

# 4 Mbit (x16) Multi-Purpose Flash

## SST39WF400A



Data Sheet

### FEATURES:

- **Organized as 256K x16**
- **Single Voltage Read and Write Operations**
  - 1.65-1.95V
- **Superior Reliability**
  - Endurance: 100,000 Cycles (typical)
  - Greater than 100 years Data Retention
- **Low Power Consumption (typical values at 5 MHz)**
  - Active Current: 5 mA (typical)
  - Standby Current: 1  $\mu$ A (typical)
- **Sector-Erase Capability**
  - Uniform 2 KWord sectors
- **Block-Erase Capability**
  - Uniform 32 KWord blocks
- **Fast Read Access Time**
  - 90 ns
  - 100 ns
- **Latched Address and Data**
- **Fast Erase and Word-Program**
  - Sector-Erase Time: 36 ms (typical)
  - Block-Erase Time: 36 ms (typical)
  - Chip-Erase Time: 140 ms (typical)
  - Word-Program Time: 28  $\mu$ s (typical)
- **Automatic Write Timing**
  - Internal  $V_{PP}$  Generation
- **End-of-Write Detection**
  - Toggle Bit
  - Data# Polling
- **CMOS I/O Compatibility**
- **JEDEC Standard**
  - Flash EEPROM Pinouts and command sets
- **Packages Available**
  - 48-ball TFBGA (6mm x 8mm)
  - 48-ball WFBGA (4mm x 6mm) Micro-Package
  - 48-bump XFLGA (4mm x 6mm) Micro-Package

### PRODUCT DESCRIPTION

The SST39WF400A device is a 256K x16 CMOS Multi-Purpose Flash (MPF) manufactured with SST's proprietary, high performance CMOS SuperFlash technology. The split-gate cell design and thick-oxide tunneling injector attain better reliability and manufacturability compared with alternate approaches. The SST39WF400A writes (Program or Erase) with a 1.65-1.95V power supply. This device conforms to JEDEC standard pin assignments for x16 memories.

Featuring high-performance Word-Program, the SST39WF400A device provides a typical Word-Program time of 28  $\mu$ sec. The device uses Toggle Bit or Data# Polling to detect the completion of the Program or Erase operation. To protect against inadvertent writes, it has on-chip hardware and software data protection schemes. Designed, manufactured, and tested for a wide spectrum of applications, this device is offered with a guaranteed typical endurance of 100,000 cycles. Data retention is rated at greater than 100 years.

The SST39WF400A device is suited for applications that require convenient and economical updating of program, configuration, or data memory. For all system applications, it significantly improves performance and reliability, while lowering power consumption. It inherently uses less energy

during Erase and Program than alternative flash technologies. When programming a flash device, the total energy consumed is a function of the applied voltage, current, and time of application. Since for any given voltage range, the SuperFlash technology uses less current to program and has a shorter erase time, the total energy consumed during any Erase or Program operation is less than alternative flash technologies. These devices also improve flexibility while lowering the cost for program, data, and configuration storage applications.

The SuperFlash technology provides fixed Erase and Program times, independent of the number of Erase/Program cycles that have occurred. Therefore the system software or hardware does not have to be modified or de-rated as is necessary with alternative flash technologies, whose Erase and Program times increase with accumulated Erase/Program cycles.

To meet surface mount requirements, the SST39WF400A is offered in both a 48-ball TFBGA package and 48-ball Micro-Packages. See Figures 1 and 2 for pin assignments.



## Device Operation

Commands are used to initiate the memory operation functions of the device. Commands are written to the device using standard microprocessor write sequences. A command is written by asserting WE# low while keeping CE# low. The address bus is latched on the falling edge of WE# or CE#, whichever occurs last. The data bus is latched on the rising edge of WE# or CE#, whichever occurs first.

## Read

The Read operation of the SST39WF400A is controlled by CE# and OE#, both have to be low for the system to obtain data from the outputs. CE# is used for device selection. When CE# is high, the chip is deselected and only standby power is consumed. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when either CE# or OE# is high. Refer to the Read cycle timing diagram for further details (Figure 3).

## Word-Program Operation

The SST39WF400A is programmed on a word-by-word basis. Before programming, the sector where the word exists must be fully erased. The Program operation is accomplished in three steps. The first step is the three-byte load sequence for Software Data Protection. The second step is to load word address and word data. During the Word-Program operation, the addresses are latched on the falling edge of either CE# or WE#, whichever occurs last. The data is latched on the rising edge of either CE# or WE#, whichever occurs first. The third step is the internal Program operation which is initiated after the rising edge of the fourth WE# or CE#, whichever occurs first. The Program operation, once initiated, will be completed within 40  $\mu$ s. See Figures 4 and 5 for WE# and CE# controlled Program operation timing diagrams and Figure 16 for flowcharts. During the Program operation, the only valid reads are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. Any commands issued during the internal Program operation are ignored.

## Sector/Block-Erase Operation

The Sector- (or Block-) Erase operation allows the system to erase the device on a sector-by-sector (or block-by-block) basis. The SST39WF400A offers both Sector-Erase and Block-Erase mode. The sector architecture is based on uniform sector size of 2 KWord. The Block-Erase mode is based on uniform block size of 32 KWord. The Sector-Erase operation is initiated by executing a six-byte command sequence with Sector-Erase command (30H) and sector address (SA) in the last bus cycle. The Block-Erase

operation is initiated by executing a six-byte command sequence with Block-Erase command (50H) and block address (BA) in the last bus cycle. The sector or block address is latched on the falling edge of the sixth WE# pulse, while the command (30H or 50H) is latched on the rising edge of the sixth WE# pulse. The internal Erase operation begins after the sixth WE# pulse. The End-of-Erase operation can be determined using either Data# Polling or Toggle Bit methods. See Figures 9 and 10 for timing waveforms. Any commands issued during the Sector- or Block-Erase operation are ignored.

## Chip-Erase Operation

The SST39WF400A provides a Chip-Erase operation, which allows the user to erase the entire memory array to the "1" state. This is useful when the entire device must be quickly erased.

The Chip-Erase operation is initiated by executing a six-byte command sequence with Chip-Erase command (10H) at address 5555H in the last byte sequence. The Erase operation begins with the rising edge of the sixth WE# or CE#, whichever occurs first. During the Erase operation, the only valid read is Toggle Bit or Data# Polling. See Table 4 for the command sequence, Figure 8 for timing diagram, and Figure 19 for the flowchart. Any commands issued during the Chip-Erase operation are ignored.

## Write Operation Status Detection

The SST39WF400A provides two software means to detect the completion of a write (Program or Erase) cycle, in order to optimize the system write cycle time. The software detection includes two status bits: Data# Polling (DQ<sub>7</sub>) and Toggle Bit (DQ<sub>6</sub>). The End-of-Write detection mode is enabled after the rising edge of WE#, which initiates the internal Program or Erase operation.

The actual completion of the nonvolatile Write is asynchronous with the system; therefore, either a Data# Polling or Toggle Bit read may be simultaneous with the completion of the Write cycle. If this occurs, the system may possibly get an erroneous result, i.e., valid data may appear to conflict with either DQ<sub>7</sub> or DQ<sub>6</sub>. In order to prevent spurious rejection, if an erroneous result occurs, the software routine should include a loop to read the accessed location an additional two (2) times. If both Reads are valid, then the device has completed the Write cycle, otherwise the rejection is valid.



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### Data# Polling (DQ<sub>7</sub>)

When the SST39WF400A is in the internal Program operation, any attempt to read DQ<sub>7</sub> will produce the complement of the true data. Once the Program operation is completed, DQ<sub>7</sub> will produce true data. Note that even though DQ<sub>7</sub> may have valid data immediately following the completion of an internal Write operation, the remaining data outputs may still be invalid: valid data on the entire data bus will appear in subsequent successive Read cycles after an interval of 1  $\mu$ s. During internal Erase operation, any attempt to read DQ<sub>7</sub> will produce a '0'. Once the internal Erase operation is completed, DQ<sub>7</sub> will produce a '1'. The Data# Polling is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector-, Block- or Chip-Erase, the Data# Polling is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 6 for Data# Polling timing diagram and Figure 17 for a flowchart.

### Toggle Bit (DQ<sub>6</sub>)

During the internal Program or Erase operation, any consecutive attempts to read DQ<sub>6</sub> will produce alternating 1s and 0s, i.e., toggling between 1 and 0. When the internal Program or Erase operation is completed, the DQ<sub>6</sub> bit will stop toggling. The device is then ready for the next operation. The Toggle Bit is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector-, Block- or Chip-Erase, the Toggle Bit is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 7 for Toggle Bit timing diagram and Figure 17 for a flowchart.

### Data Protection

The SST39WF400A provides both hardware and software features to protect nonvolatile data from inadvertent writes.

#### Hardware Data Protection

Noise/Glitch Protection: A WE# or CE# pulse of less than 5 ns will not initiate a write cycle.

V<sub>DD</sub> Power Up/Down Detection: The Write operation is inhibited when V<sub>DD</sub> is less than 1.0V.

Write Inhibit Mode: Forcing OE# low, CE# high, or WE# high will inhibit the Write operation. This prevents inadvertent writes during power-up or power-down.

### Software Data Protection (SDP)

The SST39WF400A provides the JEDEC approved Software Data Protection scheme for all data alteration operations, i.e., Program and Erase. Any Program operation requires the inclusion of the three-byte sequence. The three-byte load sequence is used to initiate the Program operation, providing optimal protection from inadvertent Write operations, e.g., during the system power-up or power-down. Any Erase operation requires the inclusion of six-byte sequence. This group of devices are shipped with the Software Data Protection permanently enabled. See Table 4 for the specific software command codes. During SDP command sequence, invalid commands will abort the device to Read mode within T<sub>RC</sub>. The contents of DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, during any SDP command sequence.

### Common Flash Memory Interface (CFI)

The SST39WF400A also contains the CFI information to describe the characteristics of the device. In order to enter the CFI Query mode, the system must write three-byte sequence, same as Software ID Entry command with 98H (CFI Query command) to address 5555H in the last byte sequence. Once the device enters the CFI Query mode, the system can read CFI data at the addresses given in Tables 5 through 7. The system must write the CFI Exit command to return to Read mode from the CFI Query mode.



**Product Identification**

The Product Identification mode identifies the devices as the SST39WF400A and manufacturer as SST. This mode may be accessed by software operations. Users may use the Software Product Identification operation to identify the part (i.e., using the device ID) when using multiple manufacturers in the same socket. For details, see Table 4 for software operation, Figure 11 for the Software ID Entry and Read timing diagram, and Figure 18 for the Software ID Entry command sequence flowchart.

**TABLE 1: PRODUCT IDENTIFICATION TABLE**

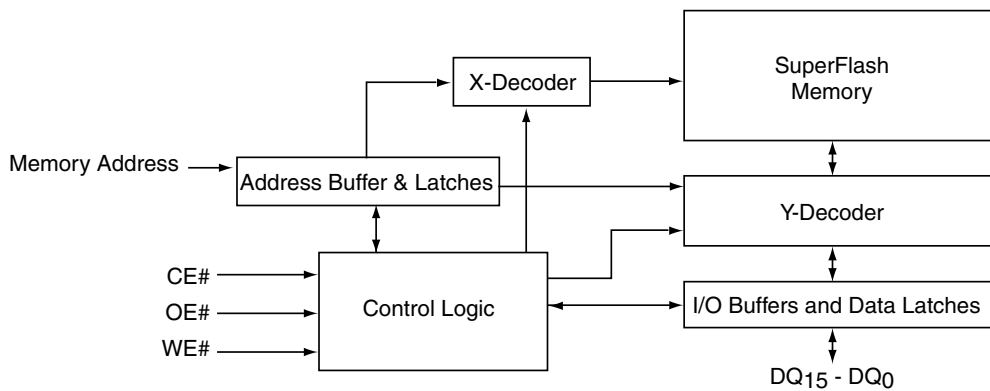
|                          | Address | Data  |
|--------------------------|---------|-------|
| Manufacturer's ID        | 0000H   | 00BFH |
| Device ID<br>SST39WF400A | 0001H   | 272FH |

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**Product Identification Mode Exit/  
CFI Mode Exit**

In order to return to the standard Read mode, the Software Product Identification mode must be exited. Exit is accomplished by issuing the Software ID Exit command sequence, which returns the device to the Read mode. This command may also be used to reset the device to the Read mode after any inadvertent transient condition that apparently causes the device to behave abnormally, e.g., not read correctly. Please note that the Software ID Exit/CFI Exit command is ignored during an internal Program or Erase operation. See Table 4 for software command codes, Figure 13 for timing waveform, and Figure 18 for a flowchart.

