128K × 8 ELECTRICALLY ERASABLE EPROM

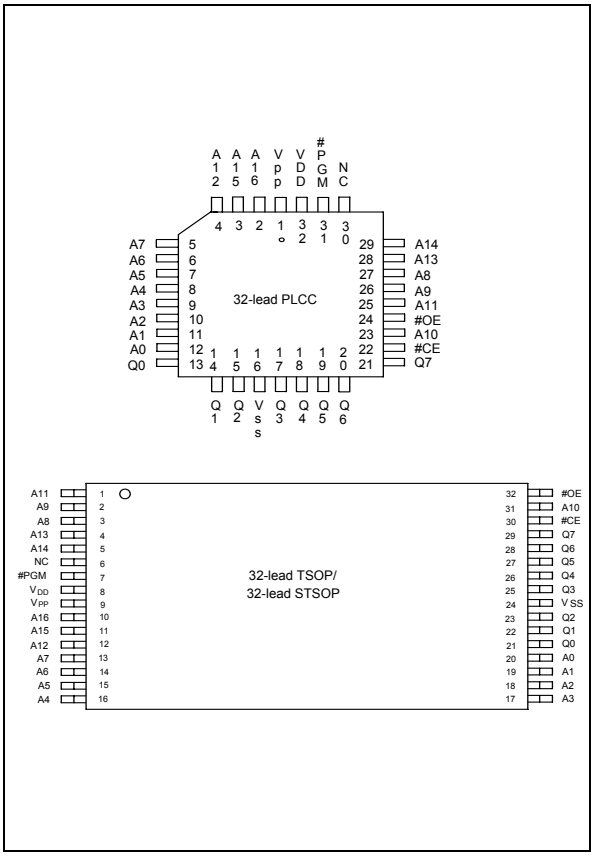
1. GENERAL DESCRIPTION

The W27L01 is a high speed, low power consumption Electrically Erasable and Programmable Read Only Memory organized as 131,072 × 8 bits. It requires only one supply in the range of 3.3V ± 10% in normal read mode. The W27L01 provides an electrical chip erase function.

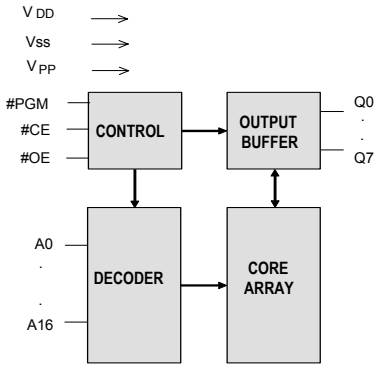
2. FEATURES

- Single power supply voltage:
  3.3V ±10%
- High speed access time:
  70/90 nS (max.)
- Read operating current: 15 mA (max.)
- Erase/Programming operating current:
  30 mA (max.)
- Standby current: 20 μA (max.)
- +12V erase/programming voltage
- Fully static operation
- All inputs and outputs directly TTL/CMOS compatible
- Three-state outputs
- Available packages: 32-lead PLCC, 32-lead STSOP and 32-lead TSOP.

3. PIN CONFIGURATIONS



4. BLOCK DIAGRAM



5. PIN DESCRIPTION

SYMBOL	DESCRIPTION
A0 – A16	Address Inputs
Q0 – Q7	Data Inputs/Outputs
#CE	Chip Enable
#OE	Output Enable
#PGM	Program Enable
VPP	Program/Erase Supply Voltage
VDD	Power Supply
Vss	Ground
NC	No Connection

6. FUNCTIONAL DESCRIPTION

Read Mode

Like conventional UVEPROMs, the W27L01 has two control functions and both of these produce data at the outputs.

#CE is for power control and chip select. #OE 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 #CE to output (T_{CE}), and data are available at the outputs T_{OE} after the falling edge of #OE, 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 W27L01 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 V_{PP} is raised to V_{PE} (12V), $V_{DD} = V_{CE}$ (5V), #CE low, #OE high, A9 = V_{HH} (12V), A0 low, and all other address pins low and data input pins high. Pulsing #PGM 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 automatically ensures a substantial erase margin. This mode will be entered after the erase operation if $V_{DD} = V_{PE}$ (5V), #CE low, and #OE low, #PGM high.

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 V_{PP} is raised to V_{PP} (12V), $V_{DD} = V_{CP}$ (5V), #CE low, #OE high, the address pins equal the desired addresses, and the input pins equal the desired inputs. Pulsing #PGM 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 $V_{PP} = V_{PP}$ (12V), #CE low, #OE low, and #PGM high.

Erase/Program Inhibit

Erase or program inhibit mode allows parallel erasing or programming of multiple chips with different data. When #CE high , erasing or programming of non-target chips is inhibited, so that except for the #CE, the W27L01 may have common inputs.

