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S29AL008J

8 Mbit (1 M x 8-Bit/512 K x 16-Bit), 3 V Boot Sector Flash

Distinctive Characteristics

Architectural Advantages

- Single Power Supply Operation
  - Full voltage range: 2.7 to 3.6 volt read and write operations for battery-powered applications
- Manufactured on 110 nm Process Technology
  - Fully compatible with 200 nm S29AL008D
- Secured Silicon Sector region
  - 128-word/256-byte sector for permanent, secure identification through an 8-word/16-byte random Electronic Serial Number accessible through a command sequence
  - May be programmed and locked at the factory or by the customer
- Flexible Sector Architecture
  - One 16 Kbyte, two 8 Kbyte, one 32 Kbyte, and fifteen 64 Kbyte sectors (byte mode)
  - One 8 Kword, two 4 Kword, one 16 Kword, and fifteen 32 Kword sectors (word mode)
- Sector Group Protection Features
  - A hardware method of locking a sector to prevent any program or erase operations within that sector
  - Sectors can be locked in-system or via programming equipment
  - Temporary Sector Unprotect feature allows code changes in previously locked sectors
- Unlock Bypass Program Command
  - Reduces overall programming time when issuing multiple program command sequences
- Top or Bottom Boot Block Configurations Available
- Compatibility with JEDEC standards
  - Pinout and software compatible with single-power supply Flash
  - Superior inadvertent write protection

Performance Characteristics

- High Performance
  - Access times as fast as 55 ns
  - Extended temperature range (–40°C to +125°C)
- Ultra Low Power Consumption (typical values at 5 MHz)
  - 0.2 µA Automatic Sleep mode current
  - 0.2 µA standby mode current
  - 7 mA read current
  - 20 mA program/erase current
- Cycling Endurance: 1,000,000 cycles per sector typical
- Data Retention: 20 years typical

Package Options

- 48-ball Fine-pitch BGA
- 48-pin TSOP

Software Features

- CFI (Common Flash Interface) Compliant
  - Provides device-specific information to the system, allowing host software to easily reconfigure for different Flash devices
- Erase Suspend/Erase Resume
  - Suspends an erase operation to read data from, or program data to, a sector that is not being erased, then resumes the erase operation
- Data# Polling and Toggle Bits
  - Provides a software method of detecting program or erase operation completion

Hardware Features

- Ready/Busy# Pin (RY/BY#)
  - Provides a hardware method of detecting program or erase cycle completion
- Hardware Reset Pin (RESET#)
  - Hardware method to reset the device to reading array data
- WP# input pin
  - For boot sector devices: at V_{IL}, protects first or last 16 Kbyte sector depending on boot configuration (top boot or bottom boot)

General Description

The S29AL008J is a 8 Mbit, 3.0 Volt-only Flash memory organized as 1,048,576 bytes or 524,288 words. The device is offered in 48-ball Fine-pitch BGA (0.8 mm pitch), and 48-pin TSOP packages. The word-wide data (x16) appears on DQ15–DQ0; the byte-wide (x8) data appears on DQ7–DQ0. This device is designed to be programmed in-system with the standard system 3.0 volt V_{CC} supply. A 12.0 V V_{PP} or 5.0 V_{CC} are not required for write or erase operations. The device can also be programmed in standard EPROM programmers.

The device offers access times of up to 55 ns allowing high speed microprocessors to operate without wait states. To eliminate bus contention the device has separate chip enable (CE#), write enable (WE#) and output enable (OE#) controls.

The device requires only a **single 3.0 volt power supply** for both read and write functions. Internally generated and regulated voltages are provided for the program and erase operations.

The S29AL008J is entirely command set compatible with the **JEDEC single-power-supply Flash standard**. Commands are written to the command register using standard microprocessor write timings. Register contents serve as input to an internal state-machine that controls the erase and programming circuitry. Write cycles also internally latch addresses and data needed for the programming and erase operations. Reading data out of the device is similar to reading from other Flash or EPROM devices.

Device programming occurs by executing the program command sequence. This initiates the **Embedded Program** algorithm—an internal algorithm that automatically times the program pulse widths and verifies proper cell margin. The **Unlock Bypass** mode facilitates faster programming times by requiring only two write cycles to program data instead of four.

Device erasure occurs by executing the erase command sequence. This initiates the **Embedded Erase** algorithm—an internal algorithm that automatically preprograms the array (if it is not already programmed) before executing the erase operation. During erase, the device automatically times the erase pulse widths and verifies proper cell margin.

The host system can detect whether a program or erase operation is complete by observing the RY/BY# pin, or by reading the DQ7 (Data# Polling) and DQ6 (toggle) **status bits**. After a program or erase cycle has been completed, the device is ready to read array data or accept another command.

The **sector erase architecture** allows memory sectors to be erased and reprogrammed without affecting the data contents of other sectors. The device is fully erased when shipped from the factory.

Hardware data protection measures include a low V_{CC} detector that automatically inhibits write operations during power transitions. The **hardware sector protection** feature disables both program and erase operations in any combination of the sectors of memory. This can be achieved in-system or via programming equipment.

The **Erase Suspend/Erase Resume** feature enables the user to put erase on hold for any period of time to read data from, or program data to, any sector that is not selected for erasure. True background erase can thus be achieved.

The **hardware RESET# pin** terminates any operation in progress and resets the internal state machine to reading array data. The RESET# pin may be tied to the system reset circuitry. A system reset would thus also reset the device, enabling the system microprocessor to read the boot-up firmware from the Flash memory.

The device offers two power-saving features. When addresses have been stable for a specified amount of time, the device enters the **automatic sleep mode**. The system can also place the device into the **standby mode**. Power consumption is greatly reduced in both these modes.

Spansion Flash technology combines years of Flash memory manufacturing experience to produce the highest levels of quality, reliability and cost effectiveness. The device electrically erases all bits within a sector simultaneously via Fowler-Nordheim tunneling. The data is programmed using hot electron injection.

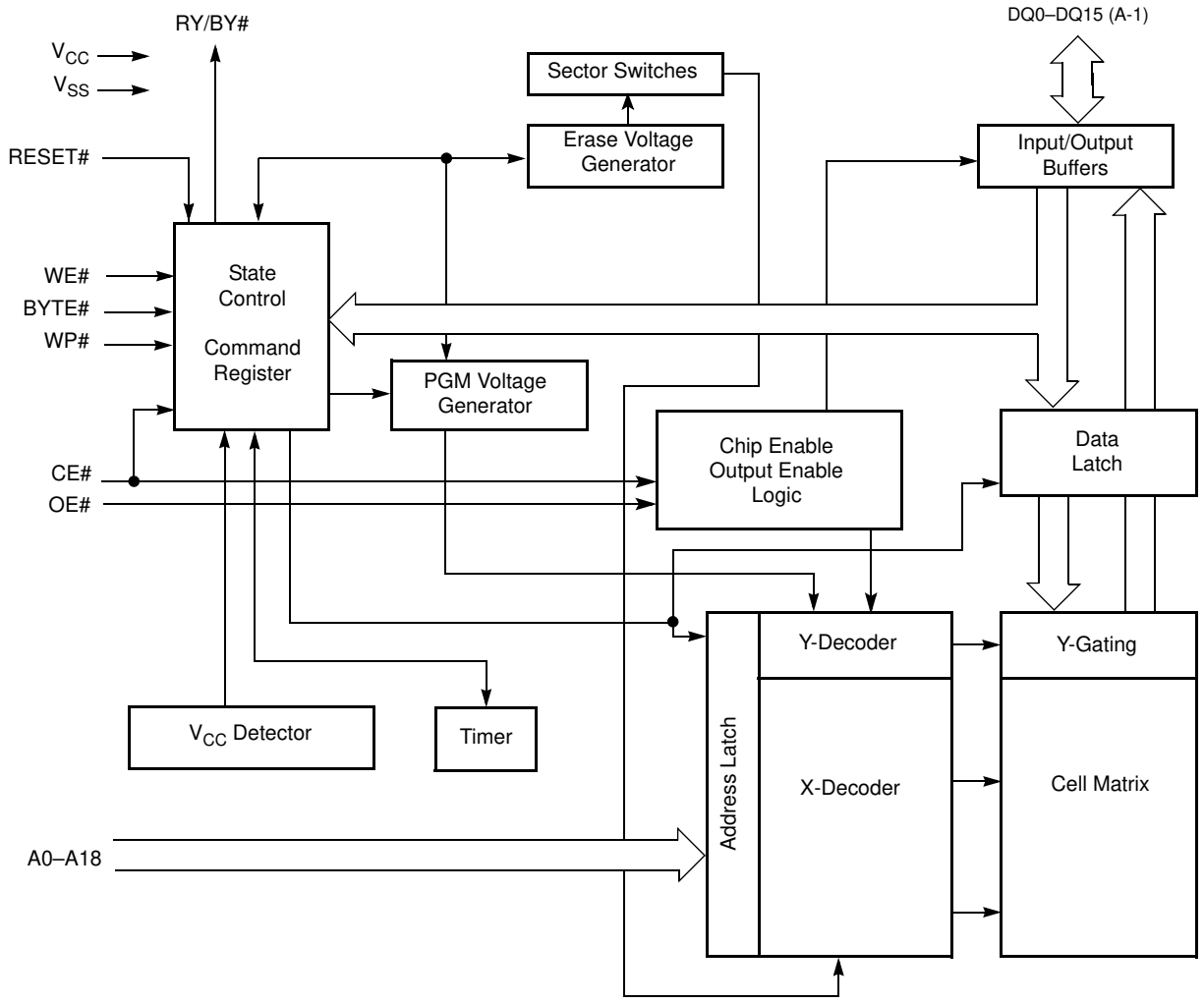
Contents

1. Product Selector Guide

Family Part Number		S29AL008J	
Speed Option	Voltage Range: V_{CC} = 2.7-3.6V		70
	V_{CC} = 3.0-3.6V	55	
Max access time, ns (t_{ACC})		55	70
Max CE# access time, ns (t_{CE})		55	70
Max CE# access time, ns (t_{OE})		30	30

Note
See AC Characteristics on page 35 for full specifications.

