

# 512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit (x8) Multi-Purpose Flash

SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040

SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040



*Data Sheet*

## FEATURES:

- **Organized as 64K x8 / 128K x8 / 256K x8 / 512K x8**
- **Single Voltage Read and Write Operations**
  - 3.0-3.6V for SST39LF512/010/020/040
  - 2.7-3.6V for SST39VF512/010/020/040
- **Superior Reliability**
  - Endurance: 100,000 Cycles (typical)
  - Greater than 100 years Data Retention
- **Low Power Consumption (typical values at 14 MHz)**
  - Active Current: 5 mA (typical)
  - Standby Current: 1  $\mu$ A (typical)
- **Sector-Erase Capability**
  - Uniform 4 KByte sectors
- **Fast Read Access Time:**
  - 45 ns for SST39LF512/010/020/040
  - 55 ns for SST39LF020/040
  - 70 ns for SST39VF512/010/020/040
- **Latched Address and Data**
- **Fast Erase and Byte-Program:**
  - Sector-Erase Time: 18 ms (typical)
  - Chip-Erase Time: 70 ms (typical)
  - Byte-Program Time: 14  $\mu$ s (typical)
  - Chip Rewrite Time:
    - 1 second (typical) for SST39LF/VF512
    - 2 seconds (typical) for SST39LF/VF010
    - 4 seconds (typical) for SST39LF/VF020
    - 8 seconds (typical) for SST39LF/VF040
- **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**
  - 32-lead PLCC
  - 32-lead TSOP (8mm x 14mm)
  - 48-ball TFBGA (6mm x 8mm)
  - 34-ball WFBGA (4mm x 6mm) for 1M and 2M
- **All devices are RoHS compliant**

## PRODUCT DESCRIPTION

The SST39LF512, SST39LF010, SST39LF020, SST39LF040 and SST39VF512, SST39VF010, SST39VF020, SST39VF040 are 64K x8, 128K x8, 256K x8 and 512K x8 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 SST39LF512/010/020/040 devices write (Program or Erase) with a 3.0-3.6V power supply. The SST39VF512/010/020/040 devices write with a 2.7-3.6V power supply. The devices conform to JEDEC standard pinouts for x8 memories.

Featuring high performance Byte-Program, the SST39LF512/010/020/040 and SST39VF512/010/020/040 devices provide a maximum Byte-Program time of 20  $\mu$ sec. These devices use Toggle Bit or Data# Polling to indicate the completion of Program operation. To protect against inadvertent write, they have on-chip hardware and Software Data Protection schemes. Designed, manufactured, and tested for a wide spectrum of applications, they are offered with a guaranteed typical endurance of 100,000 cycles. Data retention is rated at greater than 100 years.

The SST39LF512/010/020/040 and SST39VF512/010/020/040 devices are suited for applications that require convenient and economical updating of program, configu-

ration, or data memory. For all system applications, they significantly improves performance and reliability, while lowering power consumption. They inherently use less energy during Erase and Program than alternative flash technologies. 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 SST39LF512/010/020/040 and SST39VF512/010/020/040 devices are offered in 32-lead PLCC and 32-lead TSOP packages. The SST39LF/VF010 and SST39LF/VF020 are also offered in a 48-ball TFBGA package. See Figures 2, 3, 4, and 5 for pin assignments.



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### 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 SST39LF512/010/020/040 and SST39VF512/010/020/040 device 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 6).

### Byte-Program Operation

The SST39LF512/010/020/040 and SST39VF512/010/020/040 are programmed on a byte-by-byte basis. Before programming, the sector where the byte 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 byte address and byte data. During the Byte-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 20  $\mu$ s. See Figures 7 and 8 for WE# and CE# controlled Program operation timing diagrams and Figure 17 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 written during the internal Program operation will be ignored.

### Sector-Erase Operation

The Sector-Erase operation allows the system to erase the device on a sector-by-sector basis. The sector architecture is based on uniform sector size of 4 KByte. 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 sector address is latched on the falling edge of the sixth WE# pulse, while the command (30H) 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 can be determined using either Data# Polling or Toggle Bit methods. See Figure 11 for timing waveforms. Any commands written during the Sector-Erase operation will be ignored.

### Chip-Erase Operation

The SST39LF512/010/020/040 and SST39VF512/010/020/040 devices provide a Chip-Erase operation, which allows the user to erase the entire memory array to the '1's state. This is useful when the entire device must be quickly erased.

The Chip-Erase operation is initiated by executing a six-byte Software Data Protection command sequence with Chip-Erase command (10H) with address 5555H in the last byte sequence. The internal Erase operation begins with the rising edge of the sixth WE# or CE#, whichever occurs first. During the internal Erase operation, the only valid read is Toggle Bit or Data# Polling. See Table 4 for the command sequence, Figure 12 for timing diagram, and Figure 20 for the flowchart. Any commands written during the Chip-Erase operation will be ignored.

### Write Operation Status Detection

The SST39LF512/010/020/040 and SST39VF512/010/020/040 devices provide 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.



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

When the SST39LF512/010/020/040 and SST39VF512/010/020/040 are 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 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- or Chip-Erase, the Data# Polling is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 9 for Data# Polling timing diagram and Figure 18 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 '0's and '1's, i.e., toggling between 0 and 1. When the internal Program or Erase operation is completed, the toggling will stop. 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- or Chip-Erase, the Toggle Bit is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 10 for Toggle Bit timing diagram and Figure 18 for a flowchart.

## Data Protection

The SST39LF512/010/020/040 and SST39VF512/010/020/040 provide 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 1.5V.

**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 SST39LF512/010/020/040 and SST39VF512/010/020/040 provide the JEDEC approved Software Data Protection scheme for all data alteration operation, i.e., Program and Erase. Any Program operation requires the inclusion of a series of 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 load sequence. These 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>.

## Product Identification

The Product Identification mode identifies the devices as the SST39LF/VF512, SST39LF/VF010, SST39LF/VF020 and SST39LF/VF040 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 13 for the Software ID Entry and Read timing diagram, and Figure 19 for the Software ID entry command sequence flowchart.

**TABLE 1: Product Identification**

|                   | Address | Data |
|-------------------|---------|------|
| Manufacturer's ID | 0000H   | BFH  |
| Device ID         |         |      |
| SST39LF/VF512     | 0001H   | D4H  |
| SST39LF/VF010     | 0001H   | D5H  |
| SST39LF/VF020     | 0001H   | D6H  |
| SST39LF/VF040     | 0001H   | D7H  |

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## Product Identification Mode Exit/Reset

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 operation. Please note that the Software ID Exit command is ignored during an internal Program or Erase operation. See Table 4 for software command codes, Figure 14 for timing waveform, and Figure 19 for a flowchart.



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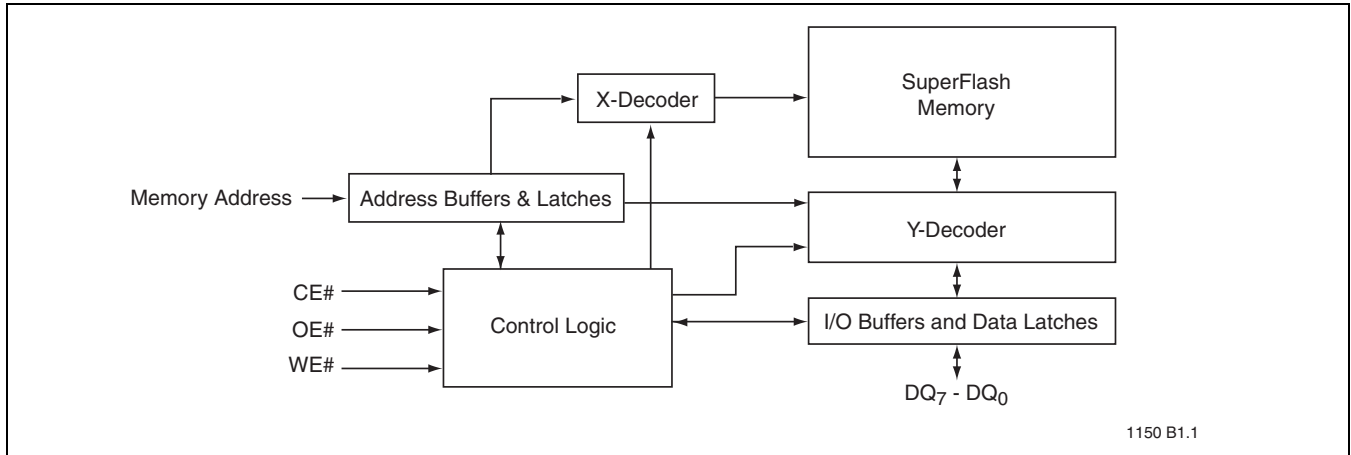


FIGURE 1: Functional Block Diagram

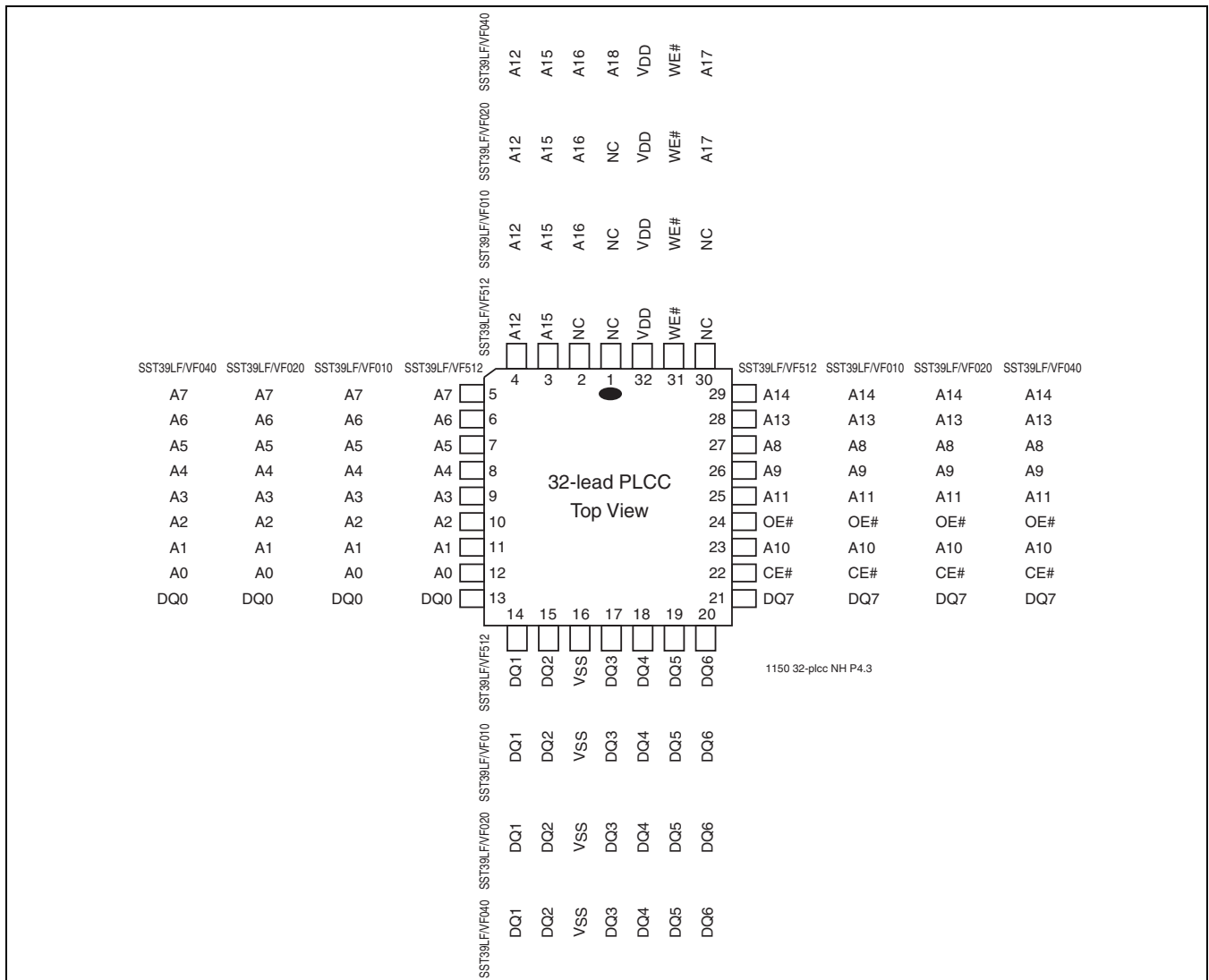
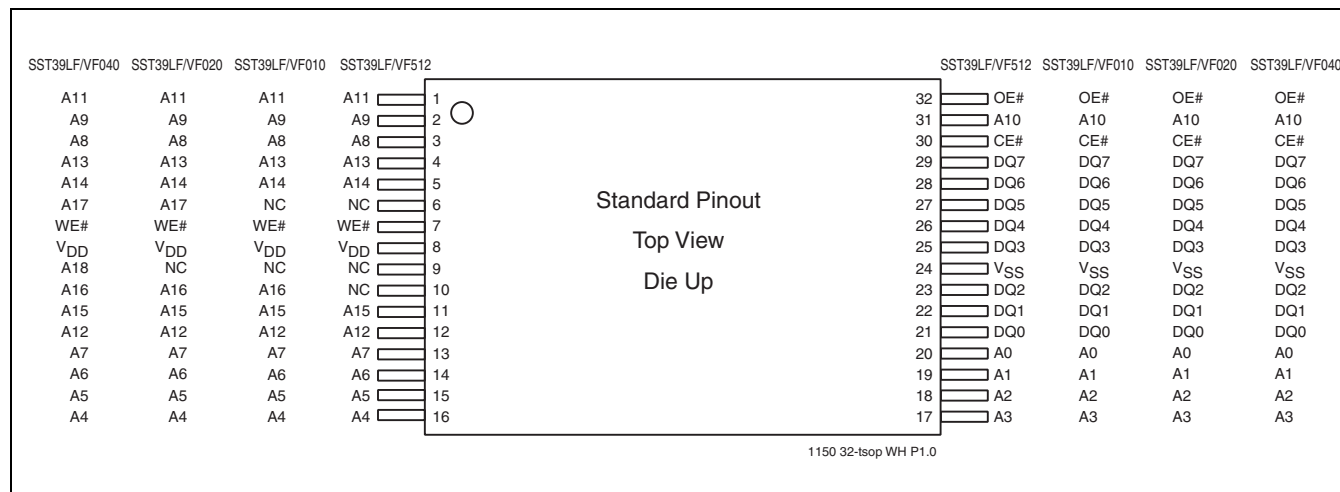


