



MACRONIX
INTERNATIONAL CO., LTD.

MX25L25635E

MX25L25635E
HIGH PERFORMANCE
SERIAL FLASH SPECIFICATION

Contents

FEATURES	5
GENERAL DESCRIPTION	7
Table 1. Additional Features	7
PIN CONFIGURATION	8
PIN DESCRIPTION	8
BLOCK DIAGRAM.....	9
DATA PROTECTION.....	10
Table 2. Protected Area Sizes	11
Table 3. 4K-bit Secured OTP Definition.....	11
Memory Organization.....	12
Table 4. Memory Organization	12
DEVICE OPERATION	13
Figure 1. Serial Modes Supported (for Normal Serial mode)	13
HOLD FEATURES	14
Figure 2. Hold Condition Operation	14
COMMAND DESCRIPTION.....	15
Table 5. Command Sets	15
(1) Write Enable (WREN)	17
(2) Write Disable (WRDI).....	17
(3) Read Identification (RDID).....	17
(4) Read Status Register (RDSR)	18
(5) Write Status Register (WRSR).....	19
Protection Modes	19
(6) Enter 4-byte mode (EN4B).....	20
(7) Exit 4-byte mode (EX4B)	20
(8) Read Data Bytes (READ)	20
(9) Read Data Bytes at Higher Speed (FAST_READ)	20
(10) 2 x I/O Read Mode (2READ)	21
(11) 4 x I/O Read Mode (4READ).....	21
(12) Sector Erase (SE).....	22
(13) Block Erase (BE).....	22
(14) Block Erase (BE32K)	22
(15) Chip Erase (CE).....	23
(16) Page Program (PP).....	23
(17) 4 x I/O Page Program (4PP).....	24
Program/Erase Flow(1) - verify by reading array data	25
Program/Erase Flow(2) - verify by reading program/erase fail flag bit.....	26
(18) Continuously program mode (CP mode)	27
(19) Parallel Mode (Highly recommended for production throughputs increasing)	27
(20) Deep Power-down (DP)	28
(21) Release from Deep Power-down (RDP), Read Electronic Signature (RES)	28
(22) Read Electronic Manufacturer ID & Device ID (REMS), (REMS2), (REMS4)	28
Table 6. ID Definitions	29
(23) Enter Secured OTP (ENSO).....	29

(24) Exit Secured OTP (EXSO).....	29
(25) Read Security Register (RDSCUR)	29
Security Register Definition	30
(26) Write Security Register (WRSCUR).....	30
(27) Write Protection Selection (WPSEL).....	31
BP and SRWD if WPSEL=0	31
The individual block lock mode is effective after setting WPSEL=1	32
WPSEL Flow	33
(28) Single Block Lock/Unlock Protection (SBLK/SBULK).....	34
Block Lock Flow	34
Block Unlock Flow	35
(29) Read Block Lock Status (RDBLOCK).....	36
(30) Gang Block Lock/Unlock (GBLK/GBULK).....	36
(31) Clear SR Fail Flags (CLSR).....	36
(32) Enable SO to Output RY/BY# (ESRY).....	36
(33) Disable SO to Output RY/BY# (DSRY).....	36
(34) Read DMC mode (RDDMC)	37
Discoverable Memory Capabilities (DMC) Signature and Parameter Identification Data Values (Advanced Information)	37
Parameter ID (0) (Advanced Information)	38
Parameter ID (1) (Advanced Information)	39
Parameter ID (2) (Advanced Information)	39
POWER-ON STATE	40
ELECTRICAL SPECIFICATIONS	41
ABSOLUTE MAXIMUM RATINGS	41
Figure 3. Maximum Negative Overshoot Waveform	41
CAPACITANCE TA = 25°C, f = 1.0 MHz.....	41
Figure 4. Maximum Positive Overshoot Waveform	41
Figure 5. OUTPUT LOADING	42
Table 7. DC CHARACTERISTICS (Temperature = -40°C to 85°C for Industrial grade, VCC = 2.7V ~ 3.6V) .	43
Table 8. AC CHARACTERISTICS (Temperature = -40°C to 85°C for Industrial grade, VCC = 2.7V ~ 3.6V)	44
Timing Analysis	46
Figure 6. Serial Input Timing	46
Figure 7. Output Timing.....	46
Figure 8. Hold Timing	47
Figure 9. WP# Setup Timing and Hold Timing during WRSR when SRWD=1.....	47
Figure 10. Write Enable (WREN) Sequence (Command 06).....	48
Figure 11. Write Disable (WRDI) Sequence (Command 04).....	48
Figure 12. Read Identification (RDID) Sequence (Command 9F).....	49
Figure 13. Read Status Register (RDSR) Sequence (Command 05).....	49
Figure 14. Write Status Register (WRSR) Sequence (Command 01).....	49
Figure 15. Read Data Bytes (READ) Sequence (Command 03)	50
Figure 16. Read at Higher Speed (FAST_READ) Sequence (Command 0B)	50
Figure 17. 2 x I/O Read Mode Sequence (Command BB).....	51
Figure 18. 4 x I/O Read Mode Sequence (Command EB).....	51
Figure 19. 4 x I/O Read Enhance Performance Mode Sequence (Command EB)	52

Figure 20. Sector Erase (SE) Sequence (Command 20).....	53
Figure 21. Block Erase (BE/EB32K) Sequence (Command D8/52).....	53
Figure 22. Chip Erase (CE) Sequence (Command 60 or C7).....	53
Figure 23. Page Program (PP) Sequence (Command 02).....	54
Figure 24. 4 x I/O Page Program (4PP) Sequence (Command 38).....	54
Figure 25. Continously Program (CP) Mode Sequence with Hardware Detection (Command AD).....	55
Figure 26-1. Enter Parallel Mode (ENPLM) Sequence (Command 55)	56
Figure 26-2. Exit Parallel Mode (EXPLM) Sequence (Command 45).....	56
Figure 26-3. Parallel Mode Read Identification (Parallel RDID) Sequence (Command 9F)	56
Figure 26-4. Parallel Mode Read Electronic Manufacturer & Device ID (Parallel REMS) Sequence (Command 90)	57
Figure 26-5. Parallel Mode Release from Deep Power-down (RDP) and Read Electronic Signature (RES) Sequence	57
Figure 26-6. Parallel Mode Read Array (Parallel READ) Sequence (Command 03)	58
Figure 26-7. Parallel Mode Page Program (Parallel PP) Sequence (Command 02)	58
Figure 27. Deep Power-down (DP) Sequence (Command B9).....	59
Figure 28. Release from Deep Power-down and Read Electronic Signature (RES) Sequence (Command AB)	59
Figure 29. Release from Deep Power-down (RDP) Sequence (Command AB)	59
Figure 30. Read Electronic Manufacturer & Device ID (REMS) Sequence (Command 90 or EF or DF).....	60
Figure 31. Write Protection Selection (WPSEL) Sequence (Command 68).....	60
Figure 32. Single Block Lock/Unlock Protection (SBLK/SBULK) Sequence (Command 36/39).....	61
Figure 33. Read Block Protection Lock Status (RDBLOCK) Sequence (Command 3C)	61
Figure 34. Gang Block Lock/Unlock (GBLK/GBULK) Sequence (Command 7E/98)	61
Figure 35. Power-up Timing	62
Table 9. Power-Up Timing	62
INITIAL DELIVERY STATE.....	62
RECOMMENDED OPERATING CONDITIONS.....	63
ERASE AND PROGRAMMING PERFORMANCE	64
DATA RETENTION	64
LATCH-UP CHARACTERISTICS	64
ORDERING INFORMATION	65
PART NAME DESCRIPTION	66
PACKAGE INFORMATION.....	67
REVISION HISTORY	68

256M-BIT [x 1/x 2/x 4] CMOS MXSMIO™ (SERIAL MULTI I/O) FLASH MEMORY**FEATURES****GENERAL**

- Serial Peripheral Interface compatible -- Mode 0 and Mode 3
- 268,435,456 x 1 bit structure or 134,217,728 x 2 bits (two I/O mode) structure or 67,108,864 x 4 bits (four I/O mode) structure
- 8192 Equal Sectors with 4K bytes each
 - Any Sector can be erased individually
- 1024 Equal Blocks with 32K bytes each
 - Any Block can be erased individually
- 512 Equal Blocks with 64K bytes each
 - Any Block can be erased individually
- Power Supply Operation
 - 2.7 to 3.6 volt for read, erase, and program operations
- Latch-up protected to 100mA from -1V to Vcc +1V

PERFORMANCE

- High Performance
 - VCC = 2.7~3.6V
 - Normal read
 - 50MHz
 - Fast read
 - 1 I/O: 80MHz with 8 dummy cycles
 - 2 I/O: 70MHz with 4 dummy cycles
 - 4 I/O: 70MHz with 6 dummy cycles
 - Fast program time: 1.4ms(typ.) and 5ms(max.)/page (256-byte per page)
 - Byte program time: 9us (typical)
 - Continuously Program mode (automatically increase address under word program mode)
 - Fast erase time: 60ms (typ.)/sector (4K-byte per sector) ; 0.5s(typ.) /block (32K-byte per block); 0.7s(typ.) /block (64K-byte per block); 160s(typ.) /chip
- Low Power Consumption
 - Low active read current: 45mA(max.) at 80MHz, 40mA(max.) at 70MHz and 30mA(max.) at 50MHz
 - Low active programming current: 25mA (max.)
 - Low active erase current: 25mA (max.)
 - Standby current: 200uA (max.)
 - Deep power down current: 80uA (max.)
- Typical 100,000 erase/program cycles

SOFTWARE FEATURES

- Input Data Format
 - 1-byte Command code
- Advanced Security Features
 - BP0-BP3 block group protect
 - Flexible individual block protect when OTP WPSEL=1

- Additional 4K bits secured OTP for unique identifier
- Auto Erase and Auto Program Algorithms
 - Automatically erases and verifies data at selected sector
 - Automatically programs and verifies data at selected page by an internal algorithm that automatically times the program pulse width (Any page to be programmed should have page in the erased state first.)
- Status Register Feature
- Electronic Identification
 - JEDEC 1-byte Manufacturer ID and 2-byte Device ID
 - RES command for 1-byte Device ID
 - Both REMS,REMS2, REMS4 commands for 1-byte Manufacturer ID and 1-byte Device ID
- Support Discoverable Memory Capabilities (DMC) signature

HARDWARE FEATURES

- SCLK Input
 - Serial clock input
- SI/SIO0
 - Serial Data Input or Serial Data Input/Output for 2 x I/O mode and 4 x I/O mode
- SO/SIO1/PO7
 - Serial Data Output or Serial Data Input/Output for 2 x I/O mode and 4 x I/O mode or Parallel Data
- WP#/SIO2
 - Hardware write protection or serial data Input/Output for 4 x I/O mode
- HOLD#/SIO3
 - HOLD# pin or serial data Input/Output for 4 x I/O mode, an internal weak pull up on the pin
- PO0~PO6
 - For parallel mode data
- PACKAGE
 - 16-pin SOP (300mil)
 - **All Pb-free devices are RoHS Compliant**

GENERAL DESCRIPTION

MX25L25635E is 268,435,456 bits serial Flash memory, which is configured as 33,554,432 x 8 internally. When it is in two or four I/O mode, the structure becomes 134,217,728 bits x 2 or 67,108,864 bits x 4. The MX25L25635E features a serial peripheral interface and software protocol allowing operation on a simple 3-wire bus. The three bus signals are a clock input (SCLK), a serial data input (SI), and a serial data output (SO). Serial access to the device is enabled by CS# input.

MX25L25635E, MXSMIO™ (Serial Multi I/O) flash memory, provides sequential read operation on whole chip and multi-I/O features.

When it is in dual I/O mode, the SI pin and SO pin become SIO0 pin and SIO1 pin for address/dummy bits input and data output. When it is in quad I/O mode, the SI pin, SO pin, WP# pin and HOLD# pin become SIO0 pin, SIO1 pin, SIO2 pin and SIO3 pin for address/dummy bits input and data Input/Output. Parallel mode is also provided in this device. It features 8 bit input/output for increasing throughputs. This feature is recommended to be used for factory production purpose.

After program/erase command is issued, auto program/ erase algorithms which program/ erase and verify the specified page or sector/block locations will be executed. Program command is executed on byte basis, or page (256 bytes) basis, or word basis for Continuously Program mode, and erase command is executes on sector (4K-byte), block (32K-byte/64K-byte), or whole chip basis.

To provide user with ease of interface, a status register is included to indicate the status of the chip. The status read command can be issued to detect completion status of a program or erase operation via WIP bit.

When the device is not in operation and CS# is high, it is put in standby mode and draws less than 200uA DC current.

The MX25L25635E utilizes Macronix's proprietary memory cell, which reliably stores memory contents even after 100,000 program and erase cycles.

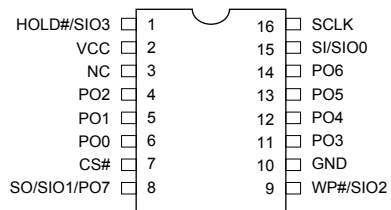
Table 1. Additional Features

Part Name	Additional Features	Protection and Security		Read Performance			
	Flexible or Individual block (or sector) protection	4K-bit secured OTP	1 I/O Read (80 MHz)	2 I/O Read (70 MHz)	4 I/O Read (70 MHz)	8 I/O Parallel Mode (6 MHz)	
MX25L25635E	V	V	V	V	V	V	

Part Name	Additional Features	Identifier				
		RES (command: AB hex)	REMS (command: 90 hex)	REMS2 (command: EF hex)	REMS4 (command: DF hex)	RDID (command: 9F hex)
MX25L25635E		18 (hex)	C2 18 (hex)	C2 18 (hex)	C2 18 (hex)	C2 20 19 (hex)

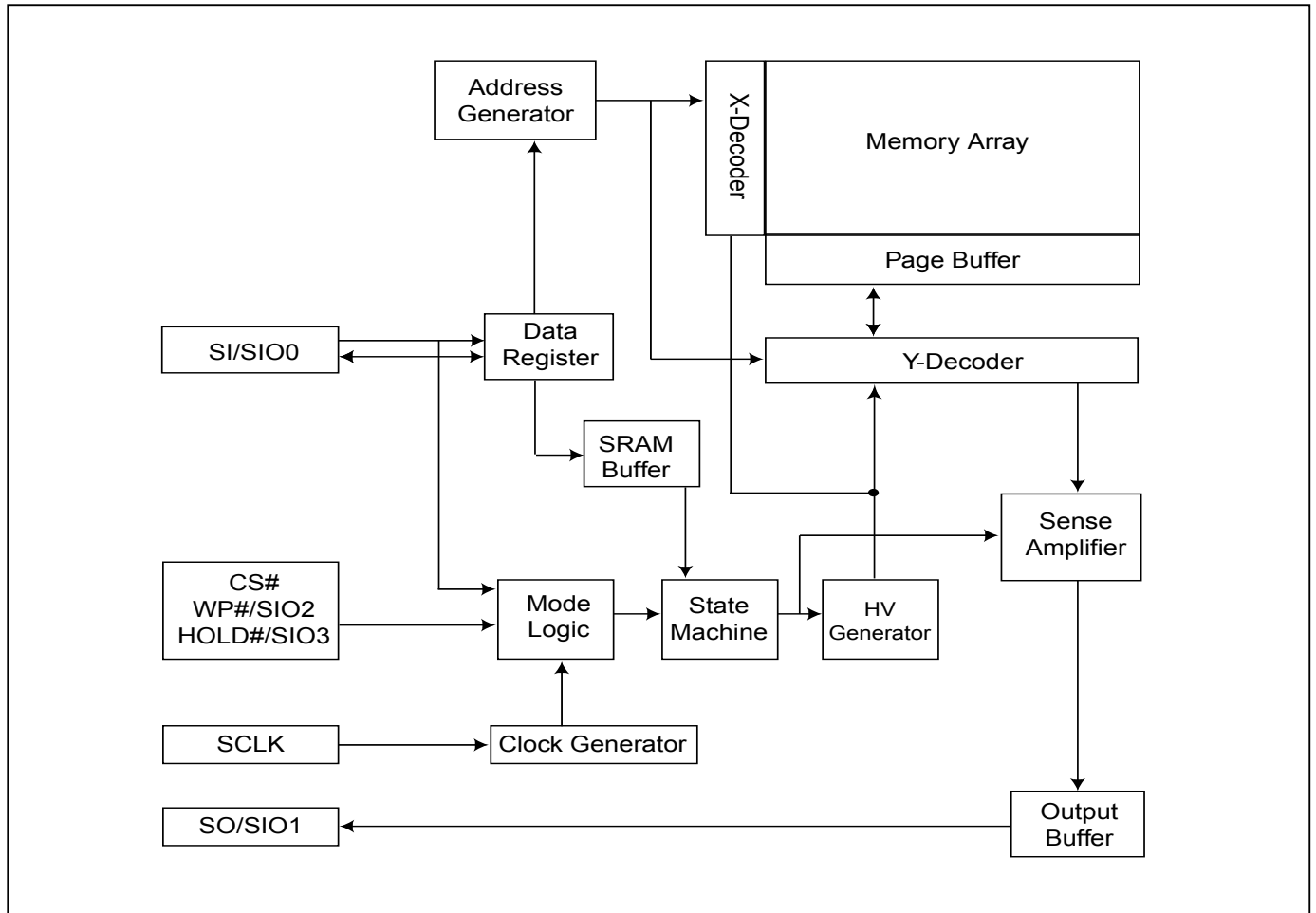
PIN CONFIGURATION

16-PIN SOP (300mil)



PIN DESCRIPTION

SYMBOL	DESCRIPTION
CS#	Chip Select
SI/SIO0	Serial Data Input (for 1xI/O)/ Serial Data Input & Output (for 2xI/O or 4xI/O mode)
SO/SIO1/PO7	Serial Data Output (for 1xI/O)/Serial Data Input & Output (for 2xI/O or 4xI/O mode) / Parallel Data Output/Input
SCLK	Clock Input
WP#/SIO2	Write protection: connect to GND or Serial Data Input & Output (for 4xI/O mode)
HOLD#/SIO3	HOLD# pin or Serial Data Input & Output (for 4xI/O mode)
VCC	+ 3.3V Power Supply
GND	Ground
PO0~PO6	Parallel data output/input (PO0~PO6 can be connected to NC in Serial Mode)
NC	No Connection

BLOCK DIAGRAM

DATA PROTECTION

MX25L25635E is designed to offer protection against accidental erasure or programming caused by spurious system level signals that may exist during power transition. During power up the device automatically resets the state machine in the standby mode. In addition, with its control register architecture, alteration of the memory contents only occurs after successful completion of specific command sequences. The device also incorporates several features to prevent inadvertent write cycles resulting from VCC power-up and power-down transition or system noise.

- Valid command length checking: The command length will be checked whether it is at byte base and completed on byte boundary.
- Write Enable (WREN) command: WREN command is required to set the Write Enable Latch bit (WEL) before other command to change data. The WEL bit will return to reset stage under following situation:
 - Power-up
 - Write Disable (WRDI) command completion
 - Write Status Register (WRSR) command completion
 - Page Program (PP, 4PP) command completion
 - Continuously Program mode (CP) instruction completion
 - Sector Erase (SE) command completion
 - Block Erase (BE, BE32K) command completion
 - Chip Erase (CE) command completion
 - Single Block Lock/Unlock (SBLK/SBULK) instruction completion
 - Gang Block Lock/Unlock (GBLK/GBULK) instruction completion
 - Write Security Register (WRSCUR) instruction completion
 - Write Protection Selection (WPSEL) instruction completion
- Deep Power Down Mode: By entering deep power down mode, the flash device also is under protected from writing all commands except Release from Deep Power Down mode command (RDP) and Read Electronic Signature command (RES).

I. Block lock protection

- The Software Protected Mode (SPM) uses (BP3, BP2, BP1, BP0) bits to allow part of memory to be protected as read only. The protected area definition is shown as table of "Protected Area Sizes", the protected areas are more flexible which may protect various area by setting value of BP0-BP3 bits. Please refer to table of "Protected Area Sizes".
- The Hardware Protected Mode (HPM) use WP#/SIO2 to protect the (BP3, BP2, BP1, BP0) bits and SRWD bit. If the system goes into four I/O mode, the feature of HPM will be disabled.
- MX25L25635E provide individual block (or sector) write protect & unprotect. User may enter the mode with WPSEL command and conduct individual block (or sector) write protect with SBLK instruction, or SBULK for individual block (or sector) unprotect. Under the mode, user may conduct whole chip (all blocks) protect with GBLK instruction and unlock the whole chip with GBULK instruction.

Table 2. Protected Area Sizes

Status bit				Protection Area
BP3	BP2	BP1	BP0	256Mb
0	0	0	0	0 (none)
0	0	0	1	1 (2 blocks, block 510th-511th)
0	0	1	0	2 (4 blocks, block 508th-511th)
0	0	1	1	3 (8 blocks, block 504th-511th)
0	1	0	0	4 (16 blocks, block 496th-511th)
0	1	0	1	5 (32 blocks, block 480th-511th)
0	1	1	0	6 (64 blocks, block 448th-511th)
0	1	1	1	7 (128 blocks, block 384th-511th)
1	0	0	0	8 (256 blocks, block 256th-511th)
1	0	0	1	9 (512 blocks, all)
1	0	1	0	10 (512 blocks, all)
1	0	1	1	11 (512 blocks, all)
1	1	0	0	12 (512 blocks, all)
1	1	0	1	13 (512 blocks, all)
1	1	1	0	14 (512 blocks, all)
1	1	1	1	15 (512 blocks, all)

Note: The device is ready to accept a Chip Erase instruction if, and only if, all Block Protect (BP3, BP2, BP1, BP0) are 0.

II. Additional 4K-bit secured OTP for unique identifier: to provide 4K-bit One-Time Program area for setting device unique serial number - Which may be set by factory or system maker. Please refer to Table 3. 4K-bit Secured OTP Definition.

- Security register bit 0 indicates whether the chip is locked by factory or not.
- To program the 4K-bit secured OTP by entering 4K-bit secured OTP mode (with ENSO command), and going through normal program procedure, and then exiting 4K-bit secured OTP mode by writing EXSO command.
- Customer may lock-down the customer lockable secured OTP by writing WRSCUR(write security register) command to set customer lock-down bit1 as "1". Please refer to table of "Security Register Definition" for security register bit definition and table of "4K-bit Secured OTP Definition" for address range definition.
- Note: Once lock-down whatever by factory or customer, it cannot be changed any more. While in 4K-bit Secured OTP mode, array access is not allowed.

Table 3. 4K-bit Secured OTP Definition

Address range	Size	Standard Factory Lock	Customer Lock
xxx000~xxx00F	128-bit	ESN (electrical serial number)	Determined by customer
xxx010~xxx1FF	3968-bit	N/A	

Memory Organization

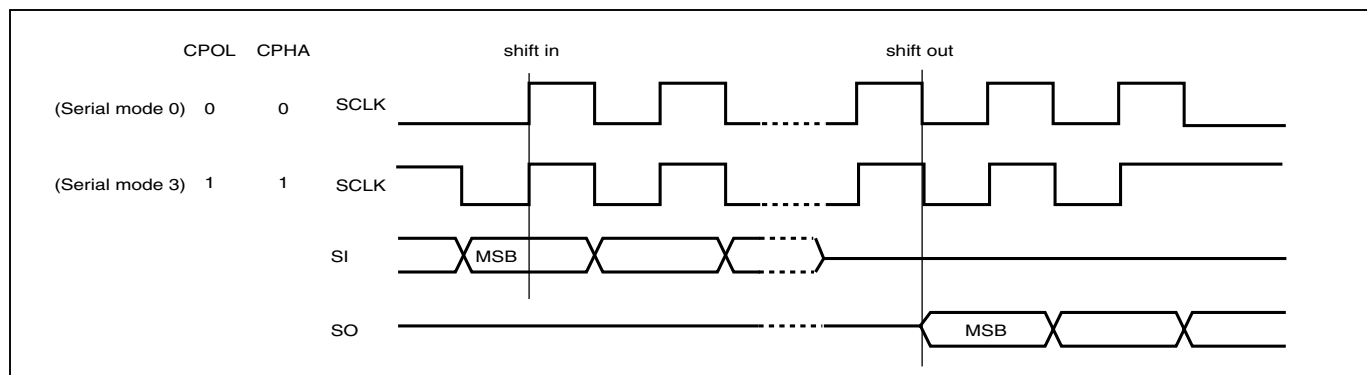
Table 4. Memory Organization

	Block(64K-byte)	Block(32K-byte)	Sector	Address Range		
individual block lock/unlock unit:64K-byte	511	1023	8191	1FFF000h	1FFFFFFh	individual 16 sectors lock/unlock unit:4K-byte
			⋮	⋮	⋮	
			8184	1FF8000h	1FF8FFFh	
			8183	1FF7000h	1FF7FFFh	
		1022	⋮	⋮	⋮	
			8176	1FF0000h	1FF0FFFh	
			8175	1FEF000h	1FEFFFFh	
			⋮	⋮	⋮	
	510	1021	8168	1FE8000h	1FE8FFFh	
			8167	1FE7000h	1FE7FFFh	
			⋮	⋮	⋮	
			8160	1FE0000h	1FE0FFFh	
		1020	8159	1FDF000h	1FDFFFFh	
			⋮	⋮	⋮	
			8152	1FD8000h	1FD8FFFh	
			8151	1FD7000h	1FD7FFFh	
individual block lock/unlock unit:64K-byte	509	1019	⋮	⋮	⋮	individual 16 sectors lock/unlock unit:4K-byte
			8144	1FD0000h	1FD0FFFh	
		1018	⋮	⋮	⋮	
			8144	1FD0000h	1FD0FFFh	
			⋮	⋮	⋮	
			8144	1FD0000h	1FD0FFFh	
			⋮	⋮	⋮	
			8144	1FD0000h	1FD0FFFh	
	508	1017	8143	1FDF000h	1FDFFFFh	
			8142	1FD8000h	1FD8FFFh	
			8141	1FD7000h	1FD7FFFh	
			8140	1FD6000h	1FD6FFFh	
		1016	8139	1FD5000h	1FD5FFFh	
			8138	1FD4000h	1FD4FFFh	
			8137	1FD3000h	1FD3FFFh	
			8136	1FD2000h	1FD2FFFh	
individual block lock/unlock unit:64K-byte	507	1015	8135	1FD1000h	1FD1FFFh	individual 16 sectors lock/unlock unit:4K-byte
			8134	1FD0000h	1FD0FFFh	
			8133	1FEF000h	1FEFFFFh	
			8132	1FE8000h	1FE8FFFh	
		1014	8131	1FE7000h	1FE7FFFh	
			8130	1FE6000h	1FE6FFFh	
			8129	1FE5000h	1FE5FFFh	
			8128	1FE4000h	1FE4FFFh	
	506	1013	8127	1FE3000h	1FE3FFFh	
			8126	1FE2000h	1FE2FFFh	
			8125	1FE1000h	1FE1FFFh	
			8124	1FE0000h	1FE0FFFh	
		1012	8123	1FDF000h	1FDFFFFh	
			8122	1FD8000h	1FD8FFFh	
			8121	1FD7000h	1FD7FFFh	
			8120	1FD6000h	1FD6FFFh	
individual block lock/unlock unit:64K-byte	505	1011	8119	1FD5000h	1FD5FFFh	individual 16 sectors lock/unlock unit:4K-byte
			8118	1FD4000h	1FD4FFFh	
			8117	1FD3000h	1FD3FFFh	
			8116	1FD2000h	1FD2FFFh	
		1010	8115	1FD1000h	1FD1FFFh	
			8114	1FD0000h	1FD0FFFh	
			8113	1FDF000h	1FDFFFFh	
			8112	1FD8000h	1FD8FFFh	
	504	1009	8111	1FD7000h	1FD7FFFh	
			8110	1FD6000h	1FD6FFFh	
			8109	1FD5000h	1FD5FFFh	
			8108	1FD4000h	1FD4FFFh	
		1008	8107	1FD3000h	1FD3FFFh	
			8106	1FD2000h	1FD2FFFh	
			8105	1FD1000h	1FD1FFFh	
			8104	1FD0000h	1FD0FFFh	
individual block lock/unlock unit:64K-byte	503	1007	8103	1FDF000h	1FDFFFFh	individual 16 sectors lock/unlock unit:4K-byte
			8102	1FD8000h	1FD8FFFh	
			8101	1FD7000h	1FD7FFFh	
			8100	1FD6000h	1FD6FFFh	
		1006	8099	1FD5000h	1FD5FFFh	
			8098	1FD4000h	1FD4FFFh	
			8097	1FD3000h	1FD3FFFh	
			8096	1FD2000h	1FD2FFFh	
	502	1005	8095	1FD1000h	1FD1FFFh	
			8094	1FD0000h	1FD0FFFh	
			8093	1FDF000h	1FDFFFFh	
			8092	1FD8000h	1FD8FFFh	
		1004	8091	1FD7000h	1FD7FFFh	
			8090	1FD6000h	1FD6FFFh	
			8089	1FD5000h	1FD5FFFh	
			8088	1FD4000h	1FD4FFFh	
individual block lock/unlock unit:64K-byte	501	1003	8087	1FD3000h	1FD3FFFh	individual 16 sectors lock/unlock unit:4K-byte
			8086	1FD2000h	1FD2FFFh	
			8085	1FD1000h	1FD1FFFh	
			8084	1FD0000h	1FD0FFFh	
		1002	8083	1FDF000h	1FDFFFFh	
			8082	1FD8000h	1FD8FFFh	
			8081	1FD7000h	1FD7FFFh	
			8080	1FD6000h	1FD6FFFh	
	500	1001	8079	1FD5000h	1FD5FFFh	
			8078	1FD4000h	1FD4FFFh	
			8077	1FD3000h	1FD3FFFh	
			8076	1FD2000h	1FD2FFFh	
		1000	8075	1FD1000h	1FD1FFFh	
			8074	1FD0000h	1FD0FFFh	
			8073	1FDF000h	1FDFFFFh	
			8072	1FD8000h	1FD8FFFh	

