

# W27E512



## 64K × 8 ELECTRICALLY ERASABLE EPROM

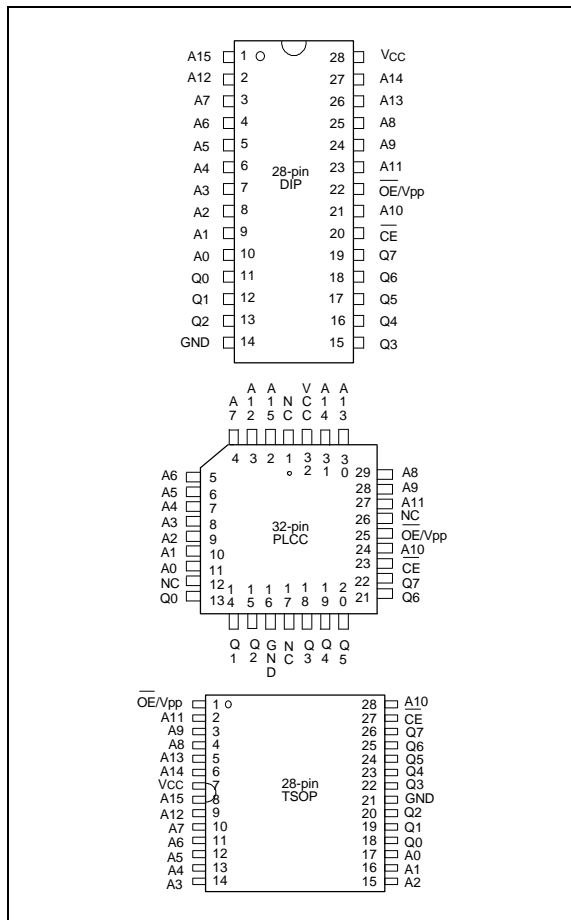
### GENERAL DESCRIPTION

The W27E512 is a high speed, low power Electrically Erasable and Programmable Read Only Memory organized as 65536 × 8 bits that operates on a single 5 volt power supply. The W27E512 provides an electrical chip erase function.

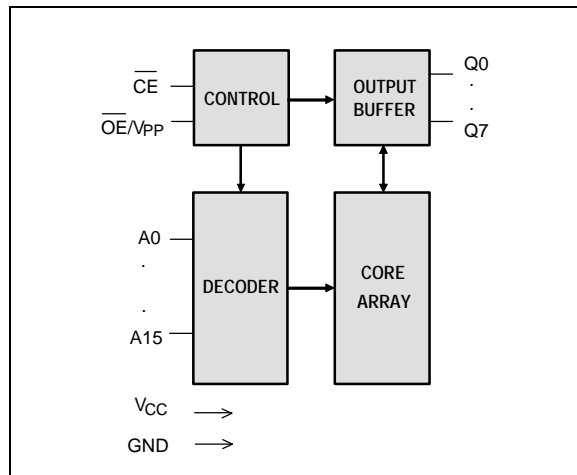
### FEATURES

- High speed access time: 45/55/70/90/120/150 nS (max.)
- Read operating current: 30 mA (max.)
- Erase/Programming operating current 30 mA (max.)
- Standby current: 1 mA (max.)
- Single 5V power supply
- +14V erase/+12V programming voltage
- Fully static operation
- All inputs and outputs directly TTL/CMOS compatible
- Three-state outputs
- Available packages: 28-pin 600 mil DIP, 330 mil SOP, TSOP and 32-pin PLCC

### PIN CONFIGURATIONS



### BLOCK DIAGRAM



### PIN DESCRIPTION

SYMBOL	DESCRIPTION
A0–A15	Address Inputs
Q0–Q7	Data Inputs/Outputs
CE	Chip Enable
OE/VPP	Output Enable, Program/Erase Supply Voltage
VCC	Power Supply
GND	Ground
NC	No Connection



## FUNCTIONAL DESCRIPTION

### Read Mode

Like conventional UVEPROMs, the W27E512 has two control functions, both of which produce data at the outputs.  $\overline{CE}$  is for power control and chip select.  $\overline{OE}/V_{PP}$  controls the output buffer to gate data to the output pins. When addresses are stable, the address access time ( $T_{ACC}$ ) is equal to the delay from  $\overline{CE}$  to output ( $T_{CE}$ ), and data are available at the outputs  $T_{OE}$  after the falling edge of  $\overline{OE}/V_{PP}$ , if  $T_{ACC}$  and  $T_{CE}$  timings are met.

### Erase Mode

The erase operation is the only way to change data from "0" to "1." Unlike conventional UVEPROMs, which use ultraviolet light to erase the contents of the entire chip (a procedure that requires up to half an hour), the W27E512 uses electrical erasure. Generally, the chip can be erased within 100 mS by using an EPROM writer with a special erase algorithm.

Erase mode is entered when  $\overline{OE}/V_{PP}$  is raised to  $V_{PE}$  (14V),  $V_{CC} = V_{CE}$  (5V),  $A_9 = V_{PE}$  (14V),  $A_0$  low, and all other address pins low and data input pins high. Pulsing  $\overline{CE}$  low starts the erase operation.

### Erase Verify Mode

After an erase operation, all of the bytes in the chip must be verified to check whether they have been successfully erased to "1" or not. The erase verify mode ensures a substantial erase margin if  $V_{CC} = V_{CE}$  (3.75V),  $\overline{CE}$  low, and  $\overline{OE}/V_{PP}$  low.

### Program Mode

Programming is performed exactly as it is in conventional UVEPROMs, and programming is the only way to change cell data from "1" to "0." The program mode is entered when  $\overline{OE}/V_{PP}$  is raised to  $V_{PP}$  (12V),  $V_{CC} = V_{CP}$  (5V), the address pins equal the desired addresses, and the input pins equal the desired inputs. Pulsing  $\overline{CE}$  low starts the programming operation.

### Program Verify Mode

All of the bytes in the chip must be verified to check whether they have been successfully programmed with the desired data or not. Hence, after each byte is programmed, a program verify operation should be performed. The program verify mode automatically ensures a substantial program margin. This mode will be entered after the program operation if  $\overline{OE}/V_{PP}$  low and  $\overline{CE}$  low.

### Erase/Program Inhibit

Erase or program inhibit mode allows parallel erasing or programming of multiple chips with different data. When  $\overline{CE}$  high, erasing or programming of non-target chips is inhibited, so that except for the  $\overline{CE}$  and  $\overline{OE}/V_{PP}$  pins, the W27E512 may have common inputs.



## Standby Mode

The standby mode significantly reduces VCC current. This mode is entered when  $\overline{CE}$  high. In standby mode, all outputs are in a high impedance state, independent of  $\overline{OE}/V_{PP}$ .

