



AN309010

Migration Guide

How to Migrate to Numonyx M29W320E from Spansion* S29GL032N Flash Memory

The objective of this application note is to explain how to migrate an application based on the S29GL032N Flash memory to an M29W320E Flash memory. The purpose of this document is not to provide detailed information on the devices, but to highlight the similarities and differences between them. The comparison takes into consideration the signal descriptions, packages, architecture, software command set, performance, and block protections.

Introduction

The Numonyx M29W320E memory, manufactured on the mature 110nm technology, is ideal for all applications needing a reliable (min 100,000 cycles, 20 years data retention), fast, parallel NOR device (available in 70ns). More than 360 million devices¹ shipped worldwide on this technology.

Using the industry standard command set, the M29W320E can replace many competitors' parts such as the Spansion S29GL032N. Customers that value reliability will benefit from using the M29W320E based on single level cell, floating gate technology (100,000 cycles, 20 years retention minimum) compared to the S29GL016A based on MirrorBit technology (100,000 cycles, 20 years typical). M29W320E is offered in –40 °C to 85 °C, industrial temperature range. The version in –40° °C to 125 °C extended temperature range and related automotive compliance is called M29W320F, please refer to separate datasheet and contact your local sales for availability of your preferred combination. M29W320E and M29W320F are processed on the same technology and have equivalent timing. The compatibility with Spansion S29GL032N in most of the cases should be compared to the M29W320E. The option S29GL032Nxx 01,02 (Uniform with TSOP56) may be challenging, but not impossible, to be replaced with M29W320E. Please inquire with your sales office for further support.

In this document, the S29GL032N, top and bottom boot block, (03 and 04 models), will be referred to as S29GL032N, and the M29W320ET (top boot block) and the M29W320EB (bottom boot block) will be referred to as M29W320E unless otherwise specified.

Please refer to the S29GL032N and M29W320E datasheets for additional information on devices.

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Memory architecture and protection groups

The S29GL032N comes in uniform and boot block architectures. The uniform versions have 64 blocks of 32 Kwords (64 Kbytes) each. The boot block versions have 63 main blocks of 32 Kwords (64 Kbytes) each, and 8 boot blocks of 4 Kwords (8 Kbytes) each. M29W320E is only available in a boot block architecture.

Both devices have an extended memory block. The S29GL032N has a block size of 128 words in x 16 mode or of 256 bytes in x 8 mode. The M29W320E has a block size of 32 Kwords in x16 mode and 16 Kbytes in x8 mode.

Hardware migration

This section provides a detailed comparison between S29GL032N and M29W320E signals and package pin-out.

Signal Descriptions

[Table 1](#) gives a comparison between the S29GL032N and M29W320E signals.

On the M29W320E devices, applying 12 V to the V_{PP}/\overline{WP} pin will temporarily unprotect any block previously protected (including the two outermost blocks). However, the WP/ACC pin can be left floating or unconnected on S29GL032N, while V_{PP}/\overline{WP} can't be left floating or unconnected on M29W320E.

Table 1: Signal description for the S29GL032N and M29W320E devices

Name		Description	Direction
S29GL032N	M29W320E		
A0-A20		Address inputs	Inputs
DQ0-DQ7		Data inputs/outputs	I/O
DQ8-DQ14		Data inputs/outputs	I/O
DQ15A-1 (or DQ15)		Data input/output or address input (or data input/output)	I/O
CE#	\overline{E}	Chip Enable	Input
OE#	\overline{G}	Output Enable	Input
WE#	\overline{W}	Write Enable	Input
RESET#	\overline{RP}	Reset/Block Temporary Unprotect	Input
RY/BY#	\overline{RB}	Ready/Busy output	Output
BYTE#		Byte/word organization select	Input
V_{CC}		Supply voltage	Supply
WP#/ACC	V_{PP}/\overline{WP}	Supply voltage for fast program (optional) or write	Input
V_{SS}		Ground	—

Packages

The S29GL032N and M29W320E are delivered in TSOP48 – 12 x 20 mm and TFBGA48 – 6 x 8 mm, 0.8 mm pitch packages. Compared with S29GL032N, the package size of M29W320E TFBGA48 is smaller than that of S29GL032N VBK48 – 6.15 x 8.15mm. In addition, M29W320E holds a different BGA ball size from what S29GL032N does. The BGA ball size of M29W320E ranges from 0.35mm to 0.45mm while the BGA ball size of S29GL032N ranges from 0.35mm to 0.43mm.