2. Block Diagram



3. Connection Diagrams

Figure 3.1 48-pin Standard TSOP (TS048)

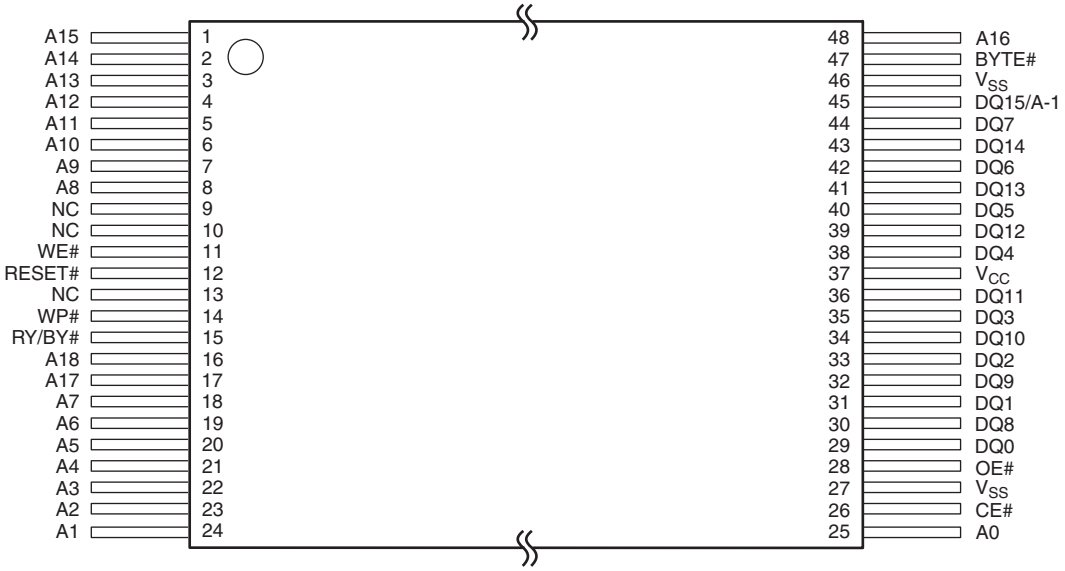
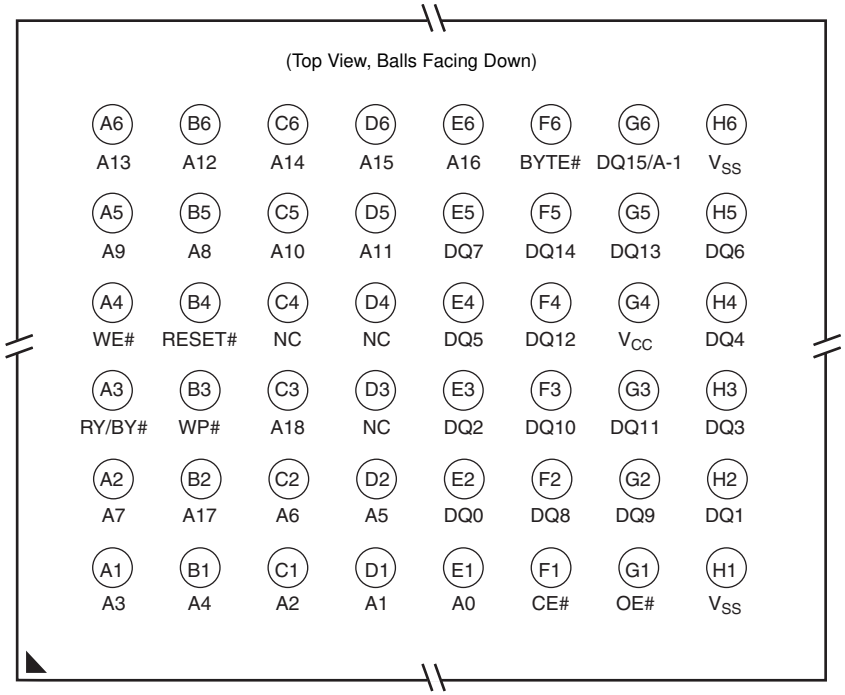


Figure 3.2 48-ball Fine-pitch BGA (VBK048)



3.1 Special Handling Instructions

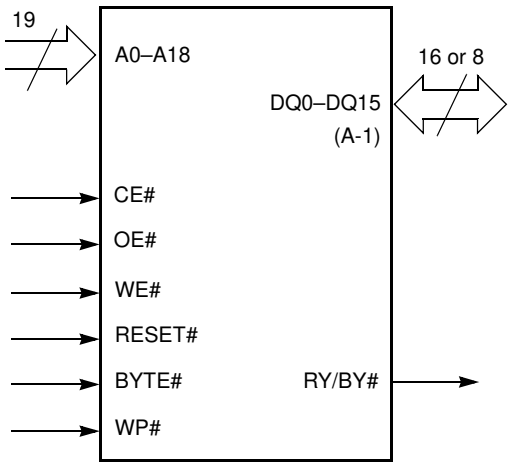
Special handling is required for Flash Memory products in BGA packages.

Flash memory devices in BGA packages may be damaged if exposed to ultrasonic cleaning methods. The package and/or data integrity may be compromised if the package body is exposed to temperatures above 150°C for prolonged periods of time.

4. Pin Configuration

A0–A18	19 addresses
DQ0–DQ14	15 data inputs/outputs
DQ15/A-1	DQ15 (data input/output, word mode), A-1 (LSB address input, byte mode)
BYTE#	Selects 8-bit or 16-bit mode
CE#	Chip enable
OE#	Output enable
WE#	Write enable
WP#	Write protect: The WP# contains an internal pull-up; when unconnected, WP is at V_{IH}.
RESET#	Hardware reset
RY/BY#	Ready/Busy output
V_{CC}	3.0 volt-only single power supply (see *Product Selector Guide* on page 4 for speed options and voltage supply tolerances)
V_{SS}	Device ground
NC	Pin not connected internally

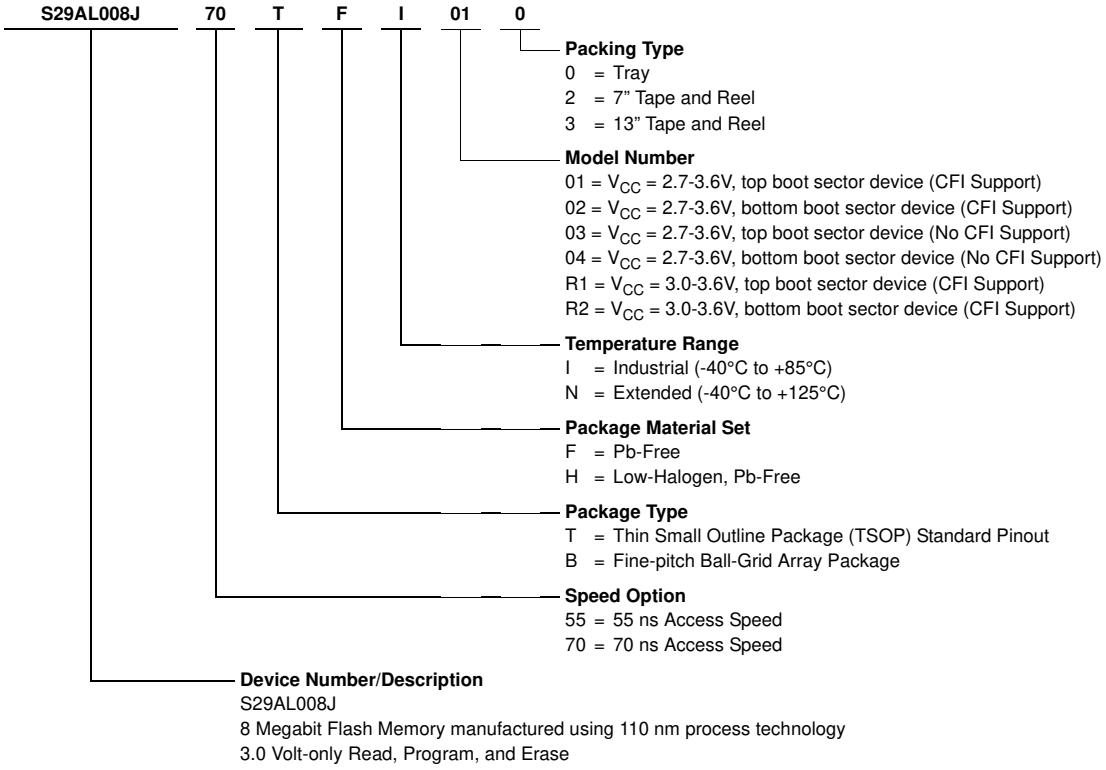
5. Logic Symbol



6. Ordering Information

6.1 S29AL008J Standard Products

Spansion standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of the elements below.



Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult your local sales office to confirm availability of specific valid combinations and to check on newly released combinations.

S29AL008J Valid Combination					Package Description	
Device Number	Speed Option	Package Type, Material, and Temperature Range	Model Number	PackingType		
S29AL008J	55	TFI, TFN	R1, R2	0, 3 (Note 1)	TS048 (Note 3)	TSOP
		BFI, BFN, BHI, BHN		0, 2, 3 (Note 1)	VBK048 (Note 4)	Fine-Pitch BGA
	70	TFI, TFN	01, 02	0, 3 (Note 1)	TS048 (Note 3)	TSOP
		BFI, BFN, BHI, BHN		0, 2, 3 (Note 1)	VBK048 (Note 4)	Fine-Pitch BGA
		TFI	03, 04	0, 3 (Note 1)	TS048 (Note 3)	TSOP
		BFN, BHN		0, 2, 3 (Note 1)	VBK048 (Note 4)	Fine-Pitch BGA

Notes

1. *Type 0 is standard. Specify other options as required.*
2. *Type 1 is standard. Specify other options as required.*
3. *TSOP package markings omit packing type designator from ordering part number.*
4. *BGA package marking omits leading* S29 *and packing type designator from ordering part number.*

7. Device Bus Operations

This section describes the requirements and use of the device bus operations, which are initiated through the internal command register. The command register itself does not occupy any addressable memory location. The register is composed of latches that store the commands, along with the address and data information needed to execute the command. The contents of the register serve as inputs to the internal state machine. The state machine outputs dictate the function of the device. Table lists the device bus operations, the inputs and control levels they require, and the resulting output. The following subsections describe each of these operations in further detail.

S29AL008J Device Bus Operations

Operation	CE#	OE#	WE#	RESET#	WP#	Addresses (Note 1)	DQ0–DQ7	DQ8–DQ15	
								BYTE# = V_{IH}	BYTE# = V_{IL}
Read	L	L	H	H	X	A_{IN}	D_{OUT}	D_{OUT}	DQ8–DQ14 = High-Z, DQ15 = A-1
Write	L	H	L	H	(Note 3)	A_{IN}	(Note 4)	(Note 4)	
Standby	V_{CC} ± 0.3 V	X	X	V_{CC} ± 0.3 V	X	X	High-Z	High-Z	High-Z
Output Disable	L	H	H	H	X	X	High-Z	High-Z	High-Z
Reset	X	X	X	L	X	X	High-Z	High-Z	High-Z
Sector Group Protect (2) (3)	L	H	L	V_{ID}	H	Sector Address, A6 = L, A3 = A2 = L, A1 = H, A0 = L	(Note 4)	X	X
Sector Group Unprotect (2) (3)	L	H	L	V_{ID}	H	Sector Address, A6 = H, A3 = A2 = L, A1 = H, A0 = L	(Note 4)	X	X
Temporary Sector Group Unprotect	X	X	X	V_{ID}	H	A_{IN}	(Note 4)	(Note 4)	High-Z

Legend

L = Logic Low = V_{IL}; H = Logic High = V_{IH}; V_{ID} = 8.5 V to 12.5 V; X = Don't Care; A_{IN} = Address In; D_{OUT} = Data Out

Notes

1. *Address In = Amax:A0 in WORD mode (BYTE#=V_{IH}), Address In = Amax:A-1 in BYTE mode (BYTE#=V_{IL}). Sector addresses are Amax to A12 in both WORD mode and BYTE mode.*
2. *The sector group protect and sector group unprotect functions may also be implemented via programming equipment. See Sector Group Protection/Unprotection on page 13.*
3. *If WP# = V_{IL}, the outermost sector remains protected (determined by device configuration). If WP# = V_{IH}, the outermost sector protection depends on whether the sector was last protected or unprotected using the method described in Section 7.10, Sector Group Protection/Unprotection on page 13. The WP# contains an internal pull-up; when unconnected, WP is at V_{IH}.*
4. *D_{IN} or D_{OUT} as required by command sequence, data polling, or sector group protection algorithm.*

7.1 Word/Byte Configuration

The BYTE# pin controls whether the device data I/O pins DQ15–DQ0 operate in the byte or word configuration. If the BYTE# pin is set at logic *1*, the device is in word configuration, DQ15–DQ0 are active and controlled by CE# and OE#.

If the BYTE# pin is set at logic *0*, the device is in byte configuration, and only data I/O pins DQ0–DQ7 are active and controlled by CE# and OE#. The data I/O pins DQ8–DQ14 are tri-stated, and the DQ15 pin is used as an input for the LSB (A-1) address function.

7.2 Requirements for Reading Array Data

To read array data from the outputs, the system must drive the CE# and OE# pins to V_{IL}. CE# is the power control and selects the device. OE# is the output control and gates array data to the output pins. WE# should remain at V_{IH}. The BYTE# pin determines whether the device outputs array data in words or bytes.

The internal state machine is set for reading array data upon device power-up, or after a hardware reset. This ensures that no spurious alteration of the memory content occurs during the power transition. No command is necessary in this mode to obtain array data. Standard microprocessor read cycles that assert valid addresses on the device address inputs produce valid data on the device data outputs. The device remains enabled for read access until the command register contents are altered.

See *Reading Array Data* on page 21 for more information. Refer to the AC *Read Operations* on page 35 for timing specifications and to Figure 17.1 on page 35 for the timing diagram. I_{CC1} in *DC Characteristics* on page 33 represents the active current specification for reading array data.

7.3 Writing Commands/Command Sequences

To write a command or command sequence (which includes programming data to the device and erasing sectors of memory), the system must drive WE# and CE# to V_{IL}, and OE# to V_{IH}.

For program operations, the BYTE# pin determines whether the device accepts program data in bytes or words. See *Word/Byte Configuration* on page 8 for more information.

The device features an **Unlock Bypass** mode to facilitate faster programming. Once the device enters the Unlock Bypass mode, only two write cycles are required to program a word or byte, instead of four. *Word/Byte Program Command Sequence* on page 22 has details on programming data to the device using both standard and Unlock Bypass command sequences.

An erase operation can erase one sector, multiple sectors, or the entire device. Table on page 11 and Table on page 12 indicate the address space that each sector occupies. A “sector address” consists of the address bits required to uniquely select a sector. The *Command Definitions* on page 21 has details on erasing a sector or the entire chip, or suspending/resuming the erase operation.

After the system writes the autoselect command sequence, the device enters the autoselect mode. The system can then read autoselect codes from the internal register (which is separate from the memory array) on DQ7–DQ0. Standard read cycle timings apply in this mode. Refer to *Autoselect Mode* on page 12 and *Autoselect Command Sequence* on page 21 for more information.

I_{CC2} in *DC Characteristics* on page 33 represents the active current specification for the write mode. *AC Characteristics* on page 35 contains timing specification tables and timing diagrams for write operations.

7.4 Program and Erase Operation Status

During an erase or program operation, the system may check the status of the operation by reading the status bits on DQ7–DQ0. Standard read cycle timings and I_{CC} read specifications apply. Refer to *Write Operation Status* on page 27 for more information, and to *AC Characteristics* on page 35 for timing diagrams.

7.5 Standby Mode

When the system is not reading or writing to the device, it can place the device in the standby mode. In this mode, current consumption is greatly reduced, and the outputs are placed in the high impedance state, independent of the OE# input.

The device enters the CMOS standby mode when the CE# and RESET# pins are both held at $V_{CC} \pm 0.3$ V. (Note that this is a more restricted voltage range than V_{IH}.) If CE# and RESET# are held at V_{IH}, but not within $V_{CC} \pm 0.3$ V, the device will be in the standby mode, but the standby current will be greater. The device requires standard access time (t_{CE}) for read access when the device is in either of these standby modes, before it is ready to read data.

If the device is deselected during erasure or programming, the device draws active current until the operation is completed.

I_{CC3} and I_{CC4} represents the standby current specification shown in the table in *DC Characteristics* on page 33.

