Winbond Electronics Corp.

64K × 8 ELECTRICALLY ERASABLE EPROM

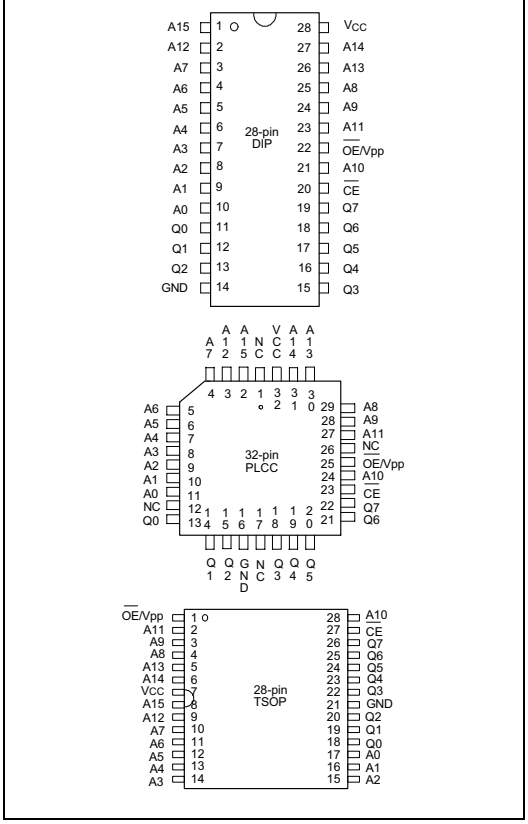
GENERAL DESCRIPTION

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.

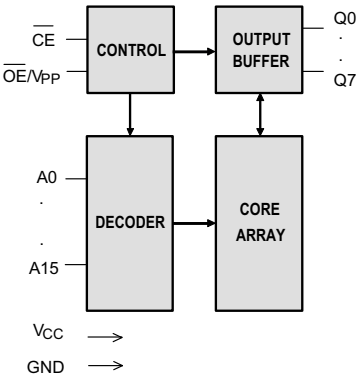
FEATURES

- 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
$\overline{CE}$	Chip Enable
$\overline{OE}$/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), A9 = V_{PE} (14V), A0 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 V_{CC} 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 μF ceramic capacitor connected between its V_{CC} 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 μF electrolytic capacitor should be placed at the array's power supply connection between V_{CC} 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	V_{CC}	OUTPUTS
Read	V_{IL}	V_{IL}	X	X	V_{CC}	D_{OUT}
Output Disable	V_{IL}	V_{IH}	X	X	V_{CC}	High Z
Standby (TTL)	V_{IH}	X	X	X	V_{CC}	High Z
Standby (CMOS)	V_{CC} ±0.3V	X	X	X	V_{CC}	High Z
Program	V_{IL}	V_{PP}	X	X	V_{CP}	D_{IN}
Program Verify	V_{IL}	V_{IL}	X	X	V_{CC}	D_{OUT}
Program Inhibit	V_{IH}	V_{PP}	X	X	V_{CP}	High Z
Erase	V_{IL}	V_{PE}	V_{IL}	V_{PE}	V_{CE}	D_{IH}
Erase Verify	V_{IL}	V_{IL}	X	X	3.75	D_{OUT}
Erase Inhibit	V_{IH}	V_{PE}	X	X	V_{CE}	High Z
Product Identifier-manufacturer	V_{IL}	V_{IL}	V_{IL}	V_{HH}	V_{CC}	DA (Hex)
Product Identifier-device	V_{IL}	V_{IL}	V_{IH}	V_{HH}	V_{CC}	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 V_{CC} Pins	-0.5 to V_{CC} +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 V_{CC} 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° C ±5° C, V_{CC} = 5.0V ±10%)

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} Erase Current	I_{CP}	$\overline{CE}$ = V_{IL}, $\overline{OE}$/V_{PP} = V_{PE}	-	-	30	mA
V_{PP} Erase Current	I_{PP}	$\overline{CE}$ = V_{IL}, $\overline{OE}$/V_{PP} = V_{PE}	-	-	30	mA
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	-	-	-
A9 Erase Voltage	V_{ID}	-	13.25	14	14.25	V
V_{PP} Erase Voltage	V_{PE}	-	13.25	14	14.25	V
V_{CC} Supply Voltage (Erase)	V_{CE}	-	4.5	5.0	5.5	V
V_{CC} Supply Voltage (Erase Verify)	V_{CE}	-	3.5	3.75	4.0	V