The M29W320E is fully pin-to-pin compatible with the S29GL032N. See Figure 1 and Figure 2, in conjunction with Table 1.

Refer to the S29GL032N and M29W320E datasheets for details on the packages.

Figure 1 S29GL032N TSOP48 connections

Figure 2 M29W320E TSOP48 connections

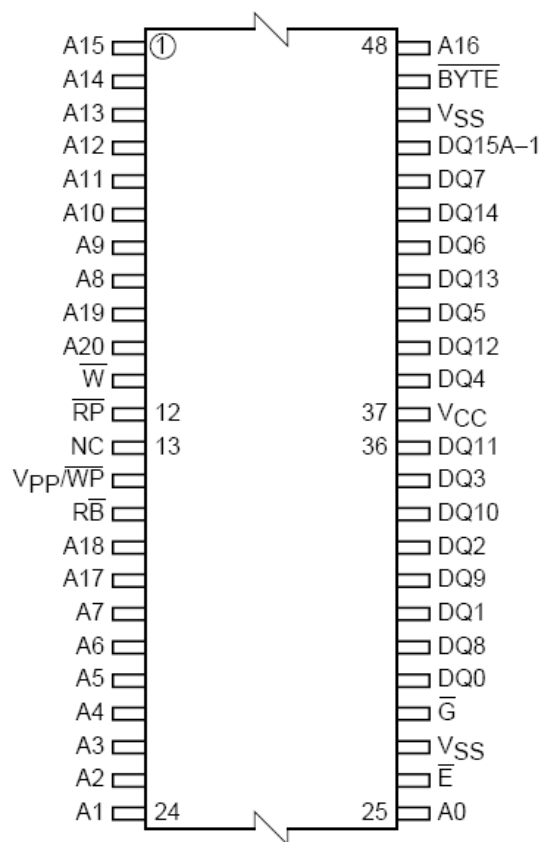
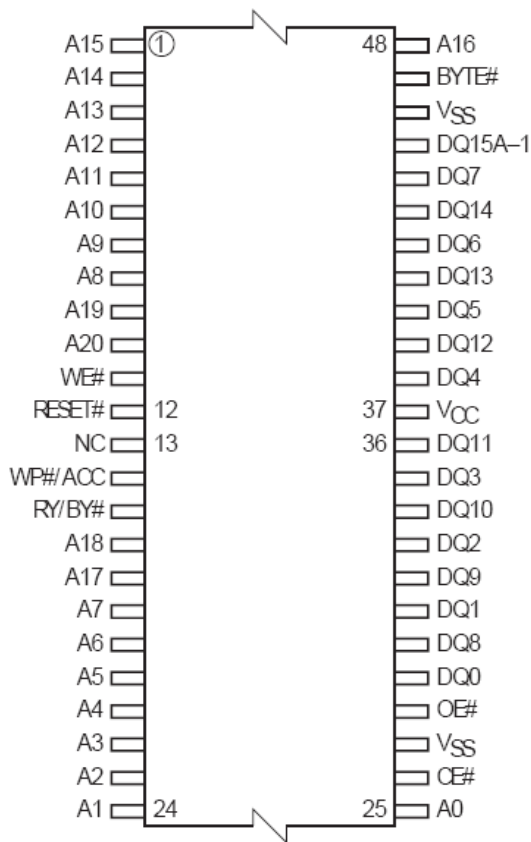
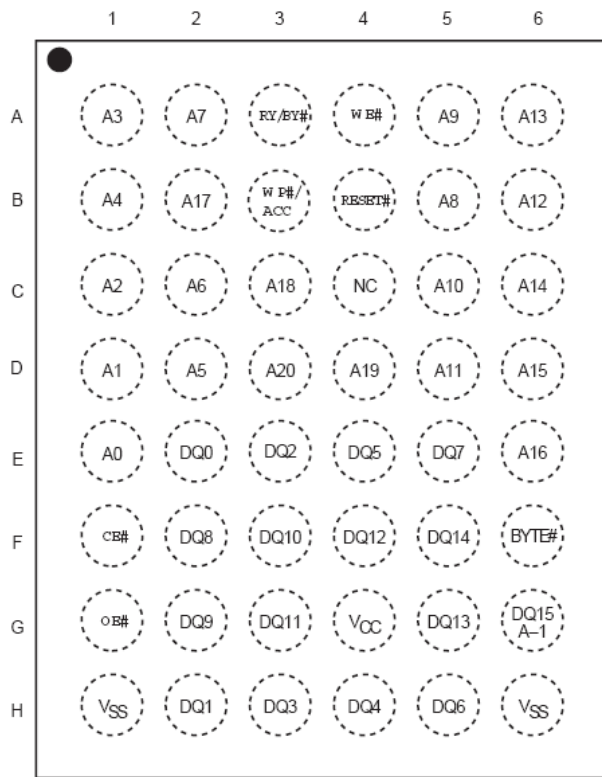
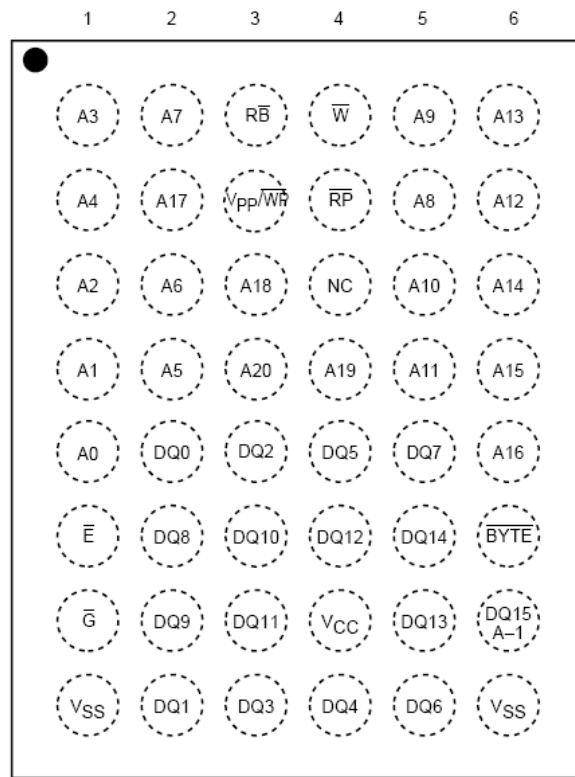


