

# 4 Mbit (x16) Multi-Purpose Flash

## SST39WF400B



EOL Data Sheet

### FEATURES:

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

### PRODUCT DESCRIPTION

The SST39WF400B is a 256K x16 CMOS Multi-Purpose Flash (MPF) manufactured with SST proprietary, high-performance CMOS SuperFlash technology. The split-gate cell design and thick-oxide tunneling injector attain better reliability and manufacturability compared to alternate approaches. The SST39WF400B writes (Program or Erase) with a 1.65-1.95V power supply. This device conforms to JEDEC standard pin assignments for x16 memories.

The SST39WF400B features high-performance Word-Programming which provides a typical Word-Program time of 28  $\mu$ sec. It uses Toggle Bit or Data# Polling to detect the completion of the Program or Erase operation. On-chip hardware and software data protection schemes protect against inadvertent writes. Designed, manufactured, and tested for a wide spectrum of applications, the SST39WF400B is offered with a guaranteed typical endurance of 100,000 cycles. Data retention is rated at greater than 100 years.

The SST39WF400B is suited for applications that require convenient and economical updating of program, configuration, or data memory. For all system applications, this MPF significantly improves performance and reliability, while lowering power consumption. It inherently uses less

energy during Erase and Program than alternative flash technologies. When programming a flash device, the total energy consumed is a function of the applied voltage, current, and time of application. For any given voltage range, SuperFlash technology uses less current to program and has a shorter erase time; therefore, 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.

SuperFlash technology provides fixed Erase and Program times independent of the number of Erase/Program cycles that have occurred. Consequently, 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 SST39WF400B is offered in 48-ball WFBGA, and a 48-ball XFLGA packages. See Figure 2 for pin assignments and Table 2 for pin descriptions.



## Device Operation

Commands, which are used to initiate the memory operation functions of the device, 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 SST39WF400B 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. See Figure 4.

## Word-Program Operation

The SST39WF400B is programmed on a word-by-word basis. The sector where the word exists must be fully erased before programming.

Programming is accomplished in three steps:

1. Load the three-byte sequence for Software Data Protection.
2. Load word address and word data. During the Word-Program operation, the addresses are latched on the falling edge of either CE# or WE#, whichever occurs last. The data is latched on the rising edge of either CE# or WE#, whichever occurs first.
3. Initiate the internal Program operation after the rising edge of the fourth WE# or CE#, whichever occurs first. Once initiated, the Program operation will be completed within 40  $\mu$ s. See Figures 5 and 6 for WE# and CE# controlled Program operation timing diagrams and Figure 16 for flowcharts.

During the Program operation, the only valid reads are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. Any commands issued during the internal Program operation are ignored.

## Sector-/Block-Erase Operation

The SST39WF400B offers both Sector-Erase and Block-Erase modes which allow the system to erase the device on a sector-by-sector, or block-by-block, basis.

The sector architecture is based on an uniform sector size of 2 KWord. Initiate the Sector-Erase operation by executing a six-byte command sequence with Sector-Erase command (30H) and sector address (SA) in the last bus cycle.

The Block-Erase mode is based on an uniform block size of 32 KWord. Initiate the Block-Erase operation by executing a six-byte command sequence with Block-Erase command (50H) and block address (BA) in the last bus cycle.

The sector or block address is latched on the falling edge of the sixth WE# pulse, while the command (30H or 50H) is latched on the rising edge of the sixth WE# pulse. The internal Erase operation begins after the sixth WE# pulse.

The End-of-Erase operation can be determined using either Data# Polling or Toggle Bit methods. See Figures 9 and 10 for timing waveforms. Any commands issued during the Sector- or Block-Erase operation are ignored.

## Chip-Erase Operation

The SST39WF400B provides a Chip-Erase operation, which allows the user to erase the entire memory array to the '1' state. This is useful when the entire device must be quickly erased.

Initiate the Chip-Erase operation by executing a six-byte command sequence with Chip-Erase command (10H) at address 5555H in the last byte sequence.

The Erase operation begins with the rising edge of the sixth WE# or CE#, whichever occurs first. During the Erase operation, the only valid read is Toggle Bit or Data# Polling. See Table 4 for the command sequence, Figure 8 for the timing diagram, and Figure 19 for the flowchart. Any commands issued during the Chip-Erase operation are ignored.



