Technical Note

Migrating from S29GL-S Devices to MT28FW NOR Flash Devices

Introduction

This technical note describes the process for converting a system design for the Spansion S29GL-S device to a system design for the Micron MT28FW single-level cell 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 MT28FW 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.

Comparative Overview

The MT28FW is compatible with the S29GL-S 512Mb and 1Gb devices, but provides superior program and erase performance.

Table 1: Part Number Comparison

Package Type	Density	Part Number		Notes
		Micron MT28FW	Spansion S29GL-S	
56-pin TSOP (14mm x 20mm)	512Mb	MT28FW512ABA1HJS-0AAT	S29GL512SxxTxVx1x	
		MT28FW512ABA1LJS-0AAT	S29GL512SxxTxVx2x	
	1Gb	MT28FW01GABA1HJS-0AAT	S29GL01GSxxTxVx1x	
		MT28FW01GABA1LJS-0AAT	S29GL01GSxxTxVx2x	
64-ball LBGA (11mm x 13mm)	512Mb	MT28FW512ABA1HPC-0AAT	S29GL512SxxFxVx1x S29GL512SxxDxVx1x	4
		MT28FW512ABA1LPC-0AAT	S29GL512SxxFxVx2x S29GL512SxxDxVx2x	4
	1Gb	MT28FW01GABA1HPC-0AAT	S29GL01GSxxFxVx1x S29GL01GSxxDxVx1x	4
		MT28FW01GABA1LPC-0AAT	S29GL01GSxxFxVx2x S29GL01GSxxDxVx2x	4
56-ball VFBGA (7mm x 9mm)	512Mb	MT28FW512ABA1HPN-0AAT	S29GL512SxxGxVx1x	
		MT28FW512ABA1LPN-0AAT	S29GL512SxxGxVx2x	

Notes:
1. To integrate line items on a variety of customer applications, the MT28FW device unifies the speed and voltage options.
2. For valid combination details, refer to www.micron.com/products and www.spansion.com.
3. All Micron materials support the temperature range –40°C to +105°C (Grade 2 AEC–Q100).
4. Spansion part number assembled in Fortified Ball-Grid Array Package (LAE064, 9mm x 9mm) has the same ball assignment as suggested by Micron part number, but is different in package dimensions.

Table 2: Features Comparison

Feature	Micron MT28FW	Spansion S29GL-S	Notes
Density	512Mb, 1Gb	512M, 1Gb	1
Package	64-ball LBGA (11mm x 13mm), 56-pin TSOP (14mm x 20mm), 56-ball VFBGA (VBU056) (7mm x 9mm)	64-ball fortified BGA (LAA064) (11mm x 13mm), 64-ball fortified BGA (LAE064) (9mm x 9mm), 56-pin TSOP (14mm x 20mm), 56-ball fortified BGA (VBU056) (9mm x 7mm)	–
Ambient operating temperature	–40°C to +105°C	–40°C to +105°C (In-Cabin)	–

Table 2: Features Comparison (Continued)

Feature	Micron MT28FW	Spansion S29GL-S	Notes
Block architecture	Uniform 128KB	Uniform 128KB	–
Data bus	x16	x16	–
Page read size	16 words	16 words	–
Extended memory block	512 words (8 + 504)	512 words (256 × 2)	–
Program write buffer size	512 words	256 words	2
V_{CC} range	2.7V to 3.6V	2.7V to 3.6V	–
V_{CCQ} range	1.65 to V_{CC}	1.65 to V_{CC}	–
V_{PP} accelerated (TYP)	9V	No	3
CFI version	1.5	1.5	–
High voltage auto select (A9)	No	No	4
Individual block write protection	Yes	Yes	–
Permanent block locking (OTP block)	Yes	Yes	–
Hardware protection	Yes	Yes	–
Unlock bypass	Yes	No	3
Chip erase	Yes	Yes	–
RY/BY# pin	Yes	Yes	–
Blank check	Yes	Yes	–
Single word program	Yes	Disabled in range –40°C to +105°C (In-Cabin)	5
Data polling	Yes	Yes	–
Read/Clear Status Register (by command)	Yes	Yes	–
Lock register	Yes	Yes	6
EFI CRC	Yes	No	–