## Two-line Output Control

Since EPROMs are often used in large memory arrays, the W27E512 provides two control inputs for multiple memory connections. Two-line control provides for lowest possible memory power dissipation and ensures that data bus contention will not occur.

## System Considerations

An EPROM's power switching characteristics require careful device decoupling. System designers are interested in three supply current issues: standby current levels ( $I_{SB}$ ), active current levels ( $I_{CC}$ ), and transient current peaks produced by the falling and rising edges of  $\overline{CE}$ . Transient current magnitudes depend on the device output's capacitive and inductive loading. Two-line control and proper decoupling capacitor selection will suppress transient voltage peaks. Each device should have a 0.1  $\mu$ F ceramic capacitor connected between its VCC and GND. This high frequency, low inherent-inductance capacitor should be placed as close as possible to the device. Additionally, for every eight devices, a 4.7  $\mu$ F electrolytic capacitor should be placed at the array's power supply connection between VCC and GND. The bulk capacitor will overcome voltage slumps caused by PC board trace inductances.

## TABLE OF OPERATING MODES

( $V_{PP} = 12V$ ,  $V_{PE} = 14V$ ,  $V_{HH} = 12V$ ,  $V_{CP} = 5V$ ,  $V_{CE} = 5V$ ,  $X = V_{IH}$  or  $V_{IL}$ )

MODE	PINS					
	$\overline{CE}$	$\overline{OE}/V_{PP}$	A0	A9	Vcc	OUTPUTS
Read	VIL	VIL	X	X	VCC	DOUT
Output Disable	VIL	VIH	X	X	VCC	High Z
Standby (TTL)	VIH	X	X	X	VCC	High Z
Standby (CMOS)	$V_{CC} \pm 0.3V$	X	X	X	VCC	High Z
Program	VIL	VPP	X	X	VCP	DIN
Program Verify	VIL	VIL	X	X	VCC	DOUT
Program Inhibit	VIH	VPP	X	X	VCP	High Z
Erase	VIL	VPE	VIL	VPE	VCE	DIH
Erase Verify	VIL	VIL	X	X	3.75	DOUT
Erase Inhibit	VIH	VPE	X	X	VCE	High Z
Product Identifier-manufacturer	VIL	VIL	VIL	VHH	VCC	DA (Hex)
Product Identifier-device	VIL	VIL	VIH	VHH	VCC	08 (Hex)



## DC CHARACTERISTICS

### Absolute Maximum Ratings

PARAMETER	RATING	UNIT
Ambient Temperature with Power Applied	-55 to +125	°C
Storage Temperature	-65 to +125	°C
Voltage on all Pins with Respect to Ground Except $\overline{OE}/V_{PP}$ , A9 and VCC Pins	-0.5 to VCC +0.5	V
Voltage on $\overline{OE}/V_{PP}$ Pin with Respect to Ground	-0.5 to +14.5	V
Voltage on A9 Pin with Respect to Ground	-0.5 to +14.5	V
Voltage VCC Pin with Respect to Ground	-0.5 to +7	V

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

### DC Erase Characteristics

( $T_A = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$ )

PARAMETER	SYM.	CONDITIONS	LIMITS			UNIT
			MIN.	TYP.	MAX.	
Input Load Current	I <sub>LI</sub>	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>	-10	-	10	μA
VCC Erase Current	I <sub>CP</sub>	$\overline{CE} = V_{IL}$ , $\overline{OE}/V_{PP} = V_{PE}$	-	-	30	mA
VPP Erase Current	I <sub>PP</sub>	$\overline{CE} = V_{IL}$ , $\overline{OE}/V_{PP} = V_{PE}$	-	-	30	mA
Input Low Voltage	V <sub>IL</sub>	-	-0.3	-	0.8	V
Input High Voltage	V <sub>IH</sub>	-	2.4	-	5.5	V
Output Low Voltage (Verify)	V <sub>OL</sub>	I <sub>OL</sub> = 2.1 mA	-	-	0.45	V
Output High Voltage (Verify)	V <sub>OH</sub>	I <sub>OH</sub> = -0.4 mA	2.4	-	-	-
A9 Erase Voltage	V <sub>ID</sub>	-	13.25	14	14.25	V
VPP Erase Voltage	V <sub>PE</sub>	-	13.25	14	14.25	V
VCC Supply Voltage (Erase)	V <sub>CE</sub>	-	4.5	5.0	5.5	V
VCC Supply Voltage (Erase Verify)	V <sub>CE</sub>	-	3.5	3.75	4.0	V

Note: VCC must be applied simultaneously or before VPP and removed simultaneously or after VPP.



## CAPACITANCE

(V<sub>CC</sub> = 5V, T<sub>A</sub> = 25° C, f = 1 MHz)

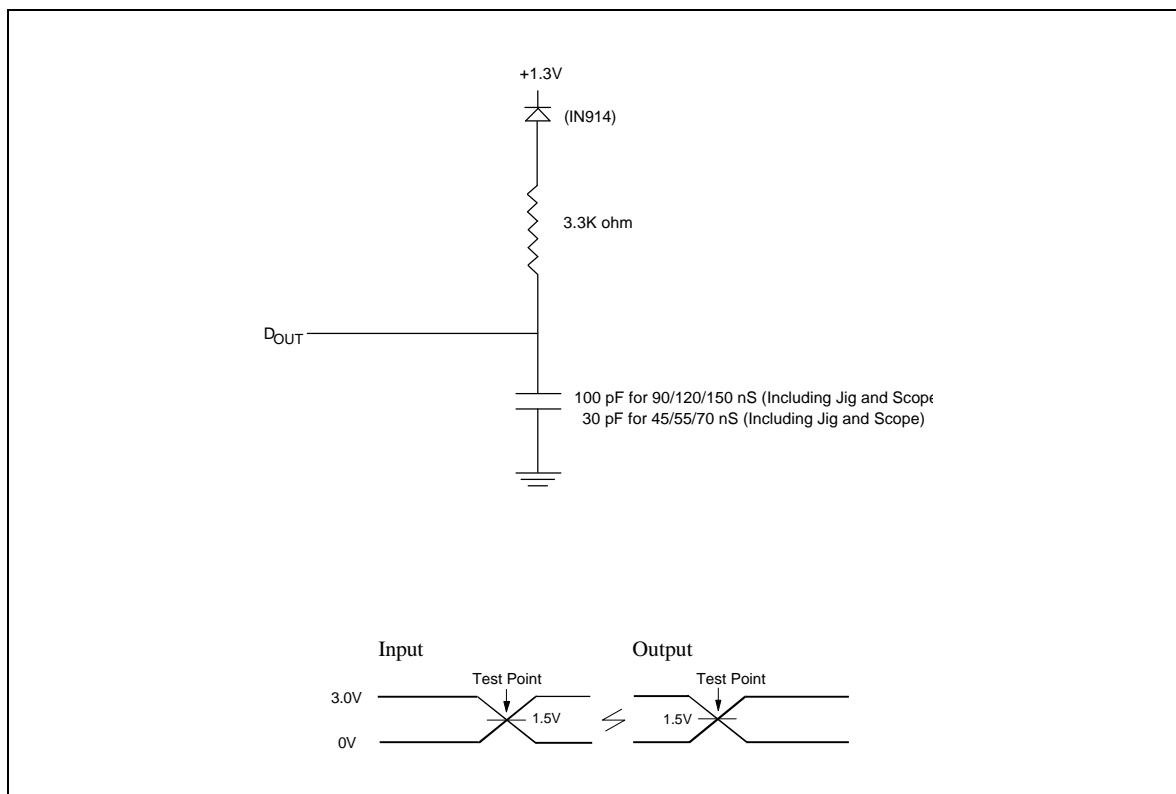
PARAMETER	SYMBOL	CONDITIONS	MAX.	UNIT
Input Capacitance	C <sub>IN</sub>	V <sub>IN</sub> = 0V	6	pF
Output Capacitance	C <sub>OUT</sub>	V <sub>OUT</sub> = 0V	12	pF

