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**Preliminary  
Specifications**

**SST 28VF040  
2.7V-only 4 Megabit  
SuperFlash EEPROM**

**June 1997**



# SST 28VF040

## 2.7V-only 4 Megabit SuperFlash EEPROM

Preliminary Specifications

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### Features:

#### Single 2.7-Volt Read and Write Operations CMOS SuperFlash EEPROM Technology

Endurance: 100,000 Cycles (typical)  
Greater than 100 years Data Retention

**Memory Organization:** 512K x 8

**Sector Erase Capability:** 256 bytes per Sector

#### Low Power Consumption:

Active Current: 10 mA (typical)  
Standby Current: 5  $\mu$ A (typical)

#### Fast Sector Erase/Byte Program Operation

Byte Program Time: 35  $\mu$ s (typical)  
Sector Erase Time: 2 ms (typical)  
Complete Memory Rewrite: 20 sec (typical)

**Fast Access Time: 250 and 300 ns**

#### Latched Address and Data

**Hardware and Software Data Protection**  
7-Read-Cycle-Sequence Software Data  
Protection

#### End of Write Detection

Toggle Bit  
Data# Polling

#### TTL I/O Compatibility

#### Packages Available

40-Pin TSOP (10 mm x 20 mm)  
32-Pin TSOP (8 mm x 20 mm)  
32-Pin PLCC  
32-Pin PDIP

### Product Description

The 28VF040 is a 512K x 8 (bits) CMOS sector erase, byte program EEPROM. The 28VF040 is manufactured using SST's proprietary, high performance CMOS SuperFlash EEPROM Technology. The split gate cell design and thick oxide tunneling injector attain better reliability and manufacturability compared with alternative approaches. The 28VF040 erases and programs with a 2.7 volt only power supply. ( $V_{CC}$ : 2.7V to 3.6V) The 28VF040 conforms to JEDEC standard pinouts for byte wide memories and is compatible with existing industry standard EPROM, flash EPROM and EEPROM pinouts.

Featuring high performance programming, the 28VF040 typically byte programs in 35  $\mu$ s. The 28VF040 typically sector erases in 2 ms. Both program and erase times can be optimized using interface features such as Toggle bit or Data# Polling to indicate the completion of the write cycle. To protect against an inadvertent write, the 28VF040 has on chip hardware and software data protection schemes. Designed, manufactured, and tested for a wide spectrum of applications, the 28VF040 is offered with a guaranteed sector endurance of  $10^4$  and  $10^3$  cycles. Data retention is rated greater than 100 years.

The 28VF040 is best suited for applications that require reprogrammable nonvolatile mass storage of program, configuration, or data memory. For all system applications, the 28VF040 significantly improves performance and reliability, while lowering

power consumption when compared with floppy diskettes or EPROM approaches. EEPROM technology makes possible convenient and economical updating of codes and control programs on-line. The 28VF040 improves flexibility, while lowering the cost of program and configuration storage application.

Figure 1 shows the functional blocks of the 28VF040. Figures 2A, 2B, and 3 show the pin assignments for the 40 pin TSOP, 32 pin TSOP, 32 pin PDIP, and 32 pin PLCC packages. Pin description and operation modes are described in Tables 1 through 4.

### Device Operation

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

### Command Definitions

Table 3 contains a command list and a brief summary of the commands. The following is a detailed description of the operations initiated by each command.



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### Sector\_Erase Operation

The Sector\_Erase operation erases all bytes within a sector and is initiated by a setup command and an execute command. A sector contains 256 bytes. This sector erasability enhances the flexibility and usefulness of the 28VF040, since most applications only need to change a small number of bytes or sectors, not the entire chip.

The setup command is performed by writing 20H to the device. The execute command is performed by writing D0H to the device. The erase operation begins with the rising edge of the WE# or CE#, whichever occurs first and terminates automatically by using an internal timer. The end of Erase can be determined using either Data# Polling, Toggle Bit, or Successive Reads detection methods. See Figure 9 for timing waveforms.

The two-step sequence of setup command followed by an execute command ensures that only memory contents within the addressed sector are erased and other sectors are not inadvertently erased.

### Sector\_Erase Flowchart Description

Fast and reliable erasing of the memory contents within a sector is accomplished by following the sector erase flowchart as shown in Figure 18. The entire procedure consists of the execution of two commands. The Sector\_Erase operation will terminate after a maximum of 4 ms. A Reset command can be executed to terminate the erase operation; however, if the erase operation is terminated prior to the 4 ms time-out, the sector may not be fully erased. An erase command can be reissued as many times as necessary to complete the erase operation. The 28VF040 cannot be "overerased".

### Chip\_Erase Operation

The Chip\_Erase operation is initiated by a setup command (30H) and an execute command (30H). The Chip\_Erase operation allows the entire array of the 28VF040 to erase in one operation, as opposed to 2048 sector erase operations. Using the Chip\_Erase operation will minimize the time to e-write the entire memory array. The Chip\_Erase operation will terminate after a maximum of 20 ms. A Reset command can be executed to terminate the erase operation; however, if the erase operation is terminated prior to the 20 ms time-out, the Chip may not be completely erased. If an erase error occurs an

erase command can be reissued as many times as necessary to complete the erase operation. The 28VF040 cannot be "overerased". (See Figure 8)

### Byte\_Program Operation

The Byte\_Program operation is initiated by writing the setup command (10H). Once the program setup is performed, programming is executed by the next WE# pulse. See Figures 5 and 6 for timing waveforms. 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, and begins the program operation. The program operation is terminated automatically by an internal timer. See Figure 16 for the programming flowchart.

The two-step sequence of a setup command followed by an execute command ensures that only the addressed byte is programmed and other bytes are not inadvertently programmed.

### The Byte\_Program Flowchart Description

Programming data into the 28VF040 is accomplished by following the Byte\_Program flowchart shown in Figure 16. The Byte\_Program command sets up the byte for programming. 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 and begins the program operation. The end of program can be detected using either the Data# Polling, Toggle bit, or Successive reads.

### Reset Operation

The Reset command is provided as a means to safely abort the erase or program command sequences. Following either setup commands (erase or program) with a write of FFH will safely abort the operation. Memory contents will not be altered. After the Reset command, the device returns to the read mode. The Reset command does not enable software data protection. See Figure 7 for timing waveforms.



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### Read

The Read operation is initiated by setting CE#, and OE# to logic low and setting WE# to logic high (See Table 2). See Figure 4 for read memory timing waveform. The read operation from the host retrieves data from the array. The device remains enabled for read until another operation mode is accessed. During initial power-up, the device is in the read mode and is software data protected. The device must be unprotected to execute a write command.

The read operation of the 28VF040 is controlled by OE# and CE# at logic low. When CE# is high, the chip is deselected and only standby power will be 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 CE# and OE# are high.

### Read\_ID operation

The Read\_ID operation is initiated by writing a single command (90H). A read of address 0000H will output the manufacturer's code (BFH). A read of address 0001H will output the device code (04H). Any other valid command will terminate this operation.

### Data Protection

In order to protect the integrity of nonvolatile data storage, the 28VF040 provides both hardware and software features to prevent inadvertent writes to the device, for example, during system power-up or power-down. Such provisions are described below.

### Hardware Data Protection

The 28VF040 is designed with hardware features to prevent inadvertent writes. This is done in the following ways:

1. Write Inhibit Mode: OE# low, CE#, or WE# high will inhibit the write operation.
2. Noise/Glitch Protection: A WE# pulse width of less than 15 ns will not initiate a write cycle.
3. V<sub>CC</sub> Power Up/Down Detection: The write operation is inhibited when V<sub>CC</sub> is less than 2.5V.
4. After power-up the device is in the read mode and the device is in the software data protect state.

### Software Data Protection (SDP)

The 28VF040 has software methods to further prevent inadvertent writes. In order to perform an erase or program operation, a two-step command sequence consisting of a set-up command followed by an execute command avoids inadvertent erasing and programming of the device.

The 28VF040 will default to software data protection after power up. A sequence of seven consecutive reads at specific addresses will unprotect the device. The address sequence is 1823H, 1820H, 1822H, 0418H, 041BH, 0419H, 041AH. The address bus is latched on the rising edge of OE# or CE#, whichever occurs first. A similar seven read sequence of 1823H, 1820H, 1822H, 0418H, 041BH, 0419H, 040AH will protect the device. Also refer to Figures 10 and 11 for the 7 read cycle sequence Software Data Protection. The I/O pins can be in any state (i.e., high, low, or tristate).

### Write Operation Status Detection

The 28VF040 provides three means to detect the completion of a write cycle, in order to optimize the system write cycle time. The end of a write cycle (erase or program) can be detected by three means: 1) monitoring the Data# Polling bit; 2) monitoring the Toggle bit; or 3) by two successive read of the same data. These three detection mechanisms are described below.

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 the DQ used. In order to prevent spurious rejection, if an erroneous result occurs, the software routine should include a loop to read the accessed location an additional two (2) times. If both reads are valid, then the device has completed the write cycle, otherwise the rejection is valid.