Standby Mode

The standby mode significantly reduces V_{DD} current. This mode is entered when #CE high. In standby mode, all outputs are in a high impedance state, independent of #OE and #PGM.

Two-line Output Control

Since EPROMs are often used in large memory arrays, the W27L01 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

EPROM power switching characteristics require careful device decoupling. System designers are concerned with 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 #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_{DD} and Vss. 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_{DD} and Vss. The bulk capacitor will overcome voltage slumps caused by PC board trace inductances.

Table of Operating Modes

V_{DD} = 3.3V ±10%, Vpp = V_{PE} = V_{HH} = 12V, V_{CP} = V_{PE} = 5V, X = V_{IH} or V_{IL}

MODE	PINS							
	#CE	**#OE**	**#PGM**	**A0**	**A9**	**V_{DD}**	**V_{PP}**	**OUTPUTS**
Read	V_{IL}	V_{IL}	X	X	X	V_{DD}	V_{DD}	D_{OUT}
Output Disable	V_{IL}	V_{IH}	X	X	X	V_{DD}	V_{DD}	High Z
Standby (TTL)	V_{IH}	X	X	X	X	V_{DD}	V_{DD}	High Z
Standby (CMOS)	V_{DD} ±0.3V	X	X	X	X	V_{DD}	V_{DD}	High Z
Program	V_{IL}	V_{IH}	V_{IL}	X	X	V_{CP}	V_{PP}	D_{IN}
Program Verify	V_{IL}	V_{IL}	V_{IH}	X	X	V_{CP}	V_{PP}	D_{OUT}
Program Inhibit	V_{IH}	X	X	X	X	V_{CP}	V_{PP}	High Z
Erase	V_{IL}	V_{IH}	V_{IL}	V_{IL}	V_{PE}	V_{CP}	V_{PE}	FF (Hex)
Erase Verify	V_{IL}	V_{IL}	V_{IH}	X	X	V_{PE}	V_{PP}	D_{OUT}
Erase Inhibit	V_{IH}	X	X	X	X	V_{CP}	V_{PE}	High Z
Product Identifier-Manufacturer	V_{IL}	V_{IL}	X	V_{IL}	V_{HH}	V_{DD}	V_{DD}	DA (Hex)
Product Identifier-Device	V_{IL}	V_{IL}	X	V_{IH}	V_{HH}	V_{DD}	V_{DD}	01 (Hex)

7. ELECTRICAL 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 V_{DD}, V_{PP} and A9 Pins	-0.5 to V_{DD} +0.5	V
Voltage on V_{DD} Pin with Respect to Ground	-0.5 to +7.0	V
Voltage on 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

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

Capacitance

(V_{DD} = 3.3V ±10%, 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

Read Operation DC Characteristics

(V_{DD} = 3.3V ±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_{DD}	-5	-	5	µA
Output Leakage Current	I_{LO}	V_{OUT} = 0V to V_{DD}	-10	-	10	µA
Standby V_{DD} Current (TTL input)	I_{SB}	#CE = V_{IH}	-	-	200	µA
Standby V_{DD} Current (CMOS input)	I_{SB1}	#CE = V_{DD} ±0.2V	-	-	20	µA
V_{DD} Operating Current	I_{CC}	#CE = V_{IL}, I_{OUT} = 0 mA, f = 5 MHz	-	-	15	mA
V_{PP} Operating Current	I_{PP}	V_{PP} = V_{DD}	-	-	10	µA
Input Low Voltage	V_{IL}	-	-0.3	-	0.6	V
Input High Voltage	V_{IH}	-	2.0	-	V_{DD} +0.5	V
Output Low Voltage	V_{OL}	I_{OL} = 1.6 mA	-	-	0.4	V
Output High Voltage	V_{OH}	I_{OH} = -0.1 mA	2.4	-	-	V
V_{PP} Operating Voltage	V_{PP}	-	V_{DD} -0.7	-	V_{DD}	V

Program/Erase DC Characteristics

(T_A = 25° C , V_{DD} = 5.0V ±10%, V_{HH} = 12V)

