycle must be 00h. Although the Spansion S29GL-P/N devices specify that the second command cycle has to be 00h, other command codes are accepted to exit the above modes.

CFI Comparison

CFI differences exist between MT28EW and S29GL-P/S29GL-N due to device features and performance characteristics.

Table 7: CFI Comparison

Address	Description		MT28EW	S29GL-N	S29GL-P
1Dh	V_{PPH} (programming) supply minimum program/erase voltage		0085h	0000h	0000h
	Bits[7:4] hex value in volts				
	Bits[3:0] BCD value in 100mV				
1Eh	V_{PPH} (programming) supply maximum program/erase voltage		0095h	0000h	0000h
	Bits[7:4] hex value in volts				
	Bits[3:0] BCD value in 10mV				
1Fh	Typical timeout for single byte/word program = 2^Nµs		0005h	0007h	0006h
20h[1]	Typical timeout for maximum-size buffer program = 2^Nµs		0009h	0007h	0006h
21h	Typical timeout for individual block erase = 2^Nµs		0008h	000Ah	0009h
22h	Typical timeout for full-chip erase = 2^Nµs	512Mb	0011h	0000h	0012h
		1Gb	0012h	N/A	0013h
23h	Maximum timeout for byte/word program = 2^N times typical		0003h	0003h	0003h
24h	Maximum timeout for buffer program = 2^N times typical		0002h	0005h	0005h
25h	Maximum timeout for individual block erase = 2^N times typical		0002h	0004h	0003h
26h	Maximum timeout for chip erase = 2^N times typical		0003h	0000h	0002h
2Ah	Maximum number of bytes in multiple byte write = 2^N	x8	08h	0005h	0006h
		x16	000Ah		
45h	Address sensitive unlock (bits[1:0])		001Ch	0010h	0014h
	0 = Required, 1 = Not required				
	Silicon revision number (bits[7:2])				
4Ch	Page mode		0003h	0002h	0002h
	00 = Not supported				
	01 = 4-word page				
	02 = 8-word page				
	03 = 16-word page				
4Dh	V_{PPH} supply minimum program/erase voltage		0085h	00B5h	00B5h
	Bits[7:4] hex value in volts				
	Bits[3:0] BCD value in 100mV				

Table 7: CFI Comparison (Continued)

Address	Description	MT28EW	S29GL-N	S29GL-P
4Eh	V_{PPH} supply maximum program/erase voltage	0095h	00C5h	00C5h
	Bits[7:4] hex value in volts			
	Bits[3:0] BCD value in 10mV			

Note: 1. Spansion GL-P/N define this value as a minimum instead of a maximum; that is, the typical timeout for a minimum size buffer write = 2^nµs.

Performance Comparison

Table 8: Program and Erase Performance Comparison – Word Mode

Parameter		MT28EW		S29GL-N		S29GL-P		Unit
		Typ	Max	Typ	Max	Typ	Max	
Block erase		200	1100	500	3500	500	3500	ms
Chip erase	512Mb	104	–	256	1024	256	1024	s
	1Gb	208	–	–	–	512	2048	
Accelerated chip erase	512Mb	95	–	–	–	–	–	
Erase suspend latency time		–	20	5	20	5	20	µs
Program suspend latency time		–	15	5	15	5	15	µs
Single word program		25	200	60	–	60	480	µs
Write-to-buffer	16 words	50	–	240	–	–	–	µs
	32 words	92	460	–	–	480	–	
	64 words	117	600	–	–	–	–	
	128 words	171	900	–	–	–	–	
	256 words	285	1500	–	–	–	–	
	512 words	512	2000	–	–	–	–	
Accelerated full buffered program		410	–	200	–	432	–	µs

Table 9: Read AC Performance Comparison – 3V

Note 1 applies to entire table

Parameter	Symbol		MT28EW		S29GL-N		S29GL-P		Unit
	Legacy	JEDEC	Min	Max	Min	Max	Min	Max	
Address valid to output valid	^{t}ACC	^{t}AVQV	–	105	–	90/110	–	100/120	ns
Page address access	^{t}PAGE	^{t}AVQV1	–	25	–	25	–	25	ns
OE# LOW to output valid	^{t}OE	^{t}GLQV	–	25	–	25	–	25	ns

Note: 1. For MT28EW, access times applies to –40°C/105°C automotive temperature range. For Spansion GL-N/GL-P applies to standard temperature range.

Table 10: Power Consumption Comparison

Parameter		Symbol	MT28EW		S29GL-N		S29GL-P		Unit
			Typ	Max	Min	Max	Min	Max	
V_{CC} random read current		I_{CC1}	26	31	30	50	30	55	mA
V_{CC} page read current			12	16	1	10	1	10	
V_{CC} standby current	512Mb	I_{CC2}	70	200	1	5	1	5	µA
	1Gb		75	230	1	5	1	5	
V_{CC} erase current		I_{CC3}	35	50	50	90	50	90	mA
V_{CC} program current			35	50	50	90	50	90	

Power-on and Reset Timings

Table 11: Reset Timing Comparison

Parameter	Symbol		MT28EW		S29GL-N		S29GL-P		Unit
	Legacy	JEDEC	Min	Max	Min	Max	Min	Max	
V_{CC} power valid to RST# HIGH	^{t}VCS	^{t}VCHPH	300	–	50	–	35	–	µs
RST# LOW to read mode during program or erase	^{t}READY	^{t}PLRH	–	25	–	20	–	35	µs
RST# pulse width	^{t}RP	^{t}PLPH	100	–	500	–	3500	–	ns
RST# HIGH to CE# LOW, OE# LOW	^{t}RH	^{t}PHEL, ^{t}PHGL	50	–	50	–	200	–	ns
RY/BY# HIGH to CE# LOW, OE# LOW	^{t}RB	^{t}RHEL, ^{t}RHGL	0	–	0	–	0	–	ns

Revision History

Rev. A – 12/14

- Initial release

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