

# Multi-Purpose Flash Plus + SRAM ComboMemory

SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281

SST32HF1621C / SST32HF1641C / SST32HF3241C



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## FEATURES:

- **ComboMemories organized as:**
  - SST32HF1621C: 1M x16 Flash + 128K x16 SRAM
  - SST32HF1641x: 1M x16 Flash + 256K x16 SRAM
  - SST32HF1681: 1M x16 Flash + 256K x16 SRAM
  - SST32HF3241x: 2M x16 Flash + 256K x16 SRAM
  - SST32HF3281: 2M x16 Flash + 512K x16 SRAM
- **Single 2.7-3.3V Read and Write Operations**
- **Concurrent Operation**
  - Read from or Write to SRAM while Erase/Program Flash
- **Superior Reliability**
  - Endurance: 100,000 Cycles (typical)
  - Greater than 100 years Data Retention
- **Low Power Consumption:**
  - Active Current: 15 mA (typical) for Flash or SRAM Read
  - Standby Current:
    - SST32HFx1: 60  $\mu$ A (typical)
    - SST32HFx1C: 12  $\mu$ A (typical)
- **Flexible Erase Capability**
  - Uniform 2 KWord sectors
  - Uniform 32 KWord size blocks
- **Erase-Suspend/Erase-Resume Capabilities**
- **Security-ID Feature**
  - SST: 128 bits; User: 128 bits
- **Hardware Block-Protection/WP# Input Pin**
  - Bottom Block-Protection (bottom 32 KWord)
- **Fast Read Access Times:**
  - Flash: 70 ns
  - SRAM: 70 ns
- **Latched Address and Data for Flash**
- **Flash Fast Erase and Word-Program:**
  - Sector-Erase Time: 18 ms (typical)
  - Block-Erase Time: 18 ms (typical)
  - Chip-Erase Time: 40 ms (typical)
  - Word-Program Time: 7  $\mu$ s (typical)
- **Flash Automatic Erase and Program Timing**
  - Internal V<sub>PP</sub> Generation
- **Flash End-of-Write Detection**
  - Toggle Bit
  - Data# Polling
- **CMOS I/O Compatibility**
- **JEDEC Standard Command Set**
- **Package Available**
  - 63-ball LFBGA (8mm x 10mm x 1.4mm)
  - 62-ball LFBGA (8mm x 10mm x 1.4mm)
- **All non-Pb (lead-free) devices are RoHS compliant**

## PRODUCT DESCRIPTION

The SST32HFx1/x1C ComboMemory devices integrate a CMOS flash memory bank with a CMOS SRAM memory bank in a Multi-Chip Package (MCP), manufactured with SST's proprietary, high performance SuperFlash technology. The SST32HF16x1/32x1 devices use a PseudoSRAM. The SST32HF16x1C/32x1C devices use standard SRAM.

Featuring high performance Word-Program, the flash memory bank provides a maximum Word-Program time of 7  $\mu$ sec. To protect against inadvertent flash write, the SST32HFx1/x1C devices contain on-chip hardware and software data protection schemes. The SST32HFx1/x1C devices offer a guaranteed endurance of 10,000 cycles. Data retention is rated at greater than 100 years.

The SST32HFx1/x1C devices consist of two independent memory banks with respective bank enable signals. The Flash and SRAM memory banks are superimposed in the same memory address space. Both memory banks share common address lines, data lines, WE# and OE#. The memory bank selection is done by memory bank enable

signals. The SRAM bank enable signal, BES# selects the SRAM bank. The flash memory bank enable signal, BEF# selects the flash memory bank. The WE# signal has to be used with Software Data Protection (SDP) command sequence when controlling the Erase and Program operations in the flash memory bank. The SDP command sequence protects the data stored in the flash memory bank from accidental alteration.

The SST32HFx1/x1C provide the added functionality of being able to simultaneously read from or write to the SRAM bank while erasing or programming in the flash memory bank. The SRAM memory bank can be read or written while the flash memory bank performs Sector-Erase, Bank-Erase, or Word-Program concurrently. All flash memory Erase and Program operations will automatically latch the input address and data signals and complete the operation in background without further input stimulus requirement. Once the internally controlled Erase or Program cycle in the flash bank has commenced, the SRAM bank can be accessed for Read or Write.



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The SST32HFx1/x1C devices are suited for applications that use both flash memory and (P)SRAM memory to store code or data. For systems requiring low power and small form factor, the SST32HFx1/x1C devices significantly improve performance and reliability while lowering power consumption when compared with multiple chip solutions. The SST32HFx1/x1C inherently use less energy during Erase and Program operations 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, 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.

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.

**Device Operation**

The SST32HFx1/x1C use BES1#, BES2 and BEF# to control operation of either the flash or the SRAM memory bank. When BEF# is low, the flash bank is activated for Read, Program or Erase operation. When BES1# is low, and BES2 is high the SRAM is activated for Read and Write operation. BEF# and BES1# cannot be at low level, and BES2 cannot be at high level at the same time. **If all bank enable signals are asserted, bus contention will result and the device may suffer permanent damage.** All address, data, and control lines are shared by flash and SRAM memory banks which minimizes power consumption and loading. The device goes into standby when BEF# and BES1# bank enables are raised to V<sub>IHC</sub> (Logic High) or when BEF# is high and BES2 is low.

**Concurrent Read/Write Operation**

The SST32HFx1/x1C provide the unique benefit of being able to read from or write to SRAM, while simultaneously erasing or programming the flash. This allows data alteration code to be executed from SRAM, while altering the data in flash. See Figure 26 for a flowchart. The following table lists all valid states.

**CONCURRENT READ/WRITE STATE TABLE**

| Flash         | SRAM  |
|---------------|-------|
| Program/Erase | Read  |
| Program/Erase | Write |

The device will ignore all SDP commands when an Erase or Program operation is in progress. Note that Product Identification commands use SDP; therefore, these commands will also be ignored while an Erase or Program operation is in progress.

**Flash Read Operation**

The Read operation of the SST32HFx1/x1C devices is controlled by BEF# and OE#. Both have to be low, with WE# high, for the system to obtain data from the outputs. BEF# is used for flash memory bank selection. When BEF# 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 OE# is high. Refer to Figure 6 for further details.



## Flash Word-Program Operation

The flash memory bank of the SST32HFx1/x1C devices is programmed on a word-by-word basis. Before Program operations, the memory must be erased first. The Program operation consists of 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 BEF# or WE#, whichever occurs last. The data is latched on the rising edge of either BEF# or WE#, whichever occurs last. The third step is the internal Program operation which is initiated after the rising edge of the fourth WE# or BEF#, whichever occurs first. The Program operation, once initiated, will be completed, within 10  $\mu$ s. See Figures 7 and 8 for WE# and BEF# controlled Program operation timing diagrams and Figure 21 for flowcharts. During the Program operation, the only valid flash Read operations are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. During the command sequence, WP# should be statically held high or low. Any SDP commands loaded during the internal Program operation will be ignored.

## Flash Sector/Block-Erase Operation

The Flash Sector/Block-Erase operation allows the system to erase the device on a sector-by-sector (or block-by-block) basis. The SST32HFx1/x1C offer 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 address lines A<sub>MS</sub>-A<sub>11</sub> are used to determine the sector address. 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 address lines A<sub>MS</sub>-A<sub>15</sub> are used to determine the block address. 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 12 and 13 for timing waveforms. Any commands issued during the Sector- or Block-Erase operation are ignored, WP# should be statically held high or low.

## Erase-Suspend/Erase-Resume Commands

The Erase-Suspend operation temporarily suspends a Sector- or Block-Erase operation thus allowing data to be read from any memory location, or program data into any sector/block that is not suspended for an Erase operation. The operation is executed by issuing one byte command sequence with Erase-Suspend command (B0H). The device automatically enters read mode typically within 20  $\mu$ s after the Erase-Suspend command had been issued. Valid data can be read from any sector or block that is not suspended from an Erase operation. Reading at address location within erase-suspended sectors/blocks will output DQ<sub>2</sub> toggling and DQ<sub>6</sub> at "1". While in Erase-Suspend mode, a Word-Program operation is allowed except for the sector or block selected for Erase-Suspend.

To resume Sector-Erase or Block-Erase operation which has been suspended the system must issue Erase Resume command. The operation is executed by issuing one byte command sequence with Erase Resume command (30H) at any address in the last Byte sequence.

## Flash Chip-Erase Operation

The SST32HFx1/x1C provide 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 BEF#, whichever occurs first. During the Erase operation, the only valid read is Toggle Bit or Data# Polling. See Table 5 for the command sequence, Figure 10 for timing diagram, and Figure 25 for the flowchart. Any commands issued during the Chip-Erase operation are ignored.

## Write Operation Status Detection

The SST32HFx1/x1C 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.



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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.

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

When the SST32HFx1/x1C flash memory banks 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 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 μs. 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 the fourth WE# (or BEF#) pulse for Program operation. For Sector- or Block-Erase, the Data# Polling is valid after the rising edge of the sixth WE# (or BEF#) pulse. See Figure 9 for Data# Polling timing diagram and Figure 22 for a flowchart.

**Toggle Bits (DQ<sub>6</sub> and DQ<sub>2</sub>)**

During the internal Program or Erase operation, any consecutive attempts to read DQ<sub>6</sub> will produce alternating "1"s and "0"s, 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. For Sector-, Block-, or Chip-Erase, the toggle bit (DQ<sub>6</sub>) is valid after the rising edge of sixth WE# (or BEF#) pulse. DQ<sub>6</sub> will be set to "1" if a Read operation is attempted on an Erase-Suspended Sector/Block. If Program operation is initiated in a sector/block not selected in Erase-Suspend mode, DQ<sub>6</sub> will toggle.

An additional Toggle Bit is available on DQ<sub>2</sub>, which can be used in conjunction with DQ<sub>6</sub> to check whether a particular sector is being actively erased or erase-suspended. Table 1 shows detailed status bits information. The Toggle Bit (DQ<sub>2</sub>) is valid after the rising edge of the last WE# (or BEF#) pulse of Write operation. See Figure 10 for Toggle Bit timing diagram and Figure 22 for a flowchart.

**TABLE 1: WRITE OPERATION STATUS**

| Status             |   | DQ <sub>7</sub>   | DQ <sub>6</sub> | DQ <sub>2</sub> |
|--------------------|---|-------------------|-----------------|-----------------|
| Normal Operation   | Standard Program                            | DQ <sub>7</sub> # | Toggle          | No Toggle       |
|                    | Standard Erase                              | 0                 | Toggle          | Toggle          |
| Erase-Suspend Mode | Read from Erase-Suspended Sector/Block      | 1                 | 1               | Toggle          |
|                    | Read from Non- Erase-Suspended Sector/Block | Data              | Data            | Data            |
|                    | Program                                     | DQ <sub>7</sub> # | Toggle          | N/A             |

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**Note:** DQ<sub>7</sub> and DQ<sub>2</sub> require a valid address when reading status information.

**Flash Memory Data Protection**

The SST32HFx1/x1C flash memory bank provides both hardware and software features to protect nonvolatile data from inadvertent writes.

**Flash Hardware Data Protection**

Noise/Glitch Protection: A WE# or BEF# 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, BEF# high, or WE# high will inhibit the flash Write operation. This prevents inadvertent writes during power-up or power-down.



## Hardware Block Protection

The SST32HFx1/x1C support bottom hardware block protection, which protects the bottom 32 KWord block of the device. The Boot Block address is 000000H-007FFFH. Program and Erase operations are prevented on the 32 KWord when WP# is low. If WP# is left floating, it is internally held high via a pull-up resistor, and the Boot Block is unprotected, enabling Program and Erase operations on that block.

## Hardware Reset (RST#)

The RST# pin provides a hardware method of resetting the device to read array data. When the RST# pin is held low for at least  $T_{RP}$ , any in-progress operation will terminate and return to Read mode. When no internal Program/Erase operation is in progress, a minimum period of  $T_{RHR}$  is required after RST# is driven high before a valid Read can take place (see Figure 17).

The Erase or Program operation that has been interrupted needs to be reinitiated after the device resumes normal operation mode to ensure data integrity.

## Flash Software Data Protection (SDP)

The SST32HFx1/x1C provide the JEDEC approved software data protection scheme for all flash memory bank data alteration operations, 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. The SST32HFx1/x1C devices are shipped with the software data protection permanently enabled. See Table 5 for the specific software command codes. During SDP command sequence, invalid commands will abort the device to Read mode, within  $T_{RC}$ . The contents of DQ<sub>15</sub>-DQ<sub>8</sub> can be  $V_{IL}$  or  $V_{IH}$ , but no other value, during any SDP command sequence.

## SRAM Read

The SRAM Read operation of the SST32HFx1/x1C is controlled by OE# and BES1#, both have to be low with WE# and BES2 high for the system to obtain data from the outputs. BES1# and BES2 are used for SRAM bank selection. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when OE# is high. Refer to the Read cycle timing diagram, Figure 3, for further details.

## SRAM Write

The SRAM Write operation of the SST32HFx1/x1C is controlled by WE# and BES1#, both have to be low, BES2 must be high for the system to write to the SRAM. During the Word-Write operation, the addresses and data are referenced to the rising edge of either BES1#, WE#, or the falling edge of BES2 whichever occurs first. The write time is measured from the last falling edge of BES#1 or WE# or the rising edge of BES2 to the first rising edge of BES1#, or WE# or the falling edge of BES2. Refer to the Write cycle timing diagrams, Figures 4 and 5, for further details.

## Product Identification

The Product Identification mode identifies the devices as the SST32HFx1/x1C and manufacturer as SST. **This mode may be accessed by software operations only. The hardware device ID Read operation, which is typically used by programmers, cannot be used on this device because of the shared lines between flash and SRAM in the multi-chip package. Therefore, application of high voltage to pin A<sub>9</sub> may damage this device.** 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 Tables 4 and 5 for software operation, Figure 14 for the software ID entry and read timing diagram and Figure 23 for the ID entry command sequence flowchart.

**TABLE 2: PRODUCT IDENTIFICATION**

|                   | Address | Data  |
|-------------------|---------|-------|
| Manufacturer's ID | 0000H   | BFH   |
| Device ID         |         |       |
| SST32HF16x1x      | 0001H   | 234BH |
| SST32HF32x1x      | 0001H   | 235BH |

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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. Exiting is accomplished by issuing the Exit ID command sequence, which returns the device to the Read operation. Please note that the software reset command is ignored during an internal Program or Erase operation. This command may also be used to reset the device to Read mode after any inadvertent transient condition that apparently causes the device to behave abnormally, e.g. not read correctly. See Table 5 for software command codes, Figure 15 for timing waveform and Figure 23 for a flowchart.

## Security ID

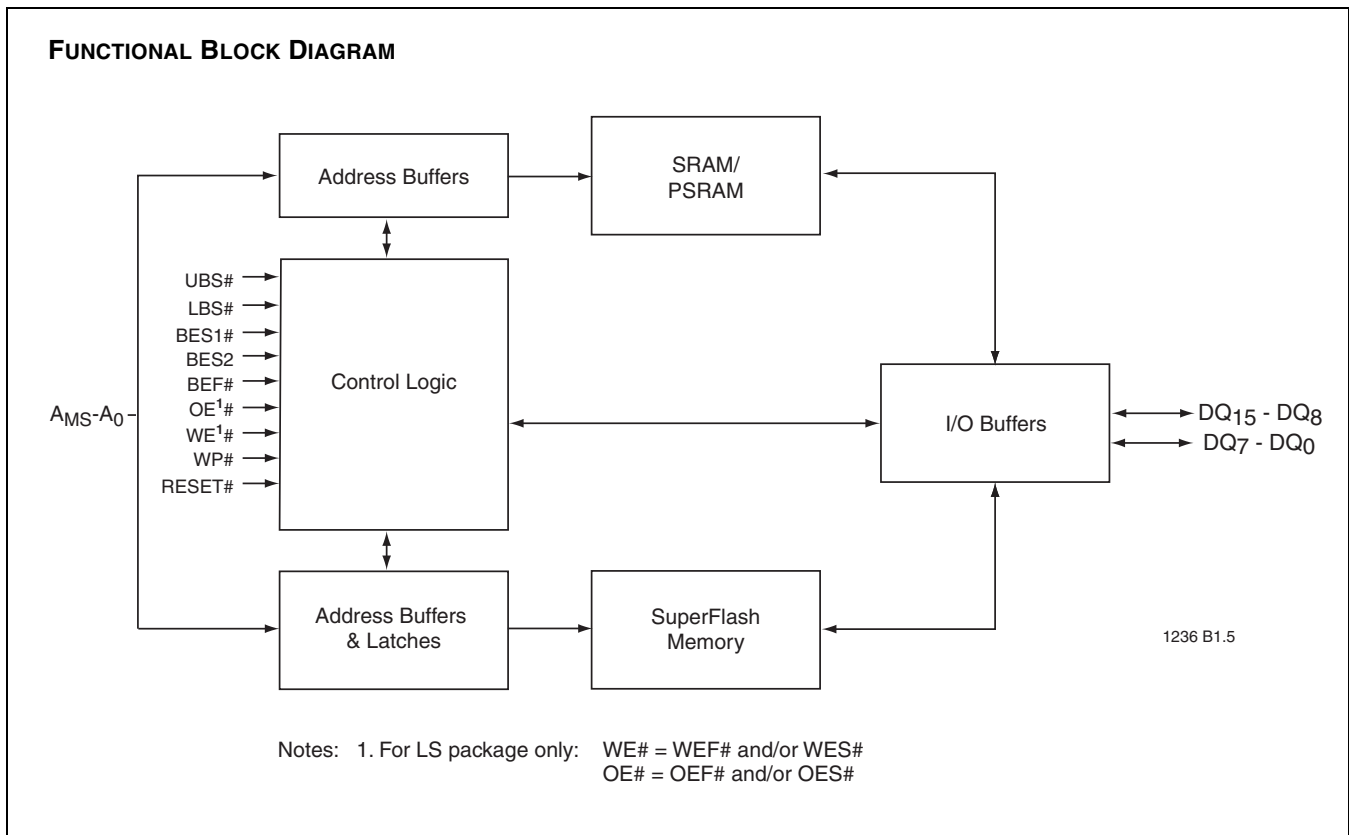
The SST32HFx1/x1C devices offer a 256-bit Security ID space. The Secure ID space is divided into two 128-bit segments - one factory programmed segment and one user programmed segment. The first segment is programmed and locked at SST with a random 128-bit number. The user segment is left un-programmed for the customer to program as desired.