FIGURE 2: Pin Assignments for 32-lead PLCC

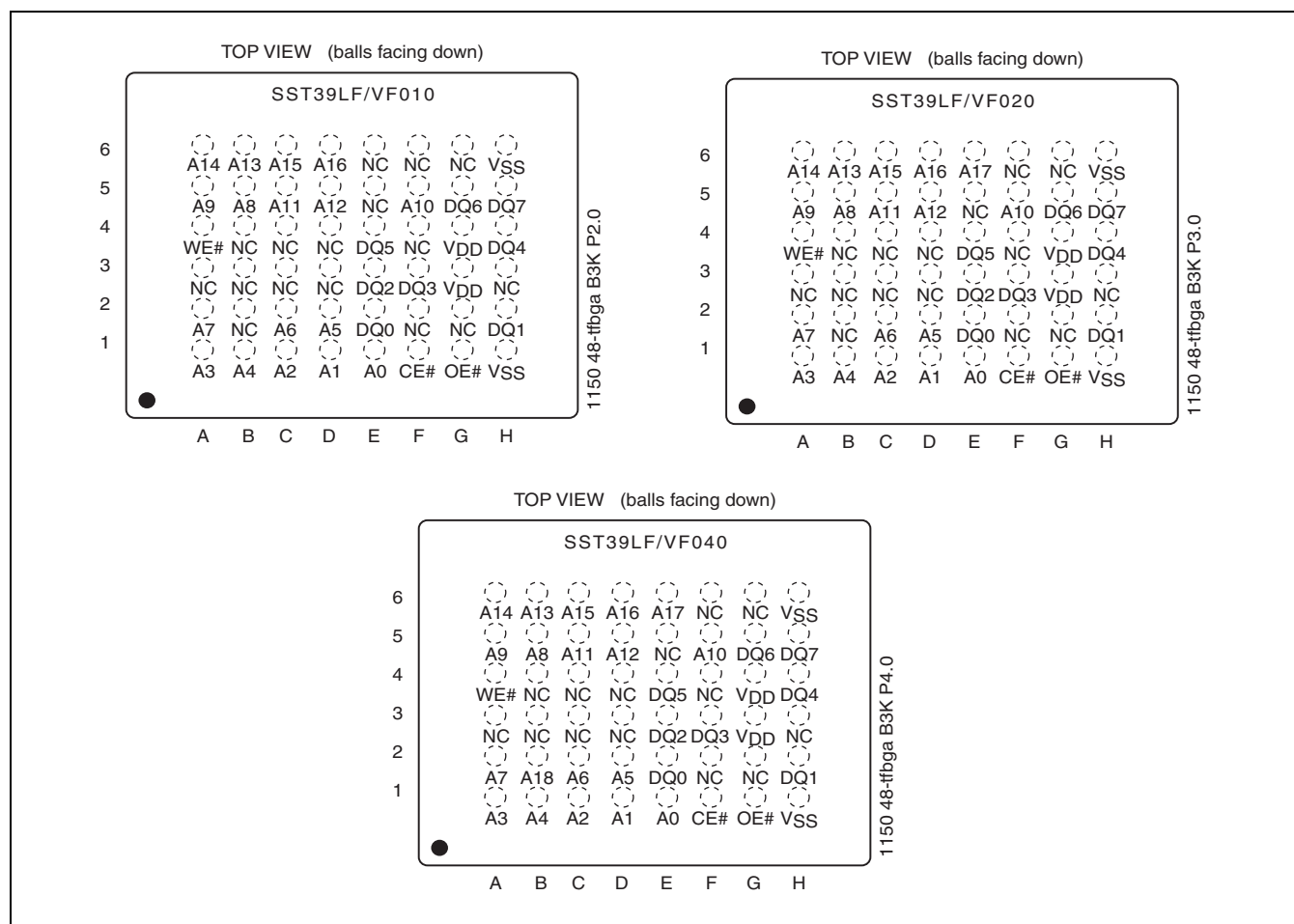
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**FIGURE 3: Pin Assignments for 32-lead TSOP (8mm x 14mm)**

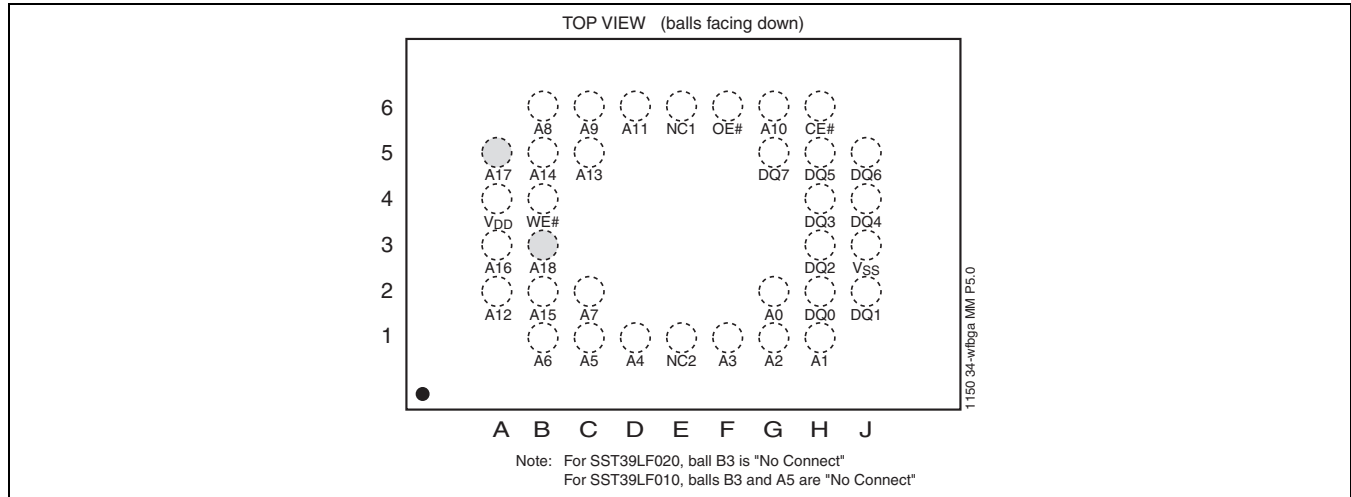


**FIGURE 4: Pin Assignment for 48-ball TFBGA (6mm x 8mm) for 1 Mbit, 2 Mbit, and 4 Mbit**



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**FIGURE 5: Pin Assignment for 34-ball WFBGA (4mm x 6mm) for 1 Mbit and 2 Mbit**

**TABLE 2: Pin Description**

| Symbol         | Pin Name          | Functions  |
|----------------|-------------------|--|
| $A_{MS}^1-A_0$ | Address Inputs    | To provide memory addresses. During Sector-Erase $A_{MS}-A_{12}$ address lines will select the sector. During Block-Erase $A_{MS}-A_{16}$ address lines will select the block.       |
| $DQ_7-DQ_0$    | 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: 3.0-3.6V for SST39LF512/010/020/040<br>2.7-3.6V for SST39VF512/010/020/040  |
| $V_{SS}$       | Ground            |  |
| NC             | No Connection     | Unconnected pins.  |

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1.  $A_{MS}$  = Most significant address

$A_{MS} = A_{15}$  for SST39LF/VF512,  $A_{16}$  for SST39LF/VF010,  $A_{17}$  for SST39LF/VF020, and  $A_{18}$  for SST39LF/VF040

**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 address,<br>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 | Addr <sup>1</sup>   | Data | Addr <sup>1</sup>   | Data | Addr <sup>1</sup>   | Data | Addr <sup>1</sup>   | Data | Addr <sup>1</sup>            | Data |
| Byte-Program                     | 5555H               | AAH  | 2AAAH               | 55H  | 5555H               | A0H  | BA <sup>2</sup>     | Data |                     |      |                              |      |
| Sector-Erase                     | 5555H               | AAH  | 2AAAH               | 55H  | 5555H               | 80H  | 5555H               | AAH  | 2AAAH               | 55H  | SA <sub>X</sub> <sup>3</sup> | 30H  |
| Chip-Erase                       | 5555H               | AAH  | 2AAAH               | 55H  | 5555H               | 80H  | 5555H               | AAH  | 2AAAH               | 55H  | 5555H                        | 10H  |
| Software ID Entry <sup>4,5</sup> | 5555H               | AAH  | 2AAAH               | 55H  | 5555H               | 90H  |                     |      |                     |      |                              |      |
| Software ID Exit <sup>6</sup>    | XXH                 | F0H  |                     |      |                     |      |                     |      |                     |      |                              |      |
| Software ID Exit <sup>6</sup>    | 5555H               | AAH  | 2AAAH               | 55H  | 5555H               | F0H  |                     |      |                     |      |                              |      |

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- Address format A<sub>14</sub>-A<sub>0</sub> (Hex),  
 Address A<sub>15</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the Command sequence for SST39LF/VF512.  
 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>15</sub> for SST39LF/VF512, A<sub>16</sub> for SST39LF/VF010, A<sub>17</sub> for SST39LF/VF020, and A<sub>18</sub> for SST39LF/VF040
- BA = Program Byte address
- SA<sub>X</sub> for Sector-Erase; uses A<sub>MS</sub>-A<sub>12</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 = BFH, is read with A<sub>0</sub> = 0,  
 SST39LF/VF512 Device ID = D4H, is read with A<sub>0</sub> = 1,  
 SST39LF/VF010 Device ID = D5H, is read with A<sub>0</sub> = 1,  
 SST39LF/VF020 Device ID = D6H, is read with A<sub>0</sub> = 1,  
 SST39LF/VF040 Device ID = D7H, is read with A<sub>0</sub> = 1.
- Both Software ID Exit operations are equivalent

**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 <sub>DD</sub> +0.5V |
| Transient Voltage (<20 ns) on Any Pin to Ground Potential | -2.0V to V <sub>DD</sub> +2.0V |
| Voltage on A <sub>9</sub> Pin to Ground Potential         | -0.5V to 13.2V                 |
| Package Power Dissipation Capability (Ta = 25°C)          | 1.0W                           |
| Surface Mount Solder Reflow Temperature <sup>1</sup>      | 260°C for 10 seconds           |
| Output Short Circuit Current <sup>2</sup>                 | 50 mA                          |

- Excluding certain with-Pb 32-PLCC units, all packages are 260°C capable in both non-Pb and with-Pb solder versions.  
 Certain with-Pb 32-PLCC package types are capable of 240°C for 10 seconds; please consult the factory for the latest information.
- Outputs shorted for no more than one second. No more than one output shorted at a time.