## AC CHARACTERISTICS

### AC Test Conditions

PARAMETER	CONDITIONS
Input Pulse Levels	0 to 3.0V
Input Rise and Fall Times	5 nS
Input and Output Timing Reference Level	1.5V/1.5V
Output Load	CL = 30 pF, I <sub>OH</sub> /I <sub>OL</sub> = -0.4 mA/2.1 mA

### AC Test Load and Waveforms





## READ OPERATION DC CHARACTERISTICS

(V<sub>CC</sub> = 5.0V ±10%, T<sub>A</sub> = 0 to 70° C)

PARAMETER	SYM.	CONDITIONS	LIMITS			UNIT
			MIN.	TYP.	MAX.	
Input Load Current	I <sub>LI</sub>	V <sub>IN</sub> = 0V to V <sub>CC</sub>	-5	-	5	μA
Output Leakage Current	I <sub>LO</sub>	V <sub>OUT</sub> = 0V to V <sub>CC</sub>	-10	-	10	μA
Standby V <sub>CC</sub> Current (TTL input)	I <sub>SB</sub>	$\overline{CE} = V_{IH}$	-	-	1.0	mA
Standby V <sub>CC</sub> Current (CMOS input)	I <sub>SB1</sub>	$\overline{CE} = V_{CC} \pm 0.2V$	-	5	100	μA
V <sub>CC</sub> Operating Current	I <sub>CC</sub>	$\overline{CE} = V_{IL}$ I <sub>OUT</sub> = 0 mA f = 5 MHz	-	-	30	mA
Input Low Voltage	V <sub>IL</sub>	-	-0.3	-	0.8	V
Input High Voltage	V <sub>IH</sub>	-	2.0	-	V <sub>CC</sub> + 0.5	V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 2.1 mA	-	-	0.45	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -0.4 mA	2.4	-	-	V

## READ OPERATION AC CHARACTERISTICS

(V<sub>CC</sub> = 5.0V ±10%, T<sub>A</sub> = 0 to 70° C)

PARAMETER	SYM.	W27E512-45		W27E512-55		W27E512-70		W27E512-90		W27E512-12		W27E512-15		UNIT
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Read Cycle Time	TRC	45	-	55	-	70	-	90	-	120	-	150	-	nS
Chip Enable Access Time	T <sub>CE</sub>	-	45	-	55	-	70	-	90	-	120	-	150	nS
Address Access Time	T <sub>ACC</sub>	-	45	-	55	-	70	-	90	-	120	-	150	nS
Output Enable Access Time	T <sub>OE</sub>	-	20	-	25	-	30	-	40	-	55	-	60	nS
$\overline{OE}$ /V <sub>PP</sub> High to High-Z Output	T <sub>DF</sub>	-	20	-	20	-	30	-	30	-	30	-	50	nS
Output Hold from Address Change	T <sub>OH</sub>	0	-	0	-	0	-	0	-	0	-	0	-	nS

Note: V<sub>CC</sub> must be applied simultaneously or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.



## DC PROGRAMMING CHARACTERISTICS

(V<sub>CC</sub> = 5.0V ±10%, T<sub>A</sub> = 25° C ±5° C)

PARAMETER	SYM.	CONDITIONS	LIMITS			UNIT
			MIN.	TYP.	MAX.	
Input Load Current	I <sub>LI</sub>	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>	-10	-	10	μA
V <sub>CC</sub> Program Current	I <sub>CP</sub>	$\overline{CE} = V_{IL}$ , $\overline{OE} / V_{PP} = V_{PP}$	-	-	30	mA
V <sub>PP</sub> Program Current	I <sub>PP</sub>	$\overline{CE} = V_{IL}$ , $\overline{OE} / V_{PP} = V_{PP}$	-	-	30	mA
Input Low Voltage	V <sub>IL</sub>	-	-0.3	-	0.8	V
Input High Voltage	V <sub>IH</sub>	-	2.4	-	5.5	V
Output Low Voltage (Verify)	V <sub>OL</sub>	I <sub>OL</sub> = 2.1 mA	-	-	0.45	V
Output High Voltage (Verify)	V <sub>OH</sub>	I <sub>OH</sub> = -0.4 mA	2.4	-	-	V
A9 Silicon I.D. Voltage	V <sub>ID</sub>	-	11.5	12.0	12.5	V
V <sub>PP</sub> Program Voltage	V <sub>PP</sub>	-	11.75	12.0	12.25	V
V <sub>CC</sub> Supply Voltage (Program)	V <sub>CP</sub>	-	4.5	5.0	5.5	V

