

# W39L020



## 256K × 8 CMOS FLASH MEMORY

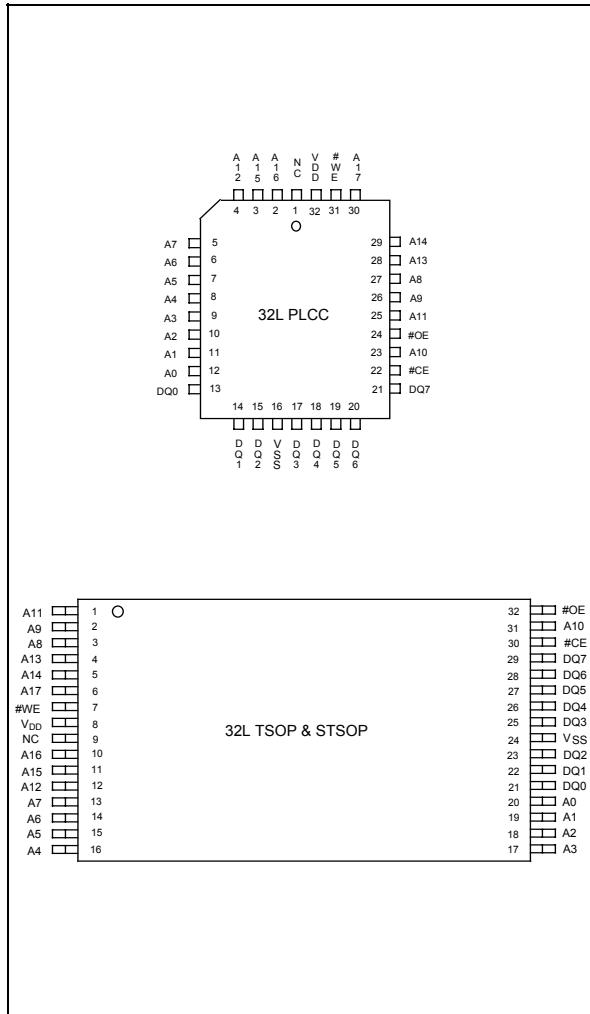
### 1. GENERAL DESCRIPTION

The W39L020 is a 2Mbit, 3.3-volt only CMOS flash memory organized as 256K × 8 bits. For flexible erase capability, the 2Mbits of data are divided into 4 uniform sectors of 64 Kbytes, which are composed of 16 smaller even pages with 4 Kbytes. The byte-wide ( $\times 8$ ) data appears on DQ7 – DQ0. The device can be programmed and erased in-system with a standard 3.3V power supply. A 12-volt VPP is not required. The unique cell architecture of the W39L020 results in fast program/erase operations with extremely low current consumption (compared to other comparable 3.3-volt flash memory products). The device can also be programmed and erased by using standard EPROM programmers.

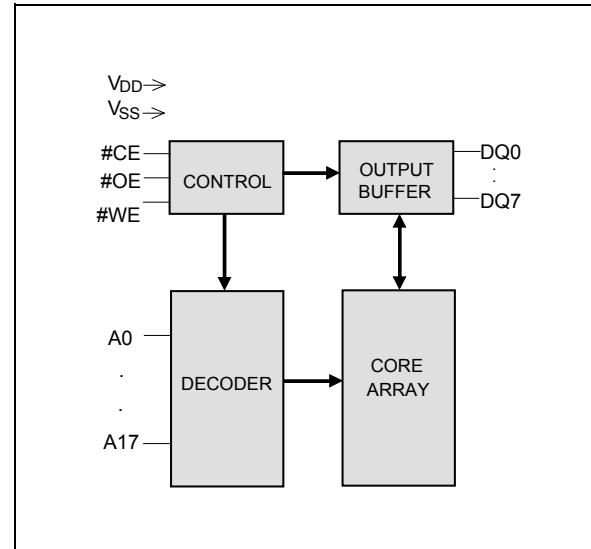
### 2. FEATURES

- Single 3.3-volt operations
  - 3.3-volt Read
  - 3.3-volt Erase
  - 3.3-volt Program
- Fast Program operation:
  - Byte-by-Byte programming: 50  $\mu$ S (max.)
- Fast Erase operation:
  - Chip Erase cycle time: 100 mS (max.)
  - Sector Erase cycle time: 25mS (max.)
  - Page Erase cycle time: 25mS (max.)
- Read access time: 70/90 nS
- 4 Even sectors with 64K bytes each, which is composed of 16 flexible pages with 4K bytes
- Any individual sector or page can be erased
- Hardware protection:
  - Optional 16K byte or 64K byte Top/Bottom Boot Block with lockout protection
- Flexible 4K-page size can be used as Parameter Blocks
- Typical program/erase cycles: 1K/10K
- Twenty-year data retention
- Low power consumption
  - Active current: 10 mA (typ.)
  - Standby current: 5  $\mu$ A (typ.)
- End of program detection
  - Software method: Toggle bit/Data polling
- TTL compatible I/O
- JEDEC standard byte-wide pinouts
- Available packages: 32L PLCC, 32L TSOP (8 x 20 mm) and 32L STSOP (8 x 14 mm)

## 3. PIN CONFIGURATIONS



## 4. BLOCK DIAGRAM



## 5. PIN DESCRIPTION

SYMBOL	PIN NAME
A0 – A17	Address Inputs
DQ0 – DQ7	Data Inputs/Outputs
#CE	Chip Enable
#OE	Output Enable
#WE	Write Enable
VDD	Power Supply
Vss	Ground

## 6. FUNCTIONAL DESCRIPTION

### Device Bus Operation

#### Read Mode

The read operation of the W39L020 is controlled by #CE and #OE, both of which have to be low for the host to obtain data from the outputs. #CE is used for device selection. When #CE is high, the chip is de-selected 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 either #CE or #OE is high. Refer to the timing waveforms for further details.

#### Write Mode

Device erasure and programming are accomplished via the command register. The contents of the register serve as inputs to the internal state machine. The state machine outputs dictate the function of the device.

The command register itself does not occupy any addressable memory location. The register is a latch used to store the commands, along with the address and data information needed to execute the command. The command register is written to bring #WE to logic low state, while #CE is at logic low state and #OE is at logic high state. Addresses are latched on the falling edge of #WE or #CE, whichever happens later; while data is latched on the rising edge of #WE or #CE, whichever happens first. Standard microprocessor write timings are used.

Refer to AC Write Characteristics and the Erase/Programming Waveforms for specific timing parameters.

#### Standby Mode

There are two ways to implement the standby mode on the W39L020 device, both using the #CE pin.

A CMOS standby mode is achieved with the #CE input held at  $V_{DD} \pm 0.5V$ . Under this condition the current is typically reduced to less than  $25 \mu A$ (max). A TTL standby mode is achieved with the #CE pin held at  $V_{IH}$ . Under this condition the current is typically reduced to  $2 mA$ (max).

In the standby mode the outputs are in the high impedance state, independent of the #OE input.

#### Output Disable Mode

With the #OE input at a logic high level ( $V_{IH}$ ), output from the device is disabled. This will cause the output pins to be in a high impedance state.

#### Auto-select Mode

The auto-select mode allows the reading of a binary code from the device and will identify its manufacturer and type. This mode is intended for use by programming equipment for the purpose of automatically matching the device to be programmed with its corresponding programming algorithm. This mode is functional over the entire temperature range of the device.

To activate this mode, the programming equipment must force VID (11.5V to 12.5V) on address pin A9. Two identifier bytes may then be sequenced from the device outputs by toggling address A0 from  $V_{IL}$  to  $V_{IH}$ . All addresses are don't cares except A0 and A1 (see "Auto-select Codes").



The manufacturer and device codes may also be read via the command register, for instance, when the W39L020 is erased or programmed in a system without access to high voltage on the A9 pin. The command sequence is illustrated in "Auto-select Codes".

Byte 0 (A0 = VIL) represents the manufacturer's code (Winbond = DAH) and byte 1 (A0 = VIH) the device identifier code (W39L020 = B5hex). All identifiers for manufacturer and device will exhibit odd parity with DQ7 defined as the parity bit. In order to read the proper device codes when executing the Auto-select, A1 must be low state.

## Data Protection

The W39L020 is designed to offer protection against accidental erasure or programming caused by spurious system level signals that may exist during power transitions. During power up the device automatically resets the internal state machine in the Read mode. Also, with its control register architecture, alteration of the memory contents only occurs after successful completion of specific multi-bus cycle command sequences. The device also incorporates several features to prevent inadvertent write cycles resulting from VDD power-up and power-down transitions or system noise.

## Boot Block Operation

There are four alternatives to set the boot block. Either 16K-byte or 64K-byte in the top/bottom location of this device can be locked as boot block, which can be used to store boot codes. It is located in the last 16K/64K bytes or first 16K/64K bytes of the memory with the address range from 3C000/30000(hex) to 3FFF(hex) for top location or 00000(hex) to 03FFF/0FFFF(hex) for bottom location.

See Command Codes for Boot Block Lockout Enable for the specific code. Once this feature is set the data for the designated block cannot be erased or programmed (programming lockout), other memory locations can be changed by the regular programming method.

In order to detect whether the boot block feature is set on the first/last 16K/64K-bytes block or not, users can perform software command sequence: enter the product identification mode (see Command Codes for Identification/Boot Block Lockout Detection for specific code), and then read from address 0002(hex) for first(bottom) location or 3FFF2(hex) for last(top) location. If the DQ0/DQ1 of output data is "1," the 64Kbytes/16Kbytes boot block programming lockout feature will be activated; if the DQ0/DQ1 of output data is "0," the lockout feature will be inactivated and the block can be erased/programmed.

To return to normal operation, perform a three-byte command sequence (or an alternate single-byte command) to exit the identification mode. For the specific code, see Command Codes for Identification/Boot Block Lockout Detection.