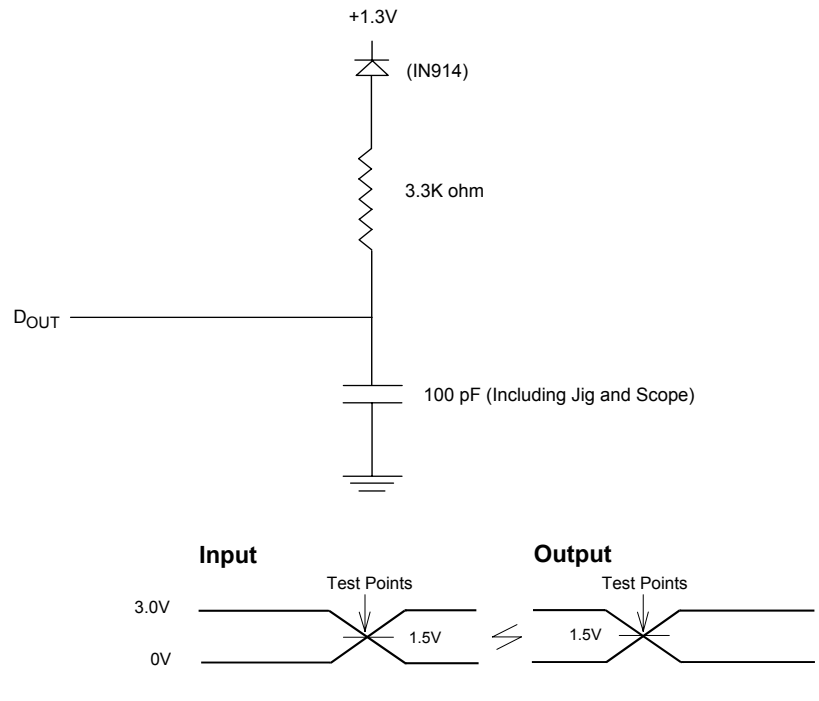
PARAMETER	SYM.	CONDITIONS	LIMITS			UNIT
			MIN.	TYP.	MAX.	
Input Load Current	I_{LI}	V_{IN} = V_{IL} or V_{IH}	-10	-	10	μA
V_{DD} Program Current	I_{CP}	#CE = V_{IL}, #OE = V_{IH}, #PGM = V_{IL}	-	-	30	mA
V_{DD} Erase Current	I_{CE}	#CE = V_{IL}, #OE = V_{IH}, #PGM = V_{IL}, A9 = V_{HH}	-	-	30	mA
V_{PP} Program Current	I_{PP}	#CE = V_{IL}, #OE = V_{IH}, #PGM = V_{IL}	-	-	30	mA
V_{PP} Erase Current	I_{PE}	#CE = V_{IL}, #OE = V_{IH}, #PGM = V_{IL}, A9 = V_{HH}	-	-	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
A9 Erase Voltage	V_{ID}	-	11.75	12.0	14.25	V
V_{PP} Program Voltage	V_{PP}	-	11.75	12.0	12.25	V
V_{PP} Erase Voltage	V_{PE}	-	11.75	12.0	14.25	V
V_{DD} Supply Voltage (Program)	V_{CP}	-	4.5	5.0	5.5	V
V_{DD} Supply Voltage (Erase)	V_{CE}	-	4.5	5.0	5.5	V
V_{DD} Supply Voltage (Erase Verify)	V_{PE}	-	-	5.0	-	V

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

AC Test Conditions

PARAMETER	CONDITIONS
Input Pulse Levels	0V to 3.0V
Input Rise and Fall Times	5 nS
Input and Output Timing Reference Level	1.5V/1.5V
Output Load	C_L = 100 pF, I_{OH}/I_{OL} = -0.1 mA/1.6 mA for Read I_{OH}/I_{OL} = -0.4 mA/2.1 mA for Program/Erase

AC Test Load and Waveforms



Read Operation AC Characteristics

(V_{DD} = 3.3V ±10%, T_A = 0 to 70° C)

PARAMETER	SYM.	W27L01-70		W27L01-90		UNIT
		MIN.	MAX.	MIN.	MAX.	
Read Cycle Time	T_{RC}	70	-	90	-	nS
Chip Enable Access Time	T_{CE}	-	70	-	90	nS
Address Access Time	T_{ACC}	-	70	-	90	nS
Output Enable Access Time	T_{OE}	-	30	-	40	nS
#OE High to High-Z Output	T_{DF}	-	25	-	25	nS
Output Hold from Address Change	T_{OH}	0	-	0	-	nS