## AC PROGRAMMING/ERASE CHARACTERISTICS

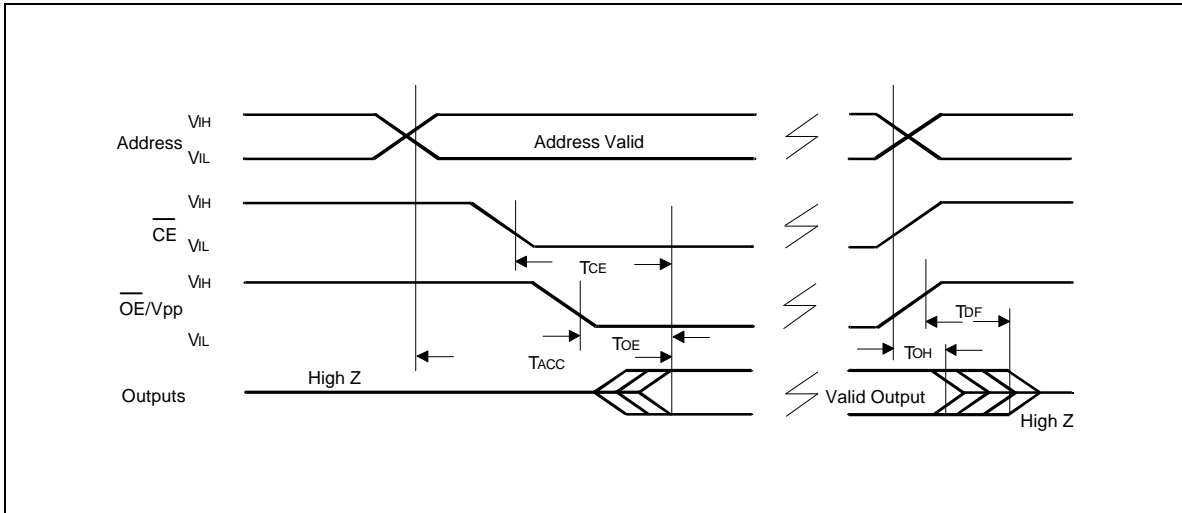
(V<sub>CC</sub> = 5.0V ±10%, T<sub>A</sub> = 25° C ±5° C)

PARAMETER	SYM.	LIMITS			UNIT
		MIN.	TYP.	MAX.	
$\overline{OE} / V_{PP}$ Pulse Rise Time	T <sub>PRT</sub>	50	-	-	nS
Data Setup Time	T <sub>DS</sub>	2.0	-	-	μS
$\overline{CE}$ Program Pulse Width	T <sub>PWP</sub>	95	100	105	μS
$\overline{CE}$ Erase Pulse Width	T <sub>PWE</sub>	95	100	105	mS
Data Hold Time	T <sub>DH</sub>	2.0	-	-	μS
$\overline{OE} / V_{PP}$ Setup Time	T <sub>OES</sub>	2.0	-	-	μS
$\overline{OE} / V_{PP}$ Hold Time	T <sub>OEH</sub>	2.0	-	-	μS
Data Valid from $\overline{CE}$	T <sub>DV1</sub>	25	-	1	μS
Data Valid from Address Change	T <sub>DV2</sub>	25	-	1	μS
$\overline{CE}$ High to Output High Z	T <sub>DFP</sub>	0	-	130	nS
Address Setup Time	T <sub>AS</sub>	2.0	-	-	μS
Address Hold Time	T <sub>AH</sub>	0	-	-	μS
Address Hold Time after $\overline{CE}$ High (Erase)	T <sub>AHC</sub>	2.0	-	-	μS
$\overline{OE} / V_{PP}$ Valid after $\overline{CE}$ High	T <sub>VS</sub>	2.0	-	-	μS
$\overline{OE} / V_{PP}$ Recovery Time	T <sub>VR</sub>	2.0	-	-	μS
Address Access Time during Erase Verify (V <sub>CC</sub> = 3.75V)	T <sub>ACV</sub>	-	-	250	nS
Output Enable Access Time during Erase Verify (V <sub>CC</sub> = 3.75V)	T <sub>OEV</sub>	-	-	150	nS

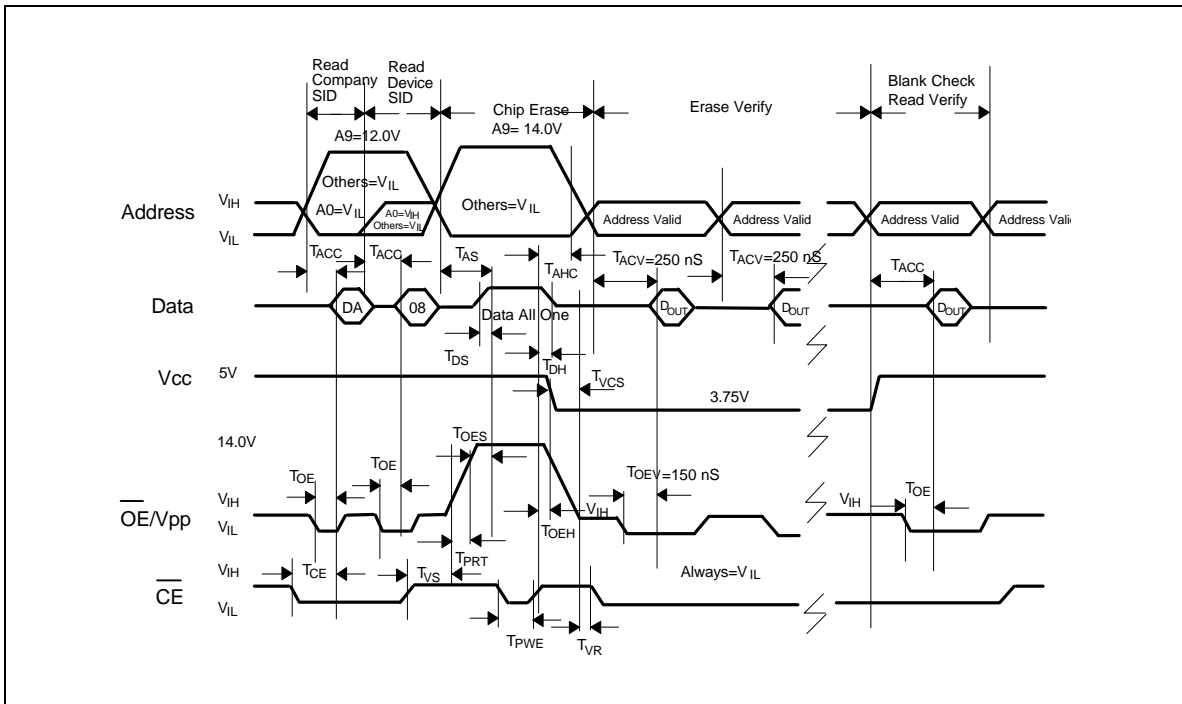
Note: V<sub>CC</sub> must be applied simultaneously or before V<sub>PP</sub> and removed simultaneously or after V<sub>PP</sub>.