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### Write Operation Status Detection

To optimize the system write cycle time, the SST39WF400B provides two software means to detect the completion of a Program or Erase write cycle. 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 completion of the nonvolatile Write is asynchronous with the system; therefore, either a Data# Polling or Toggle Bit read may occur simultaneously with the completion of the Write cycle. If this occurs, the system may get an erroneous result, i.e., valid data may appear to conflict with either DQ<sub>7</sub> or DQ<sub>6</sub>. To prevent spurious rejection in the event of an erroneous result, the software routine must 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 SST39WF400B is in the internal Program operation, any attempt to read DQ<sub>7</sub> will produce the complement of the true data. Once the Program operation is complete, DQ<sub>7</sub> will produce true data.

Although DQ<sub>7</sub> may have valid data immediately following the completion of an internal Write operation, the remaining data outputs may still be invalid. Valid data on the entire data bus will appear in subsequent successive Read cycles after an interval of 1  $\mu$ s. During an internal Erase operation, any attempt to read DQ<sub>7</sub> will produce a '0'. Once the internal Erase operation is complete, DQ<sub>7</sub> will produce a '1'.

The Data# Polling is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector-, Block-, or Chip-Erase, the Data# Polling is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 7 for Data# Polling timing diagram and Figure 17 for a flowchart.

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

During the internal Program or Erase operation, any consecutive attempts to read DQ<sub>6</sub> will produce alternating '1's and '0's, i.e., toggling between '1' and '0'.

When the Program or Erase operation is complete, the DQ<sub>6</sub> bit will stop toggling and the device is ready for the next operation.

The Toggle Bit is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector-, Block- or Chip-Erase, the Toggle Bit is valid after the rising edge of sixth WE# (or CE#) pulse. See Figure 0-1 for Toggle Bit timing diagram and Figure 17 for a flowchart.

### Data Protection

The SST39WF400B provides both hardware and software features to protect nonvolatile data from inadvertent writes.

### Hardware Data Protection

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

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

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

### Software Data Protection (SDP)

The SST39WF400B provides the JEDEC approved Software Data Protection scheme for all data alteration operations, i.e., Program and Erase. Any Program operation requires the inclusion of the three-byte sequence. The three-byte load sequence is used to initiate the Program operation, providing optimal protection from inadvertent Write operations, e.g., during the system power-up or power-down. Any Erase operation requires the inclusion of six-byte sequence. This group of devices are shipped with the Software Data Protection permanently enabled. See Table 4 for the specific software command codes. During SDP command sequence, invalid commands will abort the device to Read mode within T<sub>RC</sub>. The contents of DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, during any SDP command sequence.

### Common Flash Memory Interface (CFI)

The SST39WF400B contains the CFI information that describes the characteristics of the device, and supports both the original SST CFI Query mode implementation for compatibility with existing SST devices, as well as the general CFI Query mode.

To enter the SST CFI Query mode, the system must write the three-byte sequence, same as the Product ID Entry command, with 98H (CFI Query command) to address 5555H in the last byte sequence.



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To enter the general CFI Query mode, the system must write a one-byte sequence using the Entry command with 98H to address 55H.

Once the device enters the CFI Query mode, the system can read CFI data at the addresses given in Tables 5 through 7. The system must write the CFI Exit command to return to Read mode from the CFI Query mode.

**Product Identification**

The Product Identification mode identifies the device as the SST39WF400B and the manufacturer as SST. This mode is accessed by software operations. Use the Software Product Identification operation to identify the part (i.e., using the device ID) when using multiple manufacturers in the same socket. For details, see Table 4 for software operation, Figure 11 for the Software ID Entry and Read timing diagram, and Figure 18 for the Software ID Entry command sequence flowchart.

**TABLE 1: Product Identification Table**

|                          | Address | Data  |
|--------------------------|---------|-------|
| Manufacturer's ID        | 0000H   | 00BFH |
| Device ID<br>SST39WF400B | 0001H   | 272EH |