**FUNCTIONAL BLOCK DIAGRAM**



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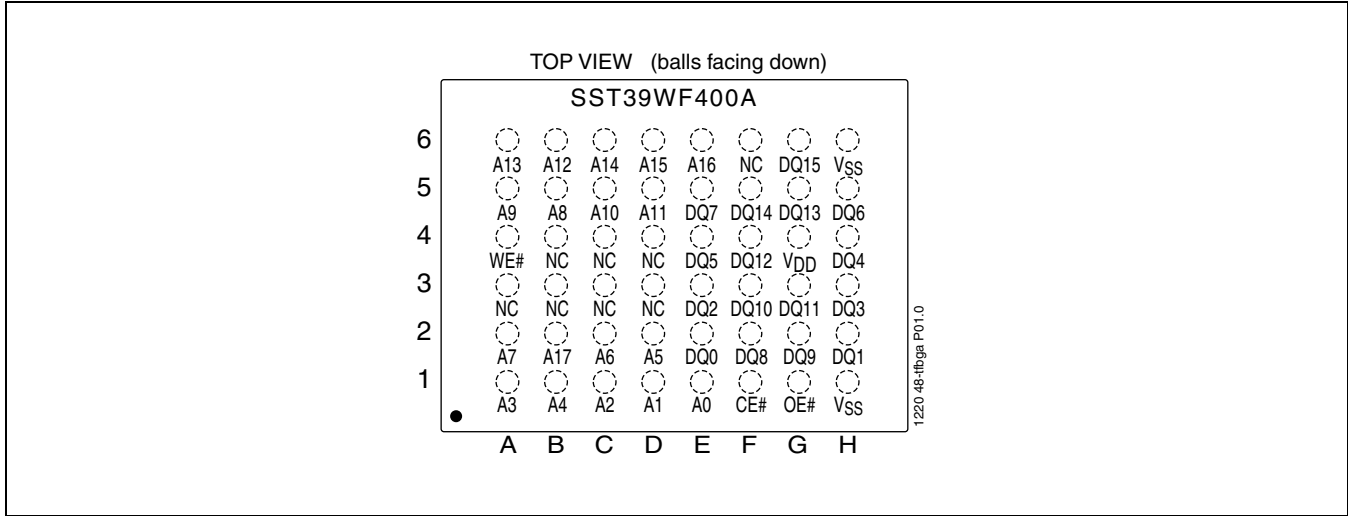


FIGURE 1: PIN ASSIGNMENTS FOR 48-BALL TFBGA

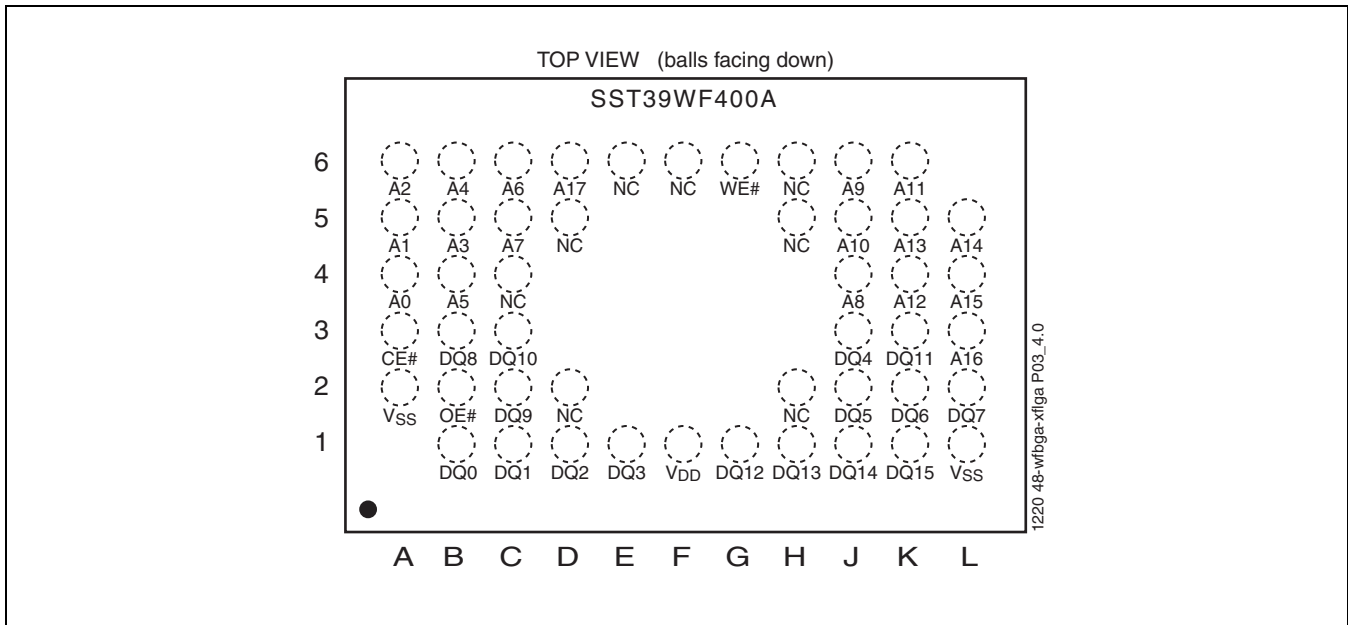


FIGURE 2: PIN ASSIGNMENTS FOR 48-BALL WFBGA AND 48-BUMP XFLGA



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**TABLE 2: PIN DESCRIPTION**

| Symbol         | Pin Name          | Functions  |
|----------------|-------------------|--|
| $A_{MS}^1-A_0$ | Address Inputs    | To provide memory addresses. During Sector-Erase $A_{MS}-A_{11}$ address lines will select the sector. During Block-Erase $A_{MS}-A_{15}$ address lines will select the block.       |
| $DQ_{15}-DQ_0$ | Data Input/output | To output data during Read cycles and receive input data during Write cycles. Data is internally latched during a Write cycle. The outputs are in tri-state when OE# or CE# is high. |
| CE#            | Chip Enable       | To activate the device when CE# is low.  |
| OE#            | Output Enable     | To gate the data output buffers.   |
| WE#            | Write Enable      | To control the Write operations.   |
| $V_{DD}$       | Power Supply      | To provide power supply voltage: 1.65-1.95V for SST39WF400A  |
| $V_{SS}$       | Ground            |  |
| NC             | No Connection     | Unconnected pins.  |

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1.  $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A

**TABLE 3: OPERATION MODES SELECTION**

| Mode                   | CE#      | OE#      | WE#      | DQ                | Address                                     |
|------------------------|----------|----------|----------|-------------------|---|
| Read                   | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ | $D_{OUT}$         | $A_{IN}$                                    |
| Program                | $V_{IL}$ | $V_{IH}$ | $V_{IL}$ | $D_{IN}$          | $A_{IN}$                                    |
| Erase                  | $V_{IL}$ | $V_{IH}$ | $V_{IL}$ | $X^1$             | Sector or Block address, XXH for Chip-Erase |
| Standby                | $V_{IH}$ | X        | X        | High Z            | X   |
| Write Inhibit          | X        | $V_{IL}$ | X        | High Z/ $D_{OUT}$ | X   |
|                        | X        | X        | $V_{IH}$ | High Z/ $D_{OUT}$ | X   |
| Product Identification |          |          |          |                   |   |
| Software Mode          | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ |                   | See Table 4                                 |

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1. X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

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**TABLE 4: SOFTWARE COMMAND SEQUENCE**

| Command Sequence                            | 1st Bus Write Cycle |                   | 2nd Bus Write Cycle |                   | 3rd Bus Write Cycle |                   | 4th Bus Write Cycle |                   | 5th Bus Write Cycle |                   | 6th Bus Write Cycle          |                   |
|---|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|------------------------------|-------------------|
|   | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>            | Data <sup>2</sup> |
| Word-Program                                | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | A0H               | WA <sup>3</sup>     | Data              |                     |                   |                              |                   |
| Sector-Erase                                | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | SA <sub>X</sub> <sup>4</sup> | 30H               |
| Block-Erase                                 | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | BA <sub>X</sub> <sup>4</sup> | 50H               |
| Chip-Erase                                  | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | 5555H                        | 10H               |
| Software ID Entry <sup>5,6</sup>            | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 90H               |                     |                   |                     |                   |                              |                   |
| CFI Query Entry <sup>5</sup>                | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 98H               |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>7</sup> /<br>CFI Exit | XXH                 | F0H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>7</sup> /<br>CFI Exit | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | F0H               |                     |                   |                     |                   |                              |                   |

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- Address format A<sub>14</sub>-A<sub>0</sub> (Hex), Addresses A<sub>MS</sub>-A<sub>15</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the Command sequence.  
A<sub>MS</sub> = Most significant address  
A<sub>MS</sub> = A<sub>17</sub> for SST39WF400A
- DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the Command sequence
- WA = Program word address
- SA<sub>X</sub> for Sector-Erase; uses A<sub>MS</sub>-A<sub>11</sub> address lines  
BA<sub>X</sub> for Block-Erase; uses A<sub>MS</sub>-A<sub>15</sub> address lines
- The device does not remain in Software Product ID mode if powered down.
- With A<sub>MS</sub>-A<sub>1</sub> = 0; SST Manufacturer's ID = 00BFH, is read with A<sub>0</sub> = 0,  
SST39WF400A Device ID = 272FH, is read with A<sub>0</sub> = 1.
- Both Software ID Exit operations are equivalent

**TABLE 5: CFI QUERY IDENTIFICATION STRING<sup>1</sup> FOR SST39WF400A**

| Address | Data  | Data   |
|---------|-------|--|
| 10H     | 0051H | Query Unique ASCII string "QRY"                              |
| 11H     | 0052H |  |
| 12H     | 0059H |  |
| 13H     | 0001H | Primary OEM command set                                      |
| 14H     | 0007H |  |
| 15H     | 0000H | Address for Primary Extended Table                           |
| 16H     | 0000H |  |
| 17H     | 0000H | Alternate OEM command set (00H = none exists)                |
| 18H     | 0000H |  |
| 19H     | 0000H | Address for Alternate OEM extended Table (00H = none exists) |
| 1AH     | 0000H |  |

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- Refer to CFI publication 100 for more details.