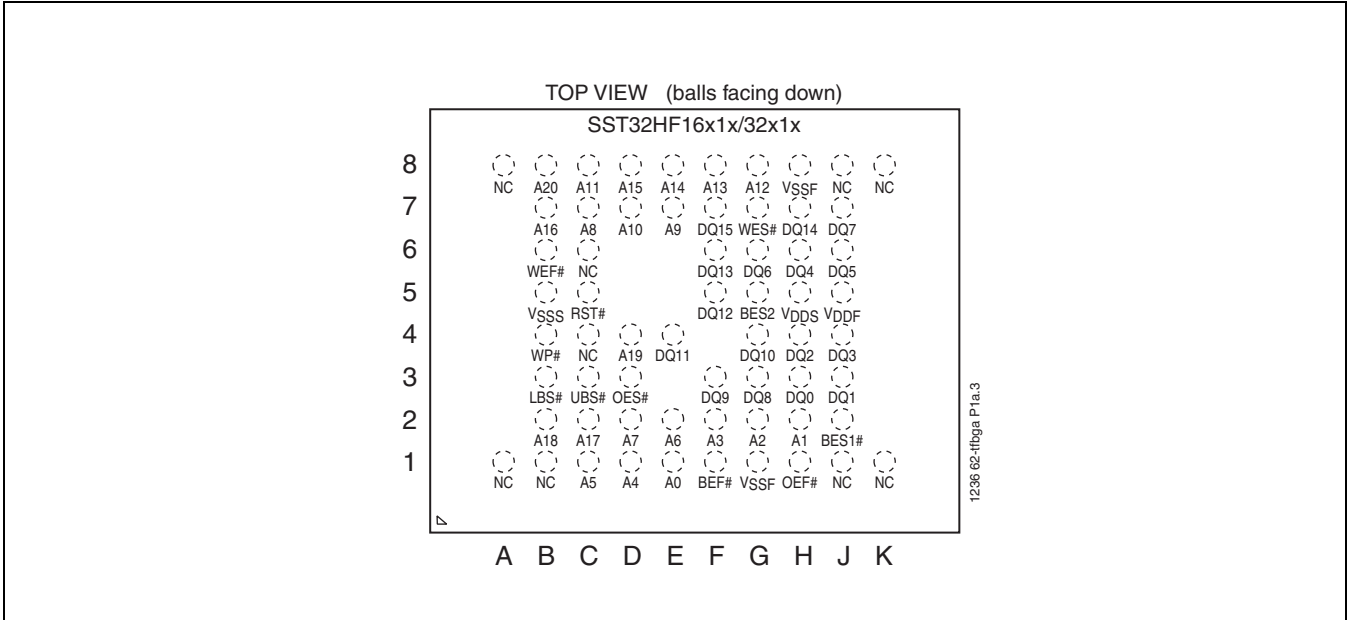
To program the user segment of the Security ID, the user must use the Security ID Word-Program command. To detect end-of-write for the SEC ID, read the toggle bits. Do not use Data# Polling. Once this is complete, the Sec ID should be locked using the User Sec ID Program Lock-Out. This disables any future corruption of this space. Note that regardless of whether or not the Sec ID is locked, neither Sec ID segment can be erased.

The Secure ID space can be queried by executing a three-byte command sequence with Enter Sec ID command (88H) at address 5555H in the last byte sequence. To exit this mode, the Exit Sec ID command should be executed. Refer to Table 5 for more details.

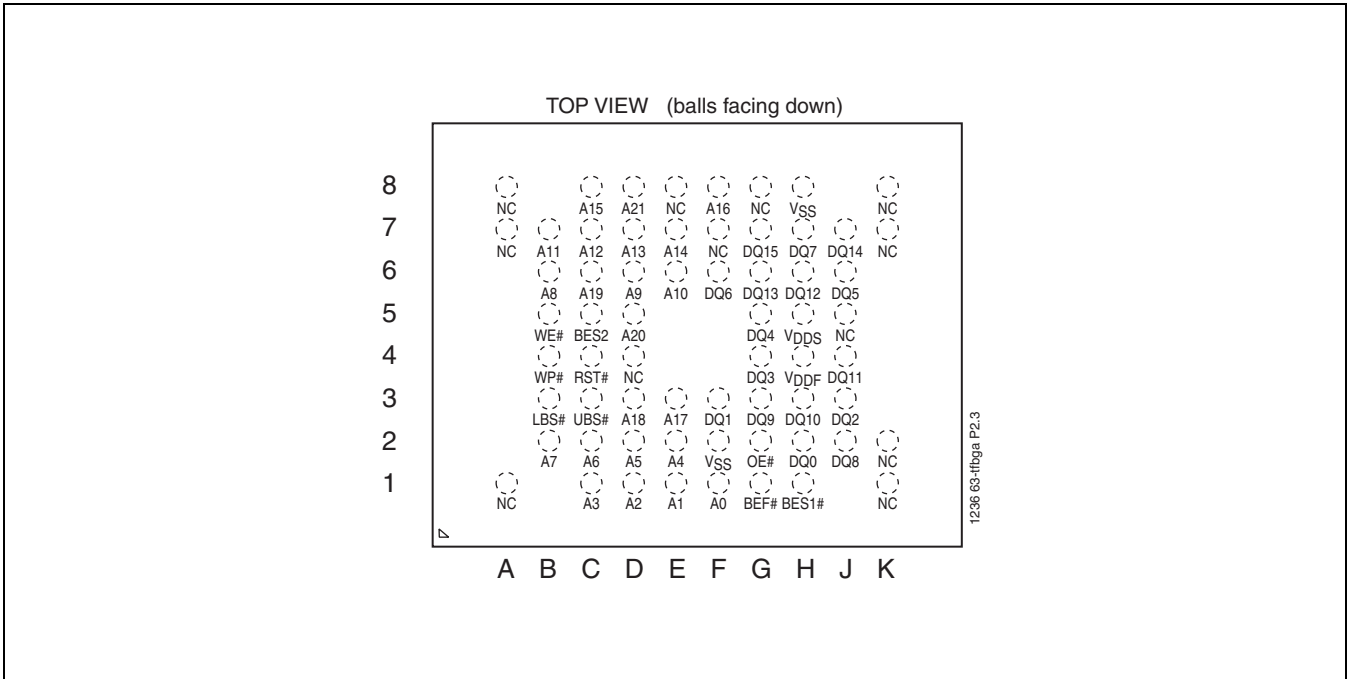
## Design Considerations

SST recommends a high frequency 0.1  $\mu$ F ceramic capacitor to be placed as close as possible between  $V_{DD}$  and  $V_{SS}$ , e.g., less than 1 cm away from the  $V_{DD}$  pin of the device. Additionally, a low frequency 4.7  $\mu$ F electrolytic capacitor from  $V_{DD}$  to  $V_{SS}$  should be placed within 1 cm of the  $V_{DD}$  pin.





**FIGURE 1: PIN ASSIGNMENTS FOR 62-BALL LFBGA (8MM X 10MM)**



**FIGURE 2: PIN ASSIGNMENTS FOR 63-BALL LFBGA (8MM X 10MM)**



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**TABLE 3: PIN DESCRIPTION**

| Symbol              | Pin Name                  | Functions  |
|---------------------|---------------------------|--|
| $A_{MS}^1$ to $A_0$ | Address Inputs            | To provide flash address, $A_{MS}-A_0$ .<br>To provide SRAM address, $A_{MS}-A_0$  |
| $DQ_{15}-DQ_0$      | Data Inputs/Outputs       | To output data during Read cycles and receive input data during Write cycles. Data is internally latched during a flash Erase/Program cycle. The outputs are in tri-state when OE# is high or BES1# is high or BES2 is low and BEF# is high. |
| BEF#                | Flash Memory Bank Enable  | To activate the Flash memory bank when BEF# is low   |
| BES1#               | SRAM Memory Bank Enable   | To activate the SRAM memory bank when BES1# is low   |
| BES2                | SRAM Memory Bank Enable   | To activate the SRAM memory bank when BES2 is high   |
| OE# <sup>2</sup>    | Output Enable             | To gate the data output buffers for Flash <sup>2</sup> only  |
| OES# <sup>2</sup>   | Output Enable             | To gate the data output buffers for SRAM <sup>2</sup> only   |
| WEF# <sup>2</sup>   | Write Enable              | To control the Write operations for Flash <sup>2</sup> only  |
| WES# <sup>2</sup>   | Write Enable              | To control the Write operations for SRAM <sup>2</sup> only   |
| OE#                 | Output Enable             | To gate the data output buffers  |
| WE#                 | Write Enable              | To control the Write operations  |
| UBS#                | Upper Byte Control (SRAM) | To enable $DQ_{15}-DQ_8$   |
| LBS#                | Lower Byte Control (SRAM) | To enable $DQ_7-DQ_0$  |
| WP#                 | Write Protect             | To protect and unprotect sectors from Erase or Program operation   |
| RST#                | Reset                     | To Reset and return the device to Read mode  |
| $V_{SS}^2$          | Ground                    | Flash <sup>2</sup> only  |
| $V_{SSS}^2$         | Ground                    | SRAM <sup>2</sup> only   |
| $V_{SS}$            | Ground                    |  |
| $V_{DDF}$           | Power Supply (Flash)      | 2.7-3.3V Power Supply to Flash only  |
| $V_{DDs}$           | Power Supply (SRAM)       | 2.7-3.3V Power Supply to SRAM only   |
| NC                  | No Connection             | Unconnected pins   |

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1.  $A_{MS}$  = Most Significant Address  
 $A_{MS} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x
2. LS package only



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**TABLE 4: OPERATIONAL MODES SELECTION<sup>1</sup>**

| Mode                                | BEF#            | BES1#           | BES2 <sup>2</sup> | OE# <sup>3</sup> | WE# <sup>3</sup> | LBS#            | UBS#            | DQ <sub>0-7</sub>  | DQ <sub>8-15</sub> |
|-------------------------------------|-----------------|-----------------|-------------------|------------------|------------------|-----------------|-----------------|--|--------------------|
| Full Standby                        | V <sub>IH</sub> | V <sub>IH</sub> | X                 | X                | X                | X               | X               | HIGH-Z   | HIGH-Z             |
|                                     |                 | X               | V <sub>IL</sub>   | X                | X                | X               | X               |  |                    |
| Output Disable                      | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub>   | V <sub>IH</sub>  | V <sub>IH</sub>  | X               | X               | HIGH-Z   | HIGH-Z             |
|                                     |                 | V <sub>IL</sub> | V <sub>IH</sub>   | X                | X                | V <sub>IH</sub> | V <sub>IH</sub> |  |                    |
|                                     | V <sub>IL</sub> | V <sub>IH</sub> | X                 | V <sub>IH</sub>  | V <sub>IH</sub>  | X               | X               | HIGH-Z   | HIGH-Z             |
|                                     |                 | X               | V <sub>IL</sub>   |                  |                  |                 |                 |  |                    |
| Flash Read                          | V <sub>IL</sub> | V <sub>IH</sub> | X                 | V <sub>IL</sub>  | V <sub>IH</sub>  | X               | X               | D <sub>OUT</sub>   | D <sub>OUT</sub>   |
|                                     |                 | X               | V <sub>IL</sub>   |                  |                  |                 |                 |  |                    |
| Flash Write                         | V <sub>IL</sub> | V <sub>IH</sub> | X                 | V <sub>IH</sub>  | V <sub>IL</sub>  | X               | X               | D <sub>IN</sub>  | D <sub>IN</sub>    |
|                                     |                 | X               | V <sub>IL</sub>   |                  |                  |                 |                 |  |                    |
| Flash Erase                         | V <sub>IL</sub> | V <sub>IH</sub> | X                 | V <sub>IH</sub>  | V <sub>IL</sub>  | X               | X               | X  | X                  |
|                                     |                 | X               | V <sub>IL</sub>   |                  |                  |                 |                 |  |                    |
| SRAM Read                           | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub>   | V <sub>IL</sub>  | V <sub>IH</sub>  | V <sub>IL</sub> | V <sub>IL</sub> | D <sub>OUT</sub>   | D <sub>OUT</sub>   |
|                                     |                 |                 |                   |                  |                  | V <sub>IH</sub> | V <sub>IL</sub> | HIGH-Z   | D <sub>OUT</sub>   |
|                                     |                 |                 |                   |                  |                  | V <sub>IL</sub> | V <sub>IH</sub> | D <sub>OUT</sub>   | HIGH-Z             |
| SRAM Write                          | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub>   | X                | V <sub>IL</sub>  | V <sub>IL</sub> | V <sub>IL</sub> | D <sub>IN</sub>  | D <sub>IN</sub>    |
|                                     |                 |                 |                   |                  |                  | V <sub>IH</sub> | V <sub>IL</sub> | HIGH-Z   | D <sub>IN</sub>    |
|                                     |                 |                 |                   |                  |                  | V <sub>IL</sub> | V <sub>IH</sub> | D <sub>IN</sub>  | HIGH-Z             |
| Product Identification <sup>4</sup> | V <sub>IL</sub> | V <sub>IH</sub> | X                 | V <sub>IL</sub>  | V <sub>IH</sub>  | X               | X               | Manufacturer's ID <sup>5</sup><br>Device ID <sup>5</sup> |                    |
|                                     |                 | X               | V <sub>IL</sub>   |                  |                  |                 |                 |  |                    |

T4.2 1236

1. X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.
2. Do not apply BEF# = V<sub>IL</sub>, BES1# = V<sub>IL</sub> and BES2 = V<sub>IH</sub> at the same time
3. OE# = OEF# and OES#  
WE# = WEF# and WES# for LS package only
4. Software mode only
5. With A<sub>MS</sub>-A<sub>1</sub> = 0; SST Manufacturer's ID = 00BFH, is read with A<sub>0</sub>=0,  
SST32HF16x1x Device ID = 234BH, is read with A<sub>0</sub>=1,  
SST32HF32x1x Device ID = 235BH, is read with A<sub>0</sub>=1.