Notes:
1. For the MT28FW 1Gb density, the VFBGA package is not available.
2. Although the MT28FW provides a larger program write buffer than S29GL-S, no software updates are required during migration. However, software updates leveraging the MT28FW device's larger write buffer can yield improved performance.
3. The MT28FW device supports V_{PPH} unlock bypass, accelerated buffered programming, and accelerated chip erase operations, all by applying 9V (nominal) to the V_{PP}/WP# pad. To prevent 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 more than 80 hours cumulative. On the 56-pin TSOP package, pin 16 should be modified; on the 64-ball LBGA package, ball B4 should be modified; on the 56-ball VFBGA package, ball A4 should be modified.
4. The MT28FW 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. To prevent damaging the device, designs applying V_{PP} voltages higher than 9.5V should be modified.

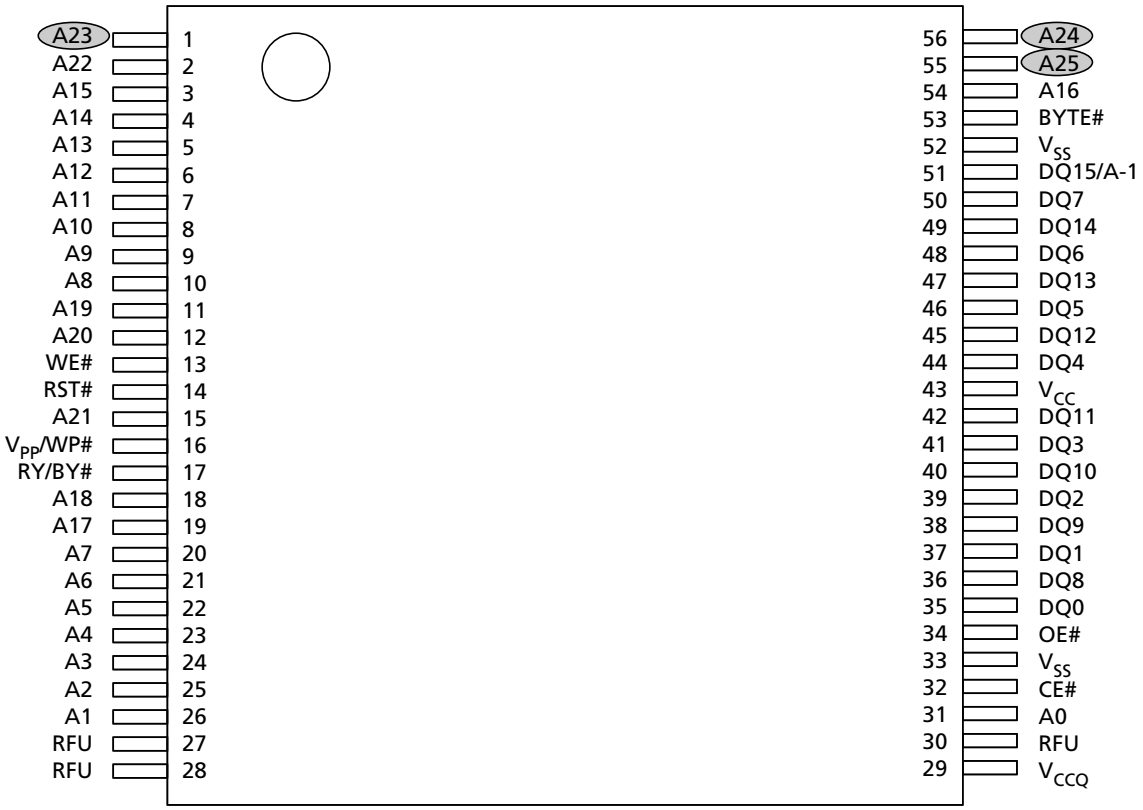
5. For the In-Cabin version (–40°C to +105°C), the S29GL-S device supports only one programming operation on each 16-word page between erase operations, and single word programming is not supported.
6. Some MT28FW device lock register bit meanings differ from those in the S29GL-S device.

