

W27C512



64K × 8 ELECTRICALLY ERASABLE EPROM

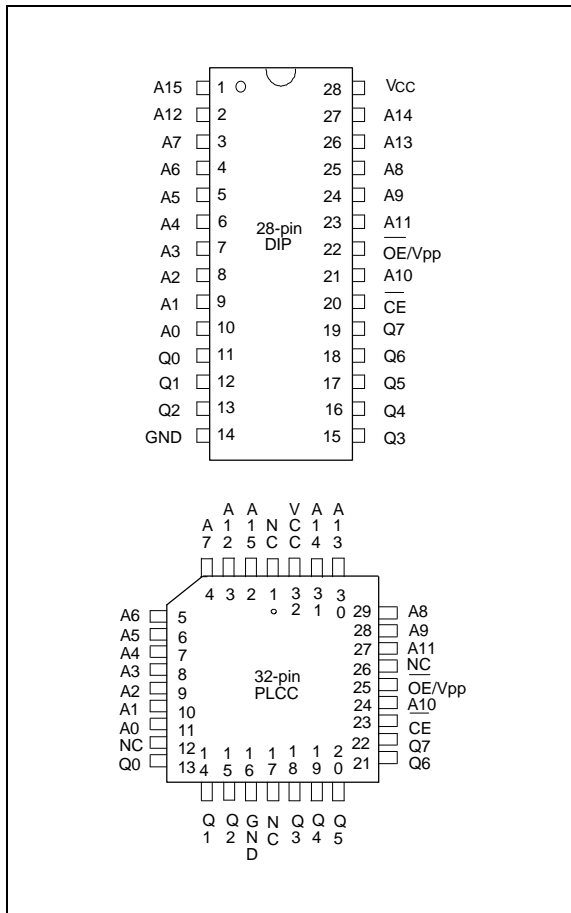
GENERAL DESCRIPTION

The W27C512 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 W27C512 provides an electrical chip erase function.

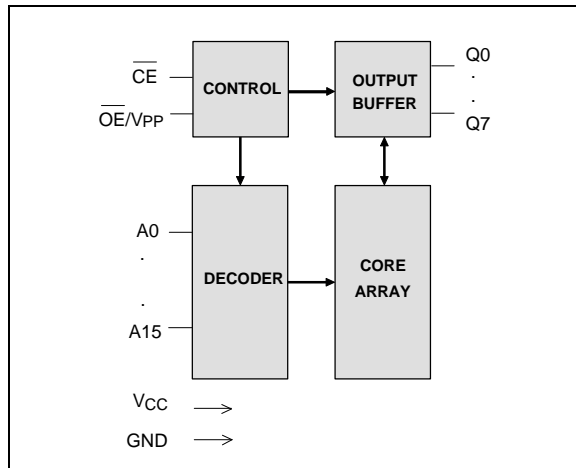
FEATURES

- High speed access time: 45/70/90/120 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 32-pin PLCC

PIN CONFIGURATIONS



BLOCK DIAGRAM



PIN DESCRIPTION

| SYMBOL | DESCRIPTION |
|------------------------|---|
| A0–A15 | Address Inputs |
| Q0–Q7 | Data Inputs/Outputs |
| \overline{CE} | Chip Enable |
| \overline{OE}/V_{PP} | Output Enable, Program/Erase Supply Voltage |
| VCC | Power Supply |
| GND | Ground |
| NC | No Connection |



FUNCTIONAL DESCRIPTION

Read Mode

Like conventional UVEPROMs, the W27C512 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 W27C512 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 W27C512 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 W27C512 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 μ 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 μ 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 |
|--|------------------|------|
| Operation Temperature | 0 to +70 | °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

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

| PARAMETER | SYM. | CONDITIONS | LIMITS | | | UNIT |
|-----------------------------------|------|---|--------|------|-------|---------------|
| | | | MIN. | TYP. | MAX. | |
| Input Load Current | ILI | $V_{IN} = V_{IL}$ or V_{IH} | -10 | - | 10 | μA |
| VCC Erase Current | ICP | $\overline{CE} = V_{IL}$, $\overline{OE}/V_{PP} = V_{PE}$ | - | - | 30 | mA |
| VPP Erase Current | IPP | $\overline{CE} = V_{IL}$, $\overline{OE}/V_{PP} = V_{PE}$ | - | - | 30 | mA |
| Input Low Voltage | VIL | - | -0.3 | - | 0.8 | V |
| Input High Voltage | VIH | - | 2.4 | - | 5.5 | V |
| Output Low Voltage (Verify) | VOL | $I_{OL} = 2.1\text{ mA}$ | - | - | 0.45 | V |
| Output High Voltage (Verify) | VOH | $I_{OH} = -0.4\text{ mA}$ | 2.4 | - | - | - |
| A9 Erase Voltage | VID | - | 13.75 | 14 | 14.25 | V |
| VPP Erase Voltage | VPE | - | 13.75 | 14 | 14.25 | V |
| VCC Supply Voltage (Erase) | VCE | - | 4.75 | 5.0 | 5.25 | V |
| VCC Supply Voltage (Erase Verify) | VCE | - | 3.5 | 3.75 | 4.0 | V |