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**TABLE 5: 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               |
| Erase-Suspend                                 | XXXXH               | B0H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |
| Erase-Resume                                  | XXXXH               | 30H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |
| Query Sec ID <sup>5</sup>                     | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 88H               |                     |                   |                     |                   |                              |                   |
| User Security ID Word-Program                 | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | A5H               | WA <sup>6</sup>     | Data              |                     |                   |                              |                   |
| User Security ID Program Lock-Out             | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 85H               | XXH <sup>6</sup>    | 0000H             |                     |                   |                              |                   |
| Software ID Entry <sup>7,8</sup>              | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 90H               |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>9,10</sup> /Sec ID Exit | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | F0H               |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>9,10</sup> /Sec ID Exit | XXH                 | F0H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |

T5.2 1236

1. Address format A<sub>14</sub>-A<sub>0</sub> (Hex).  
Addresses A<sub>15</sub>-A<sub>19</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for Command sequence for SST32HF16x1x,  
Addresses A<sub>15</sub>-A<sub>20</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for Command sequence for SST32HF32x1x.
2. DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for Command sequence
3. WA = Program Word address
4. 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  
A<sub>MS</sub> = Most significant address  
A<sub>MS</sub> = A<sub>19</sub> for SST32HF16x1x and A<sub>20</sub> for SST32HF32x1x.
5. With A<sub>MS</sub>-A<sub>4</sub> = 0; Sec ID is read with A<sub>3</sub>-A<sub>0</sub>,  
SST ID is read with A<sub>3</sub> = 0 (Address range = 000000H to 000007H),  
User ID is read with A<sub>3</sub> = 1 (Address range = 000010H to 000017H).  
Lock Status is read with A<sub>7</sub>-A<sub>0</sub> = 0000FFH. Unlocked: DQ<sub>3</sub> = 1 / Locked: DQ<sub>3</sub> = 0.
6. Valid Word-Addresses for Sec ID are from 000000H-000007H and 000010H-000017H.
7. The device does not remain in Software Product ID Mode if powered down.
8. With A<sub>MS</sub>-A<sub>1</sub> = 0; SST Manufacturer ID = 00BFH, is read with A<sub>0</sub> = 0,  
SST32HF16x1x Device ID = 234BH, is read with A<sub>0</sub> = 1,  
SST32HF32x1x Device ID = 235BH, is read with A<sub>0</sub> = 1,  
A<sub>MS</sub> = Most significant address  
A<sub>MS</sub> = A<sub>19</sub> for SST32HF16x1x and A<sub>20</sub> for SST32HF32x1x.
9. Both Software ID Exit operations are equivalent
10. If users never lock after programming, Sec ID can be programmed over the previously unprogrammed bits (data=1) using the Sec ID mode again (the programmed "0" bits cannot be reversed to "1"). Valid Word-Addresses for Sec ID are from 000000H-000007H and 000010H-000017H.



**Multi-Purpose Flash Plus + SRAM ComboMemory**  
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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.)

- Operating Temperature ..... -20°C to +85°C
- Storage Temperature ..... -65°C to +150°C
- D. C. Voltage on Any Pin to Ground Potential ..... -0.5V to  $V_{DD}^1+0.3V$
- Transient Voltage (<20 ns) on Any Pin to Ground Potential ..... -1.0V to  $V_{DD}^1+1.0V$
- Package Power Dissipation Capability ( $T_A = 25^\circ C$ ) ..... 1.0W
- Surface Mount Solder Reflow Temperature<sup>2</sup> ..... 260°C for 10 seconds
- Output Short Circuit Current<sup>3</sup> ..... 50 mA

1.  $V_{DD} = V_{DDF}$  and  $V_{DDS}$
2. 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.
3. Outputs shorted for no more than one second. No more than one output shorted at a time.

**OPERATING RANGE**

| Range      | Ambient Temp   | $V_{DD}$ |
|------------|----------------|----------|
| Commercial | 0°C to +70°C   | 2.7-3.3V |
| Extended   | -20°C to +85°C | 2.7-3.3V |

**AC CONDITIONS OF TEST**

|                       |                     |
|-----------------------|---------------------|
| Input Rise/Fall Time  | ..... 5 ns          |
| Output Load           | ..... $C_L = 30$ pF |
| See Figures 19 and 20 |                     |



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**TABLE 6: DC OPERATING CHARACTERISTICS ( $V_{DD} = V_{DDF}$  AND  $V_{DDs} = 2.7-3.3V$ )**

| Symbol           | Parameter   | Limits               |           |          | Test Conditions   |
|------------------|---|----------------------|-----------|----------|---|
|                  |   | Min                  | Max       | Units    |   |
| I <sub>DD</sub>  | Active V <sub>DD</sub> Current                          |                      |           |          | Address input = V <sub>ILT</sub> /V <sub>IHT</sub> , at f=5 MHz, V <sub>DD</sub> =V <sub>DD</sub> Max, all DQs open |
|                  | Read  |                      |           |          | OE#=V <sub>IL</sub> , WE#=V <sub>IH</sub>   |
|                  | Flash   |                      | 18        | mA       | BEF#=V <sub>IL</sub> , BES1#=V <sub>IH</sub> , or BES2=V <sub>IL</sub>  |
|                  | SRAM  |                      | 30        | mA       | BEF#=V <sub>IH</sub> , BES1#=V <sub>IL</sub> , BES2=V <sub>IH</sub>   |
|                  | Concurrent Operation                                    |                      | 40        | mA       | BEF#=V <sub>IH</sub> , BES1#=V <sub>IL</sub> , BES2=V <sub>IH</sub>   |
|                  | Write <sup>1</sup>                                      |                      |           |          | WE#=V <sub>IL</sub>   |
|                  | Flash   |                      | 35        | mA       | BEF#=V <sub>IL</sub> , BES1#=V <sub>IH</sub> , or BES2=V <sub>IL</sub> , OE#=V <sub>IH</sub>                        |
|                  | SRAM  |                      | 30        | mA       | BEF#=V <sub>IH</sub> , BES1#=V <sub>IL</sub> , BES2=V <sub>IH</sub>   |
| I <sub>SB</sub>  | Standby V <sub>DD</sub> Current SST32HFx1<br>SST32HFx1C |                      | 110<br>30 | μA<br>μA | V <sub>DD</sub> = V <sub>DD</sub> Max, BEF#=BES1#=V <sub>IHC</sub> , BES2=V <sub>ILC</sub>                          |
| I <sub>RT</sub>  | Reset V <sub>DD</sub> Current                           |                      | 30        | μA       | Reset=V <sub>SS</sub> ±0.3V   |
| I <sub>LI</sub>  | Input Leakage Current                                   |                      | 1         | μA       | V <sub>IN</sub> =GND to V <sub>DD</sub> , V <sub>DD</sub> =V <sub>DD</sub> Max                                      |
| I <sub>LO</sub>  | Output Leakage Current                                  |                      | 10        | μA       | V <sub>OUT</sub> =GND to V <sub>DD</sub> , V <sub>DD</sub> =V <sub>DD</sub> Max                                     |
| V <sub>IL</sub>  | Input Low Voltage                                       |                      | 0.8       | V        | V <sub>DD</sub> =V <sub>DD</sub> Min  |
| V <sub>ILC</sub> | Input Low Voltage (CMOS)                                |                      | 0.3       | V        | V <sub>DD</sub> =V <sub>DD</sub> Max  |
| V <sub>IH</sub>  | Input High Voltage                                      | 0.7 V <sub>DD</sub>  |           | V        | V <sub>DD</sub> =V <sub>DD</sub> Max  |
| V <sub>IHC</sub> | Input High Voltage (CMOS)                               | V <sub>DD</sub> -0.3 |           | V        | V <sub>DD</sub> =V <sub>DD</sub> Max  |
| V <sub>OLF</sub> | Flash Output Low Voltage                                |                      | 0.2       | V        | I <sub>OL</sub> =100 μA, V <sub>DD</sub> =V <sub>DD</sub> Min   |
| V <sub>OHF</sub> | Flash Output High Voltage                               | V <sub>DD</sub> -0.2 |           | V        | I <sub>OH</sub> =-100 μA, V <sub>DD</sub> =V <sub>DD</sub> Min  |
| V <sub>OLS</sub> | SRAM Output Low Voltage                                 |                      | 0.4       | V        | I <sub>OL</sub> =1 mA, V <sub>DD</sub> =V <sub>DD</sub> Min   |
| V <sub>OHS</sub> | SRAM Output High Voltage                                | 2.2                  |           | V        | I <sub>OH</sub> =-500 μA, V <sub>DD</sub> =V <sub>DD</sub> Min  |

T6.1 1236

1. I<sub>DD</sub> active while Erase or Program is in progress.

**TABLE 7: RECOMMENDED SYSTEM POWER-UP TIMINGS**

| Symbol                             | Parameter                           | Minimum | Units |
|------------------------------------|-------------------------------------|---------|-------|
| T <sub>PU-READ</sub> <sup>1</sup>  | Power-up to Read Operation          | 100     | μs    |
| T <sub>PU-WRITE</sub> <sup>1</sup> | Power-up to Program/Erase Operation | 100     | μs    |

T7.0 1236

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

**TABLE 8: CAPACITANCE (T<sub>A</sub> = 25°C, f=1 Mhz, other pins open)**

| Parameter                     | Description         | Test Condition        | Maximum |
|-------------------------------|---------------------|-----------------------|---------|
| C <sub>I/O</sub> <sup>1</sup> | I/O Pin Capacitance | V <sub>I/O</sub> = 0V | 12 pF   |
| C <sub>IN</sub> <sup>1</sup>  | Input Capacitance   | V <sub>IN</sub> = 0V  | 12 pF   |

T8.0 1236

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

**TABLE 9: FLASH RELIABILITY CHARACTERISTICS**

| Symbol                        | Parameter      | Minimum Specification | Units  | Test Method         |
|-------------------------------|----------------|-----------------------|--------|---------------------|
| N <sub>END</sub> <sup>1</sup> | Endurance      | 10,000                | Cycles | JEDEC Standard A117 |
| T <sub>DR</sub> <sup>1</sup>  | Data Retention | 100                   | Years  | JEDEC Standard A103 |
| I <sub>LTH</sub> <sup>1</sup> | Latch Up       | 100 + I <sub>DD</sub> | mA     | JEDEC Standard 78   |

T9.0 1236

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



**AC CHARACTERISTICS**

**TABLE 10: SRAM READ CYCLE TIMING PARAMETERS**

| Symbol                          | Parameter                       | Min | Max | Units |
|---------------------------------|---------------------------------|-----|-----|-------|
| T <sub>RCS</sub>                | Read Cycle Time                 | 70  |     | ns    |
| T <sub>AAS</sub>                | Address Access Time             |     | 70  | ns    |
| T <sub>BES</sub>                | Bank Enable Access Time         |     | 70  | ns    |
| T <sub>OES</sub>                | Output Enable Access Time       |     | 35  | ns    |
| T <sub>BYES</sub>               | UBS#, LBS# Access Time          |     | 70  | ns    |
| T <sub>BLZS</sub> <sup>1</sup>  | BES# to Active Output           | 0   |     | ns    |
| T <sub>OLZS</sub> <sup>1</sup>  | Output Enable to Active Output  | 0   |     | ns    |
| T <sub>BYLZS</sub> <sup>1</sup> | UBS#, LBS# to Active Output     | 0   |     | ns    |
| T <sub>BHZS</sub> <sup>1</sup>  | BES# to High-Z Output           |     | 25  | ns    |
| T <sub>OHZS</sub> <sup>1</sup>  | Output Disable to High-Z Output | 0   | 25  | ns    |
| T <sub>BYHZS</sub> <sup>1</sup> | UBS#, LBS# to High-Z Output     |     | 35  | ns    |
| T <sub>OHS</sub>                | Output Hold from Address Change | 10  |     | ns    |

T10.1 1236

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

**TABLE 11: SRAM WRITE CYCLE TIMING PARAMETERS**

| Symbol            | Parameter                     | Min | Max | Units |
|-------------------|-------------------------------|-----|-----|-------|
| T <sub>WCS</sub>  | Write Cycle Time              | 70  |     | ns    |
| T <sub>BWS</sub>  | Bank Enable to End-of-Write   | 60  |     | ns    |
| T <sub>AWS</sub>  | Address Valid to End-of-Write | 60  |     | ns    |
| T <sub>ASTS</sub> | Address Set-up Time           | 0   |     | ns    |
| T <sub>WPS</sub>  | Write Pulse Width             | 60  |     | ns    |
| T <sub>WRS</sub>  | Write Recovery Time           | 0   |     | ns    |
| T <sub>BYWS</sub> | UBS#, LBS# to End-of-Write    | 60  |     | ns    |
| T <sub>ODWS</sub> | Output Disable from WE# Low   |     | 30  | ns    |
| T <sub>OEWS</sub> | Output Enable from WE# High   | 0   |     | ns    |
| T <sub>DSS</sub>  | Data Set-up Time              | 30  |     | ns    |
| T <sub>DHS</sub>  | Data Hold from Write Time     | 0   |     | ns    |

T11.1 1236



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**SST32HF1621C / SST32HF1641C / SST32HF3241C**

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**TABLE 12: FLASH READ CYCLE TIMING PARAMETERS  $V_{DD} = 2.7-3.6V$**

| Symbol         | Parameter                       | Min | Max | Units   |
|----------------|---------------------------------|-----|-----|---------|
| $T_{RC}$       | Read Cycle Time                 | 70  |     | ns      |
| $T_{CE}$       | Chip Enable Access Time         |     | 70  | ns      |
| $T_{AA}$       | Address Access Time             |     | 70  | ns      |
| $T_{OE}$       | Output Enable Access Time       |     | 35  | ns      |
| $T_{CLZ}^1$    | BEF# Low to Active Output       | 0   |     | ns      |
| $T_{OLZ}^1$    | OE# Low to Active Output        | 0   |     | ns      |
| $T_{CHZ}^1$    | BEF# High to High-Z Output      |     | 20  | ns      |
| $T_{OHZ}^1$    | OE# High to High-Z Output       |     | 20  | ns      |
| $T_{OH}^1$     | Output Hold from Address Change | 0   |     | ns      |
| $T_{RP}^1$     | RST# Pulse Width                | 500 |     | ns      |
| $T_{RHR}^1$    | RST# High before Read           | 50  |     | ns      |
| $T_{RY}^{1,2}$ | RST# Pin Low to Read Mode       |     | 20  | $\mu$ s |

T12.1 1236

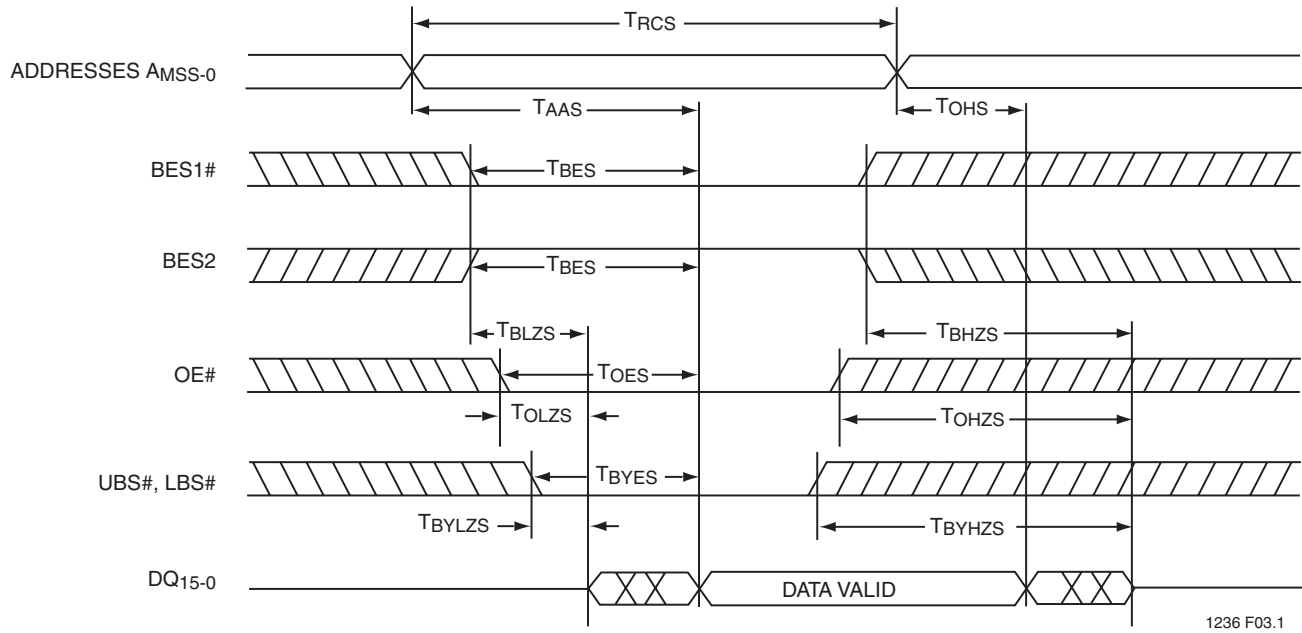
1. This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.
2. This parameter applies to Sector-Erase, Block-Erase and Program operations.  
This parameter does not apply to Chip-Erase operations.