**Operating Range for SST39LF512/010/020/040**

| Range      | Ambient Temp | V <sub>DD</sub> |
|------------|--------------|-----------------|
| Commercial | 0°C to +70°C | 3.0-3.6V        |

**Operating Range for SST39VF512/010/020/040**

| Range      | Ambient Temp   | V <sub>DD</sub> |
|------------|----------------|-----------------|
| Commercial | 0°C to +70°C   | 2.7-3.6V        |
| Industrial | -40°C to +85°C | 2.7-3.6V        |

**AC Conditions of Test**

|                       |                                   |
|-----------------------|-----------------------------------|
| Input Rise/Fall Time  | 5 ns                              |
| Output Load           |                                   |
| C <sub>L</sub>        | 30 pF for SST39LF512/010/020/040  |
| C <sub>L</sub>        | 100 pF for SST39VF512/010/020/040 |
| See Figures 15 and 16 |                                   |



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**TABLE 5: DC Operating Characteristics - $V_{DD} = 3.0\text{-}3.6\text{V}$  for SST39LF512/010/020/040 and  $2.7\text{-}3.6\text{V}$  for SST39VF512/010/020/040<sup>1</sup>**

| Symbol    | Parameter                      | Limits       |     |               | Test Conditions   |
|-----------|--------------------------------|--------------|-----|---------------|---|
|           |                                | Min          | Max | Units         |   |
| $I_{DD}$  | Power Supply Current           |              |     |               | Address input= $V_{ILT}/V_{IHT}$ , at $f=1/T_{RC}$ Min<br>$V_{DD}=V_{DD}$ Max |
|           | Read <sup>2</sup>              |              | 20  | mA            | $CE\#=V_{IL}$ , $OE\#=WE\#=V_{IH}$ , all I/Os open                            |
|           | Program and Erase <sup>3</sup> |              | 30  | mA            | $CE\#=WE\#=V_{IL}$ , $OE\#=V_{IH}$  |
| $I_{SB}$  | Standby $V_{DD}$ Current       |              | 15  | $\mu\text{A}$ | $CE\#=V_{IHC}$ , $V_{DD}=V_{DD}$ 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         |              | 10  | $\mu\text{A}$ | $V_{OUT}=\text{GND to } V_{DD}$ , $V_{DD}=V_{DD}$ Max                         |
| $V_{IL}$  | Input Low Voltage              |              | 0.8 | V             | $V_{DD}=V_{DD}$ Min   |
| $V_{IH}$  | Input High Voltage             | $0.7V_{DD}$  |     | V             | $V_{DD}=V_{DD}$ Max   |
| $V_{IHC}$ | Input High Voltage (CMOS)      | $V_{DD}-0.3$ |     | V             | $V_{DD}=V_{DD}$ Max   |
| $V_{OL}$  | Output Low Voltage             |              | 0.2 | V             | $I_{OL}=100\text{ }\mu\text{A}$ , $V_{DD}=V_{DD}$ Min                         |
| $V_{OH}$  | Output High Voltage            | $V_{DD}-0.2$ |     | V             | $I_{OH}=-100\text{ }\mu\text{A}$ , $V_{DD}=V_{DD}$ Min                        |

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1. Typical conditions for the Active Current shown on the front data sheet page are average values at  $25^{\circ}\text{C}$  (room temperature), and  $V_{DD} = 3\text{V}$  for VF devices. Not 100% tested.
2. Values are for 70 ns conditions. See the *Multi-Purpose Flash Power Rating* application note for further information.
3. 30 mA max for Erase operations in the industrial temperature range.

**TABLE 6: 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 7: Capacitance ( $T_a = 25^{\circ}\text{C}$ ,  $f=1\text{ Mhz}$ , 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    |

T7.0 1150

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

**TABLE 8: 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   |

T8.3 1150

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 9: Read Cycle Timing Parameters -  $V_{DD} = 3.0\text{-}3.6\text{V}$  for SST39LF512/010/020/040 and  $2.7\text{-}3.6\text{V}$  for SST39VF512/010/020/040**

| Symbol      | Parameter                       | SST39LF512-45<br>SST39LF010-45<br>SST39LF020-45<br>SST39LF040-45 |     | SST39LF020-55<br>SST39LF040-55 |     | SST39VF512-70<br>SST39VF010-70<br>SST39VF020-70<br>SST39VF040-70 |     | Units |
|-------------|---------------------------------|--|-----|--------------------------------|-----|--|-----|-------|
|             |                                 | Min  | Max | Min                            | Max | Min  | Max |       |
| $T_{RC}$    | Read Cycle Time                 | 45   |     | 55                             |     | 70   |     | ns    |
| $T_{CE}$    | Chip Enable Access Time         |  | 45  |                                | 55  |  | 70  | ns    |
| $T_{AA}$    | Address Access Time             |  | 45  |                                | 55  |  | 70  | ns    |
| $T_{OE}$    | Output Enable Access Time       |  | 30  |                                | 30  |  | 35  | ns    |
| $T_{CLZ}^1$ | CE# Low to Active Output        | 0  |     | 0                              |     | 0  |     | ns    |
| $T_{OLZ}^1$ | OE# Low to Active Output        | 0  |     | 0                              |     | 0  |     | ns    |
| $T_{CHZ}^1$ | CE# High to High-Z Output       |  | 15  |                                | 15  |  | 25  | ns    |
| $T_{OHZ}^1$ | OE# High to High-Z Output       |  | 15  |                                | 15  |  | 25  | ns    |
| $T_{OH}^1$  | Output Hold from Address Change | 0  |     | 0                              |     | 0  |     | ns    |

T9.2 1150

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

**TABLE 10: Program/Erase Cycle Timing Parameters**

| Symbol      | Parameter                        | Min | Max | Units         |
|-------------|----------------------------------|-----|-----|---------------|
| $T_{BP}$    | Byte-Program Time                |     | 20  | $\mu\text{s}$ |
| $T_{AS}$    | Address Setup Time               | 0   |     | ns            |
| $T_{AH}$    | Address Hold Time                | 30  |     | ns            |
| $T_{CS}$    | WE# and CE# Setup Time           | 0   |     | ns            |
| $T_{CH}$    | WE# and CE# Hold Time            | 0   |     | ns            |
| $T_{OES}$   | OE# High Setup Time              | 0   |     | ns            |
| $T_{OEh}$   | OE# High Hold Time               | 10  |     | ns            |
| $T_{CP}$    | CE# Pulse Width                  | 40  |     | ns            |
| $T_{WP}$    | WE# Pulse Width                  | 40  |     | ns            |
| $T_{WPH}^1$ | WE# Pulse Width High             | 30  |     | ns            |
| $T_{CPH}^1$ | CE# Pulse Width High             | 30  |     | ns            |
| $T_{DS}$    | Data Setup Time                  | 40  |     | ns            |
| $T_{DH}^1$  | Data Hold Time                   | 0   |     | ns            |
| $T_{IDA}^1$ | Software ID Access and Exit Time |     | 150 | ns            |
| $T_{SE}$    | Sector-Erase                     |     | 25  | ms            |
| $T_{SCE}$   | Chip-Erase                       |     | 100 | ms            |