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

CAPACITANCE

(V_{CC} = 5V, T_A = 25° C, f = 1 MHz)

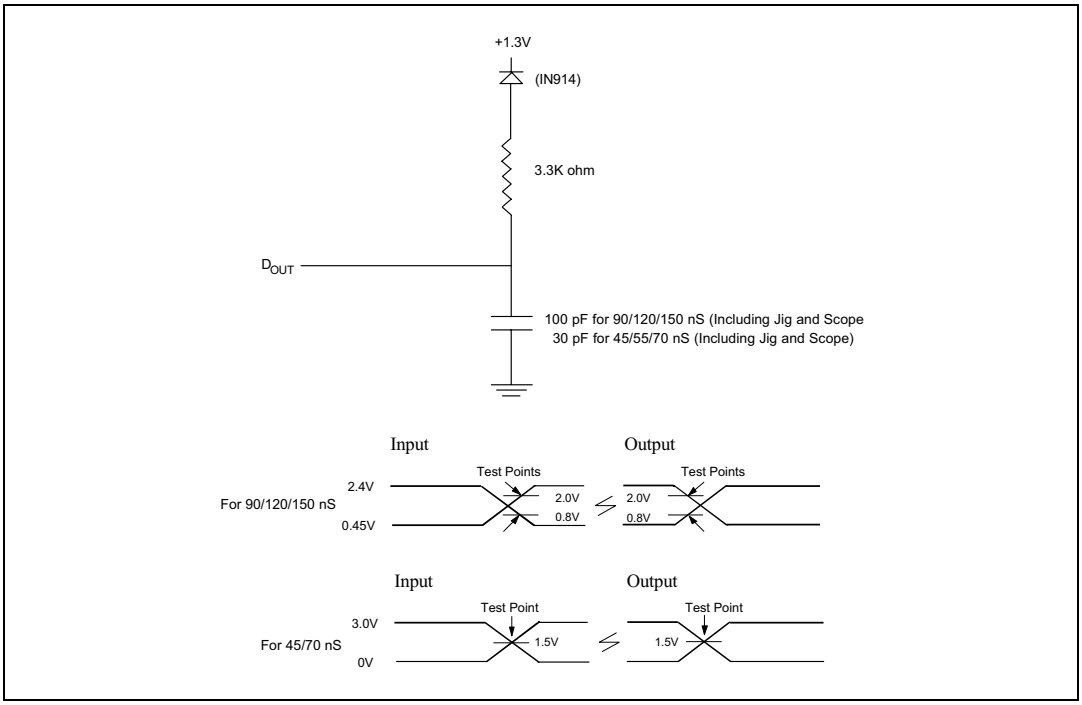
PARAMETER	SYMBOL	CONDITIONS	MAX.	UNIT
Input Capacitance	C_{IN}	V_{IN} = 0V	6	pF
Output Capacitance	C_{OUT}	V_{OUT} = 0V	12	pF

AC CHARACTERISTICS

AC Test Conditions

PARAMETER	CONDITIONS	
	45/55/70 nS	90/120/150 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	C_L = 30 pF, I_{OH}/I_{OL} = -0.4 mA/2.1 mA	C_L = 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 ±10%, 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} ±0.2V	-	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}	-	2.0	-	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 ±10%, T_A = 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	T_{RC}	45	-	55	-	70	-	90	-	120	-	150	-	nS
Chip Enable Access Time	T_{CE}	-	45	-	55	-	70	-	90	-	120	-	150	nS
Address Access Time	T_{ACC}	-	45	-	55	-	70	-	90	-	120	-	150	nS
Output Enable Access Time	T_{OE}	-	20	-	25	-	30	-	40	-	55	-	60	nS
$\overline{OE}$ /VPP High to High-Z Output	T_{DF}	-	20	-	20	-	30	-	30	-	30	-	50	nS
Output Hold from Address Change	T_{OH}	0	-	0	-	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 ±10%, 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
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}	-	4.5	5.0	5.5	V