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**TABLE 6: SYSTEM INTERFACE INFORMATION FOR SST39WF400A**

| Address | Data  | Data   |
|---------|-------|--|
| 1BH     | 0016H | V <sub>DD</sub> Min (Program/Erase)<br>DQ <sub>7</sub> -DQ <sub>4</sub> : Volts, DQ <sub>3</sub> -DQ <sub>0</sub> : 100 millivolts |
| 1CH     | 0020H | V <sub>DD</sub> Max (Program/Erase)<br>DQ <sub>7</sub> -DQ <sub>4</sub> : Volts, DQ <sub>3</sub> -DQ <sub>0</sub> : 100 millivolts |
| 1DH     | 0000H | V <sub>PP</sub> min (00H = no V <sub>PP</sub> pin)   |
| 1EH     | 0000H | V <sub>PP</sub> max (00H = no V <sub>PP</sub> pin)   |
| 1FH     | 0005H | Typical time out for Word-Program 2 <sup>N</sup> μs (2 <sup>5</sup> = 32 μs)   |
| 20H     | 0000H | Typical time out for min size buffer program 2 <sup>N</sup> μs (00H = not supported)   |
| 21H     | 0005H | Typical time out for individual Sector/Block-Erase 2 <sup>N</sup> ms (2 <sup>5</sup> = 32 ms)                                      |
| 22H     | 0007H | Typical time out for Chip-Erase 2 <sup>N</sup> ms (2 <sup>7</sup> = 128 ms)  |
| 23H     | 0001H | Maximum time out for Word-Program 2 <sup>N</sup> times typical (2 <sup>1</sup> x 2 <sup>5</sup> = 64 μs)                           |
| 24H     | 0000H | Maximum time out for buffer program 2 <sup>N</sup> times typical   |
| 25H     | 0001H | Maximum time out for individual Sector/Block-Erase 2 <sup>N</sup> times typical (2 <sup>1</sup> x 2 <sup>5</sup> = 64 ms)          |
| 26H     | 0001H | Maximum time out for Chip-Erase 2 <sup>N</sup> times typical (2 <sup>1</sup> x 2 <sup>7</sup> = 256 ms)                            |

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**TABLE 7: DEVICE GEOMETRY INFORMATION FOR SST39WF400A**

| Address | Data  | Data  |
|---------|-------|---|
| 27H     | 0013H | Device size = 2 <sup>N</sup> Byte (13H = 19; 2 <sup>19</sup> = 512 KByte)   |
| 28H     | 0001H | Flash Device Interface description; 0001H = x16-only asynchronous interface   |
| 29H     | 0000H |   |
| 2AH     | 0000H | Maximum number of byte in multi-byte write = 2 <sup>N</sup> (00H = not supported)   |
| 2BH     | 0000H |   |
| 2CH     | 0002H | Number of Erase Sector/Block sizes supported by device  |
| 2DH     | 007FH | Sector Information (y + 1 = Number of sectors; z x 256B = sector size)<br>y = 127 + 1 = 128 sectors (007FH = 127)<br>z = 16 x 256 Bytes = 4 KByte/sector (0010H = 16) |
| 2EH     | 0000H |   |
| 2FH     | 0010H |   |
| 30H     | 0000H |   |
| 31H     | 0007H | Block Information (y + 1 = Number of blocks; z x 256B = block size)<br>y = 7 + 1 = 8 blocks (0007H = 7)<br>z = 256 x 256 Bytes = 64 KByte/block (0100H = 256)         |
| 32H     | 0000H |   |
| 33H     | 0000H |   |
| 34H     | 0001H |   |

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**Absolute Maximum Stress Ratings** (Applied conditions greater than those listed under “Absolute Maximum Stress Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions or conditions greater than those defined in the operational sections of this data sheet is not implied. Exposure to absolute maximum stress rating conditions may affect device reliability.)

|   |                        |
|---|------------------------|
| Temperature Under Bias .....                                    | -55°C to +125°C        |
| Storage Temperature .....                                       | -65°C to +150°C        |
| D. C. Voltage on Any Pin to Ground Potential .....              | -0.5V to $V_{DD}+0.5V$ |
| Transient Voltage (<20 ns) on Any Pin to Ground Potential ..... | -2.0V to $V_{DD}+2.0V$ |
| Voltage on A <sub>9</sub> Pin to Ground Potential .....         | -0.5V to 11V           |
| Package Power Dissipation Capability (Ta = 25°C) .....          | 1.0W                   |
| Surface Mount Lead Soldering Temperature (3 Seconds) .....      | 240°C                  |
| Output Short Circuit Current <sup>1</sup> .....                 | 50 mA                  |

1. Outputs shorted for no more than one second. No more than one output shorted at a time.

### OPERATING RANGE

| Range      | Ambient Temp   | V <sub>DD</sub> |
|------------|----------------|-----------------|
| Commercial | 0°C to +70°C   | 1.65-1.95V      |
| Industrial | -40°C to +85°C | 1.65-1.95V      |

### AC CONDITIONS OF TEST

|                            |                        |
|----------------------------|------------------------|
| Input Rise/Fall Time ..... | 5 ns                   |
| Output Load .....          | C <sub>L</sub> = 30 pF |
| See Figures 14 and 15      |                        |



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**TABLE 8: DC OPERATING CHARACTERISTICS  $V_{DD} = 1.65\text{-}1.95\text{V}^1$**

| Symbol   | Parameter                | Limits       |             |               | Test Conditions   |
|----------|--------------------------|--------------|-------------|---------------|---|
|          |                          | Min          | Max         | Units         |   |
| $I_{DD}$ | Power Supply Current     |              |             |               | Address input= $V_{ILT}/V_{IHT}$ , at $f=5$ MHz,<br>$V_{DD}=V_{DD}$ Max<br>CE#= $V_{IL}$ , OE#= $WE\#=V_{IH}$ , all I/Os open<br>CE#= $WE\#=V_{IL}$ , OE#= $V_{IH}$ |
|          | Read                     |              | 15          | mA            |   |
|          | Program and Erase        |              | 20          | mA            |   |
| $I_{SB}$ | Standby $V_{DD}$ Current |              | 5           | $\mu\text{A}$ | CE#= $V_{DD}$ , $V_{DD}=V_{DD}$ Max   |
| $I_{LI}$ | Input Leakage Current    |              | 1           | $\mu\text{A}$ | $V_{IN}=\text{GND to } V_{DD}$ , $V_{DD}=V_{DD}$ Max  |
| $I_{LO}$ | Output Leakage Current   |              | 1           | $\mu\text{A}$ | $V_{OUT}=\text{GND to } V_{DD}$ , $V_{DD}=V_{DD}$ Max   |
| $V_{IL}$ | Input Low Voltage        |              | $0.2V_{DD}$ |               | $V_{DD}=V_{DD}$ Min   |
| $V_{IH}$ | Input High Voltage       | $0.8V_{DD}$  |             | V             | $V_{DD}=V_{DD}$ Max   |
| $V_{OL}$ | Output Low Voltage       |              | 0.1         | V             | $I_{OL}=100 \mu\text{A}$ , $V_{DD}=V_{DD}$ Min  |
| $V_{OH}$ | Output High Voltage      | $V_{DD}-0.1$ |             | V             | $I_{OH}=-100 \mu\text{A}$ , $V_{DD}=V_{DD}$ Min   |

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1. Typical conditions for the Active Current shown on the front page of the data sheet are average values at  $25^\circ\text{C}$  (room temperature), and  $V_{DD} = 1.8\text{V}$ . Not 100% tested.

**TABLE 9: RECOMMENDED SYSTEM POWER-UP TIMINGS**

| Symbol           | Parameter                           | Minimum | Units         |
|------------------|-------------------------------------|---------|---------------|
| $T_{PU-READ}^1$  | Power-up to Read Operation          | 100     | $\mu\text{s}$ |
| $T_{PU-WRITE}^1$ | Power-up to Program/Erase Operation | 100     | $\mu\text{s}$ |

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1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 10: CAPACITANCE ( $T_a = 25^\circ\text{C}$ ,  $f=1$  MHz, other pins open)**

| Parameter   | Description         | Test Condition        | Maximum |
|-------------|---------------------|-----------------------|---------|
| $C_{I/O}^1$ | I/O Pin Capacitance | $V_{I/O} = 0\text{V}$ | 12 pF   |
| $C_{IN}^1$  | Input Capacitance   | $V_{IN} = 0\text{V}$  | 6 pF    |

T10.0 1220

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**TABLE 11: RELIABILITY CHARACTERISTICS**

| Symbol          | Parameter      | Minimum Specification | Units  | Test Method         |
|-----------------|----------------|-----------------------|--------|---------------------|
| $N_{END}^{1,2}$ | Endurance      | 10,000                | Cycles | JEDEC Standard A117 |
| $T_{DR}^1$      | Data Retention | 100                   | Years  | JEDEC Standard A103 |
| $I_{LTH}^1$     | Latch Up       | $100 + I_{DD}$        | mA     | JEDEC Standard 78   |

T11.0 1220

1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.
2.  $N_{END}$  endurance rating is qualified as a 10,000 cycle minimum for the whole device. A sector- or block-level rating would result in a higher minimum specification.



AC CHARACTERISTICS

TABLE 12: READ CYCLE TIMING PARAMETERS

V<sub>DD</sub> = 1.70-1.95V FOR 90 NS<sup>1</sup>

V<sub>DD</sub> = 1.65-1.95V FOR 100 NS

| Symbol                        | Parameter                       | SST39WF400A-90 |     | SST39WF400A-100 |     | Units |
|-------------------------------|---------------------------------|----------------|-----|-----------------|-----|-------|
|                               |                                 | Min            | Max | Min             | Max |       |
| T <sub>RC</sub>               | Read Cycle Time                 | 90             |     | 100             |     | ns    |
| T <sub>CE</sub>               | Chip Enable Access Time         |                | 90  |                 | 100 | ns    |
| T <sub>AA</sub>               | Address Access Time             |                | 90  |                 | 100 | ns    |
| T <sub>OE</sub>               | Output Enable Access Time       |                | 50  |                 | 50  | ns    |
| T <sub>CLZ</sub> <sup>2</sup> | CE# Low to Active Output        | 0              |     | 0               |     | ns    |
| T <sub>OLZ</sub> <sup>2</sup> | OE# Low to Active Output        | 0              |     | 0               |     | ns    |
| T <sub>CHZ</sub> <sup>2</sup> | CE# High to High-Z Output       |                | 40  |                 | 40  | ns    |
| T <sub>OHZ</sub> <sup>2</sup> | OE# High to High-Z Output       |                | 40  |                 | 40  | ns    |
| T <sub>OH</sub> <sup>2</sup>  | Output Hold from Address Change | 0              |     | 0               |     | ns    |

T12.2 1220

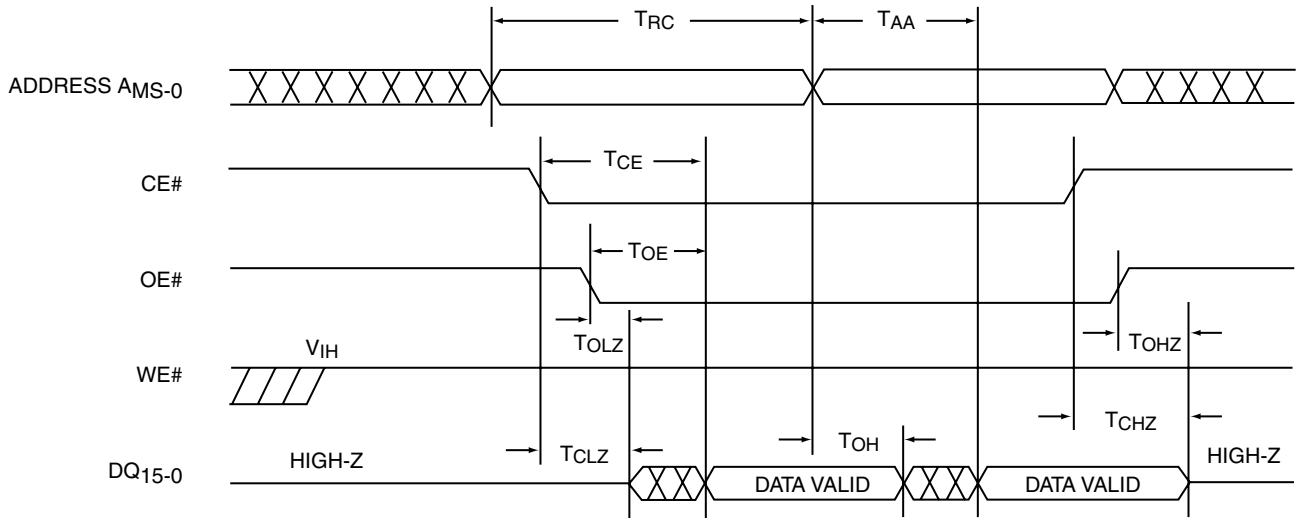
1. 90 ns parts will ONLY support voltage range 1.70-1.95V.
2. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