**TABLE 13: FLASH PROGRAM/ERASE CYCLE TIMING PARAMETERS**

| Symbol      | Parameter                        | Min | Max | Units   |
|-------------|----------------------------------|-----|-----|---------|
| $T_{BP}$    | Word-Program Time                |     | 10  | $\mu$ s |
| $T_{AS}$    | Address Setup Time               | 0   |     | ns      |
| $T_{AH}$    | Address Hold Time                | 30  |     | ns      |
| $T_{CS}$    | WE# and BEF# Setup Time          | 0   |     | ns      |
| $T_{CH}$    | WE# and BEF# Hold Time           | 0   |     | ns      |
| $T_{OES}$   | OE# High Setup Time              | 0   |     | ns      |
| $T_{OEH}$   | OE# High Hold Time               | 10  |     | ns      |
| $T_{CP}$    | BEF# Pulse Width                 | 40  |     | ns      |
| $T_{WP}$    | WE# Pulse Width                  | 40  |     | ns      |
| $T_{WPH}^1$ | WE# Pulse Width High             | 30  |     | ns      |
| $T_{CPH}^1$ | BEF# Pulse Width High            | 30  |     | ns      |
| $T_{DS}$    | Data Setup Time                  | 30  |     | 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      |
| $T_{BE}$    | Block-Erase                      |     | 25  | ms      |
| $T_{SCE}$   | Chip-Erase                       |     | 50  | ms      |

T13.2 1236

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



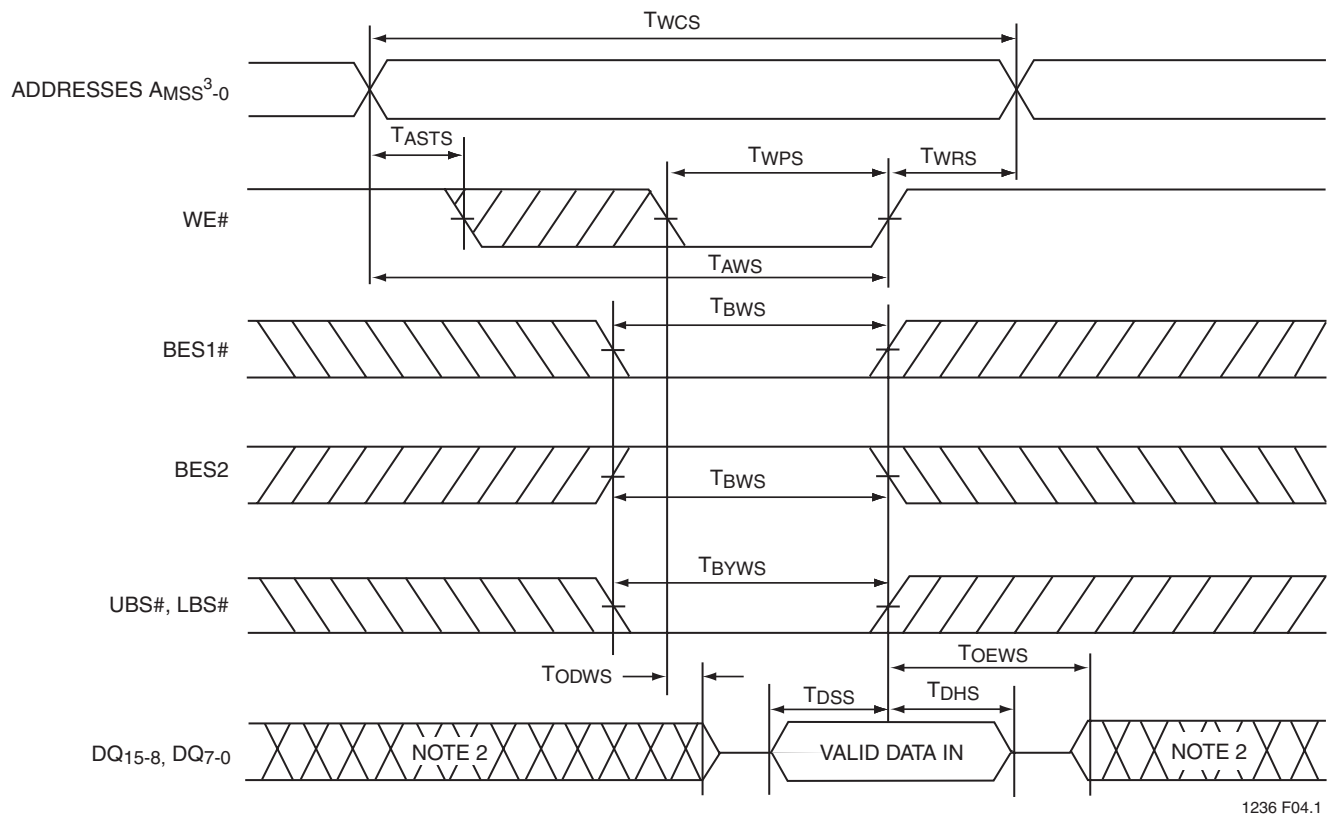
**Note:**  $A_{MSS}$  = Most Significant SRAM Address  
 $A_{MSS}$  =  $A_{16}$  for SST32HF1621C,  $A_{17}$  for SST32HFxx41x and  $A_{18}$  for SST32HFxx81

**FIGURE 3: SRAM READ CYCLE TIMING DIAGRAM**



**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

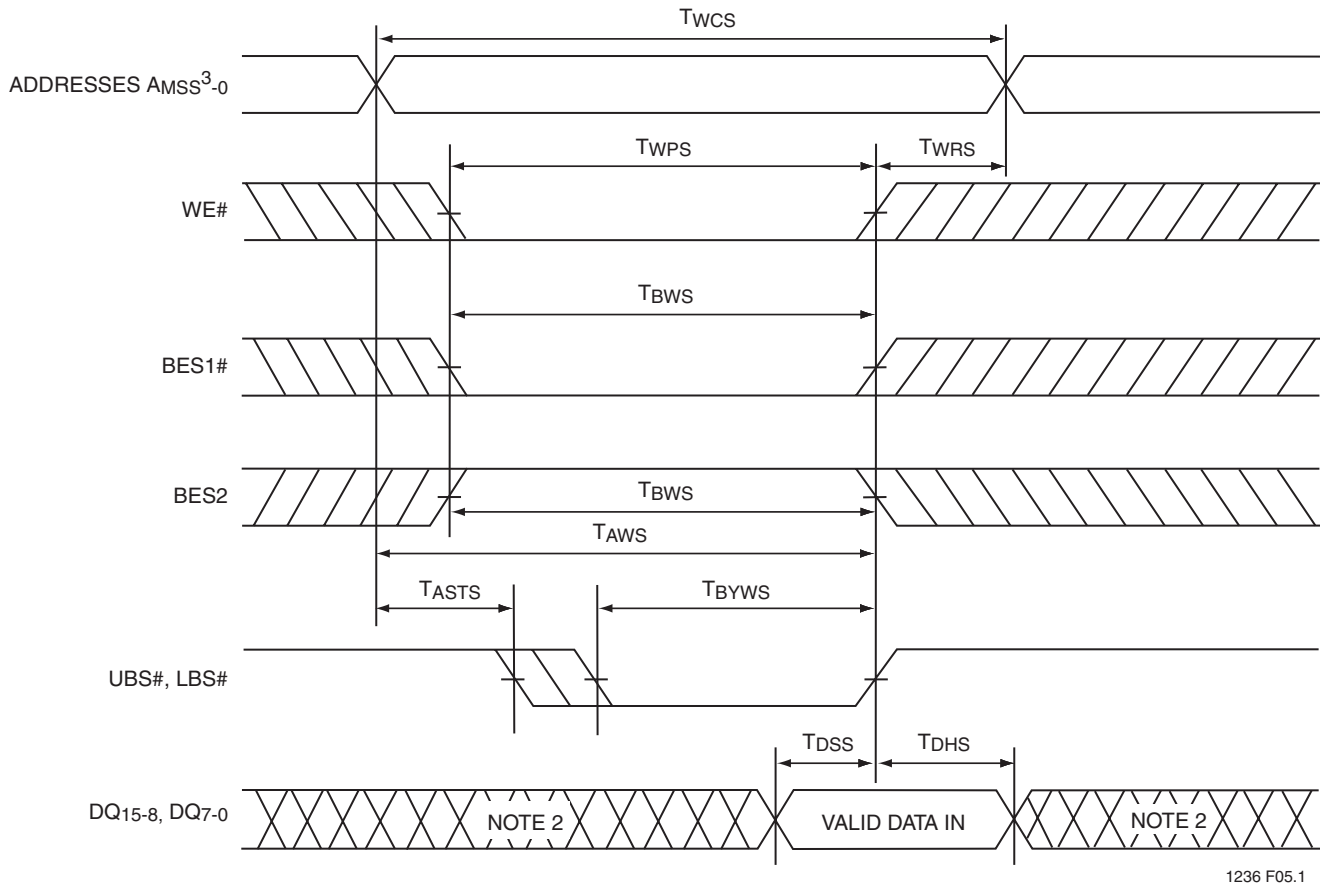
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- Note:**
1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
  2. If BES1# goes Low or BES2 goes high coincident with or after WE# goes Low, the output will remain at high impedance. If BES1# goes High or BES2 goes low coincident with or before WE# goes High, the output will remain at high impedance. Because  $D_{IN}$  signals may be in the output state at this time, input signals of reverse polarity must not be applied.
  3.  $A_{MSS}$  = Most Significant SRAM Address  
 $A_{MSS} = A_{16}$  for SST32HF1621C,  $A_{17}$  for SST32HFxx41x and  $A_{18}$  for SST32HFxx81

**FIGURE 4: SRAM WRITE CYCLE TIMING DIAGRAM (WE# CONTROLLED)<sup>1</sup>**





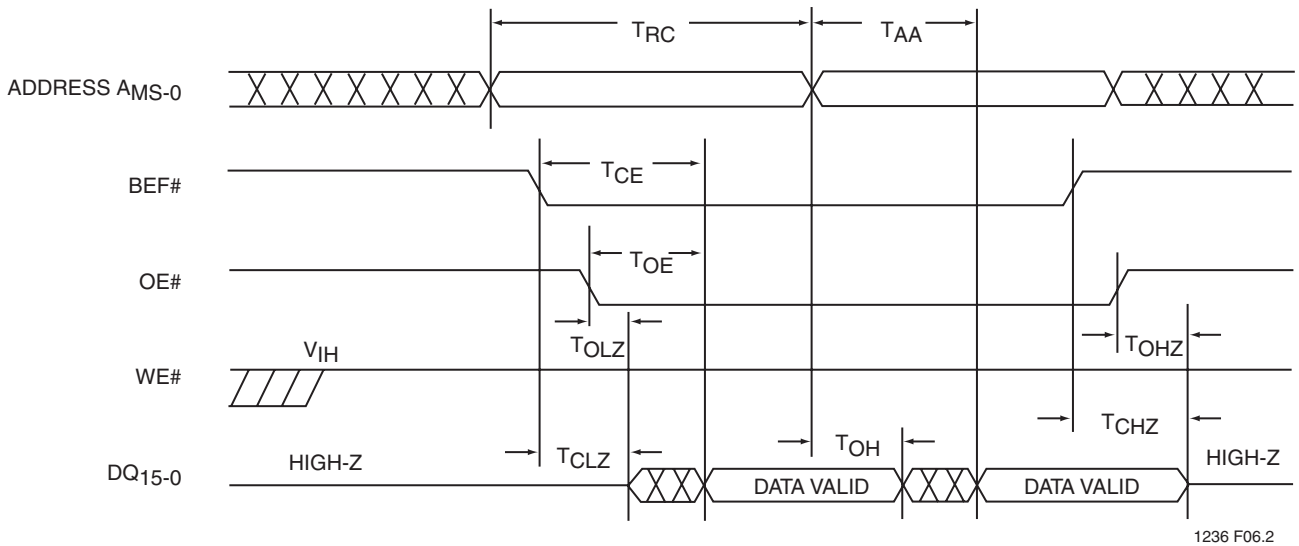
- Note:**
1. If OE# is High during the Write cycle, the outputs will remain at high impedance.
  2. Because  $D_{IN}$  signals may be in the output state at this time, input signals of reverse polarity must not be applied.
  3.  $A_{MSS}$  = Most Significant SRAM Address  
 $A_{MSS} = A_{16}$  for SST32HF1621C,  $A_{17}$  for SST32HFxx41x and  $A_{18}$  for SST32HFxx81

**FIGURE 5: SRAM WRITE CYCLE TIMING DIAGRAM (UBS#, LBS# CONTROLLED)<sup>1</sup>**



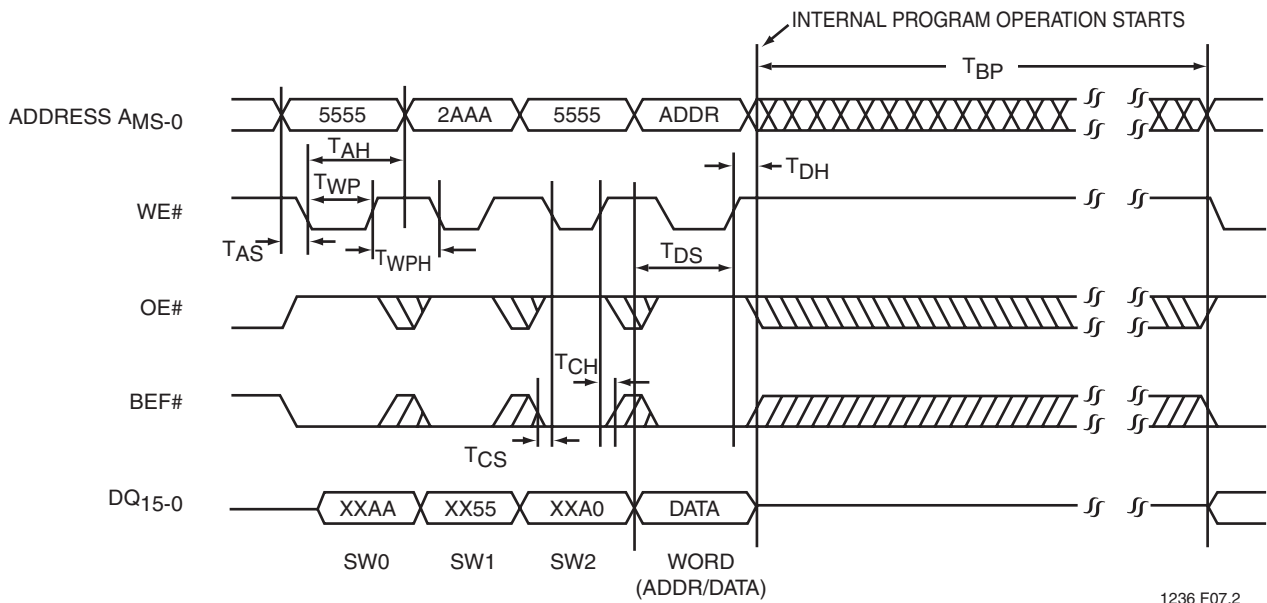
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**SST32HF1621C / SST32HF1641C / SST32HF3241C**

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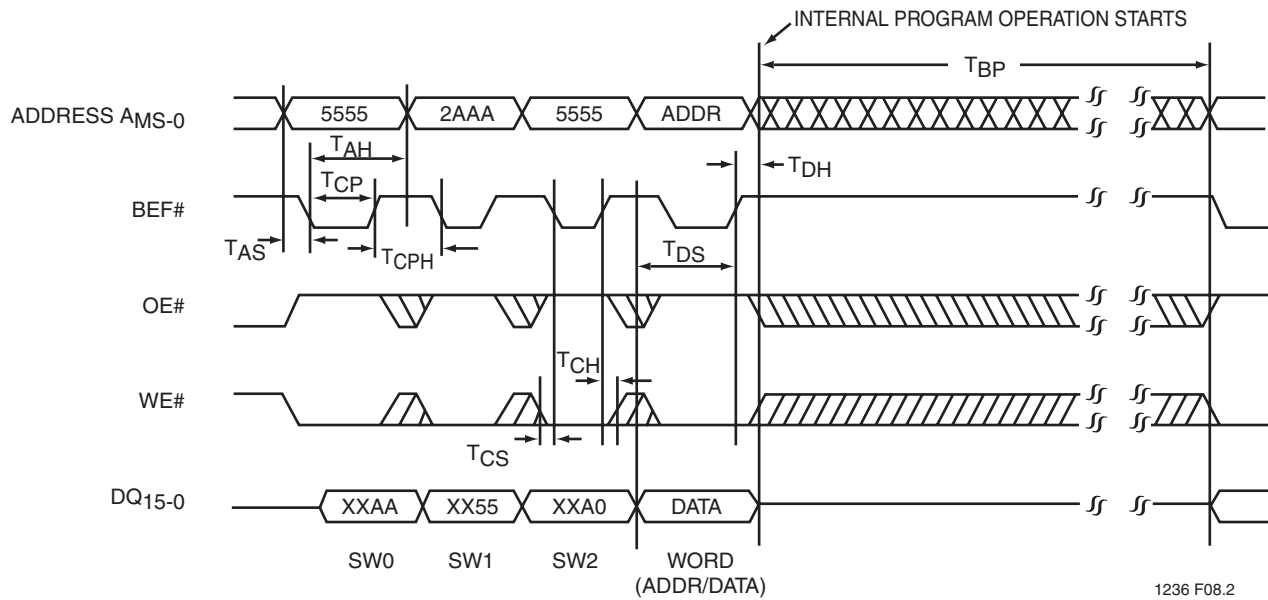
**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x