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



CAPACITANCE

(V_{CC} = 5V, T_A = 25° C, f = 1 MHz)

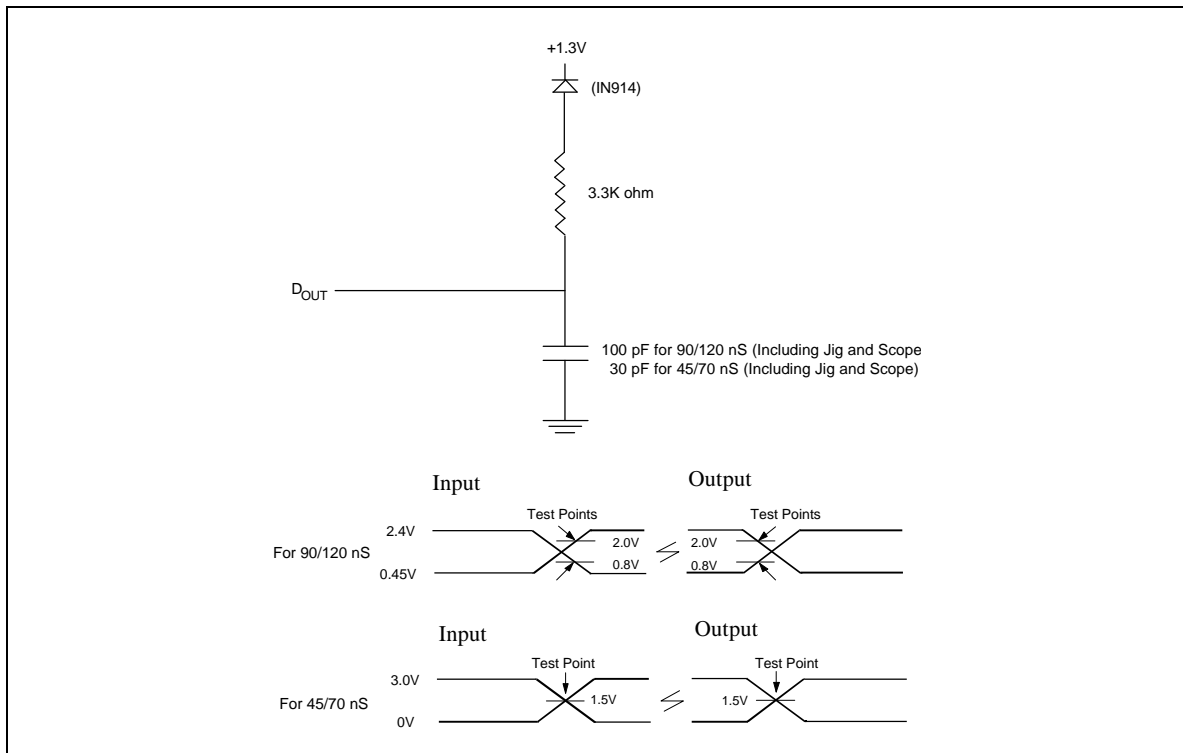
| PARAMETER | SYMBOL | CONDITIONS | MAX. | UNIT |
|--------------------|------------------|-----------------------|------|------|
| Input Capacitance | C _{IN} | V _{IN} = 0V | 6 | pF |
| Output Capacitance | C _{OUT} | V _{OUT} = 0V | 12 | pF |

AC CHARACTERISTICS

AC Test Conditions

| PARAMETER | CONDITIONS | |
|---|--|---|
| | 45/70 nS | 90/120 nS |
| Input Pulse Levels | 0 to 3.0V | 0.45V to 2.4V |
| Input Rise and Fall Times | 5 nS | 10 nS |
| Input and Output Timing Reference Level | 1.5V/1.5V | 0.8V/2.0V |
| Output Load | CL = 30 pF, I _{OH} /I _{OL} = -0.4 mA/2.1 mA | CL = 100 pF, I _{OH} /I _{OL} = -0.4 mA/2.1 mA |

AC Test Load and Waveforms





READ OPERATION DC CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 0 to 70° C)

| PARAMETER | SYM. | CONDITIONS | LIMITS | | | UNIT |
|---|------------------|--|--------|------|-----------------------|------|
| | | | MIN. | TYP. | MAX. | |
| Input Load Current | I _{LI} | V _{IN} = 0V to V _{CC} | -5 | - | 5 | μA |
| Output Leakage Current | I _{LO} | V _{OUT} = 0V to V _{CC} | -10 | - | 10 | μA |
| Standby V _{CC} Current (TTL input) | I _{SB} | $\overline{CE} = V_{IH}$ | - | - | 1.0 | mA |
| Standby V _{CC} Current (CMOS input) | I _{SB1} | $\overline{CE} = V_{CC} \pm 0.3V$ | - | 5 | 100 | μA |
| V _{CC} Operating Current | I _{CC} | $\overline{CE} = V_{IL}$ I _{OUT} = 0 mA, f = 5 MHz | - | - | 30 | mA |
| Input Low Voltage | V _{IL} | - | -0.3 | - | 0.8 | V |
| Input High Voltage | V _{IH} | - | 2.2 | - | V _{CC} + 0.5 | V |
| Output Low Voltage | V _{OL} | I _{OL} = 2.1 mA | - | - | 0.45 | V |
| Output High Voltage | V _{OH} | I _{OH} = -0.4 mA | 2.4 | - | - | V |