Hardware and Mechanical Considerations

The MT28FW device is available in 56-pin TSOP and 64-ball LBGA packages, both lead-free. The MT28FW 512Mb device is also available in 56-ball VFBGA package lead-free.

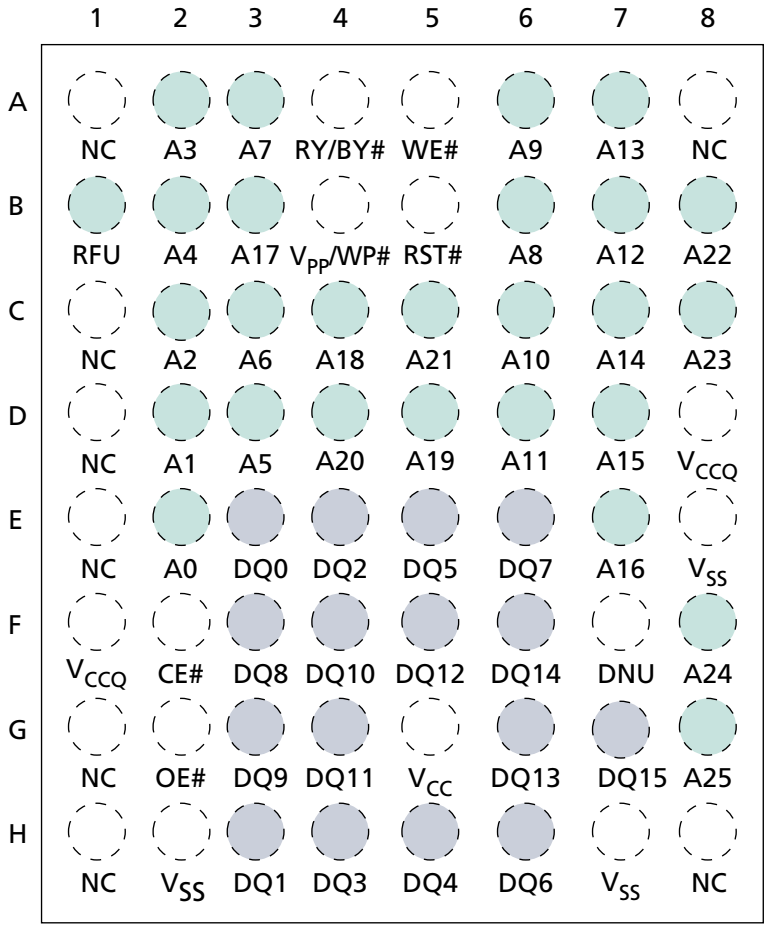
For compatibility, the MT28FW device pin and ball assignments and physical dimensions are equivalent to those in the S29GL-S device. Systems migrating from a fortified BGA to an LBGA should not need to modify the reflow process in manufacturing.

Figure 1: 56-Pin TSOP (Top View)



