



# GD25LD10E/05E

## DATASHEET



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## 1 FEATURES

- ◆ 1M/512K-bit Serial Flash
  - 128K/64K-Byte
  - 256 Bytes per programmable page
- ◆ Standard, Dual Output
  - Standard SPI: SCLK, CS#, SI, SO, WP#
  - Dual Output: SCLK, CS#, IO0, IO1, WP#
- ◆ High Speed Clock Frequency
  - 50MHz for fast read
  - Dual Output Data transfer up to 80Mbits/s
- ◆ Software/Hardware Write Protection
  - Write protect all/portion of memory via software
  - Enable/Disable protection with WP# Pin
- ◆ Endurance and Data Retention
  - Minimum 100,000 Program/Erase Cycles
  - 20-year data retention typical
- ◆ Fast Program/Erase Speed
  - Page Program time: 1.4ms typical
  - Sector Erase time: 120ms typical
  - Block Erase time: 0.4s/0.6s typical
  - Chip Erase time: 1.5s/0.8s typical
- ◆ Flexible Architecture
  - Uniform Sector of 4K-Byte
  - Uniform Block of 32/64K-Byte
- ◆ Low Power Consumption
  - 0.1 $\mu$ A typical standby current
  - 0.1 $\mu$ A typical deep power down current
- ◆ Advanced Security Features
  - 128-bit Unique ID for each device
- ◆ Single Power Supply Voltage
  - Full voltage range: 1.65-2.0V
- ◆ Package Information
  - USON6 (1.2x1.2mm)
  - USON8 (1.5x1.5mm)
  - USON8 (3x2mm)
  - SOP8 150mil

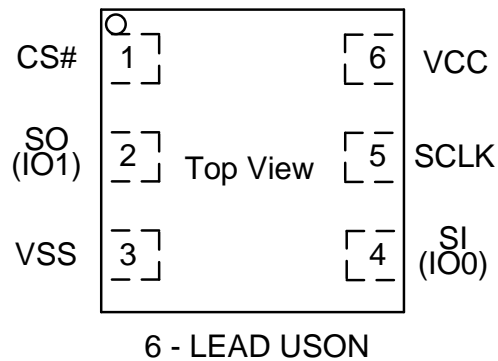


## 2 GENERAL DESCRIPTIONS

The GD25LD10E/05E (1M/512K-bit) Serial flash supports the standard Serial Peripheral Interface (SPI), and the Dual Output: Serial Clock, Chip Select, Serial Data I/O0 (SI) and I/O1 (SO). The Dual Output data is transferred with speed of 80Mbit/s.

### CONNECTION DIAGRAM AND PIN DESCRIPTION

**Figure 1 Connection Diagram for USON6 package**



**Table 1. Pin Description for USON6 Package**

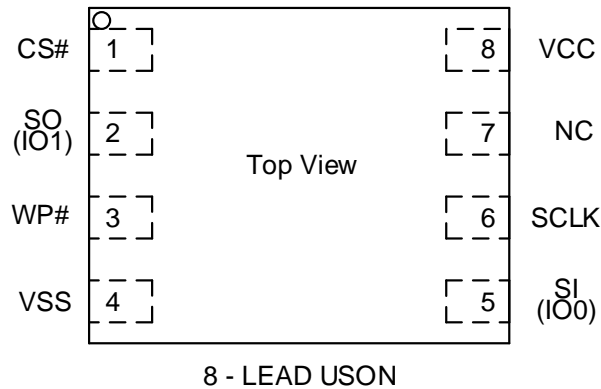
| Pin No. | Pin Name | I/O | Description                      |
|---------|----------|-----|----------------------------------|
| 1       | CS#      | I   | Chip Select Input                |
| 2       | SO (IO1) | O   | Data Output (Data Output 1)      |
| 3       | VSS      |     | Ground                           |
| 4       | SI (IO0) | I/O | Data Input (Data Input Output 0) |
| 5       | SCLK     | I   | Serial Clock Input               |
| 6       | VCC      |     | Power Supply                     |

Note:

1. CS# must be driven high if chip is not selected. Please don't leave CS# floating any time after power is on.



**Figure 2 Connection Diagram for USON package**



**Table 2. Pin Description for USON8 Package**

| Pin No. | Pin Name | I/O | Description                      |
|---------|----------|-----|----------------------------------|
| 1       | CS#      | I   | Chip Select Input                |
| 2       | SO (IO1) | O   | Data Output (Data Output 1)      |
| 3       | WP#      | I   | Write Protect Input              |
| 4       | VSS      |     | Ground                           |
| 5       | SI (IO0) | I/O | Data Input (Data Input Output 0) |
| 6       | SCLK     | I   | Serial Clock Input               |
| 7       | NC       |     | No Connection                    |
| 8       | VCC      |     | Power Supply                     |

Note:

1. CS# must be driven high if chip is not selected. Please don't leave CS# floating any time after power is on.
2. If WP# is unused, it must be driven high by the host, or an external pull-up resistor must be placed on the PCB in order to avoid allowing WP# input to float.



Figure 3 Connection Diagram for SOP8 package

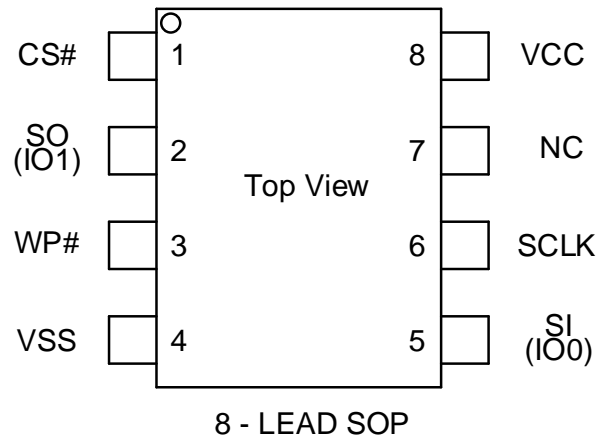


Table 3. Pin Description for SOP8 Package

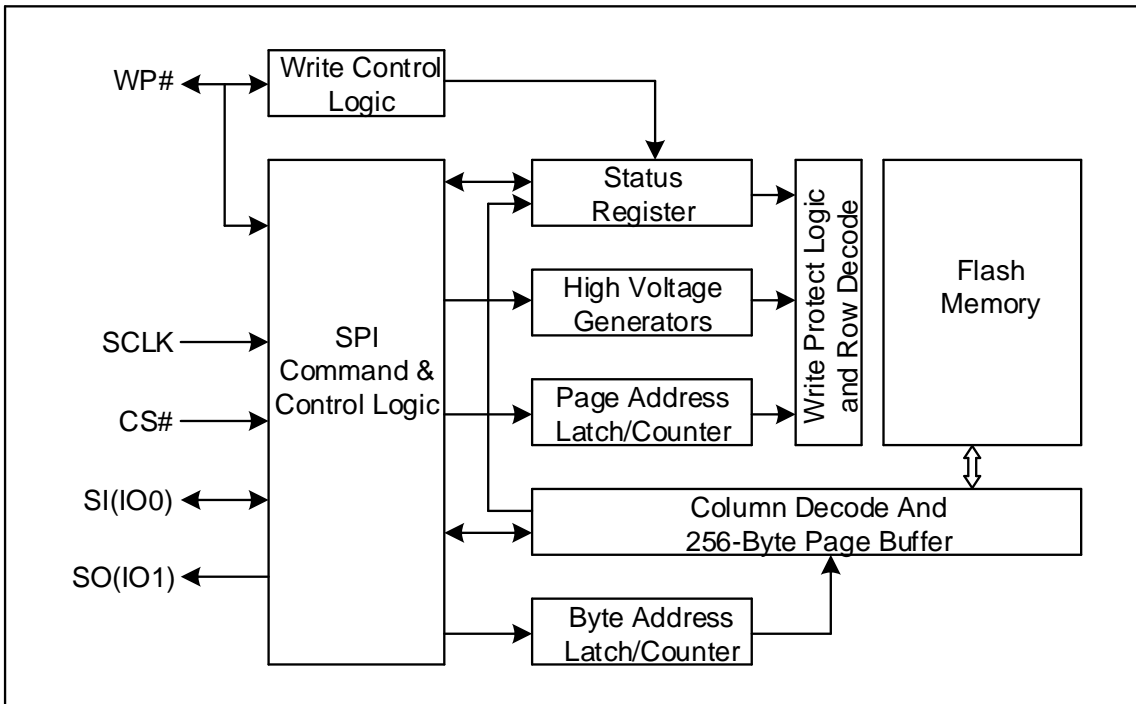
| Pin No. | Pin Name | I/O | Description                      |
|---------|----------|-----|----------------------------------|
| 1       | CS#      | I   | Chip Select Input                |
| 2       | SO (IO1) | O   | Data Output (Data Output 1)      |
| 3       | WP#      | I   | Write Protect Input              |
| 4       | VSS      |     | Ground                           |
| 5       | SI (IO0) | I/O | Data Input (Data Input Output 0) |
| 6       | SCLK     | I   | Serial Clock Input               |
| 7       | NC       |     | No Connection                    |
| 8       | VCC      |     | Power Supply                     |

Note:

1. CS# must be driven high if chip is not selected. Please don't leave CS# floating any time after power is on.
2. If WP# is unused, it must be driven high by the host, or an external pull-up resistor must be placed on the PCB in order to avoid allowing WP# input to float.



BLOCK DIAGRAM







### 3 MEMORY ORGANIZATION

#### GD25LD10E

| Each device has | Each block has | Each sector has | Each page has |         |
|-----------------|----------------|-----------------|---------------|---------|
| 128K            | 64/32K         | 4K              | 256           | bytes   |
| 512             | 256/128        | 16              | -             | pages   |
| 32              | 16/8           | -               | -             | sectors |
| 2/4             | -              | -               | -             | blocks  |

#### GD25LD05E

| Each device has | Each block has | Each sector has | Each page has |         |
|-----------------|----------------|-----------------|---------------|---------|
| 64K             | 64/32K         | 4K              | 256           | Bytes   |
| 256             | 256/128        | 16              | -             | pages   |
| 16              | 16/8           | -               | -             | sectors |
| 1/2             | -              | -               | -             | blocks  |

### UNIFORM BLOCK SECTOR ARCHITECTURE

#### GD25LD10E 64K Bytes Block Sector Architecture

| Block | Sector | Address range |         |
|-------|--------|---------------|---------|
| 1     | 31     | 01F000H       | 01FFFFH |
|       | .....  | .....         | .....   |
|       | 16     | 010000H       | 010FFFH |
| 0     | 15     | 00F000H       | 00FFFFH |
|       | .....  | .....         | .....   |
|       | 0      | 000000H       | 000FFFH |

#### GD25LD05E 64K Bytes Block Sector Architecture

| Block | Sector | Address range |         |
|-------|--------|---------------|---------|
| 0     | 15     | 00F000H       | 00FFFFH |
|       | .....  | .....         | .....   |
|       | 0      | 000000H       | 000FFFH |



## **4 DEVICE OPERATIONS**

### **4.1 SPI Mode**

#### **Standard SPI**

The GD25LD10E/05E features a serial peripheral interface on 4 signals bus: Serial Clock (SCLK), Chip Select (CS#), Serial Data Input (SI) and Serial Data Output (SO). Both SPI bus mode 0 and 3 are supported. Input data is latched on the rising edge of SCLK and data shifts out on the falling edge of SCLK.

#### **Dual SPI**

The GD25LD10E/05E supports Dual Output operation when using the “Dual Output Fast Read” (3Bh) commands. These commands allow data to be transferred to or from the device at twice the rate of the standard SPI. When using the Dual Output command the SI pin becomes bidirectional I/O pins: IO0, and the SO pin becomes IO1.



## 5 DATA PROTECTION

The GD25LD10E/05E provide the following data protection methods:

- ◆ Write Enable (WREN) command: The WREN command is set the Write Enable Latch bit (WEL). The WEL bit will return to reset by the following situation:
  - Power-Up
  - Write Disable (WRDI)
  - Write Status Register (WRSR)
  - Page Program (PP)
  - Sector Erase (SE) / Block Erase (BE) / Chip Erase (CE)
- ◆ Software Protection Mode: The Block Protect bits (BP2-BP0) define the section of the memory array that can be read but not changed.
- ◆ Hardware Protection Mode: WP# goes low to protect the Block Protect bits (BP2-BP0) and the SRP bit.
- ◆ Deep Power-Down Mode: In Deep Power-Down Mode, all commands are ignored except the Release from Deep Power-Down Mode command.
- ◆ Write Inhibit Voltage (VWI): Device would reset automatically when VCC is below a certain threshold VWI.

**Table 4. GD25LD10E Protected area size**

| Status Register Content |     |     | Memory Content |                 |         |             |
|-------------------------|-----|-----|----------------|-----------------|---------|-------------|
| BP2                     | BP1 | BP0 | Blocks         | Addresses       | Density | Portion     |
| 0                       | 0   | 0   | NONE           | NONE            | NONE    | NONE        |
| 0                       | 0   | 1   | Sector 0 to 29 | 000000H-01DFFFH | 120KB   | Lower 30/32 |
| 0                       | 1   | 0   | Sector 0 to 27 | 000000H-01BFFFH | 112KB   | Lower 28/32 |
| 0                       | 1   | 1   | Sector 0 to 23 | 000000H-017FFFH | 96KB    | Lower 24/32 |
| 1                       | 0   | 0   | Sector 0 to 15 | 000000H-00FFFFH | 64KB    | Lower 16/32 |
| 1                       | 0   | 1   | ALL            | 000000H-01FFFFH | 128KB   | ALL         |
| 1                       | 1   | X   | ALL            | 000000H-01FFFFH | 128KB   | ALL         |

**Table 5. GD25LD05E Protected area size**

| Status Register Content |     |     | Memory Content |                 |         |             |
|-------------------------|-----|-----|----------------|-----------------|---------|-------------|
| BP2                     | BP1 | BP0 | Blocks         | Addresses       | Density | Portion     |
| 0                       | 0   | 0   | NONE           | NONE            | NONE    | NONE        |
| 0                       | 0   | 1   | Sector 0 to 13 | 000000H-00DFFFH | 56KB    | Lower 14/16 |
| 0                       | 1   | 0   | Sector 0 to 11 | 000000H-00BFFFH | 48KB    | Lower 12/16 |
| 0                       | 1   | 1   | Sector 0 to 7  | 000000H-007FFFH | 32KB    | Lower 8/16  |
| 1                       | X   | X   | ALL            | 000000H-00FFFFH | 64KB    | ALL         |



## 6 STATUS REGISTER

**Table 6. Status Register**

| No. | Name     | Description                    | Note                  |
|-----|----------|--------------------------------|-----------------------|
| S7  | SRP      | Status Register Protection Bit | Non-volatile writable |
| S6  | Reserved | Reserved                       | Reserved              |
| S5  | Reserved | Reserved                       | Reserved              |
| S4  | BP2      | Block Protect Bit              | Non-volatile writable |
| S3  | BP1      | Block Protect Bit              | Non-volatile writable |
| S2  | BP0      | Block Protect Bit              | Non-volatile writable |
| S1  | WEL      | Write Enable Latch             | Volatile, read only   |
| S0  | WIP      | Erase/Write In Progress        | Volatile, read only   |

The status and control bits of the Status Register are as follows:

### WIP bit

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

### WEL bit

The Write Enable Latch (WEL) bit indicates the status of the internal Write Enable Latch. When set to 1 the internal Write Enable Latch is set, when set to 0 the internal Write Enable Latch is reset and no Write Status Register, Program or Erase command is accepted.