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

The 28VF040 features Data# Polling to indicate the write operation status. During a write operation, any attempt to read the last byte loaded during the byte-load cycle will receive the complement of the true data on DQ<sub>7</sub>. Once the write cycle is completed, DQ<sub>7</sub> will show true data. The device is then ready for the

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next operation. See Figure 12 for Data Polling timing waveforms. In order for Data# Polling to function correctly, the byte being polled must be erased prior to programming.

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

An alternative means for determining the write operation status is by monitoring the Toggle Bit, DQ<sub>6</sub>. During a write operation, consecutive attempts to read data from the device will result in DQ<sub>6</sub> toggling between logic 0 (low) and logic 1 (high). When the write cycle is completed, the toggling will stop. The device is then ready for the next operation. See Figure 13 for Toggle Bit timing waveforms.

### Successive Reads

An Alternative means for determining an end of a write cycle is by reading the same address for two consecutive data matches.

### Product Identification

The Product Identification mode identifies the device as 28VF040 and the manufacturer as SST. This mode may be accessed by hardware and software operations. The hardware operation is typically used by an external programmer to identify the correct algorithm for the 28VF040. Users may wish to use the software operation to identify the device (i.e., using the device code). For details see Table 2 for the hardware operation and Figure 19 for the software operation. The manufacturer and device codes are the same for both operations.

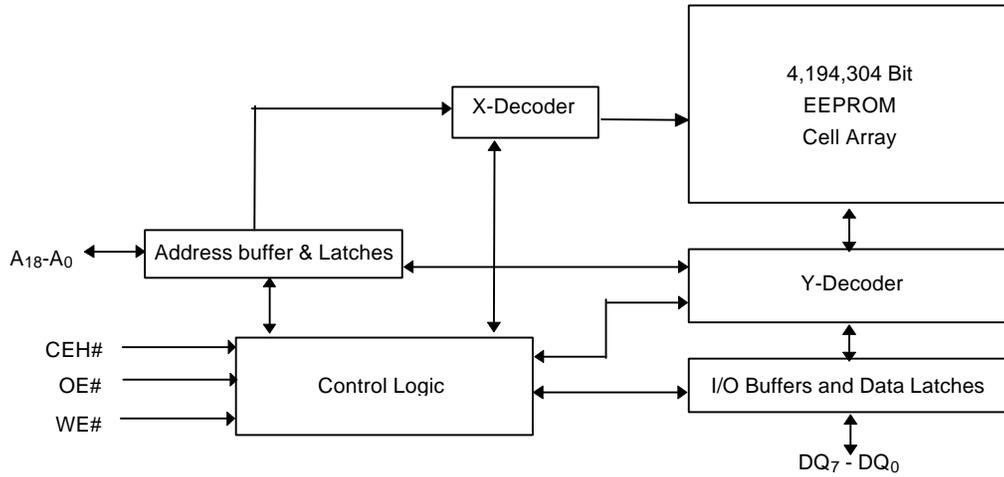
### Product Identification Table

|                   | Byte   | Data |
|-------------------|--------|------|
| Manufacturer Code | 0000 H | BF H |
| Device Code       | 0001 H | 04 H |

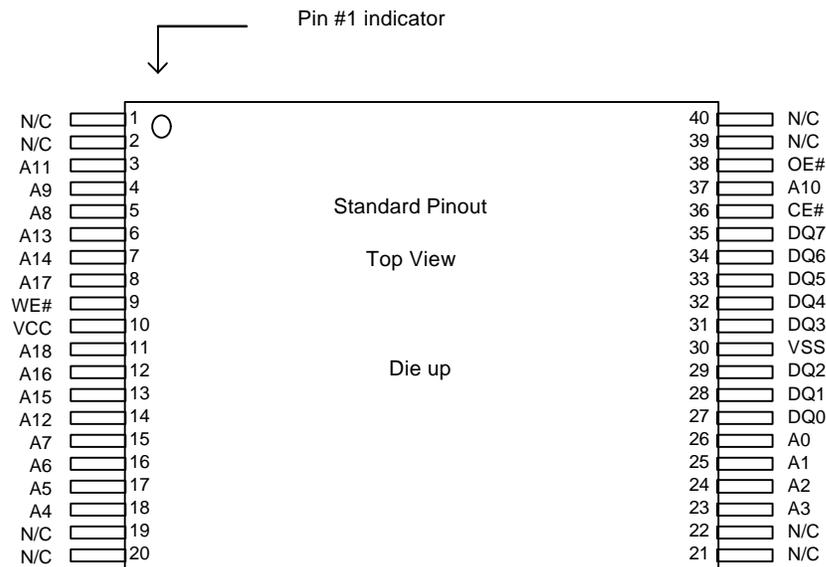


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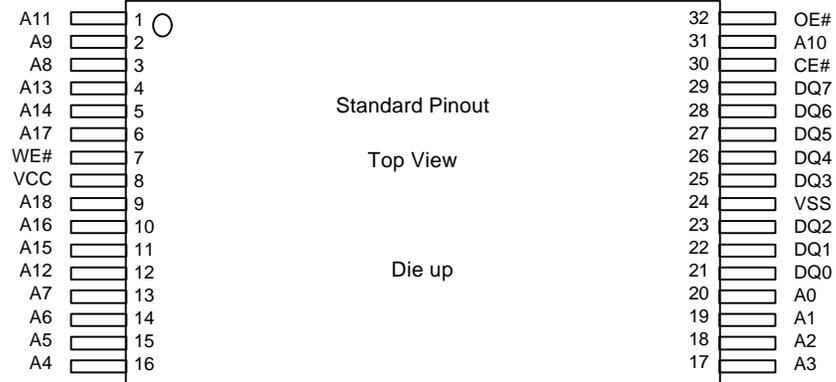


**Figure 1: Functional Block Diagram of SST 28VF040**

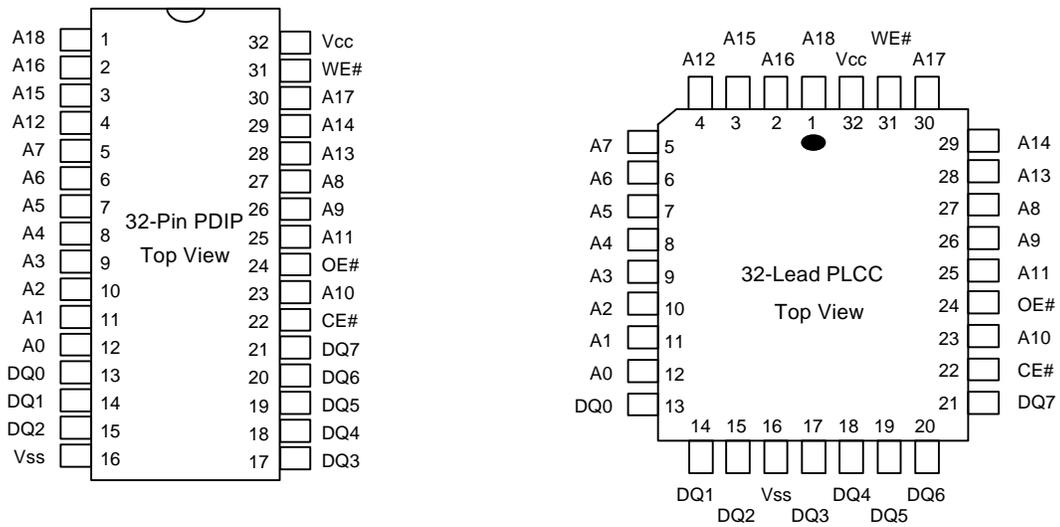


**Figure 2A: Standard Pin Assignments for 40-pin TSOP Packages**

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**Figure 2B: Standard Pin Assignments for 32-pin TSOP Packages**



**Figure 3: Pin Assignments for 32-pin Plastic DIPs and 32-pin PLCCs**



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**Table 1: Pin Description**

| Symbol                           | Pin Name              | Functions   |
|----------------------------------|-----------------------|---|
| A <sub>18</sub> -A <sub>8</sub>  | Row Address Inputs    | To provide memory addresses. Row addresses define a sector.   |
| A <sub>7</sub> -A <sub>0</sub>   | Column Address Inputs | Selects the byte within the sector.   |
| DQ <sub>7</sub> -DQ <sub>0</sub> | Data Input/Output     | To output data during read cycles and receive input data during write cycles. Data is internally latched during a write cycle. The outputs are in tri-state when OE#, CE # is high. |
| CE#                              | Chip Enable           | To activate the device when CE # is low. <sup>(1)</sup>   |
| OE#                              | Output Enable         | To gate the data output buffers. <sup>(1)</sup>   |
| WE#                              | Write Enable          | To control the write operations. <sup>(1)</sup>   |
| V <sub>cc</sub>                  | Power Supply          | To provide 3.0-volt supply ( $\pm 0.3$ V)   |
| V <sub>ss</sub>                  | Ground                |   |