AC PROGRAMMING/ERASE CHARACTERISTICS

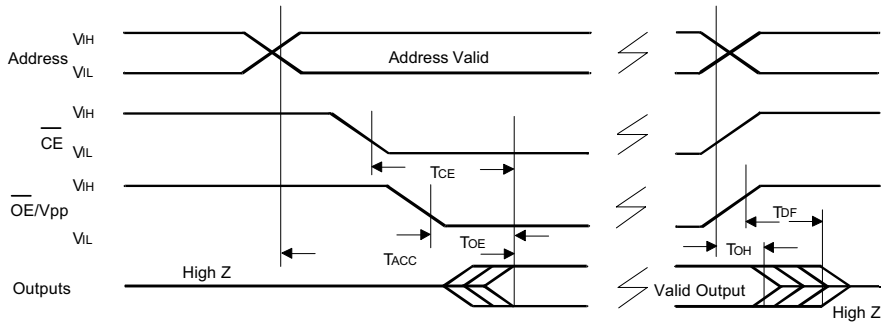
(V_{CC} = 5.0V ±10%, T_A = 25° C ±5° C)

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

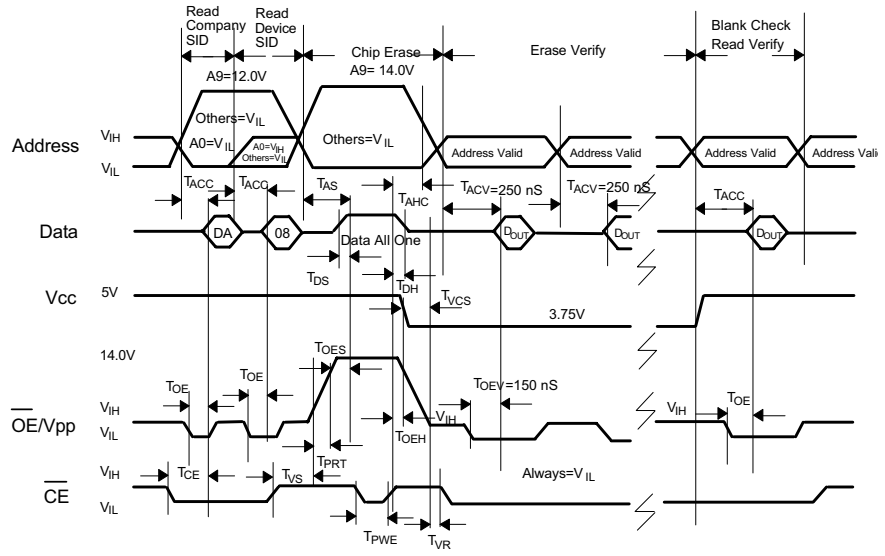
Note: V_{CC} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}.

