AN219610

Migration from SkyHigh S34ML-2 to S34ML-3-2K Page SLC NAND

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Associated Part Families: S34ML-2, S34ML-3

Related Application Notes: AN219369

AN219610 details how to migrate existing designs from SkyHigh S34ML-2 NAND flash memory (S34ML01/02/04G2) to SkyHigh S34ML-3 NAND flash memory (S34ML01/02/04G3-2K page).

1 Introduction

This application note summarizes the differences between the SkyHigh S34ML01/02/04G2 and S34ML01/02/04G3 NAND flash memory devices. It details how to migrate designs from S34ML01/02/04G2 to S34ML01/02/04G3. S34ML01/02/04G2 devices are 3.3-VNAND flash memory parts manufactured with 32-nm technology. S34ML01/02/04G3 devices are 3.3-V NAND flash memory parts manufactured with 16-nm technology.

Note: The information provided in this application note focuses on the differences between the two device families. Refer to the respective datasheets for further information and full specifications.

2 Feature Overview

Many features of the two device families are identical. For example, S34ML01/02/04G2 NAND flash devices are compatible with the S34ML01/02/04G3 NAND flash; both have the following similar characteristics:

- 2048 data bytes per page, 64 pages per block
- Unique ID (serial number)
- One-time programmable (OTP) area
- 10-year data retention
- ONFI 1.0 compliance
- JEDEC standard-compliant software command set

Table 1 summarizes the most important differences.

Table 1. Feature Differences

Features	S34ML-2	S34ML-3
Spare area per page	128 bytes	ML01G3 : 64 bytes /128 bytes options ML02G3 / 04G3: 128 bytes
Good blocks at shipment	2	8
Page read (t_R) [1]	30 µs max	Single plane: 45 µs Typ., 250 µs Max) Multi plane: 55 µs Typ., 450 µs Max)
Block erase time (t_{BERS} typ)	3.5 ms	4.0 ms
Get features/set features	-	✓
User level ECC correction	4-bit	0-bit Backward compatible with 1-bit, 4-bits, or 8-bits
Volatile/permanent block protection	-	✓
Volatile block protection	-	✓

1. Using status polling method or checking R/B# for completion achieves optimum performance

Features	S34ML- 2	S34ML- 3
Permanent block protection	-	✓
Cache read/write	✓	-
Read cycle time (t_{RC} min)	25 ns (ONFI mode 4)	20 ns (ONFI mode 5)
Program time (t_{PROG} typ)	200 µs	350 µs
Reliability	100,000 P/E cycles	100,000 P/E cycles (–40°C to 85°C)
OTP block number	0	6
Packages	TSOP-48, BGA-63	TSOP-48, BGA-63

3 Device Identification and Configuration

Table 2 shows the differences in the ONFI parameter page between S34ML-2 and S34ML-3. Software that uses dynamic adaptive ONFI probing should work without changes.

Table 2. ONFI Parameter Page Differences

Byte	Description	S34ML01/02/04G2	S34ML01/02/04G3
6-7	Features supported [4] odd to even page copyback [3] interleaved operations [2] non-sequential page program [1] multiple LUN operations [0] 16-bit data bus width	1Ch, 00h	ML01G3 : 10h, 00h ML02/04G3 : 18h, 00h
8-9	Optional commands supported [5] Read Unique ID [4] Copyback [3] Read Status Enhanced [2] Get/Set Features [1] Read Cache [0] Page Cache Program	3Bh, 00h	ML01G3: 34h, 00h ML02/04G3: 3Ch, 00h
44-63	Device model	S34ML01G2: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 31h, 47h, 32h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h S34ML02G2: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 32h, 47h, 32h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h S34ML04G2: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 34h, 47h, 32h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h	S34ML01G3: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 31h, 47h, 33h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h S34ML02G3: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 32h, 47h, 33h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h S34ML04G3: 53h, 33h, 34h, 4Dh, 4Ch, 30h, 34h, 47h, 33h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h, 20h
86-89	Number of data bytes per partial page	00h, 00h, 00h, 00h	00h, 02h, 00h, 00h
90-91	Number of spare bytes/partial page	00h, 00h	ML01G3 10h, 00h ML01/02/04G3 20h, 00h
105-106	Block endurance	01h, 05h	08h, 04h (–40°C to 85°C) 06h, 04h (–40°C to 105°C)
107	Guaranteed valid blocks at beginning	01h	08h
108-109	Endurance for guaranteed valid blocks	01h, 03h	00h, 00h
112	Number of bits ECC correctability	04h	00h
114	Interleaved operation attributes [3] Address restrictions for program cache [2] program cache supported [1] no block address restrictions [0] interleaving support	04h	00h

Byte	Description	S34ML-2	S34ML-3
129-130	Timing mode support [5] timing mode 5 [4] timing mode 4 [3] timing mode 3 [2] timing mode 2 [1] timing mode 1 [0] timing mode 0	1Fh, 00h	3Fh, 00h
131-132	Program cache timing mode support [5] timing mode 5 [4] timing mode 4 [3] timing mode 3 [2] timing mode 2 [1] timing mode 1 [0] timing mode 0	1Fh, 00h	00h, 00h
133-134	Maximum page program time (µs)	BCh, 02h	58h, 02h
137-138	Maximum page read time (µs)	1Eh, 00h	ML01G3: FAh, 00h ML02/04G3: C2h, 01h
254-255	Integrity CRC	01G200 : 68h, 4Eh 02G200 : 56h, EAh 04G200 : 28h, A1h	01G3 (64B Spare-85° C): 85h, 89h 01G3 (64B Spare-105° C): 0F, A1 01G3(128B Spare-85° C):2Bh, CFh 01G3 (128B Spare-105° C): A1, E7 02G3 (85° C): 05h, 48h 04G3 (85° C): 7Bh,03h 04G3 (105°C) : F1h,2Bh

Table 3 shows the device IDs for the S34ML-2 and S34ML-3 devices. If software uses a hardcoded device ID parameter table, new entries for S34ML-3 must be added.