DEVICE OPERATION

1. Before a command is issued, status register should be checked to ensure device is ready for the intended operation.
2. When incorrect command is inputted to this LSI, this LSI becomes standby mode and keeps the standby mode until next CS# falling edge. In standby mode, SO pin of this LSI should be High-Z.
3. When correct command is inputted to this LSI, this LSI becomes active mode and keeps the active mode until next CS# rising edge.
4. For standard single data rate serial mode, input data is latched on the rising edge of Serial Clock(SCLK) and data shifts out on the falling edge of SCLK. The difference of Serial mode 0 and mode 3 is shown as Figure 1.
5. For the following instructions: RDID, RDSR, RDSCUR, READ, FAST_READ, 2READ, 4READ, RDBLOCK, RES, REMS, REMS2, REMS4, and RDDMC the shifted-in instruction sequence is followed by a data-out sequence. After any bit of data being shifted out, the CS# can be high. For the following instructions: WREN, WRDI, WRSR, SE, BE, BE32K, HPM, CE, PP, CP, 4PP, RDP, DP, WPSEL, SBLK, SBULK, GBLK, GBULK, ENSO, EXSO, WRSCUR, EN4B, EX4B, ENPLM, EXPLM, ESRY, DSRV and CLSR the CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.
6. During the progress of Write Status Register, Program, Erase operation, to access the memory array is neglected and not affect the current operation of Write Status Register, Program, Erase.

Figure 1. Serial Modes Supported (for Normal Serial mode)



Note:

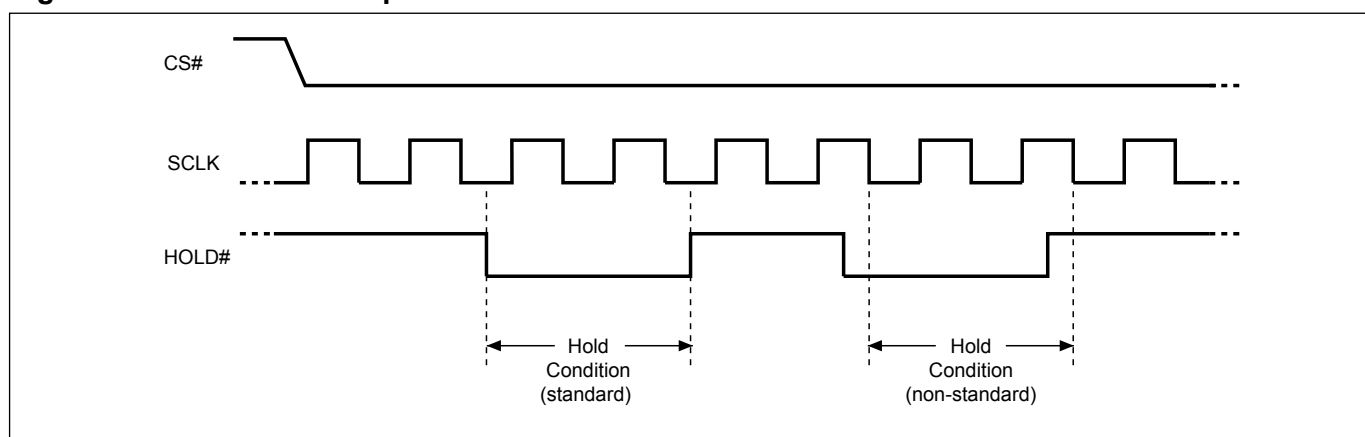
CPOL indicates clock polarity of Serial master, CPOL=1 for SCLK high while idle, CPOL=0 for SCLK low while not transmitting. CPHA indicates clock phase. The combination of CPOL bit and CPHA bit decides which Serial mode is supported.

HOLD FEATURES

HOLD# pin signal goes low to hold any serial communications with the device. The HOLD feature will not stop the operation of write status register, programming, or erasing in progress.

The operation of HOLD requires Chip Select(CS#) keeping low and starts on falling edge of HOLD# pin signal while Serial Clock (SCLK) signal is being low (if Serial Clock signal is not being low, HOLD operation will not start until Serial Clock signal being low). The HOLD condition ends on the rising edge of HOLD# pin signal while Serial Clock(SCLK) signal is being low(if Serial Clock signal is not being low, HOLD operation will not end until Serial Clock being low), see Figure 1.

Figure 2. Hold Condition Operation



The Serial Data Output (SO) is high impedance, both Serial Data Input (SI) and Serial Clock (SCLK) are don't care during the HOLD operation. If Chip Select (CS#) drives high during HOLD operation, it will reset the internal logic of the device. To re-start communication with chip, the HOLD# must be at high and CS# must be at low.

COMMAND DESCRIPTION

Table 5. Command Sets

COMMAND (byte)	WREN (write enable)	WRDI (write disable)	RDID (read identification)	RDSR (read status register)	WRSR (write status register)	EN4B (enter 4-byte mode)	EX4B (exit 4-byte mode)	READ (read data)
Command (hex)	06	04	9F	05	01	B7	E9	03
Input Cycles					Data(8)			ADD(24)
Dummy Cycles								
Action	sets the (WEL) write enable latch bit	resets the (WEL) write enable latch bit	outputs JEDEC ID: 1-byte Manufacturer ID & 2-byte Device ID	to read out the values of the status register	to write new values to the status register	to enter 4-byte mode and set 4BYTE bit as "1"	to exit 4-byte mode and clear 4BYTE bit to be "0"	n bytes read out until CS# goes high

COMMAND (byte)	FAST READ (fast read data)	2READ (2 x I/O read command) Note1	4READ (4 x I/O read command)	4PP (quad page program)	SE (sector erase)	BE (block erase 64KB)	BE 32K (block erase 32KB)	CE (chip erase)
Command (hex)	0B	BB	EB	38	20	D8	52	60 or C7
Input Cycles	ADD(24)	ADD(12)	ADD(6)+ indicator(2)	ADD(6)+ Data(512)	ADD(24)	ADD(24)	ADD(24)	
Dummy Cycles	8	4	4					
Action	n bytes read out until CS# goes high	n bytes read out by 2 x I/O until CS# goes high	n bytes read out by 4 x I/O until CS# goes high	quad input to program the selected page	to erase the selected sector	to erase the selected 64KB block	to erase the selected 32KB block	to erase whole chip

COMMAND (byte)	PP (Page program)	CP (Continuously program mode)	DP (Deep power down)	RDP (Release from deep power down)	RES (read electronic ID)	REMS (read electronic manufacturer & device ID)	REMS2 (read ID for 2x I/O mode)	REMS4 (read ID for 4x I/O mode)
Command (hex)	02	AD	B9	AB	AB	90	EF	DF
Input Cycles	ADD(24)+ Data(2048)	ADD(24)+ Data(16)				ADD(8)	ADD(8)	ADD(8)
Dummy Cycles					24	16	16	16
Action	to program the selected page	continuously program whole chip, the address is automatically increase	enters deep power down mode	release from deep power down mode	to read out 1-byte Device ID	output the Manufacturer ID & Device ID	output the Manufacturer ID & Device ID	output the Manufacturer ID & device ID

COMMAND (byte)	ENSO (enter secured OTP)	EXSO (exit secured OTP)	RDSCUR (read security register)	WRSCUR (write security register)	ESRY (enable SO to output RY/ BY#)	DSRY (disable SO to output RY/ BY#)	ENPLM (Enter Parallel Mode)	EXPLM (EXIT Parallel Mode)
Command (hex)	B1	C1	2B	2F	70	80	55	45
Input Cycles								
Dummy Cycles								
Action	to enter the 4K-bit Secured OTP mode	to exit the 4K-bit Secured OTP mode	to read value of security register	to set the lock-down bit as "1" (once lock-down, cannot be updated)	to enable SO to output RY/ BY# during CP mode	to disable SO to output RY/ BY# during CP mode	8xI/O parallel programming mode	to exit 8xI/O parallel programming mode

COMMAND (byte)	CLSR (Clear SR Fail Flags)	HPM (High Performance Enable Mode)	WPSEL (write protection selection)	SBLK (single block lock) *Note 2	SBULK (single block unlock)	RDBLOCK (block protect read)	GBLK (gang block lock)	GBULK (gang block unlock)	RDDMC (Read DMC)
Command (hex)	30	A3	68	36	39	3C	7E	98	5A
Input Cycles				ADD(24)	ADD(24)	ADD(24)			ADD(24)
Dummy Cycles									8
Action	clear security register bit 6 and bit 5	Quad I/O high Performance mode	to enter and enable individual block protect mode	individual block (64K-byte) or sector (4K-byte) write protect	individual block (64K-byte) or sector (4K-byte) unprotect	read individual block or sector write protect status	whole chip write protect	whole chip unprotect	Read DMC mode

Note 1: It is not recommended to adopt any other code not in the command definition table, which will potentially enter the hidden mode.

Note 2: In individual block write protection mode, all blocks/sectors is locked as default.

Note 3: The number in parentheses after "ADD" or "Data" stands for how many clock cycles it has.

For example, "Data(8)" represents there are 8 clock cycles for the data in. Please note the number after "ADD" are based on 3-byte address mode, for 4-byte address mode, which will be increased.

(1) Write Enable (WREN)

The Write Enable (WREN) instruction is for setting Write Enable Latch (WEL) bit. For those instructions like PP, 4PP, CP, SE, BE, BE32K, CE, WRSR, WRSCUR, WPSEL, SBLK, SBULK, GBLK and GBULK, which are intended to change the device content, should be set every time after the WREN instruction setting the WEL bit.

The sequence of issuing WREN instruction is: CS# goes low→ sending WREN instruction code→ CS# goes high. (Please refer to Figure 8)

(2) Write Disable (WRDI)

The Write Disable (WRDI) instruction is for resetting Write Enable Latch (WEL) bit.

The sequence of issuing WRDI instruction is: CS# goes low→ sending WRDI instruction code→ CS# goes high. (Please refer to Figure 9)

The WEL bit is reset by following situations:

- Power-up
- Write Disable (WRDI) instruction completion
- Write Status Register (WRSR) instruction completion
- Page Program (PP, 4PP) instruction completion
- Sector Erase (SE) instruction completion
- Block Erase (BE, BE32K) instruction completion
- Chip Erase (CE) instruction completion
- Continuously Program mode (CP) instruction completion
- Single Block Lock/Unlock (SBLK/SBULK) instruction completion
- Gang Block Lock/Unlock (GBLK/GBULK) instruction completion
- Write Security Register (WRSCUR) instruction completion
- Write Protection Selection (WPSEL) instruction completion

(3) Read Identification (RDID)

The RDID instruction is for reading the Manufacturer ID of 1-byte and followed by Device ID of 2-byte. The MXIC Manufacturer ID is C2(hex), the memory type ID is 20(hex) as the first-byte Device ID, and the individual Device ID of second-byte ID are listed as table of "ID Definitions". (Please refer to Table 8)

The sequence of issuing RDID instruction is: CS# goes low→ sending RDID instruction code → 24-bits ID data out on SO→ to end RDID operation can use CS# to high at any time during data out. (Please refer to Figure 10)

While Program/Erase operation is in progress, it will not decode the RDID instruction, so there's no effect on the cycle of program/erase operation which is currently in progress. When CS# goes high, the device is at standby stage.

(4) Read Status Register (RDSR)

The RDSR instruction is for reading Status Register. The Read Status Register can be read at any time (even in program/erase/write status register condition) and continuously. It is recommended to check the Write in Progress (WIP) bit before sending a new instruction when a program, erase, or write status register operation is in progress.

The sequence of issuing RDSR instruction is: CS# goes low→ sending RDSR instruction code→ Status Register data out on SO (Please refer to Figure 11).

The definition of the status register bits is as below:

WIP bit. The Write in Progress (WIP) bit, a volatile bit, indicates whether the device is busy in program/erase/write status register progress. When WIP bit sets to 1, which means the device is busy in program/erase/write status register progress. When WIP bit sets to 0, which means the device is not in progress of program/erase/write status register cycle.

WEL bit. The Write Enable Latch (WEL) bit, a volatile bit, indicates whether the device is set to internal write enable latch. When WEL bit sets to "1", which means the internal write enable latch is set, the device can accept program/erase/write status register instruction. When WEL bit sets to 0, which means no internal write enable latch; the device will not accept program/erase/write status register instruction. The program/erase command will be ignored and will reset WEL bit if it is applied to a protected memory area.

BP3, BP2, BP1, BP0 bits. The Block Protect (BP3, BP2, BP1, BP0) bits, non-volatile bits, indicate the protected area (as defined in Table 2) of the device to against the program/erase instruction without hardware protection mode being set. To write the Block Protect (BP3, BP2, BP1, BP0) bits requires the Write Status Register (WRSR) instruction to be executed. Those bits define the protected area of the memory to against Page Program (PP), Sector Erase (SE), Block Erase (BE) and Chip Erase (CE) instructions (only if all Block Protect bits set to 0, the CE instruction can be executed).

QE bit. The Quad Enable (QE) bit, non-volatile bit, while it is "0" (factory default), it performs non-Quad and WP# is enable. While QE is "1", it performs Quad I/O mode and WP# is disabled. In the other word, if the system goes into four I/O mode (QE=1), the feature of HPM will be disabled.

SRWD bit. The Status Register Write Disable (SRWD) bit, non-volatile bit, default value is "0". SRWD bit is operated together with Write Protection (WP#/SIO2) pin for providing hardware protection mode. The hardware protection mode requires SRWD sets to 1 and WP#/SIO2 pin signal is low stage. In the hardware protection mode, the Write Status Register (WRSR) instruction is no longer accepted for execution and the SRWD bit and Block Protect bits (BP3, BP2, BP1, BP0) are read only.

Status Register

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
SRWD (status register write protect)	QE (Quad Enable)	BP3 (level of protected block)	BP2 (level of protected block)	BP1 (level of protected block)	BP0 (level of protected block)	WEL (write enable latch)	WIP (write in progress bit)
1=status register write disable	1= Quad Enable 0=not Quad Enable	(note 1)	(note 1)	(note 1)	(note 1)	1=write enable 0=not write enable	1=write operation 0=not in write operation
Non-volatile bit	Non-volatile bit	Non-volatile bit	Non-volatile bit	Non-volatile bit	Non-volatile bit	volatile bit	volatile bit

Note 1: see the Table 2 "Protected Area Size" in page 11.

(5) Write Status Register (WRSR)

The WRSR instruction is for changing the values of Status Register Bits. Before sending WRSR instruction, the Write Enable (WREN) instruction must be decoded and executed to set the Write Enable Latch (WEL) bit in advance. The WRSR instruction can change the value of Block Protect (BP3, BP2, BP1, BP0) bits to define the protected area of memory (as shown in Table 2). The WRSR also can set or reset the Quad enable (QE) bit and set or reset the Status Register Write Disable (SRWD) bit in accordance with Write Protection (WP#/SIO2) pin signal, but has no effect on bit1(WEL) and bit0 (WIP) of the status register. The WRSR instruction cannot be executed once the Hardware Protected Mode (HPM) is entered.

The sequence of issuing WRSR instruction is: CS# goes low→ sending WRSR instruction code→ Status Register data on SI→ CS# goes high. (Please refer to Figure 12)

The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed. The self-timed Write Status Register cycle time (tW) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Write Status Register cycle is in progress. The WIP sets 1 during the tW timing, and sets 0 when Write Status Register Cycle is completed, and the Write Enable Latch (WEL) bit is reset.

Protection Modes

Mode	Status register condition	WP# and SRWD bit status	Memory
Software protection mode (SPM)	Status register can be written in (WEL bit is set to "1") and the SRWD, BP0-BP3 bits can be changed	WP#=1 and SRWD bit=0, or WP#=0 and SRWD bit=0, or WP#=1 and SRWD=1	The protected area cannot be program or erase.
Hardware protection mode (HPM)	The SRWD, BP0-BP3 of status register bits cannot be changed	WP#=0, SRWD bit=1	The protected area cannot be program or erase.

Note: As defined by the values in the Block Protect (BP3, BP2, BP1, BP0) bits of the Status Register, as shown in Table 2.

As the above table showing, the summary of the Software Protected Mode (SPM) and Hardware Protected Mode (HPM).

Software Protected Mode (SPM):

- When SRWD bit=0, no matter WP#/SIO2 is low or high, the WREN instruction may set the WEL bit and can change the values of SRWD, BP3, BP2, BP1, BP0. The protected area, which is defined by BP3, BP2, BP1, BP0, is at software protected mode (SPM).
- When SRWD bit=1 and WP#/SIO2 is high, the WREN instruction may set the WEL bit can change the values of SRWD, BP3, BP2, BP1, BP0. The protected area, which is defined by BP3, BP2, BP1, BP0, is at software protected mode (SPM)

Hardware Protected Mode (HPM):

- When SRWD bit=1, and then WP#/SIO2 is low (or WP#/SIO2 is low before SRWD bit=1), it enters the hardware protected mode (HPM). The data of the protected area is protected by software protected mode by BP3, BP2, BP1, BP0 and hardware protected mode by the WP#/SIO2 to against data modification.

Note:

To exit the hardware protected mode requires WP#/SIO2 driving high once the hardware protected mode is entered. If the WP#/SIO2 pin is permanently connected to high, the hardware protected mode can never be entered; only can use software protected mode via BP3, BP2, BP1, BP0.

If the system goes into four I/O mode, the feature of HPM will be disabled.

(6) Enter 4-byte mode (EN4B)

The EN4B instruction enables accessing the address length of 32-bit for the memory area of higher density (larger than 128Mb). The device default is in 24-bit address mode; after sending out the EN4B instruction, the bit2 (4BYTE bit) of security register will be automatically set to "1" to indicate the 4-byte address mode has been enabled. Once the 4-byte address mode is enabled, the address length becomes 32-bit instead of the default 24-bit. There are two methods to exit the 4-byte mode: power-off or writing exit 4-byte mode (EX4B) instruction.

All instructions are accepted normally, and just the address bit is changed from 24-bit to 32-bit.

The sequence of issuing EN4B instruction is: CS# goes low → sending EN4B instruction to enter 4-byte mode (automatically set 4BYTE bit as "1") → CS# goes high.

(7) Exit 4-byte mode (EX4B)

The EX4B instruction is executed to exit the 4-byte address mode and return to the default 3-bytes address mode. After sending out the EX4B instruction, the bit2 (4BYTE bit) of security register will be cleared to be "1" to indicate the exit of the 4-byte address mode. Once exiting the 4-byte address mode, the address length will return to 24-bit.

The sequence of issuing EX4B instruction is: CS# goes low → sending EX4B instruction to exit 4-byte mode (automatically clear the 4BYTE bit to be "0") → CS# goes high.

(8) Read Data Bytes (READ)

The read instruction is for reading data out. The address is latched on rising edge of SCLK, and data shifts out on the falling edge of SCLK at a maximum frequency fR. The first address byte can be at any location. The address is automatically increased to the next higher address after each byte data is shifted out, so the whole memory can be read out at a single READ instruction. The address counter rolls over to 0 when the highest address has been reached.

The default read mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode. To enter the 4-byte mode, please refer to the enter 4-byte mode (EN4B) Mode section.

The sequence of issuing READ instruction is: CS# goes low → sending READ instruction code → 3-byte or 4-byte address (depending on mode state) on SI → data out on SO → to end READ operation can use CS# to high at any time during data out. (Please refer to Figure 13)

(9) Read Data Bytes at Higher Speed (FAST_READ)

The FAST_READ instruction is for quickly reading data out. The address is latched on rising edge of SCLK, and data of each bit shifts out on the falling edge of SCLK at a maximum frequency fC. The first address byte can be at any location. The address is automatically increased to the next higher address after each byte data is shifted out, so the whole memory can be read out at a single FAST_READ instruction. The address counter rolls over to 0 when the highest address has been reached.

The default read mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode. To enter the 4-byte mode, please refer to the enter 4-byte mode (EN4B) Mode section.

The sequence of issuing FAST_READ instruction is: CS# goes low → sending FAST_READ instruction code → 3-byte or 4-byte address (depending on mode state) on SI → 1-dummy byte (default) address on SI → data out on

SO → to end FAST_READ operation can use CS# to high at any time during data out. (Please refer to Figure 14)
While Program/Erase/Write Status Register cycle is in progress, FAST_READ instruction is rejected without any impact on the Program/Erase/Write Status Register current cycle.

(10) 2 x I/O Read Mode (2READ)

The 2READ instruction enables Double throughput of Serial Flash in read mode. The address is latched on rising edge of SCLK, and data of every two bits (interleave on 2 I/O pins) shift out on the falling edge of SCLK at a maximum frequency fT. The first address byte can be at any location. The address is automatically increased to the next higher address after each byte data is shifted out, so the whole memory can be read out at a single 2READ instruction. The address counter rolls over to 0 when the highest address has been reached. Once writing 2READ instruction, the following address/dummy/data out will perform as 2-bit instead of previous 1-bit.

The default read mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode. To enter the 4-byte mode, please refer to the enter 4-byte mode (EN4B) Mode section.

The sequence of issuing 2READ instruction is: CS# goes low → sending 2READ instruction → 3-byte or 4-byte address (depending on mode state) interleave on SIO1 & SIO0 → 4-bit dummy cycle on SIO1 & SIO0 → data out interleave on SIO1 & SIO0 → to end 2READ operation can use CS# to high at any time during data out (Please refer to Figure 15 for 2 x I/O Read Mode Timing Waveform).

While Program/Erase/Write Status Register cycle is in progress, 2READ instruction is rejected without any impact on the Program/Erase/Write Status Register current cycle.

(11) 4 x I/O Read Mode (4READ)

The 4READ instruction enables quad throughput of Serial Flash in read mode. A Quad Enable (QE) bit of status Register must be set to "1" before sending the 4READ instruction. The address is latched on rising edge of SCLK, and data of every four bits (interleave on 4 I/O pins) shift out on the falling edge of SCLK at a maximum frequency fQ. The first address byte can be at any location. The address is automatically increased to the next higher address after each byte data is shifted out, so the whole memory can be read out at a single 4READ instruction. The address counter rolls over to 0 when the highest address has been reached. Once writing 4READ instruction, the following address/dummy/data out will perform as 4-bit instead of previous 1-bit.

The default read mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode. To enter the 4-byte mode, please refer to the enter 4-byte mode (EN4B) Mode section.

The sequence of issuing 4READ instruction is: CS# goes low → sending 4READ instruction → 3-byte or 4-byte address (depending on mode state) interleave on SIO3, SIO2, SIO1 & SIO0 → 6 dummy cycles → data out interleave on SIO3, SIO2, SIO1 & SIO0 → to end 4READ operation can use CS# to high at any time during data out (Please refer to Figure 16 for 4 x I/O Read Mode Timing Waveform).

Another sequence of issuing 4 READ instruction especially useful in random access is : CS# goes low → sending 4 READ instruction → 3-byte or 4-byte address (depending on mode state) interleave on SIO3, SIO2, SIO1 & SIO0 → performance enhance toggling bit P[7:0] → 4 dummy cycles → data out still CS# goes high → CS# goes low (reduce 4 Read instruction) → 3-byte or 4-byte address (depending on mode state) random access address (Please refer to Figure 17 for 4x I/O Read Enhance Performance Mode timing waveform).

In the performance-enhancing mode (the waveform figure), P[7:4] must be toggling with P[3:0] ; likewise P[7:0]=A5h,5Ah,F0h or 0Fh can make this mode continue and reduce the next 4READ instruction. Once P[7:4] is no longer toggling with P[3:0]; likewise P[7:0]=FFh,00h,AAh or 55h. These commands will reset the performance enhance mode. And afterwards CS# is raised and then lowered, the system then will return to normal operation.

While Program/Erase/Write Status Register cycle is in progress, 4READ instruction is rejected without any impact on the Program/Erase/Write Status Register current cycle.