TIMING WAVEFORMS

AC Read Waveform



Erase Waveform

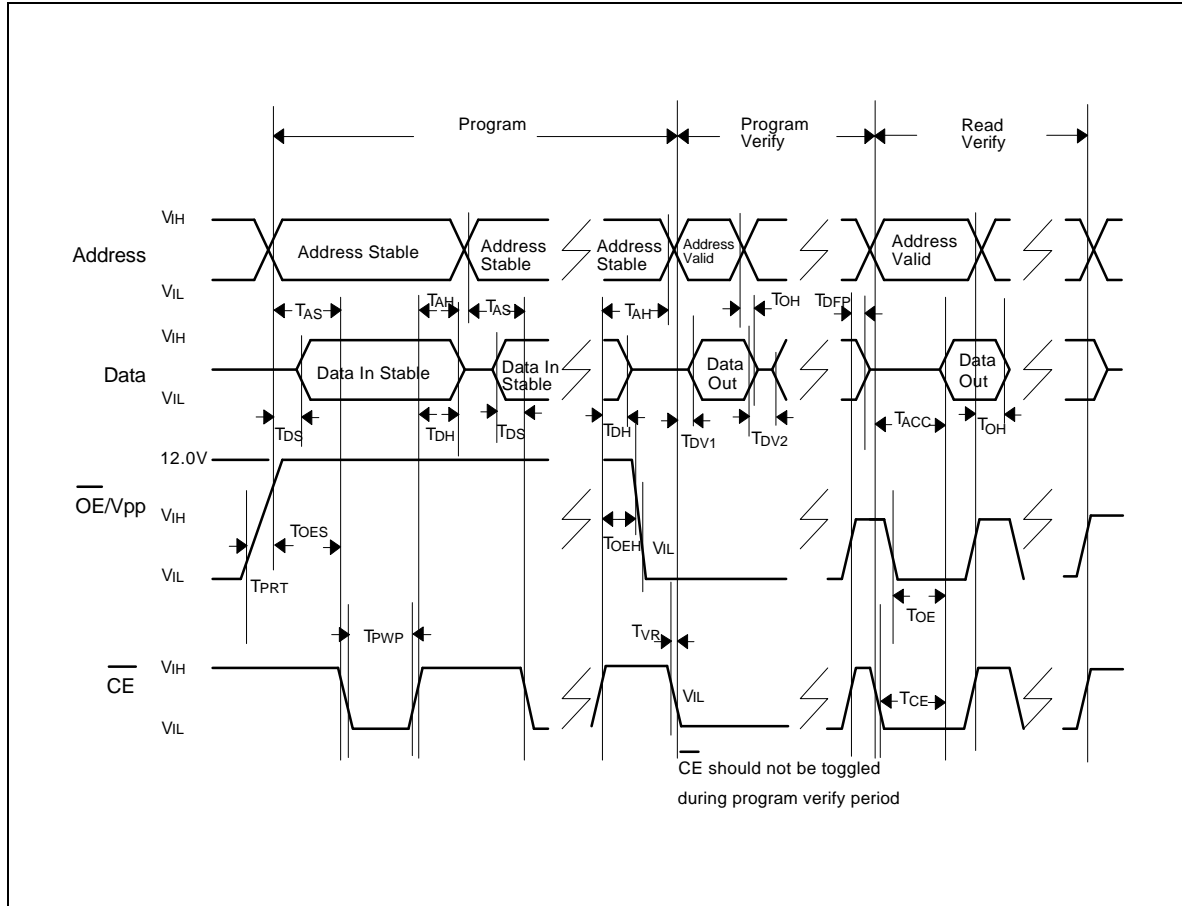






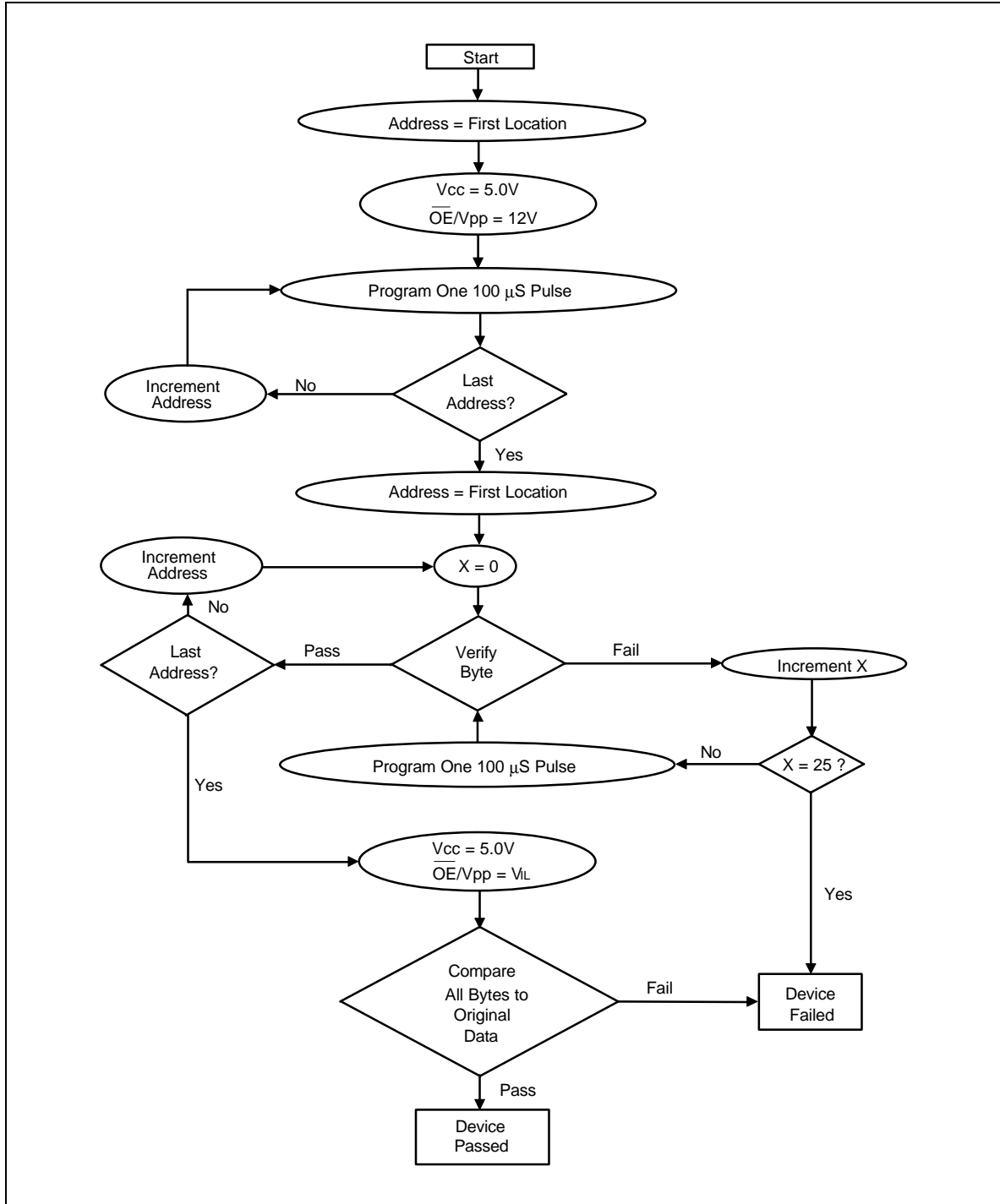
Timing Waveforms, continued

**Programming Waveform**



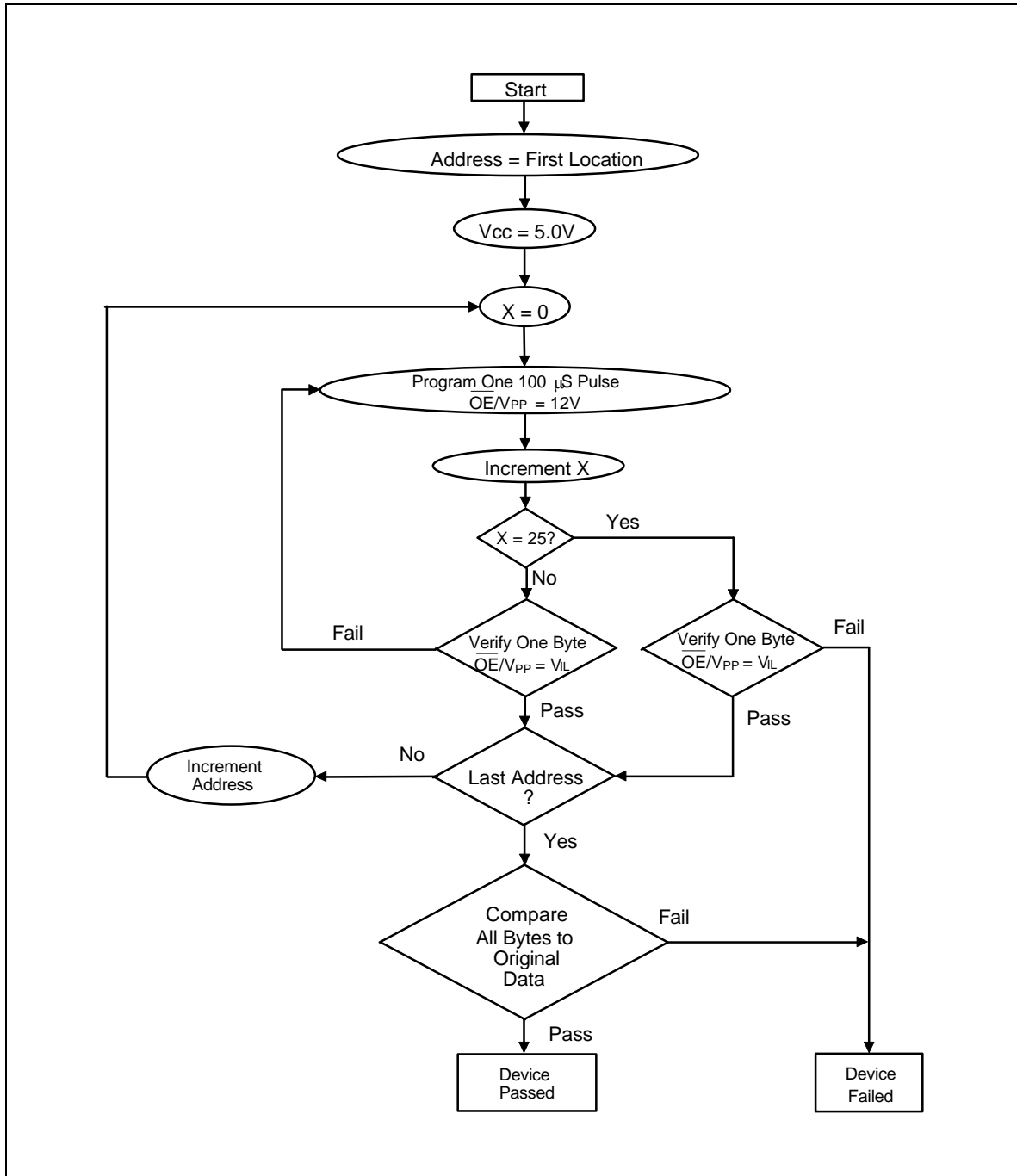


SMART PROGRAMMING ALGORITHM 1

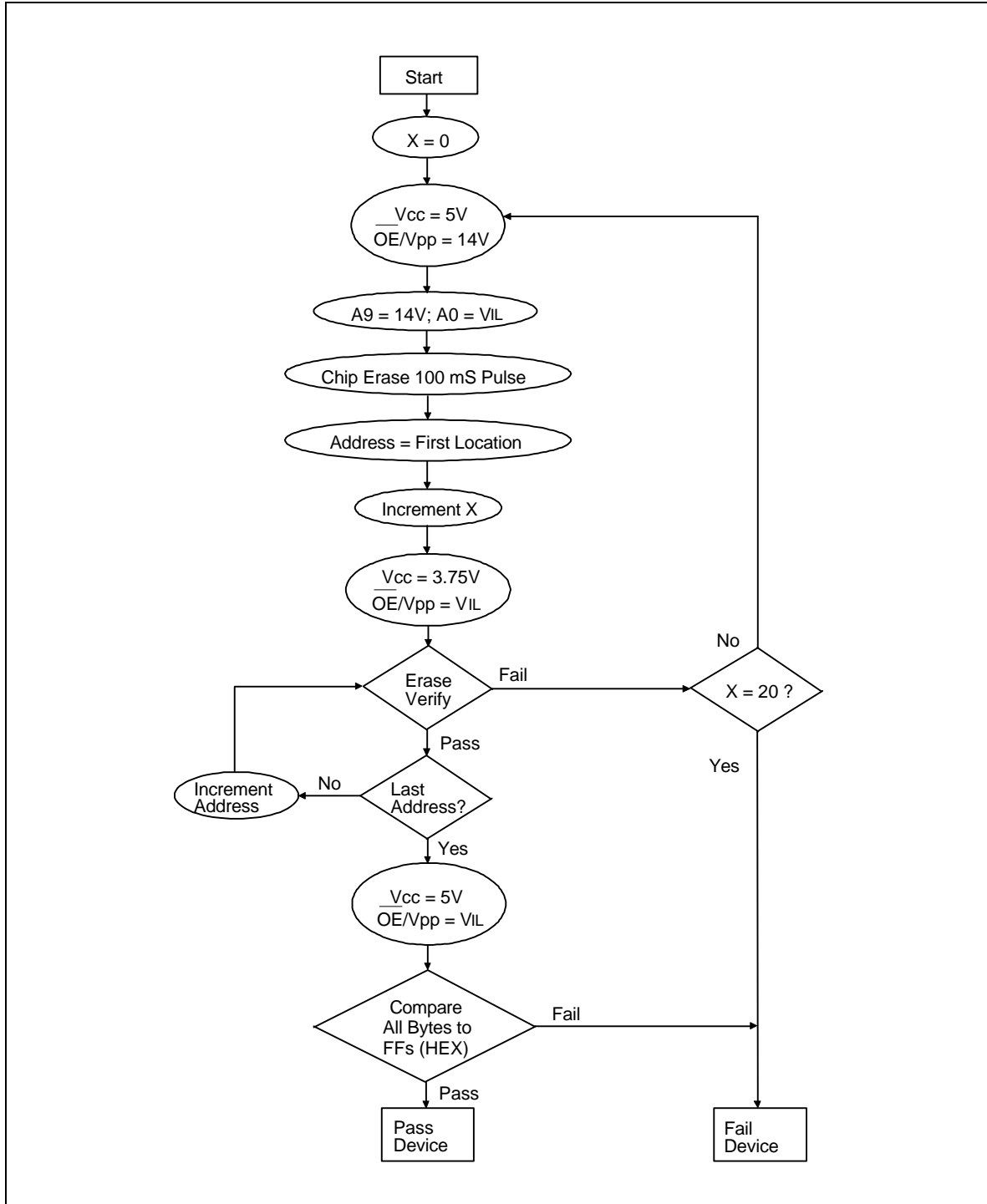




SMART PROGRAMMING ALGORITHM 2



SMART ERASE ALGORITHM





## ORDERING INFORMATION

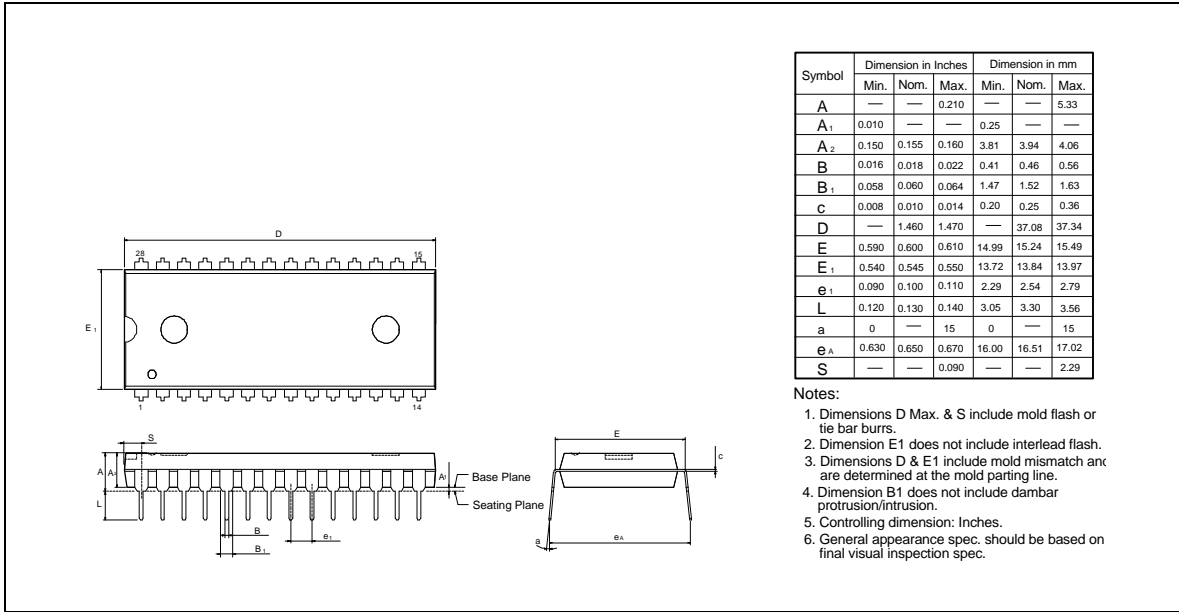
PART NO.	ACCESS TIME (nS)	OPERATING CURRENT MAX. (mA)	STANDBY CURRENT MAX. (mA)	PACKAGE
W27E512-45	45	30	100	600 mil DIP