TIMING WAVEFORMS

AC Read Waveform

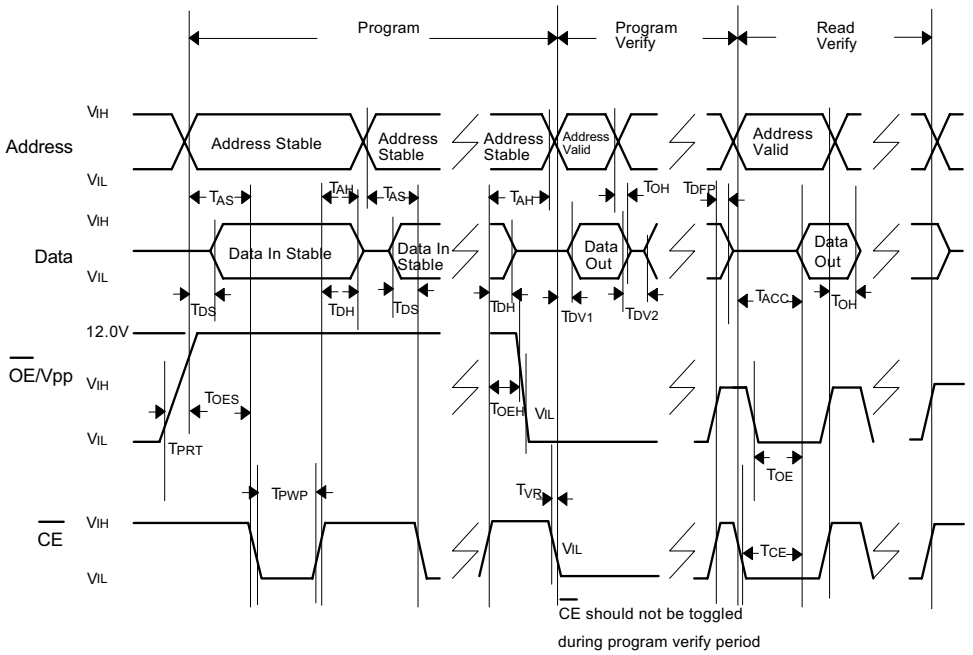


Erase Waveform

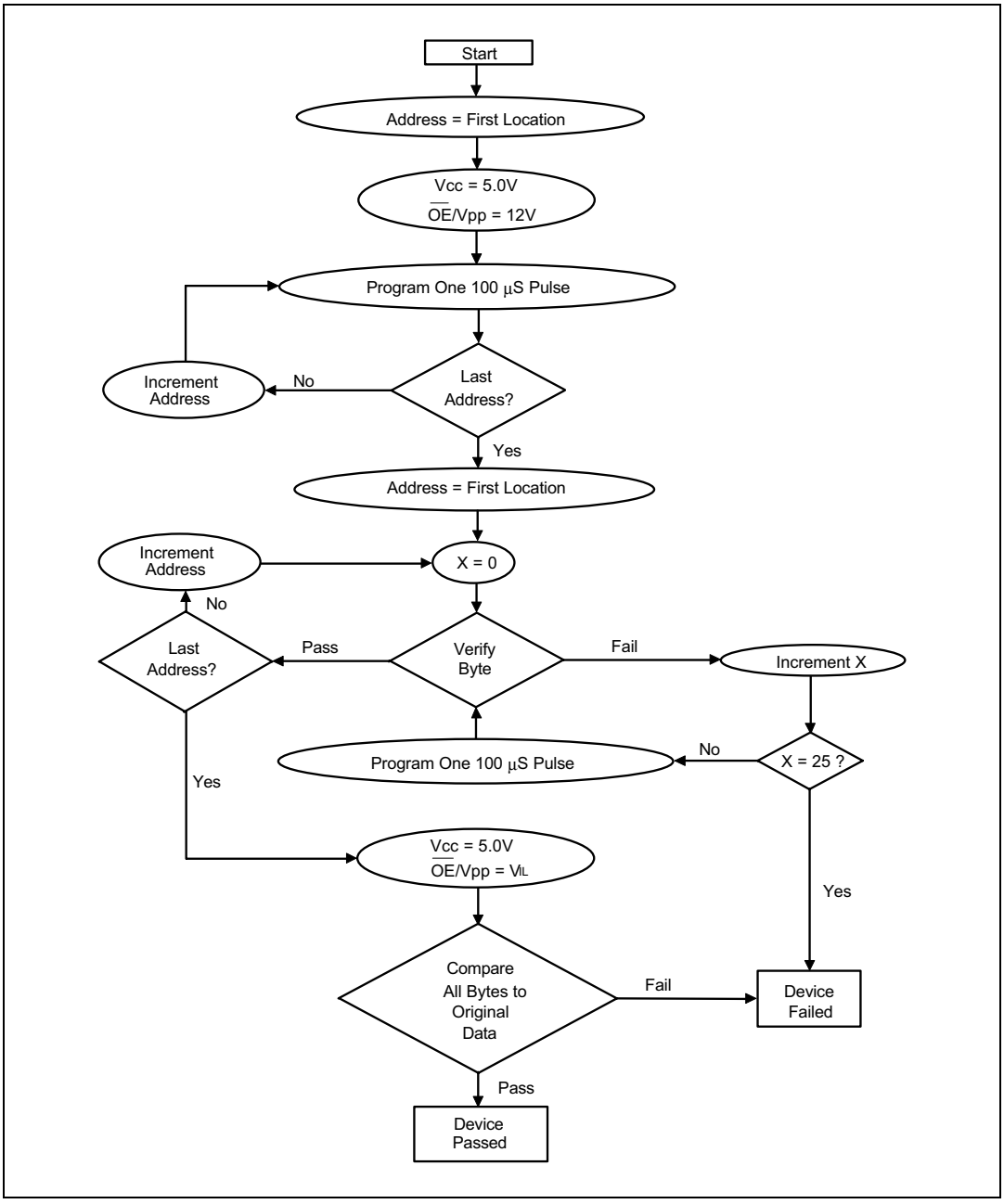


Timing Waveforms, continued