Figure 3 S29GL032N VBK048 connections



VBK048 dimensions are 6.15 mm x 8.15 mm

Figure 4 M29W320E TFBGA48 connections



TFBGA48 dimensions are 6 mm x 8 mm

Figure 5 S29GL032N VBK064 connections

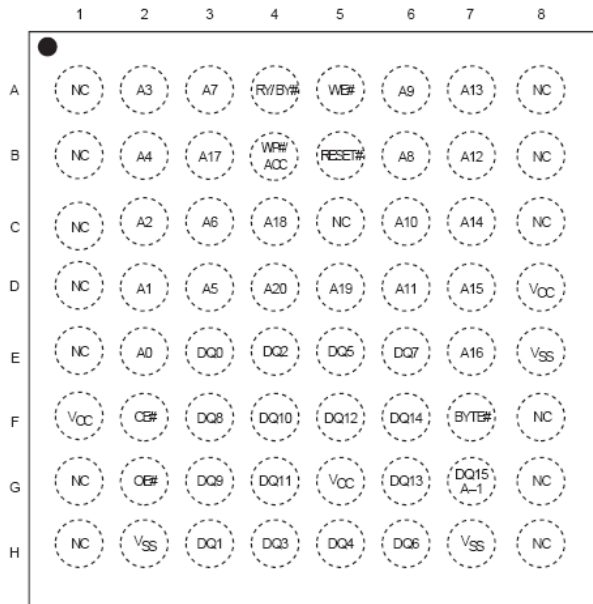
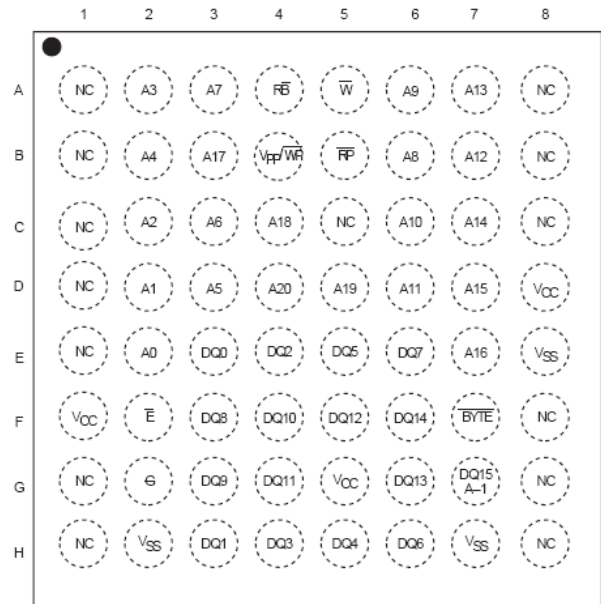