## Low VDD Inhibit

To avoid initiation of a write cycle during VDD power-up and power-down, the W39L020 locks out when  $VDD < 2.0V$  (see DC Characteristics section for voltages). The write and read operations are inhibited when  $VDD$  is less than 2.0V typical. The W39L020 ignores all write and read operations until  $VDD > 2.0V$ . The user must ensure that the control pins are in the correct logic state when  $VDD > 2.0V$  to prevent unintentional writes.

## Write Pulse "Glitch" Protection

Noise pulses of less than 10 nS (typical) on #OE, #CE, or #WE will not initiate a write cycle.



## Logical Inhibit

Writing is inhibited by holding any one of #OE = V<sub>IL</sub>, #CE = V<sub>IH</sub>, or #WE = V<sub>IH</sub>. To initiate a write cycle #CE and #WE must be a logical zero while #OE is a logical one.

## Power-up Write and Read Inhibit

Power-up of the device with #WE = #CE = V<sub>IL</sub> and #OE = V<sub>IH</sub> will not accept commands on the rising edge of #WE except 5mS delay (see the power up timing in AC Characteristics). The internal state machine is automatically reset to the read mode on power-up.

## Command Definitions

Device operations are selected by writing specific address and data sequences into the command register. Writing incorrect address and data values or writing them in the improper sequence will reset the device to the read mode. "Command Definitions" defines the valid register command sequences.

## Read Command

The device will automatically power-up in the read state. In this case, a command sequence is not required to read data. Standard microprocessor read cycles will retrieve array data. This default value ensures that no spurious alteration of the memory content occurs during the power transition.

The device will automatically return to read state after completing an Embedded Program or Embedded Erase algorithm.

Refer to the AC Read Characteristics and Waveforms for the specific timing parameters.

## Auto-select Command

Flash memories are intended for use in applications where the local CPU can alter memory contents. As such, manufacture and device codes must be accessible while the device resides in the target system. PROM programmers typically access the signature codes by raising A9 to a high voltage. However, multiplexing high voltage onto the address lines is not generally a desirable system design practice.

The device contains an auto-select command operation to supplement traditional PROM programming methodology. The operation is initiated by writing the auto-select command sequence into the command register. Following the command write, a read cycle from address XX00H retrieves the manufacture code of DAH. A read cycle from address XX01H returns the device code (W39L020 = B5hex).

To terminate the operation, it is necessary to write the auto-select exit command sequence into the register.

## Byte Program Command

The device is programmed on a byte-by-byte basis. Programming is a four-bus-cycle operation. The program command sequence is initiated by writing two "unlock" write cycles, followed by the program set-up command. The program address and data are written next, which in turn initiate the Embedded program algorithm. Addresses are latched on the falling edge of #CE or #WE, whichever happens later and the data is latched on the rising edge of #CE or #WE, whichever happens first. The rising edge of #CE or #WE (whichever happens first) begins programming using the Embedded Program



Algorithm. Upon executing the algorithm, the system is not required to provide further controls or timings. The device will automatically provide adequate internally generated program pulses and verify the programmed cell margin.

The automatic programming operation is completed when the data on DQ7 (also used as Data Polling) is equivalent to the data written to this bit at which time the device returns to the read mode and addresses are no longer latched (see "Hardware Sequence Flags"). Therefore, the device requires that a valid address to the device be supplied by the system at this particular instance of time for Data Polling operations. Data Polling must be performed at the memory location which is being programmed.

Any commands written to the chip during the Embedded Program Algorithm will be ignored. If a hardware reset occurs during the programming operation, the data at that particular location will be corrupted.

Programming is allowed in any sequence and across sector boundaries. Beware that a data "0" cannot be programmed back to a "1". Attempting to program 0 back to 1, the toggle bit will stop toggling. Only erase operations can convert "0"s to "1"s.

Refer to the Programming Command Flow Chart using typical command strings and bus operations.

## Chip Erase Command

Chip erase is a six-bus-cycle operation. There are two "unlock" write cycles, followed by writing the "set-up" command. Two more "unlock" write cycles are asserted, followed by the chip erase command.

Chip erase does not require the user to program the device prior to erase. Upon executing the Embedded Erase Algorithm command sequence the device will automatically erase and verify the entire memory for an all one data pattern. The erase is performed sequentially on each sectors at the same time (see "Feature"). The system is not required to provide any controls or timings during these operations.

The automatic erase begins on the rising edge of the last #WE pulse in the command sequence and terminates when the data on DQ7 is "1" at which time the device returns to read the mode.

Refer to the Erase Command Flow Chart using typical command strings and bus operations.

## Sector/Page Erase Command

Sector/page erase is a six bus cycles operation. There are two "unlock" write cycles, followed by writing the "set-up" command. Two more "unlock" write cycles then follows by the sector erase command. The sector/page address (any address location within the desired sector/page) is latched on the falling edge of #WE, while the command (30H/50H) is latched on the rising edge of #WE.

Sector/page erase does not require the user to program the device prior to erase. When erasing a sector/page or sectors/pages the remaining unselected sectors/pages are not affected. The system is not required to provide any controls or timings during these operations.

The automatic sector/page erase begins after the erase command is completed, right from the rising edge of the #WE pulse for the last sector/page erase command pulse and terminates when the data on DQ7, Data Polling, is "1" at which time the device returns to the read mode. Data Polling must be performed at an address within any of the sectors/pages being erased.

Refer to the Erase Command flow Chart using typical command strings and bus operations.



## Write Operation Status

### DQ7: Data Polling

The W39L020 device features Data Polling as a method to indicate to the host that the embedded algorithms are in progress or completed.

During the Embedded Program Algorithm, an attempt to read the device will produce the complement of the data last written to DQ7. Upon completion of the Embedded Program Algorithm, an attempt to read the device will produce the true data last written to DQ7.

During the Embedded Erase Algorithm, an attempt to read the device will produce a "0" at the DQ7 output. Upon completion of the Embedded Erase Algorithm, an attempt to read the device will produce a "1" at the DQ7 output.

For chip erase, the Data Polling is valid after the rising edge of the sixth pulse in the six #WE write pulse sequences. For sector erase, the Data Polling is valid after the last rising edge of the sector erase #WE pulse. Data Polling must be performed at sector addresses within any of the sectors being erased. Otherwise, the status may not be valid.

Just prior to the completion of Embedded Algorithm operations DQ7 may change asynchronously while the output enable (#OE) is asserted low. This means that the device is driving status information on DQ7 at one instant of time and then that byte's valid data at the next instant of time. Depending on when the system samples the DQ7 output, it may read the status or valid data. Even if the device has completed the Embedded Algorithm operations and DQ7 has a valid data, the data outputs on DQ0–DQ6 may be still invalid. The valid data on DQ0 – DQ7 will be read on the successive read attempts.

The Data Polling feature is only active during the Embedded Programming Algorithm, Embedded Erase Algorithm, or sector erase time-out (see "Command Definitions").

### DQ6: Toggle Bit

The W39L020 also features the "Toggle Bit" as a method to indicate to the host system that the embedded algorithms are in progress or completed.

During an Embedded Program or Erase Algorithm cycle, successive attempts to read (#OE toggling) data from the device at any address will result in DQ6 toggling between one and zero. Once the Embedded Program or Erase Algorithm cycle is completed, DQ6 will stop toggling and valid data will be read on the next successive attempt. During programming, the Toggle Bit is valid after the rising edge of the fourth #WE pulse in the four write pulse sequence. For chip erase, the Toggle Bit is valid after the rising edge of the sixth #WE pulse in the six write pulse sequence. For sector/page erase, the Toggle Bit is valid after the last rising edge of the sector/page erase #WE pulse. The Toggle Bit is active during the sector/page erase time-out.

Either #CE or #OE toggling will cause DQ6 to toggle.

## 7. TABLE OF OPERATING MODES

### Device Bus Operations

(VID = 12 ± 0.5V)

MODE	PIN						
	#CE	#OE	#WE	A0	A1	A9	DQ0 – DQ7
Read	VIL	VIL	VIH	A0	A1	A9	Dout
Write	VIL	VIH	VIL	A0	A1	A9	Din
Standby	VIH	X	X	X	X	X	High Z
Write Inhibit	X	VIL	X	X	X	X	High Z/Dout
	X	X	VIH	X	X	X	High Z/Dout
Output Disable	VIL	VIH	VIH	X	X	X	High Z
Auto select Manufacturers ID	VIL	VIL	VIH	VIL	VIL	VID	Code
Auto select Device ID	VIL	VIL	VIH	VIH	VIL	VID	Code

### Auto-select Codes (High Voltage Method)

(VID = 12 ± 0.5V)

DESCRIPTION	#CE	#OE	#WE	A9	THE OTHER ADDRESS	DQ[7:0]
Manufacturer ID: Winbond	VIL	VIL	VIH	VID	All Add = VIL	DAhex
Device ID: W39L020	VIL	VIL	VIH	VID	A1 = VIH, All other = VIL	B5hex

### Sector Address Table

SECTOR	A17	A16	SECTOR SIZE (KBYTES)	ADDRESS
SA0	0	0	64	00000h – 0FFFFh
SA1	0	1	64	10000h – 1FFFFh
SA2	1	0	64	20000h – 2FFFFh
SA3	1	1	64	30000h – 3FFFFh

Note: All sectors are 64K bytes in size.