W27E512-55	55	30	100	600 mil DIP
W27E512-70	70	30	100	600 mil DIP
W27E512-90	90	30	100	600 mil DIP
W27E512-12	120	30	100	600 mil DIP
W27E512-15	150	30	100	600 mil DIP
W27E512S-45	45	30	100	300 mil SOP
W27E512S-55	55	30	100	300 mil SOP
W27E512S-70	70	30	100	300 mil SOP
W27E512S-90	90	30	100	300 mil SOP
W27E512S-12	120	30	100	300 mil SOP
W27E512S-15	150	30	100	300 mil SOP
W27E512Q-45	45	30	100	28-pin TSOP
W27E512Q-55	55	30	100	28-pin TSOP
W27E512Q-70	70	30	100	28-pin TSOP
W27E512Q-90	90	30	100	28-pin TSOP
W27E512Q-12	120	30	100	28-pin TSOP
W27E512Q-15	150	30	100	28-pin TSOP
W27E512P-45	45	30	100	32-pin PLCC
W27E512P-55	55	30	100	32-pin PLCC
W27E512P-70	70	30	100	32-pin PLCC
W27E512P-90	90	30	100	32-pin PLCC
W27E512P-12	120	30	100	32-pin PLCC
W27E512P-15	150	30	100	32-pin PLCC

### Notes:

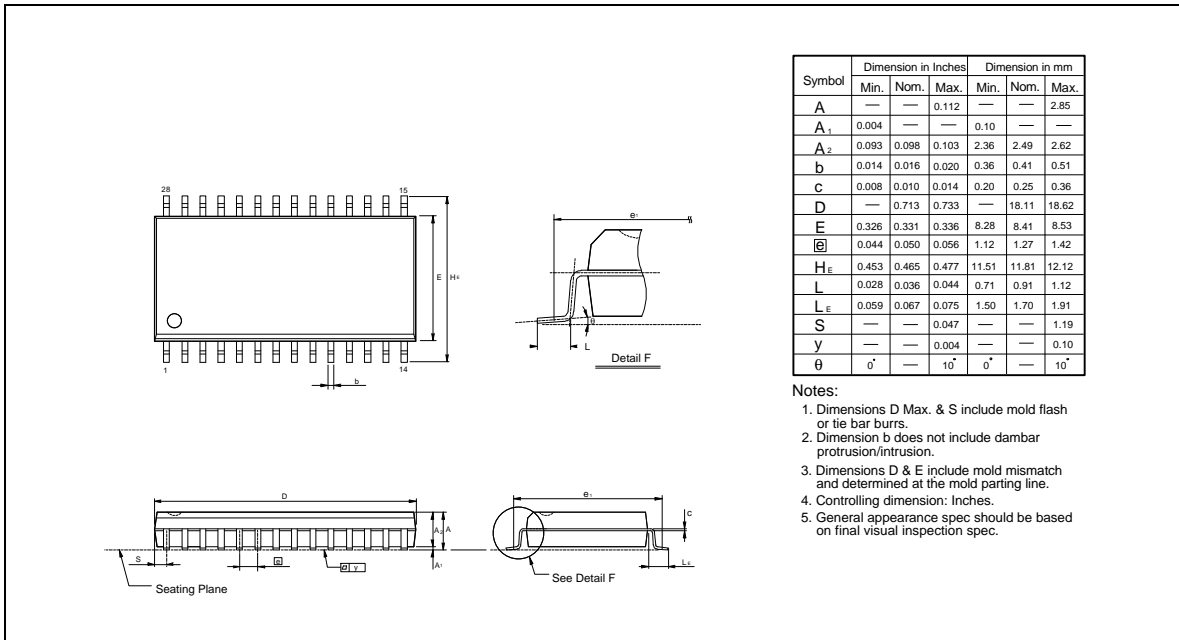
1. Winbond reserves the right to make changes to its products without prior notice.
2. Purchasers are responsible for performing appropriate quality assurance testing on products intended for use in applications where personal injury might occur as a consequence of product failure.

