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# MX25L6473E

3V, 64M-BIT [x 1/x 2/x 4]  
CMOS MXSMIO<sup>®</sup> (SERIAL MULTI I/O)  
FLASH MEMORY

## **Key Features**

- *Multi I/O Support - Single I/O, Dual I/O and Quad I/O*
- *Auto Erase and Auto Program Algorithms*
- *Continuous Program mode*
- *Permanently fixed QE bit, QE=1; and 4 I/O mode is enabled*

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**64M-BIT [x 1/x 2/x 4] CMOS MXSMIO® (SERIAL MULTI I/O) FLASH MEMORY****1. FEATURES****GENERAL**

- Supports Serial Peripheral Interface -- Mode 0 and Mode 3
- 67,108,864 x 1 bit structure or 33,554,432 x 2 bits (two I/O mode) structure or 16,777,216 x 4 bits (four I/O mode) structure
- 2048 Equal Sectors with 4K bytes each
  - Any Sector can be erased individually
- 256 Equal Blocks with 32K bytes each
  - Any Block can be erased individually
- 128 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
- Permanent fixed QE bit, QE =1 and 4 I/O mode is enabled

**PERFORMANCE**

- High Performance  
VCC = 2.7~3.6V
  - Normal read
    - 50MHz
  - Fast read
    - 1 I/O: 104MHz with 8 dummy cycles
    - 2 I/O: 86MHz with 4 dummy cycles for 2READ instruction
    - 4 I/O: Up to 104MHz
    - Configurable dummy cycle number for 4 I/O read operation
  - Fast program time: 0.7ms(typ.) and 3ms(max.)/page (256-byte per page)
  - Byte program time: 12us (typical)
  - Continuous Program mode (automatically increase address under word program mode)
  - Fast erase time: 30ms (typ.)/sector (4K-byte per sector) ; 0.25s(typ.) /block (64K-byte per block); 20s(typ.) / chip
- Low Power Consumption
  - Low active read current: 19mA(max.) at 104MHz, 10mA(max.) at 33MHz
  - Low active programming current: 15mA (typ.)
  - Low active sector erase current: 10mA (typ.)
  - Low standby current: 15uA (typ.)
  - Deep power down current: 1uA (typ.)
- Typical 100,000 erase/program cycles
- 20 years data retention

## 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
  - The REMS,REMS2, REMS4 commands for 1-byte Manufacturer ID and 1-byte Device ID
- Support Serial Flash Discoverable Parameters (SFDP) mode

## 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
  - Serial Data Output or Serial Data Input/Output for 2 x I/O mode and 4 x I/O mode
- SIO2
  - Serial data Input/Output for 4 x I/O mode
- SIO3
  - Serial data Input/Output for 4 x I/O mode
- PACKAGE
  - 16-pin SOP (300mil)
  - 8-pin SOP (200mil)
  - 8-pin VSOP (200mil)
  - 8-WSON (6x5mm)
  - 12-ball WLCSP (Ball Diameter 0.30mm)
  - **All devices are RoHS Compliant and Halogen-free**

## 2. GENERAL DESCRIPTION

MX25L6473E is 64Mb bits Serial Flash memory, which is configured as 8,388,608 x 8 internally. When it is in two or four I/O mode, the structure becomes 33,554,432 bits x 2 or 16,777,216 bits x 4.

MX25L6473E features a serial peripheral interface and software protocol allowing operation on a simple 3-wire bus while it is in single I/O mode. 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.

MX25L6473E, MXSMIO<sup>®</sup> (Serial Multi I/O) flash memory, provides sequential read operation on the whole chip and multi-I/O features.

When it is in dual or quad I/O read mode, the SI pin and SO pin become SIO0 pin and SIO1 pin for address/dummy bits input and data output.

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 Continuous Program mode, and erase command is executed on 4K-byte sector, 32K-byte/64K-byte block, 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.

The MX25L6473E utilizes Macronix's proprietary memory cell, which reliably stores memory contents even after 100,000 program and erase cycles.

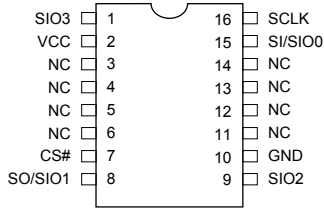
**Table 1. Read Performance**

Numbers of Dummy Cycles	4 I/O Fast Read Freq. (MHz)
6	86*
8	104

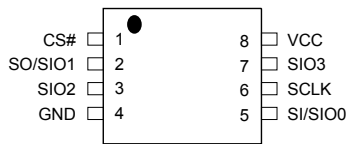
**Note:** \*means default status

### 3. PIN CONFIGURATION

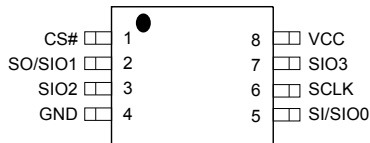
#### 16-PIN SOP (300mil)