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

AC Programming/Erase Characteristics

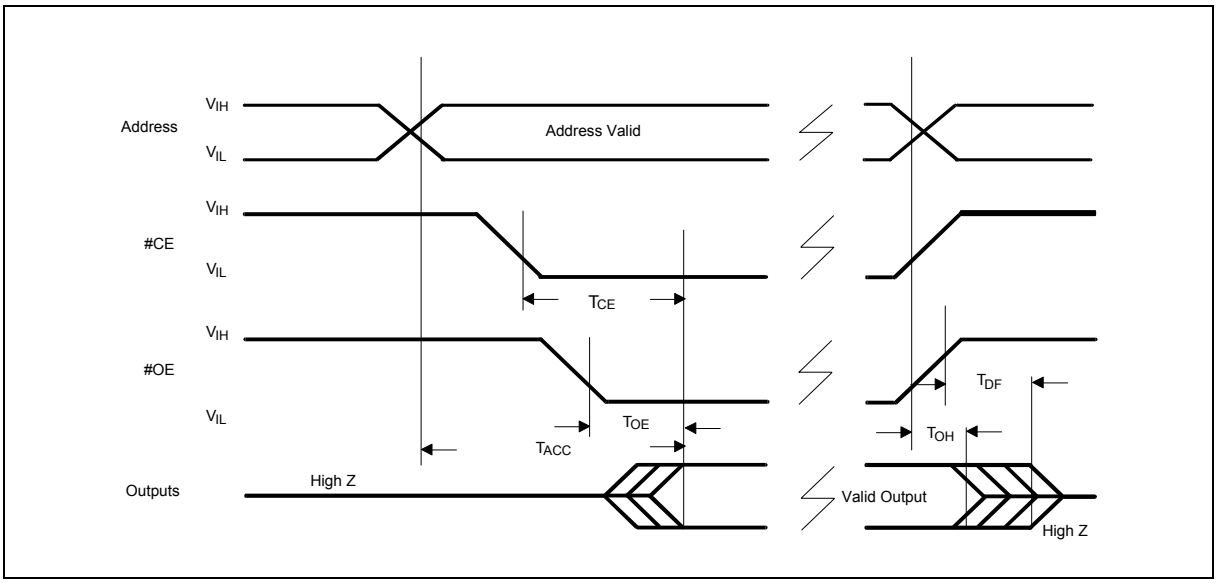
(V_{DD} = 5.0V ±10%, T_A = 25° C)

PARAMETER	SYMBOL	LIMITS			UNIT
		MIN.	TYP.	MAX.	
V_{PP} Setup Time	T_{VPS}	2.0	-	-	µS
Address Setup Time	T_{AS}	2.0	-	-	µS
Data Setup Time	T_{DS}	2.0	-	-	µS
#PGM Program Pulse Width	T_{PWP}	95	100	105	µS
#PGM Erase Pulse Width	T_{PWE}	95	100	105	mS
Data Hold Time	T_{DH}	2.0	-	-	µS
#OE Setup Time	T_{OES}	2.0	-	-	µS
Data Valid from #OE	T_{OEV}	-	-	150	nS
#OE High to Output High Z	T_{DFP}	0	-	130	nS
Address Hold Time after #PGM High	T_{AH}	0	-	-	µS
Address Hold Time (Erase)	T_{AHE}	2.0	-	-	µS
#CE Setup Time	T_{CES}	2.0	-	-	µS

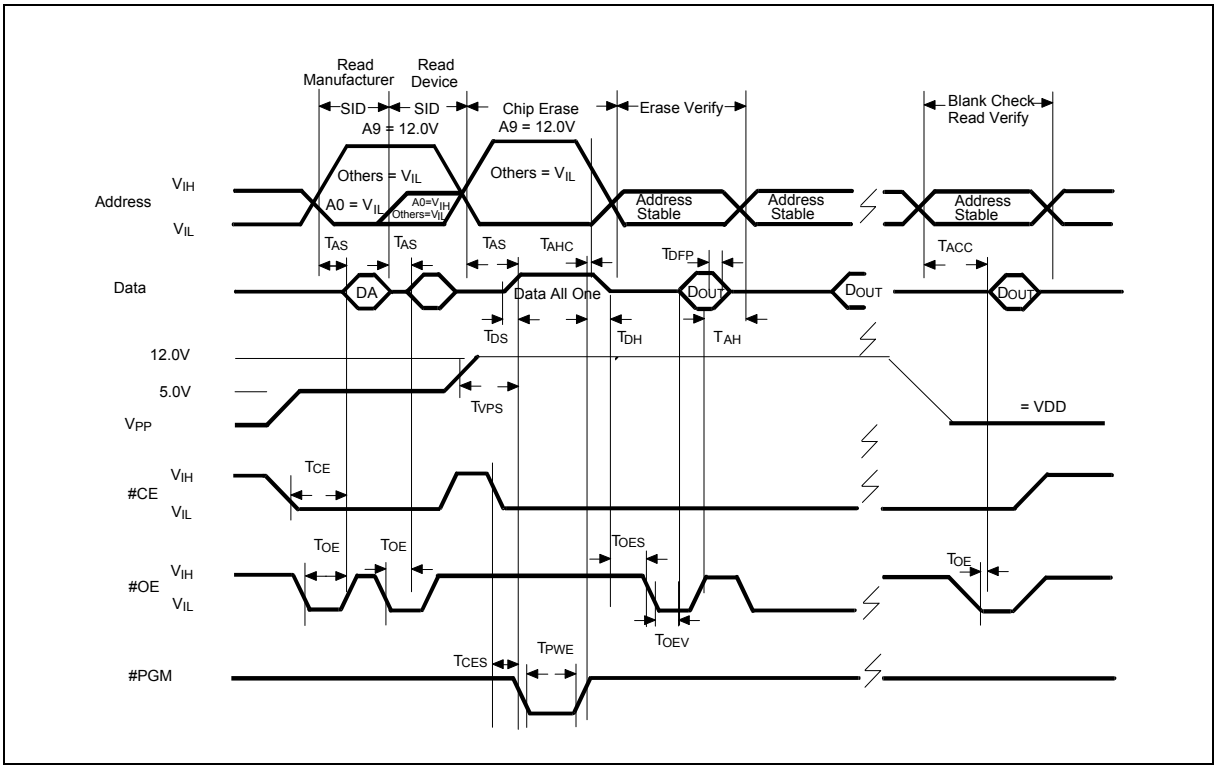
Note: V_{DD} must be applied simultaneously or before V_{PP} and removed simultaneously or after V_{PP}.