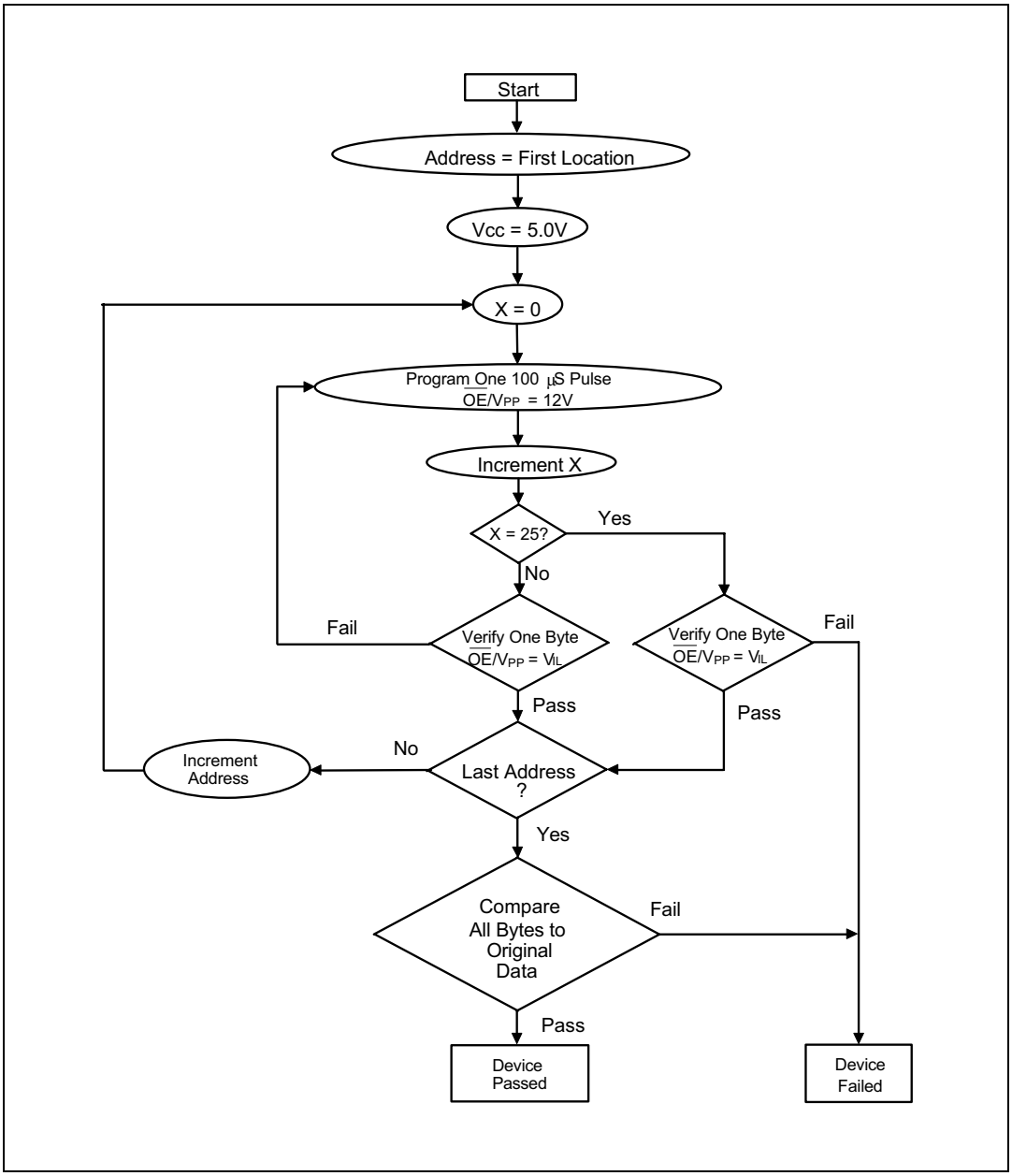
Programming Waveform



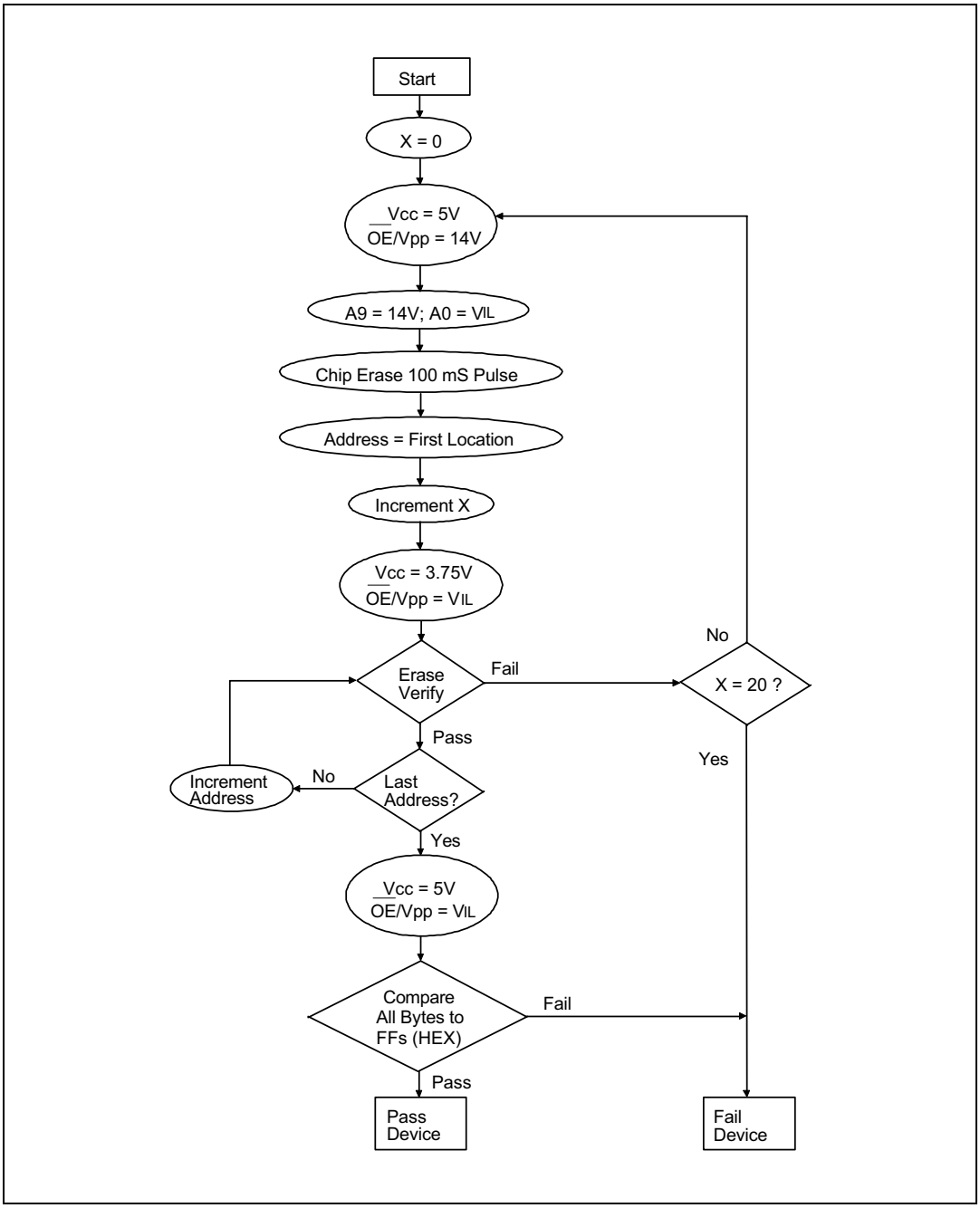
SMART PROGRAMMING ALGORITHM 1



SMART PROGRAMMING ALGORITHM 2



SMART ERASE ALGORITHM



ORDERING INFORMATION

PART NO.	ACCESS TIME (nS)	OPERATING CURRENT MAX. (mA)	STANDBY CURRENT MAX. (µA)	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