## Command Definitions

COMMAND DESCRIPTION	NO. OF Cycles	1ST CYCLE	2ND CYCLE	3RD CYCLE	4TH CYCLE	5TH CYCLE	6TH CYCLE	7TH CYCLE
		Addr. <sup>(1)</sup> Data	Addr. Data	Addr. Data	Addr. Data	Addr. Data	Addr. Data	Addr. Data
Read	1	A <sub>IN</sub> D <sub>OUT</sub>						
Chip Erase	6	5555 AA	2AAA 55	5555 80	5555 AA	2AAA 55	5555 10	
Sector Erase	6	5555 AA	2AAA 55	5555 80	5555 AA	2AAA 55	SA <sup>(3)</sup> 30	
Page Erase	6	5555 AA	2AAA 55	5555 80	5555 AA	2AAA 55	PA <sup>(4)</sup> 50	
Byte Program	4	5555 AA	2AAA 55	5555 A0	A <sub>IN</sub> D <sub>IN</sub>			
Top Boot Block Lockout – 64K/16KByte	6	5555 AA	2AAA 55	5555 80	5555 AA	2AAA 55	5555 40/70	3FFF XX <sup>(5)</sup>
Bottom Boot Block Lockout - 64K/16KByte	6	5555 AA	2AAA 55	5555 80	5555 AA	2AAA 55	5555 40/70	00000 XX <sup>(5)</sup>
Product ID Entry	3	5555 AA	2AAA 55	5555 90				
Product ID Exit <sup>(2)</sup>	3	5555 AA	2AAA 55	5555 F0				
Product ID Exit <sup>(2)</sup>	1	XXXX F0						

Notes:

1. Address Format: A14 – A0 (Hex); Data Format: DQ7 – DQ0 (Hex)

2. Either one of the two Product ID Exit commands can be used.

3. SA: Sector Address

SA = 3XXXXh for Unique Sector3

SA = 2XXXXh for Unique Sector2

SA = 1XXXXh for Unique Sector1

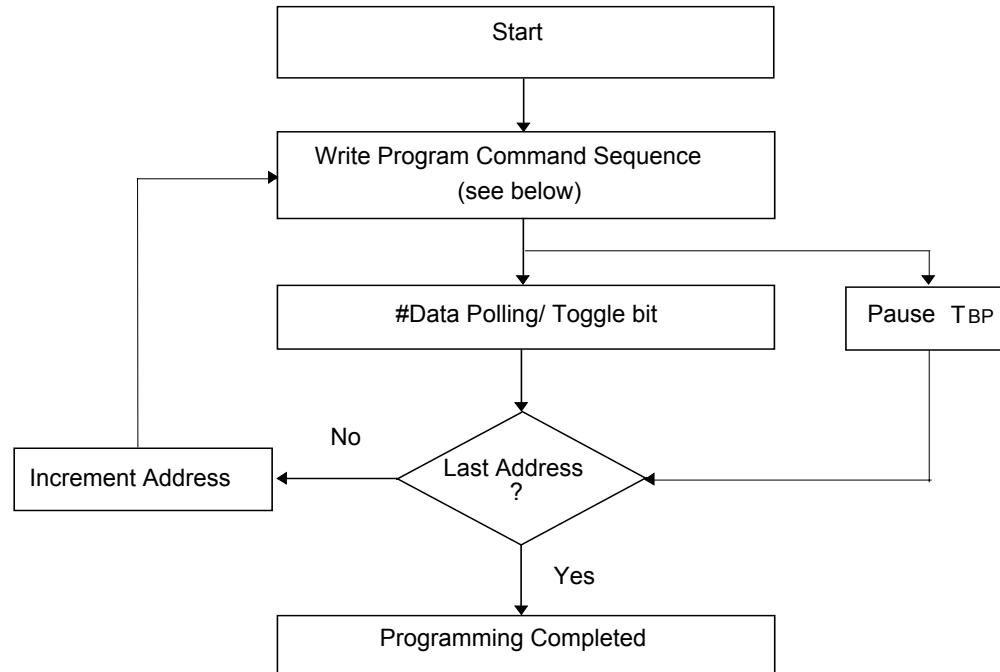
SA = 0XXXXh for Unique Sector0

4. PA: Page Address

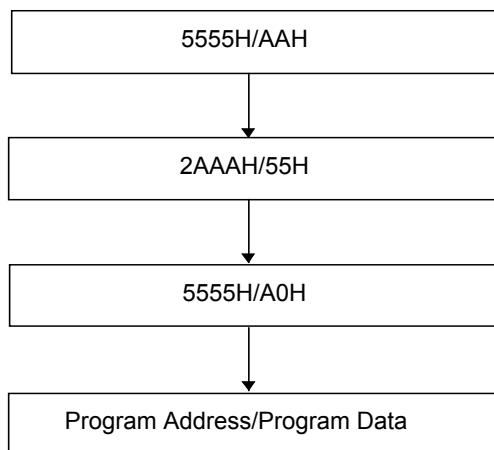
PA = 3FXXXh for Page 15 in Sector3	PA = 2FXXXh for Page 15 in Sector2	PA = 1FXXXh for Page 15 in Sector1	PA = 0FXXXh for Page 15 in Sector0
PA = 3EXXXh for Page 14 in Sector3	PA = 2EXXXh for Page 14 in Sector2	PA = 1EXXXh for Page 14 in Sector1	PA = 0EXXXh for Page 14 in Sector0
PA = 3DXXXh for Page 13 in Sector3	PA = 2DXXXh for Page 13 in Sector2	PA = 1DXXXh for Page 13 in Sector1	PA = 0DXXXh for Page 13 in Sector0
PA = 3CXXXh for Page 12 in Sector3	PA = 2CXXXh for Page 12 in Sector2	PA = 1CXXXh for Page 12 in Sector1	PA = 0CXXXh for Page 12 in Sector0
PA = 3BXXXh for Page 11 in Sector3	PA = 2BXXXh for Page 11 in Sector2	PA = 1BXXXh for Page 11 in Sector1	PA = 0BXXXh for Page 11 in Sector0
PA = 3AXXXh for Page 10 in Sector3	PA = 2AXXXh for Page 10 in Sector2	PA = 1AXXXh for Page 10 in Sector1	PA = 0AXXXh for Page 10 in Sector0
PA = 39XXXh for Page 9 in Sector3	SA = 29XXXh for Page 9 in Sector2	SA = 19XXXh for Page 9 in Sector1	SA = 09XXXh for Page 9 in Sector0
PA = 38XXXh for Page 8 in Sector3	SA = 28XXXh for Page 8 in Sector2	SA = 18XXXh for Page 8 in Sector1	SA = 08XXXh for Page 8 in Sector0
PA = 37XXXh for Page 7 in Sector3	SA = 27XXXh for Page 7 in Sector2	SA = 17XXXh for Page 7 in Sector1	SA = 07XXXh for Page 7 in Sector0
PA = 36XXXh for Page 6 in Sector3	SA = 26XXXh for Page 6 in Sector2	SA = 16XXXh for Page 6 in Sector1	SA = 06XXXh for Page 6 in Sector0
PA = 35XXXh for Page 5 in Sector3	SA = 25XXXh for Page 5 in Sector2	SA = 15XXXh for Page 5 in Sector1	SA = 05XXXh for Page 5 in Sector0
PA = 34XXXh for Page 4 in Sector3	SA = 24XXXh for Page 4 in Sector2	SA = 14XXXh for Page 4 in Sector1	SA = 04XXXh for Page 4 in Sector0
PA = 33XXXh for Page 3 in Sector3	SA = 23XXXh for Page 3 in Sector2	SA = 13XXXh for Page 3 in Sector1	SA = 03XXXh for Page 3 in Sector0
PA = 32XXXh for Page 2 in Sector3	SA = 22XXXh for Page 2 in Sector2	SA = 12XXXh for Page 2 in Sector1	SA = 02XXXh for Page 2 in Sector0
PA = 31XXXh for Page 1 in Sector3	SA = 21XXXh for Page 1 in Sector2	SA = 11XXXh for Page 1 in Sector1	SA = 01XXXh for Page 1 in Sector0
PA = 30XXXh for Page 0 in Sector3	SA = 20XXXh for Page 0 in Sector2	SA = 10XXXh for Page 0 in Sector1	SA = 00XXXh for Page 0 in Sector0