**Note:** <sup>(1)</sup>This pin is considered an input for the purposes of the DC Operation Characteristics Table.

**Table 2: Operation Modes Selection**

| Mode                      | CE#             | OE#             | WE#             | DQ                       | Address   |
|---------------------------|-----------------|-----------------|-----------------|--------------------------|---|
| Read                      | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IH</sub> | D <sub>OUT</sub>         | A <sub>IN</sub>   |
| Byte Program              | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | D <sub>IN</sub>          | A <sub>IN</sub> , See Table 3   |
| Sector Erase              | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | D <sub>IN</sub>          | A <sub>IN</sub> , See Table 3   |
| Standby                   | V <sub>IH</sub> | X               | X               | High Z                   | X   |
| Write Inhibit             | X               | V <sub>IL</sub> | X               | High Z/ D <sub>OUT</sub> | X   |
| Write Inhibit             | X               | X               | V <sub>IH</sub> | High Z/ D <sub>OUT</sub> | X   |
| Software Chip Erase       | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | D <sub>IN</sub>          | See Table 3   |
| Product Identification    |                 |                 |                 |                          |   |
| Hardware Mode             | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IH</sub> | Manufacturer Code (BF)   | A <sub>18</sub> -A <sub>1</sub> =V <sub>IL</sub> , A <sub>9</sub> =V <sub>H</sub> , A <sub>0</sub> =V <sub>IL</sub> |
| Software Mode             | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | Device Code (04)         | A <sub>18</sub> -A <sub>1</sub> =V <sub>IL</sub> , A <sub>9</sub> =V <sub>H</sub> , A <sub>0</sub> =V <sub>IH</sub> |
| SDP Enable & Disable Mode | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> |                          | See Table 3   |
| Reset                     | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> |                          | See Table 3   |

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**Table 3: Software Command Summary**

| Command Summary         | Required Cycle(s) | Setup Command Cycle |                       |                     | Execute Command Cycle |                       |                     | SDP <sup>(5)</sup> |
|-------------------------|-------------------|---------------------|-----------------------|---------------------|-----------------------|-----------------------|---------------------|--------------------|
|                         |                   | Type <sup>(1)</sup> | Addr <sup>(2,3)</sup> | Data <sup>(4)</sup> | Type <sup>(1)</sup>   | Addr <sup>(2,3)</sup> | Data <sup>(4)</sup> |                    |
| Sector_Erase            | 2                 | W                   | X                     | 20H                 | W                     | SA                    | D0H                 | N                  |
| Byte_Program            | 2                 | W                   | X                     | 10H                 | W                     | PA                    | PD                  | N                  |
| Chip_Erase              | 2                 | W                   | X                     | 30H                 | W                     | X                     | 30H                 | N                  |
| Reset                   | 1                 | W                   | X                     | FFH                 |                       |                       |                     | Y                  |
| Read_ID                 | 3                 | W                   | X                     | 90H                 | R                     | (8)                   | (8)                 | Y                  |
| Software_Data_Protect   | 7                 | R                   | (6)                   |                     |                       |                       |                     |                    |
| Software_Data_Unprotect | 7                 | R                   | (7)                   |                     |                       |                       |                     |                    |

**Notes:**

- Type definition: W = Write, R = Read, X= don't care
- Addr (Address) definition: SA = Sector Address =  $A_8 - A_8$ , sector size = 256 bytes;  $A_7 - A_0 = X$  for this command.
- Addr (Address) definition: PA = Program Address =  $A_8 - A_0$ .
- Data definition: PD = Program Data, H = number in hex.
- SDP = Software Data Protect mode using 7 Read Cycle Sequence.
  - Y = the operation can be executed with protection enabled
  - N = the operation cannot be executed with protection enabled
- Refer to Figure 11 for the 7 Read Cycle sequence for Software\_Data\_Protect.
- Refer to Figure 10 for the 7 Read Cycle sequence for Software\_Data\_Unprotect.
- Address 0000H retrieves the manufacturer' code of BFH and address 0001H retrieves the device code of 04H.

**Table 4: Memory Array Detail**

| Sector Select  | Byte Select |
|----------------|-------------|
| $A_{18} - A_8$ | $A_7 - A_0$ |



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

|   |                          |
|---|--------------------------|
| Temperature Under Bias .....                                      | -55°C to +125°C          |
| Storage Temperature .....   | -65°C to +150°C          |
| D. C. Voltage on Any Pin to Ground Potential .....                | -0.5V to $V_{CC} + 0.5V$ |
| Transient Voltage (<20 ns) on Any Pin to Ground Potential .....   | -1.0V to $V_{CC} + 1.0V$ |
| Voltage on $A_9$ Pin to Ground Potential .....                    | -0.5V to 14.0V           |
| Package Power Dissipation Capability ( $T_a = 25^\circ C$ ) ..... | 1.0W                     |
| Through Soldering Temperature (10 Seconds).....                   | 300°C                    |
| Surface Mount Lead Soldering Temperature (3 Seconds) .....        | 240°C                    |
| Output Short Circuit Current <sup>(1)</sup> .....                 | 100 mA                   |

**Note:** <sup>(1)</sup> Outputs shorted for no more than one second. No more than one output shorted at a time.

**Table 5: Operating Range**

| Range      | Ambient Temp     | $V_{CC}$    |
|------------|------------------|-------------|
| Commercial | 0 °C to +70 °C   | 2.7 to 3.6V |
| Industrial | -40 °C to +85 °C | 2.7 to 3.6V |

**Table 6: AC Conditions of Test**

|                           |                               |
|---------------------------|-------------------------------|
| Input Rise/Fall Time..... | 10 ns                         |
| Output Load.....          | 1 TTL Gate and $C_L = 100$ pF |
| See Figures 14 and 15     |                               |

**Table 7: DC Operating Characteristics**

| Symbol    | Parameter                             | Limits |      | Units   | Test Conditions   |
|-----------|---------------------------------------|--------|------|---------|---|
|           |                                       | Min    | Max  |         |   |
| $I_{CC}$  | Power Supply Current                  |        |      |         | $CE\# = OE\# = V_{IL}$ , $WE\# = V_{IH}$ ,<br>all I/Os open                     |
|           | Read                                  |        | 10   | mA      | Address input = $V_{IL}/V_{IH}$ , at $f=1/T_{RC}$ Min.<br>$V_{CC} = V_{CC}$ Max |
|           | Program and Erase                     |        | 25   | mA      | $CE\# = WE\# = V_{IL}$ , $OE\# = V_{IH}$<br>$V_{CC} = V_{CC}$ Max.              |
| $I_{SB1}$ | Standby $V_{CC}$ Current (TTL input)  |        | 1    | mA      | $CE\# = OE\# = WE\# = V_{IH}$ , $V_{CC} = V_{CC}$ Max                           |
| $I_{SB2}$ | Standby $V_{CC}$ Current (CMOS input) |        | 20   | $\mu A$ | $CE\# = OE\# = WE\# = V_{CC} - 0.3V$ ,<br>$V_{CC} = V_{CC}$ Max                 |
| $I_{LI}$  | Input Leakage Current                 |        | 1    | $\mu A$ | $V_{IN} = GND$ to $V_{CC}$ , $V_{CC} = V_{CC}$ Max.                             |
| $I_{LO}$  | Output Leakage Current                |        | 10   | $\mu A$ | $V_{OUT} = GND$ to $V_{CC}$ , $V_{CC} = V_{CC}$ Max.                            |
| $V_{IL}$  | Input Low Voltage                     |        | 0.8  | V       | $V_{CC} = V_{CC}$ Max.  |
| $V_{IH}$  | Input High Voltage                    | 2.0    |      | V       | $V_{CC} = V_{CC}$ Max.  |
| $V_{OL}$  | Output Low Voltage                    |        | 0.4  | V       | $I_{OL} = 100 \mu A$ , $V_{CC} = V_{CC}$ Min.                                   |
| $V_{OH}$  | Output High Voltage                   | 2.4    |      | V       | $I_{OH} = -100 \mu A$ , $V_{CC} = V_{CC}$ Min.                                  |
| $V_H$     | Supervoltage for $A_9$                | 11.6   | 12.4 | V       | $CE\# = OE\# = V_{IL}$ , $WE\# = V_{IH}$  |
| $I_H$     | Supervoltage Current for $A_9$        |        | 200  | $\mu A$ | $CE\# = OE\# = V_{IL}$ , $WE\# = V_{IH}$ , $A_9 = V_H$ Max.                     |

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**Table 8: Power-up Timings**

| Symbol               | Parameter                   | Maximum | Units |
|----------------------|-----------------------------|---------|-------|
| $T_{PU-READ}^{(1)}$  | Power-up to Read Operation  | 10      | ms    |
| $T_{PU-WRITE}^{(1)}$ | Power-up to Write Operation | 10      | ms    |

**Table 9: Capacitance ( $T_a = 25\text{ }^\circ\text{C}$ ,  $f=1\text{ Mhz}$ , other pins open)**

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

**Note:** <sup>(1)</sup>This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

**Table 10: Reliability Characteristics**

| Symbol               | Parameter                              | Minimum Specification         | Units  | Test Method              |
|----------------------|--|-------------------------------|--------|--------------------------|
| $N_{END}$            | Endurance                              | 1,000 & 10,000 <sup>(2)</sup> | Cycles | MIL-STD-883, Method 1033 |
| $T_{DR}^{(1)}$       | Data Retention                         | 100                           | Years  | MIL-STD-883, Method 1008 |
| $V_{ZAP\_HBM}^{(1)}$ | ESD Susceptibility<br>Human Body Model | 1000                          | Volts  | MIL-STD-883, Method 3015 |
| $V_{ZAP\_MM}^{(1)}$  | ESD Susceptibility<br>Machine Model    | 200                           | Volts  | JEDEC Standard A115      |
| $I_{LTH}^{(1)}$      | Latch Up                               | 100                           | mA     | JEDEC Standard 17        |

**Note:** <sup>(1)</sup>This parameter is measured only for initial qualification and after a design or process change that could affect this parameter.