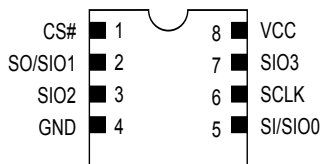
#### 8-PIN SOP (200mil)



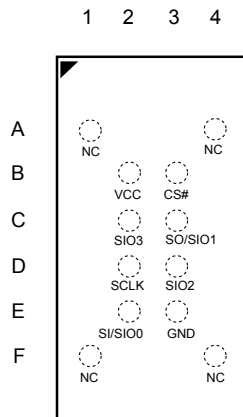
#### 8-PIN VSOP (200mil)



#### 8-WSON (6x5mm)



#### 12-BALL BGA (WLCSP) TOP View



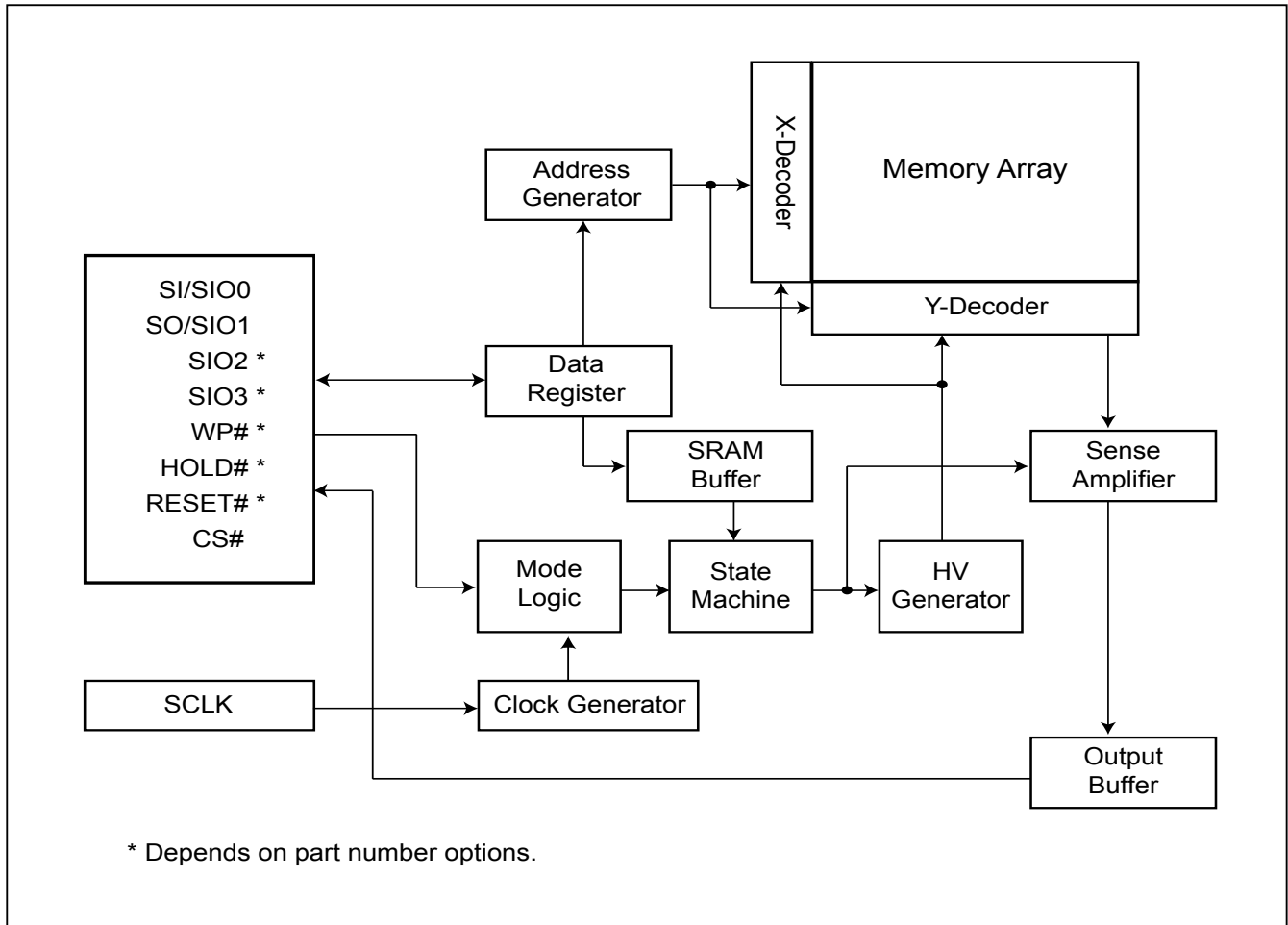
### 4. PIN DESCRIPTION

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	Serial Data Output (for 1xI/O)/Serial Data Input & Output (for 2xI/O or 4xI/O mode)
SCLK	Clock Input
SIO2	Serial Data Input & Output (for 4xI/O mode)
SIO3	Serial data Input/Output for 4 x I/O mode
VCC	+ 3.0V Power Supply
GND	Ground
NC	No Connection

Note: SIO2 and SIO3 need to be externally pulled to a high (recommended) or low state when the device is in Standby mode or Deep Power mode.