5. XX: Don't care

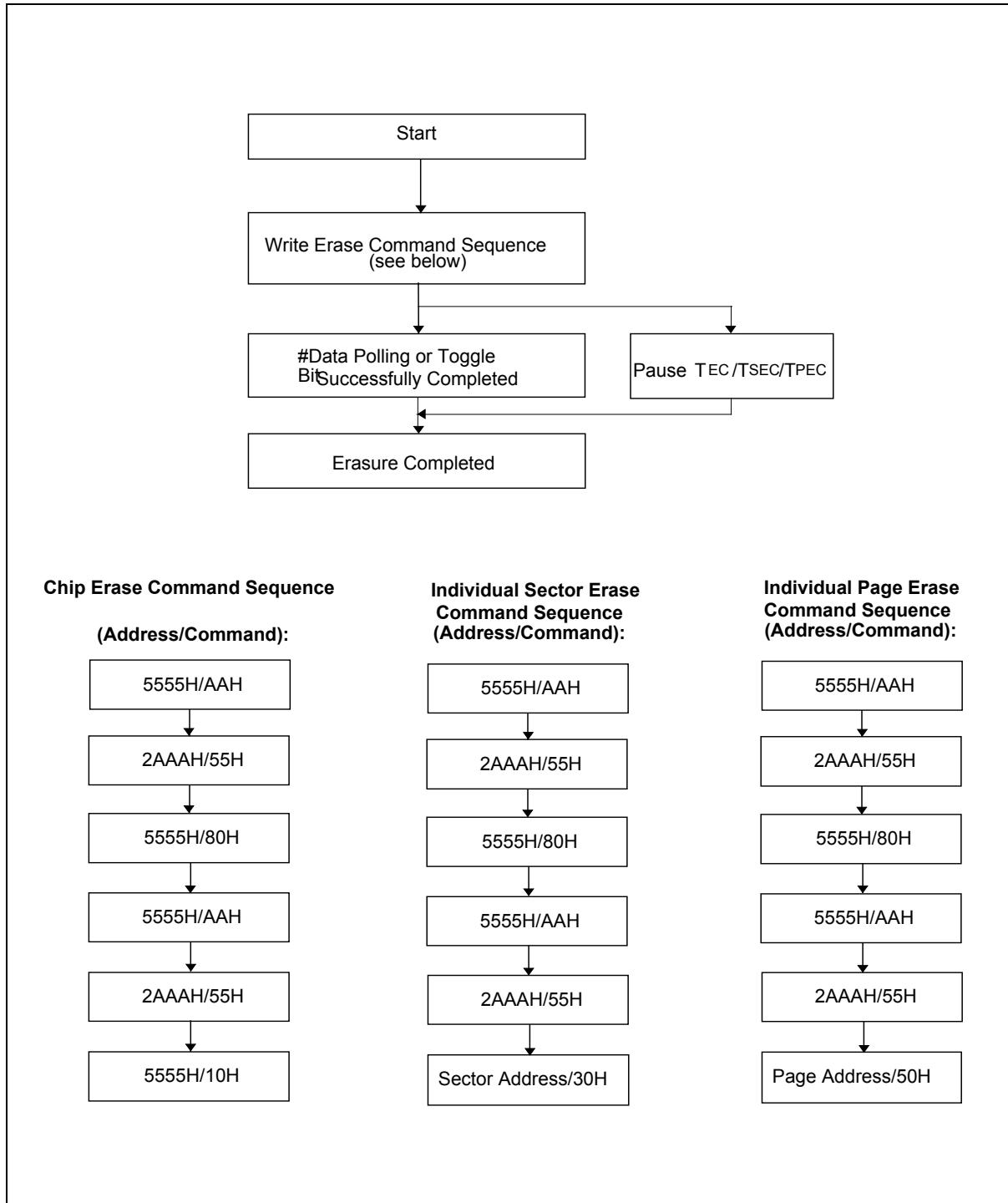
## Embedded Programming Algorithm



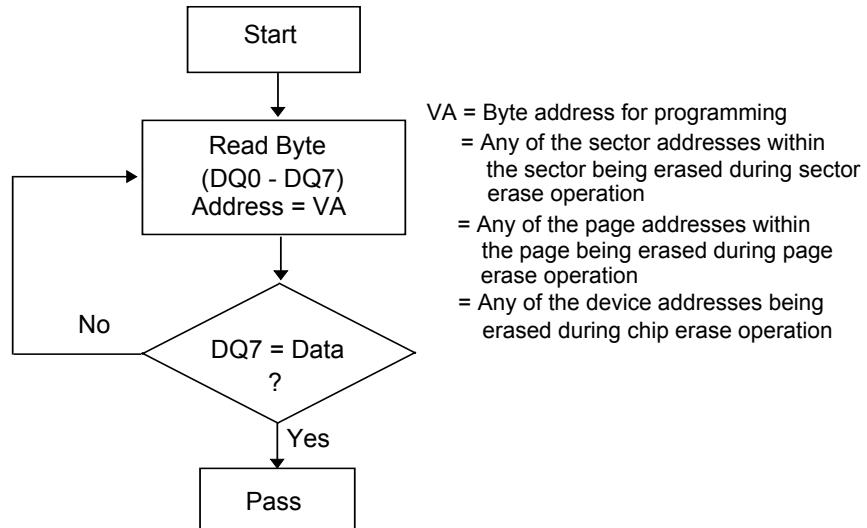
### Program Command Sequence (Address/Command):