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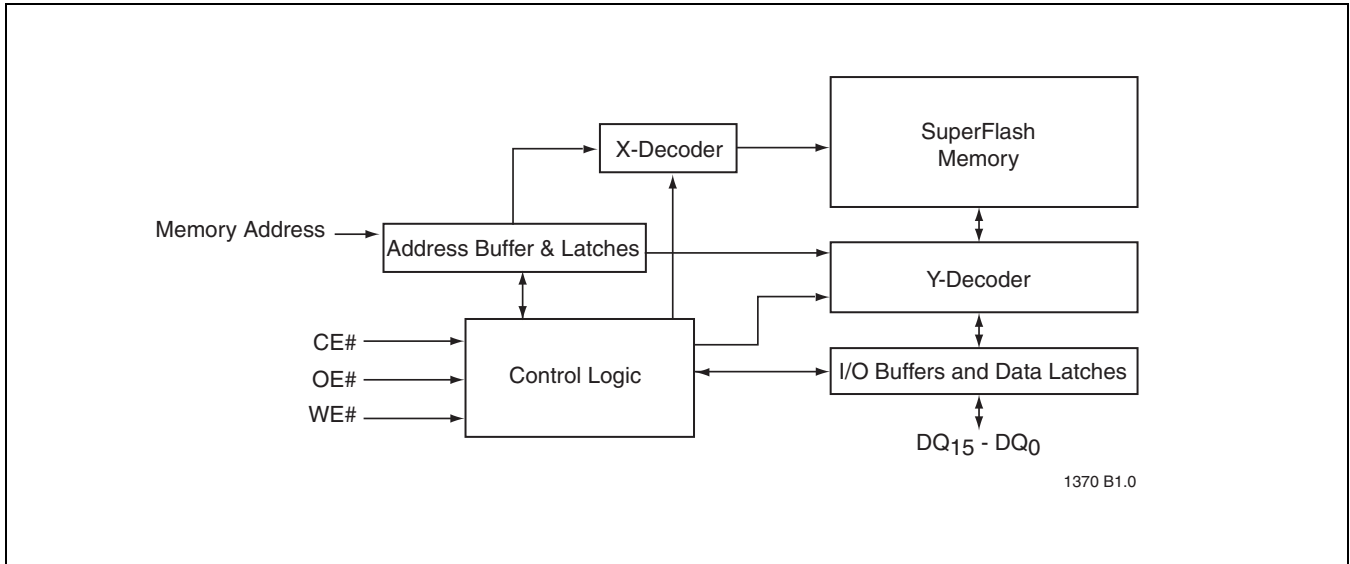
**Product Identification Mode Exit/  
CFI Mode Exit**

To return to the standard Read mode, exit the Software Product Identification mode by issuing the Software ID Exit command sequence.

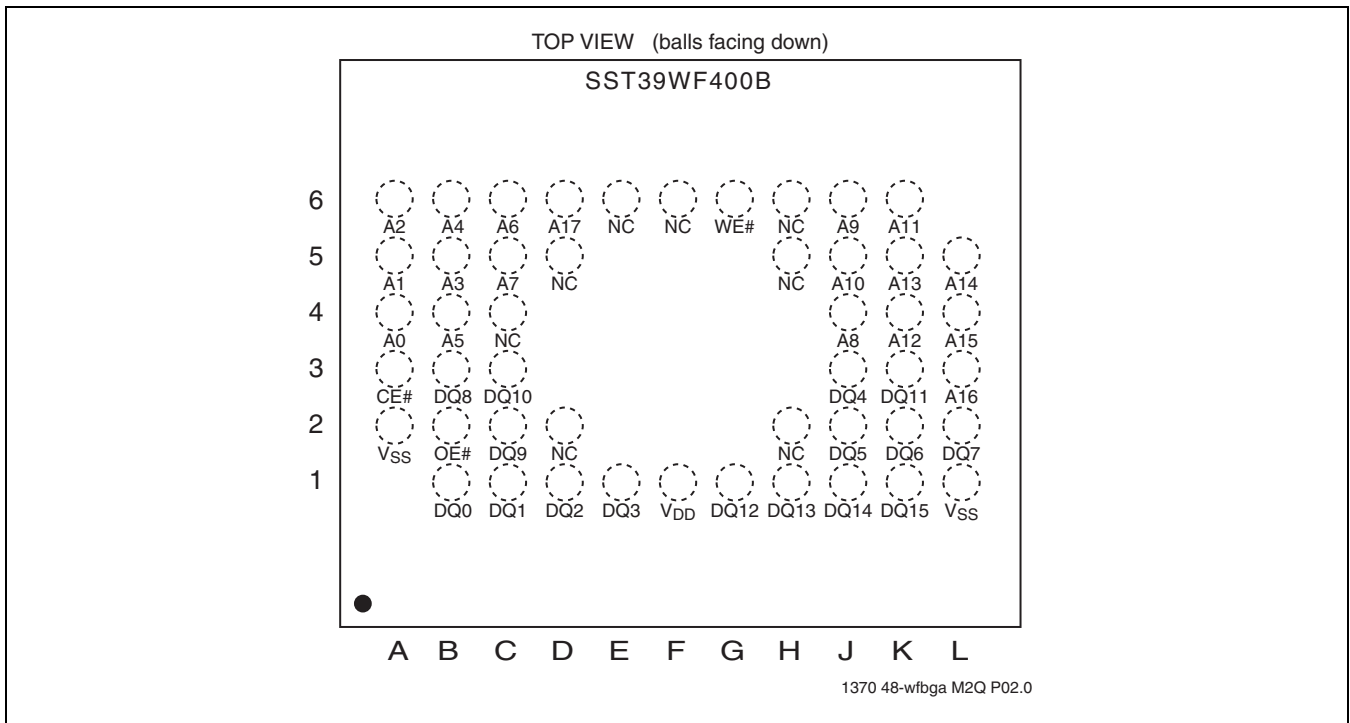
The Software ID Exit command can reset the SST39WF400B to the Read mode after an inadvertent transient condition that causes the device to behave abnormally.