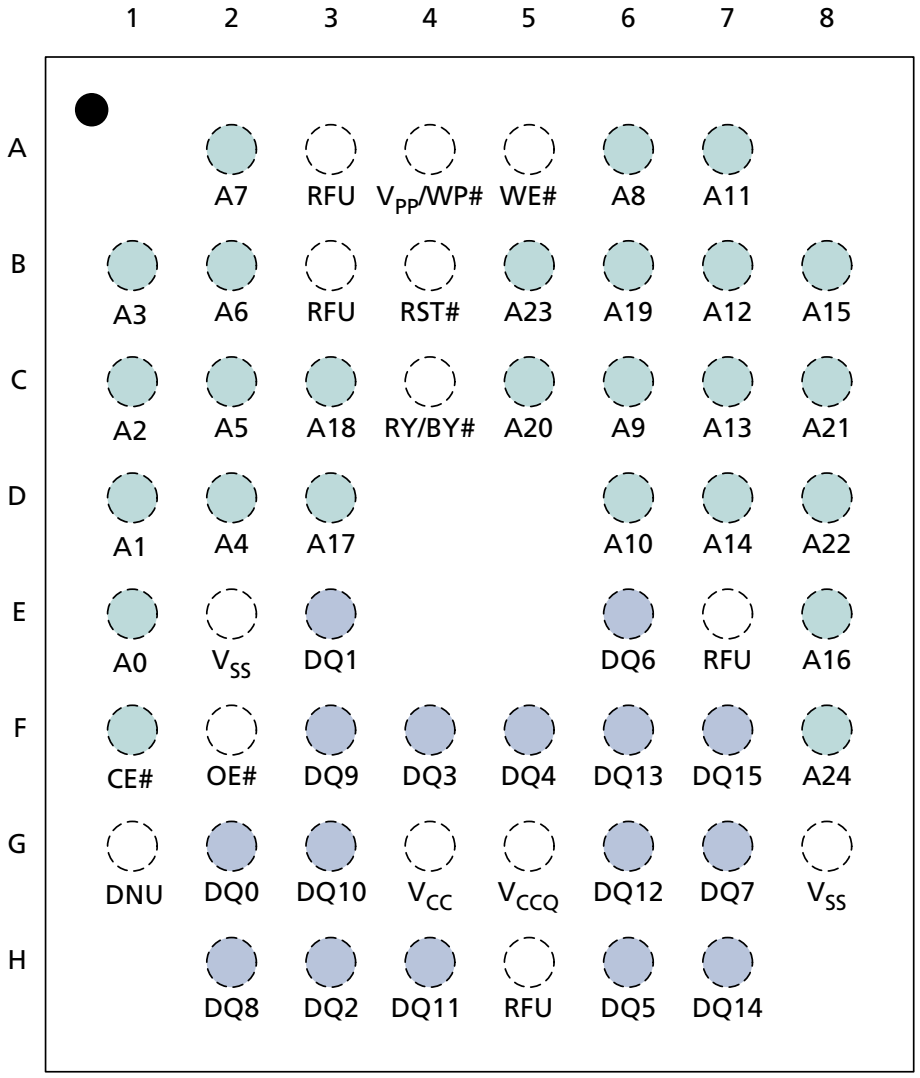
Notes:
1. A23 is valid for 256Mb and above; otherwise, it is RFU.
2. A24 is valid for 512Mb and above; otherwise, it is RFU.
3. A25 is valid for 1Gb and above; otherwise, it is RFU.

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



Notes:
1. A23 is valid for 256Mb and above; otherwise, it is RFU.
2. A24 is valid for 512Mb and above; otherwise, it is RFU.
3. A25 is valid for 1Gb and above; otherwise, it is RFU.

Figure 3: 56-Ball VFBGA (Top View – Balls Down)



Notes: 1. A23 is valid for 256Mb and above; otherwise, it is RFU.
2. A24 is valid for 512Mb and above; otherwise, it is RFU.