<sup>(2)</sup>See Ordering Information for desired type.



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### AC Characteristics

**Table 11: Read Cycle Timing Parameters**

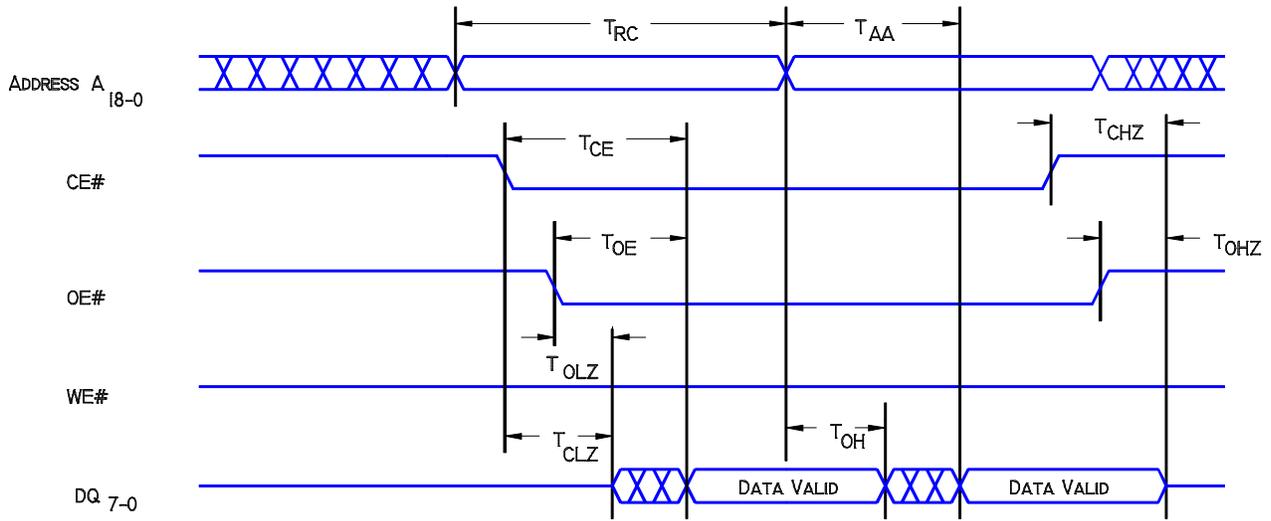
| IEEE<br>Symbol | Industry<br>Symbol              | Parameter                       | 28VF040-250 |     | 28VF040-300 |     | Units |
|----------------|---------------------------------|---------------------------------|-------------|-----|-------------|-----|-------|
|                |                                 |                                 | Min         | Max | Min         | Max |       |
| tAVAV          | T <sub>RC</sub>                 | Read Cycle time                 | 250         |     | 300         |     | ns    |
| tAVQV          | T <sub>AA</sub>                 | Address Access Time             |             | 250 |             | 300 | ns    |
| tELQV          | T <sub>CE</sub>                 | Chip Enable Access Time         |             | 250 |             | 300 | ns    |
| tGLQV          | T <sub>OE</sub>                 | Output Enable Access Time       |             | 120 |             | 150 | ns    |
| tEHQZ          | T <sub>CLZ</sub> <sup>(1)</sup> | CE# Low to Active Output        | 0           |     | 0           |     | ns    |
| tGHQZ          | T <sub>OLZ</sub> <sup>(1)</sup> | OE# Low to Active Output        | 0           |     | 0           |     | ns    |
| tELQX          | T <sub>CHZ</sub> <sup>(1)</sup> | CE# High to High-Z Output       |             | 60  |             | 60  | ns    |
| tGLQX          | T <sub>OHZ</sub> <sup>(1)</sup> | OE# High to High-Z Output       |             | 60  |             | 60  | ns    |
| tAXQX          | T <sub>OH</sub> <sup>(1)</sup>  | Output Hold from Address Change | 0           |     | 0           |     | ns    |

**Table 12: Erase/Program Cycle Timing Parameters**

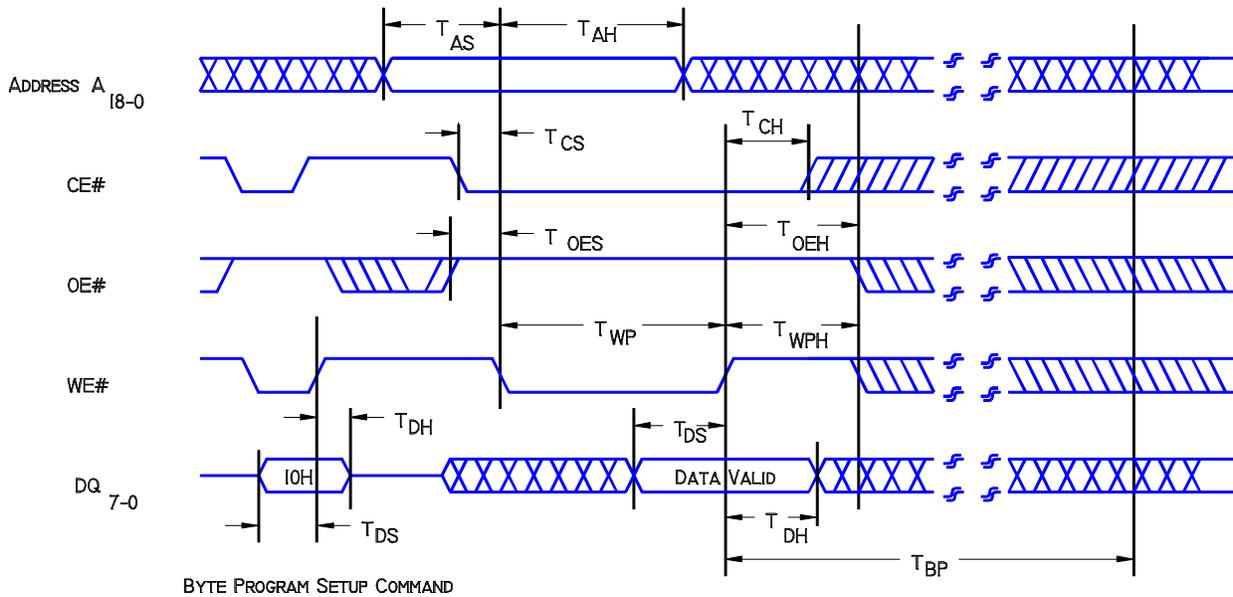
| IEEE<br>Symbol | Industry<br>Symbol              | Parameter                       | Min | Max | Units |
|----------------|---------------------------------|---------------------------------|-----|-----|-------|
| tAVA           | T <sub>BP</sub>                 | Byte Program Cycle Time         |     | 40  | μs    |
| tWLWH          | T <sub>WP</sub>                 | Write Pulse Width (WE#)         | 200 |     | ns    |
| tAVWL          | T <sub>AS</sub>                 | Address Setup Time              | 10  |     | ns    |
| tWLAX          | T <sub>AH</sub>                 | Address Hold Time               | 100 |     | ns    |
| tELWL          | T <sub>CS</sub>                 | CE# Setup Time                  | 0   |     | ns    |
| tWHEX          | T <sub>CH</sub>                 | CE# Hold Time                   | 0   |     | ns    |
| tGHWL          | T <sub>OES</sub>                | OE# High Setup Time             | 20  |     | ns    |
| tWGL           | T <sub>OEH</sub>                | OE# High Hold Time              | 20  |     | ns    |
| tWLEH          | T <sub>CP</sub>                 | Write Pulse Width (CE#)         | 200 |     | ns    |
| tDVWH          | T <sub>DS</sub>                 | Data Setup Time                 | 100 |     | ns    |
| tWHDX          | T <sub>DH</sub>                 | Data Hold Time                  | 20  |     | ns    |
| tWHWL2         | T <sub>SE</sub>                 | Sector Erase Cycle Time         |     | 4   | ms    |
|                | T <sub>RST</sub> <sup>(1)</sup> | Reset Command Recovery Time     |     | 4   | μs    |
| tWHWL3         | T <sub>SCE</sub>                | Software Chip_Erase Cycle Time  |     | 20  | ms    |
| tEHEL          | T <sub>CPH</sub>                | CE# High Pulse Width            | 50  |     | ns    |
| tWHWL1         | T <sub>WPH</sub>                | WE# High Pulse Width            | 50  |     | ns    |
|                | T <sub>PCP</sub> <sup>(1)</sup> | Protect Chip Enable Pulse Width | 20  |     | ns    |
|                | T <sub>PCH</sub> <sup>(1)</sup> | Protect Chip Enable High Time   | 20  |     | ns    |
|                | T <sub>PAS</sub> <sup>(1)</sup> | Protect Address Setup Time      | 0   |     | ns    |
|                | T <sub>PAH</sub> <sup>(1)</sup> | Protect Address Hold Time       | 100 |     | ns    |

**Note:** <sup>(1)</sup>This parameter is measured only for initial qualification and after the design or process change that could affect this parameter.