Figure 6 M29W320E TFBGA64 connections



Software command set

The S29GL032N and M29W320E feature an identical set of standard commands. The commands are compliant with the JEDEC standard.

Table 2: Software commands for the S29GL032N and M29W320E devices

Command	S29GL032N	M29W320E
Read/Reset	✓	✓
Auto Select	✓	✓
Program	✓	✓
Write Buffer	✓	-
Unlock Bypass	✓	✓
Unlock Bypass Program	✓	✓
Unlock Bypass Reset	✓	✓
Chip Erase	✓	✓
Block Erase	✓	✓
Program/Erase Suspend	✓	✓
Program/Erase Resume	✓	✓
Page Read	✓	-
Read CFI Query	✓	✓
Enter Extended Block	✓	✓
Exit Extended Block	✓	✓
Double Word Program	-	✓
Quadruple Byte Program	-	✓

Fast program commands

The S29GL032N and the M29W320E devices both feature fast program commands. S29GL032N has a 16 word write buffer. M29W320E has the capability to program 2 words, or 4 bytes at once to improve throughput.

Table 3: M29W320E fast program commands (16-bit mode)

Command	Length	Bus write operations ⁽¹⁾											
		1st		2nd		3rd		4th		5th		6th	
		Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data
Double word Program	3	555	50	PA0	PD0	PA1	PD1						

1. X Don't care, PA Program Address, PD Program Data.

Table 4: S29GL032N Write to Buffer command (16-bit mode)

Command	Cycles	Bus write cycles											
		1st		2nd		3rd		4th		5th		6th	
		Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data
Write to Buffer ⁽¹⁾	WC + 5	555	AA	2AA	55	BA ⁽²⁾	25	BA ⁽²⁾	WC ⁽²⁾	PA ₍₂₎	PD ⁽²⁾	WBL ⁽²⁾	PD ⁽²⁾

1. The total number of cycles in the command sequence is determined by the number of words to be written to the write buffer. The maximum number of cycles is 20.
2. BA Block Address, WC Number of words to be programmed - 1, PA Program Address, PD Program Data, WBL Write Buffer Location (address must be within the same write buffer page as PA).

Table 5: M29W320E fast program commands (8-bit mode)

Command	Length	Bus write operations ⁽¹⁾																	
		1st		2nd		3rd		4th		5th		6th		7th		8th		9th	
		Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data
Quadruple byte Program	5	AAA	55	PA0	PD0	PA1	PD1	PA2	PD2	PA3	PD3								

1. X Don't care, PA Program Address, PD Program Data.

Table 6: S29GL032N Write to Buffer command (8-bit mode)

Command	Length	Bus write cycles											
		1st		2nd		3rd		4th		5th		6th	
		Add	Data	Add	Data	Add	Data	Add	Data	Add	Data	Add	Data
Write to Buffer ⁽¹⁾	BC+5	AAA	AA	555	55	BA ⁽²⁾	25	BA	BC ⁽²⁾	PA ⁽²⁾	PD ⁽²⁾	WBL ⁽²⁾	PD

1. The total number of cycles in the command sequence is determined by the number of bytes to be written to the write buffer. The maximum number of cycles is 36.
2. BA Block Address, BC Number of bytes to be programmed - 1, PA Program Address, PD Program Data, WBL Write Buffer Location (address must be within the same write buffer page as PA).

