Spansion* Flash Memory to Numonyx™ StrataFlash® Wireless Memory (L) Migration Guide

Application Note #309205

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Contents

Revision History

Date of Revision	Revision	Description
February 2009	01	Initial Release

1.0 Introduction

A system design can migrate from a Spansion* S29xxxxxR/S71xxxxxR and S72xxxxxR (R- 65nm devices) flash memory device, to a Numonyx Wireless® flash memory L Family device. This migration has negligible impact on system performance.

This application note provides the following information about migrating from a Spansion to a Numonyx L flash memory device:

- Compares the features and performance of Spansion family of devices to Numonyx L family.
- Differences between the Numonyx L flash memory device and the Spansion flash memory device.
- Software Considerations.

Before you use this document, become familiar with the Numonyx L wireless flash memory and the Spansion Flash memory devices, as described in the datasheets for each device. The Numonyx LR Flash device is a 1.8V device Vs. the Numonyx LT device is a 3V device.

Note: This application note is based on information available at the time of publication, for the Numonyx Wireless Flash Memory (L) and the Spansion* S29xxxxxR,S71xxxxxR and S72xxxxxR flash memory devices. This application note might not reflect changes in specifications to either device. Refer to the appropriate documents from the respective manufacturer for the most current information about each device, before finalizing any design.

2.0 Differences Between Flash Memory Devices

This section describes key differences between the Numonyx L and the Spansion Flash memory devices.

2.1 Features

Table 1 compares the feature sets for the Numonyx L and the Spansion Flash memory devices.

Table 1: Feature Comparison for Flash Memory Devices

Feature	Type	Numonyx Wireless Flash Memory(L)	Spansion* Flash Memory
Program	Word Program	✓	✓
	Buffered Program	✓	✓
	Unlock Bypass Program	X	✓
Erase	Block Erase	✓	✓
	Chip Erase	X	✓
Suspend	Program/Erase Suspend	✓	✓
Block Locking/ Unlocking	Lock Block	✓	✓
	Unlock Block	✓	✓
	Lock-down Block	✓	X
Fast Write	Simultaneous Read While Write	✓	✓
Fast Read	Burst	✓	✓
Interface	ADMUX	✓	✓
	Non MUX	✓	✓

2.2 Performance and Block Size Comparisons

Table 2: Performance Comparison Between the Spansion* Family and Numonyx L Family of Devices

Flash Memory Function		Spansion Family	Numonyx L Family		
			L18 Devices	LR Devices	LT Devices
Program		2.4usec/byte	0.42usec/byte	1.25usec/byte	1.25usec/byte
Read Speed		104MHz	110MHz/83MHz	66MHz/54MHz	52MHz
Block Erase		0.8sec/block	0.8sec/block	1.5sec/block	1.5sec/block
Read Access Times	Max Synch Latency/ Initial Synch Access Time	75ns	100ns	70/85ns	85ns
	Max Synch Burst Access/ CLK to output valid	7.6nx	6ns @ 110MHz 9ns @ 83MHz	14ns	17ns
	Max Asynch Access Time/ Initial Asynch Access Time	80ns	100ns	70/85ns	85ns
	Max OE# Access Time/ OE# low to output valid	15ns	20ns	20ns	25ns
Current Consumption (typical values)	Cont. Burst Read	32mA @104MHz	30mA @110MHz 26mA @83MHz	30mA @66MHz 28mA @54MHz	23mA @52MHz
	Program/Erase	20mA	36.5mA	20mA	8mA
	Standby Mode	20uA	50uA	70uA	25uA
Block/Sector Size(Main Block)		128Kbytes	128Kbytes	128Kbytes	128Kbytes
Block/Sector Size(Parameter Block)		32Kbytes	32Kbytes (N/A for 512M)	32Kbytes	32Kbytes

2.3 Device Identifiers

Each flash memory device has a manufacturer ID. To retrieve the manufacturer ID, read address 00h after issuing a **Read Device Identifier** command on Numonyx flash memory devices, or after an **Autoselect** command on Spansion flash memory devices. Table 3 shows the manufacturer ID codes for Numonyx and Spansion flash memory devices.

Table 3: Manufacturer ID Codes

Manufacturer	Identifier
Numonyx(L Devices)	89h
Numonyx(LR/LT Devices)	20h
Spansion	01h

Each flash memory device is uniquely defined using a device ID. Similar to retrieving the manufacturer ID codes, the device ID is also read at address 01h after issuing the **Read Device Identifier** or the **Autoselect** command. Table 4 and Table 5 list the device ID codes for the Numonyx L and the Spansion R - 65nm devices.

Note: Three read cycles (or device ID codes) are required to successfully identify a Spansion flash memory device; the three device ID codes are read at addresses 01h, 0Eh, and 0Fh.