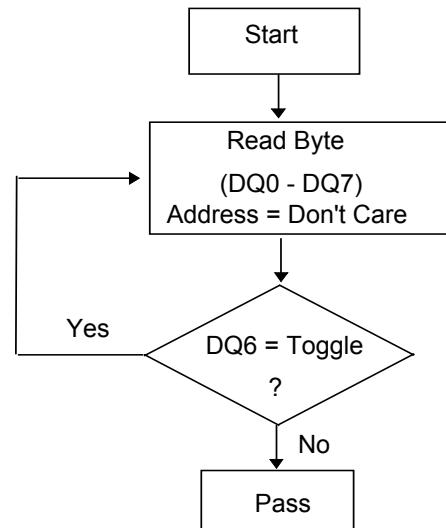
## Embedded Erase Algorithm

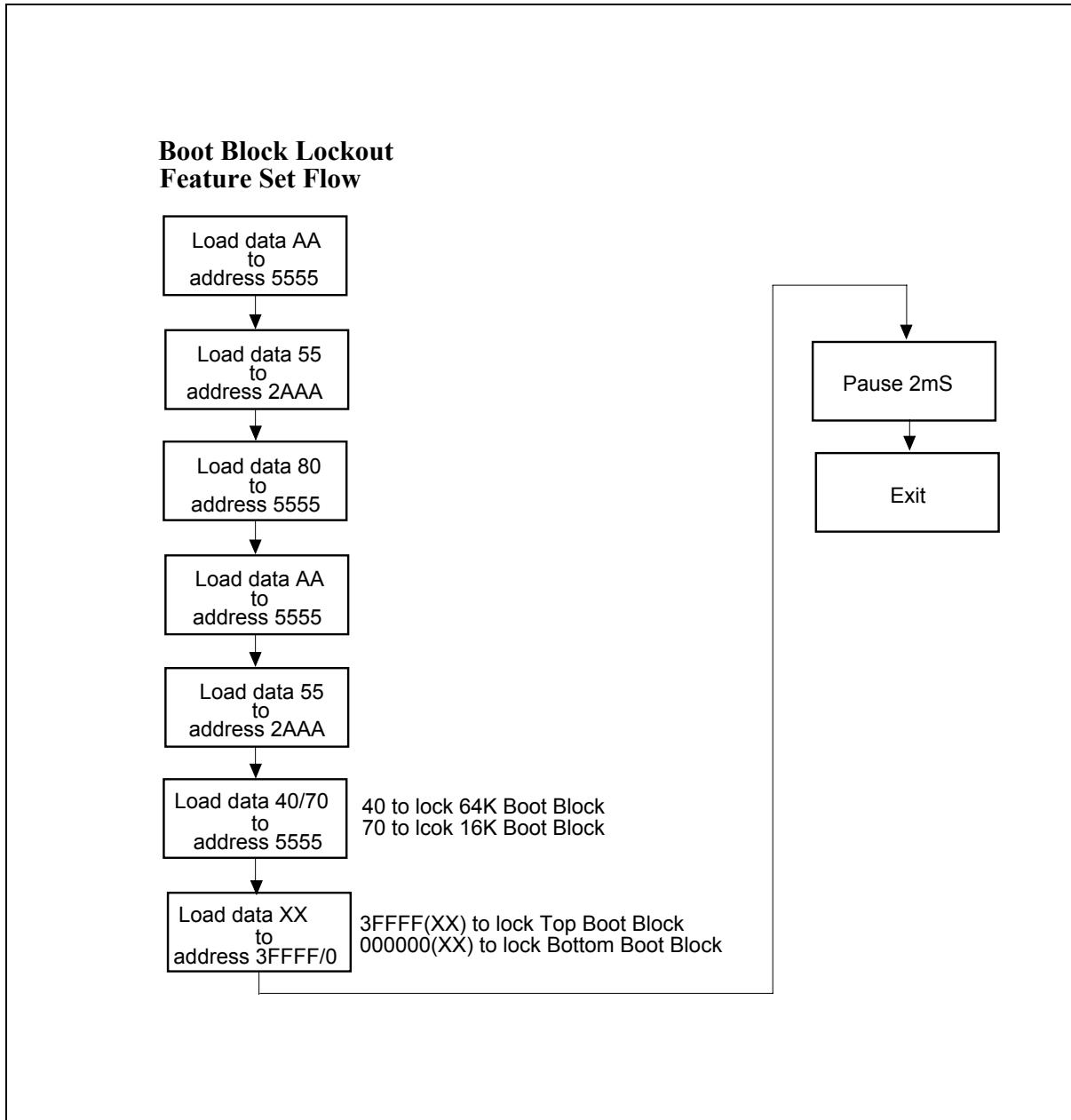


## Embedded #Data Polling Algorithm

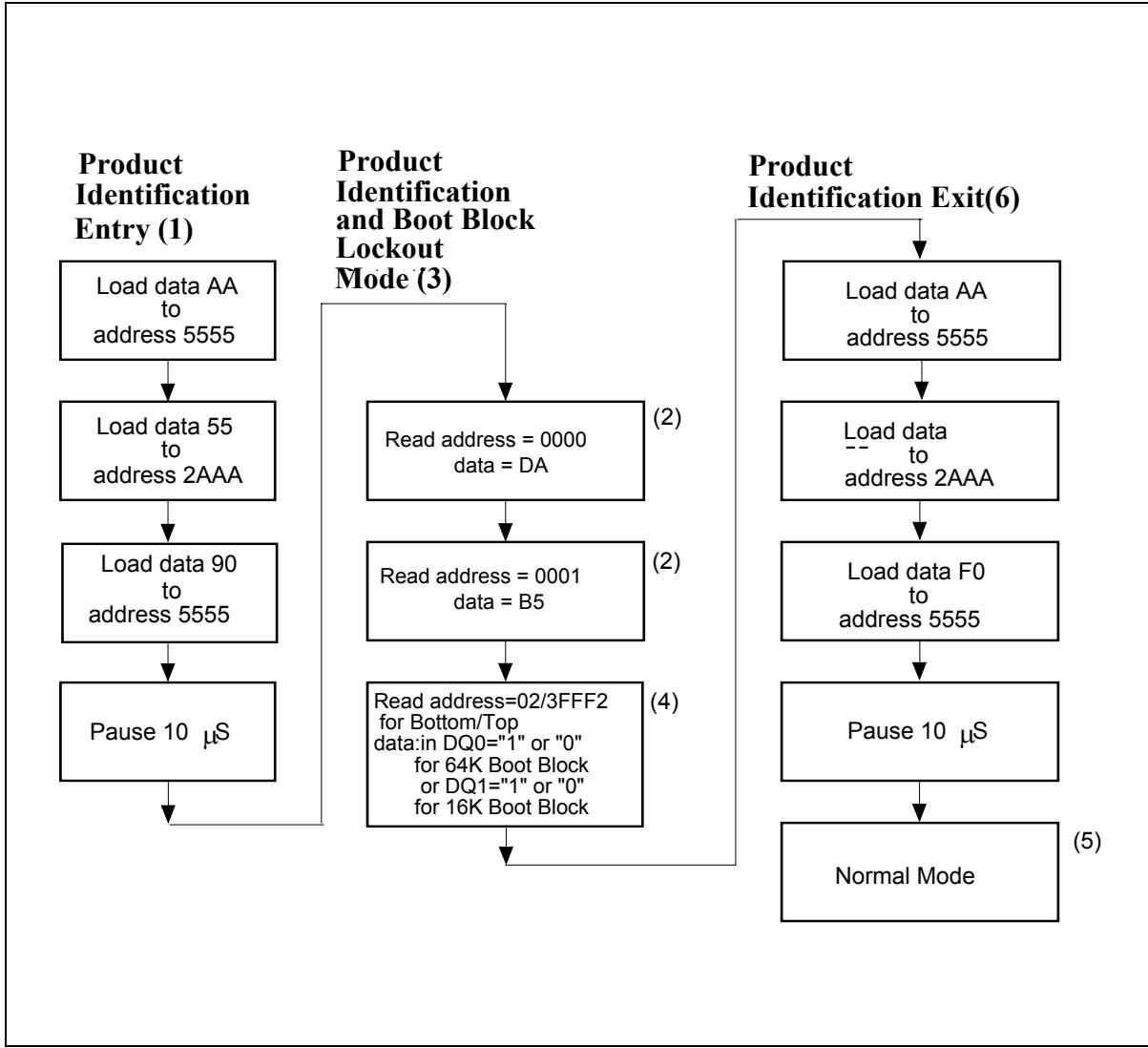


## Embedded Toggle Bit Algorithm



**Boot Block Lockout Enable Flow Chart**

## Software Product Identification and Boot Block Lockout Detection Flow Chart



Notes for software product identification/boot block lockout detection:

- (1) Data Format: DQ7 – DQ0 (Hex); Address Format: A14 – A0 (Hex)
- (2) A1 – A17 = V<sub>IL</sub>; manufacture code is read for A0 = V<sub>IL</sub>; device code is read for A0 = V<sub>IH</sub>.
- (3) The device does not remain in identification and boot block lockout detection mode if power down.
- (4) If the output data in DQ0 or DQ1 = "1" the boot block programming lockout feature is activated; if the output data in DQ0 or DQ1 = "0," the lockout feature is inactivated and the matched boot block can be programmed.
- (5) The device returns to standard operation mode.
- (6) Optional 1-byte cycle (write F0 hex at XXXX address) can be used to exit the product identification/boot block lockout detection.



## 8. DC CHARACTERISTICS

### Absolute maximum Ratings

PARAMETER	RATING	UNIT
Power Supply Voltage to Vss Potential	-2.0 to +4.6	V
Operating Temperature	0 to +70	°C
Storage Temperature	-65 to +125	°C
Voltage on Any Pin to Ground Potential Except A9	-2.0 to +4.6	V
Voltage on A9 Pin to Ground Potential	-2.0 to +13.0	V

Note: Exposure to conditions beyond those listed under Absolute maximum Ratings may adversely affect the life and reliability of the device.

### DC Operating Characteristics

(VDD = 3.3V ±0.3V, Vss = 0V, TA = 0 to 70° C)

PARAMETER	SYM.	TEST CONDITIONS	LIMITS			UNIT
			MIN.	TYP.	MAX.	
Power Supply Current	IDD	#CE = #OE = VIL, #WE = VIH, all DQs open Address inputs = VIL/VIH, at f = 5 MHz	-	10	20	mA
Standby VDD Current (TTL input)	ISB1	#CE = VIH, all DQs open Other inputs = VIL/VIH	-	1	2	mA
Standby VDD Current (CMOS input)	ISB2	#CE = VDD -0.3V, all DQs open Other inputs = VDD -0.3V/ Vss	-	5	25	μA
Input Leakage Current	ILI	VIN = Vss to VDD	-	-	1	μA
Output Leakage Current	ILO	VOUT = Vss to VDD	-	-	1	μA
Input Low Voltage	VIL	-	-0.3	-	0.8	V
Input High Voltage	VIH	-	2.0	-	VDD +0.5	V
Output Low Voltage	VOL	IOL = 2.1 mA	-	-	0.45	V
Output High Voltage	VOH	IOH = -0.4 mA	2.4	-	-	V

### Pin Capacitance

(VDD = 3.3V, TA = 25° C, f = 1 MHz)

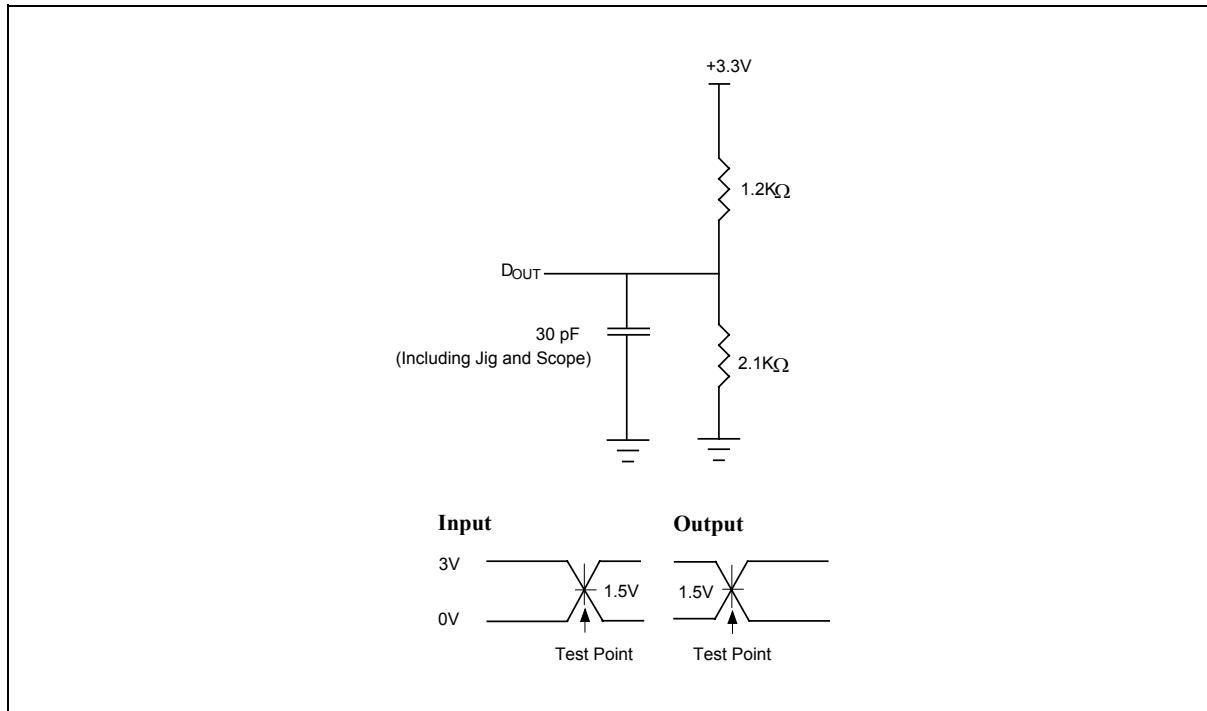
PARAMETER	SYMBOL	CONDITIONS	TYP.	MAX.	UNIT
Input Capacitance	CIN	VIN = 0V	6	8	pF
Output Capacitance	COUT	VOUT = 0V	10	12	pF

## 9. AC CHARACTERISTICS

### AC Test Conditions

PARAMETER	CONDITIONS
Input Pulse Levels	0V to 3V
Input Rise/Fall Time	<5 nS
Input/Output Timing Level	1.5V/1.5V
Output Load	1 TTL Gate and $CL = 30 \text{ pF}$

### AC Test Load and Waveform





AC Characteristics, continued

### Read Cycle Timing Parameters

(VDD = 3.3V  $\pm 0.3$ V, Vss = 0V, TA = 0 to 70° C)

PARAMETER	SYM.	W39L020-70		W39L020-90		UNIT
		MIN.	MAX.	MIN.	MAX.	
Read Cycle Time	TRC	70	-	90	-	nS
Chip Enable Access Time	TCE	-	70	-	90	nS
Address Access Time	TAA	-	70	-	90	nS
Output Enable Access Time	TOE	-	35	-	45	nS
#CE Low to Active Output	TCLZ	0	-	0	-	nS
#OE Low to Active Output	TOLZ	0	-	0	-	nS
#CE High to High-Z Output	TCHZ	-	25	-	25	nS
#OE High to High-Z Output	TOHZ	-	25	-	25	nS
Output Hold from Address Change	TOH	0	-	0	-	nS

### Write Cycle Timing Parameters

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Address Setup Time	TAS	0	-	-	nS
Address Hold Time	TAH	40	-	-	nS
#WE and #CE Setup Time	TCS	0	-	-	nS
#WE and #CE Hold Time	TCH	0	-	-	nS
#OE High Setup Time	TOES	0	-	-	nS
#OE High Hold Time	TOEH	0	-	-	nS
#CE Pulse Width	TCP	100	-	-	nS
#WE Pulse Width	TWP	100	-	-	nS
#WE High Width	TWPH	100	-	-	nS
Data Setup Time	TDS	40	-	-	nS
Data Hold Time	TDH	10	-	-	nS
Byte Programming Time	TBP	-	35	50	$\mu$ s
Chip Erase Cycle Time	TEC	-	50	100	ms
Sector/Page Erase Cycle Time	TEP	-	12.5	25	ms

Note: All AC timing signals observe the following guidelines for determining setup and hold times:

(a) High level signal's reference level is VIH and (b) low level signal's reference level is VIL.