Table 3: Signal Comparison

Description	Type	MT28FW	S29GL-S	Notes
Address inputs	Input	A[MAX:0]	A[MAX:0]	–
Chip enable	Input	CE#	CE#	–
Output enable	Input	OE#	OE#	–
Reset	Input	RST#	RESET#	–
Write enable	Input	WE#	WE#	–
V_{PP}/Write Protect	Input	V_{PP}/WP#	WP#	1

Table 3: Signal Comparison (Continued)

Description	Type	MT28FW	S29GL-S	Notes
Data inputs/outputs	I/O	DQ[15:0]	DQ[15:0]	–
Ready/Busy	Output	RY/BY#	RY/BY#	–
Supply voltage	Supply	V_{CC}	V_{CC}	–
Input/Output buffer supply voltage	Supply	V_{CCQ}	V_{IO}	–
Ground	–	V_{SS}	V_{SS}	–
No connect	–	NC	NC	–
Reserved for future use	–	RFU	RFU	–
Do not use	–	DNU	DNU	–

Note: 1. MT28FW device: Acceleration power/write protect input; S29GL-S device: Write protect input

Input/Output Capacitance

Table 4: Input/Output Capacitance Comparison

Parameter	Description	MT28FW		S29GL-S FBGA		S29GL-S TSOP		Unit
		Min	Max	Typ	Max	Typ	Max	
C_{IN}	Input capacitance	3	11	8	9	7	8	pF
C_{OUT}	Output capacitance	3	7	5	7	5	6	pF
C_{IN2}	Control Input Capacitance	3	11	4	8	3	7	pF
RY/BY#	Output Capacitance	3	7	3	4	3	4	pF

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 printed circuit board 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 printed-circuit board.

Software Considerations

Command Set

MT28FW and S29GL-S command sets are compatible. Micron provides some unique commands to support enhanced features such as UNLOCK BYPASS and EFI CRC functions.

Manufacturer ID and Auto Select Comparison

On the MT28FW, the only way to use auto select mode is to issue an AUTO SELECT ENTRY (90h) command. Micron and Spansion have different manufacturer ID and different protection register indicators. Therefore, a slight modification in the software is required during migration.

Table 5: Auto Select Comparison

Description		Address	MT28FW		S29GL-S		Note
Manufacturer ID		(Base) + 00h	0089h		0001h		–
Device ID (cycle 1)		(Base) + 01h	227Eh		227Eh		–
Device ID (cycle 2)	512Mb	(Base) + 0Eh	2223h		2223h		–
	1Gb		2228h		2228h		–
Device ID (cycle 3)		(Base) + 0Fh	2201h		2201h		–
Protection register indicator (V_{PP}/WP# locks highest block)		(Base) + 03h	0099h	Factory locked	FFFFh	Factory locked/ Customer locked	1
			0019h	Factory unlocked	FF3Fh	Factory unlocked/ Customer unlocked	1
Protection register indicator (V_{PP}/WP# locks lowest block)			0089h	Factory locked	FFEFh	Factory locked/ Customer locked	1
			0009h	Factory unlocked	FF2Fh	Factory unlocked/ Customer unlocked	1
Block protection	Protected	(Block) + 02h	0001h		0001h		–
	Unprotected		0000h		0000h		–

Note: 1. S29GL-S has two 256-word OTP regions: Factory lockable and customer lockable.

Unlock Bypass Mode

In unlock bypass mode on the MT28FW, the use of auto select mode is not recommended. If AAh/55h/90h is used to read information under unlock bypass mode, an additional F0h command must be issued after AUTO SELECT READ to return to unlock bypass mode. S29GL-S does not support unlock bypass mode.