The Software ID Exit/CFI Exit command is ignored during an internal Program or Erase operation. See Table 4 for software command codes, Figure 13 for timing waveform, and Figure 18 for a flowchart.

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**FIGURE 1: Functional Block Diagram**



**FIGURE 2: Pin Assignments for 48-Ball WFBGA and 48-Ball XFLGA**



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**TABLE 2: Pin Description**

| Symbol         | Pin Name          | Functions  |
|----------------|-------------------|--|
| $A_{MS}^1-A_0$ | Address Inputs    | To provide memory addresses. During Sector-Erase $A_{MS}-A_{11}$ address lines will select the sector. During Block-Erase $A_{MS}-A_{15}$ address lines will select the block.           |
| $DQ_{15}-DQ_0$ | Data Input/output | To output data during Read cycles and receive input data during Program cycles. Data is internally latched during a Program 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 Program operations.   |
| $V_{DD}$       | Power Supply      | To provide power supply voltage: 1.65-1.95V for SST39WF400B  |
| $V_{SS}$       | Ground            |  |
| NC             | No Connection     | Unconnected pins.  |

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1.  $A_{MS}$  = Most significant address  
 $A_{MS} = A_{17}$  for SST39WF400B

**TABLE 3: Operation Modes Selection**

| Mode                   | CE#      | OE#      | WE#      | DQ                | Address  |
|------------------------|----------|----------|----------|-------------------|--|
| Read                   | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ | $D_{OUT}$         | $A_{IN}$                                       |
| Program                | $V_{IL}$ | $V_{IH}$ | $V_{IL}$ | $D_{IN}$          | $A_{IN}$                                       |
| Erase                  | $V_{IL}$ | $V_{IH}$ | $V_{IL}$ | $X^1$             | Sector or Block address,<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 <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>   | Data <sup>2</sup> | Addr <sup>1</sup>            | Data <sup>2</sup> |
| Word-Program                                | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | A0H               | WA <sup>3</sup>     | Data              |                     |                   |                              |                   |
| Sector-Erase                                | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | SA <sub>X</sub> <sup>4</sup> | 30H               |
| Block-Erase                                 | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | BA <sub>X</sub> <sup>4</sup> | 50H               |
| Chip-Erase                                  | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 80H               | 5555H               | AAH               | 2AAAH               | 55H               | 5555H                        | 10H               |
| Software ID Entry <sup>5,6</sup>            | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 90H               |                     |                   |                     |                   |                              |                   |
| SST CFI Query Entry <sup>5</sup>            | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | 98H               |                     |                   |                     |                   |                              |                   |
| General CFI Query Mode                      | 55H                 | 98H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>7</sup> /<br>CFI Exit | XXH                 | F0H               |                     |                   |                     |                   |                     |                   |                     |                   |                              |                   |
| Software ID Exit <sup>7</sup> /<br>CFI Exit | 5555H               | AAH               | 2AAAH               | 55H               | 5555H               | F0H               |                     |                   |                     |                   |                              |                   |