AC Characteristics, continued

### Power-up Timing

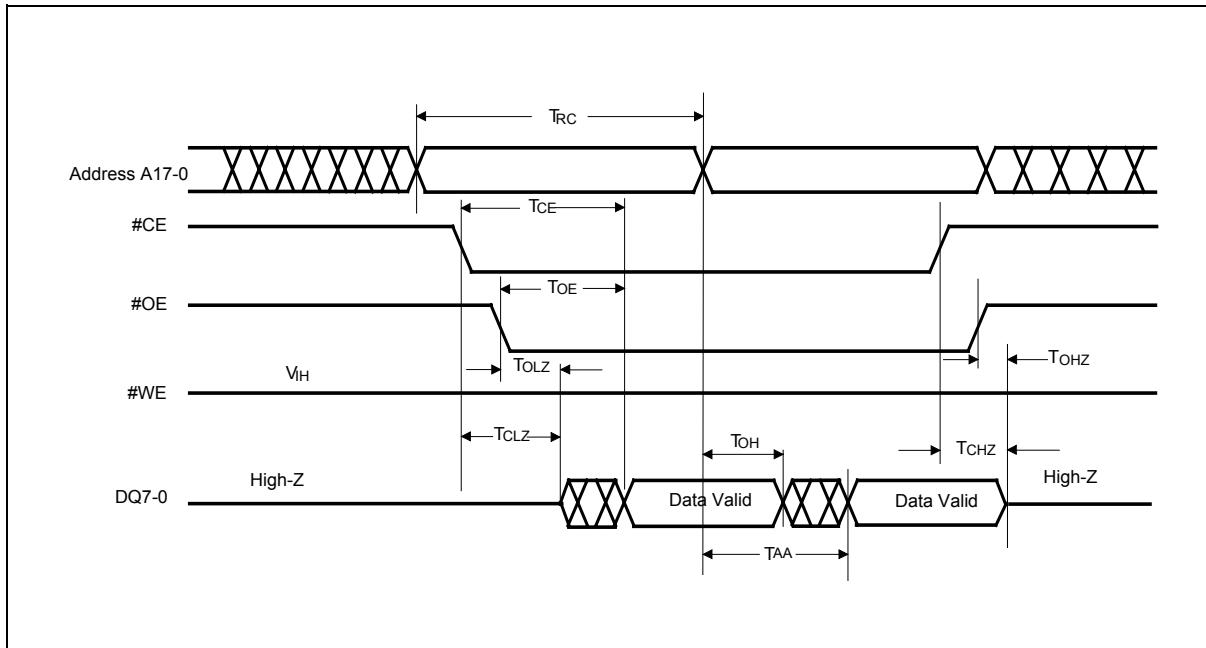
PARAMETER	SYMBOL	TYPICAL	UNIT
Power-up to Read Operation	TPU. READ	100	µS
Power-up to Write Operation	TPU. WRITE	5	ms

### Data Polling and Toggle Bit Timing Parameters

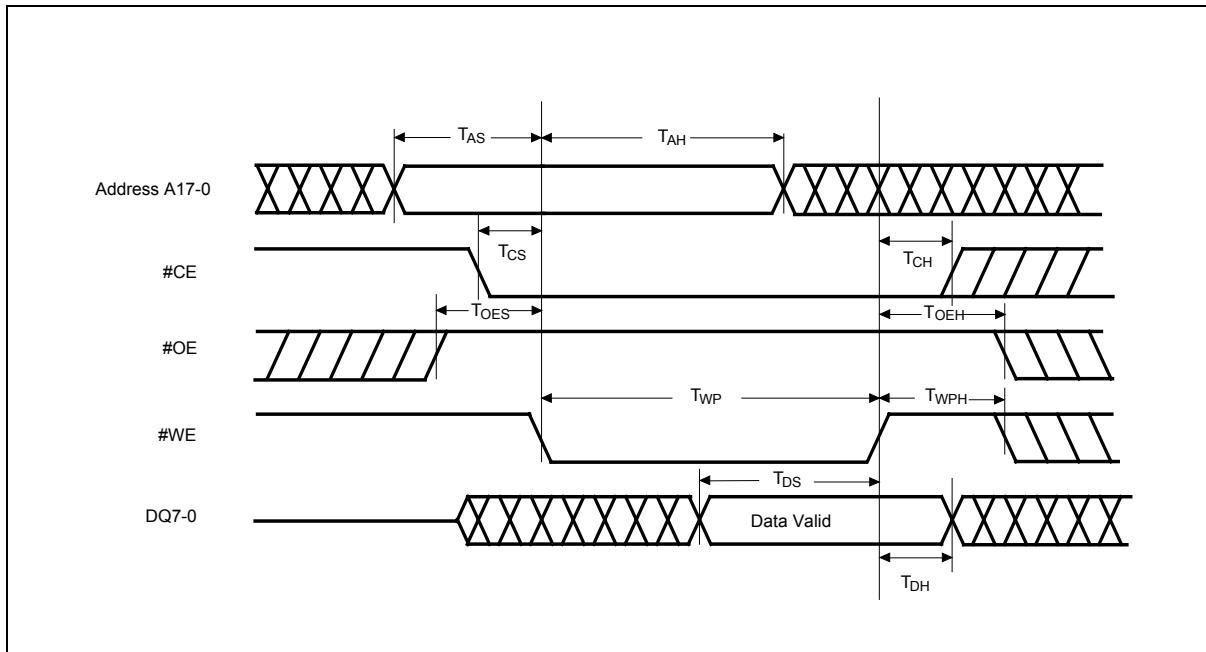
PARAMETER	SYM.	W39L020-70		W39L020-90		UNIT
		MIN.	MAX.	MIN.	MAX.	
#OE to Data Polling Output Delay	TOEP	-	35	-	45	nS
#CE to Data Polling Output Delay	TCEP	-	70	-	90	nS
#OE to Toggle Bit Output Delay	TOET	-	35	-	45	nS
#CE to Toggle Bit Output Delay	TCET	-	70	-	90	nS