### BP2, BP1, BP0 bits

The Block Protect (BP2, BP1, and BP0) bits are non-volatile. They define the size of the area to be software protected against Program and Erase commands. These bits are written with the Write Status Register (WRSR) command. When the Block Protect (BP2, BP1, BP0) bits are set to 1, the relevant memory area (as defined in Table4&5) becomes protected against Page Program (PP), Sector Erase (SE) and Block Erase (BE) commands. The Block Protect (BP2, BP1, and BP0) bits can be written provided that the Hardware Protected mode has not been set. The Chip Erase (CE) command is executed, if the Block Protect (BP2, BP1, and BP0) bits are all 0. The default value of BP2, BP1 and BP0 bits are all 0.

### SRP bit

The Status Register Protect (SRP) bits are non-volatile Read/Write bits in the status register. The SRP bit controls the method of the write protection: software protected, hardware protected, or hardware unprotected.

**Table 7. Status Register Protect (SRP) bit**

| SRP | WP# | Status Register    | Description   |
|-----|-----|--------------------|---|
| 0   | X   | Software Protected | The Status Register can be written to after a Write Enable command, WEL=1.(Default) |
| 1   | 0   | Hardware Protected | WP#=0, the Status Register locked and cannot be written to.                         |



|   |   |                      |  |
|---|---|----------------------|--|
| 1 | 1 | Hardware Unprotected | WP#=1, the Status Register is unlocked and can be written to after a Write Enable command, WEL=1 |
|---|---|----------------------|--|

**Reserved bit**

It is recommended to set the value of the reserved bit as "0".



## 7 COMMAND DESCRIPTIONS

All commands, addresses and data are shifted in and out of the device, beginning with the most significant bit on the first rising edge of SCLK after CS# is driven low. Then, the one-byte command code must be shifted in to the device, with most significant bit first on SI, and each bit is latched on the rising edges of SCLK.

Every command sequence starts with a one-byte command code. Depending on the command, this might be followed by address bytes, or by data bytes, or by both or none. CS# must be driven high after the last bit of the command sequence has been completed. For the command of Read, Fast Read, Read Status Register or Release from Deep Power-Down, and Read Device ID, the shifted-in command sequence is followed by a data-out sequence. All read instruction can be completed after any bit of the data-out sequence is being shifted out, and then CS# must be driven high to return to deselected status.

For the command of Page Program, Sector Erase, Block Erase, Chip Erase, Write Status Register, Write Enable, Write Disable or Deep Power-Down command, CS# must be driven high exactly at a byte boundary, otherwise the command is rejected, and is not executed. That is CS# must be driven high when the number of clock pulses after CS# being driven low is an exact multiple of eight. For Page Program, if at any time the input byte is not a full byte, nothing will happen and WEL will not be reset.

**Table 8. Commands**

| Command Name                    | Byte 1  | Byte 2          | Byte 3     | Byte 4    | Byte 5          | Byte 6                 | Byte 7  | Byte 8 | Byte 9 |
|---------------------------------|---------|-----------------|------------|-----------|-----------------|------------------------|---------|--------|--------|
| Write Enable                    | 06h     |                 |            |           |                 |                        |         |        |        |
| Write Disable                   | 04h     |                 |            |           |                 |                        |         |        |        |
| Read Status Register            | 05h     | (S7-S0)         | (cont.)    |           |                 |                        |         |        |        |
| Write Status Register           | 01h     | S7-S0           |            |           |                 |                        |         |        |        |
| Read Data                       | 03h     | A23-A16         | A15-A8     | A7-A0     | (D7-D0)         | (cont.)                |         |        |        |
| Fast Read                       | 0Bh     | A23-A16         | A15-A8     | A7-A0     | dummy           | (D7-D0)                | (cont.) |        |        |
| Dual Output Fast Read           | 3Bh     | A23-A16         | A15-A8     | A7-A0     | dummy           | (D7-D0) <sup>(1)</sup> | (cont.) |        |        |
| Page Program                    | 02h     | A23-A16         | A15-A8     | A7-A0     | D7-D0           | Next Byte              |         |        |        |
| Sector Erase                    | 20h     | A23-A16         | A15-A8     | A7-A0     |                 |                        |         |        |        |
| Block Erase (32K)               | 52h     | A23-A16         | A15-A8     | A7-A0     |                 |                        |         |        |        |
| Block Erase (64K)               | D8h     | A23-A16         | A15-A8     | A7-A0     |                 |                        |         |        |        |
| Chip Erase                      | 60h/C7h |                 |            |           |                 |                        |         |        |        |
| Read Manufacturer/<br>Device ID | 90h     | 00H             | 00H        | 00H       | (MID7-<br>MID0) | (ID7-ID0)              | (cont.) |        |        |
| Read Identification             | 9Fh     | (MID7-<br>MID0) | (ID15-ID8) | (ID7-ID0) | (cont.)         |                        |         |        |        |
| Read Unique ID                  | 4Bh     | 00H             | 00H        | 00H       | dummy           | (UID7-<br>UID0)        | (cont.) |        |        |
| Deep Power-Down                 | B9h     |                 |            |           |                 |                        |         |        |        |
| Release From Deep<br>Power-Down | ABh     |                 |            |           |                 |                        |         |        |        |



|   |     |       |       |       |           |         |  |  |  |
|---|-----|-------|-------|-------|-----------|---------|--|--|--|
| Release From Deep Power-Down and Read Device ID | ABh | dummy | dummy | dummy | (ID7-ID0) | (cont.) |  |  |  |
|---|-----|-------|-------|-------|-----------|---------|--|--|--|

Note:

- 1. Dual Output data
- IO0 = (D6, D4, D2, D0)
- IO1 = (D7, D5, D3, D1)

**TABLE OF ID DEFINITIONS**

**GD25LD10E**

| Operation Code | MID7-MID0 | ID15-ID8 | ID7-ID0 |
|----------------|-----------|----------|---------|
| 9Fh            | C8        | 60       | 11      |
| 90h            | C8        |          | 10      |
| ABh            |           |          | 10      |

**GD25LD05E**

| Operation Code | MID7-MID0 | ID15-ID8 | ID7-ID0 |
|----------------|-----------|----------|---------|
| 9Fh            | C8        | 60       | 10      |
| 90h            | C8        |          | 05      |
| ABh            |           |          | 05      |

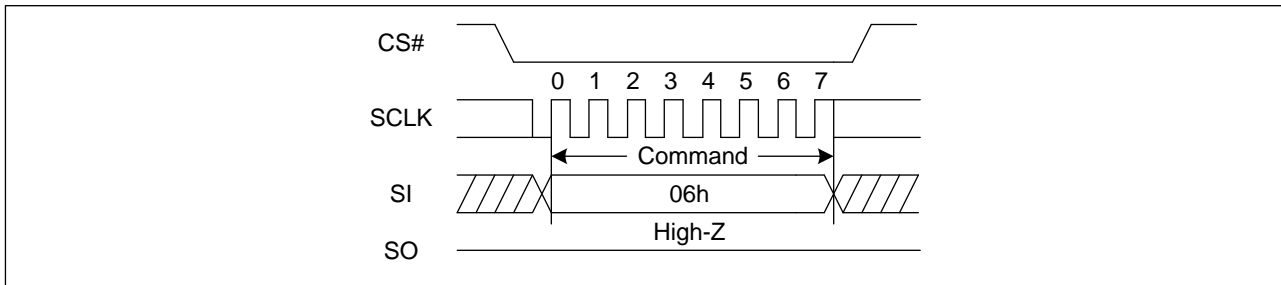


### 7.1 Write Enable (WREN) (06h)

The Write Enable (WREN) command is for setting the Write Enable Latch (WEL) bit. The Write Enable Latch (WEL) bit must be set prior to every Page Program (PP), Sector Erase (SE), Block Erase (BE), Chip Erase (CE), Write Status Register (WRSR) command.

The Write Enable (WREN) command sequence: CS# goes low → sending the Write Enable command → CS# goes high.

**Figure 4. Write Enable Sequence Diagram**



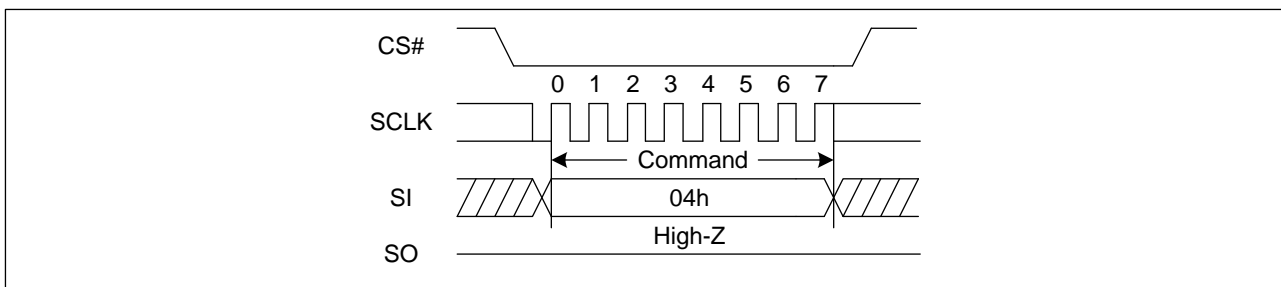
### 7.2 Write Disable (WRDI) (04h)

The Write Disable command is for resetting the Write Enable Latch (WEL) bit. The Write Enable Latch (WEL) bit may be set to 0 by issuing the Write Disable (WRDI) command to disable Page Program (PP), Sector Erase (SE), Block Erase (BE), Chip Erase (CE), Write Status Register (WRSR), that require WEL be set to 1 for execution. The WRDI command can be used by the user to protect memory areas against inadvertent writes that can possibly corrupt the contents of the memory. The WRDI command is ignored during an embedded operation while WIP bit =1.

The WEL bit is reset by following condition: Write Disable command (WRDI), Power-up, and upon completion of the Write Status Register, Page Program, Sector Erase, Block Erase and Chip Erase commands.

The Write Disable command sequence: CS# goes low → Sending the Write Disable command → CS# goes high.

**Figure 5. Write Disable Sequence Diagram**



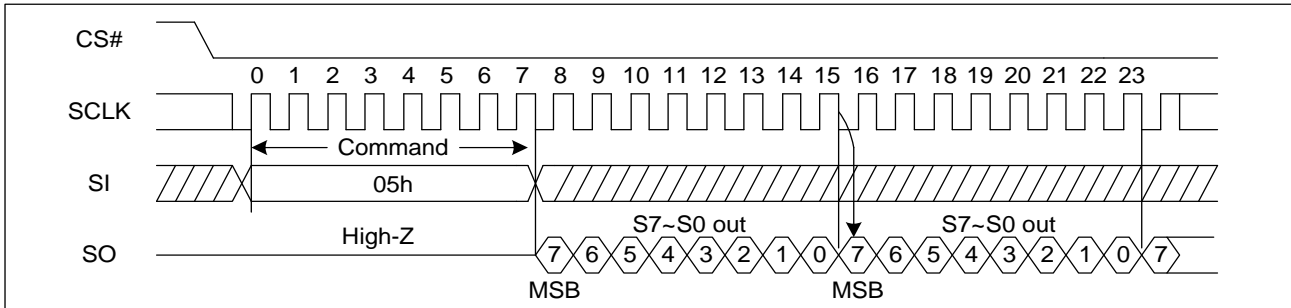
### 7.3 Read Status Register (RDSR) (05h)

The Read Status Register (RDSR) command is for reading the Status Register. The Status Register may be read at any time, even while a Program, Erase or Write Status Register cycle is in progress. When one of these cycles is in progress, it is recommended to check the Write in Progress (WIP) bit before sending a new command to the device. It is also possible to read the Status Register continuously. For command code “05h”, the SO will output Status Register bits S7~S0.





**Figure 6. Read Status Register Sequence Diagram**



### 7.4 Write Status Register (WRSR) (01h)

The Write Status Register (WRSR) instruction allows new values to be written to the Status Register. A Write Enable (WREN) instruction must be executed previously to set the Write Enable Latch (WEL) bit, before it can be accepted.

The Write Status Register (WRSR) instruction is entered by driving Chip Select (CS#) Low, followed by the instruction code and the data byte on Serial Data Input (SI).

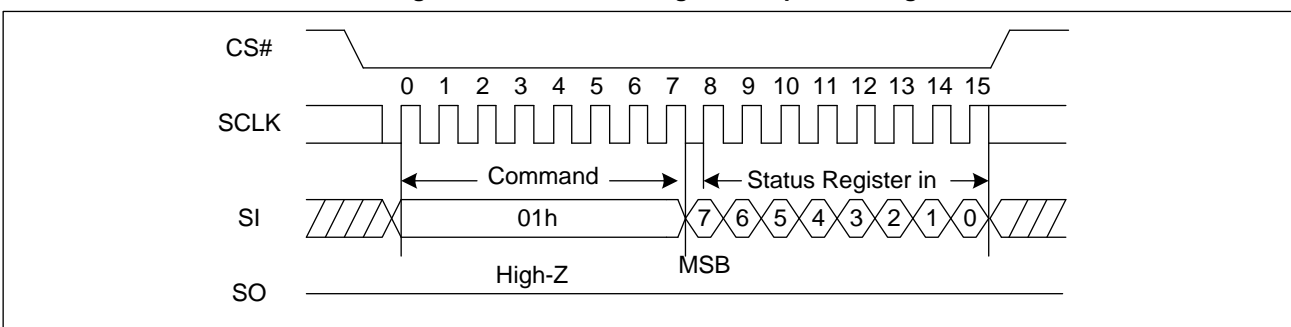
The Write Status Register (WRSR) instruction has no effect on S6, S5, S1 and S0 of the Status Register. S6 and S5 are always read as 0. Chip Select (CS#) must be driven High after the eighth bit of the data byte has been latched in. Otherwise, the Write Status Register (WRSR) instruction is not executed. As soon as Chip Select (CS#) is driven high, the self-timed Write Status Register cycle (the duration is  $t_w$ ) is initiated. While the Write Status Register cycle is in progress, reading Status Register to check the Write In Progress (WIP) bit is achievable.