TABLE 13: PROGRAM/ERASE CYCLE TIMING PARAMETERS

| Symbol                        | Parameter                        | Min | Max | Units |
|-------------------------------|----------------------------------|-----|-----|-------|
| T <sub>BP</sub>               | Word-Program Time                |     | 40  | μs    |
| T <sub>AS</sub>               | Address Setup Time               | 0   |     | ns    |
| T <sub>AH</sub>               | Address Hold Time                | 50  |     | ns    |
| T <sub>CS</sub>               | WE# and CE# Setup Time           | 0   |     | ns    |
| T <sub>CH</sub>               | WE# and CE# Hold Time            | 0   |     | ns    |
| T <sub>OES</sub>              | OE# High Setup Time              | 0   |     | ns    |
| T <sub>OEH</sub>              | OE# High Hold Time               | 10  |     | ns    |
| T <sub>CP</sub>               | CE# Pulse Width                  | 50  |     | ns    |
| T <sub>WP</sub>               | WE# Pulse Width                  | 50  |     | ns    |
| T <sub>WPH</sub> <sup>1</sup> | WE# Pulse Width High             | 30  |     | ns    |
| T <sub>CPH</sub> <sup>1</sup> | CE# Pulse Width High             | 30  |     | ns    |
| T <sub>DS</sub>               | Data Setup Time                  | 50  |     | ns    |
| T <sub>DH</sub> <sup>1</sup>  | Data Hold Time                   | 0   |     | ns    |
| T <sub>IDA</sub> <sup>1</sup> | Software ID Access and Exit Time |     | 150 | ns    |
| T <sub>SE</sub>               | Sector-Erase                     |     | 50  | ms    |
| T <sub>BE</sub>               | Block-Erase                      |     | 50  | ms    |
| T <sub>SCE</sub>              | Chip-Erase                       |     | 200 | ms    |

T13.0 1220

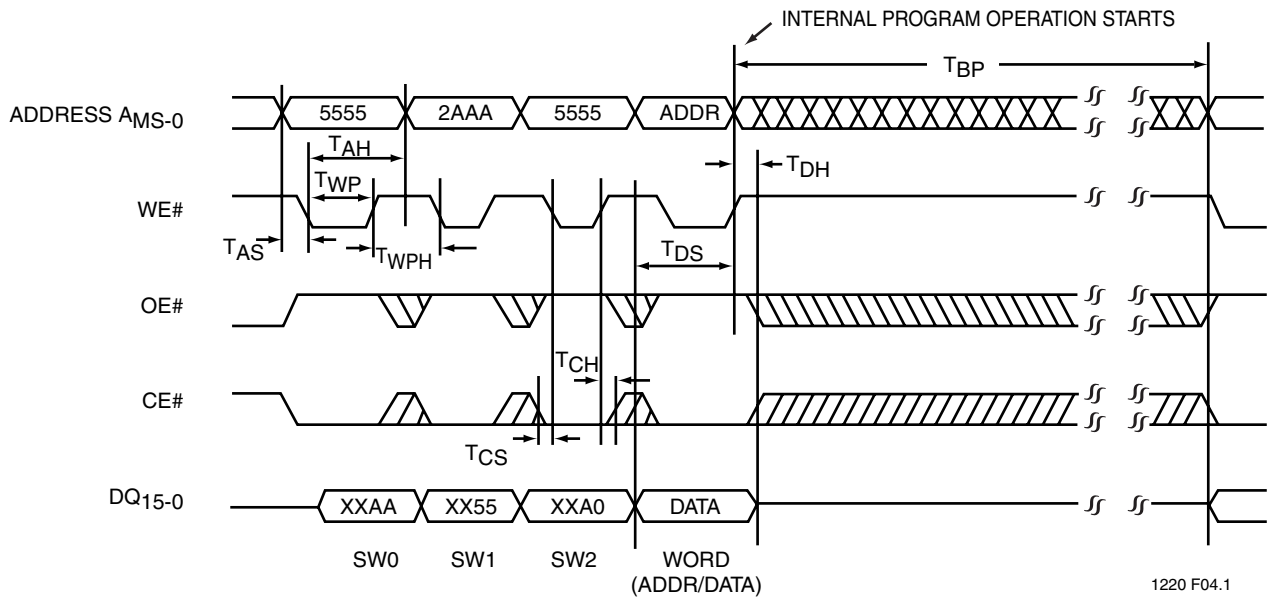
1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.



1220 F03.1

**Note:**  $A_{MS}$  = Most significant address  
 $A_{MS}$  =  $A_{17}$  for SST39WF400A

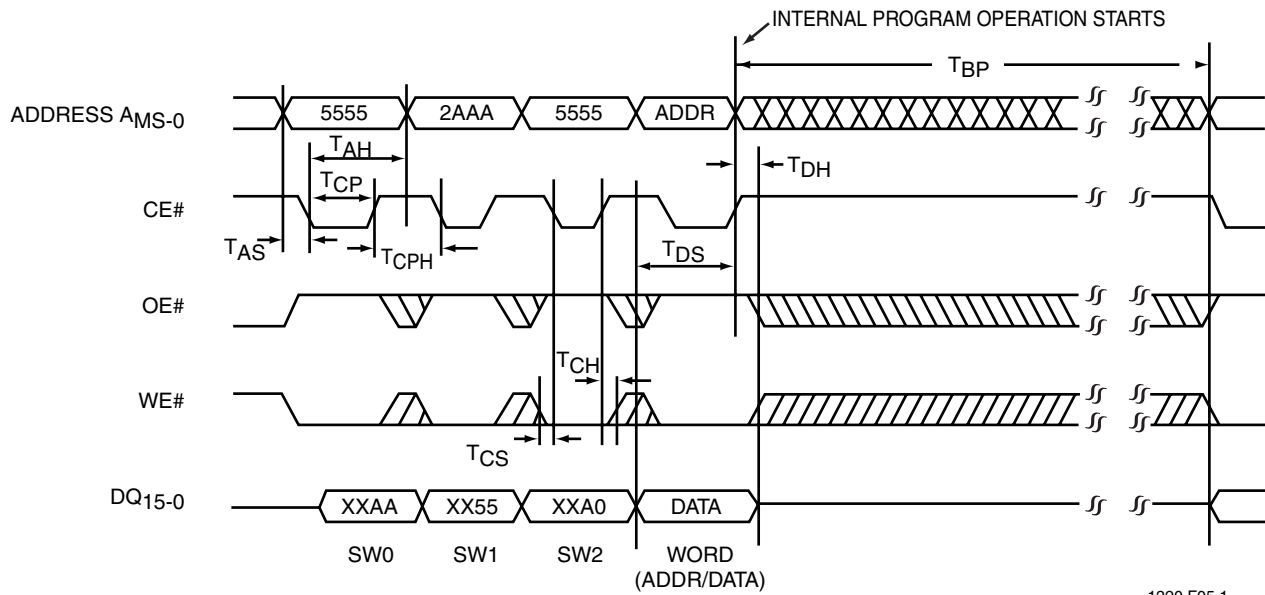
FIGURE 3: READ CYCLE TIMING DIAGRAM



1220 F04.1

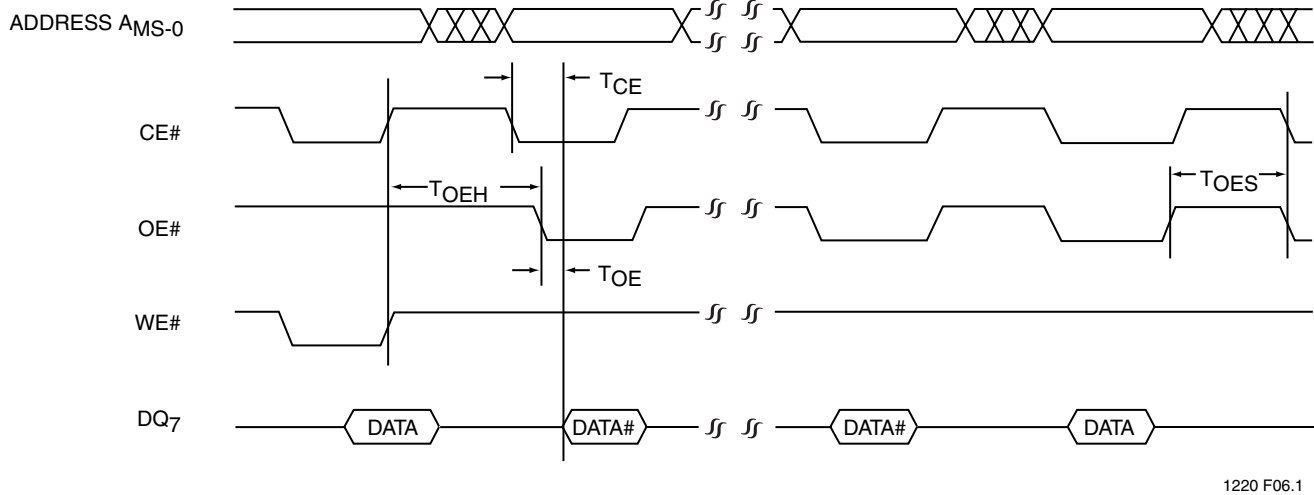
**Note:**  $A_{MS}$  = Most significant address  
 $A_{MS}$  =  $A_{17}$  for SST39WF400A  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

FIGURE 4: WE# CONTROLLED PROGRAM CYCLE TIMING DIAGRAM



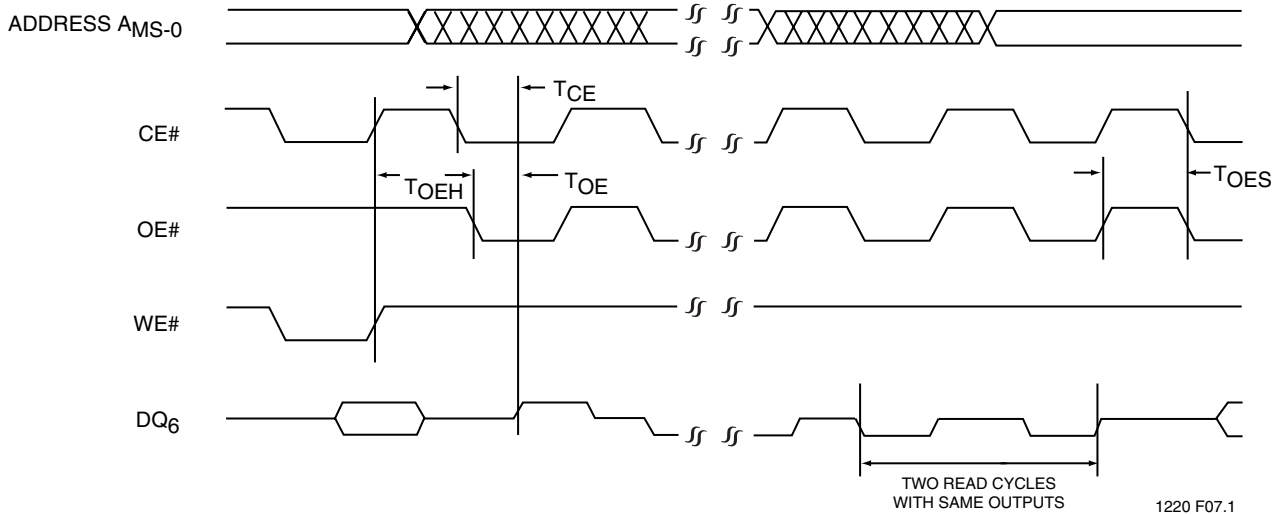
**Note:**  $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 5: CE# CONTROLLED PROGRAM CYCLE TIMING DIAGRAM**