### 5. BLOCK DIAGRAM



## 6. DATA PROTECTION

During power transition, there may be some false system level signals which result in inadvertent erasure or programming. The device is designed to protect itself from these accidental write cycles.

The state machine will be reset as standby mode automatically during power up. In addition, the control register architecture of the device constrains that the memory contents can only be changed after specific command sequences have completed successfully.

In the following, there are several features to protect the system from the accidental write cycles during VCC power-up and power-down or from 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
  - Continuous 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
- 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 "[Table 2. Protected Area Sizes](#)", the protected areas are more flexible which may protect various areas by setting value of BP0-BP3 bits.
- MX25L6473E provides 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**

**Protected Area Sizes (TB bit = 0)**

Status bit				Protect Level
BP3	BP2	BP1	BP0	64Mb
0	0	0	0	0 (none)
0	0	0	1	1 (1block, block 127th)
0	0	1	0	2 (2blocks, block 126th-127th)
0	0	1	1	3 (4blocks, block 124th-127th)
0	1	0	0	4 (8blocks, block 120th-127th)
0	1	0	1	5 (16blocks, block 112th-127th)
0	1	1	0	6 (32blocks, block 96th-127th)
0	1	1	1	7 (64blocks, block 64th-127th)
1	0	0	0	8 (128blocks, protect all)
1	0	0	1	9 (128blocks, protect all)
1	0	1	0	10 (128blocks, protect all)
1	0	1	1	11 (128blocks, protect all)
1	1	0	0	12 (128blocks, protect all)
1	1	0	1	13 (128blocks, protect all)
1	1	1	0	14 (128blocks, protect all)
1	1	1	1	15 (128blocks, protect all)

**Protected Area Sizes (TB bit = 1)**

Status bit				Protect Level
BP3	BP2	BP1	BP0	64Mb
0	0	0	0	0 (none)
0	0	0	1	1 (1block, block 0th)
0	0	1	0	2 (2blocks, block 0th-1st)
0	0	1	1	3 (4blocks, block 0th-3rd)
0	1	0	0	4 (8blocks, block 0th-7th)
0	1	0	1	5 (16blocks, block 0th-15th)
0	1	1	0	6 (32blocks, block 0th-31st)
0	1	1	1	7 (64blocks, block 0th-63rd)
1	0	0	0	8 (128blocks, protect all)
1	0	0	1	9 (128blocks, protect all)
1	0	1	0	10 (128blocks, protect all)
1	0	1	1	11 (128blocks, protect all)
1	1	0	0	12 (128blocks, protect all)
1	1	0	1	13 (128blocks, protect all)
1	1	1	0	14 (128blocks, protect all)
1	1	1	1	15 (128blocks, protect 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.

- 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 "[Table 8. Security Register Definition](#)" for security register bit definition and table of "[Table 3. 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	

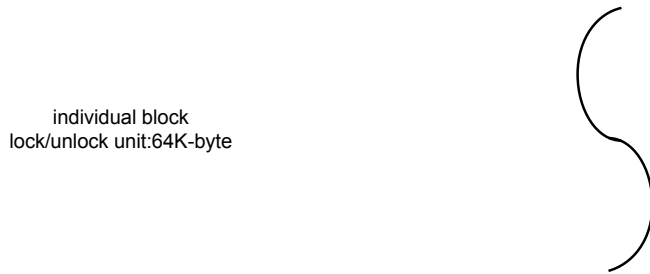
**7. MEMORY ORGANIZATION**

**Table 4. Memory Organization**

Block(64K-byte)	Block(32K-byte)	Sector (4K-byte)	Address Range	
127	255	2047	7FF000h	7FFFFFh
		⋮		
		2040	7F8000h	7F8FFFh
		2039	7F7000h	7F7FFFh
	254	⋮		
		2032	7F0000h	7F0FFFh
		2031	7EF000h	7EFFFFh
		⋮		
126	253	2024	7E8000h	7E8FFFh
		⋮		
		2023	7E7000h	7E7FFFh
		⋮		
	252	2016	7E0000h	7E0FFFh
		⋮		
		2015	7DF000h	7DFFFFh
		⋮		
125	251	2008	7D8000h	7D8FFFh
		⋮		
		2007	7D7000h	7D7FFFh
		⋮		
	250	2000	7D0000h	7D0FFFh
		⋮		
		⋮		
		⋮		