7.6 Automatic Sleep Mode

The automatic sleep mode minimizes Flash device energy consumption. The device automatically enables this mode when addresses remain stable for t_{ACC} + 30 ns. The automatic sleep mode is independent of the CE#, WE#, and OE# control signals. Standard address access timings provide new data when addresses are changed. While in sleep mode, output data is latched and always available to the system. I_{CC4} in the *DC Characteristics* on page 33 represents the automatic sleep mode current specification.

7.7 RESET#: Hardware Reset Pin

The RESET# pin provides a hardware method of resetting the device to reading array data. When the system drives the RESET# pin to V_{IL} for at least a period of t_{RP}, the device **immediately terminates** any operation in progress, tristates all data output pins, and ignores all read/write attempts for the duration of the RESET# pulse. The device also resets the internal state machine to reading array data. The operation that was interrupted should be reinitiated once the device is ready to accept another command sequence, to ensure data integrity.

Current is reduced for the duration of the RESET# pulse. When RESET# is held at V_{SS} ±0.3 V, the device draws CMOS standby current (I_{CC4}). If RESET# is held at V_{IL} but not within V_{SS} ±0.3/0.1 V, the standby current will be greater.

The RESET# pin may be tied to the system reset circuitry. A system reset would thus also reset the Flash memory, enabling the system to read the boot-up firmware from the Flash memory. Note that the CE# pin should only go to V_{IL} after RESET# has gone to V_{IH}. Keeping CE# at V_{IL} from power up through the first read could cause the first read to retrieve erroneous data.

If RESET# is asserted during a program or erase operation, the RY/BY# pin remains a *0* (busy) until the internal reset operation is complete, which requires a time of t_{READY} (during Embedded Algorithms). The system can thus monitor RY/BY# to determine whether the reset operation is complete. If RESET# is asserted when a program or erase operation is not executing (RY/BY# pin is *1*), the reset operation is completed within a time of t_{READY} (not during Embedded Algorithms). The system can read data t_{RH} after the RESET# pin returns to V_{IH}.

Refer to the tables in *AC Characteristics* on page 35 for RESET# parameters and to Figure 17.2 on page 36 for the timing diagram.

7.8 Output Disable Mode

When the OE# input is at V_{IH}, output from the device is disabled. The output pins are placed in the high impedance state.

S29AL008J Top Boot Block Sector Addresses

Sector	A18	A17	A16	A15	A14	A13	A12	Sector Size (Kbytes/ Kwords)	Address Range (in hexadecimal)	
									(x8) Address Range	(x16) Address Range
SA0	0	0	0	0	X	X	X	64/32	00000h–0FFFFh	00000h–07FFFh
SA1	0	0	0	1	X	X	X	64/32	10000h–1FFFFh	08000h–0FFFFh
SA2	0	0	1	0	X	X	X	64/32	20000h–2FFFFh	10000h–17FFFh
SA3	0	0	1	1	X	X	X	64/32	30000h–3FFFFh	18000h–1FFFFh
SA4	0	1	0	0	X	X	X	64/32	40000h–4FFFFh	20000h–27FFFh
SA5	0	1	0	1	X	X	X	64/32	50000h–5FFFFh	28000h–2FFFFh
SA6	0	1	1	0	X	X	X	64/32	60000h–6FFFFh	30000h–37FFFh
SA7	0	1	1	1	X	X	X	64/32	70000h–7FFFFh	38000h–3FFFFh
SA8	1	0	0	0	X	X	X	64/32	80000h–8FFFFh	40000h–47FFFh
SA9	1	0	0	1	X	X	X	64/32	90000h–9FFFFh	48000h–4FFFFh
SA10	1	0	1	0	X	X	X	64/32	A0000h–AFFFFh	50000h–57FFFh
SA11	1	0	1	1	X	X	X	64/32	B0000h–BFFFFh	58000h–5FFFFh
SA12	1	1	0	0	X	X	X	64/32	C0000h–CFFFFh	60000h–67FFFh
SA13	1	1	0	1	X	X	X	64/32	D0000h–DFFFFh	68000h–6FFFFh
SA14	1	1	1	0	X	X	X	64/32	E0000h–EFFFFh	70000h–77FFFh
SA15	1	1	1	1	0	X	X	32/16	F0000h–F7FFFh	78000h–7BFFFh
SA16	1	1	1	1	1	0	0	8/4	F8000h–F9FFFh	7C000h–7CFFFh
SA17	1	1	1	1	1	0	1	8/4	FA000h–FBFFFh	7D000h–7DFFFh
SA18	1	1	1	1	1	1	X	16/8	FC000h–FFFFFh	7E000h–7FFFFh

Note

Address range is A18:A-1 in byte mode and A19:A0 in word mode. See *Word/Byte Configuration on page 8**.*

Secured Silicon Sector Addresses (Top Boot)

Sector Size (bytes/words)	x8 Address Range	x16 Address Range
256/128	FFF00h–FFFFFh	7FF80h–7FFFFh

S29AL008J Bottom Boot Block Sector Addresses

Sector	A18	A17	A16	A15	A14	A13	A12	Sector Size (Kbytes/ Kwords)	Address Range (in hexadecimal)	
									(x8) Address Range	(x16) Address Range
SA0	0	0	0	0	0	0	X	16/8	00000h–03FFFh	00000h–01FFFh
SA1	0	0	0	0	0	1	0	8/4	04000h–05FFFh	02000h–02FFFh
SA2	0	0	0	0	0	1	1	8/4	06000h–07FFFh	03000h–03FFFh
SA3	0	0	0	0	1	X	X	32/16	08000h–0FFFFh	04000h–07FFFh
SA4	0	0	0	1	X	X	X	64/32	10000h–1FFFFh	08000h–0FFFFh
SA5	0	0	1	0	X	X	X	64/32	20000h–2FFFFh	10000h–17FFFh
SA6	0	0	1	1	X	X	X	64/32	30000h–3FFFFh	18000h–1FFFFh
SA7	0	1	0	0	X	X	X	64/32	40000h–4FFFFh	20000h–27FFFh
SA8	0	1	0	1	X	X	X	64/32	50000h–5FFFFh	28000h–2FFFFh
SA9	0	1	1	0	X	X	X	64/32	60000h–6FFFFh	30000h–37FFFh
SA10	0	1	1	1	X	X	X	64/32	70000h–7FFFFh	38000h–3FFFFh
SA11	1	0	0	0	X	X	X	64/32	80000h–8FFFFh	40000h–47FFFh
SA12	1	0	0	1	X	X	X	64/32	90000h–9FFFFh	48000h–4FFFFh
SA13	1	0	1	0	X	X	X	64/32	A0000h–AFFFFh	50000h–57FFFh
SA14	1	0	1	1	X	X	X	64/32	B0000h–BFFFFh	58000h–5FFFFh
SA15	1	1	0	0	X	X	X	64/32	C0000h–CFFFFh	60000h–67FFFh
SA16	1	1	0	1	X	X	X	64/32	D0000h–DFFFFh	68000h–6FFFFh
SA17	1	1	1	0	X	X	X	64/32	E0000h–EFFFFh	70000h–77FFFh
SA18	1	1	1	1	X	X	X	64/32	F0000h–FFFFFh	78000h–7FFFFh

Note
Address range is A18:A-1 in byte mode and A19:A0 in word mode. See the Word/Byte Configuration on page 8.

Secured Silicon Sector Addresses (Bottom Boot)

Sector Size (bytes/words)	x8 Address Range	x16 Address Range
256/128	000000h–0000FFh	00000h–0007Fh

7.9 Autoselect Mode

The autoselect mode provides manufacturer and device identification, and sector group protection verification, through identifier codes output on DQ7–DQ0. This mode is primarily intended for programming equipment to automatically match a device to be programmed with its corresponding programming algorithm. However, the autoselect codes can also be accessed in-system through the command register.

When using programming equipment, the autoselect mode requires V_{ID} (8.5 V to 12.5 V) on address pin A9. Address pins A6 and A3–A0 must be as shown in Table . In addition, when verifying sector group protection, the sector address must appear on the appropriate highest order address bits (see Table on page 11 and Table on page 12). Table shows the remaining address bits that are don't care. When all necessary bits have been set as required, the programming equipment may then read the corresponding identifier code on DQ7-DQ0.

To access the autoselect codes in-system, the host system can issue the autoselect command via the command register, as shown in Table on page 25. This method does not require V_{ID}. See *Command Definitions* on page 21 for details on using the autoselect mode.