## PACKAGE DIMENSIONS

### 28-pin P-DIP



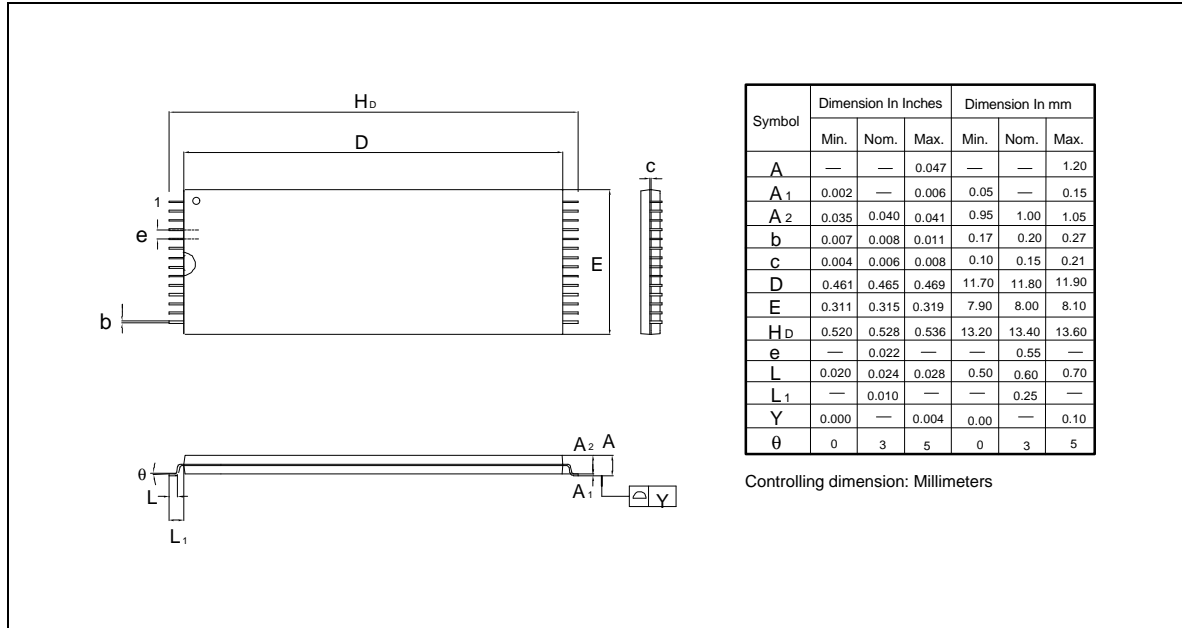
### 28-pin SO Wide Body



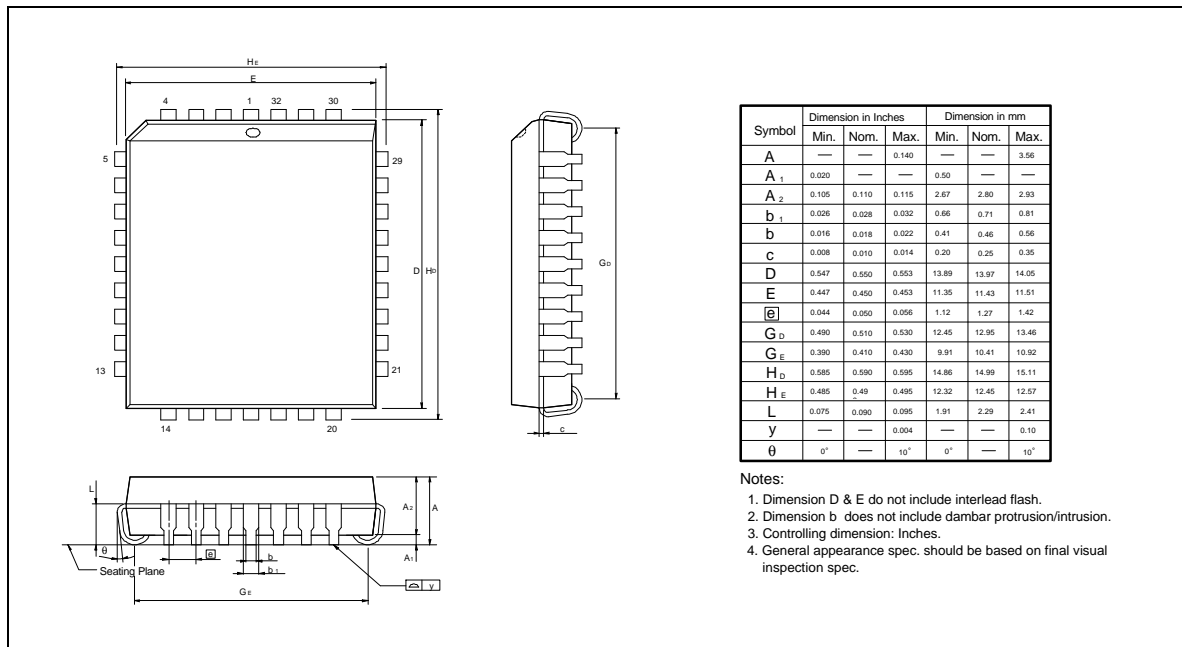


Package Dimensions, continued

## 28-pin Standard Type One TSOP



## 32-pin PLCC





## VERSION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A6	Apr. 1997	1, 13, 14	Add SOP package
A7	Feb. 1998	1, 2, 3, 5, 6, 13	Add 45/55 nS bining
A8	Nov. 1999	2, 3	Modify function description ( VIL and VIH): VIL → Low. VIH → High.
		4	Modify A9 and VPP Erase Voltage (VID and VPP): from 13.75V (min) to 13.25V (min)
		6	Modify VCC description
A9	Jun. 2000	5	Modify Input Pulse Levels in AC Test Conditions



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Note: All data and specifications are subject to change without notice.