individual block lock/unlock unit:64K-byte

individual 16 sectors lock/unlock unit:4K-byte



2	5	47	02F000h	02FFFFh
		⋮		
	4	40	028000h	028FFFh
		39	027000h	027FFFh
1	3	⋮		
		32	020000h	020FFFh
		31	01F000h	01FFFFh
		⋮		
	2	24	018000h	018FFFh
		⋮		
		23	017000h	017FFFh
		⋮		
0	1	16	010000h	010FFFh
		⋮		
		15	00F000h	00FFFFh
		⋮		
	0	8	008000h	008FFFh
		⋮		
		7	007000h	007FFFh
		⋮		
0	0	000000h	000FFFh	

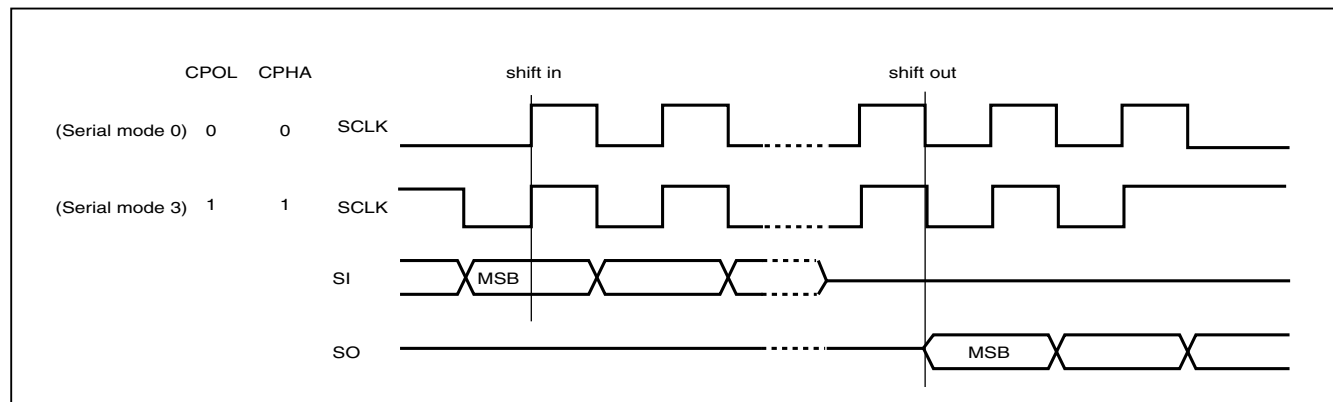
individual block lock/unlock unit:64K-byte

individual 16 sectors lock/unlock unit:4K-byte

## 8. 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 device, it enters standby mode and remains in standby mode until next CS# falling edge. In standby mode, SO pin of the device is High-Z.
3. When correct command is inputted to this device, it enters active mode and remains in 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 is shifted out on the falling edge of SCLK. The difference of Serial mode 0 and mode 3 is shown as "[Figure 1. Serial Modes Supported \(for Normal Serial mode\)](#)".
5. For the following instructions: RDID, RDSR, RDSCUR, READ, FAST\_READ, RDSFDP, 2READ, DREAD, 4READ, QREAD, RDBLOCK, RES, REMS, REMS2, and REMS4 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, CE, PP, CP, 4PP, RDP, DP, WPSEL, SBLK, SBULK, GBLK, GBULK, ENSO, EXSO, WRSCUR, ESRY and DSRY. The CS# must go high exactly at the byte boundary; otherwise, the instruction will be rejected and not executed.
6. While a Write Status Register, Program, or Erase operation is in progress, access to the memory array is neglected and will 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.

## 9. COMMAND DESCRIPTION

**Table 5. Command Sets**

### Read Commands

I/O	1	1	1	2	2	4	4
Command	READ (normal read)	FAST READ (fast read data)	RDSFDP (Read SFDP)	2READ (2 x I/O read command)	DREAD (1I / 2O read command)	W4READ	4READ (4 x I/O read command)
1st byte	03 (hex)	0B (hex)	5A (hex)	BB (hex)	3B (hex)	E7 (hex)	EB (hex)
2nd byte	AD1(8)	AD1(8)	AD1	AD1(4)	AD1(8)	AD1(2)	AD1(2)
3rd byte	AD2(8)	AD2(8)	AD2	AD2(4)	AD2(8)	AD2(2)	AD2(2)
4th byte	AD3(8)	AD3(8)	AD3	AD3(4)	AD3(8)	AD3(2)	AD3(2)
5th byte		Dummy(8)	Dummy	Dummy(4)	Dummy(8)	Dummy(4)	Dummy*
Action	n bytes read out until CS# goes high	n bytes read out until CS# goes high	Read SFDP mode	n bytes read out by 2 x I/O until CS# goes high		Quad I/O read with 4 dummy cycles	Quad I/O read with configurable dummy cycles