T10.1 1150

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



# 512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040 SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040

Data Sheet

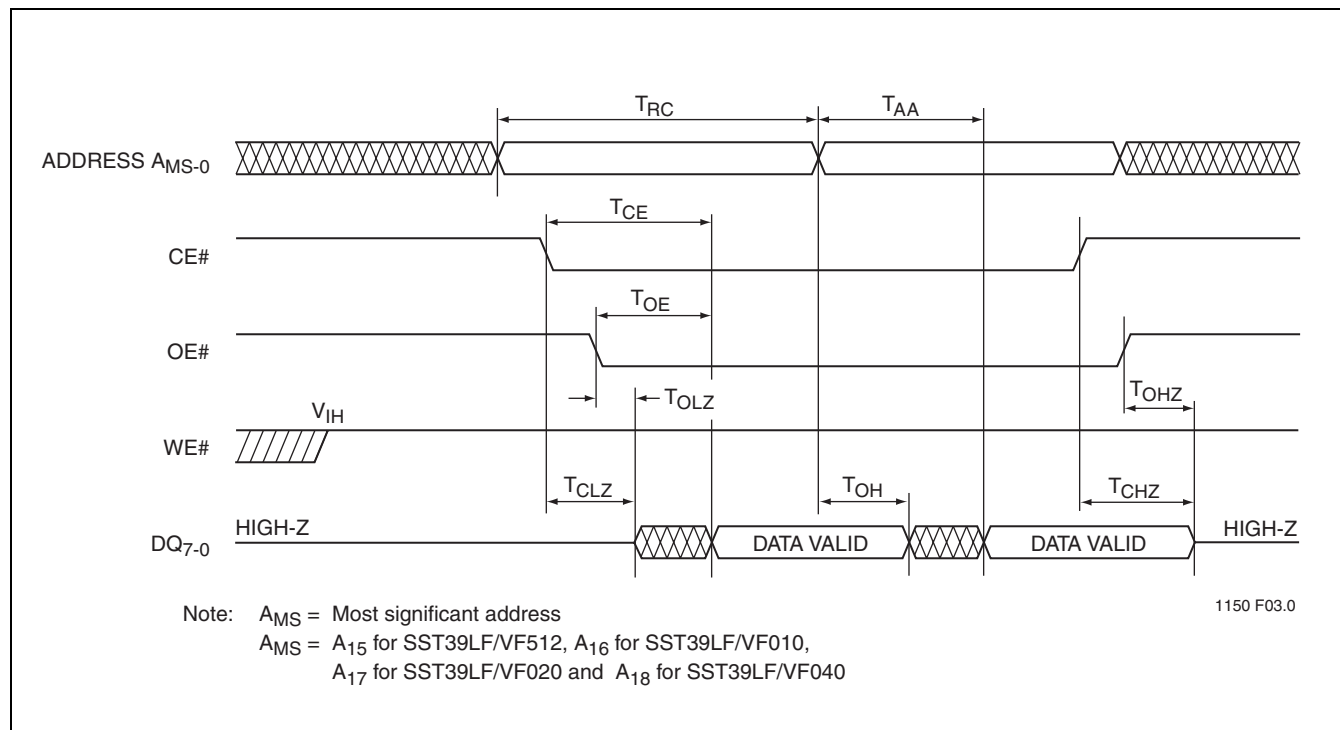


FIGURE 6: Read Cycle Timing Diagram

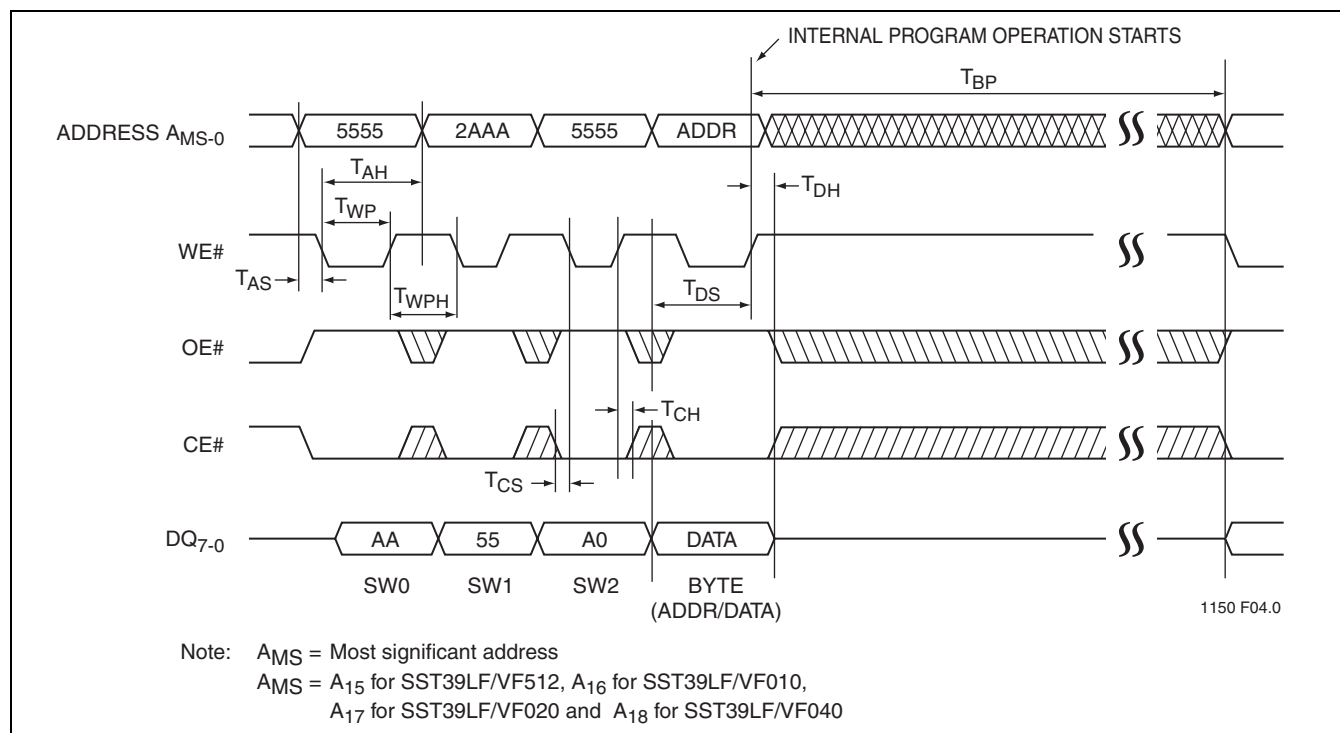


FIGURE 7: WE# Controlled Program Cycle Timing Diagram

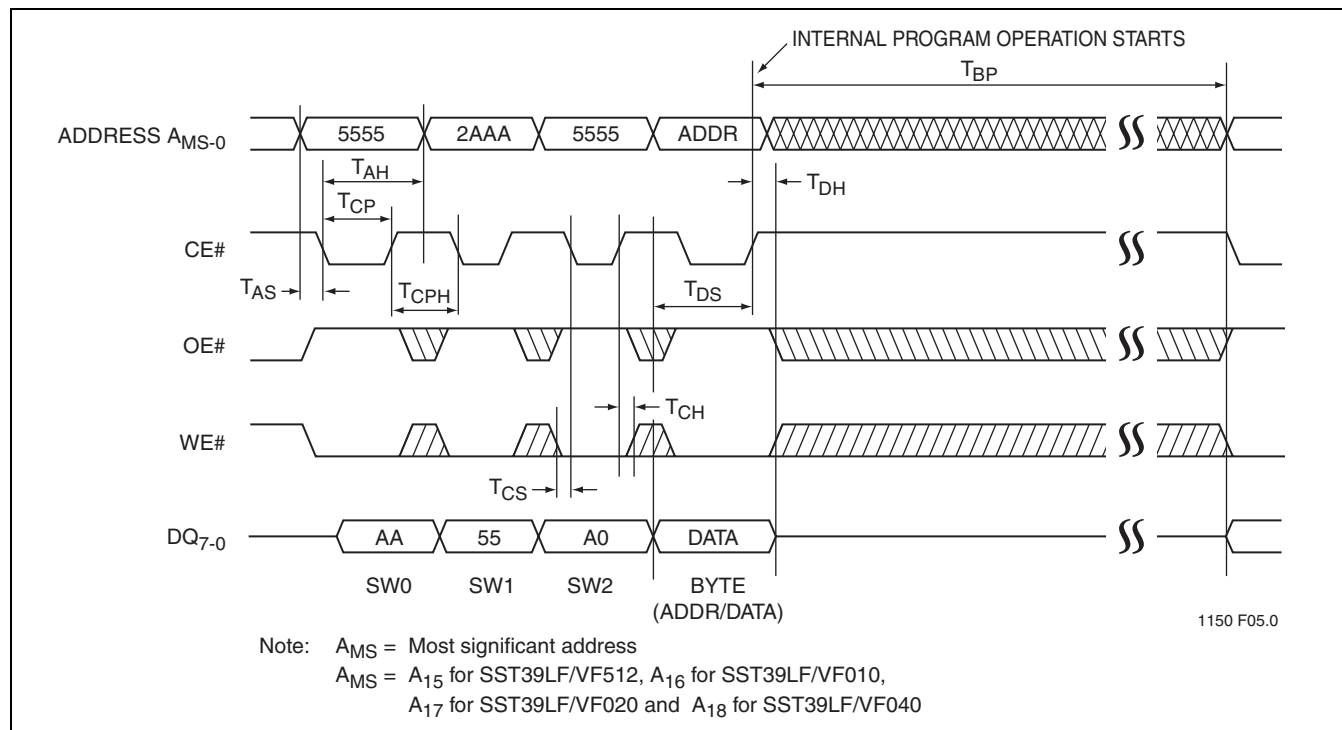


FIGURE 8: CE# Controlled Program Cycle Timing Diagram

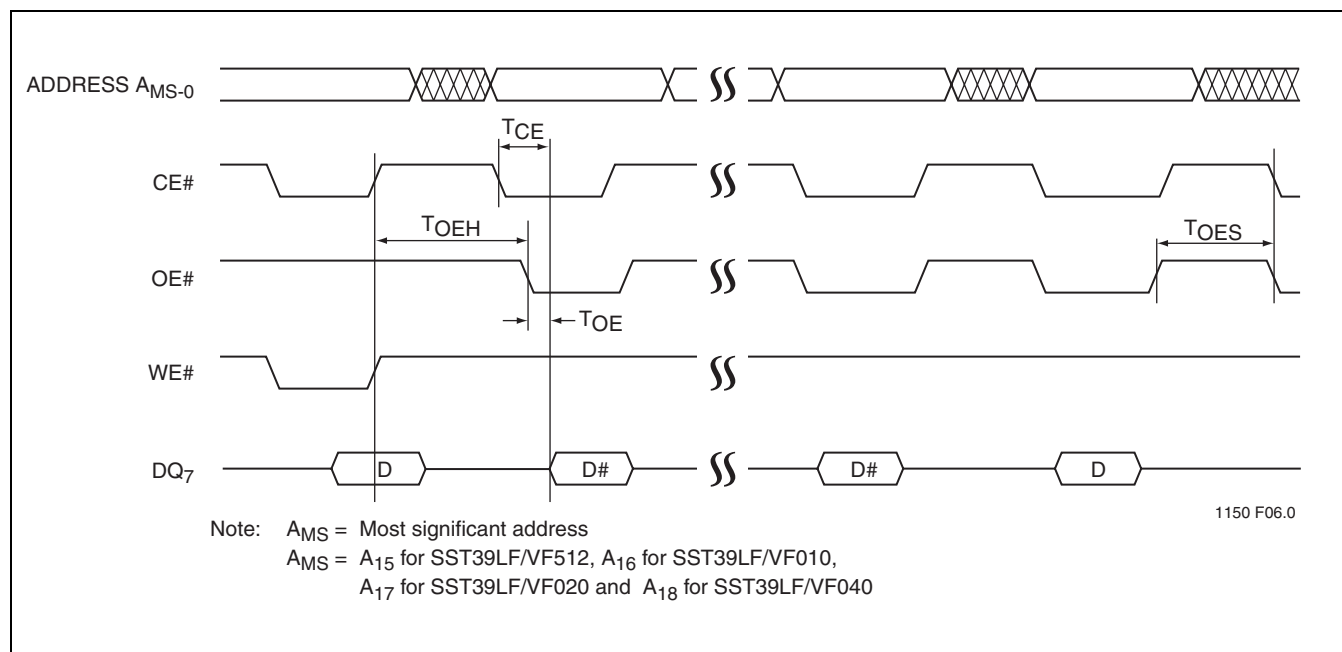
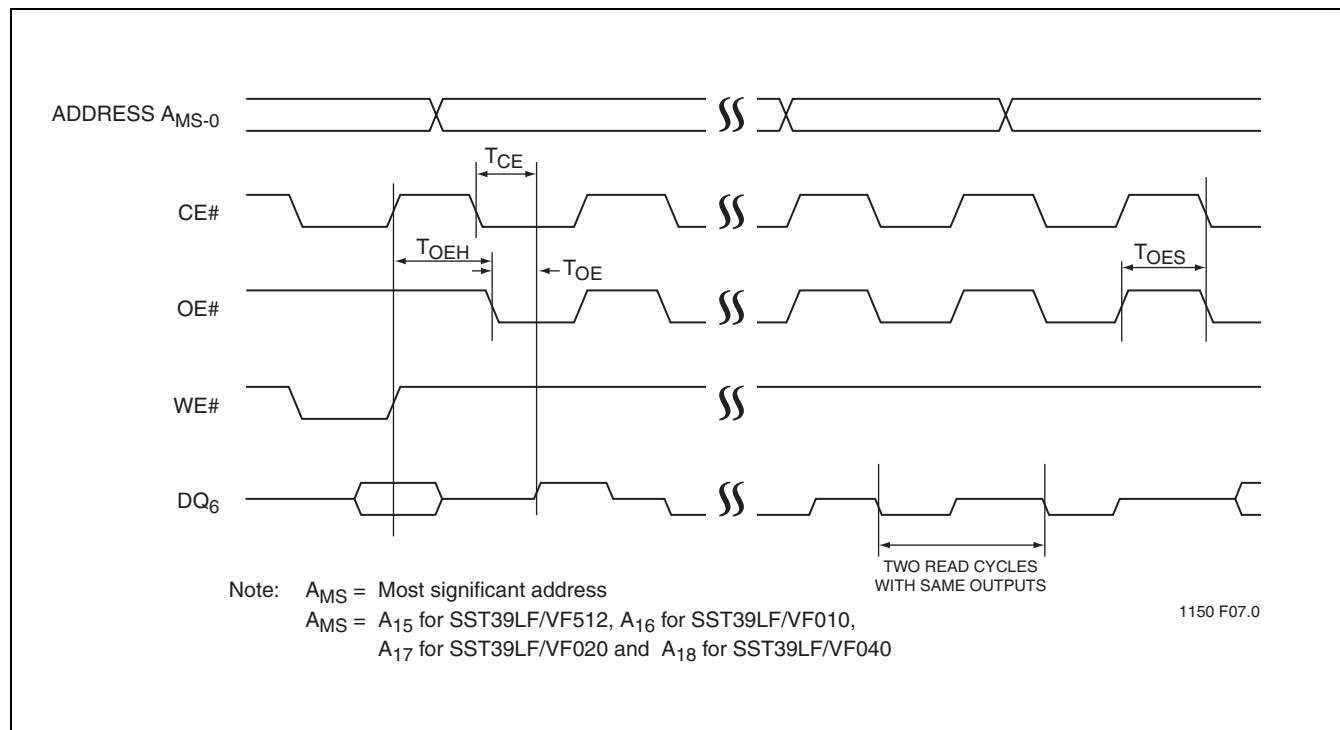


FIGURE 9: Data# Polling Timing Diagram

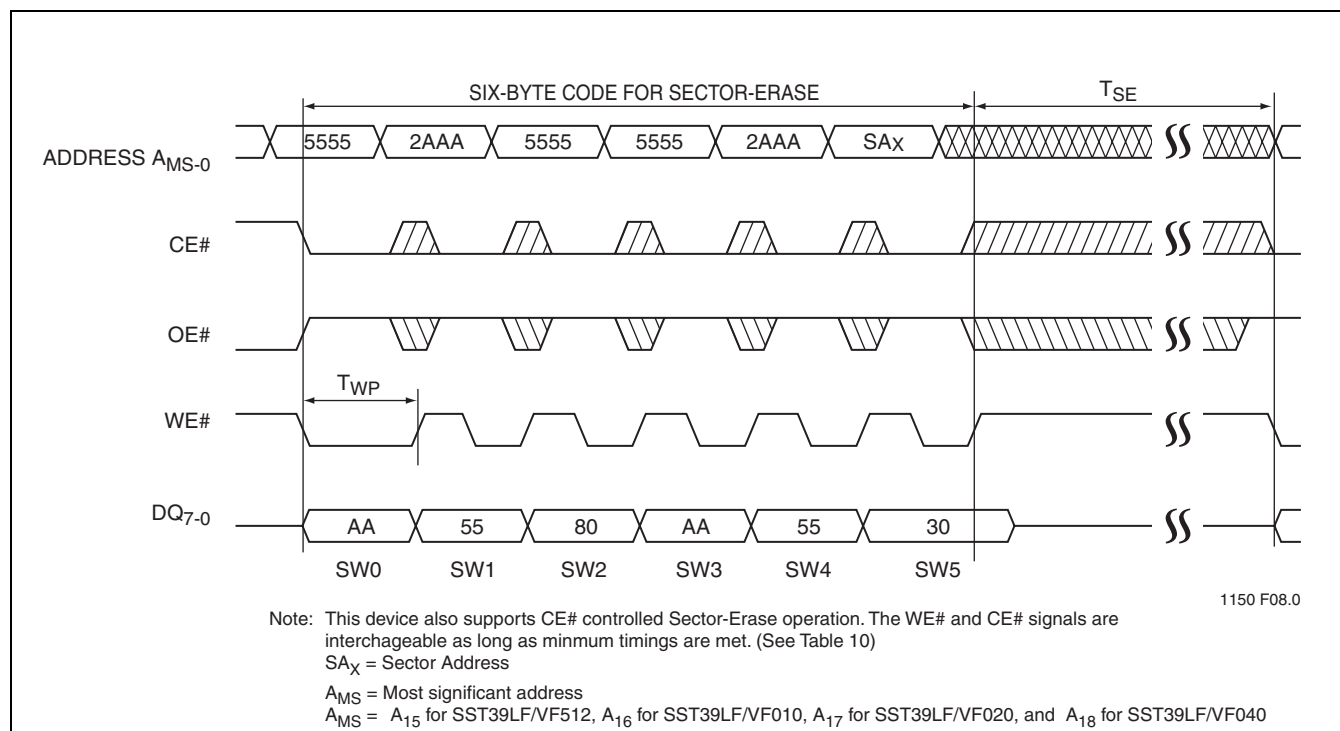


**512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash**  
**SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040**  
**SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040**