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**Figure 4: Read Cycle Timing Diagram**

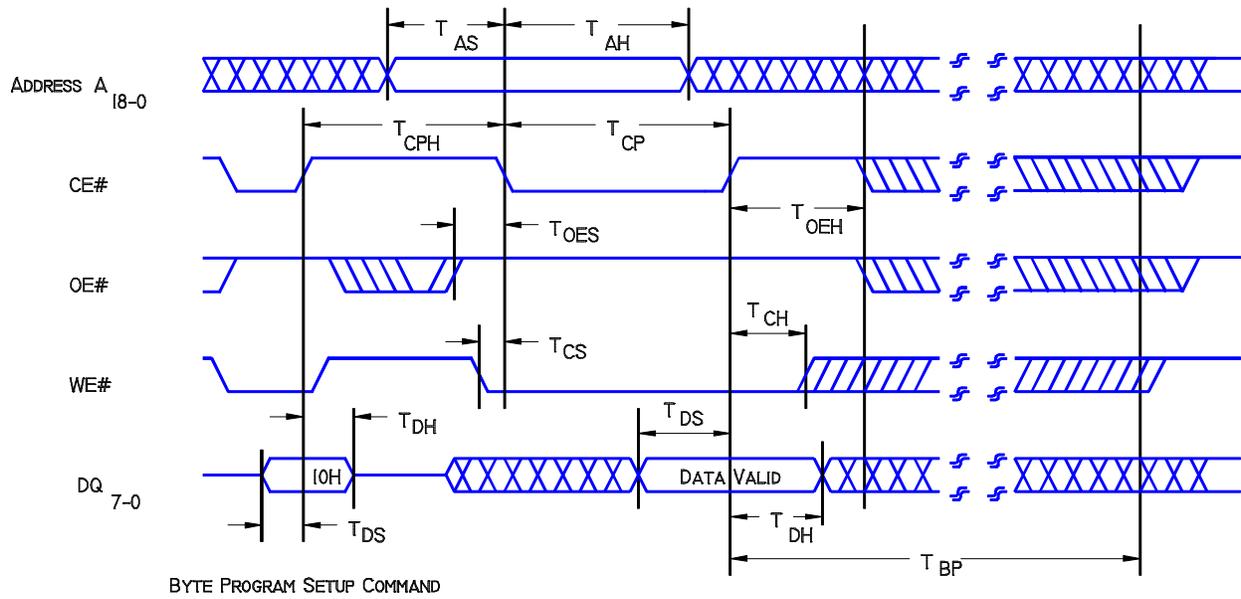


**Figure 5: WE# Controlled Byte Program Timing Diagram**

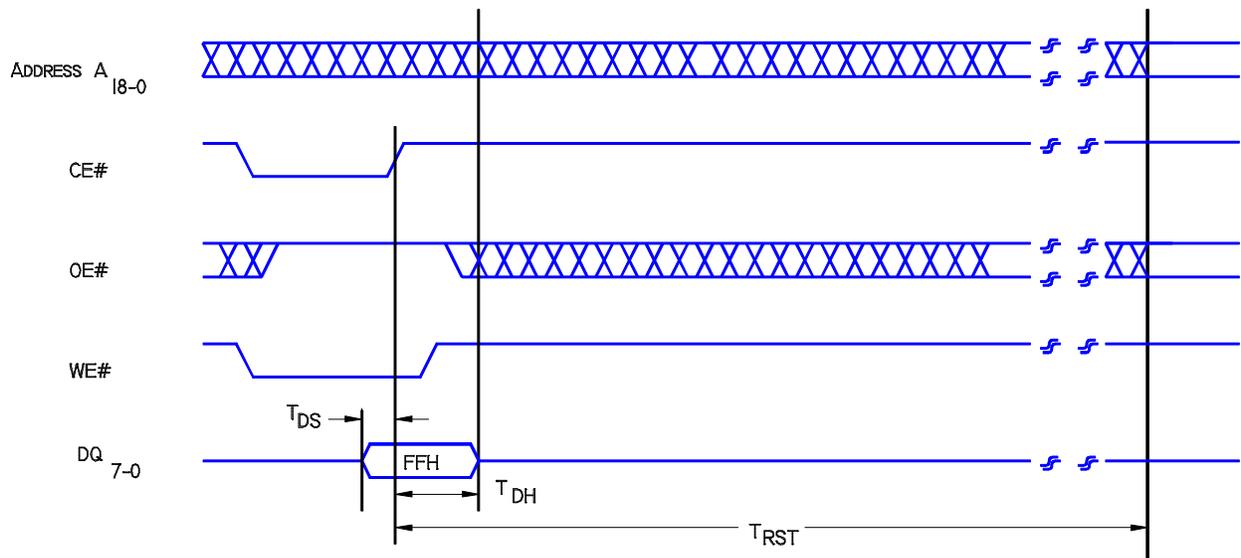


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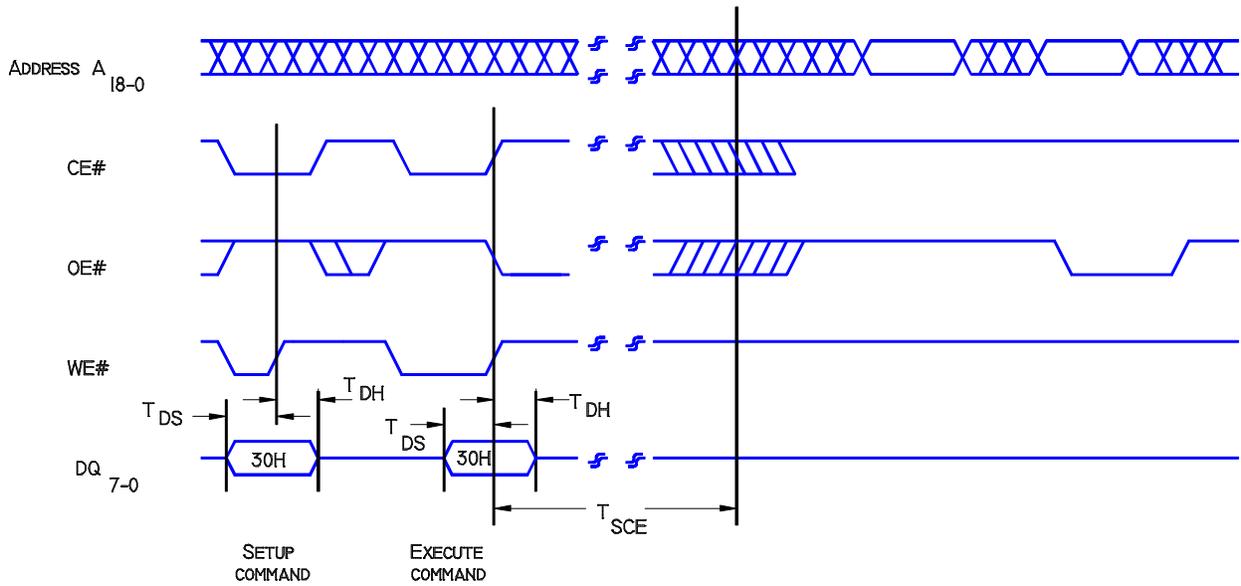
Preliminary Specifications



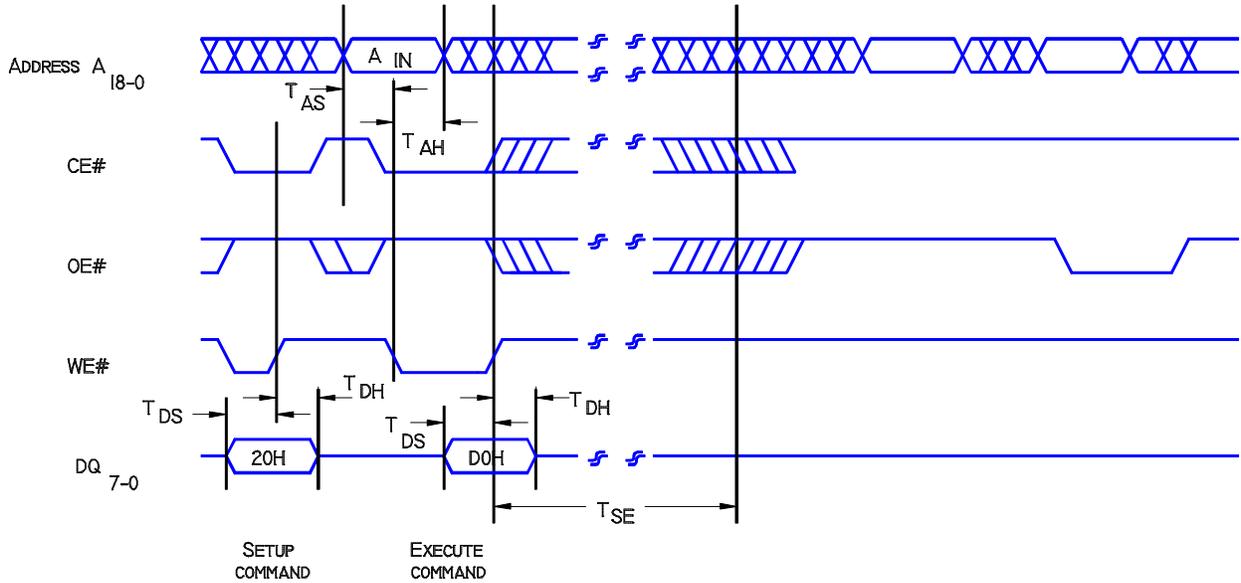
**Figure 6: CE# Controlled Byte Program Timing Diagram**