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));
/* Second cycle */
FlashWrite(ConvAddr(0x002AA),(uCPUBusType)CMD(0x0055));
/* Third cycle */
FlashWrite(ConvAddr(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 FlashResponseIntegrityCheck(ucrCode);
}
```

Extended Memory Block and Secure Silicon Region

Table 6: MT28FW Extended Memory Block Address and Data

Address Range	Data	
	Micron Prelocked	Customer Lockable
000000h to 000007h	Secure ID number	Determined by customer (default)
000008h to 0001FFh	Protected and unavailable	

Note: 1. MT28FW has one extra 512-word extended memory block.

Table 7: S29GL-S Secure Silicon Region

Address Range	Data	Size
0000h to 00FFh	Factory locked secure silicon region	256 words
0100h to 01FFh	Customer locked secure silicon region	256 words

Note: 1. S29GL-S has two extra 256-word secure silicon regions (SSR).

Exit Protection Command

In MT28FW device, the EXIT PROTECTION COMMAND SET (90/00h) command is used to exit the lock register, password protection, nonvolatile protection, volatile protection, and nonvolatile protection bit lock bit command set modes and return the device to read mode. The READ/RESET command (F0h) will be ignored under these modes.

Lock Register

Table 8: Lock Register Bit Definitions

Bit	MT28FW		S29GL-S	
	Name	Default Setting	Name	Default Setting
DQ[15:9]	Reserved	1	Reserved	1
DQ8	Reserved	0	Reserved	0
DQ7	Reserved	1	Reserved	X
DQ6	Reserved	1	SSR region 1 (Customer) lock bit	1
DQ[5:3]	Reserved	1	Reserved	1
DQ2	Password protection mode lock bit	1	Password protection mode lock bit	1
DQ1	Nonvolatile protection mode lock bit	1	Persistent protection mode lock bit	1
DQ0	Extended memory block protection bit	1	SSR region 0 (Factory) lock bit	0

Note: 1. MT28FW and S29GL-S have different lock register structure: X = "Don't Care."

Read Password

The READ PASSWORD command is used to verify the password used in password protection mode. The complete command sequence must be entered four times at four consecutive addresses selected by A[1:0].

When the MT28FW password mode lock bit is programmed and an attempt is made to read the password, the device will output 00h onto the I/O data bus; the S29GL-S device will output FFh onto the I/O data bus.

CFI Comparison

CFI differences exist between MT28FW and S29GL-S due to device features and performance characteristics.

Table 9: CFI Comparison

Address	Description	MT28FW	S29GL-S
1Dh	V_{PPH} (programming) supply minimum program/erase voltage Bits[7:4] hex value in volts Bits[3:0] BCD value in 100mV	0085h	0000h
1Eh	V_{PPH} (programming) supply maximum program/erase voltage Bits[7:4] hex value in volts Bits[3:0] BCD value in 10mV	0095h	0000h
1Fh	Typical timeout for single byte/word program = 2^Nµs	0005h	0008h
23h	Maximum timeout for byte/word program = 2^N times typical	0003h	0001h
25h	Maximum timeout for individual block erase = 2^N times typical	0002h	0003h
2Ah	Maximum number of bytes in multi-byte program or page = 2^N	000Ah	0009h
4Dh	V_{PPH} supply minimum program/erase voltage	0085h	0000h

Table 9: CFI Comparison (Continued)

Address	Description	MT28FW	S29GL-S
	Bits[7:4] hex value in volts Bits[3:0] BCD value in 100mV		
4Eh	V_{PPH} supply maximum program/erase voltage Bits[7:4] hex value in volts Bits[3:0] BCD value in 10mV	0095h	0000h
51h	Unlock bypass 00 = Not supported 01 = Supported	0001h	0000h
52h	EXTENDED MEMORY BLOCK (Customer OTP area) size 2^N bytes	000Ah	0009h
55h	Erase suspend timeout maximum < 2^Nµs	0005h	0006h
56h	Program suspend timeout maximum < 2^Nµs	0004h	0006h