Data Sheet



**FIGURE 10: Toggle Bit Timing Diagram**



**FIGURE 11: WE# Controlled Sector-Erase Timing Diagram**

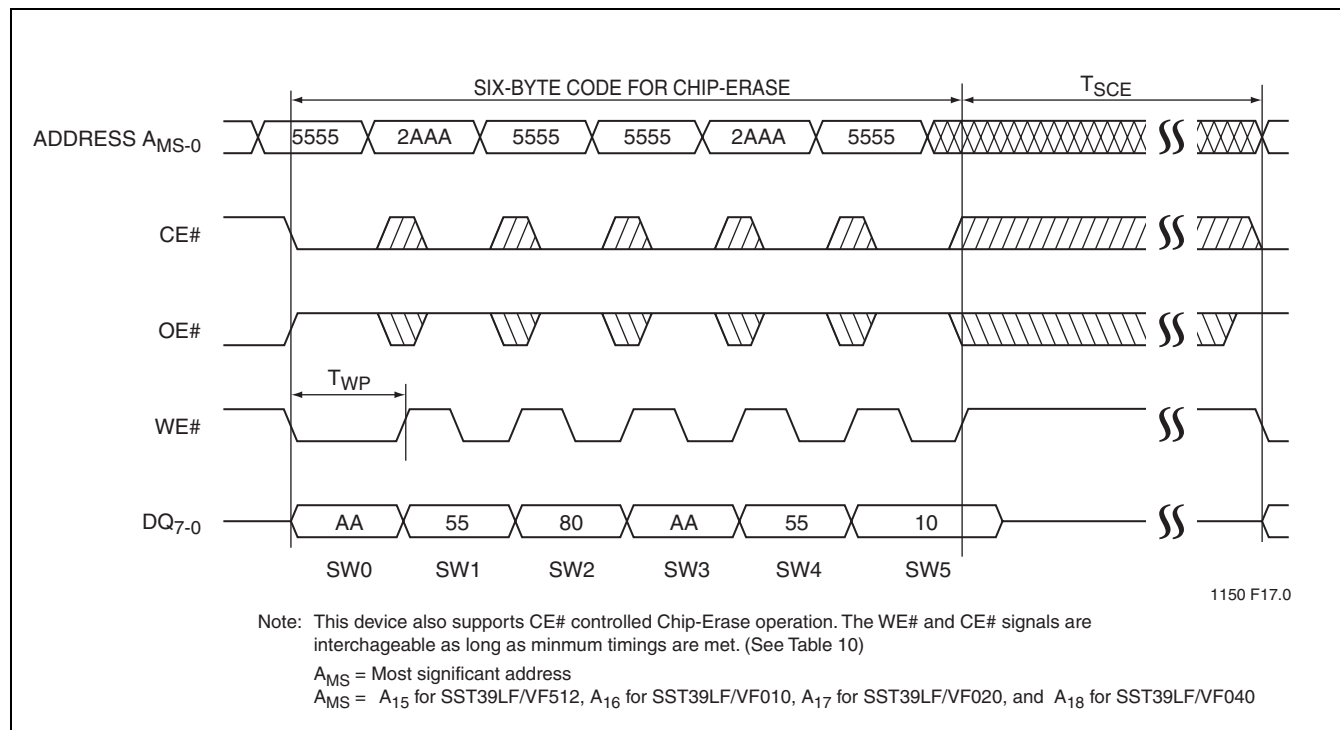


FIGURE 12: WE# Controlled Chip-Erase Timing Diagram

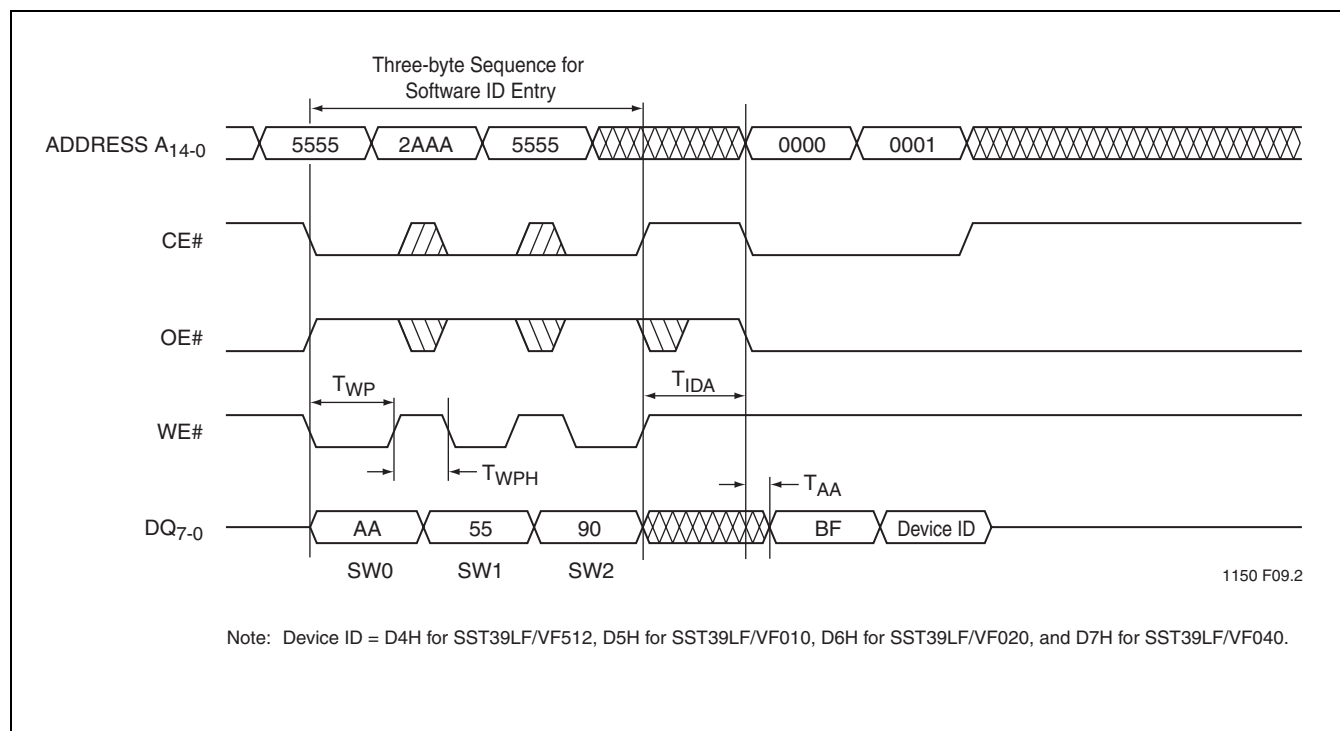
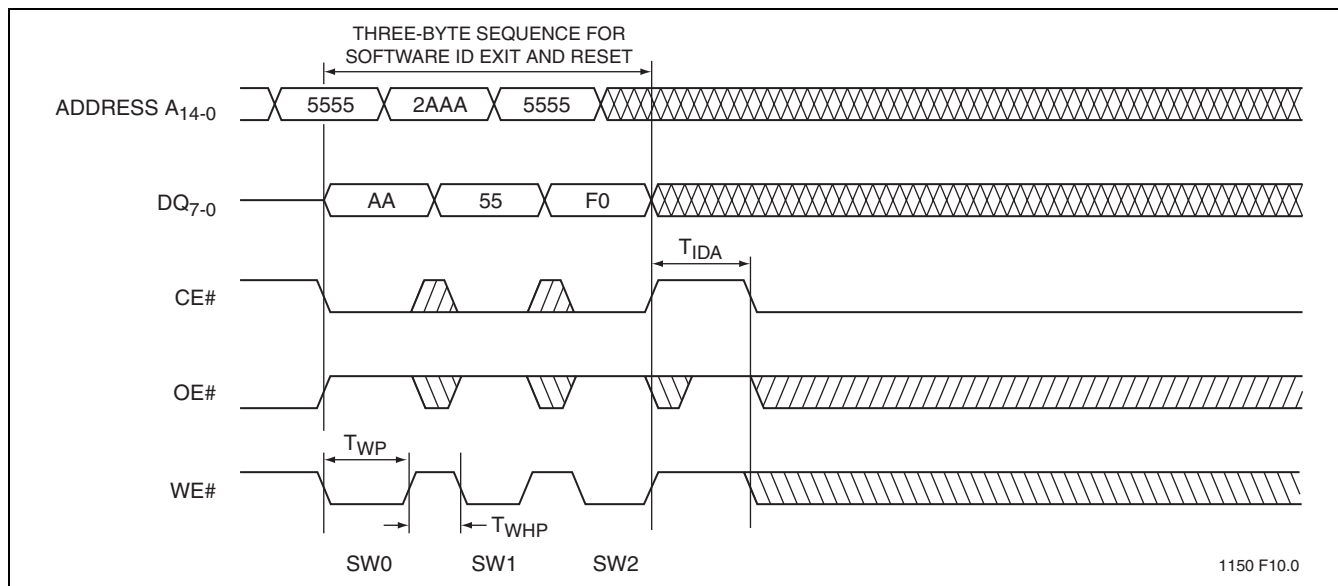