**Figure 7: Reset Command Timing Diagram**



**Figure 8: Chip\_Erase Timing Diagram**

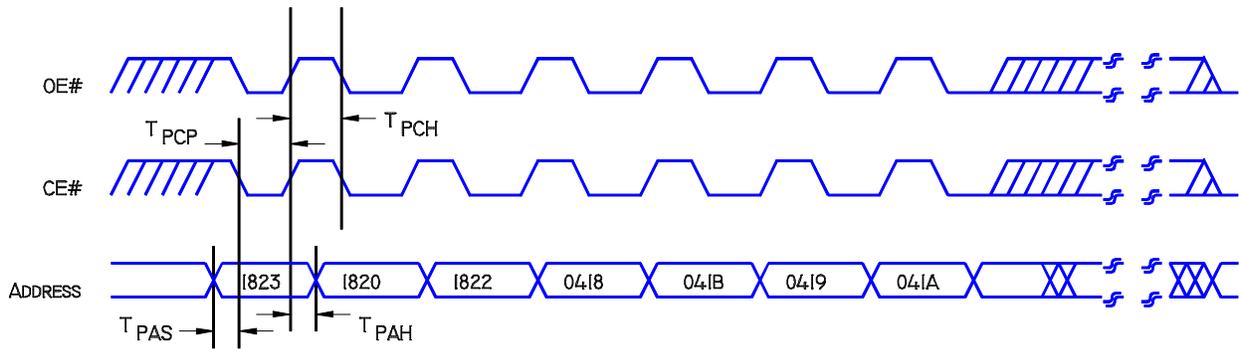


**Figure 9: Sector Erase Timing Diagram**



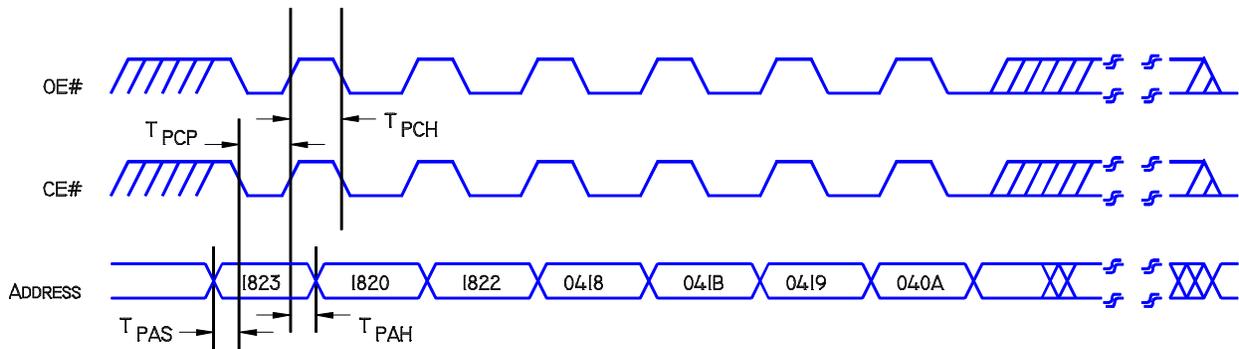
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- NOTE :
- A. ADDRESSES ARE LATCHED INTERNALLY ON THE RISING EDGE OF:
    - 1. OE# IF CE# IS KEPT AT LOW ALL TIME.
    - 2. CE# IF OE# IS KEPT AT LOW ALL TIME.
    - 3. THE FIRST PIN TO GO HIGH IF BOTH ARE TOGGLED.
  - B. ABOVE ADDRESS VALUES ARE IN HEX.
  - C. ADDRESSES > A<sub>12</sub> ARE "DON'T CARE"

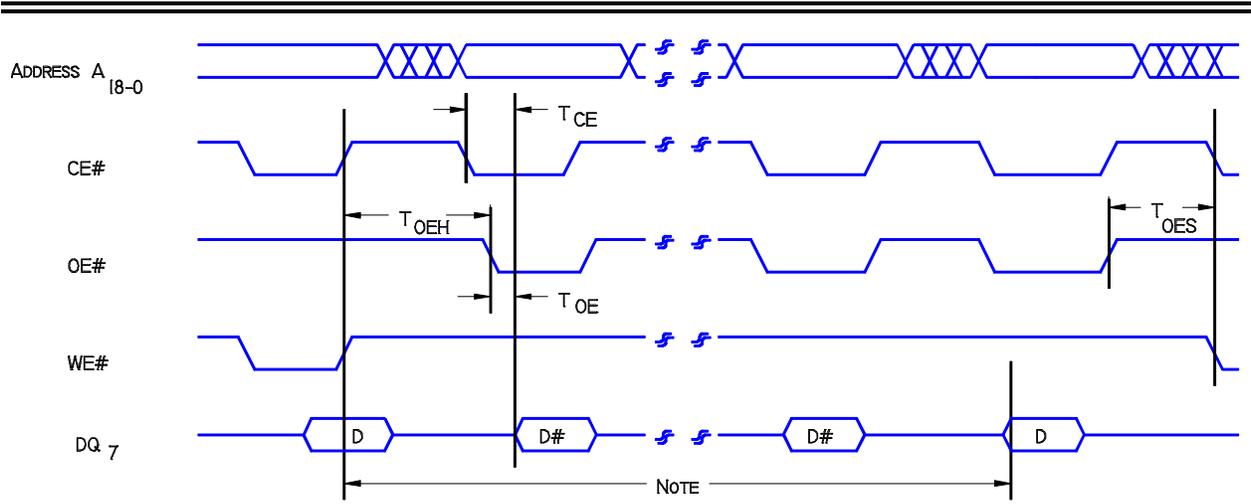
Figure 10: Software Data Unprotect Timing Diagram



- NOTE :
- A. ADDRESSES ARE LATCHED INTERNALLY ON THE RISING EDGE OF:
    - 1. OE# IF CE# IS KEPT AT LOW ALL TIME.
    - 2. CE# IF OE# IS KEPT AT LOW ALL TIME.
    - 3. THE FIRST PIN TO GO HIGH IF BOTH ARE TOGGLED.
  - B. ABOVE ADDRESS VALUES ARE IN HEX.
  - C. ADDRESSES > A<sub>12</sub> ARE "DON'T CARE"

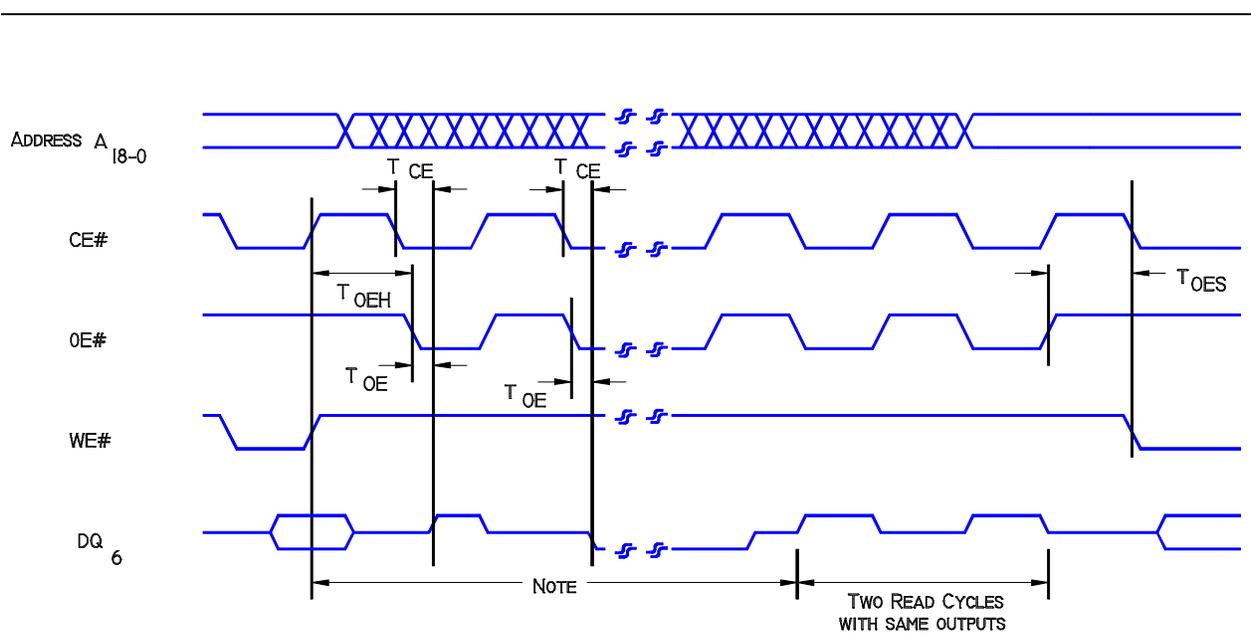
Figure 11: Software Data Protect Timing Diagram

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NOTE: THIS TIME INTERVAL SIGNAL CAN BE  $T_{SE}$  OR  $T_{BP}$  DEPENDING UPON THE SELECTED OPERATION MODE.