**FIGURE 6: FLASH READ CYCLE TIMING DIAGRAM**



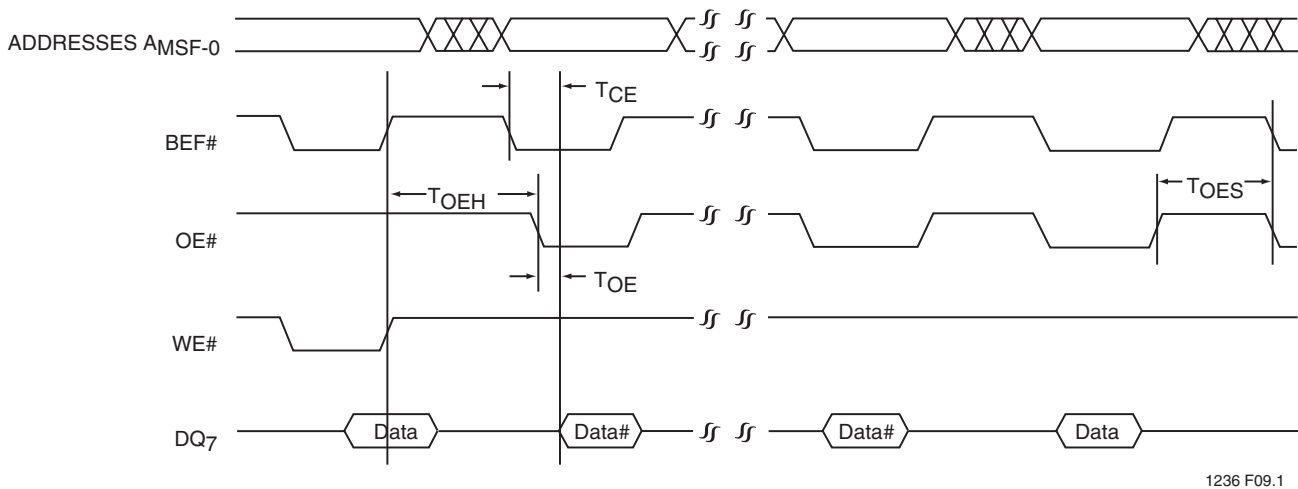
**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x  
 WP# must be held in proper logic state ( $V_{IL}$  or  $V_{IH}$ ) 1  $\mu$ s prior to and 1  $\mu$ s after the command sequence  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value

**FIGURE 7: FLASH WE# CONTROLLED PROGRAM CYCLE TIMING DIAGRAM**



**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF}$  =  $A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x  
 WP# must be held in proper logic state ( $V_{IL}$  or  $V_{IH}$ ) 1  $\mu$ s prior to and 1  $\mu$ s after the command sequence  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value

**FIGURE 8: BEF# CONTROLLED FLASH PROGRAM CYCLE TIMING DIAGRAM**



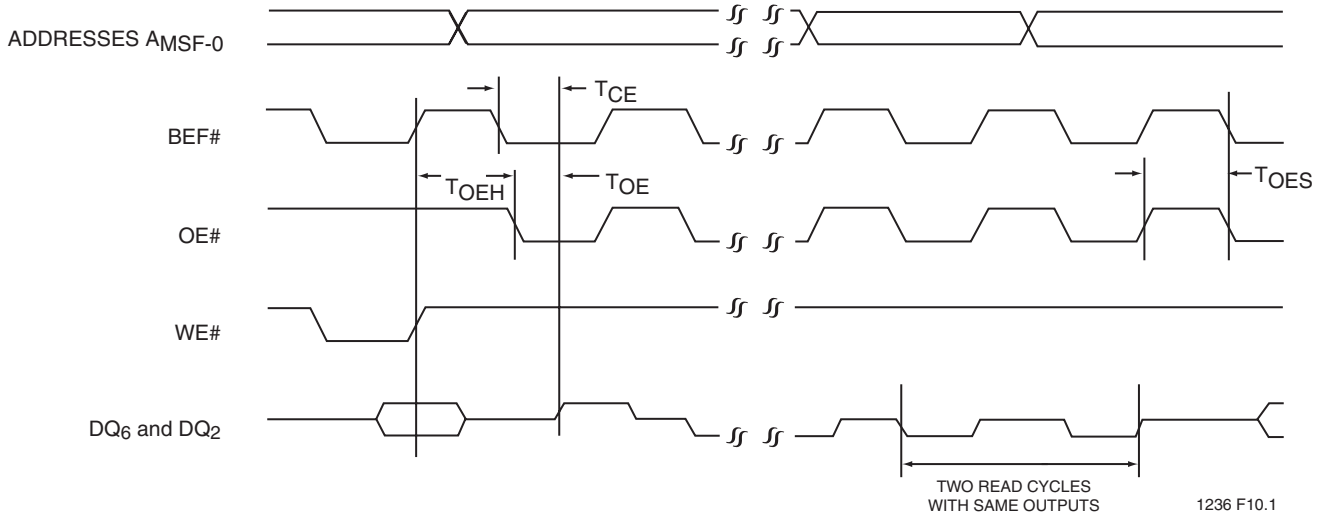
**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF}$  =  $A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x

**FIGURE 9: FLASH DATA# POLLING TIMING DIAGRAM**



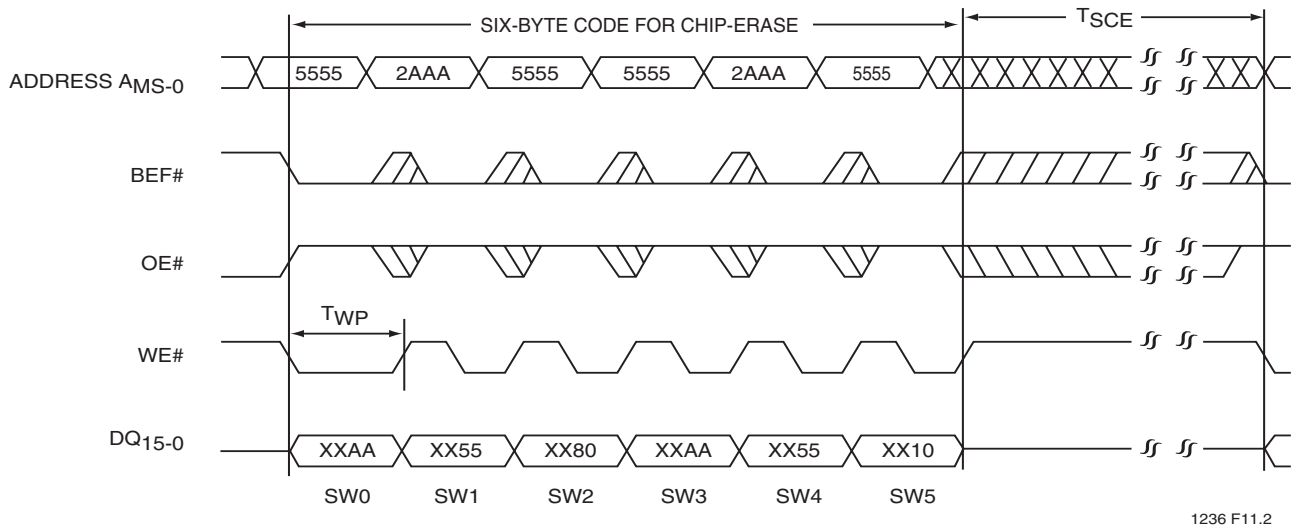
**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

EOL Data Sheet



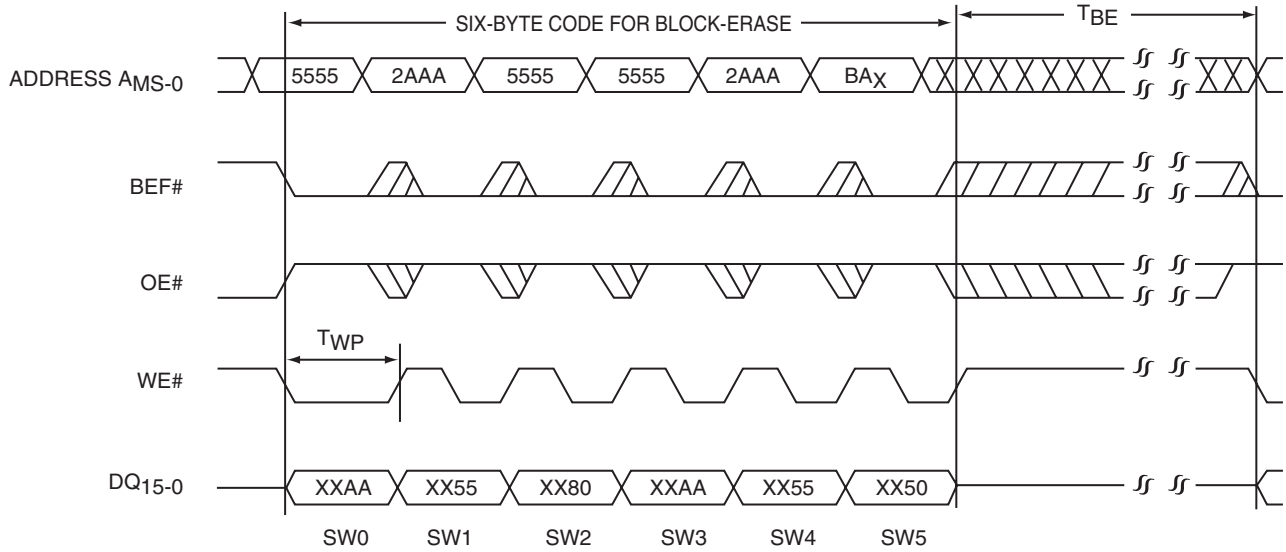
**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x

**FIGURE 10: FLASH TOGGLE BIT TIMING DIAGRAM**



**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x  
 WP# must be held in proper logic state ( $V_{IL}$  or  $V_{IH}$ ) 1  $\mu$ s prior to and 1  $\mu$ s after the command sequence  
 This device also supports BEF# controlled Chip-Erase operation.  
 The WE# and BEF# signals are interchangeable as long as minimum timings are met. (See Table 13)  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 11: WE# CONTROLLED FLASH CHIP-ERASE TIMING DIAGRAM**



1236 F13.2

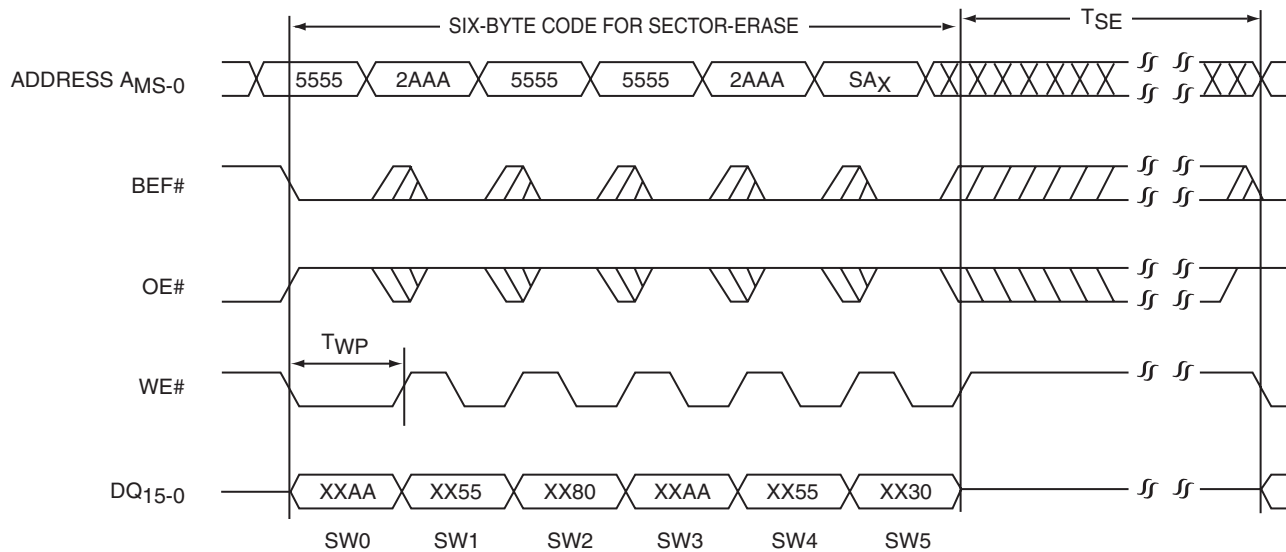
**Note:**  $A_{MSF}$  = Most Significant Flash Address  
 $A_{MSF} = A_{19}$  for SST32HF16x1x and  $A_{20}$  for SST32HF32x1x  
 This device also supports BEF# controlled Block-Erase operation.  
 The WE# and BEF# signals are interchangeable as long as minimum timings are meet. (See Table 13.)  
 $BA_x$  = Block Address  
 WP# must be held in proper logic state ( $V_{IL}$  or  $V_{IH}$ ) 1  $\mu$ s prior to and 1  $\mu$ s after the command sequence  
 X can be  $V_{IL}$  or  $V_{IH}$ , but no other value.

**FIGURE 12: WE# CONTROLLED FLASH BLOCK-ERASE TIMING DIAGRAM**



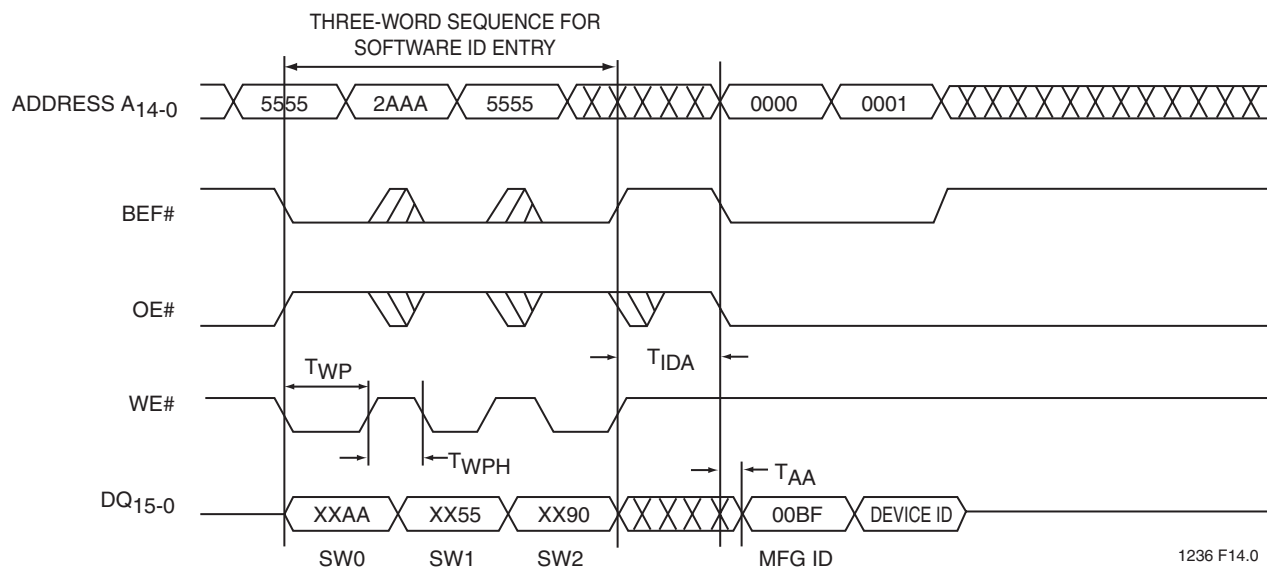
**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