Table 4: Device ID Codes, Numonyx Strataflash® Wireless Memory (L)

Device Type	Device Density	Identifier (ADMUX)	Identifier (Non MUX)
LR	128-Mbit(Top)	882Eh	88C4h
	128-Mbit(Bottom)	882Fh	88C5h
	256-Mbit(Top)	881Ch	880Dh
	256-Mbit(Bottom	881Dh	880Eh
LT	128-Mbit(Top)	N/A	88C4h
	128-Mbit(Bottom)	N/A	88C5h
L	256-Mbit(Top)	8981h	8987h
	256-Mbit(Bottom)	8985h	8989h
	512-Mbit(Symmetrical)	8982h	898Ah

Table 5: Device ID Codes, Spansion* Flash Memory (R - 65nm devices)

Device Type	Device Density	Identifier		
		Cycle 1	Cycle 2	Cycle 3
NS R	128-Mbit	3A7Eh	3A35h	3A03h
	256-Mbit	397Eh	3917h	3903h
	512-Mbit	387Eh	3816h	3803h
	1-Gbit	377Eh	3715h	3703h
WS-R	128-Mbit	007Eh	0027h	0003h
	256-Mbit	007Eh	0026h	0003h
	512-Mbit	007Eh	0025h	0003h
	1-Gbit	007Eh	0024h	0003h
VS/XS-R	128-Mbit	007Eh	0063h/Top 0065h/Bottom	0001h
	256-M bit	007Eh	0064h/Top 0066h/Bottom	0001h

2.4 Device Command Codes

The command codes between the Numonyx and the Spansion flash memory devices also differ. Table 6 lists the command codes for the common flash memory functions on both devices.

Table 6: Comparison of Numonyx and Spansion Command Sets

Command Sequence	Device	Bus Cycles							
		First		Second		Third		Fourth	
		Addr	Data	Addr	Data	Addr	Data	Addr	Data
Read Array	**Numonyx**	XX	FF						
	Spansion	RA	RD						
Read ID	**Numonyx**	XX	90	IA	ID				
	Spansion	X55	90						
Program	**Numonyx**	WA	40/10	WA	WD				
	Spansion	555 AAA	25	2AA 554	WC	PA	PD	PA	PD
Buffered Program	**Numonyx**	WA	E8	WA	N-1				
	Spansion	555 AAA	25	2AA 554	WC	PA	PD	PA	PD
Block Erase	**Numonyx**	BA	20	BA	D0				
	Spansion	555 AAA	80	2AA 554	30				
Chip Erase	**Numonyx**	N/A							
	Spansion	555 AAA	80	2AA 554	10				
Lock Block	**Numonyx**	BA	60	BA	01				
	Spansion	555 AAA	60	2AA 554	60	SLA	60		
Unlock Block	**Numonyx**	BA	60	BA	D0				
	Spansion	555 AAA	60	2AA 554	60	SLA	60		
Lockdown Block	**Numonyx**	BA	60	BA	2F				
	Spansion	N/A							
Erase Suspend	**Numonyx**	XX	B0						
	Spansion	XXX	B0						
Program Suspend	**Numonyx**	XX	B0						
	Spansion	XXX	51						
Erase Resume	**Numonyx**	XX	D0						
	Spansion	000	30						
Program Resume	**Numonyx**	XX	D0						
	Spansion	000	50						

Notes:

1. All numbers shown are in hexadecimal representation.
2. XX = Any valid address within the flash memory device.

   IA = Identification code address offset.

   RA = Address of the location to be read

RD = Read Data from location RA during read operation

RR = Read Register value

ID = Identifier data.

WA = Word address of the memory location where data is written.

WD = Word data.

WC = Word count.

BA = Address within the block.

N = Word Count of the data to be loaded into the write buffer.

3.0 Status Register

The Numonyx L family devices have exactly the same status register bits with the exception of status register bit 3.

Table 7 Status Register Bits Comparison below compares the status register bits for Spansion Vs. Numonyx devices.

Table 7: Status Register Bits Comparison

SR Bit	7	6	5	4	3	2	1	0
Spansion SR	Device Ready Status	Erase Suspend Status	Erase Status	Program Status	RFU[1]	Program Suspend Status	Sector/ Block Lock Status	Bank/ Partition Status
Numonyx L & LR/LT Families SR	Device Ready Status	Erase Suspend Status	Erase Status	Program Status	Program/ Erase Voltage Error	Program Suspend Status	Sector/ Block Lock Status	Bank/ Partition Status

1. SR bit 3 is RFU on Spansion Devices and For Numonyx L family Bit3 represents VPPS and indicates the value of Vpp Voltage. If VPPS = 0, the Vpp voltage value is within acceptable limits of program and erase operations. If VPPS = 1, the Vpp voltage is less than Vpplk during program/erase operation.