I/O	4
Command	QREAD
1st byte	6B (hex)
2nd byte	AD1(8)
3rd byte	AD2(8)
4th byte	AD3(8)
5th byte	Dummy(8)
Action	

**Note:** \*Dummy cycle number will be different, depending on the bit7 (DC) setting of Configuration Register. Please refer to "[Configuration Register](#)" Table

**Other Commands**

Command	WREN (write enable)	WRDI (write disable)	RDSR (read status register)	RDCR (read configuration register)	WRSR (write status/ configuration register)	4PP (quad page program)	SE (sector erase)
1st byte	06 (hex)	04 (hex)	05 (hex)	15 (hex)	01 (hex)	38 (hex)	20 (hex)
2nd byte					Values	AD1	AD1
3rd byte					Values	AD2	AD2
4th byte						AD3	AD3
Action	sets the (WEL) write enable latch bit	resets the (WEL) write enable latch bit	to read out the values of the status register	to read out the values of the configuration register	to write new values of the status register	quad input to program the selected page	to erase the selected sector

Command	BE 32K (block erase 32KB)	BE (block erase 64KB)	CE (chip erase)	PP (page program)	CP (continuous program)	DP (Deep power down)	RDP (Release from deep power down)
1st byte	52 (hex)	D8 (hex)	60 or C7 (hex)	02 (hex)	AD (hex)	B9 (hex)	AB (hex)
2nd byte	AD1	AD1		AD1	AD1		
3rd byte	AD2	AD2		AD2	AD2		
4th byte	AD3	AD3		AD3	AD3		
Action	to erase the selected 32KB block	to erase the selected 64KB block	to erase whole chip	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

Command	RDID (read identification)	RES (read electronic ID)	REMS (read electronic manufacturer & device ID)	REMS2 (read electronic manufacturer & device ID)	REMS4 (read electronic manufacturer & device ID)	ENSO (enter secured OTP)
1st byte	9F (hex)	AB (hex)	90 (hex)	EF (hex)	DF (hex)	B1 (hex)
2nd byte		x	x	x	x	
3rd byte		x	x	x	x	
4th byte		x	ADD (Note 2)	ADD	ADD	
Action	outputs JEDEC ID: 1-byte Manufacturer ID & 2-byte Device ID	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	to enter the 4K-bit secured OTP mode



Command	EXSO (exit secured OTP)	RDSCUR (read security register)	WRSCUR (write security register)	SBLK (single block lock)	SBULK (single block unlock)	RDBLOCK (block protect read)	GBLK (gang block lock)
1st byte	C1 (hex)	2B (hex)	2F (hex)	36 (hex)	39 (hex)	3C (hex)	7E (hex)
2nd byte				AD1	AD1	AD1	
3rd byte				AD2	AD2	AD2	
4th byte				AD3	AD3	AD3	
Action	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 update)	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

COMMAND	GBULK (gang block unlock)	NOP (No Operation)	RSTEN (Reset Enable)	RST (Reset Memory)	WPSEL (Write Protect Selection)	ESRY (enable SO to output RY/BY#)	DSRY (disable SO to output RY/BY#)
1st byte	98 (hex)	00 (hex)	66 (hex)	99 (hex)	68 (hex)	70 (hex)	80 (hex)
2nd byte							
3rd byte							
4th byte							
Action	whole chip unprotect				to enter and enable individual block protect mode	to enable SO to output RY/BY# during CP mode	to disable SO to output RY/BY# during CP mode

COMMAND	Release Read Enhanced
1st byte	FF (hex)
2nd byte	
3rd byte	
4th byte	
5th byte	
Action	All these commands FFh, 00h, AAh or 55h will escape the performance mode

Note 1: The count base is 4-bit for ADD(2) and Dummy(2) because of 2 x I/O. And the MSB is on SI/SIO1 which is different from 1 x I/O condition.

Note 2: ADD=00H will output the manufacturer ID first and ADD=01H will output device ID first.

Note 3: It is not recommended to adopt any other code not in the command definition table, which will potentially enter the hidden mode.