S29AL008J Autoselect Codes (High Voltage Method)

Description	Mode	CE#	OE#	WE#	A18 to A10	A9	A8 to A7	A6	A5 to A4	A3 to A2	A1	A0	DQ8 to DQ15	DQ7 to DQ0
Manufacturer ID: Spansion		L	L	H	X	V_{ID}	X	L	X	L	L	L	X	01h
Device ID: S29AL008J (Top Boot Block)	Word	L	L	H	X	V_{ID}	X	L	X	L	L	H	22h	DAh
	Byte	L	L	H									X	DAh
Device ID: S29AL008J (Bottom Boot Block)	Word	L	L	H	X	V_{ID}	X	L	X	L	L	H	22h	5Bh
	Byte	L	L	H									X	5Bh
Sector Group Protection Verification		L	L	H	SA	V_{ID}	X	L	X	L	H	L	X	01h (protected)
													X	00h (unprotected)
Secured Silicon Sector Indicator Bit (DQ7) Top Boot Block		L	L	H	X	V_{ID}	X	L	X	L	H	H	X	8Eh (factory locked) 0Eh (not factory locked)
Secured Silicon Sector Indicator Bit (DQ7) Bottom Boot Block		L	L	H	X	V_{ID}	X	L	X	L	H	H	X	96h (factory locked) 16h (not factory locked)

Legend
L = Logic Low = V_{IL}, H = Logic High = V_{IH}, SA = Sector Address; X = Don't care

Note
The autoselect codes may also be accessed in-system via command sequences. See Table on page 25.

7.10 Sector Group Protection/Unprotection

The hardware sector group protection feature disables both program and erase operations in any sector group (see Table on page 11 to Table on page 12). The hardware sector group unprotection feature re-enables both program and erase operations in previously protected sector groups. Sector group protection/unprotection can be implemented via two methods.

Sector protection/unprotection requires V_{ID} on the RESET# pin only, and can be implemented either in-system or via programming equipment. Figure 7.2 on page 15 shows the algorithms and Figure 17.11 on page 41 shows the timing diagram. This method uses standard microprocessor bus cycle timing. For sector group unprotect, all unprotected sector groups must first be protected prior to the first sector group unprotect write cycle.

The device is shipped with all sector groups unprotected. Spansion offers the option of programming and protecting sector groups at its factory prior to shipping the device through Spansion Programming Service. Contact a Spansion representative for details.

It is possible to determine whether a sector group is protected or unprotected. See *Autoselect Mode* on page 12 for details.

S29AL008J Top Boot Device Sector/Sector Group Protection

Sector / Sector Block	A18	A17	A16	A15	A14	A13	A12	Sector / Sector Block Size
SA0-SA3	0	0	X	X	X	X	X	256 (4x64) Kbytes
SA4-SA7	0	1	X	X	X	X	X	256 (4x64) Kbytes
SA8-SA11	1	0	X	X	X	X	X	256 (4x64) Kbytes
SA12-SA13	1	1	0	X	X	X	X	128 (2x64) Kbytes
SA14	1	1	1	0	X	X	X	64 Kbytes
SA15	1	1	1	1	0	X	X	32 Kbytes
SA16	1	1	1	1	1	0	0	8 Kbytes
SA17	1	1	1	1	1	0	1	8 Kbytes
SA18	1	1	1	1	1	1	X	16 Kbytes

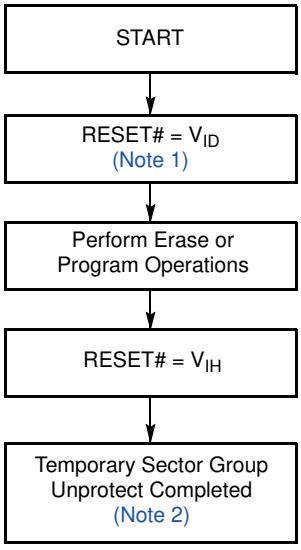
S29AL008J Bottom Boot Device Sector/Sector Group Protection

Sector / Sector Block	A18	A17	A16	A15	A14	A13	A12	Sector / Sector Block Size
SA0	0	0	0	0	0	0	X	16 Kbytes
SA1	0	0	0	0	0	1	0	8 Kbytes
SA2	0	0	0	0	0	1	1	8 Kbytes
SA3	0	0	0	0	1	X	X	32 Kbytes
SA4	0	0	0	1	X	X	X	64 Kbytes
SA5-SA6	0	0	1	X	X	X	X	128 (2x64) Kbytes
SA7-SA10	0	1	X	X	X	X	X	256 (4x64) Kbytes
SA11-SA14	1	0	X	X	X	X	X	256 (4x64) Kbytes
SA15-SA18	1	1	X	X	X	X	X	256 (4x64) Kbytes

7.11 Temporary Sector Group Unprotect

This feature allows temporary unprotection of previously protected sector groups to change data in-system. The Sector Group Unprotect mode is activated by setting the RESET# pin to V_{ID}. During this mode, formerly protected sector groups can be programmed or erased by selecting the sector addresses. Once V_{ID} is removed from the RESET# pin, all the previously protected sector groups are protected again. Figure 7.1 shows the algorithm, and Figure 17.11 on page 41 shows the timing diagrams, for this feature.

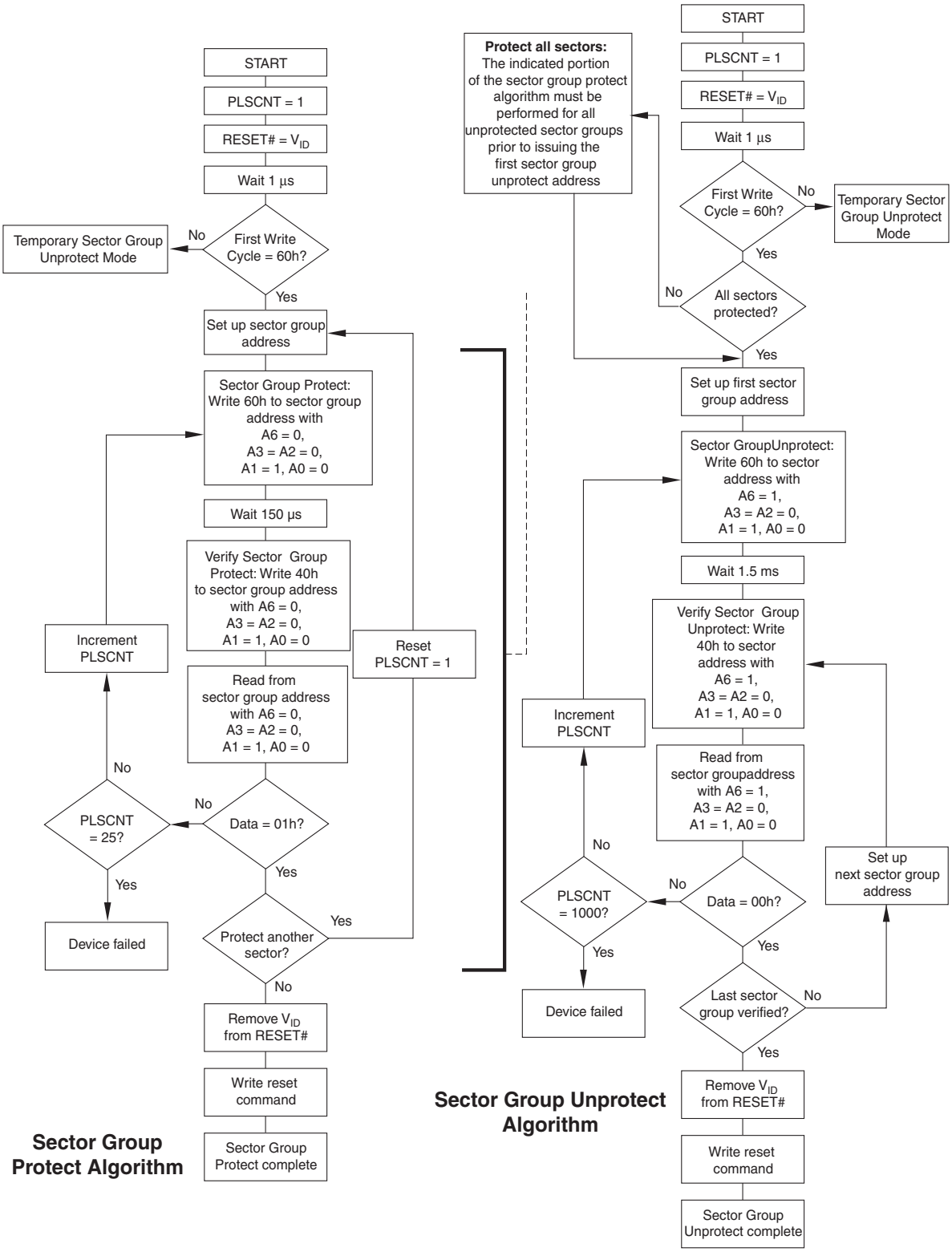
Figure 7.1 Temporary Sector Group Unprotect Operation



Notes

1. *All protected sector groups unprotected. (If WP# = V_{IL}, the highest or lowest address sector remains protected for uniform sector devices; the top or bottom two address sectors remains protected for boot sector devices).*
2. *All previously protected sector groups are protected once again.*

Figure 7.2 In-System Sector Group Protect/Unprotect Algorithms



8. Secured Silicon Sector Flash Memory Region

The Secured Silicon Sector feature provides a 256-byte Flash memory region that enables permanent part identification through an Electronic Serial Number (ESN). The Secured Silicon Sector uses a Secured Silicon Sector Indicator Bit (DQ7) to indicate whether or not the Secured Silicon Sector is locked when shipped from the factory. This bit is permanently set at the factory and cannot be changed, which prevents cloning of a factory-locked part. This ensures the security of the ESN once the product is shipped to the field.