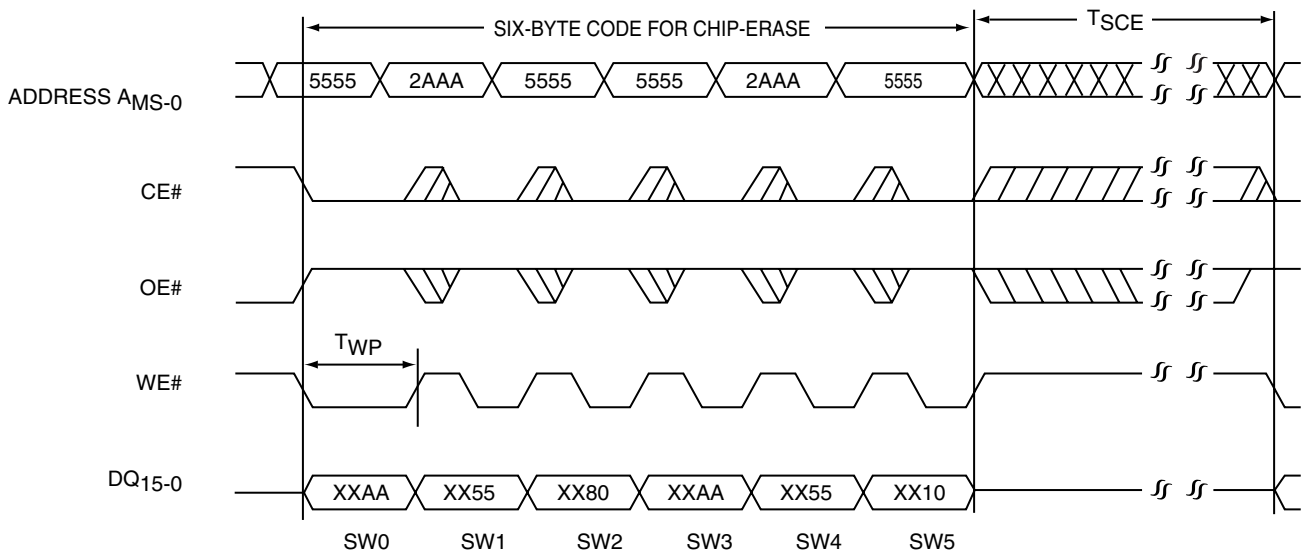
**Note:**  $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A

**FIGURE 6: DATA# POLLING TIMING DIAGRAM**



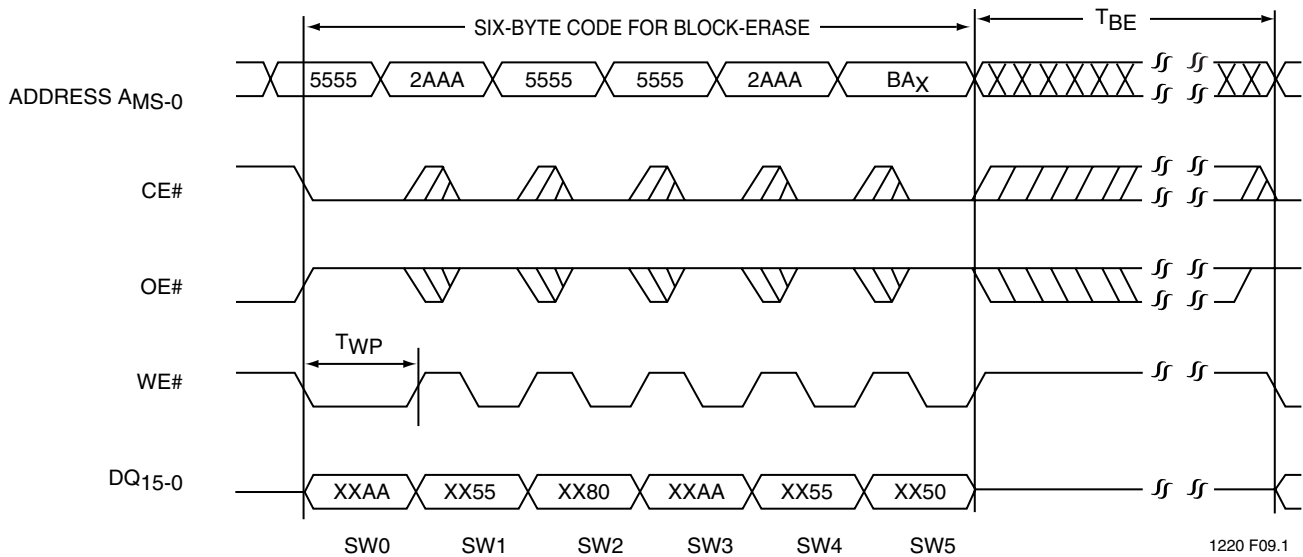
**Note:**  $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A

FIGURE 7: TOGGLE BIT TIMING DIAGRAM



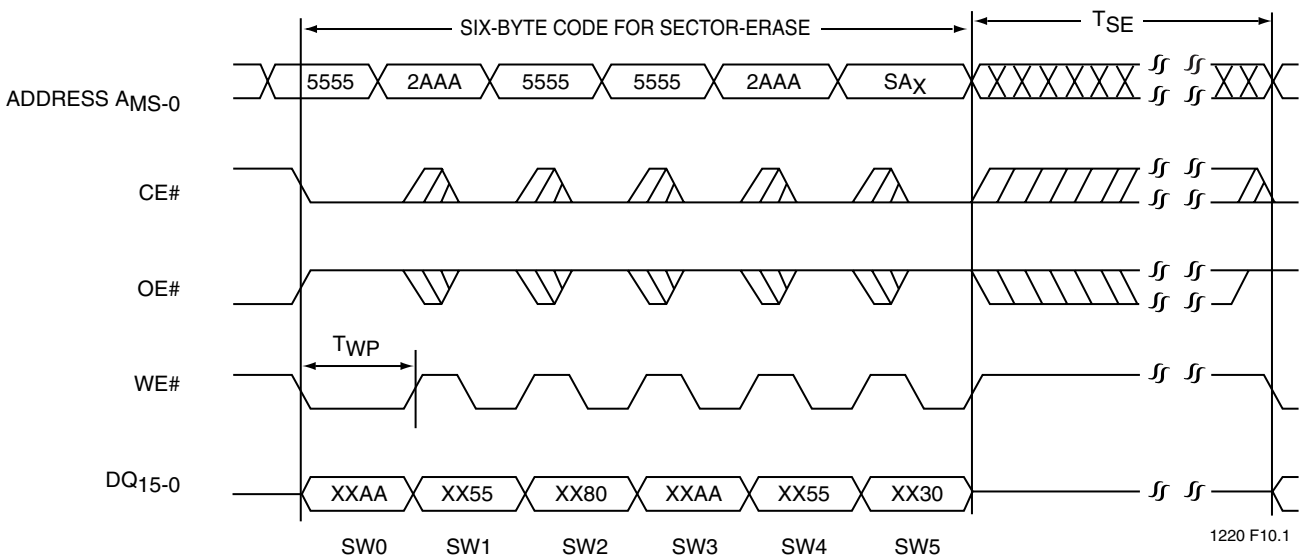
**Note:** This device also supports CE# controlled Chip-Erase operation. The WE# and CE# signals are interchangeable as long as minimum timings are met. (See Table 13)  
 $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A  
X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

FIGURE 8: WE# CONTROLLED CHIP-ERASE TIMING DIAGRAM



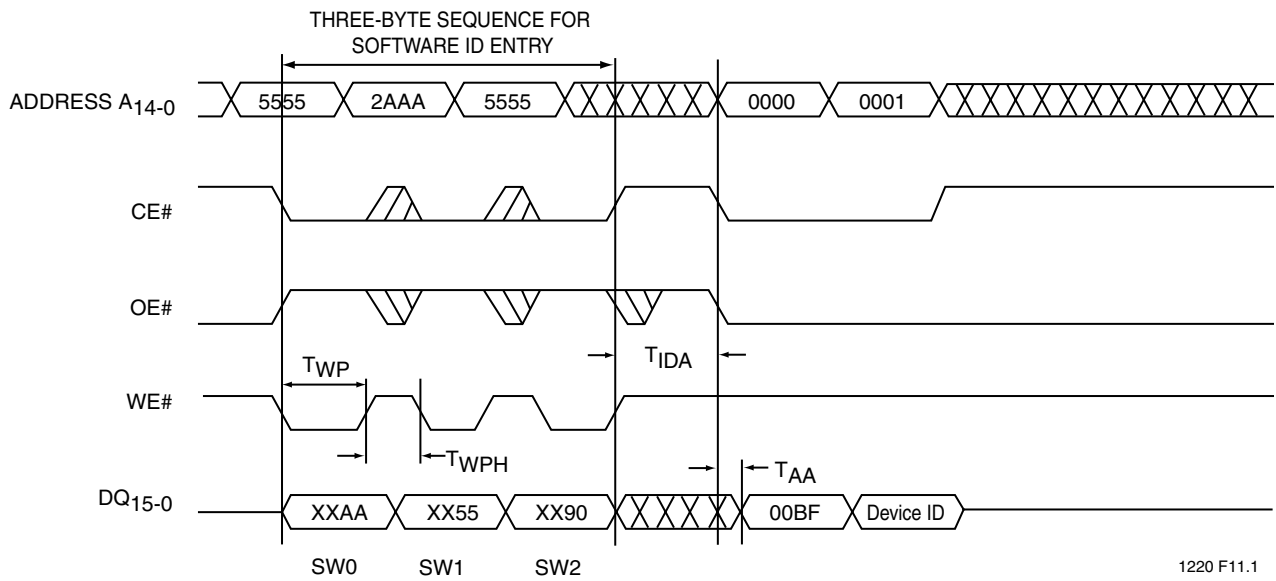
**Note:** This device also supports CE# controlled Block-Erase operation. The WE# and CE# signals are interchangeable as long as minimum timings are met. (See Table 13)  
 $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 9: WE# CONTROLLED BLOCK-ERASE TIMING DIAGRAM**



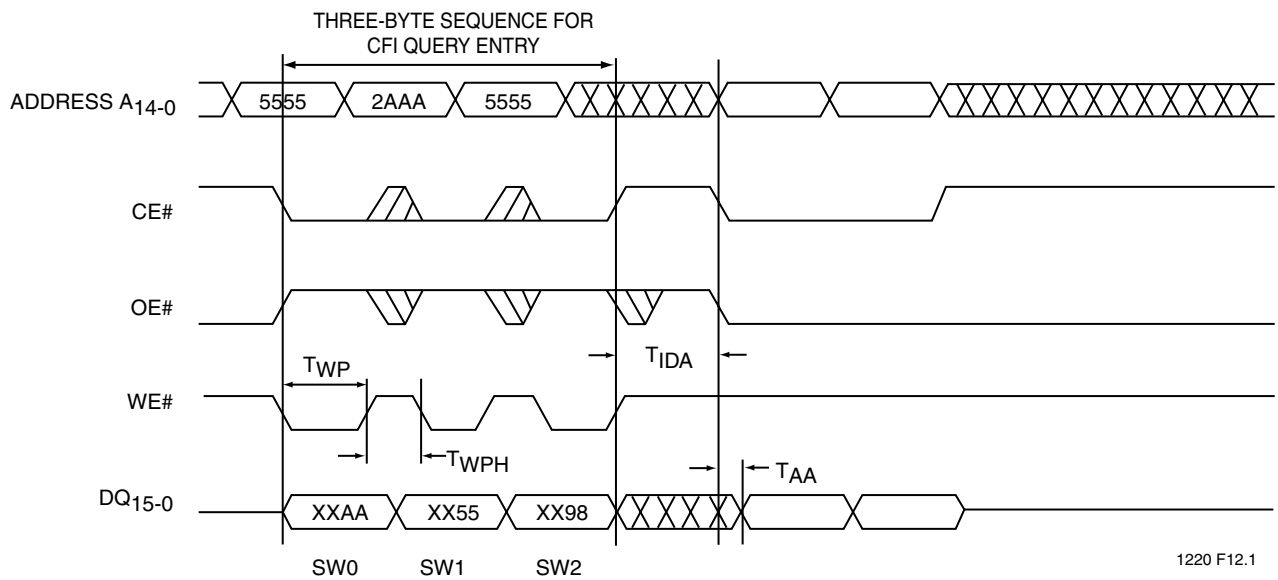
**Note:** This device also supports CE# controlled Sector-Erase operation. The WE# and CE# signals are interchangeable as long as minimum timings are met. (See Table 13)  
 $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400A  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 10: WE# CONTROLLED SECTOR-ERASE TIMING DIAGRAM**