(12) Sector Erase (SE)

The Sector Erase (SE) instruction is for erasing the data of the chosen sector to be "1". The instruction is used for any 4K-byte sector. A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Sector Erase (SE). Any address of the sector (Table of memory organization) is a valid address for Sector Erase (SE) instruction. The CS# must go high exactly at the byte boundary (the latest eighth of address byte been latched-in); otherwise, the instruction will be rejected and not executed.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing SE instruction is: CS# goes low → sending SE instruction code → 3-byte or 4-byte address (depending on mode state) on SI → CS# goes high. (Please refer to Figure 18)

The self-timed Sector Erase Cycle time (tSE) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Sector Erase cycle is in progress. The WIP sets 1 during the tSE timing, and sets 0 when Sector Erase Cycle is completed, and the Write Enable Latch (WEL) bit is reset. If the sector is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit still be reset.

(13) Block Erase (BE)

The Block Erase (BE) instruction is for erasing the data of the chosen block to be "1". The instruction is used for 64K-byte block erase operation. A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Block Erase (BE). Any address of the block (Table of memory organization) is a valid address for Block Erase (BE) instruction. The CS# must go high exactly at the byte boundary (the latest eighth of address byte been latched-in); otherwise, the instruction will be rejected and not executed.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing BE instruction is: CS# goes low → sending BE instruction code → 3-byte or 4-byte address (depending on mode state) on SI → CS# goes high. (Please refer to Figure 19)

The self-timed Block Erase Cycle time (tBE) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Sector Erase cycle is in progress. The WIP sets 1 during the tBE timing, and sets 0 when Sector Erase Cycle is completed, and the Write Enable Latch (WEL) bit is reset. If the block is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit still be reset.

(14) Block Erase (BE32K)

The Block Erase (BE32) instruction is for erasing the data of the chosen block to be "1". The instruction is used for 32K-byte block erase operation. A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Block Erase (BE32). Any address of the block (Table of memory organization) is a valid address for Block Erase (BE32) instruction. The CS# must go high exactly at the byte boundary (the latest eighth of address byte been latched-in); otherwise, the instruction will be rejected and not executed.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing BE32 instruction is: CS# goes low → sending BE32 instruction code → 3-byte or 4-byte address (depending on mode state) on SI → CS# goes high. (Please refer to Figure 19)

The self-timed Block Erase Cycle time (tBE) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Sector Erase cycle is in progress. The WIP sets 1 during the tBE timing, and sets 0 when Sector Erase Cycle is completed, and the Write Enable Latch (WEL) bit is reset. If the block is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit still be reset.

(15) Chip Erase (CE)

The Chip Erase (CE) instruction is for erasing the data of the whole chip to be "1". A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Chip Erase (CE). The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.

The sequence of issuing CE instruction is: CS# goes low → sending CE instruction code → CS# goes high. (Please refer to Figure 20)

The self-timed Chip Erase Cycle time (tCE) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Chip Erase cycle is in progress. The WIP sets 1 during the tCE timing, and sets 0 when Chip Erase Cycle is completed, and the Write Enable Latch (WEL) bit is reset. If the chip is protected the Chip Erase (CE) instruction will not be executed, but WEL will be reset.

(16) Page Program (PP)

The Page Program (PP) instruction is for programming the memory to be "0". A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Page Program (PP). The device programs only the last 256 data bytes sent to the device. If the entire 256 data bytes are going to be programmed, A7-A0 (The eight least significant address bits) should be set to 0. If the eight least significant address bits (A7-A0) are not all 0, all transmitted data going beyond the end of the current page are programmed from the start address of the same page (from the address A7-A0 are all 0). If more than 256 bytes are sent to the device, the data of the last 256-byte is programmed at the request page and previous data will be disregarded. If less than 256 bytes are sent to the device, the data is programmed at the requested address of the page without effect on other address of the same page.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing PP instruction is: CS# goes low→ sending PP instruction code→ 3-byte or 4-byte address (depending on mode state) on SI→ at least 1-byte on data on SI→ CS# goes high. (Please refer to Figure 21)

The CS# must be kept to low during the whole Page Program cycle; The CS# must go high exactly at the byte boundary (the latest eighth bit of data being latched in), otherwise, the instruction will be rejected and will not be executed.

The self-timed Page Program Cycle time (tPP) is initiated as soon as Chip Select (CS#) goes high. The Write in Progress (WIP) bit still can be check out during the Page Program cycle is in progress. The WIP sets 1 during the

tPP timing, and sets 0 when Page Program Cycle is completed, and the Write Enable Latch (WEL) bit is reset. If the page is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit will still be reset.

(17) 4 x I/O Page Program (4PP)

The Quad Page Program (4PP) instruction is for programming the memory to be "0". A Write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit and Quad Enable (QE) bit must be set to "1" before sending the Quad Page Program (4PP). The Quad Page Programming takes four pins: SIO0, SIO1, SIO2, and SIO3, which can raise programmer performance and the effectiveness of application of lower clock less than 20MHz. For system with faster clock, the Quad page program cannot provide more actual favors, because the required internal page program time is far more than the time data flows in. Therefore, we suggest that while executing this command (especially during sending data), user can slow the clock speed down to 20MHz below. The other function descriptions are as same as standard page program.

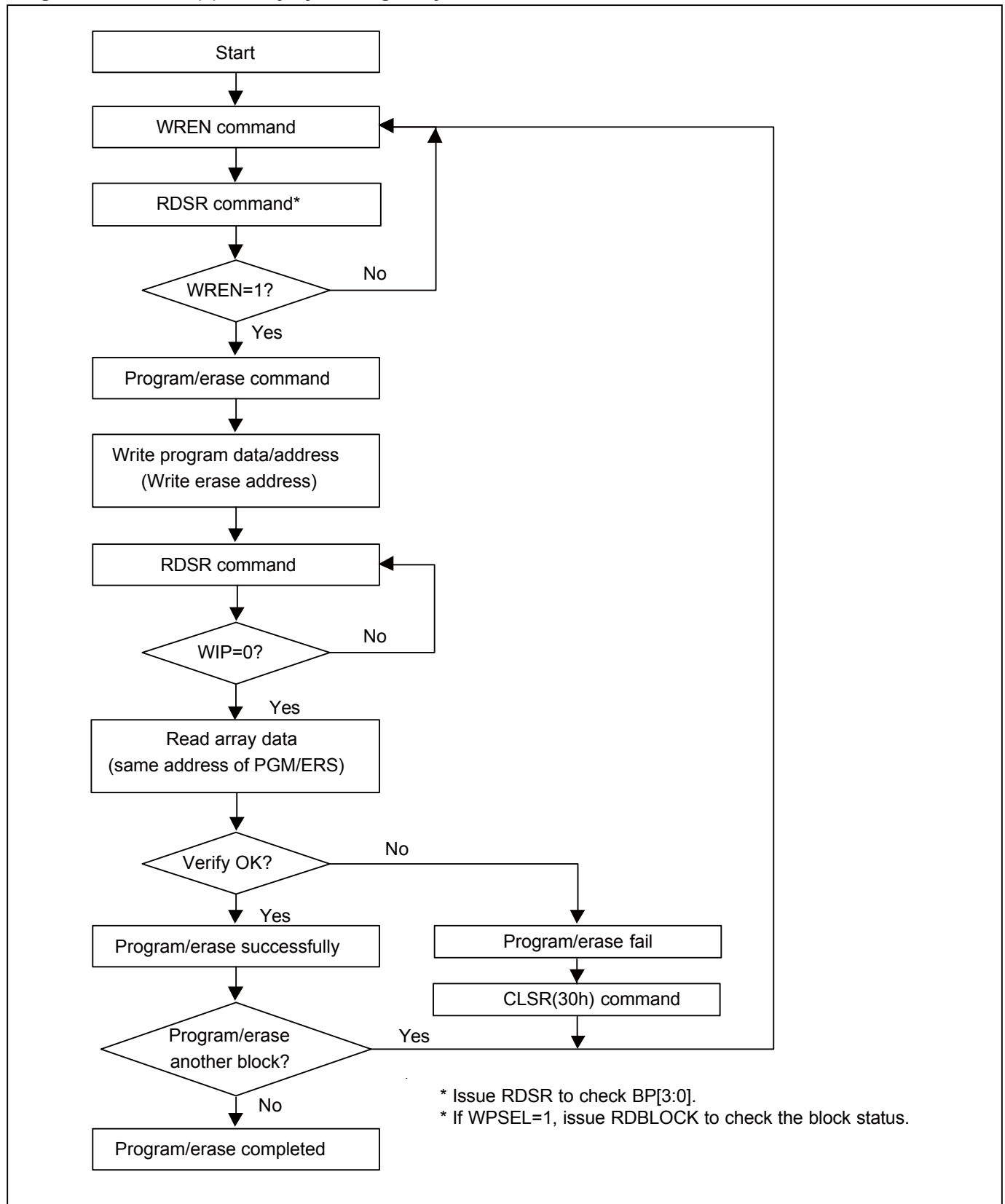
The default mode is 3-byte address, to access higher address(4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing 4PP instruction is: CS# goes low→ sending 4PP instruction code→ 3-byte or 4-byte address (depending on mode state) on SIO[3:0]→ at least 1-byte on data on SIO[3:0]→ CS# goes high. (Please refer to Figure 22)

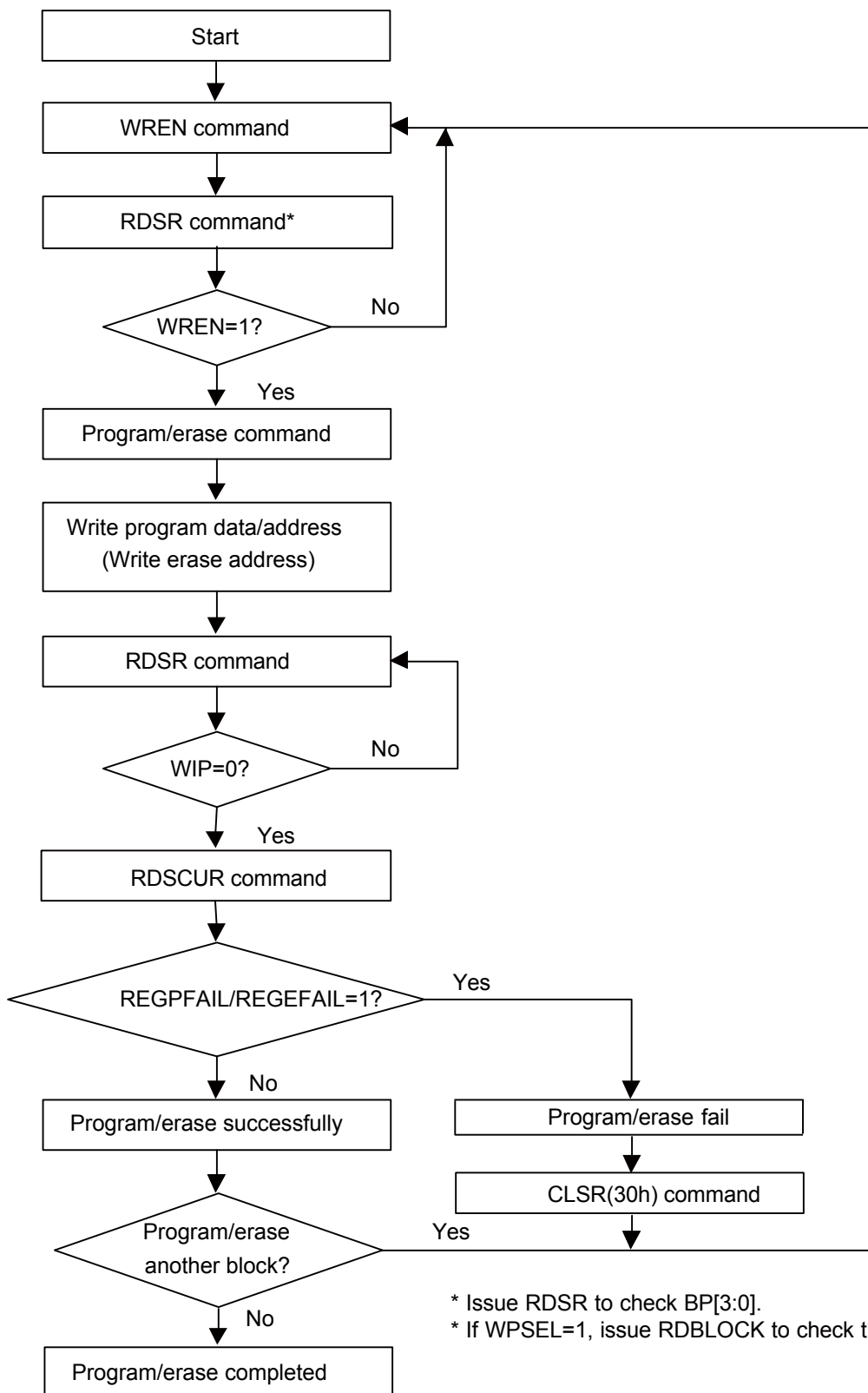
If the page is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit will still be reset.

The Program/Erase function instruction function flow is as follows:

Program/Erase Flow(1) - verify by reading array data



Program/Erase Flow(2) - verify by reading program/erase fail flag bit



* Issue RDSR to check BP[3:0].

* If WPSEL=1, issue RDBLOCK to check the block status.

(18) Continuously program mode (CP mode)

The CP mode may enhance program performance by automatically increasing address to the next higher address after each byte data has been programmed.

The Continuously program (CP) instruction is for multiple byte program to Flash. A write Enable (WREN) instruction must execute to set the Write Enable Latch (WEL) bit before sending the Continuously program (CP) instruction. CS# requires to go high before CP instruction is executing. After CP instruction and address input, two bytes of data is input sequentially from MSB(bit7) to LSB(bit0). The first byte data will be programmed to the initial address range with A0=0 and second byte data with A0=1. If only one byte data is input, the CP mode will not process. If more than two bytes data are input, the additional data will be ignored and only two byte data are valid. Any byte to be programmed should be in the erase state (FF) first. It will not roll over during the CP mode, once the last unprotected address has been reached, the chip will exit CP mode and reset write Enable Latch bit (WEL) as "0" and CP mode bit as "0". Please check the WIP bit status if it is not in write progress before entering next valid instruction. During CP mode, the valid commands are CP command (AD hex), WRDI command (04 hex), RDSR command (05 hex), and RDSCUR command (2B hex). And the WRDI command is valid after completion of a CP programming cycle, which means the WIP bit=0.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing CP instruction is : CS# goes low → sending CP instruction code → 3-byte or 4-byte address (depending on mode state) on SI pin → two data bytes on SI → CS# goes high to low → sending CP instruction and then continue two data bytes are programmed → CS# goes high to low → till last desired two data bytes are programmed → CS# goes high to low → sending WRDI (Write Disable) instruction to end CP mode → send RDSR instruction to verify if CP mode word program ends, or send RDSCUR to check bit4 to verify if CP mode ends. (Please refer to Figure 23 of CP mode timing waveform)

Three methods to detect the completion of a program cycle during CP mode:

- 1) Software method-I: by checking WIP bit of Status Register to detect the completion of CP mode.
- 2) Software method-II: by waiting for a tBP time out to determine if it may load next valid command or not.
- 3) Hardware method: by writing ESRY (enable SO to output RY/BY#) instruction to detect the completion of a program cycle during CP mode. The ESRY instruction must be executed before CP mode execution. Once it is enable in CP mode, the CS# goes low will drive out the RY/BY# status on SO, "0" indicates busy stage, "1" indicates ready stage, SO pin outputs tri-state if CS# goes high. DSRY (disable SO to output RY/BY#) instruction to disable the SO to output RY/BY# and return to status register data output during CP mode. Please note that the ESRY/DSRY command are not accepted unless the completion of CP mode.

If the page is protected by BP3~0 (WPSEL=0) or by individual lock (WPSEL=1), the array data will be protected (no change) and the WEL bit will still be reset.

(19) Parallel Mode (Highly recommended for production throughputs increasing)

The parallel mode provides 8 bit inputs/outputs for increasing throughputs of factory production purpose. The parallel mode requires 55h command code, after writing the parallel mode command and then CS# going high, after that, the Memory can be available to accept RDID/RES & REMS/READ/PP command as the normal writing command procedure. To exit parallel mode, it requires 45h command code, or power-off/on sequence. The sequence of issuing Parallel Mode instruction is : CS# goes low→sending Parallel Mode Code→CS# goes high (Please refer to Figure 24-1, and refer to Figure 24-2~24-7 for other parallel mode).

- a. For normal write command (by SI), No effect
- b. Under parallel mode, the fastest access clock freq. will be changed to 6MHz (SCLK pin clock freq.)
- c. For parallel mode, the tV will be changed to 80ns.

(20) Deep Power-down (DP)

The Deep Power-down (DP) instruction is for setting the device on the minimizing the power consumption (to entering the Deep Power-down mode), the standby current is reduced from ISB1 to ISB2). The Deep Power-down mode requires the Deep Power-down (DP) instruction to enter, during the Deep Power-down mode, the device is not active and all Write/Program/Erase instruction are ignored. When CS# goes high, it's only in standby mode not deep power-down mode. It's different from Standby mode.

The sequence of issuing DP instruction is: CS# goes low→ sending DP instruction code→ CS# goes high. (Please refer to Figure 25)

Once the DP instruction is set, all instruction will be ignored except the Release from Deep Power-down mode (RDP) and Read Electronic Signature (RES) instruction. (those instructions allow the ID being reading out). When Power-down, the deep power-down mode automatically stops, and when power-up, the device automatically is in standby mode. For RDP instruction the CS# must go high exactly at the byte boundary (the latest eighth bit of instruction code been latched-in); otherwise, the instruction will not executed. As soon as Chip Select (CS#) goes high, a delay of tDP is required before entering the Deep Power-down mode and reducing the current to ISB2.

(21) Release from Deep Power-down (RDP), Read Electronic Signature (RES)

The Release from Deep Power-down (RDP) instruction is terminated by driving Chip Select (CS#) High. When Chip Select (CS#) is driven High, the device is put in the standby Power mode. If the device was not previously in the Deep Power-down mode, the transition to the standby Power mode is immediate. If the device was previously in the Deep Power-down mode, though, the transition to the standby Power mode is delayed by tRES2, and Chip Select (CS#) must remain High for at least tRES2(max), as specified in Table 8. Once in the standby mode, the device waits to be selected, so that it can receive, decode and execute instructions.

RES instruction is for reading out the old style of 8-bit Electronic Signature, whose values are shown as table of ID Definitions. This is not the same as RDID instruction. It is not recommended to use for new design. For new design, please use RDID instruction. Even in Deep power-down mode, the RDP and RES are also allowed to be executed, only except the device is in progress of program/erase/write cycles; there's no effect on the current program/erase/write cycles in progress. The sequence is shown as Figure 26, 27.

The RES instruction is ended by CS# goes high after the ID been read out at least once. The ID outputs repeatedly if continuously send the additional clock cycles on SCLK while CS# is at low. If the device was not previously in Deep Power-down mode, the device transition to standby mode is immediate. If the device was previously in Deep Power-down mode, there's a delay of tRES2 to transit to standby mode, and CS# must remain to high at least tRES2(max). Once in the standby mode, the device waits to be selected, so it can be receive, decode, and execute instruction.

The RDP instruction is for releasing from Deep Power-down Mode.

(22) Read Electronic Manufacturer ID & Device ID (REMS), (REMS2), (REMS4)

The REMS, REMS2, and REMS4 instruction provides both the JEDEC assigned Manufacturer ID and the specific Device ID.

The instruction is initiated by driving the CS# pin low and shift the instruction code "90h", "DFh" or "EFh" followed by two dummy bytes and one bytes address (A7~A0). After which, the Manufacturer ID for MXIC (C2h) and the Device ID are shifted out on the falling edge of SCLK with most significant bit (MSB) first as shown in Figure 28. The Device ID values are listed in table of ID Definitions. If the one-byte address is initially set to 01h, then the Device ID will be read first and then followed by the Manufacturer ID. The Manufacturer and Device IDs can be read continuously, alternating from one to the other. The instruction is completed by driving CS# high.

Table 6. ID Definitions

Command Type	MX25L25635E		
	manufacturer ID	memory type	memory density
RDID	C2	20	19
RES	electronic ID		
	18		
REMS/REMS2/REMS4	manufacturer ID	device ID	
	C2	18	

(23) Enter Secured OTP (ENSO)

The ENSO instruction is for entering the additional 4K-bit Secured OTP mode. The additional 4K-bit Secured OTP is independent from main array, which may use to store unique serial number for system identifier. After entering the Secured OTP mode, and then follow standard read or program, procedure to read out the data or update data. The Secured OTP data cannot be updated again once it is lock-down.

The sequence of issuing ENSO instruction is: CS# goes low → sending ENSO instruction to enter Secured OTP mode → CS# goes high.

Please note that WRSR/WRSCUR/WPSEL/SBLK/GBLK/SBULK/GBULK/CE/BE/SE/BE32K commands are not acceptable during the access of secure OTP region, once Security OTP is lock down, only read related commands are valid.

(24) Exit Secured OTP (EXSO)

The EXSO instruction is for exiting the additional 4K-bit Secured OTP mode.

The sequence of issuing EXSO instruction is: CS# goes low → sending EXSO instruction to exit Secured OTP mode → CS# goes high.

(25) Read Security Register (RDSCUR)

The RDSCUR instruction is for reading the value of Security Register. The Read Security Register can be read at any time (even in program/erase/write status register/write security register condition) and continuously.

The sequence of issuing RDSCUR instruction is : CS# goes low → sending RDSCUR instruction → Security Register data out on SO → CS# goes high.

The definition of the Security Register is as below:

Secured OTP Indicator bit. The Secured OTP indicator bit shows the chip is locked by factory before ex- factory or not. When it is "0", it indicates non-factory lock; "1" indicates factory- lock.

Lock-down Secured OTP (LDSO) bit. By writing WRSCUR instruction, the LDSO bit may be set to "1" for customer lock-down purpose. However, once the bit is set to "1" (lock-down), the LDSO bit and the 4K-bit Secured OTP area cannot be update any more. While it is in 4K-bit Secured OTP mode, array access is not allowed.

4BYTE Indicator bit. By writing EN4B instruction, the 4BYTE bit may be set to "1" to access the address length of 32-bit for higher density (large than 128Mb) memory area. The default state is "0", which means the mode of 24-bit address. The 4BYTE bit may be clear by power off or writing EX4B instruction to reset the state to be "0".

Continuously Program Mode (CP mode) bit. The Continuously Program Mode bit indicates the status of CP mode, "0" indicates not in CP mode; "1" indicates in CP mode.

Program Fail Flag bit. While a program failure happened, the Program Fail Flag bit would be set. This bit will also be set when the user attempts to program a protected main memory region or a locked OTP region. This bit can indicate whether one or more of program operations fail, and can be reset by command CLSR (30h)

Erase Fail Flag bit. While a erase failure happened, the Erase Fail Flag bit would be set. This bit will also be set when the user attempts to erase a protected main memory region or a locked OTP region. This bit can indicate whether one or more of erase operations fail, and can be reset by command CLSR (30h)

Write Protection Select bit. The Write Protection Select bit indicates that WPSEL has been executed successfully. Once this bit has been set (WPSEL=1), all the blocks or sectors will be write-protected after the power-on every time. Once WPSEL has been set, it cannot be changed again, which means it's only for individual WP mode.

Under the individual block protection mode (WPSEL=1), hardware protection is performed by driving WP#=0. Once WP#=0 all array blocks/sectors are protected regardless of the contents of SRAM lock bits.

Security Register Definition

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
WPSEL	E_FAIL	P_FAIL	Continuously Program mode (CP mode)	x	4BYTE	LDSO (lock-down 4K-bit Secured OTP)	4K-bit Secured OTP
0=normal WP mode 1=individual WP mode (default=0)	0=normal Erase succeed 1=indicate Erase failed (default=0)	0=normal Program succeed 1=indicate Program failed (default=0)	0=normal Program mode 1=CP mode (default=0)	reserved	0=3-byte address mode, 1=4-byte address mode (default=0)	0 = not lockdown 1 = lock-down (cannot program/erase OTP)	0 = nonfactory lock 1 = factory lock
non-volatile bit	volatile bit	volatile bit	volatile bit	volatile bit	volatile bit	non-volatile bit	non-volatile bit
OTP	Read Only	Read Only	Read Only	Read Only	Read Only	OTP	Read Only

(26) Write Security Register (WRSCUR)

The WRSCUR instruction is for changing the values of Security Register Bits. A WREN instruction is required before sending WRSCUR instruction. The WRSCUR instruction may change the values of bit1 (LDSO bit) for customer to lock-down the 4K-bit Secured OTP area. Once the LDSO bit is set to "1", the Secured OTP area cannot be updated any more.

The sequence of issuing WRSCUR instruction is :CS# goes low→ sending WRSCUR instruction → CS# goes high.

The CS# must go high exactly at the boundary; otherwise, the instruction will be rejected and not executed.

(27) Write Protection Selection (WPSEL)

There are two write protection methods, (1) BP protection mode (2) individual block protection mode. If WPSEL=0, flash is under BP protection mode. If WPSEL=1, flash is under individual block protection mode. The default value of WPSEL is "0". WPSEL command can be used to set WPSEL=1. **Please note that WPSEL is an OTP bit. Once WPSEL is set to 1, there is no chance to recovery WPSEL back to "0".** If the flash is put on BP mode, the individual block protection mode is disabled. Contrarily, if flash is on the individual block protection mode, the BP mode is disabled. A WREN instruction is required before sending WPSEL instruction.

Every time after the system is powered-on, and the Security Register bit 7 is checked to be WPSEL=1, all the blocks or sectors will be write protected by default. User may only unlock the blocks or sectors via SBULK and GBULK instruction. Program or erase functions can only be operated after the Unlock instruction is conducted.

BP protection mode, WPSEL=0:

ARRAY is protected by BP3~BP0 and BP3~BP0 bits are protected by "SRWD=1 and WP#=0", where SRWD is bit 7 of status register that can be set by WRSR command.