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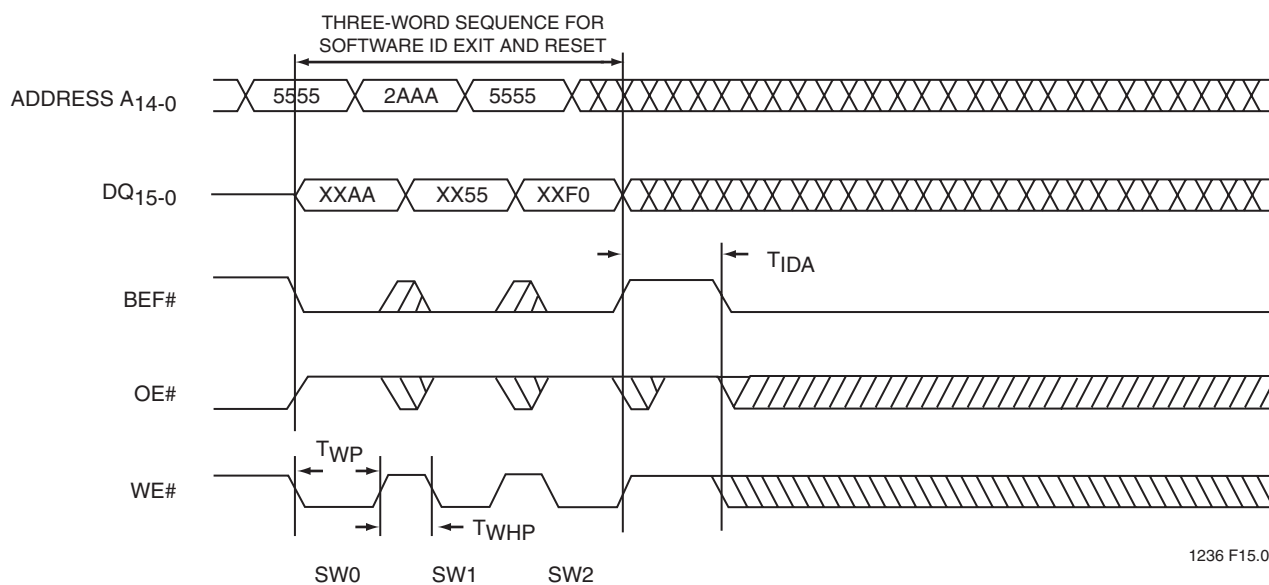
**Note:** A<sub>MSF</sub> = Most Significant Flash Address  
 A<sub>MSF</sub> = A<sub>19</sub> for SST32HF16x1x and A<sub>20</sub> for SST32HF32x1x  
 This device also supports BEF# controlled Sector-Erase operation.  
 The WE# and BEF# signals are interchangeable as long as minimum timings are meet. (See Table 13.)  
 SA<sub>X</sub> = Sector Address  
 WP# must be held in proper logic state (V<sub>IL</sub> or V<sub>IH</sub>) 1 μs prior to and 1 μs after the command sequence  
 X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

**FIGURE 13: WE# CONTROLLED FLASH SECTOR-ERASE TIMING DIAGRAM**



**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.  
 Device ID - See Table 2 on page 5

**FIGURE 14: SOFTWARE ID ENTRY AND READ**



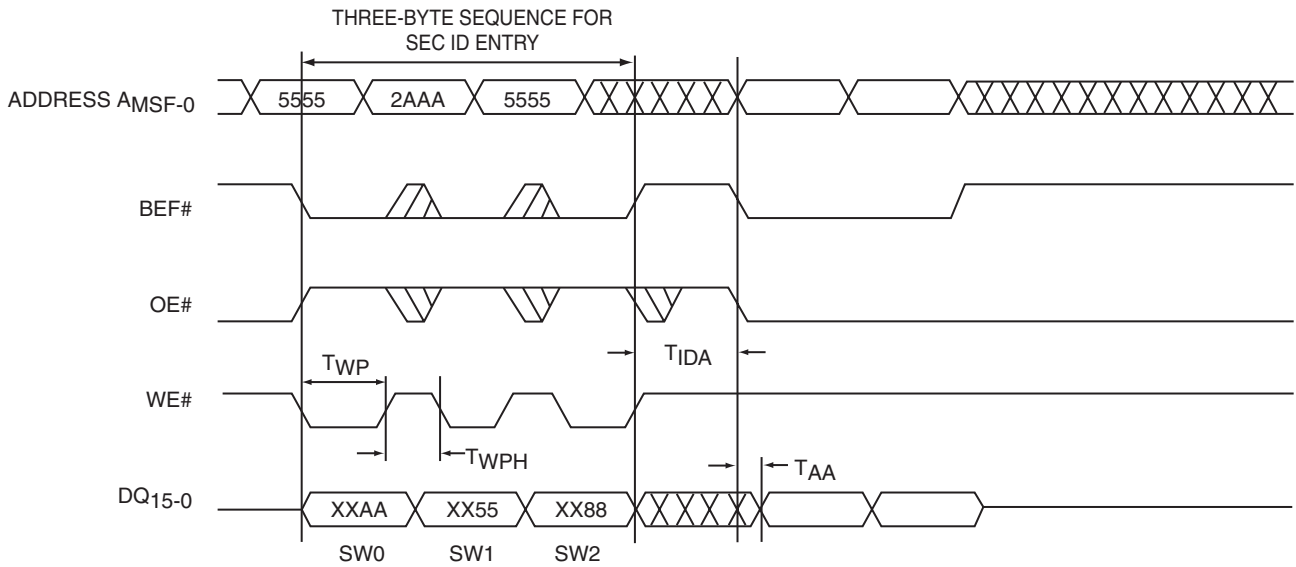
**Note:** X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

**FIGURE 15: SOFTWARE ID EXIT AND RESET**



**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

EOL Data Sheet

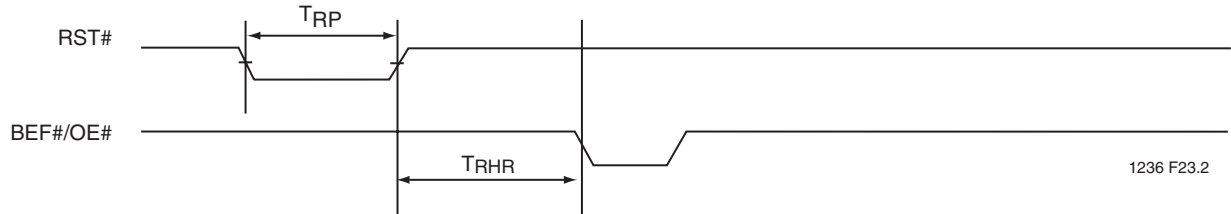


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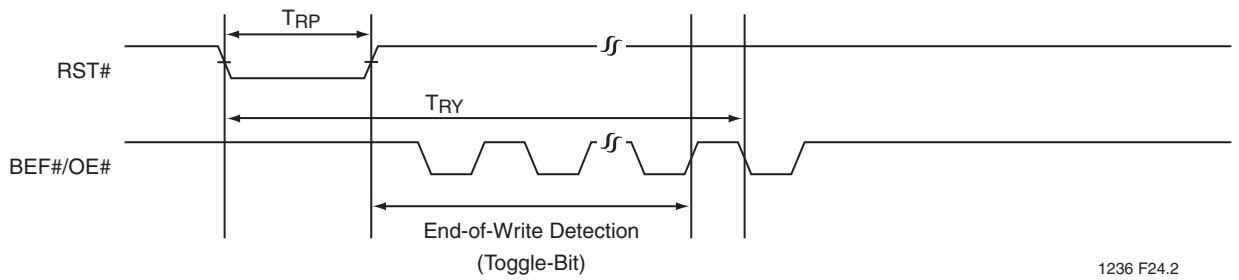
**Note:** A<sub>MSF</sub> = Most Significant Flash Address  
 A<sub>MSF</sub> = A<sub>19</sub> for SST32HF16x1x and A<sub>20</sub> for SST32HF32x1x  
 WP# must be held in proper logic state (V<sub>IL</sub> or V<sub>IH</sub>) 1 μs prior to and 1 μs after the command sequence.  
 X can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value.

**FIGURE 16: FLASH SEC ID ENTRY**





**FIGURE 17: RST# TIMING DIAGRAM (WHEN NO INTERNAL OPERATION IS IN PROGRESS)**

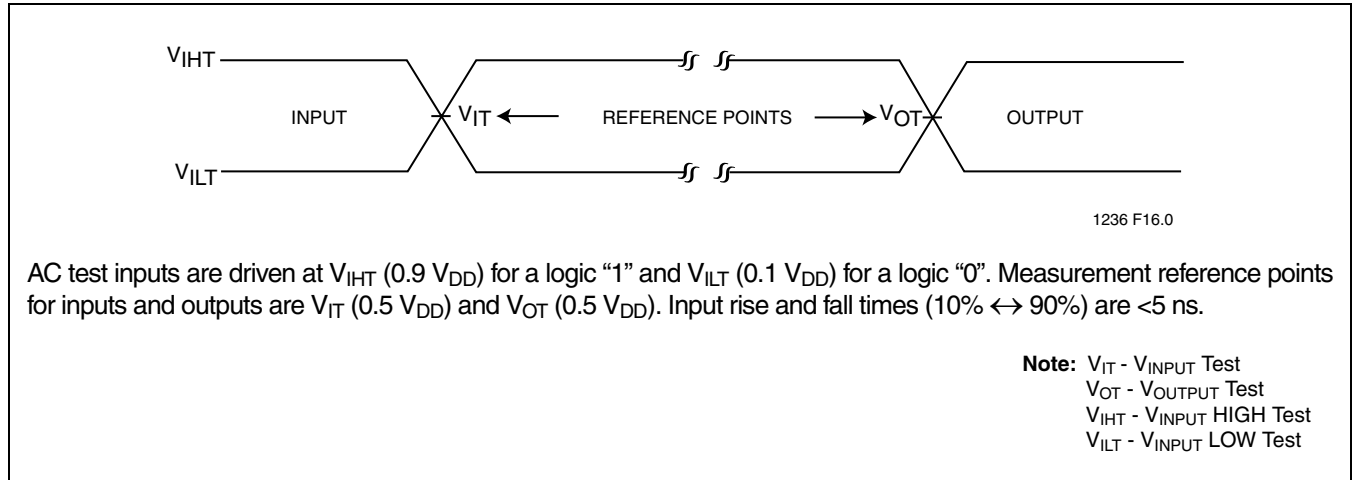


**FIGURE 18: RST# TIMING DIAGRAM (DURING PROGRAM OR ERASE OPERATION)**

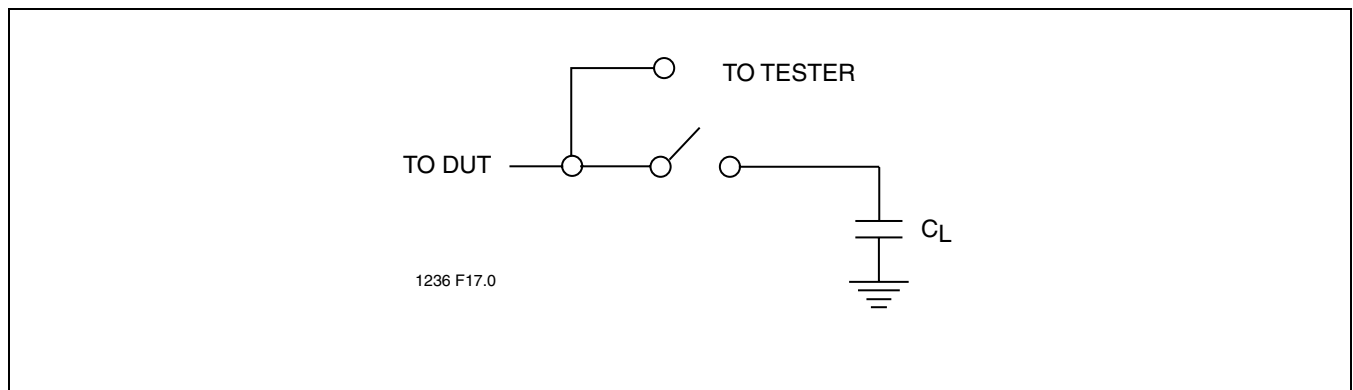


**Multi-Purpose Flash Plus + SRAM ComboMemory**  
SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281  
SST32HF1621C / SST32HF1641C / SST32HF3241C