## 10. TIMING WAVEFORMS

### Read Cycle Timing Diagram

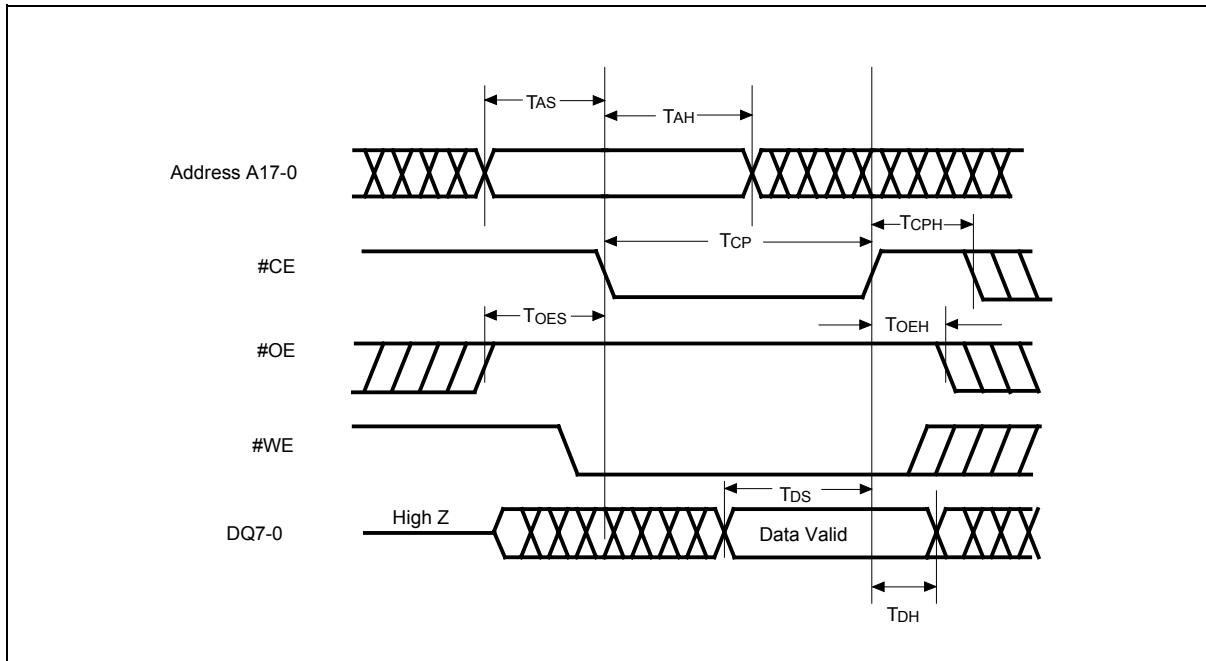


### #WE Controlled Command Write Cycle Timing Diagram

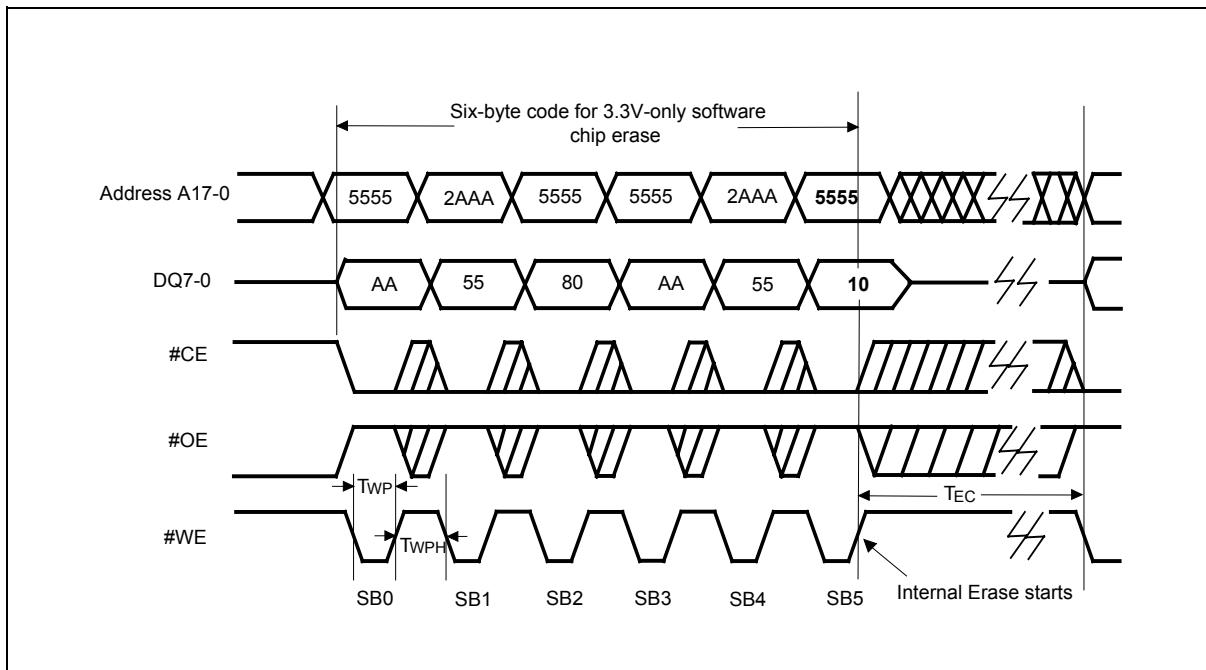


Timing Waveforms, continued

## #CE Controlled Command Write Cycle Timing Diagram

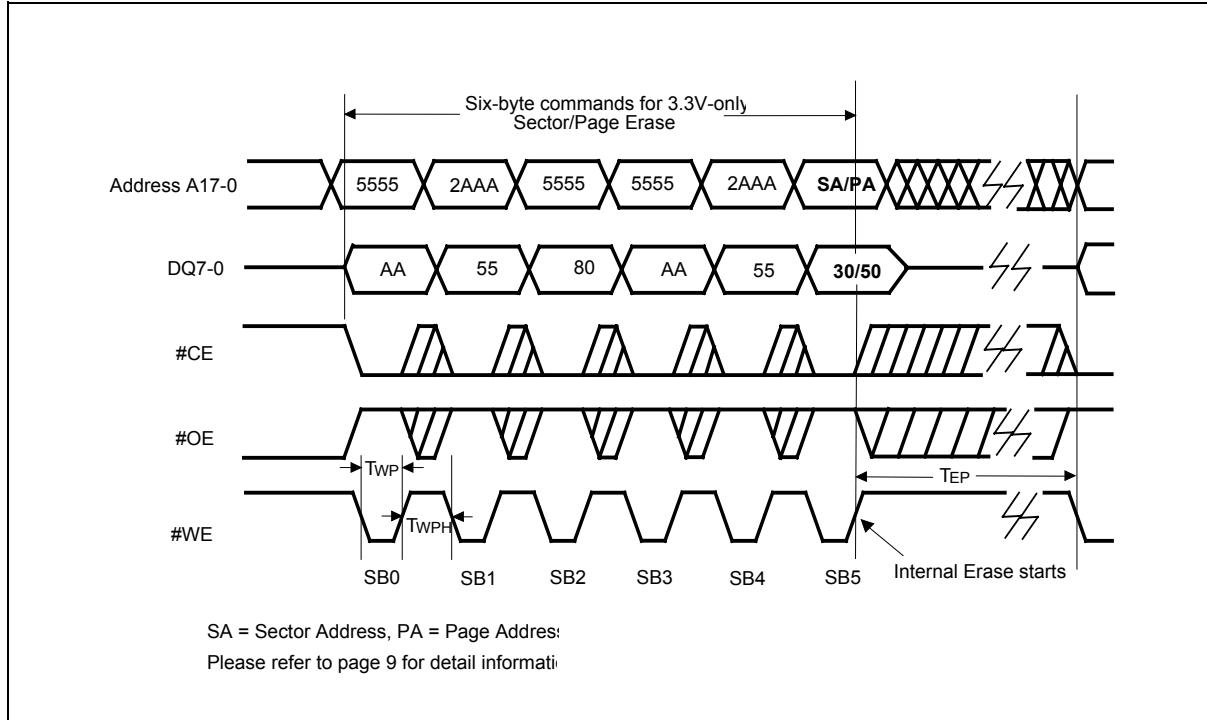


## Chip Erase Timing Diagram

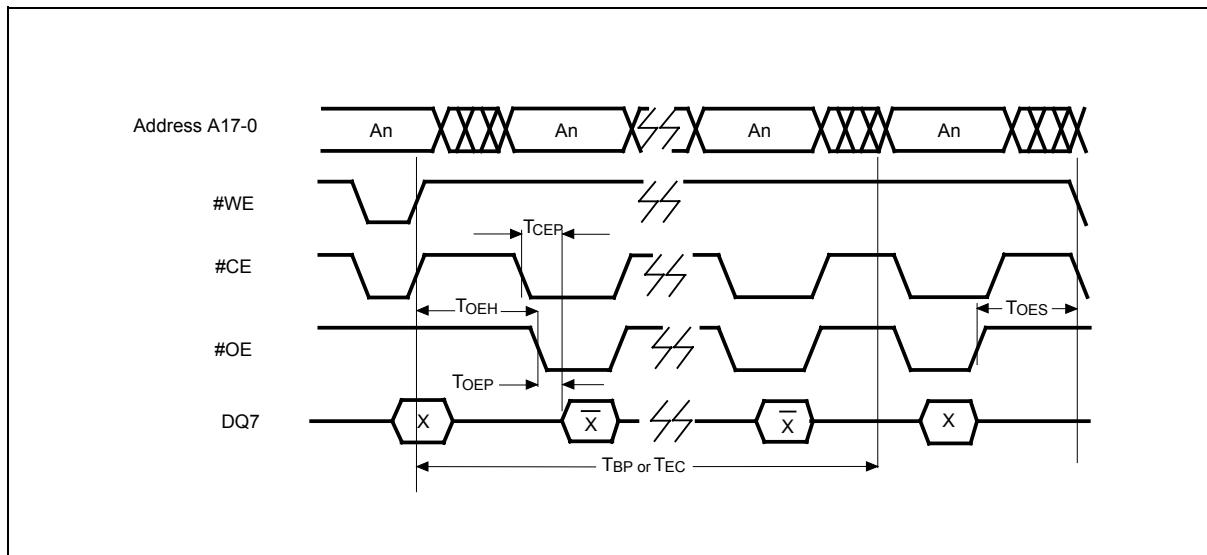


Timing Waveforms, continued

### Sector/Page Erase Timing Diagram

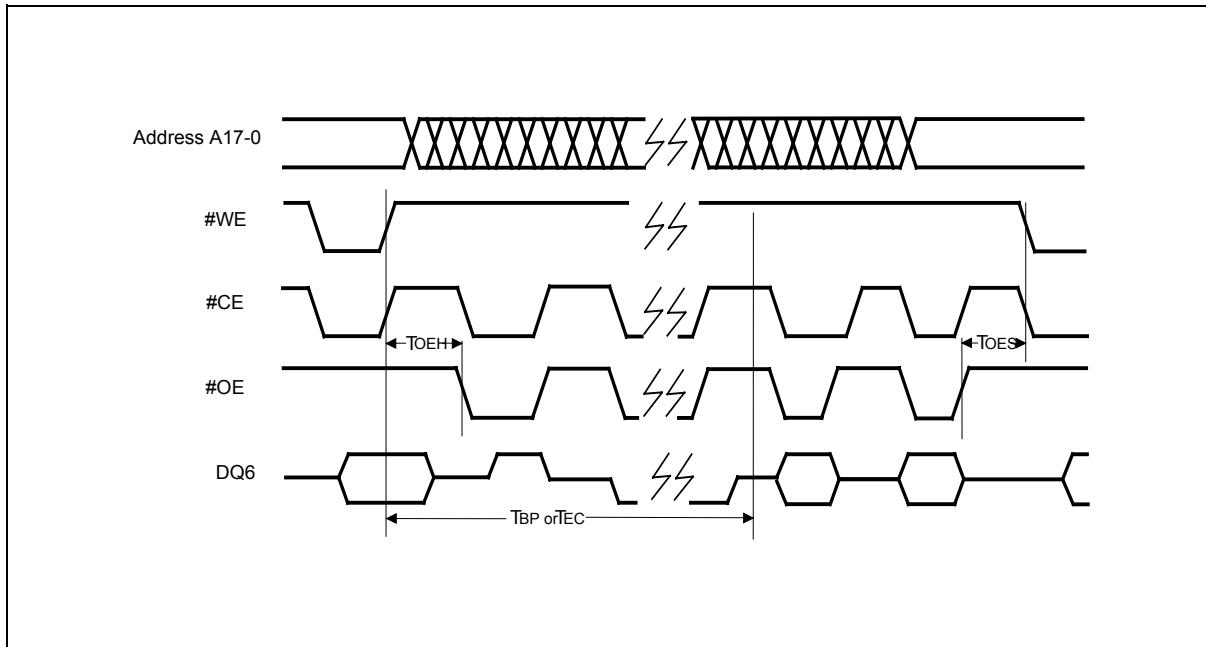


### #DATA Polling Timing Diagram



Timing Waveforms, continued

## Toggle Bit Timing Diagram





## 11. ORDERING INFORMATION

PART NO.	ACCESS TIME (nS)	POWER SUPPLY CURRENT MAX. (mA)	STANDBY V <sub>DD</sub> CURRENT MAX. (mA)	PACKAGE	CYCLE
W39L020P-70	70	20	2	32L PLCC	1K
W39L020P-90	90	20	2	32L PLCC	1K
W39L020T-70	70	20	2	32L TSOP (8 x 20 mm)	1K
W39L020T-90	90	20	2	32L TSOP (8 x 20 mm)	1K
W39L020Q-70	70	20	2	32L STSOP (8 x 14 mm)	1K
W39L020Q-90	90	20	2	32L STSOP (8 x 14 mm)	1K
W39L020P-70B	70	20	2	32L PLCC	10K
W39L020P-90B	90	20	2	32L PLCC	10K
W39L020T-70B	70	20	2	32L TSOP (8 x 20 mm)	10K
W39L020T-90B	90	20	2	32L TSOP (8 x 20 mm)	10K
W39L020Q-70B	70	20	2	32L STSOP (8 x 14 mm)	10K
W39L020Q-90B	90	20	2	32L STSOP (8 x 14 mm)	10K

Notes:

1. Winbond reserves the right to make changes to its products without prior notice.
2. Purchasers are responsible for performing appropriate quality assurance testing on products intended for use in applications where personal injury might occur as a consequence of product failure.