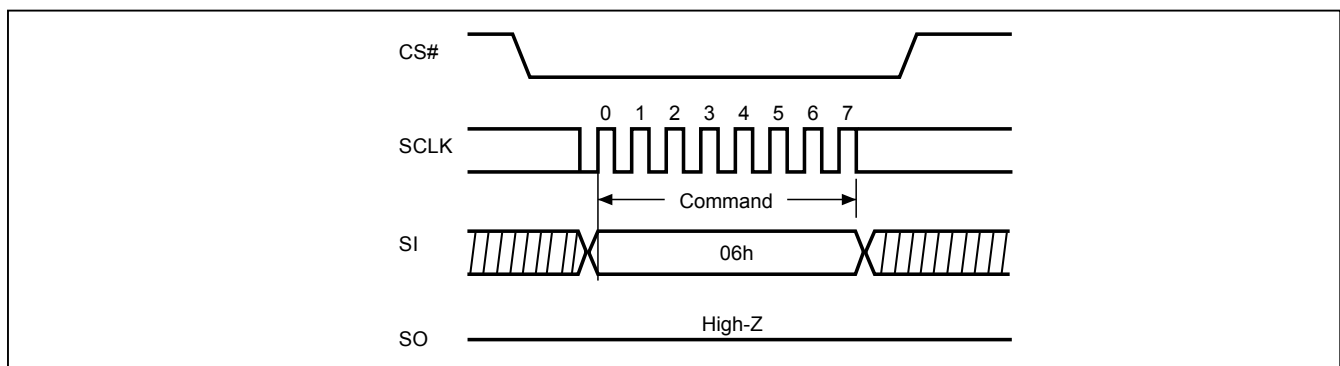
Note 4: Before executing RST command, RSTEN command must be executed. If there is any other command to interfere, the reset operation will be disabled.

**9-1. 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.

The SIO[3:1] are don't care in this mode.

**Figure 2. Write Enable (WREN) Sequence (Command 06)**

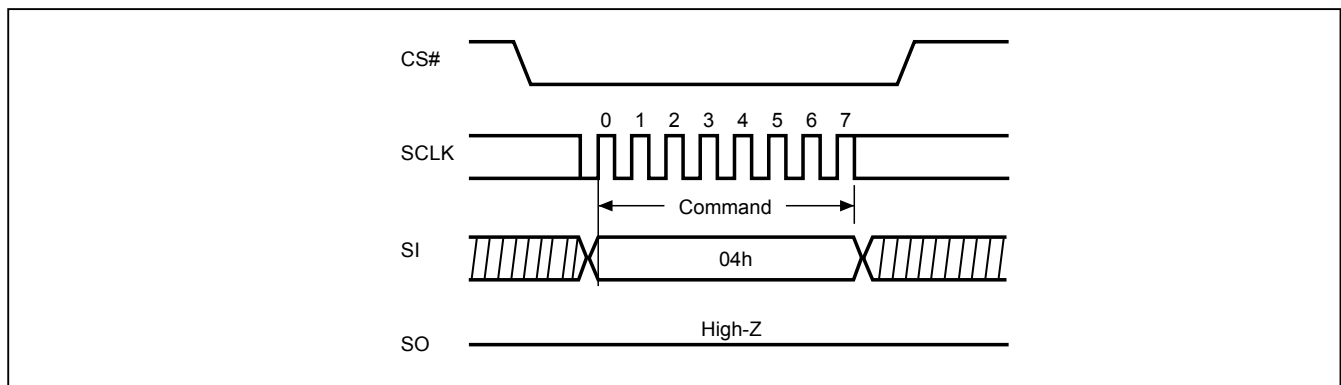
**9-2. Write Disable (WRDI)**

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.

The WEL bit is reset by following situations:

- Power-up
- Write Disable (WRDI) instruction completion
- Write Status/Configuration 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
- Continuous Program mode (CP) instruction completion
- Single Block Lock/Unlock (SBLK/SBULK) instruction completion
- Gang Block Lock/Unlock (GBLK/GBULK) instruction completion