8. TIMING WAVEFORMS

AC Read Waveform

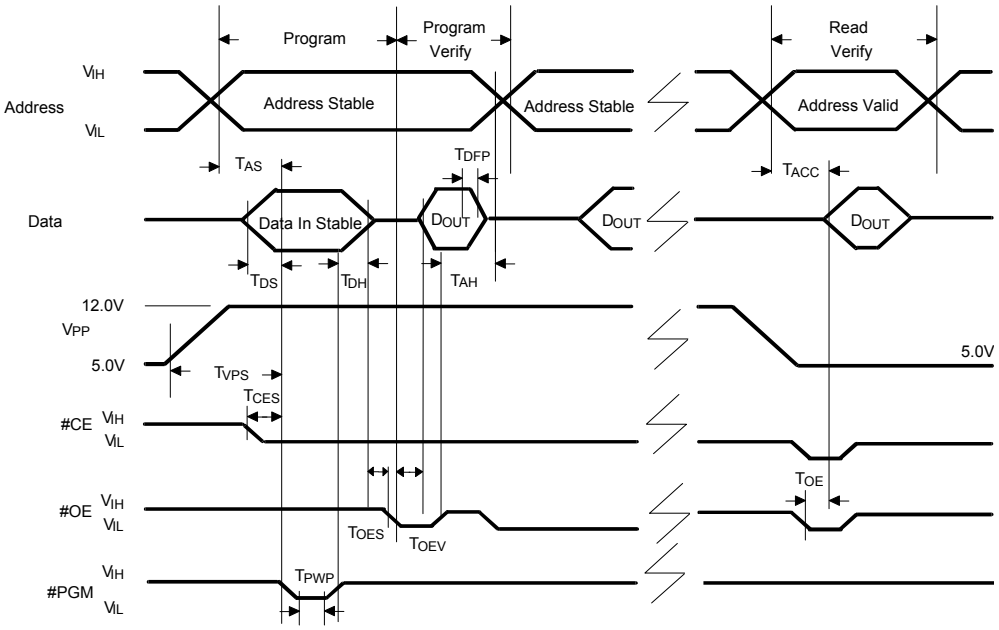


Erase Waveform

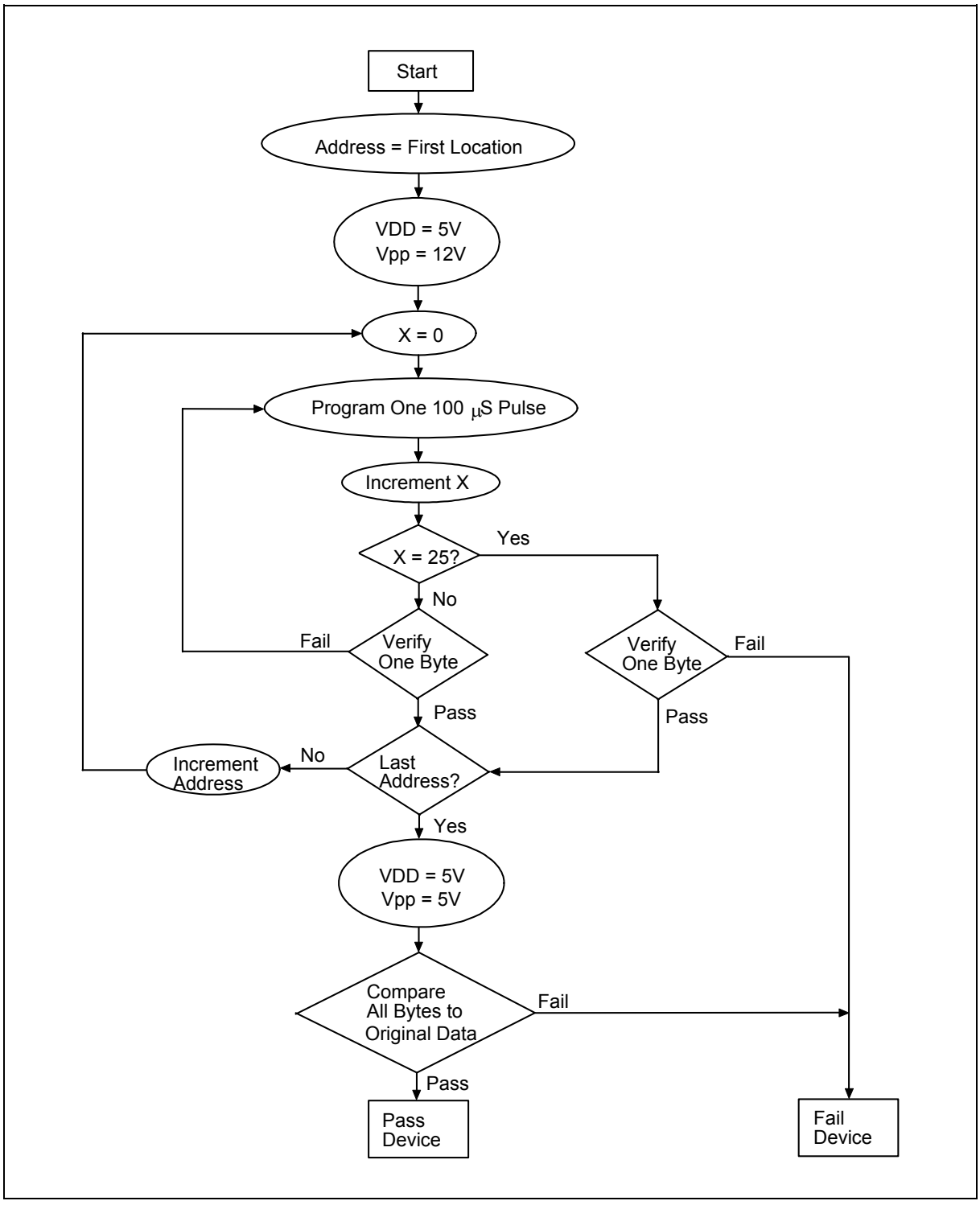


Timing Waveforms, Continued

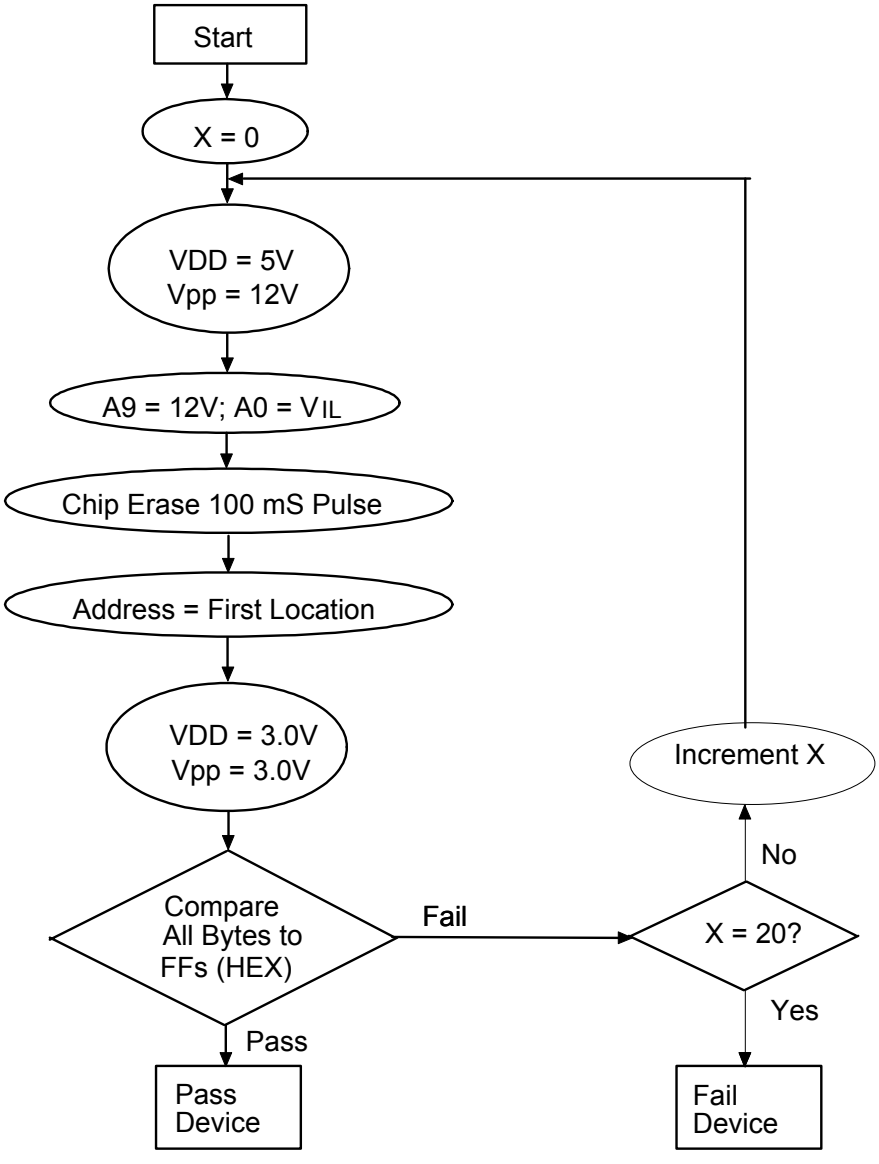
Programming Waveform



9. SMART PROGRAMMING ALGORITHM



10. SMART ERASE ALGORITHM



11. ORDERING INFORMATION

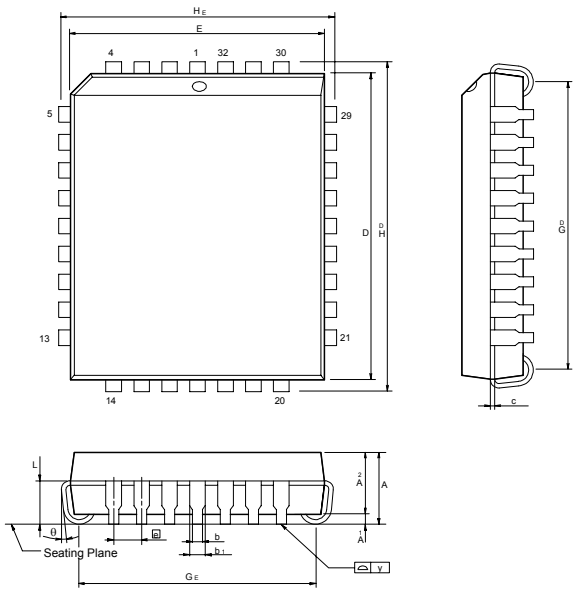
PART NO.	ACCESS TIME (nS)	POWER SUPPLY CURRENT MAX. (mA)	STANDBY V_{DD} CURRENT MAX. (μA)	PACKAGE