The Write In Progress (WIP) bit is 1 during the self-timed Write Status Register cycle, and turn to 0 on the completion of the Write Status Register. When the cycle is completed, the Write Enable Latch (WEL) is reset to 0.

The Write Status Register (WRSR) instruction allows the user to change the values of the Block Protect (BP2, BP1, BP0) bits, which are utilized to define the size of the read-only area.

The Write Status Register (WRSR) instruction also allows the user to set or reset the Status Register Protect (SRP) bit in accordance with the Write Protect (WP#) signal, by setting which the device can enter into Hardware Protected Mode. The Write Status Register (WRSR) instruction is not executed once enter into the Hardware Protected Mode.

**Figure 7. Write Status Register Sequence Diagram**

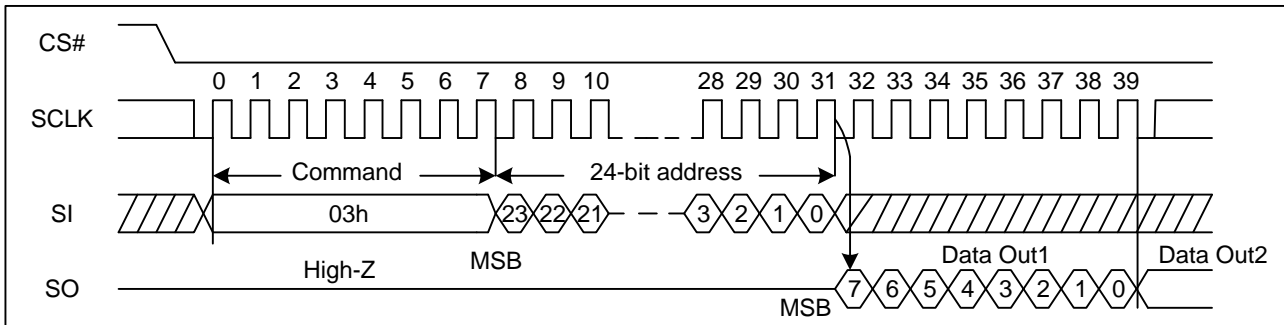


### 7.5 Read Data Bytes (READ) (03h)

The Read Data Bytes (READ) command is followed by a 3-byte address (A23-A0), and each bit is latched-in on the rising edge of SCLK. Then the memory content, at that address, is shifted out on SO, and each bit is shifted out, at a Max frequency  $f_R$ , on the falling edge of SCLK. The first byte addressed can be at any location. The address is automatically incremented to the next higher address after each byte of data is shifted out. The whole memory can, therefore, be read with a single Read Data Bytes (READ) command. Any Read Data Bytes (READ) command, while an Erase, Program or Write cycle is in progress, is rejected without having any effects on the cycle that is in progress.



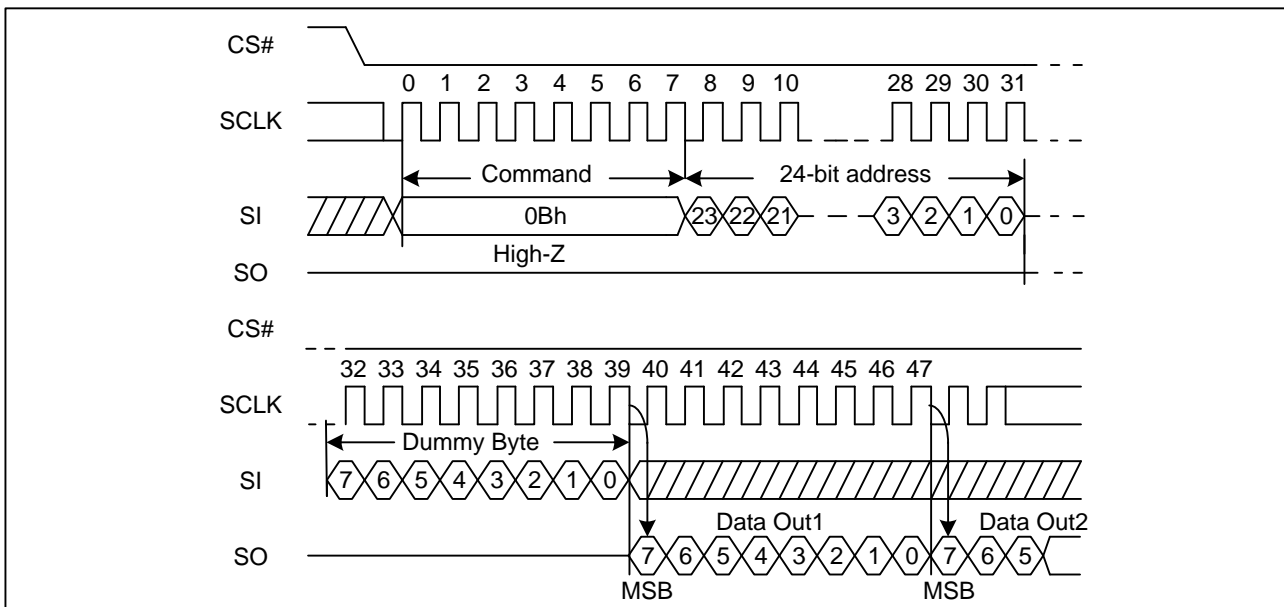
**Figure 8. Read Data Bytes Sequence Diagram**



### 7.6 Read Data Bytes at Higher Speed (Fast Read) (0Bh)

The Read Data Bytes at Higher Speed (Fast Read) command is for quickly reading data out. It is followed by a 3-byte address (A23-A0) and a dummy byte, and each bit is latched-in on the rising edge of SCLK. Then the memory content, at that address, is shifted out on SO, and each bit is shifted out, at a Max frequency  $f_c$ , on the falling edge of SCLK. The first byte address can be at any location. The address is automatically incremented to the next higher address after each byte of data is shifted out.

**Figure 9. Read Data Bytes at Higher Speed Sequence Diagram**



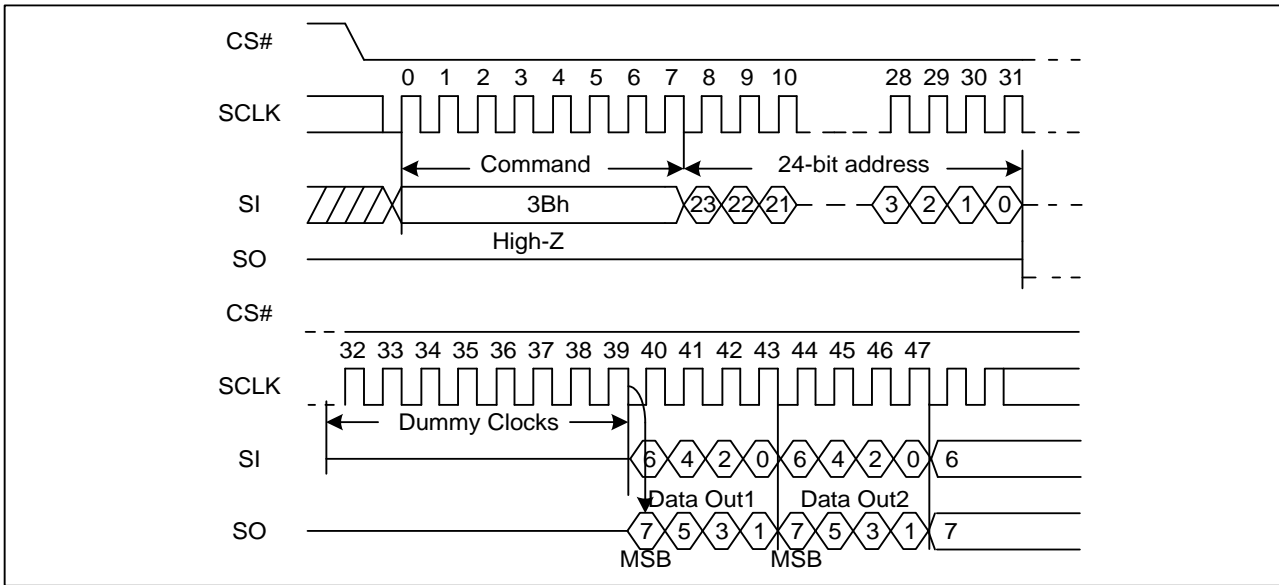
### 7.7 Dual Output Fast Read (3Bh)

The Dual Output Fast Read command is followed by 3-byte address (A23-A0) and a dummy byte, and each bit is latched in on the rising edge of SCLK, then the memory contents are shifted out 2-bit per clock cycle from SI and SO.

The first byte addressed can be at any location. The address is automatically incremented to the next higher address after each byte of data is shifted out.



**Figure 10. Dual Output Fast Read Sequence Diagram**



## 7.8 Page Program (PP) (02h)

The Page Program (PP) command is for programming the memory. A Write Enable (WREN) command must previously have been executed to set the Write Enable Latch (WEL) bit before sending the Page Program command.

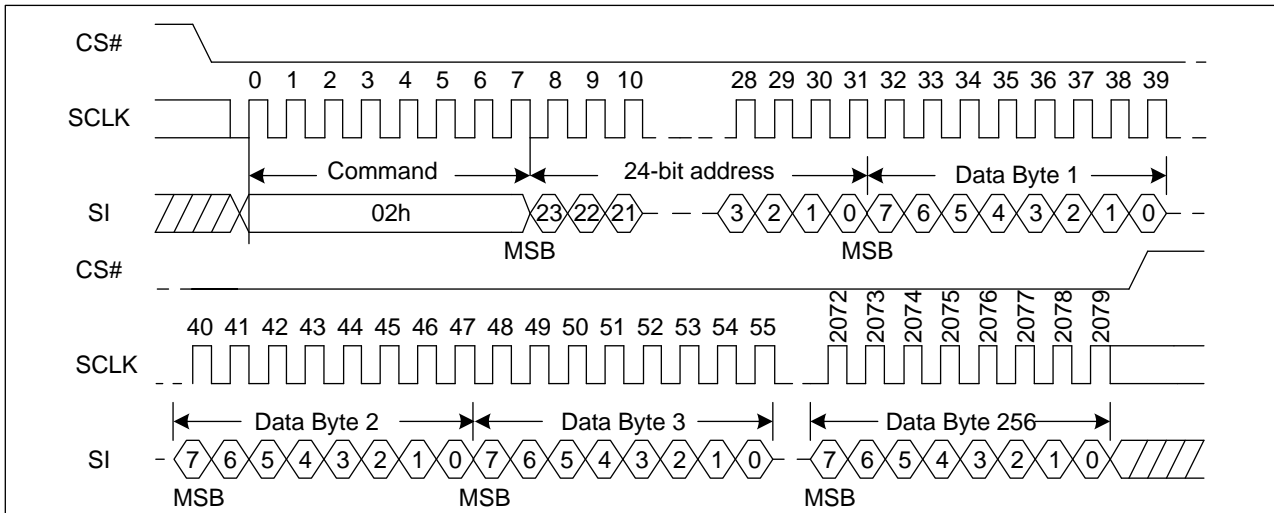
The Page Program (PP) command is entered by driving CS# Low, followed by the command code, three address bytes and at least one data byte on SI. If the 8 least significant address bits (A7-A0) are not all zero, all transmitted data that goes beyond the end of the current page are programmed from the start address of the same page (from the address whose 8 least significant bits (A7-A0) are all zero). CS# must be driven low for the entire duration of the sequence. The Page Program command sequence: CS# goes low → sending Page Program command → 3-byte address on SI → at least 1 byte data on SI → CS# goes high. If more than 256 bytes are sent to the device, previously latched data are discarded and the last 256 data bytes are guaranteed to be programmed correctly within the same page. If less than 256 data bytes are sent to device, they are correctly programmed at the requested addresses without having any effects on the other bytes of the same page. CS# must be driven high after the eighth bit of the last data byte has been latched in; otherwise the Page Program (PP) command is not executed.

As soon as CS# is driven high, the self-timed Page Program cycle (whose duration is  $t_{PP}$ ) is initiated. While the Page Program cycle is in progress, the Status Register may be read to check the value of the Write in Progress (WIP) bit. The Write in Progress (WIP) bit is 1 during the self-timed Page Program cycle, and is 0 when it is completed. At some unspecified time before the cycle is completed, the Write Enable Latch (WEL) bit is reset.

A Page Program (PP) command applied to a page which is protected by the Block Protect (BP2, BP1, and BP0) is not executed.



**Figure 11. Page Program Sequence Diagram**

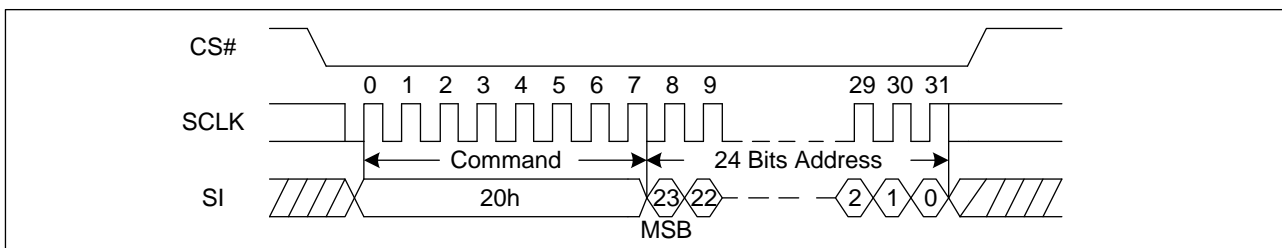


### 7.9 Sector Erase (SE) (20h)

The Sector Erase (SE) command is for erasing the all data of the chosen sector. A Write Enable (WREN) command must previously have been executed to set the Write Enable Latch (WEL) bit. The Sector Erase (SE) command is entered by driving CS# low, followed by the command code, and 3-address byte on SI. Any address inside the sector is a valid address for the Sector Erase (SE) command. CS# must be driven low for the entire duration of the sequence.

The Sector Erase command sequence: CS# goes low → sending Sector Erase command → 3-byte address on SI → CS# goes high. CS# must be driven high after the eighth bit of the last address byte has been latched in; otherwise the Sector Erase (SE) command is not executed. As soon as CS# is driven high, the self-timed Sector Erase cycle (whose duration is  $t_{SE}$ ) is initiated. While the Sector Erase cycle is in progress, the Status Register may be read to check the value of the Write in Progress (WIP) bit. The Write in Progress (WIP) bit is 1 during the self-timed Sector Erase cycle, and is 0 when it is completed. At some unspecified time before the cycle is completed, the Write Enable Latch (WEL) bit is reset. A Sector Erase (SE) command applied to a sector which is protected by the Block Protect (BP2, BP1, and BP0) bit is not executed.