FIGURE 13: Software ID Entry and Read

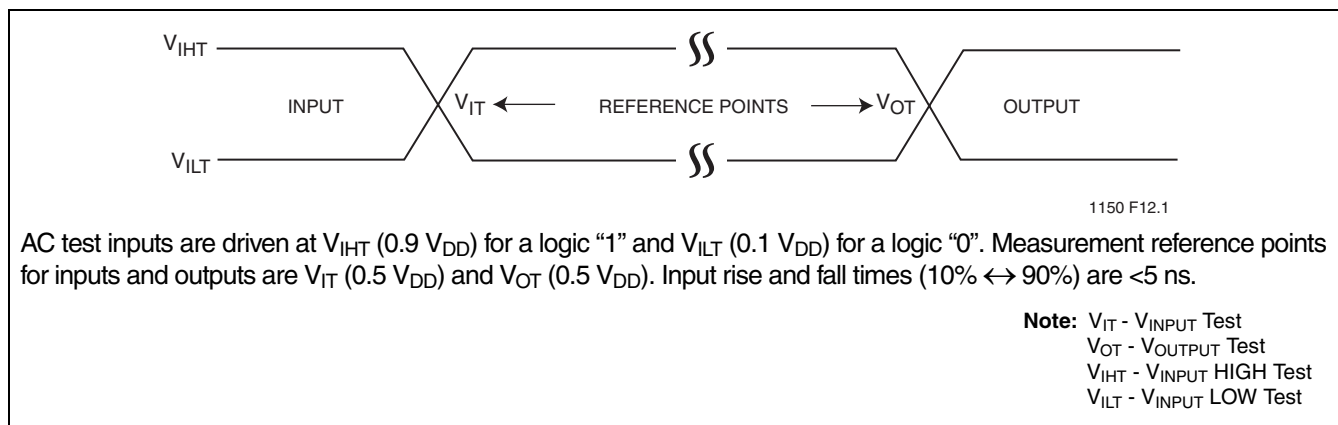


# 512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040 SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040

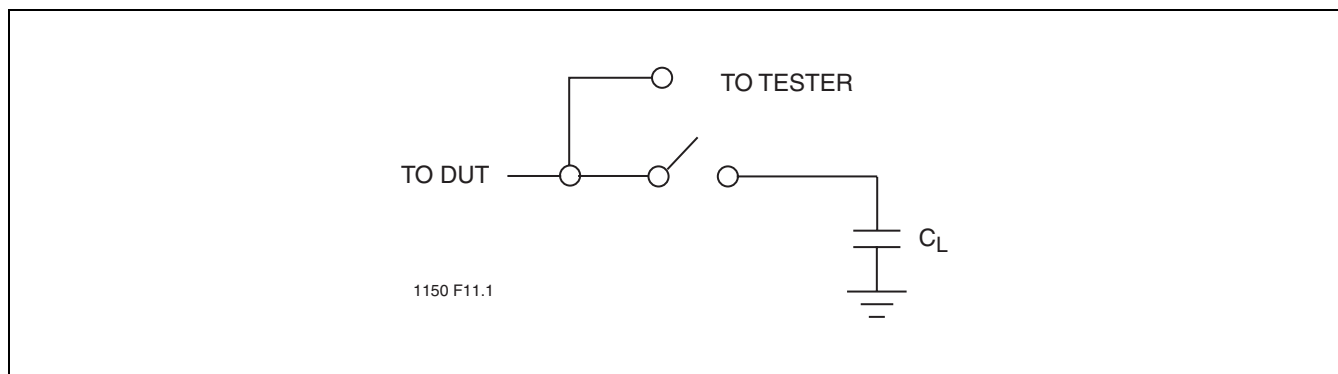
## Data Sheet



**FIGURE 14: Software ID Exit and Reset**



**FIGURE 15: AC Input/Output Reference Waveforms**



**FIGURE 16: A Test Load Example**

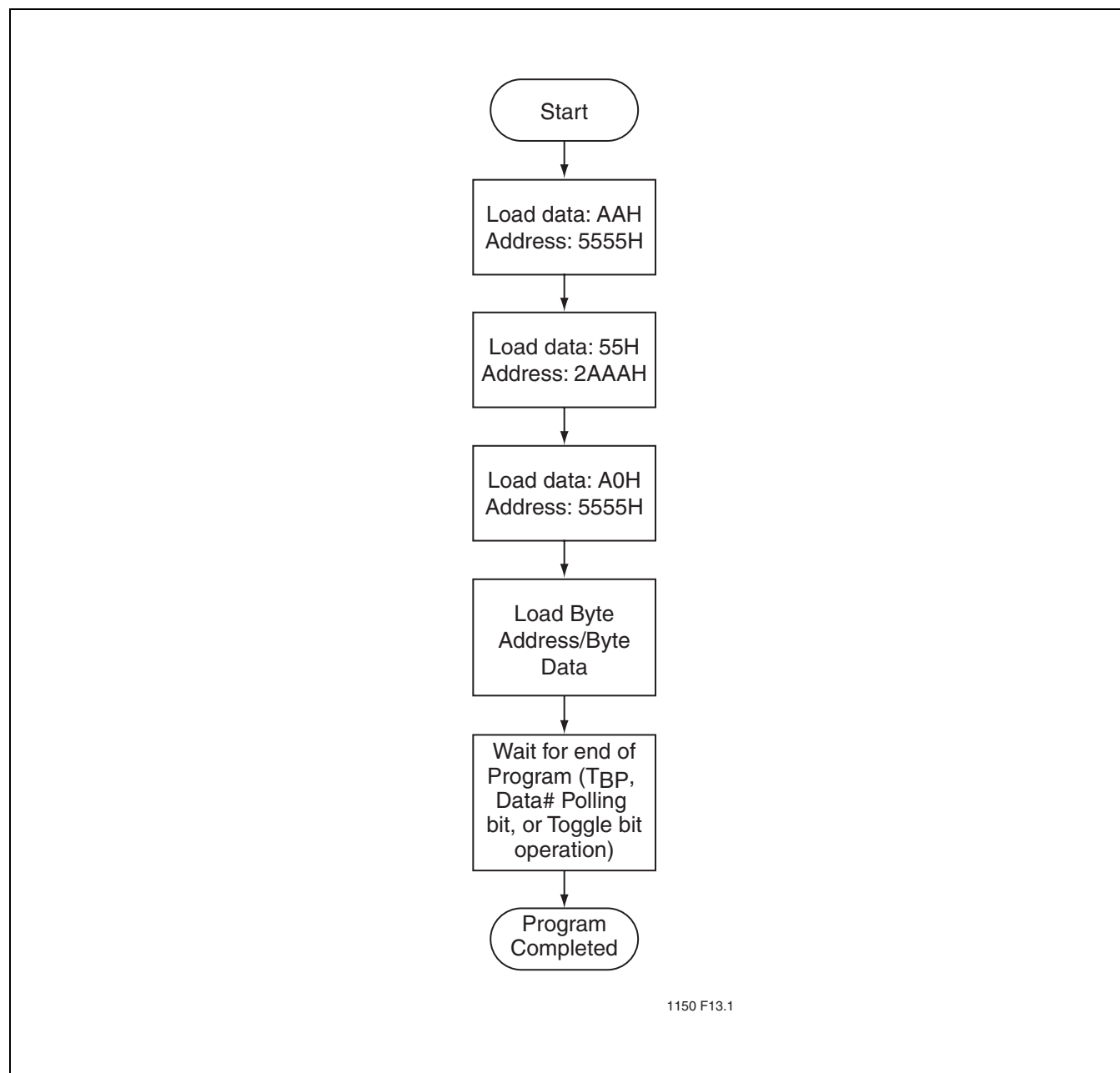


FIGURE 17: Byte-Program Algorithm

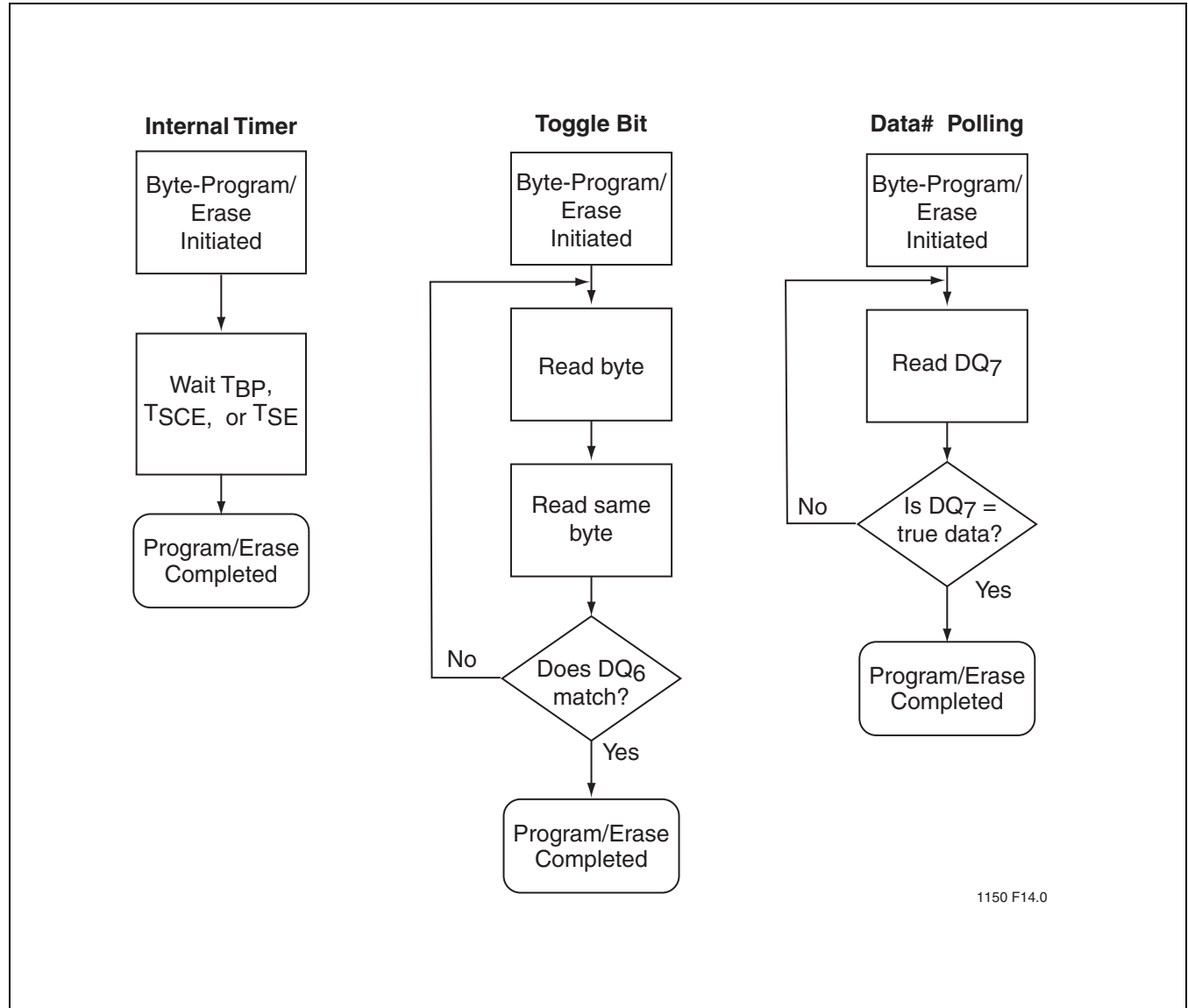


FIGURE 18: Wait Options



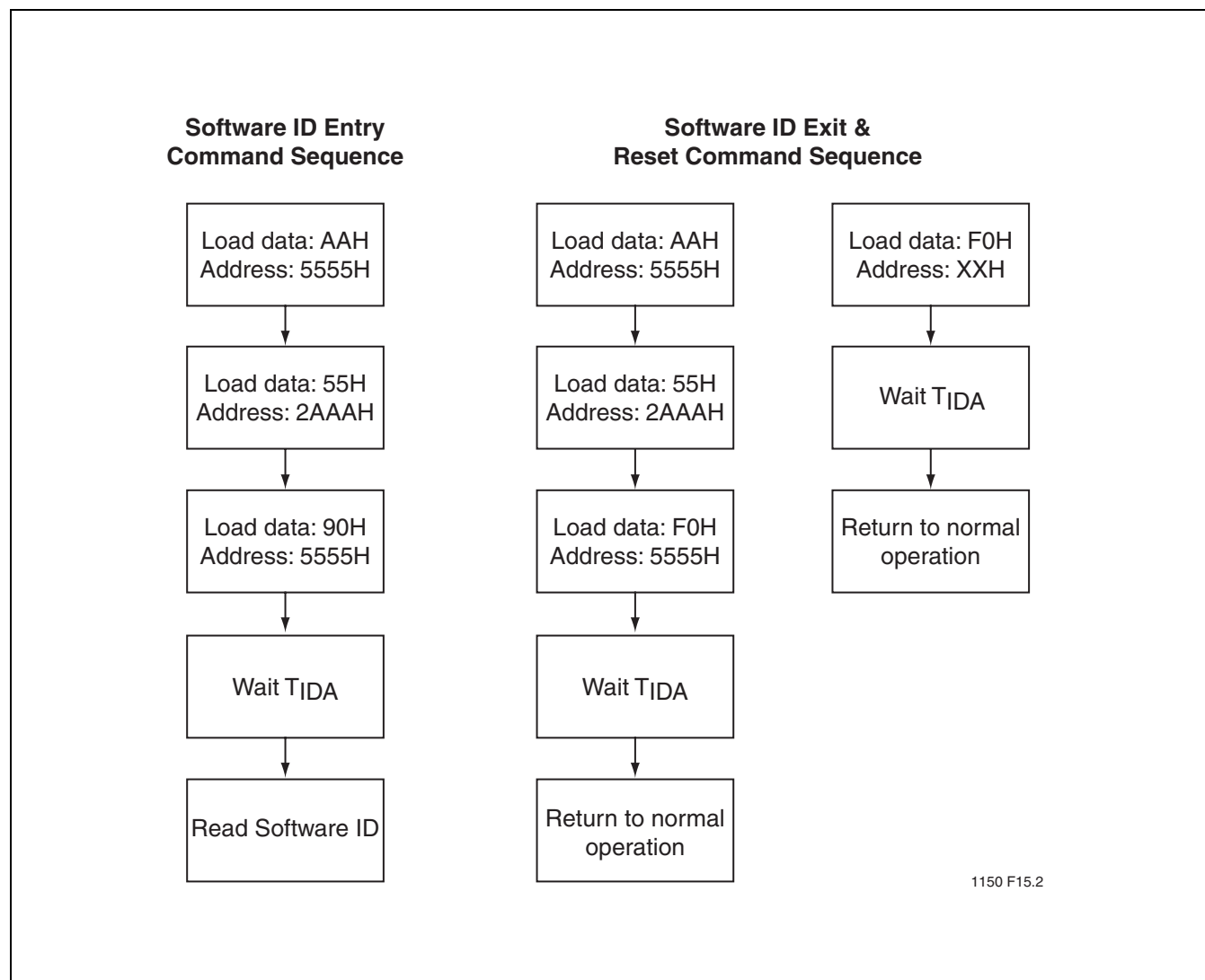


FIGURE 19: Software ID Command Flowcharts

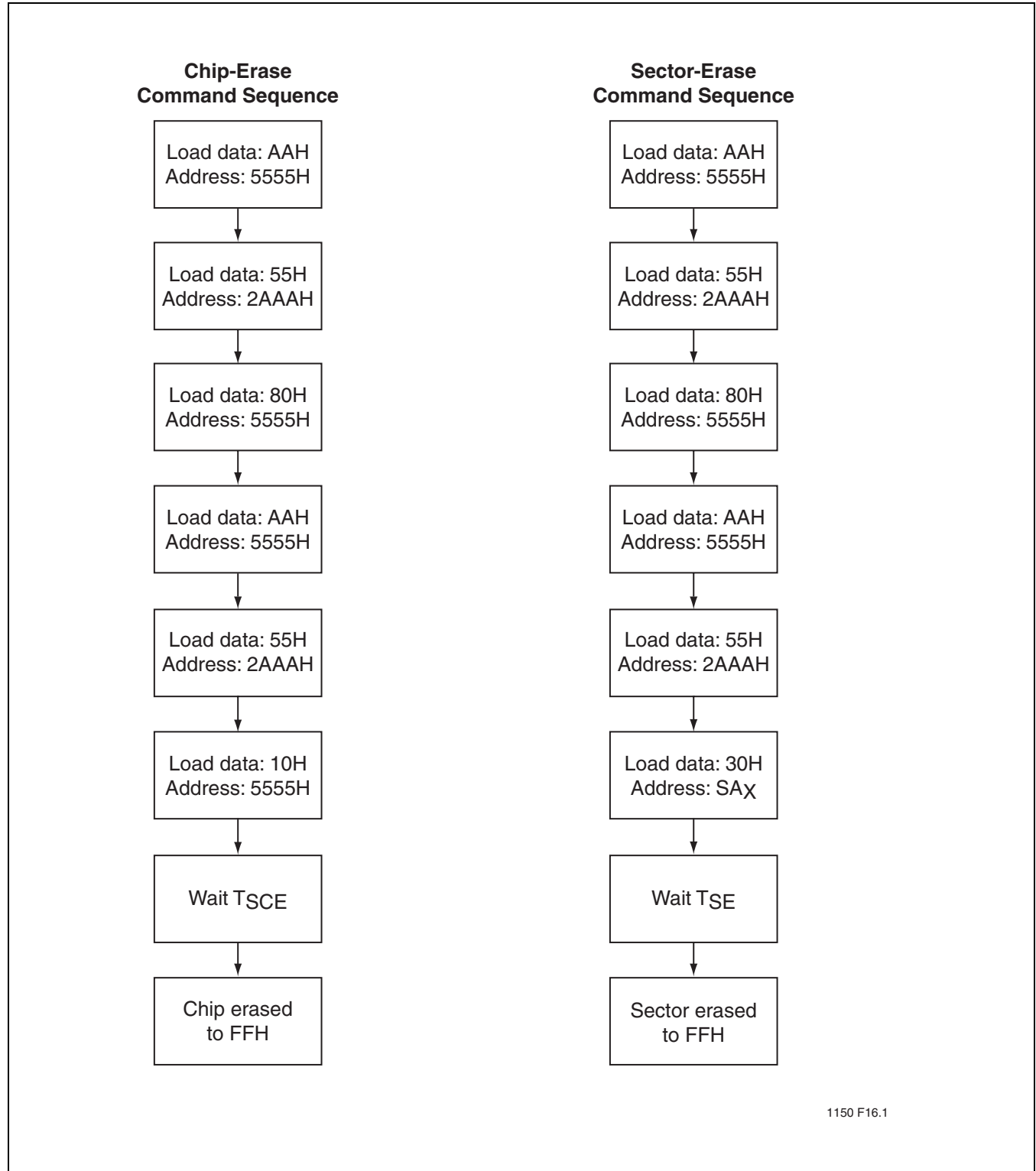
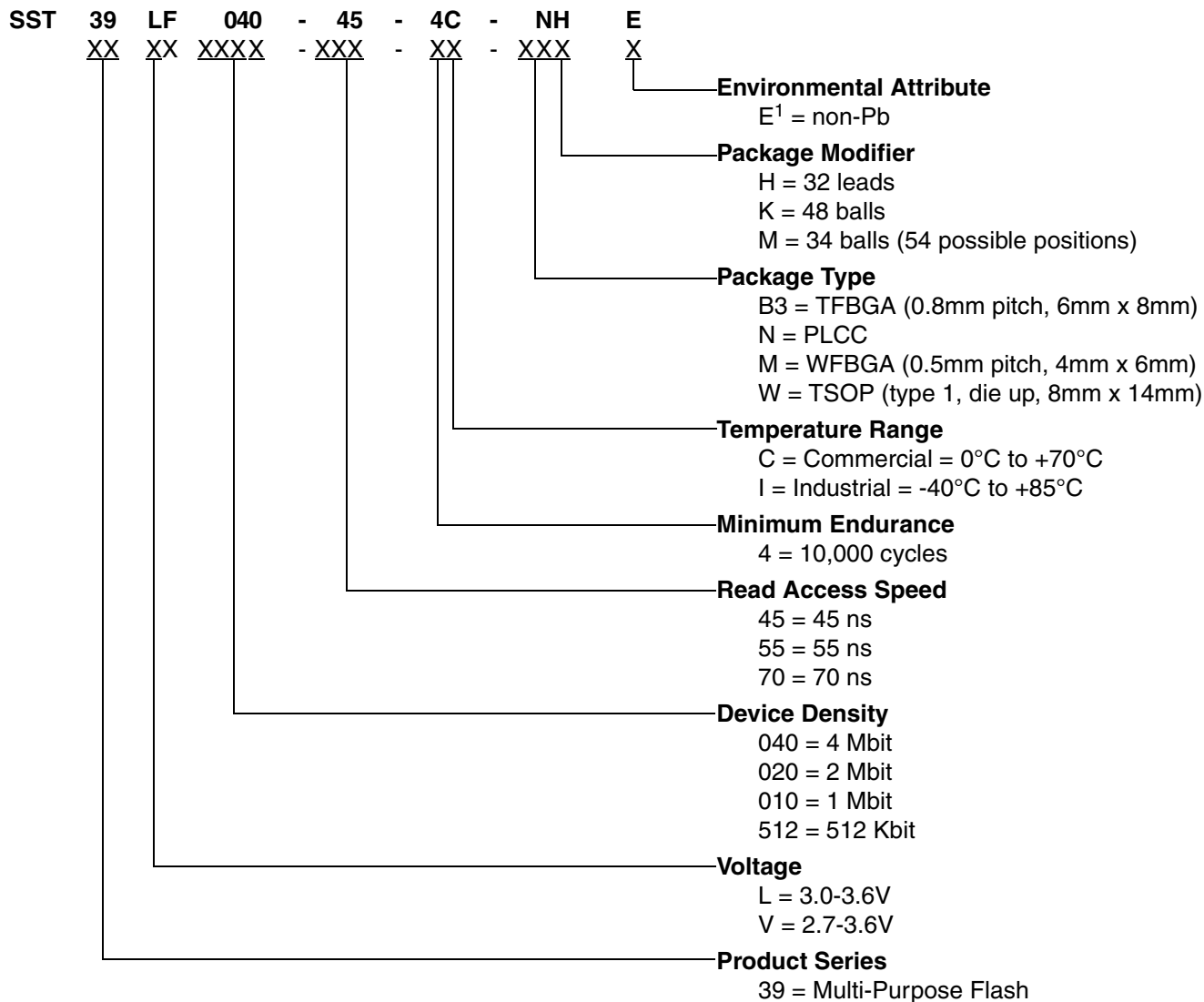


FIGURE 20: Erase Command Sequence



## PRODUCT ORDERING INFORMATION



1. Environmental suffix "E" denotes non-Pb solder. SST non-Pb solder devices are RoHS compliant.



**512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash**  
**SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040**  
**SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040**

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Data Sheet

**Valid combinations for SST39LF512**

SST39LF512-45-4C-NHE    SST39LF512-45-4C-WHE