EOL Data Sheet



**FIGURE 19: AC INPUT/OUTPUT REFERENCE WAVEFORMS**



**FIGURE 20: A TEST LOAD EXAMPLE**

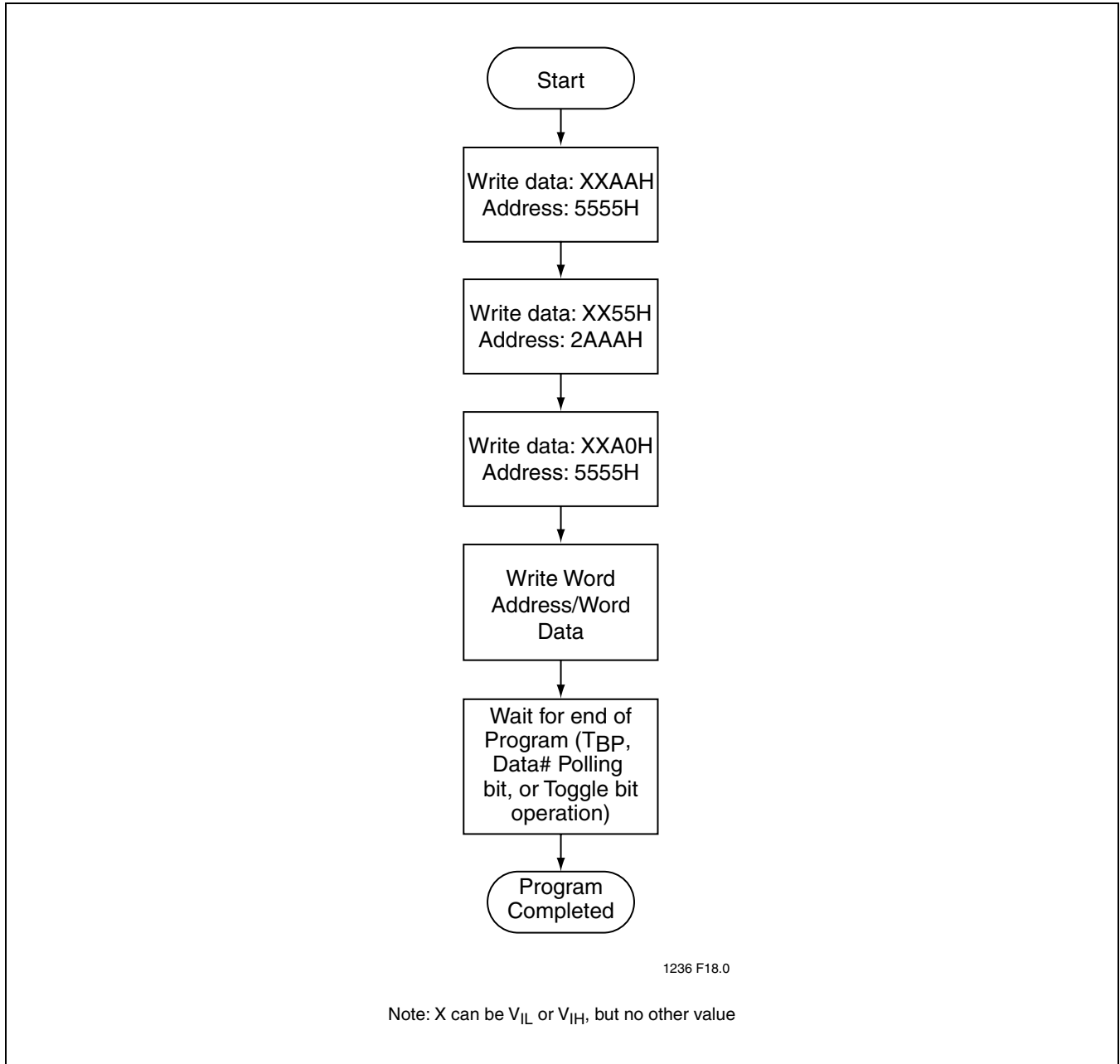


FIGURE 21: WORD-PROGRAM ALGORITHM

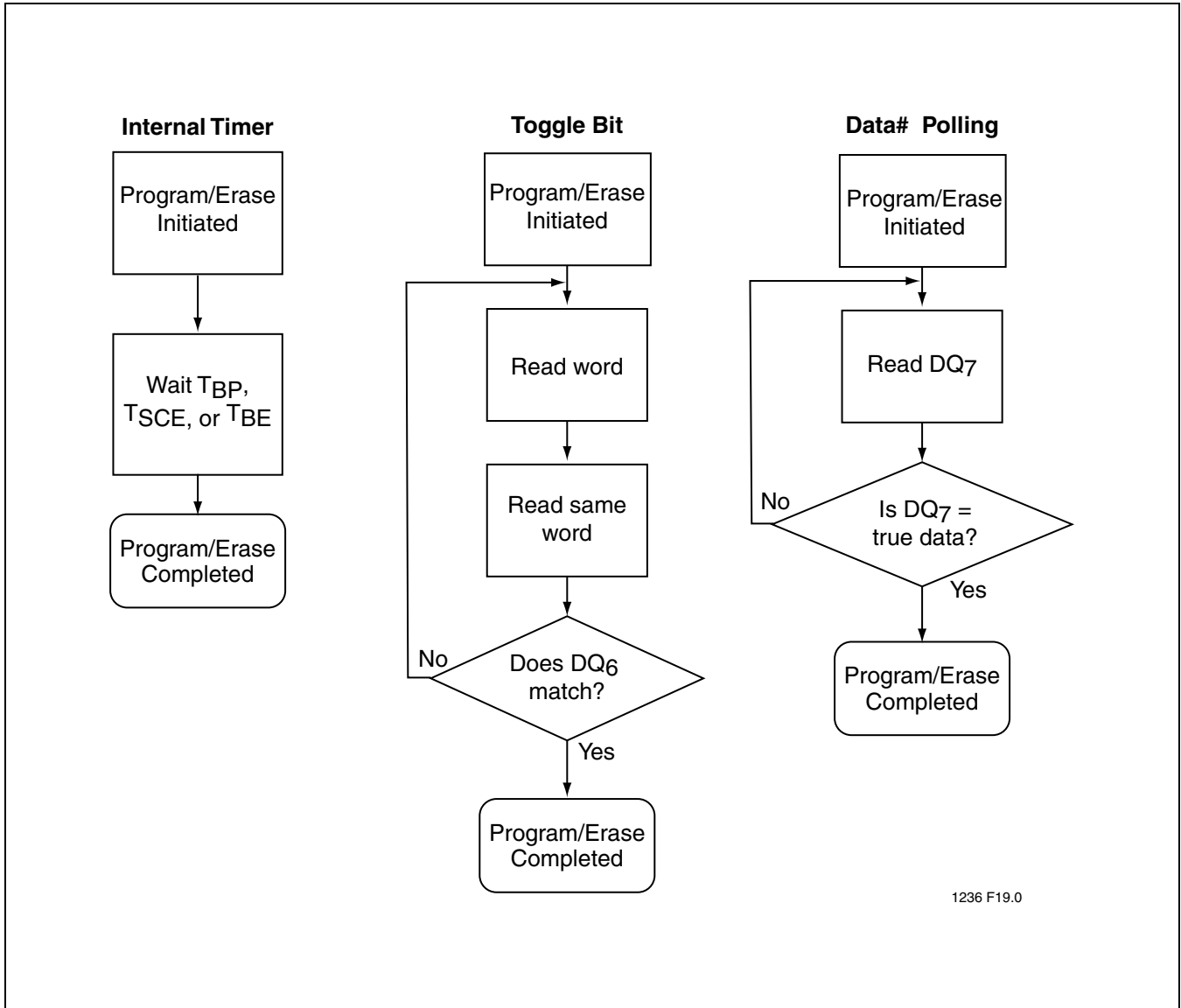
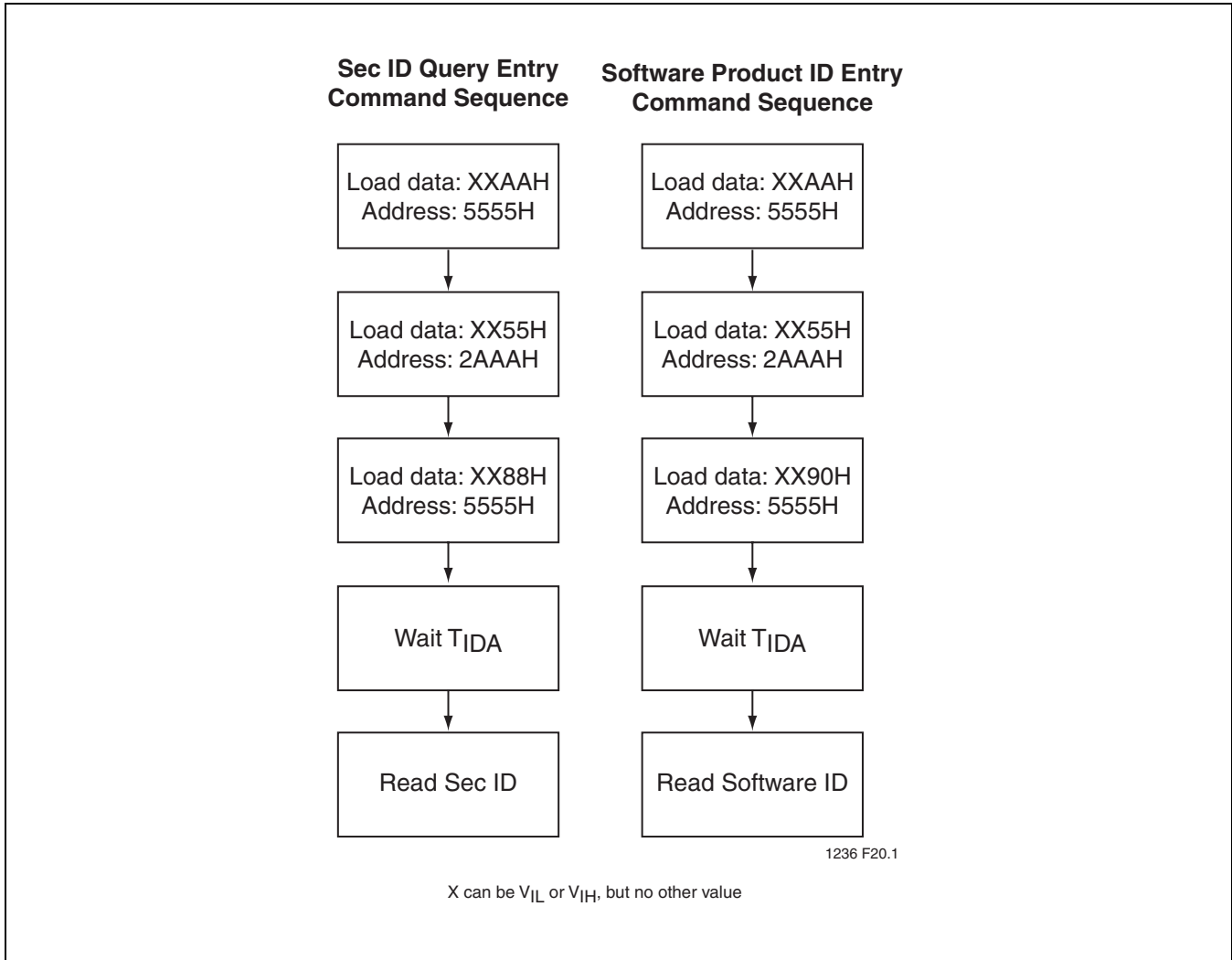


FIGURE 22: WAIT OPTIONS



**FIGURE 23: SEC ID/SOFTWARE ID COMMAND FLOWCHARTS**

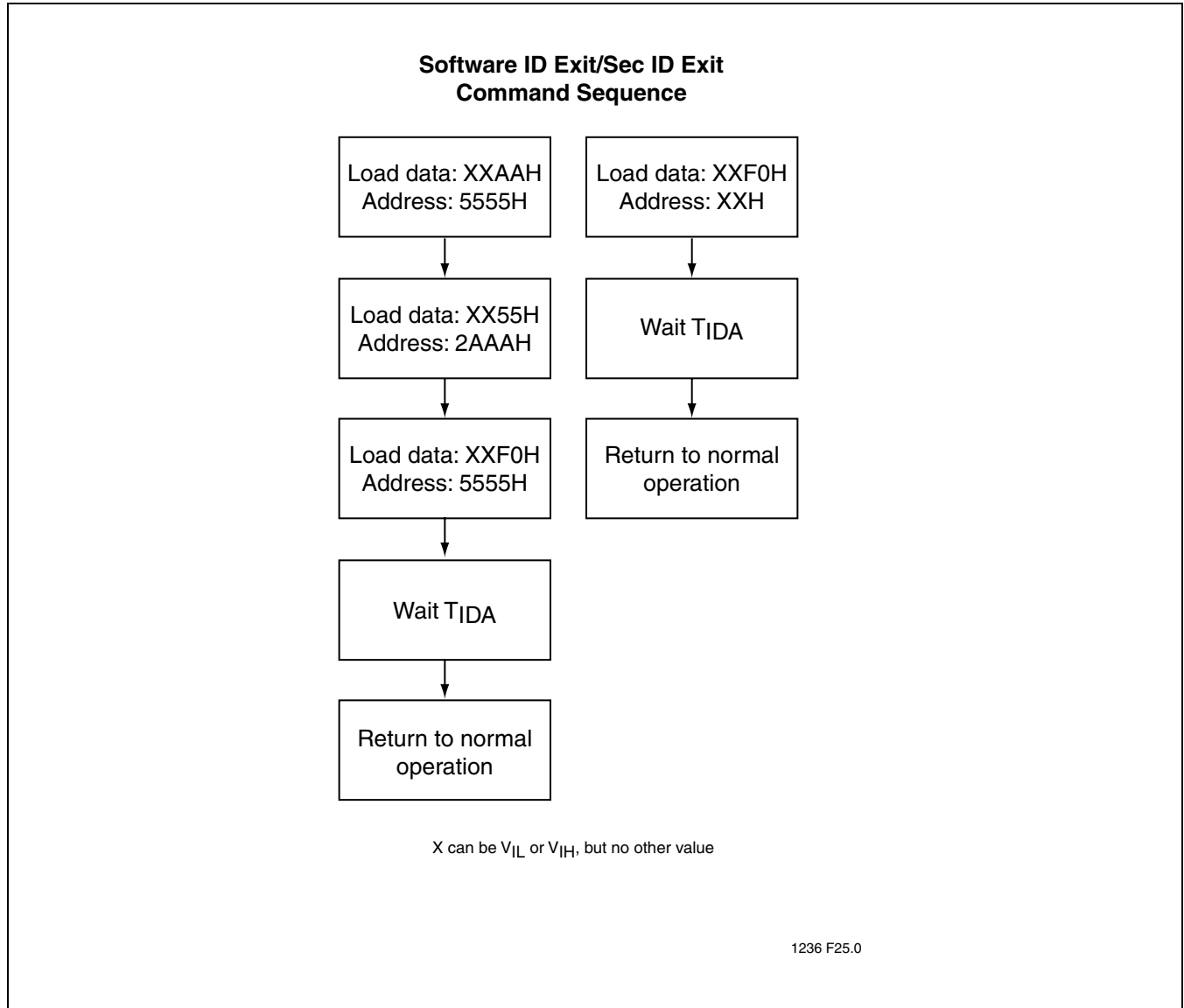
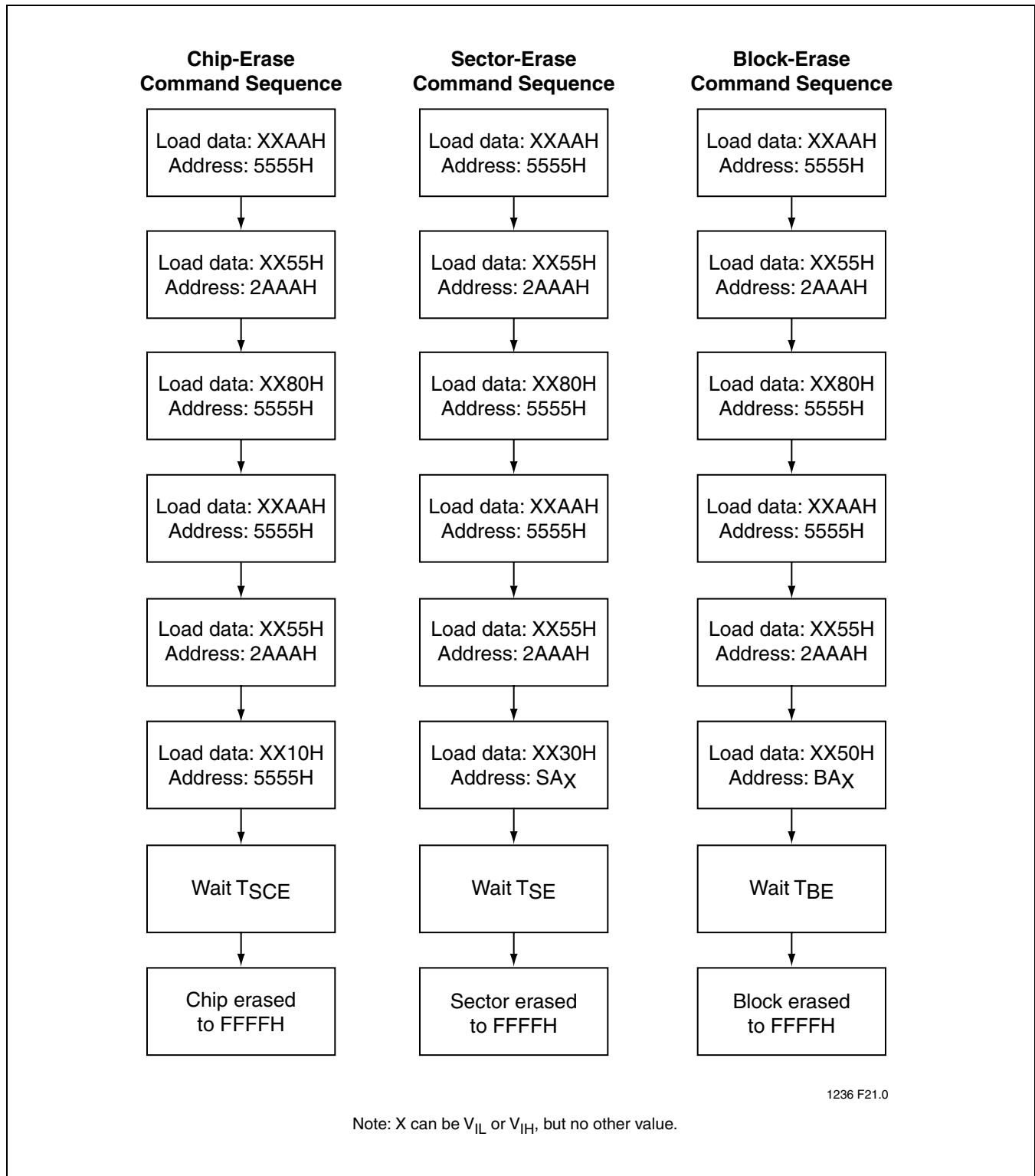
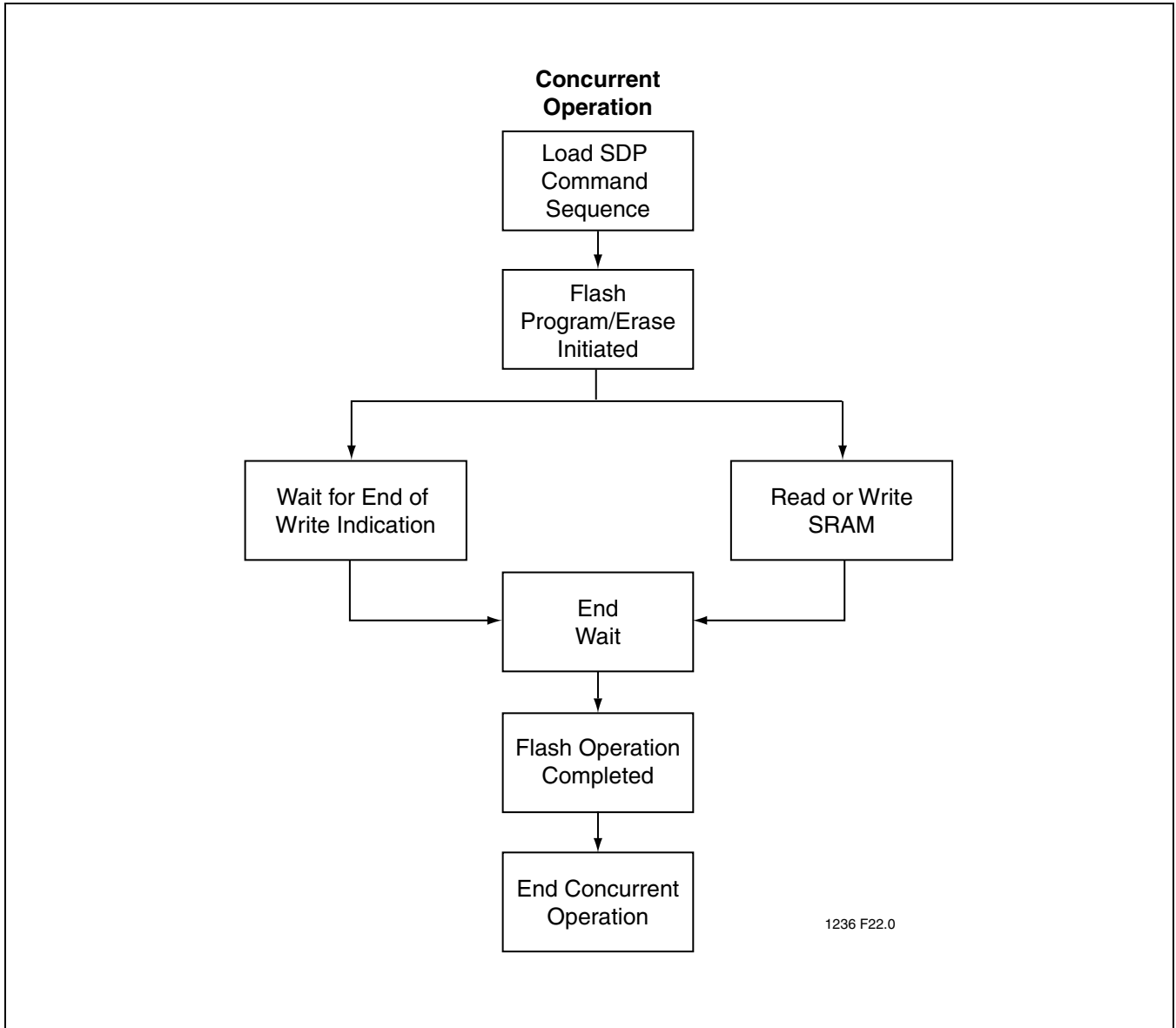