**Figure 12. Sector Erase Sequence Diagram**



### 7.10 32KB Block Erase (BE32) (52h)

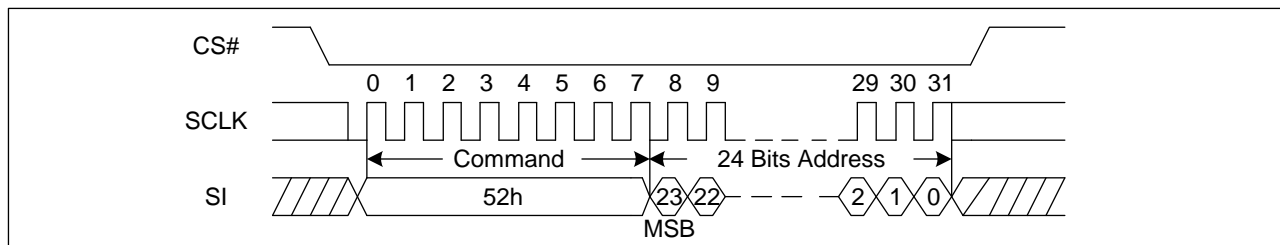
The 32KB Block Erase command is for erasing the all data of the chosen block. A Write Enable (WREN) command must previously have been executed to set the Write Enable Latch (WEL) bit. The 32KB Block Erase command is entered by driving CS# low, followed by the command code, and three address bytes on SI. Any address inside the block is a valid address for the 32KB Block Erase command. CS# must be driven low for the entire duration of the sequence.

The 32KB Block Erase command sequence: CS# goes low → sending 32KB Block Erase command → 3-byte address on SI → CS# goes high. CS# must be driven high after the eighth bit of the last address byte has been latched in; otherwise the 32KB Block Erase command is not executed. As soon as CS# is driven high, the self-timed Block Erase cycle (whose



duration is  $t_{BE1}$ ) is initiated. While the Block Erase cycle is in progress, the Status Register may be read to check the value of the Write in Progress (WIP) bit. The Write in Progress (WIP) bit is 1 during the self-timed Block Erase cycle, and is 0 when it is completed. At some unspecified time before the cycle is completed, the Write Enable Latch (WEL) bit is reset. A 32KB Block Erase command applied to a block which is protected by the Block Protect (BP2, BP1, and BP0) bits is not executed.

**Figure 13. 32KB Block Erase Sequence Diagram**

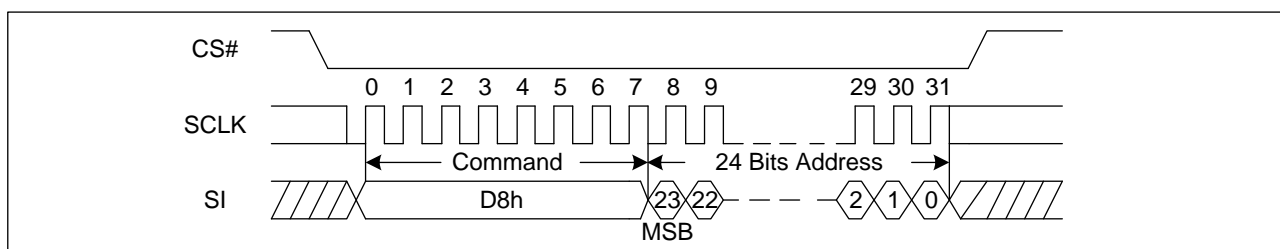


### 7.11 64KB Block Erase (BE64) (D8h)

The 64KB Block Erase command is for erasing the all data of the chosen block. A Write Enable (WREN) command must previously have been executed to set the Write Enable Latch (WEL) bit. The 64KB Block Erase command is entered by driving CS# low, followed by the command code, and three address bytes on SI. Any address inside the block is a valid address for the 64KB Block Erase command. CS# must be driven low for the entire duration of the sequence.

The 64KB Block Erase command sequence: CS# goes low → sending 64KB Block Erase command → 3-byte address on SI → CS# goes high. CS# must be driven high after the eighth bit of the last address byte has been latched in; otherwise the 64KB Block Erase command is not executed. As soon as CS# is driven high, the self-timed Block Erase cycle (whose duration is  $t_{BE2}$ ) is initiated. While the Block Erase cycle is in progress, the Status Register may be read to check the value of the Write in Progress (WIP) bit. The Write in Progress (WIP) bit is 1 during the self-timed Block Erase cycle, and is 0 when it is completed. At some unspecified time before the cycle is completed, the Write Enable Latch (WEL) bit is reset. A 64KB Block Erase command applied to a block which is protected by the Block Protect (BP2, BP1, and BP0) bits is not executed.

**Figure 14. 64KB Block Erase Sequence Diagram**



### 7.12 Chip Erase (CE) (60h/C7h)

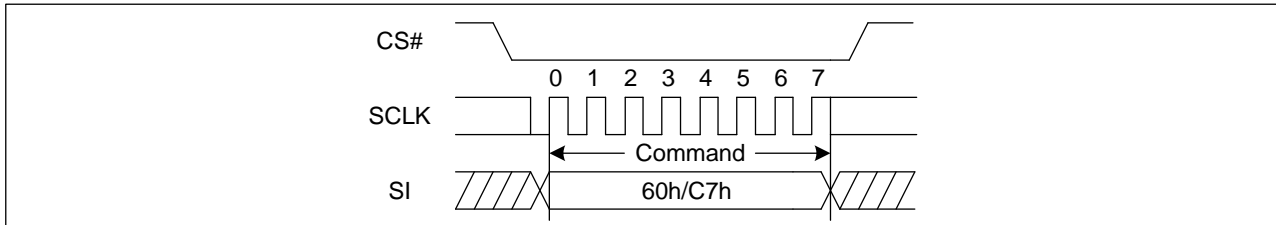
The Chip Erase (CE) command is for erasing the all data of the chip. A Write Enable (WREN) command must previously have been executed to set the Write Enable Latch (WEL) bit. The Chip Erase (CE) command is entered by driving CS# Low, followed by the command code on Serial Data Input (SI). CS# must be driven Low for the entire duration of the sequence.

The Chip Erase command sequence: CS# goes low → sending Chip Erase command → CS# goes high. CS# must be driven high after the eighth bit of the command code has been latched in; otherwise the Chip Erase command is not executed. As soon as CS# is driven high, the self-timed Chip Erase cycle (whose duration is  $t_{CE}$ ) is initiated. While the Chip Erase



cycle is in progress, the Status Register may be read to check the value of the Write in Progress (WIP) bit. The Write in Progress (WIP) bit is 1 during the self-timed Chip Erase cycle, and is 0 when it is completed. At some unspecified time before the cycle is completed, the Write Enable Latch (WEL) bit is reset. The Chip Erase (CE) command is executed if the Block Protect (BP2, BP1, BP0) bits are all 0. The Chip Erase (CE) command is not executed if any sector is under protection.

**Figure 15. Chip Erase Sequence Diagram**

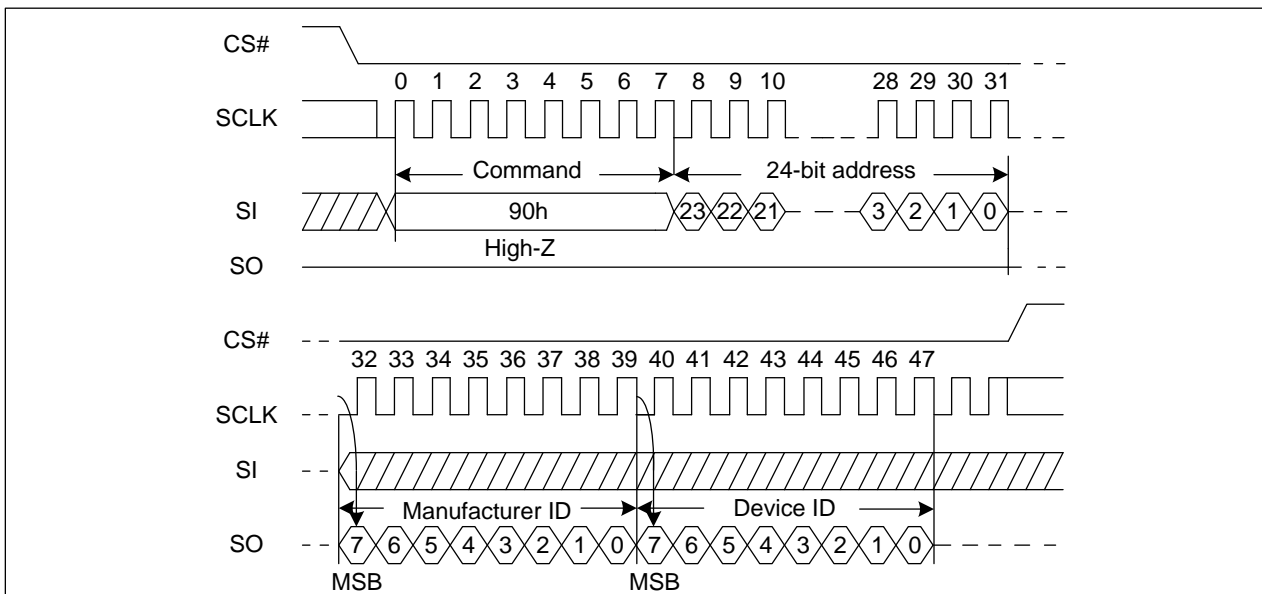


### 7.13 Read Manufacture ID/ Device ID (REMS) (90h)

The Read Manufacturer/Device ID command is an alternative to the Release from Power-Down / Device ID command that provides both the JEDEC assigned Manufacturer ID and the specific Device ID.

The command is initiated by driving the CS# pin low and shifting the command code “90h” followed by a 24-bit address (A23-A0) of 000000H. After which, the Manufacturer ID and the Device ID are shifted out on the falling edge of SCLK with most significant bit (MSB) first.

**Figure 16. Read Manufacture ID/ Device ID Sequence Diagram**



### 7.14 Read Identification (RDID) (9Fh)

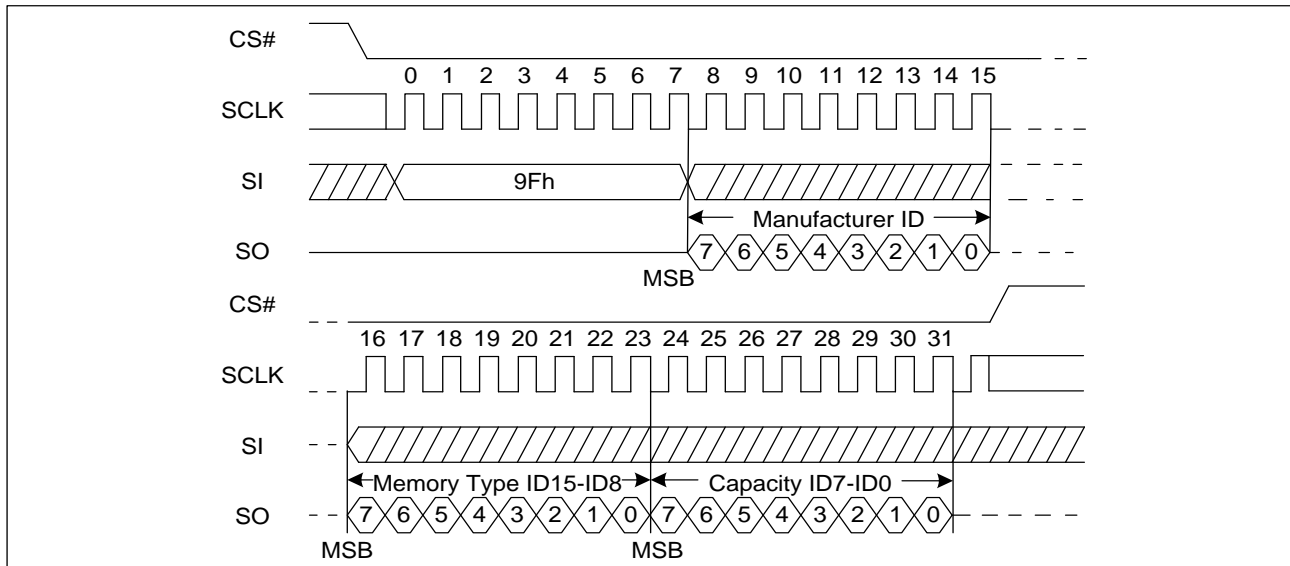
The Read Identification (RDID) command allows the 8-bit manufacturer identification to be read, followed by two bytes of device identification. The device identification indicates the memory type in the first byte, and the memory capacity of the device in the second byte. The Read Identification (RDID) command while an Erase or Program cycle is in progress, is not decoded, and has no effect on the cycle that is in progress. The Read Identification (RDID) command should not be issued while the device is in Deep Power-Down Mode.

The device is first selected by driving CS# low. Then, the 8-bit command code for the command is shifted in. This is followed by the 24-bit device identification, stored in the memory. Each bit is shifted out on the falling edge of Serial Clock. The Read Identification (RDID) command is terminated by driving CS# high at any time during data output. When CS# is driven high,



the device is in the Standby Mode. Once in the Standby Mode, the device waits to be selected, so that it can receive, decode and execute commands.

**Figure 17. Read Identification ID Sequence Diagram**

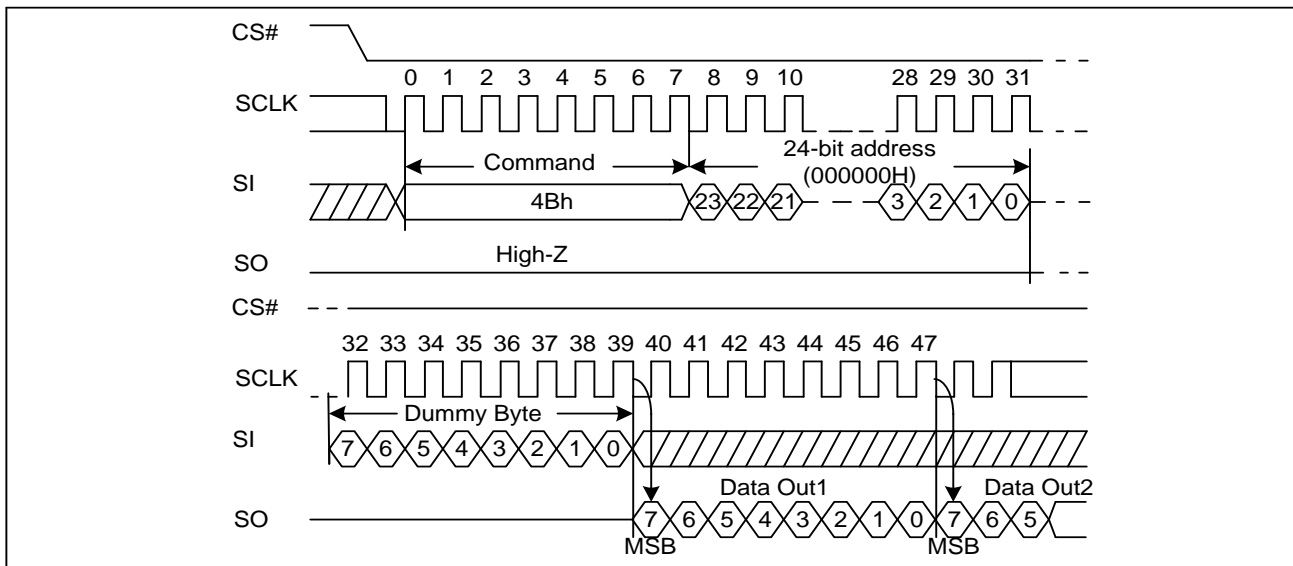


### 7.15 Read Unique ID (4Bh)

The Read Unique ID command accesses a factory-set read-only 128bit number that is unique to each device. The Unique ID can be used in conjunction with user software methods to help prevent copying or cloning of a system.