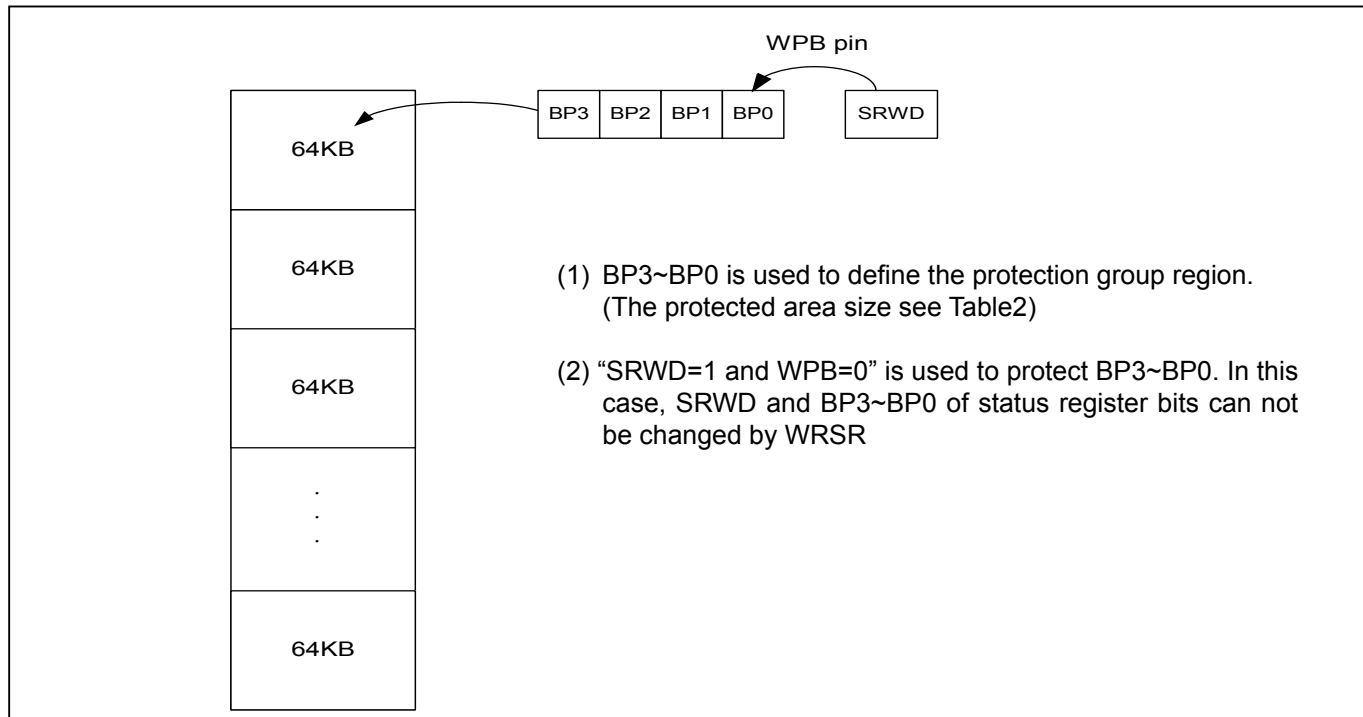
Individual block protection mode, WPSEL=1:

Blocks are individually protected by their own SRAM lock bits which are set to "1" after power up. SBULK and SBLK command can set SRAM lock bit to "0" and "1". When the system accepts and executes WPSEL instruction, the bit 7 in security register will be set. It will activate SBLK, SBULK, RDBLOCK, GBLK, GBULK etc instructions to conduct block lock protection and replace the original Software Protect Mode (SPM) use (BP3~BP0) indicated block methods. Under the individual block protection mode (WPSEL=1), hardware protection is performed by driving WP#=0. Once WP#=0 all array blocks/sectors are protected regardless of the contents of SRAM lock bits.

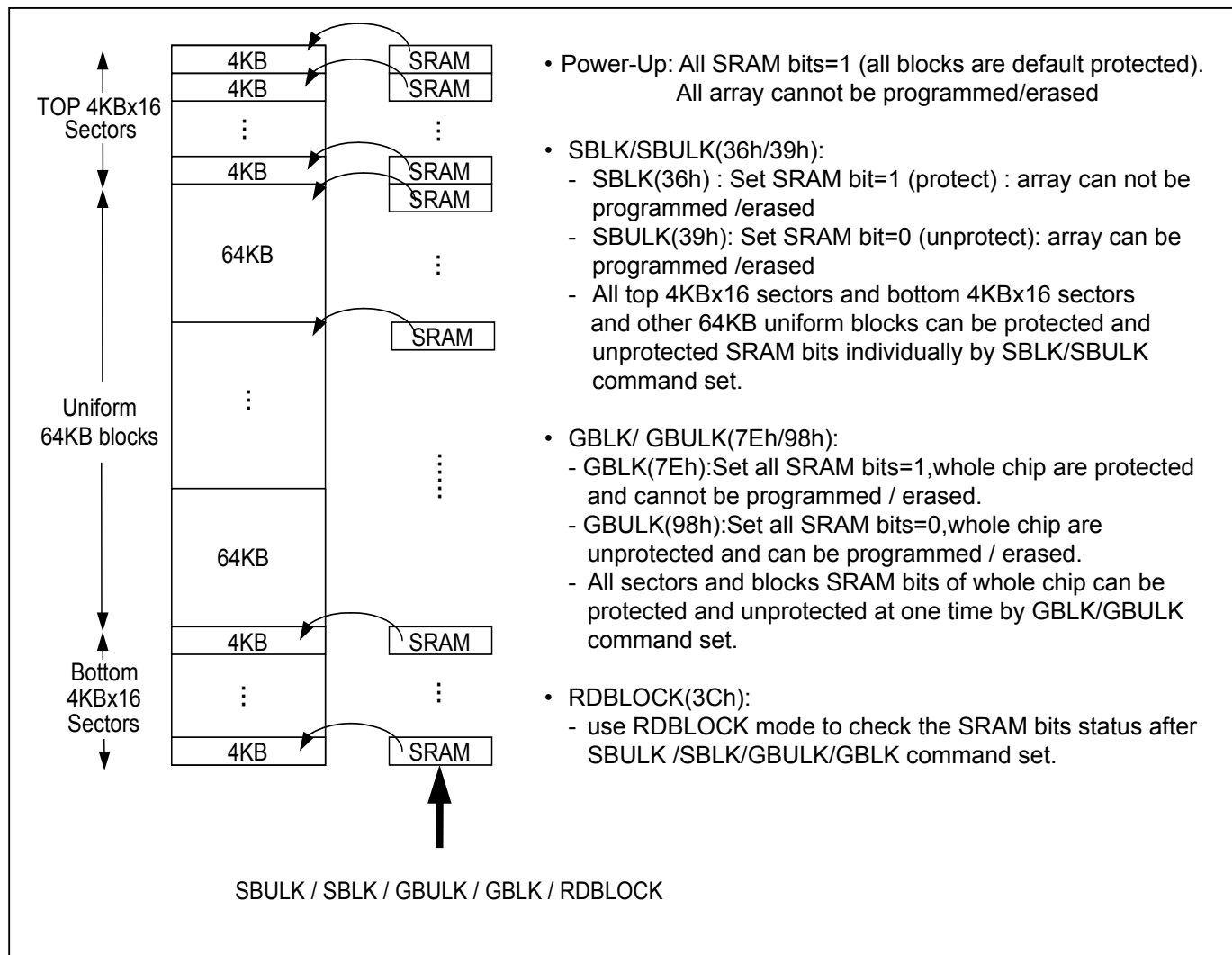
The sequence of issuing WPSEL instruction is: CS# goes low → sending WPSEL instruction to enter the individual block protect mode → CS# goes high.

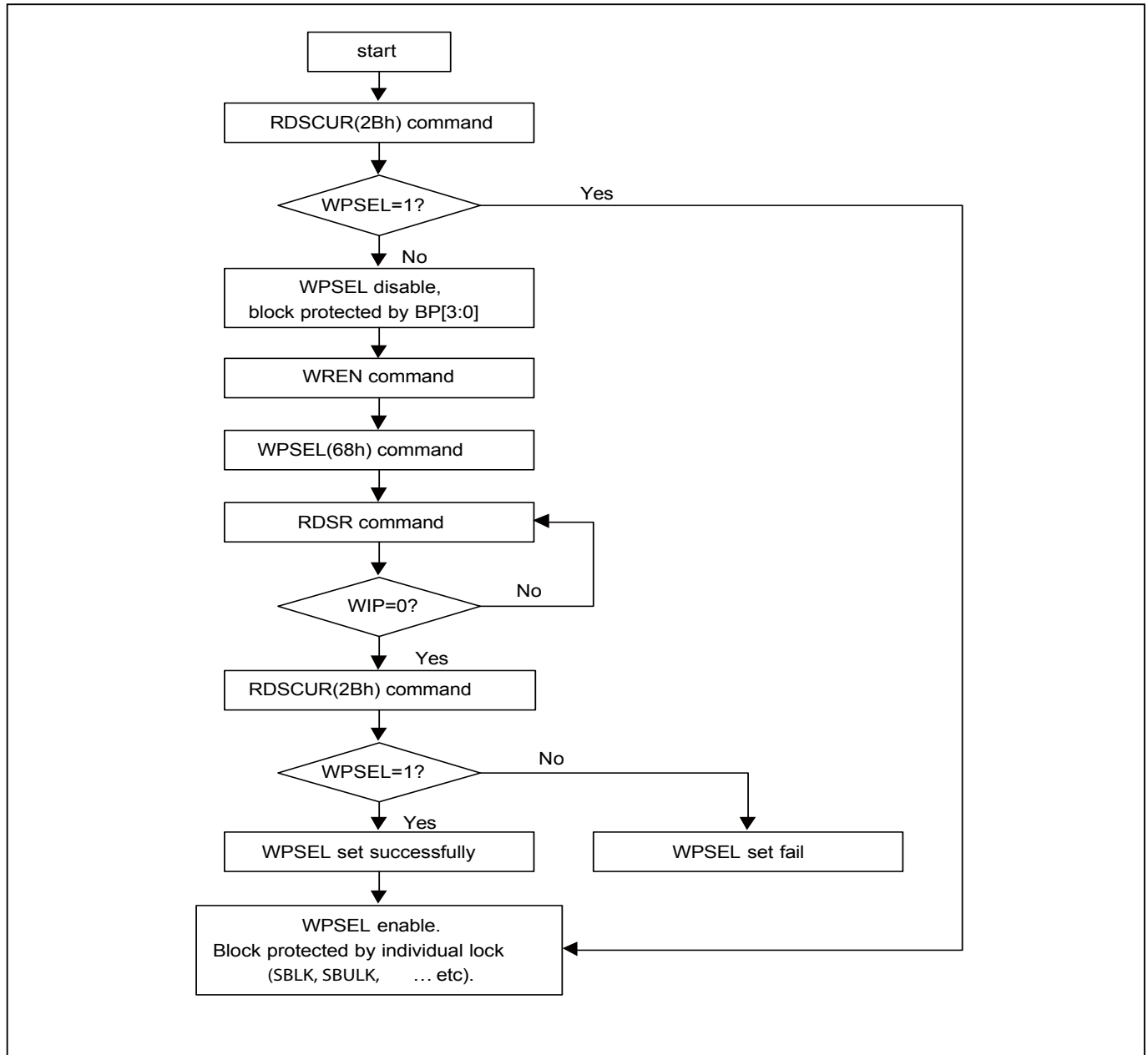
WPSEL instruction function flow is as follows:

BP and SRWD if WPSEL=0



The individual block lock mode is effective after setting WPSEL=1



WPSEL Flow

(28) Single Block Lock/Unlock Protection (SBLK/SBULK)

These instructions are only effective after WPSEL was executed. The SBLK instruction is for write protection a specified block(or sector) of memory, using address bits to assign a 64Kbyte block (or 4K bytes sector) to be protected as read only. The SBULK instruction will cancel the block (or sector) write protection state. This feature allows user to stop protecting the entire block (or sector) through the chip unprotect command (GBULK).

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

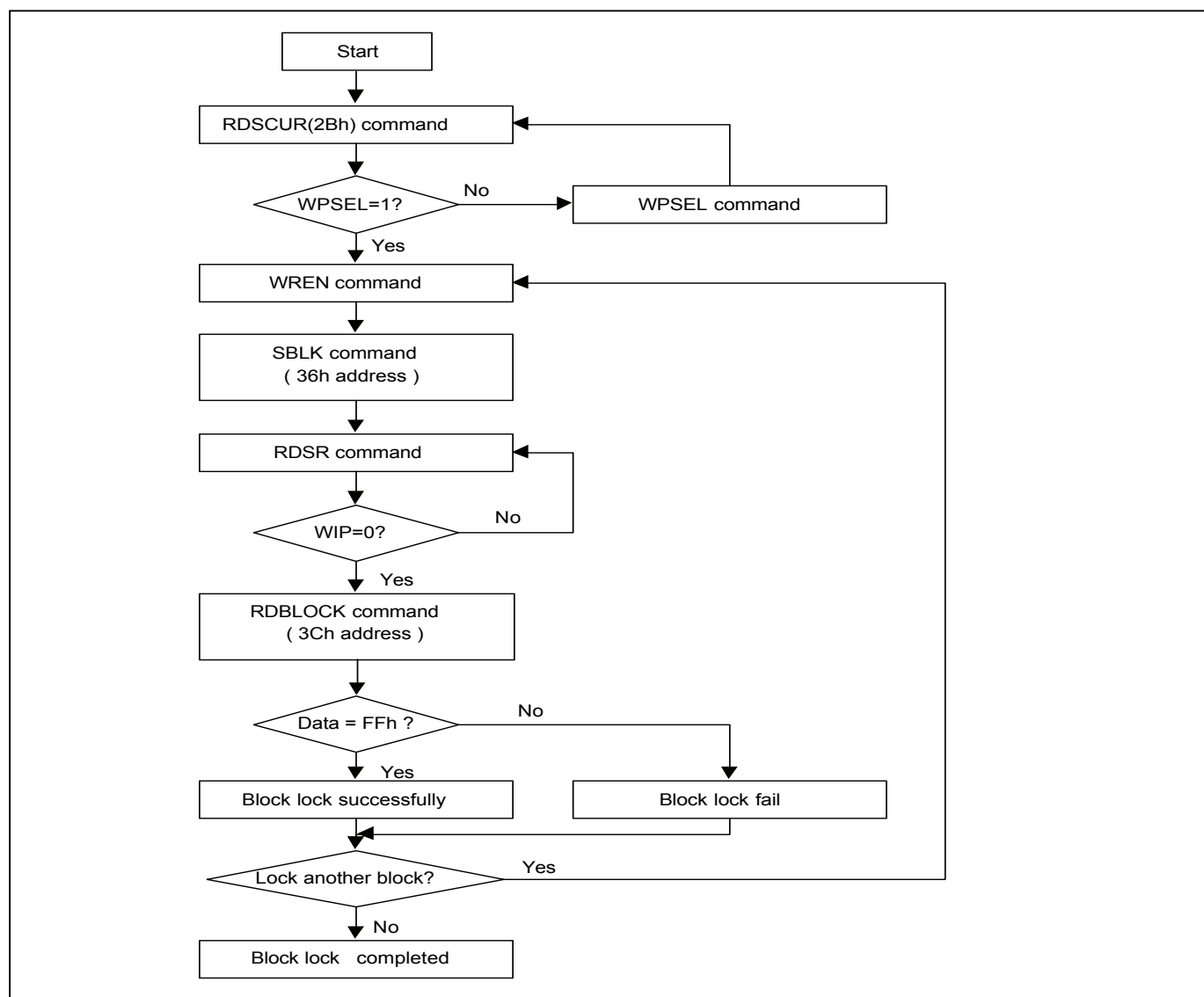
The WREN (Write Enable) instruction is required before issuing SBLK/SBULK instruction.

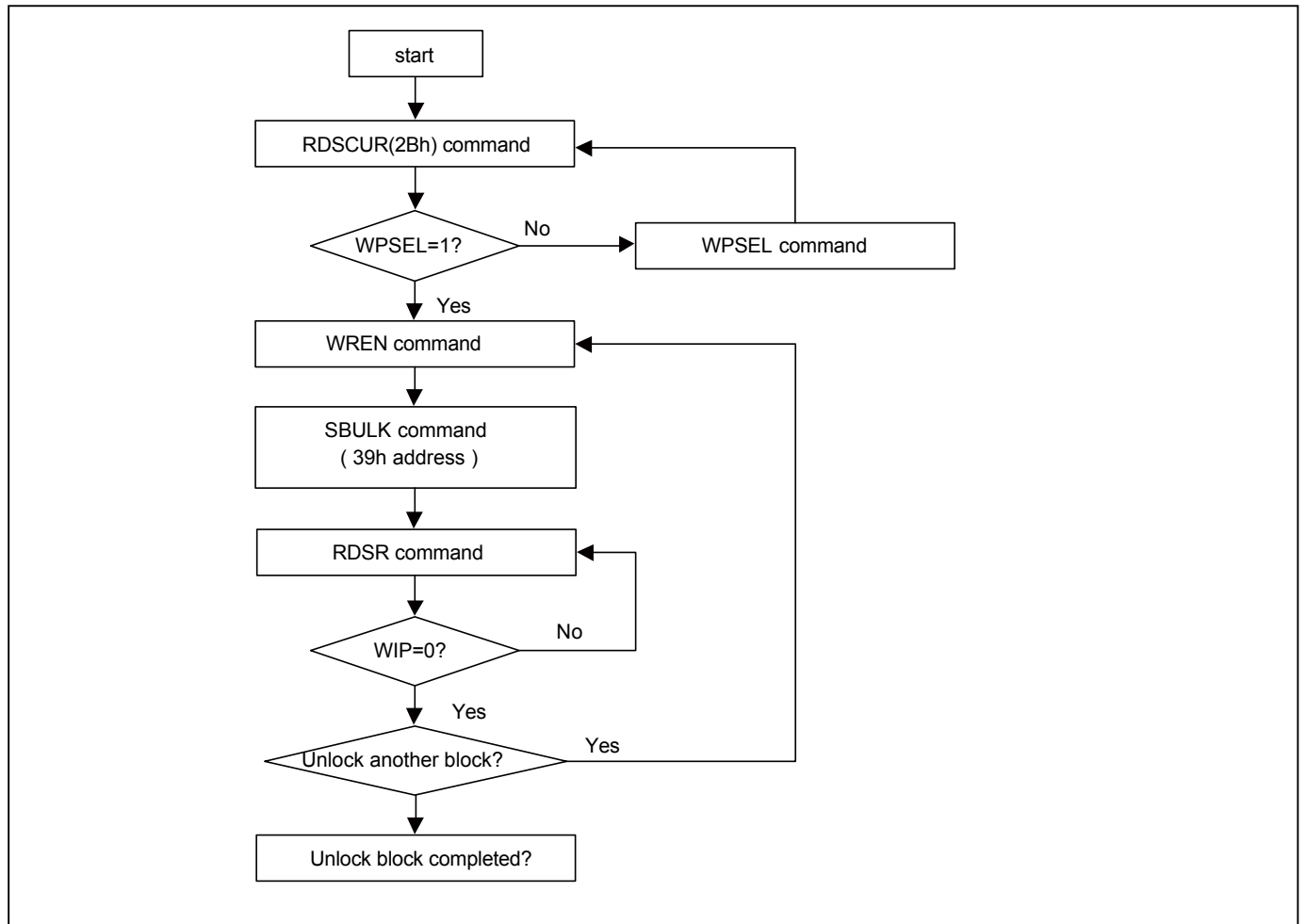
The sequence of issuing SBLK/SBULK instruction is: CS# goes low → send SBLK/SBULK (36h/39h) instruction → send 3-byte or 4-byte address (depending on mode state) assign one block (or sector) to be protected on SI pin → CS# goes high. (Please refer to Figure 30)

The CS# must go high exactly at the byte boundary, otherwise the instruction will be rejected and not be executed.

SBLK/SBULK instruction function flow is as follows:

Block Lock Flow



Block Unlock Flow

(29) Read Block Lock Status (RDBLOCK)

This instruction is only effective after WPSEL was executed. The RDBLOCK instruction is for reading the status of protection lock of a specified block(or sector), using address bits to assign a 64K bytes block (4K bytes sector) and read protection lock status bit which the first byte of Read-out cycle. The status bit is "1" to indicate that this block has been protected, that user can read only but cannot write/program/erase this block. The status bit is "0" to indicate that this block hasn't been protected, and user can read and write this block.

The default mode is 3-byte address, to access higher address (4-byte address) which requires to enter the 4-byte address read mode.

The sequence of issuing RDBLOCK instruction is: CS# goes low → send RDBLOCK (3Ch) instruction → send 3-byte or 4-byte address (depending on mode state) to assign one block on SI pin → read block's protection lock status bit on SO pin → CS# goes high. (Please refer to Figure 31)

(30) Gang Block Lock/Unlock (GBLK/GBULK)

These instructions are only effective after WPSEL was executed. The GBLK/GBULK instruction is for enable/disable the lock protection block of the whole chip.

The WREN (Write Enable) instruction is required before issuing GBLK/GBULK instruction.

The sequence of issuing GBLK/GBULK instruction is: CS# goes low → send GBLK/GBULK (7Eh/98h) instruction → CS# goes high. (Please refer to Figure 32)

The CS# must go high exactly at the byte boundary, otherwise, the instruction will be rejected and not be executed.

(31) Clear SR Fail Flags (CLSR)

The CLSR instruction is for resetting the Program/Erase Fail Flag bit of Security Register. It should be executed before program/erase another block during programming/erasing flow without read array data.

The sequence of issuing CLSR instruction is: CS# goes low → send CLSR instruction code → CS# goes high. The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.

(32) Enable SO to Output RY/BY# (ESRY)

The ESRY instruction is for outputting the ready/busy status to SO during CP mode.

The sequence of issuing ESRY instruction is: CS# goes low → sending ESRY instruction code → CS# goes high. The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.

(33) Disable SO to Output RY/BY# (DSRY)

The DSRYP instruction is for resetting ESRY during CP mode. The ready/busy status will not output to SO after DSRYP issued.

The sequence of issuing DSRYP instruction is: CS# goes low → send DSRYP instruction code → CS# goes high. The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.

(34) Read DMC mode (RDDMC)

MX25L25635E features DMC mode. Host system can retrieve the operating characteristics, structure and vendor-specified information such as identifying information, memory size, operating voltages and timing information of this device by DMC mode. Writes the DMC Query command "5AH". The system can read DMC information at the addresses given. A reset command is required to exit DMC mode and go back to ready array mode. The system can write the DMC Query command only when the device is in read mode.

The identification data values in under TBD status. The sequence of issuing RDDMC instruction is CS# goes low→send RDDMC (5A) instruction→send 3 address bytes on SI pin→send 1 dummy byte on SI pin→read DMC code→CS# goes high.

Discoverable Memory Capabilities (DMC) Signature and Parameter Identification Data Values (Advanced Information)

Description		Address (h) (Byte Mode)	Address (Bit)	Data	Comment
Discoverable Memory Capabilities Signature		00h	7:0	53h	Hex: 50444653
		01h	15:8	46h	
		02h	23:16	44h	
		03h	31:24	50h	
DMC Revision	Minor Revision	04h	7:0	00h	Start from 0x00
	Major Revision	05h	15:8	01h	Start from 0x01
Number of Parameter Header		06h	23:16	02h	
Reserved		07h	31:24	Reserved	
Parameter ID(0)		08h	7:0	00h	
Parameter Minor Revision		09h	15:8	00h	Start from 0x00
Parameter Major Revision		0Ah	23:16	01h	Start from 0x01
Parameter Length (in DW)		0Bh	31:24	02h	Based on Intel draft
Parameter Table Pointer		0Ch	7:0	20h	
		0Dh	15:8	00h	
		0Eh	23:16	00h	
Reserved		0Fh	31:24	Reserved	Reserved
Parameter ID(1)		10h	7:0	01h	
Parameter Minor Revision		11h	15:8	00h	Start from 0x00
Parameter Major Revision		12h	23:16	01h	Start from 0x01
Parameter Length (in DW)		13h	31:24	Reserved	
Parameter Table Pointer		14h	7:0	Reserved	
		15h	15:8		
		16h	23:16		
Reserved		17h	31:24	Reserved	
Parameter ID(2)		18h	7:0	02h	
Parameter Minor Revision		19h	15:8	00h	Start from 0x00
Parameter Major Revision		1Ah	23:16	01h	Start from 0x01
Parameter Length (in DW)		1Bh	31:24	02h	
Parameter Table Pointer		1Ch	7:0	30h	
		1Dh	15:8	00h	
		1Eh	23:16	00h	
Reserved		1Fh	31:24	Reserved	

Parameter ID (0) (Advanced Information)

Description	Address (h) (Byte Mode)	Address (Bit)	Data	Comment			
Minimum Block/Sector Erase sizes	20h	00	01	00=reserved 01=4KB erase 10=reserved 11=64KB erase			
		01					
Write Granularity (64Byte support)		02	1	0= No 1=Yes			
Write Enable Command Required for Writing to Volatile Status Registers		03	00	00=N/A 01=use 50h opcode 11=use 06h opcode			
		04					
Reserved		05	Reserved				
		06					
		07					
4KB Erase Opcode	21h	08	20h	4KB Erase Support (00h=not supported)			
		09					
		10					
		11					
		12					
		13					
		14					
Supports Single Input Address Dual Output Fast read	22h	15	0	0=not supported 1=support			
		Number of bytes used in addressing for flash array read, write and erase			16	01	00=3Byte 01=4Byte 10=reserved 11=reserved
					17		
		18					
		Supports Double Transfer Rate Clocking			19	0	0=not supported 1=support
		Supports Dual Input Address Dual Output Fast read			20	1	0=not supported 1=support
	Supports Quad Input Address Quad Output Fast read	21	1	0=not supported 1=support			
	Reserved	23h	22	Reserved			
			23				
			24				
			25				
			26				
27							
28							
29							
30							
31							
Flash Size in bits	27h:24h	31:00	0FFFFFFFh	256Mbits			

Parameter ID (1) (Advanced Information)

Description	Address (h) (Byte Mode)	Address (Bit)	Data	Comment
Reserved	Undefined.	31:00	Reserved	

Parameter ID (2) (Advanced Information)

Description	Address (h) (Byte Mode)	Address (Bit)	Data	Comment
Vcc Supply Maximum Voltage	31h:30h	15:00	3600h	2000h=2.00V 2800h=2.80V 3600h=3.60V
Vcc Supply Minimum Voltage	33h:32h	31:16	2700h	1650h=1.65V 2250h=2.25V 2350h=2.35V 2700h=2.70V
Vpp Supply Maximum Voltage	34h	01:00	00	00=not supported
Vpp Supply Minimum Voltage		03:02	00	00=not supported
Supports Vio Function		04	0	0=not supported 1=support
Supports HOLD# Function		05	1	0=not supported 1=support
Reserved		07:06	Reserved	
Parallel Mode Capable (Note1)	35h	08	1	0=not supported 1=support
Supports Single Input Address Quad Output Fast read		09	0	0=not supported 1=support
Supports Continuous Program Mode		10	1	0=not supported 1=support
Supports Deep Power Down Mode		11	1	0=not supported 1=support
OTP Capable		12	1	0=not supported 1=support
Supports Sector Group Protect		13	1	0=not supported 1=support
Supports 64KB Block Protect		14	1	0=not supported 1=support
Supports 4KB Sector Protect		15	1	0=not supported 1=support
Supports 64KB Block Erase	36h	16	1	0=not supported 1=support
Supports 32KB Block Erase		17	1	0=not supported 1=support
Reserved	37h	23:18	Reserved	
Reserved		31:24	Reserved	

Notes: Undefined DMC array data="00".

POWER-ON STATE

The device is at below states when power-up:

- Standby mode (please note it is not Deep Power-down mode)
- Write Enable Latch (WEL) bit is reset
- 3-byte address mode

The device must not be selected during power-up and power-down stage unless the VCC achieves below correct level:

- VCC minimum at power-up stage and then after a delay of tVSL
- GND at power-down

Please note that a pull-up resistor on CS# may ensure a safe and proper power-up/down level.