Table 3. Device IDs

Command	S34ML-2	S34ML-3
Read ID	01h, F1h, 80h, 1Dh (1 Gb)	01h, F1h, 00h, 1Dh (1 Gb) - 64 Bytes spare area 01h, F1h, 00h, 19h (1 Gb) - 128 Bytes spare area
	01h, DAh, 90h, 95h, 46h (2 Gb)	01h, DAh, 00h, 95h, 46h (2 Gb)
	01h, DCh, 90h, 95h, 56h (4 Gb)	01h, DCh, 00h, 05h, 04h (4 Gb)

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AC Characteristics

The S34ML01/02/04G2 and S34ML01/02/04G3 devices have mainly compatible AC specifications. Differences in AC characteristics between the devices are highlighted in Table 4. Apart from the page read time (data transfer time fromcell to register),the S34ML01/02/04G3 device is faster in every respect compared to the S34ML01/02/04G2 device. This means that existing S34ML01/02/04G2 timings should work for S34ML01/02/04G3 parts.

Table 4. AC Characteristics Differences

Parameter	S34ML01/02/04G2	S34ML01/02/04G3
CE# setup time (t_{CS} min)	20 ns	15 ns
Data setup time (t_{DS} min)	10 ns	7 ns
Page read (t_R) [1]	30 µs max	Single plane: 45 µs Typ., 250 µs Max) Multi plane: 55 µs Typ., 450 µs Max)
Read cycle time (t_{RC} min)	25 ns	20 ns
RE# access time (t_{REA} max)	20 ns	16 ns
RE# high hold time (t_{REH} min)	10 ns	7 ns
RE# pulse width (t_{RP} min)	12 ns	10 ns
Write cycle time (t_{WC} min)	25 ns	20 ns
WE# high hold time (t_{WH} min)	10 ns	7 ns
WE# pulse width (t_{WP} min)	12 ns	10 ns

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This also applies to power-on timing requirements. S34ML01/02/04G2 devices initialize within 5 ms, whereas S34ML01/02/04G3 parts require only 3 ms to initialize (after the reset command). For S34ML01/02/04G3 parts, a reset command (FFh) should be sent after power-on and it is recommended to keep WP# LOW during power up and down.

5 DC Characteristics

The S34ML01/02/04G2 and S34ML01/02/04G3 devices have mainly compatible DC specifications. Differences in DC characteristics between the devices are highlighted in Table 5. In standby mode, the S34ML01/02/04G3 device requires higher current than the S34ML01/02/04G2 devices. The potential impact of these differences should be evaluated and validated.

Table 5. DC Characteristics Differences

Parameter	S34ML01/02/04G2	S34ML01/02/04G3
Sequential read current (I_{CC1} max)	30 mA	35 mA
Program current (I_{CC2} max)	30 mA	35 mA
Standby current, CMOS (I_{CC5} max)	50 µA	100 µA

6 Packages

S34ML01/02/04G3 parts are available in the same TSOP-48, BGA-63, packages as S34ML01/02/04G2.

The S34ML01/02/04G3 adds a new volatile protection enable (VPE) signal that is connected to TSOP-48 pin #38, BGA-63ball G5, and BGA-67 ball F4, respectively. These pins/balls are NC for the S34ML01/02/04G2 and have a weak internal pull-down in S34ML01/02/04G3 parts to disable the VPE feature if the input is left floating. This guarantees compatibility with existing board layouts.

7 References

- S34ML01G2, S34ML02G2, S34ML04G2 1 Gb, 2 Gb, 4 Gb, 3 V, 4-Bit ECC, SLC NAND Flash Memory for Embedded, Datasheet, Specification Number 002-00499.
- S34ML04G3 4 Gb, 3 V, 2K Page Size, x8 I/O, SLC NAND Flash Memory for Embedded, Datasheet, Specification Number 002-19204.
- S34ML01G3, S34ML02G3 1 Gb, 2 Gb, 3 V, 2K Page Size, x8 I/O, SLC NANDFlash Memory for Embedded, Datasheet, Specification Number 002-19206.

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5744429	BACD	05/22/2017	New application note
*A	5971498	MNAD	11/20/2017	Removed 1 Gb and 2 Gb devices Updated performance number and parameter page values
*B		MNAD	05/22/2019	Updated to SkyHigh format Changed 1-bit ECC to 0-bit ECC for S34ML-3 in Features and Parameter Page sec.
*C		MNAD	10/18/2019	Updated Endurance to 80K P/E cycles for (–40°C to 85°C)
*D		MNAD	12/17/2019	Added a text in table 1 to clarify backward compatibility with other nodes
*E		MNAD	05/24/2021	Added 1Gb and 2Gb
F		MNADA	05/01/2025	Updated Endurance to 100K P/E cycles for (-40 C to 85 C), Added tR Max Value