The Read Unique ID command sequence: CS# goes low → sending Read Unique ID command → 3-Byte Address (000000H) → Dummy Byte → 128bit Unique ID Out → CS# goes high.

**Figure 18. Read Unique ID Sequence Diagram**



### 7.16 Deep Power-Down (DP) (B9h)

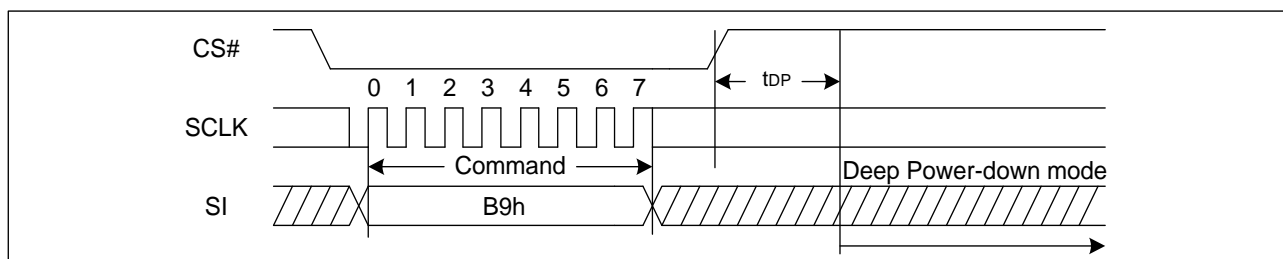
Executing the Deep Power-Down (DP) command is the only way to put the device in the lowest consumption mode (the Deep Power-Down Mode). It can also be used as an extra software protection mechanism, while the device is not in active use, since in this mode, the device ignores all Write, Program and Erase commands. Driving CS# high deselects the device,



and puts the device in the Standby Mode (if there is no internal cycle currently in progress). But this mode is not the Deep Power-Down Mode. The Deep Power-Down Mode can only be entered by executing the Deep Power-Down (DP) command. Once the device has entered the Deep Power-Down Mode, all commands are ignored except the Release from Deep Power-Down and Read Device ID (RDI) command. The Release from Deep Power-Down and Read Device ID (RDI) command releases the device from Deep Power-Down mode, also allows the Device ID of the device to be output on SO. The Deep Power-Down Mode automatically stops at Power-Down, and the device always in the Standby Mode after Power-Up.

The Deep Power-Down command sequence: CS# goes low → sending Deep Power-Down command → CS# goes high. CS# must be driven high after the eighth bit of the command code has been latched in; otherwise the Deep Power-Down (DP) command is not executed. As soon as CS# is driven high, it requires a delay of  $t_{DP}$  before the supply current is reduced to  $I_{CC2}$  and the Deep Power-Down Mode is entered. Any Deep Power-Down (DP) command, while an Erase, Program or Write cycle is in progress, is rejected without having any effects on the cycle that is in progress.

Figure 19. Deep Power-Down Sequence Diagram



### 7.17 Release from Deep Power-Down and Read Device ID (RDI) (ABh)

The Release from Power-Down and Read Device ID command is a multi-purpose command. It can be used to release the device from the Power-Down state or obtain the devices electronic identification (ID) number.

To release the device from the Power-Down state, the command is issued by driving the CS# pin low, shifting the instruction code “ABh” and driving CS# high. Release from Power-Down will take the time duration of  $t_{RES1}$  (See AC Characteristics) before the device will resume normal operation and other command are accepted. The CS# pin must remain high during the  $t_{RES1}$  time duration.

When used only to obtain the Device ID while not in the Power-Down state, the command is initiated by driving the CS# pin low and shifting the instruction code “ABh” followed by 3-dummy byte. The ID7~ID0 are then shifted out on the falling edge of SCLK with most significant bit (MSB) first. The Device ID value is listed in Manufacturer and Device Identification table. The Device ID can be read continuously. The command is completed by driving CS# high.

When used to release the device from the Power-Down state and obtain the ID7~ID0, the command is the same as previously described, except that after CS# is driven high it must remain high for a time duration of  $t_{RES2}$  (See AC Characteristics). After this time duration the device will resume normal operation and other command will be accepted. If the Release from Power-Down / Device ID command is issued while an Erase, Program or Write cycle is in process (when WIP equals 1) the command is ignored and will not have any effects on the current cycle.





Figure 20. Release Power-Down Sequence Diagram

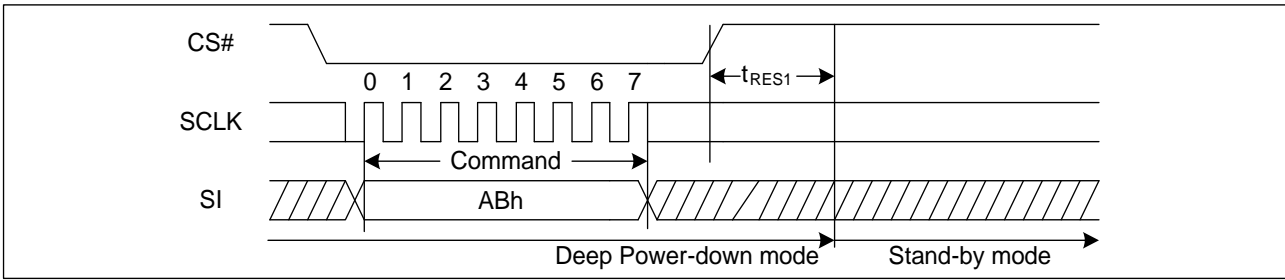
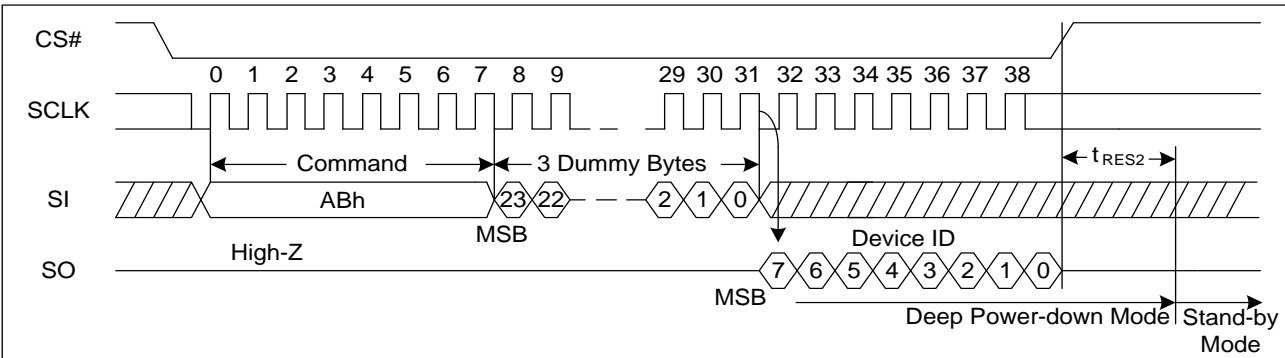


Figure 21. Release Power-Down/Read Device ID Sequence Diagram





## 8 ELECTRICAL CHARACTERISTICS

### 8.1 Power-On Timing

Figure 22. Power-On Timing Sequence Diagram

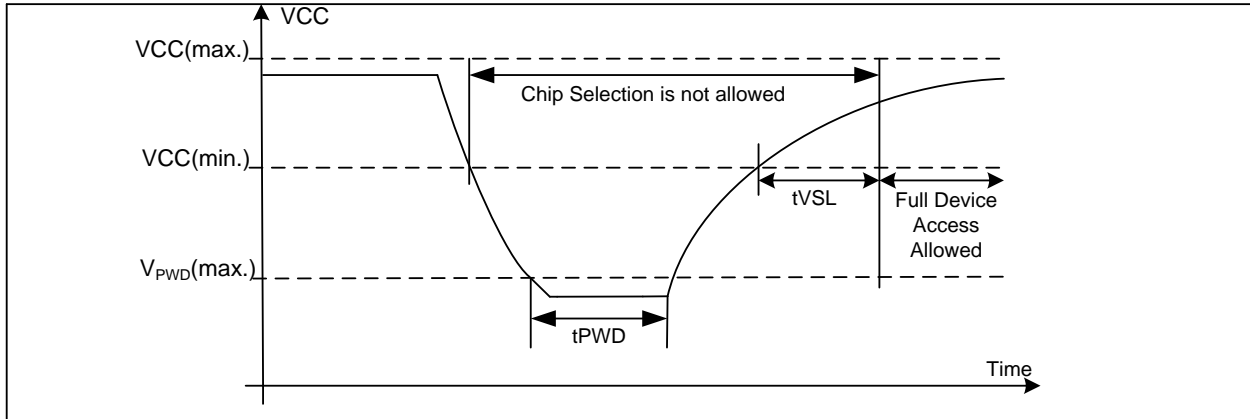


Table 9. Power-Up Timing and Write Inhibit Threshold

| Symbol | Parameter   | Min. | Max. | Unit |
|--------|---|------|------|------|
| tVSL   | VCC (min.) to device operation  | 0.3  |      | ms   |
| VWI    | Write Inhibit Voltage   | 1    | 1.4  | V    |
| VPWD   | VCC voltage needed to below VPWD for ensuring initialization will occur |      | 0.5  | V    |
| tPWD   | The minimum duration for ensuring initialization will occur             | 300  |      | μs   |

### 8.2 Initial Delivery State

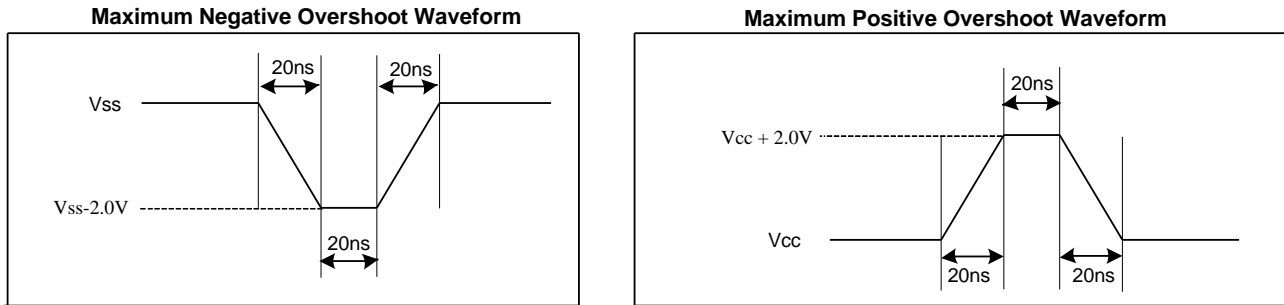
The device is delivered with the memory array erased: all bits are set to 1 (each Byte contains FFH). The Status Register contains 00H (all Status Register bits are 0).

### 8.3 Absolute Maximum Ratings

| Parameter  | Value           | Unit |
|--|-----------------|------|
| Ambient Operating Temperature ( $T_A$ )          | -40 to 85       | °C   |
|  | -40 to 105      |      |
|  | -40 to 125      |      |
| Storage Temperature                              | -65 to 150      | °C   |
| Transient Input/Output Voltage (note: overshoot) | -2.0 to VCC+2.0 | V    |
| Applied Input/Output Voltage                     | -0.6 to VCC+0.4 | V    |
| VCC  | -0.6 to 2.5     | V    |



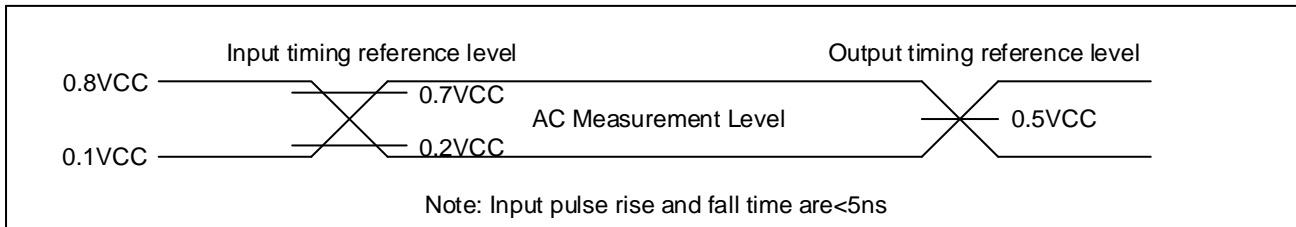
Figure 23. Input Test Waveform and Measurement Level



### 8.4 Capacitance Measurement Conditions

| Symbol           | Parameter                       | Min.                                     | Typ. | Max. | Unit | Conditions           |
|------------------|---------------------------------|--|------|------|------|----------------------|
| C <sub>IN</sub>  | Input Capacitance               |  |      | 6    | pF   | V <sub>IN</sub> =0V  |
| C <sub>OUT</sub> | Output Capacitance              |  |      | 8    | pF   | V <sub>OUT</sub> =0V |
| C <sub>L</sub>   | Load Capacitance                | 30                                       |      |      | pF   |                      |
|                  | Input Rise And Fall time        |  |      | 5    | ns   |                      |
|                  | Input Pulse Voltage             | 0.1V <sub>CC</sub> to 0.8V <sub>CC</sub> |      |      | V    |                      |
|                  | Input Timing Reference Voltage  | 0.2V <sub>CC</sub> to 0.7V <sub>CC</sub> |      |      | V    |                      |
|                  | Output Timing Reference Voltage | 0.5V <sub>CC</sub>                       |      |      | V    |                      |