**Figure 3. Write Disable (WRDI) Sequence (Command 04)**

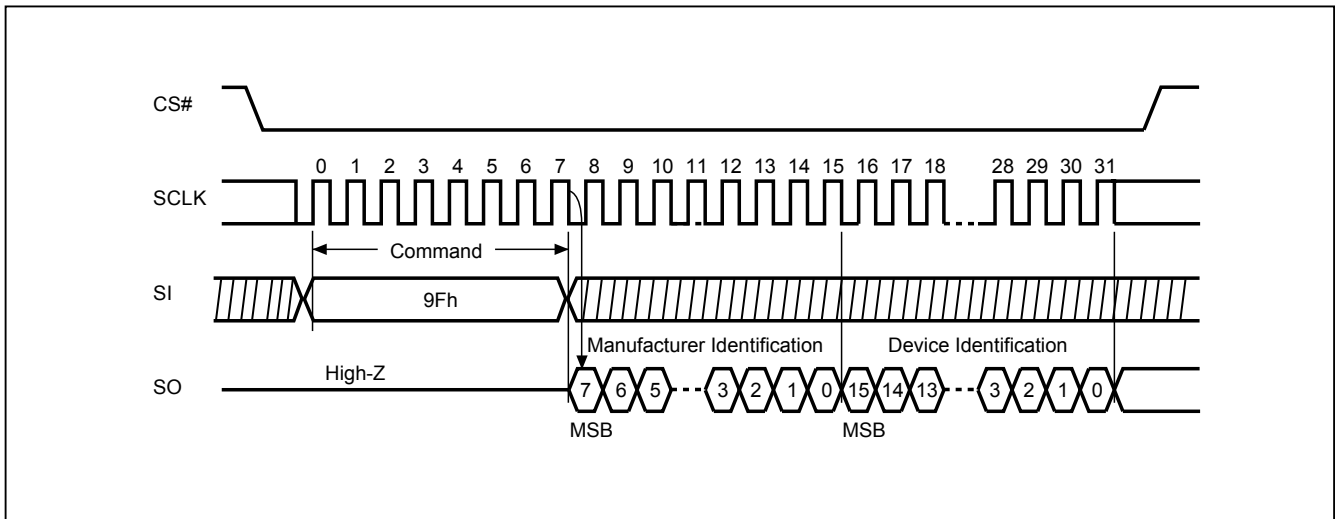
**9-3. Read Identification (RDID)**

The RDID instruction is for reading the Manufacturer ID of 1-byte and followed by Device ID of 2-byte. The Macronix 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 *"Table 7. ID Definitions"*.

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.

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.

**Figure 4. Read Identification (RDID) Sequence (Command 9F)**

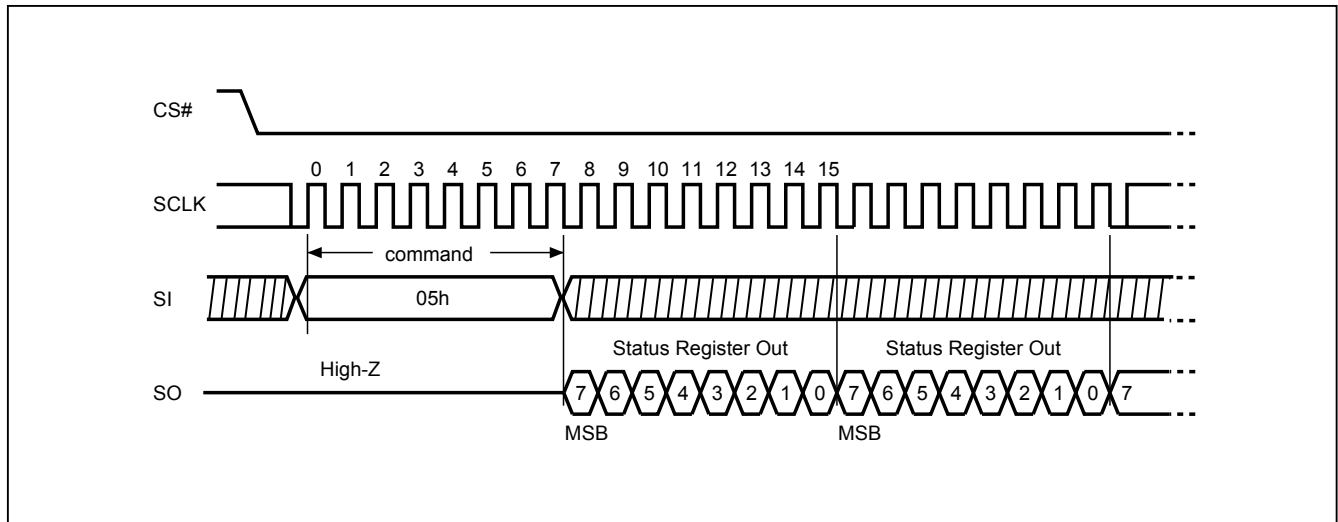


**9-4. Read Status Register (RDSR)**

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.

The SIO[3:1] are don't care when during this mode.

**Figure 5. Read Status Register (RDSR) Sequence (Command 05)**

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. To ensure both WIP bit & WEL bit are both set to 0 and available for next program/erase/operations, WIP bit needs to be confirm to be 0 before polling WEL bit. After WIP bit confirmed, WEL bit needs to be confirm to be 0.

**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. Protected Area Sizes](#)") 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). The BP3, BP2, BP1, BP0 bits are "0" as default. Which is un-protected.