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- Address format A<sub>14</sub>-A<sub>0</sub> (Hex), Addresses A<sub>MS</sub>-A<sub>15</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the Command sequence.  
A<sub>MS</sub> = Most significant address  
A<sub>MS</sub> = A<sub>17</sub> for SST39WF400B
- DQ<sub>15</sub>-DQ<sub>8</sub> can be V<sub>IL</sub> or V<sub>IH</sub>, but no other value, for the Command sequence
- WA = Program word address
- SA<sub>X</sub> for Sector-Erase; uses A<sub>MS</sub>-A<sub>11</sub> address lines  
BA<sub>X</sub> for Block-Erase; uses A<sub>MS</sub>-A<sub>15</sub> address lines
- The device does not remain in Software Product ID mode if powered down.
- With A<sub>MS</sub>-A<sub>1</sub> = 0; SST Manufacturer's ID = 00BFH, is read with A<sub>0</sub> = 0,  
SST39WF400B Device ID = 272EH, is read with A<sub>0</sub> = 1.
- Both Software ID Exit operations are equivalent

**TABLE 5: CFI Query Identification String<sup>1</sup> for SST39WF400B**

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

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- Refer to CFI publication 100 for more details.



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**TABLE 6: System Interface Information for SST39WF400B**

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

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**TABLE 7: Device Geometry Information for SST39WF400B**

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

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## ELECTRICAL SPECIFICATIONS

**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 11V                   |
| Package Power Dissipation Capability (T <sub>A</sub> = 25°C) ..... | 1.0W                           |
| Surface Mount Solder Reflow Temperature .....                      | 260°C for 10 seconds           |
| Output Short Circuit Current <sup>1</sup> .....                    | 50 mA                          |

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

### Operating Range

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

### AC Conditions of Test

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



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### Power-Up Specifications

All functionalities and DC specifications are specified for a  $V_{DD}$  ramp rate *faster* than 1V per 100 ms (0V to 1.8V in less than 180 ms). In addition, a  $V_{DD}$  ramp rate *slower* than 1V per 20  $\mu$ s is recommended. See Table 8 and Figure 3 for more information.

**TABLE 8: Recommended System Power-up Timings**

| Symbol           | Parameter                       | Minimum | Units   |
|------------------|---------------------------------|---------|---------|
| $T_{PU-READ}^1$  | $V_{DD}$ Min to Read Operation  | 100     | $\mu$ s |
| $T_{PU-WRITE}^1$ | $V_{DD}$ Min to Write Operation | 100     | $\mu$ 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.



**FIGURE 3: Power-Up Reset Diagram**



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## DC Characteristics

**TABLE 9: DC Operating Characteristics,  $V_{DD} = 1.65\text{-}1.95V^1$**

| Symbol   | Parameter                             | Limits       |             |         | Test Conditions  |
|----------|---------------------------------------|--------------|-------------|---------|--|
|          |                                       | Min          | Max         | Units   |  |
| $I_{DD}$ | Power Supply Current                  |              |             |         | Address input= $V_{ILT}/V_{IHT}$ , at $f=5$ MHz, $V_{DD}=V_{DD}$ Max |
|          | Read                                  |              | 15          | mA      | $CE\#=V_{IL}$ , $OE\#=WE\#=V_{IH}$ , all I/Os open                   |
|          | Program and Erase                     |              | 20          | mA      | $CE\#=WE\#=V_{IL}$ , $OE\#=V_{IH}$                                   |
| $I_{SB}$ | Standby $V_{DD}$ Current <sup>2</sup> |              | 40          | $\mu A$ | $CE\#=V_{DD}$ , $V_{DD}=V_{DD}$ Max                                  |
| $I_{LI}$ | Input Leakage Current                 |              | 1           | $\mu A$ | $V_{IN}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD}$ Max                       |
| $I_{LO}$ | Output Leakage Current                |              | 1           | $\mu A$ | $V_{OUT}=GND$ to $V_{DD}$ , $V_{DD}=V_{DD}$ Max                      |
| $V_{IL}$ | Input Low Voltage                     |              | $0.2V_{DD}$ |         | $V_{DD}=V_{DD}$ Min  |
| $V_{IH}$ | Input High Voltage                    | $0.8V_{DD}$  |             | V       | $V_{DD}=V_{DD}$ Max  |
| $V_{OL}$ | Output Low Voltage                    |              | 0.1         | V       | $I_{OL}=100 \mu A$ , $V_{DD}=V_{DD}$ Min                             |
| $V_{OH}$ | Output High Voltage                   | $V_{DD}-0.1$ |             | V       | $I_{OH}=-100 \mu A$ , $V_{DD}=V_{DD}$ Min                            |

T9.0 1370(03)

1. Typical conditions for the Active Current shown on the front page of the data sheet are average values at 25°C (room temperature), and  $V_{DD} = 1.8V$ . Not 100% tested.
2. 40  $\mu A$  is the maximum  $I_{SB}$  for all SST39WF400B commercial grade devices. 40  $\mu A$  is the maximum  $I_{SB}$  for all SST39WF400B industrial grade devices. For all SST39WF400B commercial and industrial devices,  $I_{SB}$  typical is 5  $\mu A$ .