0x554 Command Tolerance

In x8 mode, M29W320E does not allow 0x554 on the address for Read, Auto Select, Program, Erase, Unlock Bypass, or Extended Block commands. The address for these commands must be 0x555 as in the data sheet. S29GL032N allows 0x554 on the address for these commands.

Device codes and auto select codes

The auto select codes are composed of the manufacturer code, the device code, the block protection status, and the extended memory block verify code.

The S29GL032N and M29W320E devices have different manufacturer code, device code, and extended memory block verify code.

The S29GL032N and M29W320E devices use identical commands and address inputs to read the auto select codes. Two methods are available to access the auto select codes:

- In the first method, an Auto Select command is issued (see Table 2 Command set) to place the device in auto select mode. The auto select codes can then be read by using a bus read operation with addresses and control signals set as shown in Table 7 Bus operations for accessing the auto select codes.
- In the high voltage method, the same sequence of bus read operations as in the first method is issued, except that A9 is set at V_{ID} .

Table 7: Bus operations for accessing the auto select codes

Operation	\bar{E}	\bar{G}	\bar{W}	Address inputs		Data inputs/outputs		
				x 8 mode	x 16 mode	x 8 mode		x 16 mode
				DQ15A-1, A0-A20	A0-A20	DQ14-DQ8	DQ7-DQ0	DQ15A-1, DQ14-DQ0
Read manufacturer code	V _{IL}	V _{IL}	V _{IH}	A0-A3 = V _{IL} , A6 = V _{IL} , A9 = V _{ID} , others V _{IL} or V _{IH}		Hi-Z	see Table 8	
Read device code				A0 = V _{IH} , A1-A3 = V _{IL} , A6 = V _{IL} , A9 = V _{ID} , others V _{IL} or V _{IH}				
Block protection status				A0,A2,A3, A6= V _{IL} , A1= V _{IH} , A9 = V _{ID} , A12-A20 = Block address, others V _{IL} or V _{IH}				
Extended memory block verify code				A0-A1 = V _{IH} , A2-A3 = V _{IL} , A6 = V _{IL} , A9 = V _{ID} , others V _{IL} or V _{IH}				

Table 8: Auto select codes Boot Block

Auto select code	Spansion		Numonyx		Spansion		Numonyx	
	S29GL032N (03 model) ⁽¹⁾	S29GL032N (04 model) ⁽²⁾	M29W320ET	M29W320EB	S29GL032N (03 model) ⁽¹⁾	S29GL032N (04 model) ⁽²⁾	M29W320ET	M29W320EB
	x 16 mode				x 8 mode			
Manufacturer code	0001h		0020h	0020h	01h		20h	
Device code	227Eh 221Ah 2201h	227Eh 221Ah 2200h	227Eh 221Ah 2201h	227Eh 2210h 2200h	7Eh+10h+01h	7Eh+10h+00h	7Eh+10h+01h	7Eh+10h+00h
Block protection status	01h (protected) 00h (unprotected) ⁽³⁾		0001h (protected) 0000h (unprotected)		01h (protected) 00h (unprotected)			
Extended memory block verify indicator	XX9Ah (factory locked)	XX8Ah (factory locked)	2288h (factory locked)	2288h (factory locked)	9Ah (factory locked) 1Ah (not factory locked) ⁽³⁾	8Ah (factory locked) 0Ah (not factory locked) ⁽³⁾	88h (factory locked) 08h (not factory locked)	88h (factory y locked) 08h (not factory locked)

1. Top boot model.
2. Bottom boot model.
3. DQ8 to DQ15 are 'don't care'.

Difference in CFI operation

When exiting CFI mode on M29W320E device, Read/Reset command (0xF0h) is used to return the device to the previous mode (Main Array Read or Auto Select Mode). S29GL032N will enter main array read mode when it is issued Read/Reset command (0xF0h).