Figure 24. Absolute Maximum Ratings Diagram





## 8.5 DC Characteristics

( $T_A = -40^{\circ}\text{C} \sim 85^{\circ}\text{C}$ ,  $V_{CC} = 1.65 \sim 2.0\text{V}$ )

| Symbol    | Parameter                | Test Condition  | Min.    | Typ.               | Max.    | Unit.         |
|-----------|--------------------------|---|---------|--------------------|---------|---------------|
| $I_{LI}$  | Input Leakage Current    |   |         |                    | $\pm 2$ | $\mu\text{A}$ |
| $I_{LO}$  | Output Leakage Current   |   |         |                    | $\pm 2$ | $\mu\text{A}$ |
| $I_{CC1}$ | Standby Current          | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 2       | $\mu\text{A}$ |
| $I_{CC2}$ | Deep Power-Down Current  | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 2       | $\mu\text{A}$ |
| $I_{CC3}$ | Operating Current (Read) | CLK=0.1VCC / 0.9VCC<br>at 50MHz,<br>Q=Open(x1 I/O)    |         | 1.3                | 2       | mA            |
|           |                          | CLK=0.1VCC / 0.9VCC<br>at 40MHz,<br>Q=Open(x2 Output) |         | 1.6                | 3       | mA            |
| $I_{CC4}$ | Operating Current (PP)   | CS#=VCC   |         | 7                  | 10      | mA            |
| $I_{CC5}$ | Operating Current (WRSR) | CS#=VCC   |         | 7                  | 10      | mA            |
| $I_{CC6}$ | Operating Current (SE)   | CS#=VCC   |         | 7                  | 10      | mA            |
| $I_{CC7}$ | Operating Current (BE)   | CS#=VCC   |         | 7                  | 10      | mA            |
| $I_{CC8}$ | Operating Current (CE)   | CS#=VCC   |         | 7                  | 10      | mA            |
| $V_{IL}$  | Input Low Voltage        |   | -0.5    |                    | 0.2VCC  | V             |
| $V_{IH}$  | Input High Voltage       |   | 0.7VCC  |                    |         | V             |
| $V_{OL}$  | Output Low Voltage       | $I_{OL} = 100\mu\text{A}$                             |         |                    | 0.4     | V             |
| $V_{OH}$  | Output High Voltage      | $I_{OH} = -100\mu\text{A}$                            | VCC-0.2 |                    |         | V             |

Note:

1. Typical value at  $T_A = 25^{\circ}\text{C}$ ,  $V_{CC} = 1.8\text{V}$ .
2. Value guaranteed by design and/or characterization, not 100% tested in production.
3. For USON6 (1.2x1.2mm) package,  $I_{CC1} = 0.5\mu\text{A}$ ,  $I_{CC2} = 0.5\mu\text{A}$ .



(T<sub>A</sub> = -40°C~105°C, VCC=1.65~2.0V)

| Symbol           | Parameter                | Test Condition  | Min.    | Typ.               | Max.   | Unit. |
|------------------|--------------------------|---|---------|--------------------|--------|-------|
| I <sub>LI</sub>  | Input Leakage Current    |   |         |                    | ±2     | μA    |
| I <sub>LO</sub>  | Output Leakage Current   |   |         |                    | ±2     | μA    |
| I <sub>CC1</sub> | Standby Current          | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 8      | μA    |
| I <sub>CC2</sub> | Deep Power-Down Current  | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 8      | μA    |
| I <sub>CC3</sub> | Operating Current (Read) | CLK=0.1VCC / 0.9VCC<br>at 50MHz,<br>Q=Open(x1 I/O)    |         | 1.3                | 8      | mA    |
|                  |                          | CLK=0.1VCC / 0.9VCC<br>at 40MHz,<br>Q=Open(x2 Output) |         | 1.6                | 8      | mA    |
| I <sub>CC4</sub> | Operating Current (PP)   | CS#=VCC   |         | 7                  | 12     | mA    |
| I <sub>CC5</sub> | Operating Current (WRSR) | CS#=VCC   |         | 7                  | 12     | mA    |
| I <sub>CC6</sub> | Operating Current (SE)   | CS#=VCC   |         | 7                  | 12     | mA    |
| I <sub>CC7</sub> | Operating Current (BE)   | CS#=VCC   |         | 7                  | 12     | mA    |
| I <sub>CC8</sub> | Operating Current (CE)   | CS#=VCC   |         | 7                  | 12     | mA    |
| V <sub>IL</sub>  | Input Low Voltage        |   | -0.5    |                    | 0.2VCC | V     |
| V <sub>IH</sub>  | Input High Voltage       |   | 0.7VCC  |                    |        | V     |
| V <sub>OL</sub>  | Output Low Voltage       | I <sub>OL</sub> = 100μA                               |         |                    | 0.4    | V     |
| V <sub>OH</sub>  | Output High Voltage      | I <sub>OH</sub> = -100μA                              | VCC-0.2 |                    |        | V     |

Note:

1. Typical value at T<sub>A</sub> = 25°C, VCC = 1.8V.
2. Value guaranteed by design and/or characterization, not 100% tested in production.
3. For USON6 (1.2x1.2mm) package, I<sub>CC1</sub> = 0.5μA, I<sub>CC2</sub> = 0.5μA.



(T<sub>A</sub> = -40°C~125°C, VCC=1.65~2.0V)

| Symbol           | Parameter                | Test Condition  | Min.    | Typ.               | Max.   | Unit. |
|------------------|--------------------------|---|---------|--------------------|--------|-------|
| I <sub>LI</sub>  | Input Leakage Current    |   |         |                    | ±2     | μA    |
| I <sub>LO</sub>  | Output Leakage Current   |   |         |                    | ±2     | μA    |
| I <sub>CC1</sub> | Standby Current          | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 10     | μA    |
| I <sub>CC2</sub> | Deep Power-Down Current  | CS#=VCC,<br>VIN=VCC or VSS                            |         | 0.1 <sup>(3)</sup> | 10     | μA    |
| I <sub>CC3</sub> | Operating Current (Read) | CLK=0.1VCC / 0.9VCC<br>at 50MHz,<br>Q=Open(x1 I/O)    |         | 1.3                | 10     | mA    |
|                  |                          | CLK=0.1VCC / 0.9VCC<br>at 40MHz,<br>Q=Open(x2 Output) |         | 1.6                | 10     | mA    |
| I <sub>CC4</sub> | Operating Current (PP)   | CS#=VCC   |         | 7                  | 15     | mA    |
| I <sub>CC5</sub> | Operating Current (WRSR) | CS#=VCC   |         | 7                  | 15     | mA    |
| I <sub>CC6</sub> | Operating Current (SE)   | CS#=VCC   |         | 7                  | 15     | mA    |
| I <sub>CC7</sub> | Operating Current (BE)   | CS#=VCC   |         | 7                  | 15     | mA    |
| I <sub>CC8</sub> | Operating Current (CE)   | CS#=VCC   |         | 7                  | 15     | mA    |
| V <sub>IL</sub>  | Input Low Voltage        |   | -0.5    |                    | 0.2VCC | V     |
| V <sub>IH</sub>  | Input High Voltage       |   | 0.7VCC  |                    |        | V     |
| V <sub>OL</sub>  | Output Low Voltage       | I <sub>OL</sub> = 100μA                               |         |                    | 0.4    | V     |
| V <sub>OH</sub>  | Output High Voltage      | I <sub>OH</sub> = -100μA                              | VCC-0.2 |                    |        | V     |

Note:

1. Typical value at T<sub>A</sub> = 25°C, VCC = 1.8V.
2. Value guaranteed by design and/or characterization, not 100% tested in production.
3. For USON6 (1.2x1.2mm) package, I<sub>CC1</sub> = 0.5μA, I<sub>CC2</sub> = 0.5μA.



## 8.6 AC Characteristics

(T<sub>A</sub> = -40°C~85°C, VCC=1.65~2.0V)

| Symbol            | Parameter  | Min.                          | Typ. | Max. | Unit. |
|-------------------|--|-------------------------------|------|------|-------|
| f <sub>C1</sub>   | Serial Clock Frequency For: Fast read (0BH)                |                               |      | 50   | MHz   |
| f <sub>R1</sub>   | Serial Clock Frequency For: Read (03H) ,Dual Output (3BH)  |                               |      | 40   | MHz   |
| t <sub>CLH</sub>  | Serial Clock High Time                                     | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLL</sub>  | Serial Clock Low Time                                      | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLCH</sub> | Serial Clock Rise Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>CHCL</sub> | Serial Clock Fall Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>SLCH</sub> | CS# Active Setup Time                                      | 10                            |      |      | ns    |
| t <sub>CHSH</sub> | CS# Active Hold Time                                       | 10                            |      |      | ns    |
| t <sub>SHCH</sub> | CS# Not Active Setup Time                                  | 10                            |      |      | ns    |
| t <sub>CHSL</sub> | CS# Not Active Hold Time                                   | 10                            |      |      | ns    |
| t <sub>SHSL</sub> | CS# High Time (Read/Write)                                 | 40                            |      |      | ns    |
| t <sub>SHQZ</sub> | Output Disable Time  |                               |      | 12   | ns    |
| t <sub>CLQX</sub> | Output Hold Time   | 0                             |      |      | ns    |
| t <sub>DVCH</sub> | Data In Setup Time   | 4                             |      |      | ns    |
| t <sub>CHDX</sub> | Data In Hold Time  | 4                             |      |      | ns    |
| t <sub>CLQV</sub> | Clock Low To Output Valid                                  |                               |      | 12   | ns    |
| t <sub>WHSL</sub> | Write Protect Setup Time Before CS# Low                    | 20                            |      |      | ns    |
| t <sub>SHWL</sub> | Write Protect Hold Time After CS# High                     | 100                           |      |      | ns    |
| t <sub>DP</sub>   | CS# High To Deep Power-Down Mode                           |                               |      | 0.1  | μs    |
| t <sub>RES1</sub> | CS# High To Standby Mode Without Electronic Signature Read |                               |      | 0.1  | μs    |
| t <sub>RES2</sub> | CS# High To Standby Mode With Electronic Signature Read    |                               |      | 0.1  | μs    |
| t <sub>w</sub>    | Write Status Register Cycle Time                           |                               | 5    | 40   | ms    |
| t <sub>BP</sub>   | Byte Program Time  |                               | 50   | 150  | μs    |
| t <sub>PP</sub>   | Page Programming Time                                      |                               | 1.4  | 6.0  | ms    |
| t <sub>SE</sub>   | Sector Erase Time  |                               | 120  | 500  | ms    |
| t <sub>BE1</sub>  | Block Erase Time (32K Bytes)                               |                               | 0.4  | 2.0  | s     |
| t <sub>BE2</sub>  | Block Erase Time (64K Bytes)                               |                               | 0.6  | 3.0  | s     |
| t <sub>CE</sub>   | Chip Erase Time (GD25LD10E) 1M                             |                               | 1.5  | 4    | s     |
|                   | Chip Erase Time (GD25LD05E) 512K                           |                               | 0.8  | 2    | s     |

Note:

1. Typical value at T<sub>A</sub> = 25°C.
2. Value guaranteed by design and/or characterization, not 100% tested in production.



(T<sub>A</sub> = -40°C~105°C, VCC=1.65~2.0V)

| Symbol            | Parameter  | Min.                          | Typ. | Max. | Unit. |
|-------------------|--|-------------------------------|------|------|-------|
| f <sub>C1</sub>   | Serial Clock Frequency For: Fast read (0BH)                |                               |      | 50   | MHz   |
| f <sub>R1</sub>   | Serial Clock Frequency For: Read (03H) ,Dual Output (3BH)  |                               |      | 40   | MHz   |
| t <sub>CLH</sub>  | Serial Clock High Time                                     | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLL</sub>  | Serial Clock Low Time                                      | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLCH</sub> | Serial Clock Rise Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>CHCL</sub> | Serial Clock Fall Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>SLCH</sub> | CS# Active Setup Time                                      | 10                            |      |      | ns    |
| t <sub>CHSH</sub> | CS# Active Hold Time                                       | 10                            |      |      | ns    |
| t <sub>SHCH</sub> | CS# Not Active Setup Time                                  | 10                            |      |      | ns    |
| t <sub>CHSL</sub> | CS# Not Active Hold Time                                   | 10                            |      |      | ns    |
| t <sub>SHSL</sub> | CS# High Time (Read/Write)                                 | 40                            |      |      | ns    |
| t <sub>SHQZ</sub> | Output Disable Time  |                               |      | 12   | ns    |
| t <sub>CLQX</sub> | Output Hold Time   | 0                             |      |      | ns    |
| t <sub>DVCH</sub> | Data In Setup Time   | 4                             |      |      | ns    |
| t <sub>CHDX</sub> | Data In Hold Time  | 4                             |      |      | ns    |
| t <sub>CLQV</sub> | Clock Low To Output Valid                                  |                               |      | 12   | ns    |
| t <sub>WHSL</sub> | Write Protect Setup Time Before CS# Low                    | 20                            |      |      | ns    |
| t <sub>SHWL</sub> | Write Protect Hold Time After CS# High                     | 100                           |      |      | ns    |
| t <sub>DP</sub>   | CS# High To Deep Power-Down Mode                           |                               |      | 0.1  | μs    |
| t <sub>RES1</sub> | CS# High To Standby Mode Without Electronic Signature Read |                               |      | 0.1  | μs    |
| t <sub>RES2</sub> | CS# High To Standby Mode With Electronic Signature Read    |                               |      | 0.1  | μs    |
| t <sub>W</sub>    | Write Status Register Cycle Time                           |                               | 5    | 40   | ms    |
| t <sub>BP</sub>   | Byte Program Time  |                               | 50   | 180  | μs    |
| t <sub>PP</sub>   | Page Programming Time                                      |                               | 1.4  | 7.0  | ms    |
| t <sub>SE</sub>   | Sector Erase Time  |                               | 120  | 600  | ms    |
| t <sub>BE1</sub>  | Block Erase Time (32K Bytes)                               |                               | 0.4  | 3.5  | s     |
| t <sub>BE2</sub>  | Block Erase Time (64K Bytes)                               |                               | 0.6  | 5.0  | s     |
| t <sub>CE</sub>   | Chip Erase Time (GD25LD10E) 1M                             |                               | 1.5  | 10   | s     |
|                   | Chip Erase Time (GD25LD05E) 512K                           |                               | 0.8  | 5    | s     |

Note:

1. Typical value at T<sub>A</sub> = 25°C.
2. Value guaranteed by design and/or characterization, not 100% tested in production.