**TABLE 10: Capacitance ( $T_A = 25^\circ C$ ,  $f=1$  MHz, other pins open)**

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

T10.0 1370(03)

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

**TABLE 11: Reliability Characteristics**

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

T11.0 1370(03)

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.



EOL Data Sheet

## AC Characteristics

**TABLE 12: Read Cycle Timing Parameters**

| Symbol      | Parameter                       | 70 ns |     | Units |
|-------------|---------------------------------|-------|-----|-------|
|             |                                 | Min   | Max |       |
| $T_{RC}$    | 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    |
| $T_{CLZ}^1$ | CE# Low to Active Output        | 0     |     | ns    |
| $T_{OLZ}^1$ | OE# Low to Active Output        | 0     |     | ns    |
| $T_{CHZ}^1$ | CE# High to High-Z Output       |       | 40  | ns    |
| $T_{OHZ}^1$ | OE# High to High-Z Output       |       | 40  | ns    |
| $T_{OH}^1$  | Output Hold from Address Change | 0     |     | ns    |

T12.0 1370(03)

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

**TABLE 13: Program/Erase Cycle Timing Parameters**

| Symbol      | Parameter                        | Min | Max | Units   |
|-------------|----------------------------------|-----|-----|---------|
| $T_{BP}$    | Word-Program Time                |     | 40  | $\mu$ s |
| $T_{AS}$    | Address Setup Time               | 0   |     | ns      |
| $T_{AH}$    | Address Hold Time                | 50  |     | 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                  | 50  |     | ns      |
| $T_{WP}$    | WE# Pulse Width                  | 50  |     | ns      |
| $T_{WPH}^1$ | WE# Pulse Width High             | 30  |     | ns      |
| $T_{CPH}^1$ | CE# Pulse Width High             | 30  |     | ns      |
| $T_{DS}$    | Data Setup Time                  | 50  |     | ns      |
| $T_{DH}^1$  | Data Hold Time                   | 0   |     | ns      |
| $T_{IDA}^1$ | Software ID Access and Exit Time |     | 150 | ns      |
| $T_{SE}$    | Sector-Erase                     |     | 50  | ms      |
| $T_{BE}$    | Block-Erase                      |     | 50  | ms      |
| $T_{SCE}$   | Chip-Erase                       |     | 200 | ms      |

T13.0 1370(03)

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



# 4 Mbit (x16) Multi-Purpose Flash SST39WF400B

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**FIGURE 4: Read Cycle Timing Diagram**



**FIGURE 5: WE# Controlled Program Cycle Timing Diagram**



FIGURE 6: CE# Controlled Program Cycle Timing Diagram



FIGURE 7: Data# Polling Timing Diagram



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**FIGURE 0-1: Toggle Bit Timing Diagram**