Table 9 CFI exit sequence shows the detail exiting command sequence difference.

Table 9: CFI exit sequence

Entering CFI Sequence	Exiting from CFI to main array read command sequence	
	S29GL032N	M29W320E
Main Array Read --> CFI	0xF0h	0xF0h
Main Array Read --> Auto Select Mode --> CFI	0xF0h	0xF0h --> 0xF0h (twice cmd)

S29GL032N will enter main array read mode when it is issued Read/Reset command (0xF0h).

M29W320E reads out different CFI information in byte mode comparing with S29GL032N.

Table 10 CFI difference comparison (byte mode only)

Address (x8)	S29GL32N		M29W320E	
	Data	Description	Data	Description
20h	51h	Query Unique ASCII string "Q"	51h	Query Unique ASCII string "Q"
21h	51h	Query Unique ASCII string "Q"	00h	
22h	52h	Query Unique ASCII string "R"	52h	Query Unique ASCII string "R"
23h	52h	Query Unique ASCII string "R"	00h	
24h	53h	Query Unique ASCII string "Y"	53h	Query Unique ASCII string "Y"
21h	53h	Query Unique ASCII string "Y"	00h	

Table 11 CFI difference comparison

Address (x16)	Address (x8)	S29GL032N		M29W320E	
		Data	Description	Data	Description
1Dh	3Ah	0000h	V _{PP} Min = N/A	00B5h	V _{PP} Min = 11.5 V
1Eh	3Ch	0000h	V _{PP} Max = N/A	00C5h	V _{PP} Max = 12.5 V
1Fh	3Eh	0007h	RFU	0004h	Typical timeout per single Byte/Word Program = 2 ⁿ μs = 16μs
20h	40h	0007h	Typical timeout for Min. size buffer write 2 ⁿ μs = 128μs	0000h	Typical timeout for minimum size write buffer program = 2 ⁿ μs
23h	46h	0003h	Max. timeout for byte/word program 2 ⁿ times typical. Max time=typ*8	0004h	Maximum timeout for Byte/Word Program = 2 ⁿ times typical. Max time=Typ*16
24h	48h	0005h	Max. timeout for buffer write 2N times typical	0000h	Maximum timeout for write buffer program = 2 ⁿ μs
25h	4Ah	0004h	Max. timeout per individual block erase 2 ⁿ times typical	0003h	Maximum timeout per individual Block Erase = 2 ⁿ times typical
28h	50h	000Xh	Flash Device Interface description (refer to CFI publication 100) 0001h = x16-only bus devices 0002h = x8/x16 bus devices	0002h	Flash device interface code description
2Ah	54h	0005h	Max. number of byte in multi-byte write = 2 ⁿ (00h = not supported)	0000h	Maximum number of bytes in multi-byte program or page = 2 ⁿ
44h	88h	0033h	Minor version number, ASCII	0030h	Minor version number, ASCII
45h	8Ah	00XXh	Address Sensitive Unlock (Bits 1-0) 0 = Required, 1 = Not Required Process Technology (Bits 7-2) 0100b = 110 nm MirrorBit 0011h = x8-only bus devices 0010h = all other devices	0000h	Address sensitive unlock (bits 1 to 0) 00h = required, 01h = not required Silicon revision number (bits 7 to 2)
48h	90h	0000h	Sector Temporary Unprotect 00 = Not Supported, 01 = Supported	0001h	Temporary Block Unprotect 00h = not supported, 01h = supported
49h	92h	0008h	Sector Protect/Unprotect scheme 0008h = Advanced sector Protection	0004h	Block Protect /Unprotect
4Ch	98h	0002h	Page Mode Type 02 = 8 Word Page	0000h	Page mode: 00h = not supported, 01h = 4 page word, 02h = 8 page word
4Fh	9Eh	00XXh	Top/Bottom Boot Sector Flag 02h = Bottom Boot Device, 03h = Top Boot Device, 04h = Uniform sectors bottom WP# protect, 05h = Uniform sectors top WP# protect	00XXh	Top/Bottom Boot Block Flag 02h = Bottom Boot device 03h = Top Boot device

Performance and characteristics

The S29GL032N and the M29W320E have almost compatible DC and AC characteristics (see the respective datasheets for details). The M29W320E memories offer better performance in terms of access time than the S29GL032N devices.