W27L01P-70	70	15	20	32-Lead PLCC
W27L01P-90	90	15	20	32-Lead PLCC
W27L01Q-70	70	15	20	32-Lead STSOP
W27L01Q-90	90	15	20	32-Lead STSOP
W27L01T-70	70	15	20	32-Lead TSOP
W27L01T-90	90	15	20	32-Lead TSOP

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. PACKAGE DIMENSIONS

32-Lead PLCC

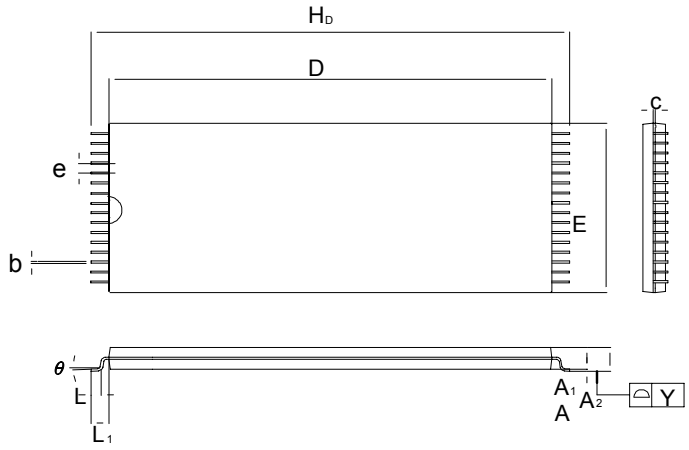


Symbol	Dimension in Inches			Dimension in mm		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	—	—	0.140	—	—	3.56
A_1	0.020	—	—	0.50	—	—
A_2	0.105	0.110	0.115	2.67	2.80	2.93
b_1	0.026	0.028	0.032	0.66	0.71	0.81
b	0.016	0.018	0.022	0.41	0.46	0.56
c	0.008	0.010	0.014	0.20	0.25	0.35
D	0.547	0.550	0.553	13.89	13.97	14.05
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	0.490	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. Dimensions 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 orfinal visual inspection sepc.