**FIGURE 8: WE# Controlled Chip-Erase Timing Diagram**



FIGURE 9: WE# Controlled Block-Erase Timing Diagram



FIGURE 10: WE# Controlled Sector-Erase Timing Diagram



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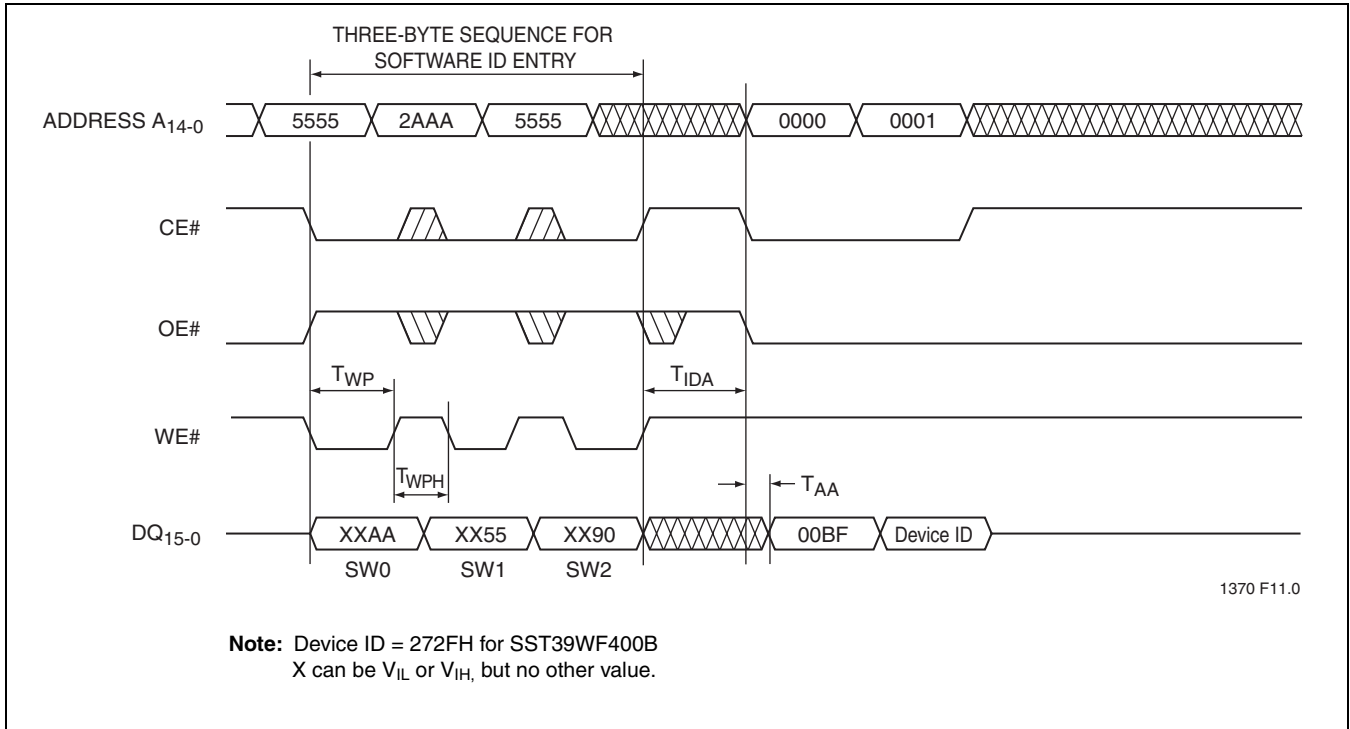