READ OPERATION AC CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 0 to 70° C)

| PARAMETER | SYM. | W27C512-45 | | W27C512-70 | | W27C512-90 | | W27C512-12 | | UNIT |
|--|------------------|------------|------|------------|------|------------|------|------------|------|------|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| Read Cycle Time | TRC | 45 | - | 70 | - | 90 | - | 120 | - | nS |
| Chip Enable Access Time | T _{CE} | - | 45 | - | 70 | - | 90 | - | 120 | nS |
| Address Access Time | T _{ACC} | - | 45 | - | 70 | - | 90 | - | 120 | nS |
| Output Enable Access Time | T _{OE} | - | 20 | - | 30 | - | 40 | - | 55 | nS |
| \overline{OE} /V _{PP} High to High-Z Output | T _{DF} | - | 20 | - | 30 | - | 30 | - | 30 | nS |
| Output Hold from Address Change | T _{OH} | 0 | - | 0 | - | 0 | - | 0 | - | nS |

Note: V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}.

DC PROGRAMMING CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 25° C ±5° C)

| PARAMETER | SYM. | CONDITIONS | LIMITS | | | UNIT |
|---------------------------------|-----------------|--|--------|------|------|------|
| | | | MIN. | TYP. | MAX. | |
| Input Load Current | I _{LI} | V _{IN} = V _{IL} or V _{IH} | -10 | - | 10 | μA |
| V _{CC} Program Current | I _{CP} | $\overline{CE} = V_{IL}$, $\overline{OE} /V_{PP} = V_{PP}$ | - | - | 30 | mA |
| V _{PP} Program Current | I _{PP} | $\overline{CE} = V_{IL}$, $\overline{OE} /V_{PP} = V_{PP}$ | - | - | 30 | mA |



DC Programming Characteristics, continued

| PARAMETER | SYM. | CONDITIONS | LIMITS | | | UNIT |
|--|-----------------|---------------------------|--------|------|-------|------|
| | | | MIN. | TYP. | MAX. | |
| Input Low Voltage | V _{IL} | - | -0.3 | - | 0.8 | V |
| Input High Voltage | V _{IH} | - | 2.4 | - | 5.5 | V |
| Output Low Voltage (Verify) | V _{OL} | I _{OL} = 2.1 mA | - | - | 0.45 | V |
| Output High Voltage (Verify) | V _{OH} | I _{OH} = -0.4 mA | 2.4 | - | - | V |
| A9 Silicon I.D. Voltage | V _{ID} | - | 11.5 | 12.0 | 12.5 | V |
| V _{PP} Program Voltage | V _{PP} | - | 11.75 | 12.0 | 12.25 | V |
| V _{CC} Supply Voltage (Program) | V _{CP} | - | 4.75 | 5.0 | 5.25 | V |

AC PROGRAMMING/ERASE CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 25° C ±5° C)

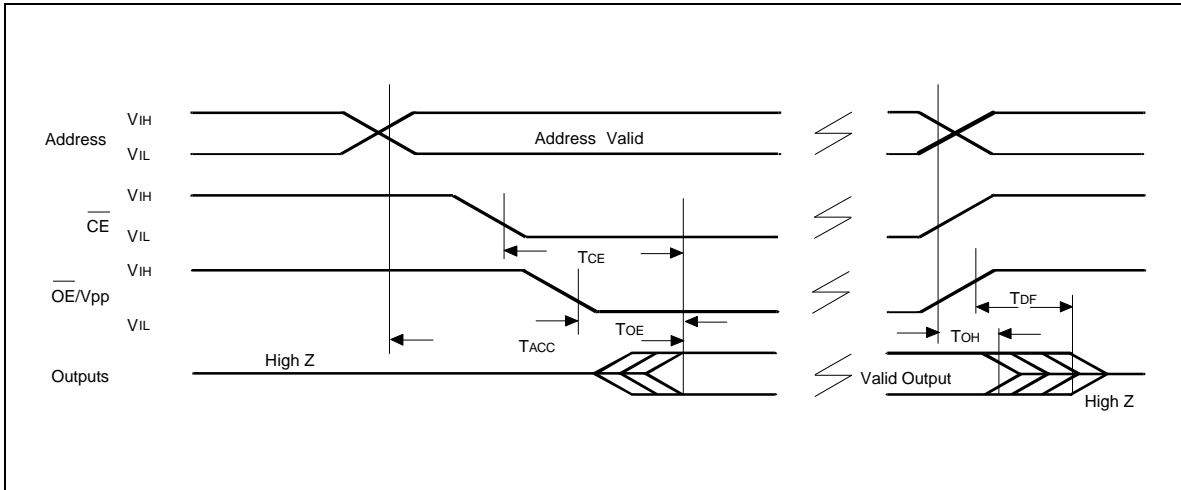
| PARAMETER | SYM. | LIMITS | | | UNIT |
|---|------|--------|------|------|------|
| | | MIN. | TYP. | MAX. | |
| \overline{OE} /V _{PP} Pulse Rise Time | TPRT | 50 | - | - | nS |
| Data Setup Time | TDS | 2.0 | - | - | μS |
| \overline{CE} Program Pulse Width | TPWP | 95 | 100 | 105 | μS |
| \overline{CE} Erase Pulse Width | TPWE | 95 | 100 | 105 | mS |
| Data Hold Time | TDH | 2.0 | - | - | μS |
| \overline{OE} /V _{PP} Setup Time | TOES | 2.0 | - | - | μS |
| \overline{OE} /V _{PP} Hold Time | TOEH | 2.0 | - | - | μS |
| Data Valid from \overline{CE} | TDV1 | 25 | - | 1 | μS |
| Data Valid from Address Change | TDV2 | 25 | - | 1 | μS |
| \overline{CE} High to Output High Z | TDFP | 0 | - | 130 | nS |
| Address Setup Time | TAS | 2.0 | - | - | μS |
| Address Hold Time | TAH | 0 | - | - | μS |
| Address Hold Time after \overline{CE} High (Erase) | TAHC | 2.0 | - | - | μS |
| \overline{OE} /V _{PP} Valid after \overline{CE} High | TVS | 2.0 | - | - | μS |
| \overline{OE} /V _{PP} Recovery Time | TVR | 2.0 | - | - | μS |
| Address Access Time During Erase Verify (V _{CC} = 3.75V) | TACV | - | - | 250 | nS |
| Output Enable Access Time during Erase Verify (V _{CC} = 3.75V) | TOEV | - | - | 150 | nS |