4.0 Configuration Registers

The Configuration Registers are very similar for Spansion and Numonyx L family for all bits except bit 7 and bit 3. The CR Bit 7 is output drive strength bit on Spansion devices and is a reserved bit on the L devices whereas the CR Bit 3 is reserved on Spansion devices and is a Burst Wrap bit on L devices.

The Configuration Register has bits 14,9,7,6 and 3 different on the LR/LT family devices as against Spansion devices.

Table 8 Configuration Register Bits Comparison below compares the different configuration registers between Spansion and Numonyx L Family devices.

Table 8: Configuration Register Bits Comparison

SR Bit	15	14	13-11	10	9	8	7	6	5-4	3	2-0
Spansion CR	Synch/ Asynch Read Mode	Read Wait States/ Latency Count		RDY/ WAIT Polarity	Reserved	RDY/ WAIT Timing[1]	Output Drive Strength	Reserved			Burst Length
Numonyx L Family RCR	Synch/ Asynch Read Mode	Read Wait States/ Latency Count		RDY/ WAIT Polarity	Reserved	RDY/ WAIT Timing	Reserved			Burst Wrap	Burst Length
Numonyx LR/LT Families RCR	Synch/ Asynch Read Mode	Reserved	Read Wait States/ Latency Count	RDY/ WAIT Polarity	Data Out Configuration	RDY/ WAIT Timing	Burst Type	Valid Clock Edge	Reserved	Burst Wrap	Burst Length

1. For Spansion Devices, CR Bit 8 = 0 means RDY is active one clock cycle before valid data and CR Bit 8 = 1 means RDY is active with valid data whereas for Numonyx devices, CR Bit 8 = 0 means WAIT is active with valid data and CR Bit 8 = 1 means WAIT is active one clock cycle before valid data

5.0 Software Considerations

There are several considerations for migrating to Numonyx StrataFlash Wireless Memory (L Family). In this case the block sizes and core functionality are the same so the migration effort is focused on a few changes. Typically the software interface with the flash device is isolated to a low level flash driver.

In most cases, the flash driver currently used can be replaced with a Numonyx driver for StrataFlash Wireless Memory. This driver can be downloaded from www.Numonyx.com, and provides software functions to interface with the flash.

In the case that existing software needs to be modified and the Numonyx driver can not be used, there are only a few isolated changes that need to be made, which are as follows:

- If the manufacturer and device identifier codes are used to identify the device, the software should be updated to utilize the identifiers for Numonyx. There are two updates needed for this. The first is the command sequence issued to the device should be changed (see Table 6. Comparison of Numonyx and Spansion Command Sets). The second change required is to add the resulting values for Numonyx devices (Table 4. Device ID Codes, Numonyx Strataflash® Wireless Memory (L), Table 5. Device ID Codes, Spansion* Flash Memory (R - 65nm devices)).
- The flash interface functions used in the software should be updated to use the Numonyx command sequence. This requires updating the commands issued to the flash with Numonyx command sequences (see Table 6. Comparison of Numonyx and Spansion Command Sets).
- The Numonyx device does not have a command comparable to the Spansion Chip erase command. This can be replaced with a small section of code that indexes through each block and erases them. The TMPL_EraseAllBlocks function found in the driver available from www.Numonyx.com can be used as a sample.

In addition to providing drivers, Numonyx also provides complete file systems. Numonyx™ Flash Data Integrator (Numonyx™ FDI) is a Numonyx supported code, data, and file manager for use in real-time embedded applications. The Numonyx FDI Data Manager component provides a simple storage API. The Data Manager also includes a high-performance interface for streaming data in voice recording and multimedia applications, as well as packet-size data. The Numonyx FDI Code Manager component allows for direct execution of code, including Java* applets and native CPU software. The Numonyx FDI File Manager component presents a user-friendly POSIX-style interface for software developers, streamlining the development of data-centric applications.

5.1 Numonyx FDI

Numonyx FDI is founded upon robust power-loss recovery mechanisms, which ensure that data remains uncorrupted even through fluctuations and failure of power to the system. Additionally, the Numonyx FDI intelligent wear-leveling techniques increase cycling endurance of flash memory blocks. The Numonyx FDI read-while-write (RWW) capabilities are optimized to allow data writes while simultaneously reading code from the same flash memory component.

Numonyx FDI acts as a real-time interrupt handler, enabling software-based RWW. In software-based RWW, Numonyx FDI queues data to be written, while code runs directly out of flash memory; when code is not being read, Numonyx FDI performs flash write operations in the background to transfer queue contents to flash memory. When hardware-based RWW is available, Numonyx FDI takes full advantage of the hardware features to reduce interrupt latency.

FDI has been ported to every major chipset vendor and is suitable for RTOS and supports L Family.

6.0 Summary

This application note illustrates that a system design can migrate from Spansion Flash Memory to Numonyx Flash memory devices across all densities with minimum software differences.