FIGURE 11: Software ID Entry and Read

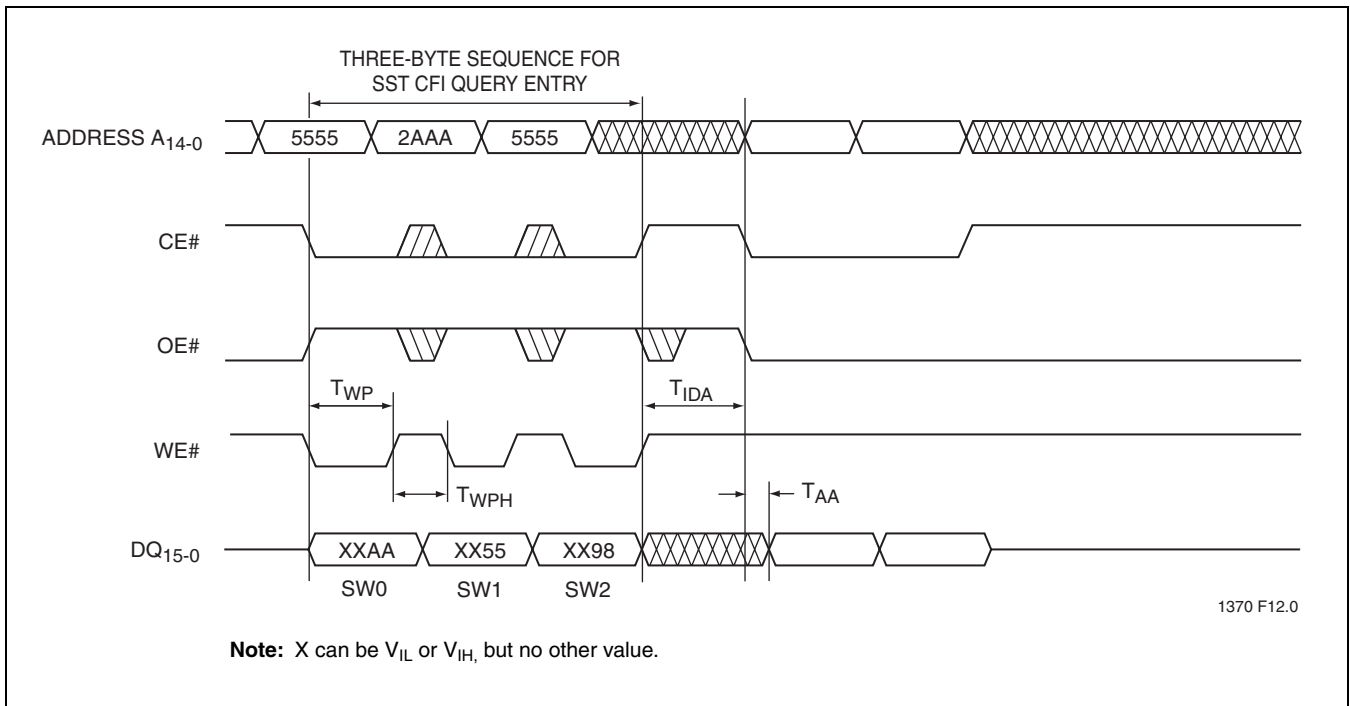


FIGURE 12: SST CFI Query Entry and Read



FIGURE 13: Software ID Exit/CFI Exit



FIGURE 14: AC Input/Output Reference Waveforms

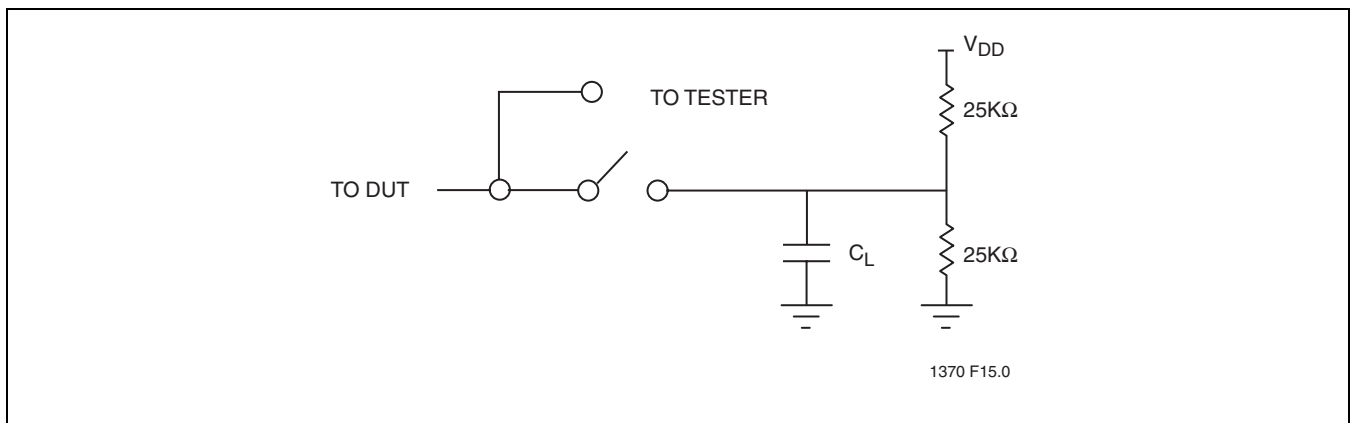


FIGURE 15: A Test Load Example



FIGURE 16: Word-Program Algorithm



FIGURE 17: Wait Options



FIGURE 18: Software ID/CFI Command Flowcharts



FIGURE 19: Erase Command Sequence



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## PRODUCT ORDERING INFORMATION



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

### Valid combinations for SST39WF400B

SST39WF400B-70-4C-D1QE    SST39WF400B-70-4I-D1QE  
 SST39WF400B-70-4C-Y1QE    SST39WF400B-70-4I-Y1QE

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



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PACKAGING DIAGRAMS



FIGURE 20: 48-Ball Extremely Thin-Profile, Fine-Pitch Land Grid Array (XFLGA) 4mm x 6mm  
SST Package Code: D1Q



FIGURE 21: 48-Ball Very-Very-Thin-Profile, Fine-Pitch Ball Grid Array (WFBGA) 4mm x 6mm  
SST Package Code: Y1Q



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**TABLE 14: Revision History**

| Number | Description  | Date     |
|--------|--|----------|
| 00     | <ul style="list-style-type: none"><li>EOL of all D1QE and Y1QE parts. Replacement parts are the CAQE and MAQE parts found in S71370.</li></ul> | Jan 2010 |