**Valid combinations for SST39VF512**

SST39VF512-70-4C-NHE    SST39VF512-70-4C-WHE

SST39VF512-70-4I-NHE    SST39VF512-70-4I-WHE

**Valid combinations for SST39LF010**

SST39LF010-45-4C-NHE    SST39LF010-45-4C-WHE    SST39LF010-45-4C-B3KE    SST39LF010-45-4C-MME

**Valid combinations for SST39VF010**

SST39VF010-70-4C-NHE    SST39VF010-70-4C-WHE    SST39VF010-70-4C-B3KE

SST39VF010-70-4I-NHE    SST39VF010-70-4I-WHE    SST39VF010-70-4I-B3KE

**Valid combinations for SST39LF020**

SST39LF020-45-4C-NHE    SST39LF020-45-4C-WHE    SST39LF020-45-4C-B3KE    SST39LF020-45-4C-MME

SST39LF020-55-4C-NHE    SST39LF020-55-4C-WHE

**Valid combinations for SST39VF020**

SST39VF020-70-4C-NHE    SST39VF020-70-4C-WHE    SST39VF020-70-4C-B3KE

SST39VF020-70-4I-NHE    SST39VF020-70-4I-WHE    SST39VF020-70-4I-B3KE

**Valid combinations for SST39LF040**

SST39LF040-45-4C-NHE    SST39LF040-45-4C-WHE    SST39LF040-45-4C-B3KE

SST39LF040-55-4C-NHE    SST39LF040-55-4C-WHE

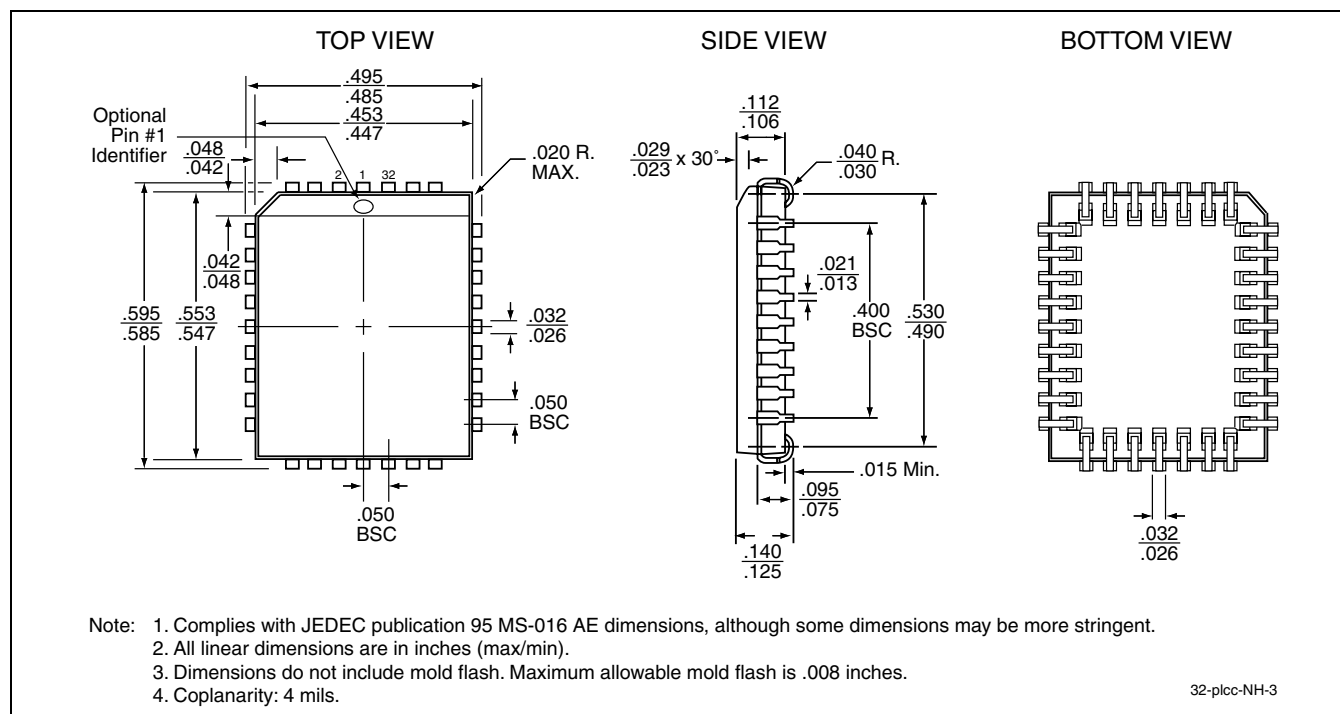
**Valid combinations for SST39VF040**

SST39VF040-70-4C-NHE    SST39VF040-70-4C-WHE    SST39VF040-70-4C-B3KE

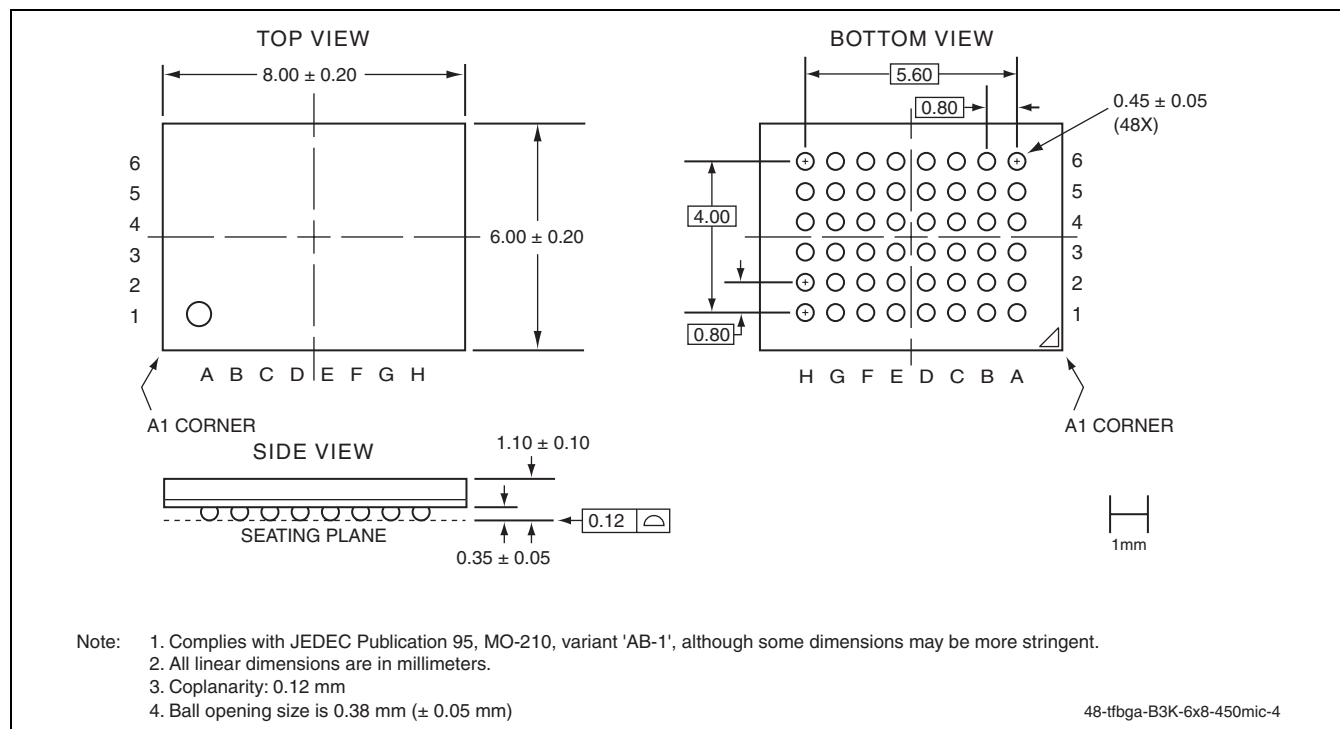
SST39VF040-70-4I-NHE    SST39VF040-70-4I-WHE    SST39VF040-70-4I-B3KE