Note: V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}.

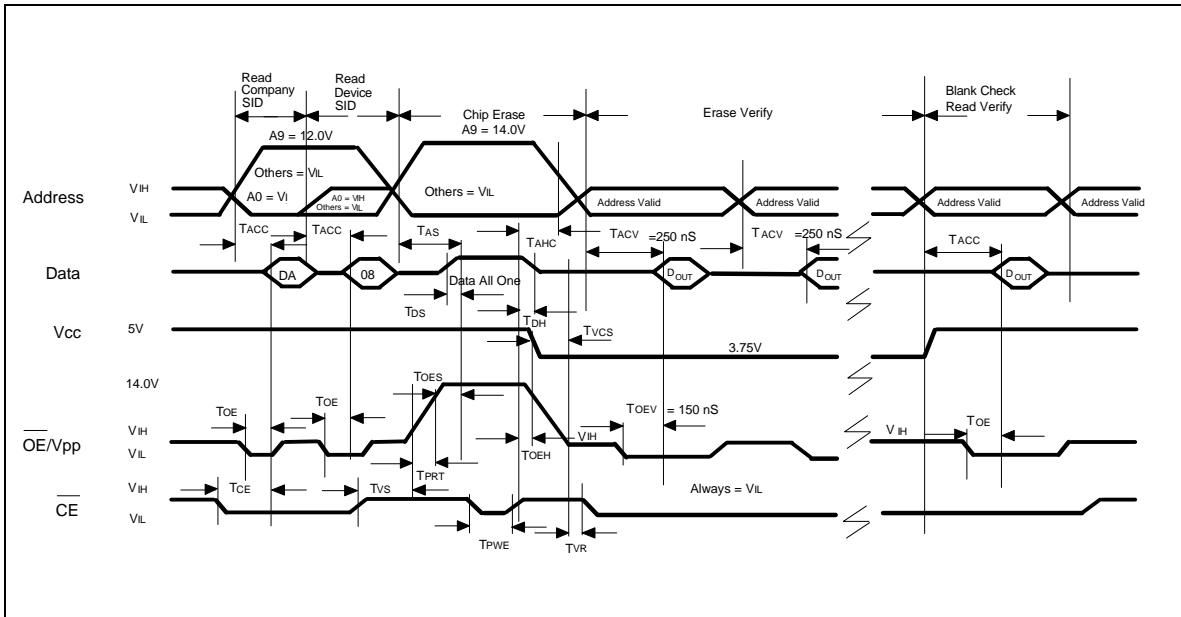


TIMING WAVEFORMS

AC Read Waveform



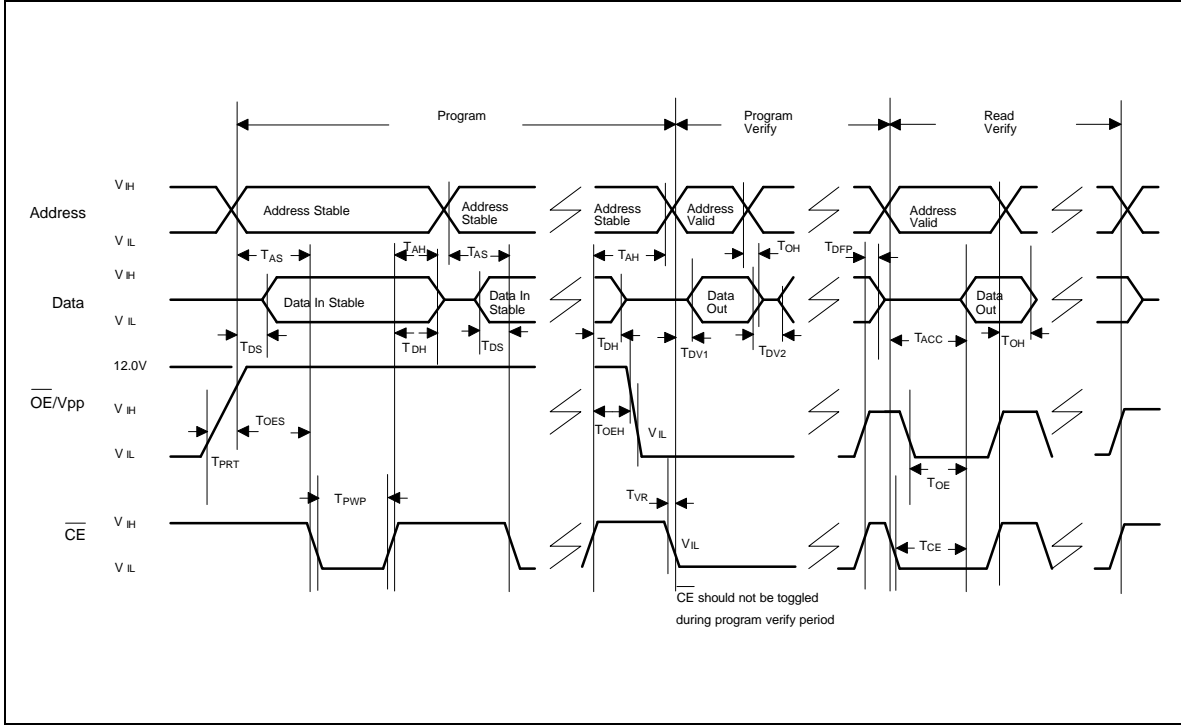
Erase Waveform





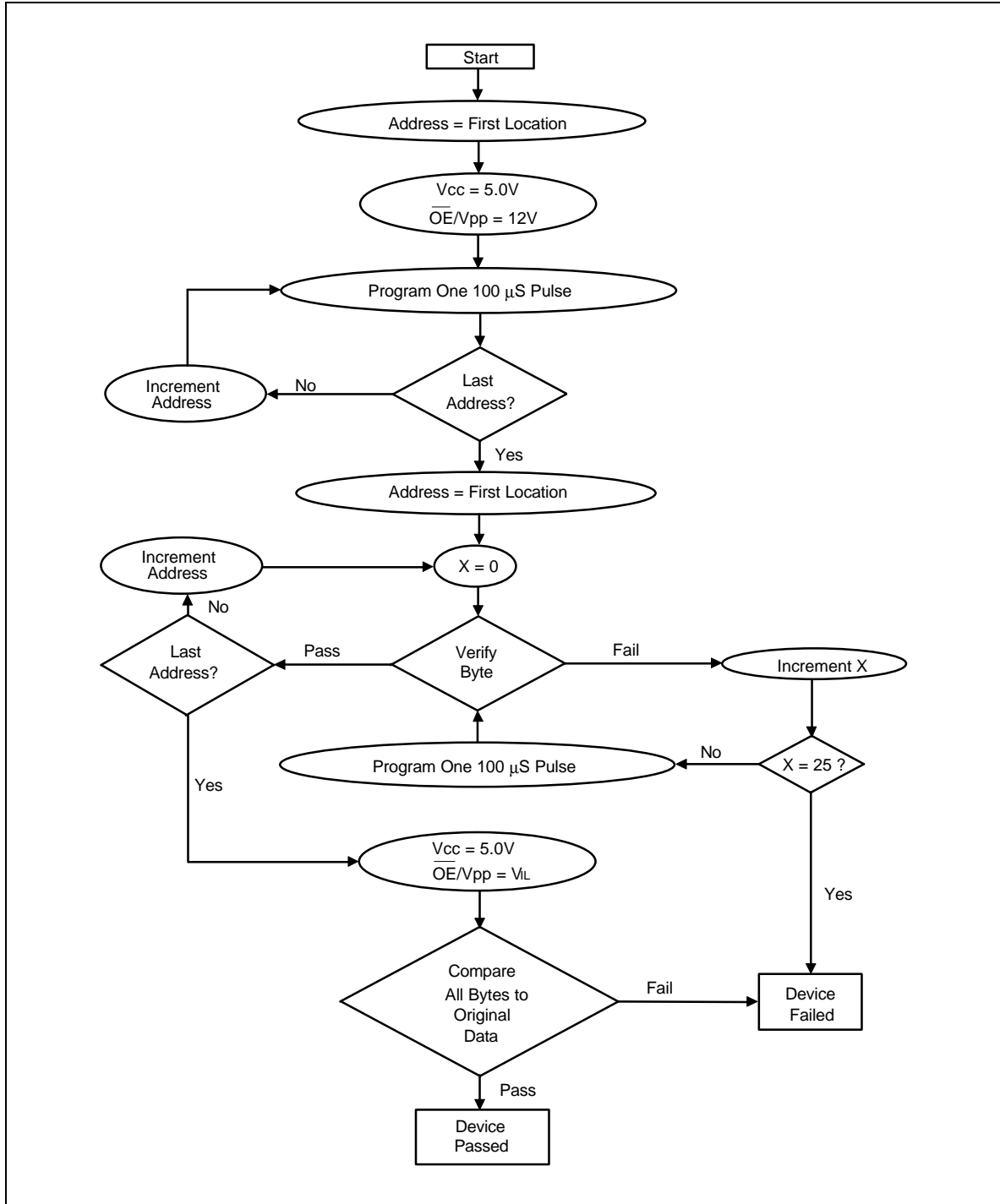
Timing Waveforms, continued