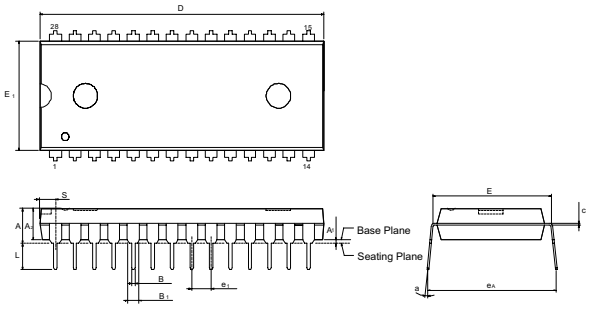
Notes:

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.

Winbond Electronics Corp.

PACKAGE DIMENSIONS

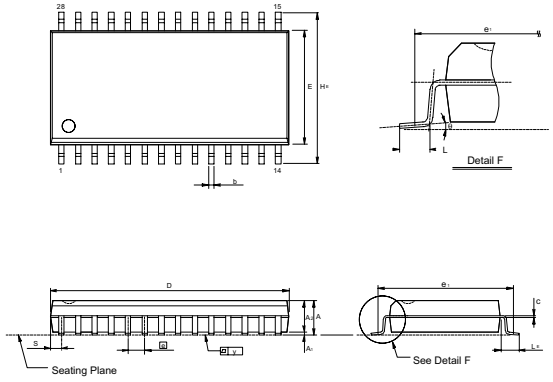
28-pin P-DIP



Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	—	—	0.210	—	—	5.33
A_1	0.010	—	—	0.25	—	—
A_2	0.150	0.155	0.160	3.81	3.94	4.06
B	0.016	0.018	0.022	0.41	0.46	0.56
B_1	0.058	0.060	0.064	1.47	1.52	1.63
c	0.008	0.010	0.014	0.20	0.25	0.36
D	—	1.460	1.470	—	37.08	37.34
E	0.590	0.600	0.610	14.99	15.24	15.49
E_1	0.540	0.545	0.550	13.72	13.84	13.97
e_1	0.090	0.100	0.110	2.29	2.54	2.79
L	0.120	0.130	0.140	3.05	3.30	3.56
a	0	—	15	0	—	15
e_A	0.630	0.650	0.670	16.00	16.51	17.02
S	—	—	0.090	—	—	2.29

Notes:
1. Dimensions D Max. & S include mold flash or tie bar burrs.
2. Dimension E1 does not include interlead flash.
3. Dimensions D & E1 include mold mismatch and are determined at the mold parting line.
4. Dimension B1 does not include dambar protrusion/intrusion.
5. Controlling dimension: Inches.
6. General appearance spec. should be based on final visual inspection spec.

28-pin SO Wide Body

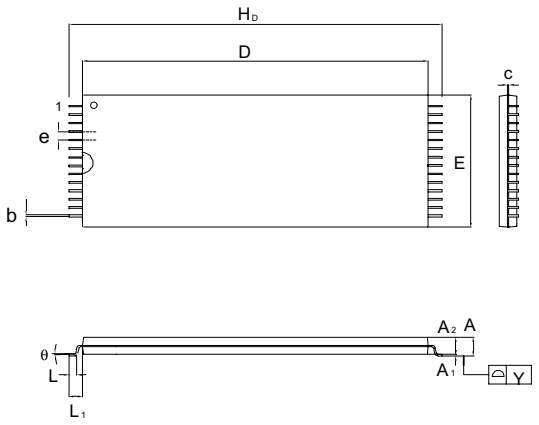


Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	—	—	0.112	—	—	2.85
A_1	0.004	—	—	0.10	—	—
A_2	0.093	0.098	0.103	2.36	2.49	2.62
b	0.014	0.016	0.020	0.36	0.41	0.51
c	0.008	0.010	0.014	0.20	0.25	0.36
D	—	0.713	0.733	—	18.11	18.62
E	0.326	0.331	0.336	8.28	8.41	8.53
e	0.044	0.050	0.056	1.12	1.27	1.42
H_E	0.453	0.465	0.477	11.51	11.81	12.12
L	0.028	0.036	0.044	0.71	0.91	1.12
L_E	0.059	0.067	0.075	1.50	1.70	1.91
S	—	—	0.047	—	—	1.19
y	—	—	0.004	—	—	0.10
θ	0°	—	10°	0°	—	10°