An internal Power-on Reset (POR) circuit may protect the device from data corruption and inadvertent data change during power up state.

For further protection on the device, if the VCC does not reach the VCC minimum level, the correct operation is not guaranteed. The read, write, erase, and program command should be sent after the time delay:

- tVSL after VCC reached VCC minimum level

The device can accept read command after VCC reached VCC minimum and a time delay of tVSL.

Please refer to the figure of "Power-up Timing".

Note:

- To stabilize the VCC level, the VCC rail decoupled by a suitable capacitor close to package pins is recommended. (generally around 0.1uF)

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

RATING		VALUE
Ambient Operating Temperature	Industrial grade	-40°C to 85°C
Storage Temperature		-55°C to 125°C
Applied Input Voltage		-0.5V to 4.6V
Applied Output Voltage		-0.5V to 4.6V
VCC to Ground Potential		-0.5V to 4.6V

NOTICE:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is stress rating only and functional operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended period may affect reliability.
2. Specifications contained within the following tables are subject to change.
3. During voltage transitions, all pins may overshoot Vss to -2.0V and Vcc to +2.0V for periods up to 20ns, see Figure 3, 4.

Figure 3. Maximum Negative Overshoot Waveform

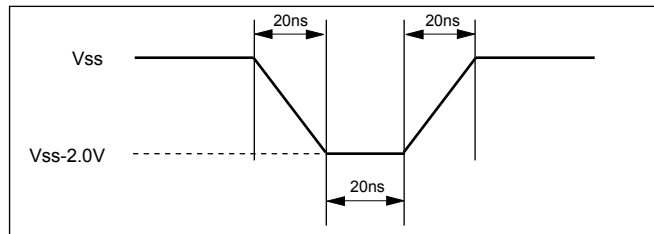
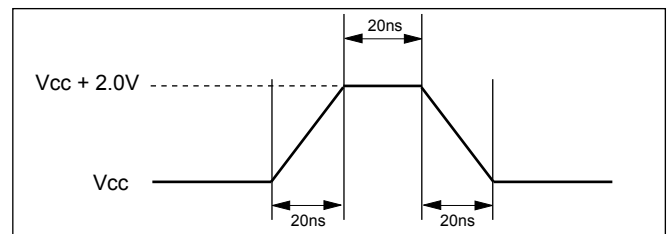


Figure 4. Maximum Positive Overshoot Waveform



CAPACITANCE TA = 25°C, f = 1.0 MHz

SYMBOL	PARAMETER	MIN.	TYP	MAX.	UNIT	CONDITIONS
CIN	Input Capacitance			6	pF	VIN = 0V
COU	Output Capacitance			8	pF	VOU = 0V

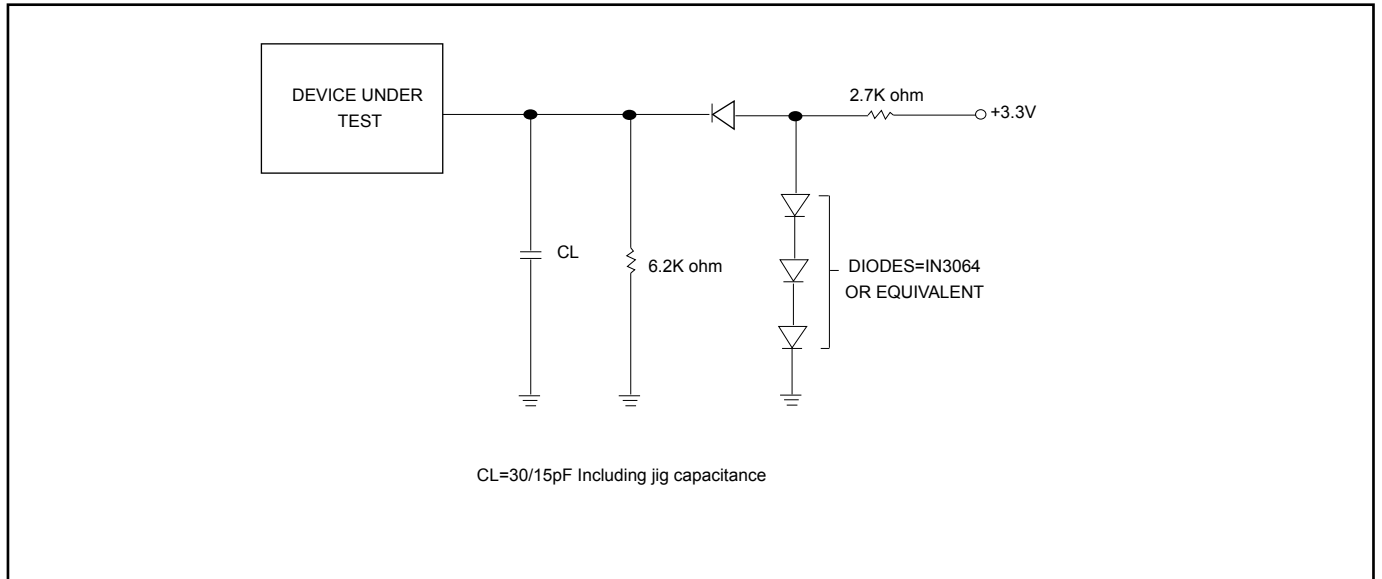
Figure 5. OUTPUT LOADING

Table 7. DC CHARACTERISTICS (Temperature = -40°C to 85°C for Industrial grade, VCC = 2.7V ~ 3.6V)

SYMBOL	PARAMETER	NOTES	MIN.	MAX.	UNITS	TEST CONDITIONS
ILI	Input Load Current	1		± 4	uA	VCC = VCC Max, VIN = VCC or GND, HOLD# = VCC
ILO	Output Leakage Current	1		± 4	uA	VCC = VCC Max, VIN = VCC or GND
ISB1	VCC Standby Current	1		200	uA	VIN = VCC or GND, CS# = VCC, HOLD# = VCC
ISB2	Deep Power-down Current			80	uA	VIN = VCC or GND, CS# = VCC, HOLD# = VCC
ICC1	VCC Read	1		45	mA	f=80MHz, fQ=70MHz (4 x I/O read) SCLK=0.1VCC/0.9VCC, SO=Open
				40	mA	fT=70MHz (2 x I/O read) SCLK=0.1VCC/0.9VCC, SO=Open
				30	mA	f=50MHz, SCLK=0.1VCC/0.9VCC, SO=Open
ICC2	VCC Program Current (PP)	1		25	mA	Program in Progress, CS# = VCC
ICC3	VCC Write Status Register (WRSR) Current			40	mA	Program status register in progress, CS#=VCC
ICC4	VCC Sector Erase Current (SE)	1		25	mA	Erase in Progress, CS#=VCC
ICC5	VCC Chip Erase Current (CE)	1		40	mA	Erase in Progress, CS#=VCC
VIL	Input Low Voltage		-0.5	0.8	V	
VIH	Input High Voltage		0.7VCC	VCC+0.4	V	
VOL	Output Low Voltage			0.4	V	IOL = 1.6mA; IOL = 140uA for parallel mode
VOH	Output High Voltage		VCC-0.2		V	IOH = -100uA; IOH = 65uA for parallel mode

Table 8. AC CHARACTERISTICS (Temperature = -40°C to 85°C for Industrial grade, VCC = 2.7V ~ 3.6V)

Symbol	Alt.	Parameter		Min.	Max.	Unit
fSCLK	fC	Clock Frequency for the following instructions: FAST_READ, PP, SE, BE, CE, DP, RES, RDP, WREN, WRDI, RDID, RDSR, WRSR	Serial	D.C.	80	MHz
			Parallel		6	MHz
fRCLK	fR	Clock Frequency for READ instructions			50	MHz
fTCLK	fT	Clock Frequency for 2READ instructions			70	MHz
	fQ	Clock Frequency for 4READ instructions			70	MHz
f4PP		Clock Frequency for 4PP (Quad page program)			20	MHz
tCH(1)	tCLH	Clock High Time	Serial	5.5 (Fast_Read)		ns
			Serial	9 (Read)		ns
			Parallel	30		ns
tCL(1)	tCLL	Clock Low Time	Serial	5.5 (Fast_Read)		ns
			Serial	9 (Read)		ns
			Parallel	30		ns
tCLCH(2)		Clock Rise Time (3) (peak to peak)	Serial	0.1		V/ns
			Parallel	0.25		V/ns
tCHCL(2)		Clock Fall Time (3) (peak to peak)	Serial	0.1		V/ns
			Parallel	0.25		V/ns
tSLCH	tCSS	CS# Active Setup Time (relative to SCLK)		8		ns
tCHSL		CS# Not Active Hold Time (relative to SCLK)		5		ns
tDVCH	tDSU	Data In Setup Time	Serial	2		ns
			Parallel	10		ns
tCHDX	tDH	Data In Hold Time	Serial	5		ns
			Parallel	10		ns
tCHSH		CS# Active Hold Time (relative to SCLK)	Serial	5		ns
			Parallel	30		ns
tSHCH		CS# Not Active Setup Time (relative to SCLK)		8		ns
tSHSL(3)	tCSH	CS# Deselect Time	Read	15		ns
			Write/Erase/Program	100		ns
tSHQZ(2)	tDIS	Output Disable Time	2.7V-3.6V Serial		12	ns
			3.0V-3.6V Serial		10	ns
			Parallel		25	ns
tCLQV	tV	Clock Low to Output Valid VCC=2.7V~3.6V	Loading: 15pF	1 I/O	12	ns
				2 I/O & 4 I/O	12	ns
			Loading: 30pF	2 I/O & 4 I/O	15	ns
				Parallel	80	ns

Symbol	Alt.	Parameter	Min.	Typ.	Max.	Unit
tCLQX	tHO	Output Hold Time	2			ns
tHLCH		HOLD# Setup Time (relative to SCLK)	8			ns
tCHHH		HOLD# Hold Time (relative to SCLK)	5			ns
tHHCH		HOLD Setup Time (relative to SCLK)	8			ns
tCHHL		HOLD Hold Time (relative to SCLK)	5			ns
tHHQX(2)	tLZ	HOLD to Output Low-Z	Serial 2.7V-3.6V		12	ns
			Serial 3.0V-3.6V		10	ns
			Parallel		25	ns
tHLQZ(2)	tHZ	HOLD# to Output High-Z	Serial 2.7V-3.6V		12	ns
			Serial 3.0V-3.6V		10	ns
			Parallel		25	ns
tWHS(4)		Write Protect Setup Time	20			ns
tSHWL(4)		Write Protect Hold Time	100			ns
tDP(2)		CS# High to Deep Power-down Mode			10	us
tRES1(2)		CS# High to Standby Mode without Electronic Signature Read			100	us
tRES2(2)		CS# High to Standby Mode with Electronic Signature Read			100	us
tW		Write Status Register Cycle Time		40	100	ms
tBP		Byte-Program		9	300	us
tPP		Page Program Cycle Time		1.4	5	ms
tSE		Sector Erase Cycle Time (4KB)		60	300	ms
tBE		Block Erase Cycle Time (32KB)		0.5	2	s
tBE		Block Erase Cycle Time (64KB)		0.7	2	s
tCE		Chip Erase Cycle Time		160	400	s
tWPS		Write Protection Selection Time			1	ms
tWSR		Write Security Register Time			1	ms

Notes:

1. tCH + tCL must be greater than or equal to 1/ fC.
2. Value guaranteed by characterization, not 100% tested in production.
3. Only applicable as a constraint for a WRSR instruction when SRWD is set at 1.

Timing Analysis

Figure 6. Serial Input Timing

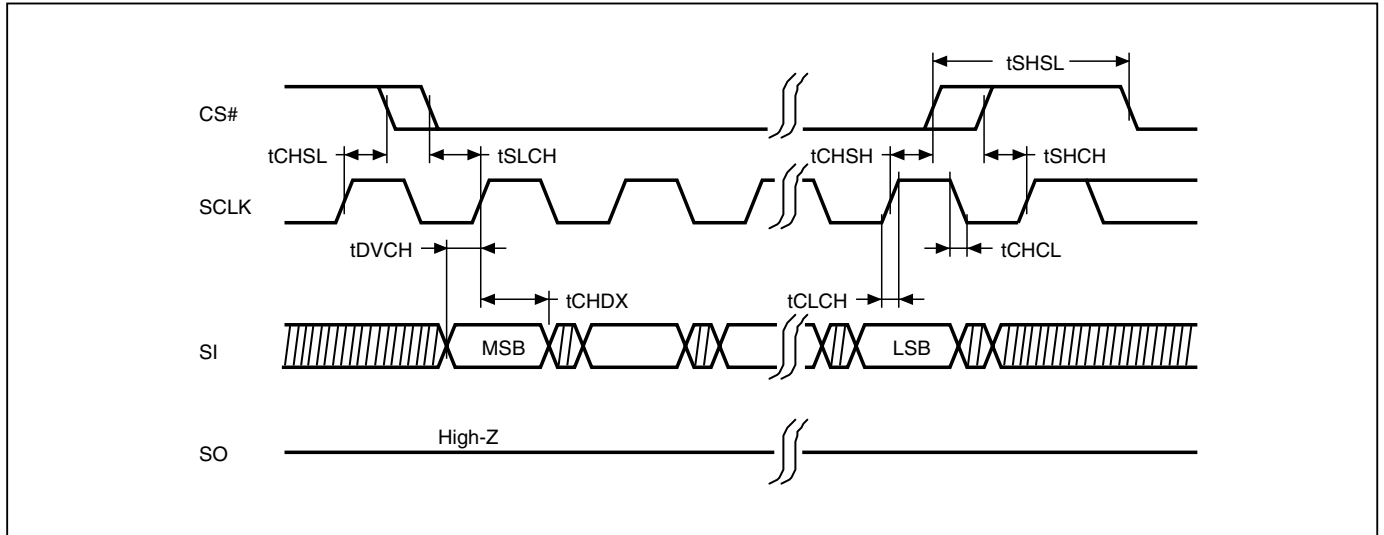


Figure 7. Output Timing

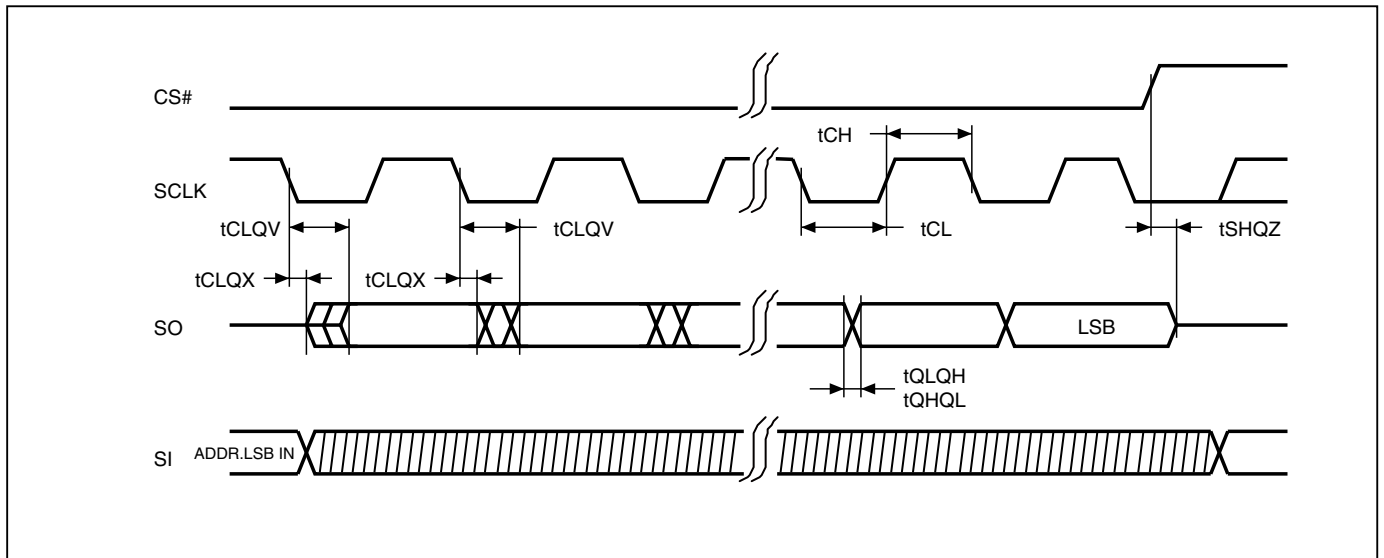
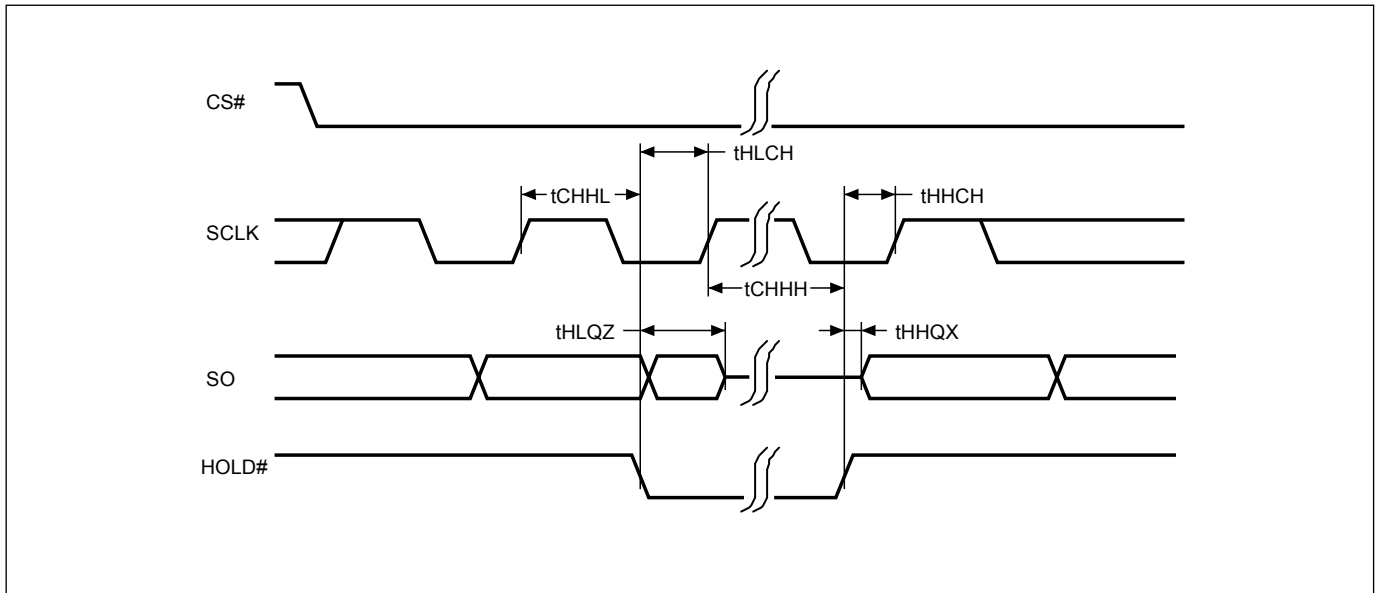


Figure 8. Hold Timing



* SI is "don't care" during HOLD operation.

Figure 9. WP# Setup Timing and Hold Timing during WRSR when SRWD=1

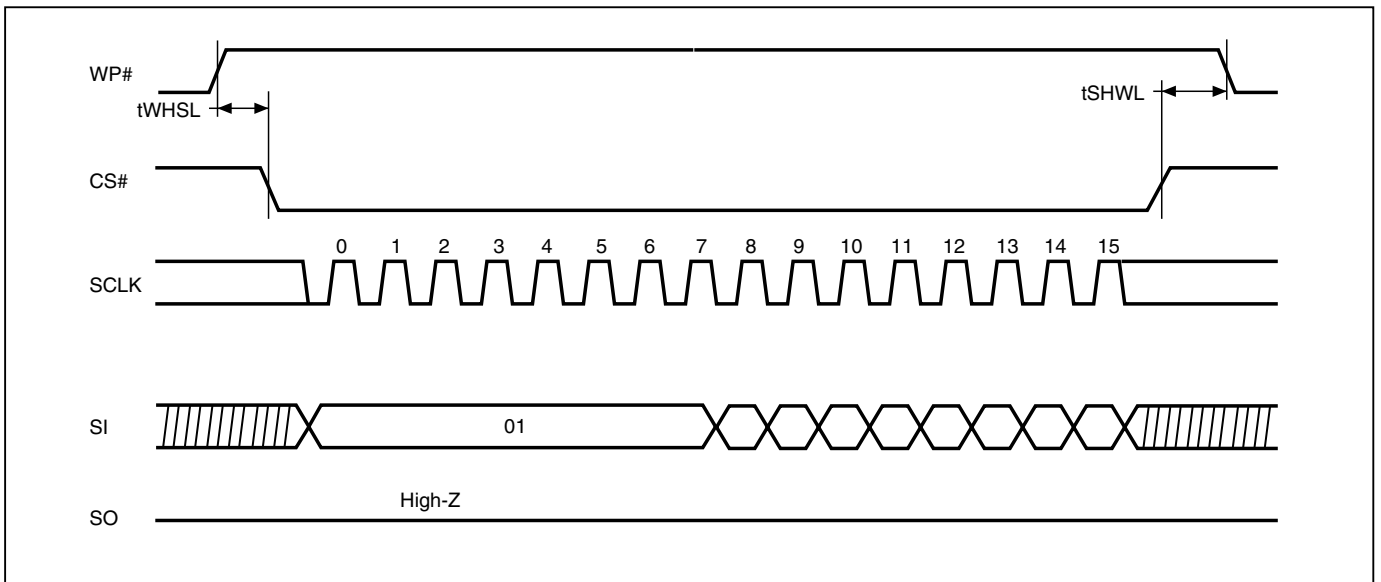


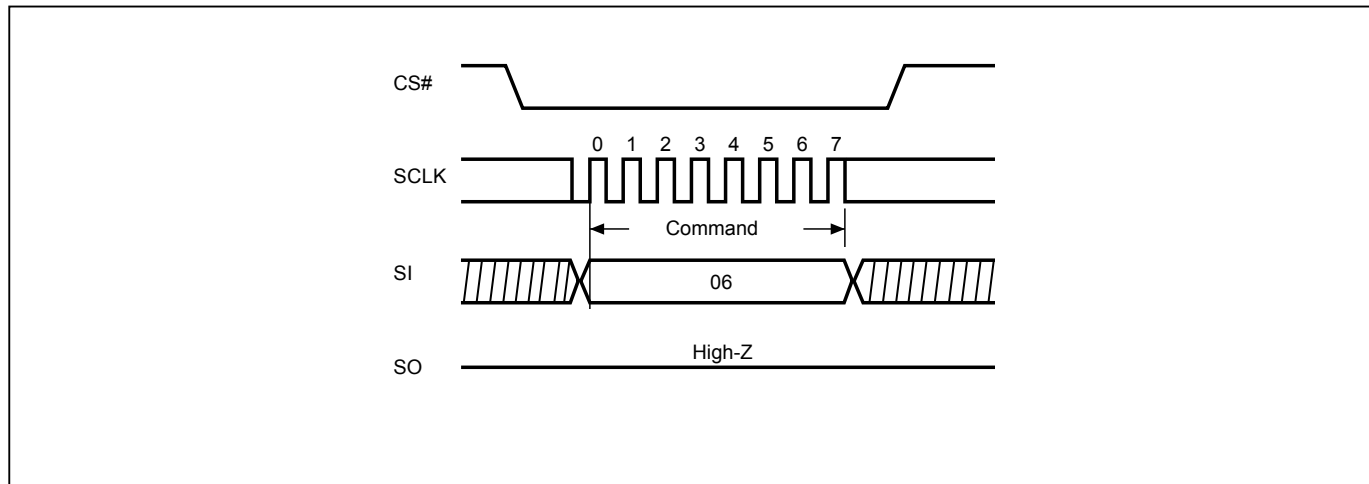
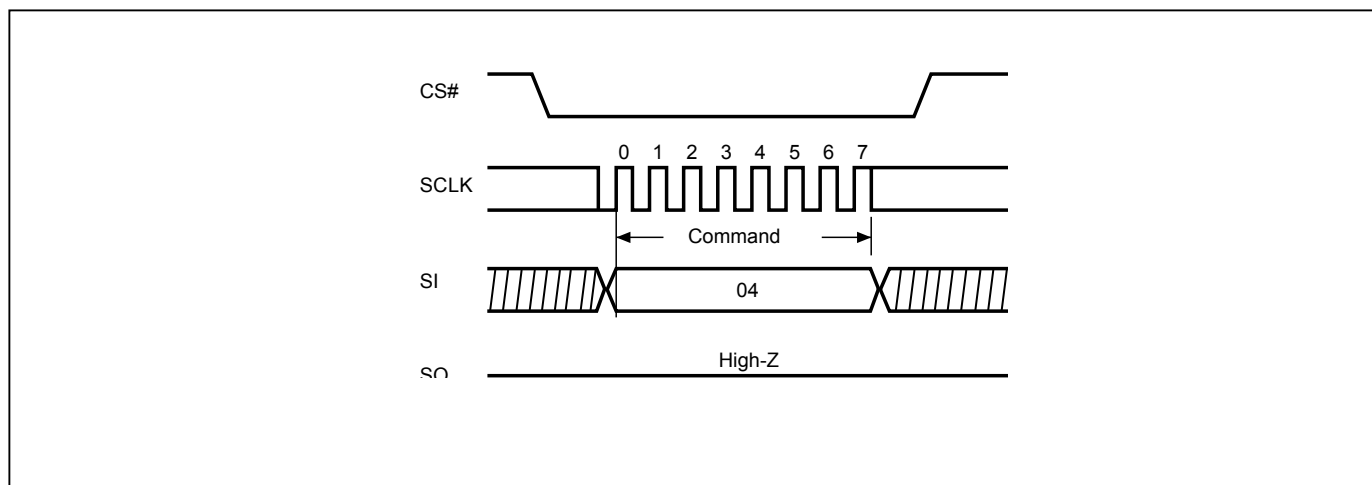
Figure 10. Write Enable (WREN) Sequence (Command 06)**Figure 11. Write Disable (WRDI) Sequence (Command 04)**

Figure 12. Read Identification (RDID) Sequence (Command 9F)