78h	tPLRH maximum < 2^Nµs Reset with reset pin	0005h	0006h

Performance Comparison

Table 10: Program and Erase Performance Comparison

Parameter		MT28FW		S29GL-S		Unit	Note
		Typ	Max	Typ	Max		
Block erase		200	1100	275	1100	ms	
Chip erase	512Mb	104	–	–	–	s	
	1Gb	208	–	–	–		
Accelerated chip erase	512Mb	95	–	–	–		
	1Gb	190	–	–	–		
Erase suspend latency time		15	20	–	50	µs	
Program suspend latency time		10	15	–	50	µs	
Single byte/word program		25	200	–	–	µs	2
Write-to-buffer	16 words	50	–	200	1050	µs	
	32 words	92	460	220	1050		
	64 words	117	600	250	1050		
	128 words	171	900	320	1050		
	256 words	285	1500	420	1050		
	512 words	512	2000	–	–		
Accelerated full buffered program		410	–	–	–	µs	
Blank check: main block		–	3.2	7.6	9.0	ms	

Notes: 1. Temperature range for the S29GL-S device is –40°C to +105°C (In-Cabine).

2. For the In-Cabin version (–40°C to +105°C) the S29GL-S device will only support one programming operation on each 16-word page between erase operations, and single word programming is not supported.

Table 11: Read AC Performance Comparison – 3V

Parameter	Symbol		MT28FW		S29GL-S		Unit	Note
	Legacy	JEDEC	Min	Max	Min	Max		
Address valid to output valid	^{t}ACC	^{t}AVQV	–	105	–	110/120	ns	1
Page address access	^{t}PAGE	^{t}AVQV1	–	25	–	25/30	ns	1
OE# LOW to output valid	^{t}OE	^{t}GLQV	–	25	–	25	ns	

Note: 1. S29GL-S device has different speed options.

Table 12: Power Consumption Comparison

Parameter		Symbol	MT28FW		S29GL-S		Unit
			Typ	Max	Typ	Max	
V_{CC} random read current		I_{CC1}	26	31	55	60	mA
V_{CC} page read current			12	16	9	25	
V_{CC} standby current	512Mb	I_{CC2}	70	200	70	200	µA
	1Gb		75	220	70	200	
V_{CC} erase current		I_{CC3}	35	50	45	100	mA
V_{CC} program current			35	50	45	100	

Power-on and Reset Timings

Because many common processors support the MT28FW timings, there should be no adverse effects from timing differences.

Table 13: Reset Timing Comparison

Parameter	Symbol		MT28FW		S29GL-S		Unit
	Legacy	JEDEC	Min	Max	Min	Max	
V_{CC} power valid to RST# HIGH	^{t}VCS	^{t}VCHPH	300	–	300	–	µs
RST# LOW to read mode during program or erase	^{t}READY	^{t}PLRH	–	25	–	35	µs
RST# pulse width	^{t}RP	^{t}PLPH	100	–	200	–	ns
RST# HIGH to CE# LOW, OE# LOW	^{t}RH	^{t}PHEL, ^{t}PHGL	50	–	50	–	ns
RY/BY# HIGH to CE# LOW, OE# LOW	^{t}RB	^{t}RHEL, ^{t}RHGL	0	–	0	–	ns

Related Information

Table 14: Document List

Document/Tool
Parallel NOR Flash Automotive Memory MT28FW datasheet (all densities)
S29GL_128S_01GS_00: SPANSION® MirrorBit® Eclipse™ Flash Non-Volatile Memory Family S29GL-S 1-Gbit, 512-Mbit, 256-Mbit, 128-Mbit CMOS 3.0 Volt Core with Versatile I/O datasheet

Notes:
1. Contact your local Micron or distribution sales office to request additional documentation.
2. Visit www.micron.com for technical documentation.

Revision History

Rev. B – 11/14

- Updated Part Number Comparison table in Comparative Overview
- Updated Features Comparison table in Comparative Overview
- Updated ballout of 64-Ball LBGA
- Updated Input/Output Capacitance Comparison table in Hardware and Mechanical Considerations
- Updated CFI Comparison table in CFI Comparison
- Updated Program and Erase Performance Comparison table in Performance Comparison
- Updated Read AC Performance Comparison table in Power-on and Reset Timings
- Updated Power Consumption Comparison table in Power-on and Reset Timings

Rev. A – 10/14

- Initial release

8000 S. Federal Way, P.O. Box 6, Boise, ID 83707-0006, Tel: 208-368-4000
www.micron.com/products/support Sales inquiries: 800-932-4992