Access time

The M29W320E has a random access time of 70 ns or 90 ns, whereas the S29GL032N has an access time of 90 ns, or 110 ns.

Page read mode

The page mode is available on the S29GL032N, while M29W320E doesn't support this feature.

Program and erase times

The time required to program or erase the whole memory is lower on the M29W320E compared to the S29GL032N. The memory can be either programmed using a Fast Program or an Enhanced Buffered Program command (see Section 3.1), or using the word by word program command.

Refer to Section 3.1 for details on fast program commands.

Table 12 M29W320E program and erase times

Parameter	Min	Typ ⁽¹⁾⁽²⁾	Max ⁽²⁾	Unit
Chip Erase		40	200 ⁽³⁾	s
Block Erase (64 Kbytes) ⁽⁴⁾		0.8	6 ⁽³⁾	s
Erase Suspend latency time			50	μs
Program (byte or word)		10	200	μs
Double Word / Quadruple Byte program		10	200	μs
Chip Program (byte by byte)		40	200 ⁽³⁾	s
Chip Program (word by word)		20	100 ⁽³⁾	s
Chip Program (Double Word/Quadruple Byte Program)		10	100 ⁽³⁾	s
Program Suspend latency time			4	μs
Program/Erase cycles (per block)	100,000			cycles
Data retention	20			years

1. Typical values measured at room temperature and nominal voltages.
2. Sampled, but not 100% tested.
3. Maximum value measured at worst case conditions for both temperature and V_{CC} after 100,000 program/erase cycles.

Table 13 Comparison: S29GL032N and M29W320E performance and characteristics

Parameter	S29GL032N	M29W320E
Access time	90, 110 ns	70, 90 ns
Page Read	25 ns (8-word page)	-
Fast Program	Write to Buffer Program	Multi-Word Program
Chip Program time	31.5 s	20 s (word by word)
		10 s (double word programming)
Supply voltage	2.7 to 3.6 V	2.7 to 3.6 V
Temperature range	-40 to 85 °C	
Chip Erase time	32 s (typical), except all 0000h programmed prior to erasing	40 s (typical)

Block protection

The M29W320E memories offer similar hardware protection as the S29GL032N devices, while don't offer advanced protection feature as S29GL032N. The table below shows how the three techniques are called in the M29W320E and S29GL032N devices, respectively.

Table 14 Block protection techniques in M29W320E and S29GL032N Flashes

M29W320E ⁽¹⁾	S29GL032N
Hardware method (V_{PP}/WP)	Hardware Data Protection (WP/ACC)
-	Advanced protection/unprotection

1. Please refer to the M29W320E datasheet for further details.

Hardware Protection

On both devices, the V_{PP} function allows the memory to use an external high voltage power supply to reduce the time required for fast program operations. The Write Protect (WP) function provides a hardware method of protecting the outermost memory blocks:

- When V_{PP}/WP is Low, V_{IL} , the two highest or lowest blocks are protected on both the S29GL032N and M29W32E devices.
- When V_{PP}/WP is High, V_{IH} , the memory reverts to the previous protection status of the outermost blocks.

Software Protection

The S29GL032N device has two additional protection features, Persistent Sector Protection and Password Sector Protection. These are not present on M29W320E. Customers requiring this functionality can use M29W640GS.

For more details, please refer to AN2392: OTP Irreversible Protection modes on the M29W640GSH/L and M29W640GST/B Secure Flash memories.

Temporary block unprotect

In the M29W320E, when held at V_{ID} , the RP or V_{PP}/WP pin temporarily unprotects all the blocks.

This functionality is not available on S29GL032N devices.

Conclusion

Applications can be easily migrated from an S29GL032N to an M29W320E Flash memory. In addition, the M29W320E features better performance with respect to the S29GL032N devices.

Revision history

Date	Revision	Changes
30-Apr-2009	1	Initial release