(T<sub>A</sub> = -40°C~125°C, VCC=1.65~2.0V)

| Symbol            | Parameter  | Min.                          | Typ. | Max. | Unit. |
|-------------------|--|-------------------------------|------|------|-------|
| f <sub>C1</sub>   | Serial Clock Frequency For: Fast read (0BH)                |                               |      | 50   | MHz   |
| f <sub>R1</sub>   | Serial Clock Frequency For: Read (03H) ,Dual Output (3BH)  |                               |      | 40   | MHz   |
| t <sub>CLH</sub>  | Serial Clock High Time                                     | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLL</sub>  | Serial Clock Low Time                                      | 45%<br>(1/f <sub>Cmax</sub> ) |      |      | ns    |
| t <sub>CLCH</sub> | Serial Clock Rise Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>CHCL</sub> | Serial Clock Fall Time (Slew Rate)                         | 0.1                           |      |      | V/ns  |
| t <sub>SLCH</sub> | CS# Active Setup Time                                      | 10                            |      |      | ns    |
| t <sub>CHSH</sub> | CS# Active Hold Time                                       | 10                            |      |      | ns    |
| t <sub>SHCH</sub> | CS# Not Active Setup Time                                  | 10                            |      |      | ns    |
| t <sub>CHSL</sub> | CS# Not Active Hold Time                                   | 10                            |      |      | ns    |
| t <sub>SHSL</sub> | CS# High Time (Read/Write)                                 | 40                            |      |      | ns    |
| t <sub>SHQZ</sub> | Output Disable Time  |                               |      | 12   | ns    |
| t <sub>CLQX</sub> | Output Hold Time   | 0                             |      |      | ns    |
| t <sub>DVCH</sub> | Data In Setup Time   | 4                             |      |      | ns    |
| t <sub>CHDX</sub> | Data In Hold Time  | 4                             |      |      | ns    |
| t <sub>CLQV</sub> | Clock Low To Output Valid                                  |                               |      | 12   | ns    |
| t <sub>WHSL</sub> | Write Protect Setup Time Before CS# Low                    | 20                            |      |      | ns    |
| t <sub>SHWL</sub> | Write Protect Hold Time After CS# High                     | 100                           |      |      | ns    |
| t <sub>DP</sub>   | CS# High To Deep Power-Down Mode                           |                               |      | 0.1  | μs    |
| t <sub>RES1</sub> | CS# High To Standby Mode Without Electronic Signature Read |                               |      | 0.1  | μs    |
| t <sub>RES2</sub> | CS# High To Standby Mode With Electronic Signature Read    |                               |      | 0.1  | μs    |
| t <sub>W</sub>    | Write Status Register Cycle Time                           |                               | 5    | 40   | ms    |
| t <sub>BP</sub>   | Byte Program Time  |                               | 50   | 220  | μs    |
| t <sub>PP</sub>   | Page Programming Time                                      |                               | 1.4  | 9.0  | ms    |
| t <sub>SE</sub>   | Sector Erase Time  |                               | 120  | 700  | ms    |
| t <sub>BE1</sub>  | Block Erase Time (32K Bytes)                               |                               | 0.4  | 5.0  | s     |
| t <sub>BE2</sub>  | Block Erase Time (64K Bytes)                               |                               | 0.6  | 6.5  | s     |
| t <sub>CE</sub>   | Chip Erase Time (GD25LD10E) 1M                             |                               | 1.5  | 15   | s     |
|                   | Chip Erase Time (GD25LD05E) 512K                           |                               | 0.8  | 7.5  | s     |

Note:

1. Typical value at T<sub>A</sub> = 25°C.
2. Value guaranteed by design and/or characterization, not 100% tested in production.



Figure 25. Input Timing

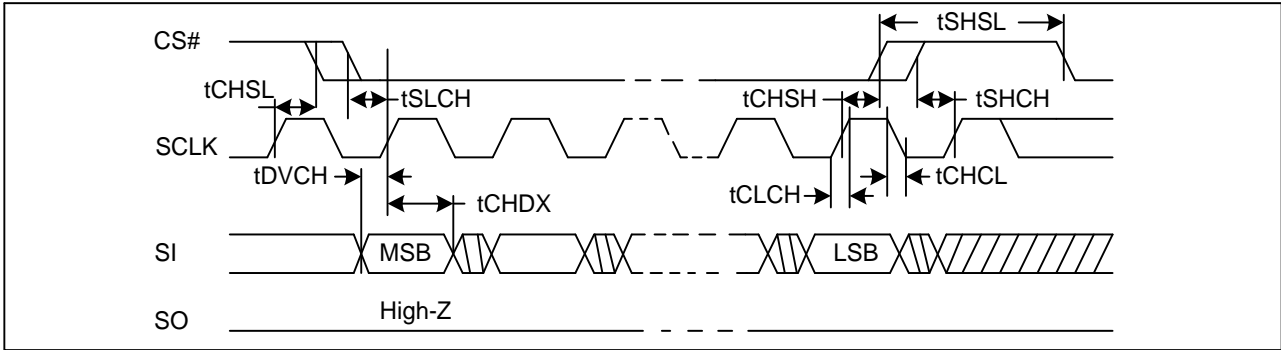


Figure 26. Output Timing

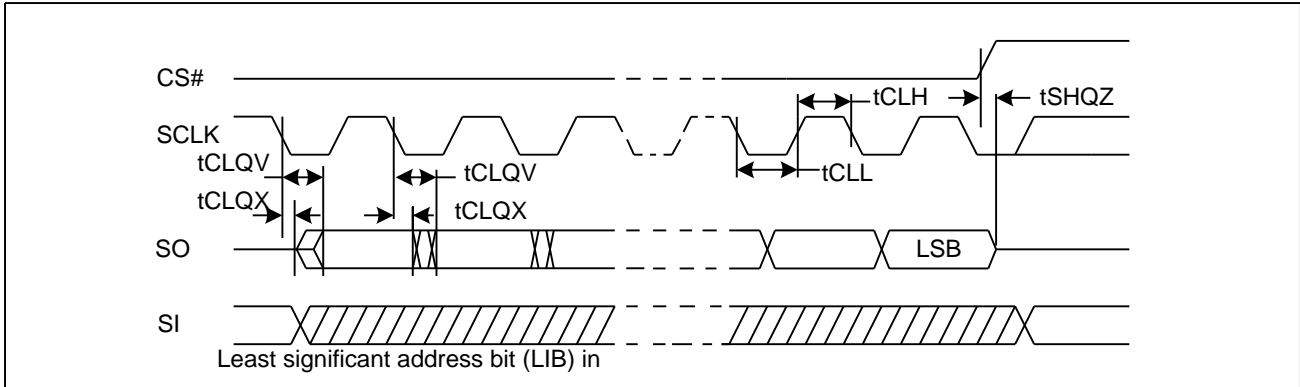
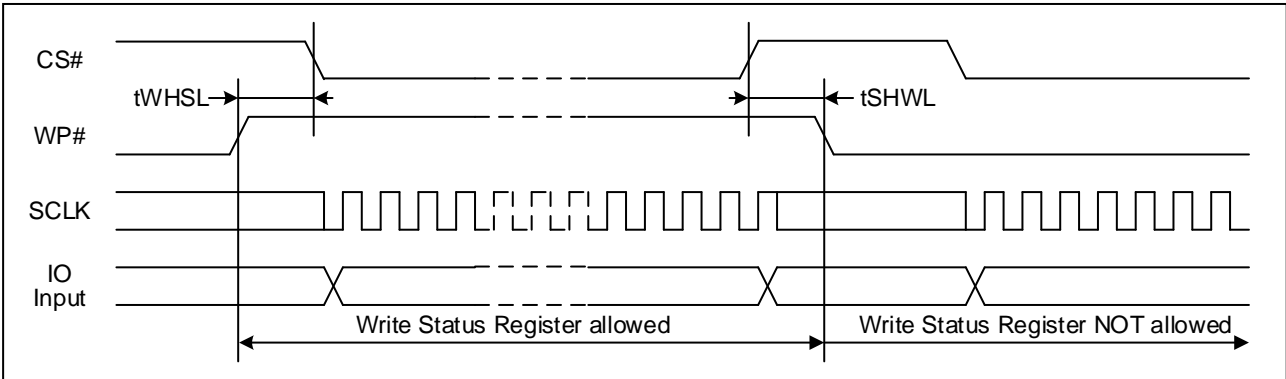
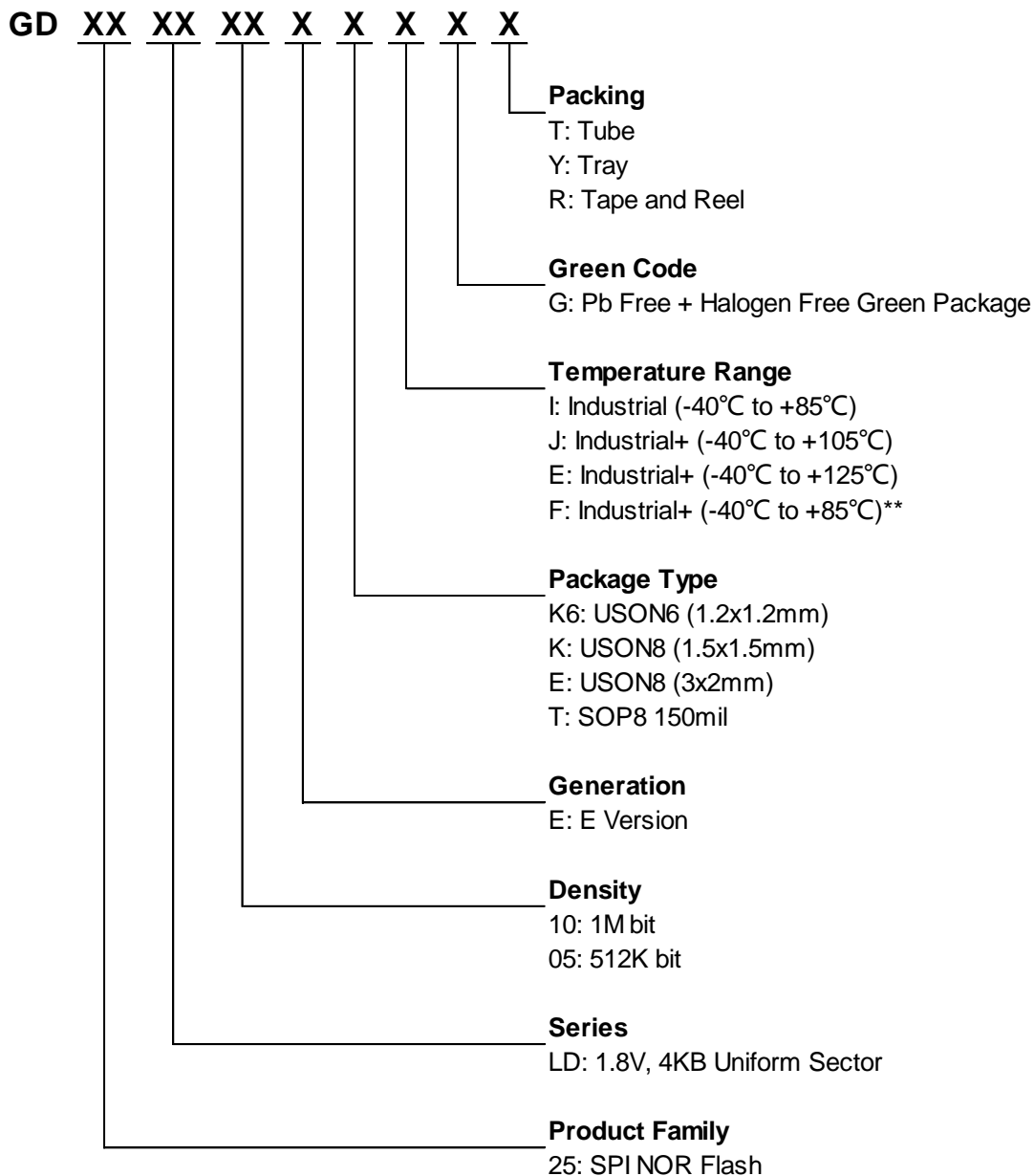


Figure 27. WP# Timing





## 9 ORDERING INFORMATION



\*\*F grade has implemented additional test flows to ensure higher product quality than I grade.



**9.1 Valid Part Numbers**

**Please contact GigaDevice regional sales for the latest product selection and available form factors.**

**Temperature Range I: Industrial (-40°C to +85°C)**

| Product Number | Density | Package Type      | Packing Options |
|----------------|---------|-------------------|-----------------|
| GD25LD10EK6IG  | 1Mbit   | USON6 (1.2x1.2mm) | R               |
| GD25LD05EK6IG  | 512Kbit |                   |                 |
| GD25LD10EKIG   | 1Mbit   | USON8 (1.5x1.5mm) | R               |
| GD25LD05EKIG   | 512Kbit |                   |                 |
| GD25LD10EEIG   | 1Mbit   | USON8 (3x2mm)     | R               |
| GD25LD05EEIG   | 512Kbit |                   |                 |
| GD25LD10ETIG   | 1Mbit   | SOP8 150mil       | T/Y/R           |
| GD25LD05ETIG   | 512Kbit |                   |                 |

**Temperature Range J: Industrial+ (-40°C to +105°C)**

| Product Number | Density | Package Type      | Packing Options |
|----------------|---------|-------------------|-----------------|
| GD25LD10EK6JG  | 1Mbit   | USON6 (1.2x1.2mm) | R               |
| GD25LD05EK6JG  | 512Kbit |                   |                 |
| GD25LD10EKJG   | 1Mbit   | USON8 (1.5x1.5mm) | R               |
| GD25LD05EKJG   | 512Kbit |                   |                 |
| GD25LD10EEJG   | 1Mbit   | USON8 (3x2mm)     | R               |
| GD25LD05EEJG   | 512Kbit |                   |                 |
| GD25LD10ETJG   | 1Mbit   | SOP8 150mil       | T/Y/R           |
| GD25LD05ETJG   | 512Kbit |                   |                 |



**Temperature Range E: Industrial+ (-40°C to +125°C)**

| Product Number | Density | Package Type      | Packing Options |
|----------------|---------|-------------------|-----------------|
| GD25LD10EK6EG  | 1Mbit   | USON6 (1.2x1.2mm) | R               |
| GD25LD05EK6EG  | 512Kbit |                   |                 |
| GD25LD10EKEG   | 1Mbit   | USON8 (1.5x1.5mm) | R               |
| GD25LD05EKEG   | 512Kbit |                   |                 |
| GD25LD10EEEG   | 1Mbit   | USON8 (3x2mm)     | R               |
| GD25LD05EEEG   | 512Kbit |                   |                 |
| GD25LD10ETEG   | 1Mbit   | SOP8 150mil       | T/Y/R           |
| GD25LD05ETEG   | 512Kbit |                   |                 |