Spansion offers the device with the Secured Silicon Sector either factory-locked or customer-lockable. The factory-locked version is always protected when shipped from the factory, and has the Secured Silicon Sector Indicator Bit permanently set to a *1*. The customer-lockable version is shipped with the Secured Silicon Sector unprotected, allowing customers to utilize the that sector in any manner they choose. The customer-lockable version has the Secured Silicon Sector Indicator Bit permanently set to a *0*. Thus, the Secured Silicon Sector Indicator Bit prevents customer-lockable devices from being used to replace devices that are factory locked.

The system accesses the Secured Silicon Sector through a command sequence (see Enter Secured Silicon Sector/Exit Secured Silicon Sector Command Sequence on page 22). After the system writes the Enter Secured Silicon Sector command sequence, it may read the Secured Silicon Sector by using the addresses normally occupied by the boot sectors. This mode of operation continues until the system issues the Exit Secured Silicon Sector command sequence, or until power is removed from the device. On power-up, or following a hardware reset, the device reverts to sending commands to the boot sectors.

8.1 Factory Locked: Secured Silicon Sector Programmed and Protected at the Factory

In a factory locked device, the Secured Silicon Sector is protected when the device is shipped from the factory. The Secured Silicon Sector cannot be modified in any way. The device is available pre-programmed with one of the following:

- A random, secure ESN only.
- Customer code through the ExpressFlash service.
- Both a random, secure ESN and customer code through the ExpressFlash service.

In devices that have an ESN, a Bottom Boot device has the 16-byte (8-word) ESN in sector 0 at addresses 00000h–0000Fh in byte mode (or 00000h–00007h in word mode). In the Top Boot device, the ESN is in sector 18 at addresses FFFF0h–FFFFFh in byte mode (or 7FFF8h–7FFFFh in word mode).

Customers may opt to have their code programmed by Spansion through the Spansion ExpressFlash service. Spansion programs the customer's code, with or without the random ESN. The devices are then shipped from the Spansion factory with the Secured Silicon Sector permanently locked. Contact a Spansion representative for details on using the Spansion ExpressFlash service.

8.2 Customer Lockable: Secured Silicon Sector NOT Programmed or Protected at the Factory

The customer lockable version allows the Secured Silicon Sector to be programmed once, and then permanently locked after it ships from Spansion. Note that the unlock bypass functions is not available when programming the Secured Silicon Sector.

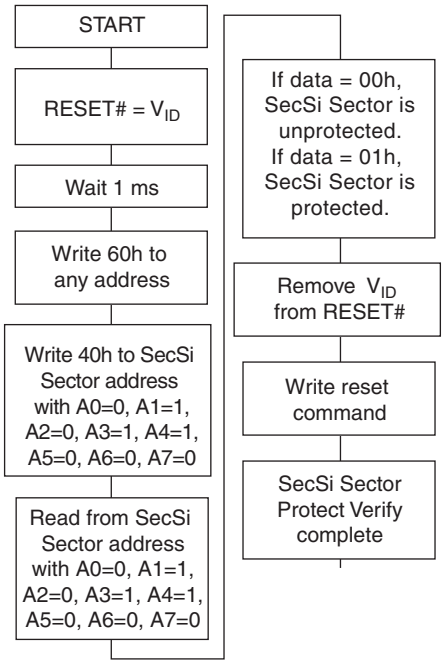
The Secured Silicon Sector area can be protected using the following procedures:

- Write the three-cycle Enter Secured Silicon Region command sequence, and then follow the in-system sector group protect algorithm as shown in Figure 7.2 on page 15, substituting the sector group address with the Secured Silicon Sector group address (A0=0, A1=1, A2=0, A3=1, A4=1, A5=0, A6=0, A7=0). Note that this method is only applicable to the Secured Silicon Sector.
- To verify the protect/unprotect status of the Secured Silicon Sector, follow the algorithm shown in Figure 8.1 on page 17.

Once the Secured Silicon Sector is locked and verified, the system must write the Exit Secured Silicon Sector Region command sequence to return to reading and writing the remainder of the array.

The Secured Silicon Sector protection must be used with caution since, once protected, there is no procedure available for unprotecting the Secured Silicon Sector area, and none of the bits in the Secured Silicon Sector memory space can be modified in any way.

Figure 8.1 Secured Silicon Sector Protect Verify



9. Common Flash Memory Interface (CFI)

The Common Flash Interface (CFI) specification outlines device and host system software interrogation handshake, which allows specific vendor-specified software algorithms to be used for entire families of devices. Software support can then be device-independent, JEDEC ID-independent, and forward- and backward-compatible for the specified flash device families. Flash vendors can standardize their existing interfaces for long-term compatibility.

This device enters the CFI Query mode when the system writes the CFI Query command, 98h, to address 55h in word mode (or address AAh in byte mode), any time the device is ready to read array data. The system can read CFI information at the addresses given in Table to Table on page 19. In word mode, the upper address bits (A7–MSB) must be all zeros. To terminate reading CFI data, the system must write the reset command.

The system can also write the CFI query command when the device is in the autoselect mode. The device enters the CFI query mode, and the system can read CFI data at the addresses given in Table to Table on page 19. The system must write the reset command to return the device to the autoselect mode.

CFI Query Identification String

Addresses (Word Mode)	Addresses (Byte Mode)	Data	Description
10h 11h 12h	20h 22h 24h	0051h 0052h 0059h	Query Unique ASCII string “QRY”
13h 14h	26h 28h	0002h 0000h	Primary OEM Command Set
15h 16h	2Ah 2Ch	0040h 0000h	Address for Primary Extended Table
17h 18h	2Eh 30h	0000h 0000h	Alternate OEM Command Set (00h = none exists)
19h 1Ah	32h 34h	0000h 0000h	Address for Alternate OEM Extended Table (00h = none exists)

System Interface String

Addresses (Word Mode)	Addresses (Byte Mode)	Data	Description
1Bh	36h	0027h	V_{CC} Min. (write/erase) D7–D4: volt, D3–D0: 100 millivolt
1Ch	38h	0036h	V_{CC} Max. (write/erase) D7–D4: volt, D3–D0: 100 millivolt
1Dh	3Ah	0000h	V_{PP} Min. voltage (00h = no V_{PP} pin present)
1Eh	3Ch	0000h	V_{PP} Max. voltage (00h = no V_{PP} pin present)
1Fh	3Eh	0003h	Typical timeout per single byte/word write 2^N µs
20h	40h	0000h	Typical timeout for Min. size buffer write 2^N µs (00h = not supported)
21h	42h	0009h	Typical timeout per individual block erase 2^N ms
22h	44h	0000h	Typical timeout for full chip erase 2^N ms (00h = not supported)
23h	46h	0005h	Max. timeout for byte/word write 2^N times typical
24h	48h	0000h	Max. timeout for buffer write 2^N times typical
25h	4Ah	0004h	Max. timeout per individual block erase 2^N times typical
26h	4Ch	0000h	Max. timeout for full chip erase 2^N times typical (00h = not supported)

Device Geometry Definition

Addresses (Word Mode)	Addresses (Byte Mode)	Data	Description
27h	4Eh	0014h	Device Size = 2^N byte
28h 29h	50h 52h	0002h 0000h	Flash Device Interface description (refer to CFI publication 100)
2Ah 2Bh	54h 56h	0000h 0000h	Max. number of byte in multi-byte write = 2^N (00h = not supported)
2Ch	58h	0004h	Number of Erase Block Regions within device
2Dh 2Eh 2Fh 30h	5Ah 5Ch 5Eh 60h	0000h 0000h 0040h 0000h	Erase Block Region 1 Information (refer to the CFI specification or CFI publication 100)
31h 32h 33h 34h	62h 64h 66h 68h	0001h 0000h 0020h 0000h	Erase Block Region 2 Information
35h 36h 37h 38h	6Ah 6Ch 6Eh 70h	0000h 0000h 0080h 0000h	Erase Block Region 3 Information
39h 3Ah 3Bh 3Ch	72h 74h 76h 78h	000Eh 0000h 0000h 0001h	Erase Block Region 4 Information

Primary Vendor-Specific Extended Query (Sheet 1 of 2)