**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.

## PACKAGING DIAGRAMS



**FIGURE 21: 32-lead Plastic Lead Chip Carrier (PLCC)**  
**SST Package Code: NH**

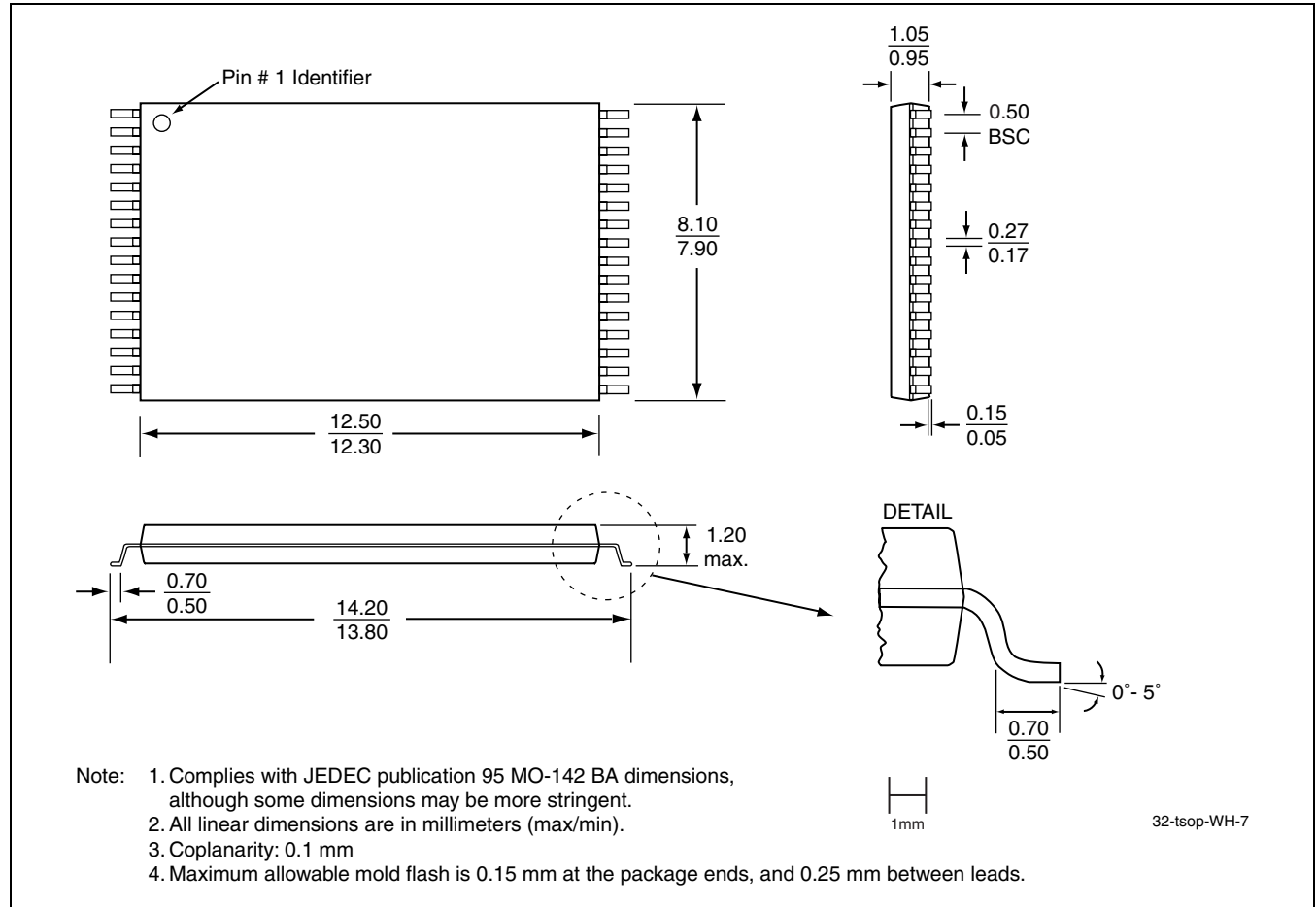


**FIGURE 22: 48-ball Thin-profile, Fine-pitch Ball Grid Array (TFBGA) 6mm x 8mm**  
**SST Package Code: B3K**

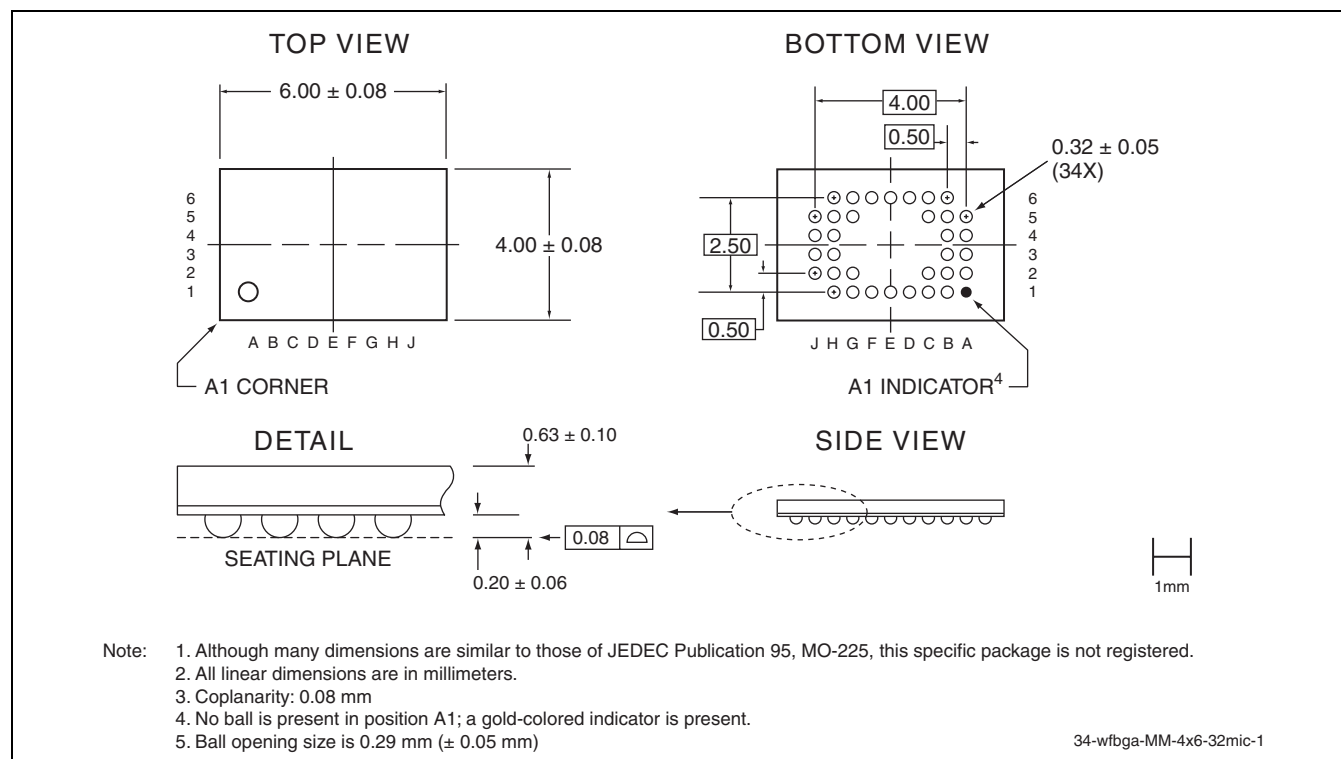


**512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash**  
**SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040**  
**SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040**

Data Sheet



**FIGURE 23: 32-lead Thin Small Outline Package (TSOP) 8mm x 14mm**  
**SST Package Code: WH**



**FIGURE 24: 34-ball Very-very-thin-profile, Fine-pitch Ball Grid Array (WFBGA) 4mm x 6mm x .63mm  
SST Package Code: MM**



**512 Kbit / 1 Mbit / 2 Mbit / 4 Mbit Multi-Purpose Flash**  
**SST39LF512 / SST39LF010 / SST39LF020 / SST39LF040**  
**SST39VF512 / SST39VF010 / SST39VF020 / SST39VF040**

Data Sheet

**TABLE 11: Revision History**

| Number | Description   | Date     |
|--------|---|----------|
| 01     | <ul style="list-style-type: none"><li>• 2000 Data Book</li></ul>  | Feb 2000 |
| 02     | <ul style="list-style-type: none"><li>• Changed speed from 45 ns to 55 ns for the SST39LF020 and SST39LF040</li></ul>   | Aug 2000 |
| 03     | <ul style="list-style-type: none"><li>• 2002 Data Book: Reintroduced the 45 ns parts for the SST39LF020 and SST39LF040</li></ul>  | Feb 2002 |
| 04     | <ul style="list-style-type: none"><li>• Added the B3K package for the 2 Mbit devices</li><li>• Added footnote in Table 5 to indicate I<sub>DD</sub> Write is 30 mA max for Erase operations in the Industrial temperature range.</li></ul>  | Oct 2002 |
| 05     | <ul style="list-style-type: none"><li>• Changes to Table 5 on page 8<ul style="list-style-type: none"><li>– Added footnote for MPF power usage and Typical conditions</li><li>– Clarified the Test Conditions for Power Supply Current and Read parameters</li><li>– Clarified I<sub>DD</sub> Write to be Program and Erase</li><li>– Corrected I<sub>DD</sub> Program and Erase from 20 mA to 30 mA</li></ul></li><li>• Part number changes - see page 20 for additional information</li></ul> | Mar 2003 |
| 06     | <ul style="list-style-type: none"><li>• Added new “MM” Micro-Package MPNs for 1M and 2M LF parts- see page 20</li></ul>   | Oct 2003 |
| 07     | <ul style="list-style-type: none"><li>• 2004 Data Book</li><li>• Added non-Pb MPNs and removed footnote (See page 20)</li><li>• Updated B3K and MM package diagrams</li></ul>   | Nov 2003 |
| 08     | <ul style="list-style-type: none"><li>• Added RoHS Compliant statement.</li><li>• Added 4 MBit to Figure 4.</li><li>• Revised Absolute Max Stress Ratings for Surface Mount Solder Reflow Temperature</li><li>• Removed SST39VFxxx-90 Timing Parameters from Figure 9.</li><li>• Added Footnote and removed Read Access Speed 90 = 90 to Product Ordering Information.</li><li>• Removed 90 part numbers Valid Combinations lists</li></ul>   | Dec 2005 |
| 09     | <ul style="list-style-type: none"><li>• Edited page Valid Combinations on page 21. Changed 39LF040-70-4C-B3KE to 39LF040-45-4C-B3KE</li></ul>   | Jan 2006 |
| 10     | <ul style="list-style-type: none"><li>• Removed leaded parts</li></ul>  | Nov 2008 |
| 11     | <ul style="list-style-type: none"><li>• Added package YME</li></ul>   | Feb 2009 |
| 12     | <ul style="list-style-type: none"><li>• Revised “Product Ordering Information” on page 19</li></ul>   | Apr 2009 |
| 13     | <ul style="list-style-type: none"><li>• Changed endurance from 10,000 to 100,000 in Product Description, page 1</li></ul>   | Sep 2009 |
| 14     | <ul style="list-style-type: none"><li>• EOL of SST39LF010-45-4C-YME. Replacement part is SST39LF010-45-4C-MME in this document.</li><li>• Removed all references to the YME package.</li></ul>  | Jan 2010 |



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