Notes:
1. Dimensions D Max. & S include mold flash or tie bar burrs.
2. Dimension b does not include dambar protrusion/intrusion.
3. Dimensions D & E include mold mismatch and determined at the mold parting line.
4. Controlling dimension: Inches.
5. General appearance spec should be based on final visual inspection spec.

Package Dimensions, continued

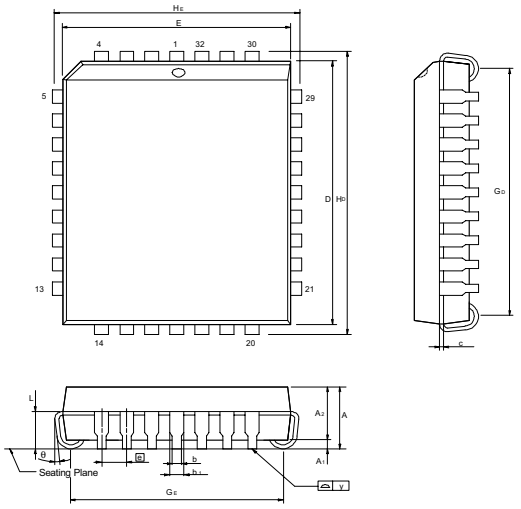
28-pin Standard Type One TSOP



Symbol	Dimension In Inches			Dimension In mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	—	—	0.047	—	—	1.20
A_1	0.002	—	0.006	0.05	—	0.15
A_2	0.035	0.040	0.041	0.95	1.00	1.05
b	0.007	0.008	0.011	0.17	0.20	0.27
c	0.004	0.006	0.008	0.10	0.15	0.21
D	0.461	0.465	0.469	11.70	11.80	11.90
E	0.311	0.315	0.319	7.90	8.00	8.10
H_D	0.520	0.528	0.536	13.20	13.40	13.60
e	—	0.022	—	—	0.55	—
L	0.020	0.024	0.028	0.50	0.60	0.70
L_1	—	0.010	—	—	0.25	—
Y	0.000	—	0.004	0.00	—	0.10
θ	0	3	5	0	3	5

Controlling dimension: Millimeters

32-pin PLCC



Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	—	—	0.140	—	—	3.56
A_1	0.020	—	—	0.50	—	—
A_2	0.105	0.110	0.115	2.67	2.80	2.93
b_1	0.026	0.028	0.032	0.66	0.71	0.81
b	0.016	0.018	0.022	0.41	0.46	0.56
c	0.008	0.010	0.014	0.20	0.25	0.35
D	0.547	0.550	0.553	13.89	13.97	14.05
E	0.447	0.450	0.453	11.35	11.43	11.51
e	0.044	0.050	0.056	1.12	1.27	1.42
G_D	0.490	0.510	0.530	12.45	12.95	13.46
G_E	0.390	0.410	0.430	9.91	10.41	10.92
H_D	0.585	0.590	0.595	14.86	14.99	15.11
H_E	0.485	0.49	0.495	12.32	12.45	12.57
L	0.075	0.090	0.095	1.91	2.29	2.41
y	—	—	0.004	—	—	0.10
θ	0	—	10	0	—	10

Notes:
1. Dimension D & E do not include interlead flash.
2. Dimension b does not include dambar protrusion/intrusion.
3. Controlling dimension: Inches.
4. General appearance spec. should be based on final visual inspection spec.

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 (V_{IL} and V_{IH}): $V_{IL} \rightarrow$ Low. $V_{IH} \rightarrow$ High.
		4	Modify A9 and V_{PP} Erase Voltage (V_{ID} and V_{PP}): from 13.75V (min) to 13.25V (min)
		6	Modify V_{CC} description

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