Addresses (Word Mode)	Addresses (Byte Mode)	Data	Description
40h 41h 42h	80h 82h 84h	0050h 0052h 0049h	Query-unique ASCII string “PRI”
43h	86h	0031h	Major version number, ASCII
44h	88h	0033h	Minor version number, ASCII
45h	8Ah	000Ch	Address Sensitive Unlock 0 = Required, 1 = Not Required Process Technology (Bits 5-2) 0011b = 0.11 µm Floating Gate NOR
46h	8Ch	0002h	Erase Suspend 0 = Not Supported, 1 = To Read Only, 2 = To Read & Write
47h	8Eh	0001h	Sector Group Protect 0 = Not Supported, X= Number of sectors in smallest sector group
48h	90h	0001h	Sector Group Temporary Unprotect 00 = Not Supported, 01 = Supported
49h	92h	0004h	Sector Group Protect/Unprotect scheme 01 = 29F040 mode, 02 = 29F016 mode, 03 = 29F400 mode, 04 = 29LV800A mode
4Ah	94h	0000h	Simultaneous Operation 00 = Not Supported, 01 = Supported
4Bh	96h	0000h	Burst Mode Type 00 = Not Supported, 01 = Supported
4Ch	98h	0000h	Page Mode Type 00 = Not Supported, 01 = 4 Word Page, 02 = 8 Word Page
4Dh	9Ah	0000h	ACC (Acceleration) Supply Minimum 00 = Not Supported, D7-D4: Volt, D3-D0: 100mV
4Eh	9Ch	0000h	ACC (Acceleration) Supply Maximum 00 = Not Supported, D7-D4: Volt, D3-D0: 100mV

Primary Vendor-Specific Extended Query (Sheet 2 of 2)

Addresses (Word Mode)	Addresses (Byte Mode)	Data	Description
4Fh	9Eh	00XXh	WP# Protection 00 = Uniform Device without WP Protect 01 = Boot Device with TOP and Bottom WP Protect 02 = Bottom Boot Device with WP Protect 03 = Top Boot Device with WP Protect 04 = Uniform Device with Bottom WP Protect 05 = Uniform Device with Top WP Protect 06 = Uniform Device with All Sectors WP Protect
50h	A0h	00XXh	Program Suspend 00 = Not Supported, 01 = Supported

9.1 Hardware Data Protection

The command sequence requirement of unlock cycles for programming or erasing provides data protection against inadvertent writes (refer to Table on page 25 for command definitions). In addition, the following hardware data protection measures prevent accidental erasure or programming, which might otherwise be caused by spurious system level signals during V_{CC} power-up and power-down transitions, or from system noise.

9.1.1 Low V_{CC} Write Inhibit

When V_{CC} is less than V_{LKO}, the device does not accept any write cycles. This protects data during V_{CC} power-up and power-down. The command register and all internal program/erase circuits are disabled, and the device resets. Subsequent writes are ignored until V_{CC} is greater than V_{LKO}. The system must provide the proper signals to the control pins to prevent unintentional writes when V_{CC} is greater than V_{LKO}.

9.1.2 Write Pulse Glitch Protection

Noise pulses of less than 5 ns (typical) on OE#, CE# or WE# do not initiate a write cycle.

9.1.3 Logical Inhibit

Write cycles are inhibited by holding any one of OE# = V_{IL}, CE# = V_{IH} or WE# = V_{IH}. To initiate a write cycle, CE# and WE# must be a logical zero while OE# is a logical one.

9.1.4 Power-Up Write Inhibit

If WE# = CE# = V_{IL} and OE# = V_{IH} during power up, the device does not accept commands on the rising edge of WE#. The internal state machine is automatically reset to reading array data on power-up.

10. Command Definitions

Writing specific address and data commands or sequences into the command register initiates device operations. Table on page 25 defines the valid register command sequences. Writing **incorrect address and data values** or writing them in the **improper sequence** resets the device to reading array data.

All addresses are latched on the falling edge of WE# or CE#, whichever happens later. All data is latched on the rising edge of WE# or CE#, whichever happens first. Refer to the appropriate timing diagrams in *AC Characteristics* on page 35.

10.1 Reading Array Data

The device is automatically set to reading array data after device power-up. No commands are required to retrieve data. The device is also ready to read array data after completing an Embedded Program or Embedded Erase algorithm.

After the device accepts an Erase Suspend command, the device enters the Erase Suspend mode. The system can read array data using the standard read timings, except that if it reads at an address within erase-suspended sectors, the device outputs status data. After completing a programming operation in the Erase Suspend mode, the system may once again read array data with the same exception. See *Erase Suspend/Erase Resume Commands* on page 24 for more information on this mode.

The system *must* issue the reset command to re-enable the device for reading array data if DQ5 goes high, or while in the autoselect mode. See *Reset Command* on page 21.

See also *Requirements for Reading Array Data* on page 8 for more information. The *Read Operations* on page 35 provides the read parameters, and Figure 17.1 on page 35 shows the timing diagram.

10.2 Reset Command

Writing the reset command to the device resets the device to reading array data. Address bits are don't care for this command.

The reset command may be written between the sequence cycles in an erase command sequence before erasing begins. This resets the device to reading array data. Once erasure begins, however, the device ignores reset commands until the operation is complete.

The reset command may be written between the sequence cycles in a program command sequence before programming begins. This resets the device to reading array data (also applies to programming in Erase Suspend mode). Once programming begins, however, the device ignores reset commands until the operation is complete.

The reset command may be written between the sequence cycles in an autoselect command sequence. Once in the autoselect mode, the reset command *must* be written to return to reading array data (also applies to autoselect during Erase Suspend).

If DQ5 goes high during a program or erase operation, writing the reset command returns the device to reading array data (also applies during Erase Suspend).

10.3 Autoselect Command Sequence

The autoselect command sequence allows the host system to access the manufacturer and devices codes, and determine whether or not a sector is protected. Table on page 25 shows the address and data requirements. This method is an alternative to that shown in Table on page 13, which is intended for PROM programmers and requires V_{ID} on address bit A9.

The autoselect command sequence is initiated by writing two unlock cycles, followed by the autoselect command. The device then enters the autoselect mode, and the system may read at any address any number of times, without initiating another command sequence.

A read cycle at address XX00h retrieves the manufacturer code. A read cycle at address XX01h returns the device code. A read cycle containing a sector address (SA) and the address 02h in word mode (or 04h in byte mode) returns 01h if that sector is protected, or 00h if it is unprotected. Refer to Table on page 11 and Table on page 12 for valid sector addresses.

The system must write the reset command to exit the autoselect mode and return to reading array data.

10.4 Enter Secured Silicon Sector/Exit Secured Silicon Sector Command Sequence

The Secured Silicon Sector region provides a secured data area containing a random, sixteen-byte electronic serial number (ESN). The system can access the Secured Silicon Sector region by issuing the three-cycle Enter Secured Silicon Sector command sequence. The device continues to access the Secured Silicon Sector region until the system issues the four-cycle Exit Secured Silicon Sector command sequence. The Exit Secured Silicon Sector command sequence returns the device to normal operation. Table on page 25 shows the addresses and data requirements for both command sequences. Note that the unlock bypass mode is not available when the device enters the Secured Silicon Sector. See also Secured Silicon Sector Flash Memory Region on page 16 for further information.

10.5 Word/Byte Program Command Sequence

The system may program the device by word or byte, depending on the state of the BYTE# pin. Programming is a four-bus-cycle operation. The program command sequence is initiated by writing two unlock write cycles, followed by the program set-up command. The program address and data are written next, which in turn initiate the Embedded Program algorithm. The system is *not* required to provide further controls or timings. The device automatically generates the program pulses and verifies the programmed cell margin. Table on page 25 shows the address and data requirements for the byte program command sequence.

When the Embedded Program algorithm is complete, the device then returns to reading array data and addresses are no longer latched. The system can determine the status of the program operation by using DQ7, DQ6, or RY/BY#. See *Write Operation Status* on page 27 for information on these status bits.

Any commands written to the device during the Embedded Program Algorithm are ignored. Note that a **hardware reset** immediately terminates the programming operation. The Byte Program command sequence should be reinitiated once the device has reset to reading array data, to ensure data integrity.

Programming is allowed in any sequence and across sector boundaries. **A bit cannot be programmed from a *0* back to a *1*.** Attempting to do so may halt the operation and set DQ5 to *1*, or cause the Data# Polling algorithm to indicate the operation was successful. However, a succeeding read will show that the data is still *0*. Only erase operations can convert a *0* to a *1*.

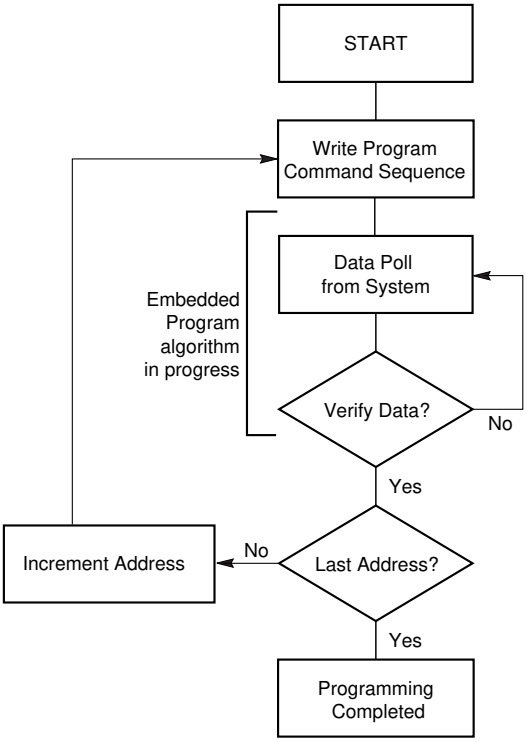
10.6 Unlock Bypass Command Sequence

The unlock bypass feature allows the system to program bytes or words to the device faster than using the standard program command sequence. The unlock bypass command sequence is initiated by first writing two unlock cycles. This is followed by a third write cycle containing the unlock bypass command, 20h. The device then enters the unlock bypass mode. A two-cycle unlock bypass program command sequence is all that is required to program in this mode. The first cycle in this sequence contains the unlock bypass program command, A0h; the second cycle contains the program address and data. Additional data is programmed in the same manner. This mode dispenses with the initial two unlock cycles required in the standard program command sequence, resulting in faster total programming time. Table on page 25 shows the requirements for the command sequence.