**Note:** Device ID = 272FH for SST39WF400A  
X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

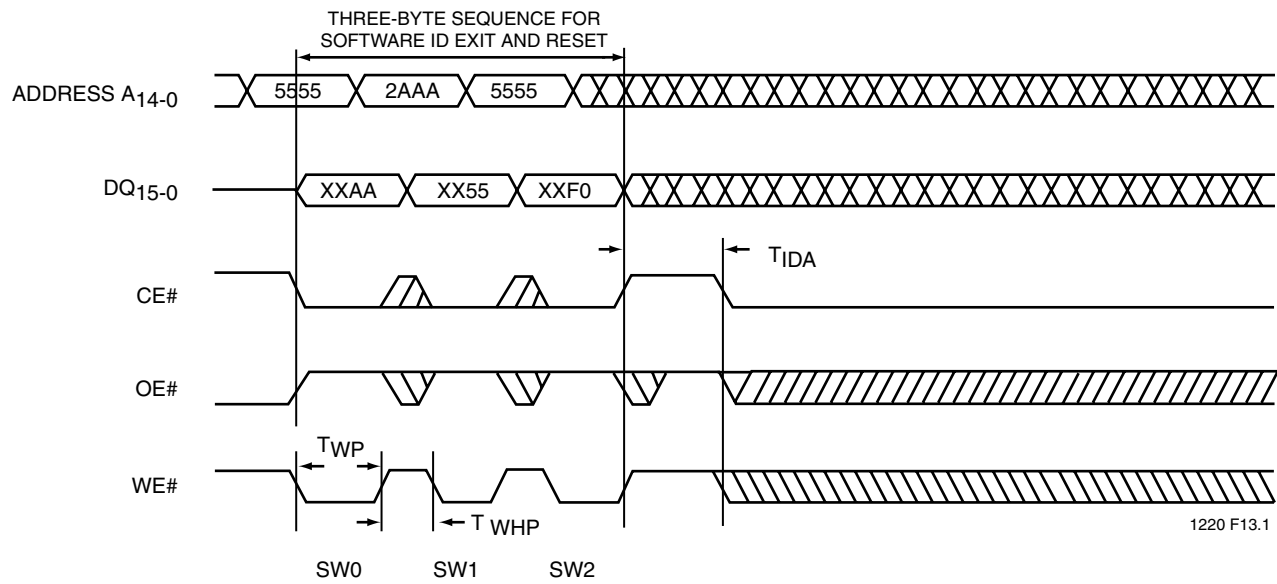
**FIGURE 11: SOFTWARE ID ENTRY AND READ**



**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

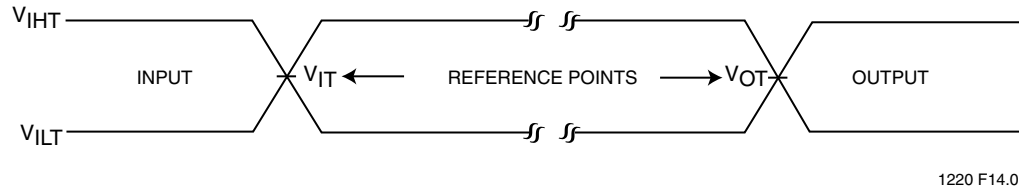
**FIGURE 12: CFI QUERY ENTRY AND READ**





**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

**FIGURE 13: SOFTWARE ID EXIT/CFI EXIT**

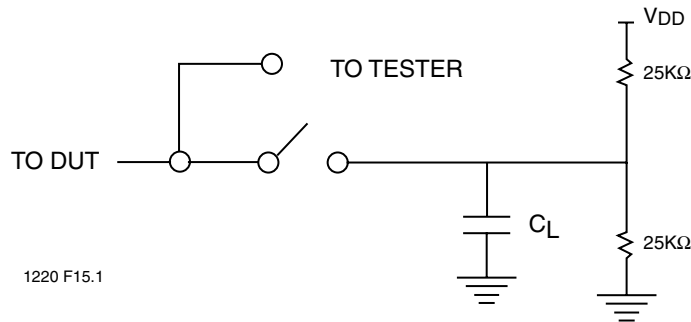


1220 F14.0

AC test inputs are driven at  $V_{IHT}$  ( $V_{DD}$ ) for a logic "1" and  $V_{ILT}$  ( $V_{SS}$ ) for a logic "0". Measurement reference points for inputs and outputs are  $V_{IT}$  ( $0.5 V_{DD}$ ) and  $V_{OT}$  ( $0.5 V_{DD}$ ). Input rise and fall times are (10%  $\leftrightarrow$  90%)  $< 5$  ns.

**Note:**  $V_{IT}$  -  $V_{INPUT}$  Test  
 $V_{OT}$  -  $V_{OUTPUT}$  Test  
 $V_{IHT}$  -  $V_{INPUT}$  HIGH Test  
 $V_{ILT}$  -  $V_{INPUT}$  LOW Test