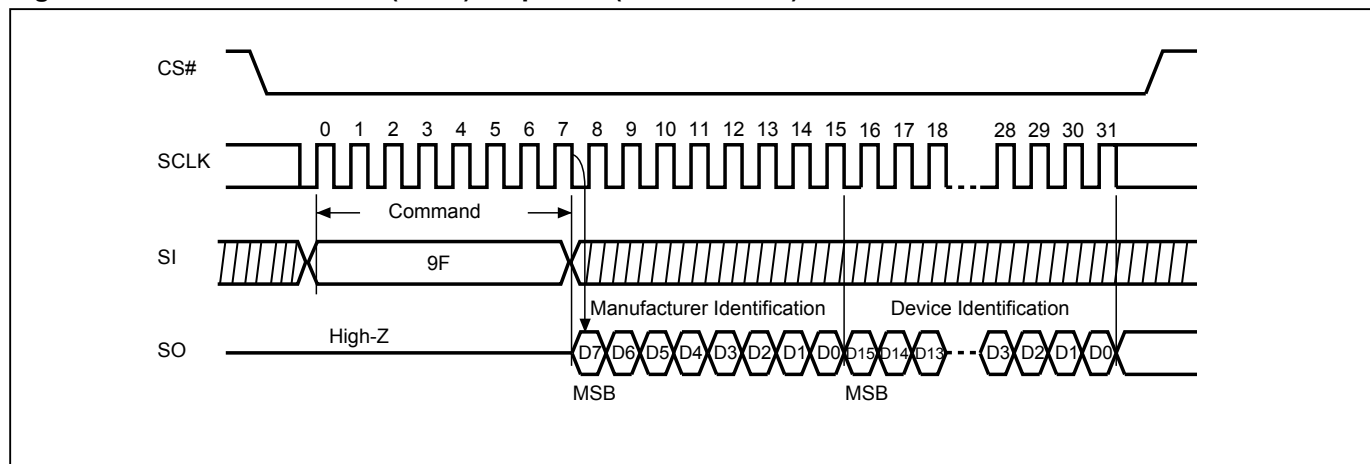


Figure 13. Read Status Register (RDSR) Sequence (Command 05)

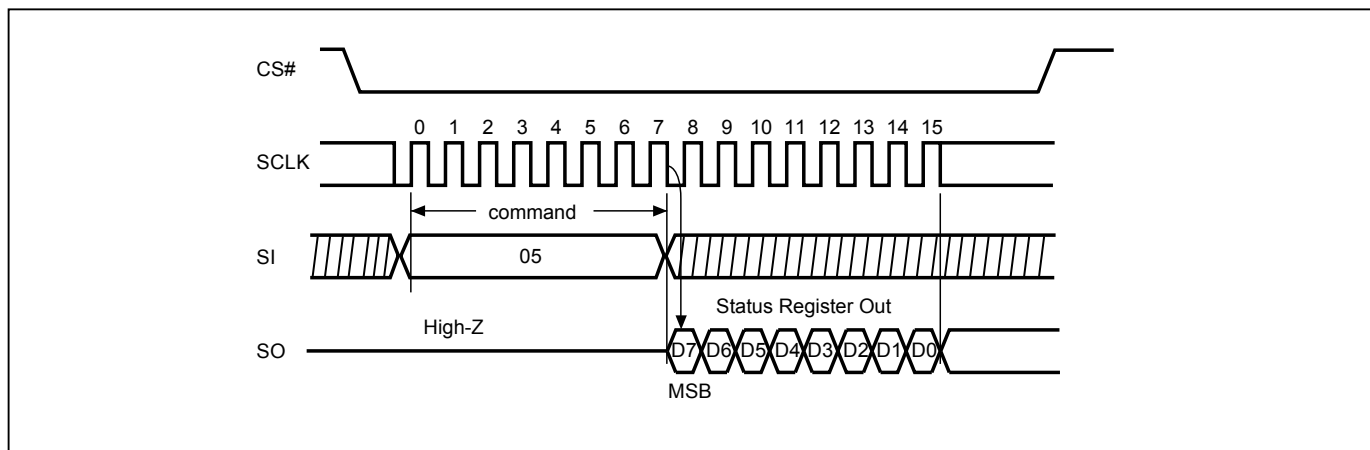


Figure 14. Write Status Register (WRSR) Sequence (Command 01)

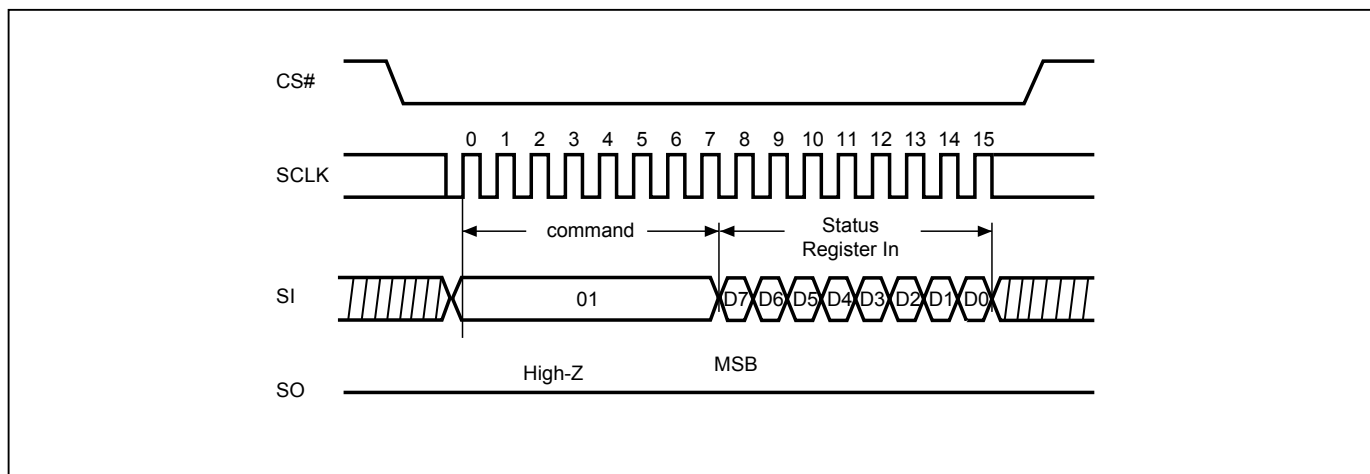
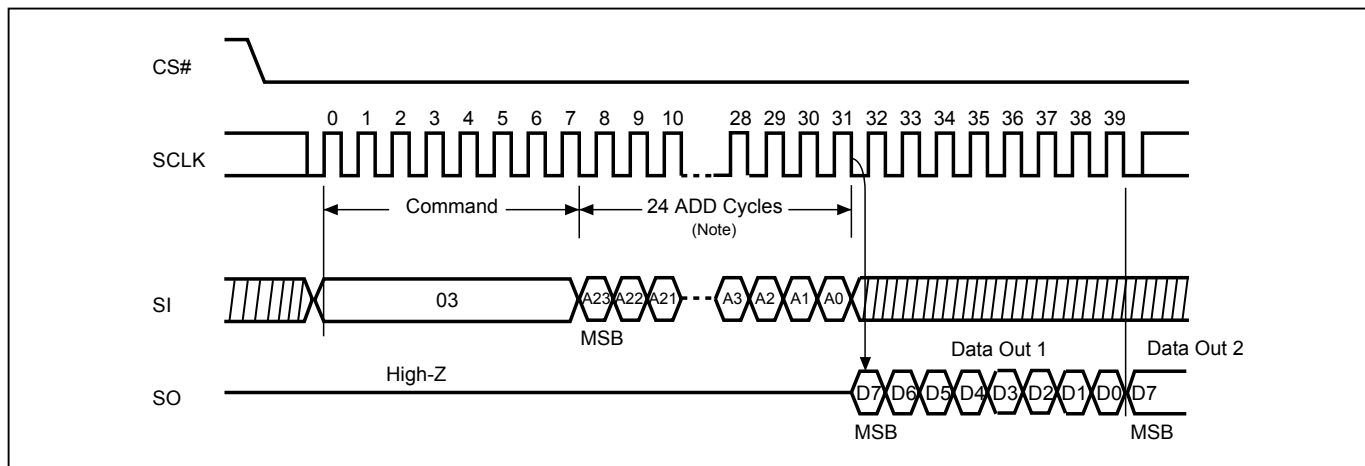
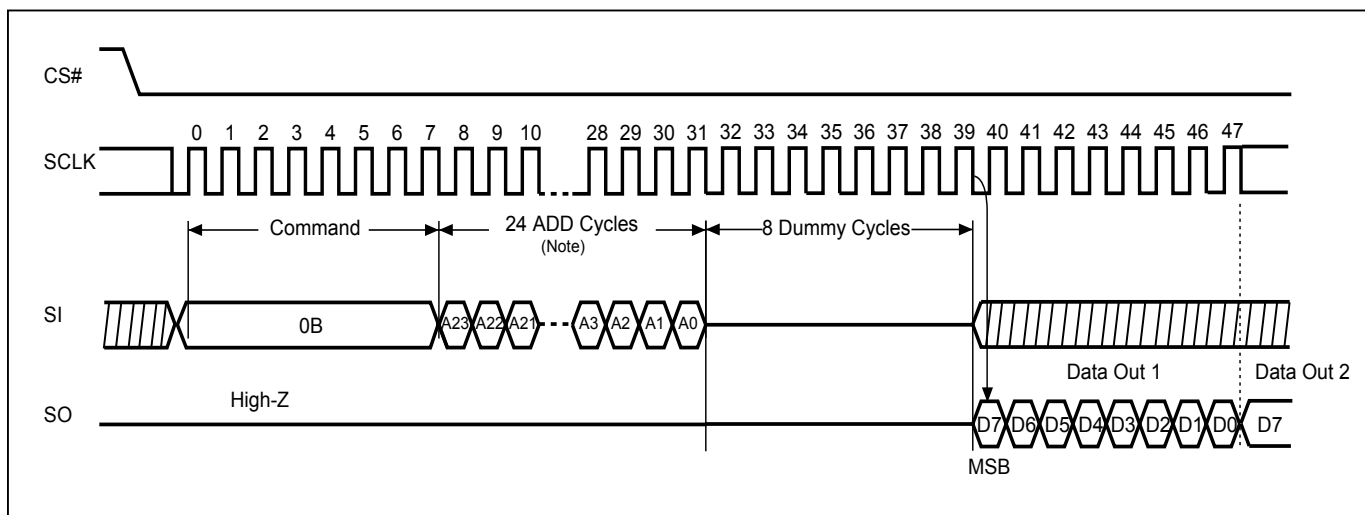


Figure 15. Read Data Bytes (READ) Sequence (Command 03)



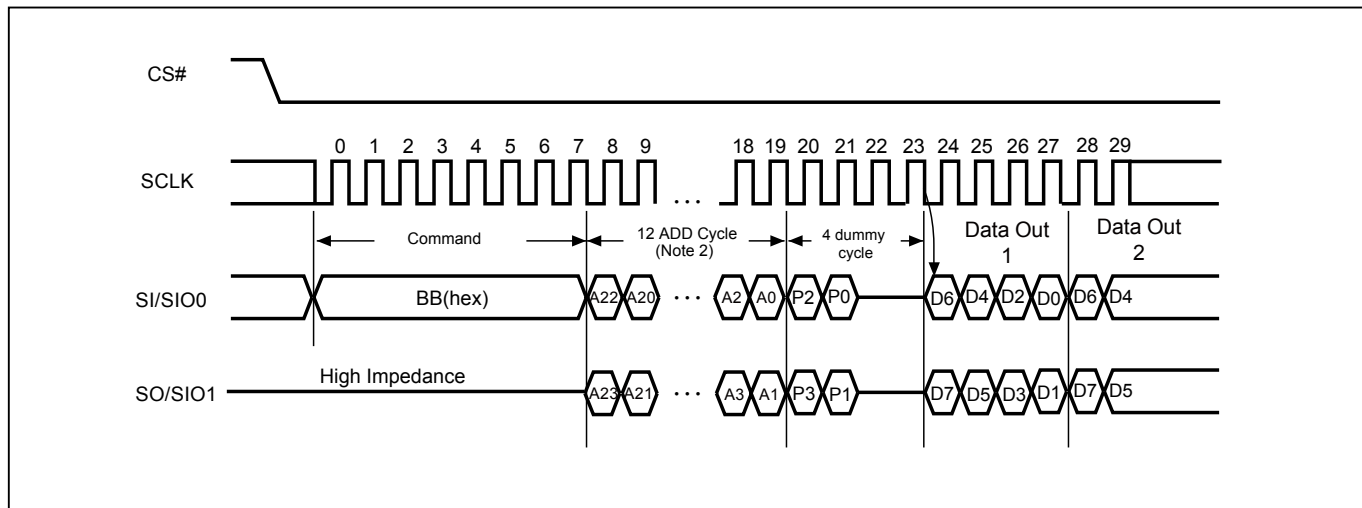
Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 16. Read at Higher Speed (FAST_READ) Sequence (Command 0B)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

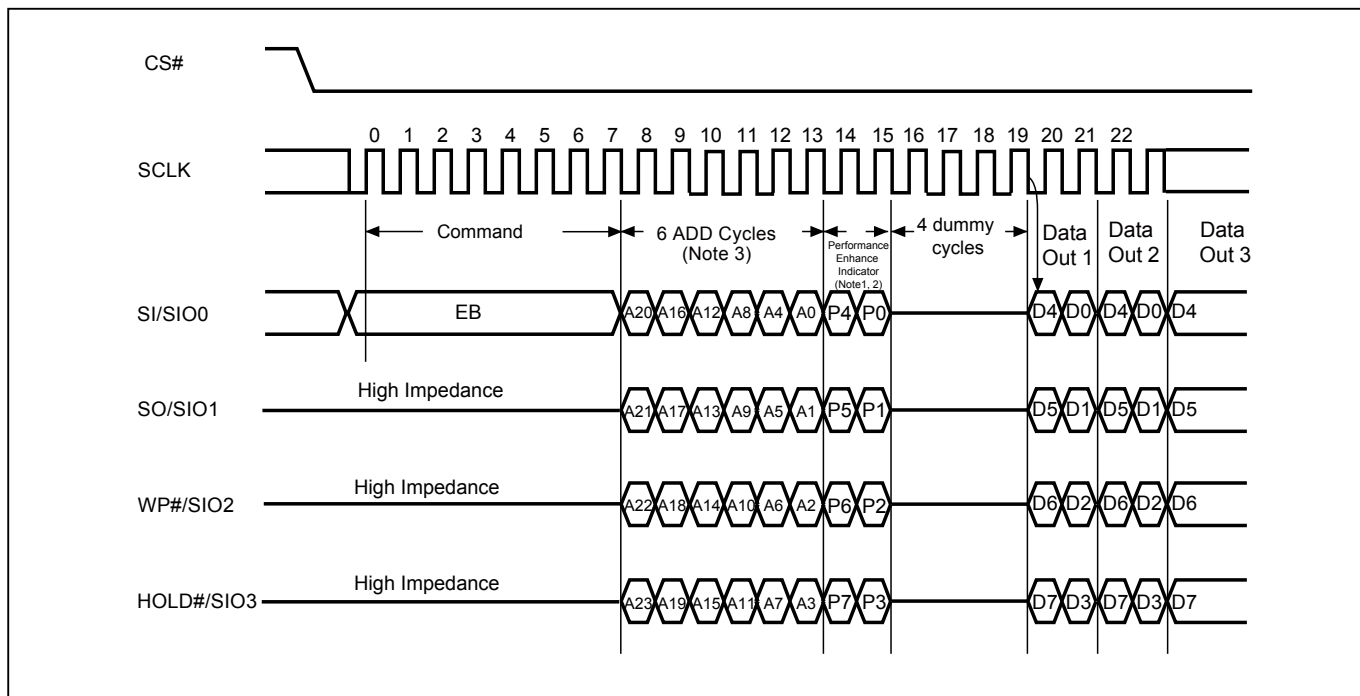
Figure 17. 2 x I/O Read Mode Sequence (Command BB)



Note:

1. SI/SIO0 or SO/SIO1 should be kept "0h" or "Fh" in the first two dummy cycles. In other words, P2=P0 or P3=P1 is necessary.
2. Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

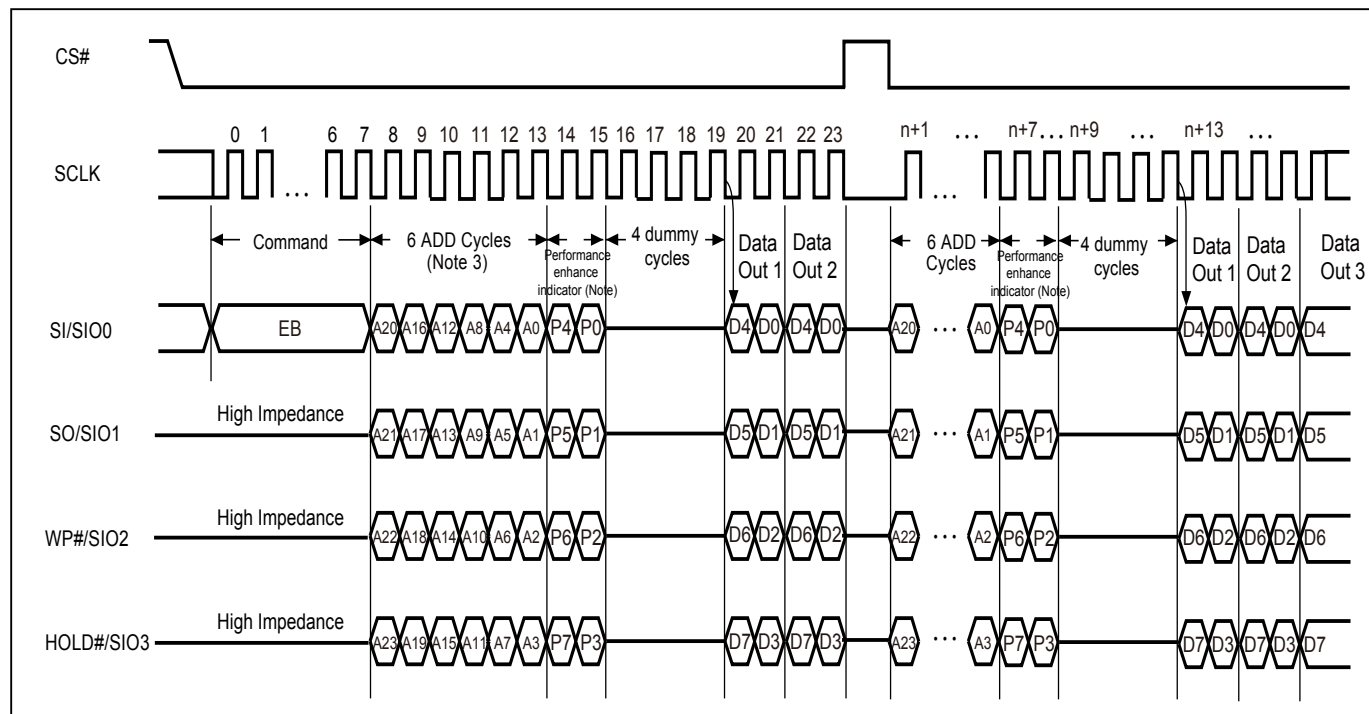
Figure 18. 4 x I/O Read Mode Sequence (Command EB)



Note:

1. Hi-impedance is inhibited for the two clock cycles.
2. P7≠P3, P6≠P2, P5≠P1 & P4≠P0 (Toggling) will result in entering the performance enhance mode.
3. Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

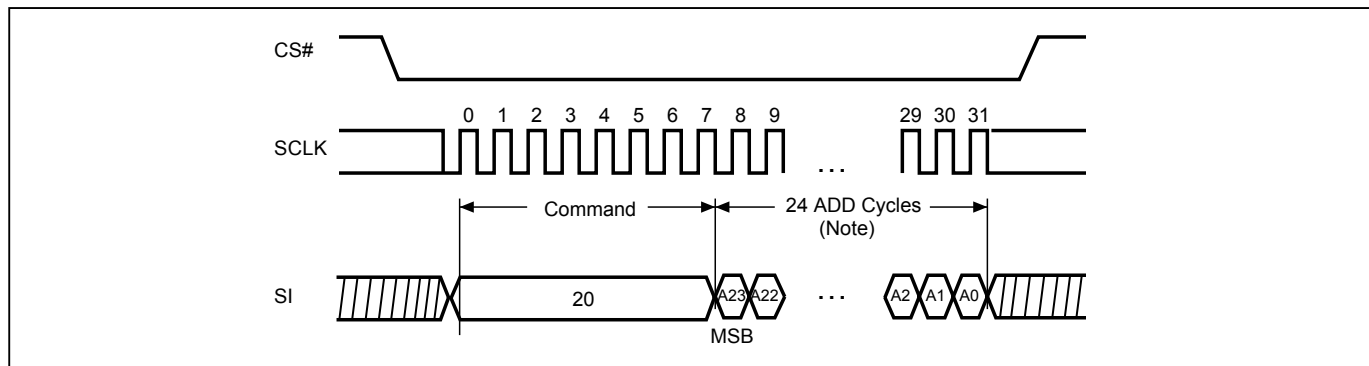
Figure 19. 4 x I/O Read Enhance Performance Mode Sequence (Command EB)



Note:

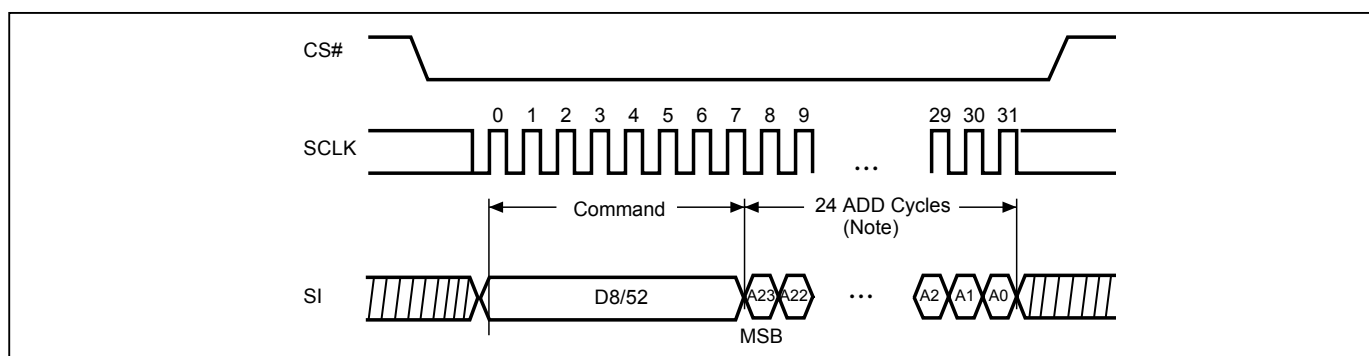
1. Performance enhance mode, if P7≠P3 & P6≠P2 & P5≠P1 & P4≠P0 (Toggling), ex: A5, 5A, 0F
2. Reset the performance enhance mode, if P7=P3 or P6=P2 or P5=P1 or P4=P0, ex: AA, 00, FF
3. Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 20. Sector Erase (SE) Sequence (Command 20)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 21. Block Erase (BE/EB32K) Sequence (Command D8/52)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 22. Chip Erase (CE) Sequence (Command 60 or C7)

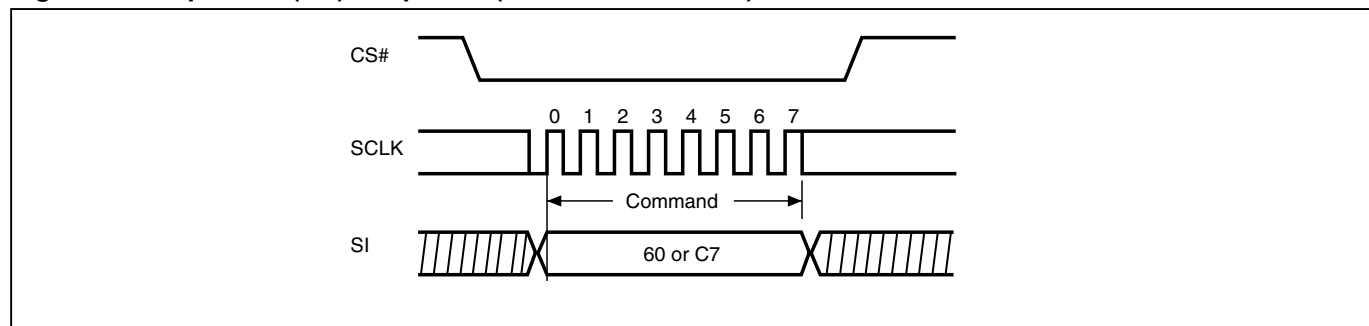
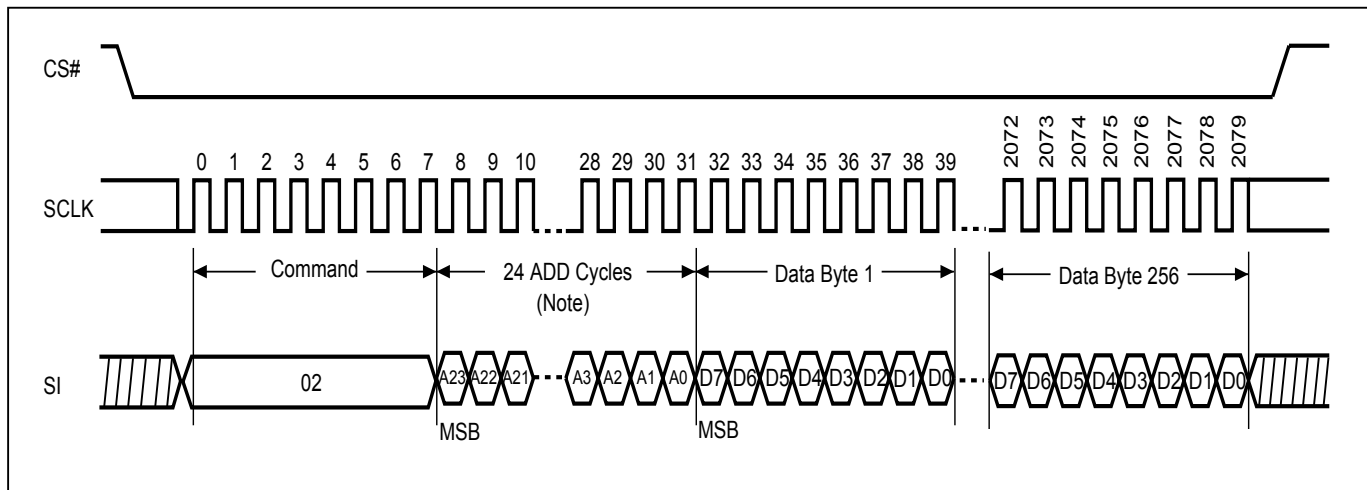
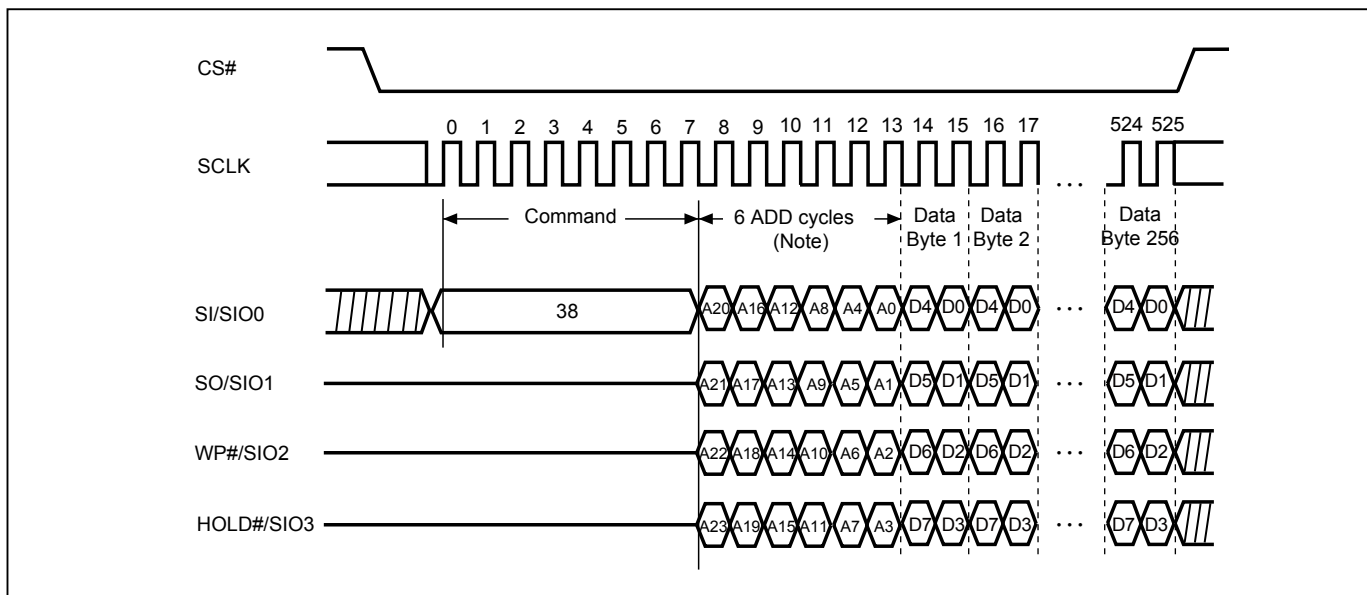