During the unlock bypass mode, only the Unlock Bypass Program and Unlock Bypass Reset commands are valid. To exit the unlock bypass mode, the system must issue the two-cycle unlock bypass reset command sequence. The first cycle must contain the data 90h; the second cycle the data 00h. Addresses are don't care for both cycles. The device then returns to reading array data.

Figure 10.1 on page 23 illustrates the algorithm for the program operation. See *Erase/Program Operations* on page 38 for parameters, and to Figure 17.5 on page 38 for timing diagrams.

Figure 10.1 Program Operation



Note
See Table on page 25 for program command sequence.

10.7 Chip Erase Command Sequence

Chip erase is a six bus cycle operation. The chip erase command sequence is initiated by writing two unlock cycles, followed by a set-up command. Two additional unlock write cycles are then followed by the chip erase command, which in turn invokes the Embedded Erase algorithm. The device does *not* require the system to preprogram prior to erase. The Embedded Erase algorithm automatically preprograms and verifies the entire memory for an all zero data pattern prior to electrical erase. The system is not required to provide any controls or timings during these operations. Table on page 25 shows the address and data requirements for the chip erase command sequence.

Any commands written to the chip during the Embedded Erase algorithm are ignored. Note that a **hardware reset** during the chip erase operation immediately terminates the operation. The Chip Erase command sequence should be reinitiated once the device has returned to reading array data, to ensure data integrity.

The system can determine the status of the erase operation by using DQ7, DQ6, DQ2, or RY/BY#. See *Write Operation Status* on page 27 for information on these status bits. When the Embedded Erase algorithm is complete, the device returns to reading array data and addresses are no longer latched.

Figure 10.2 on page 25 illustrates the algorithm for the erase operation. See *Erase/Program Operations* on page 38 for parameters, and Figure 17.6 on page 39 for timing diagrams.

10.8 Sector Erase Command Sequence

Sector erase is a six bus cycle operation. The sector erase command sequence is initiated by writing two unlock cycles, followed by a set-up command. Two additional unlock write cycles are then followed by the address of the sector to be erased, and the sector erase command. Table on page 25 shows the address and data requirements for the sector erase command sequence.

The device does *not* require the system to preprogram the memory prior to erase. The Embedded Erase algorithm automatically programs and verifies the sector for an all zero data pattern prior to electrical erase. The system is not required to provide any controls or timings during these operations.

After the command sequence is written, a sector erase time-out of 50 µs begins. During the time-out period, additional sector addresses and sector erase commands may be written. However, these additional erase commands are only one bus cycle long and should be identical to the sixth cycle of the standard erase command explained above. Loading the sector erase buffer may be done in any sequence, and the number of sectors may be from one sector to all sectors. The time between these additional cycles must be less than 50 µs, otherwise the last address and command might not be accepted, and erasure may begin. It is recommended that processor interrupts be disabled during this time to ensure all commands are accepted. The interrupts can be re-enabled after the last Sector Erase command is written. If the time between additional sector erase commands can be assumed to be less than 50 µs, the system need not monitor DQ3. **Any command other than Sector Erase or Erase Suspend during the time-out period resets the device to reading array data.** The system must rewrite the command sequence and any additional sector addresses and commands.

The system can monitor DQ3 to determine if the sector erase timer has timed out. (See *DQ3: Sector Erase Timer* on page 31.) The time-out begins from the rising edge of the final WE# pulse in the command sequence.

Once the sector erase operation has begun, only the Erase Suspend command is valid. All other commands are ignored. Note that a **hardware reset** during the sector erase operation immediately terminates the operation. The Sector Erase command sequence should be reinitiated once the device has returned to reading array data, to ensure data integrity.

When the Embedded Erase algorithm is complete, the device returns to reading array data and addresses are no longer latched. The system can determine the status of the erase operation by using DQ7, DQ6, DQ2, or RY/BY#. (Refer to *Write Operation Status* on page 27 for information on these status bits.)

Figure 10.2 on page 25 illustrates the algorithm for the erase operation. Refer to *Erase/Program Operations* on page 38 for parameters, and to Figure 17.6 on page 39 for timing diagrams.

10.9 Erase Suspend/Erase Resume Commands

The Erase Suspend command allows the system to interrupt a sector erase operation and then read data from, or program data to, any sector not selected for erasure. This command is valid only during the sector erase operation, including the 50 µs time-out period during the sector erase command sequence. The Erase Suspend command is ignored if written during the chip erase operation or Embedded Program algorithm. Writing the Erase Suspend command during the Sector Erase time-out immediately terminates the time-out period and suspends the erase operation. Addresses are *don't-cares* when writing the Erase Suspend command.

When the Erase Suspend command is written during a sector erase operation, the device requires a maximum of 35 µs to suspend the erase operation. However, when the Erase Suspend command is written during the sector erase time-out, the device immediately terminates the time-out period and suspends the erase operation.

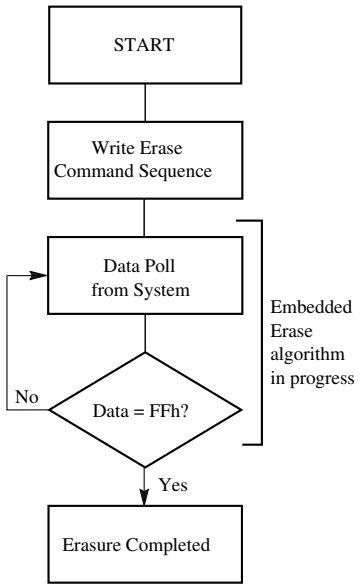
After the erase operation has been suspended, the system can read array data from or program data to any sector not selected for erasure. (The device "erase suspends" all sectors selected for erasure.) Normal read and write timings and command definitions apply. Reading at any address within erase-suspended sectors produces status data on DQ7–DQ0. The system can use DQ7, or DQ6 and DQ2 together, to determine if a sector is actively erasing or is erase-suspended. See *Write Operation Status* on page 27 for information on these status bits.

After an erase-suspended program operation is complete, the system can once again read array data within non-suspended sectors. The system can determine the status of the program operation using the DQ7 or DQ6 status bits, just as in the standard program operation. See *Write Operation Status* on page 27 for more information.

The system may also write the autoselect command sequence when the device is in the Erase Suspend mode. The device allows reading autoselect codes even at addresses within erasing sectors, since the codes are not stored in the memory array. When the device exits the autoselect mode, the device reverts to the Erase Suspend mode, and is ready for another valid operation. See *Autoselect Command Sequence* on page 21 for more information.

The system must write the Erase Resume command (address bits are *don't care*) to exit the erase suspend mode and continue the sector erase operation. Further writes of the Resume command are ignored. Another Erase Suspend command can be written after the device has resumed erasing.

Figure 10.2 Erase Operation



Notes

1. *See Table on page 25 for erase command sequence.*
2. *See DQ3: Sector Erase Timer on page 31 for more information.*

10.10 Command Definitions Table

S29AL008J Command Definitions

Command Sequence (Note 1)			Cycles	Bus Cycles (Notes 2–5)											
				First		Second		Third		Fourth		Fifth		Sixth	
				Addr	Data	Addr	Data	Addr	Data	Addr	Data	Addr	Data	Addr	Data
Read (Note 6)			1	RA	RD										
Reset (Note 7)			1	XXX	F0										
Autoselect (Note 8)	Manufacturer ID	Word	4	555	AA	2AA	55	555	90	X00	01				
		Byte		AAA		555		AAA							
	Device ID, Top Boot Block	Word	4	555	AA	2AA	55	555	90	X01	22DA				
		Byte		AAA		555		AAA		X02	DA				
	Device ID, Bottom Boot Block	Word	4	555	AA	2AA	55	555	90	X01	225B				
		Byte		AAA		555		AAA		X02	5B				
	Sector Group Protect Verify (Note 9)	Word	4	555	AA	2AA	55	555	90	(SA) X02	XX00				
											XX01				
		Byte		AAA		555		AAA		(SA) X04	00				
											01				
Enter Secured Silicon Sector		Word	3	555	AA	2AA	55	555	88						
		Byte		AAA		555		AAA							
Exit Secured Silicon Sector		Word	4	555	AA	2AA	55	555	90	XXX	00				
		Byte		AAA		555		AAA							