Programming Waveform



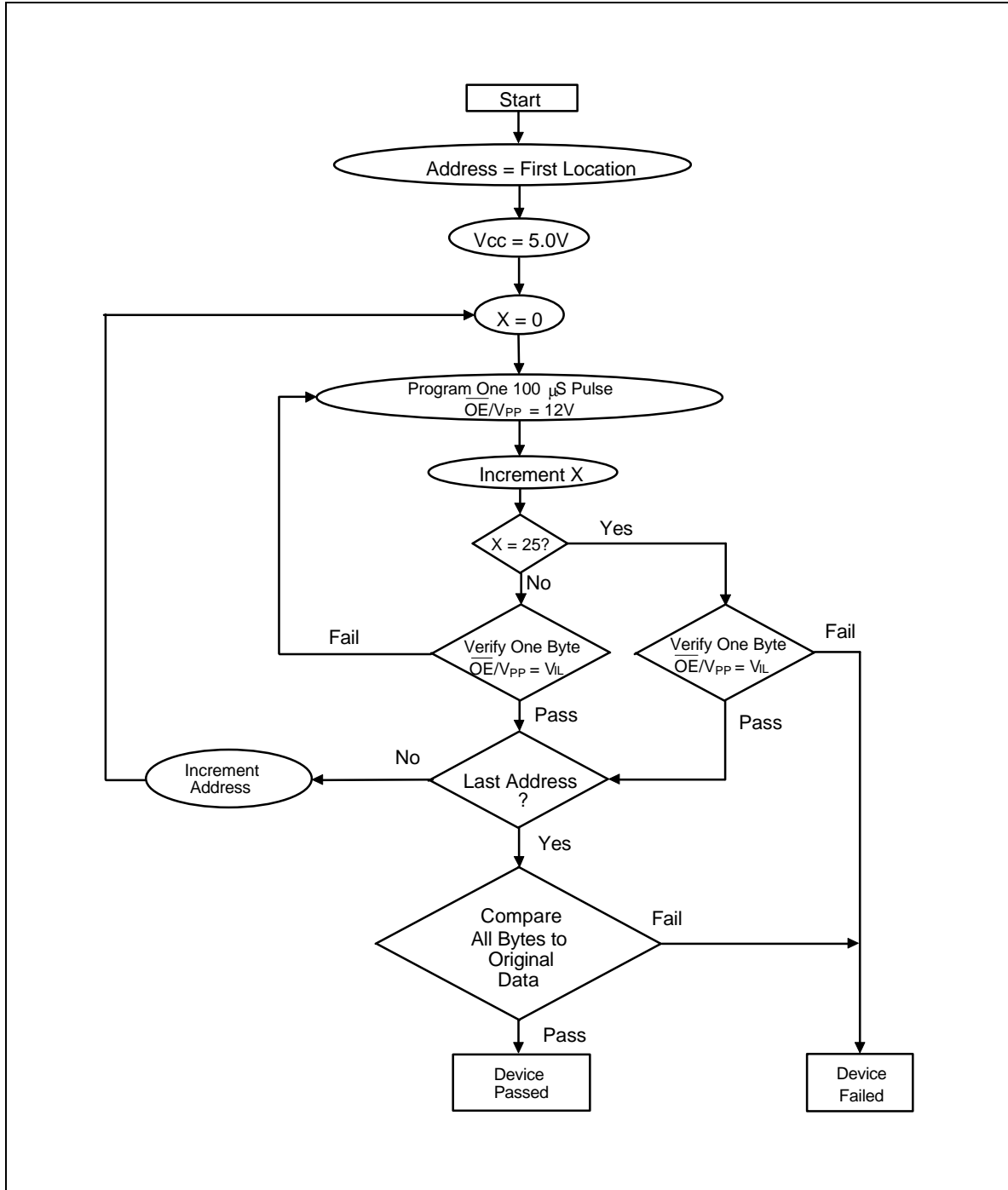


SMART PROGRAMMING ALGORITHM 1

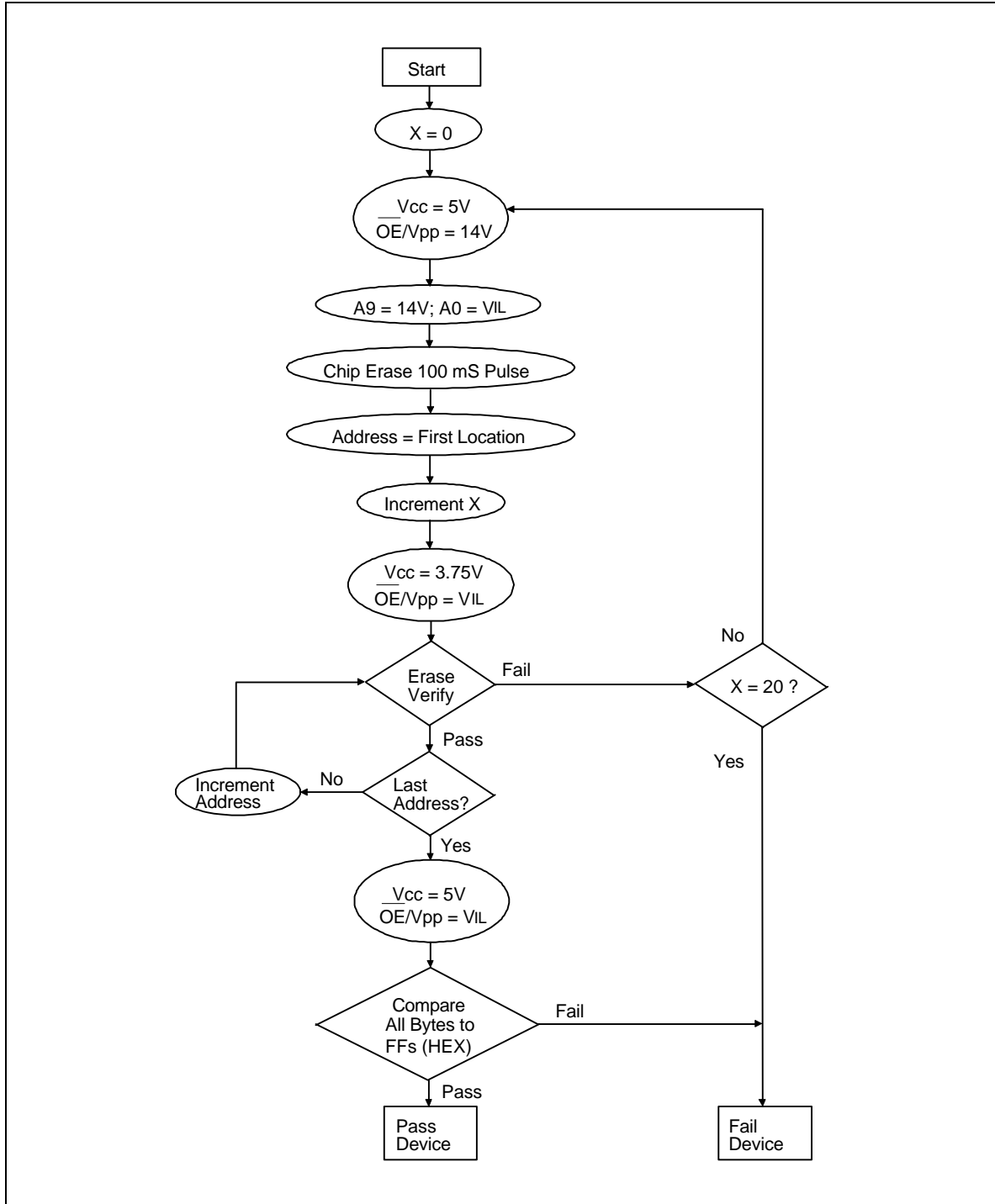




SMART PROGRAMMING ALGORITHM 2



SMART ERASE ALGORITHM



W27C512



ORDERING INFORMATION

| PART NO. | ACCESS TIME (nS) | OPERATING CURRENT MAX. (mA) | STANDBY CURRENT MAX. (mA) | PACKAGE |
|-------------|------------------|-----------------------------|---------------------------|-------------|
| W27C512-45 | 45 | 30 | 100 | 600 mil DIP |
| W27C512-70 | 70 | 30 | 100 | 600 mil DIP |
| W27C512-90 | 90 | 30 | 100 | 600 mil DIP |
| W27C512-12 | 120 | 30 | 100 | 600 mil DIP |
| W27C512P-45 | 45 | 30 | 100 | 32-pin PLCC |
| W27C512P-70 | 70 | 30 | 100 | 32-pin PLCC |
| W27C512P-90 | 90 | 30 | 100 | 32-pin PLCC |
| W27C512P-12 | 120 | 30 | 100 | 32-pin PLCC |