**Figure 12: Data# Polling Timing Diagram**



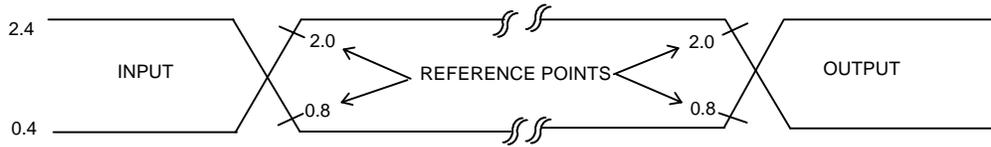
NOTE: THIS TIME INTERVAL SIGNAL CAN BE  $T_{SE}$  OR  $T_{BP}$ , DEPENDING UPON THE SELECTED OPERATION MODE.

**Figure 13: Toggle Bit Timing Diagram**



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AC test inputs are driven at  $V_{OH}$  ( $2.4 V_{TTL}$ ) for a logic "1" and  $V_{OL}$  ( $0.4 V_{TTL}$ ) for a logic "0". Measurement reference points for inputs and outputs are  $V_H$  ( $2.0 V_{TTL}$ ) and  $V_{IL}$  ( $0.8 V_{TTL}$ ). Inputs rise and fall times (10%  $\leftrightarrow$  90%) are  $<10$  ns.

Figure 14: AC Input/Output Reference Waveform

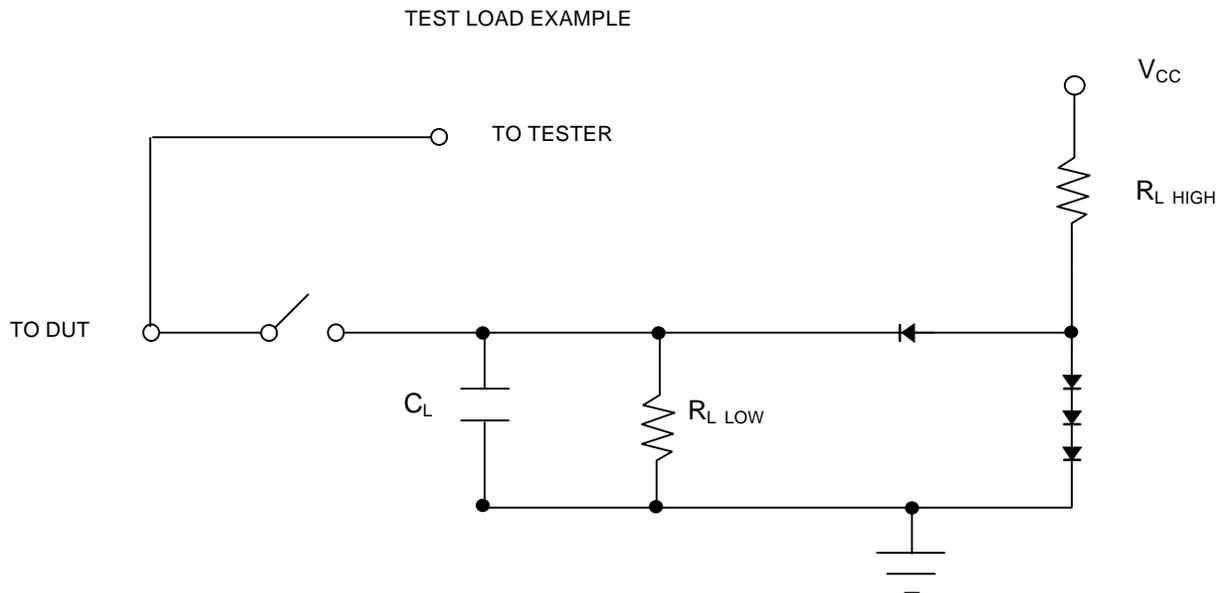
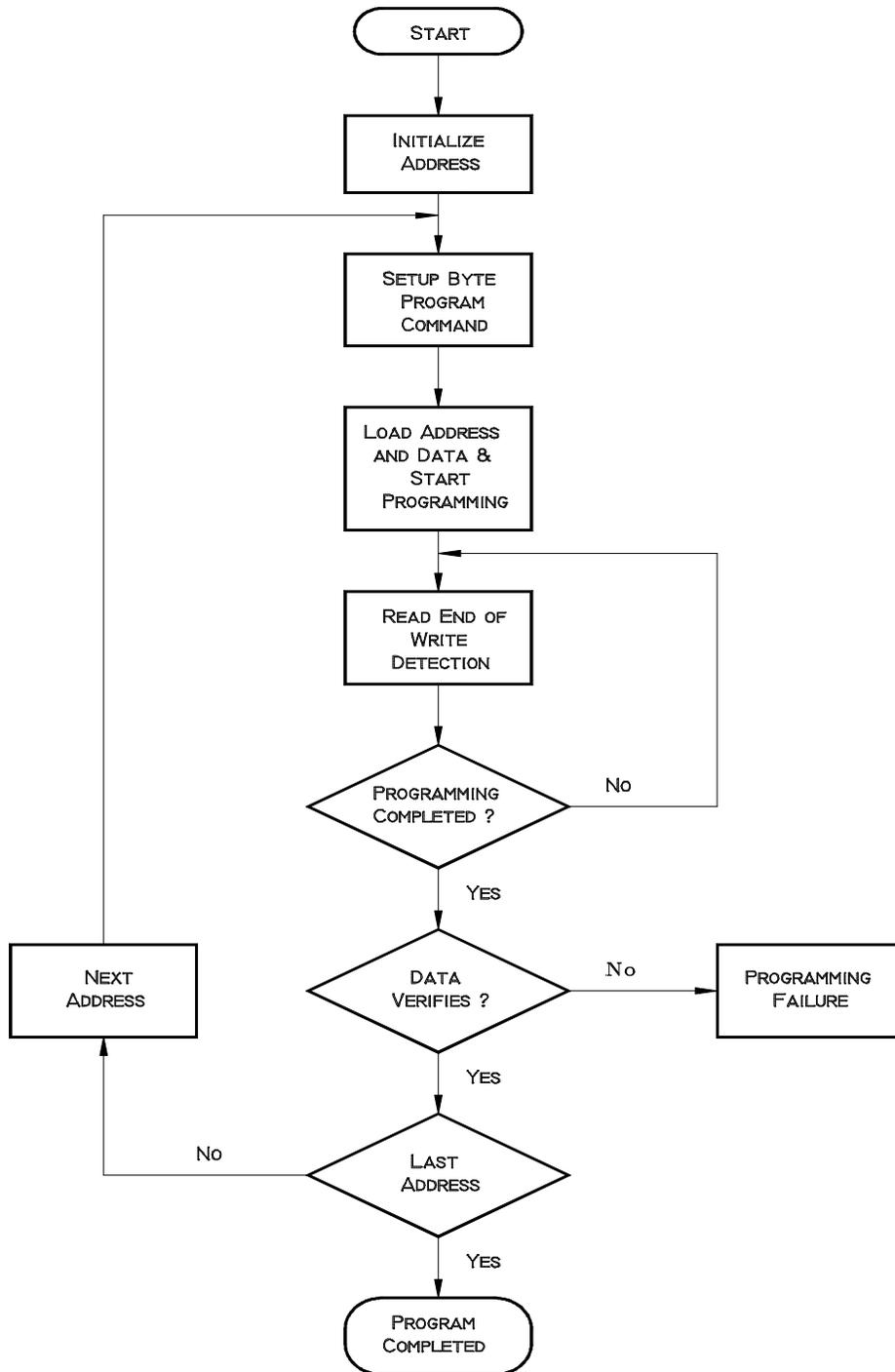