FIGURE 24: SOFTWARE ID/SEC ID COMMAND FLOWCHARTS



**FIGURE 25: ERASE COMMAND SEQUENCE**



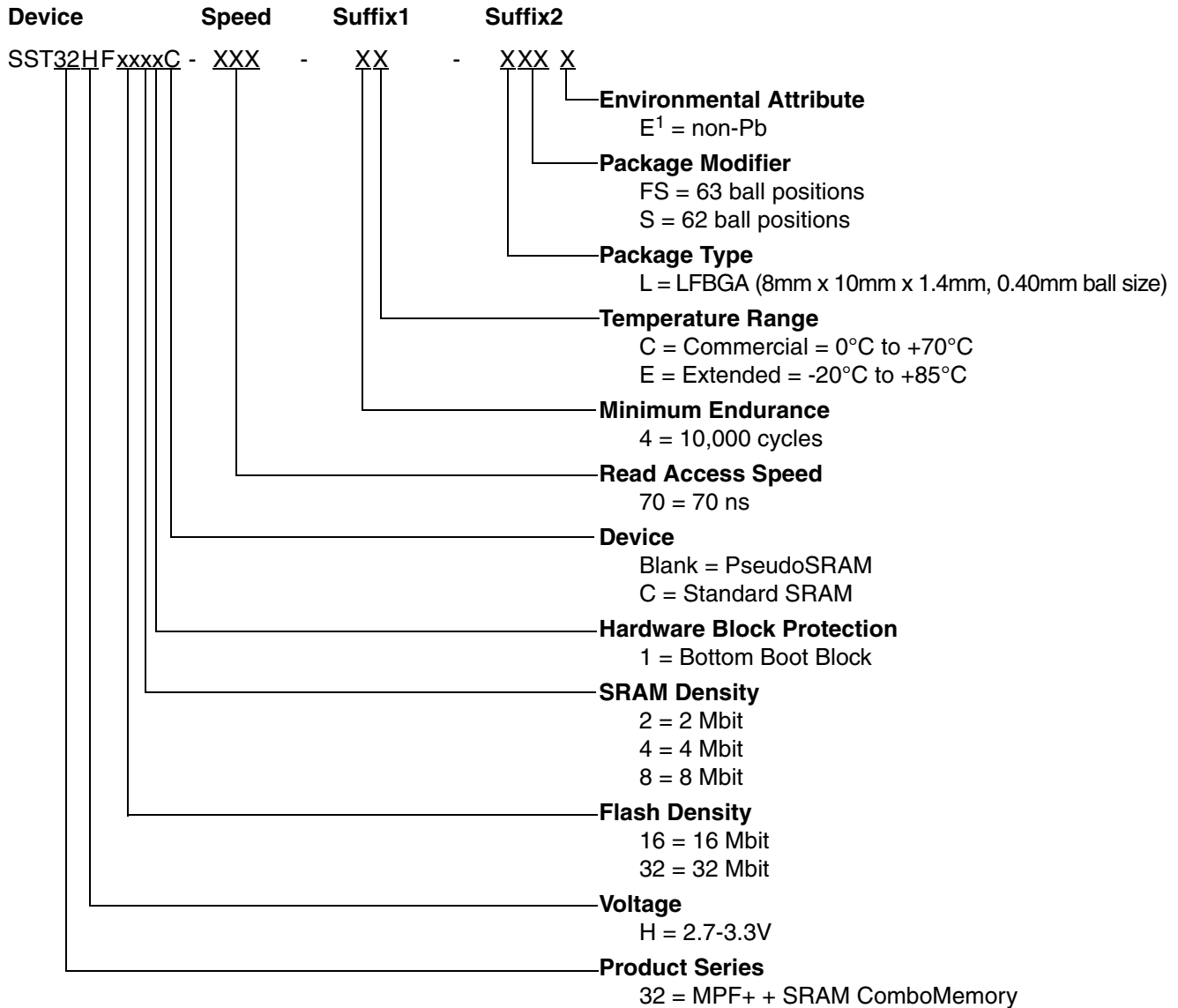
1236 F22.0

FIGURE 26: CONCURRENT OPERATION FLOWCHART





**PRODUCT ORDERING INFORMATION**



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



**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

EOL Data Sheet

**Valid combinations for SST32HF1621C**

|                        |                         |
|------------------------|-------------------------|
| SST32HF1621C-70-4C-LS  | SST32HF1621C-70-4C-LFS  |
| SST32HF1621C-70-4C-LSE | SST32HF1621C-70-4C-LFSE |
| SST32HF1621C-70-4E-LS  | SST32HF1621C-70-4E-LFS  |
| SST32HF1621C-70-4E-LSE | SST32HF1621C-70-4E-LFSE |

**Valid combinations for SST32HF1641**

|                       |                        |
|-----------------------|------------------------|
| SST32HF1641-70-4C-LS  | SST32HF1641-70-4C-LFS  |
| SST32HF1641-70-4C-LSE | SST32HF1641-70-4C-LFSE |
| SST32HF1641-70-4E-LS  | SST32HF1641-70-4E-LFS  |
| SST32HF1641-70-4E-LSE | SST32HF1641-70-4E-LFSE |

**Valid combinations for SST32HF1641C**

|                        |                         |
|------------------------|-------------------------|
| SST32HF1641C-70-4C-LS  | SST32HF1641C-70-4C-LFS  |
| SST32HF1641C-70-4C-LSE | SST32HF1641C-70-4C-LFSE |
| SST32HF1641C-70-4E-LS  | SST32HF1641C-70-4E-LFS  |
| SST32HF1641C-70-4E-LSE | SST32HF1641C-70-4E-LFSE |

**Valid combinations for SST32HF1681**

|                       |                        |
|-----------------------|------------------------|
| SST32HF1681-70-4C-LS  | SST32HF1681-70-4C-LFS  |
| SST32HF1681-70-4C-LSE | SST32HF1681-70-4C-LFSE |
| SST32HF1681-70-4E-LS  | SST32HF1681-70-4E-LFS  |
| SST32HF1681-70-4E-LSE | SST32HF1681-70-4E-LFSE |

**Valid combinations for SST32HF3241**

|                       |                        |
|-----------------------|------------------------|
| SST32HF3241-70-4C-LS  | SST32HF3241-70-4C-LFS  |
| SST32HF3241-70-4C-LSE | SST32HF3241-70-4C-LFSE |
| SST32HF3241-70-4E-LS  | SST32HF3241-70-4E-LFS  |
| SST32HF3241-70-4E-LSE | SST32HF3241-70-4E-LFSE |

**Valid combinations for SST32HF3241C**

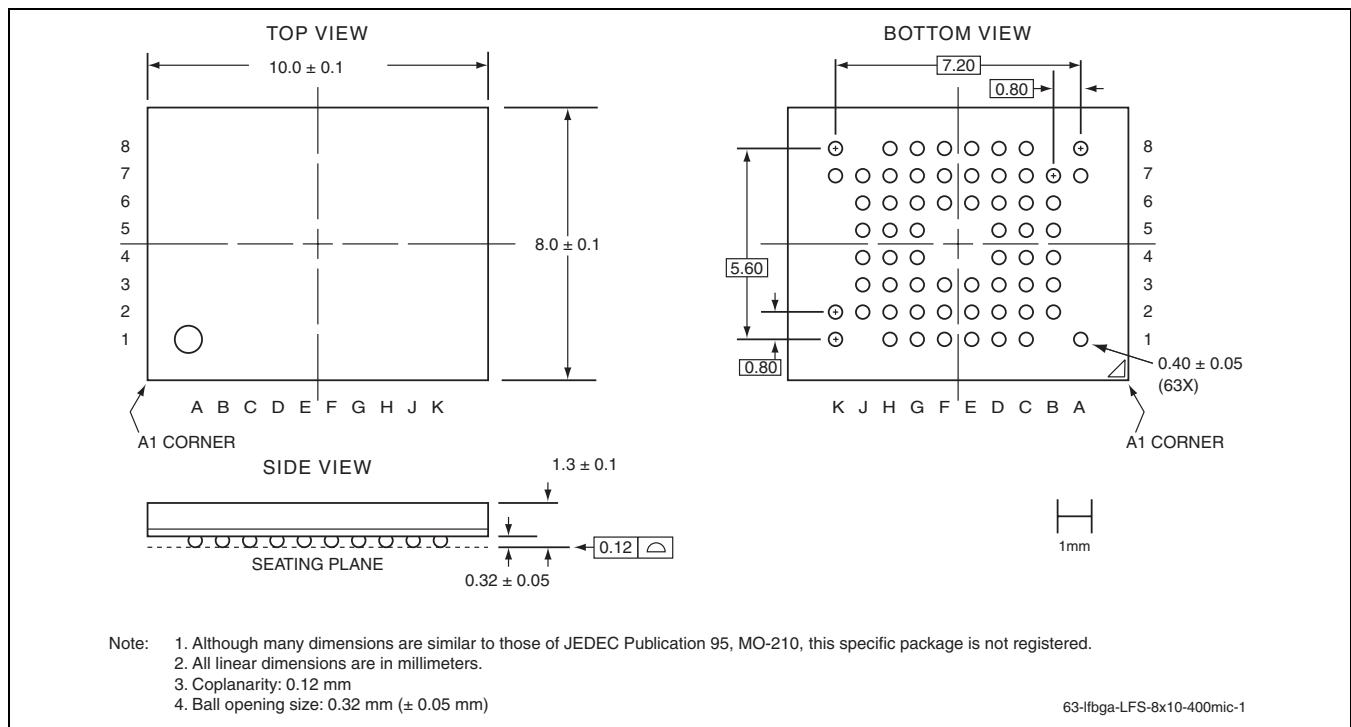
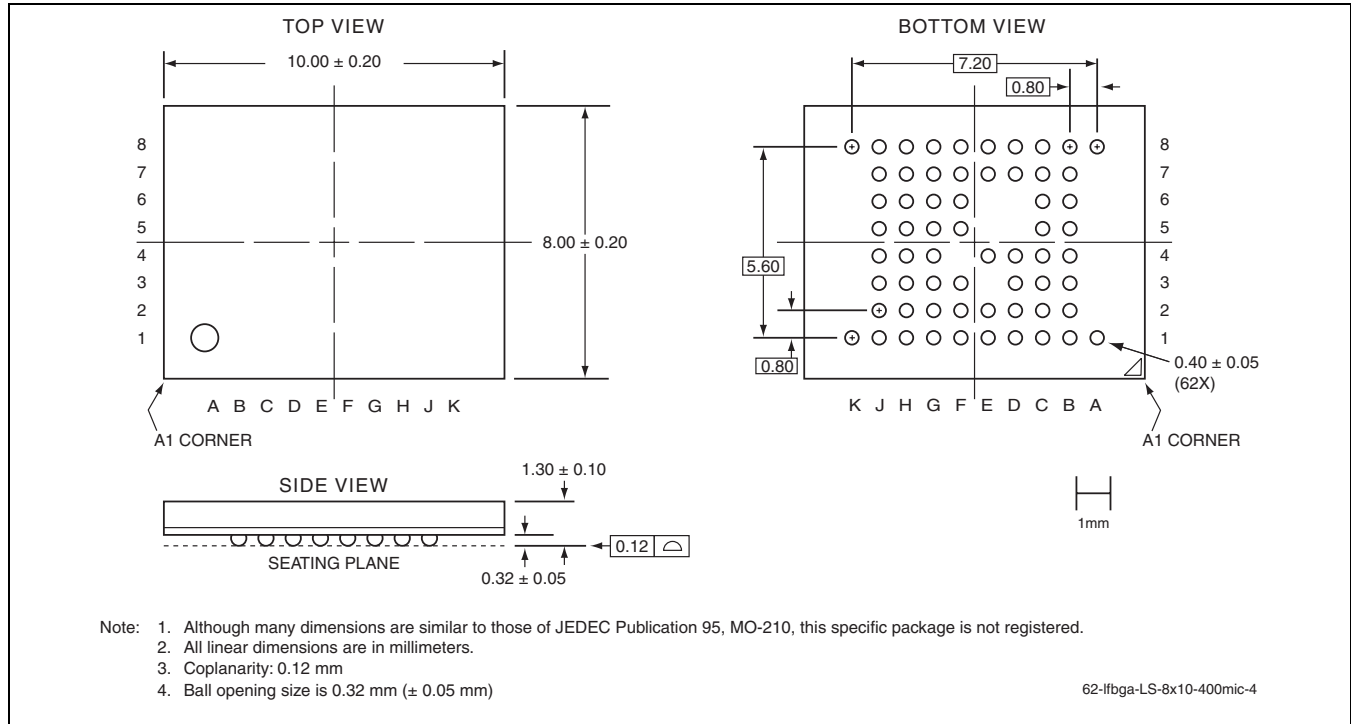
|                        |                         |
|------------------------|-------------------------|
| SST32HF3241C-70-4C-LS  | SST32HF3241C-70-4C-LFS  |
| SST32HF3241C-70-4C-LSE | SST32HF3241C-70-4C-LFSE |
| SST32HF3241C-70-4E-LS  | SST32HF3241C-70-4E-LFS  |
| SST32HF3241C-70-4E-LSE | SST32HF3241C-70-4E-LFSE |

**Valid combinations for SST32HF3281**

|                       |                        |
|-----------------------|------------------------|
| SST32HF3281-70-4C-LS  | SST32HF3281-70-4C-LFS  |
| SST32HF3281-70-4C-LSE | SST32HF3281-70-4C-LFSE |
| SST32HF3281-70-4E-LS  | SST32HF3281-70-4E-LFS  |
| SST32HF3281-70-4E-LSE | SST32HF3281-70-4E-LFSE |

**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**





**Multi-Purpose Flash Plus + SRAM ComboMemory**  
**SST32HF1641 / SST32HF1681 / SST32HF3241 / SST32HF3281**  
**SST32HF1621C / SST32HF1641C / SST32HF3241C**

EOL Data Sheet

**TABLE 14: REVISION HISTORY**

| Number | Description   | Date      |
|--------|---|-----------|
| 00     | <ul style="list-style-type: none"><li>Initial Release</li></ul>   | Jul 2003  |
| 01     | <ul style="list-style-type: none"><li>Moved 64M Flash + 16M SRAM to S71247 data sheet</li><li>Changed all TBD MPNs to L2S</li><li>Removed BFS MPNs for all devices</li><li>Updated all timing diagrams</li></ul>  | Jan 2004  |
| 02     | <ul style="list-style-type: none"><li>Added SST32HF1621C device and associated MPNs</li><li>Removed SST32HF3281C and SST32HF6481C devices and associated MPNs</li></ul>   | Jun 2004  |
| 03     | <ul style="list-style-type: none"><li>Changed I<sub>DD</sub> test condition for frequency specification from 1/T<sub>RC</sub> Min to 5 MHz<br/>See Table 6 on page 12</li><li>Updated L2S package outline drawing and pin assignments</li><li>Added RoHS compliance information on page 1 and in the “Product Ordering Information” on page 33</li><li>Added the solder reflow temperature to the “Absolute Maximum Stress Ratings” on page 11.</li><li>Removed all 90 ns information and associated MPNs beginning on page 34</li><li>Added all non-Pb MPNs beginning on page 34</li></ul> | Mar 2005  |
| 04     | <ul style="list-style-type: none"><li>Removed SST32HF6481 commercial temperature devices and MPNs</li><li>Moved SST32HF6481 extended temperature MPNs to S71299 data sheet</li></ul>  | May 2005  |
| 05     | <ul style="list-style-type: none"><li>End-of-Life data sheet for all devices in S71236</li></ul>  | June 2007 |