## 12. HOW TO READ THE TOP MARKING

Example: The top marking of 32-pin TSOP W39L020T-70



1<sup>st</sup> line: Winbond logo

2<sup>nd</sup> line: the part number: W39L020T-70

3<sup>rd</sup> line: the lot number

4<sup>th</sup> line: the tracking code: 149 O B SA

149: Packages made in '01, week 49

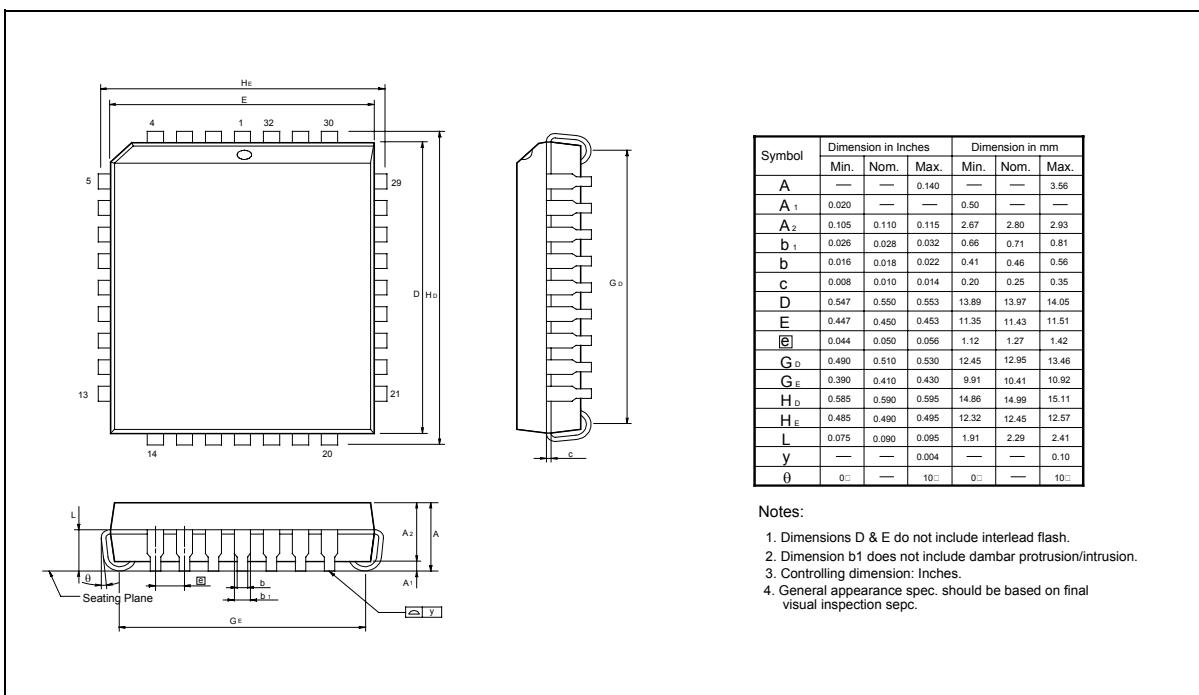
O: Assembly house ID: A means ASE, O means OSE, ...etc.

B: IC revision; A means version A, B means version B, ...etc.

SA: Process code

## 13. PACKAGE DIMENSIONS

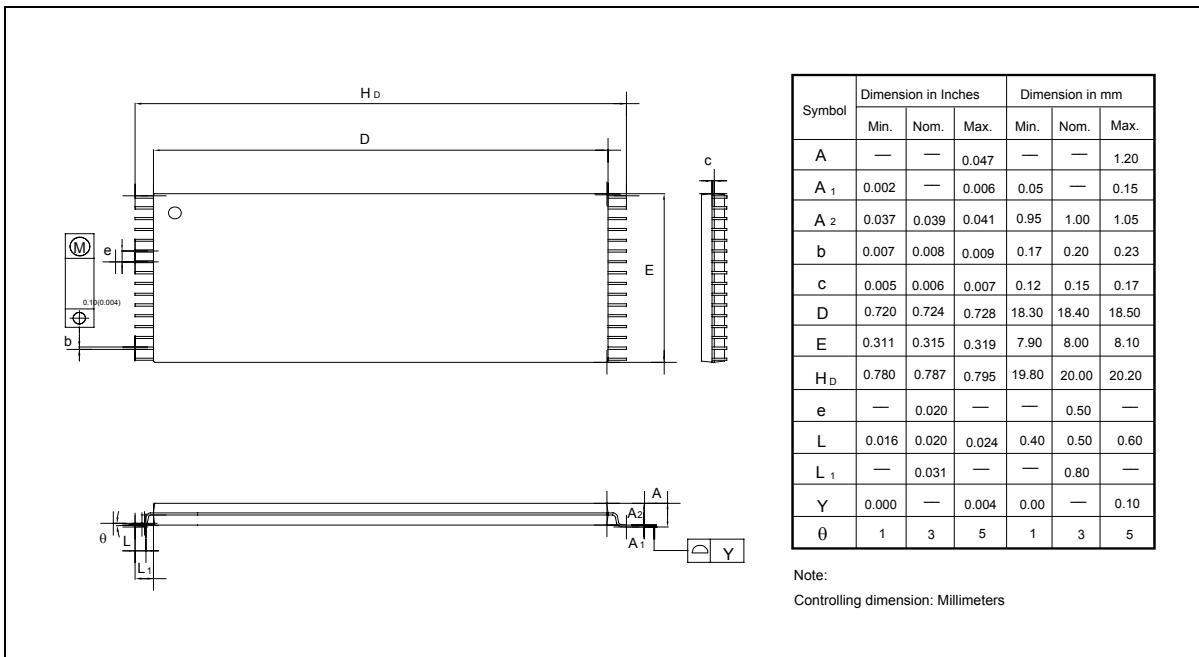
### 32L PLCC



#### Notes:

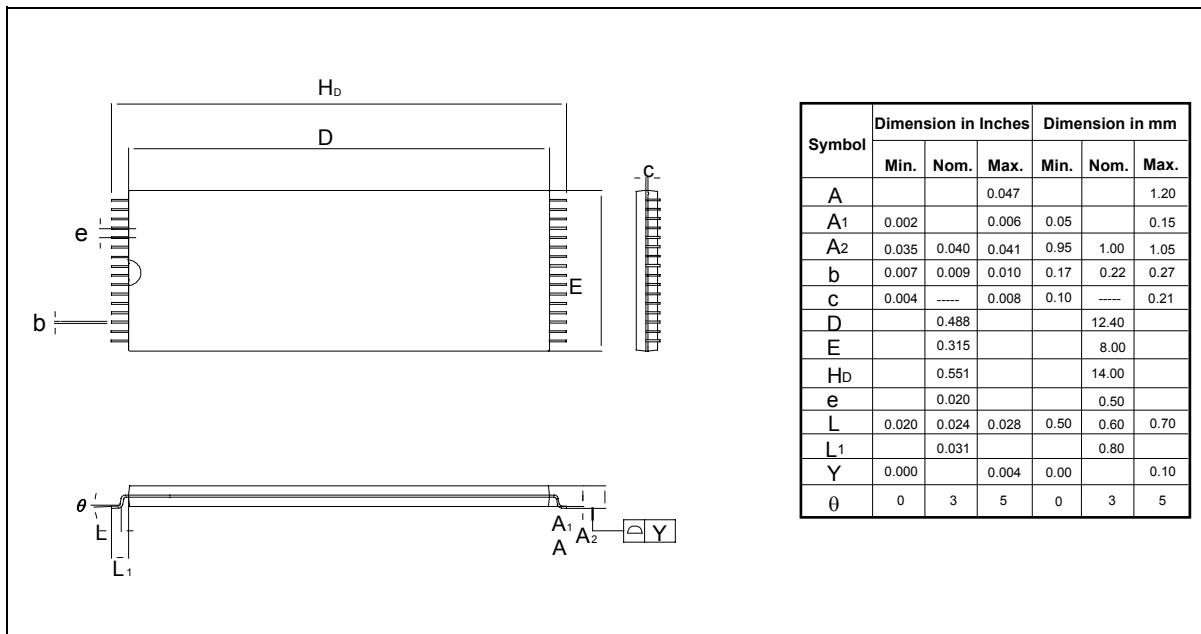
- Dimensions D & E do not include interlead flash.
- Dimension b<sub>1</sub> does not include dambar protrusion/intrusion.
- Controlling dimension: Inches.
- General appearance spec. should be based on final visual inspection spec.

### 32L TSOP (8 x 20 mm)



Package Dimensions, continued

**32L TSOP (8 x 14 mm)**





## 14. VERSION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A1	May 2001	-	Initial Issued
A2	May 31, 2002	1, 23	Add cycle of 1K
		1	Change active current from 20 to10 mA (typ.) Change standby current from 10 to15 $\mu$ A (typ.)
		4	Correct Power-up Write Inhibit as Power-up Write and Read Inhibit
			Add Low VDD inhibit description
		10 – 14	Correct old flow chart and add embedded algorithm
		15	Change IDD from 20/30 mA to10/20 mA (typ./max.) Change Isb2 from 10/20 $\mu$ A to15/50 $\mu$ A (typ./max.)
		23	Change power supply current max from 30 to 20 (mA)
			Add HOW TO READ THE TOP MARKING
A3	July 10, 2002	11	Correct Block Erase as Sector Erase in the Embedded Erase Algorithm
		12	Correct Embedded #Data Polling Algorithm
A4	Nov. 11, 2002	1, 3, 15	Change Standby Current from 15 to 5 $\mu$ A (typ.) and from 50 to 25 $\mu$ A (max.)



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