FIGURE 14: AC INPUT/OUTPUT REFERENCE WAVEFORMS



1220 F15.1

FIGURE 15: A TEST LOAD EXAMPLE

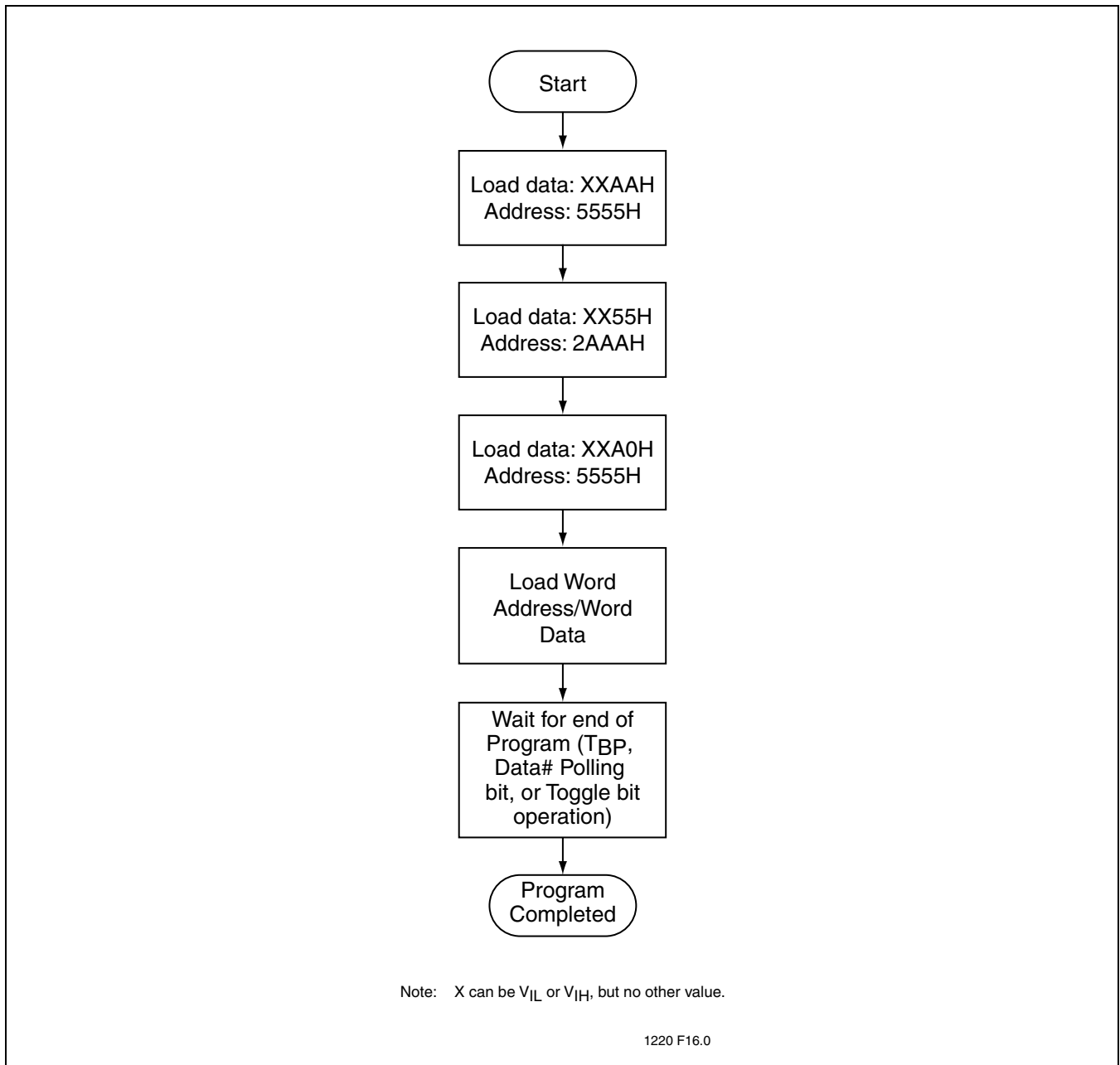


FIGURE 16: WORD-PROGRAM ALGORITHM

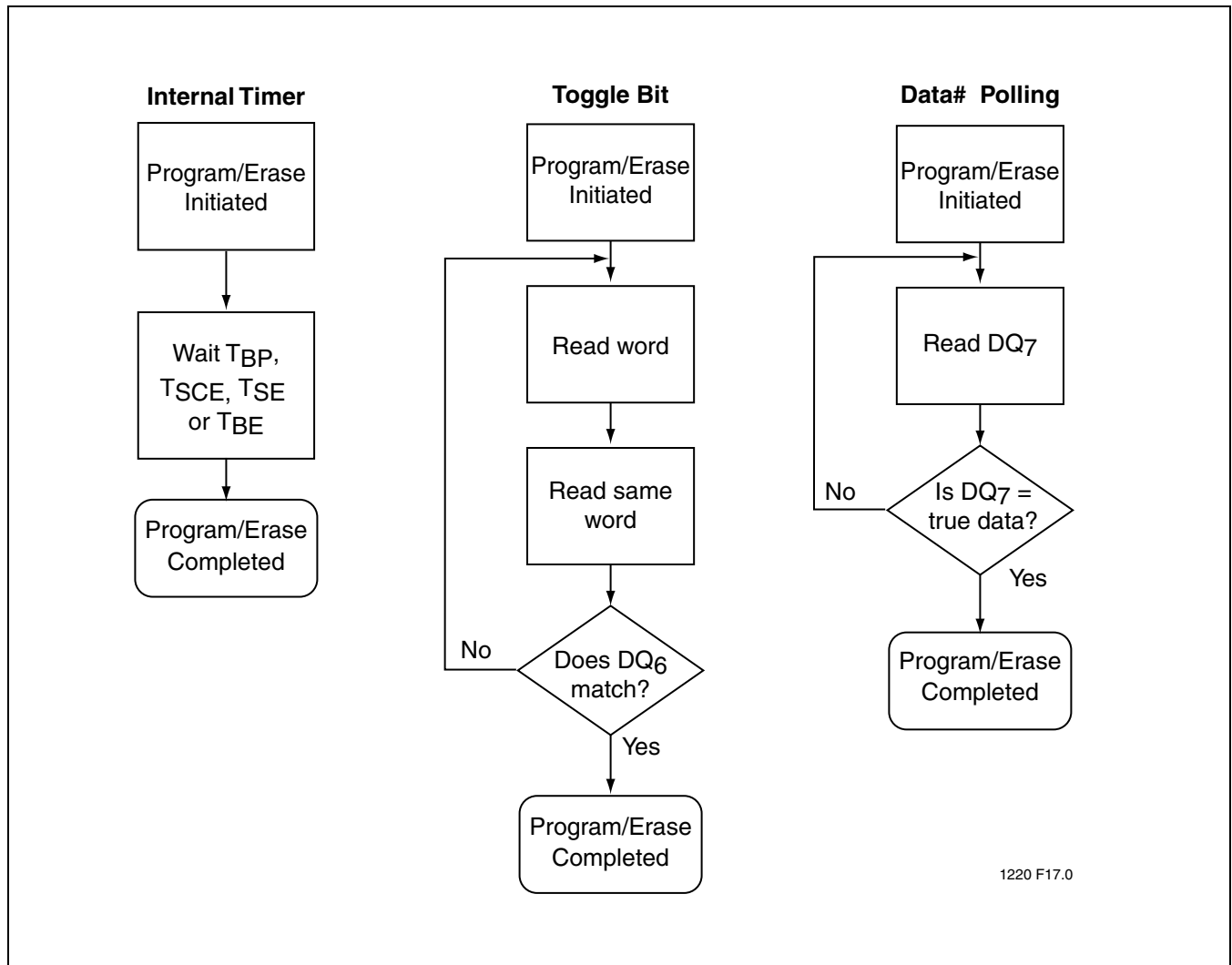


FIGURE 17: WAIT OPTIONS

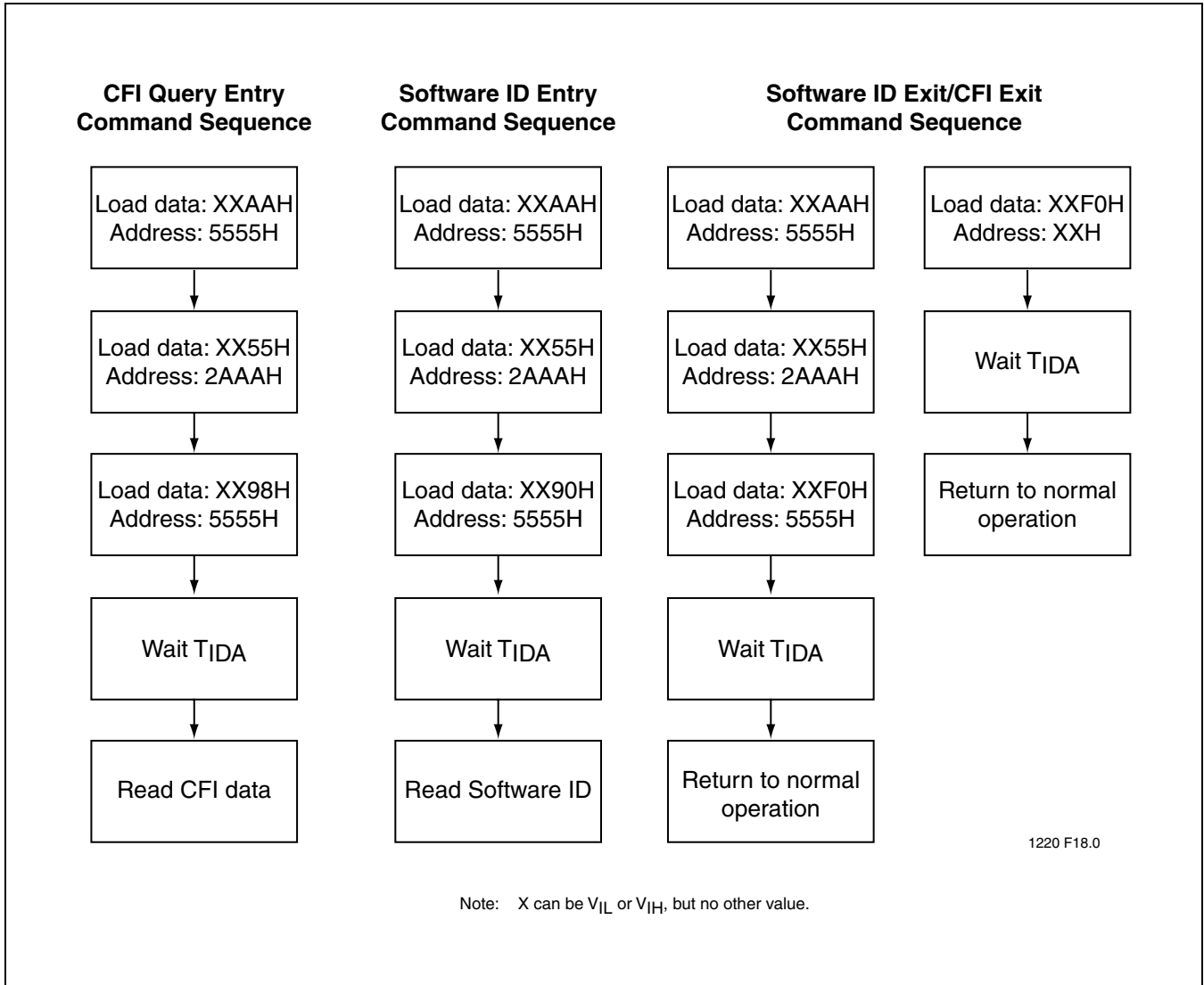


FIGURE 18: SOFTWARE ID/CFI COMMAND FLOWCHARTS

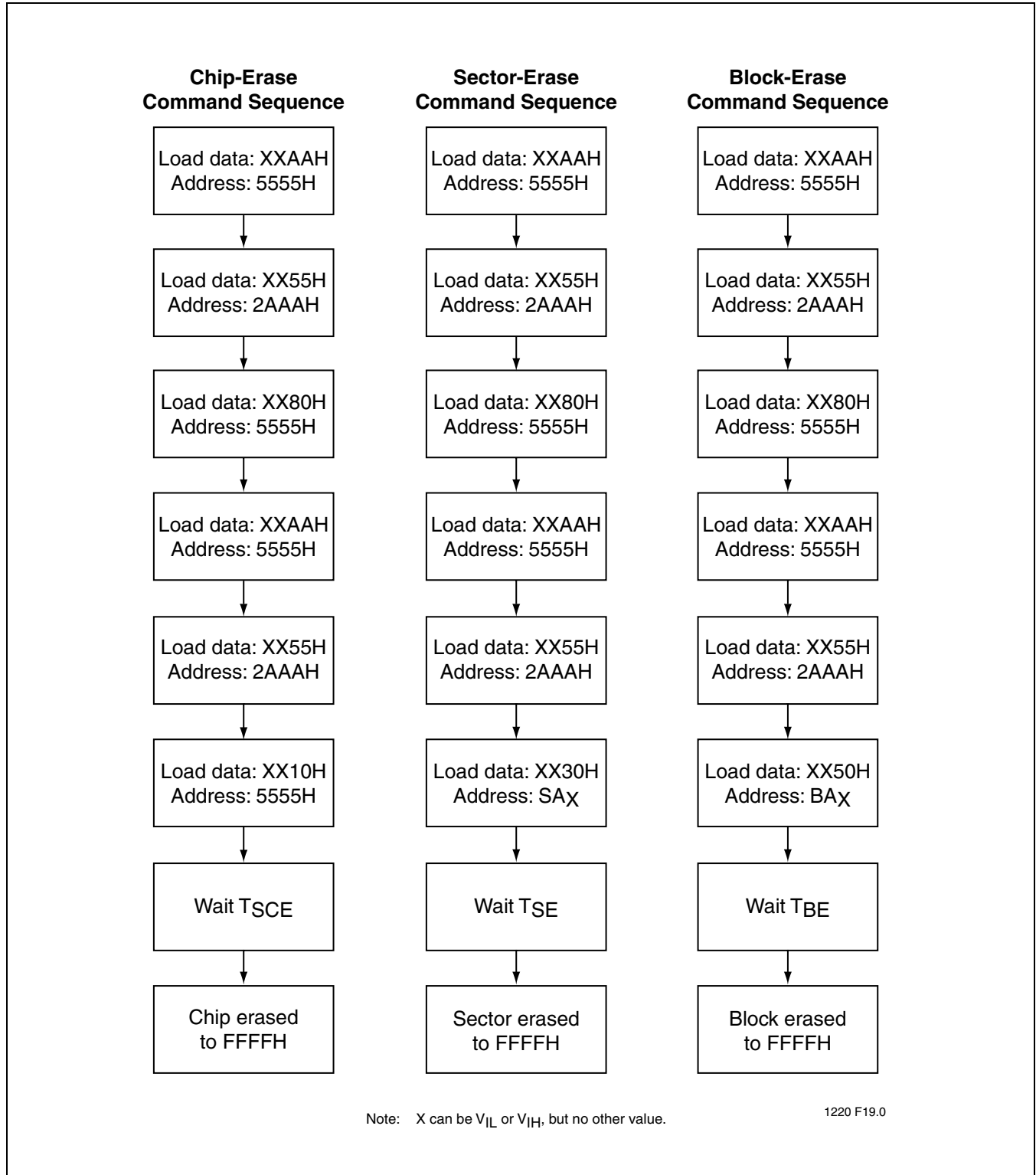


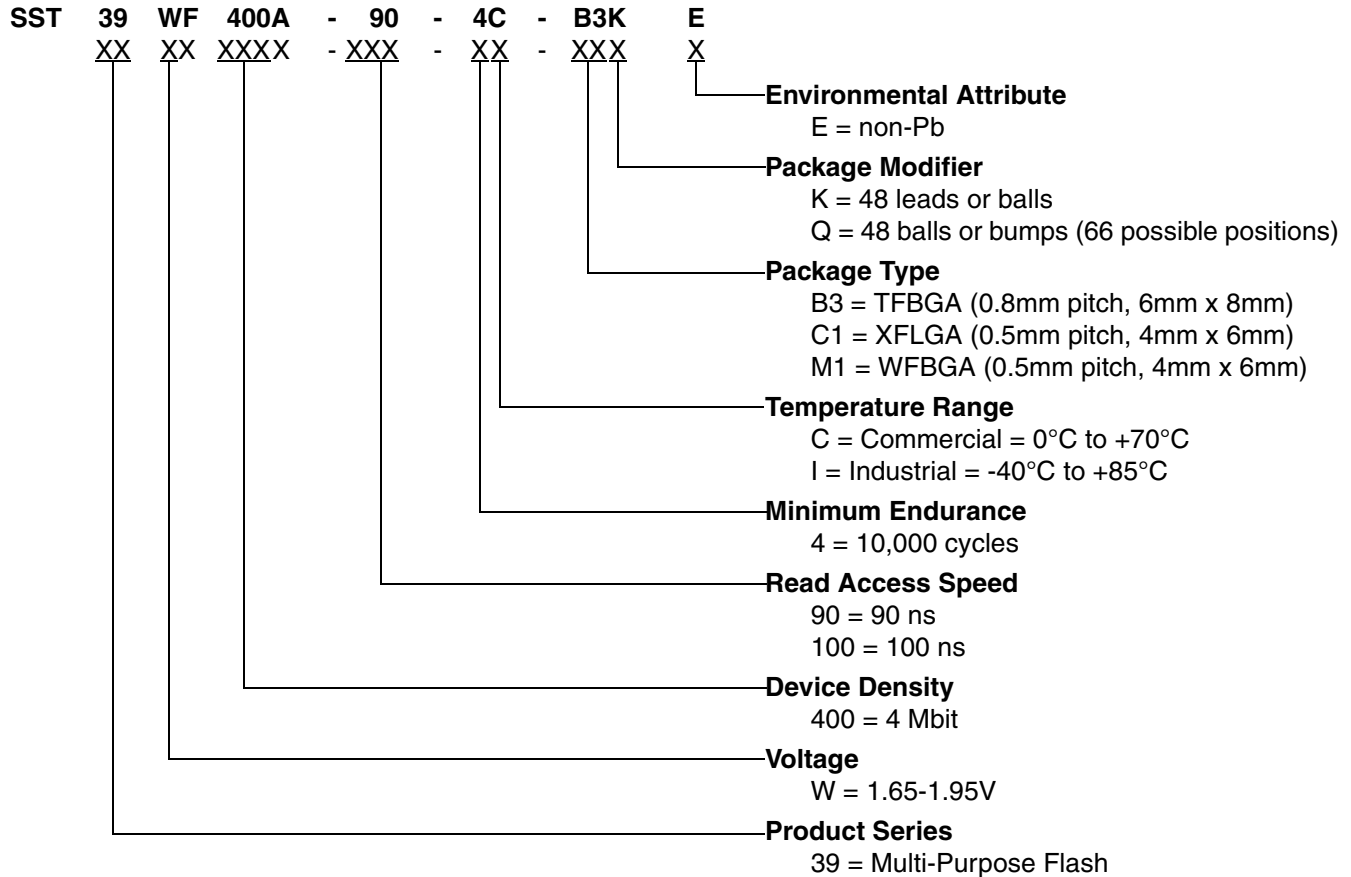
FIGURE 19: ERASE COMMAND SEQUENCE



# 4 Mbit Multi-Purpose Flash SST39WF400A

Data Sheet

## PRODUCT ORDERING INFORMATION



### Valid combinations for SST39WF400A

|                         |                         |                         |
|-------------------------|-------------------------|-------------------------|
| SST39WF400A-90-4C-B3K   | SST39WF400A-90-4C-C1Q   | SST39WF400A-90-4C-M1Q   |
| SST39WF400A-90-4C-B3KE  | SST39WF400A-90-4C-C1QE  | SST39WF400A-90-4C-M1QE  |
| SST39WF400A-90-4I-B3K   | SST39WF400A-90-4I-C1Q   | SST39WF400A-90-4I-M1Q   |
| SST39WF400A-90-4I-B3KE  | SST39WF400A-90-4I-C1QE  | SST39WF400A-90-4I-M1QE  |
| SST39WF400A-100-4I-B3K  | SST39WF400A-100-4I-C1Q  | SST39WF400A-100-4I-M1Q  |
| SST39WF400A-100-4I-B3KE | SST39WF400A-100-4I-C1QE | SST39WF400A-100-4I-M1QE |