Figure 23. Page Program (PP) Sequence (Command 02)

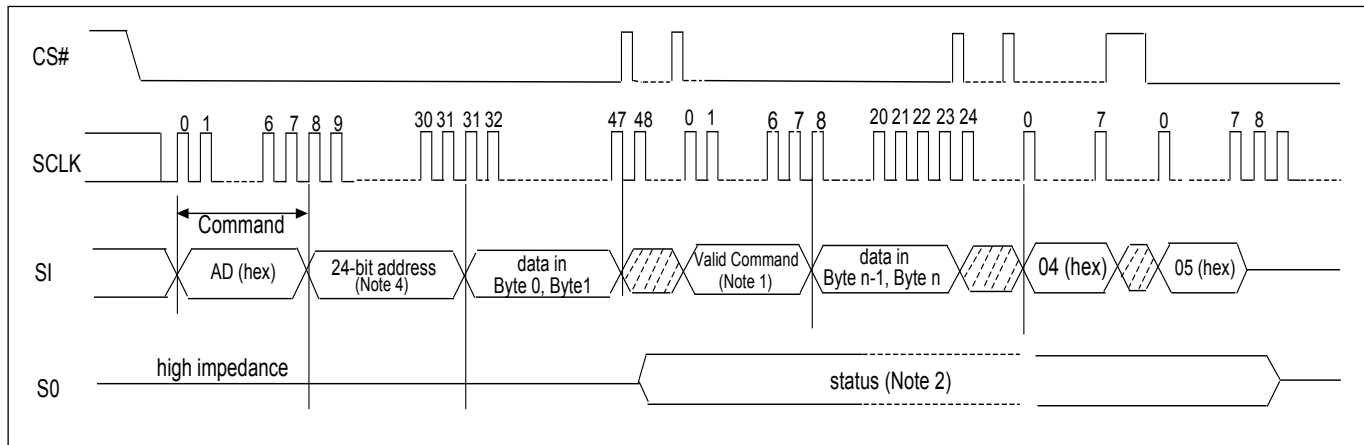


Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 24. 4 x I/O Page Program (4PP) Sequence (Command 38)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 25. Continuously Program (CP) Mode Sequence with Hardware Detection (Command AD)**Note:**

1. During CP mode, the valid commands are CP command (AD hex), WRDI command (04 hex), RDSR command (05 hex), and RDSCUR command (2B hex).
2. Once an internal programming operation begins, CS# goes low will drive the status on the SO pin and CS# goes high will return the SO pin to tri-state.
3. To end the CP mode, either reaching the highest unprotected address or sending Write Disable (WRDI) command (04 hex) may achieve it and then it is recommended to send RDSR command (05 hex) to verify if CP mode is ended.
4. Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 26-1. Enter Parallel Mode (ENPLM) Sequence (Command 55)

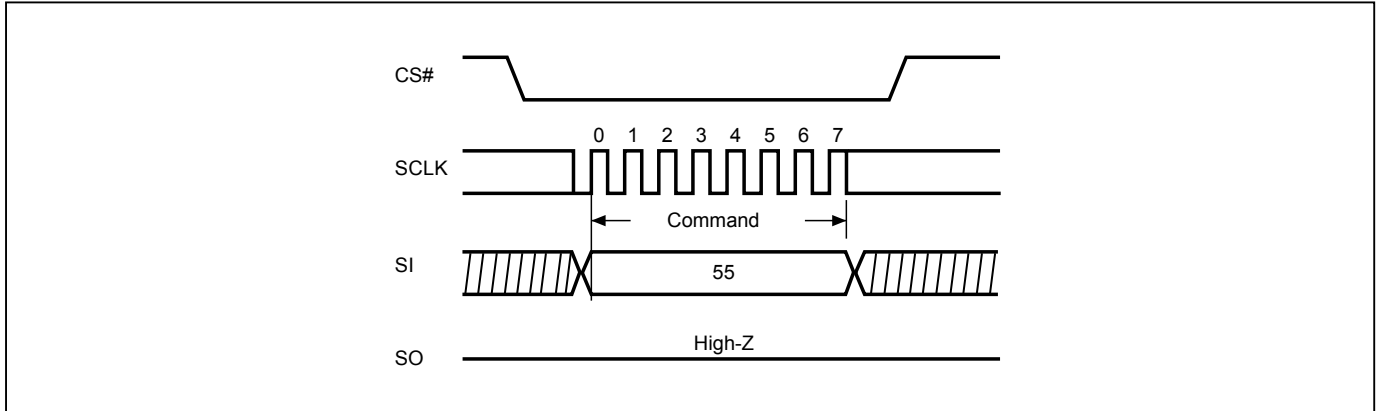


Figure 26-2. Exit Parallel Mode (EXPLM) Sequence (Command 45)

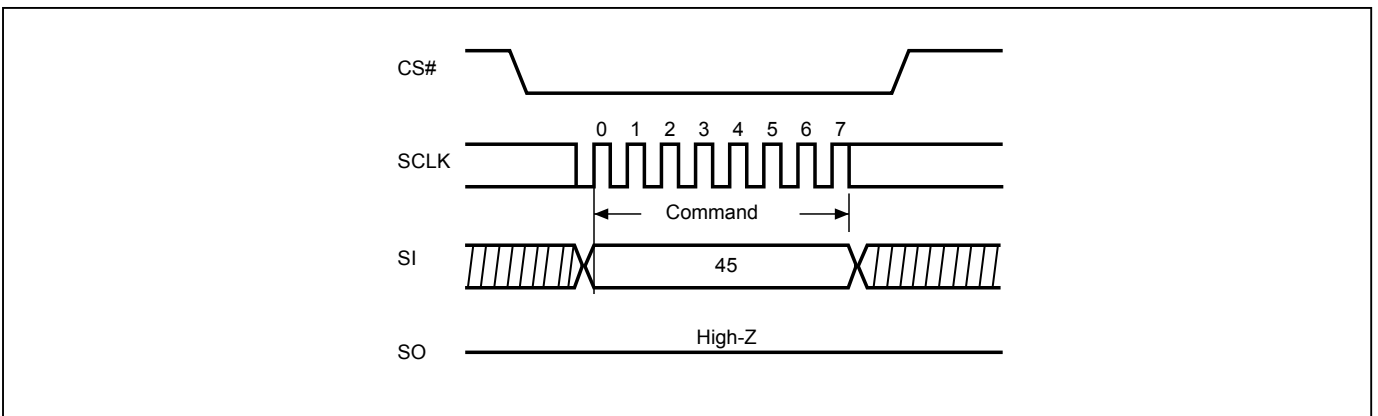
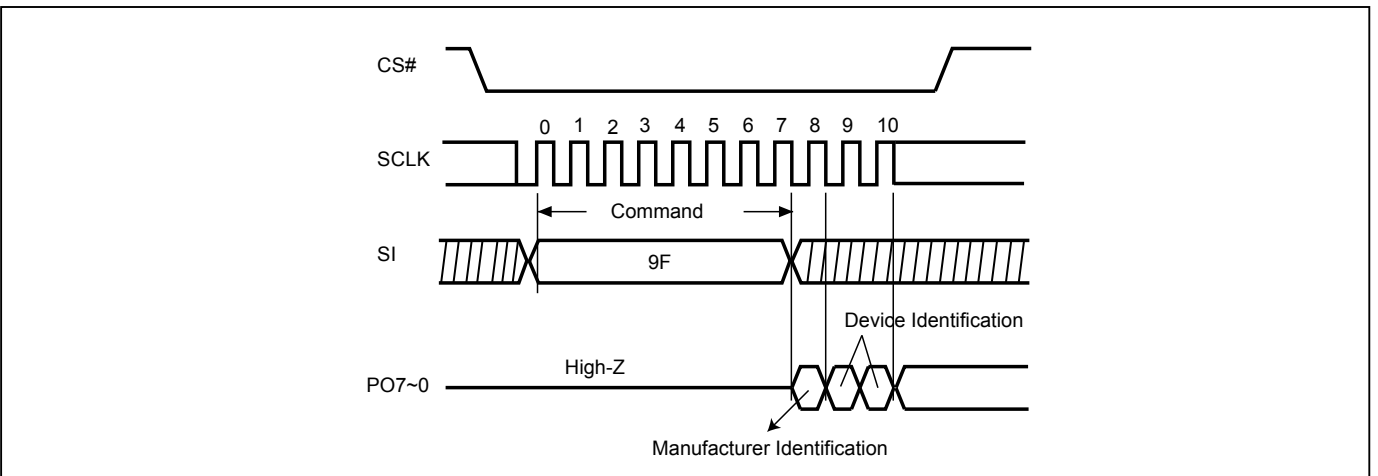


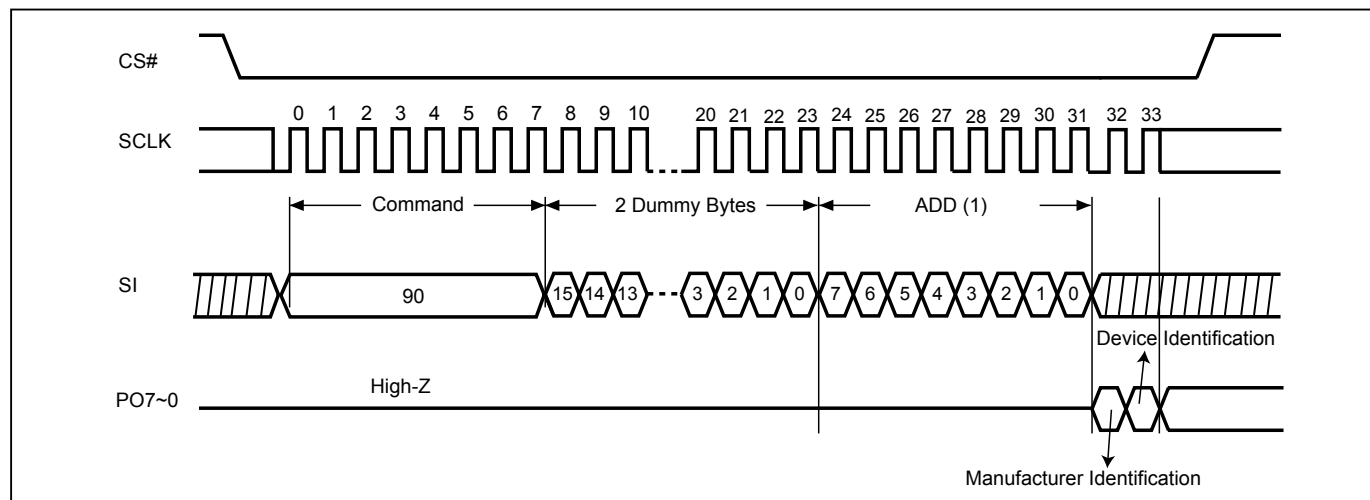
Figure 26-3. Parallel Mode Read Identification (Parallel RDID) Sequence (Command 9F)



Notes :

1. There are 3 data bytes which would be output sequentially for Manufacturer and Device ID 1'st byte (Memory Type) and Device ID 2'nd byte (Memory Density).

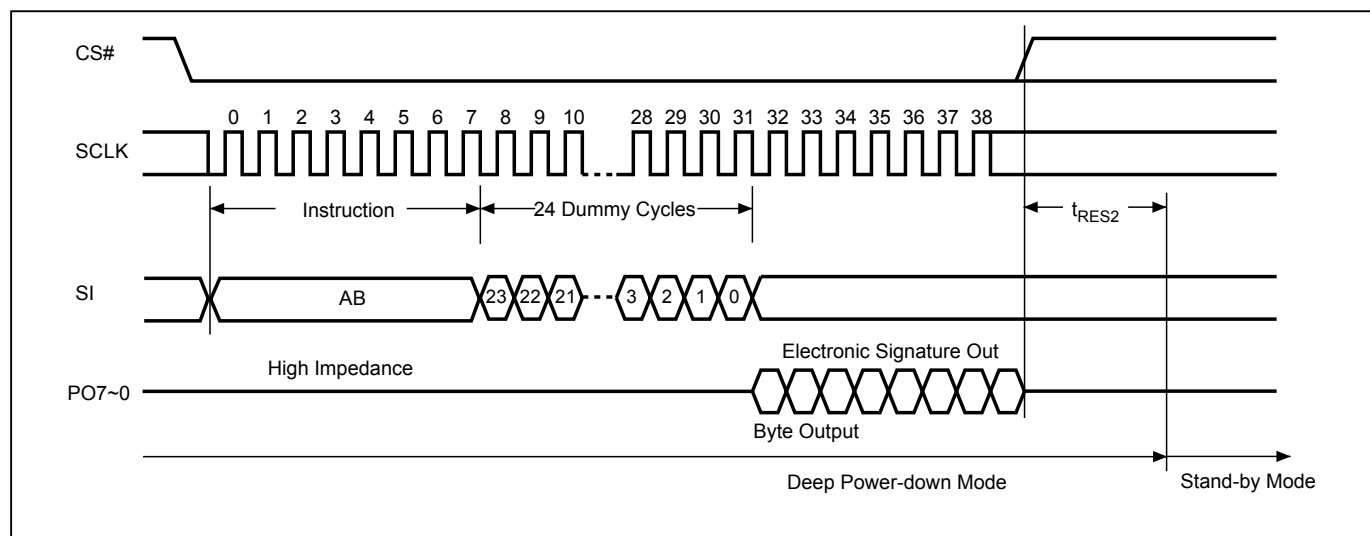
Figure 26-4. Parallel Mode Read Electronic Manufacturer & Device ID (Parallel REMS) Sequence (Command 90)



Notes :

1. A0=0 will output the Manufacturer ID first and A0=1 will output Device ID first. A1~A23 don't care.

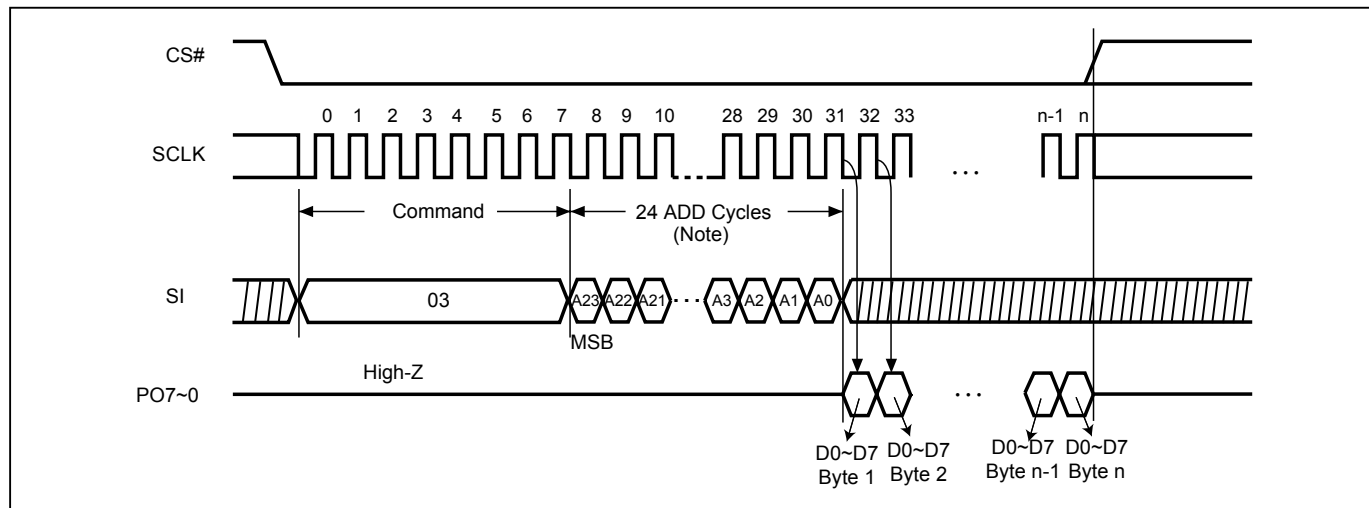
Figure 26-5. Parallel Mode Release from Deep Power-down (RDP) and Read Electronic Signature (RES) Sequence



Notes :

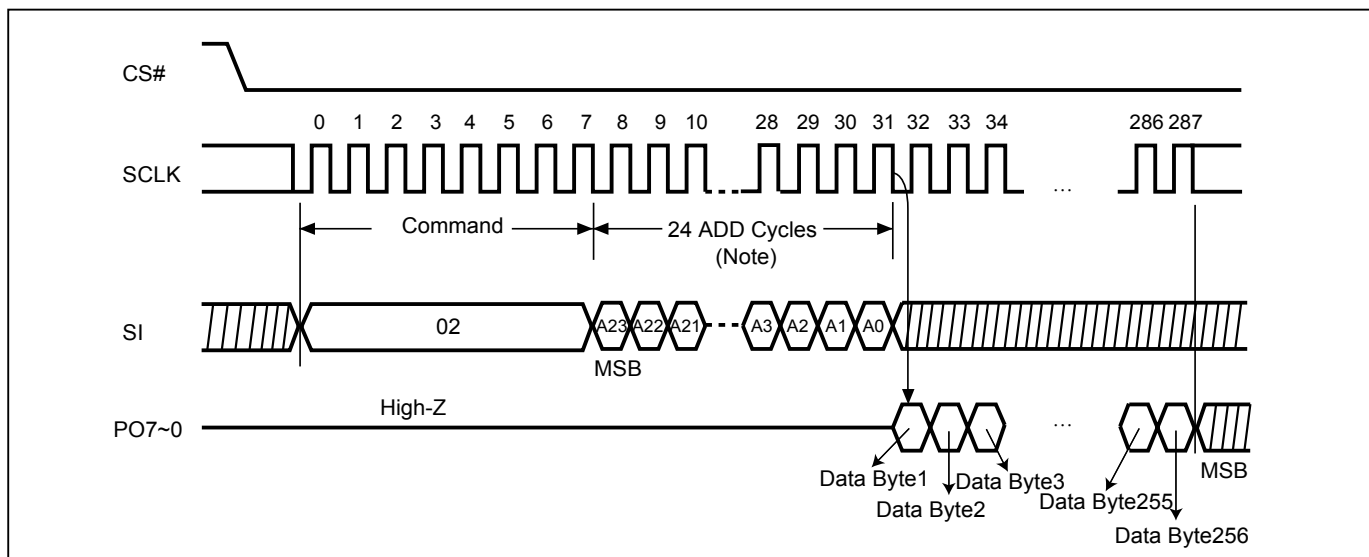
1. Under parallel mode, the fastest access clock freq. will be changed to 6MHz(SCLK pin clock freq.)
To release from Deep Power-down mode and read ID in parallel mode, which requires a parallel mode command (55h) before the read status register command.
To exit parallel mode, it requires a (45h) command or power-off/on sequence.

Figure 26-6. Parallel Mode Read Array (Parallel READ) Sequence (Command 03)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 26-7. Parallel Mode Page Program (Parallel PP) Sequence (Command 02)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 27. Deep Power-down (DP) Sequence (Command B9)

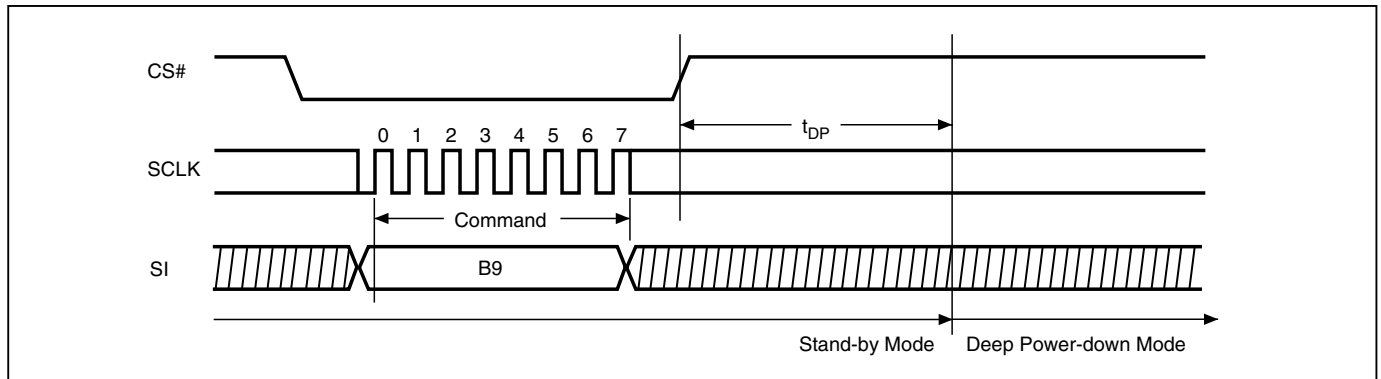


Figure 28. Release from Deep Power-down and Read Electronic Signature (RES) Sequence (Command AB)

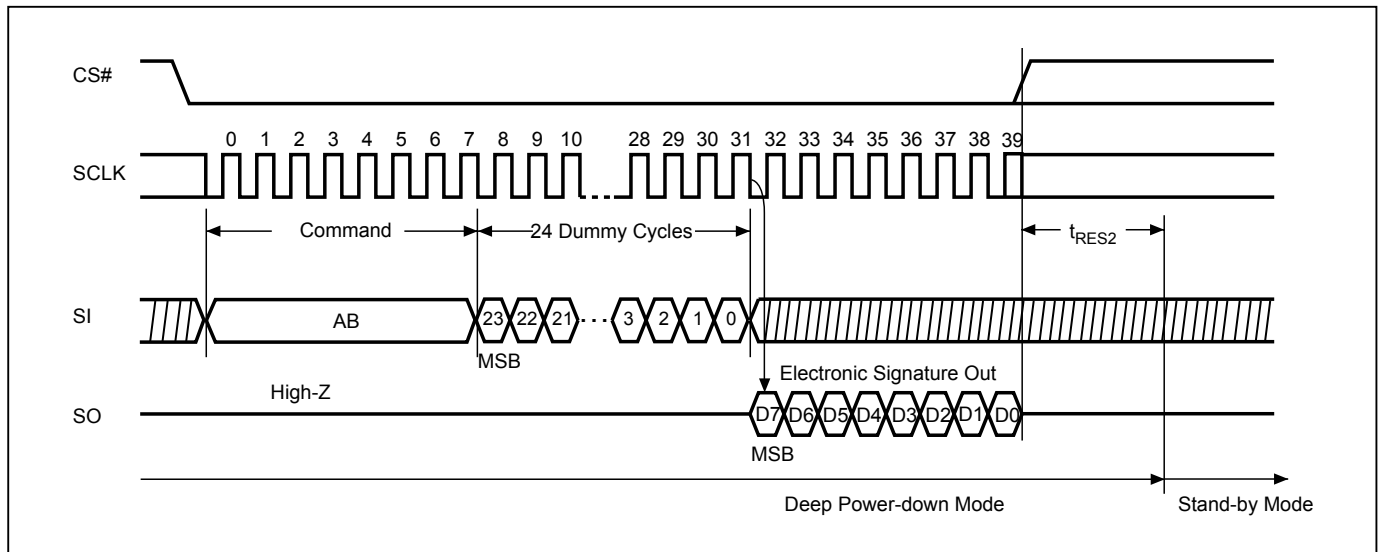


Figure 29. Release from Deep Power-down (RDP) Sequence (Command AB)

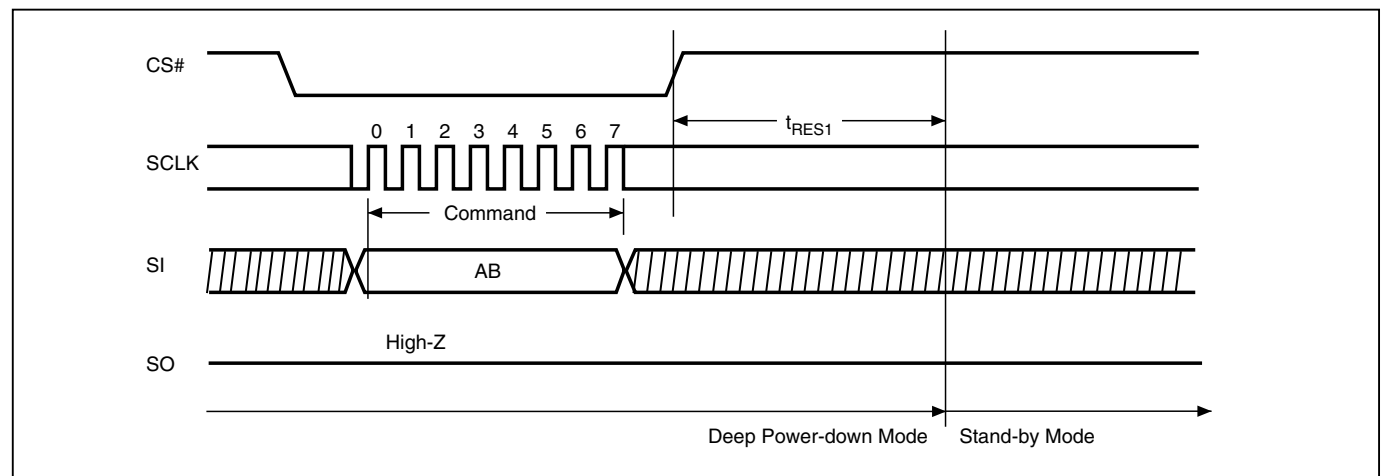
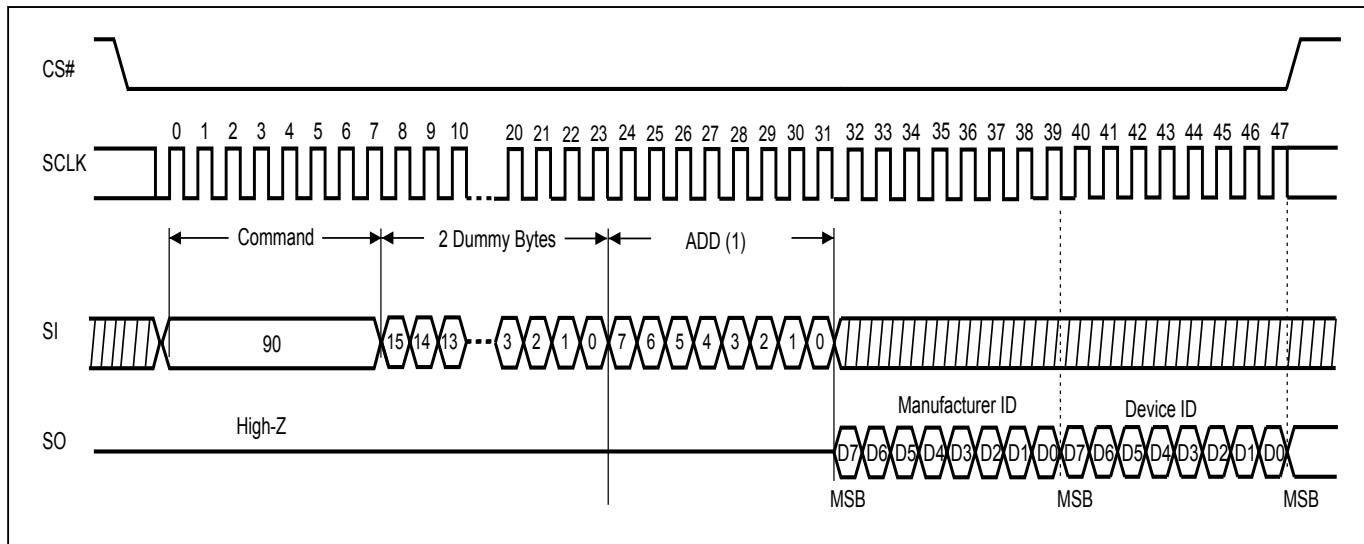


Figure 30. Read Electronic Manufacturer & Device ID (REMS) Sequence (Command 90 or EF or DF)



Notes:

1. A0=0 will output the Manufacturer ID first and A0=1 will output Device ID first. A1~A23 is don't care.
2. Instruction is either 90(hex) or EF(hex) or DF(hex).