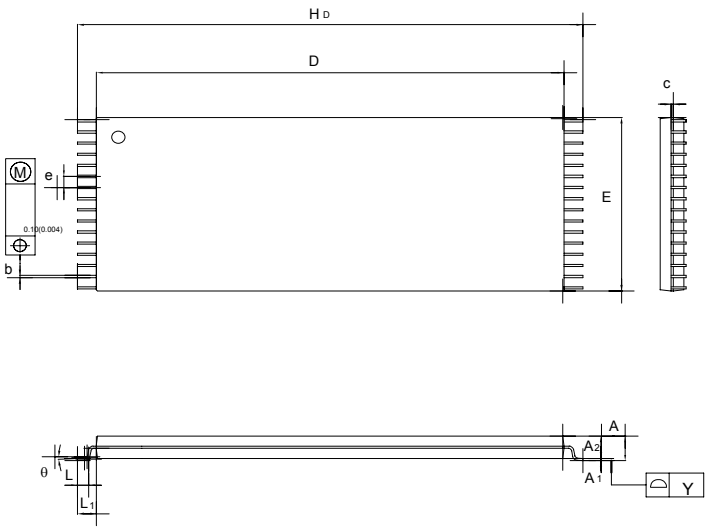
32-Lead STSOP (8 x 14 mm)



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	0.009	0.010	0.17	0.22	0.27
c	0.004	-----	0.008	0.10	-----	0.21
D		0.488			12.40	
E		0.315			8.00	
H_D		0.551			14.00	
e		0.020			0.50	
L	0.020	0.024	0.028	0.50	0.60	0.70
L_1		0.031			0.80	
Y	0.000		0.004	0.00		0.10
θ	0°	3°	5°	0°	3°	5°

Package Dimensions, continued

32-Lead TSOP (8 x 20 mm)



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	0.037	0.039	0.041	0.95	1.00	1.05
b	0.007	0.008	0.009	0.17	0.20	0.23
c	0.005	0.006	0.007	0.12	0.15	0.17
D	0.720	0.724	0.728	18.30	18.40	18.50
E	0.311	0.315	0.319	7.90	8.00	8.10
H_D	0.780	0.787	0.795	19.80	20.00	20.20
e	—	0.020	—	—	0.50	—
L	0.016	0.020	0.024	0.40	0.50	0.60
L_1	—	0.031	—	—	0.80	—
Y	0.000	—	0.004	0.00	—	0.10
θ	1	3	5	1	3	5

Note:
Controlling dimension: Millimeters

13. VERSION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A1	Apr. 2001	-	Initial Issued
A2	May 31, 2002	1, 5, 13	Modify Icc parameter from 10 mA to 15 mA
		1, 13, 14	Add in DIP package
		2, 3, 4, 6	Correct the Vcv(V_{PP}) as V_{PE}(V_{PP}) under Erase Inhibit Mode
		3	Modify the Pin of V_{PP} from V_{PE} to V_{PP} In the Erase Verify Mode
		6, 8	Modify T_A = 25°C ±5°C to 25°C
		9	Modify Erase Waveform
		All	Delete V_{DD} = 5.0V ±10%
A3	Feb. 20, 2003	1, 13, 14	Add in TSOP(8 x 20 mm) package
		1, 12, 13	Delete DIP package

Headquarters
No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5665577
http://www.winbond.com.tw/

Winbond Electronics Corporation America
2727 North First Street, San Jose,
CA 95134, U.S.A.
TEL: 1-408-9436666
FAX: 1-408-5441798

Winbond Electronics (Shanghai) Ltd.
27F, 2299 Yan An W. Rd. Shanghai,
200336 China
TEL: 86-21-62365999
FAX: 86-21-62365998

Taipei Office
9F, No.480, Rueiguang Rd.,
Neihu District, Taipei, 114,
Taiwan, R.O.C.
TEL: 886-2-8177-7168
FAX: 886-2-8751-3579

Winbond Electronics Corporation Japan
7F Daini-ueno BLDG, 3-7-18
Shinyokohama Kohoku-ku,
Yokohama, 222-0033
TEL: 81-45-4781881
FAX: 81-45-4781800

Winbond Electronics (H.K.) Ltd.
Unit 9-15, 22F, Millennium City,
No. 378 Kwun Tong Rd.,
Kowloon, Hong Kong
TEL: 852-27513100
FAX: 852-27552064