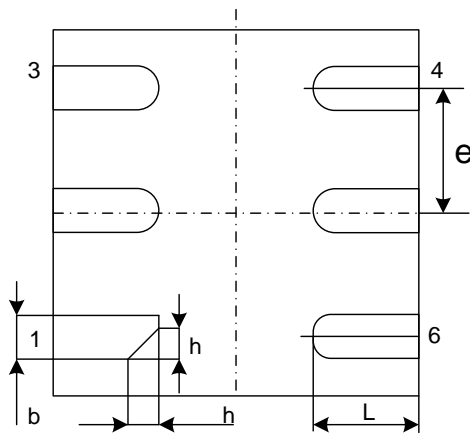
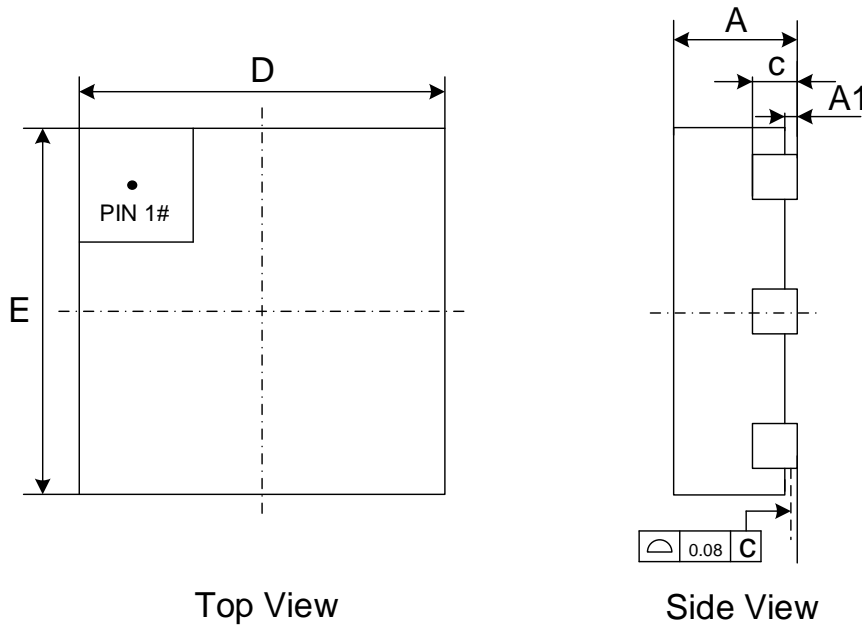
**Temperature Range F: Industrial+ (-40°C to +85°C)**

| Product Number | Density | Package Type      | Packing Options |
|----------------|---------|-------------------|-----------------|
| GD25LD10EK6FG  | 1Mbit   | USON6 (1.2x1.2mm) | R               |
| GD25LD05EK6FG  | 512Kbit |                   |                 |
| GD25LD10EKFG   | 1Mbit   | USON8 (1.5x1.5mm) | R               |
| GD25LD05EKFG   | 512Kbit |                   |                 |
| GD25LD10EEFG   | 1Mbit   | USON8 (3x2mm)     | R               |
| GD25LD05EEFG   | 512Kbit |                   |                 |
| GD25LD10ETFG   | 1Mbit   | SOP8 150mil       | T/Y/R           |
| GD25LD05ETFG   | 512Kbit |                   |                 |



## 10 PACKAGE INFORMATION

### 10.1 Package USON6 (1.2x1.2mm)



Bottom View

#### Dimensions

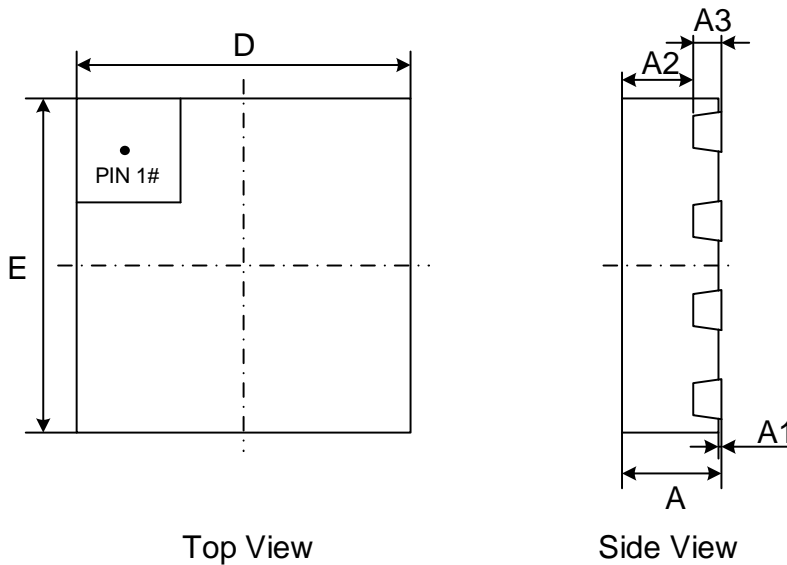
| Symbol | A   | A1   | b    | D    | E    | c            | e           | L    | h           |
|--------|-----|------|------|------|------|--------------|-------------|------|-------------|
| Unit   |     |      |      |      |      |              |             |      |             |
| mm     | Min | 0.35 | 0.00 | 0.10 | 1.15 | 0.127<br>REF | 0.40<br>BSC | 0.35 | 0.12<br>REF |
|        | Nom | -    | 0.02 | 0.15 | 1.20 |              |             | 0.40 |             |
|        | Max | 0.40 | 0.05 | 0.20 | 1.25 |              |             | 0.45 |             |

Note:

1. Coplanarity  $\leq 0.08\text{mm}$ . Package edge tolerance  $\leq 0.10\text{mm}$ .
2. The lead shape may be of little difference according to different package factories. These lead shapes are compatible with each other.

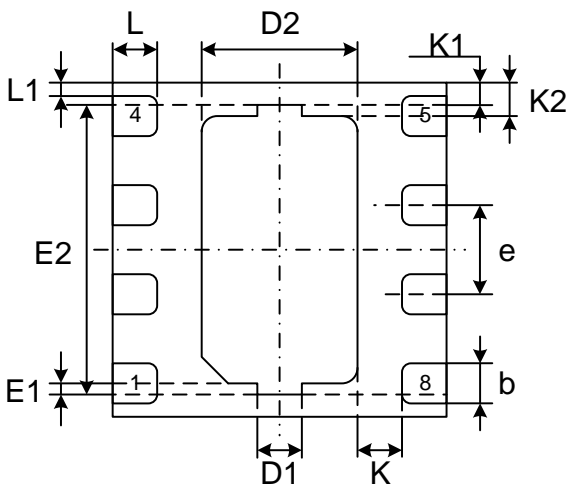


**10.2 Package USON8 (1.5x1.5mm)**



Top View

Side View



Bottom View

**Dimensions**

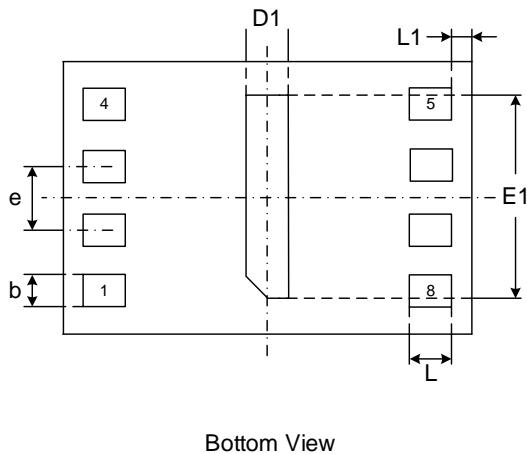
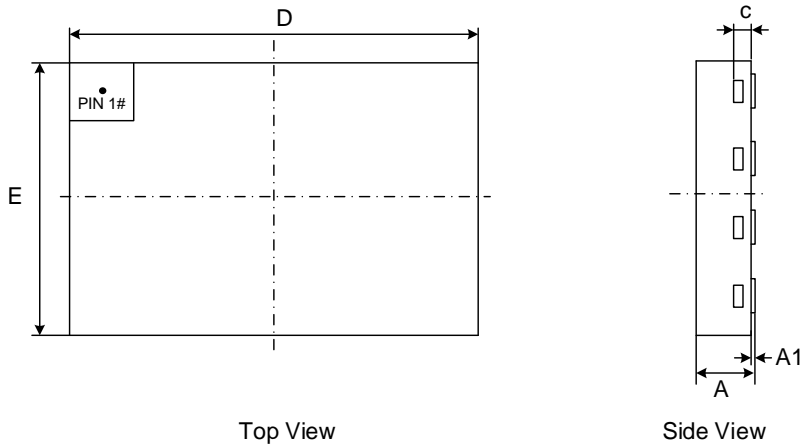
| Symbol | A   | A1   | A2   | A3   | b     | D    | E    | D1   | E1   | D2   | E2   | e    | L    | L1   | K    | K1   | K2   |      |     |      |      |     |      |     |     |     |     |
|--------|-----|------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|------|------|-----|------|-----|-----|-----|-----|
| Unit   |     |      |      |      |       |      |      |      |      |      |      |      |      |      |      |      |      |      |     |      |      |     |      |     |     |     |     |
| mm     | Min | 0.40 | 0.00 | 0.33 | 0.127 | 0.13 | 1.40 | 1.40 | 0.20 | 0.05 | 0.60 | 1.20 | 0.40 | 0.15 | 0.06 | 0.20 | 0.10 | 0.15 |     |      |      |     |      |     |     |     |     |
|        | Nom | 0.45 | 0.02 |      |       | REF  | REF  | 0.18 |      |      | 1.50 | 1.50 |      | REF  |      |      |      |      | REF | 0.70 | 1.30 | REF | 0.20 | REF | REF | REF | REF |
|        | Max | 0.50 | 0.05 |      |       | REF  | REF  | 0.25 |      |      | 1.60 | 1.60 |      | REF  |      |      |      |      | REF | 0.80 | 1.40 | REF | 0.25 | REF | REF | REF | REF |

Note:

1. The exposed metal pad area on the bottom of the package is not connected to any internal signal. It is OK to connect it to the system ground (GND) or leave it floating.
2. Coplanarity  $\leq 0.08\text{mm}$ . Package edge tolerance  $\leq 0.10\text{mm}$ .
3. The lead shape may be of little difference according to different package factories. These lead shapes are compatible with each other.



**10.3 Package USON8 (3x2mm)**



**Dimensions**

| Symbol |     | A    | A1   | c    | b    | D    | D1   | E    | E1   | e    | L    | L1   |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|
| Unit   |     |      |      |      |      |      |      |      |      |      |      |      |
| mm     | Min | 0.40 | 0.00 | 0.10 | 0.20 | 2.90 | 0.15 | 1.90 | 1.55 | 0.50 | 0.30 | 0.10 |
|        | Nom | 0.45 | 0.02 | 0.15 | 0.25 | 3.00 | 0.20 | 2.00 | 1.60 |      | 0.35 |      |
|        | Max | 0.50 | 0.05 | 0.20 | 0.30 | 3.10 | 0.25 | 2.10 | 1.65 |      | 0.40 |      |

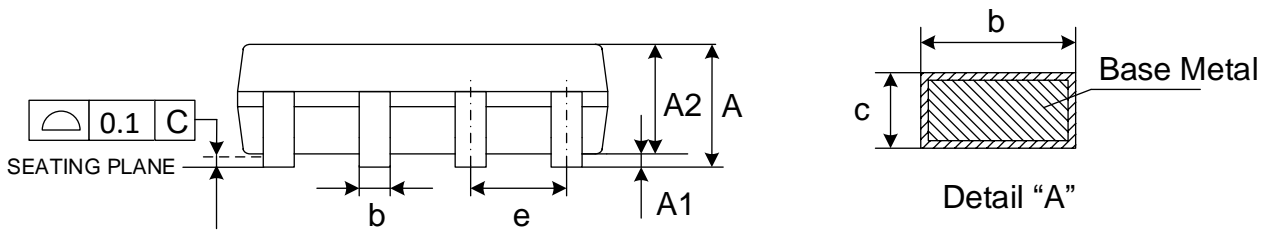
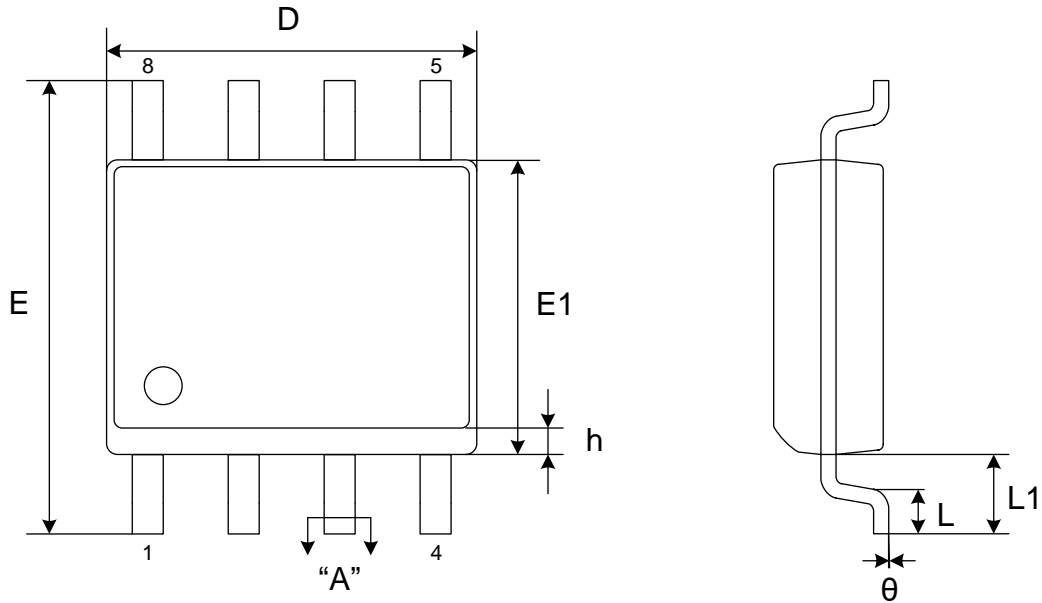
Note:

1. The exposed metal pad area on the bottom of the package is not connected to any internal signal. It is OK to connect it to the system ground (GND) or leave it floating.
2. Coplanarity  $\leq 0.08\text{mm}$ . Package edge tolerance  $\leq 0.10\text{mm}$ .
3. The lead shape may be of little difference according to different package factories. These lead shapes are compatible with each other.





**10.4 Package SOP8 150MIL**



**Dimensions**

| Symbol |     | A    | A1   | A2   | b    | c    | D    | E    | E1   | e    | L    | L1   | h    | $\theta$ |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|------|----------|
| Unit   |     |      |      |      |      |      |      |      |      |      |      |      |      |          |
| mm     | Min | -    | 0.10 | 1.25 | 0.31 | 0.10 | 4.80 | 5.80 | 3.80 | 1.27 | 0.40 | 1.04 | 0.25 | 0°       |
|        | Nom | -    | 0.15 | 1.45 | 0.41 | 0.20 | 4.90 | 6.00 | 3.90 |      | -    |      | -    |          |
|        | Max | 1.75 | 0.25 | 1.55 | 0.51 | 0.25 | 5.00 | 6.20 | 4.00 |      | 0.90 |      | 0.50 | 8°       |

Note:

- Both the package length and width do not include the mold flash.



## 11 REVISION HISTORY

| Version No | Description     | Page | Date       |
|------------|-----------------|------|------------|
| 1.0        | Initial release | All  | 2023-11-19 |



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