Figure 31. Write Protection Selection (WPSEL) Sequence (Command 68)

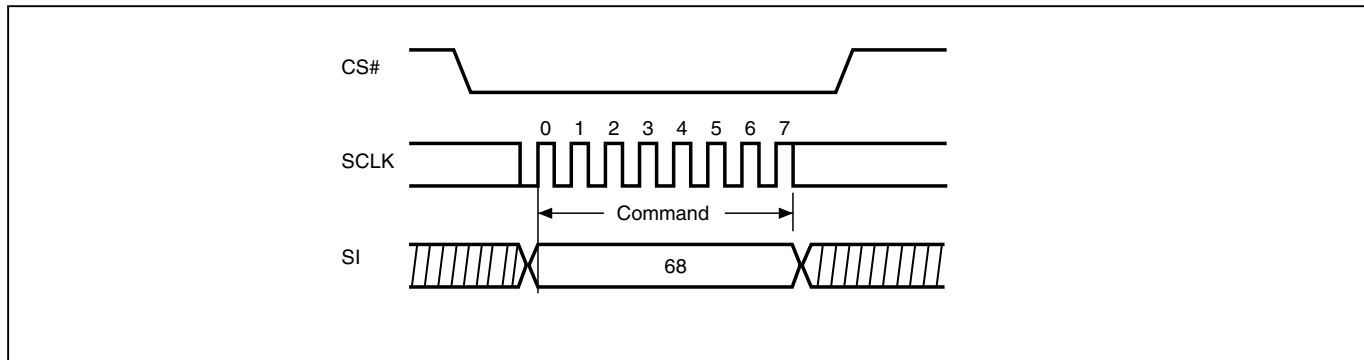
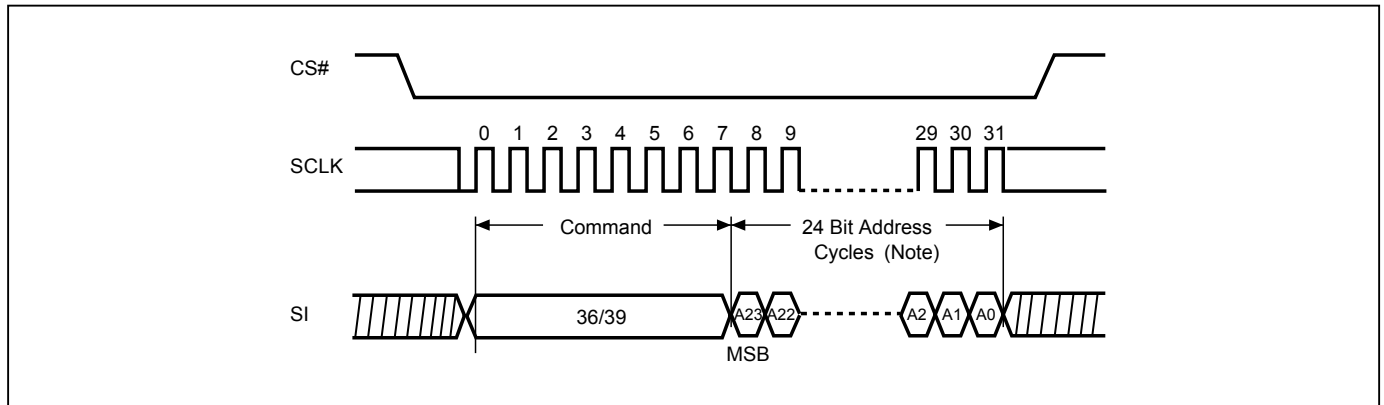
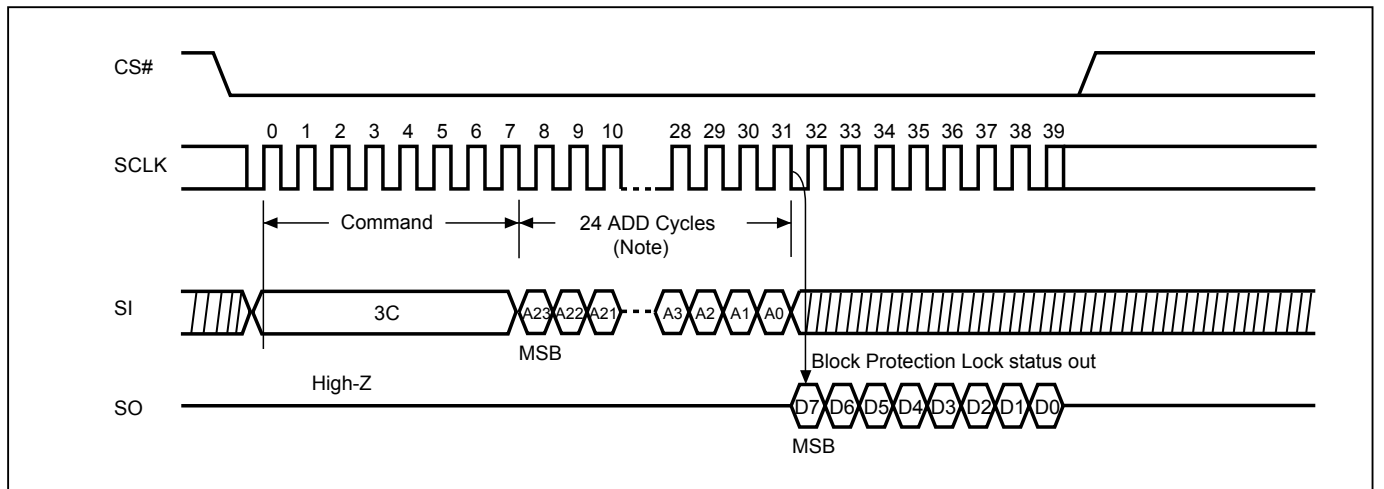


Figure 32. Single Block Lock/Unlock Protection (SBLK/SBULK) Sequence (Command 36/39)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 33. Read Block Protection Lock Status (RDBLOCK) Sequence (Command 3C)



Note: Please note the above address cycles are based on 3-byte address mode, for 4-byte address mode, the address cycles will be increased.

Figure 34. Gang Block Lock/Unlock (GBLK/GBULK) Sequence (Command 7E/98)

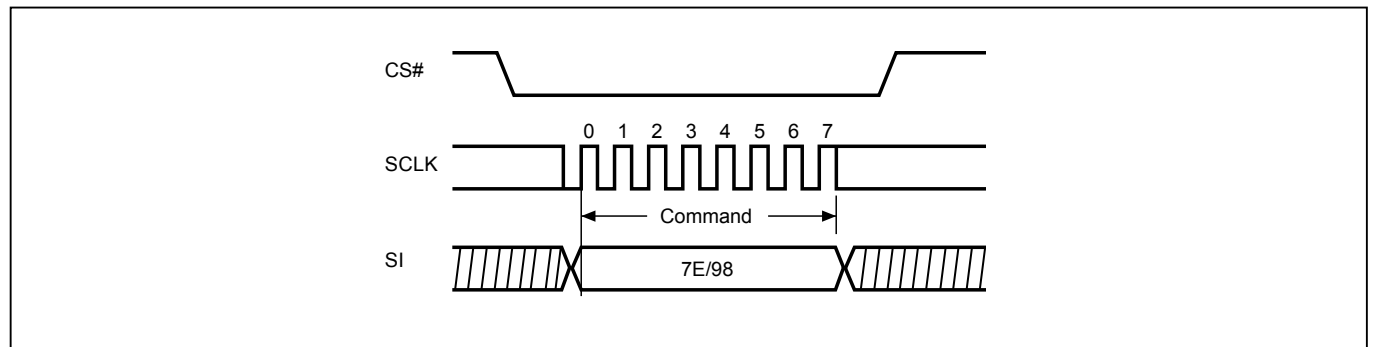
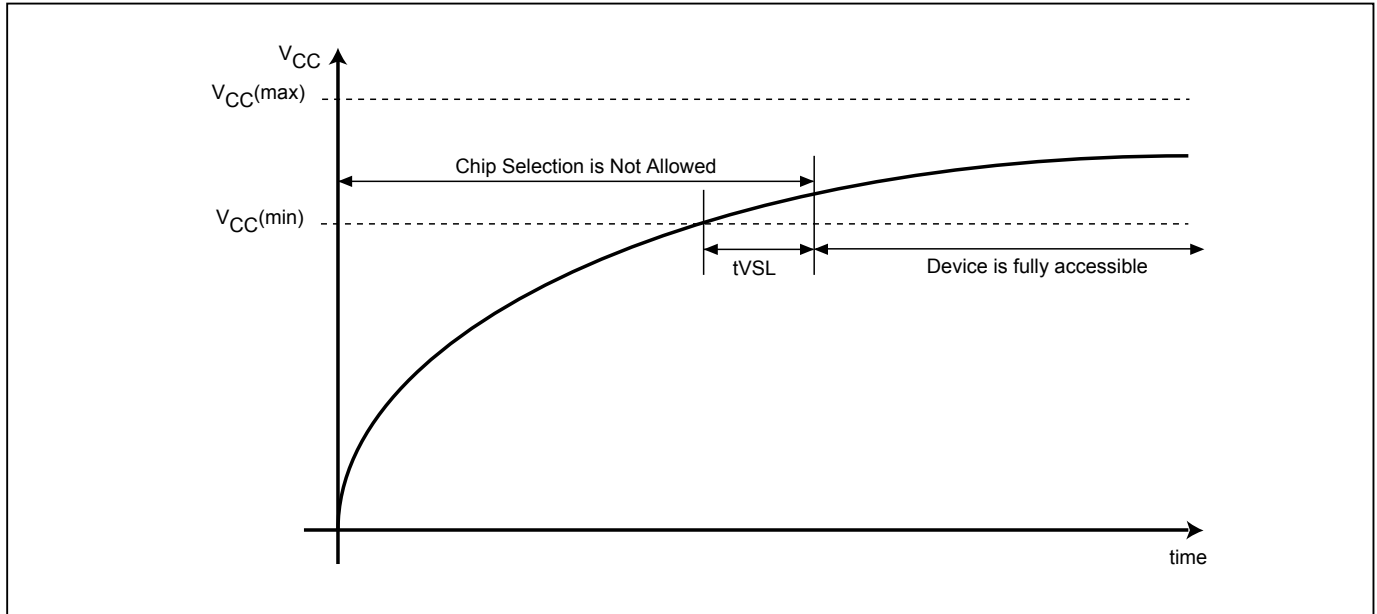


Figure 35. Power-up Timing



Note: VCC (max.) is 3.6V and VCC (min.) is 2.7V.

Table 9. Power-Up Timing

Symbol	Parameter	Min.	Max.	Unit
tVSL(1)	VCC(min) to CS# low	300		us

Note: 1. The parameter is characterized only.

INITIAL DELIVERY STATE

The device is delivered with the memory array erased: all bits are set to 1 (each byte contains FFh). The Status Register contains 00h (all Status Register bits are 0).

RECOMMENDED OPERATING CONDITIONS

At Device Power-Up

AC timing illustrated in Figure A is recommended for the supply voltages and the control signals at device power-up (e.g. VCC and CS# ramp up simultaneously). If the timing in the figure is ignored, the device may not operate correctly.

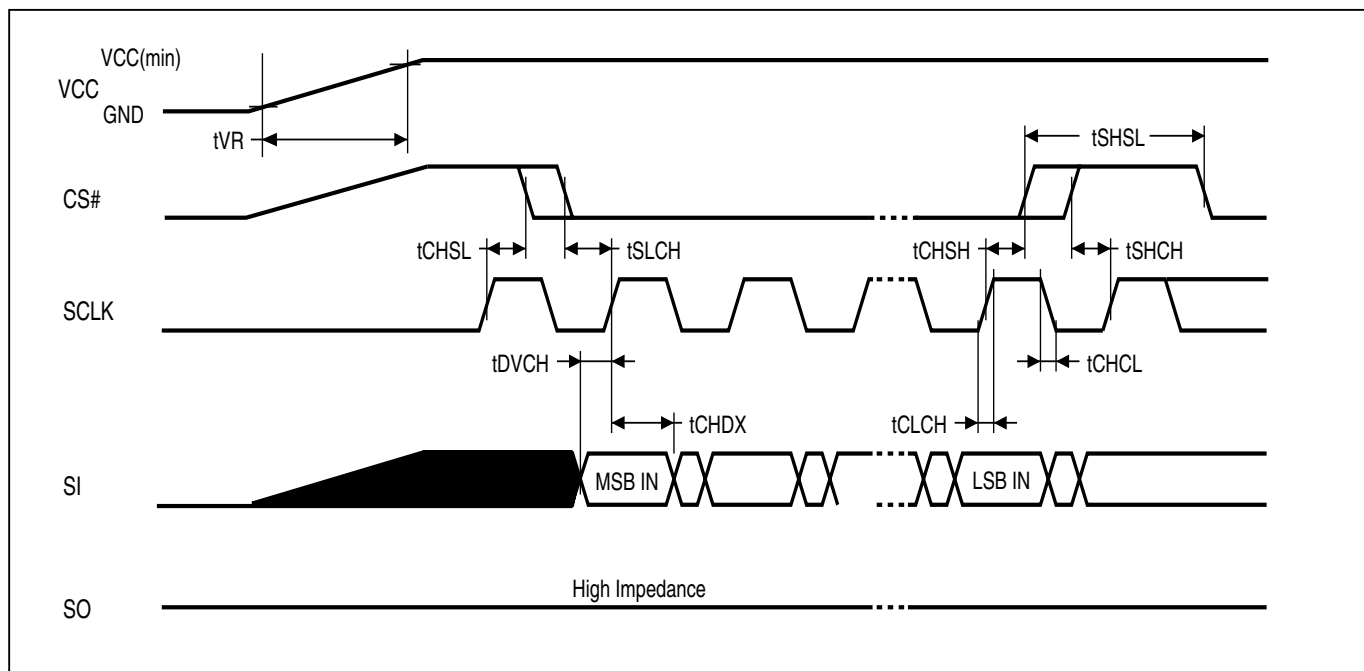


Figure A. AC Timing at Device Power-Up

Symbol	Parameter	Notes	Min.	Max.	Unit
tVR	VCC Rise Time	1	20	500000	us/V

Notes :

1. Sampled, not 100% tested.
2. For AC spec tCHSL, tSLCH, tDVCH, tCHDX, tSHSL, tCHSH, tSHCH, tCHCL, tCLCH in the figure, please refer to "AC CHARACTERISTICS" table.

ERASE AND PROGRAMMING PERFORMANCE

PARAMETER	TYP. (1)	Max. (2)	UNIT
Write Status Register Cycle Time	40	100	ms
Sector Erase Time (4KB)	60	300	ms
Block Erase Time (64KB)	0.7	2	s
Block Erase Time (32KB)	0.5	2	s
Chip Erase Time	160	400	s
Byte Program Time (via page program command)	9	300	us
Page Program Time	1.4	5	ms
Erase/Program Cycle	100,000		cycles

Note:

1. Typical program and erase time assumes the following conditions: 25°C, 3.3V, and checker board pattern.
2. Under worst conditions of 85°C and 2.7V.
3. System-level overhead is the time required to execute the first-bus-cycle sequence for the programming command.

DATA RETENTION

PARAMETER	Condition	Min.	Max.	UNIT
Data retention	55°C	20		years

LATCH-UP CHARACTERISTICS

	MIN.	MAX.
Input Voltage with respect to GND on all power pins, SI, CS#	-1.0V	2 VCCmax
Input Voltage with respect to GND on SO	-1.0V	VCC + 1.0V
Current	-100mA	+100mA
Includes all pins except VCC. Test conditions: VCC = 3.0V, one pin at a time.		

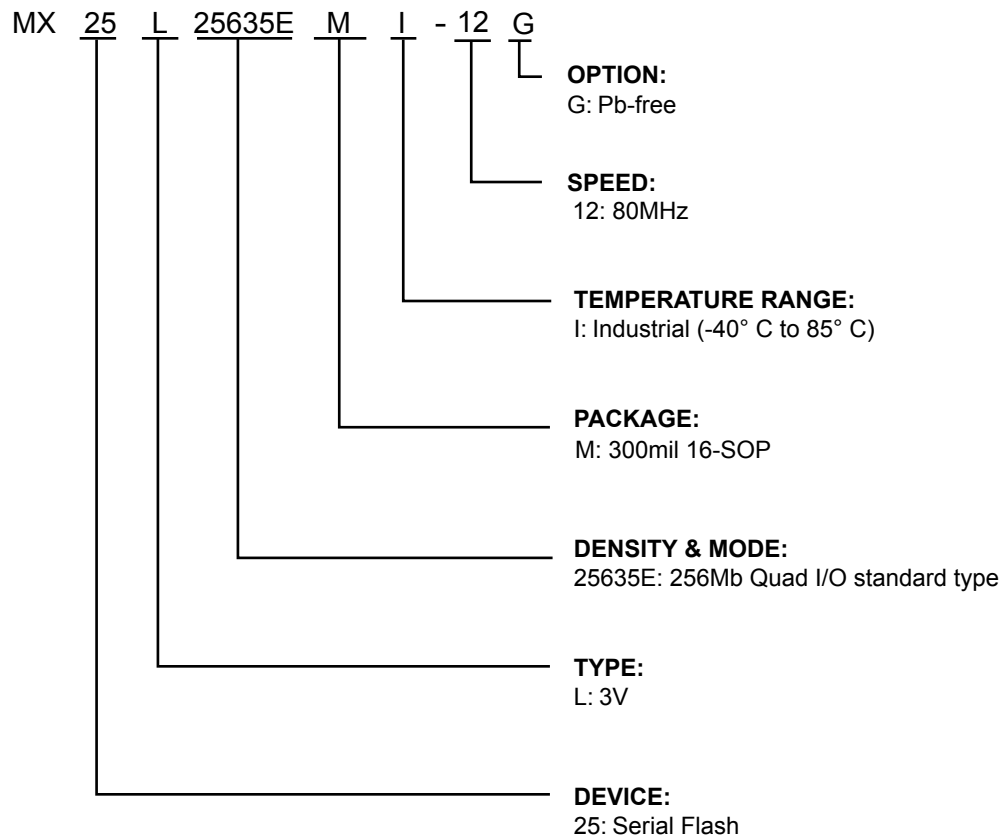


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INTERNATIONAL CO., LTD.

MX25L25635E

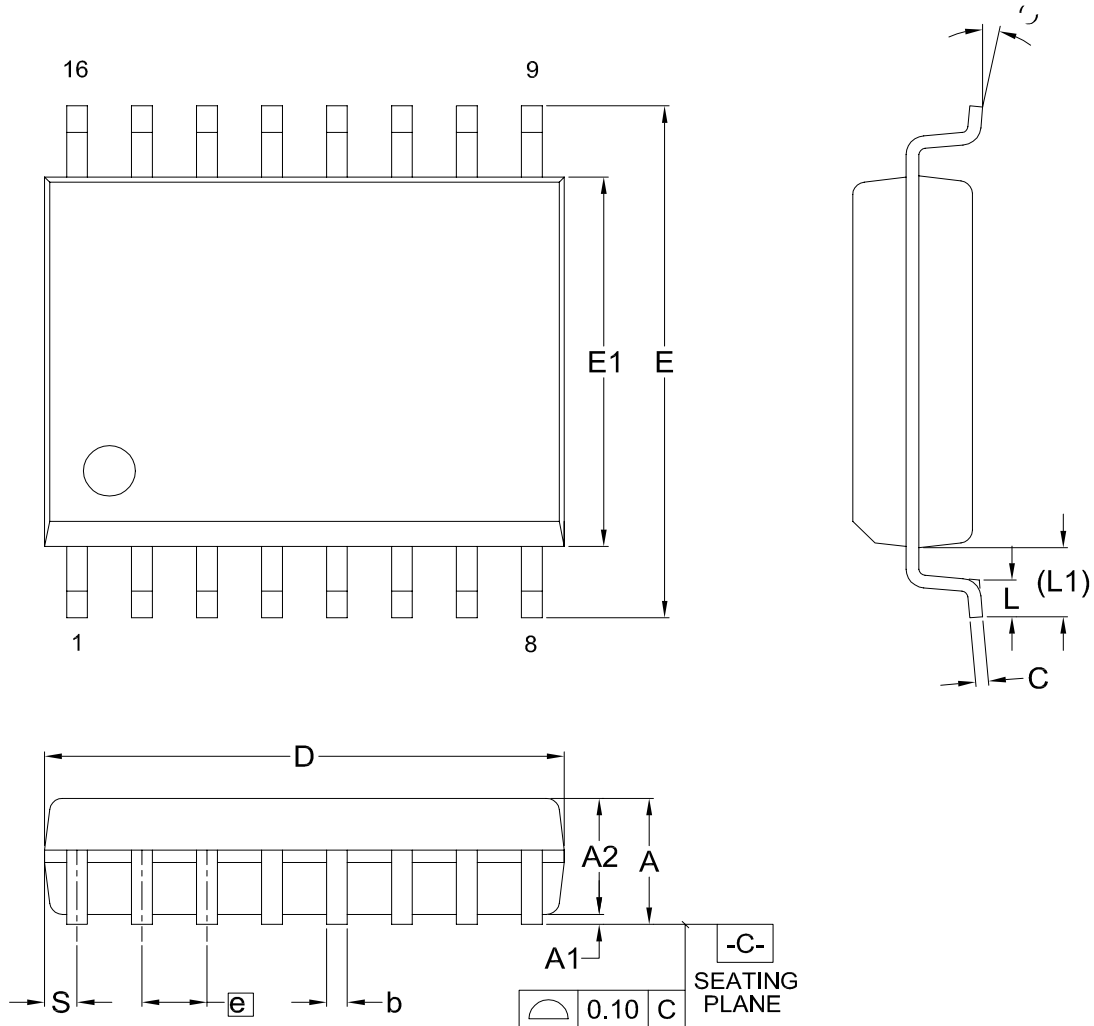
ORDERING INFORMATION

PART NO.	CLOCK (MHz)	OPERATING CURRENT MAX. (mA)	STANDBY CURRENT MAX. (uA)	TEMPERATURE	PACKAGE	Remark
MX25L25635EMI-12G	80	45	200	-40°C~85°C	16-SOP (300mil)	Pb-free

PART NAME DESCRIPTION

PACKAGE INFORMATION

Doc. Title: Package Outline for SOP 16L (300MIL)



Dimensions (inch dimensions are derived from the original mm dimensions)

SYMBOL		A	A1	A2	b	C	D	E	E1	e	L	L1	S	Θ
mm	Min.	---	0.10	2.34	0.36	0.20	10.10	10.10	7.42	---	0.40	1.31	0.51	0
	Nom.	---	0.20	2.39	0.41	0.25	10.30	10.30	7.52	1.27	0.84	1.44	0.64	5
	Max.	2.65	0.30	2.44	0.51	0.30	10.50	10.50	7.60	---	1.27	1.57	0.77	8
Inch	Min.	---	0.004	0.092	0.014	0.008	0.397	0.397	0.292	---	0.016	0.052	0.020	0
	Nom.	---	0.008	0.094	0.016	0.010	0.405	0.405	0.296	0.050	0.033	0.057	0.025	5
	Max.	0.104	0.012	0.096	0.020	0.012	0.413	0.413	0.299	---	0.050	0.062	0.030	8

Dwg. No.	Revision	Reference			
		JEDEC	EIAJ		
6110-1402	9	MS-013			

REVISION HISTORY

Revision No.	Description	Page	Date
0.01	1. Changed title from "Advanced Information" to "Preliminary".	P5	NOV/18/2009
	2. Rename CFI to DMC.	P6,13,16,37	
	3. Added DMC contents.	P37~39	
	4. Added HOLD#pin condition for ILI/ISB1/ISB2,	P43	
	revised VCC read test conditions and deleted notes of typical values.		
	5. Revised GBLK from 78h to 7Eh.	P32	
	6. Revised Figure number in NOTICE.	P41	
	7. Revised Figure 17. 2 x I/O Read Mode Sequence.	P51	
	8. Added HOLD# in 4 x I/O Sequence.	P51-52,54	
	9. Deleted CF (hex).	P60	
	10. Added VCC and CS# ramp up example in device power-up	P63	
0.02	11. Deleted chip programming time evaluation conditions	P64	JAN/19/2010
	1. Modified DMC table: 1Ch data from 28h to 30h	P37	



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MX25L25635E

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