**QE bit.** The Quad Enable (QE) bit is permanently set to "1". The flash always performs Quad I/O mode.

### Status Register

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserved	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)
Reserved	1= Quad Enable	<i>(note 1)</i>	<i>(note 1)</i>	<i>(note 1)</i>	<i>(note 1)</i>	1=write enable 0=not write enable	1=write operation 0=not in write operation
Reserved	Fixed=1	Non-volatile bit	Non-volatile bit	Non-volatile bit	Non-volatile bit	volatile bit	volatile bit

**Note 1:** Please refer to "[Table 2. Protected Area Sizes](#)".

### Configuration Register

The Configuration Register is able to change the default status of Flash memory. Flash memory will be configured after the CR bit is set.

#### TB bit

The Top/Bottom (TB) bit is a non-volatile OTP bit. The Top/Bottom (TB) bit is used to configure the Block Protect area by BP bit (BP3, BP2, BP1, BP0), starting from TOP or Bottom of the memory array. The TB bit is defaulted as "0", which means Top area protect. When it is set as "1", the protect area will change to Bottom area of the memory device. To write the TB bits requires the Write Status Register (WRSR) instruction to be executed.

### Configuration Register

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
DC (Dummy Cycle)	Reserved	Reserved	Reserved	TB (top/bottom selected)	Reserved	Reserved	Reserved
<i>(Note)</i>	x	x	x	0=Top area protect 1=Bottom area protect (Default=0)	x	x	x
Volatile bit	x	x	x	OTP	x	x	x

**Note:** See "[Dummy Cycle and Frequency Table](#)", with "Don't Care" on other Reserved Configuration Registers.

### Dummy Cycle and Frequency Table

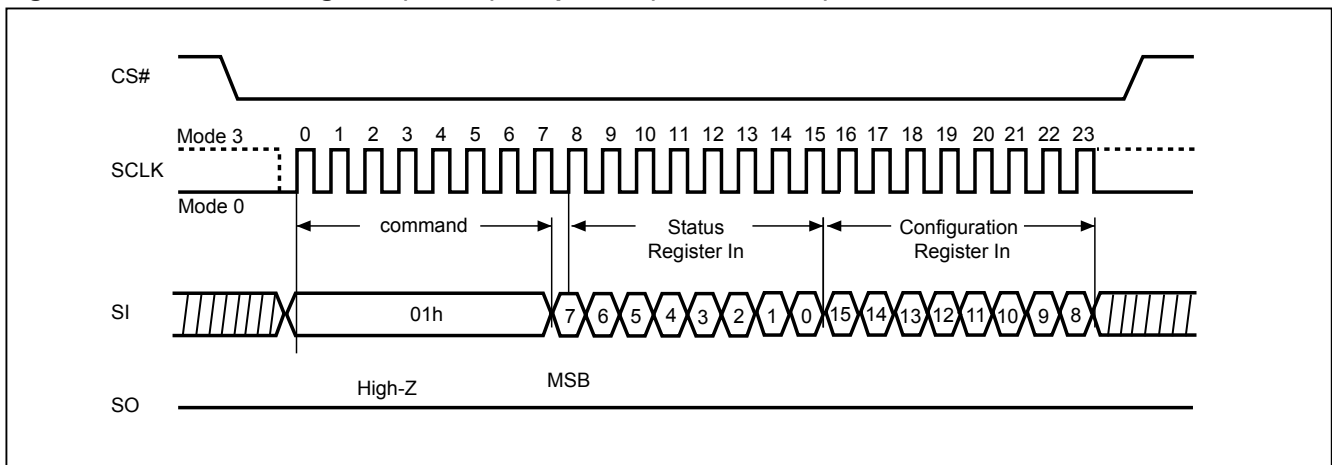
DC	Numbers of Dummy clock cycles	Quad I/O Fast Read
1	8	104
0 (default)	6	86

**9-5. Write Status Register (WRSR)**

The WRSR instruction is for changing the values of Status Register Bits and Configuration 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. Protected Area Sizes").

The sequence of issuing WRSR instruction is: CS# goes low→ sending WRSR instruction code→ Status Register data on SI→ CS# goes high.

**Figure 6. Write Status Register (WRSR) Sequence (Command 01)**





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 checked 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.

**Table 6. Protection Modes**

Mode	Status register condition	Memory
Software protection mode (SPM)	Status register can be written in (WEL bit is set to "1") and the BP0-BP3 bits <sup>(Note)</sup> can be changed	The protected area cannot be programmed or erased.

**Note:** As defined by the values in the Block Protect (BP3, BP2, BP1, BP0) bits of the Status Register, as shown in "[Table 2. Protected Area Sizes](#)".

Software Protected Mode (SPM):

- The WREN instruction may set the WEL bit and can change the values of BP3, BP2, BP1, BP0. The protected area, which is defined by BP3, BP2, BP1, BP0, is at software protected mode (SPM).

**Figure 7. WRSR flow**