Figure 15: Test Load Example

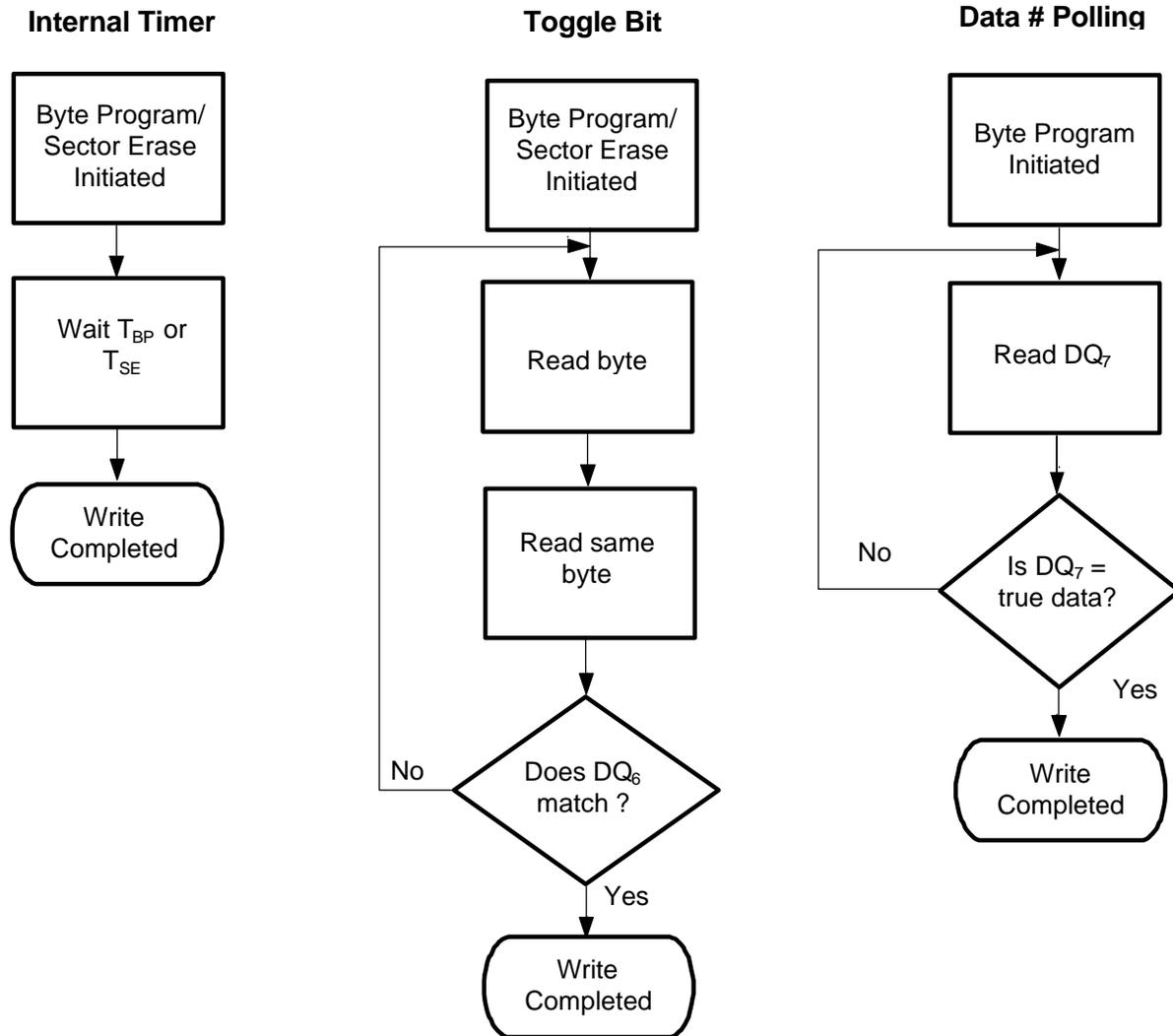


**Figure 16: Byte Program Flowchart**

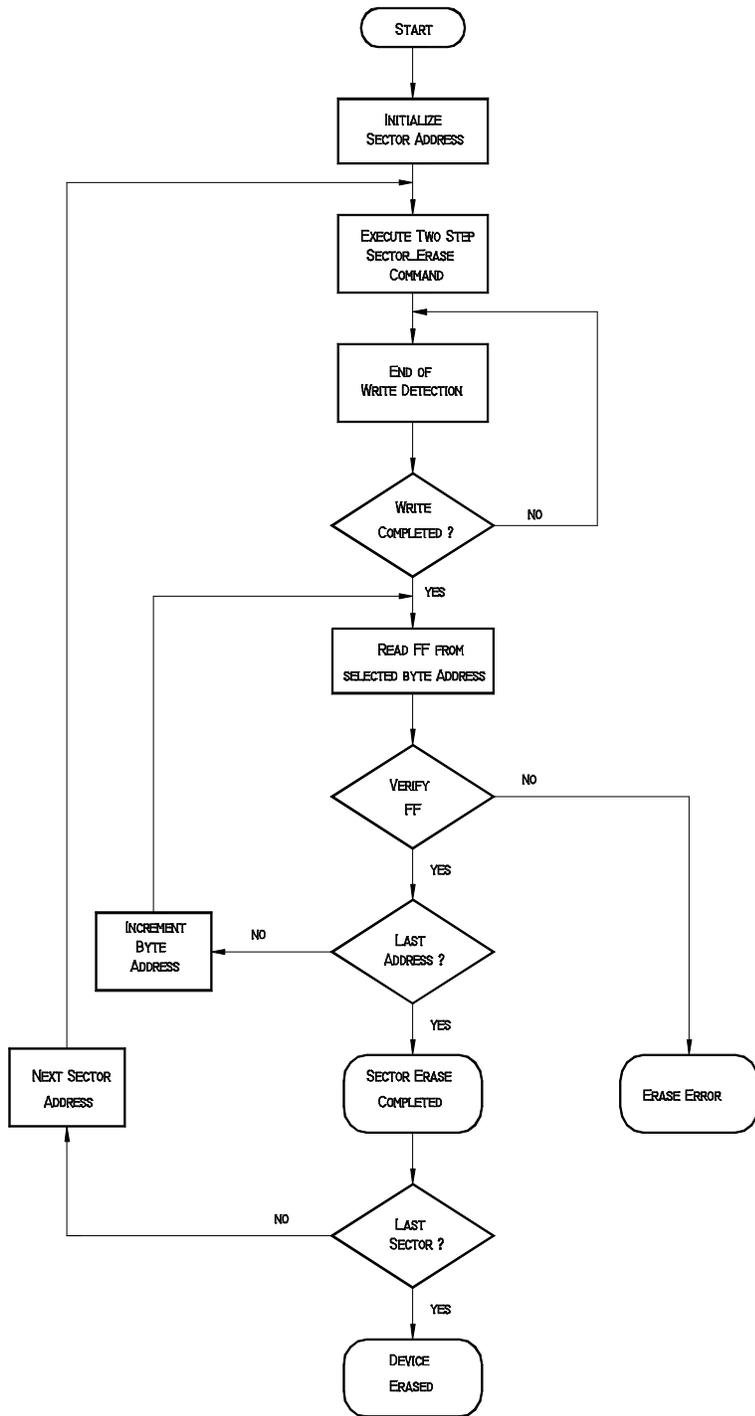


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**Figure 17: Write Wait Options**



**Figure 18: Sector\_Erase Flowchart**



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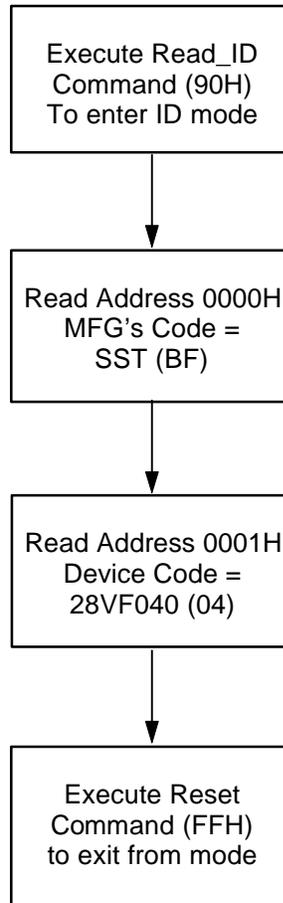


Figure 19: Software Product ID Flow





# SST 28VF040 2.7V-only 4 Megabit SuperFlash EEPROM

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## Valid combinations

|                       |                       |                       |
|-----------------------|-----------------------|-----------------------|
| SST28VF040-250-4C- EH | SST28VF040-250-4C- EI | SST28VF040-250-4C- NH |
| SST28VF040-250-4C- PH |                       |                       |
| SST28VF040-300-4C- EH | SST28VF040-300-4C- EI | SST28VF040-300-4C- NH |
| SST28VF040-300-4C- PH | SST28VF040-300-4C- U1 |                       |
| SST28VF040-250-3C- EH | SST28VF040-250-3C- EI | SST28VF040-250-3C- NH |
| SST28VF040-250-3C- PH |                       |                       |
| SST28VF040-300-3C- EH | SST28VF040-300-3C- EI | SST28VF040-300-3C- NH |
| SST28VF040-300-3C- PH | SST28VF040-300-3C- U1 |                       |
| SST28VF040-250-4I- EH | SST28VF040-250-4I- EI | SST28VF040-250-4I- NH |
| SST28VF040-300-4I- EH | SST28VF040-300-4I- EI | SST28VF040-300-4I- NH |

**Example:** 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.