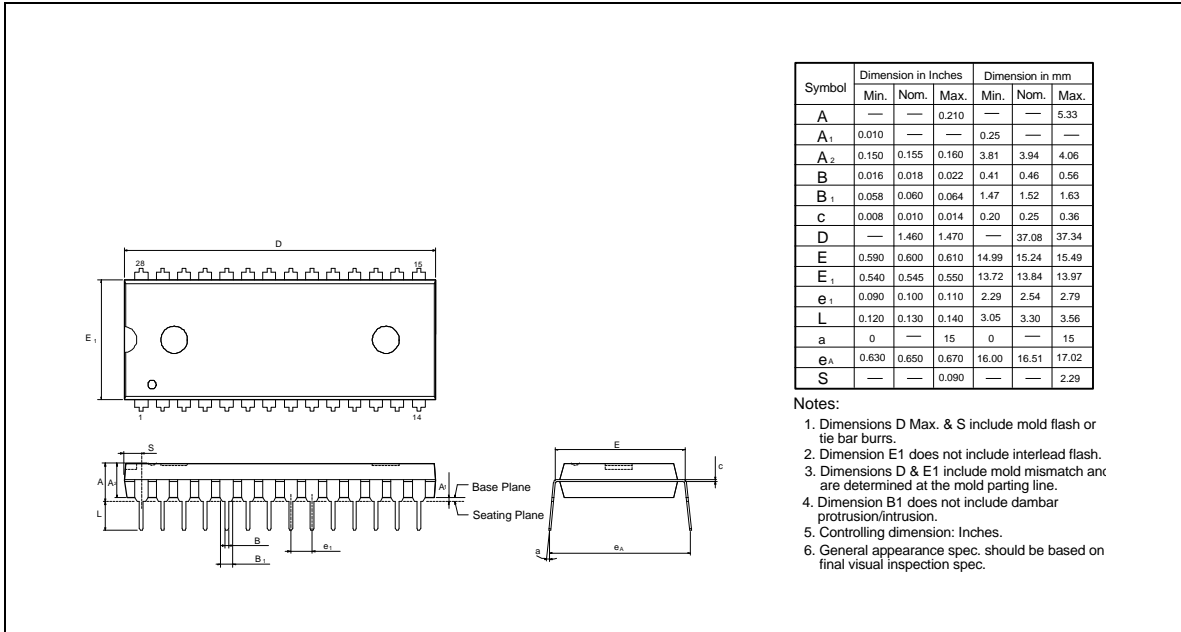
Notes:

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.

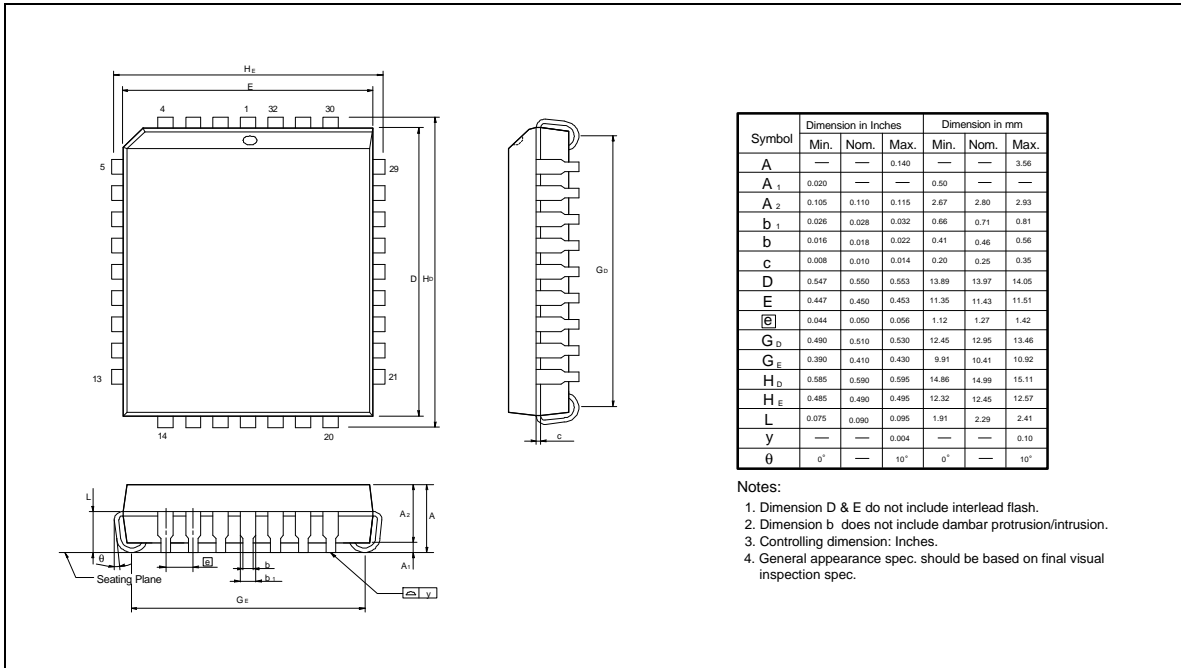


PACKAGE DIMENSIONS

28-pin P-DIP



32-pin PLCC





VERSION HISTORY

| VERSION | DATE | PAGE | DESCRIPTION |
|---------|-----------|-------------|---|
| A1 | Mar. 1998 | | Initial Issued |
| A2 | Sep. 1998 | 6 | Correct Input High Voltage (VIH) from 2.0 (min) to 2.2 (max) |
| | | 4, 6 | Correct VCC from 5.0 ±10% to 5.0 ±5% |
| A3 | Aug. 1999 | 1, 5, 6, 13 | Add 45 nS binning |
| | | 2, 3 | Modify function description (VIL and VIH): VIL → Low; VIH → High |
| A4 | Nov. 1999 | 6 | Typo correction |



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

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