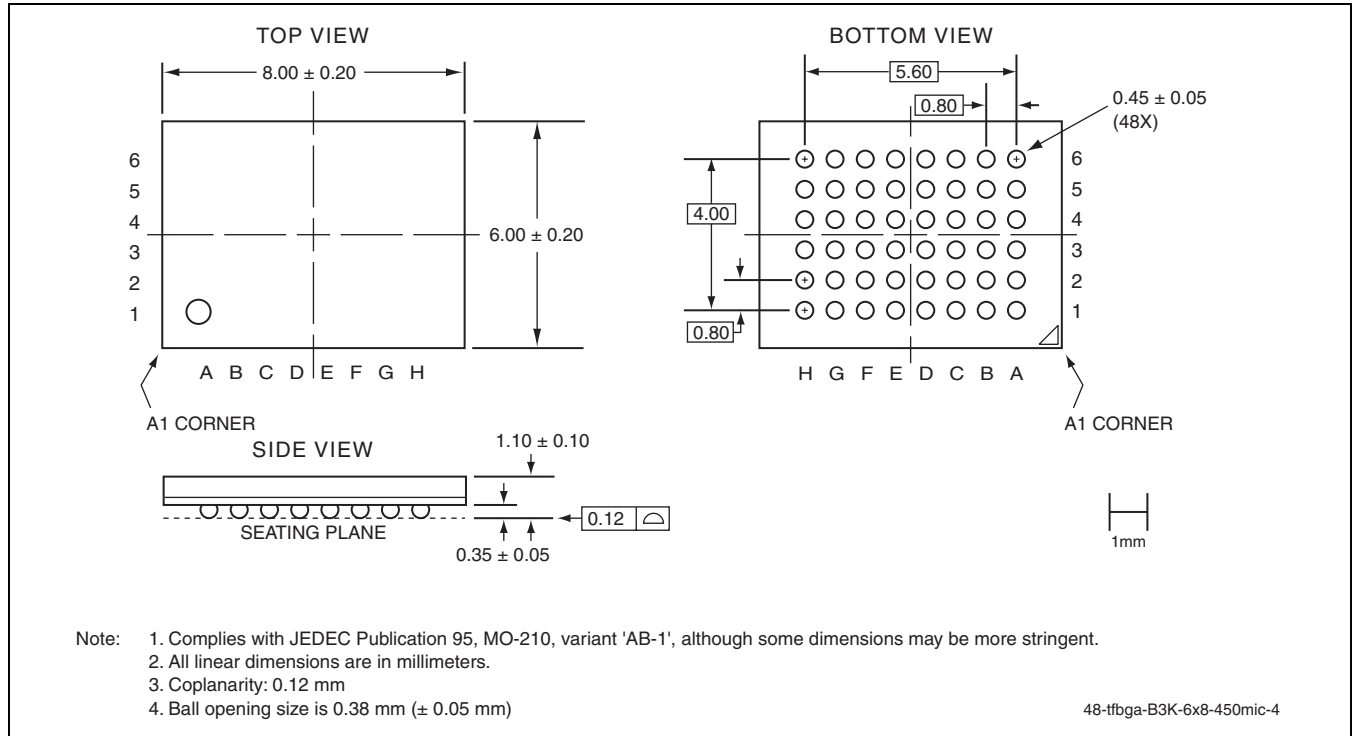
**Note:** Valid combinations are those products in mass production or will be in mass production. Consult your SST sales representative to confirm availability of valid combinations and to determine availability of new combinations.



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Data Sheet

## PACKAGING DIAGRAMS



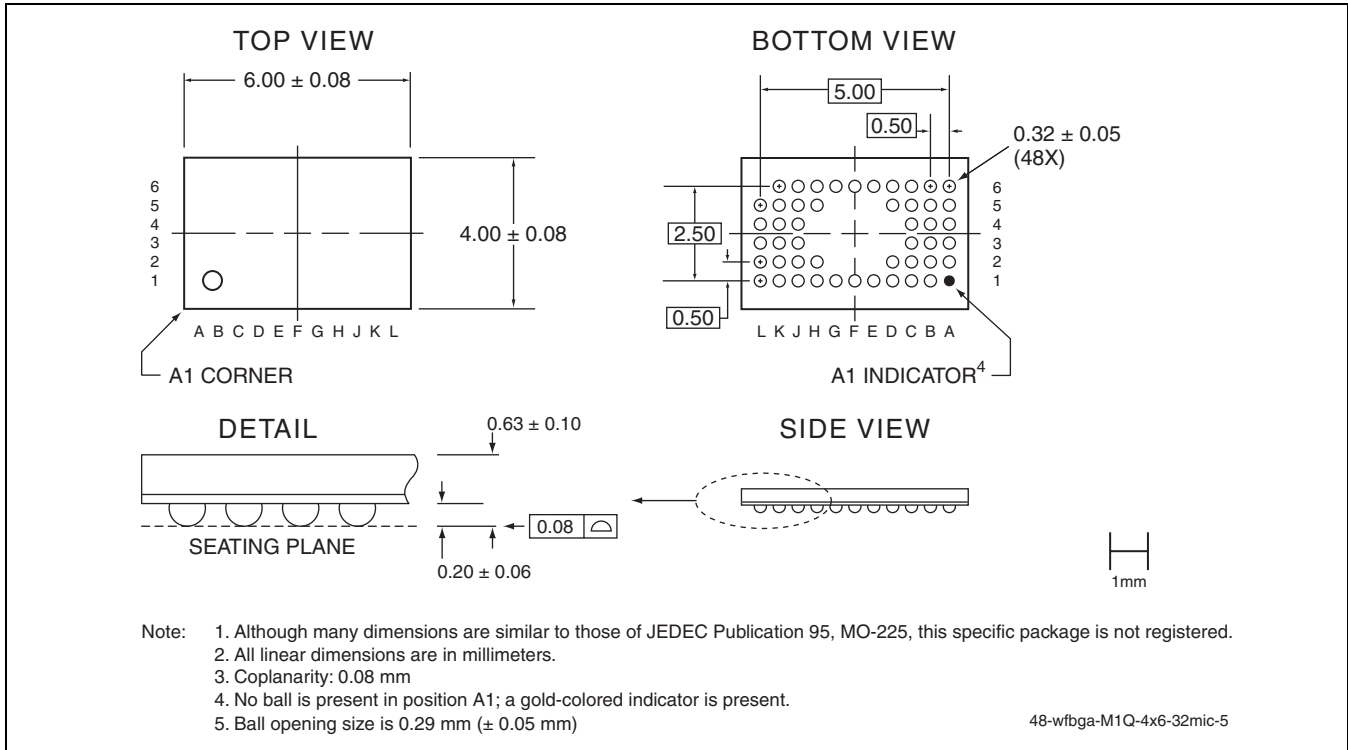
**48-BALL THIN-PROFILE, FINE-PITCH BALL GRID ARRAY (TFBGA) 6MM X 8MM**  
**SST PACKAGE CODE: B3K**



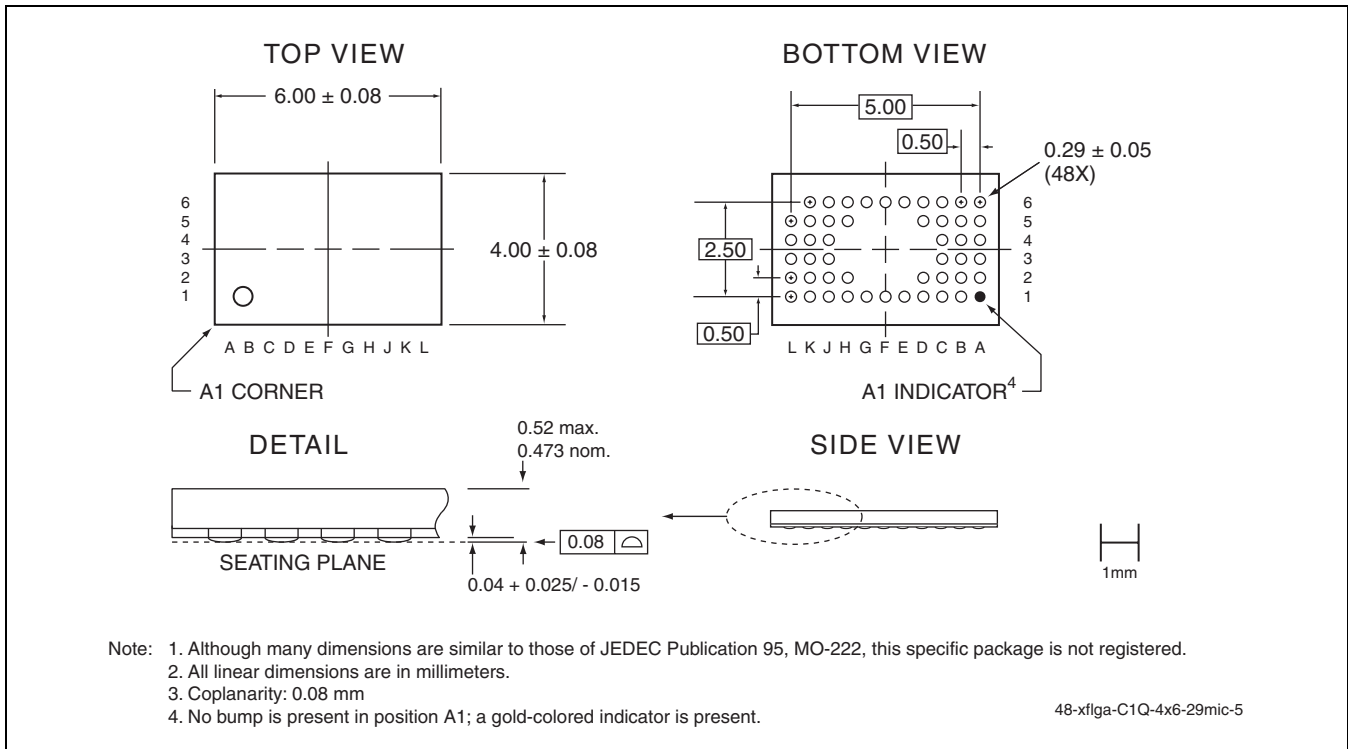
# 4 Mbit Multi-Purpose Flash SST39WF400A



Data Sheet



## 48-BALL VERY-VERY-THIN-PROFILE, FINE-PITCH BALL GRID ARRAY (WFBGA) 4MM X 6MM SST PACKAGE CODE: M1Q



## 48-BUMP EXTREMELY-THIN-PROFILE, FINE-PITCH LAND GRID ARRAY (XFLGA) 4MM X 6MM SST PACKAGE CODE: C1Q



**TABLE 14: REVISION HISTORY**

| Number | Description   | Date     |
|--------|---|----------|
| 00     | <ul style="list-style-type: none"><li>Initial release</li></ul>   | Mar 2003 |
| 01     | <ul style="list-style-type: none"><li>Added 90 ns speed parts</li><li>Output leakage current changed from 10 <math>\mu</math>A to 1 <math>\mu</math>A in Table 8 on page 10</li></ul> | Apr 2003 |
| 02     | <ul style="list-style-type: none"><li>Removed "Typical" column from Table 8 on page 10</li></ul>  | Jun 2003 |
| 03     | <ul style="list-style-type: none"><li>Added 90 ns commercial temperature range MPNs for all packages</li></ul>  | Oct 2003 |
| 04     | <ul style="list-style-type: none"><li>2004 Data Book</li><li>Updated the B3K, M1Q, and C1Q package diagrams</li></ul>   | Nov 2003 |